

U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science Directorate
Geologic Resources Division



Yukon-Charley Rivers National Preserve

GRI Ancillary Map Information Document

Produced to accompany the Geologic Resources Inventory (GRI) Digital Geologic
Data for Yukon-Charley Rivers National Preserve

yuch_geology.pdf

Version: 3/11/2021

Geologic Resources Inventory Map Document for Yukon-Charley Rivers National Preserve

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Geologic Resources Inventory Map Document



Yukon-Charley Rivers National Preserve, Alaska

Document to Accompany Digital Geologic-GIS Data

[yuch_geology.pdf](#)

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This document has been developed to accompany the digital geologic-GIS data developed by the Geologic Resources Inventory (GRI) program for Yukon-Charley Rivers National Preserve, Alaska (YUCH).

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 Maps and Source Map 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 as derived from U.S. Geological Survey Alaska region database. 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.
- 5) **Geologic Map of Alaska Unit Descriptions** – Descriptions from the Alaska State Geologic Map (SIM-3344) that was used in the production of this product.
- 6) **Ancillary Source Map Information** – Additional source map information presented by source map. For each source map this may include a stratigraphic column, index map, map legend and/or map notes.

7)**Alaska Resource Data Files** – Mine and mineral sample point database included in this product.

8)**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

The Geologic Resources Inventory (GRI) provides geologic map data and pertinent geologic information to support resource management and science-informed decision making in more than 270 natural resource parks throughout the National Park System. 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 GRI is one of 12 inventories funded by the National Park Service (NPS) Inventory and Monitoring Program. The Geologic Resources Division of the NPS Natural Resource Stewardship and Science Directorate administers the GRI. The NPS Geologic Resources Division partners with the Colorado State University Department of Geosciences to produce GRI products. Many additional partners participate in the GRI process by contributing source maps or reviewing products.

The GRI team undertakes three tasks for each park in the Inventory and Monitoring program: (1) conduct a scoping meeting and provide a summary document, (2) provide digital geologic map data in a geographic information system (GIS) format, and (3) provide a GRI report. These products are designed and written for nongeoscientists.

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: <https://www.nps.gov/articles/gri-geodatabase-model.htm>

Geologic Reports: GRI reports synthesize discussions from the original scoping meeting, follow up conference call(s), and subsequent research. Chapters of each report discuss the geologic setting of the park, distinctive geologic features and processes within the park, highlight geologic issues facing resource managers, and describe the geologic history leading to the present-day landscape. Each report also includes a poster illustrating these GRI digital geologic-GIS data.

For a complete listing of GRI products visit the GRI publications webpage: <https://go.nps.gov/gripubs>. GRI digital geologic-GIS data is also available online at the NPS Data Store: <https://irma.nps.gov/DataStore/Search/Quick>. 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: <https://>

www.nps.gov/subjects/geology/gri.htm. At the bottom of that webpage is a “Contact Us” link if you need additional information. You may also directly contact the program coordinator:

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The Geologic Resources Inventory (GRI) program is funded by the National Park Service (NPS) Inventory and Monitoring (I&M) Division. Learn more about I&M and the 12 baseline inventories at the I&M webpage: <https://www.nps.gov/im/inventories.htm>.

GRI Digital Map and Source Map Citations

The GRI digital geologic-GIS map for Yukon-Charley Rivers National Preserve, Alaska (YUCH):

Digital Geologic-GIS Map of Yukon-Charley Rivers National Preserve and Vicinity, Alaska (GRI MapCode YUCH)

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 NSA Class 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 four 1 degree x 3 degree quadrangles that cover Yukon-Charley Rivers 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 ([USGS 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: Big Delta, Charley River, Circle and Eagle.

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

Cameron, C.E., 2000, Alaska Resource Data File, Charley River Quadrangle, Alaska: U.S. Geological Survey, Open-File Report OF-2000-290, scale 1:250,000 ([USGS OF-2000-290](#)). (GRI Source Map ID 3033).

Freeman, C.J., and Schaefer, J., 1998, Alaska Resource Data File, Circle Quadrangle, Alaska: U. S. Geological Survey, Open-File Report OF-98-783, scale 1:250,000 ([USGS OF-98-783](#)). (GRI Source Map ID 3037).

Rombach, C. 1999, Alaska Resource Data File, Big Delta Quadrangle, Alaska: U.S. Geological Survey: Open-File Report OF-99-354, scale 1:250,000 ([USGS OF-99-354](#)). (GRI Source Map ID 3040).

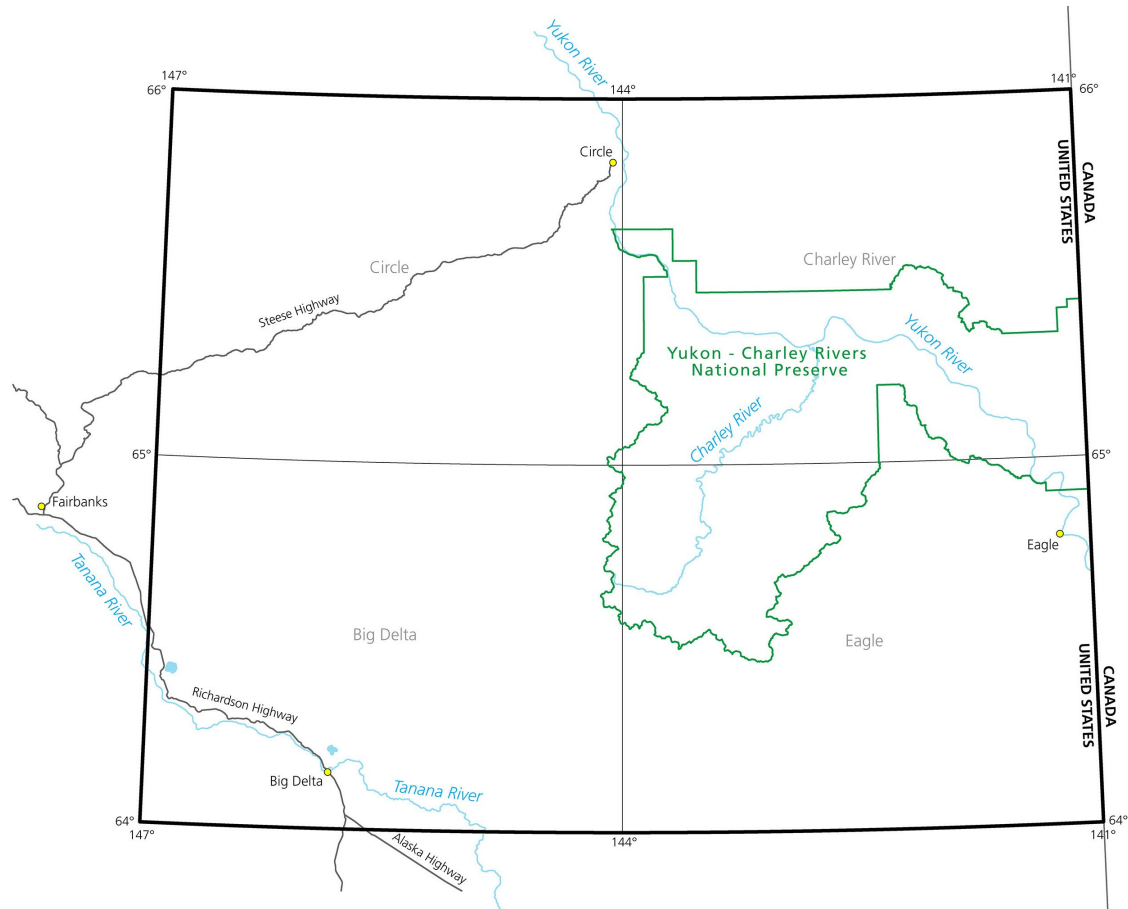
Werdon, M.B., Flynn, R.L., and Szumigala, D.J. 2004, Alaska Resource Data File, Eagle Quadrangle, Alaska: U.S. Geological Survey, Open-File Report OF-2004-1056, scale 1:250,000 ([USGS OF-2004-1056](#)). (GRI Source Map ID 68581).

U.S. Geological Survey, 2008, Alaska Resource Data File, New and Revised Records Version 1.6: U.S. Geological Survey, Open-File Report OF-2008-1225, scale 1:250,000 ([USGS OF-2008-1225](#)). (GRI Source Map ID 76130).

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

Index and Location Maps

The follow index map displays the extent of the GRI digital geologic-GIS data produced for Yukon-Charley Rivers National Preserve and covers the following 250K quadrangles: Big Delta, Charley River, Circle, and Eagle. The boundary of the National Preserve (shown in dark green, as of September, 2018) is also displayed.



Graphics by James Winter (Colorado State University).

Map Unit List

The geologic units present in the digital geologic-GIS data produced for Yukon-Charley Rivers National Preserve, Alaska (YUCH) are listed below. Units are listed with their assigned unit symbol and unit name (e.g., Qsl - Solifluction deposits). 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 (YUCHUNIT) table included with the GRI geologic-GIS data.

Cenozoic Era

Quaternary Period

[Qsl](#) - Solifluction deposits
[Qca](#) - Alluvium and colluvium
[Qc](#) - Colluvial deposits
[Qls](#) - Landslide deposits
[Qsp](#) - Swamp deposits
[Qht](#) - Placer-mine tailings and artificial fills
[Qd5](#) - Neoglacial drift
[Qdo5](#) - Neoglacialfluvial outwash
[Qm](#) - Glacigenic deposits
[Qt](#) - Terrace deposits
[Qaf](#) - Alluvial fan deposits
[Qa](#) - Alluvium
[Ql](#) - Loess
[Qdo](#) - Glacifluvial outwash, late Wisconsin age
[Qd4](#) - Glacial drift, late Wisconsin age
[Qdr](#) - Older glacial drift, pre-late Wisconsin age
[Qdo3](#) - Older glacifluvial outwash, Wisconsin age
[Qdo1](#) - Glacifluvial outwash, pre-Wisconsin age
[Qd1](#) - Glacial drift, Illinoian age
[Qfp](#) - Floodplain alluvium
[Qac](#) - Abandoned channel deposits
[Qs](#) - Sand
[Qsu](#) - Silt and peat
[Qrg](#) - Rock-glacier deposits
[Qcg](#) - Gelifluction deposits

Quaternary and Tertiary Periods

[QTd](#) - Undifferentiated drift
[QTS](#) - Old terrace deposits

Tertiary Period

[Tb](#) - Basalt
[Tcs](#) - Conglomerate and sandstone
[Tng](#) - Nenana gravel
[Tcb](#) - Coal-bearing sedimentary rocks
[Ti](#) - Intermediate volcanic rocks
[Tbg](#) - Basalt, microgabbro, and diabase
[Tw](#) - Welded tuff
[Tpt](#) - Felsic igneous rocks

Tertiary and Cretaceous Periods

[TKs](#) - Sedimentary rocks
[TKg](#) - Granitic rocks
[TKgd](#) - Granodiorite

Tertiary, Cretaceous and Jurassic Periods

[TKJg](#) - Granite and Alaskite

Tertiary, Cretaceous, Jurassic and Triassic Periods

[TMZmi](#) - Mafic igneous rocks

[TMZd](#) - Quartz diorite

[TMZm](#) - Gabbro with basalt and andesite (?)

[TKMZmgr](#) - Granitic rocks

Mesozoic Era

[Mza](#) - Adamellite

Cretaceous Period

[Kgsp](#) - Shawnee Peak intrusion

[Kr](#) - Rhyolite dikes

[Klgr](#) - Granite and granodiorite

[Klqm](#) - Granite and quartz monzonite

[Kd](#) - Diorite, gabbro, and tonalite

[Kdm](#) - Mafic dikes

[Ku](#) - Unnamed sandstone

[Kka](#) - Kandik Group, Kathul Graywacke

[Kke](#) - Kandik Group, Keenan Quartzite

[Kb](#) - Kandik Group, Biederman Argillite

Cretaceous and Jurassic Periods

[KJqa](#) - Quartzite, argillite, conglomerate, and hornfels

[KJg](#) - Plutons of the Yukon-Tanana Upland

Cretaceous, Jurassic and Triassic Periods

[KJTRmgr](#) - Granite, granodiorite, and quartz monzonite

[KJTRa](#) - Glenn Shale and equivalents

Jurassic Period

[Jd](#) - Jurassic dikes (Jurassic)

[Jga](#) - Granite, pegmatite, and aplite

[Js](#) - Syenite of Mount Veta

[Jmig](#) - Migmatite

Jurassic and Triassic Periods

[JTRqd](#) - Granodiorite and granite

Triassic Period

[TRgsl](#) - Glenn Shale, lower unit

Triassic, Permian, Pennsylvanian and Mississippian Periods

[TRMsm](#) - Sedimentary and slightly metamorphosed sedimentary rocks

Mesozoic and Paleozoic Eras

[MZPZat](#) - Argillite, tuff, quartzite, and conglomerate

[MZPZc](#) - Circle Volcanics

[MZPZd](#) - Diorite

[MZPZt](#) - Silicified tuff (?)

[MZPZaq](#) - Argillite and quartzite

[MZPZs](#) - Serpentinized rocks

Mesozoic, Paleozoic and Precambrian Eras

[MZPZPCb](#) - Basalt, gabbro, and greenstone

[MZPZPCca](#) - Chert and argillite

Paleozoic Era

[PZmv](#) - Chicken Metamorphic Complex, metavolcanic, metasedimentary, and metatuffaceous rocks

[PZq](#) - Quartzite, meta-argillite, and phyllite

[PZgs](#) - Rocks metamorphosed to upper greenschist facies

[Pzm](#) - Calcareous phyllite, marble and phyllite

[PZbl](#) - Basalt and limestone

[PZca](#) - Chert with interlayered argillite, marble and quartzite

[PZd](#) - Diorite gabbro

[PZug](#) - Ultramafic and mafic rocks and greenstone

[PZrm](#) - Pelitic schist, marble subunit

[PZmi](#) - Orthogneiss and amphibolite of igneous origin

[PZg](#) - Gneiss

[PZI](#) - Tahkandit Limestone

[PZqsg](#) - Quartz-mica schist and greenstone

[PZqs](#) - Quartz-mica schist, greenstone, dolomite, and limestone

[PZgc](#) - Greenstone and Chert

Permian Period

[Pst](#) - Step and Tahkandit Formations

[Pq](#) - Quartzite with some phyllite, micaceous quartzite, marble, and calcareous quartz schist

[Pstc](#) - Step Conglomerate

Pennsylvanian and Mississippian Periods

[PNMcb](#) - Calico Bluff Formation

Pennsylvanian, Mississippian, and Devonian Periods

[PNMDf](#) - Ford Lake Shale

Mississippian and Devonian Periods

[MDts](#) - Totatlanika Schist

[MDag](#) - Augen gneiss and orthogneiss

Devonian Period

[Dbr](#) - Blackshell rhyolite

[Dnr](#) - Nation River Formation

[Dof](#) - Ogilvie Formation

[Dka](#) - McCann Hill Chert

[Dwv](#) - Woodchopper Volcanics

[Dsv](#) - Schwatka unit, mafic volcanic rocks

Devonian and Silurian Periods

[DSd](#) - Dolomite and argillite

Devonian, Silurian, and Ordovician Periods

[DSOr](#) - Road River Formation

[DSOdc](#) - Dan Creek calcphyllite, marble, and schist

[DSOdcn](#) - Dan Creek marble

Silurian and Ordovician Periods

[SOs](#) - Siltstone, dolomite, chert, and mafic igneous rocks

Ordovician and Cambrian Periods

[OCjru](#) - Jones Ridge Formation

[OCh](#) - Hillard Limestone

Cambrian Period

[Ca](#) - Adams Argillite

[Cf](#) - Funnel Creek Limestone

Paleozoic and Precambrian Eras

[PZPCi](#) - Gneiss and felsic rocks, intermixed

[PZPCch](#) - Chert, argillite, and quartzite

[PZPCms](#) - Garnet-muscovite schist

[PZPCm](#) - Mylonite and mylonite gneiss

[PZPCcr](#) - Chert, conglomerate and limestone

[PZPClc](#) - Limestone and chert

[PZPCI](#) - Wickersham unit, limestone

[PZPCag](#) - Argillite, grit, and quartzite

[PZPCa](#) - Maroon and green argillite

[PZPCls](#) - Limestone

[PZPCdm](#) - Dolomite and marble

[PZPCps](#) - Pelitic schist and quartzite

[PZPCs](#) - Biotite-sillimanite gneiss

[PZPCbg](#) - Biotite gneiss, marble, schist, quartzite, and amphibolite

[PZPCms](#) - Mafic schist and amphibolite

[PZPCgs](#) - Gneiss, schist, and quartzite

[PZPCgg](#) - Grit, quartzite and argillite

[PZPCq](#) - Quartzite and quartzitic schists

[PZPCqm](#) - Quartzite and quartzitic schists, magnetic chlorite schist subunit

[PZPCcq](#) - Clinky quartzite

[PZPCqs](#) - Quartzite and schist

[PZPCld](#) - Chert and dolomite

[PZPCun](#) - Undifferentiated sedimentary or slightly metamorphosed sedimentary and igneous rocks

[PZPCbg](#) - Biotite schist, quartzite, and marble

Paleozoic and Neoproterozoic Eras

[PZZm](#) - Gabbro and diorite

Precambrian Era

[PCTsl](#) - Tindir Group, Dolomite and shale, stromatolite-bearing limestone

[PCTb](#) - Tindir Group, basalt and red beds

[PCTu](#) - Tindir Group

[PCT](#) - Upper Tindir Group, shale, limestone, and dolomite

[PCTd](#) - Lower Tindir Group, dolomite, dolomitic limestone, and limestone

[PCTs](#) - Upper Tindir Group, shale

[PCTlc](#) - Lower Tindir Group, quartzite and dolomite

[PCTl](#) - Upper Tindir Group, limestone

[PCq](#) - Quartzite and argillite

[PCm](#) - Quartzite and quartzitic schist, calc-silicate and marble subunit

[PCo](#) - Orthogneiss

Units of unknown age

[bu](#) - Bedrock

Map Unit Descriptions

Descriptions of all geologic map units, generally listed from youngest to oldest, are presented below. Additional geologic unit descriptions sourced from the USGS geologic-GIS data for the Alaska region are accompanied by code (eg. BD006) identifying the original source for that description. Please see the [USGS Source Map References](#) page for references associated with these codes. Most Quaternary geologic units have been compiled into one geologic unit in the Geologic Map of Alaska source; those units are identified with the compiled unit noted.

