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Cape Krusenstern National Monument, Gates of the Arctic National Park and Preserve, Kobuk Valley National Park, and Noatak National Preserve

GRI Ancillary Map Information Document

Produced to accompany the Geologic Resources Inventory (GRI) Digital Geologic Data for Cape Krusenstern National Monument, Gates of the Arctic National Park and Preserve, Kobuk Valley National Park, and Noatak National Preserve

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Geologic Resources Inventory Map Document for Cape Krusenstern National Monument, Gates of the Arctic National Park and Preserve, Kobuk Valley National Park, and Noatak National Preserve

Table of Contents

Geologic Resources Inventory Map Document.....	1
About the NPS Geologic Resources Inventory Program.....	3
GRI Digital Map and Source Map Citations.....	5
Index Map	7
Map Unit List.....	8
Map Unit Descriptions.....	14
g - Ice fields or glaciers (Holocene).....	14
Qb - Beach deposits (Holocene).....	14
Qda - Active dune deposits (Holocene).....	14
Qrg - Rock glacier deposits (Holocene).....	15
Qsf - Solifluction deposits (Holocene).....	15
Qs - Surficial deposits, undifferentiated (Pleistocene to Holocene).....	15
Qa - Alluvium (Pleistocene to Holocene).....	17
Qaf - Alluvial fan and talus deposits (Pleistocene to Holocene).....	18
Qc - Colluvium (Pleistocene to Holocene).....	19
Qls - Landslide deposits (Pleistocene to Holocene).....	19
Qoa - Older alluvium (Pleistocene to Holocene).....	19
Qt - Terrace deposits (Pleistocene to Holocene).....	20
Qsw - Swamp deposits (Pleistocene to Holocene).....	20
Qd - Dune deposits (Pleistocene to Holocene).....	20
Qfl - Loess (Pleistocene to Holocene).....	21
Qsu - Silt deposits, undifferentiated (Pleistocene to Holocene).....	21
Qm - Glacial deposits, undivided (Pleistocene? to Holocene?).....	22
Qwo - Late Wisconsin-age Glaciations, outwash deposits (late Pleistocene).....	23
Qat - Altiplanation terraces (Pleistocene).....	23
Qew - Glaciations older than late Wisconsin, Mak Hill and Eklutna Glaciations (Pleistocene).....	23
QTs - Older surficial deposits, undivided (Pliocene to Holocene).....	24
QTg - High-level gravel (Pliocene to Pleistocene).....	24
QTb - Basalt (Pliocene to Pleistocene).....	24
Tcb - Coal-bearing rocks (late Eocene? to late Miocene?).....	25
Tmb - Olivine basalt flows and cinder cones (Miocene (Langhian)).....	25
Tvab - Andesite and basalt flows (Paleocene to Eocene).....	25
Tfv - Intermediate to felsic biotite tuff (Paleocene).....	25
TKvr - Volcanic rock, light gray to pink rhyolite (Cretaceous (Campanian) to early Eocene).....	25
TKvi - Iditarod Volcanics and similar units, younger phase (Cretaceous (Campanian) to early Eocene)	26
TKgp - Hypabyssal granite porphyry dikes, sills, and plugs (Cretaceous (Campanian) to early Eocene)	26
TDg - Gabbro, undifferentiated (Devonian to Paleocene).....	26
MZPZct - White-weathering chert or silicified limestone (Paleozoic to Mesozoic).....	27

MZPZm - Arctic Alaska terrane, metabasite (Proterozoic to Jurassic).....	27
Ksb - Schrader Bluff Formation (Cretaceous (Santonian) to Cretaceous (Maastrichtian)).....	27
Kvfp - Hypabyssal rocks, dacite and rhyolite porphyry (Cretaceous (Santonian) to Cretaceous (Maastrichtian)).....	28
Kcc - Nonmarine and marine carbonate-rich conglomerate and sandstone deltaic deposits (Cretaceous).....	28
Kgu - Granitic rocks (Cretaceous).....	28
Kmn - Migmatite associated with Cretaceous plutons of southern Brooks Range (Cretaceous).....	28
Khs - Rocks of Hammond River shear zone (Cretaceous).....	29
Kga - Alaskite (Cretaceous (Campanian)).....	29
Kgdt - Granodiorite (Cretaceous (Campanian)).....	29
Kns - Nephelene syenite (Cretaceous (Albian to Santonian)).....	30
Ksy - Syenite (Cretaceous (Albian to Santonian)).....	30
Kqc - Quartz-pebble conglomerate (Cretaceous (Barremian to Santonian)).....	30
Ktu - Tuluwak Formation (Cretaceous (Turonian to Coniacian)).....	31
Ksbf - Seabee Formation (Cretaceous (Cenomanian to Coniacian)).....	32
Kmqm - Quartz monzonite, monzonite, and syenite (Cretaceous (Albian to Coniacian)).....	32
Kcvg - Calcareous graywacke and mudstone, volcanic graywacke, and volcanic conglomerate (Cretaceous (Albian to Cenomanian)).....	33
Kto - Torok Formation (Cretaceous (Aptian to Cenomanian)).....	33
Ktfm - Torok and Fortress Mountain Formations, undivided (Cretaceous (Albian to Aptian)).....	34
Kfm - Fortress Mountain Formation, interbedded wacke and mudstone (Cretaceous (Albian)).....	35
Knf - Nanushuk Formation (Cretaceous (Albian to Cenomanian)).....	37
Knu - Nanushuk Formation, upper part (Cretaceous (Albian to Cenomanian)).....	38
Knl - Nanushuk Formation, lower part (Cretaceous (Albian)).....	39
Kipc - Igneous pebble-cobble conglomerate (Cretaceous (Albian)).....	40
Kvgc - Earliest Cretaceous volcanic graywacke and conglomerate (Cretaceous (Albian)).....	41
Ktg - Tuff, volcanic graywacke, and mudstone (Early Cretaceous).....	41
Kbd - Spilitic pillow basalt and diabase (Early Cretaceous).....	41
Kko - Kongakut Formation, pebble shale and siltstone (Early Cretaceous to Cretaceous (Hauterivian)).....	42
Kit - Ipewik Formation, Tingmerkpuk sandstone member (Cretaceous (Valanginian)).....	42
Ko - Okpikruak Formation and may include Fortress Mountain Formation, interbedded wacke and mudstone (Early Cretaceous to Cretaceous (Albian)).....	42
Kofc - Okpikruak Formation, coquina limestone (Cretaceous (Valanginian)).....	50
KJvc - Volcaniclastic rocks of the Brooks Range, May be included in Okpikruak Formation (Late Jurassic to Early Cretaceous).....	51
KJva - Andesitic volcanic rocks (Late Jurassic to Early Cretaceous).....	51
KJl - Melange between Angayucham-Tozitna and Arctic Alaska and Ruby terranes (Jurassic to Early Cretaceous).....	52
KJip - Ipewik Formation, northern Alaska (Jurassic to Cretaceous (Valanginian)).....	52
KJsh - Pebble shale and Kingak Shale, undivided (Jurassic to Cretaceous (Barremian)).....	53
KJks - Kingak Shale (Jurassic to Cretaceous (Hauterivian)).....	53
KPr - Kingak Shale, Karen Creek Sandstone and Shublik Formation, undivided (Permian to Cretaceous (Barremian)).....	54
KDnb - Undivided marine and non-marine shale and siltstone (Devonian to Early Cretaceous).....	54
Jgi - Intermediate plutonic rocks, northern Alaska (Middle Jurassic).....	54
JTrob - Brooks Range ophiolite, undivided (Triassic to Jurassic).....	55
Jbod - Brooks Range ophiolite, gabbro, diabase, basalt, microgabbro, and minor diorite (Jurassic).....	56
Jbou - Brooks Range ophiolite, ultramafic and mafic rocks (Middle Jurassic).....	57
Jbob - Brooks Range ophiolite, basalt, pillows and pillow breccia (Middle Jurassic).....	57
JPNboi - Brooks Range ophiolite, mafic sills and dikes associated with upper allochthons (Pennsylvanian to Jurassic).....	58
JTRPe - Banded dark-green, gray, and red eclogite and banded amphibolite (Permian to Jurassic).....	59
JTRPt - Dishna River mafic and ultramafic rocks (Permian to Jurassic (Kimmeridgian)).....	59

JTRcs - Otuk Formation (Triassic (Olenekian) to Jurassic (Bajocian)).....	60
JPNzeg - Eivluk Group, undivided (Pennsylvanian to Jurassic (Bajocian)).....	63
JMs - Sedimentary rocks: Endicott Group (Kayak Shale), Lisburne Group and Eivluk Group (Otuk Formation and Siksikpuk Formation) (Carboniferous to Jurassic (Bajocian)).....	66
JTRPaum - Angayucham assemblage associated ultramafic rocks (Permian to Early Jurassic).....	67
JMab - Angayucham assemblage, basalt and diabase (Mississippian to Early Jurassic).....	67
JMtU - Tozitna sequence, mafic, ultramafic, and sedimentary rocks, undivided (Mississippian to Early Jurassic).....	69
TRsf - Shublik Formation, black shale, sandstone, and silty limestone (Middle Triassic to Late Triassic)	69
TRPss - Shublik and Siksikpuk Formations, undivided (Permian to Triassic).....	70
TRPNic - Eivluk Group, Imnaitchiak Chert (Pennsylvanian to Triassic).....	70
TRMtmu - Rampart Group, igneous rocks (Mississippian to Triassic).....	71
TRMts - Sedimentary rocks, formerly Rampart Group, now Tozitna sequence (Mississippian to Triassic)	72
TRDcs - Calcareous sedimentary rocks (Devonian to Triassic).....	72
TRDg - Arctic Alaska terrane and Ruby terrane, metagraywacke (Devonian to Middle Triassic).....	72
TRPsg - Sadlerochit Group, undivided (Permian to Early Triassic).....	73
Pef - Sadlerochit Group, Echooka Formation, undivided (Permian).....	74
Psk - Eivluk Group, Siksikpuk Formation, chert and shale (Permian).....	74
PZrm - Carbonates (Paleozoic).....	77
PZZm - Mafic schist (Neoproterozoic to Paleozoic).....	78
Mlw - Lisburne Group, Wachsmuth Formation (Mississippian)	78
PNMI - Lisburne Group, Alapah Limestone and Wahoo Limestone, undivided (Late Mississippian to Late Pennsylvanian)	78
Mlgn - Lisburne Group, Nasorak Formation (Early Mississippian to Late Mississippian).....	78
Mlut - Lisburne Group, Utukok Formation, limestone (Early Mississippian to Late Mississippian).....	79
Mlkg - Lisburne Group, Kograk Formation (Mississippian).....	81
PMlt - Lisburne Group, Tupik Formation (Pennsylvanian to Upper Mississippian).....	83
PMlg - Lisburne Group, undivided (Pennsylvanian to Mississippian).....	84
PMlc - Lisburne Group, Akmalik Chert (Pennsylvanian and Mississippian)	87
Mlku - Lisburne Group, Kuna Formation (Late Mississippian to Mississippian)	90
Mlgl - Lisburne Group, informal lower part (Early Mississippian to Late Mississippian).....	91
Mc - Chert (Mississippian)	92
Mgq - Globe quartzite (Mississippian).....	92
Mlt - Limestone and tuff (Mississippian)	92
MDe - Endicott Group, Itkilyariak Formation, Kekiktuk Conglomerate, Kayak Shale, Kanayut Conglomerate, Noatak Sandstone, Kurupa Sandstone, and Hunt Fork Shale, undivided (Mississippian to Devonian).....	93
Mk - Endicott Group, Kayak Shale (Mississippian to Mississippian (Visean))	93
Mkk - Endicott Group, Kayak Shale and Kekiktuk Conglomerate (Mississippian (Tournaisian to Visean))	97
Mkcc - Endicott Group, Kekiktuk Conglomerate or Kanayut Conglomerate (Mississippian (Tournaisian to Visean)).....	98
Mke - Endicott Group, Kekiktuk conglomerate (Mississippian (Tournaisian) to Mississippian).....	98
Men - Endicott Group, Kapaloak sequence of Point Hope region (Early Mississippian to Late Mississippian)	98
Mks - Endicott Group, Kurupa Sandstone (Mississippian).....	98
MDky - Endicott Group, Kanayut Conglomerate (Devonian (Frasnian) to Mississippian (Tournaisian)).....	99
MDkys - Endicott Group, Kanayut Conglomerate, Stuver Member, nonmarine shale and quartzite (Late Devonian to Early Mississippian).....	100
MDkn - Endicott Group, Kanayut Conglomerate and Noatak sandstone (Devonian (Frasnian) to Mississippian (Visean)).....	101
MDkh - Endicott Group, interlayered dark gray to black phyllite and calcareous phyllite (Devonian to Mississippian)	102
MDrao - Ruby terrane, augen gneiss and schist (Early Mississippian or Devonian (Famennian)).....	102

MCm - Marble, northern Alaska (Cambrian to Mississippian).....	103
PNMv - Lisburne Group, associated volcanic rocks and sills (Carboniferous).....	103
PNMn - Nuka Formation (Mississippian to Pennsylvanian).....	104
PMZk - Mixed schists of the Kallarichuk Hills, undivided (Neoproterozoic to Carboniferous).....	105
Dp - Phyllite of Arctic Alaska terrane (Devonian).....	108
Dpr - Ruby terrane, phyllite (Devonian).....	109
Dsb - Brooks Range schist belt, calcareous schist, gray quartz-mica schist, and marble (Devonian).....	109
Dhf - Endicott Group, Hunt Fork Shale (Devonian (Frasnian to Famennian)).....	109
Dhbw - Endicott Group, Hunt Fork Shale, wacke member (Late Devonian).....	111
Dhfm - Endicott Group, Hunt Fork Shale, metamorphosed (Late Devonian).....	112
Dkyl - Endicott Group, Kanayut Conglomerate, Ear Peak Member, lower member, nonmarine shale (Late Devonian).....	113
Dkym - Endicott Group, Kanayut Conglomerate, Shainin Lake, middle member (Late Devonian).....	113
Dkyq - Endicott Group, Kanayut Conglomerate, quartz arenite and quartz wacke member (Devonian (Frasnian to Famennian)).....	114
Dnu - Endicott Group, Noatak Sandstone and phyllite, carbonate and clastic rocks of the Nakolik River, shale (Late Devonian to Devonian).....	114
Dyao - Medium-grained granitic gneiss (Devonian (Givetian) to Late Devonian).....	117
Dbk - Baird Group, Kuguruk Formation, limestone (Devonian (Givetian) to Late Devonian).....	117
Dbe - Baird Group, Eli Limestone (Middle Devonian to Late Devonian).....	118
Dbc - Beauoup Formation, carbonaceous, siliceous, and calcareous sedimentary rocks and felsic volcanic rocks (Middle Devonian to Late Devonian).....	119
Dbfw - Beauoup Formation, wacke member (Middle Devonian to Late Devonian).....	122
Dol - Beauoup Formation, dark gray to orange weathering limestone (Middle Devonian to Devonian).....	122
Dbf - Beauoup Formation, ferruginous and calcareous schist (Middle Devonian to Late Devonian).....	124
Dbv - Beauoup Formation, volcanic rocks or volcanic rock clasts (Middle Devonian to Late Devonian).....	124
Dbs - Thin bedded black, siliceous, carbonaceous phyllite and impure chert (Middle Devonian to Late Devonian).....	125
Dyss - Calcareous clastic rocks, Devonian sandstone and shale (Devonian).....	125
Dvt - Basaltic and andesitic flows, tuff, breccia, and volcanic conglomerate altered to greenstone (Devonian).....	125
Dyp - Phyllite, slate or black shale (Early Devonian to Late Devonian).....	126
Dav - Ambler sequence, metavolcanic and lesser metasedimentary rocks (Devonian).....	126
Davf - Ambler sequence?, schistose felsic volcanic rocks (Devonian).....	126
Dg - Dark-greenish-gray fine-grained impure graywacke (Devonian).....	127
Dvf - Schistose felsic volcanic rocks (Devonian).....	127
DSOt - Metasedimentary and metavolcanic rocks of Tukpahlearik Creek, undivided (Ordovician to Devonian).....	127
DSOtq - Carbonaceous quartzite and quartz conglomerate of Tukpahlearik Creek (Ordovician to Devonian).....	128
DSOtmq - Marble and quartz schist of Tukpahlearik Creek (Ordovician to Devonian).....	128
DSOtpg - Pelitic schist and greenstone of Tukpahlearik Creek (Ordovician to Devonian).....	128
DSOtp - Pelitic schists of Tukpahlearik Creek (Ordovician to Devonian).....	129
DSOnx - Nome Complex, mixed marble, graphitic metaquartzite, and schist (Ordovician to Devonian).....	129
DSOb - Baird Group, massive light gray reefoid limestone and dolomite with local thin interbeds of calcareous phyllite (Ordovician to Devonian).....	131
DCbs - Baird Group, Skajit Limestone (Middle Cambrian to Devonian).....	132
DCld - Massively bedded limestone, dolomite, and schist (Cambrian to Devonian).....	133
DCcs - Calcareous schist (Cambrian to Devonian).....	133
DCcm - Metasedimentary and metavolcanic rocks, undivided (Paleozoic to Devonian).....	133
DZsg - Schist and paragneiss (Neoproterozoic to Devonian).....	134
DZrqm - Ruby quartz-mica schist (Neoproterozoic to Devonian).....	135
DZaqs - Arctic Alaska terrane, quartz-mica schist (Neoproterozoic to Devonian).....	135
DZss - Seward terrane, siliceous schist of the Kallarichuk Hills (Neoproterozoic to Devonian).....	137

DZacs - Brooks Range Central belt and part of Northern thrust assemblages, quartz-rich metasedimentary rocks (Neoproterozoic to Devonian).....	137
DZb - Metasedimentary rocks of Bluecloud Mountain (Neoproterozoic to Devonian).....	138
DZel - Marble and intercalated gneissic rocks (Neoproterozoic to Devonian).....	139
DZmr - Metamorphic rocks, lenses near Kobuk and Victoria Creek fault systems, amphibolite facies (Neoproterozoic to Devonian).....	139
DZrpg - Gneiss and quartzite of the Ruby crystalline complex (Neoproterozoic to Devonian).....	139
DZa - Schist belt (western part), calcareous schist, albite-rich subunit (Proterozoic to Devonian).....	140
DZmc - Schist belt, calcareous schist, metachert and conglomerate subunit (Proterozoic to Devonian).....	140
DZsm - Brooks Range schist belt, chloritic marble (Proterozoic? to Devonian).....	140
DZrqs - Ruby terrane, pelitic and quartzitic schist (Proterozoic to Devonian).....	141
Spl - Black phyllite and metalimestone (Silurian).....	142
SOj - Metasedimentary rocks of Jesse Mountain (Ordovician to Silurian).....	142
SOig - Viagik Group, undivided (Middle Ordovician to Silurian (Wenlock)).....	142
SOCb - Siltstone and phyllite (Cambrian to Silurian).....	143
SOCvs - Doonerak antiform, volcanic and sedimentary rocks (Cambrian to Silurian).....	143
SZcb - Carbonate rocks and subordinate metabasite (Neoproterozoic to Silurian).....	143
Oc - Nanielik antiform, Ordovician carbonate rocks (Ordovician to Middle Ordovician).....	143
Ocs - Casadepaga Schist (Ordovician).....	144
OCc - Carbonate rocks (Cambrian to Ordovician).....	145
OCv - Andesitic to basaltic volcanoclastic rocks and local tuffaceous phyllite, gabbro, and diabase, and black phyllite (Cambrian to Ordovician).....	145
OCZc - Nanielik antiform, older carbonate rocks (Neoproterozoic to Middle Ordovician).....	146
Zgr - Granitic rocks (Neoproterozoic).....	146
Zma - Metasedimentary and metavolcanic rocks of Mount Angayukaqsaq (Neoproterozoic).....	146
ZYog - Ernie Lake pluton orthogneiss (Mesoproterozoic to Proterozoic).....	147
bu - Bedrock of unknown type or age or areas not mapped (unknown).....	147
SIM-3340 Map Unit Descriptions.....	148
Qs - Unconsolidated surficial deposits, undivided (Quaternary).....	148
QTs - Poorly consolidated surficial deposits (Quaternary & uppermost Tertiary).....	148
QTV - Young volcanic rocks, undifferentiated (Quaternary or Tertiary).....	149
Tcb - Coal-bearing sedimentary rocks (Eocene to Pliocene).....	149
Tob - Olivine basalt flows (Miocene).....	150
Tepv - Andesite and basalt flows (Eocene and Paleocene).....	150
Tpt - Pyroclastic rocks (Early Eocene or Paleocene).....	151
TKv - Volcanic rocks in southern Alaska (Late Cretaceous to Early Tertiary).....	151
TKhi - Dikes and subvolcanic rocks (Tertiary and (or) Cretaceous).....	152
TKgb - Gabbroic rocks (Late Cretaceous (or older) to Tertiary).....	152
Kof - Okpikruak Formation and similar units (Lower Cretaceous).....	153
MzPzmb - Metabasite (Mesozoic & Paleozoic).....	154
Ksb - Schrader Bluff Formation (Upper Cretaceous).....	154
Kvu - Volcanic rocks, undivided (Cretaceous).....	155
Kcc - Carbonate-rich conglomerate and sandstone deltaic rocks (Cretaceous).....	155
Kgu - Plutonic rocks and dikes, granite to diorite (Cretaceous).....	156
Knig - Migmatite and metaplutonic rocks (Cretaceous).....	156
Khs - Rocks of Hammond River shear zone of Till and others (2008a) (Cretaceous).....	156
Klgr - Intermediate granitic rocks (Late Cretaceous).....	157
Ksy - Syenitic rocks (Cretaceous).....	157
Kqc - Quartz-pebble conglomerate, west-central Alaska (Cretaceous).....	157
Ktu - Tuluvak Formation (Cretaceous).....	158
Ksbf - Seabee Formation and Hue Shale (Upper Cretaceous).....	158
Kmqm - Quartz monzonite, monzonite and syenite (Cretaceous).....	159
Kcvg - Calcareous graywacke and mudstone, volcanic graywacke and conglomerate (Cretaceous).....	159

Kto - Torok Formation (Cretaceous)	159
Kfm - Fortress Mountain Formation (Cretaceous)	160
Knf - Nanushuk Formation (Cretaceous)	161
Kipc - Mafic igneous-clast conglomerate, sandstone and mudstone (Lower Cretaceous)	161
Kcgc - Calcareous graywacke and conglomerate (Lower Cretaceous)	162
Kvgc - Volcanic graywacke and conglomerate (Cretaceous*)	162
Ksbd - Spilitic pillow basalt and diabase (Early Cretaceous)	163
Kgk - Kongakut Formation (Lower Cretaceous)	163
Kit - Tingmerkpuk Member of the Ipewik Formation (Lower Cretaceous)	163
Khnl - Herendeen Formation and similar units (Lower Cretaceous)	163
KJiv - Andesitic volcanic rocks (Early Cretaceous & Jurassic)	164
KJm - Melange facies (Cretaceous or Jurassic?)	165
KJks - Kingak Shale and similar units (Lower Jurassic to Lower Cretaceous)	165
KPu - Kingak Shale, Shublik Formation and Karen Creek Sandstone, undivided (Permian to Lower Cretaceous)	166
JTrob - Ophiolite of the Brooks Range (Triassic to Jurassic)	166
JPztu - Ultramafic complexes of western Alaska (Jurassic or older)	167
JTro - Otuk Formation (Triassic to Middle Jurassic)	167
JIPe - Eivluk Group, undivided (Pennsylvanian to Middle Jurassic)	168
JPzs - Northern Alaska sedimentary rocks (Carboniferous to Middle Jurassic)	168
JDoc - Igneous rocks (Devonian to Jurassic)	169
Trgs - Shublik Formation (Triassic)	170
TriPeg - Siksikpuk Formation and Imnaitchiak Chert (Pennsylvanian to Triassic)	170
TrDtz - Sedimentary rocks (Devonian to Triassic)	171
TrPzgp - Metagraywacke and phyllite (Triassic & Late Paleozoic)	171
TrPsg - Sadlerochit Group, undivided (Permian to Lower Triassic)	172
Pe - Echooka Formation (Permian)	172
Pzls - Limestone and marble (Paleozoic)	173
DPxasm - Mixed assemblage of metasedimentary and metavolcanic rocks in the Brooks Range (Proterozoic to Devonian)	173
Mlgw - Wachsmuth Limestone (Mississippian)	174
Clg - Lisburne Group, undivided (Carboniferous)	174
Mlgnu - Nasorak and Utukok Formations (Mississippian)	175
Clgk - Kogruk Formation (Upper Mississippian)	175
Clgt - Tupik Formation (Pennsylvanian and Upper Mississippian)	176
Mlgac - Akmalik Chert and other black chert of the Lisburne Group (Mississippian)	176
Mlgk - Kuna Formation (Mississippian)	176
Mgg - Globe quartzite of Weber and others (1992) (Mississippian)	177
MDe - Endicott Group, undivided (Devonian to Mississippian)	177
Mk - Kayak Shale (Mississippian)	177
Mek - Kekiktuk Conglomerate (Mississippian)	178
Meks - Kapaloak sequence of Moore and others (2002) (Mississippian)	178
Mes - Kurupa Sandstone (Lower Mississippian)	178
MDegk - Kanayut Conglomerate and Noatak Sandstone, undivided (Lower Mississippian and Upper Devonian)	179
Dbf - Beaucoup Formation, undivided (Devonian)	179
MDag - Augen gneiss and orthogneiss (Early Mississippian and Late Devonian)	180
Pzcn - Marble, northern Alaska (early Paleozoic)	181
Clgv - Volcanic rocks and sills associated with Lisburne Group (Mississippian and Pennsylvanian?)	181
IPMn - Nuka Formation (Carboniferous)	181
DPxacs - Calcareous schist of Brooks Range (Proterozoic to Devonian)	182
Degh - Hunt Fork Shale (Devonian)	182
Degn - Noatak Sandstone (Upper Devonian)	183
Dogn - Granitic gneiss (Late & Middle Devonian)	183
Dke - Kugururok Formation and Eli Limestone (Devonian)	184

Dbfw - Wacke member (Upper Devonian).....	184
Dbfl - Limestone and similar rocks (Upper and Middle Devonian).....	185
Dyss - Clastic and calcareous clastic rocks (Devonian).....	185
Dv - Metavolcanic rocks and sills (Devonian).....	185
Dyp - Phyllite, slate and black shale (Devonian?).....	186
Das - Bimodal metavolcanic rocks (Devonian).....	186
DOtu - Metasedimentary and metavolcanic rocks of Tukpahlearik Creek, undivided (Ordovician to Devonian).....	187
DOtm - Marble of Tukpahlearik Creek (Ordovician to Devonian).....	187
DOtp - Pelitic schist and metavolcanic rocks of Tukpahlearik Creek (Ordovician to Devonian).....	187
DOnx - Marble, graphitic rocks, and schist (Ordovician? to Devonian).....	188
DCbg - Baird Group and similar rocks (Upper Cambrian to Middle Devonian).....	188
Pzm - Marble of the Brooks Range (Devonian and older).....	189
DPxsgm - Schist, paragneiss, and marble (Neoproterozoic to Devonian).....	190
PzPxqm - Pelitic and quartzitic schist of the Ruby terrane (Proterozoic? to Early Paleozoic).....	190
DPxaqm - Quartz-mica schist of the Brooks Range (Proterozoic to Devonian).....	191
PzPxb - Metasedimentary rocks of Bluecloud Mountain (Proterozoic? to Early Paleozoic).....	191
Sbs - Black phyllite and metalimestone (Silurian).....	192
SOig - Ivagik group of Martin (1970) (Ordovician to Silurian).....	192
SCs - Sedimentary rocks of Doonerak Window (Cambrian to Silurian).....	192
OPxls - Limestone, northern Alaska (Proterozoic? through Ordovician).....	193
Ocs - Casadepaga Schist (Ordovician).....	193
OCdv - Oldest volcanic rocks (Ordovician and Cambrian?).....	194
Zgn - Granite and orthogneiss (Neoproterozoic).....	194
Zam - Metasedimentary and metavolcanic rocks of Mount Angayukaqraq (Neoproterozoic).....	194
bu - Bedrock of unknown type or age or areas not mapped (unknown).....	195
Additional Source Data Attribute Fields.....	196
Additional USGS Data Fields to Geologic Units.....	196
Additional USGS Data Fields to Geologic Contacts, Faults and Glacial Feature Lines.....	196
Additional USGS ARDF Data Fields to Geologic Sample Localities and Mine Localities.....	197
GRI Ancillary Source Map Information.....	199
USGS Source Map References.....	199
Scientific Investigations Map SIM-3340.....	203
Pamphlet.....	203
Data.....	203
Alaska Resource Data Files.....	203
ARDF Ambler River (OF-97-856).....	204
Report.....	204
Data.....	204
Index Map.....	204
Mineral Occurrence Map.....	205
References.....	205
ARDF Baird Mountains (OF-2000-24).....	208
Report.....	208
Data.....	208
Index Map.....	209
Mineral Occurrence Map.....	210
References.....	210
ARDF Beaver (OF-2000-308).....	214
Report.....	214
Data.....	214
Index Map.....	215
Mineral Occurrence Map.....	216
References.....	216

ARDF Bettles (OF-2003-52).....	217
Report	217
Data	218
Index Map	218
Mineral Occurrence Map.....	219
References	219
ARDF Chandalar (OF-2000-357)	223
Report	223
Data	223
Index Map	224
Mineral Occurrence Map.....	225
References	225
ARDF Chandler Lake (OF-97-065).....	234
Report	234
Data	234
Index Map	235
Mineral Occurrence Map.....	236
References	236
ARDF De Long Mountains (OF-2000-23).....	237
Report	237
Data	237
Index Map	238
Mineral Occurrence Map.....	239
References	239
ARDF Philip Smith Mountains (OF-2000-291).....	243
Report	243
Data	243
Index Map	243
Mineral Occurrence Map.....	244
References	244
ARDF Howard Pass (OF-97-296).....	246
Report	246
Data	246
Index Map	247
Mineral Occurrence Map.....	248
References	248
ARDF Hughes (OF-2003-58)	250
Report	250
Data	250
Index Map	251
Mineral Occurrence Map.....	252
References	252
ARDF Killik River (OF-97-266).....	257
Report	257
Data	257
Index Map	258
Mineral Occurrence Map.....	259
References	259
ARDF Misheguk Mountain (OF-97-297)	260
Report	260
Data	260
Index Map	261
Mineral Occurrence Map.....	262
References	262

ARDF Noatak (OF-2006-1157).....	263
Report	264
Data	264
Index Map	264
Mineral Occurrence Map.....	265
References	265
ARDF Selawik (OF-2000-005).....	266
Report	266
Data	266
Index Map	267
Mineral Occurrence Map.....	268
References	268
ARDF Shungnak (OF-2000-022).....	270
Report	270
Data	270
Index Map	270
Mineral Occurrence Map.....	271
References	271
ARDF Survey Pass (OF-2000-328).....	275
Report	275
Data	275
Index Map	276
Mineral Occurrence Map.....	277
References	277
ARDF Wiseman (OF-2003-447).....	279
Report	279
Data	279
Index Map	280
Mineral Occurrence Map.....	281
References	281
GRI Digital Data Credits.....	289

Geologic Resources Inventory Map Document



Cape Krusenstern National Monument, Gates of the Arctic National Park and Preserve, Kobuk Valley National Park, and Noatak National Preserve, Alaska

Document to Accompany Digital Geologic-GIS Data

[arcn_geology.pdf](#)

Version: 9/22/2017

This document has been developed to accompany the digital geologic-GIS data developed by the Geologic Resources Inventory (GRI) program for Cape Krusenstern National Monument, Gates of the Arctic National Park and Preserve, Kobuk Valley National Park, and Noatak National Preserve, Alaska.

Attempts have been made to reproduce all aspects of the original source products, including the geologic units and their descriptions, geologic cross sections, the geologic report, references and all other pertinent images and information contained in the original publication.

This document contains the following information:

- 1) **About the NPS Geologic Resources Inventory Program** – A brief summary of the Geologic Resources Inventory (GRI) Program and its products. Included are web links to the GRI GIS data model, and to the GRI products page where digital geologic-GIS datasets, scoping reports and geology reports are available for download. In addition, web links to the NPS Data Store and GRI program home page, as well as contact information for the GRI coordinator, are also present.
- 2) **GRI Digital Map and Source Citations** – A listing of all GRI digital geologic-GIS maps produced for this project along with sources used in their completion. In addition, a brief explanation of how each source map was used is provided.
- 3) **Map Unit List** – A listing of all geologic map units present on maps for this project, generally listed from youngest to oldest.
- 4) **Map Unit Descriptions** – Descriptions for all geologic map units. If a unit is present on multiple source maps the unit is listed with its source geologic unit symbol, unit name and unit age followed by the unit's description for each source map. In addition, relevant unit descriptions present on USGS SIM-3340, the source of all mapped geologic unit data, are also presented.

- 5) **Additional Source Data Attribute Fields** – Descriptions of USGS source data attribute fields retained in the GRI digital geologic-GIS data.
- 6) **Ancillary Source Map Information** – Additional source map information presented by source map. In addition to the report and (GIS) data pertaining to USGS SIM-3340, additional relevant information for each Alaska Resource Data File (ARDF) reports used in the GRI digital geologic-GIS data is also presented.
- 7) **GRI Digital Data Credits** – GRI digital geologic-GIS data and ancillary map information document production credits.

For information about using GRI digital geologic-GIS data contact:

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About the NPS Geologic Resources Inventory Program

Background

Recognizing the interrelationships between the physical (geology, air, and water) and biological (plants and animals) components of the earth is vital to understanding, managing, and protecting natural resources. The Geologic Resources Inventory (GRI) helps make this connection by providing information on the role of geology and geologic resource management in parks.

Geologic resources for management consideration include both the processes that act upon the Earth and the features formed as a result of these processes. Geologic processes include: erosion and sedimentation; seismic, volcanic, and geothermal activity; glaciation, rockfalls, landslides, and shoreline change. Geologic features include mountains, canyons, natural arches and bridges, minerals, rocks, fossils, cave and karst systems, beaches, dunes, glaciers, volcanoes, and faults.

The Geologic Resources Inventory aims to raise awareness of geology and the role it plays in the environment, and to provide natural resource managers and staff, park planners, interpreters, researchers, and other NPS personnel with information that can help them make informed management decisions.

The GRI team, working closely with the Colorado State University (CSU) Department of Geosciences and a variety of other partners, provides more than 270 parks with a geologic scoping meeting, digital geologic-GIS map data, and a park-specific geologic report.

Products

Scoping Meetings: These park-specific meetings bring together local geologic experts and park staff to inventory and review available geologic data and discuss geologic resource management issues. A summary document is prepared for each meeting that identifies a plan to provide digital map data for the park.

Digital Geologic Maps: Digital geologic maps reproduce all aspects of traditional paper maps, including notes, legend, and cross sections. Bedrock, surficial, and special purpose maps such as coastal or geologic hazard maps may be used by the GRI to create digital Geographic Information Systems (GIS) data and meet park needs. These digital GIS data allow geologic information to be easily viewed and analyzed in conjunction with a wide range of other resource management information data.

For detailed information regarding GIS parameters such as data attribute field definitions, attribute field codes, value definitions, and rules that govern relationships found in the data, refer to the NPS Geology-GIS Data Model document available at: <http://science.nature.nps.gov/im/inventory/geology/GeologyGISDataModel.cfm>

Geologic Reports: Park-specific geologic reports identify geologic resource management issues as well as features and processes that are important to park ecosystems. In addition, these reports present a brief geologic history of the park and address specific properties of geologic units present in the park.

For a complete listing of Geologic Resource Inventory products and direct links to the download site visit the GRI publications webpage http://www.nature.nps.gov/geology/inventory/gre_publications.cfm

GRI geologic-GIS data is also available online at the NPS Data Store Search Application: <http://irma>.

nps.gov/App/Reference/Search. To find GRI data for a specific park or parks select the appropriate park (s), enter "GRI" as a Search Text term, and then select the Search Button.

For more information about the Geologic Resources Inventory Program visit the GRI webpage: <http://www.nature.nps.gov/geology/inventory>, or contact:

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The Geologic Resources Inventory (GRI) program is funded by the National Park Service (NPS) Inventory and Monitoring (I&M) Division.

GRI Digital Map and Source Map Citations

The GRI digital geologic-GIS map for Cape Krusenstern National Monument, Gates of the Arctic National Park and Preserve, Kobuk Valley National Park, and Noatak National Preserve, Alaska (CAKR-GAAR-KOVA-NOAT):

Digital Geologic-GIS Map for Cape Krusenstern National Monument, Gates of the Arctic National Park and Preserve, Kobuk Valley National Park, and Noatak National Preserve (ARCN
- GRI abbreviation for the I&M Arctic Network which includes the listed parks)

Digital GIS data was converted to the NPS GRI digital geologic-GIS geodatabase data model (v. 2.3) and ESRI 10.4 file geodatabase format from U.S. Geological Survey SIM-3340. For geologic units USGS NSAClass values were preserved, and for many units used to divided the unit into more detailed sub-units. The extent of the data converted was defined by nineteen 1 degree x 3 degree quadrangles that cover Cape Krusenstern National Monument, Gates of the Arctic National Park and Preserve, Kobuk Valley National Park, and Noatak National Preserve.

Wilson, F.H., Hults, C.P., Mull, C.G, and Karl, S.M, 2015, Geologic Map of Alaska: U.S. Geological Survey, Scientific Investigations Map SIM-3340, scale 1:1,584,000. ([SIM-3340](#)). (GRI Source Map ID 76064).

The extent of the GRI digital geologic-GIS data is defined by the following 1 degree by 3 degree quadrangles that define the GRI digital geologic-GIS map extent: Ambler River, Baird Mountains, Beaver, Bettles, Chandalar, Chandler Lake, De Long Mountains, Howard Pass, Hughes, Killik River, Kotzebue, Misheguk Mountain, Noatak, Philip Smith Mountains, Point Hope, Selawik, Shungnak, Survey Pass and Wiseman.

Digital data for seventeen Alaska Resource Data File reports were also converted and are represented in the GRI digital geologic-GIS data. These sources are listed below.

Britton, J.M., 2000, Alaska Resource Data File, Beaver Quadrangle, Alaska: U.S. Geological Survey, Open-File Report OF-2000-308, scale 1:250,000 ([OF-2000-308](#)). (GRI Source Map ID 39381).

Britton, J.M., 2003, Alaska Resource Data File, Bettles Quadrangle, Alaska: U.S. Geological Survey, Open-File Report OF-2003-52, scale 1:250,000 ([OF-2003-52](#)). (GRI Source Map ID 54852).

Britton, J.M., 2000, Alaska Resource Data File, Chandalar Quadrangle, Alaska: U.S. Geological Survey, Open-File Report OF-2000-357, scale 1:250,000 ([OF-2000-357](#)). (GRI Source Map ID 2554).

Britton, J.M., 2003, Alaska Resource Data File, Hughes Quadrangle, Alaska: U.S. Geological Survey, Open-File Report OF-2003-58, scale 1:250,000 ([OF-2003-58](#)). (GRI Source Map ID 55354).

Britton, J.M., 2000, Alaska Resource Data File, Philip Smith Mountains Quadrangle, Alaska: U.S. Geological Survey, Open-File Report OF-2000-291, scale 1:250,000 ([OF-2000-291](#)). (GRI Source Map ID 2555).

Britton, J.M., 2003, Alaska Resource Data File, Wiseman Quadrangle, Alaska: U.S. Geological Survey, Open-File Report OF-2003-447, scale 1:250,000 ([OF-2003-447](#)). (GRI Source Map ID 62518).

Dover, J., 1997, Alaska Resource Data File, Howard Pass Quadrangle, Alaska: U.S. Geological Survey, Open-File Report OF-97-296, scale 1:250,000 ([OF-97-296](#)). (GRI Source Map ID 2838).

Dover, J., 1997, Alaska Resource Data File, Misheguk Mountain Quadrangle, Alaska: U.S. Geological Survey, Open-File Report OF-97-297, scale 1:250,000 ([OF-97-297](#)). (*GRI Source Map ID 2839*).

Grybeck, D.J. and Dumoulin, J.A., 2006, Alaska Resource Data File, Noatak Quadrangle, Alaska, U.S. Geological Survey, Open-File Report OF-2006-1157, scale 1:250,000 ([OF-2006-1157](#)). (*GRI Source Map ID 76111*).

Kelly, K., 1997, Alaska Resource Data File, Chandler Lake Quadrangle, Alaska: U.S. Geological Survey, Open-File Report OF-97-265, scale 1:250,000 ([OF-97-065](#)). (*GRI Source Map ID 3042*).

Kelly, K., 1997, Alaska Resource Data File, Killik River Quadrangle, Alaska: U.S. Geological Survey, Open-File Report OF-97-266, scale 1:250,000 ([OF-97-266](#)). (*GRI Source Map ID 3043*).

Nelson, S.M., 1997, Alaska Resource Data File, Ambler River Quadrangle, Alaska: U.S. Geological Survey, Open-File Report OF-97-856, scale 1:250,000 ([OF-97-856](#)). (*GRI Source Map ID 2575*).

Nelson, S.M., 2000, Alaska Resource Data File, Survey Pass Quadrangle, Alaska: U.S. Geological Survey, Open-File Report OF-2000-328, scale 1:250,000 ([OF-2000-328](#)). (*GRI Source Map ID 3046*).

Williams, A., 2000, Alaska Resource Data File, Baird Mountains Quadrangle, Alaska: U.S. Geological Survey, Open-File Report OF-2000-24, scale 1:250,000 ([OF-2000-24](#)). (*GRI Source Map ID 2719*).

Williams, A., 2000, Alaska Resource Data File, De Long Mountains Quadrangle, Alaska: U.S. Geological Survey, Open-File Report OF-2000-23, 1:250000 scale ([OF-2000-23](#)). (*GRI Source Map ID 2842*).

Williams, A., 2000, Alaska Resource Data File, Selawik Quadrangle, Alaska: U.S. Geological Survey, Open-File Report OF-2000-005, scale 1:250,000 ([OF-2000-005](#)). (*GRI Source Map ID 2720*).

Williams, A., 2000, Alaska Resource Data File, Shungnak Quadrangle, Alaska: U.S. Geological Survey, Open-File Report OF-2000-022, scale 1:250,000 ([OF-2000-022](#)). (*GRI Source Map ID 2721*).

Additional information pertaining to each source map is also presented in the GRI Source Map Information (ARCNMAP) table included with the GRI geologic-GIS data.

Index Map

The following index map displays the extent of the GRI digital geologic-GIS map of the Brooks Range, as well as park boundaries (in dark green, as of September, 2017), and relevant 1' by 3' quadrangles.



Map Unit List

The geologic units present in the GRI digital geologic-GIS data produced for Cape Krusenstern National Monument, Gates of the Arctic National Park and Preserve, Kobuk Valley National Park, and Noatak National Preserve, Alaska (*GRI MapCode ARCN*) are listed below. Units are listed with their assigned unit symbol and unit name (e.g., g - Ice fields or glaciers). Units are generally listed from youngest to oldest. No description for water is provided. Information about each geologic unit is also presented in the GRI Geologic Unit Information (ARCUNIT) table included with the GRI digital geologic-GIS data.

Quaternary Period

[glacier](#) - Ice fields or glaciers

[Qb](#) - Beach deposits

[Qda](#) - Active dune deposits

[Qrg](#) - Rock glacier deposits

[Qsf](#) - Solifluction deposits

[Qs](#) - Surficial deposits, undifferentiated

[Qa](#) - Alluvium

[Qaf](#) - Alluvial fan and talus deposits

[Qc](#) - Colluvium

[Qls](#) - Landslide deposits

[Qoa](#) - Older alluvium

[Qt](#) - Terrace deposits

[Qsw](#) - Swamp deposits

[Qd](#) - Dune deposits

[Qfl](#) - Loess

[Qsu](#) - Silt deposits, undifferentiated

[Qm](#) - Glacial deposits, undivided

[Qwo](#) - Late Wisconsin-age Glaciations, outwash deposits

[Qat](#) - Altiplanation terraces

[Qew](#) - Glaciations older than late Wisconsin, Mak Hill and Eklutna Glaciations

Quaternary and Tertiary Periods

[QTS](#) - Older surficial deposits, undivided

[QTg](#) - High-level gravel

[QTb](#) - Basalt

Tertiary Period

[Tcb](#) - Coal-bearing rocks

[Tmb](#) - Olivine basalt flows and cinder cones

[Tvab](#) - Andesite and basalt flows

[Tfv](#) - Intermediate to felsic biotite tuff

Tertiary and Cretaceous Periods

[TKvr](#) - Volcanic rock, light gray to pink rhyolite

[TKvi](#) - Iditarod Volcanics and similar units, younger phase

[TKgp](#) - Hypabyssal granite porphyry dikes, sills, and plugs

Tertiary, Cretaceous, Jurassic, Triassic, Permian, Pennsylvanian, Mississippian, and Devonian Periods

[IDg](#) - Gabbro, undifferentiated

Mesozoic and Paleozoic Eras

[MZPZct](#) - White-weathering chert or silicified limestone

[MZPZm](#) - Arctic Alaska terrane, metabasite

Cretaceous Period

[Ksb](#) - Schrader Bluff Formation

[Kvfp](#) - Hypabyssal rocks, dacite and rhyolite porphyry

[Kcc](#) - Nonmarine and marine carbonate-rich conglomerate and sandstone deltaic deposits

[Kgu](#) - Granitic rocks

[Kmn](#) - Migmatite associated with Cretaceous plutons of southern Brooks Range

[Khs](#) - Rocks of Hammond River shear zone

[Kga](#) - Alaskite

[Kgdt](#) - Granodiorite

[Kns](#) - Nephelene syenite

[Ksy](#) - Syenite

[Kqc](#) - Quartz-pebble conglomerate

[Ktu](#) - Tuluvak Formation

[Ksbf](#) - Seabee Formation

[Kmqm](#) - Quartz monzonite, monzonite, and syenite

[Kcvg](#) - Calcareous graywacke and mudstone, volcanic graywacke, and volcanic conglomerate

[Kto](#) - Torok Formation

[Ktfm](#) - Torok and Fortress Mountain Formations, undivided

[Kfm](#) - Fortress Mountain Formation, interbedded wacke and mudstone

[Knf](#) - Nanushuk Formation

[Knu](#) - Nanushuk Formation, upper part

[Knl](#) - Nanushuk Formation, lower part

[Kipc](#) - Igneous pebble-cobble conglomerate

[Kvgc](#) - Earliest Cretaceous volcanic graywacke and conglomerate

[Ktg](#) - Tuff, volcanic graywacke, and mudstone

[Kbd](#) - Spilitic pillow basalt and diabase

[Kko](#) - Kongakut Formation, pebble shale and siltstone

[Kit](#) - Ipewik Formation, Tingmerkpuk sandstone member

[Ko](#) - Okpikruak Formation and may include Fortress Mountain Formation, interbedded wacke and mudstone

[Kofc](#) - Okpikruak Formation, coquina limestone

Cretaceous and Jurassic Periods

[Kjvc](#) - Volcaniclastic rocks of the Brooks Range (may be included in Okpikruak Formation)

[Kjva](#) - Andesitic volcanic rocks

[Kjl](#) - Melange between Angayucham-Tozitna and Arctic Alaska and Ruby terranes

[Kjip](#) - Ipewik Formation, northern Alaska

[Kjsh](#) - Pebble shale and Kingak Shale, undivided

[Kjks](#) - Kingak Shale

Cretaceous, Jurassic, Triassic, and Permian Periods

[KPru](#) - Kingak Shale, Karen Creek Sandstone and Shublik Formation, undivided

Cretaceous, Jurassic, Triassic, Permian, Pennsylvanian, Mississippian, and Devonian Periods

[KDnb](#) - Undivided marine and non-marine shale and siltstone

Jurassic Period

[Jgi](#) - Intermediate plutonic rocks, northern Alaska

[Jbod](#) - Brooks Range ophiolite, gabbro, diabase, basalt, microgabbro, and minor diorite

[Jbou](#) - Brooks Range ophiolite, ultramafic and mafic rocks

[Jbob](#) - Brooks Range ophiolite, basalt, pillows and pillow breccia

Jurassic and Triassic Periods

[JTRob](#) - Brooks Range ophiolite, undivided

Jurassic, Triassic, Permian, and Pennsylvanian Periods

[JPNboi](#) - Brooks Range ophiolite, mafic sills and dikes associated with upper allochthons

[JPNzeg](#) - Etivluk Group, undivided

Jurassic, Triassic, and Permian Periods

[JTRPe](#) - Banded dark-green, gray, and red eclogite and banded amphibolite

[JTRPtU](#) - Dishna River mafic and ultramafic rocks

[JTRcs](#) - Otuk Formation

[JTRPaum](#) - Angayucham assemblage associated ultramafic rocks

Jurassic, Triassic, Permian, and Carboniferous Periods

[JMs](#) - Sedimentary rocks: Endicott Group (Kayak Shale), Lisburne Group and Etivluk Group (Otuk Formation and Siksikpuk Formation)

Jurassic, Triassic, Permian, Pennsylvanian, and Mississippian Periods

[JMab](#) - Angayucham assemblage, basalt and diabase

[JMTu](#) - Tozitna sequence, mafic, ultramafic, and sedimentary rocks, undivided

Triassic Period

[TRsf](#) - Shublik Formation, black shale, sandstone, and silty limestone

Triassic and Permian Periods

[TRPss](#) - Shublik and Siksikpuk Formations, undivided

Triassic, Permian, and Pennsylvanian Periods

[TRPNic](#) - Etivluk Group, Imnaitchiak Chert

Triassic, Permian, Pennsylvanian, and Mississippian Periods

[TRMtmu](#) - Rampart Group, igneous rocks

[TRMts](#) - Sedimentary rocks, formerly Rampart Group, now Tozitna sequence

Triassic, Permian, Pennsylvanian, Mississippian, and Devonian Periods

[TRDcs](#) - Calcareous sedimentary rocks

[TRDg](#) - Arctic Alaska terrane and Ruby terrane, metagraywacke

Triassic and Permian Periods

[TRPsg](#) - Sadlerochit Group, undivided

Permian Period

[Pef](#) - Sadlerochit Group, Echooka Formation, undivided

[Psk](#) - Etivluk Group, Siksikpuk Formation, chert and shale

Paleozoic Era

[PZrm](#) - Carbonates

Paleozoic and Neoproterozoic Eras

[PZZm](#) - Mafic schist

Pennsylvanian and Mississippian Periods

[PNMI](#) - Lisburne Group, Alapah Limestone and Wahoo Limestone, undivided

[PNMv](#) - Lisburne Group, associated volcanic rocks and sills

[PNMn](#) - Nuka Formation

Carboniferous Period

[PMIt](#) - Lisburne Group, Tupik Formation

[PMIg](#) - Lisburne Group, undivided

[PMIc](#) - Lisburne Group, Akmalik Chert

Mississippian Period

[Mlw](#) - Lisburne Group, Wachsmuth Formation

[Mlgn](#) - Lisburne Group, Nasorak Formation

[Mlut](#) - Lisburne Group, Utukok Formation, limestone

[Mlkg](#) - Lisburne Group, Kogruk Formation

[Mlku](#) - Lisburne Group, Kuna Formation

[Mlql](#) - Lisburne Group, informal lower part

[Mc](#) - Chert

[Mgg](#) - Globe quartzite

[Mlt](#) - Limestone and tuff

[Mk](#) - Endicott Group, Kayak Shale

[Mkk](#) - Endicott Group, Kayak Shale and Kekiktuk Conglomerate

[Mkkc](#) - Endicott Group, Kekiktuk Conglomerate or Kanayut Conglomerate

[Mke](#) - Endicott Group, Kekiktuk conglomerate

[Men](#) - Endicott Group, Kapaloak sequence of Point Hope region

[Mks](#) - Endicott Group, Kurupa Sandstone

Mississippian and Devonian Periods

[MDe](#) - Endicott Group, Itkilyariak Formation, Kekiktuk Conglomerate, Kayak Shale, Kanayut Conglomerate, Noatak Sandstone, Kurupa Sandstone, and Hunt Fork Shale, undivided

[MDky](#) - Endicott Group, Kanayut Conglomerate

[MDkys](#) - Endicott Group, Kanayut Conglomerate, Stuver Member, nonmarine shale and quartzite

[MDkn](#) - Endicott Group, Kanayut Conglomerate and Noatak sandstone

[MDkh](#) - Endicott Group, interlayered dark gray to black phyllite and calcareous phyllite

[MDrao](#) - Ruby terrane, augen gneiss and schist

Cambrian Period to Mississippian Period

[MCm](#) - Marble, northern Alaska

Neoproterozoic Era to Carboniferous Period

[PMZk](#) - Mixed schists of the Kallarichuk Hills, undivided

Devonian Period

[Dp](#) - Phyllite of Arctic Alaska terrane

[Dpr](#) - Ruby terrane, phyllite

[Dsb](#) - Brooks Range schist belt, calcareous schist, gray quartz-mica schist, and marble

[Dhf](#) - Endicott Group, Hunt Fork Shale

[Dhbw](#) - Endicott Group, Hunt Fork Shale, wacke member

[Dhfm](#) - Endicott Group, Hunt Fork Shale, metamorphosed

[Dkyl](#) - Endicott Group, Kanayut Conglomerate, Ear Peak Member, lower member, nonmarine shale

[Dkym](#) - Endicott Group, Kanayut Conglomerate, Shainin Lake, middle member

[Dkyq](#) - Endicott Group, Kanayut Conglomerate, quartz arenite and quartz wacke member

[Dnu](#) - Endicott Group, Noatak Sandstone and phyllite, carbonate and clastic rocks of the Nakolik River, shale

[Dyao](#) - Medium-grained granitic gneiss

[Dbk](#) - Baird Group, Kugururok Formation, limestone

[Dbe](#) - Baird Group, Eli Limestone

[Dbc](#) - Beaucoup Formation, carbonaceous, siliceous, and calcareous sedimentary rocks and felsic volcanic rocks

[Dbfw](#) - Beaucoup Formation, wacke member

[Dol](#) - Beaucoup Formation, dark gray to orange weathering limestone

[Dbf](#) - Beaucoup Formation, ferruginous and calcareous schist

[Dbv](#) - Beaucoup Formation, volcanic rocks or volcanic rock clasts

[Dbs](#) - Thin bedded black, siliceous, carbonaceous phyllite and impure chert

[Dyss](#) - Calcareous clastic rocks, Devonian sandstone and shale

[Dvt](#) - Basaltic and andesitic flows, tuff, breccia, and volcanic conglomerate altered to greenstone

[Dyp](#) - Phyllite, slate or black shale

[Dav](#) - Ambler sequence, metavolcanic and lesser metasedimentary rocks

[Davf](#) - Ambler sequence?, schistose felsic volcanic rocks

[Dg](#) - Dark-greenish-gray fine-grained impure graywacke

[Dvf](#) - Schistose felsic volcanic rocks

Devonian, Silurian, and Ordovician Periods

[DSOtU](#) - Metasedimentary and metavolcanic rocks of Tukpahlearik Creek, undivided

[DSOtq](#) - Carbonaceous quartzite and quartz conglomerate of Tukpahlearik Creek

[DSOtmg](#) - Marble and quartz schist of Tukpahlearik Creek

[DSOtpg](#) - Pelitic schist and greenstone of Tukpahlearik Creek

[DSOtp](#) - Pelitic schists of Tukpahlearik Creek

[DSOnx](#) - Nome Complex, mixed marble, graphitic metaquartzite, and schist

[DSOb](#) - Baird Group, massive light gray reefoid limestone and dolomite with local thin interbeds of calcareous phyllite

Devonian, Silurian, Ordovician, and Cambrian Periods

[DCbs](#) - Baird Group, Skajit Limestone

[DCld](#) - Massively bedded limestone, dolomite, and schist

[DCcs](#) - Calcareous schist

[DCcm](#) - Metasedimentary and metavolcanic rocks, undivided

Neoproterozoic Era to Devonian Period

[DZsg](#) - Schist and paragneiss

[DZrgm](#) - Ruby quartz-mica schist

[DZaqs](#) - Arctic Alaska terrane, quartz-mica schist

[DZss](#) - Seward terrane, siliceous schist of the Kallarichuk Hills

[DZacs](#) - Brooks Range Central belt and part of Northern thrust assemblages, quartz-rich metasedimentary rocks

[DZb](#) - Metasedimentary rocks of Bluecloud Mountain

[DZel](#) - Marble and intercalated gneissic rocks

[DZmr](#) - Metamorphic rocks, lenses near Kobuk and Victoria Creek fault systems, amphibolite facies

[DZrpg](#) - Gneiss and quartzite of the Ruby crystalline complex

[DZa](#) - Schist belt (western part), calcareous schist, albite-rich subunit

[DZmc](#) - Schist belt, calcareous schist, metachert and conglomerate subunit

[DZsm](#) - Brooks Range schist belt, chloritic marble

[DZrqs](#) - Ruby terrane, pelitic and quartzitic schist

Silurian Period

[Spl](#) - Black phyllite and metalimestone

Silurian and Ordovician Periods

[SOj](#) - Metasedimentary rocks of Jesse Mountain

[SOig](#) - Magik Group, undivided

Silurian, Ordovician, and Cambrian Periods

[SOCb](#) - Siltstone and phyllite

[SOCvs](#) - Doonerak antiform, volcanic and sedimentary rocks

Silurian, Ordovician and Cambrian Periods, and Neoproterozoic Era

[SZcb](#) - Carbonate rocks and subordinate metabasite

Ordovician Period

[Oc](#) - Nanielik antiform, Ordovician carbonate rocks

[Ocs](#) - Casadepaga Schist

Ordovician and Cambrian Periods

[OCc](#) - Carbonate rocks

[OCv](#) - Andesitic to basaltic volcanoclastic rocks and local tuffaceous phyllite, gabbro, and diabase, and black phyllite

Ordovician and Cambrian Periods, and Neoproterozoic Era

[OCZc](#) - Nanielik antiform, older carbonate rocks

Neoproterozoic Era

[Zgr](#) - Granitic rocks

[Zma](#) - Metasedimentary and metavolcanic rocks of Mount Angayukaqsrq

Neoproterozoic and Mesoproterozoic Eras

[ZYog](#) - Ernie Lake pluton orthogneiss

Units of Unknown Age

[bu](#) - Bedrock of unknown type or age or areas not mapped

Map Unit Descriptions

Descriptions of all geologic map units, generally listed from youngest to oldest, are presented below. For each unit one or more unit descriptions is presented. For nearly all units the first description listed, actually a link, is the unit's applicable description on source map SIM-3340. In addition to a SIM-3340 description link, unit descriptions from specific source maps used in the compilation of the SIM-3340 are also present. Note that for many if not most units a unit is grouped with one or more other units on SIM-3340 (e.g., both unit Qb and Qda, along with several other units to lengthy to fully list, are grouped into unit Qs - Unconsolidated surficial deposits, undivided (Quaternary) on SIM-3340).

For each unit description, from SIM-3340 or from a specific SIM-3340 source map, the source's unit symbol, unit name and unit age are listed. Note that these often differ from the assigned unit symbol, unit name and/or unit ages listed in the GRI digital geologic-GIS data (GRI unit symbols, unit names and unit ages derived from USGS NSAClass values which denote units that are considered by the USGS Alaska Science Center to be the same or equivalent units). USGS NSAClass values are present in the GRI digital geologic-GIS. For each non-SIM-3340 unit description the source map of that description (e.g., KL002) is listed. A complete list of these source citations is listed in the [USGS Source Map References](#) section.

g - Ice fields or glaciers (Holocene)

Qg - Glacial ice (Quaternary, Holocene) Modern cirque glaciers. *Unit description source:* KL002

Qb - Beach deposits (Holocene)

Qs - Unconsolidated surficial deposits, undivided (Quaternary) See [Qs](#) for unit description from [SIM-3340](#).

Qb - Beach deposits (Quaternary) Pebbly sand and gravel deposits along present-day coastline and small dune deposits in the back beach area. Includes some ancient beach-terrace deposits as much as 2 km from present-day coastline. *Unit description source:* NT005

Qda - Active dune deposits (Holocene)

Qs - Unconsolidated surficial deposits, undivided (Quaternary) See [Qs](#) for unit description from [SIM-3340](#).

Qs - Eolian and water-laid sand and silt sheets and stabilized dune fields (Quaternary, Holocene and Pleistocene) Sand and coarse silt. Extensive sheets of windblown and associated water-laid deposits are present in three separate locations: Baird Mountains, Ambler River, Selawik, and Shungnak quadrangles: Modified and partly dissected sheets of mixed windblown and water-laid deposits bordering the south edge of the Brooks Range.

Kateel River and Melozitna quadrangles: Sheet-like dune fields of windblown sand mantling alluvial silt deposits of the Koyukuk Flats. Dunes are much modified and locally dissected by stream erosion. Orientation of parabolic dunes suggest deposition by prevailing northeast winds. Ruby quadrangle: A broad sheet of wind-blown silt and sand that extends over a wide area in the Nowitna Lowland south of the Yukon River. The sheet is much modified by stream erosion, but parabolic and longitudinal dune forms can be recognized in aerial photographs and on 1:63,360-scale topographic maps. The dune forms

have a strong northeast-southwest orientation and suggest deposition by prevailing northeast winds. Small isolated sand sheets also occur in Bettles, Hughes, and Medfra quadrangles. *This unit description was derived from the following sources:* AR003, BM003, BT003, HU003, and SH004

Qs - Sand (Quaternary) Eolian sand deposits of the Kobuk Sand Dunes. *Unit description source:* BM002

Qs - Eolian sand (Quaternary) Eolian sand; Massive, well-sorted homogenous gray to tan sand and silty sand. Active dunes, shown by stippled pattern on map. *Unit description source:* BV002

Qrg - Rock glacier deposits (Holocene)

Qs - Unconsolidated surficial deposits, undivided (Quaternary) See [Qs](#) for unit description from [SIM-3340](#).

Qr - Rock Glaciers (Quaternary) Active and inactive rock glaciers and associated talus aprons consisting chiefly of angular rubble; only larger deposits shown. *Unit description source:* SP002

Qsf - Solifluction deposits (Holocene)

Qs - Unconsolidated surficial deposits, undivided (Quaternary) See [Qs](#) for unit description from [SIM-3340](#).

Qsm - Solifluction mantle on bedrock (Quaternary) Solifluction mantle on bedrock; Poorly sorted sand, silt, and clay derived from local upslope bedrock sources. *Unit description source:* BV002

Qs - Surficial deposits, undifferentiated (Pleistocene to Holocene)

Qs - Unconsolidated surficial deposits, undivided (Quaternary) See [Qs](#) for unit description from [SIM-3340](#).

Q - Undivided Quaternary (Quaternary) Undivided Quaternary. *Unit description source:* PH004

Qae - Undifferentiated alluvium, eolian terrace and slope deposits (Pleistocene and Recent) Undifferentiated alluvium and eolian terrace and slope deposits of silt and very fine sand. *Unit description source:* HU002

Qae - Undifferentiated alluvial and eolian deposits (Quaternary) Undifferentiated alluvial and eolian deposits, chiefly silt and fine sand. Includes glacial outwash and fan gravels locally. *Unit description source:* SH002

Qat - Active alluvial deposits and terrace deposits, undivided (Quaternary) Active alluvial deposits and terrace deposits composed of silt, sand, and gravel. *Unit description source:* NT005

Qs - Surficial deposits, undivided (Quaternary) Surficial deposits, undivided. *Unit description source:* BM007

Qs - Surficial deposits (Quaternary) Undivided unconsolidated deposits including glacial drift,

outwash, and high-level terraces, mostly boulders, gravel, sand, silt, and clay. *Unit description source:* CL002 and CL008

Qs - Surficial deposits, undivided (Quaternary) Unconsolidated stratified and unstratified surficial deposits, including side-stream alluvium; colluvium; terrace gravels; landslide deposits; delta, fan, and talus deposits; and glacial deposits. *Unit description source:* HW003, HW004, and MU012

Qs - Surficial deposits, undivided (Quaternary) Frost-rived rubble on slopes and broad low ridges; glacial moraine; glacially deposited sand, gravel, and boulders; fluvial gravel and sand; marine and fluvial terrace deposits; wetlands. *Unit description source:* KZ005

Qs - Surficial Deposits (Quaternary) Glacial deposits, alluvium, colluvium, and landslides. *Unit description source:* WI002

Qu - Undifferentiated surficial deposits (Quaternary) Undifferentiated surficial deposits; glacial drift, morainal deposits, glacial stream outwash, slope wash, solifluction creep surfaces, talus, glacial terrace deposits, fluviolacustrine deposits, and the Great and Little Kobuk Sand Dunes. *Unit description source:* AR002

Qu - Undifferentiated surficial deposits (Quaternary) Alluvial, glacial, lacustrine, terrace, and eolian deposits. *Unit description source:* BM002

Qu - Surficial deposits, undifferentiated (Quaternary) Frost-rived rubble and glacial gravel on broad upland slopes; colluvium, fan and floodplain alluvium and glacial gravel on steep slopes and in small valleys. *Unit description source:* CH002

Qu - Surficial deposits, undivided (Quaternary) Undivided surficial deposits. *Unit description source:* DL002, DL003, and DL004

Qu - Quaternary deposits, undifferentiated (Quaternary) Fine-grained colluvial deposits of reworked silt, with minor sand, pebbles, cobbles, and thin bedrock slabs, typically found on gentle slopes as apron-like features or a blanketing mantle over low hills and ridges. Material is derived from underlying or nearby topographically higher bedrock unit and transported by frost creep and gelifluction. Unit is gradational with other surficial deposits. Often exhibits horsetail drainage patterns from ephemeral streams. In areas of poor drainage, surface is typically characterized by broad expanses of grass tussocks. *Unit description source:* DL010

Qu - Surficial deposits, undivided (Quaternary) Includes colluvium and older vegetated alluvial deposits above present streams levels, alluvial fans, upland silt deposits, lacustrine material in Killik, Okokmilaga, and Okpikruak River valleys, and other surficial material not otherwise differentiated. *Unit description source:* KL002

Qu - Surficial Deposits, Undivided (Quaternary) Includes tundra, soil, lacustrine, talus, and glacial deposits. *Unit description source:* MU002, MU003, and MU004

Qu - Surficial deposits, undivided (Quaternary) Unconsolidated clay, silt, sand, and gravel. Includes tundra, soil, lacustrine, alluvial, colluvial, and glacial deposits. *Unit description source:* NT005

Qu - Surficial Deposits, Undivided (Quaternary) Mostly glacial and alluvial deposits. Mapped and described in detail by Hamilton (1978). *Unit description source:* PS002

Qua - Alluvial, colluvial, glacial, and windblown terrace and slope deposits, undivided (Quaternary, Holocene and Pleistocene) Chiefly silt and very fine sand including thick deposits of

micaceous silt in the Koyukuk Flats and Nowitna and Innoko Lowlands. Local deposits of alluvial fan and glacial outwash gravels. Widespread in lowland areas throughout the central and southern parts of the map area. *Unit description source:* AR003, BT003, HU003, SE004, and WI003

This unit is also present on source maps DL005, and NT006, however, no description was present on these sources.

Qa - Alluvium (Pleistocene to Holocene)

Qs - Unconsolidated surficial deposits, undivided (Quaternary) See [Qs](#) for unit description from [SIM-3340](#).

al - Alluvium, undifferentiated (Quaternary) Ranges from poorly sorted, moderately well stratified, subangular to subrounded sandy coarse gravel near heads of mountain valleys to moderately well sorted, well stratified, subrounded to rounded sandy gravel and gravelly sand along slow-flowing stretches of major streams. May contain local beds and lenses of sand and sandy silt. Includes fan, flood-plain, and low terrace deposits too small to be designated separately. *Unit description source:* WI009

al2 - Modern alluvium (Quaternary, Holocene) Sand and gravel, generally unvegetated and commonly subject to icings. Differentiated only along Koyukuk River and its North, Middle, and South Forks, and along John River. *Unit description source:* WI009

Qa - Alluvial deposits (Quaternary) Alluvial deposits; boulders, gravel, and sand. *Unit description source:* AR002

Qa - Alluvial deposits (Quaternary) Unconsolidated gravel, sand, silt, and clay. *Unit description source:* BM002

Qa - Alluvium, undifferentiated (Quaternary) Silt, sand, and gravel deposited in active, typically meandering stream and river channels; including intermittent tributaries active during seasonal runoff and flood events. Unit includes abandoned channels and floodplain deposits which may be mantled by fluvial silt overbank deposits with little or no vegetation. Unit may also include low terraces above the active floodplain that locally support dwarf willows adjacent to the rivers. *Unit description source:* DL010

Qa - Main stream alluvium (Quaternary) Unconsolidated, silt, sand, and gravel in active main stream channels. *Unit description source:* HW003 and HW004

Qal - Flood-plain and low-terrace alluvium (Quaternary) Flood-plain and low-terrace alluvium; Well-stratified layers and lenses of gray to brown, coarse to fine, well sorted, rounded to subangular gravel, and minor amounts of sand and silt. *Unit description source:* BV002

Qal - Surficial deposits, flood-plain alluvium (Quaternary, recent) Flood-plain alluvium. *Unit description source:* CH002

Qal - Alluvium (Quaternary, Holocene) Unconsolidated debris including boulders, gravel, sand, silt, clay, and humic material. Unit includes sediment in river channels, active flood plains, bogs, and swamps. *Unit description source:* CL002

Qal - Active alluvial deposits (Quaternary) Surficial deposits. Unconsolidated silt, sand, and gravel that is actively reworked during stream floods. Surfaces marked by sparse vegetation in most places. *Unit description source:* DL002, DL003, DL004, MU002, MU003, and MU004

Qal - Active alluvial deposits (Quaternary) Silt, sand and gravel deposited by modern streams; includes flood-plain deposits which are lightly vegetated in some areas. *Unit description source:* KL002

Qal - Alluvium (Quaternary, Holocene) Gravel and finer grained detritus along floodplains and on older willow- and low plant-covered terraces as much as 2 m above present stream levels. Deposits consist of locally derived materials and clasts from older gravels; includes minor lacustrine sediments. Contacts approximately located. *Unit description source:* MU006, MU007, and MU008

Qal - Stream alluvium (Quaternary, Holocene) Alluvium along larger stream courses. *Unit description source:* MU012

Qal - Active alluvial deposits (Quaternary, Holocene) Unconsolidated silt, sand, and gravel which is actively reworked during stream floods. Surfaces contain sparse vegetation in places. *Unit description source:* NT005

Qal - Alluvium (Quaternary) Primarily alluvium on active flood plains. Consists of chiefly boulders, gravel, and sand with local areas of silt and clay. *Unit description source:* SP002

Qf - Floodplain and tidal flats deposits (Quaternary, Holocene) Gravel, sand, silt, and peat. Floodplain deposits in Koyukuk Flats and along Yukon River composed mainly of light gray micaceous silt. Deposits occur along floodplains of major drainages and on tidal flats bordering the shores of Selawik Lake, Hotham Inlet, Eschscholtz Bay, Norton Sound, and Norton Bay. Floodplain deposits characterized physiographically by bars, oxbow lakes, meander scrolls, abandoned channels, and other evidence of recent floodplain building. *Unit description source:* AR003, BT003, HU003, and WI003

Qfp - Flood Plain deposits (Pleistocene and recent) Flood plain deposits of gravel, sand, and silt along flood plains of major drainages. *Unit description source:* HU002

Qfp - Flood-plain deposits (Quaternary) Silt, sand, and gravel along flood plains of major drainages. Locally includes some fan and terrace deposits along narrow tributary valleys. *Unit description source:* SH002

Qft - Flood-plain deposits (Quaternary) Silt, sand, and gravel along flood plains of major drainages. Locally includes some fan and terrace deposits along narrow tributary valleys. *Unit description source:* SE002

This unit is also present on source maps DL005 and NT006, however, no description was present on these sources.

Qaf - Alluvial fan and talus deposits (Pleistocene to Holocene)

Qs - Unconsolidated surficial deposits, undivided (Quaternary) See [Qs](#) for unit description from [SIM-3340](#).

Qaf - Alluvial fan silt deposits (Quaternary) Alluvial fan silt deposits; Well-stratified to poorly stratified layers and lenses of gray to brown well-sorted silt, fine sand, and sand and fine gravel. *Unit description source:* BV002

Qaf - Alluvial fan deposits (Quaternary) Poorly to moderately sorted fluvial silt, sand and gravel forming deltoid fans and aprons where tributaries join higher order streams. *Unit description source:* KL002

Qat - Alluvial fan and related terrace deposits (Quaternary) Alluvial fan and related terrace deposit; Well-stratified to poorly stratified layers and lenses of gray to brown, well-sorted, coarse to fine gravel with minor sand, silt, and peat. *Unit description source:* BV002

Qf - Fan deposits (Quaternary) Fan deposits. Poorly sorted to very poorly sorted, angular to subangular, silty, sandy gravel. Minor boulders. *Unit description source:* BV002

Qc - Colluvium (Pleistocene to Holocene)

Qs - Unconsolidated surficial deposits, undivided (Quaternary) See [Qs](#) for unit description from [SIM-3340](#).

Qc - Colluvium (Quaternary, Holocene) Thin surficial material on shallow slopes; interpreted from streaky nonintegrated surface drainage pattern on aerial photographs where bedrock is not visible. Consists of plant (tundra) cover on frost- and gravity-worked accumulations of windblown detritus, vegetation remains, bedrock clasts and alluvial debris. Contacts approximately located. *Unit description source:* MU006, MU007, and MU008

Qc - Colluvium (Quaternary) Primarily outcrop rubble and talus on glaciated valley walls and tundra covered areas. Consists primarily of angular boulders and gravel with minor silt and sand size material. *Unit description source:* SP002

This unit is also present on source maps DL005 and PH004, no description was present on these sources.

Qls - Landslide deposits (Pleistocene to Holocene)

Qs - Unconsolidated surficial deposits, undivided (Quaternary) See [Qs](#) for unit description from [SIM-3340](#).

Ql - Landslide Deposits (Quaternary) Chiefly debris avalanche material. *Unit description source:* SP002

Qs - Landslide deposits (Quaternary) Landslide deposits, source uncertain, apparently Dover. *Unit description source:* HW003

Qoa - Older alluvium (Pleistocene to Holocene)

Qs - Unconsolidated surficial deposits, undivided (Quaternary) See [Qs](#) for unit description from [SIM-3340](#).

Qoa - Older Alluvium (Holocene and Pleistocene) Consists of orange-weathering silt, sand, and gravel that form small resistant hills. *Unit description source:* SP002

Qt - Terrace deposits (Pleistocene to Holocene)

Qs - Unconsolidated surficial deposits, undivided (Quaternary) See [Qs](#) for unit description from [SIM-3340](#).

Qat - Terrace Deposits (Quaternary) Terrace gravels up to 4 m above modern stream level consisting of clast-supported, moderately sorted cobble and pebble gravel with minor silt and sand deposited along modern rivers and streams. Terraces are tundra covered. *Unit description source:* DL010

Qt - Surficial deposits, terrace deposits (Quaternary, Pleistocene?) Alluvium of elevated flood plains and related fans. *Unit description source:* CH002

Qt - Terrace deposits (Quaternary) Surficial deposits. Inactive alluvial deposits composed of silt, sand, and gravel at or above present high-water stage. Surface covered by stable vegetation. *Unit description source:* DL002, DL004, MU003 and MU004

Qt - Terrace deposits (Quaternary) Inactive alluvial deposits composed of silt, sand, and gravel at or above high water stage. Surface covered by stable vegetation. *Unit description source:* NT005

Qua - Alluvial, colluvial, glacial, and windblown terrace and slope deposits, undivided (Quaternary, Holocene and Pleistocene) Chiefly silt and very fine sand including thick deposits of micaceous silt in the Koyukuk Flats and Nowitna and Innoko Lowlands. Local deposits of alluvial fan and glacial outwash gravels. Widespread in lowland areas throughout the central and southern parts of the map area. *Unit description source:* SE004

This unit is also present on source maps DL005, NT006, PH004, however, no description was present on these sources.

Qsw - Swamp deposits (Pleistocene to Holocene)

Qs - Unconsolidated surficial deposits, undivided (Quaternary) See [Qs](#) for unit description from [SIM-3340](#).

Qs - Swamps and Bogs (Quaternary) Low-lying areas of swampy tundra, bogs, small ponds, and beaded drainage, commonly contains local low-center ice-wedge polygons and typically mantled by tundra mat, tussocks, or peaty deposits. *Unit description source:* DL010

Qd - Dune deposits (Pleistocene to Holocene)

Qs - Unconsolidated surficial deposits, undivided (Quaternary) See [Qs](#) for unit description from [SIM-3340](#).

Qat - Alluvial fan and related terrace deposits (Quaternary) Alluvial fan and related terrace deposit; Well-stratified to poorly stratified layers and lenses of gray to brown, well-sorted, coarse to fine gravel with minor sand, silt, and peat. Stippled pattern showing areas of eolian sands. *Unit description source:* BV002

Qs - Eolian sand (Quaternary) Eolian sand; massive, well-sorted homogenous gray to tan sand and silty sand. *Unit description source:* BV002

Qs - Chiefly sand deposits (Quaternary) Modified and dissected deposits of wind-blown and water-laid sand with subordinate amounts of silt. *Unit description source:* SE002 and SH002

Qs - Eolian and water-laid sand and silt sheets and stabilized dune fields (Quaternary, Holocene and Pleistocene) Sand and coarse silt. Extensive sheets of windblown and associated water-laid deposits are present in three separate locations: Baird Mountains, Ambler River, Selawik, and Shungnak quadrangles: Modified and partly dissected sheets of mixed windblown and water-laid deposits bordering the south edge of the Brooks Range. Kateel River and Melozitna quadrangles: Sheet-like dune fields of windblown sand mantling alluvial silt deposits of the Koyukuk Flats. Dunes are much modified and locally dissected by stream erosion. Orientation of parabolic dunes suggest deposition by prevailing northeast winds. Ruby quadrangle: A broad sheet of wind-blown silt and sand that extends over a wide area in the Nowitna Lowland south of the Yukon River. The sheet is much modified by stream erosion, but parabolic and longitudinal dune forms can be recognized in aerial photographs and on 1:63,360-scale topographic maps. The dune forms have a strong northeast-southwest orientation and suggest deposition by prevailing northeast winds. Small isolated sand sheets also occur in Bettles, Hughes, and Medfra quadrangles. *Unit description source:* WI003

Qsa - Actively drifting and recently stabilized dune fields (Quaternary, Holocene) Fine- to coarse-grained sand. Great Kobuk and Little Kobuk Sand Dunes in the southwestern Ambler River and southeastern Baird Mountains quadrangles, and Nogahabara Sand Dunes in the Kateel River quadrangle. The Great Kobuk and Little Kobuk dune fields covering 65 square kilometers and 8 square kilometers, respectively, are composed of parabolic or U-shaped dunes and large transverse dune ridges that locally develop into barchan-like dunes. Wind direction varies from northeast to southeast. The Nogahabara Sand Dunes are characterized by a circular field 8 kilometers in diameter consisting of transverse dunes that migrate outward in wavelike fashion from a deflationary area in the central and western part of the field. The main field is surrounded by smaller circular and elliptical fields of wavelike transverse dunes that have been recently stabilized or partially stabilized by a thin cover of vegetation. *Unit description source:* AR003

Qsd - Sand and dunes (Quaternary) Moderately sorted fine- to medium-grained sand, horizontally bedded to slightly cross-bedded. Initially deposited by slow-moving glacial streams reworking glacial outwash. Locally reworked into eolian deposits as sand sheets and dunes. *Unit description source:* KL002

Qws - Chiefly wind-blown and water-laid silt (Quaternary) Chiefly wind-blown and water-laid silt. Locally includes glacial outwash. *Unit description source:* SE002

Qfl - Loess (Pleistocene to Holocene)

Qs - Unconsolidated surficial deposits, undivided (Quaternary) See [Qs](#) for unit description from [SIM-3340](#).

Ql - Loess (Quaternary) Loess; massive, well-sorted homogenous tan to gray silt. *Unit description source:* BV002

Qsu - Silt deposits, undifferentiated (Pleistocene to Holocene)

Qs - Unconsolidated surficial deposits, undivided (Quaternary) See [Qs](#) for unit description from [SIM-3340](#).

Qsu - Perennially frozen silt, undifferentiated (Quaternary) Irregular blankets of massive, homogeneous, unconsolidated silt and sand largely retransported from original hillside sites to lower slopes and valley bottoms by mudflows, slope wash, and gullyng. Surface is generally smooth to gently sloping and mantled by tundra and broad expanses of grass tussocks. Permafrost in valley bottoms creates poor drainage manifesting as local bogs (unit Qs). *Unit description source:* DL010

Qm - Glacial deposits, undivided (Pleistocene? to Holocene?)

Qs - Unconsolidated surficial deposits, undivided (Quaternary) See [Qs](#) for unit description from [SIM-3340](#).

Qg - Glacial deposits (Quaternary) Undifferentiated glacial deposits. *Unit description source:* BM002

Qg - Surficial deposits, glacial drift (Quaternary, Pleistocene) Glacial drift; morainal sand, gravel and boulders; varved clay and boulder clay in lake beds on Tobin Creek and Kern Creek. *Unit description source:* CH002

Qg - Glacial deposits, undivided (Quaternary) Mainly unstratified glacial drift in moraines along west side of Makpik Creek. *Unit description source:* HW003

Qg - Glacial Moraine Deposits (Quaternary) Glacial moraine deposits. *Unit description source:* MU002 and MU004

Qg - Glacial deposits (Quaternary) Sand and gravel deposits in upper part of Kivalina River. Consist of outwash and possibly some morainal deposits. *Unit description source:* NT005

Qgm - Glacial moraine deposits (Quaternary) Surficial deposits. Glacial moraine. *Unit description source:* DL002, DL003, and DL004

Qgm - Morainal deposits (Quaternary) Poorly sorted unstratified till ranging from clayey stony silt to sandy bouldery gravel, contains large erratic boulders in some places; deposits from subdued to distinct, lightly to heavily vegetated, lateral and terminal moraines that in some places form well defined nested concentric ridges. Includes deposits of Anaktuvuk River, Sagavanirktok River, and Itkillik glaciations. *Unit description source:* KL002

Qgu - Glacial deposits, undifferentiated (Quaternary) Stratified and unstratified drift of various glacial intervals. Includes till, outwash and ice-contact deposits. *Unit description source:* KL002

Qm - Undifferentiated Glacial Moraine (Holocene and Pleistocene) Includes ground, lateral, and end moraines from Holocene and Pleistocene glaciers. *Unit description source:* SP002

Qt - Till (Quaternary) Till, poorly sorted silty, sandy, bouldery gravel. *Unit description source:* BV002

QTgl - Glacial and glaciolacustrine deposits. (Quaternary, Pleistocene and Tertiary, Pliocene?) Includes unsorted to poorly sorted till, outwash sand and gravel, alluvium, and eolian deposits. Along the southern edge of Brooks Range, unit is characterized by little-modified middle and late Pleistocene drift including prominent morainal ridges (shown by hachured lines), ice-contact features, and glaciolacustrine deposits. Further south, in Bettles, Hughes, Shungnak, and Selawik quadrangles, unit is composed of discontinuous areas of highly modified drift of Pliocene(?) and early Pleistocene age interspersed with alluvium and eolian deposits. Glacial erratics occur in hilly parts of the central Shungnak and Hughes quadrangles to an elevation of 600 meters. In the Bettles quadrangle the southern

margin of the unit consists chiefly of lacustrine sediments deposited from a large proglacial lake. Glacial drift deposits bordering the southern edge of the Brooks Range and extending to the southern edge of the Selawik, Shungnak, Hughes, and Bettles quadrangles. Also includes drift from small Pleistocene alpine glaciers in the Melozitna, Tanana, and Medfra quadrangles. *Unit description source:* AR003, BM003, and WI003

Qwo - Late Wisconsin-age Glaciations, outwash deposits (late Pleistocene)

Qs - Unconsolidated surficial deposits, undivided (Quaternary) See [Qs](#) for unit description from [SIM-3340](#).

Qgo - Glacial outwash deposits (Quaternary) Surficial deposits. Glacial outwash. *Unit description source:* DL004

Qat - Altiplanation terraces (Pleistocene)

Qs - Unconsolidated surficial deposits, undivided (Quaternary) See [Qs](#) for unit description from [SIM-3340](#).

Qap - Altiplanation terrace (Quaternary) Altiplanation terrace; flat surfaces formed on bedrock at altitudes of 2500 to 3500 feet and mantled with a thin veneer of rock rubble. *Unit description source:* BV002

Qew - Glaciations older than late Wisconsin, Mak Hill and Eklutna Glaciations (Pleistocene)

Qs - Unconsolidated surficial deposits, undivided (Quaternary) See [Qs](#) for unit description from [SIM-3340](#).

Qda - Glacial drift (Quaternary, probable Wisconsin) Chiefly till and outwash deposits of Ambler Glaciation. Locally includes outwash of Walker Lake Glaciation. *Unit description source:* SH002

Qga - Undifferentiated older glacial drift, alluvium, and eolian deposits (Quaternary, Illinoian) Chiefly highly modified till and outwash gravels mantled by wind-blown and water-laid silt and fine sand. *Unit description source:* SE002 and SH002

QTgl - Glacial and glaciolacustrine deposits (Quaternary, Pleistocene and Tertiary, Pliocene?) Includes unsorted to poorly sorted till, outwash sand and gravel, alluvium, and eolian deposits. Along the southern edge of Brooks Range, unit is characterized by little-modified middle and late Pleistocene drift including prominent morainal ridges, ice-contact features, and glaciolacustrine deposits. Further south, in Bettles, Hughes, Shungnak, and Selawik quadrangles, unit is composed of discontinuous areas of highly modified drift of Pliocene(?) and early Pleistocene age interspersed with alluvium and eolian deposits. Glacial erratics occur in hilly parts of the central Shungnak and Hughes quadrangles to an elevation of 600 meters. In the Bettles quadrangle the southern margin of the unit consists chiefly of lacustrine sediments deposited from a large proglacial lake. Glacial drift deposits bordering the southern edge of the Brooks Range and extending to the southern edge of the Selawik, Shungnak, Hughes, and Bettles quadrangles. Also includes drift from small Pleistocene alpine glaciers in the Melozitna, Tanana, and Medfra quadrangles. *Unit description source:* BT003 and HU003

QTs - Older surficial deposits, undivided (Pliocene to Holocene)

QTs - Poorly consolidated surficial deposits, undivided (Quaternary) See [QTs](#) for unit description from [SIM-3340](#).

Qti - Ilyrak gravels (Quaternary) Ilyrak gravels. *Unit description source:* PH004

Ts - Gravel and sand (Tertiary) A small cutbank exposure of moderately dipping gravel and sand at north edge of Selawik Hills on eastern tributary of Mangoak River. Composed chiefly of poorly sorted granitic rock detritus that appears to have been derived from nearby granitic rocks. *Unit description source:* SE002

QTg - High-level gravel (Pliocene to Pleistocene)

QTs - Poorly consolidated surficial deposits, undivided (Quaternary) See [QTs](#) for unit description from [SIM-3340](#).

Qtg - High-level gravel (Quaternary) Gravels on remnants of formerly more extensive terraces from about 5 to 150 m above present stream levels; mapped mostly from nearly flat terraces surfaces as seen on aerial photographs. Clasts consist largely of chert, mafic igneous rocks, and quartzitic sandstone and wacke. The most prominent surfaces trend northeastward across the northern part of the region and probably reflect the broad, subsequent valley of the ancestral Colville River prior to beheading of it by drainages of the Utukok River system. *Unit description source:* MU006, MU007, and MU008

QTg - High-level gravel and sand (Quaternary or Tertiary) High-level gravel and sand; Stratified gray to blue-gray to rusty-brown, well-sorted, pebble to boulder gravel and coarse sand. *Unit description source:* BV002

QTgr - Quartz gravel deposits (Quaternary or Tertiary) High-level deposits of quartz pebble gravel; overlies basalt flows of unit Tb. Southeast corner of Bettles quadrangle and northeast corner of Tanana quadrangle. *Unit description source:* BT003

QTs - Soligvik gravels (Quaternary and Tertiary) Soligvik gravels. *Unit description source:* PH004

QTt - Terrace gravel (Quaternary and Tertiary) Gravel and sandy gravel, forms terraces ranging from 3-4 m above modern stream levels, to high-level terraces as much as 110 m above modern stream levels. Includes extensive low level terrace material near major stream valleys and extensive higher level surfaces near Killik River. *Unit description source:* KL002

QTb - Basalt (Pliocene to Pleistocene)

QTV - Young volcanic rocks, undifferentiated (Quaternary or Tertiary) See [QTV](#) for unit description from [SIM-3340](#).

QTb - Basalt (Pleistocene or Late Tertiary) Dissected, nearly horizontal flows of gray to dark-red vesicular olivine basalt. *Unit description source:* SE002 and SH002

Tcb - Coal-bearing rocks (late Eocene? to late Miocene?)

Tcb - Coal-bearing sedimentary rocks (Eocene to Pliocene) See [Tcb](#) for unit description from [SIM-3340](#).

Ts - Sedimentary rocks (Tertiary) Sedimentary rocks; yellow and gray, thin-bedded water-lain tuff and siltstone; quartz-pebble conglomerate; and amber-bearing coal beds. *Unit description source:* BV002

Tmb - Olivine basalt flows and cinder cones (Miocene (Langhian))

Tob - Olivine basalt flows (Miocene) See [Tob](#) for unit description from [SIM-3340](#).

Tb - Basalt (Tertiary?) Horizontal, vesicular, olivine basalt flows. About 1,000 ft. thick. *Unit description source:* CH002

Tvab - Andesite and basalt flows (Paleocene to Eocene)

Tepv - Andesite and basalt flows (Eocene and Paleocene) See [Tepv](#) for unit description from [SIM-3340](#).

QTb - Basalt (Quaternary or Tertiary) Horizontal flows of dark vesicular to massive olivine basalt; subordinate volcanic conglomerate and breccia. *Unit description source:* BT002

Tfv - Intermediate to felsic biotite tuff (Paleocene)

Tpt - Pyroclastic rocks (Early Eocene or Paleocene) See [Tpt](#) for unit description from [SIM-3340](#).

TKv - Felsic volcanic rocks (Tertiary and Cretaceous (?)) Brown, gray, and light-tan porphyritic flows, breccia, conglomerate, and tuff of acidic and intermediate composition. *Unit description source:* BT002

Kv - Andesitic volcanic rocks (Early Cretaceous) Andesitic crystal-bearing lithic tuff and tuff breccia; probably correlative with andesitic volcanic rocks of Neocomian age in Hughes quad (Patton and Miller, 1966). *Unit description source:* BT002

TKvr - Volcanic rock, light gray to pink rhyolite (Cretaceous (Campanian) to early Eocene)

TKv - Volcanic rocks in southern Alaska (Late Cretaceous to Early Tertiary) See [TKv](#) for unit description from [SIM-3340](#).

TKd - Dacite and rhyolite lava flows, domes, and volcanoclastic and hypabyssal rocks (Early Tertiary and Late Cretaceous) Dacite, rhyolite, and trachyandesite lava flows, domes, sills, dikes, and interlayered breccias and tuffs. Composed of phenocrysts of plagioclase, quartz, sanidine, and biotite in a groundmass of quartz and feldspar. Locally in Unalakleet and Medfra quadrangles, tuffs at the base of unit contain interbeds of quartz-chert-pebble conglomerate, sandstone, siltstone, and thin coaly layers with abundant plant fossils. Forms a large volcanic field and small domal bodies in Medfra and Ruby

quadrangles. Also is sparsely distributed as small flow fields in Unalakleet quadrangle and as small domal bodies in eastern Bettles quadrangle. Unit locally interlayered with unit TKa. *Unit description source:* BT003

TKr - Rhyolite (Tertiary or Cretaceous) Gray, brown, pale-red, and orange porphyritic rhyolite, welded rhyolite tuff, and silicified laminated rhyolitic flows. *Unit description source:* BV002

TKvi - Iditarod Volcanics and similar units, younger phase (Cretaceous (Campanian) to early Eocene)

TKv - Volcanic rocks in southern Alaska (Late Cretaceous to Early Tertiary) See [TKv](#) for unit description from [SIM-3340](#).

TKa - Andesite and basalt flows and volcaniclastic rocks (Early Tertiary and Late Cretaceous) Columnar-jointed andesite, basaltic andesite, and basalt lava flows. Composed of phenocrysts of plagioclase and pyroxene in a fine-grained groundmass of plagioclase microlites, granular pyroxene, and dark glass. Forms a large volcanic field in northwestern part of Medfra quadrangle and south-central part of Ruby quadrangle. Also occurs as small widely scattered bodies in the central and eastern part of Unalakleet quadrangle. Unit is locally interlayered with unit TKd. *Unit description source:* AR003

TKgp - Hypabyssal granite porphyry dikes, sills, and plugs (Cretaceous (Campanian) to early Eocene)

TKhi - Dikes and subvolcanic rocks (Tertiary and (or) Cretaceous) See [TKhi](#) for unit description from [SIM-3340](#).

TKi - Shallow intrusive rocks of silicic and intermediate composition (Tertiary and Late Cretaceous) Includes a wide variety of shallow intrusive rocks including rhyolite, dacite, trachyte, and andesite plugs, domes, sills, and dikes and larger more coarsely crystalline bodies of granite, granodiorite, tonalite, and monzonite porphyry. Small bodies scattered throughout map area. *Unit description source:* BT003 and SE004

Khi - Hypabyssal intrusive rocks (Cretaceous) Small bodies of hypabyssal intrusive rocks including latite and quartz latite porphyry. *Unit description source:* HU002

TDg - Gabbro, undifferentiated (Devonian to Paleocene)

TKgb - Gabbroic rocks (Late Cretaceous (or older) to Tertiary) See [TKgb](#) for unit description from [SIM-3340](#).

TDg - Gabbro and diabase (Tertiary? to Devonian?) Fresh to altered gabbroic and diabasic intrusive bodies. Unit intrudes rocks as old as middle Paleozoic and as young as Cretaceous. May represent a wide range of ages. Small scattered bodies in Medfra, Ophir, Ruby, and Hughes quadrangles. *Unit description source:* HU003

MZPZct - White-weathering chert or silicified limestone (Paleozoic to Mesozoic)

Kof - Okpikruak Formation and similar units (Lower Cretaceous) See [Kof](#) for unit description from [SIM-3340](#).

wc - White-weathering chert or silicified limestone (unknown) Forms isolated rubble exposures surrounded by tundra; weathering character similar to chert in Ilnavik River allochthon but in places difficult to distinguish from weathered rubble exposures of limestone member of Otuk Formation. *Unit description source:* KL002

MZPZm - Arctic Alaska terrane, metabasite (Proterozoic to Jurassic)

MzPzmb - Metabasite (Mesozoic & Paleozoic) See [MzPzmb](#) for unit description from [SIM-3340](#).

b - Metabasalt (Age not given) Metabasaltic rock of unknown age, not as a separate mappable unit(?), but of significant size within other units to warrant distinction on the map. In DOB and KJm. Polygons within unit MzPzm assigned NSAClass of 5140. *Unit description source:* BM002

Dv - Mafic Metavolcanic Rocks (Devonian) Dark green to dark gray massive metabasalt, greenstone, and greenschist. Locally includes well developed pillow basalt and greenstone with ophitic and porphyritic textures. Greenschist and greenstone contain low grade (greenschist) metamorphic assemblages that include porphyroblastic albite, actinolite and garnet, rare glaucophane, chlorite, muscovite, and epidote. *Unit description source:* SP002

MzPxma - Metabasite (Mesozoic? to Proterozoic?) Varies from thinly layered greenschist to more massively layered greenstone bodies representing altered mafic and intermediate volcanic and shallow intrusive rocks. The characteristic minerals are chlorite, albite, actinolite, and epidote. Unit may include rocks of several different ages. Some of the bodies are interlayered with the Devonian felsic schist of unit Df and are part of a bimodal volcanic assemblage. Other bodies are interlayered with carbonate rocks (unit Pzca) that contain fossils of probable Devonian and Mississippian age. Still other bodies may represent tectonically emplaced slices of unit JDv of the Angayucham-Tozitna terrane. Small scattered bodies in Wiseman, Survey Pass, Ambler River, Baird Mountains, and Selawik quadrangles. *Unit description source:* AR003, HU003, SE004, and WI003

Ksb - Schrader Bluff Formation (Cretaceous (Santonian) to Cretaceous (Maastrichtian))

Ksb - Schrader Bluff Formation (Upper Cretaceous) See [Ksb](#) for unit description from [SIM-3340](#).

Ksb - Schrader Bluff Formation (Late Cretaceous) Consists of 3 members, Rogers Creek, Barrow Trail, and Sentinel hill members, but not separated on this map. Formation consists of shale, claystone, sandstone, and bentonite. Shale is medium- to light-gray, bentonitic, clayey, fissile and includes tuff beds. Claystone is medium-gray, commonly well-indurated, and probably tuffaceous in part. Sandstone is light-gray to light-brown, fine-grained, laminated and micaceous. Bentonite beds consists of medium- to light-grayish green bentonite that is locally silty and grades to gray tuffaceous siltstone. *Unit description source:* CL002

Kvfp - Hypabyssal rocks, dacite and rhyolite porphyry (Cretaceous (Santonian) to Cretaceous (Maastrichtian))

Kvu - Volcanic rocks, undivided (Cretaceous) See [Kvu](#) for unit description from [SIM-3340](#).

Kfv - Felsic volcanic rocks (middle Cretaceous) Varies locally, consists of latite, quartz latite, and trachyte flows, crystal-lithic tuff, rhyolitic and rhyodacitic welded tuff and flow(?) and hypabyssal intrusive rocks. *Unit description source:* SH002

Kcc - Nonmarine and marine carbonate-rich conglomerate and sandstone deltaic deposits (Cretaceous)

Kcc - Carbonate-rich conglomerate and sandstone deltaic rocks (Cretaceous) See [Kcc](#) for unit description from [SIM-3340](#).

Kcc - Carbonate-clast conglomerate, sandstone, and shale (Late and Early Cretaceous) Poorly sorted nonmarine and shallow-water shelf deposits consisting of carbonate-rich conglomerate (calciuridite), sandstone (calcarenite), and shale (calcilutite). Unit contains abundant plant debris and thin seams of bituminous coal. Clast-supported cobble to boulder conglomerate, composed almost entirely of carbonate rocks, grades eastward into trough cross-bedded, medium- to coarse-grained sandstone and pebble conglomerate fan-delta deposits, which in turn grade eastward into cross-bedded, fine- to coarse-grained, inner and outer shelf sandstone and shale. Chert, volcanic rock, quartz, and schist detritus present in subordinate amounts. Unit derived in large part from Paleozoic carbonate rocks (lcs) of the Seward terrane. Unit contains sparse palynomorphs of Cretaceous(?) age in the Norton Bay quadrangle. Unit extensively exposed in western parts of Norton Bay and Candle quadrangles and in a small area in northwestern part of Selawik quadrangle south of Kobuk River. *Unit description source:* SE004

Kgu - Granitic rocks (Cretaceous)

Kgu - Plutonic rocks and dikes, granite to diorite (Cretaceous) See [Kgu](#) for unit description from [SIM-3340](#).

Kag - Albite granite (Cretaceous ??) Leucocratic medium- to coarse-grained albite granite composed predominately of albite and quartz (Single small pluton in middle of quadrangle (per Bill Patton, March, 1999). *Unit description source:* HU002

Kmn - Migmatite associated with Cretaceous plutons of southern Brooks Range (Cretaceous)

Kmig - Migmatite and metaplutonic rocks (Cretaceous) See [Kmig](#) for unit description from [SIM-3340](#).

Kgc - Contaminated granitic rocks (Cretaceous) Dark, fine- to coarse-grained contaminated granitic rocks with abundant mafic schlieren. *Unit description source:* BV002

Dm - Migmatite (Devonian) Migmatite; granitic rocks intercalated with biotite schist and some hornblende hornfels; also some pyroxene hornfels and granitic dikes. *Unit description source:* CH002

Khs - Rocks of Hammond River shear zone (Cretaceous)

Khs - Rocks of Hammond River shear zone of Till and others (2008a) (Cretaceous) See [Khs](#) for unit description from [SIM-3340](#).

Khs - Rocks of the Hammond River shear zone (Cretaceous?) Heterogeneous mix of finely laminated, mostly mylonitic lithologies derived in part from adjacent units exposed in the eastern Wiseman and western Chandalar quadrangles. Unit is recessive, poorly exposed, and includes large (up to 0.5 km across) bodies of black quartzite and smaller exposures of quartz-rich schist, metagabbro, dark brown marble, and relatively undeformed metasandstone and metasilstone. In thin section, minerals are strained and broken. No age control available. The unit encompasses a zone of deformation between the Schist and Central belts. This unit is part of the Central belt. *Unit description source:* CH004

Dc - Chloritic and carbonate rocks (Late or Middle Devonian?) Green and gray phyllite and dolomite; chloritic, calcareous meta-sandstone and marble; and carbonate-clast conglomerate. Southeastern part of Dillon unit reassigned; eastern exposures Till and others Khs. *Unit description source:* WI008

DSk - Skajit limestone (Devonian and older?) Marble, dolomite, carbonate conglomerate, and minor quartzite and graphitic and calcareous schist. Locally may include marble layers of undifferentiated older formations. Southern part of unit reassigned to Till and others Khs unit. *Unit description source:* WI008

Kga - Alaskite (Cretaceous (Campanian))

Klgr - Intermediate granitic rocks (Late Cretaceous) See [Klgr](#) for unit description from [SIM-3340](#).

Ka3 - Alaskite (Late Cretaceous) Medium-grained alaskite at west end of Wheeler Creek plutons. *Unit description source:* SH002

Kgdt - Granodiorite (Cretaceous (Campanian))

Klgr - Intermediate granitic rocks (Late Cretaceous) See [Klgr](#) for unit description from [SIM-3340](#).

Kg3 - Granodiorite and quartz monzonite (Late Cretaceous) Chiefly leucocratic, medium-grained, hornblende-biotite granodiorite and quartz monzonite in Zane Hills and Wheeler Creek plutons. *Unit description source:* SH002

Kgd - Granodiorite and granite (Late Cretaceous) Generally fine- to medium-grained equigranular, but locally porphyritic, hornblende-biotite granodiorite, and alaskitic biotite granite. Locally includes tonalite and quartz monzodiorite. Forms three large plutons and numerous small plutons in the southern parts of Shungnak and Hughes quadrangles and along a belt that extends diagonally southwestward across the central part of Melozitna quadrangle. *Unit description source:* HU003 and SH004

Kgq - Granodiorite and quartz monzonite (Late Cretaceous) Medium-grained hornblende-biotite granodiorite and quartz monzonite with lesser diorite. *Unit description source:* HU002

Kns - Nephelene syenite (Cretaceous (Albian to Santonian))

Ksy - Syenitic rocks (Cretaceous) See [Ksy](#) for unit description from [SIM-3340](#).

Kn2 - Nepheline syenite (Early Cretaceous) Chiefly leucocratic, medium-grained nephelene syenite and related mafic alkaline rocks. *Unit description source:* SH002

Kns - Nepheline syenite (Early Cretaceous) Chiefly leuco- to melanocratic, medium-grained nephelene syenite and malignite, with subordinate ijolite, shonkinite, and pyroxenite. *Unit description source:* SE002

Ksy - Syenite (Cretaceous (Albian to Santonian))

Ksy - Syenitic rocks (Cretaceous) See [Ksy](#) for unit description from [SIM-3340](#).

Kgi - Syenite and monzonite (Early Cretaceous) Chiefly leuco- to mesocratic, medium-grained gneissic syenite and monzonite. *Unit description source:* SE002

Km2 - Monzonite (Early Cretaceous) Chiefly leucocratic, medium-grained porphyritic, biotite-pyroxene monzonite. *Unit description source:* SH002

Ks2 - Syenite (Early Cretaceous) Chiefly leucocratic, medium-grained gneissic hornblende syenite. *Unit description source:* SH002

Ksy - Syenite, monzonite, and nepheline syenite (Early Cretaceous) Composed of syenite, monzonite, and subordinate quartz monzonite, monzodiorite, quartz syenite, and nepheline syenite and related mafic alkaline rocks including malignite, ijolite, shonkinite, and pyroxenite. Unit occurs in two separate Early Cretaceous plutonic belts (fig. 3, sheet 2): a western belt that can be traced from Shungnak quadrangle westward through Selawik quadrangle and southward into the Candle quadrangle and an eastern belt that extends from the northeastern part of Bettles quadrangle to southwestern part of the Nulato quadrangle. Unit is widespread in the western belt, but is confined to a single composite pluton at the northeastern end of the eastern belt. *Unit description source:* BT003 and WI003

Kqc - Quartz-pebble conglomerate (Cretaceous (Barremian to Santonian))

Kqc - Quartz-pebble conglomerate, west-central Alaska (Cretaceous) See [Kqc](#) for unit description from [SIM-3340](#).

Kb - Bergman Group (Cretaceous) Conglomerate of pebbles and boulders of quartz, quartzite, schist, slate, black and red chert and, at one locality, of volcanic rocks; interbedded lithic and feldspathic graywacke with about 1 percent volcanic rock fragments. *Unit description source:* CH002

Kc - Conglomerate (Cretaceous) Buff to gray, lenticularly bedded, poorly sorted, quartz- and carbonate-rich, pebble and cobble conglomerate; reddish gray, massive to thin bedded, fine- to coarse-grained quartz sandstone; subordinate olive-gray, fossiliferous, mica-rich siltstone, and rare coal lenses. Well rounded and moderately sorted. *Unit description source:* BM002

Knc - Nonmarine conglomerate, sandstone, mudstone, and coal (Late Cretaceous) Conglomerate composed chiefly of well-sorted white quartz pebbles in quartzose and micaceous matrix; also has pebbles of phyllite, schist, greenstone, and chert in subordinate amounts. Interbedded quartzose and micaceous sandstone and mudstone. *Unit description source:* SE002, SE003, SE004

Kq - Quartz conglomerate (Late Cretaceous) Conglomerate composed chiefly of quartz pebbles in a quartzose and micaceous matrix; pebbles of phyllite, schist, greenstone, and chert; interbedded quartzose and micaceous sandstone and mudstone; coal seams. *Unit description source:* AR002

Kq - Quartz conglomerate, sandstone, and mudstone (Late Cretaceous) Conglomerate composed chiefly of white quartz pebbles in quartzose and micaceous matrix; also has pebbles of phyllite, schist, greenstone, and chert in subordinate amounts. Interbedded quartzose and micaceous sandstone and mudstone. *Unit description source:* SH002 and SP002

Kqc - Quartz- and metagraywacke-clast conglomerate, sandstone, and shale (Cretaceous) Composed chiefly of well-sorted and well-rounded clasts of white quartz and/or metagraywacke in a quartzose and micaceous matrix; schist, chert, greenstone, and limestone clasts occur in subordinate amounts. Conglomerate is interbedded with quartzose, cross-bedded sandstone and carbonaceous and micaceous mudstone. Contains rare interbeds of ashy tuff. Plant fossils and thin bituminous coal seams are locally abundant. Unit composed chiefly of debris eroded from the Arctic Alaska and Ruby terranes. Grades downward into unit (Kmc) reflecting the progressive unroofing of the Arctic Alaska and Ruby terranes beneath the Angayucham-Tozitna terrane. Unit is regionally metamorphosed to stretched-pebble conglomerate, semischist, and phyllite in northeastern part of the Shungak quadrangle and in adjoining parts of the Ambler River and Hughes quadrangles. Unit exposed along the northern and southeastern margin of the Yukon-Koyukuk Basin from Baird Mountains and Selawik quadrangles eastward to Wiseman and Bettles quadrangles and southwestward to Melozitna quadrangle. *Unit description source:* AR003, BT003, HU003, SE004 and WI003

Kqc - Quartz-pebble conglomerate (Late Cretaceous) Conglomerate with well rounded clasts of quartz, quartzite, graywacke, chert, schist, and mafic volcanic and intrusive rocks; minor sandstone, shale, and thin ash-fall tuff. *Unit description source:* BT002

Ktu - Tuluvak Formation (Cretaceous (Turonian to Coniacian))

Ktu - Tuluvak Formation (Cretaceous) See [Ktu](#) for unit description from [SIM-3340](#).

Kc - Colville Group, undivided; Foredeep deposits of the Colville basin (Late Cretaceous) Poorly exposed interbedded marine sandstone and shale. *Unit description source:* KL002

Kc - Colville Group (Late Cretaceous) Gray to olive-gray; medium bedded to massive quartz arenite to volcanic wacke with interbeds of laminated siltstone and shale, and abundant plant debris and coal fragments; some yellow-weathering very fine grained laminated vitric tuff. Mostly nonmarine. Exposed thickness about 60m. *Unit description source:* PS002

Kp - Prince Creek Formation (Late Cretaceous) Only Tuiluvak Tongue of formation recognized in the quadrangle; formation changes in character from southwest to northeast in the quadrangle. In northeast (?), unit description mixes directions, can't be sure which is which) it is principally sandstone, siltstone, mudstone, coal, and tuff. Sandstone is light- to medium-gray, yellowish gray, brownish gray, thin- to medium-bedded, fine- to coarse-grained, locally conglomeratic, and includes conglomerate beds composed mostly of smaller pebbles of black chert and white quartz and quartzite. Mudstone, siltstone, and shale are end members of a continuum of lithologies that are typically medium- to dark-gray, fissile

in part, and bentonitic in part. In northwest(?) part of quadrangle, unit consists of conglomerate, sandstone, siltstone, and shale. Conglomerate is in basal part of unit and consists of well-rounded pebbles of white to light-gray quartz, quartzite, and medium- to dark-gray chert. Conglomerate has sandstone matrix and quartz cement. Sandstone, siltstone, and shale of upper part of unit are poorly exposed; sandstone is gray, probably mostly quartz and chert and prominently cross-bedded. Siltstone and shale are gray and brownish gray and poorly indurated. Tuff beds, coal, and ironstone are found locally. *Unit description source:* CL002

Ksbf - Seabee Formation (Cretaceous (Cenomanian to Coniacian))

Ksbf - Seabee Formation and Hue Shale (Upper Cretaceous) See [Ksbf](#) for unit description from [SIM-3340](#).

Ks - Seabee Formation (Late Cretaceous) Consists of 2 members in the quadrangle; Shale Wall and overlying Aiyak Members. Shale Wall Member consists of medium-gray shale that is typically bentonitic and clayey. Bentonite beds, laminated siltstone beds, and limestone concretions are included in unit. Locally gray to black organic shale, clayey limestone concretions up to 2.4 m thick and marine fossils are found, as are medium- to medium-light-gray, fine-grained sandstone and siltstone. Calcite cement is common. Aiyak Member is mostly greenish-gray and olive-gray siltstone. Siltstone is typically shaly and grades to mudstone. Brownish- and greenish-gray, mostly fine-grained, thin- to medium-bedded sandstone is also present; locally sandstone is coarse grained and includes thin lenticular beds of conglomerate containing black chert and white quartz pebbles. Impure limestone, shale and both ironstone and calcareous concretions are present locally. *Unit description source:* CL002

Kmqm - Quartz monzonite, monzonite, and syenite (Cretaceous (Albian to Coniacian))

Kmqm - Quartz monzonite, monzonite, and syenite (Cretaceous) See [Kmqm](#) for unit description from [SIM-3340](#).

Kg - Granitic rocks (Cretaceous) Porphyritic to granular, locally gneissic, granitic rocks including quartz monzonite and granite, aplite, and pegmatitic dikes. *Unit description source:* BV002

Kgr - Granite and granodiorite (Early Cretaceous) Unit consists chiefly of biotite and muscovite-biotite granite and granodiorite. Unit occurs in two separate Early Cretaceous plutonic belts (fig. 3, sheet 2): an eastern belt that extends from northeastern Bettles quadrangle to the southwestern part of Nulato quadrangle and a western belt that can be traced from Shungnak quadrangle westward through Selawik quadrangle and then southward into Candle quadrangle. *Unit description source:* BT003 and SE004

Kq2 - Quartz monzonite (Early Cretaceous) Chiefly leucocratic, medium-grained porphyritic, biotite quartz monzonite in Purcell Mtn. and Ekiek Creek plutons. *Unit description source:* SH002

Kqi+ - Quartz monzonite and alaskite (Early Cretaceous) Chiefly leucocratic, fine- to medium-grained cataclastic-textured, monzonite and alaskite. *Unit description source:* SE002

MzPzp - Mesozoic or Late Paleozoic (Granitic rocks) In Monarch Creek - Keating Creek area; hornblende-biotite granodiorite and quartz monzonite; some granite; commonly porphyritic, with potash feldspar phenocrysts. In Chuttoh Bluffs area; porphyritic biotite-hornblende granite and quartz monzonite; many aplite dikes. Seems gradational with adjacent gneissic granite. *Unit description source:* CH002

Kcvg - Calcareous graywacke and mudstone, volcanic graywacke, and volcanic conglomerate (Cretaceous (Albian to Cenomanian))

Kcvg - Calcareous graywacke and mudstone, volcanic graywacke and conglomerate (Cretaceous) See [Kcvg](#) for unit description from [SIM-3340](#).

Kcvg - Carbonate and volcanic clast graywacke and mudstone (late Early Cretaceous) Cyclically interbedded fine- to coarse-grained highly calcareous graywacke; hard, fine- to medium-grained, carbonaceous, volcanic graywacke; and dark carbonaceous mudstone. Graywacke is typically graded and sole-marked. Carbonized plant debris is abundant. Graywackemudstone ratios are generally high. The unit is interpreted to represent middle and outer submarine fan lobe deposits; some locally thick sections of mudstone probably represent basin plain deposits. Paleocurrents are generally to the northeast. Unit appears to be transitional between the carbonate-rich deposits of map unit Kcg and the volcanic-rich deposits of map unit Kvg. *Unit description source:* BM003, SE004, and SH004

Kto - Torok Formation (Cretaceous (Aptian to Cenomanian))

Kto - Torok Formation (Cretaceous) See [Kto](#) for unit description from [SIM-3340](#).

Kcs - (Cretaceous?) Not described -- outcrops occur within Kto, Torok Formation. Could this be mislabeled "cobblestone-sandstone unit (Ktoc)" of the Torok Formation?. *Unit description source:* CL002

Kfs - Foredeep deposits of the Colville Basin, Torok Shale (Early Cretaceous, Albian) Soft dark-gray to black clay shale and thinly interbedded silty shale, generally exposed in only discontinuous stream cutbanks, most exposures tightly folded; lower portion interfingers with Fortress Mountain Formation. *Unit description source:* HW009

Kt - Torok Formation (Early Cretaceous) Probably more than 2 km of dark-gray claystone, mudstone, and siltstone and minor thin beds of turbidite subgraywacke sandstone. *Unit description source:* MU006 and MU008

Kt - Torok Formation (Early Cretaceous) Dark-gray, laminated and cross-laminated, silty clay shale and siltstone, with thin limestone interbeds and abundant marcasite nodules; minor very fine grained sandstone. Marine. More than 130 m thick. *Unit description source:* PS002

Kto - Torok Formation (Early Cretaceous) Shale, mudstone, siltstone, and sandstone, mostly and characteristically bluish-gray, dark-greenish-gray, and dark-gray shale, mudstone, and clayey siltstone. Shale is fissile in part, mostly very thin-bedded and includes partings and thin interbeds of siltstone and very fine-grained sandstone. Sandstone is medium-light-gray, very fine- to very coarse-grained, silty and shaly, and in part conglomeratic. Sandstone also includes lenses of granule conglomerate, most granules of which are chert. *Unit description source:* CL002

Kto - Torok Formation (Cretaceous, Albian) Dark-gray mudstone and silty mudstone, with lesser amounts of greenish-gray, thin-bedded siltstone. Generally poorly exposed, grades upward into lower unit of Nanushuk Formation. Thickness unknown but estimated to be more than 5,000 ft. *Unit description source:* DL005

Kto - Torok Formation (Cretaceous, Aptian or Aptian-Albian) Silty shale and clay shale, predominately dark gray, interbedded with medium gray siltstone and minor amounts of medium gray to tan, fine-grained sandstone. Shale is thin-bedded and finely laminated, has characteristic nodular

fracture. Interbedded siltstone and sandstone is thin-to medium-bedded, with platy to blocky fracture; slightly to moderately calcareous; contains graded bedding, wave- and current-ripple bedforms, sole markings, load casts, shale ripups, horizontal burrows, and scattered carbonaceous plant fragments. Sandstone beds most common in the upper parts of formation and appear to lack lateral continuity. The unit is a thick prodelta deposit; and is gradational and intertonguing with both overlying and underlying units. The Torok is relatively incompetent and acts as a detachment surface for decollement folding of the overlying competent Nanushuk Group. Torok occupies the lowlands of the map area, commonly has thin tundra cover, but in some areas forms bare unvegetated slopes with white powdery, calcareous weathering surface that is conspicuous on aerial photographs. Good outcrops are limited to scattered stream cutbanks. Outcrops typically intensely folded, making thickness of unit difficult to determine. Thickness: Probably >2,500 m in map area, based upon projection of dips in overlying and underlying units; probably thicker in areas beyond the depositional limit where the Mt. Kelly Graywacke pinches out into shale. Age: Aptian or Aptian-Albian in map area, based upon palynomorphs from a number of localities (Mickey and Haga, 1995, 1998, 2000) (table 2). *Unit description source:* DL010

Kto - Foredeep deposits of the Colville Basin, Torok Shale (Early Cretaceous, Albian) Soft dark-gray to black clay shale and thinly interbedded silty shale, generally exposed in only discontinuous stream cutbanks, most exposures tightly folded; lower portion interfingers with Fortress Mountain Formation. *Unit description source:* HW007

Kto - Torok Shale (Early Cretaceous, Albian) Soft, dark-gray to black clay shale and thinly interbedded silty shale, generally exposed only in discontinuous stream cutbanks, most exposures tightly folded, lower portion interfingers with Fortress Mountain Formation. *Unit description source:* KL002

Kto - Torok Formation (Early Cretaceous) Probably more than 2 km of dark-gray claystone, mudstone, and siltstone and minor thin beds of turbidite subgraywacke sandstone. *Unit description source:* MU012

Ktoc - Torok Formation, cobblestone sandstone unit (Early Cretaceous) Informal unit for mappable and discrete bodies of sandstone and conglomerate in lower part of Torok Formation. Unit comprised of sandstone, siltstone, mudstone, and conglomerate. sandstone is mostly yellowish brown weathering, olive- to greenish-gray, coarse- to very fine-grained, very thin- to massive-bedded, partly laminated and partly small-scale and wispy crossbedded. Siltstone is yellowish-brown weathering, olive- to greenish-gray mostly very thin-bedded to laminated and grades to very fine-grained sandstone. Mudstone is medium-dark-gray to medium-greenish-gray, mostly thin-bedded, very silty and very sandy in part and locally includes sandstone partings. Conglomerate is framework-supported, well-rounded clasts of mostly chert, but including silicified aphanitic rocks fragments, mafic igneous rock and carbonate rocks fragments. Clasts range from granule to cobble sized but are mostly pebble-sized. *Unit description source:* CL002

Ktfm - Torok and Fortress Mountain Formations, undivided (Cretaceous (Albian to Aptian))

Kto - Torok Formation (Cretaceous) See [Kto](#) for unit description from [SIM-3340](#).

Ktf - Torok and Fortress Mountain Formations, undivided (Early Cretaceous) At least 0.5 km of dark-gray shale, subgraywacke and wacke sandstone lithologically similar to those in the Torok Formation and to those in the sandstone member of the Fortress Mountain Formation, but contains intermediate proportions of those rocks. May be in part a relatively proximal facies of the Torok Formation. *Unit description source:* MU006, MU007, and MU008

Ktfm - Torok Shale and Fortress Mountain Formation, undivided (Early Cretaceous (Albian and Aptian)) Undifferentiated and regionally interfingering units of the Torok Shale, characterized by folded, thinly interbedded, black clay shale and silty shale; and the Fortress Mountain Formation, consisting predominantly of greenish-gray graywacke, interbedded with dark-gray mudstone and shale, and massive beds of pebble to cobble-conglomerate containing clasts of variegated chert and altered mafic igneous rocks. *Unit description source:* HW003 and HW004

Kfm - Fortress Mountain Formation, interbedded wacke and mudstone (Cretaceous (Albian))

Kfm - Fortress Mountain Formation (Cretaceous) See [Kfm](#) for unit description from [SIM-3340](#).

Kf - Foredeep deposits of the Colville Basin, Fortress Mountain Formation, undivided (Early Cretaceous, Albian) Dominantly greenish-gray graywacke interbedded with dark-gray mudstone and shale; interfingers with Torok Shale, in places contains a differentiated conglomerate unit (Kfcg). *Unit description source:* HW009

Kf - Fortress Mountain Formation (Early Cretaceous) Terrigenously derived rocks of variable thickness, probably more than 1.5 km in places. Exposed in three belts of possibly co-eval rocks. Members are, north to south, Wacke and conglomerate member, shale member, and sandstone member. *Unit description source:* MU006, MU007, and MU012

Kf - Fortress Mountain Formation (Cretaceous) Greenish-gray calcareous micaceous wacke. exposed at rubbly outcrops in northwestern part of map area. *Unit description source:* NT005

Kfc - Fortress Mountain Formation, conglomerate and sandstone (Early Cretaceous) Mostly light-greenish-gray weathering greenish-gray pebble conglomerate in beds up to 1.2 m thick. Nonmarine and marine. Beds are lenticular and crossbedded, showing locally prominent pebble imbrication. Rip-up clasts, scarce mudcracks in thin, discontinuous mudstone intervals and plant debris ranging from small carbonized wood to coalified logs. Conglomerate clasts include varieties of chert, varieties of mafic igneous rocks, limestone, argillite, organic shale and granitic rocks. Conglomerate interbedded with bioturbated marine sandstone and sandstone showing local ripple and wave crossbedding, gravel lenses, abundant wood debris and locally, marine mollusks. *Unit description source:* CL002

Kfc - Foredeep deposits of the Colville Basin, Fortress Mountain Formation, conglomerate (Early Cretaceous, Albian) Dominantly greenish-gray graywacke interbedded with dark-gray mudstone and shale; contains thick massive beds of pebble to boulder conglomerate; clasts are well-rounded and consist dominantly of gray, black, and green chert and a large variety of altered mafic igneous rocks. *Unit description source:* HW009

Kfcg - Fortress Mountain Formation, conglomerate (Early Cretaceous, Albian) Dominantly greenish-gray graywacke interbedded with dark-gray mudstone and shale; forms Pingaluligit Mountain and lower resistant linear ridges between Okpikruak River and Kurupa River; interfingers with Torok Shale. Contains thick massive beds of pebble- to boulder-conglomerate, clasts are well rounded and consist dominantly of gray, black, and green chert and a large variety of altered mafic rocks. *Unit description source:* KL002

Kfl - Fortress Mountain Formation, shale member (Early Cretaceous) Dark-gray claystone and mudstone with about 30 percent thin-bedded gray micaceous siltstone and sandstone which exhibit small-scale crossbedding, ripple marks, and rare mudcracks. *Unit description source:* MU006, MU007 and MU008

Kfm - Foredeep deposits of the Colville Basin, Fortress Mountain Formation, shale and mudstone (Early Cretaceous, Albian) Dominantly dark-gray mudstone and shale; interfingers with Torok Shale, in places contains a differentiated conglomerate unit (Kfc). *Unit description source:* HW009

Kfm - Fortress Mountain Formation, undivided (Early Cretaceous, Albian) Dominantly greenish-gray graywacke interbedded with dark-gray mudstone and shale; forms Pingaluligit Mountain and lower resistant linear ridges between Okpikruak River and Kurupa River; interfingers with Torok Shale, in places contains differentiated units Kfcg and Kfs. *Unit description source:* KL002

Kfm - Fortress Mountain Formation (Early Cretaceous) Fortress Mountain Formation. *Unit description source:* PH004

Kfm - Fortress Mountain Formation (Early Cretaceous) Cyclic units of poly-mictic conglomerate, lithic wacke, siltstone and shale; rocks in upper cycles generally finer grained and thinner bedded than those in lower cycles. Conglomerate composed of well-rounded cobbles to granules of black, gray and green chert, and minor white quartz, quartzite, limestone and igneous rock; massive to medium bedded. Lithic wacke, dusky yellow green to dark-gray; coarse to fine grained; massive to thin bedded. Siltstone and shale dark gray. Carbonized plant debris common throughout. Marine and nonmarine. Early Cretaceous (Albian) pelecypods. Thickness 1,300 m. *Unit description source:* PS002

Kfmc - Fortress Mountain conglomerate? (Cretaceous) Guess this is Fortress Mountain conglomerate. Not in list of map units from Gil Mull, so it is uncertain. *Unit description source:* DL005

Kfs - Fortress Mountain Formation, shale and mudstone (Early Cretaceous, Albian) Dominantly greenish-gray graywacke interbedded with dark-gray mudstone and shale; forms Pingaluligit Mountain and lower resistant linear ridges between Okpikruak River and Kurupa River; interfingers with Torok Shale. Dominantly dark-gray shale and mudstone. *Unit description source:* KL002

Kfs - Fortress Mountain Formation, sandstone member (Early Cretaceous, Albian) Characterized by about 40 percent gray and olive-gray subgraywacke sandstone and granule to pebble conglomeratic sandstone interbedded with mudstone and siltstone. Thickness estimated to range from 1 to 1.5 km. Contains striking turbidite features similar to wacke and conglomerate member. Matrix is calcite, chlorite, and clay minerals. *Unit description source:* MU006, MU007, MU008, and MU012

Kft - Fortress Mountain Formation, turbidite sandstone and conglomerate (Early Cretaceous) Turbidite sandstone and conglomerate not associated with recognized shallow marine and nonmarine deposits. Most sandstone is fine- to medium-grained but grades to very coarse-grained in beds as much as 1.5 m thick. Sandstone beds are massive, graded, laminated and locally, wispy crossbedded. Sandstone interbedded with siltstone and silty mudstone. *Unit description source:* CL002

Kfw - Fortress Mountain Formation, Wacke and mudstone member (Cretaceous) Commonly more than 50% fine- to medium-grained wacke that is usually calcareous, well bedded, and locally conglomeratic. Some wacke beds have shale chips. Weathers medium to light brown on hill slopes. *Unit description source:* DL002, DL003, and DL004

Kfw - Fortress Mountain Formation, wacke and conglomerate member (Early Cretaceous) Roughly 50 percent greenish-gray wacke and granule to pebble wacke conglomerate interbedded with siltstone and mudstone. Thickness estimated to range from 50 to 1000 m. Common turbidite features are graded bedding, sole marks and flute, groove, and striation casts. Very small-scale crossbedding common in most wacke beds. Rocks are texturally and compositionally immature, with clasts of chert, quartz, claystone, carbonaceous and kerogenous rocks, igneous rocks, and carbonate rocks in a matrix of chlorite, calcite, quartz and clay minerals. *Unit description source:* MU006, MU007, and MU008

Kfwc - Fortress Mountain Formation - Wacke and conglomerate member (Cretaceous) Brown-weathering, gray and grayish-green wacke and granule- to pebble-wacke conglomerate interbedded with subordinate siltstone and mudstone. Texturally and compositionally immature; contains clasts of quartz, limestone, chert, diabase, and shale. *Unit description source:* DL004

Kky - Mount Kelly graywacke (Fortress Mountain equivalent) (Cretaceous) Graywacke, characterized by sometimes very abundant detrital muscovite and carbonate grains. *Unit description source:* DL005

Kmk - Mount Kelly Graywacke Tongue of the Fortress Mountain Formation, Lower part (Cretaceous, Aptian) Predominantly sandstone, fine- to medium-grained, some coarse-grained, medium gray-green to brown sandstone, interbedded with poorly exposed dark gray silty shale and local conglomeratic channels. Contains abundant carbonaceous plant material on the top of some beds. Weathers orange-brown to olive-brown; forms rounded rubble-covered ridges and hills marked by resistant conglomerate and sandstone bedrock traces that are often unreliable for determining bedding attitudes due to frost disruption. Sandstone beds are thin- to thick-bedded and organized in generally fining- and thinning-upward sequences. Includes massive, homogeneous beds, parallel lamination, planar and trough cross-bedding, climbing ripples, wave ripple and wave-modified current ripple bedforms on bed tops, hummocky cross-stratification, convolute bedding, fluid-escape structures, shale ripups, and bi-directional and multidirectional sole markings. In the map area, the lower part of Mount Kelly Graywacke is exposed only on the northwest limb of the southwest plunging anticlinal nose in the extreme southeast corner of the map area. Thickness: Probably >2,000m. Age: Probably Aptian, based upon age of the gradationally overlying Torok Formation, which yields probable Aptian palynomorphs (Mickey and Haga, 2000). *Unit description source:* DL010

Kmku - Mount Kelly Graywacke Tongue of the Fortress Mountain Formation, Upper part (Cretaceous, Aptian) Sandstone, fine- to medium-grained, dark brownish-gray to greenish-gray with interbedded poorly exposed, slightly micaceous silty shale, generally forms poorly exposed, low, rubble-covered ridges. Composed of poorly sorted quartz, chert, lithic rock fragments, and moderate muscovite in an argillaceous matrix, with slight to moderate calcareous cement. Contains abundant carbonaceous plant fragments on some beds. Weathers light brown to gray, and is slightly less calcareous and micaceous than the lower part of the Mount Kelly Graywacke. Sandstone bedding is generally massive and homogeneous and generally thickens upward, with poorly exposed interbedded silty shale intervals up to 2 m thick. Some beds have small-scale trough and tabular sets of planar cross-bedding, dish structures, possible convolute dewatering structures, flutes and groove casts and symmetrical wave-ripple bedforms. Near its contact with overlying Torok Formation, unit contains scattered channelized lenticular pebble to cobble conglomerate beds to 2 m thick. Thickness: ~1,000 m, includes shale interval separating it from the underlying main body of Mount Kelly Graywacke. Age: Probably Aptian, based upon age of the gradationally overlying Torok Formation, which yields probable Aptian palynomorphs (Mickey and Haga, 2000). *Unit description source:* DL010

Knf - Nanushuk Formation (Cretaceous (Albian to Cenomanian))

Knf - Nanushuk Formation (Cretaceous) See [Knf](#) for unit description from [SIM-3340](#).

Kn - Nanushuk Group (Cretaceous) Nanushuk Group, includes Corwin and Kukpowruk Formations. *Unit description source:* PH004

Knu - Nanushuk Formation, upper part (Cretaceous (Albian to Cenomanian))

Knf - Nanushuk Formation (Cretaceous) See [Knf](#) for unit description from [SIM-3340](#).

Kc - Nanushuk Group, Corwin Formation (Cretaceous) Continental to marginal-shore marine (lower delta-plain) siltstone, subgraywacke sandstone, mudstone, coal, carbonaceous shale, ironstone, and bentonitic clay. Grades into and intertongues with underlying Kukowruk Formation. *Unit description source:* MU008

Knc - Chandler Formation (part) (Cretaceous) Killik Tongue; sandstone, conglomerate, siltstone, shale, and coal. Sandstone and conglomerate are light-olive-gray, greenish-gray, and medium-gray, weathering salt-pepper. conglomeratic sandstone and conglomerate beds include clasts mostly of chert and quartz. coal beds as much as 3 m thick present in upper part of unit; together with siltstone and shale are poorly exposed and weather easily. *Unit description source:* CL002

Knc - Nanushuk Group, Chandler Formation; Foredeep deposits of the Colville basin (Late Cretaceous, Cenomanian to Early Cretaceous, Albian) Dominantly nonmarine, gray to light-gray sandstone and quartz- and chert-pebble conglomerate interbedded with dark-gray shale and coal, forms rolling tundra covered hills with occasional resistant sandstone or conglomerate ledges north of Tuktu Escarpment. *Unit description source:* KL002

Knc - Chandler Formation (Late and Early Cretaceous) Massive pebble to cobble conglomerate composed mainly of chert and quartz clasts; quartz arenite to quartz wacke, medium-bedded to massive; interbedded carbonaceous shale and siltstone, minor coal beds less than 30cm thick. Scour marks and crossbedding common. Fluvial and shallow marine. Late Cretaceous (Cenomanian) pelecypods and Early Cretaceous (Albian) Chaetopods. Exposed thickness 440m. *Unit description source:* PS002

Kns - Ninuluk and Chandler (part) Formations, undivided (Late Cretaceous) Principally nonmarine sandstone of the Niakogan Tongue of the Chandler Formation interfingering with the laterally equivalent and principally marine sandstone of Ninuluk Formation. Chandler Formation here comprises sandstone, siltstone, and mudstone. Sandstone is light-olive-gray, greenish-gray, and medium-gray, fine- to coarse-grained, thin-bedded to massive, well-indurated and locally limonite cemented. Ninuluk Formation is mostly sandstone, siltstone, and shale. Sandstone is greenish- to brownish-gray, thin-bedded to massive, laminated in part, crossbedded, friable to moderately indurated, and fine- to very fine-grained, grading to siltstone. Conglomeratic sandstone also present. Across map area, in a northeasterly direction, sandstone becomes finer grained, thinner bedded, more clayey, and more commonly carbonate cemented. Siltstone, is hard greenish-gray, and hackly weathering; shale is dark-bluish-gray and clay-rich. *Unit description source:* CL002

Knu - Nanushuk Formation, upper unit (Cretaceous, Albian to Cenomanian) Dominantly nonmarine to marginal marine, gray to light-gray sandstone and quartz- and chert-pebble conglomerate interbedded with poorly exposed siltstone, dark-gray silty carbonaceous shale, and abundant coal. Interbedded with marine rocks in upper and lower part of unit. Rocks formerly mapped as Corwin Formation. *Unit description source:* DL005

Knu - Nanushuk Group, upper part (Cretaceous, Albian to Cenomanian) Sandstone, medium-gray to yellowish-brown, fine- to coarse-grained, thin- to medium-bedded lithic and chert arenite, and sparse conglomerate and conglomeratic sandstone; forms resistant beds and rubble traces. Interbedded recessive rocks, which make up the greater thickness of beds, consist of dark gray silty shale, clay shale, black carbonaceous shale, siltstone, and local coal beds. Sand grains consist dominantly of quartz and chert, with lesser amounts of calcite, feldspar, and lithic fragments. Conglomerate clasts are predominantly sub-rounded pebbles and cobbles of white quartz and black, gray, greenish-gray, and

maroon chert, and local ironstone, coal, gray sandstone, quartzite, argillite, and mafic igneous rocks. Generally upward-fining and -thinning successions show plane-parallel lamination, tabular sets of planar and inclined cross-stratification, asymmetrical ripple cross-lamination and bed forms, trough cross-bedding, and basal channel scours. Sandstone and siltstone beds are lenticular and pinch and grade laterally to shale. Conglomerate is commonly exposed as large-scale multilateral and/or multistory channel fills. Unit contains well-preserved Albian plant fossils and rooted tree stumps at localities along Kukpowruk River (Herman and Spicer, in press) (table 2). Sandstones are generally tight, with measured porosity < 11 percent, average - 5 percent, and permeability < 1 md (Ahlbrandt and others, 1979). Top of Nanushuk not exposed in map area; base of upper Nanushuk interfingers with lower Nanushuk. Thickness: - 1,300 to - 2,500 m, varying markedly in some areas of Coke Basin and Tupikchak Syncline. Age: Regionally dated as Albian to Cenomanian (Chapman and Sable, 1960; Herman and Spicer, in press; table 2) but probably entirely Albian in map area because upper part is not present. *Unit description source:* DL010

Knl - Nanushuk Formation, lower part (Cretaceous (Albian))

Knf - Nanushuk Formation (Cretaceous) See [Knf](#) for unit description from [SIM-3340](#).

Kk - Nanushuk Group, Kukpowruk Formation (Early Cretaceous) Mostly nearshore marine, with some continental-transitional strata; siltstone, subgraywacke sandstone, and mudstone with very minor thin coaly beds in the upper part. Grades into and intertongues with a distal marine facies, the upper part of the underlying Torok Formation. *Unit description source:* MU006 and MU008

Knl - Nanushuk Formation, lower unit (Cretaceous, Albian) Dominantly gray to greenish-gray, very-fine to fine-grained marine sandstone and minor conglomerate. Intertongues with underlying Torok Formation. Rocks formerly mapped as Kukpowruk Formation. *Unit description source:* DL005

Knl - Nanushuk Group, lower part (Cretaceous, Albian) Sandstone, light-gray to medium- to yellowish-gray, fine- to medium-grained, generally thin- to medium-bedded, lithic arenite, and less commonly conglomerate lenses. Contains interbedded dark-gray, fissile to silty shale, medium- to dark-gray siltstone, and carbonaceous shale. In map area, closely spaced and laterally persistent dark yellowish-brown-weathering lower Nanushuk sandstone beds form prominent resistant cuestas that rim the synclines. Sandstones dominantly consist of quartz and chert, with lesser amounts of calcite, feldspar, and lithic fragments. Conglomerate clasts are predominantly sub-rounded pebbles of white quartz and black, gray, or greenish chert. Upward-coarsening and thickening successions are capped by sandstones with a variety of sedimentary structures, including plane-parallel lamination, current- and wave-ripple bedforms, large- and small-scale trough cross-stratification, hummocky cross-stratification and swaley cross-stratification. Biogenic structures are locally common and include *Teichichnus*, *Diplocraterion*, *Rhizocorallium*, *Planolites*, *Paleophycos*, among others. Locally contains common marine pelecypods, coalified plant fragments, and plant impressions. Upward intertonguing of marine and marginal-marine to nonmarine sediments marks transition to the upper Nanushuk. Sandstones generally tight with porosity <10 percent and permeability <1 md (Ahlbrandt and others, 1979). The base of Nanushuk is gradational and intertongues with the underlying recessive shales of Torok Formation; contact is mapped at the base of the stratigraphically lowest laterally persistent sandstone trace visible on aerial photographs. Shale at the top of Torok Formation is usually covered by tundra or undifferentiated Quaternary deposits. On the map this results in the appearance of pinch-out of basal Nanushuk sandstone beds into the undifferentiated Quaternary unit (Qu), but is consistent with intertonguing of the basal Nanushuk with the Torok, which underlies the Quaternary cover. Thickness: 0 to - 500 m, locally pinches out on southeast flank of Coke Basin and on south flank of Tupikchak syncline, best exposed on Igloo Mountain. Age: Albian, based upon marine pelecypods and microfauna (Chapman and Sable, 1960). *Unit description source:* DL010

Knt - Nanushuk Group, Tuktu Formation; Foredeep deposits of the Colville basin (Early Cretaceous, Albian) Dominantly gray to greenish-gray very-fine to fine-grained sandstone and conglomeratic sandstone. *Unit description source:* KL002

Knt - Tuktu Formation (Early Cretaceous) Gray; fine to very fine grained; thin to medium-bedded quartz wacke; ripple marked and crossbedded; interbedded micaceous siltstone and shale more abundant in lower part. Flute casts, load casts and drag marks common. Marine. Early Cretaceous pelecypods, and cephalopods. Thickness 150m. *Unit description source:* PS002

Ktg - Tuktu and Grandstand Formations, undivided (Early Cretaceous) Principally grayish-green to greenish-gray medium- to very fine-grained, sandstone, shaly in part and crossbedded in part. Greenish-gray siltstone and mudstone are minor part of unit. *Unit description source:* CL002

Kipc - Igneous pebble-cobble conglomerate (Cretaceous (Albian))

Kipc - Igneous-clast conglomerate, sandstone, and mudstone (Lower Cretaceous) See [Kipc](#) for unit description from [SIM-3340](#).

Kc - Igneous pebble-cobble conglomerate (late Early Cretaceous (Albian)) Massive poorly stratified and poorly sorted conglomerate composed of pebble- to cobble-sized clasts of mafic extrusive and intrusive rocks in a graywacke and mudstone matrix. *Unit description source:* SH002

Kc - Igneous pebble conglomerate (Early Cretaceous) Interbedded brownish-gray poorly sorted volcanic sandstone and conglomerate containing well-rounded clasts of green chert and diabase. *Unit description source:* SP002

Kic - Igneous pebble-cobble conglomerate (Early Cretaceous) Conglomerate of poorly-sorted clasts of mafic volcanic and intrusive rocks, chert, and graywacke. *Unit description source:* BT002

Kmc - Mafic igneous-clast conglomerate, sandstone, and mudstone (Cretaceous) Consists of massive poorly stratified and poorly sorted conglomerate composed of pebble- to cobble-size clasts in a graywacke and mudstone matrix. Clasts predominately mafic intrusive and extrusive rocks, varied colored chert, and locally metagraywacke. Limestone, quartz, and granitic rock clasts present in subordinate amounts. Conglomerate is interbedded with mafic- and calcareous-clast graywacke and mudstone. Unit composed chiefly of debris eroded from the Angayucham-Tozitna terrane. Unit stratigraphically underlies unit Kqc. Occurs at scattered localities along the northern and southeastern margin of the Yukon-Koyukuk Basin from Baird Mountains and Selawik quadrangles eastward to Wiseman and Bettles quadrangles and then southwestward to Ruby quadrangle. *Unit description source:* AR003, BT003, and WI003

Kmc - Mafic igneous-clast conglomerate, sandstone, and mudstone (Late(?) and Early Cretaceous) Consists of massive poorly stratified and poorly sorted conglomerate composed of pebble- to cobble-size clasts in a graywacke and mudstone matrix. Clasts predominately mafic intrusive and extrusive rocks, varied colored chert, and locally metagraywacke. Limestone, quartz, and granitic rock clasts present in subordinate amounts. Conglomerate is interbedded with mafic- and calcareous-clast graywacke and mudstone. Unit composed chiefly of debris eroded from the Angayucham-Tozitna terrane. Unit stratigraphically underlies unit Kqc. Occurs at scattered localities along the northern and southeastern margin of the Yukon-Koyukuk Basin from Baird Mountains and Selawik quadrangles eastward to Wiseman and Bettles quadrangles and then southwestward to Ruby quadrangle. *Unit description source:* HU003 and SE004

Kvgc - Earliest Cretaceous volcanic graywacke and conglomerate (Cretaceous (Albian))

Kcgc - Calcareous graywacke and conglomerate (Lower Cretaceous) See [Kcgc](#) for unit description from [SIM-3340](#).

Kgm - Volcanic graywacke and mudstone (Cretaceous) Fine- to coarse-grained, poorly sorted graywacke interbedded with mudstone. *Unit description source:* BT002

Kgm - Graywacke and mudstone (late Early Cretaceous (Albian)) Fine- to medium-grained, locally calcareous, poorly sorted graywacke interbedded with mudstone. *Unit description source:* HU002

Kv - Volcanic graywacke and mudstone (late Early Cretaceous (Albian)) Poorly sorted dark greenish-gray volcanic graywacke and mudstone. *Unit description source:* SH002

Kvg - Volcanic-clast graywacke and mudstone (Cretaceous) Hard, fine-grained to conglomeratic, locally tuffaceous, graywacke and dark-gray finely laminated mudstone. The graywacke is composed of matrix-supported clasts of intermediate and mafic volcanic and intrusive rocks and chert. Clasts of quartz and of metamorphic and granitic rocks are present in subordinate amounts. Some of the graywacke beds are characterized by a distinctly mottled appearance owing to the presence of laumontite, most commonly in fine-grained tuffaceous-rich layers. Metamorphic detritus becomes increasingly abundant in the upper part of the unit. The graywacke beds display a typical "Bouma" sequence grading from massive at the base to laminated in the middle to cross laminated at the top. Mudstone rip-up clasts are common at the base of the graywacke beds. The unit has a high graywacke to mudstone ratio and is interpreted to represent middle and outer submarine fan deposits. *Unit description source:* HU003 and WI003

Ktg - Tuff, volcanic graywacke, and mudstone (Early Cretaceous)

Kvgc - Volcanic graywacke and conglomerate (Cretaceous*) See [Kvgc](#) for unit description from [SIM-3340](#).

Ktg - Tuff, volcanic graywacke, and mudstone (Late(?) and Early Cretaceous) Andesitic and latitic volcaniclastic rocks including crystal -lithic tuff, lithic tuff, volcanic graywacke, and mudstone. *Unit description source:* HU002

Kbd - Spilitic pillow basalt and diabase (Early Cretaceous)

Ksbd - Spilitic pillow basalt and diabase (Early Cretaceous) See [Ksbd](#) for unit description from [SIM-3340](#).

Kbd - Spilitic pillow basalt and diabase (Early Cretaceous(?)) Dark greenish- to reddish-brown, fine-grained, spilitic amygdaloidal pillow basalt flows and dark-greenish-gray, medium- to coarse-grained, spilitic diabase intrusive rocks. *Unit description source:* SH002

Kko - Kongakut Formation, pebble shale and siltstone (Early Cretaceous to Cretaceous (Hauterivian))

Kgk - Kongakut Formation (Lower Cretaceous) See [Kgk](#) for unit description from [SIM-3340](#).

Kk - Kongakut Formation (Early Cretaceous) Dark gray to black, manganiferous shale and siltstone with interbeds of fine-grained dark graywacke; nodules and lenticular beds of red weathering clay ironstone; polished black chert pebbles in lower part. Marine. Early Cretaceous (Neocomian) pelecypods. Thickness more than 300m Lateral (northern) equivalent of Okpikruak Formation. *Unit description source:* PS002

Kit - Ipewik Formation, Tingmerkpuk sandstone member (Cretaceous (Valanginian))

Kit - Tingmerkpuk Member of the Ipewik Formation (Lower Cretaceous) See [Kit](#) for unit description from [SIM-3340](#).

Ki - Tingmerkpuk (Cretaceous, Valanginian) Quartzose sandstone in DeLong and Misheguk. *Unit description source:* DL005

Kit1 - Tingmerkpuk subunit of the Ipewik unit, Okpikruak Formation (Early Cretaceous (Valanginian)) Fine- to medium-grained, massive to thick-bedded, clean quartz sandstone. Locally interbedded with red shale that has concretions and shell beds containing Early Cretaceous fossils. Part of the Brooks Range allochthon, Key Creek sequence. *Unit description source:* DL002 and DL003

Koq - Okpikruak Formation, quartzite member (Early Cretaceous) Consists of light- to dark-dark gray siliceous, silty quartzitic subgraywacke to orthoquartzite sandstone interbedded with beds of siltstone, variegated shale, and coquinoid sandstone with fine-ribbed *Buchia*. Sandstone is ripple-marked and thinly crossbedded; clasts are mostly quartz and chert. *Unit description source:* MU006 and MU008

Ko - Okpikruak Formation and may include Fortress Mountain Formation, interbedded wacke and mudstone (Early Cretaceous to Cretaceous (Albian))

Kof - Okpikruak Formation and similar units (Lower Cretaceous) See [Kof](#) for unit description from [SIM-3340](#).

Kfo - Fortress Mountain and Okpikruak Formations, undivided (Cretaceous) Interbedded wacke and mudstone. *Unit description source:* DL002 and DL004

Kfo - Fortress Mountain and Okpikruak Formations, undivided (Cretaceous) Interbedded wacke and mudstone. *Unit description source:* DL003

Kk - Kisimilok Formation (Early Cretaceous) Kisimilok Formation. *Unit description source:* PH004

Kms - Micaceous sandstone (Early Cretaceous) Distinctive unit of rhythmically interbedded dark-gray, quartzitic, micaceous sandstone, siltstone, and claystone, having graded bedding and small-scale sole markings and ripple marks, minor granule conglomerate and minor reddish and greenish shale. 300 to 500 m thick. Clasts mostly quartz, carbonate rocks, and chert. Unit resembles rhythmically bedded unit in wacke member of the Okpikruak Formation and includes similar sandstone but has yielded no *Buchia* or *Inoceramus*. *Unit description source:* MU006, MU007, and MU008

Ko - Okpikruak Formation (Cretaceous) Greenish-gray lithic wacke and gray mudstone. *Unit description source:* DL002, DL003, and DL004

Ko - Okpikruak Formation, undivided; Endicott Mountains Allochthon, Killik River Sequence (Early Cretaceous, Valanginian?) Dominantly greenish-gray graywacke with interbedded mudstone and shale, in places divided into Kocg, Kos, and Kob. *Unit description source:* KL002

Ko - Okpikruak Formation; Endicott Mountains Allochthon, Ivotuk Hills Sequence (Early Cretaceous, Berriasian or Valanginian) Greenish gray graywacke with interbedded mudstone and shale, forms rubble covered hills, generally poorly exposed. Along Otuk Creek north of Ivotuk Hills, contains poorly sorted polymict cobble to boulder conglomerate and breccia, clasts consists of chert, mafic igneous rocks, gabbro, granitic rocks, limestone, and quartzitic sandstone, probably deposited as debris flows. Thickness unknown but probably <500 m, in places contains Kos. *Unit description source:* KL002

Ko - Okpikruak Formation; Endicott Mountains Allochthon, Key Creek Sequence (Early Cretaceous, Berriasian or Valanginian) Dominantly graywacke with interbedded poorly exposed mudstone, exposed only locally between Ivotuk River and East Fork or Etivluk River, in places contains differentiated unit Kocg. *Unit description source:* KL002

Ko - Okpikruak Formation; Endicott Mountains Allochthon, Okpikruak River Sequence (Early Cretaceous, Berriasian to Valanginian) Light greenish gray, thin-bedded graywacke sandstone and siltstone, with rhythmically interbedded silty mudstone, turbidite sequence, approximately 600 m thick. Type section well exposed on east side of Okpikruak River in northeastern part of quad. *Unit description source:* KL002

Ko - Okpikruak Formation; Picnic Creek Allochthon, Akmalik Creek Sequence (Early Cretaceous, Berriasian? and Valanginian) Dominantly greenish gray graywacke turbidites with interbedded mudstone and shale, forms smooth greenish-gray weathering hillsides, in places divided into: Kocg or Kos. *Unit description source:* KL002

Ko - Okpikruak Formation; Iqnavik River Allochthon, Zebra Creek Sequence (Early Cretaceous, Valanginian) Graywacke, greenish-gray fine- grained to very coarse-grained, dominantly rubble exposures, in places contains Kocg. *Unit description source:* KL002

Ko - Okpikruak Formation; Iqnavik River Allochthon, Iteriak Creek Sequence (Early Cretaceous, Berriasian? to Valanginian) Greenish-gray, thin- to thick-bedded, fine- to very coarse-grained graywacke sandstone and siltstone, with rhythmically interbedded mudstone and shale, some beds contain sole markings and small scale ripple cross-lamination and convolute bedding; in other localities contains slightly calcareous and micaceous sandstones, coarse-grained beds contain conspicuous white leached chert grains and black shale flakes; intruded by white felsic dike at one locality on Otuk Creek. Contains Valanginian buchias. Locally contains Kocg. *Unit description source:* KL002

Ko - Okpikruak Formation; Iqnavik River Allochthon, Itlikruich Ridges Sequence (Early Cretaceous, Berriasian? to Valanginian)) Green to greenish gray graywacke, fine to coarse grained and poorly exposed gray silty mudstone; locally contains Kom. *Unit description source:* KL002

Ko - Okpikruak Formation (Cretaceous) Included with the Rocks Not Assigned a Specific Sequence - Greenish-gray lithic wacke and gray mudstone. *Unit description source:* MU002, MU003, and MU004

Ko - Okpikruak Formation (Early Cretaceous) Mostly interbedded wacke sandstone and mudstone with common coarse-ribbed Buchia. *Unit description source:* MU006, MU007, MU008, and MU012

Ko - Okpikruak Formation (Early Cretaceous) Interbedded gray mudstone and greenish gray lithic wacke. *Unit description source:* NT005

Ko - Okpikruak Formation (Early Cretaceous) Siltstone and shale in lower part grading into rhythmically-bedded dark gray siltstone, graywacke and minor conglomeratic beds in upper part. Thin limestone beds and concretions locally abundant; polished chert pebbles locally in shale in northern outcrops; coquina bed near base. Marine. Early Cretaceous (Valanginian) pelecypods in coquina near base of formation; indeterminate bivalves and pelecypods in higher parts of formation. Thickness more than 600m. *Unit description source:* PS002

Ko1 - Okpikruak Formation (Early Cretaceous) Part of the Brooks Range allochthon, Key Creek sequence. Interbedded gray mudstone and fine- to medium-grained wacke. Locally contains blocks of older rocks that are possible olistoliths from higher allochthons. *Unit description source:* DL002, DL003, and DL004

Ko1 - Okpikruak Formation (Cretaceous) Part of the Key Creek Sequence - Gray mudstone with minor amounts of thin-bedded wacke. Contains Early Cretaceous pelecypod *Buchia*; lower part may be Late Jurassic. Exposed thickness ranges from 0 to more than 1,000 m with an unconformity at base. Depositional thickness is probably variable. *Unit description source:* MU002, MU003, and MU004

Ko2 - Okpikruak Formation (Cretaceous) Interbedded brown-weathering, fine- to medium-grained wacke and gray mudstone. Locally contains blocks of older rocks that are possible olistoliths from higher allochthons. Part of the Picnic Creek allochthon, Wulik sequence. *Unit description source:* DL002 and DL003

Ko2 - Okpikruak Formation (Cretaceous) Interbedded gray-brown, fine- to medium-grained wacke and gray mudstone. Locally contains blocks of older rocks that are possible olistoliths from higher allochthons. Part of the Picnic Creek allochthon, Amaruk sequence. *Unit description source:* DL002, DL003, and DL004

Ko2 - Okpikruak Formation (Cretaceous) Part of the Wulik Sequence - Gray mudstone with minor amounts of thin-bedded, fine grained wacke. Lower part may be Late Jurassic. Exposed thickness ranges from 0 to more than 200 m with an unconformity at base. Depositional thickness is probably variable. *Unit description source:* MU002

Ko2 - Okpikruak Formation (Cretaceous) Part of the Picnic Sequence - Gray mudstone with minor amounts of thin-bedded fine-grained wacke. Contains early Cretaceous pelecypod, *Buchia*; lower part may be Later Jurassic. Exposed thickness ranges from 0 to more than 500 m with an unconformity at the base. Depositional thickness is probably variable. *Unit description source:* MU002, MU003, and MU004

Ko2 - Okpikruak Formation, Picnic Creek Allochthon, Amaruk Sequence (Early Cretaceous) Interbedded gray to brown, fine- to medium-grained wacke and gray mudstone. Early Cretaceous age inferred from stratigraphic correlation with similar beds that contain the pelecypod *Buchia* in adjacent sequences. Regionally, is inferred to have an unconformity at base; locally may be conformable on shale of Etivluk Group. *Unit description source:* NT005

Ko3 - Okpikruak Formation (Cretaceous) Interbedded fine- to medium-grained lithic wacke and mudstone with local wacke conglomerate. Part of the Kelly River allochthon, Kelly sequence. *Unit description source:* DL002, DL003, and DL004

Ko3 - Okpikruak Formation, Kelly River Allochthon, Amphitheatre Sequence (Early Cretaceous)

Interbedded gray to brown, fine- to medium-grained wacke and gray mudstone. Early Cretaceous age inferred from regional stratigraphic correlations. Regionally, is inferred to have an unconformity at base; locally may be conformable on shale of Etivluk Group. *Unit description source:* NT005

Ko3 - Okpikruak Formation, Kelly River Allochthon, Kelly Sequence (Early Cretaceous)

Interbedded fine- to medium-grained greenish gray wacke and gray mudstone. Early Cretaceous age inferred from stratigraphic correlation with similar beds that contain the pelecypod *Buchia* in adjacent sequences. Regionally, is inferred to have an unconformity at base; locally may be conformable on shale of Etivluk Group. *Unit description source:* NT005

Ko3 - Okpikruak Formation (Cretaceous) Part of the Kelly Sequence - Interbedded medium to fine grained lithic wacke and mudstone with local conglomerate. Pebble to cobble-size conglomerate clasts are chert, mafic igneous rocks, granite, and limestone. Contains Neocomian pelecypod, *Buchia*. Lower part may be Later Jurassic. Exposed thickness is probably variable. *Unit description source:* MU002, MU003, and MU004

Ko3e - Okpikruak Formation (Cretaceous) Part of the Eli Sequence - Interbedded medium- to fine-grained lithic wacke and mudstone with local conglomerate. Pebble to cobble-size conglomerate clasts are limestone, chert, granite, and mafic igneous rocks. Lower part may be Late Jurassic. Exposed thickness ranges from 0 to more than 100 m with an unconformity at base. Depositional thickness is probably variable. *Unit description source:* MU002 and MU004

Ko4 - Okpikruak Formation (Cretaceous) Interbedded fine- to medium-grained lithic wacke and mudstone with local wacke conglomerate. Locally contains blocks of older rocks that are possible olistoliths from higher allochthons. Part of the Iqnavik River allochthon, Puzzle Creek sequence. *Unit description source:* DL004

Ko4 - Okpikruak Formation (Cretaceous) Part of the Iqnavik Sequence - Interbedded coarse to fine-grained lithic wacke, conglomerate, and mudstone. Pebble to cobble-size conglomerate clasts consist of chert, mafic rocks, granite, and limestone. Contains early Valanginian pelecypod, *Buchia*. Lower part may be Later Jurassic. Exposed thickness ranges from 0 to more than 1,000 m with an unconformity at base. Depositional thickness is probably variable. *Unit description source:* MU002, MU003, and MU004

Ko4n - Okpikruak Formation (Cretaceous) Part of the Nachralik Pass Sequence - Interbedded lithic, coarse to fine-grained wacke, conglomerate, and mudstone. Pebble to cobble size conglomerate clasts are chert, mafic rocks, granite, and limestone. Age is Early Cretaceous based on regional stratigraphy but lower part may be Late Jurassic. Exposed thickness ranges from 0 to more than 300 m with an unconformity at base. Depositional thickness is probably variable. *Unit description source:* MU002, MU003, and MU004

Ko5 - Okpikruak Formation (Cretaceous) Part of the Bogie Sequence - Interbedded gray mudstone and minor greenish-gray medium to fine grained lithic wacke. Distinctive cannon-ball concretions occur in mudstone around Nuka Ridge. Age is Early Cretaceous based on regional stratigraphy but lower part may be Late Jurassic. Exposed thickness ranges from 0 to more than 100 m with an unconformity at base. Depositional thickness is probably variable. *Unit description source:* MU002, MU003, and MU004

Ko5 - Okpikruak Formation, Nuka Ridge Allochthon, Bogie Sequence (Early Cretaceous)

Interbedded gray mudstone and greenish gray, medium- to fine-grained lithic wacke. Age is early Cretaceous from regional stratigraphic correlations but may prove to be Middle or Late Jurassic. *Unit description source:* NT005

Ko5b - Okpikruak Formation (Cretaceous) Part of the Bastille Sequence - Greenish-gray, lithic, medium to fine grained wacke with lesser amounts of gray mudstone. Age is Early Cretaceous based on regional stratigraphy, but the lower part may be Late Jurassic. Exposed thickness ranges from 0 to 200 m with an unconformity at base. Depositional thickness is probably variable. *Unit description source:* MU002 and MU004

Kob - Okpikruak Formation, breccia; Endicott Mountains Allochthon, Killik River Sequence (Early Cretaceous, Valanginian?) Dominantly greenish-gray graywacke with interbedded mudstone and shale. Consists of tectonic breccia or olistostrome, usually broken formation bearing exotic blocks of chert, silicified limestone or mudstone in sheared mudstone matrix. *Unit description source:* KL002

Koc - Conglomerate member, Okpikruak Formation (Cretaceous) Wacke conglomerate with rounded cobbles and pebbles that consist of chert, limestone, granite, and mafic igneous rocks. *Unit description source:* DL003 and DL004

Koc - Okpikruak Formation, conglomerate member (Early Cretaceous) Wacke conglomerate with rounded cobbles and pebbles of lithic clasts that consist of chert, limestone, and diabase. *Unit description source:* NT005

Koc1 - Conglomerate member, Okpikruak Formation (Cretaceous) Wacke conglomerate with rounded boulders and pebbles that consist of chert, limestone, granite, dacite, diabase, and gabbro. Part of the Brooks Range allochthon, Key Creek sequence. *Unit description source:* DL003 and DL004

Koc2 - Conglomerate member, Okpikruak Formation (Cretaceous) Wacke conglomerate with rounded boulders and pebbles of chert, limestone, granite, dacite, diabase, and gabbro. Part of the Picnic Creek allochthon, Wulik sequence. *Unit description source:* DL003 and DL004

Koc2 - Conglomerate member, Okpikruak Formation (Cretaceous) Wacke-matrix conglomerate with rounded boulders and pebbles of chert, limestone, granite, dacite, and diabase. Part of the Picnic Creek allochthon, Amaruk sequence. *Unit description source:* DL003 and DL004

Koc3 - Conglomerate member, Okpikruak Formation (Cretaceous) Wacke conglomerate containing rounded cobbles and pebbles of chert, limestone, granite, and basalt. Part of the Kelly River allochthon, Kelly sequence. *Unit description source:* DL004

Koc4 - Conglomerate member, Okpikruak Formation (Cretaceous) Wacke conglomerate with rounded to angular cobbles and pebbles that consist of chert, limestone, granite, and basalt. Part of the Ipnayik River allochthon, Puzzle Creek sequence. *Unit description source:* DL004

Kocg - Okpikruak Formation, conglomerate; Endicott Mountains Allochthon, Killik River Sequence (Early Cretaceous, Valanginian?) Dominantly greenish-gray graywacke with interbedded mudstone and shale. Contains massive cobble- to boulder-conglomerate, in many places is chaotic and unsorted to poorly sorted debris flow deposit; clasts consist dominantly of conspicuous white-weathering diorite and granodiorite, varicolored chert, and some light-gray sandstone and limestone. *Unit description source:* KL002

Kocg - Okpikruak Formation, conglomerate; Endicott Mountains Allochthon, Key Creek Sequence (Early Cretaceous, Berriasian or Valanginian) Dominantly graywacke with interbedded poorly exposed mudstone, exposed only locally between Ivotuk River and East Fork or Etivluk River, in places contains differentiated unit Kocg, which contains massive conglomerate and/or breccia. Unit not found on map. *Unit description source:* KL002

Kocg - Okpikruak Formation, conglomerate; Picnic Creek Allochthon, Akmalik Creek Sequence (Early Cretaceous, Berriasian? and Valanginian) Dominantly greenish gray graywacke turbidites with interbedded mudstone and shale, forms smooth greenish-gray weathering hillsides. Contains cobble to boulder conglomerate. In Heather Creek and Imnaitchiak Creek area, unit is an olistostome containing large rounded cobbles and boulders of white, gray, and blank chert, light-gray limestone, granodiorite, diorite, gabbro, basalt, fine-grained mafic igneous rock, and angular blocks of limestone up to 5 m long. *Unit description source:* KL002

Kocg - Okpikruak Formation, conglomerate; Ilnavik River Allochthon, Zebra Creek Sequence (Early Cretaceous, Valanginian) Graywacke, greenish-gray fine- grained to very coarse-grained, dominantly rubble exposures. Contains cobble to boulder conglomerate, clasts are well rounded pebbles to boulders of estimated 40% altered gabbro and fine-grained mafic igneous rock, 40% light gray micritic limestone, 19% dark-gray to black chert, and 1% light gray diorite or granodiorite; clasts mostly 2-16 cm diameter, but scattered diorite boulders range up to 75 cm diameter. Exposed mostly as rubble, thickness estimated < 100 m. *Unit description source:* KL002

Kocg - Okpikruak Formation, conglomerate; Ilnavik River Allochthon, Iteriak Creek Sequence (Early Cretaceous, Berriasian? to Valanginian) Cobble to boulder conglomerate. On tributary of Iteriak Creek forms 7 m high pinnacle, composed dominantly of round boulders of felsite, granite, granodiorite, tonalite, fine-grained altered mafic and intermediate igneous rock, and tuff-breccia up to 70 cm diameter, and small black chert pebbles. On a tributary of Otuk Creek, a 25 m thick chaotic disorganized conglomerate debris flow contains round cobbles and boulders to 45 cm diameter consisting of granodiorite, gabbro, fine-grained altered mafic igneous rock, limestone, tasmanite, and smaller pebbles of black, gray, blue-green, and white chert; interbedded graywacke contains blue amphibole grains; interval forms conspicuous channel cut into graywacke and underlying cherts. *Unit description source:* KL002

Kocgl - Okpikruak Formation, conglomerate (Cretaceous) Conglomerate. *Unit description source:* DL005

Kof - Okpikruak Formation, graywacke (Cretaceous) Fine-grained graywacke, shaly, silty. *Unit description source:* DL005

Kog - Okpikruak Formation, turbidites (Cretaceous) Typical Okpikruak graywacke turbidites. *Unit description source:* DL005

Kog - Okpikruak Formation, olistostrome blocks (Cretaceous) In the areas of some of the Cretaceous Kog, there are small patches mapped as TrPco, Trso, Mlo, bio, Dlo. These are exotic olistostrome blocks of various of the formations listed below. The "o" stands for olistostrome. *Unit description source:* DL005

Kog - Endicott Mountains Allochthon - Okpikruak Formation (Cretaceous) Lithic graywacke speculatively exposed south of Alutunitok Hills. *Unit description source:* NT006

Kog - Kelly River Allochthon - Okpikruak Formation (Cretaceous) Dirty lithic graywacke and conglomerate. *Unit description source:* NT006

Koi - Okpikruak Formation (Early Cretaceous (Valanginian and Berriasian)) Dark-gray to grayish-tan mudstone, siltstone, graywacke sandstone, and local conglomerate containing cobbles and boulders of gabbro, fine-grained mafic igneous rocks, light-gray diorite or granodiorite, light-gray micritic limestone, and gray to black chert. Intensely deformed and base structurally detached in places. Thickness unknown. *Unit description source:* HW003

Koi - Okpikruak Formation - Iqnavik River sequence (Early Cretaceous (Valanginian and Berriasian)) Dark-gray to grayish-tan mudstone, siltstone, graywacke sandstone, and minor conglomerate; locally contains interbeds of distinctive reddish-gray coquinooid limestone. Includes rock types assigned to the Ipewik unit to the west and considered to be of Jurassic and Early Cretaceous age. Intensely deformed and base structurally detached in places. Thickness unknown. *Unit description source:* HW004

Kon - Okpikruak Formation (Early Cretaceous (Valanginian)) Gray mudstone and minor greenish-gray, medium- to fine-grained lithic wacke, containing distinctive cannon-ball concretions in the Nuka Ridge area; intensely deformed and base structurally detached in places. Thickness unknown. *Unit description source:* HW003

Kon - Okpikruak Formation - Nuka Ridge sequence (Early Cretaceous (Valanginian)) Dark-gray to grayish-tan mudstone, siltstone, graywacke sandstone, and minor conglomerate; locally contains interbeds of distinctive reddish-gray coquinooid limestone. Includes rock types assigned to the Ipewik unit to the west and considered to be of Jurassic and Early Cretaceous age. Intensely deformed and base structurally detached in places. Thickness unknown. *Unit description source:* HW004

Kop - Okpikruak Formation (Early Cretaceous (Valanginian)) Dark-gray to grayish-tan mudstone, siltstone, and graywacke sandstone. Intensely deformed and base structurally detached in many places. Thickness unknown. *Unit description source:* HW003

Kop - Okpikruak Formation- Picnic Creek sequence (Early Cretaceous (Valanginian)) Dark-gray to grayish-tan mudstone, siltstone, graywacke sandstone, and minor conglomerate; locally contains interbeds of distinctive reddish-gray coquinooid limestone. Includes rock types assigned to the Ipewik unit to the west and considered to be of Jurassic and Early Cretaceous age. Intensely deformed and base structurally detached in places. Thickness unknown. *Unit description source:* HW004

Kos - Okpikruak Formation, shale and mudstone; Endicott Mountains Allochthon, Killik River Sequence (Early Cretaceous, Valanginian?) Dominantly greenish-gray graywacke with interbedded mudstone and shale. Dominantly dark-gray shale and mudstone. *Unit description source:* KL002

Kos - Okpikruak Formation; Endicott Mountains Allochthon, Ivotuk Hills Sequence (Early Cretaceous, Berriasian or Valanginian) same as Ko (Okpikruak Fm), dominantly dark-gray shale and mudstone. *Unit description source:* KL002

Kos - Okpikruak Formation, shale; Picnic Creek Allochthon, Akmalik Creek Sequence (Early Cretaceous, Berriasian? or Valanginian) Dominantly greenish gray graywacke turbidites with interbedded mudstone and shale, forms smooth greenish-gray weathering hillsides. Dominantly mudstone and shale. Unit not found on map. *Unit description source:* KL002

Kom - Okpikruak Formation; Iqnavik River Allochthon, Itkilikruich Ridges Sequence (Early Cretaceous, Berriasian? to Valanginian) Green to greenish gray graywacke, fine to coarse grained and poorly exposed gray silty mudstone. Contains abundant mafic igneous clasts, some agglomerate, and breccia; generally poorly exposed, apparently derived from and difficult to differentiate from associated mafic igneous rocks (mii). *Unit description source:* KL002

Kos - Okpikruak Formation (Early Cretaceous) Sandstone and shale member -- tan; fine grained; medium bedded quartz wacke beds interbedded with shale locally in lower part of formation. *Unit description source:* PS002

Kot4 - Tuff (Cretaceous) Part of the Iqnavik Sequence - Weathers light gray and occurs as thin, discontinuous beds in the Okpikruak Formation. Predominantly composed of clay, plagioclase, and

quartz. Greatest thickness less than 4 m. Best exposures are in the northern part of the Iggiuk Mountains (southeast Misheguk Mountain quadrangle map). *Unit description source:* MU003

Kow - Okpikruak Formation, wacke member (Early Cretaceous) Consists of two units: a unit of interlensing wacke sandstone and conglomerate, mudstone with lesser ferruginous limestone and a unit of rhythmically interbedded wacke, sandstone, and mudstone with distinctive ferruginous limestone lenses and nodules. Thickness highly variable, as much as 500 m. Both unit contain sole markings and graded bedding suggesting turbidite origin. Most coarse-ribbed *Buchia* in lower part of unit. *Unit description source:* MU006, MU007, and MU008

Ku - Cretaceous rocks, undivided (Early Cretaceous) Clastic rocks, mostly graywacke and subgraywacke, in areas which either have not been adequately examined or where poor exposure preclude identification of units. In absence of age-diagnostic fauna, are assumed to be equivalent to the Fortress Mountain and Okpikruak Formations. Some fine-grained rocks may also be of Jurassic age. *Unit description source:* MU006 and MU007

KJa - Argillaceous unit (Early Cretaceous and Jurassic) Largely soft black claystone and gray clay with minor reddish and greenish claystone and unusual accessory rock types: marcasite concretions, septarian concretions, limestone breccia, pebble conglomerate, and coquinoid limestone and claystone with fine-ribbed *Buchia* of Early Cretaceous Valanginian age. *Unit description source:* MU006

KJo - Okpikruak Formation (Early Cretaceous (Valanginian) to Late Jurassic (Kimmeridgian)) Dark-gray to grayish-tan mudstone, siltstone, graywacke sandstone, and minor conglomerate; locally contains interbeds of distinctive reddish-gray coquinoid limestone. Includes rock types assigned to the Ipewik unit to the west and considered to be of Jurassic and Early Cretaceous age. Intensely deformed and base structurally detached in places. Thickness unknown. *Unit description source:* HW003

KJo - Okpikruak Formation - Endicott sequence (Early Cretaceous (Valanginian) to Late Jurassic (Kimmeridgian)) Dark-gray to grayish-tan mudstone, siltstone, graywacke sandstone, and minor conglomerate; locally contains interbeds of distinctive reddish-gray coquinoid limestone. Includes rock types assigned to the Ipewik unit to the west and considered to be of Jurassic and Early Cretaceous age. Intensely deformed and base structurally detached in places. Thickness unknown. *Unit description source:* HW004

KJm - Melange (Cretaceous and (or) Jurassic) Tectonic melange. *Unit description source:* BM002

KJsc - Wacke, sandstone, and conglomerate (Early Cretaceous? and Jurassic?) Differentiated from KJsm on basis of association with older rocks other than the Shublik Formation and contains more abundant and coarser conglomerate. Interbedded and interlensed brownish weathering, gray to greenish subgraywacke sandstone, greenish wacke, siltstone, and mudstone. *Unit description source:* MU006 and MU007

KJsm - Wacke, sandstone, and mudstone (Early Cretaceous? and Jurassic?) Interbedded and interlensed brownish weathering, gray to greenish subgraywacke sandstone, greenish wacke, siltstone, and mudstone. Maximum thickness more than 700 m. Local thick pebble conglomerate of two types, one having mafic and felsic igneous rocks clasts; the other mafic igneous rocks and chert clasts. Unit associated with Shublik Formation. *Unit description source:* MU006 and MU008

KJwc - Wacke with cannonball concretions (Early Cretaceous? and Jurassic?) Unit distinguished by concretions in irregularly bedded wacke and mudstone. Wacke is fine-grained, greenish-gray, weather dull brownish, and contains distinctive spheroidal concretions, as much as 1 m in size, of similar, but more calcareous wacke. As much as 500 m thick. Unit is strongly deformed; part of a melange like chaos east of the Utukok River. *Unit description source:* MU006 and MU007

KTr - Cretaceous through Triassic, undivided (Early Cretaceous to Triassic) Cretaceous through Triassic, undivided. *Unit description source:* PH004

KMaf - Arctic Foothills Assemblage (Early Cretaceous to Mississippian) Consists of 7 previously recognized units; Lower Cretaceous coquinoid limestone, undivided Upper Jurassic and Cretaceous strata, Jurassic mafic igneous rocks, Permian and Triassic chert, the Nuka Formation (Carboniferous), marble and melange. *Unit description source:* CL002

c - Metachert (Age not given) Blocks of bedded metachert in melange of unit KJm. Single polygon in unit MzPzm assigned NSAClass of 5145 and CLASS code of 930. *Unit description source:* BM002

m - Marble (Age not given) Blocks of bedded or massive marble of unknown age or affinity in melange of unit KJm. Polygons in unit MzPzm assigned NSAClass of 5145 and CLASS 931. *Unit description source:* BM002

This unit is also present on source map DL005, however, no description was present on this source.

Kofc - Okpikruak Formation, coquina limestone (Cretaceous (Valanginian))

Khnl - Herendeen Formation and similar units (Lower Cretaceous) See [Khnl](#) for unit description from [SIM-3340](#).

Kcq - Coquinoid Limestone; Endicott Mountains Allochthon, Killik River Sequence (Early Cretaceous, Valanginian) Dominantly siltstone and shale, minor 'chert' or silicified mudstone, in four lithogenetic units: a thin basal member--greenish-gray siltstone; grades up to unit B--maroon- to light-green-mottled siltstone with scattered barite seams and crystal aggregates; unit C--resistant green-to greenish-gray silicified mudstone or chert; and unit D--poorly exposed gray clay shale. Thickness <100 m. *Unit description source:* KL002

Kcq - Coquinoid Limestone; Endicott Mountains Allochthon, Key Creek Sequence (Early Cretaceous, Valanginian) Dominantly siltstone and shale, minor 'chert' or silicified mudstone, in four lithogenetic units: a thin basal member--greenish-gray siltstone; grades up to unit B--maroon- to light-green-mottled siltstone with scattered barite seams and crystal aggregates; unit C--resistant green-to greenish-gray silicified mudstone or chert; and unit D--poorly exposed gray clay shale. In Key Creek sequence, unit is completely deformed and commonly closely associated with Otuk Formation; found in float overlying Otuk Formation at two localities between Outwash Creek and the East Fork or the Etivuk River. Unit not found on map. *Unit description source:* KL002

Kcq - Coquinoid Limestone; Endicott Mountains Allochthon, Ivotuk Hills Sequence (Early Cretaceous, Valanginian) Distinctive thin marker unit of gray to dark-gray limestone coquina composed of the pelecypod *Buchia sublaevis*, in beds up to 2 m thick, usually weathers reddish-brown, interbedded with reddish-brown to black clay shale; thickness less than 10 m. In the Ivotuk Hills sequence, unit is complexly deformed and commonly closely associated with Otuk Formation; is well exposed in a small outcrop on east bank of Otuk Creek 5.5 km north of Ivotuk Hills. *Unit description source:* KL002

Koc - Okpikruak Formation, coquinoid limestone (Cretaceous) Coquinoid limestone, (This usage was a bit ill advised, because there is really no graywacke associated with this distinctive limestone coquina.). *Unit description source:* DL005

c - coquina limestone (Early Cretaceous and Jurassic?) Distinctive reddish-gray coquinoid limestone composed of the pelecypod *Buchia sublevis* of early Valanginian age. Also contains *Buchia* of middle and late Valanginian and possible Kimmeridgian age in and west of map area. *Unit description source:* HW003

KJvc - Volcaniclastic rocks of the Brooks Range, May be included in Okpikruak Formation (Late Jurassic to Early Cretaceous)

Kof - Okpikruak Formation and similar units (Lower Cretaceous) See [Kof](#) for unit description from [SIM-3340](#).

KJmv - Volcaniclastic rocks of Memorial Creek (Cretaceous? and Jurassic?) Predominantly volcaniclastic rocks and subordinate associated mafic to intermediate volcanic rocks, mapped only in the Memorial Creek area of the Howard Pass quadrangle. Unit has some lithologic similarities to the Okpikruak Formation in other thrust sequences and a similar degree of induration. *Unit description source:* HW003

KJva - Andesitic volcanic rocks (Late Jurassic to Early Cretaceous)

KJiv - Andesitic volcanic rocks (Early Cretaceous & Jurassic) See [KJiv](#) for unit description from [SIM-3340](#).

Kab (or Kab?) - Porphyritic andesite and basalt (Early Cretaceous) Chiefly greenish-gray and dark-reddish porphyritic andesite and basalt flows and shallow intrusive rocks. Pillows and columnar jointing common. *Unit description source:* SH002

Kv - Andesite and basalt lava flows and volcaniclastic rocks (Early Cretaceous) Flows of andesite and basalt, interbedded with tuff, tuff breccia, agglomerate, volcanic conglomerate, and volcanic graywacke. Flows typically have phenocrysts of plagioclase and pyroxene set in a matrix of devitrified glass, altered plagioclase microlites, pyroxene, chlorite, and opaque oxides. Rhyolite and dacite flows are present locally. Tuffs are composed chiefly of fine-grained basalt and andesite clasts, plagioclase crystals, and mafic minerals in an altered matrix of devitrified glass. Tuffs commonly occur in cyclically repeated sequences that grade upward from coarse tuff breccia and lapilli tuff to very fine-grained cherty tuff and blue-green radiolarian chert. Massive agglomerate, breccia, and volcanic conglomerate are present locally. Widely exposed in Hughes, Shungnak, Selawik, Candle, Kateel River, and Melozitna quadrangles, and in the central part of Unalakleet quadrangle. *Unit description source:* SH004

KJv - Andesitic volcanic rocks (Late Jurassic and Early Cretaceous) Volcanic rocks including andesitic crystal-bearing tuff, tuff breccia, and agglomerate intercalated with porphyritic pyroxene andesite and trachyandesite flows. *Unit description source:* HU002

KJv - Andesitic volcanic rocks (earliest(?) Cretaceous and Jurassic(?)) Chiefly andesitic crystal-bearing lithic tuff, volcanic breccia, and volcanic conglomerate with subordinate intercalated andesitic flows. *Unit description source:* SE002

KJv (or KJv?) - Andesitic volcanic rocks (earliest(?) Cretaceous and Jurassic(?)) Chiefly dark greenish-gray, andesitic crystal-bearing lithic tuff, volcanic breccia, and volcanic conglomerate with subordinate intercalated trachy andesite and basalt flows. Minor volcanic graywacke and mudstone. *Unit description source:* SH002

KJl - Melange between Angayucham-Tozitna and Arctic Alaska and Ruby terranes (Jurassic to Early Cretaceous)

KJm - Melange facies (Cretaceous or Jurassic?) See [KJm](#) for unit description from [SIM-3340](#).

sz - Shear zone (Cretaceous?) Melange; zone of pervasively sheared and structurally mixed strata. Appears to separate allochthons, but provided description is lacking detail. *Unit description source:* CL002

KJm - Melange (Early Cretaceous and Jurassic?) Mélange consists of blocks of carbonate rocks, chert, metagraywacke, and altered mafic volcanic and intrusive rocks in a matrix of phyllite. Within the mélange unit, large blocks of carbonate rocks from units Pzca and Pzcr and altered basalt, diabase, and gabbro from unit JDv are mapped separately. Mélange probably formed during time of tectonic emplacement of Angayucham-Tozitna terrane structurally above Arctic Alaska and Ruby terranes. Along the faulted contact between Angayucham-Tozitna and Arctic Alaska terranes from Baird Mountains quadrangle eastward to Survey Pass quadrangle and along the faulted contact between Angayucham-Tozitna and Ruby terranes in the Bettles and Tanana quadrangles. *Unit description source:* AR003, BT003, and HU003

Dvc - Volcanic rocks and chert --chert (Devonian?) Red, green, black, gray, and white bedded, locally radiolarian chert and siliceous argillite. *Unit description source:* CH002

MzPzma - Metabasite (Mesozoic or Paleozoic) Varies from thinly layered greenschist to more massively layered greenstone bodies representing altered mafic and intermediate volcanic and shallow intrusive rocks. The characteristic minerals are chlorite, albite, actinolite, and epidote. Unit may include rocks of several different ages. Some of the bodies are interlayered with the Devonian felsic schist of unit Df and are part of a bimodal volcanic assemblage. Other bodies are interlayered with carbonate rocks (unit Pzca) that contain fossils of probable Devonian and Mississippian age. Still other bodies may represent tectonically emplaced slices of unit JDv of the Angayucham-Tozitna terrane. This polygon is part of Angayucham melange. *Unit description source:* SE004

cs - Chlorite schist (Age not given) Blocks of chlorite schist in melange of MzPzm. *Unit description source:* BM002

c - Metachert (Age not given) Blocks of bedded metachert in melange of unit KJm. Single polygon in unit MzPzm assigned NSAClass of 5145 and CLASS code of 930. *Unit description source:* BM002

m - Marble (Age not given) Blocks of bedded or massive marble of unknown age or affinity in melange of unit KJm. Polygons in unit MzPzm assigned NSAClass of 5145 and CLASS 931. *Unit description source:* BM002

KJip - Ipewik Formation, northern Alaska (Jurassic to Cretaceous (Valanginian))

KJks - Kingak Shale and similar units (Lower Jurassic to Lower Cretaceous) See [KJks](#) for unit description from [SIM-3340](#).

KJi - Ipewik unit (Cretaceous and Jurassic) Thin-bedded maroon and gray shale. *Unit description source:* DL002

KJi1 - Ipewik unit (Cretaceous and Jurassic) Maroon and gray shale, coquinoid limestone, siltstone, and clean quartz sandstone. Shale locally contains sparse well-rounded pebbles that consist of quartz, chert, gabbro, and granite. Shale contains local light-weathering clay beds (bentonite?) and volcanic rocks of intermediate composition. Part of the Brooks Range allochthon, Key Creek sequence. *Unit description source:* DL002, DL003, and DL004

KJi2 - Ipewik unit (Cretaceous and Jurassic) Maroon and gray shale. Part of the Picnic Creek allochthon, Wulik sequence. *Unit description source:* DL003 and DL004

KJsh - Pebble shale and Kingak Shale, undivided (Jurassic to Cretaceous (Barremian))

KJks - Kingak Shale and similar units (Lower Jurassic to Lower Cretaceous) See [KJks](#) for unit description from [SIM-3340](#).

KJok - Okpikruak Formation, Kongakut Formation and Kingak Shale, Undivided (Early Cretaceous and Jurassic) Includes a small outcrop of black siltstone and mudstone near Lupine River containing pelecypods of Late Jurassic and Early Cretaceous (?) age, and rocks in a complex fault zone on Atigun River including Lower Jurassic Kingak Shale and graywacke and coquina beds of Okpikruak Formation. *Unit description source:* PS002

KJks - Kingak Shale (Jurassic to Cretaceous (Hauterivian))

KJks - Kingak Shale and similar units (Lower Jurassic to Lower Cretaceous) See [KJks](#) for unit description from [SIM-3340](#).

Jk - Kingak Shale (Jurassic) Dark gray, gun-metal blue weathering; hard siltstone with shale interbeds; abundant nodules of clay ironstone and marcasite. Southwest of Ribdon River consists only of a local unit of black organic clay shale that is too thin to map. This unit is included in undivided Jurassic and Cretaceous rocks (KJok) on Atigun River, but may also be present in some poorly exposed areas mapped either as Kongakut or Okpikruak Formations. Marine. Middle and Late Jurassic ammonites and pelecypods in northeastern part of unit; Early Jurassic pelecypods in southwest. Thickness about 370m in northwest; 30 m or less in southwestern part of unit. *Unit description source:* PS002

Jw - Wacke and Mudstone (Jurassic) Included with the Rocks Not Assigned a Specific Sequence - Rhythmically bedded mudstone and wacke along the lower Kugururok River. Contains Late Jurassic species of pelcypod *Buchia*. Contacts are covered. *Unit description source:* MU002

KJo - Ogotaruk Formation (Early Cretaceous and Jurassic) Ogotaruk Formation. *Unit description source:* PH004

KJot - Ogotaruk and Telavirak Formations, undivided (Cretaceous and Jurassic) Ogotaruk and Telavirak Formations, undivided. *Unit description source:* PH004

KJt - Telavirak Formation (Early Cretaceous and Jurassic) Telavirak Formation. *Unit description source:* PH004

This unit is also present on source map DL005, no description was present on this source.

KPru - Kingak Shale, Karen Creek Sandstone and Shublik Formation, undivided (Permian to Cretaceous (Barremian))

KPu - Kingak Shale, Shublik Formation, and Karen Creek Sandstone, undivided (Permian to Lower Cretaceous) See [KPu](#) for unit description from [SIM-3340](#).

KJk/Trs - Kingak Shale/Shublik Formation, undifferentiated (Early Cretaceous, Valanginian to Late Triassic) Unit locally undifferentiated due to map scale. *Unit description source:* DL010

KDnb - Undivided marine and non-marine shale and siltstone (Devonian to Early Cretaceous)

Kof - Okpikruak Formation and similar units (Lower Cretaceous) See [Kof](#) for unit description from [SIM-3340](#).

KMi - Rocks of the Ipnarik River sequence, undivided (Cretaceous to Mississippian) Mapped tentatively in areas of limited or isolated exposure not examined in the field or identifiable by photo interpretation; unit assignment based on structural position of general sequence inferred from geologic relations mapped in surrounding areas. *Unit description source:* HW003 and HW004

KMn - Rocks of the Nuka Ridge sequence, undivided (Cretaceous to Mississippian) Mapped tentatively in areas of limited or isolated exposure not examined in the field or identifiable by photo interpretation; unit assignment based on structural position of general sequence inferred from geologic relations mapped in surrounding areas. *Unit description source:* HW003

KMp - Rocks of the Picnic Creek sequence, undivided (Early Cretaceous (Neocomian) to Mississippian) Mapped tentatively in areas of limited or isolated exposure not examined in the field or identifiable by photo interpretation; unit assignment based on structural position of general sequence inferred from geologic relations mapped in surrounding areas. *Unit description source:* HW003

KMp - Rocks of the Picnic Creek sequence, undivided (Early Cretaceous (Neocomian) to Devonian) Mapped tentatively in areas of limited or isolated exposure not examined in the field or identifiable by photo interpretation; unit assignment based on structural position of general sequence inferred from geologic relations mapped in surrounding areas. *Unit description source:* HW004

Jgi - Intermediate plutonic rocks, northern Alaska (Middle Jurassic)

JTrob - Ophiolite of the Brooks Range (Triassic to Jurassic) See [JTrob](#) for unit description from [SIM-3340](#).

Ji7 - Intermediate Plutonic Rocks (Jurassic) Part of the Misheguk Igneous Sequence - Coarse-grained plutonic rocks that occur as small dikes or plugs that intrude gabbro (unit Jg7). Composition is diorite, quartz diorite, and granite with varying proportions of quartz, plagioclase, hornblende, and biotite. Potassium-argon dates from biotite and hornblende collected in rocks of similar lithology and geologic setting at Siniktanneyak Mountain mafic and ultramafic complex in Howard Pass quadrangle give ages of 163 and 172 m.y. respectively (M. L. Silberman, written commun., 1978). *Unit description source:* MU002 and MU004

JTRrob - Brooks Range ophiolite, undivided (Triassic to Jurassic)

JTrob - Ophiolite of the Brooks Range (Triassic to Jurassic) See [JTrob](#) for unit description from [SIM-3340](#).

Jsf - Felsic intrusive rocks (Middle? Jurassic) Typically ranges from diorite to hornblende-plagiogranite in composition; alaskite dikes also common. Formed above, and by differentiation from, massive gabbro (unit Jsg). Locally intruded by late-stage diabase dikes. Nearly 2 km thick in places. This is one of six map units that is distinguished within the Jsu unit. It represents the second highest level intrusive setting in the complex. *Unit description source:* HW003

Jsu - Igneous complex of Siniktanneyak Mountain, undivided (Middle? Jurassic) Predominantly mafic and ultramafic rocks considered by most workers to represent an essentially complete ophiolite sequence; grades upward from tectonized and serpentinized mantle peridotite, dunite, harzburgite, and lherzolite at the base, through a crustal sequence of cumulate ultramafic rocks and layered gabbro, massive gabbro, high-level felsic igneous differentiates, and sheeted diabase dikes, and capped by basalt tuffs. *Unit description source:* HW003

JTri6 - Intermediate Igneous Rocks, Copter Peak Allochthon, Copter Igneous Sequence (Jurassic and Triassic) Part of the Copter Igneous Sequence - Includes a quartz diorite dike in mafic rocks southeast of upper Trail Creek (south-central Misheguk Mountain quadrangle map) and various fine-grained igneous rocks of dacitic andesitic, and basaltic composition in lower Kugururok Valley (southwestern Misheguk Mountain quadrangle map). Age based upon common association and intrusive relation with basalt (unit JTrb6). *Unit description source:* MU002 and MU004

MzPzm - Metamorphosed Sedimentary and Igneous Rocks (Mesozoic and or Paleozoic) Part of the Rocks Not Assigned a Specific Sequence - Includes quartz-muscovite-chlorite-garnet schist, actinolite-albite-chlorite schist, and marble probably derived from pelitic sedimentary rocks, mafic igneous rocks, and limestone. Metamorphism probably occurred during Late Jurassic and or Early Cretaceous at base of Misheguk Mountain (southwestern and south-central Misheguk Mountain quadrangle maps). Basal contact is a thrust fault. *Unit description source:* MU002 and MU004

MzPzm - Metamorphic rocks (Mesozoic and or Paleozoic) Fine-grained quartz-sericite schist and amphibole-epidote-plagioclase schist. *Unit description source:* NT005

ba - Basalt dikes and sills; Ilnavik River Allochthon, Iteriak Creek Sequence (unknown) Dark green, fine- to coarse-grained basalt, weathers reddish brown, mostly in rubble exposures; commonly intruded into unnamed limestone and chert of Lisburne Group and in some places into Ilnaitchiak Chert; age uncertain. *Unit description source:* KL002

mi - Fine-grained mafic igneous rocks (unknown) Mostly small isolated masses of weathered basalt, probably part of either Ilnavik River or Copter Peak allochthon emplaced as tectonic slivers of olistoliths within Okpikruak Formation. *Unit description source:* KL002

mii - Mafic igneous rocks; Ilnavik River Allochthon, Itkilikruich Ridges Sequence (unknown) Dark green, fine- to coarse-grained basalt, underlies Itkilikruich Ridge, light gray to greenish gray aphanitic rocks and volcanic breccia form isolated hills to south; on prominent cone-shaped mountain west of Ivotuk airstrip unit is conspicuously vesicular and amygdaloidal, age uncertain. *Unit description source:* KL002

Jbod - Brooks Range ophiolite, gabbro, diabase, basalt, microgabbro, and minor diorite (Jurassic)

JTrob - Ophiolite of the Brooks Range (Triassic to Jurassic) See [JTrob](#) for unit description from [SIM-3340](#).

Jfg7 - Gabbro (Jurassic) Part of the Misheguk Igneous Sequence - Fine to medium-grained phases. Most minerals are plagioclase, clinopyroxene, and green amphibole. *Unit description source:* MU002 and MU004

Jg7 - Gabbro (Jurassic) Medium- to coarse-grained gabbro. Predominant minerals are plagioclase, clinopyroxene, orthopyroxene, hornblende, and olivine. Locally banded with plagioclase- and pyroxene-rich layers, and locally includes small dikes of peridotite, pyroxenite, and hornblende-plagioclase pegmatite. Part of the Misheguk Mountain allochthon, Misheguk igneous sequence. *Unit description source:* DL002 and DL004

Jg7 - Gabbro (Jurassic) Part of the Misheguk Igneous Sequence - Medium to coarse-grained phases. Most minerals are plagioclase, clinopyroxene, orthopyroxene, hornblende, and olivine. Commonly banded with plagioclase and pyroxene-rich layers. Locally includes minor small dikes of peridotite, pyroxenite, and hornblende-plagioclase pegmatite. Age based on potassium-argon date of 164 m.y. from hornblende separated from gabbro collected at Misheguk Mountain mafic and ultramafic igneous complex (south-central Misheguk Mountain quadrangle map) (Patton and others, 1977). *Unit description source:* MU002 and MU004

Jsd - Diabase (Middle? Jurassic) Occurs as localized swarms of subparallel dikes as much as 2 m thick and having chilled margins; two distinct generations of dikes reported by S.W. Nelson. This is one of six map units that is distinguished within the Jsu unit. It represents the third highest (or intermediate) level intrusive setting in the complex. *Unit description source:* HW003

Jslg - Layered gabbro (Middle? Jurassic) Predominantly gray-green cumulate gabbro that includes interlayered ultramafic rocks in the lower part; banding typically expressed by melanocratic and leucocratic layers. As much as 4 km thick. This is one of six map units that is distinguished within the Jsu unit. It represents the second lowest intrusive setting in the complex. *Unit description source:* HW003

Jsg - Massive gabbro (Middle? Jurassic) Predominantly grayish-weathering, medium- to coarse-grained, hypersthene-bearing hornblende-pyroxene-gabbro having generally directionless texture but well-developed mineral banding in places. Grades downward into layered gabbro (unit Jslg). This is one of six map units that is distinguished within the Jsu unit. It represents the third lowest (or intermediate) level intrusive setting in the complex. *Unit description source:* HW003

KJm - Mafic igneous rocks (Early Cretaceous? to Jurassic?) Gabbro, diabase, basalt, microgabbro, and minor diorite; dark-grayish-green to dark-gray. Includes some pillow, pillow-layer, or flow structures locally. *Unit description source:* MU006 and MU007

Mzg - Gabbro (Mesozoic) Massive, isotropic, medium-grained, light to medium green gabbro. *Unit description source:* BM002

MzPzi - Mafic to intermediate igneous rocks (Mesozoic and or Paleozoic) Coarse-grained gabbro at one locality, medium-grained diorite and quartz-diorite at another. *Unit description source:* NT005

g - Gabbro (Age not given) Blocks of gabbro (Mzg) occurring in melange of unit KJm. Gabbro is identical to Mzg but lacks intrusive contacts. *Unit description source:* BM002

This unit is also present on source map NT006, no description was present on this source.

Jbou - Brooks Range ophiolite, ultramafic and mafic rocks (Middle Jurassic)

JTrob - Ophiolite of the Brooks Range (Triassic to Jurassic) See [JTrob](#) for unit description from [SIM-3340](#).

Jsdh - Dunite and harzburgite (Middle? Jurassic) Orange-weathering dunite predominates, but harzburgite common in places; also includes lesser amounts of lherzolite, serpentized peridotite, and olivine pyroxenite; most lithologies typically tectonized and foliated, especially near the structural base of the complex. This is one of six map units that is distinguished within the Jsu unit. It represents the lowest intrusive setting in the complex. *Unit description source:* HW003

Ju7 - Ultramafic rocks (Jurassic) Predominantly orange-weathering peridotite and partly serpentized dunite with minor amounts of pyroxenite in small dikes. Part of the Misheguk Mountain allochthon, Misheguk sequence. *Unit description source:* DL002 and DL004

Ju7 - Ultramafic Rocks (Jurassic) Part of the Misheguk Igneous Sequence - Includes mainly orange-weathering peridotite and partly serpentized dunite with minor amounts of pyroxenite in small dikes. Basal contact is a thrust fault. *Unit description source:* MU002 and MU004

Ju7 - Ultramafic rocks, Misheguk Mountain Allochthon, Misheguk Igneous Sequence (Jurassic) Serpentinized and partly serpentized peridotite. *Unit description source:* NT005

gabbro - Misheguk Mountains Allochthon - Gabbro / Dunite (Age unspecified) Exposed at Asik Mountain and Iyikrok Mountain. *Unit description source:* NT006

This unit is also present on source map NT006, however, no description was present on this source.

Jbob - Brooks Range ophiolite, basalt, pillows and pillow breccia (Middle Jurassic)

JTrob - Ophiolite of the Brooks Range (Triassic to Jurassic) See [JTrob](#) for unit description from [SIM-3340](#).

Jsb - Basalt (Middle? Jurassic) Predominantly brown to greenish, vesicular and amygdaloidal basalt containing broken pillow breccia in places; bedded silicic tuff containing soft-sediment deformation features found at one locality. This is one of six map units that is distinguished within the Jsu unit. It represents the highest level intrusive setting in the complex. *Unit description source:* HW003

Jsb - Basalt - Misheguk sequence, Igneous complex of Siniktanneyak Mountain (Middle Jurassic?) Predominantly brown to greenish, vesicular and amygdaloidal basalt containing broken pillow breccia in places; bedded silicic tuff containing soft-sediment deformation features found at one locality. This is one of six map units that is distinguished within the Jsu unit. It represents the highest level intrusive setting in the complex. *Unit description source:* HW004

JTrb6 - Basalt, Copter Peak Allochthon, Copter Igneous Sequence (Jurassic and Triassic) Part of the Copter Igneous Sequence - Pillow structures are common. Includes minor amounts of gray shale and radiolarian chert. Triassic age is based on radiolarian fossils from chert intercalated with pillow basalt. Jurassic age is more speculative, and is based upon the possibility that gabbroic rocks of

Jurassic age, equivalent to those exposed in the Misheguk igneous sequence, may have been the source for some of the basalt. Basal contact is a thrust fault. *Unit description source:* MU002 and MU004

JTrb6 - Basalt, Copter Peak allochthon, Copter Igneous Sequence (Jurassic? and Triassic)

Basalt. Locally has pillow structures. Part of the Copter Peak allochthon, Copter igneous sequence. *Unit description source:* DL004

JTrb6 - Basalt, Copter Peak Allochthon, Copter Igneous Sequence (Jurassic? and Triassic)

Brown-weathering basalt and diabase, locally has pillow structures. Triassic age inferred from lithologic correlation with similar rocks in Misheguk Mountain quadrangle. Jurassic? age based on possibility that gabbroic rocks of Jurassic age, similar to those in Misheguk igneous sequence may have been source of some of the basalt. *Unit description source:* NT005

Mzb - Basalt (Mesozoic) Dark dull green to bluish green, aphanitic to augite porphyritic basalt. *Unit description source:* BM002

JDbc - Basalt - Copter Creek sequence (Jurassic? to Devonian?) Greenish-gray, vesicular, and amygdaloidal, locally pillowed basalt; also contains minor volcanic breccia, tuff, and volcanoclastic rocks, as well as lenses or interpillow intercalations of radiolarian chert and fossiliferous limestone. Assignment of the Siniktanneyak and Memorial Creek basalt exposures to one long-lived unit is based on similarities in petrologic character and structural occurrence, and poor age distribution knowledge. *Unit description source:* HW003 and HW004

mi - Mafic igneous rocks (Cenozoic to Paleozoic) Altered and partly vesicular basalt at one locality, brown-weathering basalt and diabase at another. *Unit description source:* NT005

bi - Basic igneous, Copter Peak Allochthon, Copter Igneous Sequence (Age not given) Probably pillow basalt. Today's Copter Peak allochthon. *Unit description source:* DL005

bi - Copter Peak Allochthon - Basalt (Age unspecified) Basalt, possibly pillow basalts, at Maiyumerak Mountain, and in syncline between Asik and Maiyumerak Mountains. Also widespread south of Iyikrok Mountain. *Unit description source:* NT006

none - Maiyumerak Mountain (Age unspecified) Not labelled but is continuation of rocks assigned to unit 4870, unit Mzb in the adjacent Baird Mountains quadrangle described as dark dull green to bluish green, aphanitic to augite porphyritic basalt. *Unit description source:* NT006

JPNboi - Brooks Range ophiolite, mafic sills and dikes associated with upper allochthons (Pennsylvanian to Jurassic)

JTroB - Ophiolite of the Brooks Range (Triassic to Jurassic) See [JTrob](#) for unit description from [SIM-3340](#).

JIPm4 - Mafic sills and dikes (Jurassic to Pennsylvanian) Consists mostly of diabase composed of plagioclase and augite. Intrudes the black chert unit and the limestone unit of the Baird Group. Part of the Ilnavik River allochthon, Puzzle Creek sequence. *Unit description source:* DL004

JIPm4 - Mafic sills and dikes (Jurassic to Pennsylvanian) Part of the Ilnavik Sequence - Fine to coarse-grained diabase mainly composed of plagioclase and augite. Commonly is partly or completely altered to clay minerals. Generalized age based upon apparent intrusion of diabase into imprecisely

dated chert of the Etivuk Group. The authors are uncertain that this rock unit is as young as upper part of the Etivuk Group. *Unit description source:* MU002, MU003, and MU004

JIPm4 - Mafic sills and dikes, Ilnavik River Allochthon, Ilnavik Sequence (Jurassic? to Pennsylvanian) Fine- to coarse-grained diabase mainly composed of plagioclase and augite. Age inferred from regional correlations in Misheguk Mountain and Howard Pass quadrangles where diabase of this sequence appears to have intruded chert of Etivuk Group. *Unit description source:* NT005

JIPm4n - Mafic sills and dikes (Jurassic to Pennsylvanian) Part of the Nachralik Pass Sequence - Small and sparse sill and dikes. Mostly diabase mainly composed of plagioclase and augite. Age based on correlation with similar mafic rocks in Ilnavik sequence which intrude chert of the Etivuk Group. *Unit description source:* MU002, MU003, and MU004

JIPm5 - Mafic sills and dikes (Jurassic to Pennsylvanian) Part of the Bogie Sequence - Sills or dikes are present north of lower Tunit Creek (south-central Misheguk Mountain quadrangle map) and dismembered shallow intrusive bodies occur around Nuka Ridge (southeastern Misheguk Mountain quadrangle map). Age based on lithologic similarity with mafic rocks in Ilnavik sequence. *Unit description source:* MU002, MU003, and MU004

JMmi - Mafic sills and dikes - Ilnavik River sequence (Jurassic? to Mississippian?) Typically dark-greenish-gray, mostly diabasic to gabbroic sills and dikes; composed mainly of plagioclase and augite. Comprises a characteristic component of the Ilnavik thrust sequence, but similar mafic rocks locally intrude rocks of the Etivuk Group in the Picnic Creek and Endicott thrust sequences. Generally altered; age uncertain, but permissible age range based on intrusive relations with rocks of the Lisburne and Etivuk Groups. *Unit description source:* HW003, HW004, and MU012

JTRPe - Banded dark-green, gray, and red eclogite and banded amphibolite (Permian to Jurassic)

JPztu - Ultramafic complexes of western Alaska (Jurassic or older) See [JPztu](#) for unit description from [SIM-3340](#).