Qsl - Solifluction deposits (Holocene)

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

Qsl - Solifluction deposits (Holocene) Unsorted, water-saturated colluvial material restricted to unglaciated, higher mountain peaks mostly in western part of map area; characterized by numerous elongated terraced or flattish areas that step down into adjacent active drainage. Maximum thickness less than 4 m. Unit description source: BD006

Qca - Alluvium and colluvium (Quaternary)

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

Qac - Alluvium and colluvium (Quaternary) Boulders, gravel, sand, silt, and angular rock fragments, mostly poorly sorted and poorly stratified. Unit description source: CI002, CI012

Qc - Alluvium and colluvium (Holocene) Sand, gravel and silt in stream valleys and fine to coarse colluvium in heads of valleys. Unit description source: EA002

Qca - Alluvium and colluvium, undifferentiated (Quaternary) Interstratified alluvium and colluvium that include mudflows, debris flows, snow and avalanche fans, and colluvial deposits emanating from steep channels and gullies. Consists of poorly stratified, nonsorted, gravelly to silty sediment. Unit description source: BD004, CI004

Qca - Colluvial and alluvial valley-fill deposits (Quaternary) Elongate, apron- and fan-shaped, heterogeneous mixtures of poorly to moderately sorted angular rock fragments with trace to some gravel, sand, and silt deposited in upper stream courses and on lower slopes along the margins of stream valleys by complex mass-movement processes (including rolling, sliding, flowing, gelifluction, and frost action) and strongly influenced by meltwater and slope runoff. Other important depositional processes may include debris flows, brief, intense (torrential) summer stream flows, and minor snow-avalanching. Commonly forms alternating stratified and unstratified zones and lenses in gullies and steep tributary valleys with intermittent or ephemeral streams. Locally overlain by variable thickness of ice-rich organic silt and muck, especially in areas of little or no slope. Surface disturbances, such as from excavation, commonly result in melting and subsequent slumping and flowage. Surface steep to gently sloping, with local low scarps and shallow channels from ephemeral runoff streams. Unit description source: EA009, EA012

Qc - Colluvium (Quaternary, Holocene) Residual deposits of clay, silt, sand, pebbles, and cobbles that mantle gently to moderately dipping slopes. Estimated thickness ranges up to 15 m at the base of hill slopes. Unit description source: EA015

Qg - Gravel (Quaternary) Light-gray to light-yellowish-brown, pebble to boulder size, containing thin layers of sand and silt. Probably was at one time large alluvial fan of Yukon River. Unit description source: CI002

Qs - Surficial deposits (Quaternary) Mostly alluvium and colluvium, but locally includes glacial, lacustrine, eolian, landslide, and organic silt and peat deposits. Unit description source: EA014

Qc - Colluvial deposits (Quaternary)

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

Qac - Alluvium and colluvium (Quaternary) Boulders, gravel, sand, silt, and angular rock fragments. In large river valleys contains much perennially frozen organic silt and peat. Unit description source: BD002

Qc - Colluvial deposits (Quaternary) Boulder- to cobble-size, unconsolidated talus, slope-failure deposits, colluvium, and minor alluvial deposits. Unit includes alluvial deposits within small, narrow active stream channels Unit description source: BD003

Qc - Colluvial deposits, undifferentiated (Quaternary) Angular, poorly sorted, nonstratified gravel with varying amounts of sand, silt, and clay. Common on slopes less than 45 degrees, where these deposits form blanketing mantles. May include gelifluction deposits and minor alluvium. Deposits usually include permafrost Unit description source: BD004, CI004

Qcd - Colluvial drift (Quaternary) Reworked surfaces of moraines and other glacial deposits. Consists mainly of retransported glacial diamicton and outwash. Contains varying amounts of sand, silt, and boulders Unit description source: CI004

Qc - Colluvium (Holocene) Residual deposits of clay, silt, sand, and angular pebbles and cobbles that mantle shallow-dipping slopes; most common in weakly dissected terrane in eastern part of map area. Thickness uncertain, but probably less than 1 m. Unit description source: BD006

Qcf - Fine-grained colluvium (Quaternary) Retransported silt, locally interbedded with sand and gravel. Mainly on lower hillslopes and valley bottoms Unit description source: BD004, CI004

Qcc - Slope talus (Quaternary) Coarse, blocky, rock rubble that forms a blanketing layer of talus and scree on mountain slopes. Includes stone stripes, gelifluction deposits, and rock-glacier talus Unit description source: BD004, CI004

Qct - Talus fans and aprons, undifferentiated (Quaternary) Coarse, blocky, rock rubble along the base of steep mountain slopes. Associated with cone- or fan-shaped talus landforms that often coalesce, forming talus aprons. Includes avalanche boulder tongues, boulder trains, and may include debris flow deposits Unit description source: BD004, CI004

Qfy - Young alluvial fan deposits (Holocene) Poorly sorted silty sand and gravel that form small alluvial fans along margins of all major stream drainages. Maximum thickness unknown. Recoded polygons from Day's B-1 map to colluvium, young alluvial fans just doesn't seem correct. Unit description source: BD005

Qls - Landslide deposits (Quaternary)

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

Qd - Debris flow deposits (Holocene) Coarse, unconsolidated deposits of locally derived, angular pebbles, cobbles, and boulders associated with fine-grained matrix of sand and silt; confined to steep alpine gulches in west-central part of map area. Unit description source: BD006

Qcl - Landslide deposits (Quaternary) Unconsolidated sediments disturbed by slope failure in the form of slumps or slides. Deposits usually exhibit hummocky surface morphology and tipped, uprooted, and leaning trees and vegetation Unit description source: BD004

Qls - Landslide deposits (Holocene) Angular fragments of bedrock mixed with soil, or heterogeneous mixtures of boulders and finer grained material derived from adjacent steep hill slopes; characterized by irregular-shaped, hummocky topography and numerous closed depressions. Maximum thick Unit description source: BD006

Ql - Landslide deposits (Holocene) Mixed coarse and fine unconsolidated landslide deposits Unit description source: EA002

Qcl - Landslide deposits (Quaternary) Oval- to tongue-shaped heterogeneous mixture of fractured bedrock and pebble-cobble gravel with trace to some sand and silt deposited by near-surface to deep creep, flowing, and sliding due to instability of failed bedrock and unconsolidated surficial deposits. Unit description source: EA012

Qsp - Swamp deposits (Quaternary)

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

Qlp - Peat, peaty silt, and fen deposits (Holocene) Accumulations of peat in bogs and swamps. May be interstratified with loess or alluvium. Usually found in low-lying areas; deposits are up to several meters thick Unit description source: CI004

Qsp - Silt and peat (Quaternary) Organic silt deposited in swamps, black or mottled gray and brown. Mostly perennially frozen. Only the large areas of this unit in the vicinity of the Tanana valley are mapped Unit description source: BD002

Qs - Swamp deposits (Quaternary) Elongate to blanket deposits of complexly bedded peat, organic silt, and organic sand accumulated as surface deposits in local basins and in former stream channels. Saturated and locally frozen, locally ice rich. Thickness highly variable. Surface smooth Unit description source: EA009, EA012

Qht - Placer-mine tailings and artificial fills (Quaternary)

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

Qht - Placer tailings (Holocene) Irregular piles and mounds of mining waste and overburden. Consists mainly of gravel, sand, and minor silt. Unit description source: CI004

Qh - Placer-mine tailings and artificial fills (Quaternary, Holocene) Pebble-cobble gravel with

trace to some sand and silt forming bases for roads and airports and piled in active or former gravel pits, open-pit mines, and dredged areas. Well to poorly sorted. Surface smooth to irregular. Extent based primarily on distribution between July 1978 and August 1987 when the aerial photographs were taken. Unit description source: EA009, EA012

Qd5 - Neoglacial drift (late Pleistocene to Holocene)

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

Qd5 - Glacial drift (Holocene to late Pleistocene) Heterogeneous glacial diamicton and minor outwash deposits. Consists of nonstratified, poorly to moderately sorted sandy gravel with varying amounts of silt, clay, and boulders. Deposits are associated with valley-head moraines in cirques. Least extensive of all drift units recognized. Age uncertain, but probably late Pleistocene to Holocene. Unit description source: BD004, CI004

Qdo5 - Neoglacialfluvial outwash (late Pleistocene to Holocene)

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

Qdo5 - Glacialfluvial outwash (Holocene to late Pleistocene) Moderately to well sorted, clast-supported, cobble and small boulder gravel with minor silt and sand. Deposits form fluvial terraces that are related to glacial drift units by morphologic relations. Estimated age same as associated drift units. Outwash terraces are usually mantled by several feet of frozen eolian silt and sand. May have placer potential. Unit description source: BD004, CI004

Qm - Glacigenic deposits (Holocene and Pleistocene (?))

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

Qcd - Colluvial drift (Quaternary) Reworked surfaces of moraines and other glacial deposits. Consists mainly of retransported glacial diamicton and outwash. Contains varying amounts of sand, silt, and boulders. Unit description source: BD004

Qm - Glacial moraine deposits (Holocene and Pleistocene?) Poorly sorted, unconsolidated deposits of silt, sand, gravel, and boulders in small glacial cirques in southeastern part of map area and in adjacent, upper reaches of Boulder Creek. Maximum thickness unknown. Unit description source: BD006

Qd - Glacigenic deposits, undifferentiated (Quaternary) Includes all varieties of till, outwash, and minor colluviated drift or other diamicton. Consists of poorly sorted, generally nonstratified, gravelly sediment, with a sand and silt matrix. Age unknown. Unit description source: BD004, CI004

Qm - Morainal deposits (Pleistocene) Silty sand, gravel and boulders. Unit description source: EA002

Qm - Morainal deposits, undifferentiated (Quaternary) Boulders, gravel, sand, silty sand in terminal, lateral, cirque and ground moraine. Unit description source: CI002

Qm - Moraine deposits (Quaternary) Boulders, gravel, sand, and silty sand, in terminal moraine, lateral moraine, moraine in cirques, and ground moraine of several different ice advances. Unit description source: BD002

Qt - Terrace deposits (Holocene and Pleistocene (?))

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

Qt - Terrace deposits (Holocene and Pleistocene?) Fluvial sand and pebble-size gravel deposits restricted to Goodpaster River and its main tributary the Eisenmenger Fork, in northern part of map area; interfingers with older alluvial fan deposits (Qfo). Maximum thickness unknown. Unit description source: BD006

Qt - Terrace deposits (Holocene and Pleistocene) Alluvium in terraces standing as much as 150 m above present day stream level. Unit description source: CY002

Qa - Undifferentiated alluvium (Quaternary) Moderately to well-sorted cobble and pebble gravel, sand and silt. Undifferentiated with respect to age. Generally forms low terraces above active flood plains. May have placer potential. Unit description source: BD004, CI004

Qat3 - Young terrace alluvium (Quaternary) Elongate deposits of well-sorted, well-rounded to subrounded, stratified pebble-cobble gravel and sand with trace to some silt and rare to numerous boulders forming elevated benches bordering floodplains of larger streams. Unit description source: EA009

Qat3 - Young terrace alluvium (Quaternary) Elongate deposits of well sorted, well rounded to subrounded, stratified pebble-cobble gravel and sand with trace to some silt and rare to numerous boulders forming elevated benches bordering Mosquito Fork, Dennison Fork, North Fork, and Buckskin Creek floodplains. Clearly related to Recent drainage. Maximum tread elevation approximately 30 m above the present streams. Deposits may be capped by variable thickness of locally ice-rich primary and reworked eolian silt. Surface smooth to hummocky with local low scarps and bogs. Unit description source: EA012

Qat4 - Youngest terrace alluvium (Quaternary) Elongate deposits of well sorted, well rounded to subrounded, stratified pebble-cobble gravel and coarse sand with trace to some silt and rare to numerous boulders forming low terrace bordering Mosquito Fork floodplain. Clearly related to modern drainage. May be overlain by up to 3 m of locally ice-rich organic silt, muck, and overbank deposits. Surface smooth to hummocky with local low scarps and bogs. Unit description source: EA012

Qaf - Alluvial fan deposits (Holocene and Pleistocene (?))

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

Qaf - Alluvial fan deposits (Quaternary) Gray, tan, and brown sandy pebble-cobble gravel and pebble-cobble-boulder gravel having lenses and layers of sand, silt, and organic material. Unit description source: CI002

Qaf - Alluvial fan deposits, undifferentiated (Quaternary) Moderately sorted, crudely stratified, cobble and pebble gravel with minor sand and silt. Forms cone- or fan-shaped alluvial deposits along the base of mountain fronts and valley slopes. Usually clast-supported and may contain lenses or wedges of angular colluvial gravel. Unit description source: BD004, CI004

Qaf - Alluvial-fan deposits (Quaternary) Fan-shaped, heterogeneous mixtures of poorly to moderately sorted, partially stratified gravel with some sand and silt and scattered to numerous, subangular to rounded boulders, especially in proximal areas. Deposits are locally channelized across fan surface. Clasts generally locally derived from the immediate vicinity along the short, steep streams feeding many of the fans. May include torrential fluvial deposits and debris-flow deposits. Thick- to thin-bedded. Generally form at intersection between tributary and trunk streams. Surface smooth except for numerous shallow, interconnected channels. Unit description source: EA009, EA012

Qf - Fan deposits (Quaternary) Sand, gravel, and cobbles, in fairly well-stratified layers and lenses. Primarily distal segments of undifferentiated glacial outwash fans, mantled with loess. Unit description source: BD002

Qfo - Old alluvial fan deposits (Holocene and Pleistocene?) Poorly sorted silty sand and gravel deposited in inactive, generally large alluvial fans along the Goodpaster River and its tributaries in eastern part of map area; interfingers with terrace deposits (Qt). Maximum thickness unknown. Unit description source: BD006

Qaf - Surficial deposits, alluvial fan deposits (Quaternary, Holocene) Alluvial fan deposits. Unit description source: CY003

Qfy - Young alluvial fan deposits (Holocene) Poorly sorted silty sand and gravel that form small alluvial fans along margins of all major stream drainages. Maximum thickness unknown. Unit description source: BD006

Qa - Alluvium (Holocene and Pleistocene)

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

Qab - Abandoned flood plain alluvium (Quaternary) Gray to brown gravel, granule to boulder size, well-sorted, well-stratified, covered with as much as 8 m of silt and organic material. Perennially frozen. Unit description source: CI002

Qac - Alluvial and colluvial deposits (Quaternary) Boulder- to silt-size, unconsolidated alluvial and colluvial deposits. Unit includes material deposited in stream channels, flood plains, abandoned river and stream channels, swamps, and wetlands. Unit description source: BD003

Qaf - Alluvial and fluvial deposits (Holocene) Clay, silt, sand, and pebble to cobble gravel deposited in narrow stream channels and on broad alluvial slopes at base of low hills and mountain fronts and on steeper mountain flanks; locally includes minor colluvium (Qc). Maximum thickness unknown. Unit description source: BD006

Qa - Alluvial and fluvial deposits (Quaternary, Holocene) Clay, silt, sand, and pebble to cobble gravel deposited in narrow stream channels; locally includes minor colluvium (Qc). Maximum thickness unknown. Unit description source: EA015

Qa - Alluvium (Quaternary) Gravel, sand, silt; gray or buff, unconsolidated, well-stratified; mapped only in valleys of major streams. Includes gravel, sand, and silt of low terraces. Unit description source: BD002

Qa - Alluvium (Quaternary) Gravel, sand, and silt, gray, buff, or brown. Unconsolidated, well-sorted, well-stratified. Unit description source: CI002

Qa - Alluvium (Holocene and Pleistocene) Silt, sand, and gravel deposited as channel fill, floodplain, alluvial fan, and deltaic deposits. Unit description source: CY002

Qa - Alluvium (Holocene) Sand, gravel and silt along major streams. Unit description source: EA002

Qa - Alluvium of modern stream channels (Quaternary) Elongate deposits of moderately to well-sorted, well-stratified, fluvial pebble-cobble gravel, sand, and silt, with scattered to numerous boulders, deposited in active stream channels, floodplains, and associated low terraces. Unit description source: EA009, EA012

Qal - Flood-plain alluvium (Holocene) Moderately to well sorted cobble and pebble gravel, sand, and overbank silt on flood plains or in active stream channels. May contain organic detritus as discrete beds or layers. May be mantled by colluvial deposits along flood plain margins. Coarse-grained alluvium may contain placer deposits. Unit description source: BD004, CI004