JPe - Eclogite and amphibolite (Jurassic (?), Triassic (?), and Permian (?)) Banded dark-green, gray, and red eclogite and banded amphibolite. Eclogite is composed of green pyroxene, poikiloblastic garnet with inclusions of pyroxene, secondary(?) plagioclase, and secondary amphibole and chlorite that replace the garnet and pyroxene. contact relations with volcanic rocks of unit JPV are not known, but the mafic composition of both units JPe and JPV suggests that they are related. *Unit description source:* BV002

JTRPtU - Dishna River mafic and ultramafic rocks (Permian to Jurassic (Kimmeridgian))

JPztu - Ultramafic complexes of western Alaska (Jurassic or older) See [JPztu](#) for unit description from [SIM-3340](#).

Ju - Ultramafic rocks (Jurassic) Ultramafic rocks; Sheared serpentinite locally mixed with basaltic rocks; Locally serpentinitized peridotite and dunite; locally contains asbestos and soapstone and nephrite jade. *Unit description source:* AR002

Jumc - Mafic-ultramafic complexes (Jurassic) The complexes consist of: 1) a cumulate magmatic suite composed of interlayered dunite, wehrlite, olivine clinopyroxenite, and gabbro, 2) a mantle suite composed of harzburgite, dunite, and minor clinopyroxenite, and 3) a metamorphic sole consisting of a highly tectonized layer of amphibolite, garnet amphibolite, and pyroxene granulite. The harzburgite in the mantle suite typically is partly to mostly serpentinized. Chromite is generally restricted to centimeter-scale layers in dunite and as an accessory mineral. The complexes are intruded by narrow dikes of fresh clinopyroxenite, hornblendite, gabbro, and gabbro pegmatite. *Unit description source:* BT003 and WI003

JPu - Ultramafic rocks (Jurassic (?), Triassic (?), and Permian) Ultramafic rocks of serpentinized peridotite and dunite. *Unit description source:* BT002

MzPzum - Mafic-ultramafic complexes (Mesozoic and Paleozoic?) The complexes consist of: (1) a cumulate magmatic suite composed of interlayered dunite, wehrlite, olivine clinopyroxenite, and gabbro, (2) a mantle suite composed of harzburgite, dunite, and minor clinopyroxenite, and (3) a metamorphic sole consisting of a highly tectonized layer of amphibolite, garnet amphibolite, and pyroxene granulite. The harzburgite in the mantle suite typically is partly to mostly serpentinized. Chromite is generally restricted to centimeter-scale layers in dunite and as an accessory mineral. The complexes are intruded by narrow dikes of fresh clinopyroxenite, hornblendite, gabbro, and gabbro pegmatite. The complexes appear to form the roots of the Koyukuk volcanic arc that was active from Jurassic to late Early Cretaceous. The protolith age of the mantle suite is uncertain and may be as old as Paleozoic. Unit exposed along southeastern and northern borders of Yukon-Koyukuk Basin, in the south-central part of Unalakleet quadrangle where it is spatially associated with the trondjemite and tonalite unit Jgt, and in one small area along the western border of the basin in southern Candle quadrangle. Also included in this unit is a small complex exposed in a window(?) through the Innoko terrane in the south-central part of Ophir quadrangle. *Unit description source:* BT003

JTRrcs - Otuk Formation (Triassic (Olenekian) to Jurassic (Bajocian))

JTro - Otuk Formation (Triassic to Middle Jurassic) See [JTro](#) for unit description from [SIM-3340](#).

JTRo - Otuk Formation, Etivluk Group (Jurassic and Triassic) Light- to dark-gray radiolarian chert with thin siliceous shale partings. Upper part weathers to cream-colored or light-brown and green bed surfaces. *Unit description source:* DL002, DL003, and DL004

JTro - Otuk Formation (Middle Jurassic to Triassic) Interbedded fossiliferous black chert and shale, and thin-bedded, black and banded limestone. The Jurassic Blankenship Member at the top is locally exposed (but not mapped separately) and consists of organic-rich black shale and thin-bedded chert. Formation is commonly exposed only as rubble or in structurally complicated partial sections in stream cuts. Thickness less than 100 m. *Unit description source:* HW003

JTro - Otuk Formation - Endicott sequence, Etivluk group (Middle Jurassic to Triassic) Interbedded fossiliferous black chert and shale, and thin-bedded, black and banded limestone. The Jurassic Blankenship Member at the top is locally exposed (but not mapped separately) and consists of organic-rich black shale and thin-bedded chert. Formation is commonly exposed only as rubble or in structurally complicated partial sections in stream cuts. Thickness less than 100 m. *Unit description source:* HW004

JTro - Otuk Formation, Etivluk Group; Endicott Mountains Allochthon, Killik River Sequence (Middle Jurassic to Early Triassic) Interbedded fossiliferous black chert, limestone, and shale in four lithogenetic units: a basal poorly exposed shale member--black organic shale (Early and Middle Triassic); the 'chert' member--black silicified mudstone, chert and shale (Middle and Late Triassic); the

limestone member--thinly interbedded shale and thin-bedded black- and light-gray banded limestone and silicified limestone; and Blankenship member--organic-rich black shale and thin bedded chert, represents condensed deposition (Early and Middle Jurassic). Not well exposed, thickness <100 m. *Unit description source:* KL002

JTro - Otuk Formation; Endicott Mountains Allochthon, Ivotuk Hills Sequence (Middle Jurassic to Early Triassic) Interbedded fossiliferous black chert, limestone, and shale in four lithogenetic units: a basal poorly exposed shale member--black organic shale (Early and Middle Triassic); the 'chert' member--black silicified mudstone, chert and shale (Middle and Late Triassic); the limestone member--thinly interbedded shale and thin-bedded black- and light-gray banded limestone and silicified limestone; and Blankenship member--organic-rich black shale and thin bedded chert, represents condensed deposition (Early and Middle Jurassic). In the Ivotuk Hills sequence, unit is generally not well exposed, commonly exposed only as yellow-gray weathering rubble of the limestone member or in a few well exposed but structurally complicated partial sections in stream cuts. Type locality is on east bank of Otuk Creek, 6.3 km north of Ivotuk Hills, where thickness <50 m and shale member is mostly covered. *Unit description source:* KL002

JTro - Otuk Formation; Endicott Mountains Allochthon, Key Creek Sequence (Middle Jurassic to Early Triassic) Interbedded fossiliferous black chert, limestone, and shale in four lithogenetic units: a basal poorly exposed shale member--black organic shale (Early and Middle Triassic); the 'chert' member--black silicified mudstone, chert and shale (Middle and Late Triassic); the limestone member--thinly interbedded shale and thin-bedded black- and light-gray banded limestone and silicified limestone; and Blankenship member--organic-rich black shale and thin bedded chert, represents condensed deposition (Early and Middle Jurassic). In Key Creek sequence, unit is generally poorly exposed, commonly as yellow-gray weathering rubble of the limestone member; Blankenship Member at top and the shale member at base is not exposed. Thickness <100 m. *Unit description source:* KL002

JTro - Otuk Formation; Endicott Mountains Allochthon, Okpikruak River Sequence (Middle Jurassic to Early Triassic) Interbedded fossiliferous black chert, limestone, and shale in four lithogenetic units: a basal poorly exposed shale member--black organic shale (Early and Middle Triassic); the 'chert' member--black silicified mudstone, chert and shale (Middle and Late Triassic); the limestone member--thinly interbedded shale and thin-bedded black- and light-gray banded limestone and silicified limestone; and Blankenship member--organic-rich black shale and thin bedded chert, represents condensed deposition (Early and Middle Jurassic). In Okpikruak River sequence unit is exposed mostly as yellow-gray weathering rubble of the limestone member in the Okpikruak River area. Blankenship Member at top and shale member at base not exposed. Thickness probably <75 m. *Unit description source:* KL002

JTro - Otuk Formation (Jurassic and Triassic) Included with the rocks not assigned a specific sequence. Gray and cream-colored, well-bedded chert with siliceous shale partings. *Unit description source:* MU003

JTro - Otuk Formation (Jurassic and Triassic) Gray to dark-gray radiolarian chert with siliceous shale partings, weathers gray, green, brown and cream-colored. *Unit description source:* NT005

JTro1 - Otuk Formation, Etivluk Group (Middle Jurassic to Early Triassic) Light- to dark-gray chert with thin siliceous shale partings. Upper part weathers to cream-colored or light-brown and green bedding surfaces and contains a few siliceous limestone beds that contain *Monotis*. Middle part is well-bedded, gray, brown, or dark-gray chert containing *Halobia* in shaly layers. Lower part, which is locally present, is gray shale with a few carbonate beds that contain Early Triassic conodonts. Part of the Brooks Range allochthon, Key Creek sequence. *Unit description source:* DL002, DL003, and DL004

JTro1 - Otuk Formation (Jurassic and Triassic) Part of the Key Creek Sequence - Light gray to dark-gray chert with thin siliceous shale partings (Mull and others, 1982). Upper part contains Triassic pelecypods, Monotis and Halobia, typically cream-colored or light-brown- and green-weathering rind of chert beds, and commonly contains a few carbonate beds. Lower part includes 5-m interval black chert that resembles Carboniferous chert. Chert contains Triassic radiolarians. Depositional thickness is approximately 30-50 m. Base is probably gradational into the Siksikpuk Formation. *Unit description source:* MU002, MU003, and MU004

JTro2 - Otuk Formation, Etivluk Group (Jurassic and Triassic) Light- to dark-gray chert with thin siliceous shale partings. Weathers to cream-colored or light-brown and green bedding surfaces, and commonly contains a few carbonate beds. Part of the Picnic Creek allochthon, Wulik sequence. *Unit description source:* DL002, DL003, and DL004

JTro2 - Otuk Formation, Etivluk Group (Jurassic and Triassic) Light- to dark-gray chert with thin siliceous shale partings. Upper part contains cream-colored bed surfaces with Monotis. Lower part is mostly shale with a few limestone beds containing Triassic conodonts. Part of the Picnic Creek allochthon, Amaruk sequence. *Unit description source:* DL002, DL003, and DL004

JTro2 - Otuk Formation (Jurassic and Triassic) Part of the Picnic Sequence - Light to dark-gray chert with thin siliceous shale partings. Locally cream-colored on bed surfaces. Commonly contains Triassic pelecypod, Monotis and Triassic radiolarians. Depositional thickness is approximately 30-40 m. Base is probably gradational in the Siksikpuk Formation. *Unit description source:* MU003 and MU004

JTro3 - Otuk Formation, Etivluk Group (Jurassic and Triassic) Gray to dark-gray, well-bedded chert with siliceous shale partings. Contains a few interbedded siliceous limestone beds near top. Weathers to brown, green, yellow, and cream-colored bedding surfaces. Part of the Kelly River allochthon, Amphitheatre sequence. *Unit description source:* DL003 and DL004

JTro3 - Otuk Formation, Etivluk Group (Jurassic and Triassic) Gray and maroon well-bedded chert with siliceous shale partings. Cream-colored zone near top has a few limestone beds. Part of the Kelly River allochthon, Kelly sequence. *Unit description source:* DL003 and DL004

JTro3 - Otuk Formation (Jurassic and Triassic) Part of the Kelly Sequence - Gray, well-bedded chert with siliceous shale partings. Cream-colored chert with a few interbedded limestone beds near top contain Triassic pelecypod, Monotis, and Triassic radiolarians. Locally, chert, shale, and limestone are maroon in color. Chert and siliceous limestone beds contain radiolarians. Depositional thickness is approximately 30-40 m. Base is probably gradational into the Siksikpuk Formation. *Unit description source:* MU002 and MU004

JTro3 - Otuk Formation, Kelly River Allochthon, Amphitheatre Sequence (Jurassic and Triassic) Gray to dark-gray, well-bedded chert with siliceous shale partings. Contains a few interbedded siliceous limestone beds near top. Weather brown, green, yellow, and cream-colored bed surfaces. *Unit description source:* NT005

JTro3 - Otuk Formation, Kelly River Allochthon, Amphitheatre Sequence (Jurassic and Triassic) Gray chert, weathers brown and cream-colored. *Unit description source:* NT005

JTro3e - Otuk Formation (Jurassic and Triassic) Part of the Eli Sequence - Gray chert that commonly weathers brown or yellowish brown and has cream-colored bed surfaces in upper part. Contains Triassic pelecypod, Monotis, and radiolarians. Mapped in a few small outcrops north and northwest of Misheguk Mountain (southwestern and south-central Misheguk Mountain quadrangles). Thickness in outcrop is approximately 20 m; depositional contact on the Siksikpuk Formation is not exposed but is inferred from regional stratigraphic relations. *Unit description source:* MU002 and MU004

JTro4 - Otuk Formation, Etivluk Group (Jurassic and Triassic) Light- to dark-gray chert with thin siliceous shale partings. Upper part has cream-colored rind on bed surfaces. Part of the Ilnavik River allochthon, Puzzle Creek sequence. *Unit description source:* DL004

JTro5 - Otuk Formation, Nuka Ridge Allochthon, Bogie Sequence (Jurassic and Triassic) Gray radiolarian chert weathers brown with some cream-colored beds. *Unit description source:* NT005

JTros - Otuk and Shublik Formations, undivided (Jurassic and Triassic) Otuk Formation consists of (in ascending order) shale, chert, and limestone members and the Blankenship Member. Shale is dark-gray, grayish-black, and greenish-gray shale and mudstone, thin beds of dark-gray limestone, and dark-gray to black chert. Locally phosphatic. Chert member is dark-gray to black chert, silicified micritic limestone, and dark-gray to black, soft, sooty, silty shale. Chert is rhythmically bedded, thin-bedded and locally fossiliferous. Limestone member is mainly rhythmically bedded yellowish-gray, light-brownish-gray, and tan weathering dark-gray, fine-grained and very impure, having parting parts of dark-gray and black shale. Shublik Formation is mostly dark- to very dark-gray, soft, sooty, fissile shale and dark-gray, medium-dark-gray, and brownish-gray impure limestone. *Unit description source:* CL002

Trs - Shublik Formation (Late and Middle Triassic) Less than 150 m thick, upper part is fossiliferous light-hued calcilutite containing pelecypod *Monotis* and interbedded gray, bluish, greenish, and locally reddish chert. Remainder of unit contains similar chert, siliceous shale, and black chert, dark-gray limestone, and black shale which contain *Halobia*. As mapped, locally includes organic shale of Jurassic? age and some siliceous and argillaceous rocks possibly equivalent to the Siksikpuk Formation. *Unit description source:* MU006, MU007, MU008, and MU012

Trs - Shublik (now Otuk Formation) (Triassic) Shublik (now Otuk Formation). *Unit description source:* DL005

Trs(m) - Shublik (now Otuk Formation) (Triassic) Shublik (now Otuk Formation) with *Monotis* fossils observed. *Unit description source:* DL005

JPNzeg - Etivluk Group, undivided (Pennsylvanian to Jurassic (Bajocian))

JIPe - Etivluk Group, undivided (Pennsylvanian to Middle Jurassic) See [JIPe](#) for unit description from [SIM-3340](#).

JPe - Etivluk Group; Endicott Mountains Allochthon, Killik River Sequence (Middle Jurassic to Permian) Divided into: JTro and Ps. *Unit description source:* KL002

JIPe - Etivluk Group, undivided (Jurassic to Pennsylvanian) Maroon, red, green, gray, black, and variegated chert and siliceous argillite, minor maroon calcareous siltstone and argillite, and rare maroon or gray limestone lenses. *Unit description source:* BM002

JIPe - Etivluk Group (Jurassic to Pennsylvanian) Gray radiolarian chert with siliceous shale partings. *Unit description source:* DL002, DL003, and DL004

JIPe - Etivluk Group (Middle Jurassic to Pennsylvanian) Assemblage of variegated but mostly black, gray, or greenish-gray bedded chert containing partings and subordinate interbeds of shale and siliceous shale. Typically is intensely tectonically disrupted. *Unit description source:* HW003

JIPe - Etivluk Group - Endicott sequence (Middle Jurassic to Pennsylvanian) Assemblage of variegated but mostly black, gray, or greenish-gray bedded chert containing partings and subordinate interbeds of shale and siliceous shale. Typically is intensely tectonically disrupted. *Unit description source:* HW004

JIPe - Etivluk Group (Jurassic to Pennsylvanian) Gray chert with siliceous shale partings. Chert contains radiolarians. *Unit description source:* MU002, MU003, and MU004

JIPe - Etivluk Group (Jurassic to Pennsylvanian) Gray, olive-gray, and maroon radiolarian chert with siliceous shale partings, weathers to shades of brown, green, cream-colored, gray, black, and maroon. Age inferred from stratigraphic correlation with similar beds in De Long Mountains that contain Carboniferous to early Mesozoic radiolarians and conodonts, and near their top, Triassic pelecypod, Monotis. Depositional thickness about 110 m. *Unit description source:* NT005

JIPe1 - Etivluk Group (Middle Jurassic to Pennsylvanian) Gray chert with minor amounts of shale; weathers brown, yellow, gray, green, and maroon. Consists of the Siksikpuk and Otuk Formations. Part of the Brooks Range allochthon, Key Creek sequence. *Unit description source:* DL002, DL003, and DL004

JIPe1 - Etivluk Group, Key Creek Sequence (Jurassic to Pennsylvanian) Part of the Key Creek Sequence - Gray chert with minor amounts of shale; weathers to shades of brown, yellow, gray, green, and maroon. Contains Pennsylvanian to Triassic radiolarians and Triassic Pelecypod Monotis in upper part. *Unit description source:* MU002, MU003, and MU004

JIPe2 - Etivluk Group (Jurassic to Pennsylvanian) Gray chert with minor amounts of shale; weathers to shades of brown, yellow, gray, green, and maroon. Consists of the Siksikpuk and Otuk Formations. Part of Picnic Creek allochthon, Wulik sequence. *Unit description source:* DL002, DL003, and DL004

JIPe2 - Etivluk Group (Jurassic to Pennsylvanian) Gray chert with minor amounts of shale; weathers to shades of brown, yellow, gray, green, and maroon. Consists of the Siksikpuk and Otuk Formations. Part of the Picnic Creek allochthon, Amaruk sequence. *Unit description source:* DL002, DL003, and DL004

JIPe2 - Etivluk Group (Jurassic to Pennsylvanian) Part of the Wulik Sequence - Gray chert with siliceous shale partings. Includes undifferentiated parts of the Siksikpuk and Otuk Formations. Chert contains radiolarians. *Unit description source:* MU002

JIPe2 - Etivluk Group (Jurassic to Pennsylvanian) Part of the Picnic Sequence - Gray chert with siliceous shale partings. Contains Pennsylvanian to Triassic radiolarians. *Unit description source:* MU003 and MU004

JIPe2 - Etivluk Group, Picnic Creek Allochthon, Amaruk Sequence (Jurassic to Pennsylvanian) Mostly gray radiolarian chert with minor siliceous shale, weathers to shades of brown, yellow, gray, green, and maroon. Age inferred from stratigraphic correlation with similar beds in De Long Mountains that contain Carboniferous to early Mesozoic radiolarians and conodonts, and near their top, Triassic pelecypod, Monotis. Depositional thickness about 110 m. *Unit description source:* NT005

JIPe3 - Etivluk Group (Jurassic to Pennsylvanian) Gray chert with minor amounts of shale; weathers to shades of brown, yellow, gray, green, and maroon. Consists of the Siksikpuk and Otuk Formations. Part of the Kelly River allochthon, Amphitheatre sequence. *Unit description source:* DL002, DL003, and DL004

JIPe3 - Etivluk Group (Jurassic to Pennsylvanian) Gray, black, brown, and maroon radiolarian chert with siliceous shale partings. Consists of the Siksikpuk and Otuk Formations. Part of the Kelly River allochthon, Kelly sequence. *Unit description source:* DL002, DL003, and DL004

JIPe3 - Etivluk Group (Jurassic to Pennsylvanian) Part of the Kelly Sequence - Gray chert with siliceous shale parings. Chert contains radiolarians. *Unit description source:* MU002, MU003, and MU004

JIPe3 - Etivluk Group, Kelly River Allochthon, Amphitheatre Sequence (Jurassic to Pennsylvanian) Gray radiolarian chert with minor siliceous shale, weathers to shades of brown, yellow, gray, green, and maroon. Consists of Siksikpuk and Otuk Formations. Age inferred from stratigraphic correlation with similar beds in De Long Mountains that contain Carboniferous to early Mesozoic radiolarians and conodonts, and near their top, Triassic pelecypod, Monotis. Depositional thickness about 110 m. Locally subdivided. *Unit description source:* NT005

JIPe3 - Etivluk Group, Kelly River Allochthon, Kelly Sequence (Jurassic to Pennsylvanian) Gray, olive-gray, and maroon radiolarian chert with minor siliceous shale, weathers to shades of brown, yellow, gray, green, and maroon. Consists of Siksikpuk and Otuk Formations. Age inferred from stratigraphic correlation with similar beds in De Long Mountains that contain Carboniferous to early Mesozoic radiolarians and conodonts, and near their top, Triassic pelecypod, Monotis. Depositional thickness about 110 m. Locally subdivided. *Unit description source:* NT005

JIPe3e - Etivluk Group (Jurassic to Pennsylvanian) Part of the Eli Sequence - Well-bedded gray chert with siliceous shale partings. Chert contains radiolarians. *Unit description source:* MU002 and MU004

JIPe4n - Etivluk Group (Jurassic to Pennsylvanian) Part to the Nachralik Pass Sequence - Gray and maroon chert with siliceous shale partings. Chert contains radiolarians. *Unit description source:* MU002, MU003, and MU004

JIPe4 - Etivluk Group (Jurassic to Pennsylvanian) Part of the Ilnavik Sequence - Gray or greenish-chert. Upper part rarely contains Triassic pelecypod, Monotis, Contains radiolarians. *Unit description source:* MU002, MU003, MU004, and MU012

JIPe4 - Etivluk Group (Jurassic to Pennsylvanian) Gray, black, brown, and maroon radiolarian chert with siliceous shale partings. Part of the Ilnavik River allochthon, Puzzle Creek sequence. *Unit description source:* DL004

JIPe4 - Etivluk Group, Ilnavik River Allochthon, Ilnavik Sequence (Jurassic to Pennsylvanian) Maroon, green, and gray radiolarian chert with minor siliceous shale. Age inferred from stratigraphic correlation with similar strata that contain radiolarians and conodonts. Depositional thickness about 110 m. Locally subdivided. *Unit description source:* NT005

JIPe5 - Etivluk Group (Jurassic to Pennsylvanian) Part of the Bogie Sequence - Gray, greenish-gray, black, and maroon chert and minor shale. May include part of the Siksikpuk Formation. Chert contains radiolarians. Upper part rarely contains Triassic pelecypod, Monotis. Depositional thickness estimated to be less than 150 m; base is gradational into the Nuka Formation at Nuka Ridge. *Unit description source:* MU002, MU003, and MU004

JIPe5 - Etivluk Group, Nuka Ridge Allochthon, Bogie Sequence (Jurassic to Pennsylvanian) Gray, greenish gray, and maroon radiolarian chert with minor interbedded siliceous shale. Weathers light-brown and cream-colored in upper part. Consists of Siksikpuk and Otuk Formations. *Unit description source:* NT005

JIPe5b - Etivluk Group (Jurassic to Pennsylvanian) Part of the Bastille Sequence - Gray chert with siliceous shale partings. Contains radiolarians. *Unit description source:* MU002 and MU004

JIPen - Etivluk Group (Middle Jurassic to Pennsylvanian) Assemblage of variegated but mostly black, gray, or greenish-gray bedded chert containing partings and subordinate interbeds of shale and siliceous shale. Typically is intensely tectonically disrupted. *Unit description source:* HW003

JIPen - Etivluk Group - Nuka Ridge sequence (Middle Jurassic to Pennsylvanian) Assemblage of variegated but mostly black, gray, or greenish-gray bedded chert containing partings and subordinate interbeds of shale and siliceous shale. Typically is intensely tectonically disrupted. *Unit description source:* HW004

JMc - Chert, Undivided (Jurassic to Mississippian) Included with the rocks not assigned a specific sequence. As mapped may include one or more of the following units: Etivluk Group, Otuk Formation, Siksikpuk Formation, and black chert (unit PMc4). *Unit description source:* MU003 and MU004

JMcU - Cherty rocks, undivided (Jurassic? to Mississippian) Includes two poorly defined cherty units; light-colored cherty unit (JPacI) and dark-colored cherty unit (PaMcd). *Unit description source:* MU006, MU007, and MU008

JIPcl - Light-colored cherty unit (Jurassic? to Pennsylvanian) Thin- to medium-bedded, vitreous to dull, gray, bluish, greenish, olive, reddish, and minor black chert, siliceous claystone, argillite, and siltstone, 100 to 200 m thick. Probably mostly Permian and Triassic in age, equivalent in part to Siksikpuk and Shublik Formations but may contain Lisburne equivalent rocks. *Unit description source:* MU006, MU007, and MU008

TrPs - Undifferentiated Siksikpuk and Otuk Formations (Triassic to Permian) Shaly, undifferentiated Siksikpuk and what we now call Otuk, dominantly shaly, fossiliferous Triassic pelecypods. *Unit description source:* DL005

MzPz - Mesozoic and Paleozoic rocks, undivided (Mesozoic and Paleozoic) Mostly pre-Cretaceous cherty and carbonate rocks in highly complex structural relationships. *Unit description source:* MU006, MU007, and MU008

cht - Gray, bluish gray, greenish-gray, or black chert and silicified mudstone (unknown) Undivided siliceous sediments of Etivluk Group or Lisburne Group; mostly rubble patches not examined on the ground. *Unit description source:* KL002

JMs - Sedimentary rocks: Endicott Group (Kayak Shale), Lisburne Group and Etivluk Group (Otuk Formation and Siksikpuk Formation) (Carboniferous to Jurassic (Bajocian))

JPzs - Northern Alaska sedimentary rocks (Carboniferous to Middle Jurassic) See [JPzs](#) for unit description from [SIM-3340](#).

JCs - Sedimentary rocks (Jurassic to Carboniferous) Sandstone, shale, argillaceous limestone, limestone, dolostone, mudstone, chert and siltstone in north-central Wiseman quadrangle. The unit conformably overlies the Kanayut Conglomerate of the Endicott Group. Consists of Kayak Shale of the Endicott Group, Lisburne Group, and Siksikpuk Formation and Otuk Formation of the Etivluk Group. *Unit description source:* WI007

JTRPaum - Angayucham assemblage associated ultramafic rocks (Permian to Early Jurassic)

JPztu - Ultramafic complexes of western Alaska (Jurassic or older) See [JPztu](#) for unit description from [SIM-3340](#).

Js - Serpentinite (Jurassic) Numerous small highly sheared and tectonically emplaced(?) bodies of serpentinite, also a large mass of serpentinite at Asbestos Mtn in the Cosmos Hills, and a large mass of partially serpentinized peridotite and dunite in the Jade Mtns. *Unit description source:* SH002

MzPzum - Mafic-ultramafic complexes (Mesozoic and Paleozoic?) The complexes consist of: (1) a cumulate magmatic suite composed of interlayered dunite, wehrlite, olivine clinopyroxenite, and gabbro, (2) a mantle suite composed of harzburgite, dunite, and minor clinopyroxenite, and (3) a metamorphic sole consisting of a highly tectonized layer of amphibolite, garnet amphibolite, and pyroxene granulite. The harzburgite in the mantle suite typically is partly to mostly serpentinized. Chromite is generally restricted to centimeter-scale layers in dunite and as an accessory mineral. The complexes are intruded by narrow dikes of fresh clinopyroxenite, hornblendite, gabbro, and gabbro pegmatite. The complexes appear to form the roots of the Koyukuk volcanic arc that was active from Jurassic to late Early Cretaceous. The protolith age of the mantle suite is uncertain and may be as old as Paleozoic. Unit exposed along southeastern and northern borders of Yukon-Koyukuk Basin, in the south-central part of Unalakleet quadrangle where it is spatially associated with the trondhjemite and tonalite unit Jgt, and in one small area along the western border of the basin in southern Candle quadrangle. Also included in this unit is a small complex exposed in a window(?) through the Innoko terrane in the south-central part of Ophir quadrangle. *Unit description source:* AR003 and SH004

s - Serpentinite (Age not given) Green and black serpentinite of unknown age or source associated with melange of unit MzPzm (Most of unit on map, associated with unit KJm, assigned NSAClass of 5190). *Unit description source:* BM002

JMab - Angayucham assemblage, basalt and diabase (Mississippian to Early Jurassic)

JDoc - Igneous rocks (Devonian to Jurassic) See [JDoc](#) for unit description from [SIM-3340](#).

Jv - Altered mafic volcanic rocks (Jurassic) Volcanic rocks including aphanitic amygdaloidal andesite and basalt flows; possibly correlative with rocks of Christian quadrangle (Reiser and others, 1965). *Unit description source:* HU002

Jv - Mafic volcanic rocks (Jurassic (?)) Chiefly dark-greenish gray basalt flows and diabase intrusives; commonly altered or partially altered to aggregate of chlorite, epidote, and sodic plagioclase. *Unit description source:* SH002

JPv - Mafic volcanic rocks (Jurassic to Permian) Strongly indurated hypabyssal and sea floor diabase and basalt; contains local chert deposits. *Unit description source:* AR002

JDab - Mafic metavolcanic and metaintrusive rocks, metachert, metalimestone, and amphibolite of the Angayucham terrane (Early Jurassic to Devonian) Metamorphosed pillow basalt, hyaloclastic breccia, basaltic tuff, diabase, microgabbro, radiolarian and tuffaceous chert, minor metalimestone, and rare mafic schist in an imbricate package exposed along the southern boundary of the map area. Commonly, metamorphic minerals partially overprint primary igneous and sedimentary textures in the metabasalts and metagabbros, but some foliated and lineated metabasalts occur in the

western Ambler River quadrangle. Devonian, Mississippian, Triassic, and Jurassic radiolarians, conodonts, and megafossils have been collected from chert, cherty tuff, metalimestone layers, interpillow sediments, and fault slivers. This unit is part of the Angayucham terrane. *Unit description source:* CH004

JDv - Altered basalt, gabbro, and chert, argillaceous rocks, tuff, graywacke, and carbonate rocks (Jurassic and Devonian) Variably altered and metamorphosed flows and shallow intrusives of basalt, diabase, and gabbro interbedded with varying proportions of chert, argillite, slate, phyllite, volcanoclastic rocks, graywacke, and carbonate rocks. The basalt, diabase, and gabbro are weakly metamorphosed to prehnite-pumpellyite facies and generally increase in metamorphic grade structurally downward. Greenschist facies metamorphism and locally high-pressure blueschist metamorphism, as indicated by the presence of glaucophane and lawsonite, occur near the base of the terrane where it structurally overlies the Ruby terrane. The chert includes both interpillow and bedded varieties and ranges from pure radiolarian and spiculitic chert to cherty tuff. In the southeastern part of Nulato quadrangle and adjoining parts of Ruby quadrangle, the unit is characterized by sill-like bodies of diabase and gabbro, argillaceous rocks, fine-grained to conglomeritic graywacke, and chert. *Unit description source:* AR003, SH004, and WI003

mi1 - Mafic Igneous Rocks (Jurassic to Devonian) Part of the Key Creek Sequence - Mafic igneous dikes that cut the Hunt Fork Shale and undifferentiated parts of the Noatak Sandstone and Kanayut Conglomerate. Age is uncertain. *Unit description source:* MU002

mi1 - Mafic Igneous Rocks, Key Creek Sequence (Jurassic to Devonian) Part of the Key Creek Sequence - Mafic igneous dikes that cut the Hunt Fork Shale and undifferentiated parts of the Noatak Sandstone and Kanayut Conglomerate. Age is uncertain. *Unit description source:* MU003

JPzu - Undifferentiated mafic volcanic rocks and phyllite (Jurassic and late Paleozoic and early Mesozoic) Mafic volcanic rocks (unit Jv) and dark phyllite (Pzp), undivided, in complex fault and intrusive relationships. *Unit description source:* SH002

IPmi - Unnamed Mafic Igneous Complex; Copter Peak and Nuka Ridge Allochthons, undivided, Kikiktat Mountain Klippe (Pennsylvanian) Basalt, dark green, fine grained, massive; contains discontinuous chert horizons up to 2 m thick. Basalt is mostly homogeneous but contains scattered well developed pillow structures. Crudely stratified resistant layers up to 5 m thick are interpreted as individual flows or sills; unit contains a 15 m thick columnar basalt interval on the west peak of Kikiktat Mountain. Pumpellyite vein fillings are present in some fractures. Intercalated chert contains Early Pennsylvanian to Late Mississippian radiolarians. Interval is 500 m thick on Kikiktat Mountain. Baked contact of basalt with underlying Nuka Formation is well exposed on southwest side of Kikiktat Mountain in lower end of 'Duttweiler Canyon.'. *Unit description source:* KL002

IPmil - Mafic Igneous Complex, lower part; Copter Peak and Nuka Ridge Allochthons, undivided, Kikiktat Mountain Klippe (Pennsylvanian(?)) Basalt with intervals of intercalated black chert, dolomitic(?) limestone, and shale. Basalt is fine grained and homogeneous although sheared in places, is composed of several 2 m thick layers that may be either sills or flows; near top of unit one zone appears to contain pillows. A 3 m thick interval of chert, limestone, and shale forms a prominent white to light-gray weathering band near middle of basalt interval; chert beds appear to be diagenetic and preserve parallel and cross bedded lamination, in some places have irregular bedding or occur in isolated masses. Contains bryozoans in two localities. Some basalt-sediment contacts are concordant and some are thrust contacts. Age uncertain. 30-50 m thick. Associated basalt and limestone, and beneath Nuka Fm are characteristic of Ilnavik River allochthon, but for convenience, unit is mapped as part of Kikiktat Mountain klippe. Base is a thrust fault. *Unit description source:* KL002

MzPzv(Is) - Undifferentiated limestone and marble (Mississippian and Devonian) The undifferentiated limestone and marble units have been classed based on the units they are contained within using 5XX where XX is the class of the surrounding unit. *Unit description source:* SP002

MzPzv - Mafic Volcanic Rocks (Mesozoic and (or) Paleozoic) Very low grade to low grade metamorphosed massive dark gray to dark green volcanic rocks; mostly basaltic in composition but may contain minor, more felsic units. Poorly developed pillows occur in Helpmejack Hills, and well developed pillows occur locally in southwestern part of quadrangle. Patton and Miller (1966) correlate volcanic rocks with similar rocks of Jurassic age in eastern Brooks Range. *Unit description source:* SP002

b - Metabasalt (Age not given) Metabasaltic rock of unknown age, not as a separate mappable unit(?), but of significant size within other units to warrant distinction on the map. In DOB and KJm. Polygons within unit MzPzm assigned NSAClass of 5140. *Unit description source:* BM002

b - Metabasalt (Age not given) Metabasaltic rock of unknown age, not as a separate mappable unit(?), but of significant size within other units to warrant distinction on the map. In DOB and KJm. These polygons are probably the Copter Peak allochthon. *Unit description source:* BM007

JMtu - Tozitna sequence, mafic, ultramafic, and sedimentary rocks, undivided (Mississippian to Early Jurassic)

JDoc - Igneous rocks (Devonian to Jurassic) See [JDoc](#) for unit description from [SIM-3340](#).

JPv - Mafic volcanic and intrusive rocks (Jurassic (?), Triassic (?), and Permian) Mafic volcanic and intrusive rocks including pillow basalt, diabase, and gabbro; subordinate basaltic and andesitic volcanoclastic rocks, chert, and cherty mudstone. *Unit description source:* BT002

JDv - Altered basalt, gabbro, and chert, argillaceous rocks, tuff, graywacke, and carbonate rocks (Jurassic and Devonian) Variably altered and metamorphosed flows and shallow intrusives of basalt, diabase, and gabbro interbedded with varying proportions of chert, argillite, slate, phyllite, volcanoclastic rocks, graywacke, and carbonate rocks. The basalt, diabase, and gabbro are weakly metamorphosed to prehnite-pumpellyite facies and generally increase in metamorphic grade structurally downward. Greenschist facies metamorphism and locally high-pressure blueschist metamorphism, as indicated by the presence of glaucophane and lawsonite, occur near the base of the terrane where it structurally overlies the Ruby terrane. The chert includes both interpillow and bedded varieties and ranges from pure radiolarian and spiculitic chert to cherty tuff. In the southeastern part of Nulato quadrangle and adjoining parts of Ruby quadrangle, the unit is characterized by sill-like bodies of diabase and gabbro, argillaceous rocks, fine-grained to conglomeritic graywacke, and chert. *Unit description source:* BT003 and WI003

Dv - Volcanic rocks and chert --flows and intrusive rocks (Devonian?) Pyroxene andesite flows and pyroxene diorite intrusive rocks; hornblende andesite pyroclastic rocks; some diabase and gabbro. *Unit description source:* CH002

TRsf - Shublik Formation, black shale, sandstone, and silty limestone (Middle Triassic to Late Triassic)

Trgs - Shublik Formation (Triassic) See [Trgs](#) for unit description from [SIM-3340](#).

Trs - Shublik Formation (Late Triassic) Thin-bedded black limestone and rhythmically interbedded black organic-rich paper shale, and tight green and less commonly black silicified mudstone; limestone dominates the top of the unit and weathers buff to light gray. Contains scattered phosphate nodules. Mottled texture of the mudstone suggests bioturbation. Unit is interpreted to record deposition in a low-energy, restricted marine environment characterized by high organic productivity. In the map area, the unit is exposed only at the Surprise Creek locality in the faulted core of a tightly folded and faulted, slightly overturned, south-vergent anticline (fig. 2). Top of the unit is disconformably overlain by the Kingak Formation; base is not exposed. Organic-rich shale and limestone contain up to ~4 percent total organic carbon characterized by Type I and II kerogen, and constitute excellent potential hydrocarbon source beds. Thermal maturity of R. 0.8 to 1.3 indicates that the Shublik Formation at Surprise Creek ranges from thermally mature for generation of liquid hydrocarbons, to slightly overmature and in the range for generation of dry gas (table I). Thickness: ~25 m exposed at Surprise Creek. Age: Upper Triassic, based upon pelecypods *Monotis* sp. and *Halobia* sp. (table 2), which are abundant in the limestone and in some of the shale beds. *Unit description source:* DL010

Trs - Shublik Formation (Late, Middle, and Early Triassic) Upper part: dark gray to black, calcareous, phosphatic siltstone and shale, with thin gray limestone interbeds; varicolored chert beds present locally southwest of Accomplishment Creek; limestone concretions locally abundant. Lower part: black clay shale, locally weathers rusty; limestone concretions and laminated silty limestone beds. Lower part probably absent northeast of Accomplishment Creek. Marine. Late Triassic pelecypods and ammonites, and Middle Triassic pelecypods in upper part; Early Triassic pelecypods in lower part. Thickness about 30 to 150m. *Unit description source:* PS002

TRPss - Shublik and Siksikpuk Formations, undivided (Permian to Triassic)

Trgs - Shublik Formation (Triassic) See [Trgs](#) for unit description from [SIM-3340](#)

TrPs - Shublik Formation and Siksikpuk Formation (Triassic and Permian) Shublik Formation - pink weathering limestone; Siksikpuk Formation - black slate and orange weathering black chert. *Unit description source:* SP002

TrPss - Shublik and Siksikpuk Formations, undivided (Triassic and Permian) Shublik and Siksikpuk Formations, undivided. *Unit description source:* PH004

TRPNic - Etivluk Group, Imnaitchiak Chert (Pennsylvanian to Triassic)

TrIPeg - Siksikpuk Formation and Imnaitchiak Chert (Pennsylvanian to Triassic) See [TrIPeg](#) for unit description from [SIM-3340](#)

JIPii - Imnaitchiak Chert of Etivluk Group (Jurassic to Pennsylvanian) Gray to greenish-gray bedded chert or siliceous mudstone in beds 2-15 cm thick, with greenish-gray to distinctive maroon, siliceous, silty mudstone partings and interbeds. Distinguishable from Imnaitchiak Chert of Picnic Creek sequence only by stratigraphic association here in the Iqnavik sequence with underlying Rim Butte unit of the Lisburne Group of Dumoulin and others (1993). Intensely deformed. Thickness < 76 m. *Unit description source:* HW003

JIPii - Imnaitchiak Chert of Etivluk Group of Mull and others (1987) - Iqnavik River sequence, Etivluk group (Jurassic to Pennsylvanian) Gray to greenish-gray bedded chert or siliceous mudstone in beds 2-15 cm thick, intercalated with greenish-gray to distinctive maroon, siliceous, silty mudstone partings and interbeds. In Picnic Creek sequence, distinguishable from Imnaitchiak Chert of Iqnavik River

sequence only by stratigraphic association with underlying Akmalik Chert. Unit typically structurally contorted; thickness probably 75 m or less. *Unit description source:* HW004 and MU012

JIPip - Imnaitchiak Chert of Etivluk Group (Jurassic to Pennsylvanian) Gray to greenish-gray bedded chert or siliceous mudstone in beds 2-15 cm thick, intercalated with greenish-gray to distinctive maroon, siliceous, silty mudstone partings and interbeds. In Picnic Creek sequence, distinguishable from Imnaitchiak Chert of Iqnavik River sequence only by stratigraphic association with underlying Akmalik Chert. Unit typically structurally contorted; thickness probably 75 m or less. *Unit description source:* HW003

JIPip - Imnaitchiak Chert of Etivluk Group of Mull and others (1987) - Picnic Creek sequence, Etivluk group (Jurassic to Pennsylvanian) Gray to greenish-gray bedded chert or siliceous mudstone in beds 2-15 cm thick, intercalated with greenish-gray to distinctive maroon, siliceous, silty mudstone partings and interbeds. In Picnic Creek sequence, distinguishable from Imnaitchiak Chert of Iqnavik River sequence only by stratigraphic association with underlying Akmalik Chert. Unit typically structurally contorted; thickness probably 75 m or less. *Unit description source:* HW004

TrPc - Chert (Imnaitchiak Chert, Etivluk Group) (Triassic to Permian) Thin-bedded cherts, essentially what we call Imnaitchiak Chert today, unfossiliferous. *Unit description source:* DL005

TrPc - Kelly River Allochthon - Permo-Triassic cherts (Triassic and Permian) Probably equivalent to Siksikpuk and Otuk formations, or Imnaitchiak Chert of Etivluk Group, thin bedded siliceous mudstone and shale, maroon, greenish gray, gray, some silty chert. *Unit description source:* NT006

TrIPi - Imnaitchiak Chert, of Etivluk Group; Picnic Creek Allochthon, Akmalik Creek Sequence (Triassic to Pennsylvanian) Yellowish-orange weathering gray to greenish gray thin-bedded chert or silicified mudstone, with interbedded siliceous shale, overlain by greenish-gray to maroon silty mudstone, base contains a distinctive dark gray evenly laminated glauconitic, phosphatic siltstone bed up to 1 m thick; locality at Akmalik Creek marked by an oncolitic conglomerate replaced by barite. Unit commonly structurally contorted, thickness of < 75 m thick. *Unit description source:* KL002 and KL006

TrIPi - Imnaitchiak Chert, of Etivluk Group; Iqnavik River Allochthon, Zebra Creek Sequence (Triassic to Pennsylvanian) Gray to greenish gray bedded chert or silicified mudstone, and greenish-gray to maroon silty mudstone, interbedded with gray to greenish-gray siliceous shale, beds 2-13 cm thick, exposed mostly as rubble. Contains Pennsylvanian to Late Triassic radiolarians. Thickness <100 m. *Unit description source:* KL002

TrIPi - Imnaitchiak Chert (of Etivluk Group); Iqnavik River Allochthon, Iteriak Creek Sequence (Triassic to Pennsylvanian) Gray, greenish gray, and maroon bedded chert, silicified mudstone, and silty shale commonly contains brilliant turquoise-blue-green chert where associated with basalt, commonly contains associated blocks and beds of tasmanite, a distinctive organic rich shale. *Unit description source:* KL002

TrIPi - Imnaitchiak Chert, of Etivluk Group; Iqnavik River Allochthon, Itkilikruich Ridges Sequence (Triassic to Pennsylvanian) Gray, greenish gray, to black chert and silicified mudstone, mostly rubble exposures. *Unit description source:* KL002

TRMtmu - Rampart Group, igneous rocks (Mississippian to Triassic)

JDoc - Igneous rocks (Devonian to Jurassic) See [JDoc](#) for unit description from [SIM-3340](#).

JPv - Mafic volcanic and intrusive rocks (Jurassic (?), Triassic (?), and Permian (?)) Mafic volcanic and intrusive rocks including basalt, gabbro, diorite, and andesite. *Unit description source:* BV002

MzPzg - Greenstone and basic schist (Mesozoic or Paleozoic) Dark green, coarse grained, slightly to strongly foliated greenstone and basic schist. *Unit description source:* BV002

MzPzmr - Metabasite (Mesozoic? to Proterozoic?) Massive greenstone to thinly layered greenschist bodies that probably represent metamorphosed mafic to ultramafic intrusive rocks and mafic to intermediate flows and tuffs. Unit is intercalated with units PzPxsr, Pzcr, and Dgnr. Small widely scattered bodies in the Bettles, Tanana, and Nulato quadrangles. *Unit description source:* BT003

TRMTs - Sedimentary rocks, formerly Rampart Group, now Tozitna sequence (Mississippian to Triassic)

TrDtz - Sedimentary rocks (Devonian to Triassic) See [TrDtz](#) for unit description from [SIM-3340](#)

JPc - Chert and argillite (Jurassic (?), Triassic (?), and Permian (?)) Red, green, gray, and black bedded chert, dark-green siliceous argillite, and black shale and siltstone. *Unit description source:* BV002

TRDCs - Calcareous sedimentary rocks (Devonian to Triassic)

JPzs - Northern Alaska sedimentary rocks (Carboniferous to Middle Jurassic) See [JPzs](#) for unit description from [SIM-3340](#).

TRCs - Sedimentary rocks (Triassic to Carboniferous) Quartzite, phyllite, siltstone, conglomerate, shale, sandstone, limestone, argillaceous limestone, dolomitic limestone, and cherty dolostone. Occurs in the Mount Doonerak area in northeastern Wiseman and northwestern Chandalar quadrangles, where it is interpreted to unconformably overlie lower Paleozoic rocks (map unit SCvs). Consists of Kekiktuk Conglomerate and Kayak Shale of the Endicott Group, Lisburne Group, Echooka Formation of Sadlerochit Group, and Shublik Formation and Karen Creek Sandstone. Succession is similar to that of map unit JCs but differs in some details. This unit is part of the Doonerak antiform. *Unit description source:* CH004

TRCs (or TRCs?) - Sedimentary rocks (Late Triassic through Carboniferous) Includes: Shublik and Otuk Formations - Black shale, siltstone, limestone, and black chert; Sadlerochit Group - black shale, and bluff calcareous siltstone; Siksikpuk Formation - black, red, and green shale and siltstone; buff calcareous siltstone; Lisburne Group - gray cherty limestone, black chert, and shale; Kayak Shale - black shale and limestone; Kekiktuk Conglomerate - quartzite, conglomerate, and felsic volcanoclastic interlayers. *Unit description source:* WI002

TRDg - Arctic Alaska terrane and Ruby terrane, metagraywacke (Devonian to Middle Triassic)

TrPzgp - Metagraywacke and phyllite (Triassic & Late Paleozoic) See [TrPzgp](#) for unit description from [SIM-3340](#)

Dgw - Graywacke and phyllite -- graywacke (Devonian?) Gray, fine- to medium-grained micaceous graywacke with 50 to 60 percent quartz and chert fragments, no volcanic rocks fragments; interbedded black slate. Grade into Dp (Phyllite) below. *Unit description source:* CH002

MzPzs - Sandstone (Mesozoic and (or) Paleozoic) Light-gray to brown and purple weathering wacke sandstone. Ripple marks, crossbedding, and flute casts occur locally. *Unit description source:* SP002

Pzg - Metagraywacke and subordinate phyllite (Paleozoic?) Fine- to medium-grained metagraywacke and metasiltstone composed chiefly of quartz and chert clasts, but in places containing a significant component of volcanic rock and feldspar clasts. Overprinted by low-grade penetrative metamorphic fabric, but turbidite features, such as graded bedding and sole marks, are locally discernible. Interbedded with subordinate amounts of phyllite. Distributed along the belt of unit Pzpa in Hughes, Survey Pass, and Wiseman quadrangles. *Unit description source:* HU003 and WI003

TRPsg - Sadlerochit Group, undivided (Permian to Early Triassic)

TrPsg - Sadlerochit Group, undivided (Permian to Lower Triassic) See [TrPsg](#) for unit description from [SIM-3340](#).

TrPs - Sadlerochit Group (Triassic and Permian) Reddish brown weathering, fine-grained sandstone and quartzose siltstone grading to black phyllite shale. Strongly folded and faulted. *Unit description source:* AR002

TrPs - Sadlerochit Formation (Triassic and Permian) The Sadlerochit Formation is well exposed and is one of the most persistent units within the mapped area. It crops out in a belt 1 to 3 miles wide extending northeasterly along the north front of the Brooks Range. Typically the rocks are the flanking beds of the east- and west-plunging en echelon anticlines which form the mountain front, and generally are exposed best in cutbanks on smaller streams. The rocks which lie stratigraphically between the Lisburne Group and the Shublik Formation in the Canning River area and elsewhere in the mapped area include siltstone, shale, limestone, and chert, in addition to sandstone. The formation is divided into two members; the Echooka member of Permian age and the Mishak member of Early Triassic age. *Unit description source:* PS003

TrPs - Autochthonous Rocks in Colville Basin, Shublik Formation and Sadlerochit Group (Triassic-Permian) Triassic Marine shale and limestone; and Triassic-Permian braided-stream conglomerate and sandstone to the north, fine grained marine sandstone and shale to the south. *Unit description source:* PS004

TrPs - Sadlerochit Group (Early Triassic and Permian) Composed of Mishak Formation (Lower Triassic) and Echooka Formation (Permian), which are not shown separately on this map. Mishak Formation -- Laminated gray siltstone and shale in upper third; massive, fine-grained quartz arenite in middle third; gray laminated shale and siltstone with abundant limestone nodules and concretions, and locally with barite nodules in lower third. Marine. Early Triassic ammonites and pelecypods. Thickness about 550 to 720m in the north, about 170m in the south. Echooka Formation -- Calcareous siltstone and shale; local thick units of thin to medium bedded limestone; siliceous siltstone and massive quartz arenite beds in upper part. Marine. Early Permian brachiopods; early late Permian brachiopods locally northeast of Lupine River. Thickness about 110m to 260m. *Unit description source:* PS002

TrPs - Sadlerochit Group (Early Triassic and Permian) Composed of Mishak Formation (Lower Triassic) and Echooka Formation (Permian), which are not shown separately on this map. Mishak Formation -- Laminated gray siltstone and shale in upper third; massive, fine-grained quartz arenite in

middle third; gray laminated shale and siltstone with abundant limestone nodules and concretions, and locally with barite nodules in lower third. Marine. Early Triassic ammonites and pelecypods. Thickness about 550 to 720m in the north, about 170m in the south. Echooka Formation -- Calcareous siltstone and shale; local thick units of thin to medium bedded limestone; siliceous siltstone and massive quartz arenite beds in upper part. Marine. Early Permian brachiopods; early late Permian brachiopods locally northeast of Lupine River. Thickness about 110m to 260m. Unit assigned to Autochthonous rocks of Colville Basin. *Unit description source: PS006*

TrPs - Etivluk Group, Sadlerochit Group, undifferentiated (Early Triassic to Permian) Siltstone, dark-gray, mottled, apparently bioturbated, locally with Zoophycos and other trace fossils; and, hard, dense, quartzite with scattered limonitic spots, and thin barite seams. Interbedded with black silty shale. Exposed only at eastern edge of map area; resistant units 2 to 3 m thick form mostly rubble-covered hills and local ridges; total interval may be >100 m thick unless structurally imbricated. Overlies about 100 m of mostly covered interval underlain by black silty mudstone that appears to overlie Lisburne Group with no exposures of Echooka Formation or unit A of Siksikpuk Formation. Overlying beds unknown owing to poor exposures. Section does not resemble Siksikpuk Formation in adjacent areas, stratigraphic sequence is more similar to a distal equivalent of the Kavik Shale and Ilishak Formation of Philip Smith Mountains 30 km northeast of map area. With Lisburne Group, this section forms folded and faulted thrust sheet that locally is both structurally above and below thrust sheets with Siksikpuk Formation and Lisburne Group rocks. *Unit description source: PS010*

TrPs - Sadlerochit Group, undifferentiated, Ellesmerian Sequence (Early Triassic to Permian) Siltstone, dark-gray, hard, dense, quartzitic, with scattered limonitic spots, mottled, apparently bioturbated, locally with Zoophycos and other trace fossils and thin barite seams. Interbedded with black silty shale. Total interval probably greater than 100 m thick; may be structurally imbricated. Unit represents a distal equivalent of the Ilishak Formation and Kavik Shale Member (which gradationally overlies the Echooka Formation). Composition and sedimentary structures indicate a northerly source, and rocks thin and fine to the south. *Unit description source: PS011*

Pef - Sadlerochit Group, Echooka Formation, undivided (Permian)

Pe- Echooka Formation (Permian) See [Pe](#) for unit description from [SIM-3340](#).

Psl - Sadlerochit Group (Permian) Only the Permian basal part of Sadlerochit Group is present in the map area. Consists mostly of siltstone, sandstone, and mudstone. *Unit description source: CL002*

Psk - Etivluk Group, Siksikpuk Formation, chert and shale (Permian)

TrIPeg - Siksikpuk Formation and Immaitchiak Chert (Pennsylvanian to Triassic) See [TrIPeg](#) for unit description from [SIM-3340](#)

TrIPs - Siksikpuk Formation, Etivluk Group (Triassic to Pennsylvanian) Maroon and gray radiolarian chert and siliceous shale. *Unit description source: DL002, DL003, and DL004*

TrIPs - Siksikpuk Formation (Triassic to Pennsylvanian) Part of the rocks not assigned a specific sequence. Maroon and gray chert and siliceous shale. Chert contains radiolarians. *Unit description source: MU002, MU003, MU004, NT005 and NT006*

TrIPs1 - Siksikpuk Formation, Etivluk Group (Early Triassic to Pennsylvanian) Gray chert and gray, olive-gray, and maroon siliceous shale. Middle part of unit is mostly shale that grades both up and down into well-bedded chert with thin siliceous shale partings. Mammillary bedding structures locally common especially near base. Part of Brooks Range allochthon, Key Creek sequence. *Unit description source:* DL002, DL003, and DL004

TrIPs1 - Siksikpuk Formation (Triassic to Pennsylvanian) Part of the Key Creek Sequence - Gray chert and gray, olive, and maroon siliceous shale. Middle part of unit is mostly shale which grades both up and down into well-bedded gray chert with thin siliceous shale partings. Mammillary bedding structures locally command. Chert contains Pennsylvanian to Triassic radiolarians. Depositional thickness is approximately 40-60m. Base contains bedded chert which appears to be gradational into the Kuna Formation, and one or more prominent orange-and yellow-weathering clay-rich horizons (benzonite?) that are of regional extent. *Unit description source:* MU002, MU003, MU004

TrIPs2 - Siksikpuk Formation, Etivluk Group (Triassic to Pennsylvanian) Gray and maroon chert and siliceous shale. Part of the Picnic Creek allochthon, Wulik sequence. *Unit description source:* DL002, DL003, and DL004

TrIPs2 - Siksikpuk Formation, Etivluk Group (Triassic to Pennsylvanian) Olive-gray and maroon chert and siliceous shale. Part of the Picnic Creek allochthon, Amaruk sequence. *Unit description source:* DL002, DL003, and DL004

TrIPs2 - Siksikpuk Formation (Triassic to Pennsylvanian) Part of the Wulik Sequence - Gray and maroon chert and siliceous shale. Chert contains Pennsylvanian to Early Permian radiolarians. Depositional thickness is approximately 40-60 m. *Unit description source:* MU002

TrIPs2 - Siksikpuk Formation (Triassic to Pennsylvanian) Part of the Picnic Sequence - Olive-gray and maroon chert and siliceous shale. Chert contains Pennsylvanian to Permian radiolarians. Depositional thickness is approximately 40-60 m. Base is gradational into black chert (unit PMc2). *Unit description source:* MU002, MU003, and MU004

TrIPs2 - Siksikpuk Formation, Picnic Creek Allochthon, Amaruk Sequence (Triassic to Pennsylvanian) Maroon and olive-gray argillite and chert. Mapped in only one outcrop east of upper Okpiksugruk Creek, base probably gradational into black chert. *Unit description source:* NT005

TrIPs3 - Siksikpuk Formation, Etivluk Group (Triassic to Pennsylvanian) Gray radiolarian chert and gray, olive-gray, and maroon siliceous shale. Part of the Kelly River allochthon, Amphitheatre sequence. *Unit description source:* DL002, DL003, and DL004

TrIPs3 - Siksikpuk Formation, Etivluk Group (Triassic to Pennsylvanian) Gray, olive-gray, and maroon radiolarian chert and siliceous shale. Part of the Kelly River allochthon, Kelly sequence. *Unit description source:* DL002, DL003, and DL004

TrIPs3 - Siksikpuk Formation (Triassic to Pennsylvanian) Part of the Kelly Sequence - Gray chert and gray, olive, and maroon siliceous shale. Chert contains radiolarians. Age based on stratigraphic correlation with similar contact with the Tupik Formation could be a disconformity. *Unit description source:* MU002 and MU004

TrIPs3 - Siksikpuk Formation, Kelly River Allochthon, Amphitheatre Sequence (Triassic to Pennsylvanian) Gray, olive-gray, and maroon siliceous shale and radiolarian chert. *Unit description source:* NT005

TrIPs3 - Siksikpuk Formation, Kelly River Allochthon, Kelly Sequence (Triassic to Pennsylvanian) Maroon and gray chert. *Unit description source:* NT005

TrIPs3e - Siksikpuk Formation (Triassic to Pennsylvanian) Part of the Eli Sequence - Gray and maroon chert and shale. Chert contains radiolarians. Depositional thickness is estimated to be 20-40m. Age based on stratigraphic correlation with similar rocks in structurally lower sequences. *Unit description source:* MU002 and MU004

TrIPs4 - Siksikpuk Formation, Etivluk Group (Triassic to Pennsylvanian) Olive-gray and maroon radiolarian chert and siliceous shale. Part of the Ilnavik River allochthon, Puzzle Creek sequence. *Unit description source:* DL004

TrIPs4 - Siksikpuk Formation (Triassic to Pennsylvanian) Part of the Ilnavik Sequence - Maroon and gray chert and siliceous shale. Chert contains Pennsylvanian to Triassic radiolarians. Depositional thickness is approximately 30-60 m. Base is gradational into black chert (unit PMc4). *Unit description source:* MU002, MU003, and MU004

TrIPs4 - Siksikpuk Formation, Ilnavik River Allochthon, Ilnavik Sequence (Triassic to Pennsylvanian) Maroon and gray siliceous argillite. *Unit description source:* NT005

TrIPs4n - Siksikpuk Formation (Triassic to Pennsylvanian) Part of the Nachralik Pass Sequence - Maroon and gray chert and siliceous shale. Chert contains Pennsylvanian to Triassic radiolarians. Depositional thickness is estimated to be 30-60 m. Base is gradational into black chert (unit PMc4n). *Unit description source:* MU002, MU003, and MU004

TrIPs5 - Siksikpuk Formation, Nuka Ridge Allochthon, Bogie Sequence (Triassic to Pennsylvanian) Maroon siliceous shale and radiolarian chert. *Unit description source:* NT005

TrPc - Endicott Mountains Allochthon - Permo-Triassic cherts (Triassic and Permian) Siliceous shale, probably equivalent to Siksikpuk and Otuk Formations, speculatively present south of Alutunitok Hills. *Unit description source:* NT006

Pas - Siksikpuk Formation (Early Permian) Black shale and argillite, green and red pyritic slate and argillite, and pale gray fissile siliceous siltstone that weathers orange; barite nodules. Recognized only south of Continental Divide in T. 14 S. , R. 22 E., and T. 15 S., R. 21 E. Marine. No fossils found. Incomplete thickness preserved, about 70m. *Unit description source:* PS002

Ps - Siksikpuk Formation (Permian) Consists of 3 lithofacies. Lithofacies 1 is mostly mudstone and siltstone with minor shale and limestone. Lithofacies 2 is mostly shale and mudstone with minor very impure limestone. Lithofacies 3 is siltstone and shale. *Unit description source:* CL002

Ps - Siksikpuk Formation? (Permian?) Guess this is the unit, not described in Gil Mull's list of map units. *Unit description source:* DL005

Ps - Siksikpuk Formation, Etivluk Group; Endicott Mountains Allochthon, Killik River Sequence (Permian) Dominantly siltstone and shale, minor 'chert' or silicified mudstone, in four lithogenetic units: a thin basal member--greenish-gray siltstone; grades up to unit B--maroon- to light-green-mottled siltstone with scattered barite seams and crystal aggregates; unit C--resistant green-to greenish-gray silicified mudstone or chert; and unit D--poorly exposed gray clay shale. Thickness <100 m. *Unit description source:* KL002

Ps - Siksikpuk Formation; Endicott Mountains Allochthon, Ivotuk Hills Sequence (Permian) Dominantly siltstone and shale, minor 'chert' or silicified mudstone, in four lithogenetic units: a thin basal

member--greenish-gray siltstone; grades up to unit B--maroon- to light-green-mottled siltstone with scattered barite seams and crystal aggregates; unit C--resistant green-to greenish-gray silicified mudstone or chert; and unit D--poorly exposed gray clay shale. In the Ivotuk Hills sequence, unit is exposed only on south side of Ivotuk Hills, contains barite nodules on tributary of Otuk Creek at west end of Ivotuk Hills. Thickness probably <75 m. *Unit description source:* KL002

Ps - Siksikpuk Formation; Endicott Mountains Allochthon, Key Creek Sequence (Permian)

Dominantly siltstone and shale, minor 'chert' or silicified mudstone, in four lithogenetic units: a thin basal member--greenish-gray siltstone; grades up to unit B--maroon- to light-green-mottled siltstone with scattered barite seams and crystal aggregates; unit C--resistant green-to greenish-gray silicified mudstone or chert; and unit D--poorly exposed gray clay shale. In the Key Creek sequence, unit is present mostly in rubble along mountain front in western part of quadrangle. Thickness <100 m. *Unit description source:* KL002

Ps - Siksikpuk Formation; Endicott Mountains Allochthon, Okpikruak River Sequence (Permian)

Dominantly siltstone and shale, minor 'chert' or silicified mudstone, in four lithogenetic units: a thin basal member--greenish-gray siltstone; grades up to unit B--maroon- to light-green-mottled siltstone with scattered barite seams and crystal aggregates; unit C--resistant green-to greenish-gray silicified mudstone or chert; and unit D--poorly exposed gray clay shale. In Okpikruak River sequence, unit is mostly poorly exposed yellowish-orange weathering green siltstone and mottled maroon to light green siltstone; contains massive barite lenses on Okokmilega river. Thickness probably <75 m. *Unit description source:* KL002

PIPs - Siksikpuk Formation (Permian to Pennsylvanian) Predominantly nonresistant thin-bedded siltstone, shale, siliceous mudstone, and thin-bedded chert. Distinctive thin basal yellowish-orange-weathering, greenish-gray siltstone. Formation is commonly structurally complicated and exposed only as rubble on hillsides or recognized in streamcuts as the yellowish orange-weathering beds overlying the Lisburne Group. *Unit description source:* HW003

PZrm - Carbonates (Paleozoic)

Pzls - Limestone and marble (Paleozoic) See [Pzls](#) for unit description from [SIM-3340](#).

Pzcr - Carbonate rocks (Paleozoic) Gray to white, partly to wholly recrystallized limestone, marble, dark-gray dolomitic marble, and impure schistose limestone. Unit occurs in layers as much as 25m thick intercalated with quartz-mica schist, mica schist, graphitic schist, metabasite, and quartzite. Some contacts are gradational; others are sharp and may be faulted. Scattered small bodies within schistose rocks of unit PzPxsr in Nulato, Ruby, Melozitna, Tanana, and Bettles quadrangles. Map shows only the larger of these bodies that were observed in the field or on aerial photographs. Undoubtedly many additional unrecognized bodies exist in areas mapped as unit PzPxsr. Also included in this unit is a small area of metacarbonate rocks exposed in a window(?) within the thrust-faulted Innoko terrane in east-central Ophir quadrangle. *Unit description source:* BT003

Pzl - Limestone (Paleozoic) Dark-gray recrystallized limestone, dark-gray crinoidal limestone, and light-gray dolomitic limestone. *Unit description source:* BV002

Pzm - Marble (Late Paleozoic or Devonian) Small masses of coarsely crystalline marble; local hornfels. *Unit description source:* BT002

Pzm - Marble (Paleozoic) Gray coarsely crystalline marble, locally interbedded with dolomite. *Unit description source:* BV002

PZZm - Mafic schist (Neoproterozoic to Paleozoic)

DPxasm - Mixed assemblage of metasedimentary and metavolcanic rocks in the Brooks Range (Proterozoic to Devonian) See [DPxasm](#) for unit description from [SIM-3340](#).

bs - Biotite schist (Mesozoic and (or) Paleozoic) Plagioclase-quartz-biotite-schist; may be metamorphosed quartz diorite. *Unit description source:* AR002

Pzgg - Greenstone and Greenschist (Paleozoic?) Massive dark greenstone commonly composed of albite, actinolite, epidote, and chlorite, and greenschist composed of albite, chlorite and minor magnetite. Poorly developed pillows in compositionally layered biotite quartz chlorite schist and semischist, garnet epidote albite amphibolite, and feldspathic biotite epidote quartz gneiss with lenticular chloritic patches suggest that these are metamorphosed volcanic rocks of various types. *Unit description source:* SP002

Pzgg(Is) - Undifferentiated limestone and marble (Mississippian and Devonian) The undifferentiated limestone and marble units have been classed based on the units they are contained within using 5XX where XX is the class of the surrounding unit. *Unit description source:* SP002

Mlw - Lisburne Group, Wachsmuth Formation (Mississippian)

Mlgw - Wachsmuth Limestone (Mississippian) See [Mlgw](#) for unit description from [SIM-3340](#).

Mlw - Wachsmuth Limestone (Late and Early Mississippian) Bioclastic limestone, dolomite and dolomitic limestone, black nodular chert; in lower part much argillaceous and shaley limestone and minor shale. Differentiated only where mapped by Bowsher and Dutro near Itkillik Lake. *Unit description source:* PS002

PNMI - Lisburne Group, Alapah Limestone and Wahoo Limestone, undivided (Late Mississippian to Late Pennsylvanian)

Clg - Lisburne Group, undivided (Carboniferous) See [Clg](#) for unit description from [SIM-3340](#).

IPMLu - Late part of Lisburne Group (Pennsylvanian and Mississippian) Includes upper part of Alapah Limestone and Wahoo Limestone. Generally weathers light to medium gray, fine to medium grained limestone and dolomite, and black to light gray nodular chert, with much silicified limestone. In Itkillik Lake-Galbraith Lake area, a marker zone of black dolomite and chert occurs near middle of unit. Upper 100-200 m commonly includes much white-weathering coarse-grained and very fine grained limestone, light-gray nodular chert, some orange-weathering pyritic limestone, and locally a few tiny crystals and veinlets of fluorite. Top bed commonly black massive chert. Bottom contact indefinite and variable. Marine. Unit assigned to Autochthonous rocks of Colville Basin. *Unit description source:* PS002 and PS006

Mlgn - Lisburne Group, Nasorak Formation (Early Mississippian to Late Mississippian)

Mlgnu - Nasorak and Utukok Formations (Mississippian) See [Mlgnu](#) for unit description from [SIM-3340](#).

This unit is also present on source map PH004, however, no description was present on this source.

Mlut - Lisburne Group, Utukok Formation, limestone (Early Mississippian to Late Mississippian)

Mlgnu - Nasorak and Utukok Formations (Mississippian) See [Mlgnu](#) for unit description from [SIM-3340](#).

MI - Limestone (Mississippian) Part of the rocks not assigned a specific sequence. Occurs as isolated blocks commonly along thrust faults. *Unit description source:* MU002, MU003, and MU004

Mu - Utukok Formation (Mississippian) Buff-weathering limestone and locally calcareous, fine-grained sandstone. May represent a thin, discontinuous tongue below the Kogruk Formation, and may not have been deposited in some places within this sequence. Depositional thickness probably ranges from 0 to 80 m. Base is probably gradational into Devonian limestone. *Unit description source:* HW003

Mu - Lisburne Group, Utukok Formation (Mississippian) Mostly medium-dark-gray, medium-bedded ferruginous sandy limestone which weathers to a distinct dark-yellowish-brown and yellowish-orange "rust" color; interbedded with limy siltstone, limy sandstone, quartzite, minor limy claystone and coaly beds. As much as 1.4 km thick. *Unit description source:* MU006 and MU007

Mu - Utukok? Formation (Mississippian?) Calcareous sandstone, shale, and limestone. *Unit description source:* NT005

Mu - Endicott Mountains Allochthon - Lisburne Group, Utukok Formation (Mississippian) Cherty crinoidal limestone, shallow platform deposition. *Unit description source:* NT006

Mu - Kelly River Allochthon - Lisburne Group, Utukok Formation (Mississippian) (Eli Ls, (?)). *Unit description source:* NT006

Mu1 - Utukok Formation (Early Mississippian) Buff-weathering, light-gray, coarse-grained limestone with interbedded clean, fine-grained quartz sandstone, siltstone, and shale. Part of the Brooks Range allochthon, Key Creek sequence. *Unit description source:* DL002, DL003, and DL004

Mu1 - Utukok Formation (Mississippian) Part of the Key Creek Sequence - Gray coarse-grained limestone with interbeds of clean fine-grained quartz sandstone. Locally contains numerous Mississippian crinoids and brachiopod fragments. Locally discontinuous; depositional thickness estimated to be approximately 0-50 m. Base seems to have been deposited conformably and possibly gradationally on the Noatak Sandstone of the Kanayut Conglomerate at the mouth of Nimiuktuk River and at west end of Ginny Creek lead-zinc-silver deposit (shown by pattern on southwestern Misheguk Mountain quadrangle map). *Unit description source:* MU002, MU003, and MU004

Mu2 - Utukok Formation (Mississippian) Interbedded sandy limestone and calcareous sandstone. Part of the Picnic Creek allochthon, Wulik sequence. *Unit description source:* DL002, DL003, and DL004

Mu2 - Utukok Formation (Mississippian) Approximately 60-70% buff-weathering limestone of sandy limestone and 30-40% interbedded shale. Part of the Picnic Creek allochthon, Amaruk sequence. *Unit description source:* DL002, DL003, and DL004

Mu2 - Utukok Formation (Mississippian) Part of the Wulik Sequence - Buff-weathering limestone,

sandy limestone, and sandstone. Mapped only north of lower Kagvik Creek (southwestern Misheguk Mountain quadrangle map). Contains Early Mississippian brachiopods and crinoids. Depositional thickness probably more than 30 m. Depositional contact on the Noatak Sandstone is not exposed but is inferred from regional stratigraphic relations. *Unit description source:* MU002

Mu3 - Utukok Formation (Mississippian) Buff-weathering limestone, sandy limestone, and fine-grained sandstone. Interbedded gray shale may comprise as much as 50% in lower part west of Wulik River. Part of the Kelly River allochthon, Kelly sequence. *Unit description source:* DL002, DL003, and DL004

Mu3 - Utukok Formation (Mississippian) Part of the Kelly Sequence - Buff weathering limestone, sandy limestone, sand limestone, and fine grained sandstone with a few thin, gray shale beds. Contains numerous Early to Late Mississippian brachiopods, gastropods, pelecypods, and crinoids (Sable and Dutro, 1961). Thickness in outcrop is less than 100 m. Basal contact is usually a thrust fault but may conformably overlie limestone of the Baird Group in upper Picnic Creek Region (southeastern Misheguk Mountain quadrangle map). *Unit description source:* MU002, MU003, and MU004

Mu3 - Utukok Formation, Kelly River Allochthon, Kelly Sequence (Mississippian) Upper part contains light-gray to buff-weathering limestone; commonly blocky-weathering on talus slopes. Lower part contains sandy limestone, calcareous siltstone, shale, and fine-grained sandstone, less resistant to erosion than Kogruk Formation or Baird Group, thus commonly forms saddles or recessive zones. Locally subdivided. *Unit description source:* NT005

Mu3 - Utukok Formation, Kelly River Allochthon, Eli Sequence (Mississippian) Buff-weathering limestone, sandy limestone and fine-grained calcareous quartzite. *Unit description source:* NT005

Mu3e - Utukok Formation (Mississippian) Part of the Eli Sequence - Buff weathering limestone and locally calcareous, fine-grained sandstone. Contains brachiopods, crinoids, and corals. May represent a thin, discontinuous tongue below the Kogruk Formation or micritic limestone (unit Mml3e) and may not have been deposited in some places within this sequence. Depositional thickness probably ranges from 0 to greater than 30 m. Base is probably gradational into the Baird Group. *Unit description source:* MU002 and MU004

Mul1 - Limestone and shale member, Utukok Formation (Mississippian) Consists of 75% buff-weathering limestone interbedded with 25% gray calcareous shale. Part of the Brooks Range allochthon, Key Creek sequence. *Unit description source:* DL003 and DL004

Mul3 - Buff limestone member, Utukok Formation (Mississippian) Buff-weathering limestone interbedded with subordinate sandy limestone and shale. Part of the Kelly River allochthon, Kelly sequence. *Unit description source:* DL002 and DL004

Mul3 - Utukok Formation, Buff limestone member, Kelly River Allochthon, Kelly Sequence (Mississippian) Buff- to light-gray weathering medium-grained limestone; interbedded with minor sandy limestone and calcareous shaly layers in upper part of Utukok Formation. *Unit description source:* NT005

Mul3 - Utukok Formation, Buff limestone member, Kelly River Allochthon, Eli Sequence (Mississippian) Buff- and light-gray weathering medium-grained limestone. *Unit description source:* NT005

Mul4 - Buff limestone member, Utukok Formation (Mississippian) Predominantly limestone with a few interlayered sandstone beds. Part of the Ilnavik River allochthon, Puzzle Creek sequence. *Unit description source:* DL004

Muls3 - Limestone and shale member, Utukok Formation (Mississippian) Approximately equal amounts of interbedded buff limestone and gray silty shale. May contain a few calcareous sandstone beds. Part of the Kelly River allochthon, Kelly sequence. *Unit description source:* DL004

Muls4 - Limestone and shale member, Utukok Formation (Mississippian) Interbedded buff-weathering silty limestone and gray shale. Part of the Ipnarik River, Puzzle Creek sequence. *Unit description source:* DL004

Mus1 - Sandstone member, Utukok Formation (Mississippian) Buff-weathering, fine- to medium-grained clean quartz sandstone interbedded with sandy limestone and subordinate gray shale. Part of the Brooks Range allochthon, Key Creek sequence. *Unit description source:* DL002, DL003, and DL004

Mus2 - Sandstone member, Utukok Formation (Mississippian) Buff-weathering, fine- to medium-grained, clean quartz sandstone interbedded with sandy limestone and subordinate gray shale. Part of the Picnic Creek allochthon, Amaruk sequence. *Unit description source:* DL003 and DL004

Mus3 - Sandstone member, Utukok Formation (Mississippian) Interbedded buff-weathering, fine-grained sandstone, calcareous sandstone, sandy limestone, and shale. Part of the Kelly River allochthon, Kelly sequence. *Unit description source:* DL002 and DL004

Mus3 - Utukok Formation, sandstone member, Kelly River Allochthon, Eli Sequence (Mississippian) Gray to light-brown, fine-grained quartzite with minor interbedded sandy limestone. Sandier beds commonly covered by black lichens. *Unit description source:* NT005

Mugl3 - Light-gray limestone member, Utukok Formation (Mississippian) Medium- to thick-bedded, medium-grained limestone. Part of the Kelly River allochthon, Kelly sequence. *Unit description source:* DL004

MDI - Limestone (Mississippian and (or) Devonian) White- to gray-weathering, light- to dark-gray, fine to medium crystalline recrystallized limestone and lesser dolostone. Includes rocks that are correlative with rocks of units Mko, Mk, MDue, and (or) DOB. *Unit description source:* BM002

MDI - Limestone, Undivided (Mississippian and or Devonian) Part of the Rocks Not Assigned a Specific Sequence - Occurs as isolated blocks along thrust faults and as possible olistoliths within the Okpikruak Formation. *Unit description source:* MU002, MU003, and MU004

Mlkg - Lisburne Group, Kogruk Formation (Mississippian)

Clgk - Kogruk Formation (Upper Mississippian) See [Clgk](#) for unit description from [SIM-3340](#).

Mk - Lisburne Group, Kogruk Formation (Mississippian) Mostly medium- to light-gray, medium- to thick-bedded limestone with about 15 percent dark-gray chert as lenses, nodules, and interbeds, and minor limy claystone and dolomitic limestone. As much as 500 m thick. *Unit description source:* MU006, MU007, and MU008

Mko - Kogruk Formation (Mississippian) Light-gray limestone with black chert nodules and lenses. *Unit description source:* DL002, DL003, and DL004

Mko - Kogruk Formation (Mississippian) Light- to medium-gray-weathering, medium- to dark-gray, fine- to coarsely crystalline, recrystallized limestone and lesser dolostone. Chert, black and less commonly gray to white, occurs in layers and nodules. May include rocks coeval with Tupik Formation of Sable and Dutro (1961). *Unit description source:* BM002

Mko1 - Kogruk Formation (Mississippian) Gray, medium-grained limestone with as much as 25% black chert nodules and lenses, locally dolomitic. Part of the Brooks Range allochthon, Key Creek sequence. *Unit description source:* DL002 and DL004

Mko2 - Kogruk Formation, Picnic Creek Allochthon, Amaruk Sequence (Mississippian) Well-bedded, medium-grained limestone with subordinate black nodular chert. Depositional thickness estimated to be up to 30 m. *Unit description source:* NT005

Mko2 - Kogruk Formation (Mississippian) Well-bedded, medium-grained limestone with less than 20% black nodular chert. Part of the Picnic Creek allochthon, Amaruk sequence. *Unit description source:* DL002, DL003, and DL004

Mko3 - Kogruk Formation (Mississippian) Light-gray-weathering, medium-grained limestone containing as much as 25% black chert nodules and lenses. Part of the Kelly River allochthon, Amphitheatre sequence. *Unit description source:* DL002, DL003, and DL004

Mko3 - Kogruk Formation (Mississippian) Light-gray limestone that in most places has less than 25% black chert nodules and lenses. Locally contains subordinate thin zones of dark-gray, micritic carbonate rocks with lenses of black chert. Part of the Kelly River allochthon, Kelly sequence. *Unit description source:* DL002, DL003, and DL004

Mko3 - Kogruk Formation (Mississippian) Part of the Kelly Sequence - Light-gray-weathering limestone with black chert nodules and lenses. Common fossils are Mississippian corals, crinoids, brachiopods, and foraminifers (Sable and Dutro, 1961; Armstrong and Mamet, 1977). Depositional thickness ranges from about 30 m west of Nimiuktuk River in the southeastern part of Misheguk Mountain quadrangle to more than 300 m west of Nunaviksak Creek in southwestern part of Misheguk Mountain quadrangle. Base is gradational in the Utukok Formation. *Unit description source:* MU002, MU003, and MU004

Mko3 - Kogruk Formation, Kelly River Allochthon, Amphitheatre Sequence (Mississippian) Well-bedded, medium-grained limestone with subordinate black nodular chert. Depositional thickness estimated to be up to 30 m. *Unit description source:* NT005

Mko3 - Kogruk Formation, Kelly River Allochthon, Kelly Sequence (Mississippian) Light-gray, medium- to coarse-grained limestone; generally contains less than 10 percent black and gray chert nodules. Limestone commonly has silicified zones of gray quartz and chalcedony. Depositional thickness estimated to be 100 to 250 m. *Unit description source:* NT005

Mko3 - Kogruk Formation, Kelly River Allochthon, Eli Sequence (Mississippian) Light-gray weathering, medium-grained limestone; locally has a few black chert nodules in upper part and few thin stringers of silicified limestone elsewhere in section. Difficult to lithologically distinguish from Baird Group in many places. *Unit description source:* NT005

Mko3e - Kogruk Formation (Mississippian) Part of the Eli Sequence -Light-gray weathering limestone with black chert nodules and lenses. Common fossils are Late Mississippian corals, crinoids, brachiopods, and foraminifers. Depositional thickness is approximately 250 m. Base is gradational into micritic limestone (unit Mml3e). *Unit description source:* MU002 and MU004

Mkoc3 - Cherty limestone member, Kogruk Formation (Mississippian) Consists of medium-grained limestone with 25-50% black chert lenses and beds. Part of the Kelly River allochthon, Kelly sequence. *Unit description source:* DL002 and DL004

Mkoc3 - Kogruk Formation, cherty limestone member, Kelly River Allochthon, Amphitheatre Sequence (Mississippian) Medium- to fine-grained light-gray interbedded limestone and dolomite with 25 to 50 percent black chert nodules and lenses; uppermost part of Kogruk Formation. Carbonate and chert beds are commonly silicified to gray quartz and chalcedony. May correlate with Tupik Formation. *Unit description source:* NT005

MI - Limestone (Mississippian) Medium-gray-weathering, medium- to dark-gray, fine crystalline recrystallized limestone and lesser light-brown weathering, medium-gray, fine crystalline dolostone. *Unit description source:* BM002

MI1 - Gray Limestone (Mississippian) Part of the Key Creek Sequence - Gray medium-grained limestone with black chert nodules and lenses. Resembles the Kogruk Formation of Kelly sequence and the Alapah and Wachsmuth Limestones of central Brooks Range. Contains crinoids, brachiopods, and Mississippian foraminifers. Locally discontinuous, with depositional thickness approximately 0-20 m. Base is gradational into the Kayak Shale. *Unit description source:* MU002, MU003, and MU004

MIc - Lisburne Group (Kogruk) (Mississippian) Crinoidal limestone (=Kogruk)-shelf carbonate. (on Kelly River allochthon in today's nomenclature). *Unit description source:* DL005

MIc - Endicott Mountains Allochthon - Lisburne Group, Kogruk Limestone (Mississippian) Cherty crinoidal limestone, shallow platform deposition. *Unit description source:* NT006

MIc - Kelly River Allochthon - Lisburne Group, Kogruk Limestone (Mississippian) Platform carbonates, cherty. *Unit description source:* NT006

MIk - Kogruk Formation, Lisburne Group (Mississippian) Kogruk Formation, Lisburne Group. *Unit description source:* PH004

Pzdp - Dark phyllite (Mississippian(?)) Dark gray carbonaceous phyllite with a few thin intercalated limestone beds; may be equivalent to Mk. *Unit description source:* AR002

MDI - Limestone (Mississippian or Devonian) Light-gray-weathering, medium- to thick-bedded limestone. Includes a few dark-gray chert nodules. *Unit description source:* DL002, DL003, and DL004

MDI3 - Limestone and dolomite, Kelly River Allochthon, Eli Sequence (Mississippian or Devonian) Light-gray weathering carbonate rocks that are correlative with either part of the Mississippian Kogruk Formation or the Devonian part of the Baird Group. *Unit description source:* NT005

PMIt - Lisburne Group, Tupik Formation (Pennsylvanian to Upper Mississippian)

Clgt - Tupik Formation (Pennsylvanian & Upper Mississippian) See [Clgt](#) for unit description from [SIM-3340](#).

MId and KJm - Lisburne Group, dark-colored facies and Mafic igneous rocks, undivided (Cretaceous? to Mississippian) Locally distinguished black to dark-gray limestone, claystone and chert. As much as 400 m thick. Resembles Tupik Formation but locally contains more abundant claystone and thicker chert beds. Also includes rocks of unit KJm, Dark-grayish-green to dark-gray gabbro, diabase, basalt, microgabbro, and minor diorite; locally includes some pillow, pillow-layer, or flow structures. *Unit description source:* MU007

JMcU and Mld - Cherty rocks, undivided and Lisburne Group, dark-colored facies, undivided (Jurassic? to Mississippian) Includes two poorly defined cherty units; light-colored cherty unit (JPacl) and dark-colored cherty unit (PaMcd). Also may include parts of Mld, Locally distinguished black to dark-gray limestone, claystone and chert. As much as 400 m thick. Resembles Tupik Formation but locally contains more abundant claystone and thicker chert beds. *Unit description source:* MU007

Mlt - Tupik Formation, Lisburne Group (Mississippian) Tupik Formation, Lisburne Group. *Unit description source:* PH004

Mt - Lisburne Group, Tupik Formation (Mississippian) Dark-gray to black, micritic, silty, mostly thin-bedded limestone with thin chert interbeds. 100-200 m thick. *Unit description source:* MU006, MU007, and MU008

Mt, JPacl - Tupik Formation (Lisburne) and Light-colored cherty unit, undivided (Mesozoic and late Paleozoic) Dark-gray to black, micritic, silty, mostly thin-bedded limestone having thin chert interbeds and Thin- to medium-bedded, vitreous to dull, gray, bluish, greenish, olive, reddish, and minor black chert. *Unit description source:* MU007

Mt3 - Tupik Formation (Mississippian) Part of the Kelly Sequence - Approximately equal amounts of interbedded fine-grained light-gray limestone and black chert. Top beds of unit have not been systematically sampled for fossils and may prove to be Pennsylvanian in age. Depositional thickness is less than 30 m. Base is gradational into the Kogruk Formation. *Unit description source:* MU002, MU003, and MU004

Mt3e - Tupik Formation (Mississippian) Part of the Eli Sequence - Medium-grained, light gray limestone with 25-50 percent nodular to bedded black chert. Depositional thickness is approximately 20 m. Base is gradational into the Kogruk Formation. *Unit description source:* MU002 and MU004

PMLg - Lisburne Group, undivided (Pennsylvanian to Mississippian)

Clg - Lisburne Group, undivided (Carboniferous) See [Clg](#) for unit description from [SIM-3340](#).

IPMI - Lisburne Group; Endicott Mountains Allochthon, Killik River Sequence (Early Pennsylvanian, Atokan, to late Mississippian, Meramecian) Dominantly massive, light-gray weathering, cliff-forming crinoidal limestone and dolomite; in places contains abundant black chert nodules, lenses, and beds, contains distinctive sooty black phosphatic shale and limestone in upper part. Thickness up to 500 m, thins to the west along the mountain front, and west of Outwash Creek is replaced by Kuna Formation. *Unit description source:* KL002

IPMI - Lisburne Group, undivided (Pennsylvanian and Mississippian) Gray limestone and dolomite, shaley limestone, nodular chert. Marine. About 700 to 1,000m thick. In those sections Lisburne is divided formally into Wachsmuth Limestone (Lower and Upper Mississippian), Alapah Limestone (Upper Mississippian) and Wahoo Limestone (Upper Mississippian, Lower and Middle Pennsylvanian). Wachsmuth Limestone is mapped separately only near Itkillik Lake. *Unit description source:* PS002 and PS006

IPMIc - Unnamed Limestone and Black Chert of Lisburne Group; Iqnavik River Allochthon, Zebra Creek Sequence (Pennsylvanian to Mississippian) Rhythmically thinly interbedded dark gray to black micritic limestone, black silicified limestone, and siliceous mudstone; upper third of section contains thick section of bedded black chert or silicified limestone and mudstone; has a distinctive black

and gray banded appearance where well exposed. Deposited as a carbonate turbidite. On Zebra Creek, contains Osagean to Meramecian conodonts. In Howard Pass quad, contains Osagean conodonts. >145 m thick, contains poorly exposed Kurupa Sandstone at base. *Unit description source:* KL002

IPMcl - Unnamed Gray Limestone and Chert of Lisburne Group; Ipnarik River Allochthon, Ileriak Creek Sequence (Pennsylvanian to Mississippian) Thinly interbedded gray to dark gray micritic limestone and gray to black chert; limestone contains abundant sponge spicules in places; chert frequently weathers white; limestone weathers gray; forms smooth rubble covered hillsides with few bedrock exposures. Dated by analogy to rocks of Akmalik Creek sequence. Near Ileriak Creek contains conodonts no older than middle Osagean. *Unit description source:* KL002

IPMvc1 - Volcaniclastic Rocks (Pennsylvanian and Mississippian) Part of the Key Creek Sequence - Thick bedded to massive calcareous rocks with volcanic fragments. Commonly coarse-grained limestone with disseminated light-green chloritic minerals. Unit contains sparsely distributed and strongly altered mafic (basaltic?) volcanic rocks. Recognized only east of upper Picnic Creek (southeastern Misheguk Mountain quadrangle map). Mapped as Carboniferous because of apparent stratigraphic position near or at top of the Kuna Formation. *Unit description source:* MU003

IPDI - Limestone (Pennsylvanian, Mississippian, Devonian) Light gray limestone. *Unit description source:* BM002

MI - Lisburne Group (Mississippian) Medium to thick, well-bedded dolomite and limestone with local black chert nodules and thin irregular chert beds; locally metamorphosed to marble and strongly sheared; may be equivalent to Lisburne rocks exposed along north side of Mount Doonerak in Wiseman quad. *Unit description source:* AR002

MI - Limestone, undivided (Mississippian) Limestone, Endicott sequence, Lisburne group, Bupto facies *Unit description source:* HW004

MI - Lisburne Group (Mississippian) Largely carbonate rocks consisting carbonate, cherty, and clastic lutitic rocks. *Unit description source:* MU006

MI - Endicott Mountains Allochthon, Lisburne Group (Mississippian) Cherty crinoidal limestone, shallow platform deposition. *Unit description source:* NT006

MI - Lisburne Group (Mississippian) Gray limestone and gray nodular chert and bedded chert. *Unit description source:* SP002

MI2 - Fine Grained Limestone (Mississippian) Part of the Wulik Sequence - Black fine-grained limestone, weathers light gray. Beds from 0.3 to 5 cm thick weather flaggy to platy. Contains Late Mississippian foraminifers. Depositional thickness probably varies from 5 to 30 m. Base is gradational into black shale unit. *Unit description source:* MU002

MIb - Bupto facies (Late and Early Mississippian) Thin-bedded to massive dolostone, chert, and subordinate limestone; locally parallel- and cross-laminated. Entire succession may be as much as 360 m thick. Upper section has three units. Upper and lower subunits are chiefly chert; middle subunit mostly dolostone. Lowest beds are limestone. Sedimentary structures and faunal evidence primarily suggest an open marine setting. Dolostone subunit accumulated in shallower water shoals. *Unit description source:* HW003

MIb - Bupto facies - Endicott sequence, Lisburne group (Early and Late Mississippian) Thin-bedded to massive dolostone, chert, and subordinate limestone; locally parallel- and cross-laminated. Entire succession may be as much as 360 m thick. Upper section has three units. Upper and lower

subunits are chiefly chert; middle subunit mostly dolostone. Lowest beds are limestone. Sedimentary structures and faunal evidence primarily suggest an open marine setting. Dolostone subunit accumulated in shallower water shoals. *Unit description source:* HW004

Mld - Lisburne Group, undivided; Endicott Mountains Allochthon, Ivotuk Hills Sequence (Mississippian, Meramecian to Chesterian) Dolomite, light to medium gray, thin- to thick-bedded, massive, with white to bluish-gray weathering chert, some bioclastic beds, some beds of spiculitic mudstone and chert, dominantly thin-bedded chert and minor shale in lower part. In some zones, contains abundant pinpoint to vugular porosity filled with tarry oil and solid hydrocarbons. Forms high rubble covered ridges of Ivotuk Hills. Contains conodonts ranging from late Meramecian to latest Chesterian. 225 m thick. *Unit description source:* KL002

Mlmc - Lisburne, micritic to crinoidal, Kelly River allochthon (Mississippian) Lisburne, micritic to crinoidal (betwixt and between the crinoidal to micritic carbonate)--perhaps shelf to slope. (Kelly River allochthon). *Unit description source:* DL005

Mlmc - Endicott Mountains Allochthon, Lisburne Group (Mississippian) Cherty crinoidal limestone, shallow platform deposition. *Unit description source:* NT006

Mlo - Okpikruark Formation, olistrome Lisburne olistrome blocks in Okpikruark Formation. *Unit description source:* DL005

Mlr - Rough Mountain Creek unit of Dumoulin and Harris, 1997 (Early Mississippian) Predominantly light- to dark-gray limestone interbedded with subordinate black fissile shale and blocky mudstone. Limestone mainly poorly to well-sorted, medium to very coarse-grained skeletal grainstone and packstone. Some beds are graded; others parallel-laminated or bioturbated. Lithologic and faunal data indicate deposition mainly in shallow-water, inner- to middle-shelf settings. Thickness generally 8-17 m. *Unit description source:* HW003

Mml1 - Micritic limestone, Brooks Range allochthon, Key Creek sequence (Mississippian) Dark-gray, light-weathering, thin-bedded limestone with subordinate interbedded black shale. Part of the Brooks Range allochthon, Key Creek sequence. *Unit description source:* DL003 and DL004

Mml2 - Micritic limestone, Picnic Creek allochthon, Wulik sequence (Mississippian) Dark-gray, fine-grained limestone; weathers light gray in flaggy and platy forms. Contains black chert nodules. Part of the Picnic Creek allochthon, Wulik sequence. *Unit description source:* DL002, DL003, and DL004

Mml2 - Micritic limestone, Picnic Creek allochthon, Amaruk sequence (Mississippian) Dark-gray, fine-grained limestone; weathers light-gray with flaggy to platy beds. Part of the Picnic Creek allochthon, Amaruk sequence. *Unit description source:* DL002, DL003, and DL004

Mml3 - Micritic limestone, Kelly River allochthon, Amphitheatre sequence (Mississippian) Gray to dark-gray, fine-grained limestone. Weathers light gray to buff and is platy to flaggy on talus slopes. Locally contains medium- to coarse-grained crinoidal limestone beds near top. Part of the Kelly River allochthon, Amphitheatre sequence. *Unit description source:* DL002 and DL003

Mml3 - Micritic Limestone, Kelly River Allochthon, Amphitheatre Sequence (Mississippian) Gray to dark-gray, fine-grained limestone. Weathers light-gray to buff and breaks into platy to flaggy fragments on talus slopes. Contains a few black chert nodules in uppermost part and subordinate interbedded calcareous dark-gray shale in lower part. Basal contact a thrust fault. *Unit description source:* NT005

Mml3e - Micritic Limestone, Kelly River allochthon, Eli Sequence (Mississippian) Part of the Eli Sequence - Light to dark-gray-weathering, thinly laminated to platy micritic limestone and lesser thin-

bedded or nodular black chert. Mapped only west of Kugururok River (southwestern Misheguk Mountain quadrangle map), where it probably intertongues with the Kogruk Formation. Upper part locally contains Late Mississippian brachiopods, bryozoans, and foraminifers. Lower part contains Late Devonian to Early Mississippian foraminifers. Depositional thickness is less than 500 m. Base lies on a thin tongue of the Utukok Formation north of Avan Hills mafic and ultramafic complex; east of the complex, it may lie conformably on limestone of the Baird Group. *Unit description source:* MU002

Pzl - Partly recrystallized, reef-like limestone and dolomite (Mississippian or Devonian?) Chiefly light-gray, partly recrystallized, reef-like limestone and dolomite containing minor intercalated phyllite and schist. Isolated masses resemble Lisburne Group and may be of Mississippian age. *Unit description source:* SH002

Mu(Is) - Undifferentiated limestone and marble (Mississippian and Devonian) The undifferentiated limestone and marble units have been classed based on the units they are contained within using 5XX where XX is the class of the surrounding unit. *Unit description source:* SP002

PC - Permian and Carboniferous, undivided (Permian and Carboniferous) Permian and Carboniferous, undivided. *Unit description source:* PH004

This unit is also present on source maps DL005, HW003, and PH004; however, no description was present on these sources.

PMLc - Lisburne Group, Akmalik Chert (Pennsylvanian and Mississippian)

MLgac - Akmalik Chert and other black chert of the Lisburne Group (Mississippian) See [MLgac](#) for unit description from [SIM-3340](#).