Qfp - Flood-plain deposits (Holocene) Silt, sand, and gravel in flood plains of primary rivers and in some smaller periglacial channels of smaller tributaries; includes thick boulder gravel deposits and glacial outwash along Boulder Creek in east-central part of map area. Maximum thickness Unit description source: BD006

Qfp - Surficial deposits, floodplain deposits (Quaternary, Holocene) Flood-plain deposits. Unit description source: CY003

QI - Loess (Holocene and Pleistocene)

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

QI - Loess (Quaternary) Silt, eolian; light brown to brownish gray, unconsolidated, well-sorted, massive to poorly stratified; locally mottled by iron stains. In places contains ventifacts. Thickness ranges from 1 to 50 m. Unit description source: BD002

QI - Loess (Quaternary) Silt and sandy silt, eolian, yellowish-gray to light-gray. Well-sorted, homogeneous, unconsolidated, generally perennially frozen. Unit description source: CI002

QI - Loess (Pleistocene) Wind-blown silt and sand, includes alluvium, colluvium, or other surficial materials in places. Unit description source: CY002

Qdo - Glacifluvial outwash, late Wisconsin age (Holocene and Pleistocene)

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

Qdo4 - Glacifluvial outwash (Late Pleistocene) Moderately to well sorted, clast-supported, cobble and small boulder gravel with minor silt and sand. Deposits form fluvial terraces that are related to glacial drift units by morphologic relations. Estimated age same as associated drift units. Outwash terraces are usually mantled by several feet of frozen eolian silt and sand. May have placer potential. Unit description source: BD004, CI004

Qdo - Outwash of Donnelly glaciation (Quaternary) Gravel and sandy gravel, light yellowish-brown to gray, moderately to well-rounded, in unconsolidated well-stratified layers and lenses. Unit description source: BD002

Qd4 - Glacial drift, late Wisconsin age (late Pleistocene)

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

Qd4 - Glacial drift (Late Pleistocene) Heterogeneous glacial diamicton associated with unmodified knob-and-kettle moraine. Consists of till and minor outwash. Sediment ranges from poorly sorted bouldery gravel in a silty matrix to well-sorted sandy gravel. Less extensive than Qd3 but more extensive than Qd5. Age uncertain, but probably late Pleistocene. Unit description source: BD004, CI004

Qdr - Older glacial drift, pre-late Wisconsin age (middle to late Pleistocene)

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

Qd3 - Glacial drift (Middle to Late Pleistocene) Heterogeneous glacial diamicton in moraines and minor glaciofluvial deposits. Drift bodies and moraines are partially subdued and locally exhibit hummocky, ice-stagnation topography. Natural exposures and hand-dug pits reveal poorly sorted silty gravel and moderately well sorted, sandy gravel with variable amounts of boulders and cobbles. Less extensive than Qd2 but more extensive than Qd4. Age uncertain, but probably middle to late Pleistocene. Unit description source: BD004, CI004

Qdo3 - Older glaciofluvial outwash, Wisconsin age (middle to late Pleistocene)

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

Qdo3 - Glaciofluvial outwash (Middle to Late Pleistocene) Moderately to well sorted, clast-supported, cobble and small boulder gravel with minor silt and sand. Deposits form fluvial terraces that are related to glacial drift units by morphologic relations. Estimated age same as associated drift units. Outwash terraces are usually mantled by several feet of frozen eolian silt and sand. May have placer potential. Unit description source: BD004, CI004

Qdo1 - Glaciofluvial outwash, pre-Wisconsin age (Holocene and Pleistocene)

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

Qdo1 - Glaciofluvial outwash (Early to middle Pleistocene) Moderately to well sorted, clast-supported, cobble and small boulder gravel with minor silt and sand. Deposits form fluvial terraces that are related to glacial drift units by morphologic relations. Estimated age same as associated drift units. Outwash terraces are usually mantled by several feet of frozen eolian silt and sand. May have placer potential. Unit description source: BD004, CI004

Qdlo - Outwash of Delta glaciation (Quaternary) Gravel silty or sandy, with lenses of well-sorted sand; light yellowish -brown. Gravel well-rounded, poorly to moderately well-sorted in unconsolidated moderately well-stratified layers. Unit description source: BD002

Qd1 - Glacial drift, Illinoian age (Holocene and Pleistocene)

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

Qd2 - Glacial drift (Middle Pleistocene) Heterogeneous glacial diamicton associated with subdued moraine and outwash deposits. Usually present as isolated remnants on valley floors inside limits of Qdl. Consists of poorly sorted to moderately well sorted silty gravel with variable amounts of silt, sand, and boulders. Age uncertain, but probably middle Pleistocene. Morainal crests generally wind deflated and littered with highly weathered and pitted erratic boulders. Unit description source: BD004

Qd1 - Glacial drift (Early to middle Pleistocene) Heterogeneous glacial diamicton, present in very subdued drift bodies that partially cap ridges and knolls. Includes varying amounts of till, outwash, colluviated drift, and gelifluction deposits. Consists of poorly sorted, silty gravel. Locally frozen below depths of about 3 feet. Age uncertain but is probably early to middle Pleistocene. Qdl is the most extensive drift recognized. Generally not associated with recognizable morainal topography. Contains exhumed, highly weathered erratic boulders. Unit description source: BD004, CI004

Qdlm - Morainal deposits of Delta glaciation (Quaternary) Till, sandy, yellowish-gray to light reddish-brown, unconsolidated, unstratified. Gravel is angular to well-rounded, 2 cm to 24 cm in diameter. Unit description source: BD002

Qfp - Floodplain alluvium (Quaternary)

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

Qfp - Floodplain alluvium (Quaternary) Elongate deposits of moderately to well-sorted, well-stratified, fluvial gravel, sand, and silt with scattered to numerous boulders in floodplains and associated low terraces. Locally auriferous. Deposits may reflect former channels and flow regimes. Unit description source: EA009, EA012

Qac - Abandoned channel deposits (Quaternary)

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

Qab - Abandoned flood plain alluvium (Quaternary) Unconsolidated silt, sand, pebbles, and cobbles, in well-stratified layers and lenses. Light to dark gray and buff to brown; includes much organic material and grades into swamp deposits in poorly drained areas. Unit description source: BD002

Qac - Abandoned channel deposits (Quaternary) Elongate deposits of variable grain size, sorting, and bedding style deposited in channels of former streams not related to modern stream regimes. These deposits are closely related to the oldest terrace deposits (Qat1) found throughout the Fortymile mining district. Composition ranges from thin, local surface lags of cobbles and boulders to thick deposits of well sorted, clean pebble-cobble gravel, and gravelly medium to coarse sand with rare to numerous cobbles up to 0.5 m diameter. Thin to thick bedded, locally crossbedded. Deposits

reflect former channels and flow regimes that may be related to early Pleistocene glaciations in the regional stream headwaters. Locally thickly mantled by ice-rich, primary and reworked silt deposits. Surface disturbances of the silt mantle, such as from excavation, commonly result in melting and subsequent slumping and flowage. Placer mining in upper Lost Chicken Creek has exposed more than 8 m of frozen silt and gravel overlying auriferous channel gravels. The channel gravels of upper Lost Chicken Creek consist of well bedded, clast supported, pebble-cobble gravel and sand, with rounded to well-rounded clasts up to 13 cm diameter. The deposit is characterized by numerous limonite-filled fractures, prominent orange stains on bedding planes, and extensive limonite and MnO staining. Twigs and large wood in association with the channel gravels are abundant, but all analyzed material returned infinite dates. The Lost Chicken tephra is preserved in 0-6 cm thick discontinuous lenses and pods of fine white ash approximately 26 cm above the top of the auriferous channel gravels. Naeser and others (1982) used fission-track methods on zircon microphenocrysts and glass shards to date the tephra at 1.7 to 2.6 Ma. Surface smooth with local low scarps and bogs. Unit description source: EA012

Qac - Apparent abandoned channel (Quaternary) Apparent abandoned channel. Unit description source: BD005

Qs - Sand (Quaternary)

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

Qs - Sand (Quaternary) Sand, eolian; yellowish brown to grayish orange, light gray and olive gray, unconsolidated, forms dunes as much as 21 m high and dune fields 1 or more square kilometers in area. Sand is commonly overlain by as much as 1 m of loess. Unit description source: BD002

Qsu - Silt and peat (Quaternary)

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

Qs - Silt and peat (Quaternary) Organic silt deposited in swamps. Black, dark-gray, mottled dark-gray and brown. Mostly perennially frozen. Unit description source: CI002

Qsu - Silt, undifferentiated and organic material (Quaternary) Gray, dark-gray, dark-brown or black silt, organic silt, and peat, containing local sandy lenses and layers. Locally highly organic, generally perennially frozen. Up to 60 m thick. Unit description source: CI002

Qrg - Rock-glacier deposits (Quaternary)

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

Qrg - Rock-glacier deposits (Quaternary) Lobate or tongue shaped accumulations of bouldery talus and scree exhibiting evidence of downslope movement. Often characterized by multiple crescentic ridges that are parallel to but upslope of deposit terminus. Unit description source: CI004

Qcg - Gelifluction deposits (Quaternary)

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

Qcg - Gelifluction deposits (Quaternary) Poorly sorted to angular gravel with varying amounts of sand, silt, and clay. Forms lobate sheets or individual tongues of reworked sediments on underlying deposits that are prone to seasonal freezing and thawing. Well developed in older, subdued glacial drift. Unit description source: BD004, CI004

QTd - Undifferentiated drift (Quaternary or Pliocene)

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

Qd - Undifferentiated drift (Quaternary [or Pliocene]) Heterogeneous mixtures of poorly to moderately sorted, subangular to rounded boulders, gravel, sand, and silt believed to be deposited by ancient alpine glaciers. Preserved as extremely localized, irregular patches of possible drift characterized by hummocky topography with a surface scattering of angular to subrounded boulders up to 1.5 m diameter, and associated with coarse boulder lags in streams that form small rapids. Identified only in two localities in the southeastern map area. Associated valley headwalls in the highest elevations exhibit subdued cirque-like morphology that is especially apparent on northern faces. Valley cross-profiles are highly modified U-shaped, with streams that are markedly underfit for the relative valley width. Based on characteristics such as subdued morphology, elevation of source areas, and apparent extreme age, the mapped deposits may be correlative with glacial deposits of Charley River age (early Pleistocene) mapped by Weber (1986) in the Yukon-Tanana Upland. Unit description source: EA009

QTs - Old terrace deposits (Quaternary and Tertiary)

QTs - Poorly consolidated surficial deposits (Quaternary, Pleistocene, and uppermost Tertiary) See [QTs](#) for unit description from: [USGS SIM-3340](#)

Tg - Gravel-rich terrace deposits (Tertiary, post-Paleocene) Residual boulder and gravel deposits with lesser amounts of clay, sand, and silt deposited on flat to gently sloping undissected surfaces throughout northeastern extent of map area at elevations between 300 and 600 m above adjacent drainages. Overlies Paleocene welded tuffs (Tr) in northeastern part of map area. Interpreted to cover a middle Tertiary erosion surface developed prior to major incision of the Goodpaster River and its main tributaries. Unit description source: BD006

Qt - Intermediate and high terrace deposits (Holocene and (or) Pleistocene) Silt, sand, and gravel form high level terrace deposits along the Fortymile and Seventymile Rivers, locally as much as 215 m above present streams (Foster, 1976). Windblown silt and sand (loess) locally mantle terrace deposits along Yukon River. Unit description source: EA002

Qat2 - Old terrace alluvium (Quaternary) Elongate deposits of well-sorted, well-rounded to subrounded, pebble-cobble gravel and sand with trace to some silt and rare to numerous boulders forming elevated benches bordering major streams. Probably related to Pleistocene drainage. Maximum tread elevation approximately 100 - 130 m above the present streams. Thickness highly variable. Deposits locally capped by variable thickness of ice-rich primary and reworked eolian silt. Surface smooth to hummocky with local low scarps and bogs. Unit description source: EA009, EA012

Qat1 - Oldest terrace alluvium (Quaternary) Elongate deposits of well-sorted, well-rounded to

subangular, generally poorly stratified gravel, sand, and silt, possibly of glaciofluvial origin, forming elevated benches bordering major streams. Especially prominent and continuous on north side of Walker Fork valley and lower Canyon Creek. Maximum tread elevation approximately 200 to 220 m above the present streams. Thickness highly variable, ranging from thin gravel veneers on bedrock to a reported maximum of 40 m at Napoleon Creek in the Eagle A-2 Quadrangle (Yeend, 1996). Drilling by a placer miner on the north side terrace of Walker Fork near Boundary showed maximum gravel thicknesses of approximately 13 m. Maximum cobble size observed was 0.5 m diameter, but most large clasts are in the range of 0.1 to 0.2 m diameter. Mostly clast-supported, with a medium to coarse, subangular sand matrix. Locally stained orange by limonite. While generally massive and structureless, exposures may locally preserve bedding structures, boulder lags, and ice-wedge casts up to 2 m tall. Locally thickly mantled by ice-rich, primary and redeposited eolian silt. Surface generally smooth and heavily vegetated. Bench gravels are auriferous and have been successfully mined at Napoleon Creek and upper Walker Fork. Unit description source: EA009

Qat1 - Oldest terrace alluvium (Quaternary) Elongate deposits of well sorted, well rounded to subangular, generally poorly stratified gravel, sand, and silt, possibly of glaciofluvial origin, forming elevated benches bordering Mosquito Fork, Dennison Fork, North Fork, Buckskin Creek, Uhler Creek, Napoleon Creek, and Chicken Creek basin. Maximum tread elevation approximately 165 - 230 m above the present streams. Thickness highly variable, ranging from thin gravel veneers on bedrock near Wall Street Creek and Dennison Fork to 15 m thick observed in the Napoleon Creek area. Yeend (1996) reported maximum gravel thickness of 40 m at Napoleon Creek. Maximum cobble size observed was 0.5 m diameter, but most clasts are in the range of 0.1 to 0.2 m diameter. Mostly clast-supported, with a medium to coarse, subangular sand matrix. Locally stained orange by limonite. While generally massive and structureless, a vague bedding fabric at Napoleon Creek suggests a slight (~9 degree) dip to the west. Locally thickly mantled by ice-rich, primary and redeposited eolian silt. Surface generally smooth and heavily vegetated. Bench gravels are auriferous and have been very successfully mined at Napoleon Creek. Unit description source: EA012

Tb - Basalt ((late) Tertiary)

Tvu - Volcanic rocks of southern Alaska (Tertiary, Pliocene? and older) See [Tb](#) for unit description from: [USGS SIM-3340](#)

ITb - Alkali basalt (late Tertiary) Dark gray, variably vesicular, alkali basalt containing phenocrysts of olivine + augite, in an aphanitic groundmass of augite + plagioclase + magnetite, with calcite-filled amygdules. Magnetic susceptibility is high, typically $\sim 5 \times 10^{-3}$ SI. Unit description source: EA009

Tb - Basalt (Tertiary) Dark-gray to black, nonfoliated basalt dike containing small, randomly oriented plagioclase phenocrysts set in devitrified aphanitic groundmass. Age uncertain, but may be correlative with a 50 Ma basaltic dike swarm occurring throughout Yukon-Tanana Upland. Unit description source: BD003

Thm - Basalt dikes (Tertiary, Eocene?) Dark-gray to black, nonfoliated basalt dikes containing small, randomly oriented plagioclase phenocrysts set in devitrified aphanitic groundmass. Age uncertain, but may be correlative with 50-54 Ma suite of bimodal volcanic rocks; basaltic dike swarms are commonly associated with these rocks throughout this part of the Yukon-Tanana Upland. Unit description source: BD006

Tbeq - Basaltic to andesitic dikes (Tertiary, Eocene?) Dark-gray to black, non-foliated basalt dike containing small, randomly oriented plagioclase phenocrysts set in devitrified aphanitic groundmass. Age uncertain, but may be correlative with a 50-54 Ma suite of bimodal volcanic rocks; basaltic dike swarms are commonly associated with these rocks throughout this part of the Yukon-Tanana Upland (Newberry and others, 1995, 1998). Non-foliated fabric indicates intrusions were emplaced after regional ductile deformation occurred (post-Early Jurassic, Dusel-Bacon and others, 2006). Unit description source: EA015

Tcs - Conglomerate and sandstone (Tertiary)

Tsu - Sedimentary rocks, undivided (Tertiary) See [Tsu](#) for unit description from: [USGS SIM-3340](#)

Tcs - Conglomerate and sandstone (Tertiary) Mostly gray or tan, but locally pink or orange-brown conglomerate. Ranges in grain size from coarse to fine, grades into sandstone. Sandstone is gray, tan, iron-oxide stained, commonly with "salt and pepper" appearance, fine to coarse-grained and locally slightly argillaceous. Locally chunks of lignite and coal(?) are found in float associated with unit. Unit description source: CI002, CI003

Tcs - Conglomerate, Sandstone, Siltstone, Shale (Tertiary) Light gray, poorly consolidated, poorly bedded. Conglomerate clasts are well-rounded to fairly angular and extremely variable in size ranging from granules to 1 m boulders of several types of granitic rock, gneiss, white quartz, and rarely schist. Sand Unit description source: BD002

Tng - Nenana gravel (Tertiary)

Tng - Nenana Gravel (Tertiary, Pliocene and upper Miocene) See [Tng](#) for unit description from: [USGS SIM-3340](#)

Tn - Nenana gravel (Tertiary) Conglomerate and minor amounts of sandstone; yellowish-gray to reddish-brown, poorly consolidated, well-sorted. Conglomerate particles, mostly well-rounded, up to 8 cm in diameter, characteristically iron-stained. Unit description source: BD002

Tcb - Coal-bearing sedimentary rocks (Tertiary)

Tcb - Coal-bearing sedimentary rocks (Tertiary, Pliocene to Eocene?) See [Tcb](#) for unit description from: [USGS SIM-3340](#)

Tcb - Coal-bearing formation (Tertiary) Sandstone, siltstone, claystone, and conglomerate, light-yellowish-gray to light-reddish-brown, poorly consolidated, easily eroded. Conglomerate particles mostly well-rounded quartz and chert as much as 4 cm in diameter. Lignitic coal layers as much as 30 cm thick are rare. Limonitic sandstone concretions common. Unit description source: BD002

Ts - Sedimentary rocks (Tertiary) Conglomerate, sandstone, tuffaceous sandstone, tuff, shale, and lignitic coal. Considered non-marine. Sources appear to be local, except along Tintina Fault. Age uncertain, some clearly Miocene or Pliocene, some may be older and may include some rocks of Cretaceous age. Unit description source: EA003

Ti - Intermediate volcanic rocks (Tertiary (?))