IPMa - Akmalik Chert, of Lisburne Group; Picnic Creek Allochthon, Akmalik Creek Sequence (Early Pennsylvanian, Atokan to Mississippian, Osagean) Bedded black chert with finely disseminated pyrite, in beds to 10 cm thick with thin siliceous shale partings, contains two laterally persistent thin micritic limestone beds to 1 m thick near base. Locally includes underlying thin Kayak Shale, which is generally poorly exposed and not mappable at scale of map. Well exposed at type locality on Akmalik Creek 2 km north of mountain front and in Kurupa Hills. Contains Osagean to Morrowan or younger conodonts; in Howard Pass quad, contains Osagean conodonts. Thickness about 75 m. *Unit description source:* KL002 and KL006

IPMap - Akmalik Chert of Lisburne Group of Mull and others (1987) - Picnic Creek sequence, Lisburne group (Pennsylvanian and Mississippian) Black bedded chert in beds as much as 10 cm thick, with thin, black siliceous shale partings; locally contains barite deposits in Cutaway Basin window and rare interbeds of calcareous radiolarite. In the Howard Pass C-5 quadrangle, unit includes abundant interbeds 2-7 cm thick of brownish-black dolostone. These rocks formed in a deep-water, basinal setting. Unit is generally a few tens of meters thick at most. *Unit description source:* HW003 and HW004

IPMap - Akmalik Chert of Lisburne Group (Pennsylvanian and Mississippian) Black bedded chert in beds as much as 10 cm thick, with thin, black siliceous shale partings; locally contains barite deposits in Cutaway Basin window and rare interbeds of calcareous radiolarite. In the Howard Pass C-5 quadrangle, unit includes abundant interbeds 2-7 cm thick of brownish-black dolostone. These rocks formed in a deep-water, basinal setting. Unit is generally a few tens of meters thick at most. [Description derived from Dover and others (unpub, MU005) map.]. *Unit description source:* MU012

IPMc - Black chert (Pennsylvanian? and Mississippian) Well-bedded black chert with a few black siliceous shale partings. *Unit description source:* DL002 and DL004

IPMc - Black Chert (Pennsylvanian and Mississippian) Part of the rocks not assigned a specific sequence. Well-bedded. Contains radiolarians. *Unit description source:* MU002, MU003, and MU004

IPMc2 - Black chert (Pennsylvanian? and Mississippian) Well-bedded black chert with a few siliceous black shale partings. Local white-weathering rind on bedding surfaces. Part of the Picnic Creek allochthon, Wulik sequence. *Unit description source:* DL002, DL003, and DL004

IPMc2 - Black chert (Pennsylvanian? and Mississippian) Well-bedded black chert with a few black shale partings and less than 10% gray- or brown-weathering carbonate beds. Part of the Picnic Creek allochthon, Amaruk sequence. *Unit description source:* DL002, DL003, and DL004

IPMc2 - Black Chert (Pennsylvanian and Mississippian) Part of the Picnic Sequence - Well-bedded. Contains a few black shale partings which are more common near bottom, and a few thin, rusty weathering beds near top. Contains Mississippian to Early Pennsylvanian radiolarians and gradational zone at top contains conodonts of Morrowan age. Depositional thickness is approximately 40-60 m. Basal contact is sharp on the Kayak Shale. *Unit description source:* MU003 and MU004

IPMc2 - Black chert, Picnic Creek Allochthon, Amaruk Sequence (Pennsylvanian(?) and Mississippian) Well-bedded black chert locally interbedded with light-gray-weathering limestone. Base gradational in Kogrük Formation or conformable on the Kayak shale. *Unit description source:* NT005

IPMc3 - Black chert, Kelly River Allochthon, Amphitheatre Sequence (Pennsylvanian(?) and Mississippian) Black to dark-gray chert overlying a thin discontinuous zone of black carbonaceous, siliceous shale. Also includes subordinate amounts of interbedded limestone. Appears to be laterally gradational into cherty limestone member of Kogrük Formation. Description suggest maybe equivalent to Kuna Formation?. *Unit description source:* NT005

IPMc4 - Black chert, Ilnavik River Allochthon, Ilnavik Sequence (Pennsylvanian(?) and Mississippian) Well-bedded radiolarian chert with a few shale partings. Commonly bleached white and recrystallized by intrusions of mafic dikes and sills. Also includes subordinate amounts of interbedded limestone. Appears to be laterally gradational into cherty limestone member of Kogrük Formation. Description suggest maybe equivalent to Kuna Formation?. *Unit description source:* NT005

IPMc4 - Black chert (Pennsylvanian? and Mississippian) Well-bedded black chert with a few black shale partings and less than 10% gray- or brown-weathering carbonate beds. Part of the Ilnavik River allochthon, Puzzle Creek sequence. *Unit description source:* DL004

IPMc4 - Black Chert (Pennsylvanian and Mississippian) Part of the Ilnavik Sequence - Well-bedded chert with a few shale partings. May contain minor amounts of interbedded limestone and black chert. Contains persistent mafic sills and dikes as much as 100 m thick. Contains Late Mississippian foraminifers of Mamet Zone 11 or younger. Upper part may be Pennsylvanian on the basis of stratigraphic correlation with black chert in structurally lower sequences. Intertongues with black chert and limestone (unit PMc14). Depositional thickness is estimated to be less than 100 m. Basal contact is sharp on the Kayak Shale. *Unit description source:* MU002, MU003, and MU004

IPMc4n - Black Chert (Pennsylvanian and Mississippian) Part of the Nachralik Pass Sequence - Well-bedded. Rusty weathering dolomite interbedded with chert in lower part of Nachralik Pass. Contains Late Mississippian to Pennsylvanian radiolarians. Age based on stratigraphic correlation with fossiliferous rocks in black chert (unit PMc4) of Ilnavik sequence. Depositional thickness is estimated to be less than 100 m. Basal contact is sharp on the Kayak Shale. *Unit description source:* MU002, MU003, and MU004

IPMcd2 - Black chert and dolomite (Pennsylvanian? and Mississippian) Approximately equal amounts of interbedded black chert and fine-grained, gray- or brown-weathering dolomite. Part of the Picnic Creek allochthon, Amaruk sequence. *Unit description source:* DL003 and DL004

IPMcd4 - Black chert and dolomite (Pennsylvanian? and Mississippian) Approximately equal amounts of interbedded chert and gray- or brown-weathering dolomites. Part of the Ilnavik River allochthon, Puzzle Creek sequence. *Unit description source:* DL004

IPMcl - Black chert and limestone (Pennsylvanian? and Mississippian) Black chert and limestone. Occurs as isolated olistoliths(?) and (or) thrust slices. *Unit description source:* DL002, DL003, and DL004

IPMcl - Black Chert and Limestone (Pennsylvanian and Mississippian) Part of the Rocks Not Assigned a Specific Sequence - Interbedded black chert and fine-grained limestone. Mapped in only a few isolated outcrops west of lower Kuguruk River (southwestern Misheguk Mountain quadrangle map), and may represent a transitional Mississippian facies between Nachralkik Pass and Eli sequences. *Unit description source:* MU002

IPMcl2 - Black chert and limestone (Pennsylvanian? and Mississippian) Equal amounts of interbedded black chert and micritic limestone. Locally may have a few dolomitic beds. Part of the Picnic Creek allochthon, Wulik sequence. *Unit description source:* DL002, DL003, and DL004

IPMcl2 - Black chert and limestone (Pennsylvanian and Mississippian) Approximately equal amounts of interbedded black chert and fine-grained gray limestone. In some areas limestone beds are pervasively silicified. Part of the Picnic Creek allochthon, Amaruk sequence. *Unit description source:* DL002, DL003, and DL004

IPMcl4 - Black chert and limestone (Pennsylvanian? and Mississippian) Approximately equal amounts of interbedded black chert and fine-grained limestone. Part of the Ilnavik River allochthon, Puzzle Creek sequence. *Unit description source:* DL004

IPMrc4 - Black chert, recrystallized, Ilnavik River Allochthon, Ilnavik Sequence (Pennsylvanian?) and Mississippian) Recrystallized black chert consisting of dark-gray to light-gray weathering chalcedony and quartz. *Unit description source:* NT005

Barite - Barite deposit (Pennsylvanian or Mississippian) Barite deposit shown as unit on map, may be associated with nearby Kuna Formation. *Unit description source:* MU003

PMc2 - Black chert (Mississippian) Part of the Wulik Sequence - Well-bedded black chert with a few siliceous black shale partings. Local white-weathering rind on bed surfaces. Chert contains Late Mississippian to Pennsylvanian radiolarians. Depositional thickness is 40-60 m. Sharp basal contact with fine-grained limestone (unit MI2). *Unit description source:* MU002

MIri - Rim Butte unit of the Lisburne Group of Dumoulin and others (1993) - Ilnavik River sequence, Lisburne Group (Mississippian) Generally thin-bedded and distinctively color-banded succession composed of lighter layers of limestone turbidite, interbedded with darker layers of siliceous, spiculitic mudstone like that in the Kuna Formation and lesser chert. Limestone, in beds 3-80 cm thick, makes up 15-70 percent of sections studied. At least 70-85 m thick. Base of unit generally faulted or not exposed. Much of unit has a depositional age of early middle Osagean. *Unit description source:* HW003 and HW004

MIld - Lisburne Group, dark-colored facies (Mississippian) Locally distinguished black to dark-gray limestone, claystone and chert. As much as 400 m thick. Resembles Tupik Formation but locally

contains more abundant claystone and thicker chert beds. Probably equivalent to lower part of Kuna Formation [Description derived from adjacent Sable and others (1984, MU007) map.]. *Unit description source:* MU012

MIku - Lisburne Group, Kuna Formation (Late Mississippian to Mississippian)

MIgk - Kuna Formation (Mississippian) See [MIgk](#) for unit description from [SIM-3340](#).

IPMc - Carbonaceous chert and siliceous phyllite (Pennsylvanian to Mississippian) Black carbonaceous metachert, quartzite, and siliceous or calcareous phyllite, commonly distinctive silvery blue (phosphatic) bloom on weathered surfaces. Similar to and correlative with the Kuna Formation of Mull and others (1982). *Unit description source:* BM002

IPMcd - Dark-colored cherty unit (Pennsylvanian and Mississippian) Thin- to thick-bedded, black to dark-gray interbedded chert with dark-colored limestone, claystone, siliceous claystone, and dolomite. *Unit description source:* MU006, MU007, MU008, and MU012

IPMcI4 - Black Chert and Limestone (Pennsylvanian and Mississippian) Part of the Ipnarik Sequence - Interbedded black chert and fine-grained limestone. Beds range from 1 to 20 cm thick. Rare sponge spicules and crinoids in limestone. Contains persistent mafic sills and dikes. Age based on stratigraphic correlation and intertonguing relation with black chert (unit PMc4). Depositional thickness is estimated to be less than 100 m. Basal contact is sharp on the Kayak Shale. *Unit description source:* MU002, MU003, and MU004

IPMk - Kuna Formation (Pennsylvanian and Mississippian) Black carbonaceous shale and subordinate black chert. Contains a few thin, fine-grained limestone beds. *Unit description source:* DL002 and DL003

IPMk - Kuna Formation - Endicott sequence, Lisburne group, Bupto facies (Early Pennsylvanian and Mississippian) Predominantly black siliceous mudstone and sooty, carbonaceous shale, including minor gray carbonate interbeds and concretions. Siliceous beds are rich in sponge spicules and radiolarians. Thin carbonate layers are chiefly dolomitic mudstone and calcitized radiolarite. Sedimentological and faunal evidence suggest that the Kuna was deposited in an anoxic, deep-water setting. Maximum thickness = 70 m. *Unit description source:* HW003 and HW004

IPMk - Kuna Formation of Lisburne Group; Endicott Mountains Allochthon, Key Creek Sequence (Early Pennsylvanian, Morrowan to Mississippian, Osagean) Interbedded black siliceous mudstone, sooty limestone and dolomite, and shale; forms low resistant ridges north of mountain front. Reference section for formation is located on Otuk Creek 2.5 km north of mountain front. In Howard Pass quad, contains Osagean (Late Toumaisian) conodonts, but siliceous zones at top elsewhere contain Osagean to Morrowan radiolarians. *Unit description source:* KL002

IPMk - Kuna Formation (Pennsylvanian and Mississippian) Black carbonaceous shale with a bluish-silver sheen on weathering. *Unit description source:* NT005

IPMk1 - Kuna Formation (Early or Middle Pennsylvanian and Early Mississippian) Black carbonaceous shale with subordinate interbedded black chert, except in top 10 m where chert predominates. Contains a few dark-gray, fine-grained limestone interbeds. A few beds of calcareous granule sandstone are found west of Wulik River. Shale surfaces commonly acquire a bluish-silver sheen upon weathering. Part of the Brooks Range allochthon, Key Creek sequence. *Unit description source:* DL002, DL003, and DL004

IPMk1 - Kuna Formation (Pennsylvanian to Mississippian) Part of the Key Creek Sequence - Black carbonaceous shale with subordinate interbedded black chert; contains a few beds of gray to dark-gray, medium to fine-grained limestone (Mull and others, 1982). Chert predominates over shale in top 10 m of unit. Shale in lower part often weathers to a bluish-silver sheen. Chert contains radiolarians and is correlative with black chert of Late Mississippian and Pennsylvanian age in Picnic Creek allochthon; limestone contains rare brachiopods and Mississippian conodonts. Radiolarians from beds near top indicate Early and (or) Middle Pennsylvanian age and conodonts from limestone beds indicate Early and Late Mississippian age. Depositional thickness is approximately 40-60 m. Basal contact is either sharp on gray limestone (unit M1) or gradational into the Kayak Shale. *Unit description source:* MU002, MU003, and MU004

IPMk1 - Kuna Formation, Brooks Range Allochthon, Key Creek Sequence (Pennsylvanian and Mississippian) Black carbonaceous shale with interbedded black chert. Contains a few dark-gray fine-grained limestone interbeds. Shale commonly has a bluish-silver sheen on weathering. Age inferred from stratigraphic correlation with similar beds that contain conodonts, radiolarians, and brachiopods elsewhere in the De Long Mountains. *Unit description source:* NT005

IPMk2 - Kuna Formation (Pennsylvanian and Mississippian) Black carbonaceous shale with subordinate black chert beds. Locally contains numerous thin beds of micritic limestone. Part of the Picnic Creek allochthon, Wulik sequence. *Unit description source:* DL002, DL003, and DL004

IPMk3 - Kuna Formation (Pennsylvanian and Mississippian) Black, carbonaceous shale and subordinate interbedded fine-grained limestone. Part of the Kelly River allochthon, Amphitheatre sequence. *Unit description source:* DL002 and DL004

IPMk3 - Kuna Formation (Pennsylvanian and Mississippian) Black chert and carbonaceous shale, thin and discontinuous. Part of the Kelly River allochthon, Kelly sequence. *Unit description source:* DL002 and DL004

IPMko - Kuna Formation, of Lisburne Group; Endicott Mountains Allochthon, Okpikruak River Sequence (Early Pennsylvanian, Morrowan to Mississippian, Osagean) Dark-gray, fine grained micritic limestone, with black chert and sooty black shale, in tightly folded crumpled exposures that form low resistant ridges and rubble exposures along Okpikruak River, Okokmilaga River, and Killik river north of mountain front. Dated by analogy to dated Kuna in Key Creek sequence to the west. Exposed thickness <50 m. Unit not found on map. *Unit description source:* KL002

Mld - Lisburne Group, dark-colored facies (Mississippian) Locally distinguished black to dark-gray limestone, claystone and chert. As much as 400 m thick. Resembles Tupik Formation but locally contains more abundant claystone and thicker chert beds. Probably equivalent to lower part of Kuna Formation. *Unit description source:* MU007 and MU008

Mlgl - Lisburne Group, informal lower part (Early Mississippian to Late Mississippian)

Clg - Lisburne Group, undivided (Carboniferous) See [Clg](#) for unit description from [SIM-3340](#).

Maw - Lisburne Group, Alapah and Wachmuth Limestones, undivided (Mississippian) Mostly light-brownish-gray packstone and wackestone composed of bioclastic framework clasts and interstitial lime mud. Bedding ranges from thin to massive and includes crossbedded and cross-laminated beds.

Dark-gray shale, carbonaceous limestone, shaly limestone, and limy shale constitute between 10 and 30 percent of section. Very dark-gray to medium-dark-gray argillaceous limestone, limy shale and nodular chert in lower part of Alapah Limestone. Beds include abundant phosphatic nodules or ooids. *Unit description source:* CL002

Mawc - Lisburne Group, Alapah and Wachmuth Limestones, chert facies (Mississippian) Mostly very dark-gray to black dense, nearly opaque chert that is massive and conchoidally fracturing. Chert includes locally abundant medium-light-gray dolomitized micrite to very coarse-grained grainstone in lenses, layers of dark- to very dark-gray argillaceous siltstone and medium-gray limestone and shows faint wispy structures, which may be relict bedding. Chert facies is a replacement of an anomalously thin part of unit. *Unit description source:* CL002

MII - Early part of Lisburne Group (Pennsylvanian and Mississippian) Includes lower part of Alapah Limestone, and south of Ribdon River, also includes Wachsmuth Limestone. Generally weathers dark to medium gray. Mostly dark gray fine to medium grained limestone and dolomite, with much thin bedded to shaley limestone, abundant black nodular chert, and much silicified limestone. Light gray weathering dolomite and coarse grained limestone locally in lower part. Marine. Unit assigned to Autochthonous rocks of Colville Basin. *Unit description source:* PS002 and PS006

Mc - Chert (Mississippian)

Clg - Lisburne Group, undivided (Carboniferous) See [Clg](#) for unit description from [SIM-3340](#).

Mch - Chert (Mississippian) Dark-gray to black well bedded chert containing Mississippian radiolarians and intruded by dark green diabase. *Unit description source:* SP002

Mgq - Globe quartzite (Mississippian)

Mgq - Globe quartzite of Weber and others (1992) (Mississippian) See [Mgq](#) for unit description from [SIM-3340](#).

Pzq - Quartzite (Paleozoic) Dark gray to black albite muscovite quartzite and graphitic quartzite. Forms resistant outcrops and locally is interlayered with felsic schist (Df). *Unit description source:* SP002

Mlt - Limestone and tuff (Mississippian)

Clgv - Volcanic rocks and sills associated with Lisburne Group (Mississippian & Pennsylvanian?) See [Clgv](#) for unit description from [SIM-3340](#).

Mlt - Limestone and tuff (Mississippian) Orange-, tan-, or light brown-weathering, thinly laminated limestone, tuff, and volcanoclastic rocks, with subordinate sills and plugs of intermediate to mafic composition. Conodonts of early Early Mississippian. *Unit description source:* BM002

MDe - Endicott Group, Itkilyariak Formation, Kekiktuk Conglomerate, Kayak Shale, Kanayut Conglomerate, Noatak Sandstone, Kurupa Sandstone, and Hunt Fork Shale, undivided (Mississippian to Devonian)

MDe - Endicott Group, undivided (Devonian to Mississippian) See [MDe](#) for unit description from [SIM-3340](#).

KDe - Rocks of the Endicott sequence, undivided (Early Cretaceous (Neocomian) to Devonian)

Mapped tentatively in a few areas of limited or isolated exposure in the north-central part of the map area. Not examined in the field or identifiable by photo interpretation; assignment based on inferred but unconfirmed continuity with stratigraphic assignments by other geologists within what appears to be the same structural plate or sequence. Presently there is no independent evidence to justify assignment to other sequences. *Unit description source:* HW003

Mikv - Volcanic-rich part of Isikut unit of Mull and Werdon (1994) and Kayak(?) Shale, undivided (early Early Mississippian) This unit is the same as the Isikut unit, but representing a part of the Isikut containing more abundant volcanic components than is typical. *Unit description source:* HW003

Ms1 - Red-brown siltstone (Mississippian) Reddish-brown-weathering siltstone, locally calcareous, with subordinate amounts of sandstone and shale. Ironstone concretions are locally abundant in shaly intervals. Crossbeds and ripple marks in sandy beds. Part of the Brooks Range allochthon, Key Creek sequence. *Unit description source:* DL002

MDe - Endicott Group, undivided (Mississippian and (or) Devonian) Unit includes the Hunt Fork Shale, Noatak Sandstone, Kanayut Conglomerate, Kekiktuk Conglomerate, and Kayak Shale. *Unit description source:* BM002

MDe1 - Endicott Group, undivided, Brooks Range Allochthon, Key Creek Sequence (Mississippian and Devonian) Brown- and reddish-brown weathering siltstone and sandstone and gray shale. Age inferred from lithologic correlation with beds that contain conodonts, plant fragments, and brachiopods elsewhere in the Mugrave Hills and De Long Mountains. *Unit description source:* NT005

Mk - Endicott Group, Kayak Shale (Mississippian to Mississippian (Visean))

Mk - Kayak Shale (Mississippian) See [Mk](#) for unit description from [SIM-3340](#).

Mi - Isikut unit of Mull and Werdon (1994) - Endicott, sequence, Endicott group, Aniuk River facies (Early Mississippian) Reddish-tan to grayish-green, tan- to reddish-brown-weathering, thin-bedded to platy siltstone and phyllitic shale; bioturbation and flaser structure common. Locally contains quartzitic sandstone interbeds at the base and thin, sandy limestone interbeds higher in the section. Includes some interbeds typical of the Kayak Shale. Minimum thickness about 200 m. Pervasively folded; typically displays prominent axial-plane cleavage. *Unit description source:* HW003 and HW004

Mik - Isikut unit of Mull and Werdon (1994) and Kayak Shale, undivided (early Early Mississippian) Isikut: Reddish-tan to grayish-green, tan- to reddish-brown-weathering, thin-bedded to platy siltstone and phyllitic shale; bioturbation and flaser structure common. Locally contains quartzitic sandstone interbeds at the base and thin, sandy limestone interbeds higher in the section. Includes some interbeds typical of the Kayak Shale. Minimum thickness about 200 m. Pervasively folded; typically displays prominent axial-plane cleavage. Kayak: Dark-gray to black, fissile clay shale containing conspicuous yellowish-brown-weathering, thin, fossiliferous limestone interbeds near the top and greenish-gray siltstone and sandy siltstone in the lower part. Sideritic concretions are characteristic

in places. Locally contains felsic to intermediate intrusive, extrusive, and volcanoclastic rocks. Minimum thickness 45 m; typically complexly folded and pervasively sheared. - Endicott sequence, Endicott group, Key Creek facies (window west of Safari Creek window). *Unit description source:* HW003 and HW004

Mk - Kayak Shale (Early Mississippian) Kayak shale; Black carbonaceous slate and phyllite with few interbeds of rusty to orange weathering fossiliferous limestone. *Unit description source:* AR002

Mk - Kayak Shale (Mississippian) Dark gray to black siliceous or calcareous slate and phyllite, with subordinate intercalated orange- to rusty- weathering gray recrystallized limestone, calcareous metasiltstone, and thin-bedded, locally calcareous quartz metasandstone. *Unit description source:* BM002

Mk - Kayak Shale (Early Mississippian) Predominantly shale with interbedded bioclastic limestone and finely crystalline limestone. shale is dark-gray to grayish-black, carbonaceous, generally micaceous and fissile, clayey to very silty and soft to brittle. Bioclastic limestone beds generally less than 1.8 m thick and are reddish- and yellowish-brown weathering fossils hash. Argillaceous limestone is finely crystalline and dark-gray to grayish-black. *Unit description source:* CL002

Mk - Kayak Shale (Mississippian) Dark-gray shale with a few interbeds of rusty-weathering limestone. Shale contains ironstone concretions. *Unit description source:* DL002, DL003, and DL004

Mk - Kayak Shale (Early Mississippian) Dark-gray to black, fissile clay shale containing conspicuous yellowish-brown-weathering, thin, fossiliferous limestone interbeds near the top and greenish-gray siltstone and sandy siltstone in the lower part. Sideritic concretions are characteristic in places. Locally contains felsic to intermediate intrusive, extrusive, and volcanoclastic rocks. Minimum thickness 45 m; typically complexly folded and pervasively sheared. *Unit description source:* HW003

Mk - Kayak Shale - Endicott sequence, Endicott group, Key Creek facies (Early Mississippian) Dark-gray to black, fissile clay shale containing conspicuous yellowish-brown-weathering, thin, fossiliferous limestone interbeds near the top and greenish-gray siltstone and sandy siltstone in the lower part. Sideritic concretions are characteristic in places. Locally contains felsic to intermediate intrusive, extrusive, and volcanoclastic rocks. Minimum thickness 45 m; typically complexly folded and pervasively sheared. *Unit description source:* HW004

Mk - Kayak Shale; Endicott Mountains Allochthon, Killik River Sequence (Early Mississippian) Dark-gray to black fissile clay shale with yellowish-brown-weathering thin fossiliferous limestone beds near top, commonly contains conspicuous reddish-brown-weathering nodules; lower part contains thin interbeds of gray sandstone, gradational downward into Kanayut Conglomerate. Is complexly deformed by isoclinal folding; acts as a detachment zone for the overlying Lisburne; thickness probably over 500 m. *Unit description source:* KL002

Mk - Kayak Shale; Endicott Mountains Allochthon, Ivotuk Hills Sequence (Early Mississippian) Dominantly black phyllitic shale and mudstone, and minor dolomite, contains scattered reddish brown weathering concretions; some beds contain abundant bioclastic debris, occasional thin layers contain abundant sponge spicules. Thickness unknown, unit is mostly covered beneath talus from overlying Lisburne, is well exposed only in a 50 m thick section along Otuk Creek below Lisburne at west end of Ivotuk Hills. Early Mississippian (Osagean) based on conodont fauna. *Unit description source:* KL002

Mk - Kayak Shale; Endicott Mountains Allochthon, Key Creek Sequence (Mississippian) Dark gray to black fissile clay shale with abundant reddish brown weathering nodules, grades down into Kanayut Conglomerate. *Unit description source:* KL002

Mk - Kayak Shale (Mississippian) Part of the Rocks Not Assigned a Specific Sequence - Dark-gray shale with a few interbeds of rusty-weathering limestone and ironstone concretions. Mapped in a few isolated outcrops in the hills west of lower Kugururuk River (southwestern Misheguk Mountain quadrangle map). *Unit description source:* MU002 and MU003

Mk - Endicott Mountains Allochthon - Kayak Shale (Mississippian) Black, phyllitic shale. *Unit description source:* NT006

Mk - Kayak Shale (Mississippian) Mostly black, fissile clay shale and silty shale, in part rusty-weathering, with small ironstone nodules; interbedded with orange-weathering siltstone in southern half of quadrangle. Fossiliferous limestone in lenses and in beds as much as 10m thick, abundant in upper part; is generally dark gray, argillaceous or shaley; weathers yellow orange, or olive, and locally contains nodular black chert. Thin beds and lenses of gray and brown, irregularly bedded fine to medium grained, impure, partly worm-burrowed sandstone near base. *Unit description source:* PS002

Mk - Kayak Shale (Mississippian) Mostly black, fissile clay shale and silty shale, in part rusty-weathering, with small ironstone nodules; interbedded with orange-weathering siltstone in southern half of quadrangle. Fossiliferous limestone in lenses and in beds as much as 10m thick, abundant in upper part; is generally dark gray, argillaceous or shaley; weathers yellow orange, or olive, and locally contains nodular black chert. Thin beds and lenses of gray and brown, irregularly bedded fine to medium grained, impure, partly worm-burrowed sandstone near base. Unit assigned to Autochthonous rocks of Colville Basin. *Unit description source:* PS006

Mk (or Mk?) - Kayak Shale (Early Mississippian) Occurs in three areas. In northern part of quadrangle consists of black phyllite or slate and is interlayered with brown and locally orange weathering fossiliferous siltstone and sandstone. South of Noatak River it is black dark gray locally red and green weathering slaty phyllite and argillite with minor semischistose quartz rich siltstone and marble. In eastern part of quadrangle similar to that south of Noatak River. *Unit description source:* SP002

Mk(Is) - Undifferentiated limestone and marble (Mississippian and Devonian) The undifferentiated limestone and marble units have been classed based on the units they are contained within using 5XX where XX is the class of the surrounding unit. *Unit description source:* SP002

Mk1 - Kayak Shale (Early Mississippian) Black to dark-gray shale with interbedded rusty-weathering fossiliferous limestone and pyritic ironstone concretions. Locally contains a few siltstone and sandstone beds. Part of the Brooks Range allochthon, Key Creek sequence. *Unit description source:* DL002, DL003, and DL004

Mk1 - Kayak Shale (Mississippian) Part of the Key Creek Sequence - Dark-gray and black shale with interbedded rusty-weathering fossiliferous limestone and pyritic ironstone concretions. Locally contains a few thin siltstone and fine grained sandstone beds. Common fossils include Early Mississippian crinoids, brachiopods, bryozoans, and foraminifers. Depositional thickness estimated to vary from 10 to more than 40 m. In some areas, such as around Ginny Creek (southwestern Misheguk Mountain quadrangle map), base is gradational into a thin tongue of Utukok Formation. In places where the Utukok Formation was not deposited, such as the Iggiruk Hills or upper Picnic Creek area (southeastern Misheguk Mountain quadrangle map), base is gradational into the Noatak Sandstone of the Kanayut Conglomerate. *Unit description source:* MU002, MU003, and MU004

Mk2 - Kayak Shale (Mississippian) Gray fissile shale with interbedded light-gray- to buff-weathering limestone and local rusty-weathering ironstone concretions. Local bioclastic limestone beds containing crinoid debris. Part of the Picnic Creek allochthon, Wulik sequence. *Unit description source:* DL002, DL003, and DL004

Mk2 - Kayak Shale (Mississippian) Gray fissile shale with subordinate amounts of interbedded rust- or buff-weathering limestone. Part of the Picnic Creek allochthon, Amaruk sequence. *Unit description source:* DL002, DL003, and DL004

Mk2 - Kayak Shale (Mississippian) Part of the Picnic Sequence - Brown to black, fine-grained siltstone and shale with orange-weathering ironstone concretions. Some tan-weathering, thin limestone beds. Thickness in outcrop is about 20 m, and basal contact is a thrust fault.. *Unit description source:* MU004

Mk2 - Kayak Shale, Picnic Creek Allochthon, Amaruk Sequence (Mississippian) Gray shale with subordinate amounts of interbedded rusty-weathering silty limestone and siltstone. Depositional thickness estimated to be up to 30 m. *Unit description source:* NT005

Mk4 - Kayak Shale (Mississippian) Black fissile shale with interbedded orange-weathering limestone, siltstone, and ironstone concretions. *Unit description source:* DL004

Mk4 - Kayak Shale (Mississippian) Part of the Ipnarik Sequence - Black fissile shale with lesser amounts of interbedded orange-weathering limestone and rusty-weathering sandstone beds. Age based on presence of Mississippian conodonts. Thickness in outcrop is approximately 70 m; depositional contact on the Baird Group is not exposed but is inferred from regional stratigraphic relations. *Unit description source:* MU002, MU003, and MU004

Mk4 - Kayak Shale, Ipnarik River Allochthon, Ipnarik Sequence (Mississippian) Dark-gray shale with interbedded rusty-weathering calcareous concretions. *Unit description source:* NT005

Mk4n - Kayak Shale (Mississippian) Part of the Nachalik Pass Sequence - Dark-gray shale with a few thin, fine-grained, brown sandstone beds. Contains sparse calcareous iron-stained concretions. Age based on identification of probable Early Mississippian corals and stratigraphic correlation with the fossiliferous Kayak Shale in Ponavik sequence. Thickness in outcrop is as much as 40 m. Basal contact is a thrust fault. *Unit description source:* MU002 and MU004

Mk5 - Kayak Shale (Mississippian) Part of the Bogie Sequence - Dark-gray shale, with interbedded, orange-weathering limestone, siltstone, and minor fine-grained sandstone. Contains Mississippian foraminifers and brachiopods. Maximum thickness in outcrop is estimated to be 350 m. Basal contact is a thrust fault. Includes beds formerly mapped as Lisburne Group by Tailleux and Sable (1963).. *Unit description source:* MU002, MU003, and MU004

Mk5 - Kayak Shale, Nuka Ridge Allochthon, Bogie Sequence (Mississippian) Gray shale interbedded with 1 to 4 cm thick beds of encrinuritic, orange-weathering limestone beds. *Unit description source:* NT005

Mka - Kayak Shale (Early Mississippian) Dark-gray shale, yellowish-weathering platy limestone, siltstone, and minor sandstone more than 450 m thick. *Unit description source:* MU007

Mkf5 - Kayak Shale, feldspathic sandstone member, Nuka Ridge Allochthon, Bogie Sequence (Mississippian) Brown-weathering, feldspathic, calcareous sandstone interbedded with gray shale and a few thin limestone beds. *Unit description source:* NT005

Mkl - Limestone unit of Kayak Shale (early Early Mississippian) Orange-weathering, gray fossiliferous limestone in beds 0.1-5 m thick, interbedded with dark gray to black shale. Lithologically similar beds commonly occur in the upper part of the Kayak Shale elsewhere in the map area but are too thin and (or) discontinuous to map separately. *Unit description source:* HW003

Mkl5 - Kayak Shale, limestone and shale member, Nuka Ridge Allochthon, Bogie Sequence (Mississippian) Brown-weathering, thin-bedded silty limestone interbedded with gray calcareous shale. *Unit description source:* NT005

Mks2 - Kayak Shale, sandstone member, Picnic Creek Allochthon, Amaruk Sequence (Mississippian) Interbedded siltstone, shale, and fine-grained quartzite, locally calcareous. Weathers light-brown or reddish brown. *Unit description source:* NT005

Mls3 - Shale and micritic limestone member, Micritic limestone unit, Kelly River allochthon, Amphitheatre sequence (Mississippian) Mostly gray to black carbonaceous shale with 20-40% interbedded micritic limestone. Part of the Micritic limestone unit of the Kelly River allochthon, Amphitheatre sequence. *Unit description source:* DL002

Ms2 - Black Shale (Mississippian) Part of the Wulik Sequence - Contains a few fine-grained limestone and black chert beds. Probably stratigraphically equivalent to the Kayak Shale or lower part of the Kuna Formation. Depositional thickness is more than 20 m. Depositional contact on the Utukok Formation is not exposed but is inferred from regional stratigraphic relations. *Unit description source:* MU002

IPMs4 - Black shale (Pennsylvanian? and Mississippian) Black carbonaceous shale with a few interbedded black siliceous shale, chert, and thin, fine-grained, dark-gray limestone or dolomite beds. Local small calcareous concretions. Part of the Ilnavik River allochthon, Puzzle Creek sequence. *Unit description source:* DL004

Pzs - Feldspathic sandstone (Paleozoic) Fine-grained, light-brown-weathering, calcareous sandstone. *Unit description source:* NT005

Mkk - Endicott Group, Kayak Shale and Kekiktuk Conglomerate (Mississippian (Tournaisian to Visean))

MDe - Endicott Group, undivided (Devonian to Mississippian) See [MDe](#) for unit description from [SIM-3340](#).

Mk - Kayak Shale and Kekiktuk Conglomerate (Early Mississippian) Kayak Shale and Kekiktuk Conglomerate, contains fossils. *Unit description source:* WI010

Mkk - Kayak shale and Kekiktuk conglomerate (Early Mississippian) Kayak shale and Kekiktuk conglomerate; Intercalated quartzite, conglomerate, and phyllite. *Unit description source:* AR002

Mu - Undivided Mississippian Sedimentary Rocks (Mississippian) Interbedded dark gray phyllite red and green weathering phyllite, quartz semischist, and minor quartz conglomerate. Also includes limestone and marble of Lisburne Group (MI), Kayak Shale (Mk), and Kekiktuk Conglomerate (Mke). *Unit description source:* SP002

Mu - Metasedimentary rocks, undivided (Mississippian) Quartz conglomerate, quartzite, metasandstone, phyllite, shale, and metalimestone in the Ambler River, Survey Pass, and Wiseman quadrangles. *Unit description source:* WI007

Mkcc - Endicott Group, Kekiktuk Conglomerate or Kanayut Conglomerate (Mississippian (Tournaisian to Visean))

Mek - Kekiktuk Conglomerate (Mississippian) See [Mek](#) for unit description from [SIM-3340](#).

Mc - Quartz conglomerate (Early Mississippian) Conglomerate of stretched clasts of milky quartz, vericolored chert, quartzite, and grey slate chips in a quartz-muscovite matrix; also in Baird Mountains quad. *Unit description source:* AR002

Mke - Endicott Group, Kekiktuk conglomerate (Mississippian (Tournaisian) to Mississippian)

Mek - Kekiktuk Conglomerate (Mississippian) See [Mek](#) for unit description from [SIM-3340](#).

Mke (or Mke?) - Kekiktuk Conglomerate (Early Mississippian) Consists of three low-grade metasedimentary rock units.

Unit 1 - semischistose chlorite-muscovite-quartz metasandstone and metaconglomerate

Unit 2 - chloritoid bearing semischistose metaquartzite and quartz mylonite

Unit 3 - calcareous and feldspathic chlorite muscovite quartz semi-schistose metasandstone and metaconglomerate. *Unit description source:* SP002

Mke - Kekiktuk conglomerate (Early Mississippian) Kekiktuk conglomerate; Fine- to coarse-grained quartzite and quartz conglomerate; clasts are well-rounded gray chert, quartz, and quartzite. *Unit description source:* AR002

Mke(l)s - Undifferentiated limestone and marble (Mississippian and Devonian) The undifferentiated limestone and marble units have been classed based on the units they are contained within using 5XX where XX is the class of the surrounding unit. *Unit description source:* SP002

Mu? - Undivided Mississippian Sedimentary Rocks (Mississippian) Interbedded dark gray phyllite red and green weathering phyllite, quartz semischist, and minor quartz conglomerate. Also includes limestone and marble of Lisburne Group (MI), Kayak Shale (Mk), and Kekiktuk Conglomerate (Mke). *Unit description source:* SP002

Men - Endicott Group, Kapaloak sequence of Point Hope region (Early Mississippian to Late Mississippian)

Meks - Kapaloak sequence of Moore and others (2002) (Mississippian) See [Meks](#) for unit description from [SIM-3340](#).

Ms - Sedimentary rocks, undivided (Mississippian) Sedimentary rocks, undivided. *Unit description source:* PH004

Mks - Endicott Group, Kurupa Sandstone (Mississippian)

Mes - Kurupa Sandstone (Lower Mississippian) See [Mes](#) for unit description from [SIM-3340](#).

Mku - Kurupa Sandstone; Picnic Creek Allochthon, Akmalik Creek Sequence (Early

Mississippian) Sandstone, light- to medium-gray, beds up to 1 m thick, abundant amalgamated graded beds, abundant flutes and grooves and well developed Bouma sequences. Sand components in declining order of abundance: quartz, chert, feldspar. Weathers reddish brown, forms resistant ridges or spurs on valley walls. Well exposed at type locality in Kurupa Hills and in Akmalik Creek. Contains abundant plant fossils particularly near top formation, and scattered brachiopods near Otuk Creek. Kinderhookian to Meramecian. Thickness < 40 m, grades downward into Hunt Fork Shale. *Unit description source:* KL002 and KL006

Mku - Kurupa Sandstone; Ipnarik River Allochthon, Zebra Creek Sequence (Early Mississippian) Gray quartzitic sandstone, weathers gray to reddish brown, mostly rubble exposures, exposed locally near Otuk Creek and present as rubble on Zebra Creek. Thickness estimated <20 m. *Unit description source:* KL002

Mku - Kurupa Sandstone; Ipnarik River Allochthon, Iteriak Creek Sequence (Early Mississippian) Generally gray quartzitic sandstone, exposed as rubble, one exposure of light brown friable quartzose sandstone west of Iteriak Creek. Thickness probably <10 m. *Unit description source:* KL002

MDky - Endicott Group, Kanayut Conglomerate (Devonian (Frasnian) to Mississippian (Tournaisian))

MDegk - Kanayut Conglomerate and Noatak Sandstone, undivided (Lower Mississippian & Upper Devonian) See [MDegk](#) for unit description from [SIM-3340](#).

MDk - Kanayut Conglomerate (Mississippian and Devonian) White-weathering, light-gray, medium-bedded and cross-bedded quartzite, pebbly quartzite, and metaconglomerate. *Unit description source:* BM002

MDk - Kanayut Conglomerate (Early Mississippian? and Late Devonian) Gray to brown, tannish-brown-weathering, quartzitic sandstone and subordinate quartz- and chert-pebble conglomerate. Lower part contains gray to black shale, siltstone, sandstone, and conglomerate. Weathered surfaces characterized by black lichen growth. Forms resistant ledges and steep slopes of coarse, blocky talus. Thickness may vary, but about 800 m was reported east of Etivuk River by Mull and Werndon (1994). *Unit description source:* HW003

MDk - Kanayut Conglomerate - Endicott sequence, Endicott group, Key Creek facies (Early Mississippian? and Late Devonian) Gray to brown, tannish-brown-weathering, quartzitic sandstone and subordinate quartz- and chert-pebble conglomerate. Lower part contains gray to black shale, siltstone, sandstone, and conglomerate. Weathered surfaces characterized by black lichen growth. Forms resistant ledges and steep slopes of coarse, blocky talus. Thickness may vary, but about 800 m was reported east of Etivuk River by Mull and Werndon (1994). *Unit description source:* HW004

MDk - Allochthonous Rocks, Endicott Mountains Allochthon, Key Creek and Ivotuk Hills sequences, undivided; Kanayut Conglomerate (Early Mississippian to Late Devonian) Thick succession of gray to brown weathering quartzitic sandstone and minor quartz- and chert-pebble conglomerate, forms highest peaks in western Endicott Mountains. *Unit description source:* HW007

MDk - Allochthonous Rocks, Endicott Mountains Allochthon, Aniuk River sequence; Kanayut Conglomerate (Early Mississippian? and Late Devonian) Dark-gray to black weathering, fine- to coarse-grained quartzitic sandstone, and minor quartz- and chert-pebble conglomerate. *Unit description source:* HW007

MDk - Kanayut Conglomerate; Endicott Mountains Allochthon, Killik River Sequence (Early Mississippian(?) to Late Devonian) Thick succession of gray- to brown-weathering quartzitic sandstone, quartz- and chert-pebble conglomerate, and shale, forms high mountains in the southern part of the quadrangle, interpreted as dominantly fluvial deltaic deposits, thins and becomes finer grained westward; divided into: MDks, Dksl, and Dke. *Unit description source:* KL002

MDka - Kanayut Conglomerate (Early Mississippian? and Late Devonian) Gray to brown, gray-weathering, fine- to coarse-grained, quartzitic sandstone, and minor quartz- and chert-pebble conglomerate; commonly has gray to black mudstone, shale, and phyllitic shale partings and interbeds as much as a few meters thick. Interfingers downward with Noatak Sandstone. Thickness of about 183 m and 112 m measured at Isikut Mountain and along Aniuk River respectively. *Unit description source:* HW003

MDka - Kanayut Conglomerate - Endicott sequence, Endicott group, Aniuk River facies (Early Mississippian? and Late Devonian) Gray to brown, gray-weathering, fine- to coarse-grained, quartzitic sandstone, and minor quartz- and chert-pebble conglomerate; commonly has gray to black mudstone, shale, and phyllitic shale partings and interbeds as much as a few meters thick. Interfingers downward with Noatak Sandstone. Thickness of about 183 m and 112 m measured at Isikut Mountain and along Aniuk River respectively. *Unit description source:* HW004

Dk - Kanayut Conglomerate (Late Devonian) Medium- to thick-bedded clean quartzite and conglomerate; clasts include milky quartz and gray quartzite. *Unit description source:* AR002

Dk (or Dk?) - Kanayut Conglomerate (Late Devonian) Interbedded quartz wacke, subfeldspathic lithic wacke, feldspathic wacke, and black to dark gray phyllite and siltstone. *Unit description source:* SP002

Dksl - Kanayut Conglomerate, Shainin Lake Member; Endicott Mountains Allochthon, Killik River Sequence (Late Devonian) Pebble to cobble conglomerate quartzitic sandstone, and minor shale; conglomerate clasts consist of chert, quartz, and minor quartzite; braided stream deposit, forms a massive dark gray to black weathering resistant marker unit up to 600 m thick; becomes thinner and less conspicuous in the western and southern part of the quadrangle; grades down into Ear Peak Member. *Unit description source:* KL002

Dku - Kanayut Conglomerate, Stuver Member, middle conglomerate member and lower shale member, undivided (Late Devonian) Quartzite and conglomerate, partly rusty weathering, abundant red shale. *Unit description source:* PS002

DI - Unnamed limestone; Endicott Mountains Allochthon, Killik River Sequence (Late Devonian) Possibly part of Beaucoup Formation, mapped locally south of Toyuk thrust near head of Kakivilak Creek in southcentral part of quadrangle. *Unit description source:* KL002

MDkys - Endicott Group, Kanayut Conglomerate, Stuver Member, nonmarine shale and quartzite (Late Devonian to Early Mississippian)

MDegk - Kanayut Conglomerate and Noatak Sandstone, undivided (Lower Mississippian & Upper Devonian) See [MDegk](#) for unit description from [SIM-3340](#).

MDks - Kanayut Conglomerate, Stuver Member; Endicott Mountains Allochthon, Killik River Sequence (Early Mississippian(?) to Late Devonian) Thin bedded brown fine-grained quartzose and quartzitic sandstone with minor quartz- and chert- pebble conglomerate interbedded with micaceous

gray, greenish gray, reddish gray and brown shale and silty shale, generally upward-fining succession; meandering stream deposit, up to 200 m thick, grades down into Shainin Lake Member. *Unit description source:* KL002

Dks - Kanayut Conglomerate, Stuver Member (Late Devonian) Mostly shale, shaley siltstone and thin bedded sand stone and quartzite; minor conglomerate. Shale and siltstone, micaceous; red, green, brown, and black. Sandstone, ferruginous, micaceous, shaley, and fine grained. Quartzite, firmly cemented by silica, is gray, greenish gray or hematitic; mostly thin to medium bedded, partly crossbedded; fine to medium grained. Conglomerate and conglomeratic quartzite of chert and quartz pebbles occur locally at base of fining-upward cycles of quartzite and sandstone. Members weathers to dark brown and orange slopes in western half of quadrangle; red shale more conspicuous in eastern half. *Unit description source:* PS002

MDkn - Endicott Group, Kanayut Conglomerate and Noatak sandstone (Devonian (Frasnian) to Mississippian (Visean))

MDegk - Kanayut Conglomerate and Noatak Sandstone, undivided (Lower Mississippian & Upper Devonian) See [MDegk](#) for unit description from [SIM-3340](#).

MDkn - Kanayut conglomerate and Noatak sandstone (Early Mississippian? and Late Devonian) Middle Endicott Group, Kanayut conglomerate (Upper Devonian and Lower Mississippian) - Nonmarine sandstone, conglomerate, and shale with minor marine tongues. Noatak sandstone (Upper Devonian) - Marine, partly calcareous, sandstone, and shale. *Unit description source:* WI002

MDkna - Kanayut Conglomerate and Noatak Sandstone (Early Mississippian and Late Devonian) Endicott sequence, Endicott group, Aniak River facies. *Unit description source:* HW004

MDn1 - Noatak Sandstone and Kanayut Conglomerate, undivided (Early Mississippian and Late Devonian) Mostly light-brown- to reddish-brown-weathering, well-indurated, fine- to coarse-grained sandstone with interbeds of conglomerate, siltstone, and maroon and gray shale. Sandstone locally calcareous. *Unit description source:* DL002 and DL003

MDn1 - Noatak Sandstone and Kanayut Conglomerate, undivided (Mississippian and Devonian) Part of the Key Creek Sequence - Interbedded fine to coarse-grained, well indurated sandstone, siltstone, and shale, commonly rusty-weathering. Contains a few thin conglomerate beds. Marine calcareous sandstone beds locally contain Late Devonian crinoids and brachiopods. Top is also probably time equivalent to non-marine sandstone that contains Mississippian plant fossils *Lepidodendropsis* sp. (S. H. Mamay, written commun., 1976) in Howard Pass quadrangle and *Stigmaria varrucosa* (Smith and Mertie, 1930) in Killik River quadrangle. Depositional thickness is probably greater than 200 m. Base is gradational into the Hunt Fork Shale. *Unit description source:* MU002, MU003, and MU004

Dk - Endicott Mountains Allochthon - Kanayut Conglomerate (Devonian) Probably mostly what we would now call Noatak, marine sandstones, not a lot of conglomerate. *Unit description source:* NT006

Dkh - Sandstone member of Kanayut Conglomerate and Wacke member of Hunt Fork Shale, undivided (Late Devonian) Forms brown and dark gray shaley slopes and cliffs. Beds in western part strike into wake member; those in eastern part are mostly sandstone member. *Unit description source:* PS002

Dkln - Kanayut Conglomerate and Noatak sandstone, undivided (Late Devonian) Ear Peak Member of Kanayut Conglomerate and Noatak Sandstone. Ear Peak Member is mostly shale,

mudstone, sandstone, and conglomerate. Shale is reddish brown, grayish-green, brownish-gray, and grayish-black, very silty, micaceous and grades to siltstone. Sandstone is quartz-rich and ranges between orthoquartzite and quartz-rich with varying cements. Conglomerate is largely granule- to cobble-sized quartz and chert having a sandstone matrix. Unit varies across map area; sandstone most abundant in north and east, shale south of Toyuk mountain Thrust. Noatak Sandstone is principally sandstone and mudstone. Pinkish-gray, light-brownish-gray, and light light-gray calcareous-cemented, fine- to coarse-grained sandstone is typical. Locally sandstone is deeply iron-stained, providing possible evidence of nonmarine sedimentation. *Unit description source:* CL002

Dkn - Kanayut Conglomerate (part) and Noatak sandstone, undivided (Late Devonian)

Sandstone, shale, and conglomerate. Sandstone is reddish-brown to brownish-gray, iron-stained, fine- to coarse-grained, moderately to poorly sorted, thin- to medium-bedded and prominently crossbedded. Reddish-brown and dark-gray shale is very silty, sandy in part, carbonaceous in part and ferruginous in part. Conglomerate is framework-supported, granule to pebble in size and composed of chert, quartz, and silicic rock fragments. *Unit description source:* CL002

Dkn - Kanayut Conglomerate and Noatak Sandstone, undivided; Endicott Mountains

Allochthon, Killik River Sequence (Late Devonian) Intertongued transitional facies south of Toyuk thrust in southwestern part of quadrangle, and north of Toyuk thrust between Ivotuk Creek and East Fork of Etivluk River. *Unit description source:* KL002

MDkh - Endicott Group, interlayered dark gray to black phyllite and calcareous phyllite (Devonian to Mississippian)

Dbf - Beacoup Formation, undivided (Devonian) See [Dbf](#) for unit description from [SIM-3340](#).

MDcp - Phyllite (Mississippian and Devonian) Interlayered dark gray to black phyllite and calcareous phyllite. Unit is more siliceous than either Early Mississippian Kayak Shale or Late Devonian Hunt Fork Shale although it is lithologically similar to both. At present, these rocks are considered undivided Kayak and Hunt Fork Shales.

Unit split into western and eastern parts by Till and others, western part 6686, eastern remains 6331.

Unit description source: SP002

MDcp(l)s - Undifferentiated limestone and marble (Mississippian and Devonian)

The undifferentiated limestone and marble units have been classed based on the units they are contained within using 5XX where XX is the class of the surrounding unit. *Unit description source:* SP002

Pzbs - Black metasedimentary rocks (Paleozoic) Dark gray to black phyllite and calcareous phyllite with dark gray to orange-weathering marble and dolostone layers up to 50 m thick, exposed in the northeastern Survey Pass and northwestern Wiseman quadrangles. This unit is part of the Central belt.

Unit description source: WI007

MDrao - Ruby terrane, augen gneiss and schist (Early Mississippian or Devonian (Famennian))

MDag - Augen gneiss and orthogneiss (Early Mississippian & Late Devonian) See [MDag](#) for unit description from [SIM-3340](#).

MzPzg - Mesozoic or Late Paleozoic (Granitic rocks) Gneissic chloritized biotite granite, quartz monzonite, and granodiorite. Some gneissic chloritized hornblende granite and granodiorite with

secondary epidote and calcite along northwest margin of Geroe Creek pluton, in sill through Horace Mtn. and at Our Creek grades locally to closely foliated chloritic granite gneiss. Includes some biotitic quartzite southwest of Caro. Bodies south of Kobuk Fault, part of Ruby terrane. *Unit description source:* CH002

MCm - Marble, northern Alaska (Cambrian to Mississippian)

Pzcn - Marble, northern Alaska (early Paleozoic) See [Pzcn](#) for unit description from [SIM-3340](#).

Pzca - Carbonate rocks (Paleozoic) Ranges from light gray to white partly recrystallized limestone to coarsely crystalline marble. Dark finely crystalline dolomitic marble. Interbedded calc schist, chloritic schist, and quartzite in subordinate amounts. Unit ranges in age from Ordovician to Mississippian and may locally include rocks as old as Cambrian. Distributed along northern edge of map area from Baird Mountains and Selawik quadrangle on the west to Wiseman quadrangle on the east. Occurs as scattered bodies within schistose and phyllitic rocks of units PzPxsa, PzPxua, and Pzpa and as tectonic blocks in the mélange unit KJm. *Unit description source:* AR003, SE004, SH004, and WI003

Pzkm - Marble of Klery Creek (Paleozoic) White-weathering, medium- to light-gray marble with subordinate intercalated gray to green quartz chlorite schist, black carbonaceous quartzite and tan calcareous mica schist. *Unit description source:* BM002

Pzl - Limestone (middle Paleozoic) Light-gray, recrystallized, limestone and dolomite containing minor intercalated phyllite and mica schist. Arctic Alaska terrane, northern part of quadrangle. *Unit description source:* SE002

Pzm - Marble (Paleozoic) White to gray, fine to coarsely crystalline, massive to platy marble and subordinate light-gray, finely crystalline dolostone. *Unit description source:* BM002

DI - Limestone (Devonian) Light-gray fine-grained recrystallized limestone; probably correlative with Skajit Limestone of Wiseman (Brosge and Reiser, 1960, 1964). *Unit description source:* HU002

PNMv - Lisburne Group, associated volcanic rocks and sills (Carboniferous)

Clgv - Volcanic rocks and sills associated with Lisburne Group (Mississippian & Pennsylvanian?) See [Clgv](#) for unit description from [SIM-3340](#).

IPMkv - Volcaniclastic rocks (Pennsylvanian? and Mississippian?) Predominantly light-gray to green-gray, light-brown to rusty-weathering felsic tuff containing abundant feldspar and sparse biotite phenocrysts; typically has calcareous cement and disseminated sulfide minerals. Commonly associated with tuffaceous sandstone, coarse-grained limestone containing disseminated light-green chloritic minerals, and thick-bedded to massive calcareous rocks containing volcanic fragments. *Unit description source:* HW003

IPMv1 - Intermediate to mafic volcanic rocks (Pennsylvanian or Mississippian) May include hypabyssal intrusive rocks. Andesite or basalt composed of plagioclase, augite, biotite, apatite, and ilmenite(?) that is partly altered to chlorite, kaolinite, calcite, and leucoxene. Probably interfingers with upper part of the Kuna Formation. Part of the Brooks Range allochthon, Key Creek sequence. *Unit description source:* DL003

IPMv1 - Felsic Volcanic Rocks (Pennsylvanian and Mississippian) Part of the Key Creek Sequence - Includes hypabyssal intrusive rocks. Biotite latite or andesite in exposures west of Nimiuktuk River (southeastern Misheguk Mountain quadrangle map); porphyritic biotite latite and tuffaceous sedimentary rocks west of Kugururok River (southwestern Misheguk quadrangle map). In uncertain stratigraphic position but probably in upper part or top of the Kuna Formation. Potassium-argon date from biotite in volcanic rocks near Nimiuktuk River 333±17 m.y. (Mayfield and others, 1979). *Unit description source:* MU002 and MU003

Mv - Volcanic Rocks (Mississippian) Sill of chloritized andesite and diorite, composed of andesine, chlorite, actinolite, calcite. Crops out only in north part of quadrangle. Correlated with dikes, sills, and andesitic flow and tuff in Mississippian part of Lisburne Group about 10km farther north. *Unit description source:* PS002

PNMn - Nuka Formation (Mississippian to Pennsylvanian)

IPMn - Nuka Formation (Carboniferous) See [IPMn](#) for unit description from [SIM-3340](#).

IPMn - Nuka Formation (Pennsylvanian and Mississippian) Light gray- to buff-weathering, coarse- to medium-grained arkose, arkosic limestone, and limestone. Contains locally abundant glauconite and rare hematite-cemented beds. Arkose consists of quartz with potassium and plagioclase feldspars apparently derived from a southern source. Depositional thickness is estimated to range from a few meters to 300 m. Base is gradational into Kayak Shale. *Unit description source:* HW003

IPMn - Nuka Formation - Nuka Ridge sequence, Lisburne Group (Pennsylvanian and Mississippian) Light gray- to buff-weathering, coarse- to medium-grained arkose, arkosic limestone, and limestone. Contains locally abundant glauconite and rare hematite-cemented beds. Arkose consists of quartz with potassium and plagioclase feldspars apparently derived from a southern source. Depositional thickness is estimated to range from a few meters to 300 m. Base is gradational into Kayak Shale. *Unit description source:* HW004

IPMn - Nuka Formation; Copter Peak and Nuka Ridge Allochthons, undivided, Kikiktat Mountain Klippe (Pennsylvanian-Mississippian) Arkosic limestone and sandstone, medium gray, weathers light gray, and interbedded black clay shale. Sandstone is fine to medium grained, calcareous, in thickening- and coarsening- upward beds, section has turbidite characteristics with graded beds up to 1 m thick with convolute bedding and large flute casts at base of some beds; base of section dominantly black clay shale. Arkosic limestone contains Late Mississippian to Early Pennsylvanian fossils in scattered localities. Section approximately 30 m thick, overlain by Pami at a baked contact. Thrust fault contact with underlying mafic igneous rock Pamil. *Unit description source:* KL002

IPMn - Nuka Formation (Permian, Pennsylvanian, and Mississippian) Very distinctive light-hued, gray and greenish, arkosic, calcarenitic, and glauconitic marine sandstone and conglomerate, intimately associated limy siltstone, platy limestone, sandy dolomite, dark claystone, and mostly light-colored unit. Likely only a few hundred m thick. *Unit description source:* MU006, MU007, and MU012

IPMn5 - Nuka Formation (Pennsylvanian? and Mississippian) Light-gray- to buff-weathering, coarse-grained arkose, limestone, arkosic limestone, and glauconitic calcareous sandstone. Part of the Nuka Ridge allochthon, Bogie sequence. *Unit description source:* DL004

IPMn5 - Nuka Formation (Pennsylvanian and Mississippian) Part of the Bogie Sequence - Light-gray to buff-weathering coarse to medium-grained arkose, arkosic limestone, and limestone. Contains locally abundant glauconite and rare hematite cemented beds. Arkose consists of quartz with potassium

and plagioclase feldspars apparently derived from an unknown southern granitic source. The upper part of the Nuka Formation has previously been dated on the basis of brachiopod identifications as Permian in age (Tailleur and others, 1973). However recent collections of conodonts (Table 2) from the top beds of this unit at Nuka Ridge indicate that its age is not older than Early Pennsylvanian (A. G. Harris, written commun., 1982). Mississippian foraminifers and conodonts occur in the Nuka from a wide area of the western Brooks Range. The age of the Nuka therefore is considered to be Late Mississippian and Early Pennsylvanian. Depositional thickness is estimated to range from a few meters to 300 m; base is gradational into the Kayak Shale. *Unit description source:* MU002, MU003, and MU004

IPMn5 - Nuka Formation, Nuka Ridge Allochthon, Bogie Sequence (Pennsylvanian? and Mississippian) Light-gray to maroon, medium- to coarse-grained arkose, calcareous arkose, and coarse-grained limestone. Locally contains red beds, glauconitic sandstone, and gray shale. Depositional thickness probably less than 40 m. *Unit description source:* NT005

MDI5 - Limestone, Bastille Sequence (Mississippian and or Devonian) Part of the Bastille Sequence - Light-gray-weathering, well bedded limestone. Locally contains glauconite. Interbedded coarse-to fine-grained feldspathic sandstone at top of Mount Bastille (south-central Misheguk Mountain quadrangle map) contains up to 15 percent potassium feldspar and may be equivalent of the Nuka Formation. Age based on uncertain correlation with fossiliferous Mississippian limestone in other sequences and Devonian limestone and dolomite (unit DI5). Includes upper part of the Kugururok Formation at Mount Bastille (Sable and Dutro, 1961). In most places base is a thrust fault; at Mount Bastille base is gradational into limestone and dolomite (unit DI5), and south of Copter Peak (southwestern Misheguk Mountain quadrangle map) base is gradational into shale, limestone, calcareous siltstone and sandstone (unit Dsl5). *Unit description source:* MU002 and MU004

PMn, Mka, JPacl - Nuka Formation, Kayak Shale and Light-colored cherty unit (Mesozoic and (or) Paleozoic) Very distinctive light-hued, gray and greenish, arkosic, calcarenitic and glauconitic marine sandstone and conglomerate and dark-gray shale, yellowish-weathering platy limestone, siltstone, and minor sandstone and dark-gray to black, micritic, silty, mostly thin-bedded limestone having thin chert interbeds and Dark-gray shale, yellowish-weathering platy limestone, siltstone, and minor sandstone more than 450 m thick, undivided. *Unit description source:* MU006

PMn, Mka, JPacl - Nuka Formation, Kayak Shale and Light-colored cherty unit (Mesozoic and (or) Paleozoic) Very distinctive light-hued, gray and greenish, arkosic, calcarenitic and glauconitic marine sandstone and conglomerate and dark-gray shale, yellowish-weathering platy limestone, siltstone, and minor sandstone and dark-gray to black, micritic, silty, mostly thin-bedded limestone having thin chert interbeds and Dark-gray shale, yellowish-weathering platy limestone, siltstone, and minor sandstone more than 450 m thick and Thin- to medium-bedded, vitreous to dull, gray, bluish, greenish, olive, reddish, and minor black chert, siliceous claystone, argillite, and siltstone, 100 to 200 m thick. Probably mostly Permian and Triassic in age, equivalent in part to Siksikpuk and Shublik Formations but may contain Lisburne equivalent rocks, undivided. *Unit description source:* MU006

Pn? Pns - Nuka Ridge Allochthon - Nuka Formation (Permian) Arkosic limestone. Probably should be Mn rather than Pn, based upon later regional paleo data. Recognized only in a couple of pinnacles in the northwestern part of the quad. *Unit description source:* NT006

PMZk - Mixed schists of the Kallarichuk Hills, undivided (Neoproterozoic to Carboniferous)

DPxacs - Calcareous schist of Brooks Range (Proterozoic to Devonian) See [DPxacs](#) for unit description from [SIM-3340](#).

Pzca - Calcareous schist (Paleozoic) Brown weathering calcareous quartz albite muscovite schist. This schist contains 15-25 percent calcite but is otherwise similar to quartz muscovite schist (Pzqms). *Unit description source:* SP002

Pzca(Is) - Undifferentiated limestone and marble (Mississippian and Devonian) The undifferentiated limestone and marble units have been classed based on the units they are contained within using 5XX where XX is the class of the surrounding unit. *Unit description source:* SP002

Pzcm - Chlorite marble (Devonian and older (?)) Mostly orange weathering chloritic marble. *Unit description source:* AR002

Pzcq (or Pzqc?) - Chloritic quartzite (Carboniferous?) Massive- to thick-bedded, clean, and light greenish gray quartzite with local thin quartz pebble conglomerate; mostly quartz-muscovite-chlorite paragneiss; also albite-quartz-muscovite-chlorite orthogneiss; may correlate with similar, less metamorphosed, Carboniferous coarse clastic-volcanic sequence in northeast Baird Mountains. *Unit description source:* AR002

Pzcs (or Pzcs?) - Calc-schist (Devonian and older (?)) Calc-schist; Buff weathering calcite-quartz-muscovite-chlorite +/- albite schist; includes lesser greenstone and marble. *Unit description source:* AR002

Pzm - Marble (Ordovician (?)) Gray, buff or red weathering, light-gray, and commonly dolomitic marble; mapped as a unique unit independent of Pzmq when possible. *Unit description source:* AR002AR004

Pzmq - Marble and quartzite (Ordovician (?)) Complex stratigraphic and structural unit composed of clean white fine-grained quartzite interbedded with marble or limestone; contains gray phyllite, siltstone, and quartz-mica +/- chlorite schist; quartzite (Pzq) and marble (Pzm) mapped where possible. *Unit description source:* AR004

Pzmsm - Mixed Schist and Marble (Paleozoic) Interlayered gray marble, orange dolomitic marble, magnetite bearing chlorite schist, and garnet biotite quartz schist with small calcsilicate skarns containing amphibole near the Arrigetch pluton. Intermediate amount of interlayered marble distinguishes these rocks from marble unit, DSso (more marble), and the schist unit Pzsch (less marble); however, they may be equivalent in age. *Unit description source:* SP005

Pzmsm(Is) - Undifferentiated limestone and marble (Mississippian and Devonian) The undifferentiated limestone and marble units have been classed based on the units they are contained within using 5XX where XX is the class of the surrounding unit except in the case of class 591 which was used for the limestone and marble units between two different units. *Unit description source:* SP005

Pzs - Schist and phyllite (middle Paleozoic) Chiefly light- to dark-gray fine-grained quartz-mica schist and grayish-black phyllite. Subordinate calcareous schist, limestone, chlorite schist, and amphibolite schist. May locally include metasedimentary rocks of middle Cretaceous age. *Unit description source:* SE002

Pzsch - Schist (Paleozoic) Predominantly very light gray to gray weathering garnet biotite albite muscovite quartz schist. Schist includes minor tan weathering muscovite quartzite and gray quartz muscovite schist and is interlayered with marble (Pzl and DSsk) and greenstone (Pzgg). Unit may be higher metamorphic grade equivalent to metamorphic rocks (Pzqms) in "schist belt" to south. *Unit description source:* SP002

Pzsch(Is) - Undifferentiated limestone and marble (Mississippian and Devonian) The undifferentiated limestone and marble units have been classed based on the units they are contained within using 5XX where XX is the class of the surrounding unit except in the case of class 591 which was used for the limestone and marble units between two different units. *Unit description source:* SP002

Pzuc (or Pzuc?) - Undifferentiated chloritic quartzite and schist (Carboniferous? and Devonian?) Mostly greenish gray quartz-chlorite-albite +/- calcite schist that includes feldspathic orthogneiss; Lesser amounts of undifferentiated quartz-mica schist, quartzite, marble, and calcareous schist may represent Pzmg, Pzcs, Pzcm, uqm, and Pzi. In part equivalent to Pzcq. *Unit description source:* AR002

Dca - Chloritized amphibole-schist (Devonian) Gray and green, slightly calcareous schist with conspicuous chlorite after amphibole; quartz, albite, chlorite after garnet, muscovite, calcite, epidote, little remnant amphibole and calcium garnet; rare interbedded marble. *Unit description source:* CH002

Dch - Calc-silicate hornfels (Devonian) Pale olive to grayish green, dense, fine-grained, well bedded, altered limestone of variable composition: actinolite, epidote, muscovite, calcite, garnet, biotite, chlorite, calcite; diopside, epidote, calcite; all with quartz and commonly with feldspar. Interbedded with marble, black and white siliceous siltstone, and arkose hornfels that locally contains biotite, diopside, and scapolite. *Unit description source:* CH002

Dqq - Siltstone and quartzite (Devonian) Light-gray, reddish-brown-weathering pyritic silicified siltstone and quartzite. *Unit description source:* CH002

DSom - Orange Marble (Devonian and Silurian) Orange weathering, medium- to coarse-grained chloritic marble, locally highly sheared; contains boudins. *Unit description source:* AR002

DSsk - Skajit Limestone (Devonian and Silurian) Massive light gray weathering cream to very light gray fine to medium grained granoblastic marble. Includes minor muscovite and quartz bearing marble. Minor calc-silicate skarns have been developed near Arrigetch pluton. *Unit description source:* SP005

DSso - Orange Dolomitic Marble (Devonian and Silurian) Orange weathering medium to coarse grained granoblastic chlorite muscovite quartz dolomite(?) marble. Marble contains interlayered chlorite schist, calcareous muscovite schist, and gray marble (DSsk). *Unit description source:* SP002

DSso(Is) - Undifferentiated limestone and marble (Mississippian and Devonian) The undifferentiated limestone and marble units have been classed based on the units they are contained within using 5XX where XX is the class of the surrounding unit. *Unit description source:* SP002

DpCsc - Calcareous schist, Schist belt (Devonian to Proterozoic) Light gray, brown and locally orange-weathering, lithologically heterogeneous mix of marble and carbonate-rich, quartz-rich, and mafic schist derived from metasedimentary and metaigneous protoliths, one of two major units that extends along the length of the Schist belt. Within the unit, lithologies are interlayered at scales varying from millimeters to tens of meters. Part of the Schist belt. *Unit description source:* AR004CH004

PzPcs? - Calcareous schist (Proterozoic or Paleozoic) Banded schist, paragneiss, and orthogneiss that may have been regionally metamorphosed three times. Upper greenschist facies rocks predominate, but includes amphibolite facies paragneiss, and local relict blueschist and eclogite facies metabasite. Calcareous schist with layers of marble and PzPs. *Unit description source:* WI002

PzPkc - Calcareous schist and marble of the Kallarichuk Hills (Paleozoic and (or) Proterozoic) Tan to brown calcareous quartz-mica schist, gray quartz-albite-mica schist, black carbonaceous schist, and lenses of massive gray marble tens of meters thick. *Unit description source:* BM002

PzPku - Mixed schists of the Kallarichuk Hills, undivided (Paleozoic and (or) Proterozoic) Silvery green and gray quartz-mica schists, brown calcareous schists, gray marble and black quartzite. *Unit description source:* BM002

PzZcs - Calcareous schist (Proterozoic or Paleozoic) Banded schist, paragneiss, and orthogneiss that may have been regionally metamorphosed three times. Upper greenschist facies rocks predominate, but includes amphibolite facies paragneiss, and local relict blueschist and eclogite facies metabasite. Calcareous schist with layers of marble and PzPs. *Unit description source:* WI002

PzZqs - Quartz-rich metasedimentary rocks (Paleozoic to Proterozoic?) Relatively homogeneous assemblage dominated by light greenish-gray fine-grained quartz-rich schist, typically accompanied by minor layers of metaconglomerate, marble, and calcareous schist. Exposed in the southern Central belt in the western Survey Pass quadrangle and straddling the Wiseman-Chandalar quadrangle boundary. This unit is part of the Central belt. *Unit description source:* AR004

Emma Creek schist - Coldfoot terrane (Early Devonian to Silurian) Calcareous schist and subordinate interlayered noncalcareous schist and marble. *Unit description source:* CH009

Midnight Dome schist - Coldfoot terrane (early Paleozoic) Light-gray quartz schist and structurally higher unit of micaceous quartzite, calcareous schist, and marble. Contains intercalated layers of mafic schist becoming more numerous upward. Contains pseudomorphs of amphibole, rarely cored by blue amphibole. *Unit description source:* CH009

Vi Creek schist - Hammond terrane (early Paleozoic) Laminated very fine-grained white mica-chlorite-quartz schist and sparse metaconglomerate and marble. *Unit description source:* CH009

Dp - Phyllite of Arctic Alaska terrane (Devonian)

TrPzgp - Metagraywacke and phyllite (Triassic & Late Paleozoic) See [TrPzgp](#) for unit description from [SIM-3340](#)

Dp - Graywacke and phyllite -- phyllite (Devonian?) Black phyllite and slate; interbedded fine-grained quartzitic, locally schistose, subgraywacke and lithic graywacke like that in overlying unit (Dgw) increase upward. *Unit description source:* CH002

Pzp - Phyllite (Paleozoic and older (?)) Lithologically homogenous brown and gray phyllite or slate composed of fine-grained quartz and sericite. *Unit description source:* AR002

Pzp - Phyllite (Paleozoic?) Phyllite, fine-grained schist, and phyllonite of the Central belt that underlie areas of poor exposure in the northeastern Baird Mountains quadrangle, western Ambler River quadrangle, and northwestern Chandalar quadrangle. Locally contains minor lenses of metalimestone and metaconglomerate. This unit is part of the Central belt. *Unit description source:* CH004

Pzp - Phyllite (Paleozoic) Light to dark gray phyllite and slate, commonly sericitic. Phyllite may be in part gradational into chloritoid bearing schist (Pzcs) and quartz muscovite schist (Pzqms). Because of poor exposures, phyllite may contain unrecognized mafic volcanic rocks (MzPzv). *Unit description source:* SP002

Pzpa - Phyllite and subordinate metagraywacke (Paleozoic?) Dark phyllite and minor metagraywacke that have a penetrative fabric ranging from slaty cleavage to weakly schistose. Unit

locally contains slices of little deformed shallow-water Devonian carbonate rocks that are enveloped in basalt flows and debris-flow(?) breccias composed of blocks of vesicular basalt in a matrix of volcanic and carbonate debris. Age of unit is probably middle or late Paleozoic and correlative with Pzpr unit in the Ruby terrane. Forms a belt extending along northern edge of the map area from Baird Mountains quadrangle to Wiseman quadrangle. *Unit description source:* AR003, HU003, and WI003

Dpr - Ruby terrane, phyllite (Devonian)

TrPzgp - Metagraywacke and phyllite (Triassic & Late Paleozoic) See [TrPzgp](#) for unit description from [SIM-3340](#)

Dh – Hornfels (Devonian(?)) Thermally altered gray to black quartzite, spotted siltstone, and phyllite Assigned to Rampart Group sedimentary rocks. Reassigned single polygon to Ruby phyllite. *Unit description source:* BV004

Pzp - Phyllite (Late Paleozoic or Devonian) Dark-gray to black phyllite with subordinate fine-grained metagraywacke. *Unit description source:* BT002

Dsb - Brooks Range schist belt, calcareous schist, gray quartz-mica schist, and marble (Devonian)

DPxacs - Calcareous schist of Brooks Range (Proterozoic to Devonian) See [DPxacs](#) for unit description from [SIM-3340](#).

Dgh - Garnet-hornblende greenschist (Devonian) Garnet-hornblende greenschist; dark greenish-gray granular to schistose rock composed of albite, chlorite, hornblende, garnet, epidote, calcite, and locally, biotite. Locally includes undifferentiated biotite schist, calc-silicate hornfels and thin granite sills. *Unit description source:* CH002

Dgs - Greenschist (Devonian) Greenschist; albite-epidote-chlorite-muscovite schist with calcite, quartz, sphene and rare hornblende. *Unit description source:* CH002

Dqs - Quartz-mica schist (Devonian) Locally mapped basal(?) black fine-grained quartz-muscovite-chlorite schist. *Unit description source:* CH002

Dhf - Endicott Group, Hunt Fork Shale (Devonian (Frasnian to Famennian))

Degh - Hunt Fork Shale (Devonian) See [Degh](#) for unit description from [SIM-3340](#).

Dh - Hunt Fork Shale (Late Devonian) Mostly shale and sandstone; shale is medium-dark-gray and olive-gray. Sandstone is grayish-green and greenish-gray, mostly fine- to medium-grained, micaceous, and locally ripple crossbedded and or graded. *Unit description source:* CL002

Dh - Hunt Fork Shale, Endicott sequence, Endicott group, Key Creek facies (Late Devonian) Endicott sequence, Endicott group, Key Creek facies. *Unit description source:* HW004

Dha - Hunt Fork Shale (Late Devonian) Endicott sequence, Endicott group, Aniuk River facies. *Unit description source:* HW004

Dhf - Hunt Fork shale (Late Devonian) Hunt Fork shale; Homogenous gray phyllite; Upper half contains a few thin interbeds of fine-grained siltstone. *Unit description source:* AR002

Dhf - Hunt Fork Shale (Devonian) Light to dark, silvery gray to green or black phyllite with intercalated siliceous or calcareous metasiltstone, wacke, and metasandstone. *Unit description source:* BM002

Dhf - Hunt Fork Shale (Late Devonian) Dark gray to black phyllite and lesser gray-green phyllite with thin layers of siliceous or calcareous metasiltstone, lithic wacke, metasandstone, and minor layers of fossiliferous metalimestone exposed along the length of the northern boundary of the map. Locally massive mafic sills and dikes up to 10 m thick are common. Mafic bodies in the unit (both strongly or weakly foliated parts) display lower greenschist-facies minerals. *Unit description source:* CH004

Dhf - Hunt Fork Shale; Endicott Mountains Allochthon, Killik River Sequence (Late Devonian) Dark gray- and olive-green shale, with interbedded thin bedded quartz-chert wacke, quartzite, sandstone, and minor conglomerate in upper part north of Toyuk thrust, grades upwards into Noatak Sandstone; dominantly micaceous phyllitic shale in lower part; interpreted as a pro-delta deposit, more than 1000 m thick. South of Toyuk thrust, unit grades progressively down from thinly interbedded greenish-gray micaceous sandstone and phyllite into dominantly micaceous phyllite that forms smoothly weathered slopes with conspicuous micaceous sheen. *Unit description source:* KL002

Dhf - Hunt Fork Shale; Picnic Creek Allochthon, Akmalik Creek Sequence (Late Devonian) Greenish gray to gray silty mudstone and fissile shale, usually poorly exposed, but up to 500 m thick in Kurupa Hills. *Unit description source:* KL002

Dhf - Hunt Fork Shale (Late Devonian) Black slate and phyllite, minor fossiliferous limestone; lithic wacke locally in upper part; basal quartz-chert clast conglomerate and sandstone. Twice metamorphosed sedimentary and volcanic rocks; Middle to Upper Greenschist facies. Metamorphic facies and texture increases southward; mostly phyllite and limestone in north; schist and marble in south. Lower Endicott Group- Carbonaceous siliceous clastic rocks. Grades downward into Beaucoup Formation in some places; unconformably overlies upper Middle Devonian and older rocks in other places.. *Unit description source:* WI002

Dhf (or Dhf?) - Hunt Fork Shale (Late Devonian) Dark gray to black slate and phyllite. Minerals recognizable in thin section are chlorite, muscovite, quartz, and albite. *Unit description source:* SP002

Dhf? - Hunt Fork Shale (Late Devonian) Twice metamorphosed sedimentary and volcanic rocks; Middle to Upper Greenschist facies. Metamorphic facies and texture increases southward; mostly phyllite and limestone in north; schist and marble in south. Lower Endicott Group- Carbonaceous siliceous clastic rocks. Grades downward into Beaucoup Formation in some places; unconformably overlies upper Middle Devonian and older rocks in other places. Black slate and phyllite, minor fossiliferous limestone; lithic wacke locally in upper part; basal quartz-chert clast conglomerate and sandstone. *Unit description source:* WI002

Dhf1 - Hunt Fork Shale (Late Devonian) Shale, slate, and phyllite with lesser amounts of interbedded siltstone and sandstone. Part of Brooks Range allochthon, Key Creek sequence. *Unit description source:* DL002

Dhf1 - Hunt Fork Shale (Devonian) Part of the Key Creek Sequence - Shale, slate and phyllite with lesser amounts of well-indurated, thin interbedded siltstone and fine-grained sandstone. Calcareous beds contain a few impressions of Late Devonian crinoids, brachiopods, and cephalopods. Depositional thickness probably greater than 300 m. Base not exposed in map area. *Unit description source:* MU002, MU003, and MU004

Dhf(Is) - Undifferentiated limestone and marble (Mississippian and Devonian) The undifferentiated limestone and marble units have been classed based on the units they are contained within using 5XX where XX is the class of the surrounding unit. *Unit description source:* SP002

Dhl - Hunt Fork Shale, Limestone member (Late Devonian) Dark gray limestone, that weathers yellow, brown, and gray; thin to medium bedded or nodular; algal lumps common. Commonly argillaceous and locally interbedded with black shale; arenaceous near Dietrich River. Commonly includes some orange-weathering partly calcareous siltstone and fine grained sandstone above or below the limestone. *Unit description source:* PS002

Dhs - Hunt Fork Shale, shale member (Late Devonian) Mudstone, shale, and sandstone; mudstone and shale are medium- to medium-dark-gray, very silty, fissile, and interbedded with sandstone. Sandstone is brownish- and greenish-gray, fine- to medium-grained, mostly fine-grained, laminated, low-angle crossbedded and wavy laminated in part. *Unit description source:* CL002

Dhs - Hunt Fork Shale, Shale member (Late Devonian) Dark gray to medium gray, fissile, laminated clay shale and slate, silt, and micaceous siltstone; few ironstone concretion; weathers black to brown; locally pyritic and weathers rusty. Interbedded with as much as 25% brown-weathering, thin bedded fine grained, partly calcareous sandstone and graystone, including both quartz-chert arenite and quartz-chert wacke; sandstone schistose in southern part of area. Minor thin beds of ferruginous, argillaceous, fossiliferous limestone. Cyclic depositional pattern evident, with siltstone grading upward into shale; limestone in upper parts of some cycles. *Unit description source:* PS002

Ds - Shale (Devonian) Black sooty siliceous and calcareous shale containing lenses of chert and fossiliferous calcareous quartz sandstone. Coeval with calcareous phyllites and sandstones of the Nakolik River sequence (Dnu). *Unit description source:* BM002

Dst - Siltstone (Late Devonian) Black siltstone, occurs locally at base of unit and locally above basal conglomerate. *Unit description source:* CH002

Dhbw - Endicott Group, Hunt Fork Shale, wacke member (Late Devonian)

Degn - Noatak Sandstone (Upper Devonian) See [Degn](#) for unit description from [SIM-3340](#).

Dbw - Unnamed brown calcareous clastic rocks, Wacke member (Late Devonian) Sandstone and shale that weather brown and orange. Sandstone mostly limonitic, thin-bedded, calcareous and noncalcareous, micaceous, fine-grained, quartz-chert wacke; some gray quartzite and very fine grained shaley sandstone. Clay shale and shaley siltstone brown, grayish green, and black, manganiferous, micaceous. Local calcareous conglomerate and black siliceous siltstone. Weathers to brown smooth slopes. Apparently contains less green shale and siltstone, and more calcareous sandstone than wacke member of Hunt Fork Shale. *Unit description source:* PS002

Dhc - Hunt Fork Shale, Calcareous sandstone member (Late Devonian) Sandstone and shale that weather light brown and orange. Sandstone mostly thin bedded, very fine to grained, partly to highly calcareous; minor amounts of noncalcareous medium to thick bedded, fine to medium grained sandstone. Clay shale and shaley siltstone dark gray to grayish green, locally manganiferous; contain thin beds of orange weathering limestone at one locality. *Unit description source:* PS002

Dhfs (or Dhfs?) - Hunt Fork Shale - Wacke sandstone member (Late Devonian) Interbedded dark gray, brown weathering feldspathic and subfeldspathic lithic wacke, dark gray brown to tan weathering siliceous siltstone and dark gray to black phyllite. *Unit description source:* SP002

Dhq - Hunt Fork Shale, Quartzite member (Late Devonian) Fine grained quartzite that weathers dark gray to rusty orange, and some calcareous sandstone; interbedded with black slate and siltstone. Probably marine. *Unit description source:* PS002

Dhw - Hunt Fork Shale, wacke member (Late Devonian) Siltstone, mudstone, and sandstone; siltstone and mudstone are greenish-gray, brownish-gray, olive-gray, and medium-dark-gray. Sandstone is light- to medium-olive-gray, fine- to medium-grained, and locally conglomeratic. *Unit description source:* CL002

Dhw - Hunt Fork Shale, Wacke member (Late Devonian) Mostly (50-80%) grayish green, brown, and black micaceous manganiferous clay shale and shaley siltstone. Interbedded thin to medium bedded, fine to medium grained, limonitic quartzitic quartz-chert wacke that weathers orange and brown, green fine-grained wacke, and minor amounts of gray quartzite and calcareous sandstone. Wacke composed of fragments of quartz, chert, muscovite and biotite schist, and minor amounts of plagioclase feldspar. Ferruginous lenses contain brachiopod coquina and pebbles of chert and shale and ironstone. *Unit description source:* PS002

Dsq - Sandstone and subgraywacke (Late Devonian) Fine- to medium-grained ferruginous quartzitic sandstone and subgraywacke; minor quartz and slate-pebble conglomerate. *Unit description source:* CH002

Dss - Sandstone, siltstone, and slate (Late Devonian) Upper third is predominantly fine-grained sandstone with a moderate amount of clay matrix; lower two-thirds of unit is interbedded fine grained sandstone, siltstone, slate, and minor thin lenses of tan weathering gritty limestone with crinoid fragments. *Unit description source:* AR002

Dhfm - Endicott Group, Hunt Fork Shale, metamorphosed (Late Devonian)

Degh - Hunt Fork Shale (Devonian) See [Degh](#) for unit description from [SIM-3340](#).

Dhf - Endicott Mountains Allochthon - Hunt Fork Shale (Devonian) Gray, phyllitic shale. *Unit description source:* NT006

Dhf - Hunt Fork Shale (Late Devonian) Split unit to more nearly match Till and others (2007). These polygons are the more strongly foliated portion of the unit. Twice metamorphosed sedimentary and volcanic rocks; Middle to Upper Greenschist facies. Metamorphic facies and texture increases southward; mostly phyllite and limestone in north; schist and marble in south. Lower Endicott Group-Carbonaceous siliceous clastic rocks. Grades downward into Beaucoup Formation in some places; unconformably overlies upper Middle Devonian and older rocks in other places. Black slate and phyllite, minor fossiliferous limestone; lithic wacke locally in upper part; basal quartz-chert clast conglomerate and sandstone. *Unit description source:* WI008

Dhf (or Dhf_101) - Hunt Fork Shale - foliated exposures (Late Devonian) Dark gray to black phyllite and lesser gray-green phyllite with thin layers of siliceous or calcareous metasiltstone, lithic wacke, metasandstone, and minor layers of fossiliferous metalimestone exposed along the length of the northern boundary of the map. This part of the unit is more strongly foliated and sedimentary structures are less obvious. *Unit description source:* SP005

Ds - Slate (Late Devonian) Slate; black slate, phyllite, and phyllitic siltstone and some interbedded gray, fine-grained limonitic schistose sandstone. Locally includes greenstone. Basal conglomerate(?),

locally mapped by symbol, consists mainly of stretched quartz, chert, siltstone, and slate fragments and a few limestone and dolomite pebbles and feldspar grains. Part of Doonerak Fenster. *Unit description source:* CH002

This unit is also present on source map WI011, however, no description was present on this source.

Dkyl - Endicott Group, Kanayut Conglomerate, Ear Peak Member, lower member, nonmarine shale (Late Devonian)

MDegk - Kanayut Conglomerate and Noatak Sandstone, undivided (Lower Mississippian & Upper Devonian) See [MDegk](#) for unit description from [SIM-3340](#).

Dke - Kanayut Conglomerate, Ear Peak Member; Endicott Mountains Allochthon, Killik River Sequence (Late Devonian) Shale, siltstone, sandstone, quartzite, and conglomerate. Shale is red to brown in northern part of area and black in southern part, quartzite, conglomeratic sandstone, and conglomerate generally in beds 1 to 3 m thick, conglomerate clasts of quartz and gray, black, green, and occasionally red to maroon chert, generally fining and upward thinning cycles, meandering stream deposit; up to 300 m thick. *Unit description source:* KL002

Dkls - Kanayut Conglomerate, Lower shale member (Late Devonian) Mostly (60-80%) red, grayish green and manganiferous brown shale containing thin beds of brown and grayish-green ferruginous sandstone. Proportion of shale increases downward through member. Interbedded units of more resistant rock about 2 to 20 m thick are typically fining-upward sequences of gray and brown granule or pebble conglomerate, gray conglomerate quartzite and gray to brown thin to medium bedded limonitic sandstone; partly calcareous; partly crossbedded. Local black shale with coal. Upper part forms red slopes banked with gray cliff-forming beds; lower part forms brown and red slopes. *Unit description source:* PS002

Dkym - Endicott Group, Kanayut Conglomerate, Shainin Lake, middle member (Late Devonian)

MDegk - Kanayut Conglomerate and Noatak Sandstone, undivided (Lower Mississippian & Upper Devonian) See [MDegk](#) for unit description from [SIM-3340](#).

Dkm - Kanayut Conglomerate, Middle conglomerate member (Late Devonian) Mostly gray to rusty orange-weathering conglomerate, quartzite, and sandstone in cliff-forming units about 10 - 70 m thick, separated by less resistant units of shale, siltstone and impure sandstone. Conglomerate pebbles mostly of varicolored chert and white quartz, with minor amounts of quartzite, and in southernmost part of quadrangle, with abundant slate pebbles. Near south edge of quadrangle, pebbles are stretched. Quartz-chert arenite forms matrix of conglomerate and also occurs in thin to massive, partly crossbedded nonconglomerated beds that are generally gray quartzite, firmly cemented by silica, but include some brown weathering beds and irregular patches that are partly cemented by calcite. Unit assigned to Hammond terrane. *Unit description source:* PS002 and PS006

Dkmm - Kanayut Conglomerate, Massive marker bed (Late Devonian) Conglomerate and coarse-grained sandstone about 200m thick. *Unit description source:* PS002

Dkyq - Endicott Group, Kanayut Conglomerate, quartz arenite and quartz wacke member (Devonian (Frasnian to Famennian))

MDegk - Kanayut Conglomerate and Noatak Sandstone, undivided (Lower Mississippian & Upper Devonian) See [MDegk](#) for unit description from [SIM-3340](#).

MDku - Kanayut Conglomerate, upper part (Early Mississippian? and Late Devonian) Consists of Stuver and Shainin Lake Members. Stuver Member is sandstone, siltstone, conglomerate and shale. Consists of iron-stained sandstone ranging from very fine-grained to very coarse-grained and conglomeratic. Sandstone is orthoquartzite and quartz-rich. Member also includes micaceous, very silty and sandy dark-gray to grayish-black shale and argillaceous siltstone. Shainin Lake Member consist mostly of conglomerate and sandstone; conglomerate is as much half of unit. Conglomerate is principally framework-supported generally well-rounded pebbles and cobbles of mostly chert, quartz, and quartzite. Member also includes reddish-brown, greenish-gray, and dark-gray to grayish-black silty, sandy shale, siltstone, and argillaceous sandstone. *Unit description source:* CL002

MDku - Upper part of Kanayut Conglomerate, undivided; Endicott Mountains Allochthon, Killik River Sequence (Early Mississippian(?) and Late Devonian) Includes part of Stuver and Shainin Lake Members north of the Toyuk thrust, mapped in area of upper drainages of East Fork or Etivuk River and Outwash Creek. *Unit description source:* KL002

MDs1 - Sandstone (Mississippian and Devonian) Part of the Key Creek Sequence - Well-indurated, medium to thick bedded, medium-grained quartz sandstone. Commonly appears black or dark gray from covering of black lichens. Intertongues with the Noatak Sandstone, and may be partly equivalent to sandstone of the Kanayut Conglomerate. Depositional thickness probably less than 30 m. *Unit description source:* MU003

Dkq - Kanayut Conglomerate - Quartz arenite and quartz wacke member (Late Devonian) Quartz arenite and quartz wacke in massive resistant beds. Locally, contains reddish-brown ferruginous mudstone interbeds. *Unit description source:* SP002

Dkss - Kanayut Conglomerate, Sandstone member (Late Devonian) Generally brown and gray weathering, thin, tabular-bedded, slightly calcareous limonitic sandstone, interbedded with black shale and ironstone. Some gray quartzite; conglomeratic sandstone rare. Ferruginous lenses of chert and ironstone pebbles and snail and brachiopod shells at several localities. Unit assigned to Hammond terrane. *Unit description source:* PS002 and PS006

Dnu - Endicott Group, Noatak Sandstone and phyllite, carbonate and clastic rocks of the Nakolik River, shale (Late Devonian to Devonian)

Degn - Noatak Sandstone (Upper Devonian) See [Degn](#) for unit description from [SIM-3340](#).

MDn2 - Noatak Sandstone (Early Mississippian and Late Devonian) Calcareous, medium-brown to buff-weathering, well-indurated, fine- to medium-grained sandstone and siltstone. Contains a few ironstone concretions. Part of the Picnic Creek allochthon, Wulik sequence. *Unit description source:* DL003

MDn2 - Noatak Sandstone (Mississippian and Devonian) Part of the Wulik Sequence - Light-brown well-bedded medium to fine grained sandstone. Only exposures located south of Kuruk Creek and north of lower Kagvik Creek (southwestern Misheguk Mountain quadrangle map). Thickness in outcrop is approximately 10 m and base is not exposed. *Unit description source:* MU002

DI - Limestone (Devonian) Whitish-gray-weathering, brownish-gray, very fine crystalline to micritic, locally recrystallized limestone. *Unit description source:* BM002

Dn - Noatak Sandstone (Devonian) Tan- to brown-weathering, dull greenish gray, maroon, gray or white, thin- to medium-bedded, commonly cross-bedded, quartz metasandstone, metasilstone and phyllite. *Unit description source:* BM002

Dn - Noatak Sandstone (Late Devonian) Light-gray to tan, fine- to medium-grained, thick-bedded sandstone containing abundant siltstone and shale interbeds; sandstone is typically cross-bedded. Contains abundant limonitic spots and scattered to abundant detrital muscovite. Thickness of 500 m or more reported east of Nigu River by Mull and Werdon (1994); distinctly thicker than equivalent rocks in the Aniuk River facies south and west of the Howard Hills thrust. *Unit description source:* HW003

Dn - Noatak Sandstone - Endicott sequence, Endicott group, Key Creek facies (Late Devonian) Light-gray to tan, fine- to medium-grained, thick-bedded sandstone containing abundant siltstone and shale interbeds; sandstone is typically cross-bedded. Contains abundant limonitic spots and scattered to abundant detrital muscovite. Thickness of 500 m or more reported east of Nigu River by Mull and Werdon (1994); distinctly thicker than equivalent rocks in the Aniuk River facies south and west of the Howard Hills thrust. *Unit description source:* HW004

Dn - Allochthonous Rocks, Endicott Mountains Allochthon, Key Creek and Ivotuk Hills sequences, undivided; Noatak Sandstone (Late Devonian) Light-gray to light-brown, fine- to coarse-grained, thick-bedded sandstone and quartzite in units up to 29 m thick; interbedded with dark-gray to brown shale with ironstone nodules; sandstone commonly crossbedded, contains scattered limonitic spots. Upper part generally forms steep tan-weathering rubble-covered mountain slopes, becomes thinner down section. *Unit description source:* HW007

Dn - Allochthonous Rocks, Endicott Mountains Allochthon, Aniuk River sequence; Noatak Sandstone (Early Mississippian? and Late Devonian) Light-gray to light-brown, fine- to medium-grained thick-bedded, crossbedded and ripple marked sandstone in beds up to 1 m thick; interbedded dark-brownish-gray to black shale intervals that become thicker upsection. Some sandstone beds contain conspicuous small red shale clasts and occasional thin red clay laminae and clay drapes over ripple marked sandstone. *Unit description source:* HW007

Dn - Noatak Sandstone, undivided; Endicott Mountains Allochthon, Killik River Sequence (Late Devonian, Famennian) Light gray- to light-brown, fine- to coarse-grained thick bedded sandstone and quartzite in units up to 20 m thick; interbedded with dark-gray to brown shale with ironstone nodule; upper part generally forms steep tan-weathering rubble -covered mountain slopes, becomes thinner bedded downward in section. In southwestern part of quadrangle south of Toyuk thrust formation is locally divided into: Dnl and Dnc. *Unit description source:* KL002

Dna - Noatak Sandstone (Late Devonian) Light-gray to tan, fine- to medium-grained, thick-bedded sandstone with abundant siltstone and shale interbeds; sandstone typically cross-bedded and ripple marked. Contains abundant limonitic spots; commonly has scattered to abundant detrital muscovite. Thicknesses of 138 and 215 m measured at Isikut Mountain and along Aniuk River, respectively; distinctly thinner than equivalent rocks in the Key Creek facies. *Unit description source:* HW003

Dna - Noatak Sandstone- Endicott sequence, Endicott group, Aniuk River facies (Late Devonian) Light-gray to tan, fine- to medium-grained, thick-bedded sandstone containing abundant siltstone and shale interbeds; sandstone is typically cross-bedded. Contains abundant limonitic spots and scattered to abundant detrital muscovite. Thickness of 500 m or more reported east of Nigu River by Mull and Werdon (1994); distinctly thicker than equivalent rocks in the Aniuk River facies south and west of the Howard Hills thrust. *Unit description source:* HW004

Dnc - Allochthonous Rocks, Endicott Mountains Allochthon, Key Creek and Ivotuk Hills sequences, undivided; Noatak Sandstone, conglomerate and sandstone unit, unnamed (Late Devonian) Massive, thick-bedded, white to light-gray weathering pebble conglomerate and quartzitic sandstone; conglomerate contains matrix supported white quartz and black and gray chert pebbles to 2 cm in diameter; sandstone is dominantly fine-to medium-grained, quartzose, siliceous cemented, locally calcareous, contains abundant yellowish-brown limonite spots in places. Local conspicuous cliff-forming marker horizon up to 25 m thick between Ivotuk Creek and Iteriak Creek in western part of Killik river quadrangle. *Unit description source:* HW007

Dnc - Noatak Sandstone, Conglomerate and Sandstone unit; Endicott Mountains Allochthon, Killik River Sequence (Late Devonian, Famennian) Massive, thick-bedded, white to light-gray weathering pebble conglomerate and quartzitic sandstone; conglomerate contains matrix-supported white quartz and black and gray chert pebbles to 2 cm diameter; sandstone is dominantly fine- to medium- grained, quartzose, siliceous cement, locally calcareous, contains abundant yellowish-brown limonite spots in places. Unit is up to 25 m thick, forms conspicuous cliff-forming marker horizon between Ivotuk Creek and Iteriak Creek in southwestern part of quadrangle. *Unit description source:* KL002

Dnl - Allochthonous Rocks, Endicott Mountains Allochthon, Key Creek and Ivotuk Hills sequences, undivided; Noatak Sandstone, lower part (Late Devonian) Gray to greenish-gray, medium-bedded sandstone, generally fine-grained, calcareous, finely micaceous, contains abundant yellow-orange limonitic spots, commonly contains conspicuous crossbeds and ripple marks; beds up to 2 m thick, interbedded with gray silty micaceous shale and local thin silty limestone beds. Interval forms generally smooth reddish-brown to brown weathering, rubble-covered slopes in mountains northeast of Nigu River, probable > 500 m thick. *Unit description source:* HW007

Dnl - Noatak Sandstone, lower part; Endicott Mountains Allochthon, Killik River Sequence (Late Devonian) Gray to greenish-gray medium-bedded sandstone, generally fine-grained, calcareous, finely micaceous, contains abundant yellow-orange limonitic spots, commonly contains conspicuous cross beds and ripple marks; beds up to 2 m thick, interbedded with gray silty micaceous shale and local thin silty limestone beds; interval forms generally smooth dark reddish-brown to brown weathering, rubble-covered mountain slopes, dominantly marine shelf sediments, probably >500 m thick. *Unit description source:* KL002

Dnh - Noatak Sandstone and Hunt Fork Shale, undivided; Endicott Mountains Allochthon, Killik River Sequence (Late Devonian) Transitional facies south of Toyuk thrust in southwestern part of quadrangle; consists of gray to greenish-gray medium-bedded micaceous and calcareous sandstone as in overlying Noatak Sandstone, beds up to 1 m thick, interbedded with dolomitic siltstone and gray silty micaceous shale; interval forms generally smooth dark reddish-brown to brown weathering mountain slopes with local micaceous sheen. Thickness probably about 300 m. *Unit description source:* KL002

Dsl2 - Sandstone, Shale and Limestone (Devonian) Part of the Wulik Sequence - These lithologies are interbedded and occur in only a few isolated places, mainly along tributaries of Kuruk and Kagvik Creeks north of Avan Hills mafic and ultramafic complex (southwestern Misheguk Mountain quadrangle map). Thought to represent intertonguing relation between Upper Devonian clastic rocks of the Noatak Sandstone and carbonate rocks of the Baird Group. Limestone beds contain numerous well-preserved Late Devonian (Famennian) brachiopods. Thickness in outcrop is approximately 150 m and base is not exposed. *Unit description source:* MU002

Dyao - Medium-grained granitic gneiss (Devonian (Givetian) to Late Devonian)

Dogn - Granitic gneiss (Late & Middle Devonian) See [Dogn](#) for unit description from [SIM-3340](#).

Kg1 - Granite (Early Cretaceous) Chiefly leucocratic, medium-grained gneissic muscovite-biotite albite granite in Cosmos Hills. *Unit description source:* SH002

Kgr - Meta-granite (Cretaceous) Meta-granite; Metamorphosed granitic plutonic rocks with roughly equal proportions of quartz, K-spar, and plagioclase, stringy to weakly metamorphosed; usually recrystallized to quartz-k-spar-albite-muscovite +- biotite orthogneiss. *Unit description source:* AR002

MzPzi - Intrusive rocks of intermediate to mafic composition (Mesozoic to Paleozoic) Light- to medium-green, massive, semischistose, fine- to medium-grained, inequigranular, locally porphyroblastic, metadiorite and metagabbro with relict igneous textures. *Unit description source:* BM002

MzPzg - Granitic rocks (Mesozoic or Late Paleozoic) Gneissic chloritized biotite granite, quartz monzonite, and granodiorite. Some gneissic chloritized hornblende granite and granodiorite with secondary epidote and calcite along northwest margin of Geroe Creek pluton, in sill through Horace Mtn. and at Our Creek grades locally to closely foliated chloritic granite gneiss. Includes some biotitic quartzite southwest of Caro. Bodies north of the Kobuk Fault, part of Arctic Alaska terrane. *Unit description source:* CH002

Pzi - Intermediate igneous rocks (Carboniferous?) Quartz-albite-muscovite +- stilpnomelane +- K-spar schist thought to be metamorphosed igneous rocks ranging from granodiorite to quartz diorite in composition. *Unit description source:* AR002

Dg - Granitic orthogneiss (Devonian) Tan to gray weathering, equigranular to porphyroblastic, fine to coarse grained metagranitic bodies ranging in size from less than a kilometer to over 20 kms across, found in both the Schist and Central belts. Generally granitic in composition and made up of quartz, K-feldspar, albite, muscovite, and biotite. In the Chandalar quadrangle, the Horace Mountain pluton is dioritic to granodioritic in composition, and contains hornblende. Chlorite, sericite, Fe-Ti oxides, epidote minerals, and calcite are also present in many of the plutons. Remnants of intrusive contact relations are locally preserved. Exposures of skarn have been mapped at the contacts and within the orthogneiss bodies. Skarns at the contacts of some of the plutons are mineralized (Sn or Cu). *Unit description source:* CH004

Dg - Granite gneiss (Devonian and Devonian?) Coarse-grained muscovite-biotite quartz monzonite gneiss. *Unit description source:* WI002

Dgr - Granitic Orthogneiss (Middle Devonian) Metamorphosed intrusive rocks that are predominantly muscovite-biotite granite ranging in composition from alkali-feldspar granite to tonalite (fig.1, sheet 2). Coarse grained augen gneiss and granitic textured granite occur locally within Arrigetch Peaks and Mount Igikpak plutons.

Note: Extensive map description. *Unit description source:* SP002

Dbk - Baird Group, Kugururok Formation, limestone (Devonian (Givetian) to Late Devonian)

Dke - Kugururok Formation and Eli Limestone (Devonian) See [Dke](#) for unit description from [SIM-3340](#).

Dbl - Limestone, Baird Group, upper part (Devonian) Massive to thick-bedded, light-gray limestone. *Unit description source:* DL004

Dbl3 - Limestone, Baird Group, upper part (Devonian) Light-gray, medium- to coarse-grained limestone. Occurs as isolated blocks along thrust faults at base of the micritic limestone unit along upper part of Saksot Creek. Part of the Kelly River allochthon, Amphitheatre sequence. *Unit description source:* DL002, DL003, and DL004

Dbl3 - Limestone, Baird Group, upper part (Devonian) Light-gray, medium- to coarse-grained limestone. Found as isolated blocks along thrust faults at base of Utukok Formation. Part of the Kelly River allochthon, Kelly sequence. *Unit description source:* DL002, DL003, and DL004

Dbl4 - Limestone, Baird Group, upper part (Devonian) Massive- to thin-bedded, light-gray, medium- to coarse-grained limestone; weathers blocky to flaggy. Part of the Iqnavik River allochthon, Puzzle Creek sequence. *Unit description source:* DL004

Dk - Kugururok Limestone (Devonian) Gray- to orange-weathering, medium- to dark-gray calcareous sandstone, dolostone and limestone. *Unit description source:* BM002

Dk - Kugururok Formation (Devonian) Mostly light-colored calcarenite and crossbedded dolomite overlying claystone, sandstone, and conglomerate. *Unit description source:* MU006

Dl5 - Limestone and Dolomite (Devonian) Part of the Bastille Sequence - Massive to thin-bedded limestone and lesser dolomite. Gray chert nodules are locally common. Late Devonian horn corals and brachiopods are locally common in upper two-thirds of unit. Lower part contains stromatoporoid, *Amphipora*. As mapped, includes upper part of the Kugururok Formation (named by Sable and Dutro, 1961). Depositional thickness is estimated to be greater than 300 m; basal contact is sharp on shale, limestone, calcareous siltstone, and sandstone (unit Dsl5). *Unit description source:* MU002 and MU004

Dlm - Kelly River Allochthon - Kugururok Limestone (Devonian) Light-gray-weathering limestone, commonly recrystallized, non-cherty, massive. *Unit description source:* NT006

Dsl5 - Shale, Limestone, Calcareous Siltstone, and Sandstone, Bastille Sequence (Devonian) Part of the Bastille Sequence - Contains a few hematitic conglomerate beds at Mount Bastille (south-central Misheguk Mountain quadrangle map). Predominant lithology is shale at Mount Bastille and calcareous siltstone south of Copter Peak. In part equivalent to lower part of the Kugururok Formation (named by Sable and Dutro, 1961). Contains brachiopods and conodonts of Middle to Late Devonian age. Thickness is less than 150 m. Basal contact is a thrust fault. *Unit description source:* MU002 and MU004

Du - Devonian rocks, undivided (Late Devonian) Crystalline fossiliferous limestone and interbedded grayish-brown, gray, and black claystone of Late Devonian age. In fault slivers. *Unit description source:* MU006, MU007, and MU008

Dbe - Baird Group, Eli Limestone (Middle Devonian to Late Devonian)

Dke - Kugururok Formation and Eli Limestone (Devonian) See [Dke](#) for unit description from [SIM-3340](#).