Tvu - Volcanic rocks of southern Alaska (Tertiary, Pliocene? and older) See [Tvu](#) for unit description from: [USGS SIM-3340](#)

Ti - Intermediate volcanic rocks (Tertiary (?)) Lava, volcanic breccia and tuff. Mostly of andesitic composition. Unit description source: EA002

Tbg - Basalt, microgabbro, and diabase (Tertiary)

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

Tb - Basalt (Tertiary (?)) Fine- to coarse-grained, dark greenish black basalt. Weathers rusty brown. Unit description source: EA002

Tg - Microgabbro/diabase (Tertiary) Fine- to medium-grained (1-5 mm) tholeiitic microgabbro or diabase. Typical mineralogy is 50-70 percent felsic plagioclase laths, 30-50 percent altered clinopyroxene + olivine, 3-5 percent magnetite + ilmenite, and 0-3 percent biotite. Although previously mapped as fine- to coarse-grained basalt (Foster, 1976), the absence of columnar jointing, layering, vesicles, volcanic breccias, or other evidence of extrusive character suggests that this unit is predominantly of shallow (?) intrusive origin or the interior portion of a thick flow. Contacts with adjacent units, where exposed, are high-angle and sheared, suggesting faulted intrusive contacts. Ar/Ar biotite plateau age of 57.5 Ma (sample 1; table 1). Probably correlates with Tertiary basalts of similar major- and trace-element compositions (within-plate) throughout Interior Alaska. Early Tertiary resets in Ar spectra for minerals of the Chicken area and some early Tertiary Ar/Ar isochrons (Layer and others, 2001) indicate this magmatism may have been extensive in the study region. Relatively unaltered mafic dikes (too small to be shown at map scale) are sporadically present elsewhere in the map area and probably represent the same early Tertiary magmatism. Magnetic susceptibility of the unit is moderate to high, usually 1–11 x 10 SI. Large bodies spatially correspond to aeromagnetic lows, indicating they are reversely magnetized, similar to Tertiary basalt in the Fairbanks area (Roe and Stone, 1993). Unit description source: EA012

Tw - Welded tuff (Tertiary (?))

TKwt - Welded tuff and other felsic volcanic rocks (early Tertiary? and early Late Cretaceous) See [TKwt](#) for unit description from: [USGS SIM-3340](#)

Tf - Felsic igneous rocks (Tertiary (?)) Felsic shallow intrusive rocks including porphyries, tuffs, welded tuffs, and volcanic breccia. Unit description source: EA002

Tw - Welded tuff (Tertiary (?)) Siliceous light-gray welded tuff that weathers tan or orange brown. Unit description source: EA002

Tpt - Felsic igneous rocks (Tertiary)

Tpt - Pyroclastic rocks (Tertiary, early Eocene or Paleocene) See [Tpt](#) for unit description from: [USGS SIM-3340](#)

Tf - Felsic igneous rocks (Tertiary) Lava, shallow, intrusives and dikes and sills. Lava in eastern part of quad, gray with smoky quartz, sanidine, plagioclase, biotite, and hornblende phenocrysts. Phenocrysts may be as long as 2 - 5 mm. Some are 10 mm long. Rock generally fractured and crumbly. Locally glass matrix; glass has perlitic dehydration cracks. Unit description source: BD002

Tr - Rhyolite (Paleocene) Dark-gray to white, crystal-rich biotite-hornblende rhyolitic welded tuff. Phenocrysts of quartz, sanidine, biotite, and hornblende make up to 20-25% of rock. Local silicic and argillic alteration. Contains vent-facies devitrified crystal-rich rhyolite vitrophyre. Part of rhyolite flow-dome complex in northeast part of quad straddles and potentially overlies the Black Mountain tectonic zone to the east. Unit description source: BD006

Tfv - Rhyolite dikes (Tertiary) Light-gray, nonfoliated rhyolite dikes containing as much as 10%

feldspar phenocrysts set in an aphanitic groundmass. Dikes are thin, approximately 1-3 m wide, and cut Cretaceous intrusive rocks and Tertiary rhyolitic volcanic rocks. Absolute age uncertain, but presumed to be either part of the Tertiary volcanism (Tr) or part of 50-54 Ma suite of bimodal volcanic rocks associated with unit Tb.

TKs - Sedimentary rocks (Pliocene (?) and (Late) Cretaceous)

TKs - Conglomerate, sandstone, and lignite (lower Tertiary to Upper Cretaceous) See [Tks](#) for unit description from: [USGS SIM-3340](#)

TKd - Detrital rocks (Pliocene (?) to Late Cretaceous (??)) Conglomerate, sandstone, mudstone, shale, breccia and lignite. Nonmarine, folded and faulted. Unit description source: EA002

TKs - Sandstone, mudstone, and conglomerate (Tertiary (Pliocene?) and (Late) Cretaceous) Sandstone and conglomerate, poorly sorted, friable, composed mostly of lithic fragments and about 5 percent potash feldspar. Thin, lignitic coal beds common. Non marine. Thickness 200 to at least 3,000 feet. Unit description source: CY003

TKs - Sedimentary rocks (Tertiary and Cretaceous) Conglomerate, sandstone, tuffaceous sandstone, tuff, shale, and lignitic coal. Considered non-marine. Present in Tanacross and Eagle quadrangles. Sources appear to be local, except along Tintina Fault. In Eagle quadrangle limited fossil data indicate. Unit description source: EA007

Ts - Sedimentary rocks (Tertiary) Poorly- to well-indurated, nonmarine sedimentary rocks of Tertiary age, as established by pollen (Foster, 1976; Foster and Igarashi, 1990). The unit typically consists of conglomerate, with lesser sandstone, shale, siltstone, and graywacke. Magnetic susceptibility is very low, $<0.1 \times 10^{-3}$ SI (Système International). Spatial association with placer-gold-bearing gravels in the Baby Creek area suggests that this unit may be gold-bearing as well. The unit is truncated by high-angle faults; unconformable contacts with older units are not observed. Unit description source: EA009

Ts - Sedimentary rocks (Tertiary) Poorly- to well-indurated, nonmarine sedimentary rocks of early Tertiary age, as established by plant fossils (Foster, 1976). Typically consists of conglomerate, sandstone, shale, amber-bearing coal, siltstone, and graywacke. Includes local felsic tuff, usually rhyolite composition, with distinctive quartz and sanidine phenocrysts in a light colored, fine-grained matrix or fine-grained, layered ash tuff. Total thickness of unit in excess of 140 m. Silicified basal conglomerate with cobbles to 1 m is over 40 m thick in lower Napoleon Creek. Magnetic susceptibility is very low, $<0.1 \times 10^{-3}$ SI (Système International). Petrified wood, within massive black chalcidony containing abundant plant fossils, is locally present in the Chicken area. Silicified and altered regional correlatives of this unit contain epithermal gold prospects, as at Ptarmigan Hill, 10 km west of Eagle, Alaska, and Grew Creek, near Ross River, Yukon Territory (Newberry and others, 1998b). Spatial association with placer gold-bearing gravels in the Chicken and Napoleon Creek areas suggests that this unit may be gold-bearing as well. The unit is usually truncated by high-angle faults; unconformable contacts with older units are only rarely observed. The age of this unit may extend into the Cretaceous (based on Ar/Ar biotite plateau age of 105.4 Ma and white mica plateau age of 108.8 Ma on tuffaceous? material, east side of Ingle Creek, Eagle A-3 Quadrangle; Layer and others, 2001). Unit description source: EA012

TKs - Undifferentiated Cretaceous sediments (Tertiary and Late Cretaceous) Sandstone, mudstone, and conglomerate with thin lignitic coal stringers. Unit description source: CY005

TKg - Granitic rocks (Tertiary and Cretaceous)

TKg - Felsic granitic rocks (Tertiary, Paleocene, or Late Cretaceous, Maastrichtian) See [TKg](#) for unit description from: [USGS SIM-3340](#)

TKf - Felsic igneous rocks (Tertiary and/or Cretaceous) Light-gray weather, gray to tan, fine- to coarse-grained quartz porphyry. Hypabyssal(?) Unit description source: CI002

TKg - Granite (Tertiary and/or Cretaceous) Mostly light- to medium-gray, hypidiomorphic granular to porphyritic granite. Biotite most common mafic mineral, hornblende locally present. Incidental two-mica granite. Unit description source: CI002

TKg - Granite (Tertiary and/or Cretaceous) Mostly light- to medium-gray, hypidiomorphic granular to porphyritic granite. Unit description source: CI003

Tg - Granitic rocks (Tertiary) Quartz monzonite to granite; medium to coarse grained; equigranular to porphyritic; massive without linear or planar fabric or microfabric; commonly weathered and crumbly. Only plutons with Tertiary K-Ar dates are included in this unit. Plutons that may be Tertiary but are undated are included in TKg. Unit description source: BD002

TKg - Granodiorite to quartz monzonite (Tertiary and Cretaceous) Medium grained; equigranular to porphyritic; massive without linear or planar fabric. The rocks contain biotite, hornblende, muscovite, with biotite the most common mafic mineral. The rocks in this unit are not radiometrically dated. Unit description source: BD002

TKgd - Granodiorite (Late Cretaceous to Paleocene)

TKg - Felsic granitic rocks (Tertiary, Paleocene, or Late Cretaceous, Maastrichtian) See [TKg](#) for unit description from: [USGS SIM-3340](#)

TKgd - Granodiorite (Paleocene to late Cretaceous) Light- to dark-gray, fine- to medium-grained, equigranular to porphyritic, biotite-hornblende granodiorite. Estimated mode: 45 percent plagioclase (An40-45), 30 percent quartz, 20 percent K-feldspar, 2 percent hornblende, 2 percent biotite, and <1 percent zircon and calcite as accessories. Unit description source: CI004

TKJg - Granite and Alaskite (Jurassic to Tertiary)

TKg - Felsic granitic rocks (Tertiary, Paleocene, or Late Cretaceous, Maastrichtian) See [TKg](#) for unit description from: [USGS SIM-3340](#)

TJcp - Chicken Pluton Porphyry (Tertiary? to Jurassic) One small body of medium- to coarse-grained, pink and gray, K-feldspar-porphyritic biotite hornblende granite. Typical modal mineralogy consists of 20-28 percent quartz, 20-30 percent plagioclase, 30-40 percent K-feldspar, 5-15 percent hornblende, 10-20 percent biotite, and less or equal to 1 percent opaques. Intrudes the southern margin of the Chicken pluton (Jc). Magnetic susceptibility is 9-9.5 x 10 SI. Spatially associated with aplite dikes. Southern margin is structurally brecciated adjacent to fault. Unit description source: EA012

Kg - Cretaceous granite (Cretaceous) Chloritized porphyritic (hornblende) biotite monzogranite; 5--10 mm quartz and 10--45 mm microcline phenocrysts in 2--5 mm groundmass; primary trace minerals include zircon, allanite, apatite, and ilmenite; plagioclase extensively zoned, and appreciably sericitized; trace hornblende slightly altered to biotite; biotite slightly to completely altered to chlorite, rutile, sphene, magnetite, and calcite; thin quartz-chlorite veins and veinlets are common;

disseminated sericite-quartz alteration (pattern) and sericite-quartz veinlets occur sporadically in the granite; anomalous gold concentrations are spatially associated with the sericite-quartz occurrences; apparent K-Ar ages vary from 57 ± 2 to 71 ± 2 Ma.; Ar-Ar age dating studies indicate age resetting due to Tg intrusion, a likely age of 90 ± 2 Ma. Unit description source: CI005

TKg - Granite (Tertiary and Cretaceous) Primarily biotite granite in Circle and Big Delta quadrangles, some plutons also contain hornblende and muscovite. Also includes hornblende diorite, hornblende syenite, and hornblende quartz monzonite of Mount Fairplay in the Tanacross quadrangle (coded separately as NSA 1660). Unit description source: EA003

Kgg - Granite of Gold Bottom Creek (Late Cretaceous) Light-gray, non-foliated biotite-hornblende granitic hypabyssal intrusion with characteristic coarse-grained dark gray smoky quartz phenocrysts, which exhibit both rounded and euhedral morphology, set in a fine-grained granitic groundmass. Crystallization U-Pb SHRIMP age of 67.9 ± 1.1 Ma (table 1, sample 4) is within analytical error of that of the granite of Veta Creek (Kgvc) and the granite of Kechumstuk Creek (Kgkc); thus all these late Cretaceous granitic units are thought to be coeval. Unit description source: EA015

Kgkc - Granite of Kechumstuk Creek (Late Cretaceous) Light-gray, homogeneous, fine-grained, non-foliated biotite granite. Occurs as isolated intrusion east of the Kechumstuk fault zone. SHRIMP U-Pb zircon crystallization age of 67.7 ± 0.7 Ma (table 1, sample 3). Temporally and compositionally similar to granitic and rhyolitic units Kgvc, Kgg, and Kr, indicating unit was part of a broad Late Cretaceous intrusive event. Unit description source: EA015

Kgvc - Granite of Veta Creek (Late Cretaceous) Light-gray, homogeneous, medium-grained, non-foliated biotite-hornblende granite with minor alkali feldspar phenocrysts up to 1.5 cm diameter. Unit intrudes base of quartz monzonite of Mount Veta (Jgmv). SHRIMP U-Pb zircon crystallization ages ~ 65.8 Ma (table 1, samples 1 and 2). Unit description source: EA015

Kggp - Porphyritic granite of Gold Bottom Creek (Late Cretaceous) Greenish-gray, non-foliated, porphyritic late-phase of granite of Gold Bottom Creek intrusion. Unit is porphyritic with distinctive dark gray "smoky" quartz phenocrysts in fine-grained gray silicified matrix. Unit is hydrothermally altered with distinctive network of quartz veins with minor disseminated pyrite and molybdenite. Unit description source: EA015

TMZmi - Mafic igneous rocks (Tertiary (?) and Mesozoic (?))

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

TMzm - Mafic igneous rocks (Tertiary (?) and Mesozoic (?)) Primarily basalt and gabbro with minor diabase and diorite, northern half of quadrangle. Unit description source: EA002

TMZd - Quartz diorite (Tertiary (?) and Mesozoic (?))

TKgd - Granodiorite to quartz monzodiorite (Tertiary, Paleocene, or Late Cretaceous, Maastrichtian) See [TKgd](#) for unit description from: [USGS SIM-3340](#)

TMzd - Diorite (Tertiary (?) and Mesozoic (?)) Diorite, quartz diorite and diorite porphyry with minor granodiorite and gabbro. Unit description source: EA002

TMZm - Gabbro with basalt and andesite (?) (Tertiary (?) and Mesozoic (?))

Jg - Plutons of the Yukon-Tanana Upland (Early Jurassic) See [Jg](#) for unit description from: [USGS SIM-3340](#)

TMzm - Mafic igneous rocks (Tertiary (?) and Mesozoic (?)) Primarily basalt and gabbro with minor diabase and diorite, southern half of quadrangle. Unit description source: EA002

Jcp - Biotite clinopyroxenite dikes (Jurassic) Fine- to coarse-grained, dark green, generally unfoliated and equigranular (rarely porphyritic) dikes. Typical modal mineralogy consists of 15–90 percent clinopyroxene, 0–50 percent amphibole (secondary?), 0–30 percent plagioclase, 0–7 percent biotite, 0–4 percent quartz, and 3–5 percent opaques. Locally highly altered. Secondary minerals include actinolite, chlorite, talc, carbonate, epidote, clinozoisite, opaques, carbonate, and sericite. Magnetic susceptibilities vary from 0.01–0.7 x 10 SI to 3.6–5.1 x 10 SI. Spatially co-extensive with the Napoleon pluton and Jg intrusions in northwestern map area and generally not foliated. Compositionally and texturally similar biotite clinopyroxenite dikes in the northeastern Eagle Quadrangle yield K-Ar ages of 184–185 Ma (Newberry and others, 1998). Such biotite clinopyroxenite bodies are also known to bear platinum group metals (PGM) (Foley and others, 1989) and placers in Napoleon Creek are reported to contain anomalous PGM values (Cathrall and others, 1989). A clinopyroxenite dike/inclusion within the Napoleon pluton contains up to 25 ppb platinum and 6 ppb palladium (Weldon and others, 2000). Unit description source: EA012

MzPzmh - Metahornblendite dike (Early Jurassic and older (pre-Early? Cretaceous)) Black, coarse-grained, foliated metahornblendite dike. Age uncertain, but presence of tectonic foliation indicates unit present during regional pre-Early Cretaceous deformation. Unit description source: EA015

TKMZmgr - Granitic rocks (Triassic to Tertiary)

Kmgr - Granitic rocks of central and southeast Alaska (Cretaceous, Coniacian to Albian) See [Kmgr](#) for unit description from: [USGS SIM-3340](#)

Kgb - Goodpaster batholith (Early Cretaceous) Composite batholith made up of nonfoliated to weakly foliated, coarse-grained, equigranular biotite granodiorite, granite, and pegmatite. Unit description source: BD003

Kgbf - Goodpaster batholith - early intrusive phase (Early Cretaceous) Medium-grained, hypidiomorphic, equigranular, moderately foliated biotite +/- hornblende granodiorite along southern margin of Goodpaster batholith. Foliation parallels east-trending trace of southern margin; interpreted to be flow foliation related to emplacement. Distinguished from Kgtc by presence of hornblende, a foliated fabric, and minor sericitic and iron oxide alteration. Unit description source: BD006

Kgb - Goodpaster batholith - main intrusive phase (Early Cretaceous) Equigranular, nonfoliated, coarse-grained hornblende-biotite granodiorite. Locally weathers to distinctive ochre-colored gneiss. Unit forms relatively low-lying hills along center of Goodpaster River watershed. Unit description source: BD006

Kg - Granite and granodiorite (Cretaceous) Granite, granodiorite and locally includes quartz monzonite, diorite, aplite, alaskite, and pegmatite. Light-gray to pinkish-gray, fine- to coarse grained, but generally medium-grained. Unit description source: CY007

Kg - Granitic rocks (Cretaceous) Granitic rocks. Unit description source: CY007

Kgmh - Granitic rocks of Mount Harper batholith (Early Cretaceous) Predominantly medium-grained, equigranular, light-gray to light-pink, massive, nonfoliated biotite granodiorite to granite with

local enclaves of hornblende-biotite diorite. Locally weak to moderate foliation; interpreted to be from shearing along margin during emplacement. Unit description source: BD006

Kgcd - Granitoid dike (Early Cretaceous) Composite granitoid dikes; highly variable compositions include light-gray, fine-grained, equigranular, nonfoliated biotite granodiorite, coarse-grained leucogranite, and simple biotite quartz alkali-feldspar pegmatite. Unit description source: BD003

Kgcd - Granitoid dikes and plugs (Early Cretaceous) Composite granitoid dikes located west of Last Chance fault; highly variable compositions include light-gray, fine-grained, equigranular, nonfoliated biotite granodiorite, coarse-grained leucogranite, and biotite-quartz-alkali-feldspar pegmatite that intrude metamorphosed Paleozoic rocks (Pzgn). Cut by late-stage quartz veins. Potassium- and silica rich

gossans commonly developed in adjacent country rock. Zones of anomalous gold and sulfide-mineral concentrations occur in quartz veins and pegmatitic zones in country rock. Unit description source: BD006

Kgd1 - Granodiorite (Early late Cretaceous) Light- to medium-gray, fine- to coarse-grained, equigranular to porphyritic biotite-hornblende granodiorite, and biotite granite. Estimated mode for the granodiorite: 45 percent plagioclase (An40-45), 30 percent quartz, 20 percent K-feldspar, 2 percent hornblende, 2 percent biotite, and <1 percent zircon and calcite as accessories. Porphyritic phases contain abundant potassium feldspar phenocrysts and are biotite rich. Equigranular phases are fine grained, locally leucocratic, and contain minor amounts of white mica and tourmaline as accessories. Phenocrysts are poikilitic and contain abundant biotite inclusions. This pluton contains zones of abundant quartz veining as well as aplite dikes. Unit description source: BD004

Kgd2 - Granodiorite (Early late Cretaceous) Medium- to dark-gray, medium- to fine-grained, equigranular hornblende-biotite granodiorite. Estimated mode: 35 percent plagioclase (An30-35), 35 percent K-feldspar, 25 percent quartz, 2 percent hornblende, 2 percent biotite, and <1 percent chlorite, zircon, calcite, white mica, and apatite as accessories. Contains small (generally less than one-inch wide) dikelets of similar composition. Zones of dark-gray, fine-grained biotite granodiorite are present locally. Center of Kgd2 body is medium grained, grading to fine-grained border phase. Unit description source: BD004

Kgbr - Granodiorite of Brink intrusion (Early Cretaceous) Light-gray to white, nonfoliated, coarse-grained biotite +/- hornblende granodiorite. Gold mineralization associated with late-stage quartz veins within pluton. Unit lies within core of Black Mountain tectonic zone. Unit description source: BD006

Kgru - Granodiorite to granite, undivided (Early Cretaceous) Medium- to coarse- grained, equigranular biotite granodiorite to granite. Composed of as much as 5 percent biotite; locally contains accessory amounts of garnet, ilmenite, chlorite, and apatite. Biotite is altered to muscovite. Unit description source: BD003

Kg - Granodiorite to Quartz Monzonite (Cretaceous) Medium to coarse grained; mostly equigranular; massive without linear or planar fabric. The rocks contain biotite is the most common mafic mineral; hornblende is less common. Unit description source: BD002

TKg - Granodiorite to Quartz Monzonite (Tertiary and Cretaceous) Medium grained; equigranular to porphyritic; massive without linear or planar fabric. The rocks contain biotite, hornblende, muscovite, with biotite the most common mafic mineral. New radiometric dates and inference suggests these pluton are mid-Cretaceous in age. Unit description source: BD005

TKg - Granodiorite to Quartz Monzonite (Tertiary and Cretaceous) Medium grained; equigranular to porphyritic; massive without linear or planar fabric. The rocks contain biotite, hornblende,

muscovite, with biotite the most common mafic mineral. Single polygon recoded to match Big Delta. Unit description source: CI012

TMzg - Undifferentiated granitic rocks (Tertiary (?) and Mesozoic (??)) Primarily quartz monzonite and granodiorite but includes granite to diorite with local aplite, alaskite, and pegmatite. Unit description source: EA002, EA014

Kw - Walker Fork Pluton (Cretaceous) Sub-equigranular, medium-grained, hornblende biotite granodiorite and lesser tonalite herein called the Walker Fork pluton. Typical primary modal mineralogy is 25-30 percent quartz, 30-55 percent plagioclase, 10-20 percent poikilitic K-feldspar, 8-15 percent biotite, 0-5 percent hornblende, 1 percent myrmekite, 1 percent opaques, and trace apatite and sphene. Distinguished from nearby Jurassic and Triassic plutons by large, prominent biotite crystals and lack of foliation. Locally cut by garnet-bearing, aplite-pegmatite dikes with secondary pyrite and calcite. The pluton is commonly altered, with 0-20 percent sericite-chlorite-epidote-carbonate-rutile-pyrite, mostly after plagioclase and mafic minerals. Magnetic susceptibility is high, typically 3-30 x 10 SI. Pluton is highly fractured near high-angle faults. As demonstrated by presence and absence of hornfels zones, both intrusive and fault contacts with surrounding gneissic rocks are present. This body is not known to contain or be spatially associated with metallic mineralization or placer gold, although it is cut by chalcedonic quartz veins. Ar/Ar biotite plateau age of 100 Ma (sample 2; table 1); biotite from nearby gneiss yielded a K-Ar reset age of 99Ma (Wilson and others, 1985). Unit description source: EA012

MZa - Adamellite (Mesozoic)

TKg - Felsic granitic rocks (Tertiary, Paleocene, or Late Cretaceous, Maastrichtian) See [TKg](#) for unit description from: [USGS SIM-3340](#)

Mza - Adamellite (Mesozoic) Medium- to coarse-grained adamellite. Biotite is chief accessory mineral. Hornblende less abundant. Muscovite and garnet occur locally. Adamellite has xenoliths of schist and is cut by apatite dikes. The adamellite forms generally structureless bodies. Unit description source: CY003

Kgsp - Shawnee Peak intrusion (Late Cretaceous)

Kmgr - Granitic rocks of central and southeast Alaska (Cretaceous, Coniacian to Albian) See [Kmgr](#) for unit description from: [USGS SIM-3340](#)

Kgsp - Shawnee Peak intrusion (Late Cretaceous) Coarse-grained, nonfoliated, equigranular, light-gray, biotite diorite to biotite tonalite. Lacks evidence for intergranular recrystallization as seen in the granite of Swede Peak (unit Kgs), implying intrusion occurred at a higher structural level relative to the granite of Swede Peak and emplacement postdated regional Early Cretaceous deformation. Unit description source: BD003

Kr - Rhyolite dikes (Late Cretaceous)

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

Kr - Rhyolite dikes (Late Cretaceous) Light-tan to light-gray felsic dikes of fine-grained quartz porphyry to quartz-feldspar porphyry rhyolite with biotite phenocrysts in an aphanitic groundmass. Locally pyrite bearing, causing rock to weather light brown. SHRIMP U-Pb zircon ages between ~ 65

Ma and 68.1 +/- 0.8 Ma (table 1, samples 5 and 6, respectively), making these dikes coeval, within analytical uncertainty, with the granite of Gold Bottom Creek (Kgg), the granite of Veta Creek (Kgvc), the granite of Kechumstuk Creek (Kgkc), and rhyolite tuff and granite porphyry of the Middle Fork caldera, which is approximately 10 km northwest of the map area (Bacon and Lanphere, 1996; Bacon and others, 2012). Unit description source: EA015

Klgr - Granite and granodiorite (Late Cretaceous)

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

Kgr2 - Granite (Late Cretaceous) Light-gray, coarse-grained, equigranular to porphyritic, biotite granite with potassium feldspar phenocrysts to one-inch long. Estimated mode: 40 percent microcline, 25 percent quartz, 20 percent plagioclase (An25-30), 10 percent biotite, 3 percent chlorite, 1 percent white mica (muscovite ?), and <1 percent zircon, calcite, apatite and opaques as accessories. Unit description source: CI004

Kgr1 - Granite and granodiorite (Late Cretaceous) Medium gray, medium- to coarse-grained, porphyritic, muscovite-biotite granite with potassium feldspar phenocrysts to one-half inch long and quartz phenocrysts to one-half inch in diameter; and medium to dark-gray, fine to medium-grained, biotite granodite. Locally unit contains abundant quartz veining. Quartz veinlets contain quartz crystals, muscovite, limonite, and specular hematite. Estimated modal composition of the granite phase: 45 percent microcline, 20 percent plagioclase (An20-25), 20 percent quartz, 12 percent biotite, 2 percent white mica (muscovite?), <1 percent apatite, chlorite, zircon, and calcite as accessories. Unit description source: CI004

Klqm - Granite and quartz monzonite (Late Cretaceous)

Klqm - Quartz monzonite and monzonite (Late Cretaceous) See [Klqm](#) for unit description from: [USGS SIM-3340](#)

Kgr4 - Granite and quartz monzonite (Late Cretaceous) Light- to medium-gray, fine- to medium-grained, equigranular to porphyritic, biotite granite and gray, medium-grained, porphyritic quartz monzonite with potassium feldspar phenocrysts to one-eighth inch long. Estimated mode for the granite: 45 percent microcline, 35 percent quartz, 17 percent plagioclase, 2 percent biotite, and <1 percent muscovite and zircon as accessories. Unit contains abundant pegmatite dikes. Pegmatite dikes are medium to dark gray, medium- to coarse grained, equigranular rocks containing quartz, plagioclase, white mica, biotite and garnet locally. Unit also contains zones of quartz-tourmaline veining. Unit description source: CI004

Kgr5 - Quartz monzonite and granite (Late Cretaceous) Medium light-gray to gray, fine- to medium-grained, slightly porphyritic muscovite-biotite quartz monzonite and gray, fine- to medium grained, equigranular muscovite-biotite granite. Estimated mode for the granitic phase: 35 4 percent microcline, 30-35 percent quartz, 22 percent plagioclase (An25-35) 3 percent biotite, and <1 percent muscovite and zircon as accessories. Locally unit has an incipient foliation. Unit description source: BD004

Kd - Diorite, Gabbro, and tonalite ((Late) and (Early) Cretaceous)

Kmgr - Granitic rocks of central and southeast Alaska (Cretaceous, Coniacian to Albian) See [Kmgr](#) for unit description from: [USGS SIM-3340](#)

Kd - Diorite and Gabbro (Cretaceous) Diorite medium gray, medium grained; dominantly pyroxene, biotite and plagioclase; amphibole may be absent; in places quartz diorite; locally may be gabbro; generally massive. Unit also includes undated dike and lens-like mass of dark-greenish gray, medium- to coarse-grained gabbro ; consists of green hornblende with minor biotite, pyroxene, and plagioclase. Unit description source: BD002

Kdt - Diorite and tonalite (Late Cretaceous) Medium-grained, dark-gray, nonfoliated, equigranular, hornblende-biotite diorite to tonalite. In Liese Creek, outcrops of unit exhibit weak to moderate quartz-chlorite-sericite alteration and overlie the Pogo gold deposit. Unit description source: BD003

Kdi - Diorite dikes (Early Cretaceous) Dark-gray to dark-green, nonfoliated biotite-hornblende diorite dikes. Unit contains distinctive medium-grained, subhedral hornblende-biotite and plagioclase phenocrysts and glomerocrysts set in a fine-grained dioritic matrix; interpreted to be emplaced as subvolcanic dikes and small intrusions. Unit description source: BD006

Kdm - Mafic dikes (Late (?) and Early (?) Cretaceous)

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

Kdm - Mafic dikes (Early? and Late? Cretaceous) Dark gray, non-foliated dioritic to basaltic dikes and small plugs with 2-4 mm diameter biotite +/- hornblende phenocrysts in altered dark gray fine-grained matrix. Distinguished from unit Tb due to high degree of alteration. Unit cuts Early Cretaceous granite of Corner (Kgc); absolute age uncertain. Unit description source: EA015

Ku - Unnamed sandstone (Cretaceous)

Kkg - Flysch and quartzite, Kandik Group and equivalents (Lower Cretaceous, Albian to Valanginian) See [Kkg](#) for unit description from: [USGS SIM-3340](#)

Ku - Unnamed sandstone (Cretaceous) Unnamed sandstone about 70 m thick along Nation River. Brown to gray reddish-brown weathering, fine- to coarse-grained sandstone with interbedded black shale and siltstone. Percentage of sandstone increases in upper part of unit. Unit description source: CY005

Kka - Kandik Group, Kathul Graywacke ((Early) Cretaceous)

Kkg - Flysch and quartzite, Kandik Group and equivalents (Lower Cretaceous, Albian to Valanginian) See [Kkg](#) for unit description from: [USGS SIM-3340](#)

Kka - Kandik Group, Kathul Graywacke (Early Cretaceous) Sandstone, conglomerate, and argillite. Sandstone, dark-greenish-gray, feldspathic (about 25 percent potash and plagioclase feldspar) graywacke with secondary chlorite and epidote. Conglomerate clasts of chert, volcanic rocks, argillite, and sandstone in matrix of graywacke or argillite. Argillaceous rocks mainly dark-gray argillite but include olive-gray shale and mudstone. Contains a few stratigraphically long-ranging marine pelecypods. Seems correlative with non-marine rocks in Eagle quadrangle to the south which contain plants of probable Albian age. Thickness several thousand feet. Named and described by Brabb (1967). Unit description source: CY003

Kka - Kathul Graywacke (Cretaceous) Sandstone, conglomerate, and argillite. Unit description source: CY005

Kke - Kandik Group, Keenan Quartzite ((Early) Cretaceous)

Kkg - Flysch and quartzite, Kandik Group and equivalents (Lower Cretaceous, Albion to Valanginian) See [Kkg](#) for unit description from: [USGS SIM-3340](#)

Kke - Kandik Group, Keenan Quartzite (Early Cretaceous) Medium-gray massive quartzite and sandstone with a few interbeds of dark-gray siltstone and argillite. Weathers white and forms resistant ridges. Locally contains abundant *Buchia sublaevis* of Valanginian age. Thickness varies from 100 to 1,000 feet. Unit description source: CY003

Kke - Keenan Quartzite (Cretaceous) Resistant quartzite and sandstone with occasional siltstone and argillite interbeds. Unit description source: CY005

Kb - Kandik Group, Biederman Argillite ((Early) Cretaceous (Valanginian))

Kkg - Flysch and quartzite, Kandik Group and equivalents (Lower Cretaceous, Albion to Valanginian) See [Kkg](#) for unit description from: [USGS SIM-3340](#)

Kb - Biederman Argillite (Cretaceous) Argillite rhythmically interbedded with quartz-rich sandstone and siltstone. Unit description source: CY005

Kb - Kandik Group, Biederman Argillite (Early Cretaceous) Rhythmically interbedded, dark-gray argillite and medium-gray siltstone and sandstone. Siltstone and sandstone mainly quartz arenite commonly with carbonate cement. Convolute structures and cross-laminations common. Includes a few beds of chert-pebble conglomerate, siliceous shale, chert-limestone breccia and limestone. Contains very few pelcypods of Valanginian age near base. Thickness at least 5,000 feet. Named and described by Brabb (1969). Unit description source: CY003

Kb - Kandik Group; Biederman Argillite (Early Cretaceous, Valanginian) Rhythmically interbedded argillite, siltstone, and sandstone having calcareous cement. Locally includes chert-pebble conglomerate, siliceous shale, chert-limestone breccia, and limestone. Unit description source: CY002