Db3e - Baird Group (Devonian) Part of the Eli Sequence - Light-gray limestone and dark gray dolomite (Tailleur and others, 1967). Probably correlative with some Devonian limestone thrust slivers mapped in uncertain sequence at base of Iqnavik allochthon. Common fossils are Late Devonian brachiopods,

stromatoporoids, and conodonts. Thickness in outcrop is less than 700 m west of Kugururok River. Basal contact is a thrust fault. *Unit description source:* MU002, and MU004

Dbl3e - Unnamed Limestone and Eli(?) Formation (Devonian) Part of the Eli-Sequence - Massive, light-gray limestone in upper part contains corals, brachiopods, and latest Devonian to earliest Mississippian foraminifers of Mamet Zones 5 or 6. Lower part contains buff-weathering, thin bedded limestone and minor shale and Late Devonian foraminifers of Mamet Zone 2 or older and may be lithologically similar to the Eli Formation (Tailleur and others, 1967). Common fossils are brachiopods and stromatoporoids. Greatest thickness of about 500 m occurs west of Kugururok River. *Unit description source:* MU002

Dbs3 - Limestone and shale, Baird Group, upper part (Devonian) Gray shale interbedded with light-gray- to buff-weathering limestone. Most limestone is fine grained and weathers to platy and flaggy fragments. Part of the Kelly River allochthon, Kelly sequence. *Unit description source:* DL004

Dbs4 - Shale and limestone, Baird Group, upper part (Devonian) Interbedded light-silver-gray shale and light-gray limestone. Locally has a few thin sandstone beds. Limestone is mostly fine-grained and weathers light-gray with flaggy to platy beds, but locally may be medium-grained, medium bedded, and weathered to a buff color. Shale is commonly well indurated and in some places has slaty cleavage. Part of the Ilnavik River allochthon, Puzzle Creek sequence. *Unit description source:* DL004

Dcs - Calc-schist - Igichuk Hills (Devonian) Interbedded thin bedded limestone and schist. Apparently gradationally underlies Devonian limestone. *Unit description source:* NT006

Dbc - Beaucoup Formation, carbonaceous, siliceous, and calcareous sedimentary rocks and felsic volcanic rocks (Middle Devonian to Late Devonian)

Dbf - Beacoup Formation, undivided (Devonian) See [Dbf](#) for unit description from [SIM-3340](#).

MzPzph - Phyllite and Siltstone (Cretaceous or Devonian) Thick unit of gray thin bedded phyllite with few interbeds of calcareous siltstone and rare thin-bedded limestone. *Unit description source:* AR002

MzPzph? - Phyllite and Siltstone (Cretaceous or Devonian) Thick unit of gray thin bedded phyllite with few interbeds of calcareous siltstone and rare thin-bedded limestone. *Unit description source:* AR002

Db - Beaucoup Formation; Endicott Mountains Allochthon, Killik River Sequence (Late Devonian) Gray shale, weathers to smooth brown, orange, or gray weathering slopes, exposed locally north of Easter Creek. *Unit description source:* KL002

Db - Beaucoup Formation, Brown sandstone, shale, and limestone member (Late Devonian) Highly variable sequence of interbedded shale, sandstone, limestone and conglomerate. Upper part mostly brown, gray and black shale and siltstone interbedded with as much as 20% brown-weathering sandstone, limestone units 2-20m thick, and local beds of chert and slate-pebble conglomerate; typically in cyclic sequences about 100m thick composed of calcareous sandstone with local basal conglomerate, grading up through siltstone and shale to massive coral stromatoporoid reefs capped by brown weathering silty coquinoid limestone. Thicker units of limestone mapped separately as parts of limestone member. *Unit description source:* PS002

Dbb (or Dbb?) - Beaucoup Formation - Black Rocks (Late Devonian and Late or Middle Devonian) Carbonaceous, siliceous, and calcareous sedimentary rocks and felsic volcanic rocks. Grades downward and southwestward into DSk (Skajit). Laterally equivalent to the Whiteface Mountain and Ambler rocks. Black calcareous phyllite and thin, dark limestone. *Unit description source:* WI002

Dbc - Beaucoup Formation, Conglomerate member (Late Devonian) Maroon, purple, green, and gray conglomerate composed of chert, slate, limestone, and quartz pebbles; maroon, green and greenish-gray argillite, slate and phyllite, locally calcareous; black siltstone and gray micaceous siltstone. At one locality includes more than 100m of black hematitic conglomeratic limestone containing granules of quartz, chert, and phosphatic siltstone. *Unit description source:* PS002

Dbc (or Dbc?) - Beaucoup Formation - Conglomerate (Late or Middle Devonian) Carbonaceous, siliceous, and calcareous sedimentary rocks and felsic volcanic rocks. Grades downward and southwestward into DSk. Laterally equivalent to the Whiteface Mountain and Ambler rocks. Quartz and chert pebble conglomerate. *Unit description source:* WI002

Dbc - Beaucoup Formation (Early Late to Middle Devonian) Chlorite-muscovite quartzite, conglomerate, and sandstone. *Unit description source:* WI010

Dbcw - Beaucoup Formation, Calcareous chloritic wacke (Late or Middle Devonian?) Carbonaceous, siliceous, and calcareous sedimentary rocks and felsic volcanic rocks. Grades downward and southwestward into DSk. Laterally equivalent to the Whiteface Mountain and Ambler rocks. Upper part; calcareous wacke with common plagioclase clasts. Lower part; interbedded calcareous, limonitic quartz sandstone and conglomerate, limestone and gray, red and green phyllite. Local basal conglomerate. Correlates with Dw. *Unit description source:* WI002

Dbs - Beaucoup Formation, Brown shale member (Late Devonian) Mostly light brown and orange-weathering partly calcareous gray and greenish-gray shale, slate and shaley micaceous siltstone, and dark-gray and rusty-weathering noncalcareous black shale and slate; ironstone and siltstone concretions common. Interbedded brown weathering, partly calcareous, thin bedded, fine grained, micaceous sandstone and brown and gray, thin to medium bedded micaceous, fine grained quartzite, including both quartz-chert arenite and wacke. Contains lenses or beds conglomerate of chert, quartz and shale pebbles. Few thin beds and lenses of fossiliferous limestone. *Unit description source:* PS002

Dbs (or Dbs?) - Beaucoup Formation(?) Black slate, phyllite, and limestone (Late or Middle Devonian? or older?) Black, calcareous, phyllitic siltstone, slate, and quartzite with lenses of brown dolomite; black, calcareous phyllite and schist with thin limestone interbeds. No faunal control. In part resembles fossiliferous Ordovician rocks of the Chandalar Quadrangle. *Unit description source:* WI002

Dc (or Dc?) - Chlorite and Chloritoid Bearing Phyllite and Semischist (Middle Devonian?) Light green weathering chloritic phyllite and chloritoid bearing muscovite chlorite quartz semischist. Includes minor gray phyllite and slate and, locally, mylonite schist. Chloritoid bearing rocks are similar to some units in undivided Mississippian sedimentary rocks (Mu) but contain probable Devonian fossils. *Unit description source:* SP002

Dc - Chloritic and carbonate rocks (Late or Middle Devonian?) Green and gray phyllite and dolomite; chloritic, calcareous meta-sandstone and marble; and carbonate-clast conglomerate. Northern part of Dillon unit reassigned; eastern exposures equal Till and others Pzw_572 [NSA 6927], western exposures = Till and others PzZcm [8655]. *Unit description source:* WI008

Dc - Chloritic siltstone and conglomerate (Late Devonian) Chloritic siltstone and conglomerate; Gray green metasiltstone and gray phyllite; interbedded quartz pebble and slate chip conglomerate beds. *Unit description source:* AR002

Dls - Limestone and siltstone (early Late Devonian) Gray and black, pink- and light-brown-weathering fine- to medium-grained thin-bedded, micaceous, silty limestone and light-brown-weathering calcareous to noncalcareous siltstone, slate, phyllite, and calcareous gritty sandstone. *Unit description source:* CH002

Dmu - Metasedimentary and lesser metaigneous rocks (Middle and Late Devonian) Heterogeneous expanses of calcareous, siliceous, and volcanoclastic metasedimentary rocks, with lesser metaigneous rocks, exposed along the length of the Central belt. Includes significant expanses of rocks mapped as Beaucoup Formation by some workers. This unit is part of the Central belt. *Unit description source:* CH004

Dnu - Phyllite, carbonate and clastic rocks of the Nakolik River, undivided (Devonian) Light green, gray and maroon siliceous and calcareous phyllite, metalimestone, and quartzose metasandstone and metaconglomerate. Similar to (and possibly correlative with) unit Pzqs and parts of the Beaucoup Formation of Dutro and others (1978) and Dillon and others (1986). *Unit description source:* BM002

Dsp - Slate and phyllite (Late Devonian) Purple, green, and red chloritic slate and phyllite; some green chloritic siltstone and fine, gritty sandstone. *Unit description source:* CH002

Dt - Tactite (Devonian?) Calcsilicate hornfels and skarn. *Unit description source:* WI008

Metagraywacke, conglomerate - Hammond terrane (Late Devonian) Metagraywacke, conglomerate - Hammond terrane. *Unit description source:* WI011

qms - Quartz-mica schist - Igichuk Hills (Devonian or older) Quartz mica schist--non-calcareous schists, apparently gradationally underlie calc schists. *Unit description source:* NT006

Pzbq - Black quartzite and siliceous semischist (Paleozoic) Sooty black quartzite and semischist which locally has quartz segregations, flattened quartz pebbles, and weathers rusty, yellowish, or bluish white. *Unit description source:* BM002

Pzbs - Black shale and carbonate rocks (Paleozoic) Dark gray to black siliceous and calcareous shale, with intercalated meter scale lenses of white- to tan-weathering gray limestone or dolostone, and lenses of light green volcanoclastic rocks. *Unit description source:* BM002

Pzmq (or Pzmq?) - Marble and quartzite (Ordovician (?)) Complex stratigraphic and structural unit composed of clean white fine-grained quartzite interbedded with marble or limestone; contains gray phyllite, siltstone, and quart-mica +/- chlorite schist; quartzite (Pzq) and marble (Pzm) mapped where possible. *Unit description source:* AR002

Pzw - Metasedimentary rocks (Paleozoic) Weakly metamorphosed metasandstone, meta-argillite, phyllite, conglomerate, and rare marble exposed in two belts on the Wiseman-Chandalar quadrangle boundary. This subunit, the northern belt, is composed of metasandstone and argillite, and contains abundant detrital white mica. This unit is part of the Central belt. *Unit description source:* CH004

Pzw_572 - Metasedimentary rocks (Paleozoic) Weakly metamorphosed metasandstone, meta-argillite, phyllite, conglomerate, and rare marble exposed in two belts on the Wiseman-Chandalar quadrangle boundary. This subunit, the southern of the two belts, is composed of phyllite, metasandstone with volcanic clasts, argillite, sandstone, pebble conglomerate and rare marble. This unit is part of the Central belt. *Unit description source:* CH004

Pzwv - Rocks of Whiteface Mountain - Volcanic conglomerate (Late or Middle Devonian? or older?) Polymictic conglomerate with metavolcanic, carbonate, and vein quartz clasts. Metavolcanic and metasedimentary rocks, stratigraphically and lithologically equivalent to the Beaucoup Formation and to the Ambler metavolcanic rocks. *Unit description source:* WI002

Dbfw - Beaucoup Formation, wacke member (Middle Devonian to Late Devonian)

Dbfw - Wacke member (Upper Devonian) See [Dbfw](#) for unit description from [SIM-3340](#).

MzPzfw (or MzPzfw?) - Felspathic wacke (Cretaceous or Devonian) Calcareous felspathic volcanic wacke containing a few intercalated phyllite and limestone beds; mostly fine-grained gray green sandstone and siltstone. *Unit description source:* AR002

Dhbw - Wacke member of Hunt Fork Shale and Wacke Member of Unnamed Brown Calcareous Clastic Rocks, Undivided (Beaucoup Formation) (Later Devonian) Contains Late Devonian brachiopods. *Unit description source:* PS002

Dw (or Dw?) - Rocks of Whiteface Mountain - Wacke (Late or Middle Devonian?) Fine-grained wacke, graywacke, calcareous shale-chip and granule conglomerate with some volcanic clasts, thin fossiliferous limestone. Metavolcanic and metasedimentary rocks, stratigraphically and lithologically equivalent to the Beaucoup Formation and to the Ambler metavolcanic rocks. *Unit description source:* WI002

Trembley Creek phyllite - Hammond terrane (Devonian to Ordovician) Trembley Creek phyllite, tan weathering metasandstone and argillite, contains abundant grains of detrital white mica, contains relict graded bedding and sharp, erosional bases. *Unit description source:* CH009

Pzqs - Quartz metaconglomerate, metasandstone, and siliceous phyllite (Paleozoic) Buff, white, or light green quartz pebble metaconglomerate, quartz metasandstone, calcareous quartz metasandstone, and green, maroon, and gray phyllite. *Unit description source:* BM002

Pzw - Rocks of Whiteface Mountain - Wacke and Limestone (Devonian or older) Fine-grained wacke and conglomerate, calcareous schist and phyllite, micaceous platy limestone, sandy limestone, and sandstone, purple, green, and gray phyllite, and felsic flows, plugs, and tuff. Metavolcanic and metasedimentary rocks, stratigraphically and lithologically equivalent to the Beaucoup Formation and to the Ambler metavolcanic rocks. *Unit description source:* WI002

DCw - Wacke (Paleozoic) Meta-wacke and calcareous meta-tuff. Abundant clasts of epidote-rich, intermediate plutonic rocks. May be equivalent to unit Pzw. Basement rocks of the Doonerak Window. Lower greenschist and prehnite-pumpellyite facies. Unconformably overlain by Mississippian Kekiktuk conglomerate. *Unit description source:* WI002

Dol - Beaucoup Formation, dark gray to orange weathering limestone (Middle Devonian to Devonian)

Dbfl - Limestone and similar rocks (Upper & Middle Devonian) See [Dbfl](#) for unit description from [SIM-3340](#).

Dbl - Beaucoup Formation, Limestone member (Late Devonian) Gray weathering dark-gray

limestone, commonly fetid or carbonaceous; commonly overlain, underlain or interbedded with brown and orange weathering argillaceous or shaley limestone and minor amounts of brown sandstone. Abundant corals and stromatoporoids. Marine. *Unit description source:* PS002

Dfc(Is) (or Dfc?(Is)) - Undifferentiated limestone and marble (Mississippian and Devonian) The undifferentiated limestone and marble units have been classed based on the units they are contained within using 5XX where XX is the class of the surrounding unit. *Unit description source:* SP002

DI - Limestone (early Late Devonian) Black massive limestone; occurs as beds in unit DIs. *Unit description source:* CH002

DI - Limestone (Devonian) Limestone and dolostone structurally detached from surrounding rocks; occurs most commonly at the base of the Ilnavik thrust sequence. Uncertain stratigraphic affinity. Chief rock types are peloidal support stone, lime mudstone with locally well-developed fenestral fabric, and skeletal grainstone and packstone. Sections are generally fault-bounded and less than 130 m thick. *Unit description source:* HW003

DI (or DI?) - Limestone (Late or Middle Devonian) Dark gray to orange weathering limestone that occurs as interbeds with metaconglomerate (Dcg) or ferruginous calcareous metasedimentary rocks (Dfc). *Unit description source:* SP002

Dlk - Limestone (Devonian) Light-gray limestone and dark-gray dolostone. Occurs depositionally beneath the Utukok Formation in the Misheguk Mountain quadrangle. *Unit description source:* HW003

DIs - Limestone and Marble (Devonian) Coarse-grained, light-gray limestone, commonly recrystallized, forms white-weathering pinnacles up to 10 m high surrounded by tundra near Nogak Creek and Otuk Creek. Distinguished from limestone of Lisburne Group by light-gray color and absence of chert; resembles Baird Group carbonates in southern Brooks Range. Probably emplaced as tectonic slivers at base of Ilnavik River allochthon. Unfossiliferous, but similar rocks in Howard Pass quad contain Middle or Late Devonian fossils. *Unit description source:* KL002

Dnl - Limestone of the Nakolik River (Devonian) Fossiliferous metalimestone and marble; subordinate quartz-carbonate metasandstone, metasiltstone, and phyllite. *Unit description source:* BM002

Dsc - Siliceous clastic rocks (Middle Devonian?) Partly calcareous, chloritic siliceous metasiltstone, sandstone, phyllite, grit and conglomerate, and felsic volcanoclastic rocks. Underlies DSK; correlative with unit Dsg and upper part of unit Pzw. *Unit description source:* WI002

Dsg - Graywacke of Sillyasheen Mountain (Middle Devonian) Calcareous graywacke and conglomerate with shale chip, chert and volcanic clasts; green purple phyllite and siltstone; lenses of fossiliferous, tuffaceous limestone. *Unit description source:* WI002

Dt - Tactite (Devonian?) Calcsilicate hornfels and skarn. *Unit description source:* WI008

Pzl - Undifferentiated, limestone and marble (Devonian and older (?)) Light gray coarse- to fine-grained limestone; in many places recrystallized to marble. *Unit description source:* AR002

PDlc - Limestone (Permian and Devonian) Mapped mainly west and northwest of Siniktanneyak Mountain. Brownish- to light-gray, fine-grained limestone, correlative with small limestone lenses included in unit JDbc. *Unit description source:* HW003

Dbf - Beaucoup Formation, ferruginous and calcareous schist (Middle Devonian to Late Devonian)

Dbf - Beacoup Formation, undivided (Devonian) See [Dbf](#) for unit description from [SIM-3340](#).

Dcg - Metaconglomerate (Late or Middle Devonian) Dark gray to black chlorite chloritoid muscovite chert quartz metaconglomerate and meta-wacke sandstone with minor interlayered gray chloritoid bearing phyllite, purple phyllite, and green chlorite bearing phyllite. Unit description source: SP002

Dcg(Is) - Undifferentiated limestone and marble (Mississippian and Devonian) The undifferentiated limestone and marble units have been classed based on the units they are contained within using 5XX where XX is the class of the surrounding unit. Unit description source: SP002

Dfc (or Dfc?) - Ferruginous, Calcareous Metasedimentary Rocks (Late or Middle Devonian) Light brown and orange weathering, gray calcareous micaceous schist, phyllite, and metasiltstone. Outcrops are commonly coated with a white effervescent powder, which Mayfield and TAILLEUR (1978) reported in Ambler River quadrangle as being dolomite and the soluble salts, epsomite and hexahydrate. Unit description source: SP002

Dsc - Siliceous clastic rocks (Middle Devonian?) Partly calcareous, chloritic siliceous metasiltstone, sandstone, phyllite, grit and conglomerate, and felsic volcanoclastic rocks. Underlies DSK; correlative with unit Dsg and upper part of unit Pzw. Unit description source: WI002

Dsg - Graywacke of Sillyasheen Mountain (Middle Devonian) Calcareous graywacke and conglomerate with shale chip, chert and volcanic clasts; green purple phyllite and siltstone; lenses of fossiliferous, tuffaceous limestone. Unit description source: WI002

Dt - Tactite (Devonian?) Calcsilicate hornfels and skarn. Unit description source: WI008

Dbv - Beaucoup Formation, volcanic rocks or volcanic rock clasts (Middle Devonian to Late Devonian)

Dbf - Beacoup Formation, undivided (Devonian) See [Dbf](#) for unit description from [SIM-3340](#).

Dmu_541 - Metasedimentary and lesser metaigneous rocks, volcanic-rock bearing subunit (Middle and Late Devonian) Part of heterogeneous expanses of calcareous, siliceous, and volcanoclastic metasedimentary rocks, with lesser metaigneous rocks, exposed along the length of the Central belt, thought to be correlative with the Beaucoup Formation. This subunit contains felsic to intermediate volcanic rocks or sedimentary rocks with abundant volcanic clasts. This unit is part of the Central belt. *Unit description source:* CH004 and WI007

Nutirwik Creek metavolcanoclastic rocks - Hammond terrane (Devonian) Nutirwik Creek metavolcanoclastic rocks - Hammond terrane. *Unit description source:* CH009 and WI011

Pzr - Rhyolite (Paleozoic) Light apple green, thinly laminated to massive, quartz porphyritic rhyolitic plugs, flows, and pyroclastic deposits. May be correlative with the Whiteface Mountain Volcanics of the Wiseman quadrangle. *Unit description source:* BM002

Dbs - Thin bedded black, siliceous, carbonaceous phyllite and impure chert (Middle Devonian to Late Devonian)

Degh - Hunt Fork Shale (Devonian) See [Degh](#) for unit description from [SIM-3340](#).

Dbs - Black siliceous phyllite (Late and Middle Devonian) Thin bedded black, siliceous, carbonaceous phyllite and impure chert; may be equivalent to Pzbs. *Unit description source:* AR002

Pzbs (or Pzbs?) - Black phyllite and siliceous phyllite (Devonian and (or) Silurian) Fine-grained gray to dark gray carbonaceous phyllite; local siliceous zones may appear as black chert; probably equivalent to Dbs. *Unit description source:* AR002

Dyss - Calcareous clastic rocks, Devonian sandstone and shale (Devonian)

Dyss - Clastic and calcareous clastic rocks (Devonian) See [Dyss](#) for unit description from [SIM-3340](#).

Dss - Sandstone and shale (Devonian) Yellow- and brown-weathering, gray to greenish-gray, fine- to medium-grained, thin- to medium-bedded, partly calcareous and limonitic quartz arenite and quartz wacke. Includes interbedded dark-gray shale, calcareous mudstone, and sandy ferruginous limestone. On Granite and Mud Forks, unit is schistose. Slightly metamorphosed mudstone and sandy crinoidal limestone interbedded in sandstone east of Mud Fork contain spiriferoid brachiopods of probably Late Devonian age. Lack of chert clasts and abundance of carbonate in the quartz wackes distinguishes unit from unit Dg, graywacke. *Unit description source:* BV002

Dvt - Basaltic and andesitic flows, tuff, breccia, and volcanic conglomerate altered to greenstone (Devonian)

Dv - Metavolcanic rocks and sills (Devonian) See [Dv](#) for unit description from [SIM-3340](#).

mr - Mafic Rocks (Jurassic? to Devonian) Orange and dark green weathering clinopyroxene gabbro and diabase, commonly altered to calcitic greenstone; commonly schistose near margins. Occur in bodies 1-100m thick, some with fine-grain chilled margins, or in contact with hornfels in the adjacent slate. *Unit description source:* PS002

Dg - Greenstone (Devonian) Greenstone; green, schistose hornblende diorite and pyroxene diorite sills and andesitic flows(?) with chlorite, epidote, calcite. *Unit description source:* CH002

Dm - Metabasite (Jurassic?, Devonian and Devonian?) Originally mapped as part of the metabasite unit of Dillon and others (1986), northern polygons have been reassigned to this NSAClass and given a new source code. These are the basic intrusive and extrusive rocks described as elsewhere in quadrangle. *Unit description source:* WI008

Dv - Volcanic rocks (Devonian) Pillow basalt, amygdaloidal basalt, and basalt capped by tuffaceous limestone; commonly schistose and altered to calcitic greenstone; may in part have been olivine basalt. Flows, about 10 to 80m thick, intertongue with lower part of Hunt Fork Shale and with unnamed brown calcareous clastic rocks. *Unit description source:* PS002

PzPm - Metabasite (Early Paleozoic? or Proterozoic) Diabase and gabbro dikes and actinolite-epidote chlorite albite greenschist. Banded schist, paragneiss, and orthogneiss that may have been regionally metamorphosed three times. Upper greenschist facies rocks predominate, but includes

amphibolite facies paragneiss, and local relict blueschist and eclogite facies metabasite. *Unit description source:* WI002

Dyp - Phyllite, slate or black shale (Early Devonian to Late Devonian)

Dyp - Phyllite, slate, and black shale (Devonian?) See [Dyp](#) for unit description from [SIM-3340](#).

Dp - Phyllite (Devonian (?)) Dark-gray to black phyllite and schistose siltstone interbedded with subordinate amounts of quartz wacke and sheared slate- and chert-pebble conglomerate. Age probably Devonian. *Unit description source:* BV002

Dav - Ambler sequence, metavolcanic and lesser metasedimentary rocks (Devonian)

Das - Bimodal metavolcanic rocks (Devonian) See [Das](#) for unit description from [SIM-3340](#).

Da - Ambler sequence (Devonian) Interlayered white to medium gray weathering metarhyolite, dark green weathering metabasite, pale gray weathering marble, and brown to dark gray weathering calcareous, pelitic and carbonaceous schist exposed in two areas in the Schist belt. "Metarhyolite porphyries" with megacrysts of feldspar up to 5 cm across and quartz quartz eyes up to 1 cm across are typical of the unit. "Aphanitic metarhyolite" layers and lenses are characteristic and show rare flow banding, breccia textures, and possible welded shard textures. Metabasites occur as pods and lenses; exposures in the Ambler River quadrangle retain remnant pillow structures. Near the Ambler River Survey Pass quadrangle boundary, where it has been studied in the most detail, the unit is thought to be 700-1,850 meters thick ; there, massive sulfide deposits are associated with the metarhyolites, including the world-class Arctic deposit. This unit is part of the Schist belt. *Unit description source:* AR004

Da (or Da?) - Ambler metavolcanic rocks (Late, Middle, and Early? Devonian) Interbedded black quartz schist and quartzite, marble and calcareous schist. Devonian fossils at one locality. Abundant mafic and felsic volcanic rocks. Correlative with Ambler sequence of Hitzman and others (1982). *Unit description source:* WI002

Dm - Metabasite (Jurassic?, Devonian and Devonian?) Metabasite of the bimodal Ambler volcanics in southwestern portion of quadrangle. Basic intrusive and extrusive rocks elsewhere in quadrangle. *Unit description source:* WI002

mi (or mi?) - Metamafic igneous rocks (Mesozoic and (or) Paleozoic) Predominantly greenstone derived from either diabase or basalt; most rocks are believed to be dikes or sills. *Unit description source:* AR002

MzPzfm - Metabasite (MzPxma) and felsic schist (Df), undivided (Mesozoic? to Proterozoic?) Metabasite (MzPxma) and felsic schist (Df), undivided. *Unit description source:* WI003

Davf - Ambler sequence?, schistose felsic volcanic rocks (Devonian)

Das - Bimodal metavolcanic rocks (Devonian) See [Das](#) for unit description from [SIM-3340](#).

Df - Felsic Schist (Devonian) Very light gray to brownish red weathering resistant schistose felsic

volcanic rocks. Includes muscovite quartzite and is associated with mafic metavolcanic rocks (Dv). Unit locally contains coarse-grained porphyroclasts of albite and potassium feldspar. Felsic schists are associated with volcanogenic, massive sulfide Cu Zn Pb Ag deposits. *Unit description source:* SP002

Df (or Df?) - Felsic Metavolcanic rocks (Devonian) Felsic flow, tuff, and blastoporphyratic intrusive rocks with interlayers of metasedimentary rocks. Felsic portion of Da and Pzw units. *Unit description source:* WI002

Df - Felsic schist (Devonian) Schistose felsic volcanic rocks, including flows, tuffs, and porphyritic hypabyssal? rocks, interlayered with metasedimentary rocks belonging to units PzPxsa and Pzca. An important component of this unit is the widely recognized "button schist" -a porphyritic rhyolite composed of quartz megacrysts and albite porphyroblasts in a groundmass of quartz, potassium feldspar, and muscovite. Occurs as thin layers in pelitic schist, calc schist, quartzite, and carbonate rocks in Wiseman and Survey Pass quadrangles. *Unit description source:* WI003

Dfm - Metamorphosed Bimodal Igneous rocks (Devonian and Devonian?) Complexly interlayered felsic and mafic extrusive and intrusive rocks, undivided, of Ambler metavolcanic rocks in southern portion of quadrangle; mixed with clastic rocks at the head of Michigan Creek. *Unit description source:* WI002

Dg - Dark-greenish-gray fine-grained impure graywacke (Devonian)

Dyss - Clastic and calcareous clastic rocks (Devonian) See [Dyss](#) for unit description from [SIM-3340](#).

Dg - Graywacke (Devonian (?)) Brown-weathering, gray to olive-gray, fine- to medium-grained, thin- to medium-bedded quartz-chert graywacke and lithic wacke, interbedded black shale, siltstone, and minor ironstone. Rocks are schistose west and north of Twin Sisters and near Lone Mountain. Contains unidentifiable plant fragments in outcrops on west bank of Hodzana River. Age uncertain, but probably Devonian and correlative with plant-bearing lithic wacke of Devonian(?) age on the Christian River. *Unit description source:* BV002

Dh - Hornfels (Devonian (?)) Hornfels; thermally altered gray to black quartzite, spotted siltstone, and phyllite Assigned to Rampart Group sedimentary rocks. *Unit description source:* BV004

Dvf - Schistose felsic volcanic rocks (Devonian)

Dv - Metavolcanic rocks and sills (Devonian) See [Dv](#) for unit description from [SIM-3340](#).

Df (or Df?) - Felsic Metavolcanic rocks (Devonian) Felsic flow, tuff, and blastoporphyratic intrusive rocks with interlayers of metasedimentary rocks. Felsic portion of Da and Pzw units. North of Ambler belt. *Unit description source:* WI008

DSOtu - Metasedimentary and metavolcanic rocks of Tukpahlearik Creek, undivided (Ordovician to Devonian)

DOtu - Metasedimentary and metavolcanic rocks of Tukpahlearik Creek, undivided (Ordovician to Devonian) See [DOtu](#) for unit description from [SIM-3340](#).

DOtu - Metasedimentary and metavolcanic rocks of Tukpahlearik Creek, undivided (Devonian to Ordovician) Black carbonaceous quartzite and siliceous argillite with lenses of dolostone and marble, silvery gray to silvery green pelitic schist, gray chert pebble metaconglomerate, green calc-schist, orange-weathering micaceous marble, dark green mafic metavolcanic rocks, gray or white metachert and gray- to white-weathering marble. May be coeval with Pzbq, Pzbs, Pzqs, PzPku, PzPks, and PzPkc. *Unit description source:* BM002

DOtu - Metasedimentary and metavolcanic rocks of Tukpahlearik Creek, undivided (Devonian to Ordovician) Black carbonaceous quartzite and siliceous argillite with lenses of dolostone and marble, silvery gray to silvery green pelitic schist, gray chert pebble metaconglomerate, green calc-schist, micaceous marble, dark green mafic metavolcanic rocks, gray or white metachert, and gray- to white-weathering marble. Greenschist and blueschist facies metamorphism. *Unit description source:* SE003

DSOtq - Carbonaceous quartzite and quartz conglomerate of Tukpahlearik Creek (Ordovician to Devonian)

DOtu - Metasedimentary and metavolcanic rocks of Tukpahlearik Creek, undivided (Ordovician to Devonian) See [DOtu](#) for unit description from [SIM-3340](#).

DOtq - Carbonaceous quartzite and quartz conglomerate of Tukpahlearik Creek (Devonian(?) to Ordovician) Black carbonaceous quartzite, gray chert pebble metaconglomerate, and quartz schist with minor intercalated lenses of gray marble, micaceous marble, dolostone, and grey quartz mica schist. May be correlative with Pzbq. *Unit description source:* BM002

DSOtmq - Marble and quartz schist of Tukpahlearik Creek (Ordovician to Devonian)

DOtm - Marble of Tukpahlearik Creek (Ordovician to Devonian) See [DOtm](#) for unit description from [SIM-3340](#).

DOtm - Marble of Tukpahlearik Creek (Devonian to Ordovician) Orange-weathering gray micaceous marble. *Unit description source:* BM002

DOtmq - Marble and quartz schist of Tukpahlearik Creek (Devonian to Ordovician) Greenish gray, gray, or green, fine- to medium-grained chloritic quartz schists and siliceous chlorite schists. *Unit description source:* BM002

DSOtpg - Pelitic schist and greenstone of Tukpahlearik Creek (Ordovician to Devonian)

DOtp - Pelitic schist and metavolcanic rocks of Tukpahlearik Creek (Ordovician to Devonian) See [DOtp](#) for unit description from [SIM-3340](#).

DOtpg - Pelitic schist and greenstone of Tukpahlearik Creek (Devonian to Ordovician) Green and gray pelitic schists identical to the schist of unit DOtp with intercalated masses of dark green metabasite, mafic dikes, mafic extrusive rocks and white metachert. *Unit description source:* BM002

DSOtp - Pelitic schists of Tukpaklearik Creek (Ordovician to Devonian)**D0tp - Pelitic schist and metavolcanic rocks of Tukpahlearik Creek (Ordovician to Devonian)**

See [D0tp](#) for unit description from [SIM-3340](#).

D0tp - Pelitic schists of Tukpaklearik Creek (Devonian to Ordovician) Greenish-gray, green, or gray fine- to medium-grained chloritic quartz schist and siliceous chlorite schist. *Unit description source:* BM002 and SE003

DSOnx - Nome Complex, mixed marble, graphitic metaquartzite, and schist (Ordovician to Devonian)

DOnx - Marble, graphitic rocks, and schist (Ordovician? to Devonian) See [DOnx](#) for unit description from [SIM-3340](#).

iPzPxu - Schist and phyllite (middle Paleozoic) Chiefly light- to dark-gray fine-grained quartz-mica schist and grayish-black phyllite. Subordinate calcareous schist, limestone, chlorite schist, and amphibolite schist. May locally include metasedimentary rocks of middle Cretaceous age. Subdivision added by Patton (2000). *Unit description source:* SE004

PzPxus - Pelitic schist, calc schist, and quartzite (PzPxss) and carbonate rocks (Pzcs), undivided (Paleozoic and Proterozoic?) Scattered exposures along the western edge of the map area extending from Norton Bay quadrangle to southwestern part of Selawik quadrangle. *Unit description source:* SE004

DOx - Mixed marble, graphitic metaquartzite, and schist, Nome Complex (Devonian through Ordovician) Interlayered pure and impure marble, graphitic metasiliceous rock, pelitic schist, calc-schist, and mafic schist. Gray and orange weathering marble and dark gray-black weathering graphitic metasiliceous rock are the most common lithologies in the unit, which is dominated locally by one or the other. Gray-weathering pure marble forms rounded ridgelines which may stretch along strike for several kilometers, and rounded hills of slabby, black graphitic metasiliceous rock can be recognized from great distances. The unit is defined by its position structurally below the Casadepaga schist (unit Ocs). Good exposures are rare; minor lithologies generally do not crop out. Lithologies thicken and thin along strike on a scale of kilometers, a feature which may be depositional as well as structural.

In the western Solomon quadrangle and Nome quadrangle, there is a consistent general stacking pattern of lithologies within DOx. Everywhere in those areas, the structurally upper part of the unit is composed of mixed schist and marble, including pelitic schist, gray marble, orange-weathering impure marble, black schistose marble, and black metasiliceous rock; these lithologies are interlayered on scale of meters and decameters. The uppermost lithology is commonly an orange-weathering chlorite marble that forms stepped outcrops. The total thickness of the mixed schist and marble package varies from 250 meters to over 2 kilometers. The structurally lower parts of the unit are dominated by gray marble or black metasiliceous rock. Where the gray marble is dominant, it reaches thicknesses of 1-2 km and contains minor thin (less than 50 meters) layers of metaquartzite, pelitic schist, and chlorite-albite schist. Where the black metasiliceous rock is dominant, it reaches thicknesses of around 500 meters. It is underlain by 10-30 meters of gray marble interlayered with thin bands of pelitic schist.

Metabasites are found in both the mixed schist and marble package and within the thick, unit-dominating gray marble and black metasiliceous rock. They are boudins or layers of glaucophane-, epidote-, and garnet-bearing metabasite, or chlorite-, albite-, actinolite-bearing metabasite similar to those found in the Casadepaga schist. They occur in greatest volume in DOx south of Salmon Lake near the boundary between the Nome and Solomon quadrangles. The gray-weathering pure marble is pale

gray to white on the fresh surface, and composed of coarse crystalline calcite. The graphitic metasiliceous rock is generally homogeneous, dark-gray or black, and compositionally limited to quartz, graphite, and very small amounts of white mica, albite, and chlorite. Graphite may be present in sufficient quantities to rub off on the hands. Locally a centimeter-thick banding of dark gray-black quartz-graphite schist and gray-black quartz-graphite-calcite schist are found. In the Nome quadrangle, DOx contains several small rubble patches of carbonate conglomerate, as well as rubble and outcrops of light gray dolostone, locally mottled with orange, pink, or light brown, that retains relict sedimentary features. Conglomerate is matrix supported and contains rounded to angular clasts, as much as 8 cm long, of pale-orange to medium-gray dolostone; at one locality, subordinate clasts of marble and quartz-white mica schist also occur. The matrix is beige to orange pink or light brown dolomite with lesser quartz and white mica. Relict textures, seen in conglomerate clasts and in mottled dolostone rubble, include coated grains, crinoid ossicles, and possible brachiopod fragments.

In the northwestern Solomon quadrangle, DOx contains an interval of dolostone-clast conglomerate as much as 100 to 200 m thick and 480 m in lateral extent. The conglomerate ranges from matrix-supported (1 to 10 percent clasts) to clast-supported (>80 percent clasts) and contains interlayers and (or) lenses of clast-free schist and dolostone. Clasts are rounded to irregular; most have a flattened, ovoidal shape but some are rod-like. Sorting is poor; clasts range from a few millimeters to 70 cm in maximum dimension. Some clasts are finely laminated. Most clasts consist of light-gray- to rusty-weathering, very light gray, fine-grained ferric dolostone with minor amounts of quartz, white mica, and calcite. About 1 to 5 percent of clasts are medium light gray marble. The conglomerate matrix is quartz schist that also contains white mica, dolomite, chlorite, epidote, and chloritoid. A less extensive (several meters thick by 10 m long) but otherwise similar lens of dolostone-clast conglomerate occurs in Ocs in the Nome quadrangle. The dolostone clasts at both localities resemble, and may have been derived from, dolostone equivalent to that in unit d. The age range of DOx is not strictly known. Conodonts of Ordovician age were obtained from relatively pure marble in the Solomon quadrangle; marble in the Nome quadrangle produced conodonts of early Paleozoic age (Table A-1, T. Carr and T. Hudson, written commun., 1982, 1984). Recrystallized radiolarians collected in the northern Darby Mountains in banded calcite-bearing graphitic metasiliceous rock are of probable pre-Devonian age (B. K. Holdsworth, written commun., 1985).

The part of the unit in the Teller quadrangle shown with the diagonal line overlay is distinct in age and lithology. Dolostone, dolomitic marble, and marble form an elongate belt, extending for almost 40 km, in the westernmost part of DOx in the eastern Teller quadrangle; only the southern half of the belt has been examined. The unit forms rubble-covered hills with rare outcrops. Dolostone is medium gray to dark gray and weathers light to medium gray, very pale orange, or dark yellow brown. Sedimentary structures include millimeter- to centimeter-scale parallel lamination and lesser color mottling that likely reflects bioturbation. Intraclasts (maximum 1 cm in diameter) and millimeter-scale burrows occur locally. In thin section, dolostone is mostly finely crystalline and non-ferroan; some samples contain minor amounts of fine-grained quartz and white mica, or rare clasts (bioclasts?). Marble is white to grayish black and has few relict sedimentary features other than locally well-developed parallel lamination.

Conodonts of late Silurian-Devonian age have been recovered from two localities; a third locality produced a fauna of Silurian (late Llandovery-Ludlow) age (Table A-1). Sedimentary structures and conodont biofacies suggest a warm, shallow-water depositional setting. Faunal and lithofacies data indicate that these rocks may correlate, at least in part, with unit Sd in the Nome Complex. Correlation with units Ddm and SOdl and SOul (York terrane) is also possible, although these units contain more abundant megafossils than DOx (overlay). Shallow-water Silurian rocks also occur widely in the Brooks Range. Units that contain such strata and could correlate, at least in part, with DOx (overlay) include "DOb" (Baird Group), "DOc", and "DSc" of Till and others (2008b); Silurian lithofacies in "DSc" are an especially good match. DOx with overlay is equivalent to parts of "Pzm" and "pCn" of Sainsbury (1972). Three detrital zircon samples have been collected from DOx in southern Seward Peninsula. One yielded largely Neoproterozoic zircons, another yielded zircon populations as young as Silurian, and the third

yielded a robust population of Middle and Early Devonian zircons (Amato, written commun., 2008). Apparently, at least part of DOx must be Devonian or younger.

On the eastern edge of the map area, on the boundary of the Norton Bay and Candle quadrangles, exposures of metasedimentary rocks include calcareous, pelitic, and quartz-rich lithologies. These rocks have not been studied in detail; some may ultimately prove to have histories separate from the Nome Complex. These rocks are equivalent to units "PzZus" and "MzPzq" of Patton and others (2005). DOx is between 0.8-1.5 km thick, and best exposed in the eastern Solomon D-5 quadrangle on the ridge to the northwest of upper Birch and Auburn Creeks, and in east-central Solomon D-6 quadrangle on the ridge top just south of Nelson Creek. The unit includes parts of "pCs" and "slate of the York region" of Sainsbury (1974). *This unit description was derived from the following source: SE006*

DSOb - Baird Group, massive light gray reefoid limestone and dolomite with local thin interbeds of calcareous phyllite (Ordovician to Devonian)

DCbg - Baird Group and similar rocks (Upper Cambrian to Middle Devonian) See [DCbg](#) for unit description from [SIM-3340](#).

Db3 - Baird Group (Devonian) Part of the Kelly Sequence - Medium to thick-bedded, light-gray limestone and dolomite. Most exposures are discontinuous thrust slivers, and greatest thickness of approximately 100 m occurs east of lower Nimiuktuk River. Where base is exposed, it is truncated by thrust faults. *Unit description source: MU002, MU003, and MU004*

Db3 - Baird Group, upper part, Kelly River Allochthon, Eli Sequence (Devonian) Light- to dark-gray weathering, medium- to fine-grained limestone and dolomite. Massive to thick-bedded in most places. *Unit description source: NT005*

Db5 - Shaly limestone, Baird Group, Upper Part (Devonian) Gray to buff weathering thin-bedded shale and fine-grained limestone. *Unit description source: NT005*

Db4 - Baird Group (Devonian) Part of the Ilnavik Sequence - Thin-bedded, white to medium-gray micritic limestone. Contains some thin beds of gray shale. Probably conformable with the overlying Kayak Shale. Fossils include brachiopods of Late Devonian age, crinoid columnals, and bryozoans. Thickness in outcrop is approximately 50 m. with a thrust fault at base at only mapped locality on upper Trail Creek (south-central Misheguk Mountain quadrangle). Probably correlative with some Devonian limestone thrust slivers (unit DI) mapped elsewhere in uncertain sequence at base of Ilnavik River allochthon. *Unit description source: MU004*

Dbd3e - Dolomite (Devonian) Part of the Eli Sequence - Well-bedded, gray to dark-gray dolomite. Common fossil is stromatoporoid, Amphipora. Thickness less than 200 m with thrust fault at base west of Kugururok River. *Unit description source: MU002 and MU003*

Dbl - Limestone, Baird Group, Upper Part (Devonian) Fine- to coarse-grained, light- to dark-gray weathering massive to thick-bedded limestone. *Unit description source: NT005*

Dbl4 - Baird Group, upper part, Ilnavik River Allochthon, Ilnavik Sequence (Devonian) Blocky weathering, massive, light-gray, medium- to fine-grained limestone. *Unit description source: NT005*

DI - Limestone or Dolomite (Devonian) Occurs as isolated blocks commonly along thrust faults. Contains probable Middle and Late Devonian brachiopods and stromatoporoids. Gray chert nodules in dolomite are locally abundant in Picnic Creek area (southwestern Misheguk Mountain quadrangle map). *Unit description source: MU002, MU003, and MU004*

Dlm - Igichuk Hills - Devonian Baird Group limestone (Devonian) Light-gray-weathering limestone, commonly recrystallized, non-cherty, massive. *Unit description source:* NT006

Dlm - Copter Peak Allochthon - Limestone (Devonian) Light-gray-weathering limestone, commonly recrystallized, non-cherty, massive. *Unit description source:* NT006

DOb - Baird Group, undivided (Devonian to Ordovician) Beige- to orange- weathering, wavy, thinly laminated gray metalimestone and argillaceous to silty metalimestone; light- to dark-gray flaggy-bedded to massive metalimestone and marble; light- to dark-gray thin-bedded to massive dolostone. *Unit description source:* BM002

DOc - Carbonate rocks (Devonian(?), Silurian, and Ordovician) Carbonate rocks. Very light- to dark-gray (locally orange)-weathering, medium-gray to black, fine-grained dolostone and lesser metalimestone. Coeval with the Baird Group (DOb). *Unit description source:* BM002

DOc - Younger carbonate rocks of the Nanielik Antiform, Central belt and part of Northern Thrust Assemblages (Middle Devonian to Ordovician) Very light- to dark-gray- (locally orange-) weathering, gray to black, commonly massive dolostone and lesser metalimestone and marble exposed in the northeastern Baird Mountains quadrangle in the Nanielik antiform and in the northwestern Chandalar quadrangle. Unit has similarities in lithofacies and biofacies to younger part of DOb, as well as coeval strata of the York Mountains on Seward Peninsula. Ordovician biotas include some megafossils and microfossils with Siberian affinities and others with Laurentian affinities; Silurian and younger fossil assemblages are chiefly cosmopolitan. This unit is part of the Central belt. *Unit description source:* CH004

DCbs - Baird Group, Skajit Limestone (Middle Cambrian to Devonian)

Pzm - Marble of the Brooks Range (Devonian and older) See [Pzm](#) for unit description from [SIM-3340](#).

Dsk - Skajit Limestone (Middle(?) and Late Devonian) Skajit Limestone; white, gray, and black, gray-weathering, massive schistose marble and massive to slaty limestone. Includes some light-gray dolomite, thin interbedded phyllite and schist, and undifferentiated greenstone sills. *Unit description source:* CH002

DSdm - Dark gray marble (Devonian and Silurian) Dark gray weathering, strongly recrystallized marble apparently occurs locally in lower part of DSsk. *Unit description source:* AR002

DSk - Skajit limestone (Devonian and older?) Marble, dolomite, carbonate conglomerate, and minor quartzite and graphitic and calcareous schist. Locally may include marble layers of undifferentiated older formations. *Unit description source:* WI002

DSs - Skajit Limestone (Late Devonian and Silurian) Gray weathering, light to dark gray limestone and dolomite, mostly recrystallized or with slaty cleavage; rare chert nodules. In southeast part of quadrangle top beds partly replaced by massive or brecciated black recrystallized chert in discontinuous layer 1 - 10 meters thick that commonly contains pyrite and other sulfides. Marine. *Unit description source:* PS002

DSsk - Skajit Limestone (Devonian and Silurian) Skajit Limestone; Dark to light gray, thick- to massively-bedded limestone and dolomite usually recrystallized to marble. *Unit description source:* AR002

DSsk - Skagit Limestone (Devonian and Silurian) Massive light gray weathering cream to very light gray fine to medium grained granoblastic marble. Includes minor muscovite and quartz bearing marble. Minor calc-silicate skarns have been developed near Arrigetch pluton. *Unit description source:* SP002

Pzm - Marble (Paleozoic) White to gray (less commonly black), fine to coarsely crystalline, massive to platy marble and subordinate metalimestone and dolostone occurs discontinuously in all quadrangles within the map area. This unit is part of the Central belt. *Unit description source:* CH004

Skagit Limestone - Hammond terrane (Devonian to Ordovician and Cambrian to Proterozoic?)
Skagit Limestone - Hammond terrane. Massive metalimestone, dolostone, and marble. *Unit description source:* CH009

DCld - Massively bedded limestone, dolomite, and schist (Cambrian to Devonian)

Pzcn - Marble, northern Alaska (early Paleozoic) See [Pzcn](#) for unit description from [SIM-3340](#).

Pzl - Limestone (middle Paleozoic) Light-gray, recrystallized, limestone and dolomite containing minor intercalated phyllite and mica schist. Seward terrane, southwest part of quadrangle. *Unit description source:* SE002

DCcs - Calcareous schist (Cambrian to Devonian)

DPxacs - Calcareous schist of Brooks Range (Proterozoic to Devonian) See [DPxacs](#) for unit description from [SIM-3340](#).

Dac - Calcareous schist and albite-chlorite mica schist, undifferentiated (Devonian) Calcareous schist and albite-chlorite mica schist, undifferentiated. *Unit description source:* CH002

Dcm - Calcareous schist and marble (Devonian) Brown-weathering, thin-bedded calcite-muscovite-quartz-chlorite schist and schistose marble; few beds gray-weathering, white and black thick-bedded marble; interbedded noncalcareous mica-schist and phyllite. *Unit description source:* CH002

Pzc - Calcareous quartz-mica schist (Devonian and older (?)) Calcareous quartz-mica schist; Brown weathering quartz-muscovite-calcite +- chlorite +- albite schist. *Unit description source:* AR002

DCcm - Metasedimentary and metavolcanic rocks, undivided (Paleozoic to Devonian)

DPxasm - Mixed assemblage of metasedimentary and metavolcanic rocks in the Brooks Range (Proterozoic to Devonian) See [DPxasm](#) for unit description from [SIM-3340](#).

Dbcw - Beaucoup Formation, Calcareous chloritic wacke (Late or Middle Devonian?)
Carbonaceous, siliceous, and calcareous sedimentary rocks and felsic volcanic rocks. Grades downward and southwestward into DSk. Laterally equivalent to the Whiteface Mountain and Ambler rocks. Upper part; calcareous wacke with common plagioclase clasts. Lower part; interbedded calcareous, limonitic quartz sandstone and conglomerate, limestone and gray, red and green phyllite.

Local basal conglomerate. Correlates with Dw. Local recoding of Dillon unit in central part of quadrangle to match Till and others. *Unit description source:* WI008

Dc (or Dc?) - Chloritic and carbonate rocks (Late or Middle Devonian?) Green and gray phyllite and dolomite; chloritic, calcareous meta-sandstone and marble; and carbonate-clast conglomerate. *Unit description source:* WI002

Dfm - Metamorphosed Bimodal Igneous rocks (Devonian and Devonian?) Complexly interlayered felsic and mafic extrusive and intrusive rocks, undivided, mixed with clastic rocks at the head of Michigan Creek. *Unit description source:* WI008

DSk - Skajit limestone (Devonian and older?) Marble, dolomite, carbonate conglomerate, and minor quartzite and graphitic and calcareous schist. Locally may include marble layers of undifferentiated older formations. Southern part of unit reassigned to Till and others PzZcm unit. *Unit description source:* WI008

Pzcs - Calc-schist (Devonian and older (?)) Calc-schist; Buff weathering calcite-quartz-muscovite-chlorite +/- albite schist; includes lesser greenstone and marble. *Unit description source:* AR004

Pzm - Marble (Ordovician (?)) Gray, buff or red weathering, light-gray, and commonly dolomitic marble; mapped as a unique unit independent of Pzm_q when possible. *Unit description source:* AR004

Pzm_q - Marble and quartzite (Ordovician (?)) Complex stratigraphic and structural unit composed of clean white fine-grained quartzite interbedded with marble or limestone; contains gray phyllite, siltstone, and quart-mica +/- chlorite schist; quartzite (Pz_q) and marble (Pzm) mapped where where possible. *Unit description source:* AR004

Pz_q - Quartzite (Ordovician (?)) Clean white or gray, fine-grained quartzite weathering orange and yellow; mapped as a unique unit independent of Pzm_q when possible. *Unit description source:* AR002

Pzqp - Quartz-phyllite (Devonian and older (?)) Quartz-phyllite; Light gray, fine- to medium-grained quartzite interbedded with brown and gray phyllite. *Unit description source:* AR002

PzZcm - Metasedimentary and metavolcanic rocks, undivided (Paleozoic and Proterozoic?) Heterogeneous assemblage of interlayered calcareous, mafic, and siliceous rocks exposed in the central Baird Mountains, Ambler River, and Wiseman quadrangles. This unit is part of the Central belt. *Unit description source:* AR004

DZsg - Schist and paragneiss (Neoproterozoic to Devonian)

DPxsgm - Schist, paragneiss, and marble (Neoproterozoic to Devonian) See [DPxsgm](#) or unit description from [SIM-3340](#).

Pzsgn(Is) - Undifferentiated limestone and marble (Mississippian and Devonian) The undifferentiated limestone and marble units have been classed based on the units they are contained within using 5XX where XX is the class of the surrounding unit. *Unit description source:* SP002

Pzsgn - Undifferentiated Schist and Paragneiss (Paleozoic) Medium grade schist and gneiss near margins of Mount Igikpak pluton. Common metamorphic minerals (in approximate increasing order of abundance) include garnet, biotite, muscovite, amphibole, feldspar, and quartz. *Unit description source:* SP002

DZrqm - Ruby quartz-mica schist (Neoproterozoic to Devonian)

PzPxrqm - Pelitic and quartzitic schist of the Ruby terrane (Proterozoic? to Early Paleozoic)

See [PzPxrqm](#) for unit description from [SIM-3340](#).

Pzc - Calcareous schist (Paleozoic) Yellow-weathering impure calcareous marble interlayered with dark-green basic schist. *Unit description source:* BV002

DZaqs - Arctic Alaska terrane, quartz-mica schist (Neoproterozoic to Devonian)

DPxaqm - Quartz-mica schist of the Brooks Range (Proterozoic to Devonian) See [DPxaqm](#) for unit description from [SIM-3340](#).

Marion Creek schist - Coldfoot terrane (Cretaceous to Devonian) Interlayered medium-grained quartzite and graphitic pelitic and semi-pelitic schist and lenses of mafic schist. *Unit description source:* CH009

fs - Felsic schist (Mesozoic and (or) Paleozoic) Felsic schist; mostly quartz-albite +- muscovite +- K-spar +- biotite schist. *Unit description source:* AR002

mfs - Megacrystic felsic schist (Mesozoic and (or) Paleozoic) Megacrystic felsic schist; Quartz-albite-muscovite +- feldspar +- biotite schist; contains megacrystals of quartz and k-spar. *Unit description source:* AR002

ps - Phyllitic schist (Paleozoic and older (?)) Lithologically homogenous gray fine-grained schistose phyllite with thin quartz segregations between phyllite and schist layers; compositionally similar to Pzp and qm and probably of intermediate metamorphic grade. *Unit description source:* AR002

qm - Massive quartz-mica schist (Paleozoic and older (?)) Lithologically homogenous massive weathering quartz-mica schist. (Assigned to Arctic Alaska terrane). *Unit description source:* AR002

uqm - Undifferentiated quartz-mica-schist (Paleozoic and older (?)) Predominantly quartz-mica schist (qm) or phyllitic schist (ps). (Assigned to Arctic Alaska terrane). *Unit description source:* AR002

Db - Biotite schist (Devonian) Coarse-grained albite-biotite-quartz-garnet epidote schist with some undifferentiated greenschist. *Unit description source:* CH002

Dqm - Quartz-mica schist (Devonian) Quartz-mica schist; dark-gray to black, gray to reddish-brown-weathering, quartz-muscovite schist and schistose quartzite. *Unit description source:* CH002

Dqg - Quartz-mica schist (Devonian) Quartz-mica schist with intercalated greenschist and greenstone. *Unit description source:* CH002

Pzbq - Black quartz-mica schist (Devonian and (or) Silurian) Black fine-grained quartzose schist; quartz and graphite commonly segregated along principal foliation planes; complete recrystallization and higher grade metamorphic equivalent to Pzbs. *Unit description source:* AR002

Pzcs - Chloritoid Bearing Schist (Paleozoic) Predominantly gray weathering fine to medium grained chloritoid bearing quartz muscovite schist. Schist locally contains glaucophane. *Unit description source:* SP002

Pzcs(Is) - Undifferentiated limestone and marble (Mississippian and Devonian) The undifferentiated limestone and marble units have been classed based on the units they are contained within using 5XX where XX is the class of the surrounding unit. *Unit description source:* SP002

Pzis - Iron Stained Schist (Paleozoic) Brown to orange weathering iron stained schist probably equivalent to quartz muscovite schist (Pzqms) or chloritoid bearing schist (Pzcs). *Unit description source:* SP002

Pzis(Is) - Undifferentiated limestone and marble (Mississippian and Devonian) The undifferentiated limestone and marble units have been classed based on the units they are contained within using 5XX where XX is the class of the surrounding unit. *Unit description source:* SP002

Pzqms - Quartz mica schists (Paleozoic) Grayish-green or greenish-gray fine-grained quartz-muscovite-chlorite schist and mica-quartz schists. *Unit description source:* BM002

Pzqms (or Pzqms?) - Quartz-Muscovite Schist (Paleozoic) Predominantly light gray weathering chlorite quartz muscovite schist and phyllitic schist and dark gray to dark gray green porphyroblastic albite chlorite quartz muscovite schist. Minor minerals observed in thin section include garnet, zoned brown tourmaline, sphene, zircon, and apatite. Locally differentiated into units Pzca, Pzis and Pzq. *Unit description source:* SP002

Pzqms(Is) - Undifferentiated limestone and marble (Mississippian and Devonian) The undifferentiated limestone and marble units have been classed based on the units they are contained within using 5XX where XX is the class of the surrounding unit except in the case of class 591 which was used for the limestone and marble units between two different units. *Unit description source:* SP002

Pzus - Undifferentiated Schist (Paleozoic) Mostly quartz muscovite schist (Pzqms) but includes minor undifferentiated units equivalent to chloritoid bearing schist (Pzcs), calcareous schist (Pzca), felsic schist (Df), mafic metavolcanic rocks (Dv), greenstone and greenschist (Pzgg), quartzite (Pzq), iron stained schist (Pzis) and limestone and marble (Pzl) interlayered in unit Pzqms. (Assigned to Arctic Alaska terrane). *Unit description source:* SP002

Pzus(Is) - Undifferentiated limestone and marble (Mississippian and Devonian) The undifferentiated limestone and marble units have been classed based on the units they are contained within using 5XX where XX is the class of the surrounding unit except in the case of class 591 which was used for the limestone and marble units between two different units. *Unit description source:* SP002

PzZs - Schist (Early Paleozoic or Proterozoic) Coarse mica-schist and paragneiss with lenses and bands of black, graphitic schist in muscovite quartzite and quartz-feldspathic schist; a few layers of marble and calcareous schist.. Banded schist, paragneiss, and orthogneiss that may have been regionally metamorphosed three times. Upper greenschist facies rocks predominate, but includes amphibolite facies paragneiss, and local relict blueschist and eclogite facies metabasite. *Unit description source:* WI002

PzZsa - Schist and quartzite (Paleozoic and Proterozoic) Quartz-mica schist and lesser amounts of calc schist, quartzite, graphitic schist, chlorite schist, and quartz-feldspathic schist. Polydeformed greenschist-blueschist-facies characterized by quartz-muscovite-chlorite-albite±glaucophane assemblages. A relict epidote-amphibolite metamorphic assemblage suggests that, at locally, the unit underwent a pre-mid Devonian metamorphic event. Unit is interbedded with carbonate rocks of unit Pzca and therefore is, in part, Paleozoic in age. However, in the Baird Mountains quadrangle, unit is intruded by Proterozoic granitic rocks of unit PzPxi, and therefore is locally as old as Proterozoic. Forms a continuous band along northern edge of map area. *Unit description source:* AR003

PzZsa - Pelitic schist, calc schist, and quartzite (Paleozoic and Proterozoic) Quartz-mica schist and lesser amounts of calc schist, quartzite, graphitic schist, chlorite schist, and quartz-feldspathic schist. Polydeformed greenschist-blueschist-facies characterized by quartz-muscovite-chlorite-albite±glaucophane assemblages. A relict epidote-amphibolite metamorphic assemblage suggests that, at locally, the unit underwent a pre-mid Devonian metamorphic event. Unit is interbedded with carbonate rocks of unit Pzca and therefore is, in part, Paleozoic in age. However, in the Baird Mountains quadrangle, unit is intruded by Proterozoic granitic rocks of unit PzPxi, and therefore is locally as old as Proterozoic. Forms a continuous band along northern edge of map area. *Unit description source:* SE004

PzZsr - Pelitic schist, calc schist, and quartzite (Paleozoic and Proterozoic?) Quartz-mica schist, chlorite schist, quartz-feldspathic schist, quartzite, and micaceous and graphitic schist. Regionally metamorphosed to greenschist-facies, but also locally includes high-pressure greenschist-blueschist-facies (distinguished by the presence of glaucophane) and amphibolite-facies (distinguished by the presence of sillimanite and kyanite). Andalusite-cordierite hornfels and contact schist occur in broad bands around Cretaceous granitic bodies of units Kgr and Ksy. Unit locally is interlayered with carbonate rocks of unit Pzcr and therefore is, at least in part, Paleozoic in age. However, some of the unit may be as old as Proterozoic. The regional metamorphism clearly pre-dates the widespread intrusion of the Early Cretaceous granitic bodies of units Kgr and Ksy. Widely exposed along southeast side of the Yukon-Koyukuk Basin from Ophir quadrangle to the northeast corner of Bettles quadrangle. Also included in this unit are two small areas of schist exposed in windows(?) within the Innoko terrane in the east-central Ophir quadrangle. *Unit description source:* WI003

PzPxsa - Pelitic schist, calc schist, and quartzite (Paleozoic and Proterozoic) Quartz-mica schist and lesser amounts of calc schist, quartzite, graphitic schist, chlorite schist, and quartz-feldspathic schist. Polydeformed greenschist-blueschist-facies characterized by quartz-muscovite-chlorite-albite±glaucophane assemblages. A relict epidote-amphibolite metamorphic assemblage suggests that, at locally, the unit underwent a pre-mid Devonian metamorphic event. Unit is interbedded with carbonate rocks of unit Pzca and therefore is, in part, Paleozoic in age. However, in the Baird Mountains quadrangle, unit is intruded by Proterozoic granitic rocks of unit PzPxi, and therefore is locally as old as Proterozoic. Forms a continuous band along northern edge of map area. *Unit description source:* WI003

This unit is also present on source map NT006, however, no description was present on this source.

DZss - Seward terrane, siliceous schist of the Kallarichuk Hills (Neoproterozoic to Devonian)

DPxaqm - Quartz-mica schist of the Brooks Range (Proterozoic to Devonian) See [DPxaqm](#) for unit description from [SIM-3340](#).

PzPks - Siliceous schist of the Kallarichuk Hills (Paleozoic and (or) Proterozoic) Light silvery gray to silvery grayish green to dark green garnet-mica-quartz schists. *Unit description source:* BM002

DZacs - Brooks Range Central belt and part of Northern thrust assemblages, quartz-rich metasedimentary rocks (Neoproterozoic to Devonian)

DPxasm - Mixed assemblage of metasedimentary and metavolcanic rocks in the Brooks Range (Proterozoic to Devonian) See [DPxasm](#) for unit description from [SIM-3340](#).

Pzclq - Chlorite Quartzite and Chloritic Quartz Schist (Paleozoic) Monotonous sequence of light

greenish gray weathering rocks. Rocks are predominantly quartz with lesser amounts of chlorite, muscovite, biotite and plagioclase. Assigned Paleozoic age on basis of possible intrusion by granitic orthogneiss (Dgr). *Unit description source:* SP002

Pzclq(l)s - Undifferentiated limestone and marble (Mississippian and Devonian) The undifferentiated limestone and marble units have been classed based on the units they are contained within using 5XX where XX is the class of the surrounding unit. *Unit description source:* SP002

Pzpg (or Pzpg?) - Chloritic phyllite and greenstone (Devonian and older (?)) Chloritic phyllite and greenstone; Gray and green phyllite, calcareous schist, thin dolomite, black quartzose schist, and irregular lenses and pods of mafic igneous rocks (mi). May include slivers of Pzl, Pzcs, and Pzbq. *Unit description source:* AR002

Pzqt - Quartzite (Paleozoic) Orange weathering white to cream quartzite, quartz conglomerate, and schistose conglomerate. Locally quartzite contains abundant pyrite and is interbedded with minor calcareous, muscovite quartzite, and yellow weathering gray laminated calcareous phyllite. *Unit description source:* SP002

Pzqt(l)s - Undifferentiated limestone and marble (Mississippian and Devonian) The undifferentiated limestone and marble units have been classed based on the units they are contained within using 5XX where XX is the class of the surrounding unit. The limestone bodies occur at the contact between units. *Unit description source:* SP002

Vi Creek schist - Hammond terrane (early Paleozoic) Laminated very fine-grained white mica-chlorite-quartz schist and sparse metaconglomerate and marble. *Unit description source:* WI011

PzZqs - Quartz-rich metasedimentary rocks (Paleozoic to Proterozoic?) Relatively homogeneous assemblage dominated by light greenish-gray fine-grained quartz-rich schist, typically accompanied by minor layers of metaconglomerate, marble, and calcareous schist. Exposed in the southern Central belt in the western Survey Pass quadrangle and straddling the Wiseman Chandalar quadrangle boundary. This unit is part of the Central belt. *Unit description source:* CH004

DZb - Metasedimentary rocks of Bluecloud Mountain (Neoproterozoic to Devonian)

PzPxb - Metasedimentary rocks of Bluecloud Mountain (Proterozoic? to Early Paleozoic) See [PzPxb](#) or unit description from [SIM-3340](#).

Dhs (or Dhs?) - Hunt Fork Schist (Late Devonian?) Twice metamorphosed sedimentary and volcanic rocks; middle to upper Greenschist facies. Metamorphic facies and texture increases southward; mostly phyllite and limestone in north; schist and marble in south. Lower Endicott Group- Carbonaceous siliceous clastic rocks. Grades downward into Beaucoup Formation in some places; unconformably overlies upper Middle Devonian and older rocks in other places. Black quartz schist and biotite garnet quartz schist. *Unit description source:* WI002

PzZb - Metasedimentary rocks of Bluecloud Mountain (Paleozoic to Proterozoic?) Light, medium, and dark gray phyllite, dark gray to black metaquartzite, dark gray and grayish-brown calcareous phyllite, and reddish-brown weathering impure marble exposed in fault-bounded lenses along the Schist belt-Central belt contact in the Wiseman quadrangle. This unit is part of the Central belt. *Unit description source:* SP004 and WI007

DZel - Marble and intercalated gneissic rocks (Neoproterozoic to Devonian)

DPxsgm - Schist, paragneiss, and marble (Neoproterozoic to Devonian) See [DPxsgm](#) or unit description from [SIM-3340](#).

DSsk - Skajit Limestone (Devonian and Silurian) Massive light gray weathering cream to very light gray fine to medium grained granoblastic marble. Includes minor muscovite and quartz bearing marble. Minor calc-silicate skarns have been developed near Arrigetch pluton. *Unit description source:* SP005

DSso - Orange Dolomitic Marble (Devonian and Silurian) Orange weathering medium to coarse grained granoblastic chlorite muscovite quartz dolomite(?) marble. Marble contains interlayered chlorite schist, calcareous muscovite schist, and gray marble (DSsk). *Unit description source:* SP005

PzZem - Metamorphic rocks of the Ernie Lake area (Paleozoic to Proterozoic) Coarse crystalline marble, orange dolomitic marble, quartz-mica schist, metaquartzite, calcareous schist, graphitic metaquartzite, and metabasite exposed in eastern Survey Pass and western Wiseman quadrangles. Locally gneissic. This unit is part of the Central belt. *Unit description source:* W1007

Zb - Banded schist (Proterozoic?) Interlayered coarse quartz-mica schist, quartzite, calcareous schist, marble, graphitic phyllite and metabasite. Locally gneissic. Banded schist, paragneiss, and orthogneiss that may have been regionally metamorphosed three times. Upper greenschist facies rocks predominate, but includes amphibolite facies paragneiss, and local relict blueschist and eclogite facies metabasite. *Unit description source:* W1002

DZmr - Metamorphic rocks, lenses near Kobuk and Victoria Creek fault systems, amphibolite facies (Neoproterozoic to Devonian)

PzPxrqm - Pelitic and quartzitic schist of the Ruby terrane (Proterozoic? to Early Paleozoic) See [PzPxrqm](#) for unit description from [SIM-3340](#).

Dgt - Garnet-mica schist (Devonian) Gray to black quartz-muscovite schist with abundant large garnets; rare biotite; little interbedded quartzite and hornblende hornfels. *Unit description source:* CH002

Dh - Hornblende hornfels (Devonian) Dark green and gray hard fine-grained schist composed of hornblende, actinolite, plagioclase (albite-labradorite?), and chlorite, and minor epidote, biotite and quartz. *Unit description source:* CH002

DZrpg - Gneiss and quartzite of the Ruby crystalline complex (Neoproterozoic to Devonian)

PzPxrqm - Pelitic and quartzitic schist of the Ruby terrane (Proterozoic? to Early Paleozoic) See [PzPxrqm](#) for unit description from [SIM-3340](#).

Pzqg - Gneiss and quartzite (Paleozoic) Light-gray to pale-orange gneissic quartzite, quartz-biotite schist, and quartz-plagioclase gneiss. *Unit description source:* BV002

DZa - Schist belt (western part), calcareous schist, albite-rich subunit (Proterozoic to Devonian)

DPxacs - Calcareous schist of Brooks Range (Proterozoic to Devonian) See [DPxacs](#) for unit description from [SIM-3340](#).

Da - Albite-chlorite mica schist (Devonian) Gray, green, and yellowish-gray chlorite-muscovite schist; generally with coarse-grained albite and quartz; little biotite. *Unit description source:* CH002

Daq - Albite-chlorite mica schist (Devonian) Albite-chlorite-muscovite schist with interbedded chloritic quartzite composed of quartz, plagioclase (albite to andesine), chlorite, calcite, muscovite, epidote, garnet (pyrospite), sphene, and, commonly, biotite. *Unit description source:* CH002

DZmc - Schist belt, calcareous schist, metachert and conglomerate subunit (Proterozoic to Devonian)

DPxacs - Calcareous schist of Brooks Range (Proterozoic to Devonian) See [DPxacs](#) for unit description from [SIM-3340](#).

Dc - Chloritic and carbonate rocks (Late or Middle Devonian?) Green and gray phyllite and dolomite; chloritic, calcareous meta-sandstone and marble; and carbonate-clast conglomerate. Southernmost polygons of Dillon and others unit assigned to Till and others DpCsc unit, metachert dominated unit. *Unit description source:* WI007

Nugget Creek greenschist - Coldfoot terrane (Devonian?) Mafic schist. The Nugget Creek greenschist is commonly crowded with pseudomorphs of very fine grained chlorite and albite +/- actinolite after amphibole. Protolith was mafic volcanic rocks. *Unit description source:* CH009

DpCsc_101 - Calcareous schist - metachert and conglomerate subunit, Schist belt (Devonian to Proterozoic) Light gray, brown and locally orange-weathering, lithologically heterogeneous mix of marble and carbonate-rich, quartz-rich, and mafic schist derived from metasedimentary and metaigneous protoliths, one of two major units that extends along the length of the Schist belt. These exposures are dominated by metachert (mm-cm scale laminated quartz-rich rock) and calcareous schist, and contain several types of metaconglomerates. The metachert commonly contains cm-scale lenses and thin, mm-thick layers of spessartine (Mn-rich) garnet or mafic metatuff. Metabasite bodies are associated with the metachert as well. Part of the Schist belt. *Unit description source:* CH004, SP005, and WI007

DZsm - Brooks Range schist belt, chloritic marble (Proterozoic? to Devonian)

DPxsgm - Schist, paragneiss, and marble (Neoproterozoic to Devonian) See [DPxsgm](#) for unit description from [SIM-3340](#).

Pzd - Dolostone (Paleozoic) Very pale-orange to moderate-reddish-brown, creamy weathering, very fine-grained, slightly calcitic dolostone, locally laminated. *Unit description source:* BM002

Pzl - Undifferentiated, limestone and marble (Devonian and older (?)) Light gray coarse- to fine-grained limestone; in many places recrystallized to marble. Northern polygons of this unit from Mayfield and Tailleux (1978), assigned to Beaucoup Formation carbonates. *Unit description source:* AR007

Pzl - Limestone and Marble (Paleozoic) Mostly light gray, medium grained, granoblastic marble,

impure quartz muscovite marble, and minor limestone. Possibly includes carbonate rocks of different ages. *Unit description source:* SP002

Pzm? - Marble (Ordovician (?)) Gray, buff or red weathering, light-gray, and commonly dolomitic marble; mapped as a unique unit independent of Pzm_q when possible. *Unit description source:* AR002

DSso (or DSso?) - Orange Dolomitic Marble (Devonian and Silurian) Orange weathering medium to coarse grained granoblastic chlorite muscovite quartz dolomite(?) marble. Marble contains interlayered chlorite schist, calcareous muscovite schist, and gray marble (DSsk). *Unit description source:* SP005

Pzm_{sm} - Mixed Schist and Marble (Paleozoic) Interlayered gray marble, orange dolomitic marble, magnetite bearing chlorite schist, and garnet biotite quartz schist with small calcsilicate skarns containing amphibole near the Arrigetch pluton. Intermediate amount of interlayered marble distinguishes these rocks from marble unit, DSso (more marble), and the schist unit Pzsch (less marble); however, they may be equivalent in age. *Unit description source:* SP002, and SP005

Pzm_{sm}(ls) - Undifferentiated limestone and marble (Mississippian and Devonian) The undifferentiated limestone and marble units have been classed based on the units they are contained within using 5XX where XX is the class of the surrounding unit except in the case of class 591 which was used for the limestone and marble units between two different units. *Unit description source:* SP002

DZrqs - Ruby terrane, pelitic and quartzitic schist (Proterozoic to Devonian)

PzPxrqm - Pelitic and quartzitic schist of the Ruby terrane (Proterozoic? to Early Paleozoic)
See [PzPxrqm](#) for unit description from [SIM-3340](#).

Dbs - Biotite-staurolite schist (Devonian) Quartz-albite-oligoclase-biotite schist, commonly with staurolite and/or andalusite; with interbedded quartzite. *Unit description source:* CH002

Dq - Quartzite and schist (Devonian) Gray and black quartz-muscovite, locally biotitic, schist with interbedded pale yellow and gray very fine-grained, thin-bedded locally biotitic quartzite. *Unit description source:* CH002

Pzq - Quartzite (Paleozoic) Gray quartzite and quartz-mica schist. *Unit description source:* BV002

Pzs - Pelitic schist (Paleozoic) Quartz-mica schist, quartzo-feldspathic schist, and subordinate quartzite and calcareous quartz-mica schist. *Unit description source:* BV002

Pzs - Pelitic schist (Paleozoic and Precambrian (?)) Pelitic schist including quartz-mica schist, chlorite schist, quartzo-feldspathic schist, and subordinate quartzite; metamorphic grade range of lower greenschist to almandine-amphibolite facies; local hornfels. *Unit description source:* BT002

PzZsr - Pelitic schist, calc schist, and quartzite (Paleozoic and Proterozoic?) Quartz-mica schist, chlorite schist, quartzofeldspathic schist, quartzite, and micaceous and graphitic schist. Regionally metamorphosed to greenschist-facies, but also locally includes high-pressure greenschist-blueschist-facies (distinguished by the presence of glaucophane) and amphibolite-facies (distinguished by the presence of sillimanite and kyanite). Andalusite-cordierite hornfels and contact schist occur in broad bands around Cretaceous granitic bodies of units Kgr and Ksy. Unit locally is interlayered with carbonate rocks of unit Pzcr and therefore is, at least in part, Paleozoic in age. However, some of the unit may be as old as Proterozoic. The regional metamorphism clearly pre-dates the widespread intrusion of the Early Cretaceous granitic bodies of units Kgr and Ksy. Widely exposed along southeast side of the

Yukon-Koyukuk Basin from Ophir quadrangle to the northeast corner of Bettles quadrangle. Also included in this unit are two small areas of schist exposed in windows(?) within the Innoko terrane in the east-central Ophir quadrangle. *Unit description source:* BT003

Spl - Black phyllite and metalimestone (Silurian)

Sbs - Black phyllite and metalimestone (Silurian) See [Sbs](#) for unit description from [SIM-3340](#).

MDcp - Phyllite (Mississippian and Devonian) Interlayered dark gray to black phyllite and calcareous phyllite. Unit is more siliceous than either Early Mississippian Kayak Shale or Late Devonian Hunt Fork Shale although it is lithologically similar to both. At present, these rocks are considered undivided Kayak and Hunt Fork Shales. Unit split into western and eastern parts by Till and others, western part 6686, eastern remains 6331. *Unit description source:* SP005

Db - Black limestone, calcareous schist, and black siliceous phyllite, undifferentiated (Late and Middle Devonian) Black limestone, calcareous schist, and black siliceous phyllite, undifferentiated. *Unit description source:* AR002

DbI - Black limestone and calcareous schist (Late and Middle Devonian) Black or gray medium- to thin-bedded limestone intercalated with thin-bedded graphitic calcareous schist; minor graphitic phyllite occurs as smeared out layers between thin carbonate beds; groundwater leaching develops characteristic white surficial precipitate crust. *Unit description source:* AR002

Ds - Siltstone and slate (Devonian) Thin-bedded siltstone and slate with intercalated sandstone beds; lower part of unit is mostly calcareous siltstone with a few thin limestone beds. *Unit description source:* AR002

SOj - Metasedimentary rocks of Jesse Mountain (Ordovician to Silurian)

Dbf - Beacoup Formation, undivided (Devonian) See [Dbf](#) for unit description from [SIM-3340](#).

Pzj - Metasedimentary rocks of Jesse Mountain (Paleozoic) Generally fine grained, phyllitic to schistose, gray-weathering meta-argillite, black-weathering metaquartzite, marble, and brown weathering impure marble, exposed in a single area in the eastern Wiseman quadrangle. This unit is part of the Central belt. *Unit description source:* CH004 and WI007

SOig - Iviagik Group, undivided (Middle Ordovician to Silurian (Wenlock))

SOig - Iviagik group of Martin (1970) (Ordovician to Silurian) See [SOig](#) for unit description from [SIM-3340](#).

Iviagik Group (Silurian and Ordovician) Slaty black argillite and siliceous shale containing minor siltstone and chert and lithic, sand-rich turbidite deposits. *Unit description source:* PH003

SOCb - Siltstone and phyllite (Cambrian to Silurian)

SCs - Sedimentary rocks of Doonerak Window (Cambrian to Silurian) See [SCs](#) for unit description from [SIM-3340](#).

SCb (or SCb?) - Black siltstone and phyllite (Silurian to Cambrian) Black phyllite and metasilstone, minor quartzite, graywacke, red and green and purple phyllite, green chert, siliceous metatuff, lenses of brown dolomite and thin limestone beds. Abundant unmapped mafic sills. Basement rocks of the Doonerak Window. Lower greenschist and prehnite-pumpellyite. Unconformably overlain by Mississippian Kekiktuk conglomerate. *Unit description source:* WI002

SOCvs - Doonerak antiform, volcanic and sedimentary rocks (Cambrian to Silurian)

SCs - Sedimentary rocks of Doonerak Window (Cambrian to Silurian) See [SCs](#) for unit description from [SIM-3340](#).

SCvs - Volcanic and sedimentary rocks (Silurian to Cambrian) Volcanic rocks, volcaniclastic rocks, and clastic sedimentary rocks exposed in the core of the Doonerak antiform, northeast Wiseman quadrangle. The unit can be divided into at least two lithologic sequences, one dominated by volcanic rocks, the other by sedimentary rocks. This unit is part of the Doonerak antiform. *Unit description source:* CH004

SZcb - Carbonate rocks and subordinate metabasite (Neoproterozoic to Silurian)

OPxIs - Limestone, northern Alaska (Proterozoic? through Ordovician) See [OPxIs](#) for unit description from [SIM-3340](#).

PzZcb - Carbonate rocks and metabasite (Paleozoic and (or) Proterozoic) Inferred continuation of this unit eastward into the Ambler River quad. from Baird Mountains quad. Orange- to light-gray-weathering, dark-to light-gray, fine- to medium-grained crystalline dolostone, metalimestone and marble, with subordinate intercalated calcareous quartzite, quartz-mica schist, green and silver phyllite, carbonate cobble metaconglomerate, and blue amphibole-bearing metabasite. *Unit description source:* AR007

PzPcb - Carbonate rocks and metabasite (Paleozoic and (or) Proterozoic) Orange- to light-gray-weathering, dark-to light-gray, fine- to medium-grained crystalline dolostone, metalimestone and marble, with subordinate intercalated calcareous quartzite, quartz-mica schist, green and silver phyllite, carbonate cobble metaconglomerate, and blue amphibole-bearing metabasite. *Unit description source:* BM002 and BM007

Oc - Nanielik antiform, Ordovician carbonate rocks (Ordovician to Middle Ordovician)

OPxIs - Limestone, northern Alaska (Proterozoic? through Ordovician) See [OPxIs](#) for unit description from [SIM-3340](#).

OpCc (or OpCc_541) - Older carbonate rocks of the Central belt, restricted (Middle Ordovician to Proterozoic?) Dolostone, metalimestone, marble and subordinate quartzose metasedimentary rocks, carbonate conglomerate, and metabasite. Only exposures that contain the Ordovician part of unit OpC are included in this unit. *Unit description source:* SP005

Ocs - Casadepaga Schist (Ordovician)

Ocs - Casadepaga Schist (Proterozoic? through Ordovician) See [Ocs](#) for unit description from [SIM-3340](#).

Ocs - Casadepaga Schist, Nome Complex (Ordovician) Light green, silvery green and greenish-brown mafic, feldspathic, and calcareous schist. Typically occurs as frost-riven slabs and flakes that underlie rounded hills and dark greenish-black tors and rubble piles several meters across. Tors of metabasite, abundant plagioclase porphyroblasts in dark-green, chlorite-rich schist, and the quartz-poor nature of the rocks are characteristic of this unit. The most common lithologies are dominated by components of mafic, feldspathic, and calcareous composition that are intermixed and interlayered on a scale of tens of centimeters; the layering may occur in repetitive couplets.

Medium- to pale-grayish green weathering pelitic schists are common. Plagioclase, chlorite, white mica, and quartz in subequal amounts dominate these rocks; epidote, carbonate, and glaucophane (or pseudomorphs of chlorite and plagioclase after glaucophane) are typical of many of these schists. Titanite (sphene), rutile, and sulfides are present in minor amounts. Based on major element chemistry, the protoliths of these schists were shales and graywackes (Werdon and others, 2005a). Carbonate-rich schists or layers are typically buff or pale brown weathering and tend to be more recessive in outcrop than other lithologies. Pure carbonate layers are rare and thin but include both pure and impure varieties; they weather pale brown, black, or gray. Dark green weathering schists are rich in chlorite, epidote, actinolite, and plagioclase, and represent metamorphosed mafic material. Dark green weathering chlorite-rich schists spotted with white equant plagioclase grains typically contain few to no calcium-bearing phases. These are probably mafic rocks that were altered or weathered previous to metamorphism.

Boudins, lenses and layers of fine- to coarse-grained, massive metabasite comprise the greenish-black tors of the unit. In thin section these rocks are found to be composed of glaucophane, actinolite, chlorite, epidote, garnet, albite, white mica, titanite, and locally quartz, Fe-carbonate, pyroxene, and barrosite. Coarser-grained varieties have textures suggestive of a coarse-grained gabbroic protolith. Mafic schist layers in the surrounding rocks have mineral assemblages similar to the metabasite pods. The metabasites comprise two compositional groups (Werdon and others, 2005a,c). One group has weakly developed arc-like signatures (e.g., slight Nb depletion in spidergrams) reflecting crustal contamination, and another group exhibits features associated with enriched mantle (E-MORB) and alkaline intercontinental rifts (no Nb depletion, small positive Ti anomalies in spidergrams) (Ayuso and Till, 2007). Metabasites from unit DOx fall into the same two compositional groups. The chemical characteristics are thought to indicate a tectonic setting related to the early stages of continental, rift-related magmatism (Ayuso and Till, 2007); crustal contamination during rifting is thought to have produced the weak arc-like signatures.

In the western Solomon quadrangle, the contact between Ocs and the overlying impure marble unit (Oim) is exposed. Near the contact, on all sides of a synform cored by Oim, a thin (few meters - tens of meters) layer of black weathering, platey, fine grained and finely laminated quartz-graphite schist occurs. The amount of graphite in the rock is variable, though it is always black-weathering; thin laminae of lenses (mm- to cm-scale) that are more quartz-rich are common. Graphite occurs as fine disseminated material in the quartz-rich matrix, as well as in lozenges several mm across. White mica is

disseminated and minor. Semi-quantitative spectrographic analyses of a few samples from this layer show elevated values of Mo, V, Ag, and Zn (B. Gamble, written commun., 1985). Thin layers of mafic schist separate the graphitic layer from the overlying impure marble.

No direct evidence for the depositional age of Ocs exists. Seven detrital zircon samples collected from widely distributed parts of the unit contain very similar grain populations. Most grains fall into the range of 600-700 Ma; several samples contain small populations of Ordovician or Cambrian grains (Amato and others, 2003a; Till and others, 2006; 2008a). The depositional age of the unit must be younger than 600 Ma (latter part of the Neoproterozoic), and is likely Ordovician or younger. Werdon and others (2005a) considered the unit to be Cambrian in age, based on an Rb-Sr isochron. The samples included in the isochron are a mix of mafic and pelitic rocks, so their assumption that the samples shared the same initial strontium isotopic composition is likely not correct; the isochron represents a mixing line between mafic and sedimentary protoliths.

The Ordovician age assigned here is based on the detrital zircon geochronology and on the occurrence in both this and the impure marble unit (Oim) of both metabasite schist layers and unfoliated metabasite pods. The protoliths of both units apparently contained pyroclastic or redeposited mafic material as well as intrusive mafic rocks. The metabasite layers indicate that production of mafic material was at latest syn-depositional - not simply post-depositional. We postulate that Oim and Ocs were formed in the same basin. Because the impure marble unit yielded Early through Middle Ordovician conodonts, we believe that basin was formed during the Ordovician.

The unit is 0.6 to 1.6 km thick and is best exposed in southeastern Solomon D-5 quadrangle, north of the Nome-Council road on the ridge north and northwest of Horton Creek; in the central part of the Solomon D-5 quadrangle at the headwaters of Alma and Venture Creeks; and in east-central Solomon D-6 quadrangle on the ridgeline between Eldorado and Nelson Creeks, including hills 2144 and 2067. The Casadepaga schist was named and first described by Smith (1910). Partially equivalent to the "slate of the York region" of Sainsbury (1974), and "pCqms" of Miller and others (1972); equivalent to "Ocs" of Till and others (1986). *Unit description source:* SE006

OCc - Carbonate rocks (Cambrian to Ordovician)

OPxIs - Limestone, northern Alaska (Proterozoic? through Ordovician) See [OPxIs](#) for unit description from [SIM-3340](#).

OCc - Carbonate rocks (Ordovician to Cambrian) Carbonate rocks. Orange- and gray-weathering, variously impure metalimestone and marble, thin-bedded couplets of metalimestone and dolostone, graptolite-bearing phyllite, interbedded phyllite and dark-gray metalimestone, and massive white to gray marble. *Unit description source:* AR007 and BM002

OCv - Andesitic to basaltic volcanoclastic rocks and local tuffaceous phyllite, gabbro, and diabase, and black phyllite (Cambrian to Ordovician)

OCdv - Oldest volcanic rocks (Ordovician and Cambrian?) See [OCdv](#) for unit description from [SIM-3340](#).

OCv - Volcanic rocks (Ordovician and Cambrian?) Andesitic to basaltic volcanoclastic rocks and local tuffaceous phyllite, gabbro, and diabase, and black phyllite. Basement rocks of the Doonerak Window. Lower greenschist and prehnite-pumpellyite. Unconformably overlain by Mississippian Kekiktuk conglomerate. *Unit description source:* WI002

OCZc - Nanielik antiform, older carbonate rocks (Neoproterozoic to Middle Ordovician)

OPxls - Limestone, northern Alaska (Proterozoic? through Ordovician) See [OPxls](#) for unit description from [SIM-3340](#).

OpCc - Older carbonate rocks of the Central belt (Middle Ordovician to Proterozoic?) Dolostone, metalimestone, marble and subordinate quartzose metasedimentary rocks, carbonate conglomerate, and metabasite exposed in the northeastern Baird Mountains quadrangle, central Survey Pass quadrangle, and along the Dalton Highway in the Wiseman and Chandalar quadrangles. This unit is part of the Central belt. Conodonts, stromatolites, protoconodonts, cancellorid sclerites, hyolithids, and steinkerns of monoplacophoran mollusks, acrotretid brachiopods, agnostid arthropods, graptolites. *Unit description source:* CH004

Snowden Creek phyllite, Hammond terrane (Ordovician) Black phyllite with intercalated metalimestone, metachert, and metasandstone. *Unit description source:* CH009 and WI011

Snowden Mountain phyllite, Hammond terrane (Middle Cambrian) Gray phyllite with sandy metalimestone capped by bioclastic limestone. *Unit description source:* CH009

Zgr - Granitic rocks (Neoproterozoic)

Zgn - Granite and orthogneiss (Neoproterozoic) See [Zgn](#) for unit description from [SIM-3340](#).

PzPi - Meta-intrusive rocks of intermediate composition (Paleozoic and (or) Proterozoic) White, light gray, or green and white, massive to gneissic, granitic to dioritic meta-intrusive rocks. *Unit description source:* BM002

Pi - Intrusive rocks of Mount Angayukaqsaq (Proterozoic) Light to medium green gabbro and leucogabbro and buff to light gray granite and granodiorite. *Unit description source:* BM002

Zma - Metasedimentary and metavolcanic rocks of Mount Angayukaqsaq (Neoproterozoic)

Zam - Metasedimentary and metavolcanic rocks of Mount Angayukaqsaq (Neoproterozoic) See [Zam](#) for unit description from [SIM-3340](#).

Zm - Polymetamorphic mafic rocks (Proterozoic) Dark greenish-blue, strongly lineated mafic rocks with subordinate white-weathering marble or dolostone. *Unit description source:* BM002

Zsv - Metasedimentary and metavolcanic rocks of Mount Angayukaqsaq (Proterozoic) Dark green to dark brownish-black garnet amphibolite; buff, tan, apple green, dark olive-brown and dark gray quartzite, micaceous quartzite, calc-silicates and calc-schist, and light greenish gray and gray pelitic schist. *Unit description source:* BM002

ZYog - Ernie Lake pluton orthogneiss (Mesoproterozoic to Proterozoic)

Zgn - Granite and orthogneiss (Neoproterozoic) See [Zgn](#) for unit description from [SIM-3340](#).

Zg - Granite gneiss (Proterozoic?) Blastoporphyratic, foliated, coarse-grained, biotite granite orthogneiss. Banded schist, paragneiss, and orthogneiss that may have been regionally metamorphosed three times. Upper greenschist facies rocks predominate, but includes amphibolite facies paragneiss, and local relict blueschist and eclogite facies metabasite. *Unit description source:* WI002

pCgr - Ernie Lake Pluton (Precambrian?) Gray weathering biotite muscovite granite mylonite orthogneiss and mylonite orthoschist. Porphyroblasts of albite as large as 1 cm occur in very fine grained "mat" of muscovite. *Unit description source:* SP002

bu - Bedrock of unknown type or age or areas not mapped (unknown)

bu - Bedrock of unknown type or age or areas not mapped (unknown) See [bu](#) for unit description from [SIM-3340](#).

No additional description available.

SIM-3340 Map Unit Descriptions

Unit descriptions from SIM-3340 are provided for units present in the GRI digital geologic-GIS data. As previously mentioned, many units on SIM-3340, based on USGS NSAClass values, are divided into two or more units in the GRI digital geologic-GIS data. For each unit listed the unit or units the unit is represented by in the GRI digital geologic-GIS data is listed. As an examples, unit Qs (on SIM-3340, see listing and description below) is divided into units Qb, Qda and many other units, whereas unit Tcb (on SIM-3340, see listing and description below) is represented by just one unit, Tcb.

Qs - Unconsolidated surficial deposits, undivided (Quaternary)

Unconsolidated, poorly to well-sorted, poorly to moderately well-stratified deposits; consist predominantly of alluvial, colluvial, marine, lacustrine, eolian, and swamp deposits. Also includes widespread glacial and periglacial deposits that consist of end, lateral, and ground moraine, outwash, rock glacier deposits, and other glacial and periglacial deposits as well as glacially scoured bedrock that may be covered with thin, glacially derived deposits. These glacial deposits are of Holocene and Pleistocene age and may include small areas of potentially latest Tertiary deposits. Map unit locally includes reworked volcanic debris as well as block and ash flows. On generalized map, included as part of unit QTs.

This unit is divided into units [Qb](#), [Qda](#), [Qrg](#), [Qsf](#), [Qs](#), [Qa](#), [Qaf](#), [Qc](#), [Qls](#), [Qoa](#), [Qt](#), [Qsw](#), [Qd](#), [Qfl](#), [Qsu](#), [Qm](#), [Qwo](#), [Qat](#), and [Qew](#) in the GRI digital geologic-GIS data.

QTs - Poorly consolidated surficial deposits (Quaternary & uppermost Tertiary)

Silt to coarse-gravel and semi-consolidated sandstone to conglomerate are widespread as an erosional remnant deposits throughout Alaska. Genetically, unit includes deposits of fluvial, glaciofluvial, colluvial, eolian, and shallow-marine deposits and includes local tuffaceous deposits. Unit includes several named formations, including the Faneto Formation of the Aleutian Islands, the Kougarok Gravel of the Seward Peninsula, the Chariot, Saligvik, and Ilyirak Gravels of the Point Hope region, and the Gubik Formation of the North Slope as well as the informally named Holokuk gravel of Bundtzen and others (1999) in southwest Alaska. Some deposits are folded or tilted, reflecting recent tectonic movement. Some marine deposits are richly fossiliferous. Age control is generally sparse; fossils may not be age-diagnostic. The tilted Holokuk gravel of Bundtzen and others (1999) was interpreted by Bundtzen to be an outwash deposit sourced from the glaciated highlands southwest of the Kuskokwim River on the basis of pebble count and clast studies. Boulder-rich conglomeratic deposits on Adak Island, mapped as Tertiary by Coats (1956a), are probably Quaternary in age, certainly no older than Pliocene. Also included in map unit is fossiliferous marine sandstone of northern Adak Island (Coats, 1956a). On Amchitka Island, bedded sand and gravel, composed of hornblende andesite fragments, occurs at an elevation of 180 m. Some beds contain subangular cobbles and boulders, whereas others contain well-rounded cobbles and boulders up to 0.6 m in diameter. Powers and others (1960) interpreted this as a beach and nearshore marine deposit. Also on Amchitka Island, a small area of tilted sedimentary rocks (dipping about 12° SE.) is found at South Bight (Powers and others, 1960). These consist of 60 m of carbonaceous sandy silt, fine to medium sand, and pebbly sand to sandy fine gravel, in random order, a few inches to 0.6 m thick, which grades upward to 45 m of less well bedded gravel. Fragments of carbonized wood are common in silt layers. Semiconsolidated marine beach deposits consist of poorly bedded, soft, pebbly siltstone that caps sea cliffs of volcanic rock on Hagemeister Island and contain shallow-water marine fossils of Pliocene or Pleistocene age. The Gubik Formation consists of marine and fluvial deposits of well to poorly sorted and well to poorly stratified silt, sand, and gravel. Locally includes wood and woody material (Nelson and Carter, 1985). Thickness more than 10.5 m, probably less than 60 m (Reiser and others, 1980). On generalized map, included as part of unit QTs.

This unit is divided into units [Qts](#) and [Qtg](#) in the GRI digital geologic-GIS data.

QTV - Young volcanic rocks, undifferentiated (Quaternary or Tertiary)

In western Alaska, from Nunivak Island and northward to the Seward Peninsula, these rocks are dominantly alkaline and tholeiitic basalt and locally contain ultramafic inclusions (Hoare, 1975; Cox and others, 1976). Analysis of rocks of this unit from the Pribilof Islands and Nunivak Island were used to establish the radiometric time scale for geomagnetic reversals (Cox and others, 1968). Unit includes numerous alkali basalt, basanite, and hawaiite cones, short flows, and maar craters. Cones and flows have little or no vegetative cover and still preserve some primary flow structures (Patton and others, 2009). Includes tholeiitic basalt of Binakslit Bluff on Nunivak Island (Hoare and others, 1968); massive, columnar-jointed flows; normally polarized flows of Gauss polarity epoch as well as normally and reversely polarized flows older than Gauss polarity epoch. Multiple samples yielded K/Ar ages between 5.01 ± 0.15 and 3.24 ± 0.10 Ma. Also includes alkalic basalt of Ahzwiryuk Bluff on Nunivak Island: nubbly mottled flows and pyroclastic ejecta that also includes both normally and reversely polarized rocks older than Gauss polarity epoch (Hoare and others, 1968). Two samples from this unit yielded K/Ar ages of 6.28 ± 0.18 and 5.19 ± 0.15 Ma. Additionally, unit includes vesicular and dense basalt and olivine basanite flows and sills in the Pribilof Islands (Barth, 1956). Along the Alaska Peninsula and in the Aleutian Islands, unit includes a wide range of volcanic products, similar to unit Qv, the main distinction is that this unit includes rocks where the age is not unequivocally Quaternary. As such, this unit includes the Pochnoi Volcanics of Semisopochnoi Island (Coats, 1959b), as well as volcanic rocks of ancestral Mount Kanaton volcano on Kanaga Island (Coats, 1956b; Miller and others, 2003), the Massacre Bay Formation of Attu Island (Gates and others, 1971), the Williwaw Cove Formation of Little Sitkin Island (Snyder, 1959), the flows and tuff-breccia of olivine-, hypersthene-, and hornblende-bearing andesite associated with Andrew Bay volcano on Adak Island (Coats, 1956a), and agglomerate on Kanaga Island (unit Tva of Coats, 1956b). On Great Sitkin Island, unit includes flows and agglomerate of the Sand Bay Volcanics (units Tsl and Tsa of Simons and Mathewson, 1955). Locally, also includes sandstone from reworked pyroclastic deposits, as well as the pyroclastic rocks and lava flows (unit QTpl of Coats, 1959b) and crystalline vent plugs (unit QTp of Coats, 1959b) on Semisopochnoi Island. Includes interbedded flows, pyroclastic deposits, sedimentary rocks, and fine-grained dikes and sills on Tanaga, Kanaga, and Unalga Islands (unit QT of Fraser and Barnett, 1959), andesitic and basaltic tuff and tuff-breccia on Shemya Island (unit QTt of Gates and others, 1971), and Quaternary or Tertiary basaltic rocks of Bobrof Island as reported by Coats (1956c). On Little Sitkin Island, this unit locally contains areas of kaolinized, silicified, and pyritized rock (Snyder, 1959). Undated columnar-jointed flows of fine-grained tholeiitic and alkaline-olivine basalt in the western Holy Cross quadrangle (Csejtey and Keith, 1992) are included here because of similarity to volcanic rocks in the adjacent quadrangles to the north, west, and southwest. Unit includes Pliocene rocks of the Wrangell volcanic field in the Gulkana, Nabesna, Valdez, and McCarthy quadrangles (Nichols and Yehle, 1969; Richter, 1976; Richter and others, 2006; MacKevett, 1978; Winkler and others, 1981; W. Nokleberg, written commun., 1997). On generalized map, included as part of unit QTvi.

This unit is unit [Qtb](#) in the GRI digital geologic-GIS data.