KJqa - Quartzite, argillite, conglomerate, and hornfels (Cretaceous and/or Jurassic)

Kkg - Flysch and quartzite, Kandik Group and equivalents (Lower Cretaceous, Albion to Valanginian) See [Kkg](#) for unit description from: [USGS SIM-3340](#)

KJqa - Quartzite, argillite, conglomerate, and hornfels (Cretaceous and/or Jurassic) Mostly gray, fine- to medium-grained quartzite, interlayered with mostly gray, greenish-gray, reddish-gray, and tan argillite (1 northwesternmost polygon at CI-LG quad boundary). Unit description source: CI003

Kwcf - Quartzite, argillite, conglomerate, and hornfels (Cretaceous and/or Jurassic) Mostly gray, fine- to medium-grained quartzite, interlayered with mostly gray, greenish-gray, reddish-gray, and tan argillite. Unit description source: CI003

KJg - Plutons of the Yukon-Tanana Upland (Cretaceous and Jurassic)

Jg - Plutons of the Yukon-Tanana Upland (Early Jurassic) See [Jg](#) for unit description from: [USGS SIM-3340](#)

Jc - Chicken Pluton (Jurassic) Medium- to coarse-grained, tan to white, porphyritic to equigranular, weakly- to non-foliated, biotite granite and lesser hornblende biotite granodiorite, herein called the Chicken pluton. Previously mapped as part of the Taylor Mountain batholith (Foster, 1976), but displays significant contrasts in mineralogy, texture, major oxide composition, and age. Typical primary modal mineralogy is 20–25 percent quartz, 30–40 percent plagioclase, 20–30 percent K-feldspar, 0–5 percent hornblende, 5–10 percent biotite, 1–2 percent myrmekite, <1 percent sphene, magmatic? epidote and opaques, and trace apatite and allanite. K-feldspar megacrysts are common; aplite dikes are locally abundant, especially in upper Stonehouse Creek. Quartz is commonly strained and mortar texture is prevalent. Usually exhibits little alteration, but where alteration is present, it consists mostly of hornblende replaced by epidote + chlorite. Magnetic susceptibility is usually high, typically .004–.012 SI. Contacts with surrounding rocks are mostly obscure. Lack of obvious hornfels or skarn in surrounding calcareous metamorphic rocks suggests contacts are largely faulted. No significant mineralization is known to occur in this pluton, although quartz–pyrite and K feldspar–quartz veins occur at the head of Chicken Creek and gold prospects are present near the Chicken pluton at Purdy and Lilliwig Creek. Hornblende from the Chicken pluton yields a Ar/ Ar plateau age of 187.8 Ma (sample 8; table 1), and a Ar/ Ar isochron age of 54 Ma for the biotite indicates significant heating in early Tertiary time, presumably associated with nearby gabbro. The presence of apparently magmatic epidote in this pluton suggests it crystallized at elevated pressure, probably >5 kbar. Unit description source: EA012

Jg - Felsic-composition phaneritic dike-like bodies (Jurassic?) Numerous small and elongate Jurassic (?) plutons scattered throughout the northern half of the map area compositionally and texturally resemble the Chicken and Uhler plutons. May or may not be foliated, commonly porphyritic, medium-grained, tend to be elongated in east–west direction parallel to fold axial traces in surrounding metamorphic rocks, and mostly range between granite and quartz monzodiorite in composition. Typically contain 15–30 percent quartz, 15–35 percent K-feldspar, 35–45 percent plagioclase, 0–25 percent hornblende, 2–10 percent biotite, and minor sphene, opaques, and magmatic? epidote as overgrowths on trace allanite. Magnetic susceptibilities vary greatly, from 0.1–0.3 to 1–2.5 x 10⁻³ SI. Presence of magmatic epidote indicates the bodies were emplaced at mesozonal depths. Locally spatially associated with small base-metal skarns (Werdon and others, 2000) south of Buckskin Creek, and east of the South Fork of the Fortymile River just north of the mouth of Napoleon Creek. One of these dikes from just east of the map area yielded a Ar/ Ar age of 188 Ma (Layer and others, 2001). Unit description source: EA012.

Kg - Granite and granodiorite (Cretaceous) Granite, granodiorite and locally includes quartz monzonite, diorite, aplite, alaskite, and pegmatite. Light-gray to pinkish-gray, fine- to coarse-grained, but generally medium-grained. Unit description source: EA003

Jg - Granodioritic plutons (Jurassic?) Numerous small to moderate-sized, commonly elongate Jurassic(?) plutons scattered throughout the quadrangle. These bodies texturally resemble the Jurassic Uhler pluton of the Eagle A-2 Quadrangle (Werdon and others, 2001) and the Great Dike. Unit description source: EA009

Mzh - Hornblende granodiorite (Mesozoic (?)) Primarily coarse-grained hornblende granodiorite and quartz monzonite; includes gabbro and syenite. Unit description source: EA002

Jn - Napoleon creek pluton (Jurassic) Sub-equigranular, medium- to coarse-grained, weakly- to nonfoliated hornblende quartz monzonite and lesser monzonite and quartz monzodiorite, herein called the Napoleon Creek pluton. Typical primary modal mineralogy is 3–8 percent quartz, 40–50 percent plagioclase, 20–40 percent K-feldspar, 15–20 percent hornblende, 1 percent sphene, 1 percent opaques, 0–1 percent myrmekite, and trace apatite and allanite. Generally characterized by

large K-feldspar and obvious hornblende phenocrysts, which define the foliation, if present. Quartz is invariably strained, and crystal margins are commonly granulated. Most contacts with country rocks are linear zones lacking outcrops and displaying no obvious hornfels aureole, suggesting post-intrusive faulting. Magnetic susceptibility is typically high (.001–.027 SI), but the core of the body is significantly less magnetic (0.00031–0.00061 SI). Includes small bodies of biotite clinopyroxenite and coarse-grained hornblende gabbro, which may be inclusions, dikes, and (or) marginal phases. Both the Napoleon Creek pluton and the mafic phases are cut by minor late granite aplite–pegmatite dikes. Extensive, sheared zones of gold-bearing quartz–carbonate–sericite–chlorite–pyrite alteration are present within the pluton, yield an early Cretaceous Ar/ Ar isochron age (sample 4; table 1), and are under current industry investigation. Plutonic hornblende yielded a Ar/ Ar plateau age of 186 Ma (sample 7; table 1). Unit description source: EA012

Jgmv - Quartz monzonite of Mount Veta (Early Jurassic) Coarse-grained porphyritic monzonite to quartz monzodiorite characterized by potassium feldspar megacrysts set in a coarse-grained hornblende-bearing groundmass. Grades locally into zones devoid of characteristic potassium feldspar megacrysts. Unit description source: EA015

Shear zone Broad zone of interleaved faulting, fracturing, and brittle cataclastic deformation of adjacent geologic units. Unit description source: EA015

Jd - The Great Dike (Jurassic) Sub-equigranular, medium-grained, locally foliated to nonfoliated biotite granodiorite to hornblende-biotite granodiorite, present in a body 7 km long and 50–400 m wide, herein called the Great Dike. Typical modal mineralogy is 15–30 percent quartz, 35–45 percent plagioclase, 7–15 percent K-feldspar, 20 percent mafics, 1 percent each of sphene, myrmekite, and magnetite, and trace apatite and allanite. Relative mafic mineral abundance ranges from nearly all biotite to hornblende slightly greater than biotite. K-feldspars are up to 8 mm in length, other major minerals typically are 1–5 mm. Alteration is usually minor, with some chloritization of mafic minerals and sericitic dusting of plagioclase. Trace and major element characteristics indicate the body is of I-type, arc-related affinity. No obvious hornfels alteration is seen in metamorphic rocks surrounding the body; the dissimilar rock types on opposite sides of the dike suggest it was intruded along a Jurassic west–northwest-trending fault that was subsequently reactivated. Magnetic susceptibility is moderate ($0.3\text{--}1.4 \times 10^{-3}$ SI), similar to Jurassic plutons in the Eagle A-2 Quadrangle (Weldon and others, 2001). $^{40}\text{Ar}/^{39}\text{Ar}$ hornblende plateau age of 189.6 ± 1.0 Ma (sample A4; table 1) is similar to that of mildly foliated Jurassic plutons in the adjacent Eagle A-2 Quadrangle (Weldon and others, 2001). Unit description source: EA009

Jt - Tonalite (Early Jurassic) Foliated, fine- to medium-grained, leucocratic, biotite granite, hornblende tonalite, and clinopyroxene tonalite dikes and small intrusions. Locally, unit is intensely deformed, as evidenced by the mineral foliation as well as polygonal, strained quartz grains (table 1, samples 15 and 16). Unit occurs structurally beneath the main quartz monzonite of Mount Veta intrusion (Jgmv). Although U-Pb SHRIMP ages for unit Jt (184.8 ± 2.9 Ma and 190.5 ± 4.8 Ma; table 1, samples 15 and 16, respectively) are within error of those of unit Jgmv, relative age is inferred to be slightly older. Unit description source: EA015

Ju - Uhler creek pluton (Jurassic) Sub-equigranular, medium-grained, modestly- to non-foliated biotite-hornblende granodiorite and minor quartz monzodiorite, herein called the Uhler Creek pluton. Typical modal mineralogy is 15–20 percent quartz, 35–45 percent plagioclase, 10–15 percent K-feldspar, 10 percent each biotite and hornblende, 1–2 percent sphene, myrmekite, opaques, and magmatic? epidote, and trace apatite and allanite. K-feldspars are up to 8 mm in length, other major minerals typically are 2–5 mm. Alteration is usually minor, with some chloritization of mafic minerals and sericitic dusting of plagioclase. The presence of magmatic epidote (for example, overgrowths on allanite) suggests mesozonal crystallization conditions. Most contacts with country rocks are linear zones lacking outcrops and displaying no obvious hornfels aureole, suggesting post-intrusive faulting. Magnetic susceptibility is generally low (0.0001–0.0007 SI). Ar/ Ar hornblende plateau age of 188 Ma (sample 9; table 1). Unit description source: EA012

KJTRmgr - Granite, granodiorite, and quartz monzonite (Triassic to Late Cretaceous)

Kmgr - Granitic rocks of central and southeast Alaska (Cretaceous, Coniacian to Albian) See [Kmgr](#) for unit description from: [USGS SIM-3340](#)

Kg - Biotite granite (Late Cretaceous?) Light-gray, equigranular, medium-grained biotite granite. Intrudes granite of Mount Harper batholith (Kgmh). May be correlative with quartz-feldspar porphyry (Kqfp). Unit description source: BD006

Kbm - Black Mountain intrusion (Early Cretaceous) Composite intrusion predominantly made up of biotite granite and biotite-hornblende granodiorite, with lesser amounts of coeval hornblende-biotite diorite. Where diorite is mappable it is mapped as Kdi. Unit description source: BD006

Kgr3 - Granite (Late Cretaceous) Light- to medium-gray, fine- to medium- grained, equigranular and porphyritic, muscovite-biotite granite with potassium feldspar phenocrysts to one-half inch long. Estimated mode: 45 percent microcline, 25 percent quartz, 25 percent plagioclase (An15-20), 2 percent biotite, 2 percent white mica (muscovite ?), and <1 percent zircon and apatite as accessories. Border phase is medium dark-gray, fine-grained, non-porphyritic biotite granite. Unit contains numerous pegmatite dikes and thin quartz-tourmaline veins. Unit description source: CI004

Kgc - Granite of Corner (Early Cretaceous) Coarse-grained, medium-gray, non-foliated, porphyritic biotite granite with diagnostic 1.5-cm-diameter quartz and feldspar phenocrysts, and medium-grained leucogranite. U-Pb SHRIMP age of 108.8 +/- 1.7 Ma on biotite granite (table 1, sample 9) and 111.8 +/- 1.5 Ma on leucogranite (table 1, sample 10); unit emplaced after regional Mesozoic ductile deformation. Type locality crops out in the SW. SW. sec. 20, T. 26 N., R. 11 E. at vertical angle benchmark (VABM) demarked as Corner on the Eagle (A-5) quadrangle. Unit description source: EA015

Kgs - Granite of Swede Peak (Early? Cretaceous) Coarse-grained, light-gray to white, biotite-garnet-muscovite leucogranite. Western margin of unit is intrusive into overlying unit Pzpg. Unit description source: BD003

Kgtc - Granite of Tibbs Creek (Early Cretaceous) Medium-grained, nonfoliated to weakly foliated, equigranular, light-gray, massive biotite granite. Unit is highly altered west of Tibbs Creek near contact zone with Goodpaster batholith. Primary feldspar and biotite altered to intergrowths of iron oxide, sericite, chlorite, and needles of sillimanite. Interpreted to be older than Goodpaster batholith. Unit description source: BD006

Kg - Granite stock (Early? Cretaceous) Small, medium- to coarse-grained, nonfoliated to weakly foliated stocks and plugs of leucocratic biotitic granodiorite to granite composition; locally contains muscovite. Age uncertain, but predominantly nonfoliated texture indicates unit emplaced after Early Cretaceous regional tectonism. Unit description source: BD003

Mzwg - Granite, granodiorite, and quartz monzonite (Cretaceous to Triassic) Medium-grained equigranular to porphyritic biotite-muscovite granite; medium- grained, porphyritic, biotite granite, and quartz monzonite; and dark-gray, fine to medium-grained, biotite-hornblende granodiorite. Estimated mode of the granite: 45 percent K-feldspar, 25 percent quartz, 25 percent plagioclase (An25-35), 3 percent biotite, and <1 percent chlorite and muscovite as accessories. All phases are massive without a planar or linear fabric. Unit intrudes rocks of the West Point complex. Unit description source: BD004

Kqfp - Quartz-feldspar porphyry (Late Cretaceous) Quartz-feldspar porphyry dikes and small intrusions. Characterized by megacrysts and glomeroporphyritic clusters of plagioclase, rounded

quartz, and minor biotite set in medium-gray, fine-grained rhyolitic composition groundmass. Cut by quartz veins. Unit description source: BD006

Kqfp - Quartz-feldspar porphyry (Early Cretaceous) Non-foliated quartz-feldspar rhyolite porphyry characterized by distinctive medium-grained quartz eyes and sericitized plagioclase and biotite phenocrysts set in a fine-grained gray rhyolitic groundmass. These rock types yield SHRIMP U-Pb zircon ages of 93.9 +/- 1.3 Ma and 95.8 +/- 1.5 Ma, respectively (table 1, samples 7 and 8). Interpreted to be hypabyssal bodies intruded into and adjacent to Kechumstuk fault zone. Unit description source: EA015

Kp - Quartz-Orthoclase Porphyry (Cretaceous) Pink to tan weathering. Quartz and Carlsbad-twinned orthoclase occur as large as 1 cm; euhedral phenocrysts in aphanitic to fine-grained groundmass; sericitized. Unit description source: BD002

shear - Shear zones (Cretaceous) East-northeast-trending shear zones associated with the Black Mountain tectonic zone. Shear zones located along northeast-trending faults. Unit description source: BD006

KJTRa - Glenn Shale and equivalents (Triassic to Cretaceous)

Kkg - Flysch and quartzite, Kandik Group and equivalents (Lower Cretaceous, Albian to Valanginian) See [Kkg](#) for unit description from: [USGS SIM-3340](#)

Mza - Argillite (Mesozoic) Dark grayish black carbonaceous argillite. Unit may include other rocks types but is incompletely mapped because of heavy vegetation cover. Age unknown, but may be equivalent to Glenn Shale Unit. description source: CY007

KTrg - Glenn Shale (Early Cretaceous to Middle Triassic) Mainly grayish-black carbonaceous shale. Minor siltstone and quartzite. Phyllite and quartz-chlorite semischist in vicinity of Indian Grave Mountain are probably local metamorphic facies. Lower few hundred of Glenn Shale near Nation consist of dark-gray limestone and oil shale with Monotis, Halobia, Daonella, Discophyllites, and Natherstites of Middle Triassic (Ladinian) to Late Triassic (Norian) age. At other localities contains Otapiria of probable Jurassic age, Buchia Okensis of Early Cretaceous (Berriasian) age and Buchia cf. B. crassicolis of Early Cretaceous (probably Valanginian) age. Sparsely fossiliferous north of 65 degrees 25 minutes N. Maximum thickness about 5,000 feet. Named and described by Brabb (1969). Unit description source: CY003

Kdgu - Glenn Shale, undifferentiated (Cretaceous and Triassic) Undifferentiated Lower Glenn Shale and Upper Glenn Shale. Unit description source: CY005

Kg - Upper Glenn Shale (informal name) (Cretaceous) Grayish-black shale with subordinate siltstone and quartzite. Unit description source: CY005

PZPCi - Gneiss and felsic rocks, intermixed (Cretaceous (?) and Paleozoic and/or Precambrian)

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

PzpCi - Gneiss and felsic rocks, intermixed (Paleozoic and (or) Precambrian) Felsic hypabyssal and volcanic rocks intermixed with metamorphic rocks, gneiss, and granite. Coded to match adjoining Tanacross quadrangle. Unit description source: EA002

Kgu - Granite, undivided (Cretaceous) Non-foliated granodiorite to granite forming isolated dikes

and small intrusions. Age uncertain Unit description source: EA015

Kpeg - Pegmatitic dikes (Late Cretaceous?) Nonfoliated, light-pink to light-gray pegmatite dikes of granitic composition; major minerals are quartz, plagioclase, alkali feldspar, biotite, and muscovite. Pegmatitic dikes texturally and compositionally grade into quartz veins. Age uncertain, but assumed to have been emplaced during the latest part of the regional Cretaceous intrusive event. Unit description source: BD006

Jd - Jurassic dikes (Jurassic)

Aplitic to pegmatitic dikes (Jurassic) Interpreted to be the latest phase Jurassic aplitic and pegmatitic intrusions. Unit description source: EA009, EA012

Jga - Granite, pegmatite, and aplite (Jurassic)

Jg - Plutons of the Yukon-Tanana Upland (Early Jurassic) See [Jg](#) for unit description from: [USGS SIM-3340](#)

Jga - Granite pegmatite and aplite (Jurassic) Unfoliated, leucocratic granite with mixed pegmatite, aplite, and rare seriate textures. Grain size varies between >1 cm and ~1 mm, typically either coarse- or fine-grained. Variations in texture and grain size occur at the outcrop and hand-specimen scale. Typical modal mineralogy is 5 percent mafics (biotite and/or muscovite), 25–35 percent quartz, 25–30 percent K-feldspar, and 30–35 percent plagioclase. Muscovite occurs both as a replacement of biotite and as apparently primary grains. Trace and major element compositions suggest that these are highly fractionated I-type granites of arc affinities, which occur both as kilometer-scale bodies and as dikes. Magnetic susceptibility is low, typically $\sim 0.1 \times 10^{-3}$ SI. Muscovite from a large aplite-granite body yielded a $^{40}\text{Ar}/^{39}\text{Ar}$ plateau age of 181.3 ± 1.5 Ma (sample A5; table 1). Similar-appearing granite pegmatite–aplite bodies about 10 km east of the Eagle A-1 Quadrangle yield U–Pb (zircon) ages of 190–191 Ma (Mortensen, 1999). $^{40}\text{Ar}/^{39}\text{Ar}$ muscovite plateau age for similar-appearing granite in the Eagle A-2 Quadrangle is ~186 Ma (Werdon and others, 2001). These bodies may have been intruded over a protracted period in the early Jurassic. Unit description source: EA009

Jt - Tourmaline-muscovite granite (Jurassic) Medium-grained, pegmatitic to aplitic granite. Typical primary modal mineralogy is 2 percent tourmaline, 20–25 percent muscovite, 20–25 percent quartz, 25–30 percent K-feldspar, 20–25 percent plagioclase, and trace zircon. Surrounding gneiss contains float of muscovite + tourmaline quartz veins and tourmaline–muscovite granite dikes. Magnetic susceptibility is $0.01\text{--}0.02 \times 10$ SI. Ar/Ar muscovite plateau age of 185.9 Ma (sample 6; table 1). Trace-element data suggests this is a highly fractionated granite with arc-type tectonic affinities. Unit description source: EA012

Js - Syenite of Mount Veta (Jurassic)

Jg - Plutons of the Yukon-Tanana Upland (Early Jurassic) See [Jg](#) for unit description from: [USGS SIM-3340](#)

Js - Syenite of Mount Veta (Jurassic) Syenite of Mount Veta, primarily hornblende syenite porphyry but locally equigranular. Unit description source: EA002

Jmig - Migmatite (Early Jurassic)

Jg - Plutons of the Yukon-Tanana Upland (Early Jurassic) See [Jg](#) for unit description from: [USGS SIM-3340](#)

Jmig - Migmatite (Early Jurassic) Foliated migmatite with the paleosome a mixture of Paleozoic metasedimentary country rocks (Pzms), hornfels, amphibolite (Pzam), laminated marble (Pzm) invaded by neosome of foliated, medium-grained, biotite-hornblende quartz monzonite of Mount Veta (Jgmv). Neosome is foliated and forms sills within Paleozoic units parallel to strong penetrative ductile metamorphic fabric and compositional layering and is locally enfolded with the paleosome. Unit structurally underlies Jurassic quartz monzonite, forming migmatitic footwall zone of the Jurassic intrusion (Jgmv). Unit description source: EA015

JTRqd - Granodiorite and granite (Triassic to Early Jurassic)

Trqd - Quartz diorite and granodiorite (Triassic) See [Trqd](#) for unit description from: [USGS SIM-3340](#)

JTrg - Granite and granodiorite (Early Jurassic to latest Triassic) Granite and granodiorite including hornblende-plagioclase porphyry, minor quartz monzodiorite, and diorite. Largest occurrence is Taylor Mountain batholith of southern Eagle and northern Tanacross quadrangles. Unit description source: EA003, EA014

JTrg - Granodiorite of Taylor Mountain, diorite phase (Early Jurassic and (or) Late Triassic) Primarily diorite of Taylor Mountain batholith. Only locally mapped. Unit description source: EA002

JTrg - Granodiorite of Taylor Mountains (Early Jurassic and (or) Late Triassic) Medium- to coarse-grained granodiorite of Taylor Mountain batholith. Unit description source: EA002

Trg - Hornblende granodiorite (Late Triassic) Dark-gray, weakly foliated, medium-grained hornblende-biotite granodiorite, hornblende quartz monzodiorite, and hornblende leucotonalite. Unit forms batholithic intrusion in southeastern part of map and smaller intrusions to the west of the Kechumstuk fault. U-Pb zircon ages range from 207.9 +/- 2.9 Ma to 215.5 +/- 3.4 Ma (table 1, samples 17-19). Unit description source: EA015

Trt - Taylor Mountain Batholith (Triassic) Slightly foliated (interior) to strongly foliated (margins), medium- to coarse-grained, sub-equigranular, biotite-hornblende quartz monzodiorite, tonalite, granodiorite, and quartz diorite of the Taylor Mountain Batholith. Typical primary modal mineralogy is 15–25 percent quartz, 40–70 percent plagioclase, 5–20 percent K-feldspar, 5–10 percent hornblende, 0–5 percent biotite, ~1 percent sphene and opaques, and trace apatite. Strained quartz and mortar texture are ubiquitous in thin section, as is partial alteration of biotite and hornblende to chlorite + epidote + carbonate. Magnetic susceptibility of most samples is high (2–10 x 10⁻³ SI), but marginal facies and sheared samples are typically lower. Contacts with surrounding rocks are complex; zones of intimately foliated quartz dioritic dikes and sills are locally present in units uPzst, uPzv, and uPzmg near the batholith, but sheared contacts apparently predominate. Most likely the Taylor Mountain batholith intruded units uPzst, uPzv, and uPzmg, but subsequent Jurassic deformation, and later high-angle faulting, has disrupted most of the original contacts. The batholith is not in direct contact with amphibolite-facies gneissic rocks within the map area and the relationship between these two units is not known. The majority of the Taylor Mountain batholith is devoid of known metallic mineralization; however, small copper–bismuth–gold-bearing veins are present in and near the far northern edge of the batholith at Lilliwig Creek and the Highway Copper prospect. Ar/Ar dating of these prospects (Newberry and others, 1998b; sample 10; table 1) yields mineralization ages of ~183–194 Ma, that is, ~20–30 Ma younger than the batholith. Rocks of the Taylor Mountain batholith have yielded a U–Pb (sphene) age of 214 Ma (Aleinikoff and others, 1981); K–Ar ages of 177–183 Ma (Wilson and others, 1985); and Ar/Ar plateau ages of 209 Ma (hornblende), 204 Ma (biotite) (Cushing, 1984), and 210–211 Ma (biotite and hornblende; Layer and others, 2001). Most likely the magmatic age is ~214 Ma with younger apparent ages caused by an early Jurassic heating and deformation event. Cut by porphyritic hornblende quartz diorite dikes with Ar/Ar hornblende plateau age of 197.5 Ma (sample 11; table 1). Unit description source: EA012

TRgsl - Glenn Shale, lower unit (Triassic)

Trgsl - Glenn Shale, lower unit (Triassic) See [Trgsl](#) for unit description from: [USGS SIM-3340](#)

Trg - Glenn Shale (lower) (Triassic) Grayish and brownish-black carbonaceous and calcareous shale with limestone in the lower part. Abundant Halobia Monotis pelecypods in places. Unit description source: CY005

TRMsm - Sedimentary and slightly metamorphosed sedimentary rocks (Mississippian to Late Triassic)

TrMsm - Seventymile assemblage (Triassic to Mississippian) See [TrMsm](#) for unit description from: [USGS SIM-3340](#)

Pzgs - Greenschist, calcareous greenschist, and quartz-chlorite-white mica schist (Late? Paleozoic) Greenschist, calcareous greenschist, and quartz-chlorite-white mica schist, also includes marble, greenstone, and quartzite. Differs from other greenschist facies units in having abundant layers and lenses of light-gray, medium- to coarsely crystalline, thin-layered to massive marble that is locally fossiliferous and locally more than 100 m thick. Unit description source: CY007, EA003

Pza - Phyllitic argillite (Paleozoic) Siliceous argillite or argillaceous chert, locally containing abundant greenstone interlayers. Blastomylonitic phyllite. Unit description source: CY002

Pq - Quartzite and argillite (Permian) Quartzite and argillite. Includes phyllite, metaconglomerate, chert, limestone and (or) marble, and graywacke and metagraywacke. Unit description source: EA002

MzPzs - Sedimentary and slightly metamorphosed sedimentary rocks (Late Triassic to Mississippian) Includes chert, limestone, graywacke, argillite, sandstone, conglomerate, phyllite, quartzite, and tuff. Locally interlayered with greenstone. Chert is green, light and dark gray, red, mottled green and gray; massive, closely fractured with abundant silica veins and veinlets, and commonly has a sugary texture recrystallization. Unit description source: CY007, EA003

MZPZat - Argillite, tuff, quartzite, and conglomerate (Mesozoic and/or Paleozoic)

Kkg - Flysch and quartzite, Kandik Group and equivalents (Lower Cretaceous, Albian to Valanginian) See [Kkg](#) for unit description from: [USGS SIM-3340](#)

MzPzat - Argillite, tuff, quartzite and conglomerate (Mesozoic and/or Paleozoic) Two parts. One includes rocks around VABM Vrain, composed mostly of argillite and minor quartzite and slaty argillite. Second shown by ttt symbol is characterized by tuffaceous rocks associated with black or dark-gray argillite and conglomerate. VRAIN equivalent, see MzPztu also for tuffaceous part of unit. Part of unit separated and assigned to Dcb, combined Cascaden Ridge -- Beaver Bend unit, per Florence Weber's revisions. Unit description source: CI003

MZPZc - Circle Volcanics (Mesozoic and/or Paleozoic)

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

MzPzc - Circle Volcanics (Triassic and Pennsylvanian or Mississippian) Diabasic gabbro, basalt, diorite, ultramafic rocks, chert, and tuff. Rare limestone. Probably correlative with Rampart Group. Unit description source: CI002

MzPzc - Circle Volcanics (Triassic and Late Paleozoic) Mafic to intermediate intrusive and extrusive rocks with interlayers of chert, carbonaceous argillite, and quartzite, subordinate tuff, limestone, and ultramafic rocks. Unit description source: CY002

Pzc - Circle Volcanics (Paleozoic) Dark-greenish-gray basalt, diabase, and gabbro. Minor interbedded chert, quartzite, and argillite. Nonfossiliferous but consider Early Mississippian by Mertie (1930) based on correlation with a sparsely fossiliferous volcanic sequence near Rampart, about 175 miles west. Unit description source: CY003

MZPZd - Diorite (Mesozoic and/or Paleozoic)

TrPzig - Gabbro and diabase (Triassic or late Paleozoic) See [TrPzig](#) for unit description from: [USGS SIM-3340](#)

MzPzd - Diorite (Mesozoic and/or Paleozoic) Green, olive-green, or greenish-brown, medium- to very coarse-grained, porphyritic diorite. Unit description source: CI002

MZPZt - Silicified tuff (?) (Mesozoic and/or Paleozoic)

TrMsm - Seventymile assemblage (Triassic to Mississippian) See [TrMsm](#) for unit description from: [USGS SIM-3340](#)

MzPzt - Silicified tuff (?) (Mesozoic and/or Paleozoic) White, light-tan, or light-gray, massive, structureless, silica rock that is probably metamorphosed (silicified) tuff. Unit description source: EA002

MZPZaq - Argillite and quartzite (Mesozoic and/or Paleozoic)

Mgg - Globe quartzite of Weber and others (1992) (Mississippian) See [Mgg](#) for unit description from: [USGS SIM-3340](#)

MzPzaq - Argillite and quartzite (Mesozoic and/or Paleozoic) Vitreous quartzite part of unit, mapped separately. Light-gray, dense quartzite having a vitreous luster. Dark-gray to black, locally quartzitic argillite, mudstone, and siltstone. Calcareous in a few places, has local gray and black chert. Unit includes a gray, very fine-grained limestone at one locality. Dark greenish-gray mafic lavas, including amygdaloidal basalt and basalt breccia appear interlayered with the sedimentary rocks. Unit deleted on published map. Unit description source: CI002

MZPZs - Serpentinized rocks (Paleozoic to Mesozoic)

MzPzyo - Peridotite of dismembered ophiolite of the Yukon-Tanana region (Mesozoic, Triassic? or older) See [MzPzyo](#) for unit description from: [USGS SIM-3340](#)

MzPzs - Mafic and ultramafic rocks metamorphosed to lower greenschist facies: Seventymile Terrane - serpentinite (Mesozoic to Paleozoic) Green to dark gray, orange-brown weathering, slightly foliated, fine-grained rock dominated by serpentine with accessory chromite, local relict olivine,

and secondary magnetite + magnesite. In samples not totally serpentinized, olivine relicts are optically continuous for up to 5 mm, occupying a volume representing greater than 90 percent of the primary modal mineralogy. Magnetic susceptibility of the serpentinite is very high, typically $10\text{--}60 \times 10^{-3}$ SI. Consequently, serpentinite has also been mapped in areas lacking rock exposures but displaying strong magnetic anomalies. Aeromagnetic data also indicate that serpentinite locally underlies amphibolite-facies metamorphic rocks, i.e., that serpentinite occurs imbricated in thrust faults, and not as the structurally highest block. Waxy massive serpentinite with relatively low magnetic susceptibility ($0.1\text{--}1 \times 10^{-3}$ SI) is present near some fault contacts. Chrysotile typically is scarce, and is most common near fault contacts. Unit description source: EA009

Pzp - Peridotite, mostly serpentinized (Paleozoic) Generally dark-gray to black or greenish black or brown massive peridotite. In a discontinuous belt of Alpine-type ultramafic bodies. Mainly partly serpentinized harzburgite and dunite and minor clinopyroxenite. Unit description source: CY007

Pu - Periodotite, partly serpentinized (Paleozoic) Dark green to black; weathers a reddish orange brown; massive. Diabase and diorite inclusions, commonly meters in diameter. A zone of quartz and magnesite, with some dolomite, 1 to 50 m thick. The silica-carbonate rock is bright orange, orange brown, or cream with local green stains. Unit description source: BD002

Mzp - Pyroxenite and hornblendite (Mesozoic) Hornblendite, pyroxene hornblendite, hornblende pyroxenite and pyroxenite. Unit description source: EA002

Pzum - Rocks metamorphosed to amphibolite facies: Fortymile River Assemblage - meta-harzburgite (Paleozoic?) Medium-grained, moderately foliated ultramafic rock, with an original mineralogy of olivine > orthopyroxene >> clinopyroxene, partly converted to an assemblage of talc $\pm$ chlorite $\pm$ anthophyllite, and overprinted by a variable degree of serpentinization. Serpentinization is inferred to be a late-stage alteration as the grain size of serpentine in the rocks is much smaller (<0.1 mm) than that of the anthophyllite, chlorite, or talc (1–5 mm). Spatially associated with an amphibolite-bearing unit (Pza) with MORB-type trace element signature. The origin of this body is unknown, but it differs from the serpentinized ultramafic rocks of the southeastern Eagle A-1 Quadrangle by (1) significantly higher pyroxene abundance, (2) abundance of metamorphic talc, chlorite, and anthophyllite, and (3) less abundant serpentine. The presence of anthophyllite suggests it was metamorphosed with the adjacent amphibolite-facies rocks. Magnetic susceptibility is high, $5\text{--}30 \times 10^{-3}$ SI. Unit description source: EA009

MzPzum - Serpentinite (Mesozoic to Paleozoic) Medium-dark-green to dark green, fine- to medium-grained, highly altered serpentinite. Present as small isolated bodies or tabular masses along fault zones. Contains altered gabbroic rocks locally. Unit description source: BD004, CI004

MzPzs - Serpentinite (Mesozoic and (or) Paleozoic) Serpentinite primarily lizardite and clinochrysolite. Unit description source: EA002

MzPzsp - Serpentinized peridotite (Mesozoic and (or) Paleozoic) Serpentinized peridotite. Harzburgite and dunite, 50 percent or more serpentinized. Unit description source: EA002

Pzp - Serpentinized periodotite (Paleozoic) Gray, green, and greenish-gray to greenish-black, fine- to coarse-grained serpentinized peridotite. Unit description source: CI002

Pzum - Ultramafic (Late to middle Paleozoic) Light brown to dark green, coarse-grained, massive, non-foliated, weakly serpentinized metaharzburgite that forms approximately 200-m-wide body located within the metamorphosed mafic sequence (Pzam). Uncertain if protolith of ultramafic unit was coeval with protoliths of adjacent metamorphosed mafic rocks (Pzam) or, as proposed in Dusel-Bacon and others (2013), is a tectonic sliver emplaced during late Paleozoic or Mesozoic tectonism. Metaharzburgite is identical in composition and texture to partially serpentinized harzburgite in other parts of the Eagle quadrangle that are interpreted as alpine-type peridotites derived from the mantle and part of the Seventymile terrane (Group II of Foster and Keith, 1974; Foster and others, 1994).