Tcb - Coal-bearing sedimentary rocks (Eocene to Pliocene)

Widely exposed around the state, unit locally bears formal names, such as Healy Creek, Sanctuary, Suntrana, Lignite Creek, and Grubstake Formations of the Nenana coalfield; more typically, though, the unit is mapped as coal-bearing sedimentary rocks. Located largely north of the Alaska Range, unit includes the sedimentary rocks of the Jarvis Creek coal field of Nokleberg and others (1992a) and similar units in other Tertiary basins;. The following quote from Csejtey and others (1992) can be generally applied to this unit: "The coal-bearing rocks comprise terrestrial cyclic sequences, in varying proportions,

of siltstone, claystone, mudstone, shale, generally cross-bedded and pebbly sandstone, both arkosic and quartz-rich, subbituminous coal and lignite, and minor amounts of dominantly quartz- and chert-pebble conglomerate." Locally, volcanic ash is present. Unit is nonmarine and may be faulted and (or) folded. Coal most commonly is lignite but locally is subbituminous. In the Livengood quadrangle consists of poorly to well-consolidated conglomerate, graywacke, siltstone, shale, coal, greenstone, basalt, and tuff in Schwatka-Rampart area of central Alaska. Unit is nonmarine, friable, calcareous, and contains some nodules, lenses, and thin layers of ironstone. Conglomerate has locally derived well-rounded pebble- to boulder-sized clasts of greenstone, black chert, rare white quartz, and colored chert; siltstone and shale less common. In the McGrath quadrangle (Bundtzen and others, 1997a), includes fluvial gravel, silt, sand, and carbonaceous shale interbedded with coal seams as much as 12 m thick. On Saint Lawrence Island (Patton and others, 2011), poorly consolidated sandstone, grit, and conglomerate, carbonaceous mudstone, ashy tuff, volcanic breccia, and seams of lignitic coal as much as 60 cm thick is found in poorly exposed and badly slumped outcrops. Unit contains abundant plant fossils of Oligocene age (J.A. Wolfe, written commun., 1968). Patton and others (2009) reported that poorly consolidated nonmarine deposits also occur in several areas of the Yukon-Koyukuk Basin, some associated with the Kaltag Fault. Pollen samples from these deposits range in age from Oligocene to Pliocene.

This unit is unit [Tcb](#) in the GRI digital geologic-GIS data.

Tob - Olivine basalt flows (Miocene)

Vesicular, massive olivine basalt flows exposed in the Coleen and Black River quadrangles, plus an outlier in the southeast Chandalar quadrangle. In the Coleen and Black River quadrangles, the flows may be as much as 100 m thick and are interbedded with lacustrine sedimentary rocks (Fouch and others, 1994). Kunk and others (1994) reported $40\text{Ar}/39\text{Ar}$ ages that range from 15.7 ± 0.1 to 14.4 ± 0.1 Ma. In the Chandalar quadrangle, the flows are as much 300 m thick and not dated. On generalized map, included as part of unit Tvp.

This unit is unit [Tmb](#) in the GRI digital geologic-GIS data.

Tepv - Andesite and basalt flows (Eocene and Paleocene)

Composed of columnar-jointed andesite and basalt lavas that locally contain interbedded tuff, breccia, and agglomerate, this unit is exposed in two general areas, the largest of which is a belt in west-central Alaska. In the Takhakhdona Hills of the Melozitna quadrangle, dark-green to black vesicular basalt flows formerly mapped by Patton and others (1978) in their unit TKv are now known to be of Tertiary age. Isolated exposures include the Roundabout Mountain volcanic field in the Kateel River quadrangle and olivine basalt flows on the eastern part of the boundary between the Bettles and Tanana quadrangles. The second area of exposure is in the Talkeetna Mountains quadrangle, where there are outcrops of predominantly reddish-brown-weathering, aphanitic to porphyritic basaltic andesite and basalt lavas, often columnar-jointed, and including lesser tuff, and local cinder deposits (Csejtey, 1974; Anderson, 1969; Oswald, 2006). Individual flows and tuff beds are tens of meters thick; as a whole, unit may be several hundred meters thick. A small area of basalt flows is also mapped in the western Lime Hills quadrangle (Wilson and others, 1998). K/Ar isotopic cooling ages range from 65.2 ± 3.9 to 38.6 ± 2.4 Ma. On generalized map, included as part of unit Tv.

This unit is unit [Tvab](#) in the GRI digital geologic-GIS data.

Tpt - Pyroclastic rocks (Early Eocene or Paleocene)

Tuffaceous rocks distributed in several areas of Alaska. The largest area of exposure is a belt in the Bettles, Tanana, and Melozitna quadrangles where light-gray to pink rhyolite tuff, welded(?) tuff, flows, and breccia and subordinate pumice, dark vitrophyre, and obsidian constitute the unit (Patton and others, 2009). Obsidian chips and artifacts found in archeological sites in northwest Alaska may have originated from this unit. In southwest Alaska in the northeast Dillingham quadrangle, unit includes crystal tuff that contains variable amounts of biotite and feldspar crystals and varies in general appearance from crystal tuff to porphyritic plutonic rock (Wilson and others, 2003), but in all cases the groundmass is tuffaceous. The proportion of tuff appears to increase from east to west. Wallace and others (1989) report K/Ar ages of 58.6 ± 1.8 Ma (biotite) and 57.9 ± 1.7 Ma (hornblende) for this unit, whereas multiple $^{40}\text{Ar}/^{39}\text{Ar}$ age determinations on biotite yield a tight age range between 59.69 ± 0.05 and 59.25 ± 0.05 Ma (Iriondo and others, 2003). On the northern part of Saint Matthew Island in the Bering Sea, unit is chiefly rhyolite and dacite welded tuff, tuff breccia, and dark rhyolite vitrophyre (Patton and others, 1975) and also includes minor intercalated andesite and basalt flows and dikes. On southwestern part of island, unit is chiefly light-colored rhyolite and dacite hypabyssal rocks (Patton and others, 1975). These felsic rocks appear to overlie mafic flows and volcanoclastic rocks and may be extrusive and hypabyssal cogenetic equivalent of granodiorite on the island (Patton and others, 1975). Age thought to be Eocene or Paleocene (see Wittbrodt and others, 1989). Tuffaceous rocks of similar age are known from the interior of Alaska in the Tanana (Reifenstuhel and others, 1997) and Big Delta quadrangles (Weber and others, 1978; Day and others, 2007); described by Reifenstuhel and others (1997) as "white and pink, purple and white, light-orange and pink, glassy-aphanitic to very fine-grained, flow-banded rhyolite, rhyolite tuff breccia, ignimbrite, and potassium feldspar-porphyritic rhyolite. The rock types present suggest that the rhyolite was emplaced as flows, domes, tuffs, breccia, and rare obsidian, and suggest extrusion over a significant period of time." Bacon and others (1990) described areas of tuffaceous rocks in east-central Alaska that they interpreted as caldera complexes. In the easternmost Big Delta quadrangle, a complex that they called "Slate Creek," another complex they called "EC" in the easternmost Tanacross quadrangle, and additional exposures along Taylor Highway in the Eagle quadrangle have yielded a range of K/Ar and U/Pb ages that date these rocks to the Paleocene and Eocene, between 61.6 ± 2.0 and 54.6 ± 1.6 Ma (Foster and others, 1979; Bacon and others, 1990). In the northern Tyonek quadrangle, more mafic andesite to dacite welded tuff occurs, where it consists of massive welded tuff in beds thicker than several meters (P.J. Haeussler, written commun., 2007). Unit also includes the Porcupine Butte andesite of Solie and Layer (1993), which consists of columnar jointed andesite forming the neck of a Paleocene volcanic center (Solie and others, 1991a). Pyroclastic volcanic rocks are also found in southeast Alaska in the Juneau and Taku River quadrangles and range from tuff to coarse block-and-ash-fall breccia, which are recognized as part of the Sloko Group of Canada. They include minor sedimentary rocks, andesite, trachyte, dacite, rhyolite, and minor andesite and basalt flows. Age is inferred from the intimate association of the volcanic rocks with granodiorite of the Coast plutonic complex of Brew and Morrell (1979b). On generalized map, included as part of unit Tkpr.

This unit is unit [Tfv](#) in the GRI digital geologic-GIS data.

TKv - Volcanic rocks in southern Alaska (Late Cretaceous to Early Tertiary)

Primarily consists of basalt and andesite, but ranges from basalt to rhyolite, largely exposed in southwest Alaska. A common association is with rocks of the Kuskokwim Group (unit Kk), however, this volcanic rock unit is somewhat more widespread in southwest Alaska. Unit varies compositionally across exposure area and incorporates the full lithologic range of flows, tuff, and breccia and minor interbedded sandstone and shale in the Ruby, Iditarod, and Ophir quadrangles (Cass, 1959; Chapman and Patton, 1979; Chapman and others, 1985; Miller and Bundtzen, 1994). In the Iditarod quadrangle, includes that part of the Iditarod Volcanics that overlies the Kuskokwim Group. Andesite and basalt flows and volcanoclastic rocks are widely exposed in the central part of the Holy Cross quadrangle and in

a small area in the north-central part of the Russian Mission quadrangle between the Yukon and Kuskokwim Rivers. Flows are generally porphyritic and are composed of phenocrysts of plagioclase and pyroxene in a groundmass of plagioclase microlites. Some of the flows are columnar jointed and locally vesicular. Volcaniclastic rocks in this unit include breccia, tuff, and agglomerate. The andesitic and basaltic rocks commonly are interlayered with or intruded by small bodies of dacite and rhyolite (Patton and others, 2006). In the southwest part of Talkeetna quadrangle, Reed and Nelson (1980) mapped interbedded medium- to coarse-grained greenish-gray crystal-lithic lapilli tuff and mafic volcanic rubble flows in units as much as 150 m thick, as well as associated sandstone, shale, and minor calcareous mudstone. In the McGrath, Melozitna, Unalakleet, Tanana, and Medfra quadrangles (Patton and others, 1978; Patton and others, 1980; Bundtzen and others, 1997a), unit consists of dacite, rhyolite, and trachyandesite lava flows, domes, sills, dikes, and interlayered breccia and tuff. In the Bethel quadrangle, unit includes felsic rocks of the Swift Creek, Tulip, and Eek volcanic fields of Box and others (1993) as well as rhyolitic rocks in the Ruby (Cass, 1959), Denali (Bela Csejtey, Jr., written commun., 1993), Tanana (Chapman and others, 1982), and Kantishna River quadrangles (Chapman and others, 1975); unit also includes felsic tuff in the Tyonek quadrangle (Solie and others, 1991a). Locally, in Unalakleet and Medfra quadrangles, tuff at the base of unit TKv contains interbeds of quartz-chert-pebble conglomerate, sandstone, siltstone, and thin coaly layers that contain abundant plant fossils. Palynflora collected from coaly layers at the base of the unit in the Medfra quadrangle are latest Cretaceous in age. Unit overlaps compositionally and spatially with units Tpt and TKwt, described below. Where known, age determinations generally range between approximately 70 and 50 Ma. On generalized map, included as part of unit TKpr.

This unit is divided into units [TKvr](#) and [TKvi](#) in the GRI digital geologic-GIS data.

TKhi - Dikes and subvolcanic rocks (Tertiary and (or) Cretaceous)

Widely distributed in western Alaska, unit consists of a wide variety of shallow intrusive rocks including rhyolite, dacite, trachyte, and andesite plugs, domes, sills, and dikes, and larger, more coarsely crystalline bodies of granite, granodiorite, tonalite, and monzonite porphyry (Patton and others, 2009; Patton and others, in press). Typical rock is composed of a fine-grained felsic groundmass with phenocrysts of plagioclase, quartz, biotite, and hornblende. Unit forms numerous large sills, dikes, and domes intruding Cretaceous and older sedimentary rocks primarily in the Iditarod, Sleetmute, Russian Mission, northwestern Holy Cross, and northeastern Kwiguk quadrangles. Limited age control from K/Ar, $^{40}\text{Ar}/^{39}\text{Ar}$, and U/Pb techniques in southwest Alaska suggests an age range between about 72 and 60 Ma. Unit is compositionally similar to, and, where age control exists, is also similar in age to units TKg and TKgd. Unit is texturally transitional between TKg, TKgd, and unit TKv. Unit is also found less commonly in the Selawik, Bettles, Hughes, Lime Hills, Dillingham, and Lake Clark quadrangles. In the Selawik, Bettles, and Hughes quadrangles, age control is lacking, but association with mid-Cretaceous plutons suggests that these small intrusions may be older than those in southwest Alaska. On generalized map, included as part of unit TPzi.

This unit is unit [TKgp](#) in the GRI digital geologic-GIS data.

TKgb - Gabbroic rocks (Late Cretaceous (or older) to Tertiary)

Fresh to altered gabbroic and diabasic intrusive bodies including small plutons, dikes and sills. Widespread throughout western Alaska; distribution of unit mimics distribution of the more granitic rocks of units TKg and TKgd. Age control is limited relative to the granitic rocks and, in many cases, the age assigned by local geologic mappers is Devonian to Tertiary, hence, the rocks included here may, in part, be significantly older than the granitic rocks of units Tpgr, TKg, and TKgd. In the Ophir quadrangle, medium- to coarse-grained gabbro that has minor associated diorite and basalt intrudes rocks of inferred Mississippian to Triassic age and, locally, Cretaceous age. Contact relations are uncertain due to poor

exposure, but Chapman and others (1985) indicate at least one gabbro body has a hornfels aureole. A similar unit of gabbroic sills, dikes, and small plugs in the adjoining Medfra quadrangle was given a provisional Devonian to Tertiary age (Patton and others, 1980). Unit also includes poorly exposed small bodies of mafic rocks in Talkeetna Mountains and Tyonek quadrangles. In the Talkeetna Mountains, Csejtey and others (1978) described a medium- to light-gray, coarse- to medium-grained plagioclase and pale-green hornblende-bearing leucogabbro. J.M. Schmidt (written commun., 2007) also described diorite associated with the gabbroic rocks. Reed and Elliot (1970) described diorite and olivine and (or) hornblende gabbro that occur as intrusive bodies and inclusions in other Tertiary intrusive rocks in Tyonek quadrangle. Age is poorly constrained, but samples of hornblende and gabbro from Tyonek quadrangle yielded $^{40}\text{Ar}/^{39}\text{Ar}$ plateau ages of between about 84 and 69 Ma (P.J. Haeussler, unpub. data). Altered gabbro and diorite bodies crop out as small scattered bodies in the Russian Mission and southern Holy Cross quadrangles; the age of these bodies is uncertain, but not older than Jurassic. Unit TKgb includes dark-colored dikes and sills of diabase, basalt, and dioritic, gabbroic, and biotite lamprophyre that yield a K/Ar age of 64.6 ± 2 Ma on biotite from the western Nushagak Bay quadrangle (Hoare and Conrad, 1978). Unit also includes a medium- to coarse-grained pyroxene gabbro dike(?) on Saint Matthew Island (Patton and others, 1975). On generalized map, included as part of unit TKm.

This unit is unit [TDg](#) in the GRI digital geologic-GIS data.

Kof - Okpikruak Formation and similar units (Lower Cretaceous)

Dark-gray to grayish-tan mudstone, siltstone, graywacke sandstone, and minor conglomerate. Locally, unit contains interbeds of distinctive reddish-gray coquinooid limestone, is intensely deformed and, in places, the base is structurally detached. Thickness is unknown. Locally, this unit has been mapped as *mélange* or *olistostrome* between thrust sheets (see, for example, Curtis and others, 1990; Mayfield and others, 1990). The Okpikruak Formation has been dated by fossils to be as young as Valanginian (see, for example, Dover and others, 2004). Locally, the Fortress Mountain Formation is not separated in mapping (Curtis and others, 1990; Mayfield and others, 1990) and is included here; where included it consists primarily of the deep marine facies of the Fortress Mountain and, as discussed above, is also mapped separately when possible (unit Kfm).

In the Howard Pass quadrangle, Dover and others (1994) describe a unit of predominantly volcanoclastic rocks and subordinate associated mafic to intermediate volcanic rocks to which they assigned a Jurassic and Early Cretaceous age. They further indicate that it has some lithologic similarities to the Okpikruak Formation in other thrust sequences and has a similar degree of induration. We include it here with some uncertainty.

As shown here, this map unit, Kof, includes the Kisimilok Formation of Campbell (1967). The eastern exposures of Okpikruak Formation we show in the Noatak quadrangle (C.G. Mull and H.S. Sonneman, Exxon unpub. report, 1968–1974) may be better assigned to the *mélange* of the Angayucham assemblage (unit KJm here). As shown here, the Okpikruak Formation also includes small areas of sedimentary rocks in the De Long Mountains, Howard Pass, and Misheguk Mountain quadrangles that most likely belong to the Okpikruak Formation. The Kongakut Formation (unit Kgk) was originally defined by Detterman and others (1975) as a lateral (northern) equivalent of Okpikruak Formation. Also included in this unit is the undivided Arctic Foothills assemblage of Kelley (1990a) in the Chandler Lake quadrangle, which was described as follows: “consists of 7 previously recognized units; Lower Cretaceous coquinooid limestone, undivided Upper Jurassic and Cretaceous strata, Jurassic mafic igneous rocks, Permian and Triassic chert, the Nuka Formation (Carboniferous), marble and *mélange*.” The unit includes an indeterminate proportion of Cretaceous rocks. As mapped, Kelley’s (1990a) Arctic Foothills assemblage is thrust interleaved with rocks of the undivided Torok and Fortress Mountains Formations (unit Kft) and thrust over rocks of the Otuk Formation (JTro) and Lisburne Group (Clg). It is interpreted by some (for example, Peapples and others, 2007; Mull and others, 2009; D.W.

Houseknecht, written commun., 2014) as part of the Okpikruak mélange. On generalized map, included as part of unit Kok.

This unit is divided into units [MZPZct](#), [Ko](#), [KJvc](#), and [KDnb](#) in the GRI digital geologic-GIS data.

MzPzmb - Metabasite (Mesozoic & Paleozoic)

Consists of a variety of metabasite bodies exposed around the Yukon-Koyukuk Basin. Typically small bodies, these are found associated with the Schist belt of Till and others (2008a) in the Brooks Range (units DPaqm and DPacs, here), similar schist of the Ruby geanticline in the Nulato and Tanana quadrangles (included in unit Jcrqm, here) and also includes metamorphosed mafic rocks and serpentinite associated with the Kugruk Fault Zone of Till and others (2010). Varies from thinly layered greenschist to more massively layered greenstone bodies derived from altered mafic and intermediate volcanic and shallow intrusive rocks. Also includes small bodies of serpentinite, peridotite, dunite, gabbro, diorite, metabasite, and minor talc schist and roddingite. The rocks of this unit exhibit a broad range of intrusive and (or) metamorphic textures and fabrics. Age control is generally poor and inferred ages range from late Proterozoic to Mesozoic. Unit likely includes rocks of several different ages. Unit may include some rocks in the Brooks Range that might more appropriately be assigned to the Ambler sequence of Hitzman and others (1982; unit Das, here). Some of the bodies are interlayered with the Devonian felsic schist of unit Df of Nelson and Grybeck (1980) and Dillon and others (1986) and some of the bodies are part of a bimodal volcanic assemblage. Other bodies are interlayered with carbonate rocks that contain fossils of probable Devonian and Ordovician age (unit DPacs, here). Still other bodies may represent tectonically emplaced slices of unit JDv of the Angayucham-Tozitna terrane. The rocks associated with the Kugruk Fault Zone are “a tectonic assemblage of metagabbro, metabasalt, amphibolite, serpentinite, and minor chert, exposed in rubble fields and poor outcrops along the trend of the Kugruk Fault Zone. Mafic rocks within the fault zone include minor nonmetamorphosed (but altered) rocks, rocks with relict igneous textures and a single metamorphic overprint, and rocks that have experienced more than one metamorphic event. Pumpellyite- and prehnite-bearing veins that cross foliation are common in many lithologies” (Till and others, 2011). The “mafic rocks in the northern part of the fault zone (Bendeleben D-1 and Kotzebue A-1 quadrangles) display evidence of an albite-epidote amphibolite facies event overprinted by a lower grade event. Blue-green amphibole, epidote, and albite, with and without garnet, occur in equilibrium metamorphic textures. These albite-epidote-amphibolite-facies assemblages are slightly to significantly overprinted by epidote-blueschist or greenschist assemblages, largely on mineral rims or cracks. The later metamorphic event is likely the same event that affected mafic rocks in the unit further to the south” (Till and others, 2011).

This unit is unit [MZPZm](#) in the GRI digital geologic-GIS data.

Ksb - Schrader Bluff Formation (Upper Cretaceous)

Dominantly marine sandstone and shale, locally and variably tuffaceous. “Lower and upper parts * * * commonly contain varying amounts of bentonite interbedded with bentonitic shale, tuffaceous mudstone, and bentonitic, fine-grained fossiliferous sandstone, as well as beds of relatively pure bentonite * * *” (Mull and others, 2003). Lower and upper parts of unit are not well exposed; middle part of unit is notable for a resistant interval of tuffaceous sandstone and tuff (Mull and others, 2003). Bivalves and microfauna (Detterman and others, 1963; Brosgé and Whittington, 1966) and palymorphs (Mull and others, 2003) yield a Santonian to Maastrichtian age. Unit is exposed in the Ikpikpuk River, Chandler Lake, and Umiat quadrangles of northern Alaska.

This unit is unit [Ksb](#) in the GRI digital geologic-GIS data.

Kvu - Volcanic rocks, undivided (Cretaceous)

Volcanic rocks that range in composition from rhyolite to olivine basalt flows, from dacitic to andesitic tuff and tuffaceous sandstone, and rhyolitic domes (Hoare and Coonrad, 1978; Patton and others, 1968, 1975; Box 1985; Box and others, 1993). Includes Tulip volcanic field rhyolite domes and flows; Swift Creek volcanic field lithic air-fall tuff; Kipchuk volcanic field andesite and basalt flows, tuff, tuffaceous sandstone; and rhyolite domes and flows in the Bethel quadrangle (Box and others, 1993). In Shungnak and Kateel River quadrangles, unit varies locally but generally consists of latite, quartz latite, and trachyte flows, crystal-lithic tuff, rhyolitic and rhyodacitic welded tuff and flows(?), and hypabyssal intrusive rocks (Patton and others, 1968). In the Tyonek quadrangle, unit is andesite, dacite, and rhyolite flows and tuff. Includes massive and crystal-rich tuff that contains either hornblende or plagioclase as phenocryst phases, as well as flow-banded rhyolite (Solie and others, 1991; Wilson and others, 2009, 2012). In the Healy quadrangle, small exposures of andesitic and basaltic subvolcanic rocks (Csejtey and others, 1992) have yielded late Cretaceous radiometric ages of 97.3 ± 2.9 Ma and 79.1 ± 6.0 Ma, respectively. In the Tyonek and Nabesna quadrangles, unit consists of dominantly andesitic composition metamorphosed and altered volcanic tuff, breccia, or agglomerate. More mafic compositions are suggested by one outcrop of pillow lavas (small pillows, up to 30 cm in diameter) and lesser metasedimentary volcanoclastic turbidites and rare nonvolcanoclastic turbidites. Rocks are generally light green, indicative of alteration or low-grade metamorphism, but others are light-gray and fresh. Age best constrained at a locality near Hayes River Pass in the Tyonek quadrangle where the youngest detrital zircons in volcanoclastic sedimentary rocks were dated between 151 and 136 Ma, Late Jurassic to Early Cretaceous, indicating the sedimentary rocks are Hauterivian or younger (D.C. Bradley, written commun., 2008). Magoon and others (1976) included these rocks in their undivided metasedimentary rocks unit of Jurassic and (or) Cretaceous age. Other authors have included these rocks in the informally named Kahiltna assemblage (see, for example, Jones and others, 1981). In many other parts of western Alaska, unit consists of felsic dikes, sills, and hypabyssal rocks. In southeast Alaska, andesitic shallow intrusive rocks are found in the Juneau and Petersburg quadrangles thought to be Cretaceous in age (Brew and others, 1984; Brew and Ford, 1985). Locally subdivided into unit Kmvi.

This unit is unit [Kvfp](#) in the GRI digital geologic-GIS data.

Kcc - Carbonate-rich conglomerate and sandstone deltaic rocks (Cretaceous)

Tan to light-gray siltstone, sandstone, and pebbly sandstone, and light-gray-weathering conglomerate mostly composed of marble, metalimestone, and dolostone clasts. Carbonate-rich sandstone and siltstone typically occur as rubble-covered hills but are best exposed in river-cliff outcrops (Till and others, 2011). Abundant plant debris and thin seams of bituminous coal (Patton and others, 2009) are typical. Clast-supported cobble to boulder conglomerate, composed almost entirely of carbonate rocks, grades eastward into trough cross-bedded, medium- to coarse-grained sandstone and pebble conglomerate fan-delta deposits. These fan-delta desposits, in turn, grade eastward into cross-bedded, fine- to coarse-grained, inner and outer shelf sandstone and shale. Chert, volcanic rock, quartz, and schist detritus are present in subordinate amounts. Unit contains sparse palynomorphs of Cretaceous(?) age in the Norton Bay quadrangle (Patton and others, 2009). Unit is found on the Seward Peninsula and other parts of northwest Alaska, and is probably of mid-Cretaceous age. Unit derived in large part from Paleozoic carbonate rocks of the Seward Peninsula (Till and others, 1986; Patton and others, 2009). On generalized map, included as part of unit Knmt.

This unit is unit [Kcc](#) in the GRI digital geologic-GIS data.

Kgu - Plutonic rocks and dikes, granite to diorite (Cretaceous)

Consists of a variety of granitic rocks, typically granodiorite, tonalite, and quartz diorite bodies found primarily in two areas of the State. A significant area of these rocks were mapped by Nelson and others (1983) in the eastern Lake Clark quadrangle and extend into the Kenai and Tyonek quadrangles and are considered part of Alaska-Aleutian Range batholith of Reed and Lanphere (1969, 1972). They are medium- to coarse-grained, light-to medium-gray, and contain hornblende, biotite, and, rarely, muscovite; they locally have cataclastic textures. Although mapped as separate plutons by Nelson and others (1983), a number of these bodies may be fault-offset extensions of each other. Largely undated, the sparsely available K/Ar and $^{40}\text{Ar}/^{39}\text{Ar}$ dates from the west side of Cook Inlet range from 80.7 to 63.1 ± 1.8 Ma (Reed and Lanphere, 1972; P.J. Haeussler, written commun., 2008); a number of these ages are either discordant or have disturbed spectra. These rocks are typically exposed between the Jurassic part of the batholith on the east and the early Tertiary to latest Cretaceous plutons of the batholith on the west. The second large exposure area of these plutons is in the Tanacross and Eagle quadrangles, where a significant part of these quadrangles consist of undated granitic rocks (Foster, 1970, 1976, 1992). In this area, these rocks may range in age from early Tertiary to Jurassic or possibly Triassic; the most likely ages are mid-Cretaceous or early Tertiary to latest Cretaceous. Other undated, but likely Cretaceous, plutons are in the Healy, Kateel River, Hughes, and Bendeleben quadrangles. The Hughes body is a medium- to coarse-grained albite granite, and the Kateel River plutons consist of albite granite and syenite (Patton, 1966; Patton and Miller, 1966). On generalized map, included as part of unit KJgu.

This unit is unit [Kgu](#) in the GRI digital geologic-GIS data.

Kmig - Migmatite and metaplutonic rocks (Cretaceous)

These migmatitic rocks are exposed in three areas of the state: southeast Alaska, the southern Brooks Range, and on the Seward Peninsula. In southeast Alaska, migmatite is widespread and associated with Cretaceous plutons and tends to be of granodioritic to quartz dioritic composition (Brew and others, 1984; Brew and Ford, 1985; Brew, 1996; Karl, 1999; Karl and others, 1999; D.A. Brew, written commun., 1997). It ranges from agmatite (brecciated migmatite) to gneiss. Locally, schist, gneiss, and marble inclusions are present. In the southern Brooks Range and Seward Peninsula areas, these migmatitic rocks are associated with the mid-Cretaceous quartz monzonite bodies of map unit Kmqm (Brosgé and others, 1973; Till and others, 2008, 2010). In the Chandalar quadrangle, the migmatite forms an annular ring around rocks interpreted as one of the metamorphosed Devonian plutons of the Brooks Range (unit Dogn) (Brosgé and Reiser, 1964). The migmatite also forms a roof pendant on a nearby mid-Cretaceous quartz monzonite. On the Seward Peninsula, the unit is a gneissic monzonite exposed between rocks of the Casadepaga Schist (unit Ocs) and the mid-Cretaceous Kachauik pluton (units Kmgd and Kmgm) (Till and others, 2010).

This unit is unit [Kmn](#) in the GRI digital geologic-GIS data.

Khs - Rocks of Hammond River shear zone of Till and others (2008a) (Cretaceous)

Heterogeneous mix of finely laminated, mostly mylonitic lithologies derived, in part, from adjacent units exposed in the eastern Wiseman and western Chandalar quadrangles. Unit is recessive, poorly exposed, and includes large (up to 0.5 km across) bodies of black quartzite and smaller exposures of quartz-rich schist, metagabbro, dark-brown marble, and relatively undeformed metasandstone and metasiltstone (Moore and others, 1997b; A.B. Till, unpub. data). In thin section, minerals are strained and broken. Protolith rocks may range in age from Proterozoic to Paleozoic; no age control is available. Age of unit is based on likely age of tectonic event that created the shear zone, which encompasses a zone of deformation between the Schist belt and Central belt of Till and others (2008a). Equivalent to the

Hammond River phyllonite of Moore and others (1997b); westernmost extent of the unit is approximately located.

This unit is unit [Khs](#) in the GRI digital geologic-GIS data.

Klgr - Intermediate granitic rocks (Late Cretaceous)

Granitic rocks including alaskite, granite, quartz monzonite, and dominantly granodiorite of Late Cretaceous age, generally between 85 and 70 Ma. Sparsely distributed in western and south-central Alaska, the largest exposures are the isolated pluton in the Hooper Bay quadrangle and a number of monzogranite to quartz monzodiorite plutons on the Seward Peninsula. Important additional exposures include the so-called tin granites of the Seward Peninsula (Till and others, 2010; 2011). Other areas of significant exposure are in the Talkeetna Mountains north of Anchorage and across the Susitna basin in the Tyonek quadrangle. In the Yukon-Koyukuk Basin (Shungnak, Hughes, and Melozitna quadrangles), large and small plutons of granodiorite and quartz monzonite are spatially associated with the syenitic rocks of unit Ksy, but these rocks are significantly younger than unit Ksy. A small pluton in the Circle quadrangle yields a K/Ar cooling age of 72.8 Ma and is included in this unit; however, given its setting (Wilson and others, 1984), the age may be reset and the pluton may be an older Cretaceous pluton more typical of the Yukon-Tanana Upland. Similarly, other plutons of this unit in the Circle and Big Delta quadrangle yield discordant ages and may also be thermally reset plutons of older Cretaceous age (see, for example, Smith and others, 1994). A number of small, dioritic plutons of Late Cretaceous age also occur in the eastern Taylor Mountains and Lake Clark and Iliamna quadrangles.

This unit is divided into units [Kga](#) and [Kqdt](#) in the GRI digital geologic-GIS data.

Ksy - Syenitic rocks (Cretaceous)

Nepheline syenite, syenite, monzonite, and subordinate alkaline plutonic rocks and dikes including malignite, ijolite, shonkinite, and pyroxenite (Patton and Miller, 1968). Part of the "western Yukon-Koyukuk plutonic suite" of Miller (1989), a potassic and ultrapotassic belt that outcrops from the northeast corner of the Bettles quadrangle to Saint Lawrence Island. K/Ar and $^{40}\text{Ar}/^{39}\text{Ar}$ ages range from about 95 to 113 Ma with the majority of ages between 105 and 109 Ma. On generalized map, included as part of unit Kmgr.

This unit is divided into units [Kns](#) and [Ksy](#) in the GRI digital geologic-GIS data.

Kqc - Quartz-pebble conglomerate, west-central Alaska (Cretaceous)

Composed chiefly of well-sorted and well-rounded clasts of white quartz and (or) metagraywacke in a quartzose and micaceous matrix; schist, chert, greenstone, and limestone clasts occur in subordinate amounts. Conglomerate is interbedded with quartzose, cross-bedded sandstone and carbonaceous and micaceous mudstone. Contains rare interbeds of ashy tuff. Plant fossils and thin bituminous coal seams are locally abundant. Unit composed chiefly of debris eroded from the Arctic Alaska and Ruby terranes. Grades downward into unit Kipc, reflecting the progressive unroofing of Arctic Alaska and Ruby terranes beneath Angayucham-Tozitna terrane (Patton and others, 2009). Unit regionally metamorphosed, resulting in stretched-pebble conglomerate, semischist, and phyllite in northeastern part of the Shungnak quadrangle and in adjoining parts of the Ambler River and Hughes quadrangles. Sparse plant fossil collections from this unit range in age from late Early Cretaceous to Late Cretaceous. A K/Ar biotite cooling age of 86 Ma (corrected age is 85.4 ± 2.2 Ma) was reported by Patton and others (2009) and Till and others (2008a) from interbedded ash-fall tuff in the Baird Mountains quadrangle. On generalized map, included as part of unit Knmt.

This unit is unit [Kqc](#) in the GRI digital geologic-GIS data.

Ktu - Tuluvak Formation (Cretaceous)

Fine- to coarse-grained to granular sandstone and quartz- and chert-pebble conglomerate occur in several relatively resistant intervals, some of which consist of conspicuously well-rounded and well-sorted pea gravel with no interstitial matrix. Lower part typically medium- to coarse-grained, well-sorted sandstone. Clasts are dominantly quartz and chert, and the sandstone is interbedded with bentonite, bentonitic shale, carbonaceous shale, and coal. Upper part of unit dominantly fine-grained sandstone. In southwest part of exposure area, formation is thicker and contains more resistant sandstone and conglomerate; to the east and northward, formation thins and becomes finer grained as it transitions from nonmarine braided-stream deposits to marine sandstone. Forms prominent bluffs along the north and northwest side of the Colville River downstream from Umiat, and scattered exposures along the Chandler and Anaktuvuk Rivers. Mudstone, siltstone, and shale are end members of a continuum of lithologies that are typically medium- to dark-gray, fissile in parts, and bentonitic in parts. Conglomerate is locally found in basal part of unit and consists of well-rounded pebbles of white to light-gray quartz, quartzite, and medium- to dark-gray chert and has a sandstone matrix and quartz cement. Sandstone, siltstone, and shale of upper part of unit are poorly exposed; sandstone is gray, probably mostly quartz and chert and prominently cross-bedded; siltstone and shale are gray and brownish gray and poorly indurated. Tuff beds, coal, and ironstone are found locally (Kelley, 1990a). Unit defined by Gryc and others (1951), Whittington (1956), and Brosgé and Whittington (1966) as part of Prince Creek Formation and elevated to formation status by Mull and others (2003). Redefined unit also contains the now-abandoned Aiyak Member of the Seabee Formation. Lower part of unit interfingers with the Seabee Formation (D.W. Houseknecht, written commun., 2014). On generalized map, included as part of unit Knmt.

This unit is unit [Ktu](#) in the GRI digital geologic-GIS data.

Ksbf - Seabee Formation and Hue Shale (Upper Cretaceous)

Bentonitic mudstone, silty mudstone, and medium- to dark-gray to black, fissile, organic-rich shale containing interbedded bentonite and some thin, silicified tuff beds. Some localities characterized by large, yellowish-brown-weathering ovoid concretions greater than 3 ft (90 cm) in diameter. Unit consists only of rocks formerly mapped as Shale Wall Member of the Seabee Formation by Detterman and others (1963); other members have been abandoned. Unit defined by Gryc and others (1951) and Whittington (1956) and revised by Mull and others (2003). Map unit here also includes Hue Shale of Molenaar and others (1987), which consists of dark-gray, bentonitic shale in which fine-grained pyroclastic rock fragments weather yellow and greenish gray, and, in areas surrounding Sadlerochit Mountains, bright red. As mapped in Ignek Valley, includes some interbedded turbiditic shale and sandstone assigned to the Canning Formation. Interpreted by Molenaar and others (1987) to be a distal marine deposit and a condensed section; its upper parts may be equivalent, in part, with the lower part of the Canning Formation. The rocks of now-abandoned Ignek Formation are also included here; it consisted of a lower member of siltstone, shale, and locally fossiliferous subgraywacke sandstone; and an upper member, predominantly shale and lesser sandstone and siltstone beds, characterized by abundant pyroclastic deposits (Keller and others, 1961).

This unit is unit [Ksbf](#) in the GRI digital geologic-GIS data.

Kmqm - Quartz monzonite, monzonite and syenite (Cretaceous)

Large quartz monzonite plutons occur in three general areas of the state. The largest exposures are found in the Ruby terrane north of the Kaltag Fault in west-central Alaska. Plutons, such as the large Melozitna pluton, are largely quartz monzonite, but also have granite and monzonite phases. Locally, the Melozitna pluton intrudes granitic augen gneiss that has yielded a protolith emplacement age of 117.5 Ma (Roeske and others, 1995). On the southeastern Seward Peninsula, an elongate pluton 80 km long and 3 to 8 km wide extends along the crest of the Darby Mountains in the southeast part of the peninsula (Till and others, 2011). Other plutons of this unit are exposed in the Yukon–Koyukuk Basin in the Candle, Selawik, and Shungnak quadrangles, spatially associated with similar age syenite and nepheline syenite of unit Ksy. Additional exposures occur on the islands offshore of the Seward Peninsula—Little Diomedé, King, and Sledge Islands. Plutons in these two areas range in age between about 112 and 85 Ma. In the transition zone between the Tintina and Kaltag Fault Systems in north-central Alaska, a number of 92- to 88-Ma quartz monzonite plutons lie in a belt parallel to the structural trend. In eastern Alaska, a number of large quartz monzonite plutons are found in the Tanacross and Nabesna quadrangles and extend into the Yukon of Canada. Age determinations on these plutons, of which there have been very few, are more restricted in age, between about 98 and 91 Ma. Included here is a small syenite body located just a few miles north of Fairbanks in central Alaska, which has been described by Newberry and others (1998a) and yielded a nearly concordant TIMS U/Pb date of 110.6 ± 0.6 Ma. Also included is the quartz monzonite phase of the Mount Kashagnak pluton of the Skagway quadrangle, which is undated. On generalized map, included as part of unit Kmgr.

This unit is unit [Kmqm](#) in the GRI digital geologic-GIS data.

Kcvg - Calcareous graywacke and mudstone, volcanic graywacke and conglomerate (Cretaceous)

Cyclically interbedded fine- to coarse-grained, highly calcareous graywacke; hard, fine- to medium-grained, carbonaceous, volcanic graywacke; and dark carbonaceous mudstone in west-central Alaska (Patton and others, 2009). Also includes turbidite deposits of fine-grained to gritty graywacke and laminated micaceous mudstone, which are composed largely of carbonate detritus and lesser quartz, chert, volcanic rock, and mica clasts. Graywacke is typically graded and sole-marked. Contains abundant carbonized plant debris. Mudstone intervals typically display fine, convolute, cross laminations and current ripple marks. Unit grades from a high graywacke-to-mudstone ratio in the southwest of its exposure area to a low graywacke-to-mudstone ratio in the northeast part of its exposure area (Patton and others, 2009). Patton and others (2009) interpreted unit to represent middle and outer submarine fan lobe deposits; some locally thick sections of mudstone probably represent basin plain deposits. Paleocurrents generally indicate transport to northeast. Poorly preserved marine mollusks of late Early Cretaceous(?) age present in unit in Selawik quadrangle. A single collection of palynomorphs from Norton Bay quadrangle is Cretaceous in age, possibly late Early or early Late Cretaceous (Albian or Cenomanian). Abundance of detrital carbonate, quartz, and mica fragments suggest that the unit was derived largely from carbonate and schist units of the Seward terrane of Patton and others (2009) (units Pzcn and PzPnc here).

This unit is unit [Kcvg](#) in the GRI digital geologic-GIS data.

Kto - Torok Formation (Cretaceous)

Thick sequence of dominantly nonresistant, dark-gray to black silty shale, mudstone, and clay shale that has interbedded thin-bedded siltstone and lesser amounts of greenish-gray, thin-bedded siltstone and fine-grained sandstone as thick as 5,700 m (Mull and others, 2003). Unit is generally exposed only in discontinuous stream cutbanks, where most exposures are tightly folded; lower part of unit interfingers

with Fortress Mountain Formation (Mull and others, 1994). Upper part of the Torok Formation is age equivalent with the Nanushuk Formation (unit Knf here). Locally, in the western Brooks Range, the Torok and Fortress Mountain Formations are mapped undivided, where they consist of at least 500 m of dark-gray shale, subgraywacke and wacke sandstone lithologically similar to the Torok Formation and to the sandstone member of the Fortress Mountain Formation, but contain intermediate proportions of those rocks. This may represent a relatively proximal facies of the Torok Formation (Sable and Mangus, 1984, Sable and others, 1984a, b, c). The Torok Formation is a thick slope-to-prodelta deposit derived from a western source that is gradational and interfingers with both overlying and underlying units (Mull and others, 2000, 2009). The Torok is relatively incompetent and is generally poorly exposed; it acts as a detachment surface for decollement folding of the overlying competent Nanushuk Formation (Mull and others, 2009). On generalized map, included as part of unit Kns.

This unit is divided into units [Kto](#) and [Ktfm](#) in the GRI digital geologic-GIS data.

Kfm - Fortress Mountain Formation (Cretaceous)

Cyclic marine and nonmarine units of polymictic conglomerate, dusky yellow-green to dark-gray lithic wacke, dark-gray siltstone and shale; rocks in upper cycles generally finer grained and thinner bedded than those in lower cycles (Brosgé and others, 1979). Fortress Mountain includes nonmarine, shallow marine, marine slope, and deep basin facies. It contains lenticular and crossbedded beds, shows locally prominent pebble imbrication, rip-up clasts, scarce mud cracks in thin, discontinuous mudstone intervals, and has plant debris ranging from small carbonized wood to coalified logs. Conglomerate clasts include varieties of chert, varieties of mafic igneous rocks, limestone, argillite, organic shale, and granitic rocks. Conglomerate is also interbedded with bioturbated marine sandstone and with sandstone that shows local ripple and wave crossbedding, gravel lenses, abundant wood debris and, locally, marine mollusks (Kelley, 1990a). Common turbidite features in the marine and deep marine facies are graded bedding, sole marks, and flute, groove, and striation casts. Very small-scale crossbedding is common in most wacke beds. Rocks are texturally and compositionally immature and have clasts of chert, quartz, claystone, carbonaceous and kerogenous rocks, igneous rocks, and carbonate rocks in a matrix of chlorite, calcite, quartz, and clay minerals. Thickness is as much as 1,300 m (Brosgé and others, 1979; Sable and Mangus, 1984). Includes Mount Kelly Graywacke of Mull (1985), which is divided into upper and lower parts. The upper part consists of fine- to medium-grained, dark brownish-gray to greenish-gray sandstone that contains interbedded, poorly exposed, slightly micaceous silty shale; unit generally forms poorly exposed, low, rubble-covered ridges. The lower part of the Mount Kelly Graywacke consists predominantly of fine- to medium-grained sandstone and some coarse-grained, medium gray-green to brown sandstone, interbedded with poorly exposed dark-gray silty shale and local conglomeratic channels and contains abundant carbonaceous plant material on the top of some beds (Mull and others, 2000). Mull and others (2000) posit that the Mount Kelly Graywacke's abundant detrital muscovite and carbonate grains suggest a provenance in the southern Brooks Range schist belt (units DPqm and DPacs); T.H. Nilsen, (consulting geologist, written commun., 1996, cited in Mull and others, 2000) suggests a storm-dominated shelf setting, mainly on the basis of wave-generated sedimentation features. Houseknecht and Wartes (2013) suggest that the Fortress Mountain Formation spans the boundary between an orogenic wedge (Okpikuark Formation) and foredeep, with proximal strata onlapping the tectonic wedge-front and distal strata downlapping the floor of the foreland basin. In the Noatak, De Long Mountains, and Misheguk Mountain quadrangles *Inoceramus* and *Aucellina* (Mayfield and others, 1987; Curtis and others, 1990) and rare ammonites of Albian age (Sable and others, 1984a) provide the age control for the Fortress Mountain Formation, as do Albian pelecypods collected in the Philip Smith Mountains quadrangle (Brosgé and others, 1979). On generalized map, included as part of unit Kns.

This unit is unit [Kfm](#) in the GRI digital geologic-GIS data.

Knf - Nanushuk Formation (Cretaceous)

Consists of a regressive depositional sequence as thick as 2,750 m that includes marine, transitional, and nonmarine intervals (Alhbrandt and others, 1979) and has the most extensive exposure area of any unit in northern Alaska. Upper part consists of numerous thick horizons of typically nonmarine fine- to medium-grained and, locally, coarse-grained, gray to light-gray lithic arenite and quartz- and chert-pebble conglomerate interbedded with poorly exposed dark-gray carbonaceous shale and coal. Lower part is dominantly marine, greenish-gray, very fine- to fine-grained and locally fossiliferous sandstone and minor conglomerate. Alhbrandt (1979) reported that paleo-transport data from outcrops as well as from seismic and dipmeter data in wells on the North Slope indicate a generally northeast progradation of the Nanushuk, away from the Brooks Range. He hypothesized at least two river-dominated deltas for the onshore Nanushuk: "a western Corwin delta and, in the central North Slope, the Umiat delta." Huffman (1985) described the slightly older (early Albian or late Aptian? origin) Corwin delta as prograding from west to east onto a shelf consisting of fine-grained sediment of the Torok Formation. The Umiat delta developed in mid-Albian time and has an elongate to lobate form that prograded northward from the vicinity of the Endicott Mountains (Huffman, 1985). Having different source areas, the deposits of the two deltas are compositionally different: the Corwin delta sourced sedimentary rocks, shale, limestone and chert, whereas the Umiat delta sourced metamorphic rocks of the central Brooks Range (Huffman, 1985) that includes detrital blueschist facies minerals (Till, 1992). Huffman (1985) reported that petrographic analyses indicate sediment of the Torok Formation is closely related to the sources of the Corwin delta and quite different than the Umiat delta. LePain and others (2009) report a detailed study in the central part of the North Slope that led to recognition of 20 facies in the unit that are combined "to form ten facies associations, including (1) offshore-prodelta, (2) storm-influenced shoreface, (3) distributary channel and mouth-bar successions, (4) tidal inlet, (5) bayfill-estuarine, (6) crevasse channel, (7) crevasse splay, (8) sandy fluvial channel fill, (9) conglomeratic fluvial sheet, and (10) alluvial flood basin successions. Facies associations 1, 2, and 3 record deposition in open marine settings; facies associations 4 and 5 record deposition in open marine and marginal-marine settings; facies associations 6 and 7 are interbedded in both marginal-marine and nonmarine deposits of the bayfill-estuarine association and alluvial flood basin associations, respectively; facies associations 8, 9, and 10 record deposition in nonmarine settings. The abundance of storm-wave-generated structures, such as hummocky and swaley cross-stratification in marine deposits, demonstrates deposition in high-energy, storm-wave-modified deltas and associated inter-deltaic shoreface settings." Unit "is time transgressive, becoming younger to the north and northeast away from the Brooks Range" (Alhbrandt and others, 1979). The Nanushuk in northwestern Alaska consists of eastward-prograding deltaic rocks that overlie and interfinger with the Torok Formation and, together, the Torok and the Nanushuk prograde across the Colville Basin (Mull and others, 2000). Abundant and varied megafauna of pelecypods and lesser gastropods and ammonites are reported. Plant fossils common in nonmarine beds and microfauna recovered from shale. Although unit ranges in age, it is primarily Albian (Mull and others, 2003). Includes former Kukpowruk, Tuktu, Grandstand, Corwin, Chandler, and Ninuluk Formations of northern Alaska, all now abandoned. On generalized map, included as part of unit Kns.

This unit is divided into units [Knf](#), [Knu](#), and [Knl](#) in the GRI digital geologic-GIS data.

Kipc - Mafic igneous-clast conglomerate, sandstone and mudstone (Lower Cretaceous)

Massive, poorly stratified and poorly sorted conglomerate composed of pebble- to cobble-size clasts in a graywacke and mudstone matrix in west-central Alaska (Patton and others, 2009). Clasts are predominately mafic intrusive and extrusive rocks, varicolored chert, and locally, metagraywacke. Limestone, quartz, and granitic rock clasts present in subordinate amounts. Conglomerate is interbedded with mafic- and calcareous-clast graywacke and mudstone. Unit composed chiefly of debris thought to be eroded from the Angayucham-Tozitna terrane (Patton and others, 2009). Unit stratigraphically underlies unit Kqc. Contains marine mollusks of Early Cretaceous(?) age in the Selawik

quadrangle.

This unit is unit [Kipc](#) in the GRI digital geologic-GIS data.

Kcgc - Calcareous graywacke and conglomerate (Lower Cretaceous)

Hard, fine-grained to conglomeratic, locally tuffaceous graywacke and dark-gray finely laminated mudstone, typically exposed in western Alaska from Kuskokwim Bay to the southern Brooks Range. Graywacke contains matrix-supported clasts of intermediate and mafic extrusive and intrusive rocks and chert; quartz clasts and metamorphic and granitic rock clasts are present in subordinate amounts. Some graywacke beds are characterized by a distinctly mottled appearance owing to the presence of laumontite, which occurs most commonly in fine-grained, tuffaceous-rich layers (Patton and others, 2009). Metamorphic detritus is increasingly abundant towards top of unit. Graywacke beds commonly display Bouma-sequence grading from massive at the base to laminated in the middle to cross-laminated at the top. Mudstone rip-up clasts are common at the base of the graywacke beds. Unit has a high graywacke-to-mudstone ratio and is interpreted to represent middle and outer submarine fan deposits (Patton and others, 2009). It appears to correspond with similar rocks that extend in a broad belt from the southeast corner of the Saint Michael quadrangle and the northwest corner of the Holy Cross quadrangle to the south-central part of the Kwiguk quadrangle (map unit Kygc of Patton and others, 2009, in press). Marine mollusks of late Early Cretaceous (Albian) age were identified in this unit in the Bettles, Hughes, and Kateel River quadrangles (Patton and others, 2009). Although no fossils have been found in these rocks in the Saint Michael and Holy Cross quadrangles, the similar rock assemblages in the Yukon-Koyukuk Basin are thought coeval (Patton and others, in press).

This unit is unit [Kvgc](#) in the GRI digital geologic-GIS data.

Kvgc - Volcanic graywacke and conglomerate (Cretaceous*)

Consists of a variety of lithologies including thin-bedded tuffaceous chert, massive graywacke, conglomerate, argillite, a few volcanic flows and impure limestone beds, and massive, coarse-grained crystal-lithic tuff (Hoare and Coonrad, 1983) in southwest Alaska in the Bethel and Goodnews Bay quadrangles. Rocks range widely in color, mostly green and gray but also red, yellow, brown, or black (Hoare and Coonrad, 1983). Most distinctive rock type in unit in southwest Alaska is massive andesitic crystal-lithic tuff, which is at least 1,000 m thick (Hoare and Coonrad, 1983). Fine-grained tuff and some graywacke is commonly laumontized. Unit also includes turbidites composed of highly calcareous sandstone interbedded with non-calcareous micaceous siltstone and shale. Hoare and Coonrad (1983) inferred the unit to be coarsening upward from sandstone and shale to conglomerate. Generally thick-bedded to massive, with alternating sandstone and shale intervals 5 to 20 m thick, unit locally has thin-bedded sections (Hoare and Coonrad, 1983). Base of unit was not recognized, and, as such, Hoare and Coonrad (1983) suggested that rocks of Jurassic age may be present in the unit. Rocks are strongly folded and commonly overturned (Hoare and Coonrad, 1983). Box and others (1993) reported the presence of lithic clasts likely derived from the Kanektok metamorphic complex (Xio), as well as other local units. *Buchia crassicolis* of Early Cretaceous Valanginian age is found in calcareous graywacke, conglomerate, and impure limestone. In cherty tuff, *Radiolaria* of Early Cretaceous age have been found at three localities (Hoare and Coonrad, 1983). Presence of *Buchia crassicolis* indicates these rocks are, in part, coeval with the graywacke of Buchia Ridge (unit Kqcs).

This unit is unit [Ktg](#) in the GRI digital geologic-GIS data.

Ksbd - Spilitic pillow basalt and diabase (Early Cretaceous)

Dark-greenish- to reddish-brown, fine-grained, spilitic amygdaloidal pillow basalt flows and dark-greenish-gray, medium- to coarse-grained, spilitic diabase intrusive rocks (Patton and others, 1968; Patton and others, 2009), primarily in the Shungnak quadrangle. Unit inferred to overlie unit KJiv and in turn be overlain by unit Kwu. Unit most likely extends southwestward into the Candle quadrangle, where it has not been distinguished from the large area of Quaternary or Tertiary alkalic basalt (unit QTV, herein) there and in the Kateel River quadrangle. On generalized map, included as part of unit Kms.

This unit is unit [Kbd](#) in the GRI digital geologic-GIS data.

Kgk - Kongakut Formation (Lower Cretaceous)

Upper part mostly dark-gray to black, locally manganiferous pebbly shale (pebble shale member) and dark-olive-gray brownish-gray-weathering siltstone (siltstone member) that contains minor interbedded sandstone, as shown by Reiser and others (1980) and Brosgé and others (1979). Lower part is mostly dark-gray fissile shale ("clay shale member" of Reiser and others, 1980) that has nodules and lenticular beds of red-weathering clay ironstone and is overlain by thin interval of quartz arenite, the Kemik Sandstone Member (shown here, where possible, as unit Kke). Thickness is more than 300 m. Unit is restricted to northeast Alaska and is thought to be lateral (northern) equivalent of Okpikruak Formation (Brosgé and others, 1979). Unit contains Early Cretaceous (Neocomian) pelecypods. Pebble shale unit, which is sometimes mapped separately (see, for example, Bader and Bird, 1986), is thin-bedded, tan to dark-brown, gray-weathering pebbly silty shale, siltstone, sandstone, and quartzite. Worm borings are locally abundant (Reiser and others, 1971). It is distinctive, as a non-bentonitic shale about 100 m thick that contains matrix-supported, well-rounded, frosted quartz sand grains and common to rare chert and quartzite pebbles (Bader and Bird, 1986). In the Ignek Valley region, the lower part of the Kongakut Formation was subsequently reassigned (Molenaar, 1983) to the Kingak Shale (unit KJks here), extending the age range of the Kingak Shale into the Early Cretaceous (Valanginian). On generalized map, included as part of unit Kok.

This unit is unit [Kko](#) in the GRI digital geologic-GIS data.

Kit - Tingmerkpuk Member of the Ipewik Formation (Lower Cretaceous)

Where map data allows, the quartz sandstone in the Ipewik Formation, informally known as the Tingmerkpuk sandstone (see Mull, 2000 and included references), is distinguished here. It is mapped separately because of its importance in potential interpretations of "the tectonic evolution and hydrocarbon potential of the Colville Basin" (Mull, 2000) and because of its apparent northern source and composition, consisting of ~96 percent monocrystalline quartz (Reifenstuhl and others, 1998a).

This unit is unit [Kit](#) in the GRI digital geologic-GIS data.

Khnl - Herendeen Formation and similar units (Lower Cretaceous)

Thin calcarenite, limestone coquina, or similar rock units are widely present in Alaska. Units included are the Herendeen Formation on the Alaska Peninsula, the Nelchina Limestone in south-central Alaska, the Berg Creek Formation of eastern Alaska, and similar unnamed units in southwest and west-central Alaska in the Charley River quadrangle and the Brooks Range ("coquinoid limestone"). The Herendeen Formation was originally described as limestone (Atwood, 1911), but rocks are actually unusually uniform, thin-bedded, medium-grained, calcarenaceous sandstone (Detterman and others, 1996). Inoceramus fragments form major component of formation, although complete specimens have only been found in the Mount Katmai area. Presence of *Buchia crassicolis* indicates a Valanginian age for the

Herendeen in its type area, and ammonite fossils and other collections indicate a Hauterivian and Barremian age at its northern extent (J.W. Miller, written commun., 1983–85; Detterman and others, 1996). The Nelchina Limestone (Martin, 1926) of south-central Alaska and the similar Berg Creek Formation (MacKevett and others, 1978) are lithologically similar to the Herendeen, and consists of “* * * massive dark-colored unaltered fine-grained limestone separated by thin laminae of gray shale. Some beds are highly siliceous and probably ought to be called calcareous sandstone (Martin, 1926).” *Buchia crassicolis* has also been reported from the Nelchina Limestone. The coquinoïd limestone of the northern Alaska is a “[d]istinctive thin marker unit of gray to dark-gray limestone coquina composed of the pelecypod *Buchia sublaevis*, in beds up to 2 m thick, * * * interbedded with reddish-brown to black clay shale * * *” (Mull and others, 1994); its thickness is less than 10 m. Stratigraphically, unit has been associated with the Okpikruak Formation. Kelley (1990a) states that the unit occurs in both structural and stratigraphic settings; in depositional contact with the Otuk Formation and the undifferentiated Otuk and Shublik Formations; and as tectonic blocks in *mélange* in his Arctic Foothills assemblage (which is included here in unit Jls). Tectonic blocks of coquinoïd limestone in the Arctic Foothills assemblage, as well as those associated with Okpikruak Formation, may be olistostromal in nature. Other calcareous clastic units of similar age are known from southwestern Alaska (Hoare and Condon, 1978), western Alaska (Patton, 1966; Hoare and Condon, 1971; Patton and others, 2009) and in the Charley River area of eastern Alaska (Dover and Miyaoka, 1988). Also includes Kennicott and Kuskulana Pass Formations of eastern Alaska, composed dominantly of thin-bedded, fine-grained feldspathic graywacke and arkosic wacke and siltstone. Also includes shale and some conglomerate whose clasts are predominantly Nikolai Greenstone (unit ^n) at the base (MacKevett and others, 1978). Kennicott Formation is generally dark-greenish-gray, weathers brown, and has crude graded bedding, cross-bedding, sole markings, and spherical limy concretions; the older Kuskulana Pass Formation is generally similar. Both represent fairly rapid shallow marine deposition in a transgressive sea. An Albian age is assigned to the Kennicott on the basis of abundant molluscan fauna, particularly the occurrence of *Inoceramus altifluminis* McLearn (Patton, 1966) and pelecypods of genus *Aucellina*, whereas the age of the Kuskulana Pass Formation is defined as Hauterivian and Barremian based on a meager ammonite and pelecypod fauna (MacKevett and others, 1978). On generalized map, included as part of unit Kcca.

This unit is unit [Kofc](#) in the GRI digital geologic-GIS data.

KJiv - Andesitic volcanic rocks (Early Cretaceous & Jurassic)

Widely distributed in western Alaska and on Saint Lawrence Island, unit consists of flows of andesite and basalt, interbedded with tuff, tuff breccia, agglomerate, volcanic conglomerate, and volcanic graywacke. Flows typically have phenocrysts of plagioclase and pyroxene set in a matrix of devitrified glass, altered plagioclase microlites, pyroxene, chlorite, and opaque oxides. Rhyolite and dacite flows are present locally. Tuff is composed chiefly of fine-grained basalt and andesite clasts, plagioclase crystals, and mafic minerals in an altered matrix of devitrified glass. In upper part of the unit, the tuff is highly calcareous and contains abundant shelly debris, including earliest Cretaceous *Buchia sublaevis*, *Buchia subokensis*, and *Buchia crassicolis* (Patton, 1966; Patton and others, 1968) and Simbirskites (Patton, 1967). Tuff commonly occurs in cyclical sequences that grade upward from coarse tuff breccia and lapilli tuff to very fine-grained cherty tuff and blue-green radiolarian chert. Massive agglomerate, breccia, and volcanic conglomerate are present locally. Locally, unit is highly disrupted or intruded by sills and dikes of diabase, diorite, and gabbro. Some of the conglomerate beds east of the Yukon River in the Holy Cross quadrangle contain clasts of altered granitic rocks. Unit is well exposed in the Hughes, Shungnak, Selawik, and Candle quadrangles. Unit also crops out in scattered localities in the Holy Cross quadrangle and northern Russian Mission quadrangle and in several small exposures along the faulted western boundary of the Yukon-Koyukuk Basin in the Kwiguk quadrangle and adjoining Saint Michael quadrangle. Unit is assigned an age of Jurassic to Early Cretaceous based on sparse isotopic and fossil data and on its stratigraphic position below the late Early Cretaceous sedimentary rocks of the Yukon-Koyukuk Basin and above the Triassic rocks of the Angayucham-Tozitna terrane. In the area

east of the Yukon River a diorite intrusive body, included in this unit, yielded a K/Ar amphibole cooling age of 128 ± 4.5 Ma (Early Cretaceous) and an andesite porphyry clast from a volcanic conglomerate gave a K/Ar amphibole age of 164.19 ± 4.93 Ma (Middle Jurassic) (Patton and others, 2006). On generalized map, included as part of unit KJab.

This unit is unit [Kjva](#) in the GRI digital geologic-GIS data.

KJm - Melange facies (Cretaceous or Jurassic?)

Tectonic assemblage of blocks of carbonate rocks, chert, metagraywacke, and altered mafic extrusive and intrusive rocks in a matrix of phyllite exposed in low hills surrounding the Yukon-Koyukuk Basin. The mélangé locally varies in metamorphic grade from pumpellyite to greenschist facies (Patton and others, 2009; Till and others, 2008a). Till and others (2008a) report a block of mafic schist on the Baird Mountains and Ambler River quadrangle boundary that contains abundant blue amphibole, probably crossite. Age of the mélangé is not well controlled; Till and others (2008a) report Mississippian radiolarians from metachert and metalimestone bodies yielding Middle and Late Devonian and Ordovician conodonts (Pallister and Carlson, 1988, cited in Till and others, 2008a). Patton and others (2009) suggested that the mélangé probably formed during time of tectonic emplacement of Angayucham-Tozitna terrane structurally above the Arctic Alaska and Ruby terranes during the Early Cretaceous. Includes unit KJm of Patton and others (2009), but does not include that part of unit KJm of Karl and others (1989a) in the northwest part of the Baird Mountains quadrangle, which has been assigned here to the Okpikruak Formation (unit Kofm). The outcrop pattern of this part of unit KJm of Karl and others (1989a) projects into the adjoining Noatak quadrangle, where it was mapped as Okpikruak Formation at the top of the Kelly River allochthon by C.G. Mull and H.S. Sonneman (Exxon unpub. report, 1968–1974). On generalized map, included as part of unit KMm.

This unit is unit [KJl](#) in the GRI digital geologic-GIS data.

KJks - Kingak Shale and similar units (Lower Jurassic to Lower Cretaceous)

Dark-gray to dark-olive-gray shale and subordinate siltstone, claystone, and clay ironstone (Detterman and others, 1975). Upper part is clay shale, silty shale, and siltstone that has red, rusty-weathering ironstone beds. Lower part is dark-gray to black fissile paper shale, dark-gray clay shale, minor claystone, and beds and nodules of red-weathering ironstone (Reiser and others, 1980). Molenaar (1983) extended the age range of the unit from its originally defined Jurassic age (Detterman and others, 1975) to Early Cretaceous on the basis of rocks assigned to this unit exposed south of the Sadlerochit Mountains, which Detterman and others (1975) had assigned to the Kongakut Formation. As mapped here, includes the Ipewik Formation of the De Long Mountains area (Moore and others, 1986; Curtis and others, 1990; Eilersieck and others, 1990; Mayfield and others, 1990), a significant component of which is either the same as or equivalent to the Kingak Shale. Ipewik Formation consists of maroon and gray shale, coquinoid limestone, siltstone, and clean quartz sandstone. Shale locally contains sparse well-rounded pebbles that consist of quartz, chert, gabbro, and granite and contains local light-weathering clay beds (bentonite?) and volcanic rocks of intermediate composition. The Telavirak and the underlying Ogotoruk Formations of the Point Hope quadrangle are also included here. The Telavirak Formation (Campbell, 1967) consists of rhythmically interbedded mudstone and siltstone or very fine- to medium-grained sandstone in nearly equal proportions. The Ogotoruk Formation is similar; it consists of chiefly dark-gray mudstone interbedded with variable amounts of siltstone and very fine- to medium-grained, dark-gray and brown sandstone. Rocks are generally classified as arkosic or feldspathic wackes.

This unit is divided into units [KJip](#), [KJsh](#), and [KJks](#) and in the GRI digital geologic-GIS data.

KPu - Kingak Shale, Shublik Formation and Karen Creek Sandstone, undivided (Permian to Lower Cretaceous)

This undivided unit, mapped in northeast Alaska, consists of the Kingak Shale, Shublik Formation, and Karen Creek Sandstone. It may also include rocks generally assigned to the Siksikpuk Formation. Elsewhere in northern Alaska, the constituent units are mapped separately and described below as units KJKs, Trkc, and Trgs; all are included as part of unit KPss on the generalized map.

This unit is unit [KPru](#) in the GRI digital geologic-GIS data.

JTrob - Ophiolite of the Brooks Range (Triassic to Jurassic)

Predominantly mafic and ultramafic rocks considered by most workers to represent an essentially complete ophiolite sequence (Mayfield and others, 1988; Moore and others, 1994; Saltus and others, 2001; Dover and others, 2004). Unit grades upward from tectonized and serpentinized mantle peridotite, dunite, harzburgite, and lherzolite at the base through a crustal sequence of cumulate ultramafic rocks and layered gabbro, massive gabbro, high-level felsic igneous differentiates, and sheeted diabase dikes, and is capped by basalt tuffs (Dover and others, 2004). Located in the western Brooks Range and on western Saint Lawrence Island, this ophiolite is best studied at Siniktanneyak Mountain and Memorial Creek in the Howard Pass quadrangle and is commonly referred to as the Misheguk igneous sequence. Dover and others (2004) recognized six subunits in the sequence. At its base, an intrusive phase (1) consists of predominantly orange-weathering dunite, but harzburgite is common locally, as are lesser amounts of lherzolite, serpentinized peridotite, and olivine pyroxenite; most lithologies are typically tectonized and foliated. The next-higher intrusive phase in the complex is (2) a gray-green cumulate layered gabbro as thick as 4 km that includes interlayered ultramafic rocks in its lower part. The third level of the intrusive sequence is (3) predominantly grayish-weathering, medium- to coarse-grained, hypersthene-bearing hornblende-pyroxene gabbro that has a generally directionless texture but has locally well developed mineral banding. Diabase occurs in localized swarms of subparallel dikes as thick as 2 m and has chilled margins. Structurally overlying the gabbro and diabase is a subunit (4) that typically ranges from diorite to hornblende-plagiogranite; alaskite dikes are also common. Dover and others (2004) interpreted that this fourth subunit formed above, and by differentiation from, massive gabbro (5) that is the second-highest intrusive phase in the complex. Locally as thick as 2 km, it is intruded by late-stage diabase dikes. At the top of the section is (6) a predominantly brown to greenish-gray, vesicular and amygdaloidal, locally pillowed basalt and minor volcanic breccia, tuff, and volcanoclastic rocks, as well as lenses of interpillow radiolarian chert and fossiliferous limestone. Fossils in the chert and limestone are varied, and, depending on location, are pre-Permian (Mississippian?), Permian(?), Middle and Late Triassic, and Early(?) Jurassic radiolarians in chert; the limestone lenses have early Late Devonian to early Early Mississippian conodonts and Permian brachiopods. Mayfield and others (1987) inferred a Triassic age for the section in the Noatak quadrangle on the basis of lithologic correlation with similar rocks in Misheguk Mountain quadrangle. Mayfield and others (1987) also inferred a Jurassic age based on the possibility that gabbroic dikes and sills may have been feeders for some of the basalt. These dikes and sills are similar to those in Misheguk igneous sequence, which has yielded K/Ar dates that range from 164.0 ± 7.0 on hornblende (Ellersieck and others, 1982) to 153.0 ± 7.6 on biotite (Nelson and Nelson, 1982) in the Misheguk Mountain and Howard Pass quadrangles, respectively. Wirth and others (1993) reported widely ranging $^{40}\text{Ar}/^{39}\text{Ar}$ ages, between 196.6 ± 12.6 and 134.3 ± 5.8 Ma; very few samples yielded plateau ages, but those that did ranged between 168.8 ± 4.2 and 163.1 ± 4.0 Ma. The Misheguk igneous sequence is generally considered to be far-traveled oceanic crust exposed as thin klippen at the highest structural level in the Brooks Range (see, for example, Patton and others, 1977; Roeder and Mull, 1978). Modeling of magnetic and gravity data by Saltus and others (2001), however, suggests that the ophiolite is at least 8 km thick, which they postulate is inconsistent with the interpretation that the sequence is a thin klippen. Saltus and others (2001) suggest that the ophiolite may have formed in an extensional basin on a broad continental shelf. Harris and others (2003)

disagreed with that interpretation, arguing that field relations and petrochemical data support an allochthonous origin for the Misheguk igneous sequence and that Saltus and others' (2001) geophysical data had inadequate resolution. An interpretation that reconciles both points of view is yet to be published. On generalized map, included as part of unit JZu.

This unit is divided into units [Jgi](#), [JTRrob](#), [Jbod](#), [Jbou](#), [Jbob](#), and [JPNboi](#) in the GRI digital geologic-GIS data.

JPztu - Ultramafic complexes of western Alaska (Jurassic or older)

Consists of ultramafic rock complexes surrounding the Yukon-Koyukuk Basin and along the north side of the Yukon Flats basin. "The complexes consist of: (1) a cumulate magmatic suite composed of interlayered dunite, wehrlite, olivine clinopyroxenite, and gabbro, (2) a mantle suite composed of harzburgite, dunite, and minor clinopyroxenite, and (3) a metamorphic sole consisting of a highly tectonized layer of amphibolite, garnet amphibolite, and pyroxene granulite. The harzburgite in the mantle suite typically is partly to mostly serpentinized. Chromite is generally restricted to centimeter-scale layers in dunite and as an accessory mineral" (Patton and others, 2009). Also included in this unit are ultramafic rocks assigned to the Kanuti ultramafic belt (Patton, 1974) and the Pitka ultramafic complex (Brosgé and others, 1974). The Pitka ultramafic complex was originally described as an eclogite and amphibolite unit during a rapid reconnaissance of the Beaver quadrangle (Brosgé and others, 1973); more detailed analysis by Brosgé and others (1974) showed that it consists "largely of banded garnet-amphibolite, foliated dunite, and harzburgite with pronounced cleavage, gneissic leucogabbro, and only minor eclogite." Ghent and others (2001) reported that the complex had undergone granulite facies metamorphism and reported $40\text{Ar}/39\text{Ar}$ ages between 169.5 ± 0.3 and 164.8 ± 1.1 Ma. The Kanuti ultramafic belt, whose range has been extended from the original 125-km-long belt (Patton and Miller, 1970) through additional mapping, occurs "as tabular masses as much as 1,000 m thick composed of partially serpentinized dunite-harzburgite in the lower part and gabbro in the upper part. They dip 10° to 60° northwestward beneath the Cretaceous and Tertiary volcanic and sedimentary deposits of the Yukon-Koyukuk basin" (Patton, 1974). In the Nulato quadrangle, two exposures of massive chromite as much as 1.5 m thick were noted in dunite (Patton and Moll-Stalcup, 2000). "The complexes are intruded by narrow dikes of fresh clinopyroxenite, hornblende, gabbro, and gabbro pegmatite. K/Ar isotopic cooling ages from the magmatic suite average 159 Ma and two $40\text{Ar}/39\text{Ar}$ determinations yielded a plateau age of 162 Ma. K/Ar isotopic cooling ages from the metamorphic sole at the base of the complexes range from 172 to 155 Ma and one $^{40}\text{Ar}/^{39}\text{Ar}$ determination from the metamorphic sole yielded a plateau age of 161 Ma" (Patton and others, 2009). Unit includes the Dishna River mafic and ultramafic rocks of the Iditarod and Ophir quadrangles (Miller, 1990; Miller and Bundtzen, 1994), on which three questionable K/Ar ages have been determined on hornblende: 222 ± 23 and 228 ± 25 Ma (replicate) and 92.2 ± 2.8 Ma. The older sample had extremely low K_2O and was thought to have incorporated excess argon; the younger was possibly reset by nearby plutonism (Miller and Bundtzen, 1994). On generalized map, included as part of unit JZu.

This unit is divided into units [JTRPe](#), [JTRPTu](#), and [JTRPaum](#) in the GRI digital geologic-GIS data.

JTro - Otuk Formation (Triassic to Middle Jurassic)

Interbedded fossiliferous black chert, limestone, and shale in four lithogenetic units: (1) a basal, poorly exposed black organic shale, (2) a cherty member of black silicified mudstone, chert and shale, (3) a thinly interbedded shale and thin-bedded black- and light-gray banded limestone and silicified limestone member, and (4) the formally defined Blankenship Member, which is organic-rich black shale and thin bedded chert. The Blankenship Member is thought to represent condensed deposition of Early and Middle Jurassic age (Mull and others, 1982). Bedding surfaces in the silicified limestone member weather cream-colored or light-brown to green, and it has a few beds that contain *Monotis* fossils. Chert

member is well-bedded and contains *Halobia* fossils in shaly layers. Lower black shale member, which is only locally present, contains Early Triassic conodonts (Curtis and others, 1990; Ellersieck and others, 1990; Mayfield and others, 1990). Unit is less than 100 m thick. In the past, some maps assigned rocks of this unit to the Shublik Formation (unit Trgs)—see, for example, Campbell (1967), Grybeck and others (1977), Sable and others (1984a, b, c), or Sable and Mangus (1984). The coeval Shublik Formation is confined to the autochthonous part of northern Alaska in northeastern Alaska and the subsurface of the North Slope; the Otuk—in particular the Blankenship Member—is also coeval with the lower part of the Kingak Shale.

This unit is unit [JTRcs](#) in the GRI digital geologic-GIS data.

JIPe - Etivluk Group, undivided (Pennsylvanian to Middle Jurassic)

Includes Otuk and Siksikpuk Formations and Imnaitchiak Chert; consists of maroon, red, green, gray, black, and variegated chert and siliceous argillite, minor maroon calcareous siltstone and argillite, and rare maroon or gray limestone lenses (Karl and others, 1989a; Mayfield and others, 1987). Original definition suggested Etivluk Group is present only on allochthonous sheets in the Brooks Range, and not present on autochthonous rock units (Mull and others, 1982). Locally, the Otuk and Siksikpuk Formations are mapped separately as units JTRo and TRleg, but all are shown together on generalized map as part of unit JIPe.

This unit is unit [JPNzeg](#) in the GRI digital geologic-GIS data.

JPzs - Northern Alaska sedimentary rocks (Carboniferous to Middle Jurassic)

Unit includes two similar rock assemblages in the Wiseman and Chandalar quadrangles and a large part of the central Chandler Lake quadrangle. These assemblages include stratigraphic units common to the Brooks Range that are not separately mapped. The first assemblage, spatially associated with the Doonerak Window (see below, units SCs and OCdv), is composed of quartzite, phyllite, siltstone, conglomerate, shale, sandstone, limestone, argillaceous limestone, dolomitic limestone, and cherty dolostone of Triassic to Carboniferous age that unconformably overlies lower Paleozoic rocks (unit SCs) (Dillon and others, 1986). Formal rock units included, but not separately mapped in this assemblage, are the Kekiktuk Conglomerate (Mek) and Kayak Shale (Mk) of the Endicott Group, the undivided Lisburne Group (Clg), the Echooka Formation (Pe) of the Sadlerochit Group, Shublik Formation (Trgs, KPu) and Karen Creek Sandstone (Trkc). This assemblage was mapped as unit TrCs by Till and others (2008a). Exposed to the northwest of this assemblage is a second assemblage, mapped by Till and others (2008a) as JCs, which is composed of “sandstone, shale, argillaceous limestone, limestone, dolostone, mudstone, chert, and siltstone in north-central Wiseman quadrangle. The unit conformably overlies the Kanayut Conglomerate * * *” (Till and others, 2008a). (The Kanayut Conglomerate of the Endicott Group is mapped as part of unit MDegk herein). This second assemblage consists of the Kayak Shale (Mk) of the Endicott Group, the Lisburne Group (Clg), and the Siksikpuk (TrIPeg) and Otuk Formations (JTro) of the Etivluk Group. Both of these assemblages of Till were included in unit TrCs of Dillon and others (1986). “Various workers (e.g., Dutro and others, 1976; Mull, 1982; Mull and others, 1987a; Adams and others, 1997) have suggested that the general stratigraphy of TrCs is more like that of coeval parautochthonous rocks in the northeastern Brooks Range * * * than that of equivalent strata in the central part of the range that have been assigned to the Endicott Mountains allochthon (EMA; Moore and others, 1994). TrCs does differ from JCs, the nearest coeval strata in the EMA [Endicott Mountains allochthon]; the most notable contrast is the presence of somewhat deeper water facies in parts of both the Carboniferous and Permian successions in JCs. However, Lisburne Group facies in TrCs are generally similar to coeval rocks exposed to the northeast in the central Chandler Lake quadrangle (Dumoulin and others, 1997)” (Till and others, 2008a).

This unit is divided into units [JMs](#) and [TRDcs](#) in the GRI digital geologic-GIS data.

JDoc - Igneous rocks (Devonian to Jurassic)

Dominantly basalt, greenstone, gabbro, diabase, and chert, and lesser ultramafic rocks. Minor basaltic tuff, volcanic breccia, and carbonate rocks. Basalt and greenstone include pillow basalt and metamorphosed spilitic basalt. Unit consists of discontinuous and large unshaped blocks and lenses of incipiently recrystallized mafic rocks in a low metamorphic grade, blastomylonitic, metasedimentary matrix. Matrix is bedded chert of Triassic age; argillite, slate, and limestone of Mississippian age; and andesitic and basaltic tuff. (Note: much of the description of this unit, in particular the Angayucham part, is derived from Till and others, 2008a.) Hitzman and others (1982) and Pallister and Carlson (1988) recognized several distinct subunits within the package, although the subunits are lithologically similar and each is internally imbricated. Primary igneous and sedimentary textures in the metabasalt and metagabbro are partially overprinted by metamorphic minerals, which indicate prehnite-pumpellyite- to greenschist-facies metamorphism. Some metabasalt is foliated and lineated in the western Ambler River quadrangle (A.B. Till, unpub. data) and in the Angayucham Mountains in the Survey Pass quadrangle. Barker and others (1988) also reported albite-epidote-amphibolite-facies assemblages in metabasalt in the Bettles quadrangle. A sliver of mafic schist in the Angayucham Mountains retains relict hornblende and garnet from an amphibolite-facies metamorphic assemblage, contains a foliation-forming greenschist-facies assemblage, and is cut by prehnite-bearing veins (Pallister and Carlson, 1988). Locally, glaucophane is present, indicating high-pressure metamorphism (Till and others, 2008a). Devonian, Mississippian, Triassic, and Jurassic radiolarians, conodonts, and megafossils have been collected from chert, cherty tuff, metalimestone layers, interpillow sedimentary rocks, and fault slivers of carbonate rocks and chert (Pallister and Carlson, 1988; Jones and others, 1988; Till and others, 2008a). Conodonts of late Silurian to Early Devonian age are the oldest fossils collected from the unit, and Early Jurassic radiolarians are the youngest (Pallister and Carlson, 1988; Jones and others, 1988). Pennsylvanian-Permian, Permian, and early Permian radiolarians were collected near the southeast corner of the Wiseman quadrangle (Jones and others, 1988). Contrasting ages within the unit could reflect structural juxtaposition of rocks of different ages or reworking of older fossils into younger strata (Till and others, 2008a). The Tozitna and Rampart assemblages are characterized by variably altered and metamorphosed flows and shallow intrusive rocks of basalt, diabase, and gabbro interbedded with varying proportions of chert, argillite, slate, phyllite, volcanoclastic rocks, graywacke, and carbonate rocks. Sparse megafossils from these carbonate rocks range in age from Devonian to Permian (Patton and others, 2009). The basalt, diabase, and gabbro are weakly metamorphosed to prehnite-pumpellyite facies and generally increase in metamorphic grade structurally downward. Greenschist facies metamorphism and locally high-pressure blueschist metamorphism, as indicated by the presence of glaucophane and lawsonite, occur near the base assemblage where it structurally overlies the Ruby terrane (Till and others, 2008a). The chert includes both interpillow and bedded varieties and ranges from pure radiolarian and spiculitic chert to cherty tuff. In the southeastern part of the Nulato quadrangle and adjoining parts of the Ruby quadrangle, the unit is characterized by sill-like bodies of diabase and gabbro, argillaceous rocks, fine-grained to conglomeritic graywacke, and chert. Associated with these extrusive and shallow intrusive rocks are ultramafic complexes that consist of serpentinized peridotite, dunite, and harzburgite, associated layered gabbro and anorthosite, and, locally, garnet-amphibolite tectonite, possibly derived from eclogite. K/Ar hornblende ages on hornblende gabbro and hornblende-bearing dikes range from 172 to 138 Ma and dates on garnet-amphibolite range from 172 to 155 Ma (Patton and others, 1977, 1994a). These are considered cooling ages related to tectonic emplacement of the ultramafic and mafic rocks. Gabbro in the Rampart Group yielded a K/Ar age of 210 ± 6 Ma (Brosigé and others, 1969; age recalculated using constants of Steiger and Jager, 1977). In the Angayucham Mountains, where the unit has been mapped in detail, the basalts are tholeiitic and fall into "within-plate" fields on trace element discrimination diagrams; the light rare earth elements (LREE) are enriched relative to chondrite in some basalts and gabbros, but show little to no enrichment in other rocks (Barker and others, 1988; Pallister and others, 1989; Till and others, 2008a). Based on these characteristics, the

mafic rocks are thought to have been parts of oceanic plateaus or islands. The Angayucham assemblage, along with the other related assemblages here, may compose a part of a collapsed ocean basin (Till and others, 2008a). It was emplaced in a high structural position during the Brooks Range orogeny. Angayucham metabasalt along the southern flank of the Brooks Range, the "Narvak panel" of Patton and Box (1989), is typically correlated with basalt of the "Copter Peak allochthon" which is exposed at the crest of the range (Moore and others, 1994). One interpretation considers these rocks as part of a dismembered ophiolite derived from the root of a volcanic arc, rather than the more typical mid-ocean ridge setting for an ophiolite (Loney and Himmelberg, 1985; Patton and others, 1994a; see also Patton and others, 1994b).

This unit is divided into units [JMab](#), [JMTu](#), and [TRMtmu](#) in the GRI digital geologic-GIS data.

Trgs - Shublik Formation (Triassic)

Black, marine, carbonaceous, partly calcareous shale and thin-bedded limestone. Upper part is dark gray to black, calcareous, phosphatic siltstone and shale, and contains thin gray limestone interbeds. Locally, varicolored chert beds are present, as are locally abundant limestone concretions within the siltstone and shale. Lower part is black clay shale that contains limestone concretions and laminated silty limestone beds. Shale locally weathers rust-colored. Unit contains abundant fossils including Triassic pelecypods, such as *Halobia* and *Monotis*, and ammonites. Thickness is about 30 to 150 m. Unit locally may include rocks of the Karen Creek Sandstone and the Siksikpuk Formation (Brosgé and others, 1979). Generally exposed in the autochthonous part of the eastern Brooks Range and known from the subsurface of the North Slope, unit is exposed in the Surprise Creek anomaly of Mull and others (2000) in the De Long Mountains quadrangle, where it is contrasted with the Otuk Formation (unit JTro), which is more commonly exposed in the western Brooks Range. "Unit is interpreted to record deposition in a low-energy, restricted marine environment characterized by high organic productivity. * * * Organic-rich shale and limestone contain up to ~4 percent total organic carbon characterized by Type I and II kerogen, and constitute excellent potential hydrocarbon source beds" (Mull and others, 2000). The Shublik is considered to be the main source rock for oil in Arctic Alaska (D.W. Houseknecht, written commun., 2014).

This unit is divided into units [TRsf](#) and [TRPss](#) in the GRI digital geologic-GIS data.

TrIPeg - Siksikpuk Formation and Immaitchiak Chert (Pennsylvanian to Triassic)

Predominantly greenish-gray argillite; contains variable but generally very minor amounts of quartz-rich siltstone and very fine sandstone in beds 2–15 cm thick (Curtis and others, 1990; Ellersieck and others, 1990; Mayfield and others, 1990; Mull and others, 1994; Dover and others, 2004). Base contains a distinctive dark-gray, evenly laminated, glauconitic, phosphatic siltstone bed up to 1 m thick (Mull and others, 1994). Greenish-gray chert is common as interbeds in the argillite at several horizons, the most striking of which is the topmost zone of the formation where argillite is greatly subordinate to chert. Thickness is less than 100 m (Mull and others, 1994). Contains mainly Pennsylvanian to Late Triassic radiolarians but locally has yielded Early Jurassic radiolarians, which may properly belong to the Blankenship Member of the Otuk Formation (unit JTro). Ages of radiolarian collections from this unit include Permian (possibly middle and late Permian), Middle and Late Triassic (probably Ladinian, Carnian, and Norian), and Early Jurassic (Hettangian or Sinemurian) (Dover and others, 2004). As mapped, locally may include rocks of the Sadlerochit Group.

This unit is divided into units [TRPNic](#) and [Psk](#) in the GRI digital geologic-GIS data.

TrDtz - Sedimentary rocks (Devonian to Triassic)

Includes thinly and rhythmically interbedded dark-gray argillite and platy, laminated, gray siltstone; very fine- to fine-grained, gray, chert-rich, turbiditic sandstone; quartz- and chert-bearing granule-to-pebble conglomerate. Locally calcareous and fossiliferous (Weber and others, 1992). Unit also includes chert, which is dominantly medium-dark- to dark-gray, thin-banded, bedded, and radiolarian-bearing, and contains thin interbeds of slaty argillaceous rocks including argillite, slate, and phyllite. In addition, locally includes fine- to coarse-grained sandstone, limy sandstone, sandy limestone, siltstone, and shale. Sandstone ranges from clean quartz arenite to a lithic arenite that contains as much as 25 percent muscovite and metamorphic rock fragments. Also includes subordinate intermediate to basaltic volcanic and volcanoclastic rocks including lithic and water-laid tuff; fossiliferous shallow-water limestone; grit; and arkosic sandstone lenses. Where it can be determined from source maps that rock packages are predominantly igneous, they are mapped as units JMoc and JMct. Age range based on probable Permian microfossils and bryozoan and echinoderm fragments collected in the Ruby quadrangle (Chapman and Patton, 1978); Permian foraminifera, conodonts, and brachiopods (Weber and others, 1992); and Mississippian Radiolaria, conodonts, and foraminifera collected from unit in the Ruby and Medfra quadrangles (Chapman and Patton, 1979). Latest Devonian Radiolaria were collected in two localities in the southwestern Ruby quadrangle (Chapman and Patton, 1979) and are the only Devonian fossils known from rocks that are unequivocally Innoko assemblage; Patton and others (1994a) also report Devonian palynoflora from the Wiseman and Christian quadrangles in the similar Angayucham assemblage. Around the Yukon-Koyukuk Basin, unit also includes "Interbedded white to light-gray banded quartzite, dark phyllite, and gray laminated limestone. * * * Thin layers of white mica folia give the quartzite a faint foliation. The white and light-gray banding, the purity of the quartzite, and the even texture of the quartz grains suggest that the quartzite is a recrystallized chert (metachert). The quartzite is locally interlayered with dark-gray, finely laminated, slightly foliated siliceous argillite, dark phyllite, and talc- chlorite schist. In the Nulato quadrangle, the limestone is partly recrystallized and silicified and locally contains unidentifiable coral and crinoid fragments. In the Melozitna quadrangle, thin marble beds contain conodonts and crinoids of Devonian age (Anita Harris, written commun., 1983). Some of the metachert may be as young as Mesozoic and correlative with the Mesozoic chert in unit JDv [JMoc here]" (Patton and others, 2009). A K/Ar age of 302 ± 9 Ma on amphibole from tuff suggests a Pennsylvanian age in, at least, part of the unit (Miller and Bundtzen, 1994). Parts of unit were originally described by Chapman and Patton (1979). Corresponds to the Rampart Group of Brosgé and others (1969) in the Tanana quadrangle, the TrMra, TrMrb, TrMrs, and TrMrl units of Reifenhuth and others (1997) in the Tanana B-1 quadrangle, the TrMrs unit of Weber and others (1992) in the Livengood quadrangle, and unit *Mc of Foster and others in the Circle quadrangle. Corresponds to the TrMc and TrMs units of Chapman and others (1985) in the Ophir quadrangle and unit TrMc of Miller and Bundtzen (1994) in the Iditarod quadrangle. Includes the IPMc unit of Patton and others (1980) in the Medfra quadrangle. In Livengood quadrangle, includes interlayered black shale or slate; light, olive-greenish-gray thinly bedded to massive and thickly bedded radiolarian-bearing chert; and light greenish-gray tuff (Weber and others, 1992, 1994). In the Coleen quadrangle, unit includes shale and chert as thick as 600 m, previously mapped as part of the Strangle Woman and Christian River sequences of Brosgé and Reiser (1969), who presumed a Triassic or Permian age. Unit also includes 3 to 8 m of cherty limestone, which is possibly equivalent to the Lisburne Group (C.G. Mull, written commun., 2012).

This unit is unit [TRMTs](#) in the GRI digital geologic-GIS data.

TrPzgp - Metagraywacke and phyllite (Triassic & Late Paleozoic)

"Dark-gray to black phyllite and brown-weathering lithic sandstone, sandstone, and mudstone are exposed along the southern boundary of the schist belt. The unit varies in breadth along strike. In the Wiseman and Chandalar quadrangles, two subunits are recognized * * *: a northern dark, fine-grained phyllite or phyllonite, and a southern metamorphosed lithic sandstone-rich unit. * * * The northern unit is lithologically homogeneous, locally well foliated, and locally contains small bodies of mafic schist similar

in composition to those in the underlying schist belt (Dsq; Moore and others, 1997b; Gottschalk and others, 1998). * * * Rocks in the southern subunit retain relict sedimentary features that may reflect contrasting depositional settings. Sedimentary structures, such as Bouma sequences, have been recognized and are thought to indicate deep-water turbidite fan deposition (Murphy and Patton, 1988); others, such as hummocky cross-stratification and oscillation ripple marks, were seen elsewhere and are indicators of shallow-water deposition (Gottschalk and others, 1998). Palynoflora from sandstones with shallow-water structures are Early Devonian (Gottschalk, 1998)" (Till and others, 2008a). Correlative phyllite and metagraywacke is described by Patton and others (2009) in the Yukon-Koyukuk Basin. There, the "phyllite and metagraywacke are overprinted by a low-grade penetrative metamorphic fabric, but turbidite features, such as sole marks and graded bedding, are locally discernible. * * * Unit locally contains slices of little deformed shallow-water Devonian carbonate rocks that are enveloped in basalt flows and debris-flow(?) breccias composed of blocks of vesicular basalt in a matrix of volcanic and carbonate debris" (Patton and others, 2009). As shown here, unit also includes rocks mapped by Till and others (2008a) as "Phyllite, fine-grained schist, and phyllonite of the Central belt that underlie areas of poor exposure in the northeastern Baird Mountains quadrangle, western Ambler River quadrangle, and northwestern Chandalar quadrangle. Locally contains minor lenses of metalimestone and metaconglomerate." Also includes in the Ruby quadrangle "phyllite and subordinate fine-grained metagraywacke cut by abundant vein quartz. The phyllite and metagraywacke are overprinted by a low-grade penetrative metamorphic fabric, but turbidite features, such as sole marks and graded bedding, are locally discernible. Age of unit is uncertain, probably Devonian or late Paleozoic" (Patton and others, 2009).

This unit is divided into units [TRDg](#), [Dp](#), and [Dpr](#) in the GRI digital geologic-GIS data.

TrPsg - Sadlerochit Group, undivided (Permian to Lower Triassic)

A "heterogeneous assemblage of rocks that includes orthoquartzite, chert, limestone, sandstone, siltstone, and shale" (Detterman and others, 1975) that has been divided into two formations: an upper Ilishak Formation and a lower Echooka Formation, each of which is subdivided into formal members. Largely restricted to northeast Alaska and in the subsurface of the North Slope, it begins as a regressive sequence sourced from the north (Wilson and others, 2001) and transitions upward from shelf to fluvial deposits. A third formation, stratigraphically in the middle of the group, the Kavik Shale is recognized in the subsurface and is a medium to dark gray silty shale with minor siltstone and sandstone (Jones and Speers, 1976; Crowder, 1990; Wilson and others, 2001). The Kavik Shale of the subsurface is considered equivalent to the Kavik Member of the Ilishak Formation on the surface. The Sadlerochit Group includes the main reservoir rocks for the Prudhoe Bay oil field, which is estimated to hold as much as 25 billion barrels of oil and 46 trillion cubic feet (tcf) of natural gas (British Petroleum, 2013). Unit locally subdivided into the following two units, Trif and Pe.

This unit is unit [TRPsg](#) in the GRI digital geologic-GIS data.

Pe - Echooka Formation (Permian)

Composed of two formal members. The upper Ikiakpaurak Member is red-weathering, resistant, ferruginous orthoquartzite, quartzitic sandstone, and siltstone. According to Detterman and others (1975), "the Ikiakpaurak Member consists mainly of dark highly quartzose sandstone and siltstone with minor interbeds of silty shale. Locally, in the Sadlerochit and Shublik Mountains, well-defined basal channel conglomerates are present. The pebble- to cobble-sized clasts in the channel conglomerate are all well rounded, about 95 percent black chert derived from the underlying cherty limestone of the Lisburne Group." Fossils in the Ikiakpaurak Member define a Guadalupian age for the unit. The lower Joe Creek Member consists of thin- to medium-bedded quartzose calcarenite and biogenetic limestone that includes brachiopod coquinas. This part is underlain by medium- to thick-bedded chert and siliceous

siltstone overlying a lowest dusk-yellow, thin-bedded limy mudstone and calcareous siltstone. Fossils of Wolfcampian (Cisuralian) to Guadalupian age, especially brachiopods, are found in unit (Reiser and others, 1980). Thickness is about 110 m to 260 m (Brosge and others, 1979). Unit contains a prominent interval of light gray-weathering, fossiliferous, crinoidal limestone up to 30 m thick (Detterman and others, 1975); it forms prominent ledges and ridges interbedded with calcareous shale, siltstone, and sandstone (C.G. Mull, personal data, 2011). Late early Permian age for part of Sadlerochit Group is substantiated by brachiopod fauna including *Attenuatella* sp. and *Anidanthus* sp. found in Sagavanirktok quadrangle (Detterman, 1976). This unit overlies the Lisburne Group and was deposited in a shallow marine shelf environment (Crowder, 1990). As shown here, also includes shale and siltstone in the Table Mountain quadrangle that is similar, but in addition to Permian fossils, also contains Pennsylvanian fossils (Brosge and others, 1976). On generalized map, included as part of unit TrPsg.

This unit is unit [Pef](#) in the GRI digital geologic-GIS data.

Pzls - Limestone and marble (Paleozoic)

Unit consists of poorly known limestone and associated rocks generally found as lenses accompanying rocks of unit PzPrqm in central Alaska, in isolated exposures ranging from the southern Brooks Range to the Kaiyuh Mountains south of the Yukon River. Best described part of unit is "gray to white, partly to wholly recrystallized limestone, marble, dark-gray dolomitic marble, and impure schistose limestone. Unit occurs in layers as much as 25 m thick intercalated with quartz-mica schist, mica schist, graphitic schist, metabasite, and quartzite. Some contacts are gradational; others are sharp and may be faulted. Unit contains conodonts of Middle Ordovician age in the Nulato quadrangle and poorly preserved corals of Ordovician to Late Mississippian age in Ruby quadrangle" (Patton and others, 2009). In the Tanana quadrangle, unit is light- to medium-gray or tan platy limestone and massive-bedded silicified limestone and dolostone and has extensive locally developed boxwork silica and contains sparse conodonts of Famennian age (J.N. Dover, written commun., 1997). In the southeast Circle quadrangle of central Alaska, small bodies of coarse-grained marble are present in the Paleozoic or Precambrian pelitic schist of the region (unit PzPyqm).

This unit is unit [PZrm](#) in the GRI digital geologic-GIS data.

DPxasm - Mixed assemblage of metasedimentary and metavolcanic rocks in the Brooks Range (Proterozoic to Devonian)

"Heterogeneous assemblage of interlayered calcareous, mafic, and siliceous rocks exposed in the * * * Ambler River and Wiseman quadrangles. Includes black quartzite, meta-argillite, and marble; white quartzite; green, buff, and black phyllite and calcareous phyllite; orange-weathering dolostone, orange weathering chloritic marble, chloritic dolomitic marble, gray marble, medium- and dark-green mafic metavolcanic rocks; pale green and orange calcareous schist, and gray-green pelitic schist" (Till and others, 2008a). Unit represents two units of Till and others (2008a), units PzZcm and PzZm, except that they had included in PzZcm a unit called "Metasedimentary and metavolcanic rocks of Tukpahlearik Creek, undivided," of Karl and others (1989a) in the Baird Mountains quadrangle; that is unit DOTu of this map. Unit Dxasm also includes a unit that straddles the Ambler River and Survey Pass quadrangle boundary and consists of "Massive dark greenstone commonly composed of albite, actinolite, epidote, and chlorite, and greenschist composed of albite, chlorite, and minor magnetite" (unit Pzgg of Nelson and Grybeck, 1980). Locally, the greenstone appears to be altered gabbro that intruded Devonian sedimentary rocks, which have been metamorphosed to dark hornfels within 2 meters of altered gabbro. The largest area of greenstone, in the western part of the Survey Pass quadrangle, was previously mapped as biotite schist by Brosge and Pessel (1977) and by Mayfield and Tailleux (1978) in the adjacent Ambler River quadrangle, but more likely is a metamorphosed volcanic sequence. "Poorly developed pillows in compositionally layered biotite-quartz-chlorite schist and semischist, garnet-

epidote-albite amphibolite, and feldspathic biotite-epidote-quartz gneiss with lenticular chloritic patches suggest that these are metamorphosed volcanic rocks of various types" (Nelson and Grybeck, 1980). Also includes unit PzZqs of Till and others (2008a), which they described as a relatively homogeneous assemblage dominated by light greenish-gray fine-grained schist that contains minor layers of metaconglomerate, marble, and calcareous schist. Its eastern exposure has a laminated appearance and contains marble that yielded a conodont of Ordovician to Triassic age (Moore and others, 1997b). These rocks are all part of the Central belt of Till and others (2008a). On generalized map, included as part of unit DPxcn.

This unit is divided into units [PZZm](#), [DCcm](#), and [DZacs](#) in the GRI digital geologic-GIS data.

MIgw - Wachsmuth Limestone (Mississippian)

Bioclastic (crinoidal) limestone, dolostone and dolomitic limestone, black nodular chert; lower part contains abundant argillaceous and shaly limestone and minor shale. Differentiated only where mapped by Bowsher and Dutro (1957) in the Philip Smith Mountains quadrangle (Brosgé and others, 1979). The lower part of the Lisburne Group as mapped by Wartes and others (2011) is assigned to this unit in the Mount Michelson quadrangle. Type section about 375 m thick. On generalized map, included as part of unit Clgne.

This unit is unit [MIgw](#) in the GRI digital geologic-GIS data.

Clg - Lisburne Group, undivided (Carboniferous)

Carbonate and chert unit widely distributed in northern Alaska. As thick as 1,800 m, chiefly limestone and dolomite, in part cherty, with variable but generally minor amounts of interbedded shale. Exposed throughout the Brooks Range, it is also a well-developed horizon in the subsurface of the North Slope. The Lisburne Group is formally divided into several units. In eastern Alaska, in ascending order, these are the Wachsmuth Limestone, Alapah Limestone, and Wahoo Limestone. In western Alaska, the Lisburne Group includes, in ascending order, the Nasorak and Utukok Formations, Kogruk Formation, and Tupik Formation. Two other formations of the group, the Akmalik Chert and the Kuna Formation, are locally mapped, primarily in the central and western part of northern Alaska. The unit descriptions here, after the Kuna Formation, list the western units first followed by the eastern units of the group. The Lisburne Group is a component of most of the allochthons of the Brooks Range, and its various formations and their facies are important tools used in defining the allochthons. In general, the Mississippian rocks consist of crystalline and hydroclastic limestone, which locally is oolitic and lithographic. The limestone ranges from thin-bedded to massive. The massively bedded limestone is generally lighter in color than the somewhat siliceous blue-gray thin-bedded variety. Chert lenses and nodules, both primary and diagenetic, are common throughout. Phosphate-rich shale and limestone are present in the Lisburne Group, typically in the Tupik, Kuna, or Kogruk Formations or the Alapah Limestone (see Dumoulin and others, 2008, 2011). The entire sequence of rocks in the group has a strong organic odor and is generally fossiliferous. The carbonates of the Lisburne Group represent a variety of marine environments, and the portion of deep-water units increases westward; the eastern third of the Brooks Range exposures are almost entirely shallow water facies (J.A. Dumoulin, oral commun., 2012). In the Philip Smith Mountains quadrangle, the mapped upper part of the Lisburne Group contains Late Mississippian corals and brachiopods, Pennsylvanian brachiopods, and in upper 30m near Galbraith Lake, brachiopods that may be early Permian (Brosgé and others, 1979; although this age assignment is considered unlikely, J.A. Dumoulin, oral commun., 2012). Late Mississippian and Early Pennsylvanian foraminifera are common (Brosgé and others, 1979). In some areas, the Lisburne Group is mapped as informally recognized upper and lower units. Locally subdivided into the following eight formal units: MIgk, Clgt, Clgk, MIgac, MIgnu, IPIgw, MIga, MIgw.

This unit is divided into units [PNMI](#), [PMlg](#), [MlgI](#), and [Mc](#) in the GRI digital geologic-GIS data.

Mlgnu - Nasorak and Utukok Formations (Mississippian)

These formations represent the lowest part of the Lisburne Group in northwestern Alaska. The Nasorak is the more western of the two units, which are generally equivalent in age and stratigraphic position. The Nasorak is divided into three members. Upper member of the Nasorak Formation is about 550 m thick and is characterized by rhythmically interbedded thin- to medium-bedded dark-gray limestone and by thin-laminated to very thin-bedded silty calcareous shale. Shale interbeds decrease both in abundance and thickness progressively upward through the member. The Cape Thompson Member, about 70 m thick, is the middle member of the Nasorak Formation and consists of massive light-gray limestone, chiefly a crinoid biosparite that is almost entirely coarse sand- to fine-pebble-sized crinoid stem fragments and columnals. Unit locally contains very minor very fine-grained quartz silt (Campbell, 1967). Lower member consists of 50 m of interbedded dark-gray to grayish-black, locally calcareous, silty clay shale and medium-gray to dark-gray cherty limestone. Dark-gray limestone is predominantly medium- to coarse-grained biomicrite (Campbell, 1967). The Utukok Formation is a buff-weathering limestone and fine-grained, locally calcareous sandstone, locally as thick as 1,400 m in the western De Long Mountains quadrangle and possibly structurally thickened (Sable and others, 1984a, b, c). Elsewhere the Utukok is typically less than 100 m thick and may represent a thin, discontinuous tongue below the Kograk Formation (unit Clgk), or may have not been deposited locally within this sequence. Base is probably gradational into Devonian limestone (Dover and others, 2004). Upper part contains light-gray, medium-bedded ferruginous sandy limestone, which weathers to a distinct dark-yellowish-brown and yellowish-orange rust color and is commonly blocky-weathering on talus slopes. Lower part contains sandy limestone, calcareous siltstone, shale, and fine-grained sandstone, less resistant to erosion than the Kograk Formation (unit Clgk) or Baird Group (unit DCbg), thus commonly forms saddles or recessive zones. Contains Late Mississippian foraminifers and conodonts (Dumoulin and others, 2004, 2006); common megafossils are crinoids and brachiopods and locally contains abundant spiriferoid brachiopods, gastropods, pelecypods, cephalopods, trilobites, and crinoidal debris of Early Mississippian age (Sable and others, 1984a, b, c; Mayfield and others, 1987; Dutro, 1987).

This unit is divided into units [Mlgn](#) and [Mlut](#) in the GRI digital geologic-GIS data.

Clgk - Kograk Formation (Upper Mississippian)

Light-gray-weathering limestone and lesser light-brown weathering dolostone that contain less than 25 percent black chert nodules and lenses (Curtis and others, 1984; Ellersieck and others, 1984; Mayfield and others, 1990). Depositional thickness ranges from about 30 m in the southeastern part of Misheguk Mountain quadrangle to more than 300 m in southwestern part of Misheguk Mountain quadrangle. Base is gradational into the Utukok Formation (unit Mlgnu) (Curtis and others, 1984; Ellersieck and others, 1984). Common and abundant fossils are Late Mississippian corals, crinoids, brachiopods, foraminifers, and conodonts (Sable and Dutro, 1961; Patton and Dutro, 1969, Armstrong and Mamet, 1977, Lane and Ressmeyer, 1985) reflecting shallow-water deposition. Includes deformed and metamorphosed limestone and marble on the Seward Peninsula (Till and others, 2011) and Saint Lawrence Island (Patton and others, 2011) that are thought to correlate with this unit. On the eastern part of Saint Lawrence Island, unit is composed of an upper and lower member. Upper member consists chiefly of light- to medium-gray, coarsely bioclastic limestone that contains interbedded limy mudstone in its upper part. Lower member is composed of dark-gray thin-bedded limestone that contains abundant dark chert nodules. Total thickness of the unit is estimated to be between 400 and 500 m. Unit is metamorphosed to a coarse-grained marble near the contacts with granitic plutons (Patton and others, 2011) on Saint Lawrence Island. On generalized map, included as part of unit Clgtk.

This unit is unit [Mlkg](#) in the GRI digital geologic-GIS data.

Clgt - Tupik Formation (Pennsylvanian and Upper Mississippian)

Uppermost formation of the Lisburne Group in northwestern Alaska; consists primarily of interbedded grayish-black chert, dark- to medium-dark-gray carbonate mudstone, and subordinate greenish-black to dark-greenish-gray chert, and very fine to finely crystalline dolomite (Campbell, 1967). Also includes dark-gray to black, micritic, silty, mostly thin-bedded, very finely crystalline to microcrystalline limestone with thin chert interbeds. Sable and Dutro (1961) report a sparse fossil fauna that includes Mississippian sponge spicules and cephalopods and Late Mississippian foraminifers. Upper part of formation is missing at type section. Campbell (1967) geographically extended formation to the Point Hope quadrangle and speculated that the “absence of fauna of Pennsylvanian age contributes to interpretation of disconformity with overlying Siksikpuk; on other hand, no fossils have been found at higher stratigraphic position than about 150 ft [45 m] below top; it is possible that Pennsylvanian Period is represented by rather thin zone of nonfossiliferous rocks.” Unit is 100–200 m thick (Sable and others, 1984a, b, c). Base is gradational with the Kogruek Formation (Curtis and others, 1984; Mayfield and others, 1984; Eilersieck and others, 1984). On generalized map, included as part of unit Clgtk.

This unit is divided into unit [PMlt](#) in the GRI digital geologic-GIS data.

Mlgac - Akmalik Chert and other black chert of the Lisburne Group (Mississippian)

Bedded black chert in beds as much as 10 cm thick, having thin, black siliceous shale partings; locally contains barite deposits and rare interbeds of calcareous radiolarite. In the northwest Howard Pass quadrangle, unit includes abundant interbeds 2–7 cm thick of brownish-black dolostone. These rocks formed in a deep-water, basinal setting. Chert contains abundant radiolarians and lesser sponge spicules. Radiolarians are chiefly Late Mississippian but locally may be as old as late Early Mississippian (Blome and others, 1998; Dover and others, 2004). In the Killik River quadrangle, unit consists of bedded black chert that contains finely disseminated pyrite in beds up to 10 cm thick and has thin siliceous shale partings; contains two laterally persistent thin micritic limestone beds up to 1 m thick near base. Locally includes underlying thin Kayak Shale, which is generally poorly exposed and not mappable at scale of map. Contains Osagean (Middle Mississippian) to Morrowan (lowest Pennsylvanian) or younger conodonts; in Howard Pass quadrangle, contains Osagean conodonts. Thickness about 75 m (Mull and others, 1994). In most areas, units explicitly called the Akmalik Chert are restricted to the Picnic Creek allochthon (see, for example, Mull and Werdon, 1994, or Mull and others, 1994). As shown here, unit also includes small exposures of black chert in the Arctic and Table Mountains quadrangles of northeast Alaska.

This unit is unit [PMlc](#) in the GRI digital geologic-GIS data.

Mlgk - Kuna Formation (Mississippian)

Predominantly black siliceous mudstone and sooty, carbonaceous shale, including minor light-gray bioclastic limestone interbeds and concretions. Siliceous beds are rich in sponge spicules and radiolarians. Thin carbonate layers are chiefly dolomitic mudstone and calcified radiolarite. Sedimentological and faunal evidence suggests that the Kuna was deposited in a deep-water setting in which low oxygen conditions prevailed. Maximum thickness about 100 m (Mull and others, 1982). Conodonts from carbonate layers near base of type section in Howard Pass quadrangle are early middle Osagean, or approximately Middle Mississippian (Dover and others, 2004); conodont-bearing layers also contain rare cephalopods of Osagean and Meramecian (approximately Middle Mississippian) age. Siliceous beds in the uppermost Kuna yield radiolarians of Late Mississippian to Early Pennsylvanian

age (Mull and Weldon, 1994; Dover and others, 2004). Unit is considered Mississippian, although an early Pennsylvanian age is locally possible for the uppermost beds. Unit is primarily exposed in the western Brooks Range, but as mapped here includes small exposures of similar rocks in northeast Alaska.

This unit is unit [Mlku](#) in the GRI digital geologic-GIS data.

Mgq - Globe quartzite of Weber and others (1992) (Mississippian)

Light-gray, fine- to medium-grained, bimodal to moderately sorted quartzite, weathers light- or medium-gray and iron stained; is dense, vitreous, and contains well-rounded to subrounded monocrystalline quartz grains and scanty chert grains. Age based on lithologic and stratigraphic similarities to Keno Hill Quartzite in Yukon, Canada, and, to a lesser extent, a date on intruding mafic rocks (unit Trmi) (Weber and others, 1992; Dover, 1994). Occurs in the Livengood and Tanana quadrangles and is exposed in a thin sliver along one of the splays of the Tintina Fault System and in limited exposures in the Circle quadrangle (F.R. Weber, unpub. data, 1998).

This unit is unit [Mgq](#) in the GRI digital geologic-GIS data.

MDe - Endicott Group, undivided (Devonian to Mississippian)

Clastic sequence that consists of seven formally defined formations. Herein, also includes the informally defined Ulungarat formation of Anderson (1991a) at its base. Typically composed of shale, sandstone, and conglomerate (Tailleur and others, 1967). Extends throughout the Brooks Range and also known in the subsurface of the North Slope. As shown here, represents undifferentiated parts of the Endicott Group. Defined unit age extends into the early Permian, however, Pennsylvanian and Permian rocks of the unit are not exposed at the surface and only known from the subsurface of the North Slope. The Mississippian Itkilyariak Formation of Mull and Mangus (1972) is the uppermost formation of the Endicott Group in Sadlerochit Mountains of the northeast Brooks Range. There it overlies the undivided Kayak Shale and Kekiktuk Conglomerate. The Itkilyariak Formation consists of red and maroon sandstone, conglomerate, breccia, and limestone interbedded with maroon and greenish-gray shale and light-gray quartzitic sandstone about 45 m thick. Extent of unit is not mapped but, according to Mull and Mangus (1972), unconformably overlies undated and unnamed shale and sandstone at its type locality, and, in some areas, overlies—unconformably or gradationally—undivided Kayak and Kekiktuk Formations. The Itkilyariak Formation gradationally underlies the Alapah Limestone (unit Mlga) of the Lisburne Group. Age is Late Mississippian on the basis of biostratigraphic dating of early Late Mississippian fauna. Armstrong and Bird (1976) described the Itkilyariak Formation as part of a transgressive depositional suite of Carboniferous rocks of Arctic Alaska and proposed that redbeds and evaporites in the formation may represent a slowing in rate of transgression, perhaps reflecting local progradation and development of mudflats and (or) change of climate from humid to arid. On the Lisburne Peninsula between Cape Thompson and Cape Dyer, the Endicott Group consists of (ascending) the informal Mississippian Kapaloak sequence (marine and fluvial) and an unnamed Upper Mississippian (marine) shale (Moore and others, 1984).

This unit is divided into units [MDe](#) and [Mkk](#) in the GRI digital geologic-GIS data.

Mk - Kayak Shale (Mississippian)

Widely exposed across northern Alaska, the Kayak Shale is commonly the uppermost exposed unit of the Endicott Group. It consists of dark-gray to black fissile clay shale with yellowish-brown-weathering thin fossiliferous limestone beds near top. Commonly contains conspicuous reddish-brown-weathering nodules; lower part contains thin interbeds of gray and brown, irregularly bedded fine- to medium-grained,

impure, partly worm-burrowed sandstone near base. Unit disconformably overlies the Kanayut Conglomerate (unit MDegk) in its type area and the central Brooks Range and the Neruokpuk (unit CPxwn) in northeast Alaska. It is complexly deformed by isoclinal folding and shearing; its lower contact is commonly a thrust fault; it acted as a detachment zone for the overlying Lisburne. Thickness is probably more than 500 m (Brosgé and others, 1976, 1979; Mull and others, 1994). Bioclastic limestone beds are generally less than 1.8 m thick and are reddish- and yellowish-brown-weathering fossil hash. Crinoids, brachiopods, bryozoan, and corals are locally abundant (Kelley, 1990a). Siderite concretions are characteristic in places. Locally contains felsic to intermediate intrusive, extrusive, and volcanoclastic rocks (Dover and others, 2004), as well as red- and green-weathering slaty phyllite and argillite and minor semischistose quartz-rich siltstone and marble (Nelson and Grybeck, 1980).

This unit is unit [Mk](#) in the GRI digital geologic-GIS data.

Mek - Kekiktuk Conglomerate (Mississippian)

Resistant massive quartzite and granule to cobble quartzite and quartz conglomerate; clasts are well-rounded gray chert, quartz, and quartzite (Mayfield and TAILLEUR, 1978). Quartzite generally light-gray, clean, well-indurated and weathers light-gray; locally iron-stained. Conglomerate is interbedded and lenticular in quartzite beds; clasts of the conglomerate predominantly quartzite and chert. Locally contains anthracite (Reiser and others, 1980). Unit is considered Early Mississippian on the basis of plant fossils and trace fossils *Scalarituba* and *Skolithos* (Nilsen, 1981; Dutro, 1987). In the Ambler River, Survey Pass, and Wiseman quadrangles, consists of conglomerate that contains clasts of quartz, chert, quartzite, slate, and minor thin layers of metasandstone and phyllite (Till and others, 2008a). According to Till and others (2008a), "Quartz and chert clasts are most common; chert clasts are varicolored. The matrix of the conglomerate is composed of quartz, white mica, and chlorite, and clasts are typically stretched. Phyllite may be gray, green, or red." Unit is typically mapped in the central Brooks Range, but also included here are areas mapped as Kekiktuk or Kanayut Conglomerate in the Table Mountain and Coleen quadrangles (Brosgé and Reiser, 1969, Brosgé and others, 1976). On generalized map, included as part of unit MDe.

This unit is divided into units [Mkkc](#) and [Mke](#) in the GRI digital geologic-GIS data.

Meks - Kapaloak sequence of Moore and others (2002) (Mississippian)

Consists of interfingering thin- and medium- bedded marine and nonmarine sandstone, siltstone, and shale. Sandstone consists largely of quartz and chert; at base of unit a pebble conglomerate has clasts of chert and locally derived argillite. Upper part of unit is "dark-brown carbonaceous shale and siltstone and interbedded sandstone and local coal" (Moore and others, 2002). Unit contains significant amounts of coal in its upper part and contains plant fossils of Early Mississippian age and marine fossils near top as young as Late Mississippian. On generalized map, included as part of unit MDe.

This unit is unit [Men](#) in the GRI digital geologic-GIS data.

Mes - Kurupa Sandstone (Lower Mississippian)

Sandstone, light- to medium-gray, in beds up to 1 m thick. Unit contains abundant amalgamated graded beds, abundant flutes and grooves, and well developed Bouma sequences. Sand-sized grains, in declining order of abundance, are quartz, chert, and feldspar. Weathers reddish brown, forms resistant ridges or spurs on valley walls. Well exposed at type locality in Kurupa Hills and in Akmalik Creek in the Killik River quadrangle. Contains abundant plant fossils, particularly near top of formation, and has scattered brachiopods near Otuk Creek in the western Killik River quadrangle. Thickness less than 40 m; grades downward into Hunt Fork Shale (unit Degh; Mull and others, 1994). Unit is primarily mapped

in the central Brooks Range. Also included here, on the basis of lithologic similarity, are rocks mapped by Brosgé and others (1979) as the shale and sandstone member of the Kayak Shale in the Philip Smith Mountains quadrangle.

This unit is unit [Mks](#) in the GRI digital geologic-GIS data.

MDegk - Kanayut Conglomerate and Noatak Sandstone, undivided (Lower Mississippian and Upper Devonian)

Kanayut Conglomerate is one of the most widely exposed units of the Endicott Group. Nilsen and Moore (1984) locally divided it into three formal members (in ascending order): the Ear Peak, Shainin Lake, and Stuver Members. It is also commonly mapped as an undivided unit with the Noatak Sandstone. Kanayut Conglomerate has been mapped across the breadth of the Brooks Range, from the east end, by Brosgé and others (1962), to the westernmost Brooks Range, by Nilsen and Moore (1984). Where Kanayut Conglomerate and Noatak Sandstone are mapped undivided, the lower marine part of section corresponds to the Noatak Sandstone and upper parts of section represent the Kanayut Conglomerate. The lowermost member, the Ear Peak, is a sequence of fining-upward fluvial cycles of conglomerate, sandstone, and shale as thick as 1,160 m, deposited by meandering streams. The Shainin Lake Member is a sequence of fining-upward couplets of conglomerate and sandstone as thick as 530 m, deposited by braided streams. The Stuver Member is a sequence of fining-upward fluvial cycles of conglomerate, sandstone, and shale as thick as 1,300 m, deposited by meandering streams. Mull and others (1987b) suggest that the proportion of conglomerate decreases southward in the Kanayut Conglomerate. Metamorphic grade increases towards the metamorphic core of the Brooks Range (Central Belt of Till and others, 2008a). Age control based on plant fossils, largely of Late Devonian age, but including Early Mississippian plants. Noatak Sandstone described below where it is mapped separately.

This unit is divided into units [MDky](#), [MDkys](#), [MDkn](#), [Dkyl](#), [Dkym](#), and [Dkyq](#) in the GRI digital geologic-GIS data.

Dbf - Beaucoup Formation, undivided (Devonian)

Heterogeneous unit that consists of carbonaceous, siliceous, and calcareous sedimentary rocks and felsic volcanic rocks broadly distributed across the Brooks Range and especially in Central Belt of Till and others (2008a). The name Beaucoup Formation has come to include many rocks of the Brooks Range stratigraphically below the Hunt Fork Shale (unit Degh) and above the loosely defined Skajit Limestone (here mapped as parts of unit [Im](#) and [O_Is](#)). Multiple map units of Till and others (2008a) have been assigned to the Beaucoup Formation here. Till and others (2008a) divided their unit Pzw into northern and southern parts whose outcrops straddle the northern part of the Wiseman-Chandalar quadrangle boundary. "The northern belt is composed of metasandstone and argillite; in its eastern part, metasandstone contains abundant detrital white mica that yielded a Late Ordovician 40Ar/39Ar cooling age (Moore and others, 1997a). The northern belt is equivalent to the Trembley Creek phyllite of Moore and others (1997b), and Rocks of Whiteface Mountain of Dillon and others (1986). The southern belt * * * is composed of phyllite, metasandstone with volcanic clasts, argillite, sandstone, pebble conglomerate and rare marble" (Till and others, 2008a). This division into two parts or belts cannot be extended throughout the Brooks Range. "In the northeast Baird Mountains quadrangle, laminated to massive porphyritic rhyolite plugs, flows, and pyroclastic rocks are closely associated with siliceous and calcareous sedimentary rocks (Karl and others, 1989a). Along the northern part of the boundary between the Wiseman and Chandalar quadrangles, felsic to intermediate porphyries, metavolcaniclastic rocks, and rare massive hypabyssal rocks are associated with purple and green phyllite, lithic, quartz, feldspar metasandstone, and meta-argillite pebble conglomerate (Moore and others, 1997b). Elsewhere, volcanic-clast sandstone and conglomerate, feldspathic volcanic wacke or graywacke, and tuffaceous

metalimestone occur with other sedimentary rocks of the unit" (Till and others, 2008a). Unit also includes "phyllite, carbonate, and clastic rocks of the Nakolik River, undivided" of Karl and others (1989a). Megafossils and conodonts collected from calcareous black phyllite and metalimestone interlayered with purple and green phyllite in the Chandalar quadrangle are Middle and early Late Devonian in age (Dumoulin and Harris, 1994); Middle and Late Devonian conodonts were recovered from the unit in the northwest Wiseman quadrangle (Till and others, 2008a, table A-1). A foliated felsic metavolcaniclastic rock collected in the northwestern Chandalar quadrangle yielded a U/Pb zircon crystallization age of 393 ± 2 Ma (Aleinikoff and others, 1993, cited in Till and others, 2008a). This unit records the transition from early Paleozoic platform carbonate sedimentation to voluminous, widespread clastic sedimentation represented by rocks of the Endicott Group (Till and others, 2008a). Some rocks that should be assigned to this map unit are likely included in the metamorphosed part of the Hunt Fork Shale in the Chandalar quadrangle and elsewhere. Unit subdivided into the following two units, Dbfl and Dbfw, which, on the generalized map, are included as part of unit Dbf.

This unit is divided into units [MDkh](#), [Dbc](#), [Dbf](#), [Dby](#), and [SOj](#) in the GRI digital geologic-GIS data.

MDag - Augen gneiss and orthogneiss (Early Mississippian and Late Devonian)

Peraluminous granitic gneiss that contains augen of potassium feldspar generally interpreted as a blastoporphyritic texture. These metaigneous bodies are exposed in the Tanacross, Eagle, Big Delta, Circle, Mount Hayes, Tanana, Melozitna, and Chandalar quadrangles and range from weakly to strongly foliated quartzofeldspathic orthogneiss. Augen gneiss in the Big Delta quadrangle has yielded a 341 ± 3 Ma U/Pb (TIMS) and 371 ± 3 Ma (SHRIMP) age; the SHRIMP age is interpreted as a crystallization age (Dusel-Bacon and others, 2004). Similar augen gneiss in the other quadrangles yield U/Pb SHRIMP ages between about 370 and 332.6 ± 5.7 Ma (Aleinikoff and others, 1986; Dusel-Bacon and Aleinikoff, 1996; Newberry and others, 1998a; Dusel-Bacon and others, 2004; Day and others, 2014). Although the body in the Tanana quadrangle yielded an age that was interpreted as 390 ± 25 Ma (Patton and others, 1987)—significantly older than other dated bodies in this unit and similar to the age of orthogneiss in the Brooks Range (which ranges from 395 to 365 Ma; unit Dogn)—this age was interpreted on the basis of the upper intercept of a concordia plot (Patton and others, 1987) where the discordia cord was nearly parallel with the concordia; the large uncertainty is indicative of this poor fit. Unit also includes augen gneiss associated with the West Point complex of Smith and others (1994) and foliated, muscovite-biotite granitic orthogneiss bodies within the West Point complex. The West Point complex of Smith and others (1994) is exposed in the northeastern part of the Big Delta quadrangle and consists of upper amphibolite facies metamorphic rocks that were intruded by abundant pre- and post-metamorphic, felsic to intermediate igneous rocks. Smith and others (1994) reported a TIMS U/Pb age of 671 ± 34 Ma for the orthogneiss, but a U/Pb SHRIMP analysis reported by Dusel-Bacon and others (2003a) reported an average age of 113 ± 2 Ma, from 7 of the most concordant rim analyses, a subset of 16 rim samples analyzed from a total of 33 zircon grains. Both authors interpreted their ages as emplacement ages, but the majority of the zircons reported by Dusel-Bacon and others (2003a) had Devonian-age cores, which leads us to suggest that this was likely a Devonian pluton metamorphosed in the Cretaceous; nearby augen gneiss has yielded a U/Pb age of 355 ± 4 Ma (Dusel-Bacon and others, 2006) interpreted as an intrusion age. Boundaries of the West Point complex are gradational (Smith and others, 1994). The gneiss bodies in the Melozitna and Chandalar quadrangles are as yet undated. Although the Chandalar body included here is near the Brooks Range, its position south of the Kobuk Fault System leads us to assign it to this unit, whereas all the metaigneous bodies north of the Kobuk Fault System are assigned to map unit Dogn. Many of these augen gneiss and orthogneiss bodies yield Cretaceous cooling ages, typically between 115 and 105 Ma, but some are as young as 90 Ma. Rb-Sr biotite, K-feldspar, plagioclase, and whole-rock isochron ages of about 110 Ma on some of these rocks were interpreted by Wilson and others (1985) and Nokleberg and others (1992a, b) as the age of metamorphism. Emplacement age determinations on the orthogneiss bodies of this map unit overlap ages determined on

orthogneiss in the Brooks Range (unit Dogn). On generalized map, included as part of unit MDmg.

This unit is unit [MDrao](#) in the GRI digital geologic-GIS data.

Pzcn - Marble, northern Alaska (early Paleozoic)

Ranges from light-gray to white, partly recrystallized limestone to coarsely crystalline marble to dark, finely crystalline dolomitic marble. Subordinate interbedded calc-schist, chloritic schist, and quartzite. Unit ranges in age from Ordovician to Mississippian and may locally include rocks as old as Cambrian. Contains scattered fossils (Patton and others, 2009). Primarily exposed in the Baird Mountains quadrangle. On generalized map, included as part of unit Pzc.

This unit is divided into unit [MCm](#) and [DClid](#) in the GRI digital geologic-GIS data.

Clgv - Volcanic rocks and sills associated with Lisburne Group (Mississippian and Pennsylvanian?)

Typically, consists predominantly of light-gray to green-gray, light-brown to rusty-weathering felsic tuff that has abundant feldspar and sparse biotite phenocrysts; typically has calcareous cement and disseminated sulfide minerals. Tuff is associated with tuffaceous sandstone, coarse-grained limestone that contains disseminated light-green chloritic minerals, and thick-bedded to massive calcareous rocks that contain volcanic fragments (Dover and others, 2004). In the Baird Mountains quadrangle, unit is orange-, tan-, or light-brown-weathering, thinly laminated limestone, tuff, and volcaniclastic rocks with subordinate sills and plugs of intermediate to mafic composition; unit contains conodonts of early Early Mississippian age (Karl and others, 1989a). Elsewhere unit has been shown to contain conodonts of latest Late Mississippian age (Brosge and others, 2001). Where unit is known as sills, the sills are generally chloritized andesite. Most typically associated with the Lisburne Group, similar volcaniclastic rocks range from agglomerate to tuff of felsic to intermediate composition and are associated with the Kayak Shale in the Howard Pass quadrangle. Like the exposures in the Baird Mountains quadrangle, these volcaniclastic rocks contain conodonts of early Early Mississippian age. In the Table Mountains quadrangle, rhyolitic volcanic rocks are interbedded with the Kekiktuk Conglomerate of Early Mississippian age. Typically associated with the Endicott Mountains allochthon, these volcanic rocks are also known from rocks of the autochthonous North Slope of Alaska. On generalized map, included as part of unit CDbrv.

This unit is unit [Mlt](#) and [PNMy](#) in the GRI digital geologic-GIS data.

IPMn - Nuka Formation (Carboniferous)

Medium-gray, light-gray-weathering, arkosic limestone and sandstone, and interbedded black clay shale. Sandstone is fine- to medium-grained and calcareous, in thickening- and coarsening-upward beds; section has turbidite characteristics with graded beds up to 1 m thick and has convolute bedding and large flute casts at the base of some beds; base of section is dominantly black clay shale. Contains locally abundant glauconite and rare hematite-cemented beds. Depositional thickness is estimated to range from a few meters to as much as 300 m (Dover and others, 2004). Crinoids and brachiopods of Late Mississippian to Early Pennsylvanian age are conspicuous fossils in scattered localities (Mayfield and others, 1987; Mull and others, 1994). Also contains Late Mississippian foraminifers (Sable and others, 1984a, b, c; Mayfield and others, 1987) and Early Pennsylvanian conodonts (Curtis and others, 1984).

This unit is unit [PNMn](#) in the GRI digital geologic-GIS data.

DPxacs - Calcareous schist of Brooks Range (Proterozoic to Devonian)

"Light-gray-, brown- and locally orange-weathering, lithologically heterogeneous mix of marble and carbonate-rich, quartz-rich, and mafic schist derived from metasedimentary and metaigneous protoliths; one of two major units that extends along the length of the Schist belt [of Till and others, 2008a]. Within the unit, lithologies are interlayered at scales varying from millimeters to 10's of meters. Calcareous schist, albitic schist, marble, and metaquartzite (massive, mica-poor varieties of pelitic schist) are commonly interlayered; pelitic interlayers and pelitic components in calcareous schists are also characteristic" (Till and others, 2008a). Marble generally forms less than 25 percent of unit but locally may represent as much as 40 percent of the unit. The marble is in layers, lenses, and boudins of coarsely crystalline, pure calcite meters to tens of meters thick forming bare, steep slopes and ledges. Rare dolostone occurs as lenses up to several meters thick. Graphitic carbonate rocks (marble and dolostone), quartz-rich schist, and albite-rich schist are typical of the unit, as are chlorite-bearing marble, dolostone, and metaquartzite. Metabasite, metadiorite, and chlorite-albite schist vary greatly in abundance along the length of the unit (Till and others, 2008a). "It is likely that the calcareous schist unit is composed of several lithologic packages that have unknown depositional relationships. In the western part of the schist belt, * * * calcite-chlorite-albite schists, chlorite-albite schists, and marbles were apparently derived from sources rich in carbonate and mafic components. * * * Near Wiseman, two subunits can be distinguished, though some lithologies occur in both. One subunit is similar to the carbonate-mafic association in the west. The other * * * is dominated by metachert * * * and calcareous schist, and contains several types of metaconglomerates. The metachert commonly contains cm-scale lenses and thin, mm-thick layers of spessartine (Mn-rich) garnet and mafic metatuff. Metabasite bodies are associated with the metachert as well (A.B. Till, unpublished data)" (Till and others, 2008a). In discussing age control for this unit, Till and others (2008a) report conodont collections that range in age between Middle Ordovician and Middle Devonian. In the Baird Mountains quadrangle granitic orthogneiss that has yielded a Neoproterozoic U/Pb zircon age (705±35 Ma, Karl and Aleinikoff, 1990, in rocks assigned to unit Zgn here) apparently intrudes marble of this unit, which Till and others (2008a) interpreted to mean that "at least part of the unit must be Late Proterozoic or older." Spatially associated with this unit are Middle and Late Devonian orthogneiss bodies (unit Dogn); Newberry and others (1997) report skarn around the Middle Devonian orthogneiss in the Chandalar quadrangle. "Metamorphic assemblages in the calcareous schist unit show that it experienced the same early high-pressure/low-temperature metamorphic and deformational history as the quartz-mica schist [unit DPxaqm, here, and unit Dsq of Till and others, 2008a, who cite Gottschalk, 1990; Little and others, 1994; and Dinklage, 1998]. Chloritoid, glaucophane, pseudomorphs after glaucophane, and pseudomorphs after lawsonite are present in pelitic and mafic layers in the unit (Little and others, 1994; Dinklage, 1998; Till, A., unpublished data)" (Till and others, 2008a). On generalized map, included as part of unit DPxsb.

This unit is divided into units [PMZk](#), [Dsb](#), [DCcs](#), [DZa](#), and [DZmc](#) in the GRI digital geologic-GIS data.

Degh - Hunt Fork Shale (Devonian)

Mostly shale and sandstone; shale is medium-dark- and olive-gray; sandstone is grayish-green and greenish-gray, mostly fine- to medium-grained, micaceous, and locally ripple crossbedded and or graded, widely distributed across northern Alaska. Unit locally subdivided into three informal members: a shale member that consists of mudstone, shale, and sandstone; a wacke member; and a limestone member (Brosge and others, 2001; Harris and others, 2009). Shale member weathers black to brown; where locally pyritic, weathers rusty and contains a few ironstone concretions. Mudstone and shale are medium- to medium-dark-gray, very silty, fissile, and interbedded with sandstone. Interbedded sandstone is as much as 25 percent brown-weathering, thin-bedded, fine-grained, partly calcareous sandstone and graywacke that includes both quartz-chert arenite and quartz-chert wacke; sandstone is schistose in southern part of its exposure area, and has minor thin beds of ferruginous, argillaceous, fossiliferous

limestone. Unit displays a cyclic depositional pattern with siltstone grading upward into shale; limestone occurs in upper parts of some cycles (Brosgé and others, 1979; Kelley, 1990a). Wacke member is included here with the Noatak Sandstone, unit Degn. Informal dark-gray limestone member weathers yellow, brown, and gray and is thin- to medium-bedded or nodular and has common algal lumps. Commonly includes some orange-weathering, partly calcareous siltstone and fine-grained sandstone above or below the limestone. Unit is metamorphosed in core of Brooks Range and, where found, thrust imbricated in the Doonerak Window. Where metamorphosed, it consists of dark-gray to black phyllite and lesser gray-green phyllite with thin layers of siliceous or calcareous metasiltstone, lithic wacke, metasandstone, and minor layers of fossiliferous metalimestone. Locally massive mafic sills and dikes up to 10 m thick are common. Mafic bodies in the unit (both strongly and weakly foliated parts) display lower greenschist-facies minerals (Till and others, 2008a). Fossils include brachiopods (late Frasnian to early Famennian), mollusks, echinoderms, and Middle to Late Devonian conodonts (Brosgé and others, 1979; Till and others, 2008a).

This unit is divided into units [Dhf](#), [Dhfm](#), and [Dbs](#) in the GRI digital geologic-GIS data.

Degn - Noatak Sandstone (Upper Devonian)

Gray to greenish-gray, medium-bedded quartzose sandstone, generally fine-grained, calcareous, finely micaceous, probably more than 500 m thick; contains abundant yellow-orange limonitic spots and commonly contains conspicuous cross beds and ripple marks; beds are up to 2 m thick and interbedded with gray silty micaceous shale and, locally, with thin silty limestone. Locally contains massive, thick-bedded, white to light-gray-weathering pebble conglomerate, which contains matrix-supported white quartz and black and gray chert pebbles to 2 cm diameter. Unit was mostly deposited on a marine shelf (Mull and others, 1994). Conformably overlies Hunt Fork Shale. Conformably underlies Ear Peak Member of the Kanayut Conglomerate. Thickness ranges from 0 to 560 m. Contains late Late Devonian (middle Famennian) marine megafossils, including brachiopods, gastropods, pelecypods, and echinoderms, and trace fossils such as *Skolithos* (Nilsen and others, 1985). As mapped here, includes a unit informally described as wacke sandstone and quartzite members of the Hunt Fork Shale (Nelson and Grybeck, 1980; Brosgé and others, 1979). This unit is grayish green, brown, and black micaceous manganiferous clay shale and shaly siltstone that contains interbedded thin- to medium-bedded, fine- to medium-grained, limonitic quartzitic quartz-chert wacke that weathers orange and brown; green fine-grained wacke; and minor amounts of gray quartzite and calcareous sandstone. Wacke is composed of fragments of quartz, chert, muscovite and biotite schist, and minor amounts of plagioclase feldspar. Ferruginous lenses contain brachiopod coquina and pebbles of chert and shale and ironstone (Brosgé and others, 1979; Kelley, 1990a). Nelson and Grybeck (1980) reported brachiopods, gastropods, pelecypods, echinoderms, other mollusks, plants, feeding tracks, and trails. Brosgé and others (2000) mapped dark-gray wacke and brown calcareous sandstone containing coquina lenses as part of this unit. As mentioned above, unit is much more widely exposed than shown here because it is commonly mapped as a unit within the Kanayut Conglomerate.

This unit is divided into units [Dhbw](#) and [Dnu](#) in the GRI digital geologic-GIS data.

Dogn - Granitic gneiss (Late & Middle Devonian)

Generally consists of "metamorphosed intrusive rocks that are predominantly muscovite-biotite granite ranging in composition from alkali-feldspar granite to tonalite" (Nelson and Grybeck, 1980). Primarily exposed in the Survey Pass and Chandalar quadrangles, but other small exposures of this unit occur on the Seward Peninsula and in the Wiseman, Ambler River, Shungnak, and Baird Mountains quadrangles. In the Survey Pass quadrangle, unit is coarse-grained augen gneiss and granite gneiss that occur locally within Arrigetch Peaks and Mount Igikpak plutons (Nelson and Grybeck, 1980). Brosgé and Reiser (1964) and Dillon and others (1996) described the unit in the Chandalar quadrangle as generally gneissic

chloritized biotite granite, quartz monzonite, and granodiorite that locally includes chloritized hornblende granite and granodiorite, all of which are white to tan or cream-colored. On the Seward Peninsula, unit consists of texturally homogeneous, light-brownish-gray, light-orange to gray, fine-grained, biotite-plagioclase-quartz gneiss and granitic orthogneiss. The foliation in the gneiss is defined by aligned and segregated muscovite and minor biotite (Till and others, 2011). Various mapped as Cretaceous, Mesozoic, or Paleozoic, U/Pb dating has shown these bodies to be Late and Middle Devonian intrusions that have undergone a Cretaceous resetting and therefore yield Cretaceous K/Ar and $^{40}\text{Ar}/^{39}\text{Ar}$ ages. Early Rb/Sr analysis yielded an age of 373 ± 25 Ma (Silberman and others, 1979; Nelson and Grybeck, 1980). Dillon and others (1979, 1980) reported the first modern U/Pb ages (there were earlier, discredited, Pb-alpha ages in the Ambler River and Shungnak quadrangles; see Mayfield and others, 1983) that indicate a Late Devonian age (365 ± 15 Ma) for the Arrigetch Peaks and Mount Igikpak plutons. Subsequently, Aleinikoff and others (1993) determined additional U/Pb ages ranging from 395 to 388 Ma in the Chandalar quadrangle, and Till and others (2008a) reported a U/Pb age of 386 ± 1 Ma in the Shungnak quadrangle. These ages overlap the age range of augen gneiss and orthogneiss in the Yukon-Tanana Upland and Ruby terrane (unit MDag). Till and others (2011) report a U/Pb age of 390 ± 3 Ma age for orthogneiss on the Seward Peninsula. On generalized map, included as part of unit MDmg.

This unit is unit [Dyao](#) in the GRI digital geologic-GIS data.

Dke - Kugururok Formation and Eli Limestone (Devonian)

Kugururok Formation consists of three informal lithologic members: (1) a lower, dominantly clastic unit of shale that has interbedded sandstone, granule conglomerate, siltstone and limestone; (2) a middle calcarenite unit containing some conglomeratic limestone, sparse chert lenses and dolomitic(?) sandstone; and (3) an upper, light-colored, laminated to cross-bedded dolomite unit. Thickness at the type section in the Misheguk Mountain quadrangle is 1,370 ft (417 m) and elsewhere over 2,000 ft (610 m). Age is Late Devonian (Frasnian and Famennian) based on paleontological evidence (Sable and Dutro, 1961). "Eli Limestone is yellow-brown to orange weathering, medium- to dark-gray, fine- to coarse-grained, commonly argillaceous limestone and lesser dolostone; beds are planar to irregular and bioturbated and rock types range from lime mudstone to bioclastic packstone. Conodonts denote an age of late Middle or early Late to late Late Devonian (late Givetian or Frasnian to Famennian); it also contains brachiopods of Late Devonian (possibly mid-Famennian) age" (Till and others, 2008a). These units were "deposited in a range of shallow-water, inner to middle shelf environments; the shallowest and most restricted depositional regimes prevailed during the late Middle Devonian. * * * Middle Devonian carbonate rocks correlate at least in part with youngest part of Baird Group * * *" (Till and others, 2008a). As originally defined, these units were part of the Baird Group; however, as they are younger than any part of the Baird Group type section and, unlike the Baird Group; are not metamorphosed, they were excluded from the Baird Group by Till and others (2008a) and are part of the Eli River sequence of Till and others (2008a). Unit also includes Devonian limestone mapped in the Arctic (Brosge and others, 2000), Table Mountain (C.G. Mull and H.S. Sonneman, Exxon, unpub. report, 1968–1974), and Coleen (Brosge and Reiser, 1969) quadrangles, and dolostone and dolomitic limestone on Saint Lawrence Island (Patton and others, 2011). On generalized map, included as part of unit DCbg.

This unit is divided into units [Dbk](#) and [Dbe](#) in the GRI digital geologic-GIS data.

Dbfw - Wacke member (Upper Devonian)

Gray and green, thin-bedded wacke, brown and gray sandstone and quartzite, siltstone, shale, and calcareous sandstone and shale. Contains coquina lenses (Brosge and others, 2000). Apparently contains less green shale and siltstone, and more calcareous sandstone, than wacke member of Hunt Fork Shale (unit Degh) (Brosge and others, 1979). Contains Late Devonian (Frasnian) brachiopods, pelecypods, crinoids, and corals (Brosge and others, 1979; 2001). Includes wacke member of Rocks of

Whiteface Mountain of Dillon and others (1986), which consist of fine-grained wacke, graywacke, calcareous shale-chip and granule conglomerate with some volcanic clasts, and thin fossiliferous limestone.

This unit is unit [Dbfw](#) in the GRI digital geologic-GIS data.

Dbfl - Limestone and similar rocks (Upper and Middle Devonian)

Light- and dark-gray limestone and dolostone, locally cherty; weathers to gray, orange, or brown (Mayfield and TAILLEUR, 1978; Nelson and Grybeck, 1980; Brosgé and Reiser, 2000; Dover and others, 2004). As mapped, unit includes the limestone of Nakolik River of Karl and others (1989a), which consists of fossiliferous metalimestone and marble and subordinate quartz-carbonate metasandstone, metasilstone, and phyllite. Descriptions vary, but unit is locally distinguished from Lisburne Group by lack of chert. Adjacent to the Arrigetch pluton in the Survey Pass quadrangle, unit contains calc-silicate skarn (Nelson and Grybeck, 1980). Megafossils are locally abundant and include brachiopods, corals, pelmatozoans, and stromatoporoids. Megafossils and conodonts, where most precisely dated, are of Middle and early Late Devonian age (Dover and others, 2004).

This unit is unit [Dol](#) in the GRI digital geologic-GIS data.

Dyss - Clastic and calcareous clastic rocks (Devonian)

Lithic- and quartz-rich clastic sedimentary and low-grade metamorphic rocks found along the northwest and northern margin of the Yukon Flats basin. Brosgé and others (1973) and Brosgé and Reiser (2000) report gray-green, brown-weathering, fine- to medium-grained, thin- to medium-bedded lithic wacke interbedded with lesser amounts of gray and brown quartz wacke and black micaceous shale and silty shale. Faintly schistose in many exposures, weathers brown to rusty. "Rare gritty beds contain chips of shale. The quartz wacke is also fine- to medium-grained and thin- to medium-bedded. Black shale occurs in thin partings and in beds as much as 25 to 50 feet thick (8 to 15 m) that may form 30 to 50 percent of the unit. The total thickness of the unit is uncertain, but is probably about 4,000 feet (1200 m) * * *. Graywacke and shale on the upper Christian River contains Devonian plants and spores" (Brosgé and Reiser, 2000). Brosgé and Reiser (2000) also describe a schistose wacke unit, which they suggest is probably a "slightly more metamorphosed facies" of their wacke and quartzite and slate units. Till and others (2006a) assigned these rocks to the Brooks Range phyllite and graywacke belt, the so-called Slate Creek terrane. However, just across the Yukon Flats basin to the east is the Nation River Formation (unit Dnr), which has some lithologic and age similarity with these rocks. On generalized map, included as part of unit DZyf.

This unit is divided into units [Dyss](#) and [Dg](#) in the GRI digital geologic-GIS data.

Dv - Metavolcanic rocks and sills (Devonian)

Mafic and lesser felsic metavolcanic rocks and greenstone sills interlayered in Hunt Fork Shale and Beaucoup Formation (Brosgé and Reiser, 2000) and, locally, in the Kanayut Conglomerate (Mull and WERDON, 1994). It is mappable as two separate metavolcanic units in most places: a mafic metavolcanic and a felsic metavolcanic unit. Mafic unit consists of pillow basalt, amygdaloidal basalt, and basalt capped by tuffaceous limestone, commonly schistose and altered to calcic greenstone; may, in part, have been olivine basalt flows, about 10 to 80 m thick (Brosgé and others, 1979). Unit also includes younger (presumed Carboniferous) mafic to intermediate metavolcanic rocks in the Howard Pass quadrangle that are associated with limestone of the Lisburne Group and the Nuka Formation (Mull and WERDON, 1994). Felsic rocks, a minor part of the unit, include metamorphosed crystal and lithic tuff, volcanic breccia, and minor porphyry of rhyolitic compositions, now mostly recrystallized to fine

crystalline quartz-sericite schist (Brosgé and Reiser, 2000). This unit is distinct from the Ambler sequence (unit Das) in being typically associated with the Hunt Fork Shale (unit Degh) and in being a dominantly mafic unit. On generalized map, included as part of unit CDbv.

This unit is divided into units [Dvt](#) and [Dvf](#) in the GRI digital geologic-GIS data.

Dyp - Phyllite, slate and black shale (Devonian?)

Dark-gray to black phyllite and schistose siltstone interbedded with subordinate amounts of quartz wacke and sheared slate- and chert-pebble conglomerate (Brosgé and others, 1973; Brosgé and Reiser, 2000) in northeast Alaska. In the Coleen quadrangle, unit consists of laminated dark-gray, light-gray, and greenish-gray clay and silt phyllite; minor very fine-grained, thin-bedded sandstone (Brosgé and Reiser, 1969). In the Christian quadrangle, Brosgé and Reiser (2000) subdivided the unit along the East Fork of the Chandalar River; on the east the unit contains more siltstone, is darker-colored, and locally recrystallized. Brosgé and Reiser (2000) assigned the entire unit to the Venetie terrane in the Christian quadrangle, whereas Moore and others (1994) assigned the unit to the slate- and graywacke-bearing Slate Creek terrane of the southern Brooks Range. The rocks in the Beaver quadrangle were assigned to the Slate Creek thrust sheet of the Angayucham-Tozitna terrane by Patton and others (1994a). As shown here, all of the rock units assigned to this map unit are spatially associated with the Angayucham, Tozitna, and Innoko assemblages and Rampart Group units of this map. On generalized map, included as part of unit DZyf.

This unit is unit [Dyp](#) in the GRI digital geologic-GIS data.

Das - Bimodal metavolcanic rocks (Devonian)

Interlayered white- to medium-gray-weathering metarhyolite and dark-green-weathering metabasite, exposed primarily within the Schist belt of Till and others (2008a) in the Brooks Range. Unit also includes minor pale-gray-weathering marble and brown- to dark-gray-weathering calcareous, pelitic, and carbonaceous schist. Unit occurs as large lenses interfolded within unit DPxaqm and DPxacs. Generally known as the Ambler sequence of Hitzman and others (1982) or Ambler metavolcanic rocks, it is best studied near the boundary of the Ambler River and Survey Pass quadrangles, largely because of the presence of the world-class Arctic mineral deposit (Hitzman and others, 1986; Schmidt, 1986), but a much larger area of exposure occurs in the Wiseman quadrangle (Dillon and others, 1986). The felsic part of the unit is characterized by porphyritic metarhyolite that has megacrysts of feldspar and quartz eyes, as well as aphanitic metarhyolite showing rare flow banding, breccia textures, and possible welded shard textures (Hitzman and others, 1986). Hitzman and others (1986) report that metabasite occurs as pods and lenses where exposures in the Ambler River quadrangle retain remnant pillow structures. Metarhyolite, including at the Arctic deposit, has yielded U/Pb zircon ages that range from 386 to 378 Ma with one outlier at 405 Ma (see Till and others, 2008a). A conodont collection from marble in the Wiseman quadrangle yielded a Devonian age (Till and others, 2008a). Till and others (2008a) discuss megafossil collections that “have been reported but are not now considered definitive. In an abstract, Smith and others (1978) reported that poorly preserved favositid corals, crinoid columnals, bryozoans, and ichnofossils were found at a locality in the Ambler district, and assigned the rocks a tentative Middle Devonian to Early Mississippian age. The faunal assemblage was examined by two researchers. G.D. Webster (written commun. to I.L. Tailleux, 1977) indicated a Devonian age for the corals, and considered crinoid columnals to be of probable Middle Devonian and possible Devonian or Mississippian age. William A. Oliver, Jr. (written commun. to I.L. Tailleux, 1977) suggested that the solitary corals indicate a post-Middle Ordovician age and that possible thamnoporoid corals suggested a Silurian-Devonian age. Both paleontologists have reconsidered their findings (written commun. to A. Till, 1992), and neither now suggest a Middle Devonian to Early Mississippian age for the assemblage. Therefore, the age reported in Smith and others (1978) and derivative publications (for example, Hitzman and others, 1982; 1986) can

not be supported by megafossil collections.” However, Till and others (2008a) report Devonian conodonts and interpret, given this and available radiometric ages, that the unit is at least in part Devonian.

This unit is divided into unit [Dav](#) and [Davf](#) in the GRI digital geologic-GIS data.

DOtu - Metasedimentary and metavolcanic rocks of Tukpahlearik Creek, undivided (Ordovician to Devonian)

“Black carbonaceous quartzite and siliceous argillite with lenses of dolostone and marble, silvery gray to silvery green pelitic schist, gray chert pebble metaconglomerate, green calc-schist, orange-weathering micaceous marble, dark green mafic metavolcanic rocks, gray or white metachert and gray- to white-weathering marble” (Karl and others, 1989a). Karl and others (1989a) reported greenschist and blueschist facies mineral assemblages are present. Exposed in two areas of the Baird Mountains and adjoining Selawik quadrangle, pelitic schist is composed of quartz, albite, chlorite, and biotite in the southern part of the unit, whereas biotite is not present in pelitic schist in the northern part of the unit. Chert pebble metaconglomerate and graphitic quartzite commonly contain chloritoid and locally contains stilpnomelane throughout the unit (Karl and others, 1989a). Normal-marine, cool-water Ordovician conodonts from the black quartzite and Ordovician to Devonian conodonts from gray marble define the age of the unit (Karl and others, 1989a). More common black carbonaceous rocks and less carbonate distinguish these rocks from similar age rocks in the Baird Mountains quadrangle. Locally subdivided into units DOtm and DOtp.

This unit is divided into units [DSOtu](#) and [DSOtq](#) in the GRI digital geologic-GIS data.

DOtm - Marble of Tukpahlearik Creek (Ordovician to Devonian)

Orange-weathering, gray micaceous marble and gray, medium-grained, massive to thick-bedded marble in lenses tens of meters thick intercalated with green chloritic quartz schist, gray calcareous quartz schist, and black carbonaceous quartz semischist (Karl and others, 1989a). “Marble forms sections up to 300 m thick, alternating with black quartzite or semischist that is typically a few meters thick but may be as much as 100 m thick” (Karl and others, 1989a). On generalized map, included as part of unit DOtu.

This unit is unit [DSOtmq](#) in the GRI digital geologic-GIS data.

DOtp - Pelitic schist and metavolcanic rocks of Tukpahlearik Creek (Ordovician to Devonian)

“Greenish-gray, green, or gray, fine- to medium- grained chloritic quartz schist and siliceous chlorite schist * * *” that locally includes “* * * intercalated masses of dark green metabasite, mafic dikes, mafic extrusive rocks and white metachert. Mafic rocks form resistant outcrops up to 100 meters in diameter and sometimes have associated lenses of white ribbon metachert as much as 30 m thick. Metachert occurs in cm thick beds with crenulated chloritic partings. Metachert lenses or blocks also occur in pelitic schist independent of metabasite” (Karl and others, 1989a). On generalized map, included as part of unit DOtu.

This unit is divided into units [DSOtpg](#) and [DSOtp](#) in the GRI digital geologic-GIS data.

DOx - Marble, graphitic rocks, and schist (Ordovician? to Devonian)

Interlayered pure and impure marble, graphitic metasiliceous rock, pelitic schist, calc-schist, and mafic schist, unit DOx of Till and others (2011) is defined, in part, by a position structurally below the Casadepaga Schist (unit Ocs, here). The most common rock types are gray- and orange-weathering, pale-gray to white, coarse crystalline marble forming rounded ridges that may extend along strike for several kilometers, and generally homogeneous, dark gray-black-weathering graphitic metasiliceous rock forming rounded hills that can be recognized from great distances (Till and 141 others, 2011). Good exposures are rare; minor lithologies generally do not crop out. Lithologic units vary in thickness along strike on a scale of kilometers, a characteristic that may be depositional as well as structural. "In the western Solomon quadrangle and Nome quadrangle, there is a consistent general stacking pattern of lithologies within DOx. The structurally upper part of the unit is composed of mixed schist and marble, including pelitic schist, gray marble, orange-weathering impure marble, black schistose marble, and black metasiliceous rock * * * interlayered on scale of meters and decameters. The uppermost lithology is commonly an orange-weathering chlorite marble * * *. The structurally lower parts of the unit are dominated by gray marble or black metasiliceous rock. Where the gray marble is dominant, it reaches thicknesses of 1–2 km and contains minor thin (less than 50 meters) layers of metaquartzite, pelitic schist, and chlorite-albite schist. Where the black metasiliceous rock is dominant, it reaches thicknesses of around 500 meters. It is underlain by 10–30 meters of gray marble interlayered with thin bands of pelitic schist" (Till and others, 2011). Metabasite that consists of boudins or layers of glaucophane-epidote-garnet bearing metabasite, or chlorite-albite-actinolite- bearing metabasite, similar to that found in the Casadepaga Schist (unit Ocs), is found in both the mixed schist and marble package and within the gray marble and black metasiliceous rock. "The age range of DOx is not strictly known. Conodonts of Ordovician age were obtained from relatively pure marble in the Solomon quadrangle; marble in the Nome quadrangle produced conodonts of early Paleozoic age. * * * Recrystallized radiolarians collected in the northern Darby Mountains in banded calcite-bearing graphitic metasiliceous rock are of probable pre-Devonian age (B.K. Holdsworth, written commun., 1985)" (Till and others, 2011). In the Teller quadrangle " * * * conodonts of late Silurian-Devonian age have been recovered from two localities; a third locality produced a fauna of Silurian (late Llandovery-Ludlow) age. Sedimentary structures and conodont biofacies suggest a warm, shallow-water depositional setting. Faunal and lithofacies data indicate that these rocks may correlate, at least in part, with unit Sd [unit Incm, here] in the Nome Complex * * *. Shallow-water Silurian rocks also occur widely in the Brooks Range" (Till and others, 2011). Three detrital zircon samples have been collected from the unit on the southern Seward Peninsula. One yielded largely Neoproterozoic zircons, another yielded zircon populations as young as Silurian, and the third yielded a robust population of Middle and Early Devonian zircons (J.M. Amato, Univ. of New Mexico, written commun., 2008); apparently part of this unit must be Devonian or younger (Till and others, 2011). On generalized map, included as part of unit PzZncl.

This unit is unit [DSOnx](#) in the GRI digital geologic-GIS data.

DCbg - Baird Group and similar rocks (Upper Cambrian to Middle Devonian)

Originally defined as three distinct formations (the Kugururok Formation, Eli Limestone, and Skajit Limestone), the Baird Group consists of "beige- to orange-weathering, laminated, partly argillaceous to silty metalimestone and light- to dark-gray, flaggy-bedded to massive metalimestone, marble, and dolostone. The Baird Group was established by Tailleux and others (1967), but was restricted by Dumoulin and Harris (1994) to the carbonate succession of the west-central Baird Mountains quadrangle; broadly coeval carbonate strata of the eastern Baird Mountains quadrangle and Middle and Late Devonian carbonate rocks of the Maiyumerak Mountains were excluded" (Till and others, 2008a). As shown here, the Baird Group is restricted to the western part of Alaska north of Kotzebue Sound, primarily in the Baird Mountains quadrangle, and a small area in the Chandalar quadrangle to the east. The Eli Limestone and Kugururok Formation are mapped together here as unit Dke, and the Skajit Limestone is not used here. Rocks commonly assigned to the Skajit Limestone are excluded from the

Baird Group and instead included in unit Pzm here. As shown, parts of two units of Till and others (2008a), DOB (the Baird Group, proper) and DOc (Younger carbonate rocks of the Nanielik antiform) are included in this map unit. As used by Till and others (2008a), the oldest strata of the Baird Group *** are Early and Middle Ordovician, locally contain reworked Late Cambrian conodonts, and comprise two roughly coeval lithofacies: dolostone with fenestral fabric and evaporite molds that formed in locally restricted, shallow to very shallow water, and bioturbated to laminated, argillaceous to silty metacarbonate rocks with local cross-bedding, ripples, and flame structures that accumulated in somewhat deeper platform settings. *** Younger strata include Upper Ordovician and middle Silurian (Wenlock) metalimestone deposited in middle to outer platform settings and upper Silurian and Lower and Middle Devonian (Emsian, Eifelian, and possibly Givetian?) shallow-water dolostone and metalimestone with corals and stromatoporoids; the Emsian section includes an interval of calcareous, chloritic metasandstone. DOB [of Till and others, 2008a] includes local occurrences of metabasalt of unknown age that are especially abundant in western exposures. These rocks contain fine-grained blue amphibole (crossite) at multiple localities, indicating that the Baird Group has experienced blueschist facies metamorphism. The unit has similarities in lithofacies and biofacies to *** coeval strata of the York Mountains on Seward Peninsula. Conodont assemblages have both Laurentian and Siberian affinities (Dumoulin and Harris, 1994; Dumoulin and others, 2002)" (Till and others, 2008a). The Younger carbonate rocks of the Nanielik antiform (unit DOc of Till and others, 2008a) are "very light- to dark-gray (locally orange-) weathering, gray to black, commonly massive dolostone and lesser metalimestone and marble exposed in the Nanielik antiform (northeastern Baird Mountains and northwestern Ambler River quadrangles) and in the northwestern Chandalar quadrangle. DOc was first described in the Nanielik antiform (Sheep Creek section of Dumoulin and Harris, 1987) and later recognized to the east (Dumoulin and Harris, 1994). Meter- to decimeter-scale color banding is characteristic of this unit and reflects shallowing-upward peritidal cycles of darker colored, bioturbated, bioclastic and (or) peloidal carbonate strata overlain by light-colored cryptalgal laminite. Recognizable fossils include corals, stromatoporoids, brachiopods, gastropods, bryozoans, pelmatozoan debris, ostracodes, and dasycladacean algae. Corals and conodonts indicate an age of Upper Ordovician through Silurian for most of the unit. Definitively Devonian rocks have not been found in the eastern Baird Mountains quadrangle, but stromatoporoid wacke-packstone of late Early to early Middle Devonian (Emsian-Eifelian) age occurs locally in the Chandalar quadrangle. The unit is generally fault-bounded but a gradational and apparently conformable contact above O<c [Older carbonate rocks of the Nanielik antiform of Till and others (2008a), shown here as unit OCIs] is locally preserved. Sedimentary structures and fossils indicate warm, shallow-water depositional settings that were shallowest and most restricted during Late Ordovician (Richmondian or Katian) time. DOc has similarities in lithofacies and biofacies to the younger part of DOB, as well as coeval strata of the York Mountains on Seward Peninsula. Ordovician biotas include some megafossils and microfossils with Siberian affinities and others with Laurentian affinities; Silurian and younger fossil assemblages are chiefly cosmopolitan (Dumoulin and Harris, 1994; Dumoulin and others, 2002)" (Till and others, 2008a). Locally subdivided into unit Dke.

This unit is unit [DSOb](#) in the GRI digital geologic-GIS data.

Pzm - Marble of the Brooks Range (Devonian and older)

As described by Till and others (2008a), unit consists of "white to gray (less commonly black), fine to coarsely crystalline, massive to platy marble and subordinate meta- limestone and dolostone occurs discontinuously in all quadrangles within the map area. Pzm locally contains abundant disseminated quartz or mica grains, and (or) interlayers of schist, quartzite, or phyllite. In some areas, these strata contain no relict sedimentary textures and few or no fossils; elsewhere, relict sedimentary structures and fossils occur, but rocks have not been studied in sufficient detail to allow assignment to *** other better defined carbonate units of Devonian and older age. "Existing fossil data and regional relationships suggest that most Pzm is Cambrian through Mississippian in age" (Till and others, 2008a). As shown here, unit includes exposures in the Ambler River, Survey Pass, Wiseman, Chandalar, Philip Smith Mountains, Christian, and Arctic quadrangles that were traditionally assigned to the Skajit Limestone of

Baird Group, a formal unit not used herein. It excludes part of unit Pzm of Till and others (2008a) in the Baird Mountains quadrangle, which is here included in unit Pzcn. On generalized map, included as part of unit Pzc.

This unit is unit [DCbs](#) in the GRI digital geologic-GIS data.

DPxsgm - Schist, paragneiss, and marble (Neoproterozoic to Devonian)

Spatially associated with the Arrigetch Peaks orthogneiss, this unit includes pelitic schist, metaquartzite, mafic schist, and rocks originally mapped as the Skajit Limestone and an orange dolomitic marble by Nelson and Grybeck (1980) in the Survey Pass quadrangle and as banded schist by Dillon and others (1986) in the western Wiseman quadrangle. In the Survey Pass quadrangle the unit consists largely of granoblastic, massive, light-gray weathering, cream to very light-gray, fine- to medium-grained marble and orange-weathering, medium- to coarse-grained dolomitic marble. In the Wiseman quadrangle, unit is interlayered, locally gneissic, coarse-grained quartz-mica schist, quartzite, calcareous schist, marble, graphitic phyllite, and metabasite. "Upper greenschist facies rocks predominate, but includes amphibolite facies paragneiss, and local relict blueschist and eclogite facies metabasite" (Dillon and others, 1986). The informally named Ernie Lake pluton (unit Pxgn), an orthogneiss, intrudes this unit and has yielded a U/Pb zircon age of 971 ± 5 Ma (McClelland and others, 2006), which indicates that at least part of this unit is early Neoproterozoic or older. Till and others (2008a) report that gneissic textures are particularly common where the unit is closest to metaplutonic rocks of the Arrigetch Peaks and Mount Igikpak orthogneiss (unit Dogn). Mafic rocks within the unit contain assemblages of the albite-epidote-amphibolite facies (Dusel-Bacon and others, 1989; Vogl, 2002); exposures west of the major orthogneiss bodies appear to be lower in grade (Nelson and Grybeck, 1980; Toro, 1998). Unit may, in part, represent a higher metamorphic grade equivalent of a number of units of the Brooks Range, including SCbs, Dbf, Degh, DCcs, and PzPxaqm. On generalized map, included as part of unit DPxcn.

This unit is divided into units [DZsg](#), [DZel](#), and [DZsm](#) in the GRI digital geologic-GIS data.

PzPxrqm - Pelitic and quartzitic schist of the Ruby terrane (Proterozoic? to Early Paleozoic)

Poorly exposed unit of mainly muscovite- and quartz-rich schist, and subordinate calc-schist, quartzofeldspathic schist, biotite granite, and granite gneiss that includes augen gneiss. Also includes amphibolite and quartzite metamorphosed to upper amphibolite to lower granulite facies; unit also includes minor marble and calc-silicate rocks. In the north- central Tanana quadrangle, unit has a polymetamorphic history including metamorphism to greenschist, local blueschist, and amphibolite facies. The apparent grade of metamorphism varies depending on depth of exposure and proximity to zones of ductile deformation and (or) buried plutons or other thermal hot spots (Miyaoka and Dover, 1990; Dover, 1994). Evidence for blueschist-facies metamorphism has been largely obliterated by a greenschist to granulite facies overprint in the Kokrines Hills in the Ruby quadrangle (Roeske and others, 1995). South of the Kaltag Fault, these rocks are even more poorly exposed and little studied. Unit locally is interlayered with carbonate rocks of unit Pzls and therefore is, at least in part, Paleozoic in age; however, some of the unit is inferred to be as old as Proterozoic (Patton and others, 2009). Unit also appears to be intruded by orthogneiss of unit MDag. Regional metamorphism predates the widespread intrusion of the Early Cretaceous granitic bodies of unit Kmqm. Metamorphic minerals yielded K/Ar isotopic cooling ages between 144.5 ± 1.3 Ma (white mica) and 108 ± 3 Ma (biotite); the oldest ages were determined on glaucophane-bearing schist (Dillon and others, 1985; Miller and Bundtzen, 1994; Roeske and others, 1995). U/Pb zircon ages from gneiss range between 147.8 and 117.5 Ma (Dillon and others, 1985; Roeske and others, 1995).

This unit is divided into units [DZrqm](#), [DZmr](#), [DZrpg](#), and [DZrqs](#) in the GRI digital geologic-GIS data.

DPxaqm - Quartz-mica schist of the Brooks Range (Prtoerozoic to Devonian)

Exposed along the southern flank of the Brooks Range, unit is largely equivalent to unit Dsq of Till and others (2008a). Quoting Till and others (2008a) from their description of Dsq, this unit consists of “gray, dark-gray, or brownish-gray weathering, dominantly pelitic or semipelitic schist that constitutes the major lithologic unit of the Schist belt. Outcrops vary from blocky and resistant (quartz-rich varieties) to platy and less resistant (mica-rich varieties), as the abundance of quartz versus mica and albite varies at centimeter to meter scales. Scattered lenses of mafic schist, calcareous schist, albite-mica schist, graphitic metaquartzite, and marble up to 10's of meters thick are typical of the unit but volumetrically minor. Mafic lenses may be massive or schistose. In the Wiseman area, rare lenses of ultramafic rocks are up to 10's of meters thick. The dominant foliation is defined by parallel millimeter- to meter-scale variations in quartz versus mica or albite, or discontinuous layers and lens-shaped quartz segregations (Gottschalk, 1990; Little and others, 1994; Till, A.B., 2008, unpublished data). * * * At map scales, the dominant foliation is typically broadly arched or folded around axes that are subparallel to the east-west trend of the Schist belt.” No fossils have been collected from the schist, but protolith age can be partially bracketed by the age of detrital zircons from the unit. Twenty-seven detrital zircons from micaceous metaquartzite varied from pitted spherical to slightly abraded euhedral grains (Moore and others, 1997b); the rounded population (n=16) yielded single-grain 207Pb/206Pb ages that suggest the quartz-mica schist protolith included Archean and Proterozoic rocks. The euhedral grains (n=11) gave concordant single-grain 238U/206Pb ages between 371 and 361 Ma, which indicates that at least part of the protolith package is Devonian in age (Moore and others, 1997b). Middle Devonian granitic orthogneiss (unit Dogn, here) is present within the quartz-mica schist unit in the Chandalar quadrangle, but geologic mapping is insufficient to show whether there was an original intrusive relationship between Till's units Dg and Dsq, or if the orthogneiss was folded in with unit Dsq during penetrative Mesozoic deformation (Till and others, 2008a). Therefore, it is not clear whether or not the age of the orthogneiss bears directly on the age of the protolith of the quartz-mica schist. “The quartz-mica schist shared its early deformational and metamorphic history with other units of the Schist belt * * *. Common metamorphic minerals in pelitic schist include quartz, muscovite, chlorite, plagioclase, chloritoid, and accessory sphene, 126 tourmaline, rutile, opaque, graphite, and calcite. Some pelitic schists contain garnet, and many contain glaucophane or pseudomorphs of chlorite and albite after glaucophane. Metabasite typically contains a combination of actinolite, albite, epidote, garnet, chlorite, sphene, and quartz; many contain glaucophane or pseudomorphs after glaucophane. This unit may be a lithologic and metamorphic correlative to the Solomon schist of the Nome Group, Seward Peninsula, which has also yielded detrital zircons as young as Late Devonian (Till and others, 1986, 2006b)” (Till and others (2008a). On generalized map, included as part of unit DPxsb.

This unit is divided into units [DZaqs](#) and [DZss](#) in the GRI digital geologic-GIS data.

PzPxb - Metasedimentary rocks of Bluecloud Mountain (Proterozoic? to Early Paleozoic)

Light- to dark-gray phyllite, dark-gray to black metaquartzite, dark-gray and grayish-brown calcareous phyllite, and reddish-brown- weathering impure marble exposed in fault-bounded lenses along the Schist belt-Central belt contact in the Wiseman quadrangle, as described by Till and others (2008a). Lithologic layering is visible in outcrop where it crosses foliation; locally, lithologic layering is transposed by foliation, which is defined by fine-grained mica. In thin section, lithologic layering and relict clasts are recognizable; metamorphic minerals include white mica, chlorite, stilpnomelane(?), and very fine-grained garnet or albite. No protolith age control is available; the protolith may have been a sequence of turbidites (Till and others, 2008a). On generalized map, included as part of unit DPxcn.

This unit is unit [DZb](#) in the GRI digital geologic-GIS data.

Sbs - Black phyllite and metalimestone (Silurian)

"Black siliceous phyllite and metalimestone, metasandstone, metasiltstone, phyllite, and graphitic calcareous schist in the eastern Ambler River and western Survey Pass quadrangles. Conodonts and graptolites indicate Silurian ages for these strata in the Ambler River quadrangle (Dumoulin and Harris, 1988); rocks included in this unit in the Survey Pass quadrangle are undated * * *" (Till and others, 2008a). Unit has variable lithologic characteristics; according to Till and others (2008a), in the western Ambler River quadrangle, unit consists of black siliceous phyllite that contains recrystallized radiolarians and interlayers of black metalimestone. In northeastern Ambler River quadrangle, the unit is interlayered metasandstone, metasiltstone, phyllite, and metalimestone that displays turbidite features including convolute laminae, flute casts, and graded beds. "Metasandstone is made up of quartz, carbonate, feldspar, and chert grains, as well as sedimentary and volcanic lithic clasts. Carbonate interlayers are also gravity deposits, and consist of redeposited shallow-water carbonate detritus; they contain a variety of megafossils such as corals, gastropods, bryozoans, brachiopods, conularids, and orthocone cephalopods, as well as conodonts of late early to early late Silurian (Wenlockian to Ludlovian) age" (Till and others, 2008a). In the east-central Ambler River quadrangle, the unit contains a higher proportion of calcareous rocks. Sedimentary features and fossil assemblages denote an off-platform and (or) edge-of-platform setting for these rocks (Dumoulin and Harris, 1988). On generalized map, included as part of unit DPxcn.

This unit is unit [Spl](#) in the GRI digital geologic-GIS data.

SOig - Iviagik group of Martin (1970) (Ordovician to Silurian)

Consists of two informal units: a lower, finer grained unit of slaty black argillite and siliceous shale that contains minor siltstone and chert; and an upper, coarser grained unit of lithic, sand-rich turbidite deposits (Moore and others, 2002). According to Moore and others (2002), the fine-grained unit is a thin-to medium-bedded basal succession, more than 50 m thick, that contains sparse yellow-orange beds that may be bentonite. A diverse Early and Middle Ordovician graptolite fauna is present in the unit. The coarser unit consists of "channelized, thick-bedded, medium-grained sandstone, local pebbly sandstone, and minor siltstone" (Moore and others, 2002). It is at least 300 m thick and contains intercalated calcareous mudstone that yield early Silurian conodonts and graptolites.

This unit is unit [SOig](#) in the GRI digital geologic-GIS data.

SCs - Sedimentary rocks of Doonerak Window (Cambrian to Silurian)

Black phyllite and metasiltstone; minor quartzite; graywacke; red, green, and purple phyllite; green chert; siliceous metatuff; lenses of brown dolomite and thin limestone beds cut by abundant mafic sills. Middle Cambrian microfossils, brachiopods and trilobites, Ordovician conodonts, and Silurian graptolites and conodonts have all been recovered from the sedimentary rocks (Dutro and others, 1984; Repetski and others, 1987). Unit is metamorphosed to lower greenschist and prehnite-pumpellyite facies (Dillon and others, 1986). Mafic dikes cutting unit have yielded K/Ar ages on hornblende of 380.5±17 and 395 ±12 Ma (Dutro and others, 1976; ages recalculated using constants of Steiger and Jager, 1977), approximately Middle Devonian. On generalized map, included as part of unit SCda.

This unit is divided into units [SOCb](#) and [SOCvs](#) in the GRI digital geologic-GIS data.

OPxIs - Limestone, northern Alaska (Proterozoic? through Ordovician)

Unit largely corresponds to unit O<c, Older carbonate rocks of the Nanielik antiform of Till and others (2008a) and, in the central Brooks Range, the lower part of the Skagit Limestone. Description here derived from Till and others (2008a). Unit consists of "dolostone, metalimestone, marble and subordinate quartzose metasedimentary rocks, carbonate conglomerate, and metabasite exposed in the Nanielik antiform (northeastern Baird Mountains and northwestern Ambler River quadrangles), central Survey Pass quadrangle, and along the Dalton Highway in the Wiseman and Chandalar quadrangles." Lower part of unit is primarily orange- to light-gray-weathering, dark- to light-gray dolostone, metalimestone, and marble and subordinate quartzose metasedimentary rocks, carbonate-cobble conglomerate, and metabasite. Well-preserved tabular to club-shaped stromatolites and coated grains occur locally in dolostone and suggest an intertidal to shallow subtidal depositional setting. Matrix-supported conglomerate may represent debris flows (Till and others, 2008a). Metabasite, known only in the Baird Mountains quadrangle, consists of metamorphosed pillow breccia, pillow lava, and mafic pyroclastic rocks that contain blue amphibole. Three subunits overlie this lower unit: (1) impure metalimestone, marble, dolostone, and subordinate phyllite and calcareous and chloritic schist that display preserved sedimentary structures including grading, parallel and cross-laminae, which suggest deposition by turbidity currents; (2) massive marble that grades upward into thin couplets of bioturbated metalimestone and laminated dolostone, which is interpreted as shallowing-upward peritidal cycles. This subunit contains protoconodonts, cancellorid sclerites, hyolithids, and steinkerns of monoplacophoran mollusks that indicate a maximum age of Early Cambrian for the marble; presence of acrotretid brachiopods and agnostid arthropods demonstrate Middle and Late Cambrian ages for the middle and upper parts of the subunit; (3) condensed Lower and Middle Ordovician section, deposited in a shallowing-upward regime, consists of carbonaceous phyllite with subordinate layers of radiolarian chert and fine-grained metalimestone. Subunit grades upward into platform-margin carbonate turbidites and then into middle- to inner-platform bioclastic support stones; graptolites and conodonts indicate an age of Arenig (Lower Ordovician) to Caradoc (approximately Upper Ordovician) for this subunit. The stratigraphic succession of OPxc is most complete and lithologies are most diverse in the Baird Mountains and western Ambler River quadrangles. There, the close spatial relationship of the unit with Proterozoic metamorphic rocks (unit Pxam of Till and others, 2008a) is thought to reflect an original depositional relationship (Till and others, 2008a). On generalized map, included as part of unit DPxnl.

This unit is divided into units [SZcb](#), [Oc](#), [OCc](#), and [OCZc](#) in the GRI digital geologic-GIS data.

Ocs - Casadepaga Schist (Ordovician)

Light green, silvery green and greenish-brown mafic, feldspathic, and calcareous schist interpreted to have a largely igneous protolith. "Tors of metabasite, abundant plagioclase porphyroblasts in dark-green, chlorite-rich schist, and the quartz-poor nature of the rocks are characteristic of this unit" (Till and others, 2011). Smith (1910) provides illustrations that demonstrate characteristics that strongly suggest an intrusive igneous character of this unit. Dark-green-weathering schist is interpreted to be metamorphosed mafic rock and is rich in chlorite, epidote, actinolite, and plagioclase (Till and others, 2011). Medium- to pale-grayish-green-weathering pelitic schist is common; plagioclase, chlorite, white mica, and quartz are the dominant minerals, present in roughly equal amounts, and epidote, carbonate, and glaucophane (or pseudomorphs of chlorite and plagioclase after glaucophane) are also typical minerals of many of these schists (Till and others, 2011). Based on major-element chemistry, the protoliths of these pelitic schists were shale and graywacke (Werdon and others, 2005). Carbonate-rich schist layers are typically buff- or pale-brown-weathering and tend to be more recessive in outcrop than other lithologies. Pure carbonate layers are rare and thin and weather pale brown, black, or gray (Till and others, 2011). Greenish-black boudins, lenses, and layers of fine- to coarse-grained, massive metabasite in tors within the unit are composed of glaucophane, actinolite, chlorite, epidote, garnet, albite, white mica, titanite, and locally quartz, Fe-carbonate, pyroxene, and barrosite. No direct evidence exists for the age of this unit (Till and others, 2011). Seven detrital zircon samples, collected from widely distributed parts of the unit, contain

very similar grain populations; most grains fall into the range of 700–600 Ma; several samples contain small populations of Ordovician or Cambrian grains (Amato and others, 2003; Till and others, 2006b; 2008b, 2011). No fossils have been found in the Casadepaga Schist, but its age may be somewhat constrained by its inclusion in the layered sequence with units DOnx and Onim, both of which contain Ordovician conodonts. On generalized map, included as part of unit PzZncl.

This unit is unit [Ocs](#) in the GRI digital geologic-GIS data.

OCdv - Oldest volcanic rocks (Ordovician and Cambrian?)

Andesitic to basaltic volcanoclastic rocks and local tuffaceous phyllite, gabbro, and diabase, and black phyllite, metamorphosed to lower greenschist and prehnite- pumpellyite facies (Dillon and others, 1986) and exposed as part of the basement assemblage of the Doonerak Window (Till and others, 2008a) in the Wiseman quadrangle. These rocks, called the Apoon assemblage by Julian and Oldow (1998), include flows and pyroclastic rocks that have island-arc chemical affinities. $^{40}\text{Ar}/^{39}\text{Ar}$ ages on hornblende from mafic dikes were 392 ± 12 , 474 ± 14 , 487 ± 20 , and 529 ± 17 Ma (Dutro and others, 1976; Till and others, 2008a). On generalized map, included as part of unit SCda.

This unit is unit [OCv](#) in the GRI digital geologic-GIS data.

Zgn - Granite and orthogneiss (Neoproterozoic)

Granitic and metagranitic rocks of presumed Proterozoic age are exposed in the southern Baird Mountains and western Wiseman quadrangles and in an isolated exposure in the Black River quadrangle of east-central Alaska. In the Baird Mountains quadrangle, light-gray, medium- to fine-grained, foliated to gneissic metamorphosed granite is associated with unit DPxacs. This body is coarsely porphyritic and contains centimeter-sized albite porphyroblasts; Karl and Aleinikoff (1990) reported a fairly discordant upper intercept TIMS U/Pb zircon age of 705 ± 35 Ma. Granodiorite that intrudes the metamorphic complex at Mount Angayukaqsaq, in the northeastern Baird Mountains quadrangle, yielded a nearly concordant TIMS U/Pb zircon age of 750.4 ± 6.3 Ma (Karl and others, 1989b). Other exposures in the Baird Mountains quadrangle are undated and may be of Proterozoic age or of Devonian age, as is relatively common in the Brooks Range. To the east, in the Central belt of Till and others (2008a), Proterozoic metagranitic rocks span the boundary between the Survey Pass and Wiseman quadrangles. The Ernie Lake pluton yielded a SHRIMP U/Pb zircon age of 971 ± 5 Ma (McClelland and others, 2006); Dillon and others (1980) reported TIMS analyses of zircons from both the Ernie Lake orthogneiss and nearby Sixtymile River orthogneiss bodies yielded discordant zircons likely indicating a Proterozoic age. There is no age control for the exposure in the Black River quadrangle; it is a small exposure of granite (Brabb, 1970) intruding phyllite of presumed Precambrian age (shown here as unit CPxt).

This unit is divided into units [Zgr](#) and [ZYog](#) in the GRI digital geologic-GIS data.

Zam - Metasedimentary and metavolcanic rocks of Mount Angayukaqsaq (Neoproterozoic)

“Amphibolite, metaquartzite, calcareous schist, metapelite, and a few small bodies of metagranite and metagabbro, exposed in the northeastern Baird Mountains quadrangle around Mt. Angayukaqsaq and in the northeastern Ambler River quadrangle” (unit Zam, Till and others, 2008a). Primarily dark-gray- to black-weathering, massive amphibolite that is composed of hornblende, plagioclase, sphene and quartz and contains pink garnets as large as 1.5 cm in diameter. Metapelite rocks are light-green and typically interlayered with metaquartzite on a scale of centimeters. Metaquartzite forms tan-, green-, and gray-weathering layers interlayered on a millimeter to centimeter scale with tan- and brown-weathering

calcareous schist. Mineral assemblages of these rocks reflect amphibolite-facies conditions (Till, 1989) and garnet is common to each lithology (Till and others, 2008a). Light-gray- to tan-weathering metagranite and cream to brownish-green metagabbro occurs as small bodies up to 100 m across that are volumetrically minor (Till, 1989; Karl and others, 1989b). U/Pb zircon ages from the meta- granite (included in unit Pxgn here) indicate that it crystallized around 750 Ma (Karl and others, 1989b). White mica from a metapelite yielded a late Proterozoic metamorphic age (680 Ma; Till and Snee, 1995; Till and others, 2008a). A blueschist-facies overprint affected both the amphibolite facies and albite-epidote amphibolite facies rocks, and an $^{40}\text{Ar}/^{39}\text{Ar}$ age on white mica was 120 ± 0.2 Ma; evidence of this event is primarily detectable only in thin section (Till and Snee, 1995; Till and others, 2008a).

This unit is unit [Zma](#) in the GRI digital geologic-GIS data.

bu - Bedrock of unknown type or age or areas not mapped (unknown)

No further description given.

This unit is unit [bu](#) in the GRI digital geologic-GIS data.

Additional Source Data Attribute Fields

Several attribute fields were added to feature classes to accommodate capture of additional USGS data (fields are consistent with previous Alaska GRI digital geologic-GIS data).

Additional USGS Data Fields to Geologic Units

In addition to standard NPS GRI Geology-GIS Geodatabase Data Model v. 2.3 fields several fields from the U.S. Geologic Survey data were included in the GRI Geologic Units (ARCNGLG) data layer. These fields are described below.

NSAClass: Regional numeric code assigned to similar geologic units.

CLASS: Unique numeric code assigned to a geologic unit from an original source map. Number is unique only within a given quadrangle and specific to SOURCE.

QCLASS: Subdivision of attribute NSAClass providing more detailed Quaternary classification.

SOURCE: Unique code assigned to each source; uses the 2-letter quadrangle code and a three digit number. By default, 001 is reserved for the topographic map or other source of hydrologic spatial data for each quadrangle.

NSASUB: Same coding as NSAClass, but used to define the bedrock unit beneath surficial deposits. Not universally populated.

NSAMOD: Indicates if a geologic unit is altered, contact metamorphosed, or has a queried unit assignment.

STATE_SYMBOL: Number defining symbol color.

STATE_LABEL: Same as STATE_LABEL2 but uses special characters for using FGDCGeoAge font to display the symbols for geologic time periods.

STATE_LABEL2: Geologic unit label used in the Description of Map Units and detailed version of the state map. Label is in standard text font and does not use special characters. Px is used for Proterozoic and IP for Pennsylvanian.

STATE_UNITNAME: Unit name as used in the Description of Map Units.

Additional USGS Data Fields to Geologic Contacts, Faults and Glacial Feature Lines

In addition to standard NPS GRI Geology-GIS Geodatabase Data Model v. 2.3 fields one additional field from the U.S. Geologic Survey data was included in the GRI Geologic Contacts (ARCNGLGA), Faults (ARCNFLT), and Glacial Feature Lines (ARCNGFL) data layers. This field is described below.

ARC_CODE: positive integer value defining line type. Values range discontinuously from 0 to 99.

Additional USGS ARDF Data Fields to Geologic Sample Localities and Mine Localities

In addition to standard NPS GRI Geology-GIS Geodatabase Data Model v. 2.3 fields several fields from the U.S. Geologic Survey Alaska Resource Data File data were included in the GRI Geologic Sample Localities (ARCNGSL), and Mine and Mine Related Points (ARCNMIN) data layers. These fields are described below.

SITE_NAME: This field contains the name or names for the site as found in the literature. It may be a proper name or name of a nearby geographic feature. Site is 'Unnamed', if the site does not have a proper name, does not coincide with a geographic feature, and has never or only informally been identified with a geographic name.

SITE_TYPE: Sites are classified as Mine, Mines, Prospect, Prospects, Occurrence, or Occurrences. In some cases, the only suggestion of a mineral deposit existing at a site is that a claim or claims have been staked there. These sites are included in ARDF if 1) the claim or claims have been identified as a site in a previous publication (may have an MRDS number); or 2) there is clear evidence that the claim or claims have had substantial work by a reputable source. However, ARDF is NOT a claim-location database.

SITE_STATUS: The level of current activity at the site. This is the best estimate by the compiler of recent activity at the time the ARDF record was updated, and is somewhat subjective. It is not a legal definition of claim validity. Activity is not restricted to excavation or other physical exploration, but may include substantial geologic mapping, geochemical sampling, or ground geophysics within the last several years.

COMMODITY_MAIN: List of dominant elements or commodities of real or potential economic value in the mineral deposit. Commodities are listed alphabetically by chemical symbol; commodities such as barite, chromite, gypsum, and jade are spelled out. When described collectively, rare-earth elements = REE; platinum group elements = PGE. The chemical symbols are used for individual REE and PGE elements if they have been cited by element specifically as the commodities of interest at a site. Although arsenic is rarely a commodity of economic interest, it is commonly a pathfinder element and may be listed among the other commodities.

COMMODITY_OTHER: These commodities are present in minor amounts as determined by analysis or mineralogy. 'Other' may include by-products from a mine. Distinguishing 'main' and 'other' may not be possible for prospects and occurrences.

ORE_MINERALS: An alphabetical list of the ore minerals at the site. By convention, the ore minerals include all of the native metals, sulfides and sulfosalts, metallic oxides and metal-rich minerals of real or potential economic value. This includes pyrite and arsenopyrite if they are of economic value. The relative abundance should be described in the 'Geologic description' field. Barite, gypsum, chromite, fluorite, and the like may be listed here if they are the chief minerals of economic interest.

GANGUE_MINERALS:

An alphabetical list of the non-economic minerals at the site that cannot be avoided in mining. As conventionally used, gangue minerals are silicates, carbonates, and other minerals that are intergrown with the ore minerals. The term 'gangue' mineral was originally used in the context of classic vein or replacement deposits and may not apply in discussing the mineralogy of many deposits. 'Gangue' usually does not include the minerals in the host rock, nor does it normally include alteration minerals. Minerals like barite, fluorite, and gypsum are usually included as gangue minerals if present in relatively minor amounts. The relative abundance of the gangue minerals should be described in the 'Geologic description' field. This field may be blank.

MINERAL_AGE: This is the age of mineralization and the evidence for the age. May be an age, age range or inferred age. This field is empty in some ARDF records.

ARDF NO: This is a unique label assigned to each mineral deposit in the database. The form of the ARDF number is the two-letter 1:250,000 scale quadrangle code followed by a three digit number.

ARDF_DATE: Date when the record was compiled or updated. This is not the date of the last publication on the site. It is the date that a competent geologist reviewed the information in the record and, if necessary, added information to bring it up to date. The date indicates that the updater was satisfied that the record was complete and accurate as possible as of that date.

GRI Ancillary Source Map Information

USGS Source Map References

USGS geologic-GIS data for the Alaska region maintains geologic source information as an attribute attached to each geologic feature. Although the GRI considers the USGS to be the mapping source for this project, sources used and referenced by the USGS have been preserved in the GRI digital geologic-GIS data. Geologic features in the GRI digital geologic-GIS data and the unit descriptions listed in this document have references to the sources listed here.

Several attribute fields present in the USGS Alaska Science source GIS data were retained in the GRI digital geologic-GIS data to provide users with the ability to relate GIS data back to the USGS Alaska Science Center source digital data. To view source publications used in the creation of this dataset refer to the References sections of this document and visit the USGS Alaska Science Center at: <http://alaska.usgs.gov/> to obtain USGS Alaska Science source GIS data files.

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- AR003 Patton, W.W., Jr., Wilson, F.H., Labay, K.A., and Shew, Nora, 2009, Geologic map of the Yukon-Koyukuk basin, Alaska: U.S. Geological Survey Scientific Investigations Map SIM-2909, 26 p., 2 sheets, scale 1:500,000.
- AR004 Till, A.B., Dumoulin, J.A., Harris, A.G., Moore, T.E., Bleick, Heather, and Siwec, Benjamin, 2008, Bedrock geologic map of the southern Brooks Range, Alaska, and accompanying conodont data: U.S. Geological Survey Open-File Report 2008-1149, 88 p., 2 sheets, scale 1:500,000.
- AR007 Wilson, F.H., 2012, Unpublished data.
- BM002 Karl, S.M., Dumoulin, J.A., Ellersieck, Inyo, Harris, A.G., and Schmidt, J.M., 1989, Preliminary geologic map of the Baird Mountains and part of the Selawik quadrangles, Alaska: U.S. Geological Survey Open-File Report 89-551, 65 p., 1 sheet, scale 1:250,000.
- BM003 Patton, W.W., Jr., Wilson, F.H., Labay, K.A., and Shew, Nora, 2009, Geologic map of the Yukon-Koyukuk basin, Alaska: U.S. Geological Survey Scientific Investigations Map SIM-2909, 26 p., 2 sheets, scale 1:500,000.
- BM007 Wilson, F.H., 2011, Unpublished data.
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- CH009 Moore, T.E., Wallace, W.K., Mull, C.G., Adams, K.E., Plafker, George, and Nokleberg, W.J., 1997, Crustal implications of bedrock geology along the Trans-Alaska Crustal Transect (TACT) in the Brooks Range, northern Alaska: *Journal of Geophysical Research*, v. 102, no. B9, p. 20,645-20,684.
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Scientific Investigations Map SIM-3340

Wilson, F.H., Hults, C.P., Mull, C.G. and Karl, S.M., 2015, Geologic Map of Alaska: U.S. Geological Survey, Scientific Investigations Map SIM-3340, scale 1:1,584,000. (*GRI Source Map ID 76064*).

Pamphlet

The pamphlet for the Geologic Map of Alaska (SIM-3340) is available for download at the following site: [SIM-3340 Pamphlet PDF](#).

Data

The digital data and map of the Geologic Map of Alaska (SIM-3340) is available for download at the following site: [SIM-3340 Data](#).

Alaska Resource Data Files

Ancillary information regarding Alaska Resource Data Files (ARDF) data for seventeen of the nineteen 1 degree by 3 degree quadrangles that define the extent of the GRI digital geologic-GIS data is presented below. This information, as well as additional information, tables and metadata can be found online at: <https://ardf.wr.usgs.gov/index.php>

ARDF Ambler River (OF-97-856)

Nelson, S.M., 1997, Alaska Resource Data File, Ambler River Quadrangle, Alaska: U.S. Geological Survey, Open-File Report OF-97-856, scale 1:250,000. (*GRI Source Map ID 2575*).

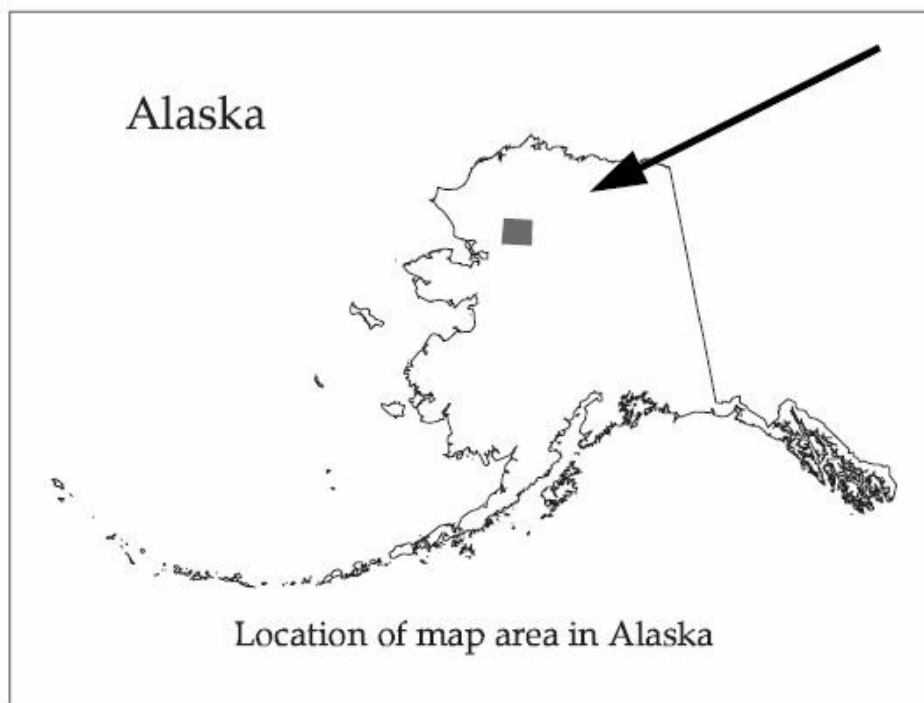
Report

The Alaska Resource Data File (ARDF) report for the Ambler River quadrangle, Alaska (OF-97-856) is available for download at the following link: [Report PDF](#).

Data

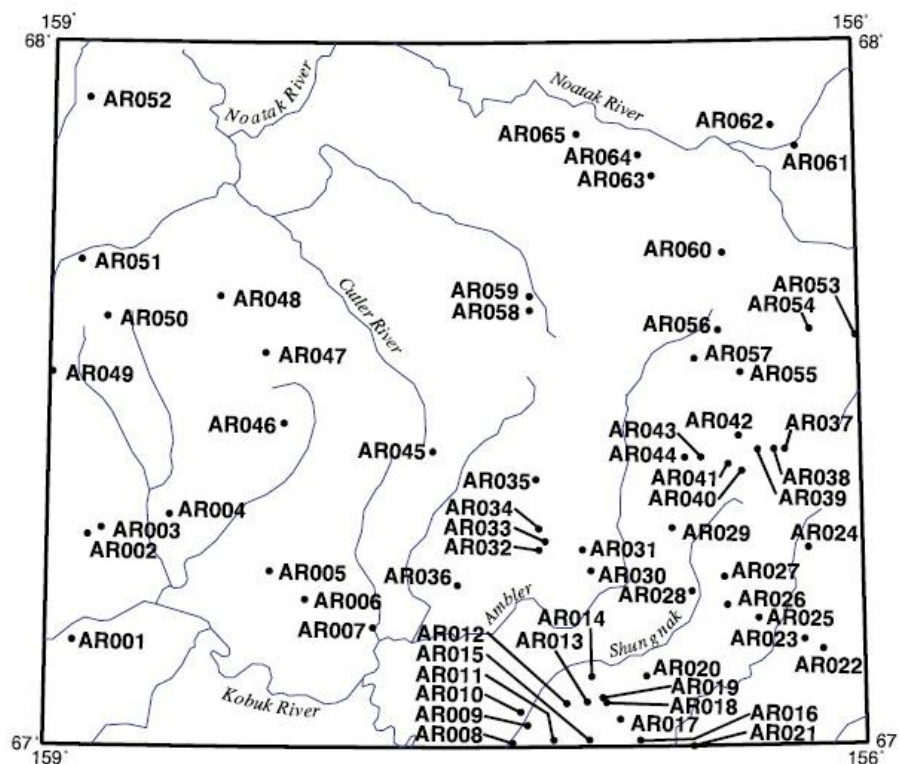
The Alaska Resource Data File (ARDF) data for the Ambler River quadrangle, Alaska (OF-97-856) are available for download at the following link: [Data](#).

Index Map



Extracted from: ([OF-97-856](#)).

Mineral Occurrence Map



Distribution of mineral occurrences in the Ambler River 1:250,000-scale quadrangle, north central Alaska

Extracted from: ([OF-97-856](#)).

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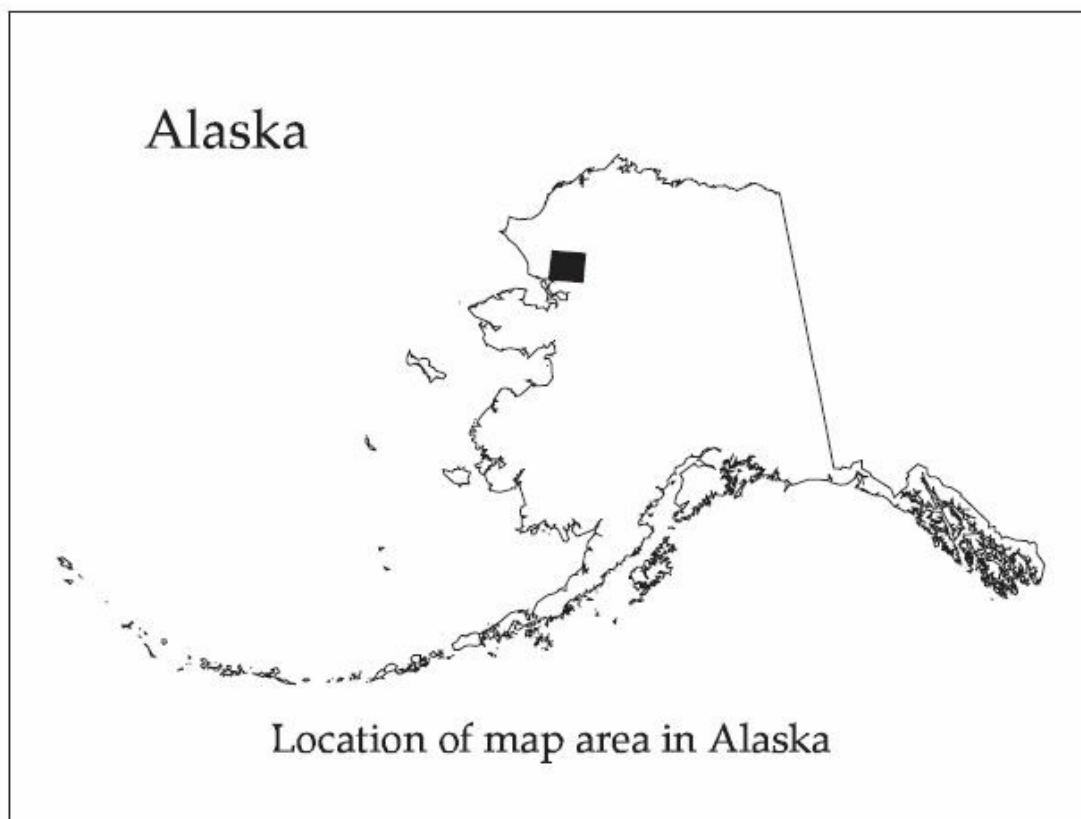
Report

The Alaska Resource Data File (ARDF) report for the Baird Mountains quadrangle, Alaska (OF-2000-24) is available for download at the following link: [Report PDF](#).

Data

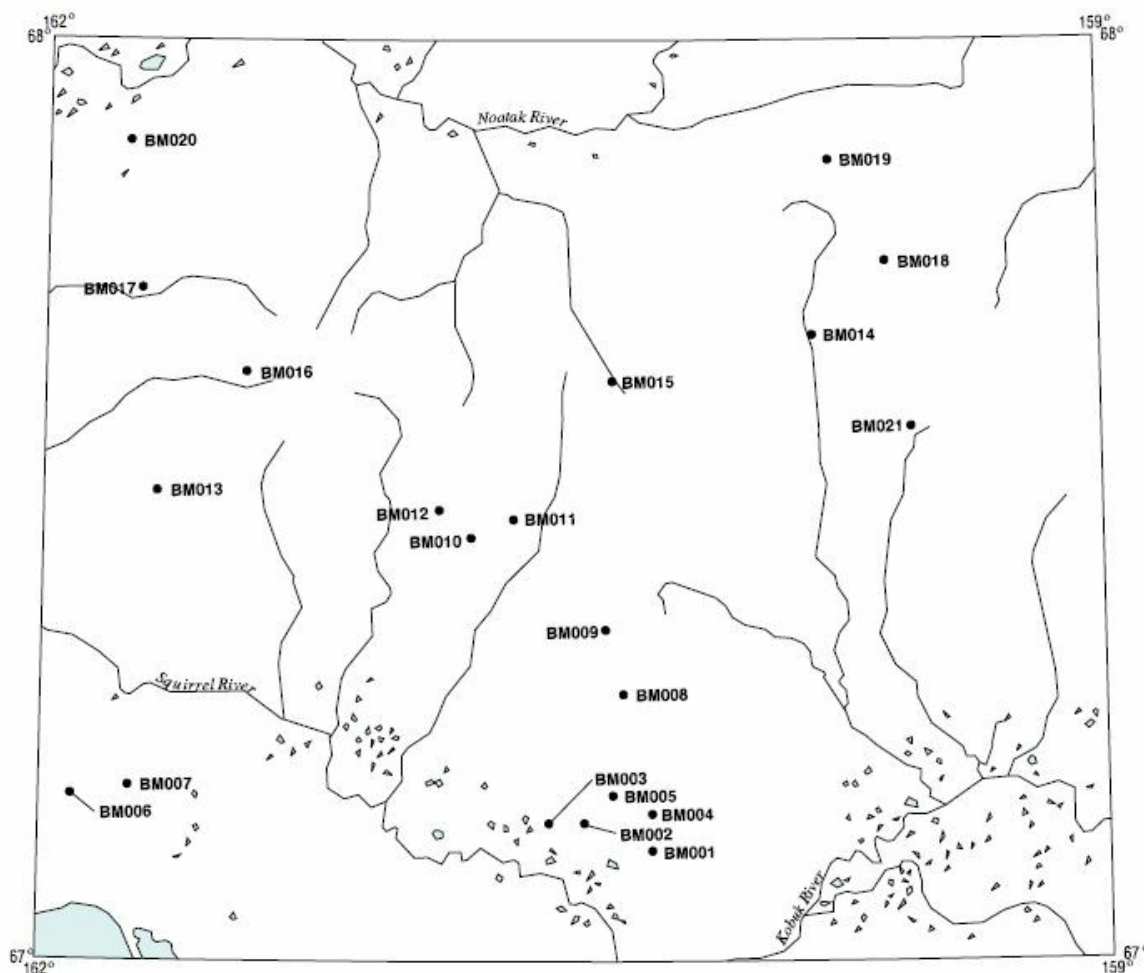
The Alaska Resource Data File (ARDF) data for the Baird Mountains quadrangle, Alaska (OF-2000-24) are available for download at the following link: [Data](#).

Index Map



Extracted from: ([OF-2000-24](#)).

Mineral Occurrence Map



*Distribution of mineral occurrences in the Baird Mountains
1:250,000-scale quadrangle, northwestern Alaska*

Extracted from: ([OF-2000-24](#)).

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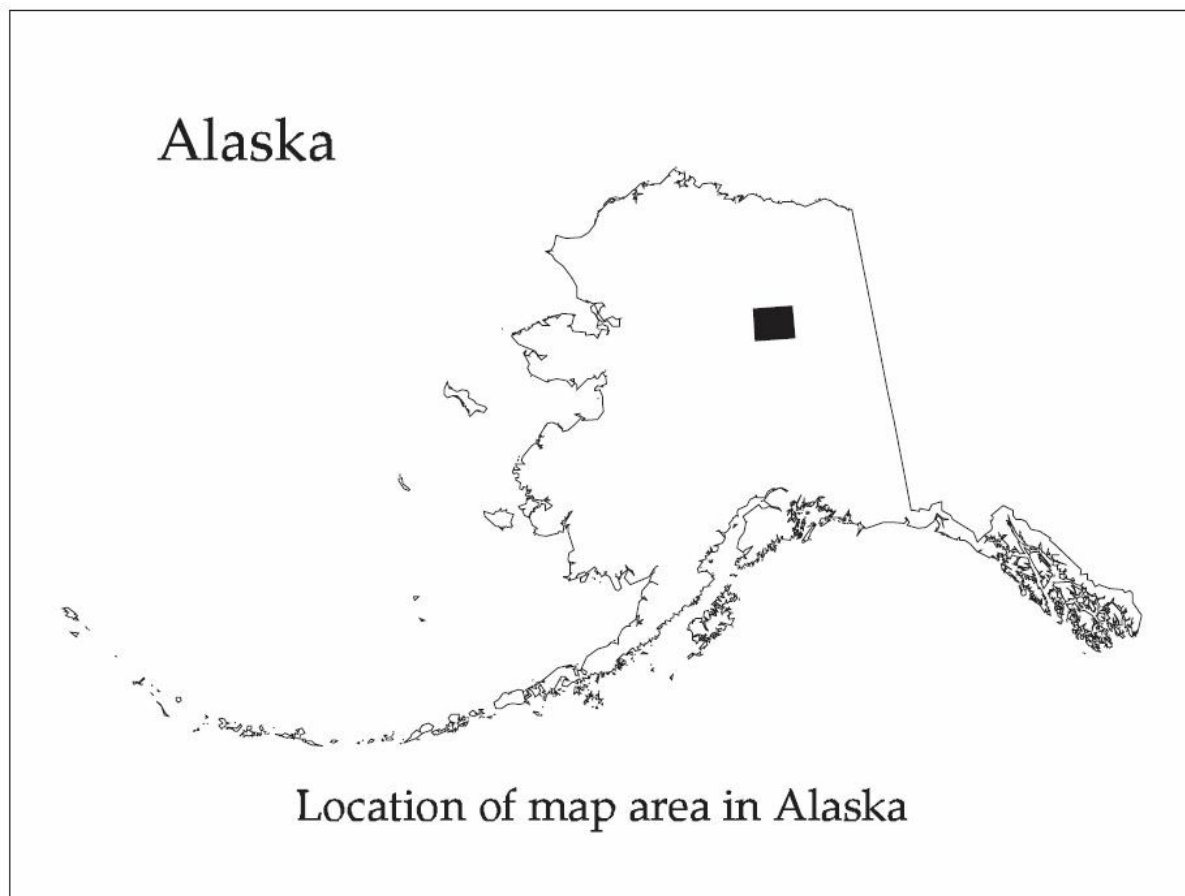
Report

The Alaska Resource Data File (ARDF) report for the Beaver quadrangle, Alaska (OF-2000-308) is available for download at the following link: [Report PDF](#).

Data

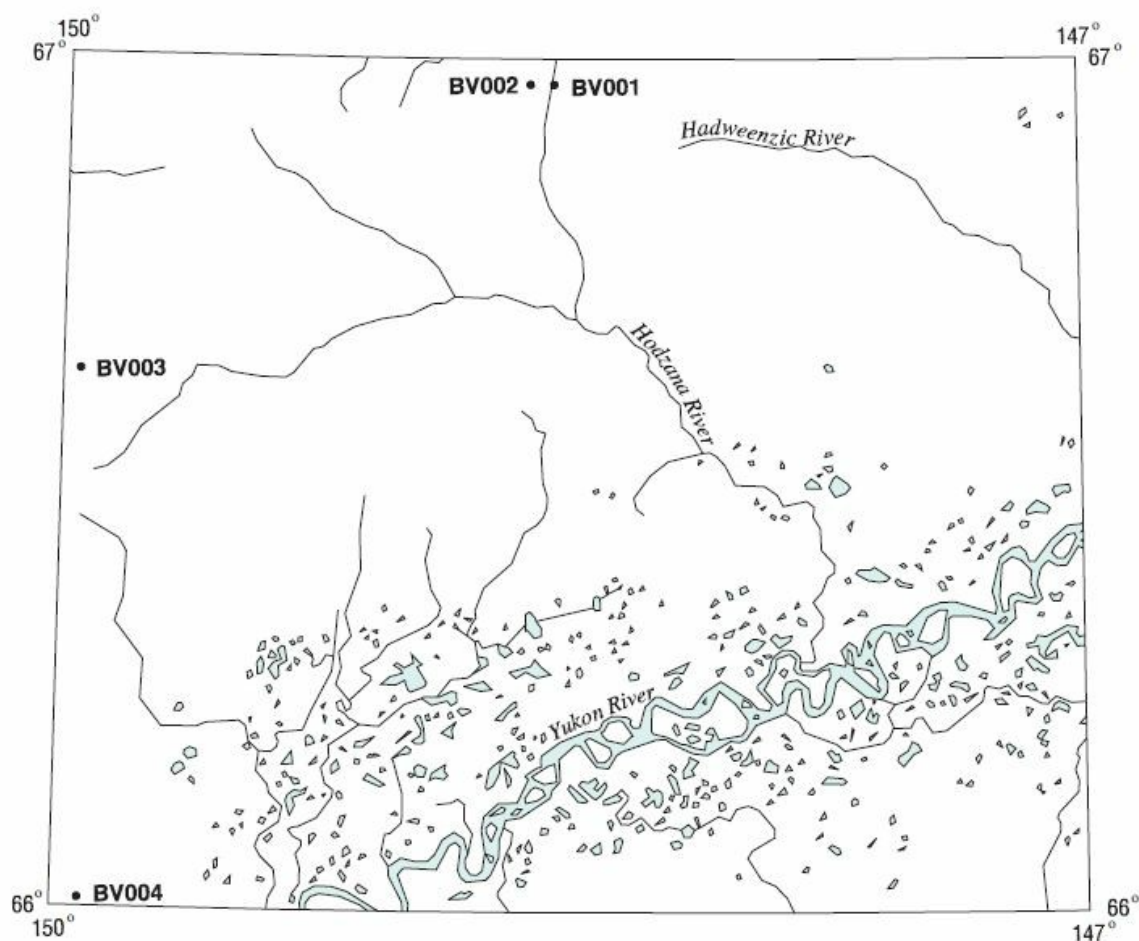
The Alaska Resource Data File (ARDF) data for the Beaver quadrangle, Alaska (OF-2000-308) are available for download at the following link: [Data](#).

Index Map



Extracted from: ([OF-2000-308](#)).

Mineral Occurrence Map



*Distribution of mineral occurrences in the Beaver
1:250,000-scale quadrangle, Alaska*

Extracted from: ([OF-2000-308](#)).

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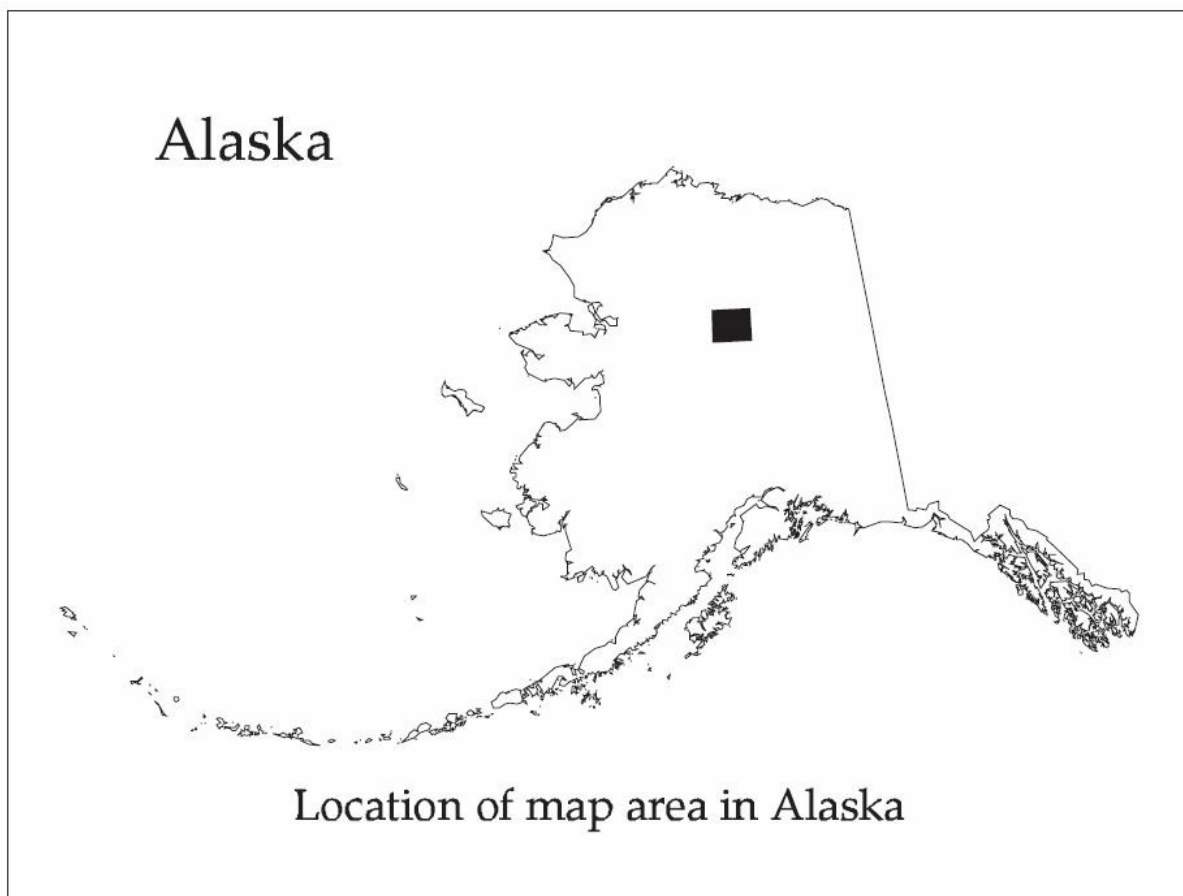
Report

The Alaska Resource Data File (ARDF) report for the Bettles quadrangle, Alaska (OF-2003-52) is available for download at the following link: [Report PDF](#).

Data

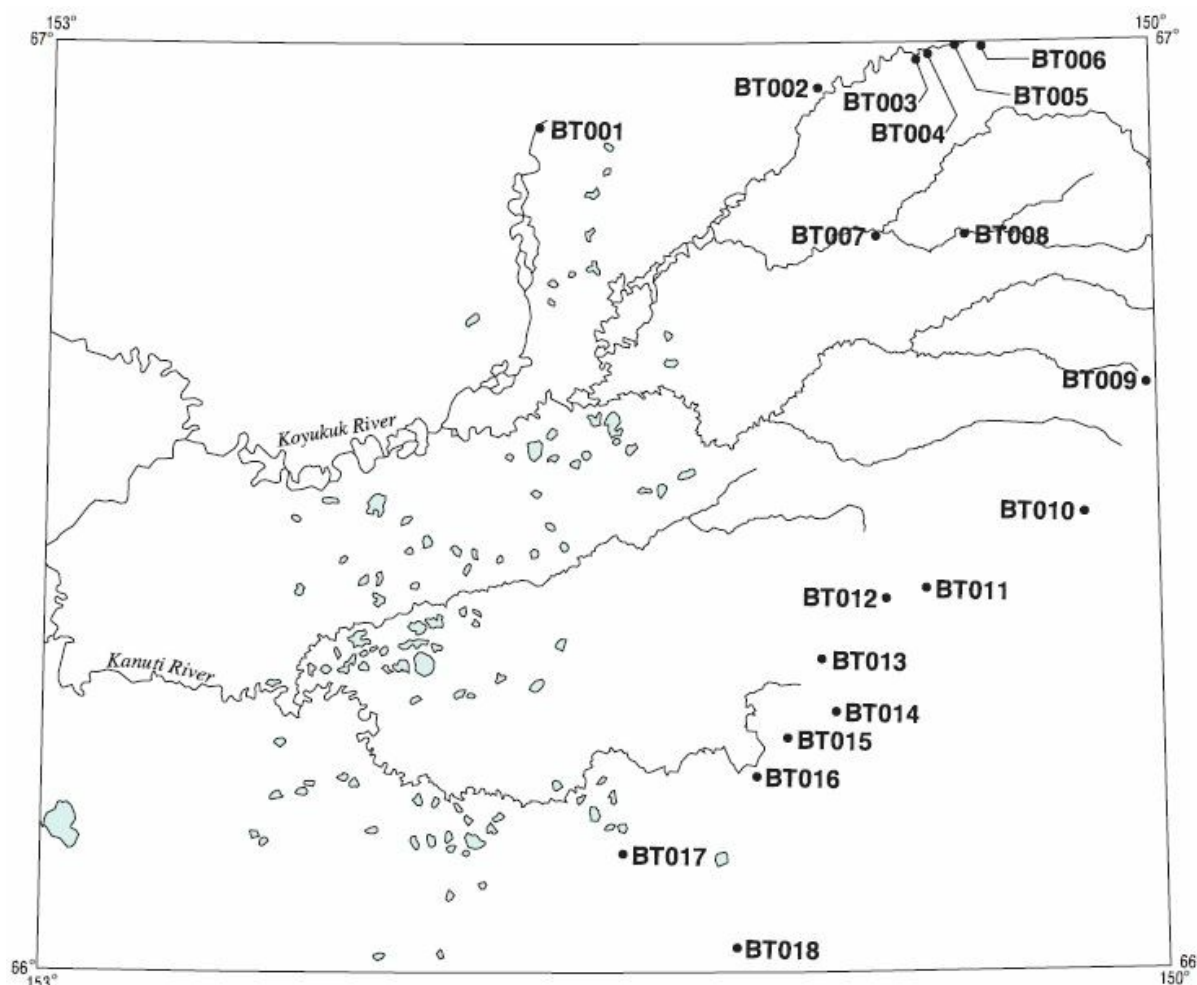
The Alaska Resource Data File (ARDF) data for the Bettles quadrangle, Alaska (OF-2003-52) are available for download at the following link: [Data](#).

Index Map



Extracted from: ([OF-2003-52](#)).

Mineral Occurrence Map



*Distribution of mineral occurrences in the Bettles
1:250,000-scale quadrangle, Alaska*

Extracted from: ([OF-2003-52](#)).

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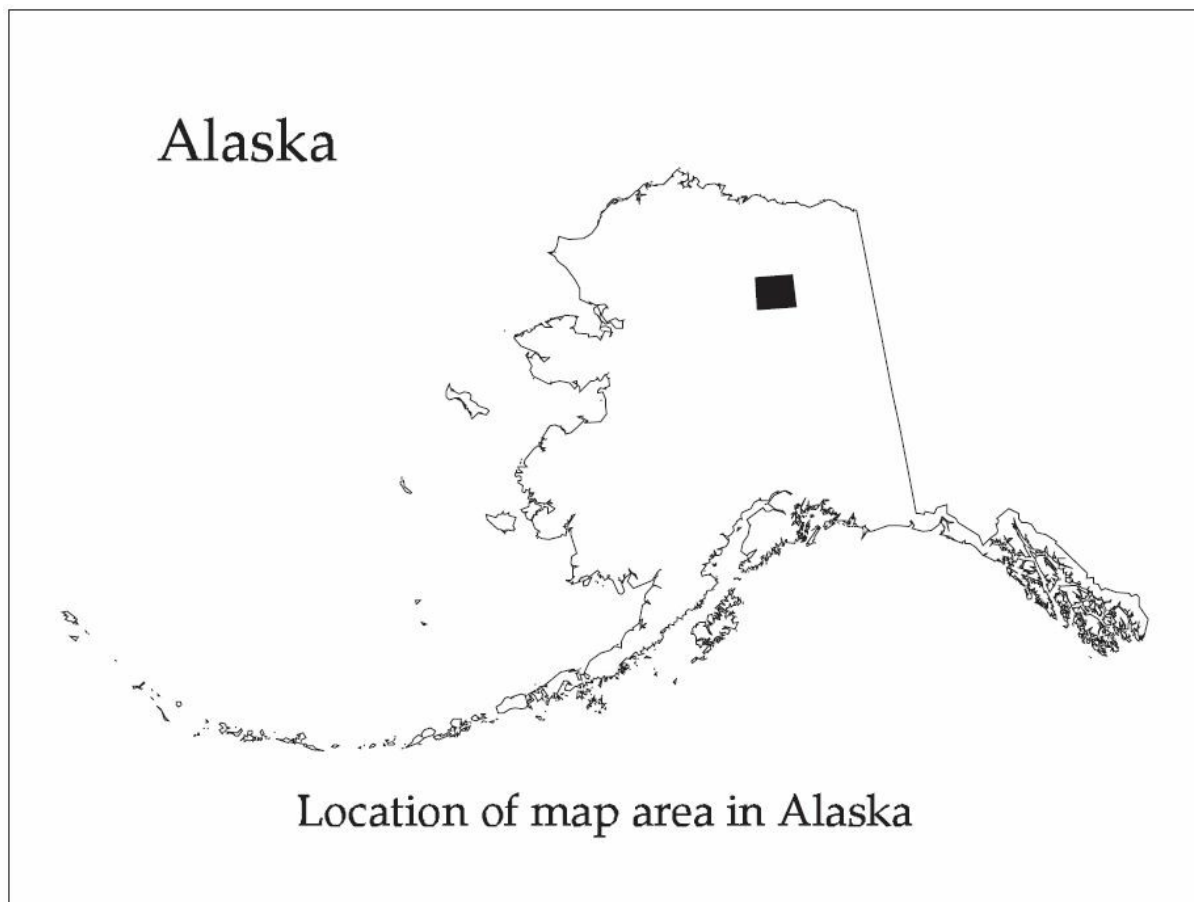
Report

The Alaska Resource Data File (ARDF) report for the Chandalar quadrangle, Alaska (OF-2000-357) is available for download at the following link: [Report PDF](#).

Data

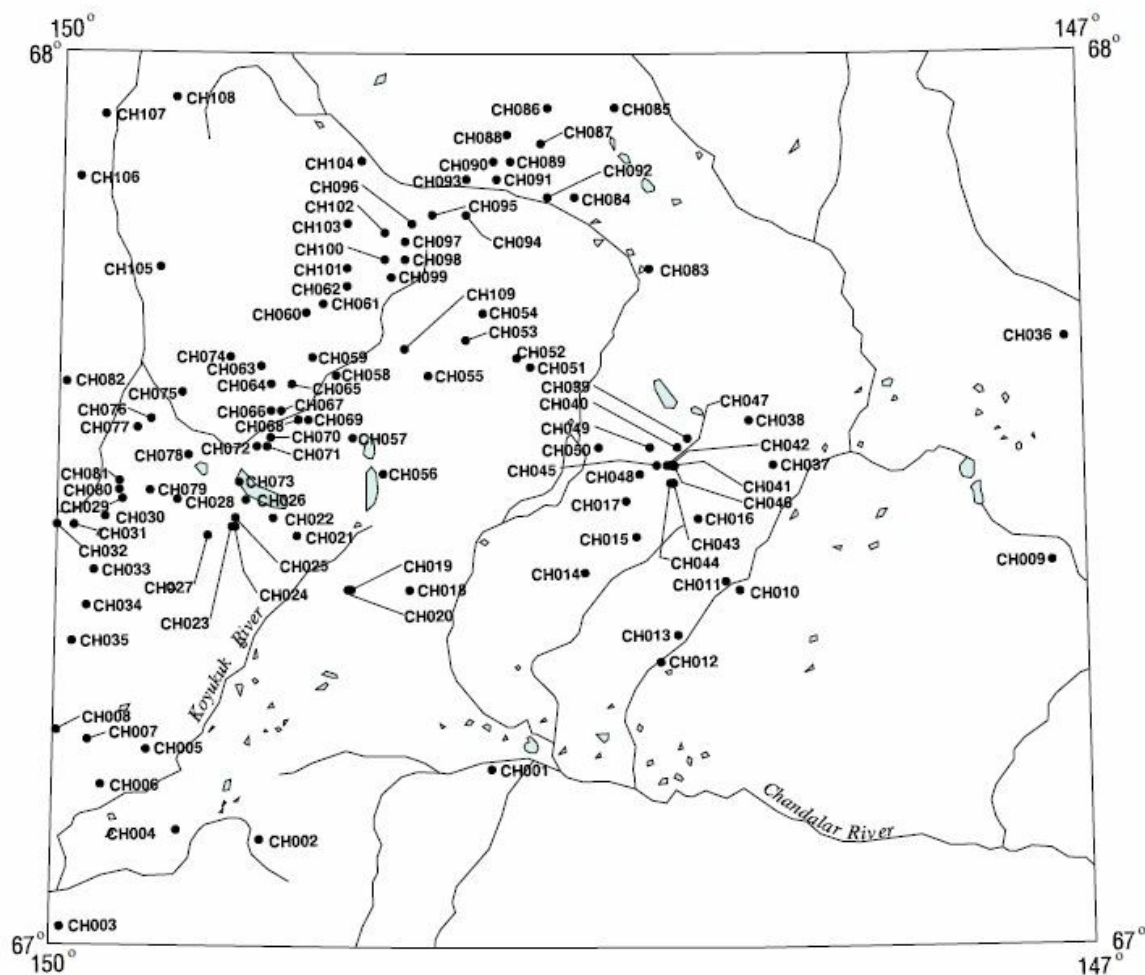
The Alaska Resource Data File (ARDF) data for the Chandalar quadrangle, Alaska (OF-2000-357) are available for download at the following link: [Data](#).

Index Map



Extracted from: ([OF-2000-357](#)).

Mineral Occurrence Map



*Distribution of mineral occurrences in the Chandalar
1:250,000-scale quadrangle, Alaska*

Extracted from: ([OF-2000-357](#)).

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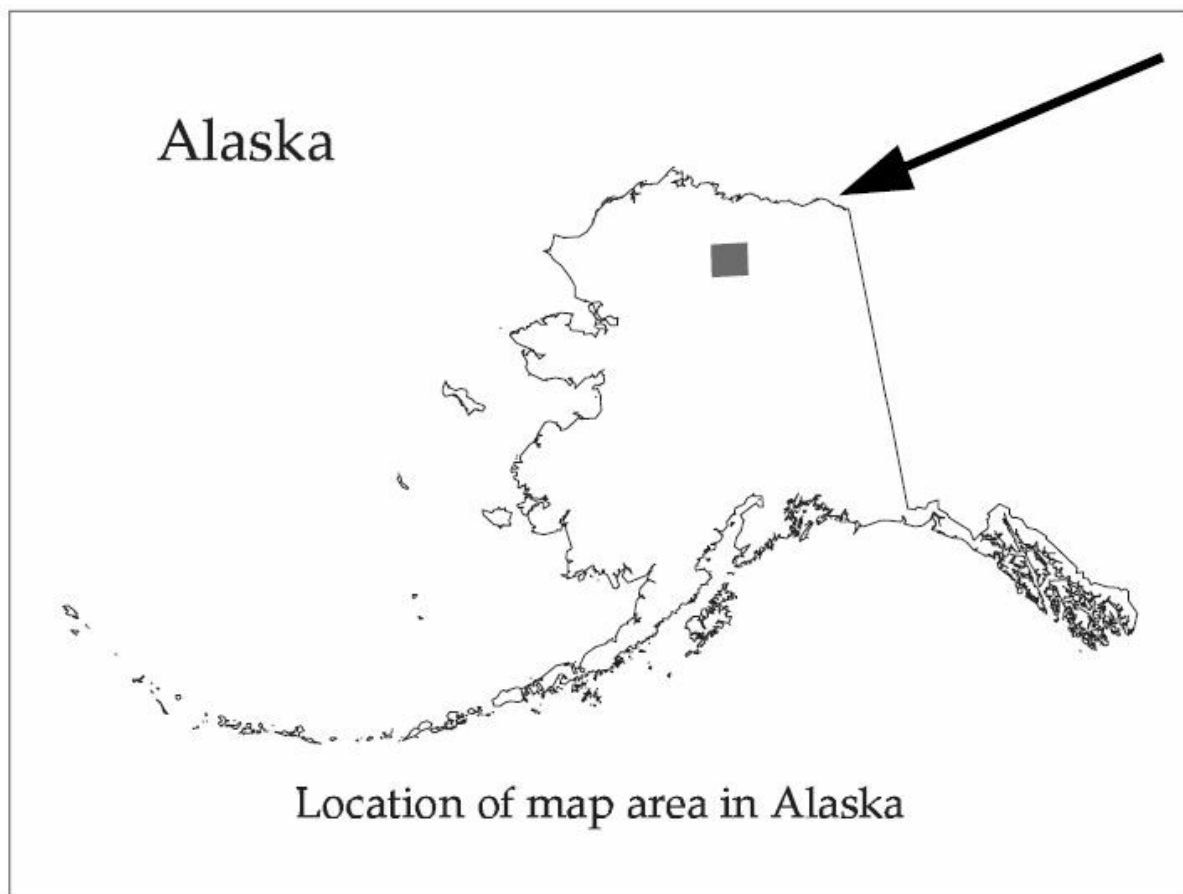
Report

The Alaska Resource Data File (ARDF) report for the Chandler Lake quadrangle, Alaska (OF-97-065) is available for download at the following link: [Report PDF](#).

Data

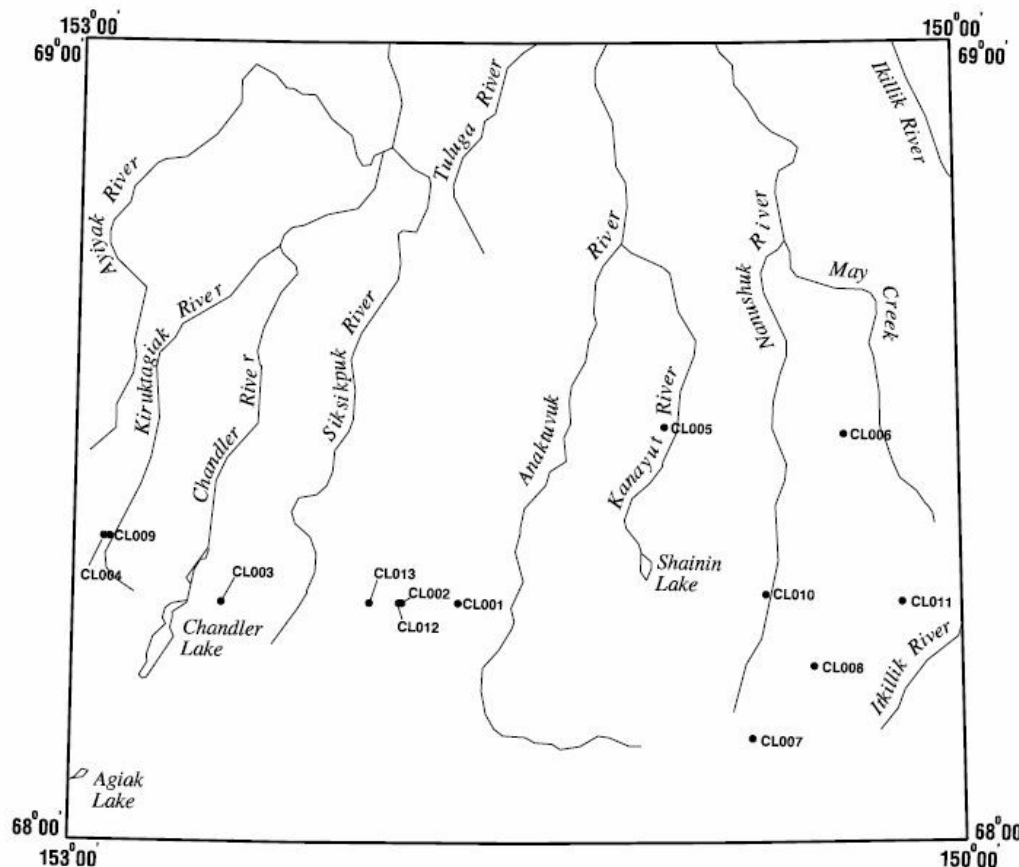
The Alaska Resource Data File (ARDF) data for the Chandler Lake quadrangle, Alaska (OF-97-065) are available for download at the following link: [Data](#).

Index Map



Extracted from: ([OF-97-065](#)).

Mineral Occurrence Map



Distribution of mineral occurrences in the Chandler Lake 1:250,000-scale quadrangle, north central Alaska

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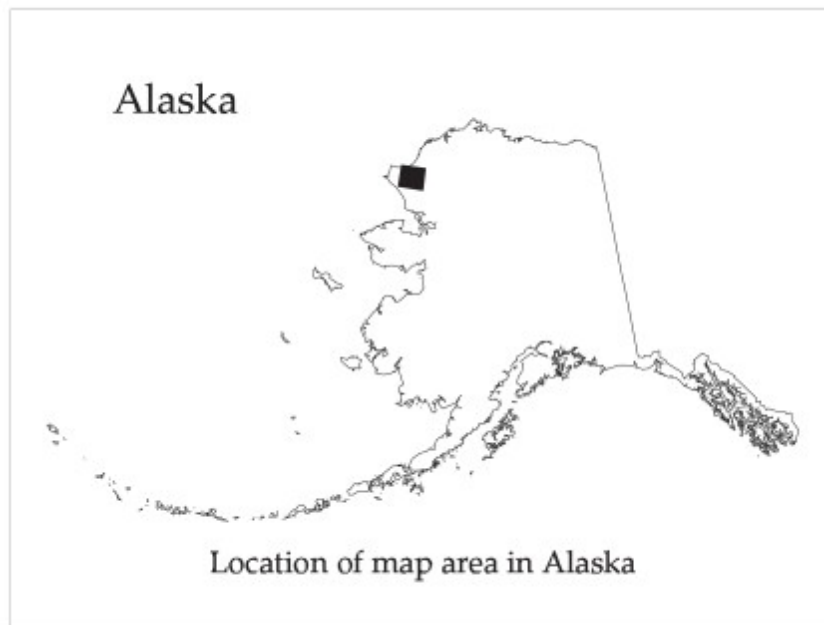
Report

The Alaska Resource Data File (ARDF) report for the De Long Mountains quadrangle, Alaska (OF-2000-23) is available for download at the following link: [Report PDF](#).

Data

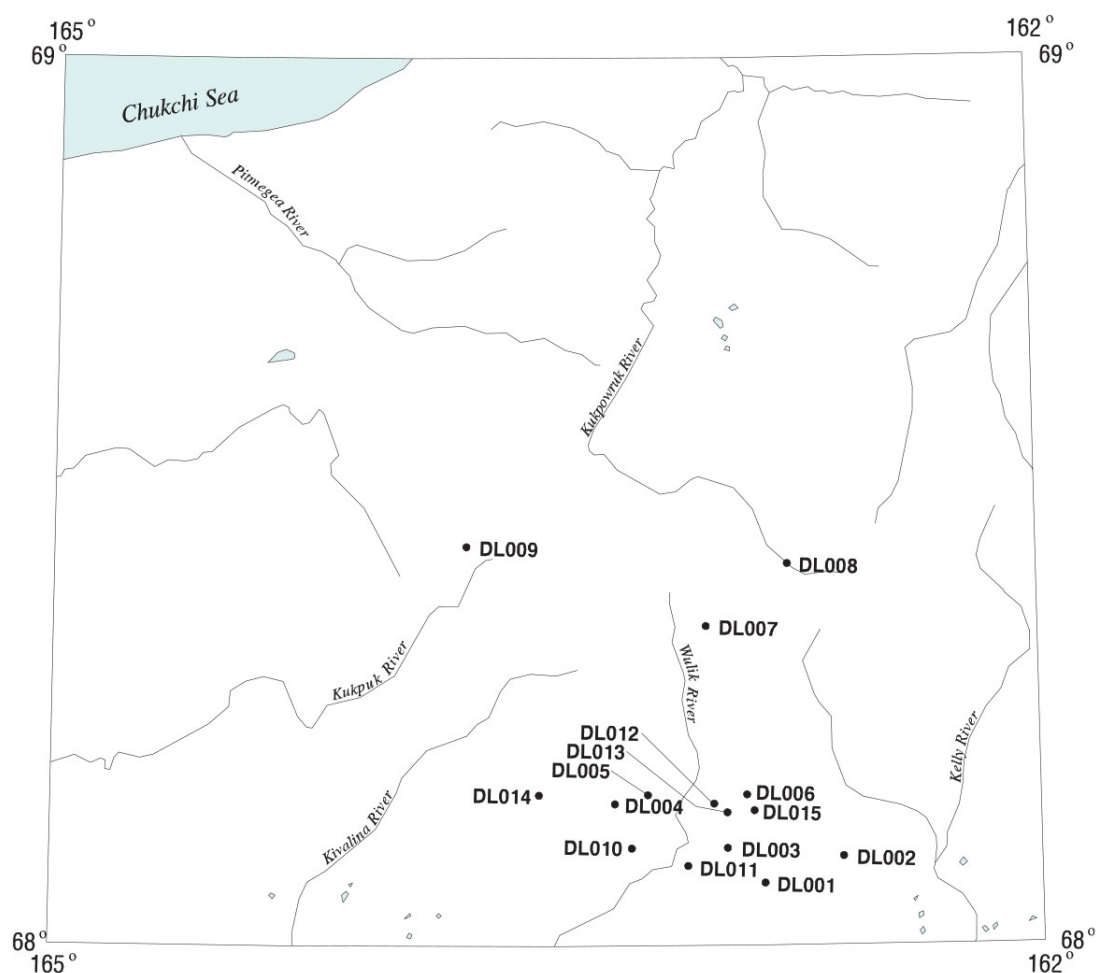
The Alaska Resource Data File (ARDF) data for the De Long Mountains quadrangle, Alaska (OF-2000-23) are available for download at the following link: [Data](#).

Index Map



Extracted from: ([OF-2000-23](#)).

Mineral Occurrence Map



Distribution of mineral occurrences in the De Long Mountains 1:250,000-scale quadrangle, northwestern Alaska

Extracted from: ([OF-2000-23](#)).

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ARDF Philip Smith Mountains (OF-2000-291)

Britton, J.M., 2000, Alaska Resource Data File, Philip Smith Mountains Quadrangle, Alaska: U.S. Geological Survey, Open-File Report OF-2000-291, scale 1:250,000. (*GRI Source Map ID 2555*).

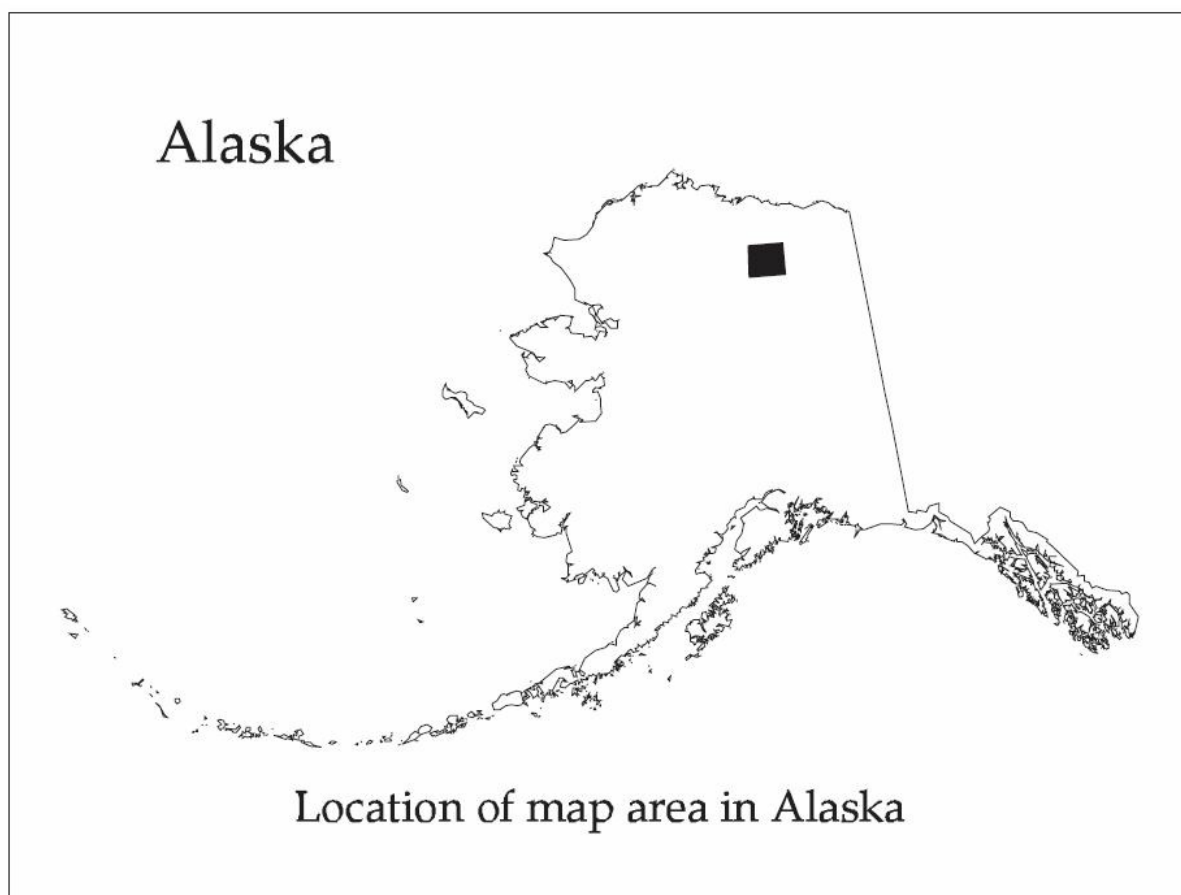
Report

The Alaska Resource Data File (ARDF) report for the Phillip Smith Mountains quadrangle, Alaska (OF-2000-291) is available for download at the following link: [Report PDF](#).

Data

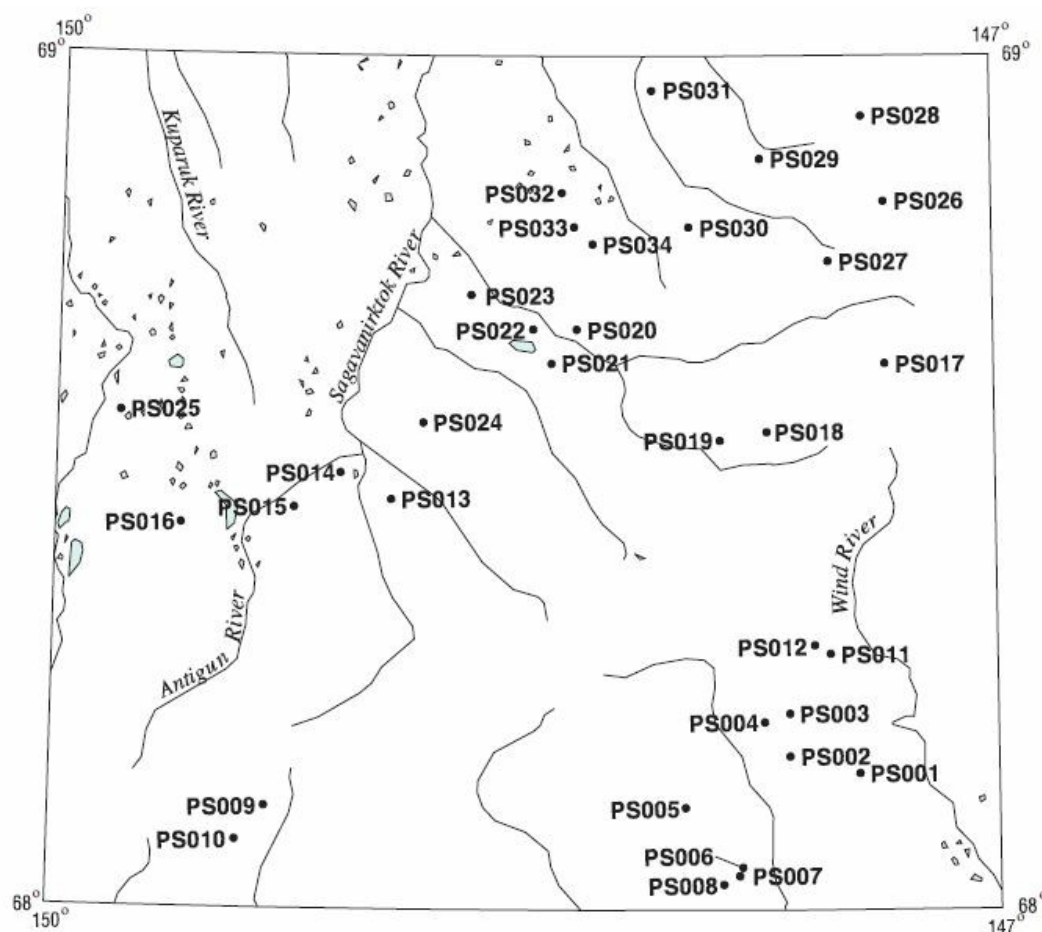
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Index Map



Extracted from: ([OF-2000-291](#)).

Mineral Occurrence Map



*Distribution of mineral occurrences in the Philip Smith Mountains
1:250,000-scale quadrangle, Alaska*

Extracted from: ([OF-2000-291](#)).

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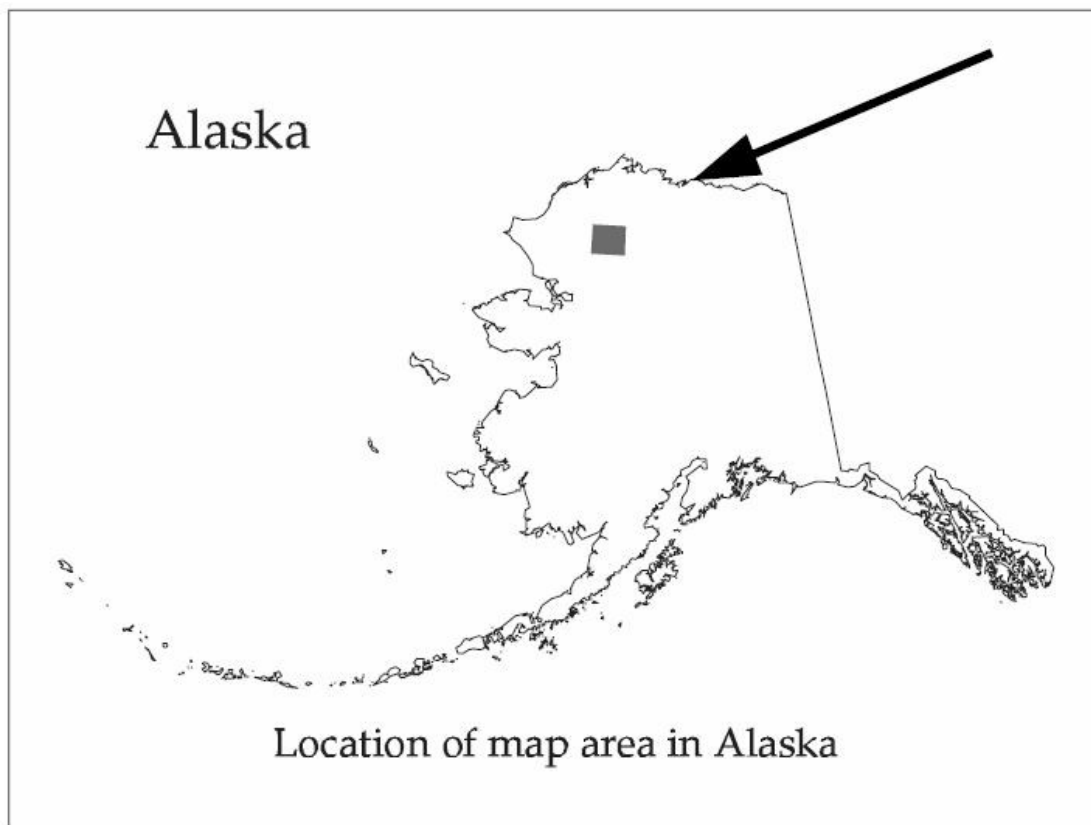
Report

The Alaska Resource Data File (ARDF) report for the Howard Pass quadrangle, Alaska (OF-97-296) is available for download at the following link: [Report PDF](#).

Data

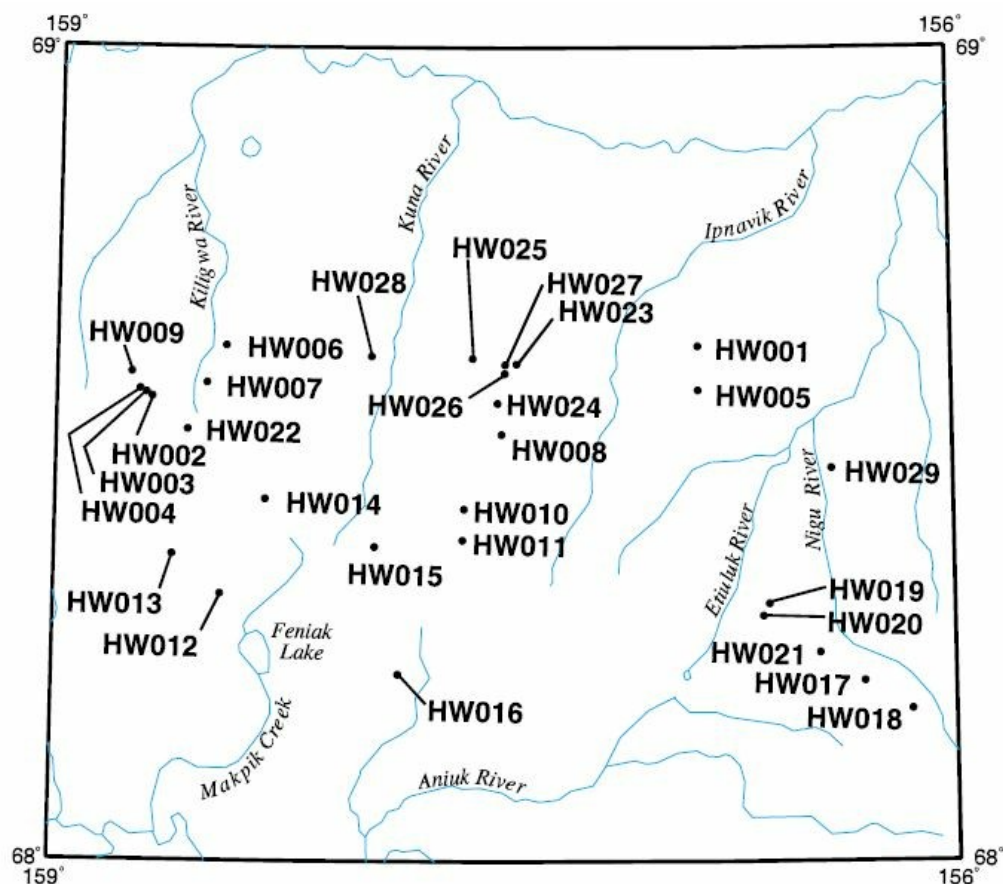
The Alaska Resource Data File (ARDF) data for the Howard Pass quadrangle, Alaska (OF-97-296) are available for download at the following link: [Data](#).

Index Map



Extracted from: ([OF-97-269](#)).

Mineral Occurrence Map



Distribution of mineral occurrences in the Howard Pass 1:250,000-scale quadrangle, north central Alaska

Extracted from: ([OF-97-269](#)).

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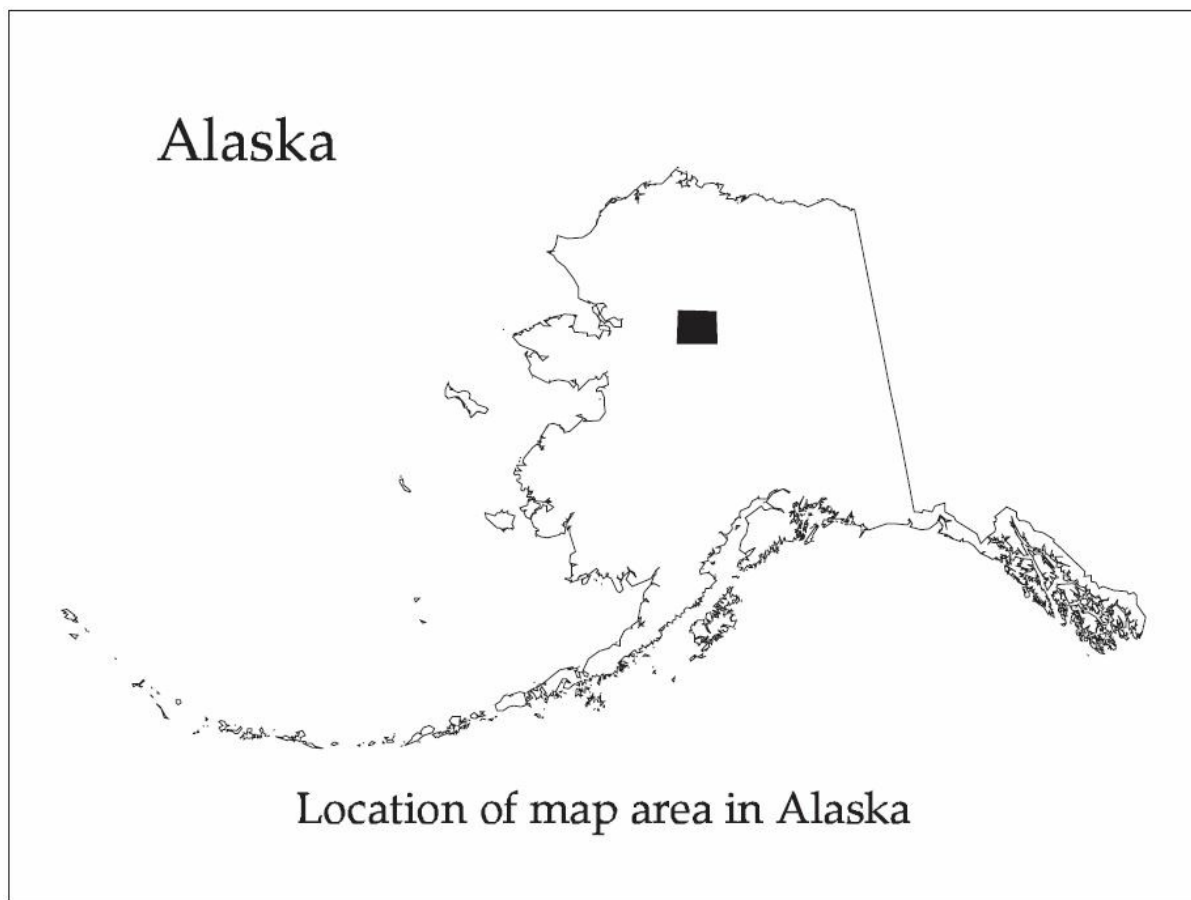
Report

The Alaska Resource Data File (ARDF) report for the Hughes quadrangle, Alaska (OF-2003-58) is available for download at the following link: [Report PDF](#).

Data

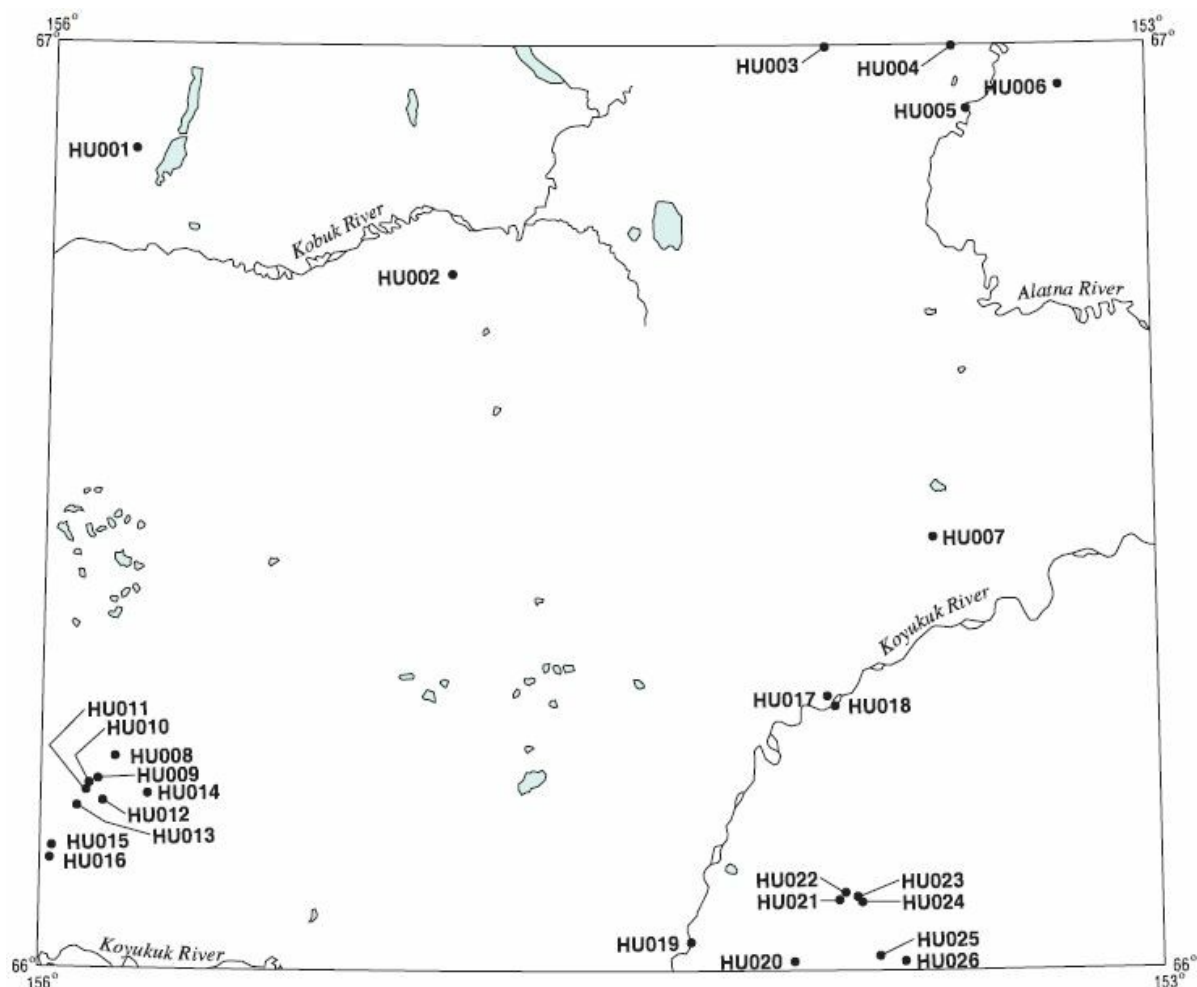
The Alaska Resource Data File (ARDF) data for the Hughes quadrangle, Alaska (OF-2003-58) are available for download at the following link: [Data](#).

Index Map



Extracted from: ([OF-2003-58](#)).

Mineral Occurrence Map



*Distribution of mineral occurrences in the Hughes
1:250,000-scale quadrangle, Alaska*

Extracted from: ([OF-2003-58](#)).

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ARDF Killik River (OF-97-266)

Kelly, K., 1997, Alaska Resource Data File, Killik River Quadrangle, Alaska: U.S. Geological Survey, Open-File Report OF-97-266, scale 1:250,000. (*GRI Source Map ID 3043*).

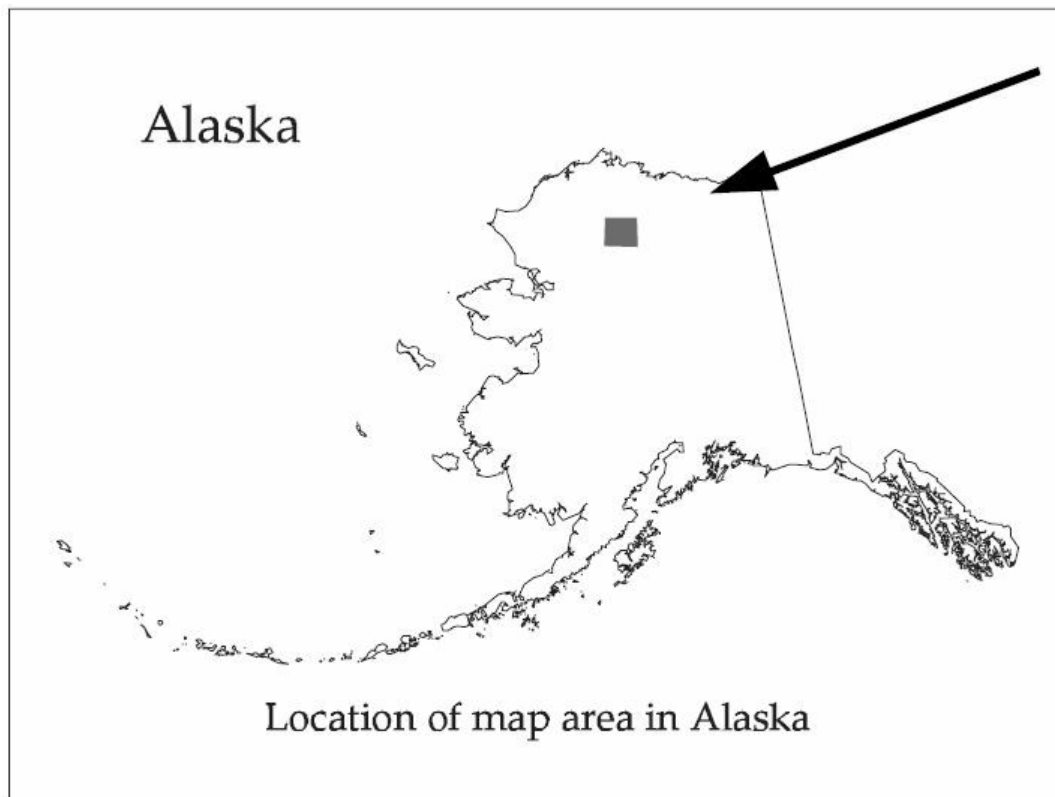
Report

The Alaska Resource Data File (ARDF) report for the Killik River quadrangle, Alaska (OF-97-266) is available for download at the following link: [Report PDF](#).

Data

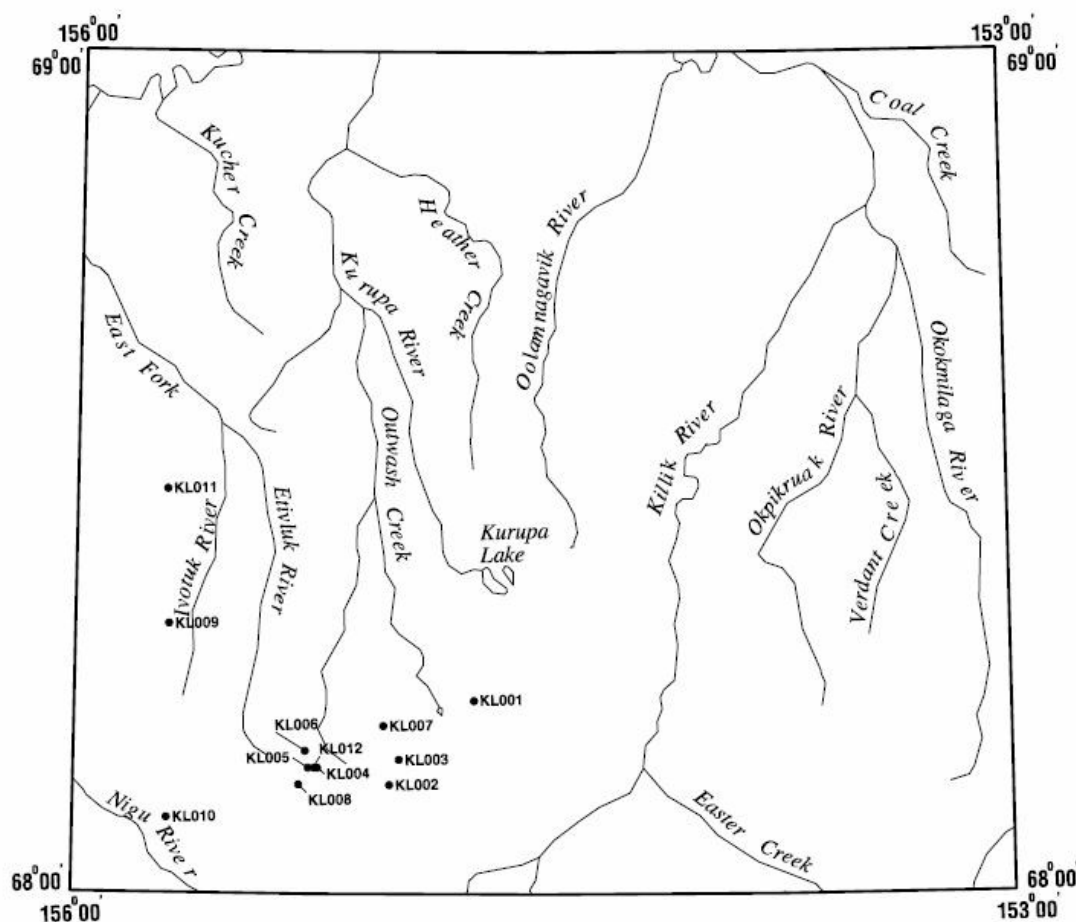
The Alaska Resource Data File (ARDF) data for the Killik River quadrangle, Alaska (OF-97-266) are available for download at the following link: [Data](#).

Index Map



Extracted from: ([OF-97-266](#)).

Mineral Occurrence Map



Distribution of mineral occurrences in the Killik River 1:250,000-scale quadrangle, north central Alaska

Extracted from: ([OF-97-266](#)).

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Extracted from: ([OF-97-266](#)).

ARDF Misheguk Mountain (OF-97-297)

Dover, J., 1997, Alaska Resource Data File, Misheguk Mountain Quadrangle, Alaska: U.S. Geological Survey, Open-File Report OF-97-297, scale 1:250,000. (*GRI Source Map ID 2839*).

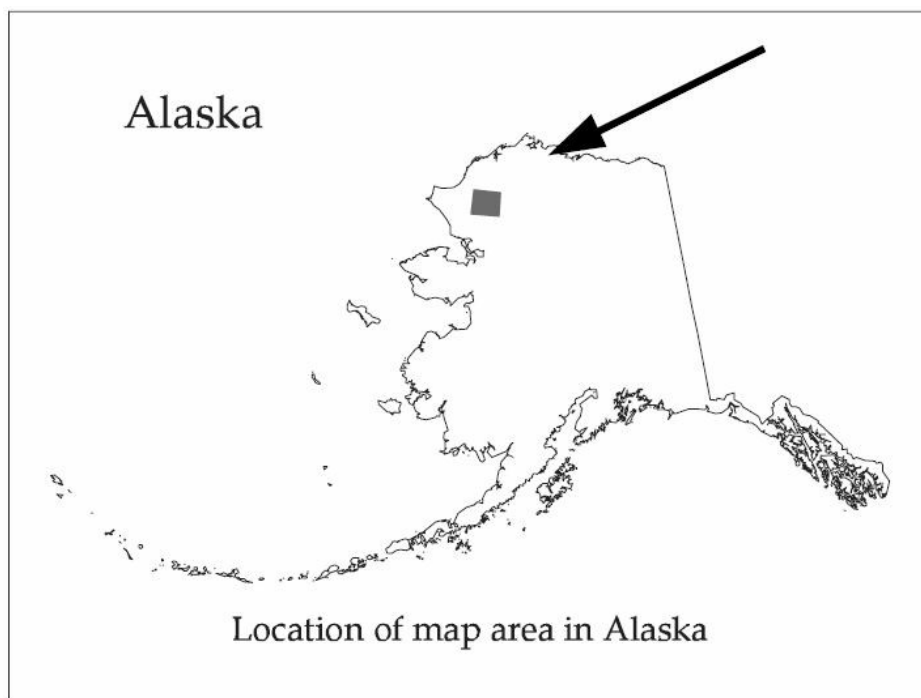
Report

The Alaska Resource Data File (ARDF) report for the Misheguk Mountain quadrangle, Alaska (OF-97-297) is available for download at the following link: [Report PDF](#).

Data

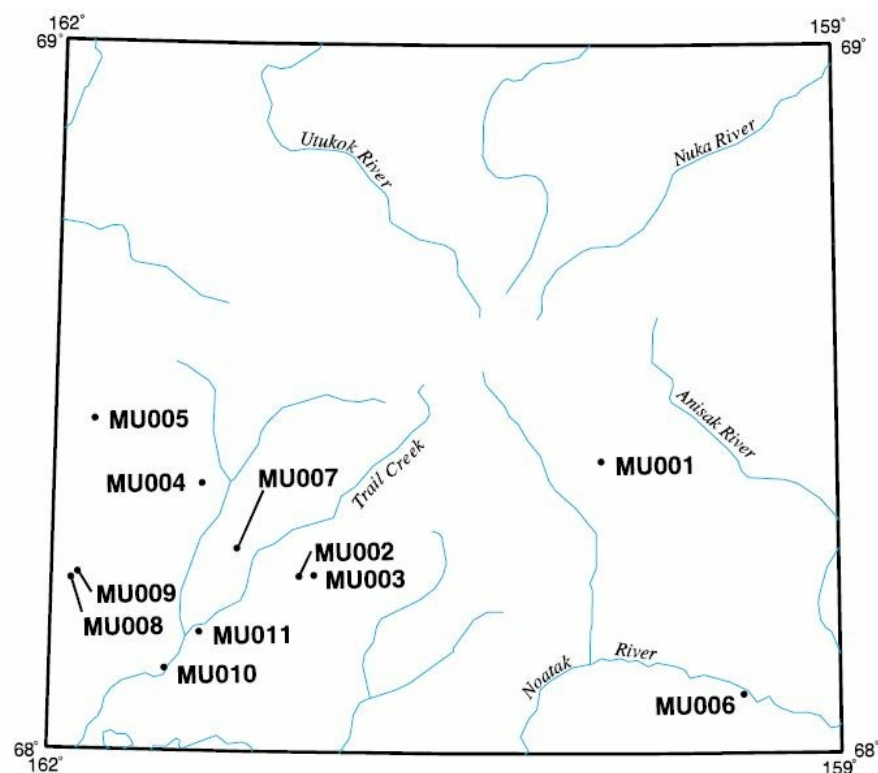
The Alaska Resource Data File (ARDF) data for the Misheguk Mountain quadrangle, Alaska (OF-97-297) are available for download at the following link: [Data](#).

Index Map



Extracted from: ([OF-97-297](#)).

Mineral Occurrence Map



Distribution of mineral occurrences in the Misheguk Mountain 1:250,000-scale quadrangle, northwestern Alaska

Extracted from: ([OF-97-297](#)).

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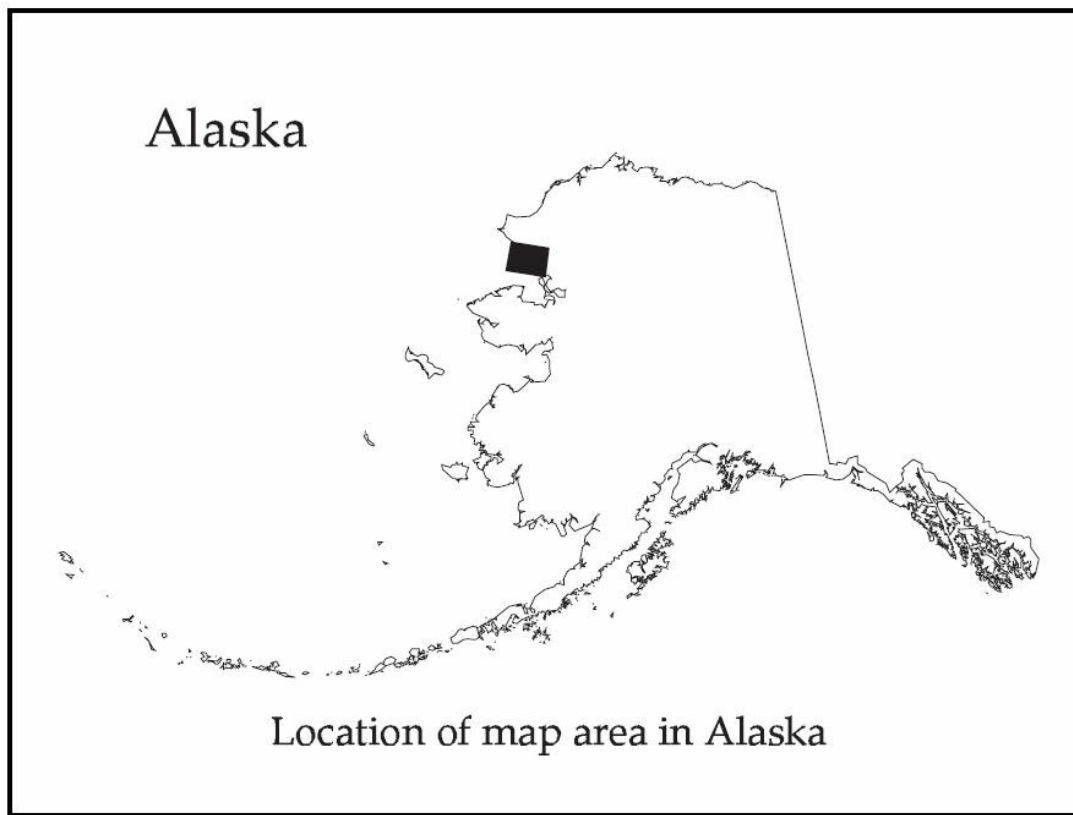
Report

The Alaska Resource Data File (ARDF) report for the Noatak quadrangle, Alaska (OF-2006-1157) is available for download at the following link: [Report PDF](#).

Data

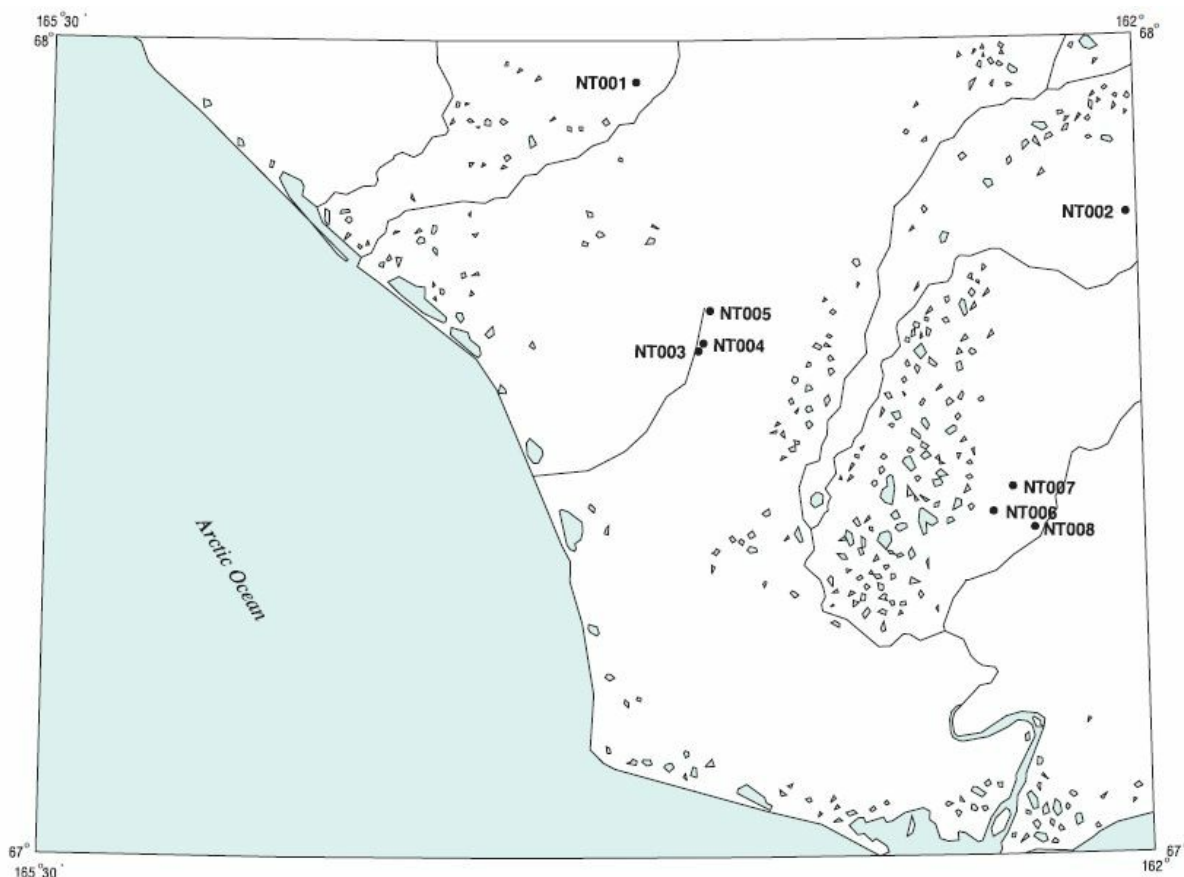
The Alaska Resource Data File (ARDF) data for the Noatak quadrangle, Alaska (OF-2006-1157) are available for download at the following link: [Data](#).

Index Map



Extracted from: ([OF-2006-1157](#)).

Mineral Occurrence Map



*Distribution of mineral occurrences in the Noatak
1:250,000-scale quadrangle, Alaska*

Extracted from: ([OF-2006-1157](#)).

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Williams, A., 2000, Alaska Resource Data File, Selawik Quadrangle, Alaska: U.S. Geological Survey, Open-File Report OF-2000-005, scale 1:250,000. (*GRI Source Map ID 2720*).

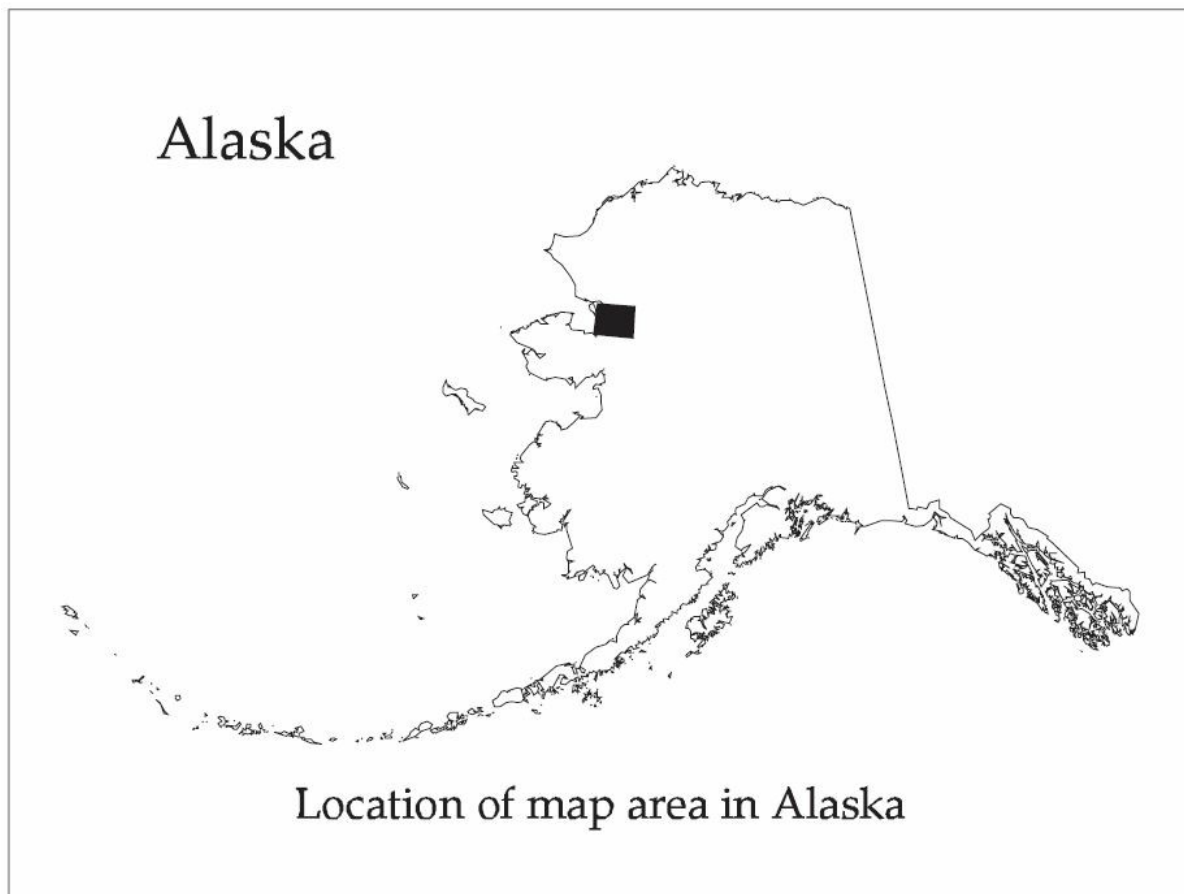
Report

The Alaska Resource Data File (ARDF) report for the Selawik quadrangle, Alaska (OF-2000-005) is available for download at the following link: [Report PDF](#).

Data

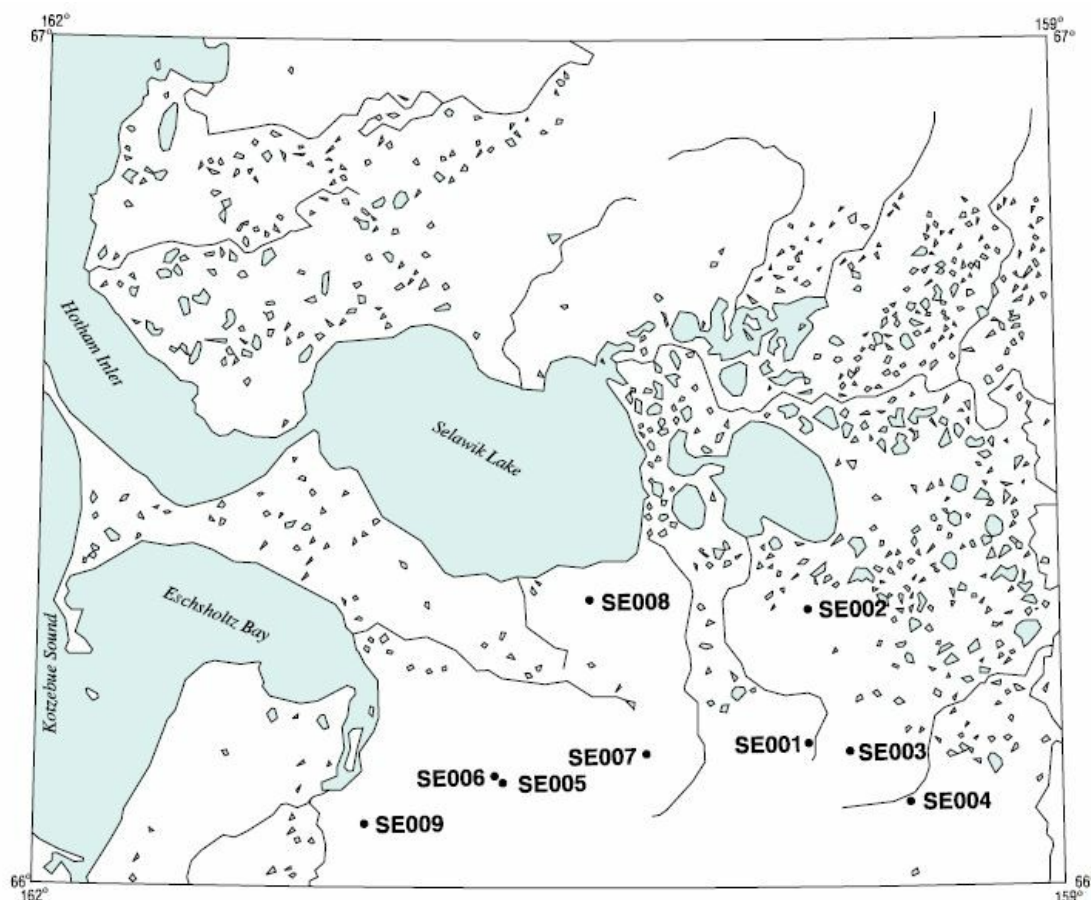
The Alaska Resource Data File (ARDF) data for the Selawik quadrangle, Alaska (OF-2000-005) are available for download at the following link: [Data](#).

Index Map



Extracted from: ([OF-2000-005](#)).

Mineral Occurrence Map



*Distribution of mineral occurrences in the Selawik
1:250,000-scale quadrangle, northwestern Alaska*

Extracted from: ([OF-2000-005](#)).

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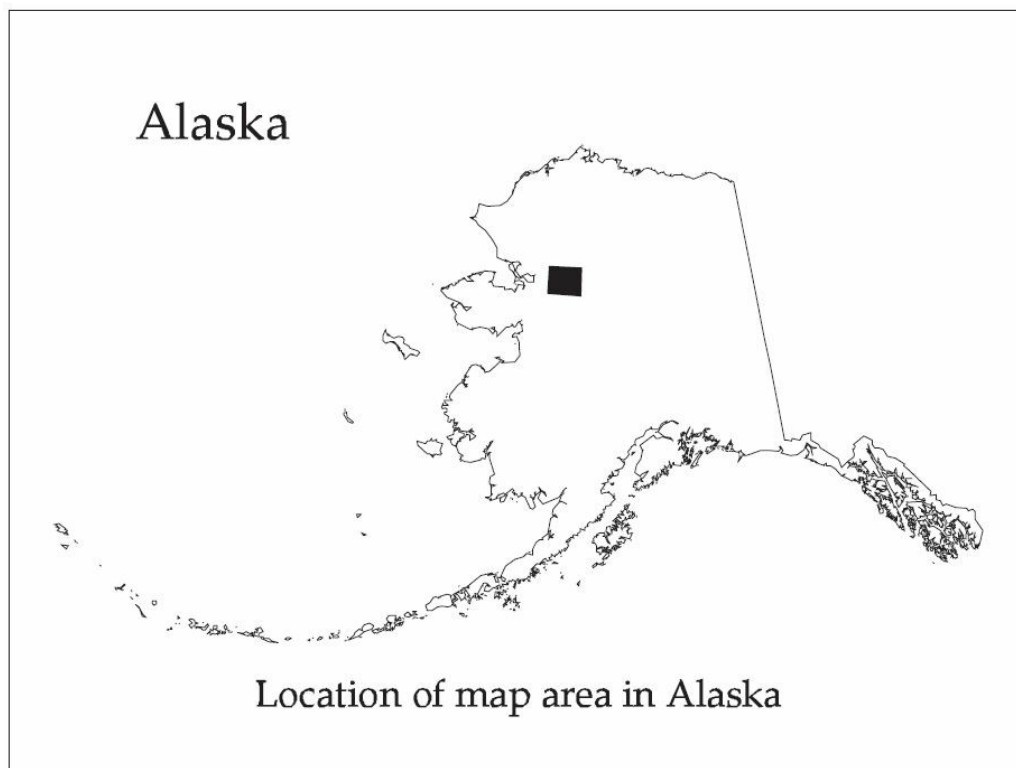
Report

The Alaska Resource Data File (ARDF) report for the Shungnak quadrangle, Alaska (OF-2000-022) is available for download at the following link: [Report PDF](#).

Data

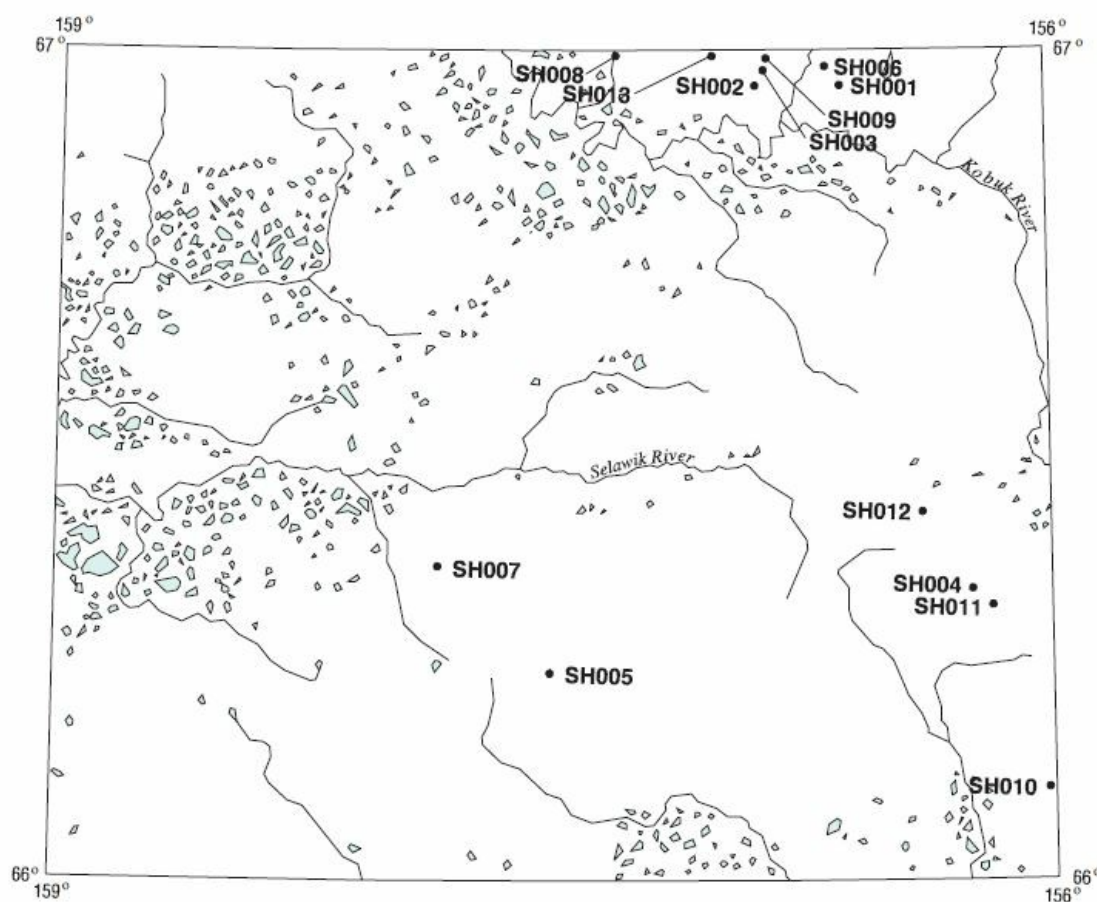
The Alaska Resource Data File (ARDF) data for the Shungnak quadrangle, Alaska (OF-2000-022) are available for download at the following link: [Data](#).

Index Map



Extracted from: ([OF-2000-022](#)).

Mineral Occurrence Map



*Distribution of mineral occurrences in the Shungnak
1:250,000-scale quadrangle, northwestern Alaska*

Extracted from: ([OF-2000-022](#)).

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Extracted from: ([OF-2000-022](#)).

ARDF Survey Pass (OF-2000-328)

Nelson, S.M., 2000, Alaska Resource Data File, Survey Pass Quadrangle, Alaska: U.S. Geological Survey, Open-File Report OF-2000-328, scale 1:250,000. (*GRI Source Map ID 3046*).

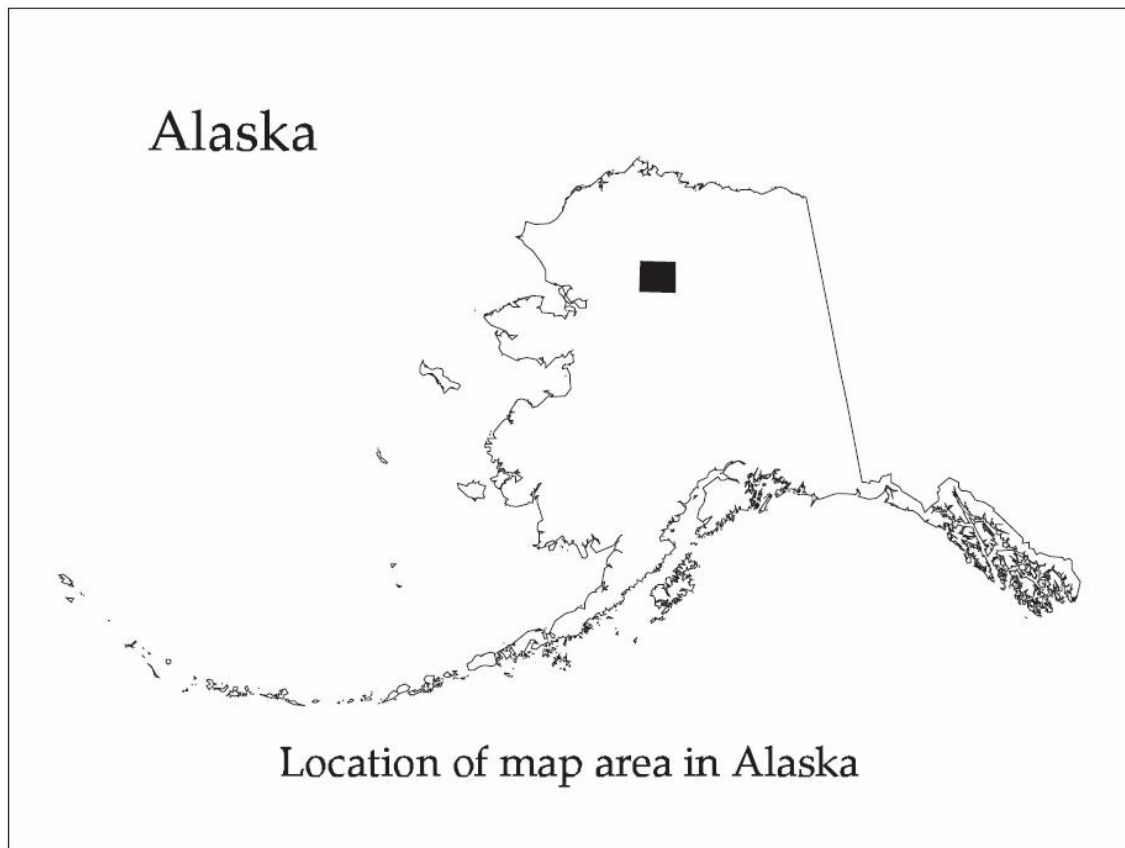
Report

The Alaska Resource Data File (ARDF) report for the Survey Pass quadrangle, Alaska (OF-2000-328) is available for download at the following link: [Report PDF](#).

Data

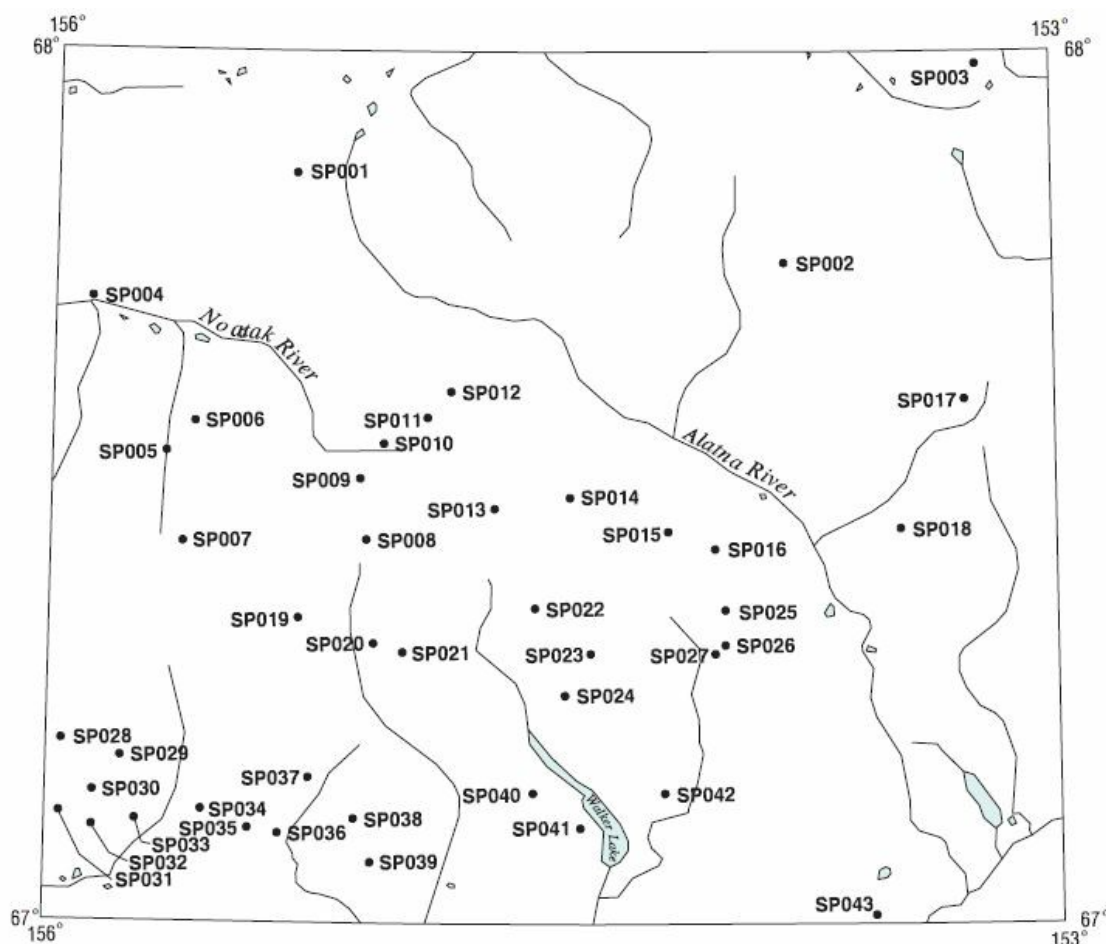
The Alaska Resource Data File (ARDF) data for the Survey Pass quadrangle, Alaska (OF-2000-328) are available for download at the following link: [Data](#).

Index Map



Extracted from: ([OF-2000-328](#)).

Mineral Occurrence Map



*Distribution of mineral occurrences in the Survey Pass
1:250,000-scale quadrangle, Alaska*

Extracted from: ([OF-2000-328](#)).

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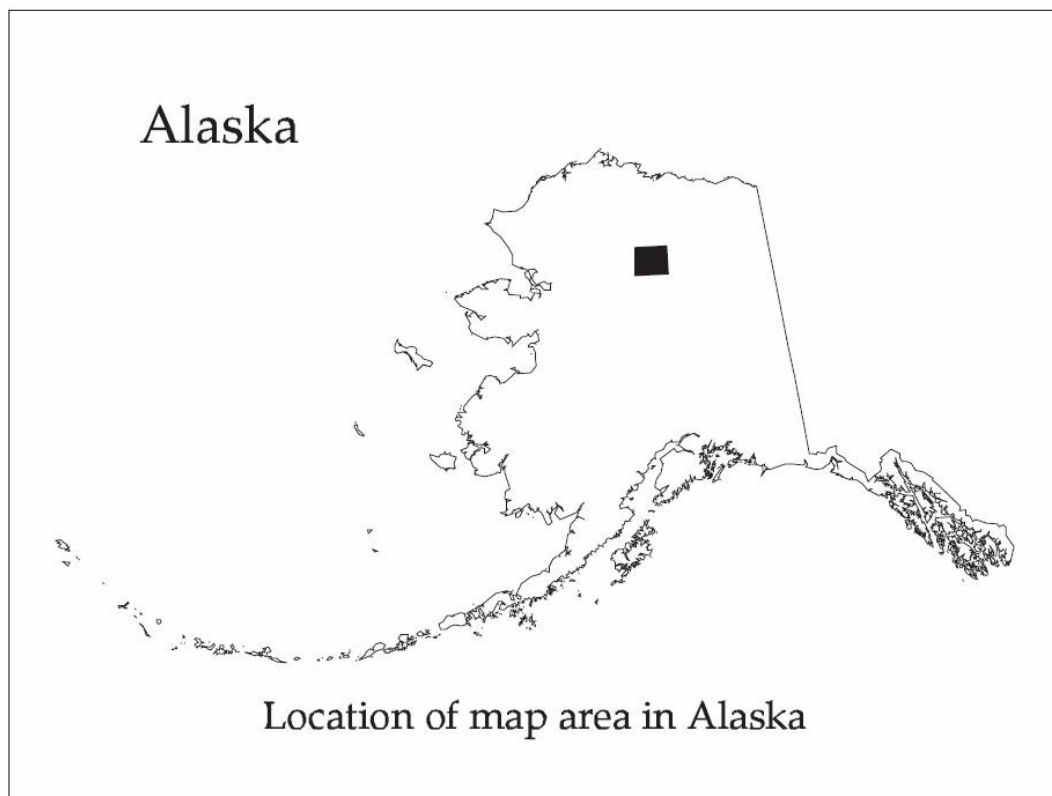
Report

The Alaska Resource Data File (ARDF) report for the Wiseman quadrangle, Alaska (OF-2003-447) is available for download at the following link: [Report PDF](#).

Data

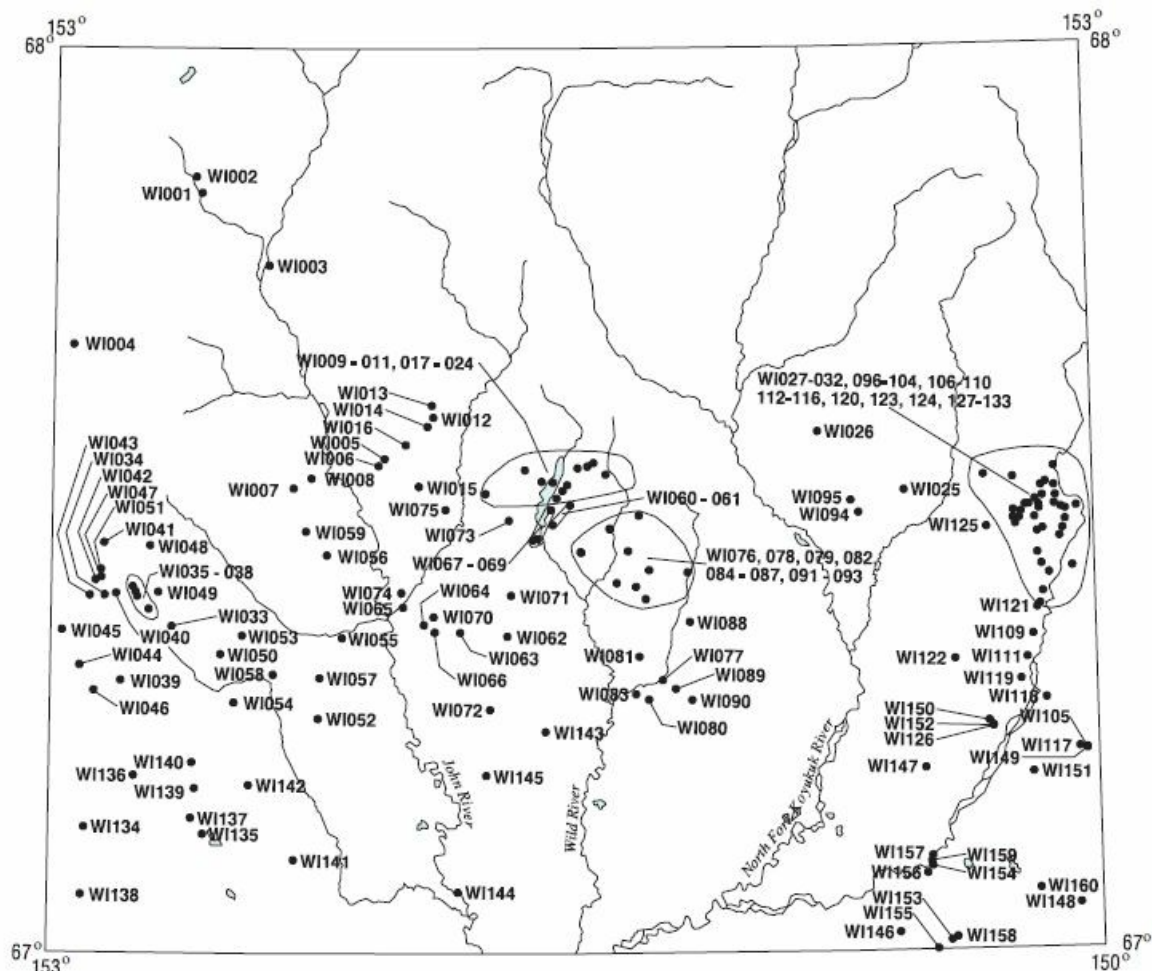
The Alaska Resource Data File (ARDF) data for the Wiseman quadrangle, Alaska (OF-2003-447) are available for download at the following link: [Data](#).

Index Map



Extracted from: ([OF-2003-447](#)).

Mineral Occurrence Map



*Distribution of mineral occurrences in the Wiseman
1:250,000-scale quadrangle, Alaska*

Extracted from: ([OF-2003-447](#)).

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The information in this document was compiled from GRI source maps, and is intended to accompany the digital geologic-GIS map and other digital data for Cape Krusenstern National Monument, Gates of the Arctic National Park and Preserve, Kobuk Valley National Park, and Noatak National Preserve, Alaska developed by Ron Karpilo, with QC and unit listing by James Chappell and Stephanie O'Meara, respectively (see the [GRI Digital Map and Source Map Citations](#) section of this document for all sources used by the GRI in the completion of this document and related GRI digital geologic-GIS map).

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