Unit description source: EA015

Pzu - Ultramafic rocks (Paleozoic) Light green, greenish gray, or black and less commonly tan, brown, or yellow green; Occurs as small foliated masses infolded with amphibolite facies gneiss and schist. Original rock was peridotite which has been regionally metamorphosed to amphibole, chlorite, and magnetite. Age unknown. Unit description source: BD002

Pzum - Ultramafic schist (Paleozoic) Dark-green, foliated, serpentized ultramafic schist. Weathers to light-brown color; protolith was peridotite. Equivalent to unit Pzu of Weber and others (1978). Age uncertain, but protolith presumed coeval with unit Pzmg. Basal contact poorly exposed, but structural discordance in foliation directions with underlying units suggests contact is low-angle fault. Unit description source: BD003

MZPZPCb - Basalt, gabbro, and greenstone (Mesozoic and/or Paleozoic, and Precambrian (?))

TrMsm - Seventymile assemblage (Triassic to Mississippian) See [TrMsm](#) for unit description from: [USGS SIM-3340](#)

MzPzb - Basalt (Mesozoic and (or) Paleozoic) Mostly altered fine-grained porphyritic basaltic rocks that are probably tholeiitic. Unit description source: EA002

MzPzb - Basalt and gabbro (Early Mesozoic? or Late Paleozoic?) Mostly fine-grained basaltic rocks. Includes pillow basalt, gabbro, diabase, mafic tuff, and breccia. Unit description source: CY007

gsi - Greenstone (Paleozoic? and Precambrian?) Coarse-grained massive greenstone similar in composition to the fine-grained greenstone. Represents basic intrusive rocks that were regionally metamorphosed. Unit description source: CY003

MZPZPCca - Chert and argillite (Mesozoic?, Paleozoic and Precambrian (?))

JMpu - Younger strata of the Porcupine River sequence of Brosge and Reiser (1969), undivided (Jurassic to Mississippian) See [JMpu](#) for unit description from: [USGS SIM-3340](#)

Pza - Argillite (Paleozoic, but may contain Mesozoic to preCambrian rocks) Dark-gray argillite and chert with minor interbeds of sandstone (chert and quartz arenite) and chert-pebble conglomerate. Contains goniatites of late Paleozoic age near intersection of Wood and Black rivers. Argillite is probably several thousand feet thick. Unit description source: CY003

Pzca - Chert and argillite (Late Paleozoic) Chert and argillite. Unit description source: CY002

PZmv - Chicken Metamorphic Complex, metavolcanic, metasedimentary and metatuffaceous rocks (Late Paleozoic)

Pzkp - Kevvy Peak Formation and similar rocks (early Paleozoic) See [Pzkp](#) for unit description from: [USGS SIM-3340](#)

uPzst - Chicken Metamorphic Complex - metasedimentary and metatuffaceous rocks (Late Paleozoic) Greenschist facies metasedimentary and lesser metavolcanic rocks. Metasedimentary

rocks of this unit are fine- to medium-grained marble, slate, quartz mica phyllite, and minor quartzite. Paleozoic age assignment based on reported crinoid columns in marble near Napoleon Creek (Prindle, 1909). Metavolcanic rocks are mostly andesitic to rhyolitic composition with mm-scale mineral and color banding suggesting a tuffaceous origin. Minor massive greenstone interbeds included in this unit. Unit thickness is unknown, but most likely in excess of 200 m. Magnetic susceptibility of this unit varies tremendously: greenstone is typically $0.5\text{--}5 \times 10^{-3}$ SI; intermediate to felsic composition metavolcanic rocks are $0.5\text{--}0.1 \times 10$ SI, and metasedimentary rocks are $<0.1 \times 10^{-3}$ SI. This unit contains gold-calcite veins at the Purdy mine, but no evidence for base-metal syngenetic mineralization. Absence of hornfels in this unit or skarn in carbonate-bearing portions near or adjacent to contacts with Jurassic and Triassic plutons suggest that these contacts are faults. Unit description source: EA012

uPzv - Chicken Metamorphic Complex - metavolcanic and lesser metasedimentary rocks (Late Paleozoic) Greenschist facies metavolcanic and lesser metasedimentary rocks. Metavolcanic rocks are mostly fine-grained, chlorite-albite-quartz-carbonate phyllite of basaltic major- and trace-element composition. May include minor phyllitic rocks of andesitic to rhyolitic composition with mm-scale mineral and color banding suggesting a tuffaceous origin. Sills or dikes 1–2 m-thick of metagabbro and metadiorite are common within 0.5 km of the contact with the metagabbro unit (uPzmg). Metasedimentary rocks of this unit are fine- to medium-grained marble, slate, quartz mica phyllite, and minor quartzite. Paleozoic age assignment based on spatial association with uPzst and uPzl units. Unit thickness is unknown, but most likely in excess of 200 m. Magnetic susceptibility of this unit varies tremendously: greenstone is typically $0.5\text{--}5 \times 10^{-3}$ SI; intermediate to felsic composition metavolcanic rocks are $0.5\text{--}0.1 \times 10^{-3}$ SI; and metasedimentary rocks are $<0.1 \times 10^{-3}$ SI. This unit contains epithermal-style veining at the Wall Street mine, but no evidence for base-metal syngenetic mineralization. Absence of either hornfels in this unit or skarn in carbonate-bearing portions near or

adjacent to contacts with Jurassic and Triassic plutons suggests that these contacts are faults. Cut by metadiorite dike with Ar/Ar hornblende plateau ages ranging from 287.7 Ma to 304.6 Ma (sample 13; table 1; Layer and others, 2001). Unit description source: EA012

Pzmv - Metavolcanic and lesser metasedimentary rocks (Middle Mississippian or older) Dark green to black, fine-grained, weakly to moderately foliated metabasalt and meta-andesite volcanics interlayered with metasedimentary rocks of the Chicken metamorphic complex of Werdon and others (2001). Thin interlayers of mylonite made up of recrystallized quartz and feldspar locally lie between foliation surfaces, presumably developed during regional tectonism, which thrust unit over supracrustal Paleozoic metamorphic rocks (Pzms). Unit metamorphosed to upper greenschist facies, with chlorite-epidote-calcite alteration assemblage. Primary age of unit uncertain, but an interlayered mylonitic felsic horizon (approximately 2 m thick), whose protolith was a dacitic volcanic rock or tonalite sill within the mafic metavolcanic rocks was dated at Middle Mississippian (table 1, sample 20). Mafic metavolcanic rocks have island-arc tholeiite trace-element signatures (Dusel-Bacon and others, 2013). U-Pb SHRIMP analyses of zoned zircons from the mylonite have cores dated at 332.6 ± 5.7 Ma (table 1, sample 20), which represent the age of volcanism (or intrusion?) of the protolith, and rims dated at ~ 70 Ma, interpreted to be the youngest possible age of tectonism undergone by the mylonite. At a locality within the Chicken metamorphic complex in the southeastern Eagle quadrangle, marble interlayered with metabasalt yielded poorly preserved conodonts of late Paleozoic, possibly Mississippian, age (Dusel-Bacon and Harris, 2003). Unit description source: EA015

PZq - Quartzite, meta-argillite and phyllite (Paleozoic)

Pzkp - Keevy Peak Formation and similar rocks (early Paleozoic) See [Pzkp](#) for unit description from: [USGS SIM-3340](#)

Pzbp - Blackshell quartzite and phyllite (Late Devonian) A 4,000- foot-thick sequence of black carbonaceous phyllite and fine-grained, dark, laminated quartzite with minor interbeds of calcschist

and marble (Pzbc), rhyolite (Pzbr), and pebble to granule conglomerate. Unit is gradational with increase of carbonate to the Dan Creek calcphyllite below, and in this map area, is in thrust-fault contact with various lithologies of Totatlanika Schist above. Consists dominantly of dark-gray to black quartzite (metachert), phyllitic quartzite, thinly laminated graphite-white mica, quartz phyllite, and black slate. Carbonaceous material typically 10-20 percent of the rock. Calcite and quartz segregations in boudins are common; limonite or pyrite is present along bedding lamination and disseminated throughout rock. Quartz veins and veinlets are abundant throughout the unit. Gray, white, or bluish-gray oxide coatings are visible on weathered surfaces. Refolding of small isoclinal folds has resulted in crenulated and warped axial planes of earlier folds. Sediments from streams draining Pzbp unit commonly enriched in zinc to several thousand parts per million. Considered correlative with upper part of the Keevy Peak Formation in the Alaska Range, from which Middle and Upper Devonian megafossils have been collected (Gilbert and Bundtzen, 1979). Unit description source: BD004, CI004

Pzq - Quartzite, meta-argillite and phyllite (Paleozoic) Black, dark-gray, or gray. Quartzite is medium-grained, thinly layered to massive. Meta-argillite may be slaty. Unit cut by abundant white quartz veins. Stratigraphically overlies calcareous phyllite and marble unit (Pzm, NSACCLASS = 5545). Unit description source: CI002

Pzq - Quartzite, Meta-Argillite, Phyllite, Slate, and Marble (Paleozoic) Quartzite commonly black but varies widely in color. Locally, color changes due to contact metamorphism. Interlayered with black or dark-gray meta-argillite. Phyllite, marble, and quartzite more commonly occur in the upper part of the formation but may be absent due to faulting or unconformity. Unit description source: BD002

PZgs - Rocks metamorphosed to upper greenschist facies (Paleozoic)

Pzkp - Keevy Peak Formation and similar rocks (early Paleozoic) See [Pzkp](#) for unit description from: [USGS SIM-3340](#)

Pzgs - Greenschist, calcareous greenschist, and quartz-chlorite-white mica schist (Late? Paleozoic) Greenschist, calcareous greenschist, and quartz-chlorite-white mica schist, also includes marble, greenstone, and quartzite. Differs from other greenschist facies units in having abundant layers and lenses of light-gray, medium- to coarsely crystalline, thin-layered to massive marble that is locally fossiliferous and locally more than 100 m thick. Unit description source: EA003

Pzq - Quartzite (Paleozoic, Mississippian?) Light-gray to black quartzite, includes minor gray phyllite, phyllitic and carbonaceous quartz schist, quartz mica schist, and locally layers of graphitic schist. Ranges in metamorphic grade from lower to upper greenschist facies. Unit description source: EA003

MDa - Rocks metamorphosed to upper greenschist facies: Nasina and Klondike Series - Nasina Actinolite schist (Mississippian-Devonian) Fine- to coarse-grained, green actinolite schist consisting of 70 to more than 90 percent actinolite + minor quartz ± clinozoisite ± biotite. Major and minor oxide analyses indicate the actinolite schist has mafic to ultramafic composition. Magnetic susceptibility is moderate: 0.1–0.5 x 10⁻³ SI. Actinolite schist grades into Nasina quartzite in several places in the Eagle A-1 Quadrangle and vicinity (Flynn and Newberry, 2001) and mafic interlayers within Nasina quartzite are described in the Yukon Territory (Mortensen, 1990). The presence of biotite distinguishes this unit from the lower-grade, but actinolite-rich metagabbro of the Seventymile Terrane. Unit description source: EA009

MDkq - Rocks metamorphosed to upper greenschist facies: Nasina and Klondike Series - Nasina Kyanite quartzite (Mississippian-Devonian) Fine- to medium-grained, bluish-gray quartzite containing ~two-thirds quartz and one-third 1–2 mm euhedral kyanite, with several percent each of 0.5 mm euhedral chlorite and white mica, and <1 percent each of apatite, rutile, opaque, and graphite. The absence of garnet, biotite, and tourmaline—invariably seen with kyanite-bearing rocks of the amphibolite facies rocks—and the presence of primary chlorite indicates that kyanite quartzite is most

similar to lithologies in the Nasina quartzite unit (MDq). Lacking any evidence of fault contacts with surrounding MDq, it is included within the Nasina Series. Most likely the protolith was a highly weathered or altered rock, for example, a paleosol or pyrophyllite-altered metarhyolite. Mortensen (1990) describes rare metarhyolitic intervals in the Nasina series, which may be less metamorphosed equivalents to the kyanite quartzite. Magnetic susceptibility is low to moderate, $0.05\text{--}0.7 \times 10^{-3}$ SI. The Unit description source: EA009

MDq - Rocks metamorphosed to upper greenschist facies: Nasina and Klondike Series - Nasina Quartzite (Mississippian-Devonian) Fine-grained, predominantly dark gray, commonly pyritic, carbonaceous quartzite and phengite-quartz schist, with lesser graphite-quartz schist and light gray quartzite. Locally grades into thin layers of biotite-albite-bearing quartz schist and quartzite, and are locally calcite-rich and include some marble. Apparent thickness is greater than 1,000 m, as this unit underlies a large adjacent area in Yukon Territory (Mortensen, 1988a). Foliation is locally crenulated; quartz lenses are common and commonly isoclinally folded. Magnetic susceptibility unit is very low, $0.01\text{--}0.15 \times 10^{-3}$ SI, with sporadic higher values. The carbonaceous rocks are strongly conductive, although low conductivity quartzite with little to no carbon is interlayered throughout the unit. Consequently, high conductivity, covered zones near outcrops of Nasina quartzite were also mapped as Nasina. Phengite from a phengite-quartz schist layer yielded $^{40}\text{Ar}/^{39}\text{Ar}$ plateau ages of 106.3 ± 0.6 Ma and 116 ± 0.9 Ma (sample A11; table 1), presumably reflecting age of cooling from peak metamorphism. Unit description source: EA009

PZm - Calcareous phyllite, marble and phyllite (Paleozoic)

Pzkp - Keevy Peak Formation and similar rocks (early Paleozoic) See [Pzkp](#) for unit description from: [USGS SIM-3340](#)

Pzbc - Blackshell calcschist and marble (Late Devonian) Tan to medium gray, calcite-rich beds interbedded with Pzdp unit; most common near gradational contact with the Dan Creek calcphyllite unit (Pzdp). Calcareous beds are typically 1-2 feet thick, interlayered and interfolded with black quartzite. Texture varies from paper-thin laminations of alternating carbonate and phyllite to banded, faintly schistose white mica-calcite quartzite. Carbonaceous concentrations along bedding traces and disseminated pyrite are present in most Pzbc units. Unit description source: BD004, CI004

Pzm - Calcareous phyllite, marble and phyllite (Paleozoic) Light to medium gray, fine to medium grained, thin layered and well foliated, commonly crumbly. Characteristically cut by abundant carbonate-quartz veins and veinlets; locally forms low tors. Age unknown, but stratigraphic relationships suggest early Paleozoic protoliths. Unit description source: BD002

Pzm - Phyllite, calcareous phyllite and marble (Paleozoic) Gray phyllite containing thin stringers of crumbly impure marble and black or gray quartzitic phyllite. May include rocks of unit Pzq (NSAClass = 5500). Unit description source: CI002

PZbl - Basalt and limestone (Paleozoic)

DZkb - Older carbonate strata of the Porcupine River sequence of Brosge and Reiser (1969) and equivalent units (Middle Devonian to Neoproterozoic?) See [DZkb](#) for unit description from: [USGS SIM-3340](#)

PzpCb - Basalt and limestone (Paleozoic) Dark-greenish- or bluish-gray, medium-fine-grained calcareous basalt, having locally well-developed pillows. Thin limestone layers at the base of the basalt. Upper units in basalt amygdaloidal, overlain by greenish-brown breccia of calcareous basalt having an opaline matrix. Black, moderately coarsely crystalline limestone overlies basaltic portion of unit. Overlying limestone is tan and brown dolomite, and dolomite containing gray chert fragments in

turn overlain by gray shale, gray recrystallized chert, and calcareous basalt. Dolomite and limestone contact may be a fault. Unit description source: CI002

PZca - Chert with interlayered argillite, marble and quartzite (Paleozoic)

DOka - McCann Hill Chert, Road River Formation, and Troublesome unit of Weber and others (1992) (Lower Devonian to Ordovician) See [DOka](#) for unit description from: [USGS SIM-3340](#)

Pzc - Chert and argillite (Paleozoic) Gray, black, and banded chert interlayered with gray, green, olive, black, gray, and tan argillite, rare gray marble, white quartzite, and white calcareous quartzite. Locally intruded by dark-greenish-gray to black diorite and gabbro. Unit description source: CI002

PZd - Diorite gabbro (Paleozoic)

PzPxmi - Mafic igneous rocks, central and northeast Alaska (early Paleozoic and (or) late Proterozoic) See [PzPxmi](#) for unit description from: [USGS SIM-3340](#)

Pzd - Diorite (Paleozoic) Medium gray to medium dark gray, fine to medium grained; dark-green to pale-brown hornblende, red-brown biotite abundant in some localities; foliation well-developed locally. Unit description source: BD002

PZug - Ultramafic and mafic rocks and greenstone (Paleozoic)

PzPxmi - Mafic igneous rocks, central and northeast Alaska (early Paleozoic and (or) late Proterozoic) See [PzPxmi](#) for unit description from: [USGS SIM-3340](#)

Pzug - Ultramafic and mafic rocks and greenstone (Paleozoic) Mostly greenish-black serpentinized peridotite. Greenstone consists of metamorphosed basalt and tuff. Unit description source: CI003

PZrm - Pelitic schist, marble subunit (Paleozoic)

PzPxyqm - Pelitic schist, including Chena River sequence (Devonian and older) See [PzPxyqm](#) for unit description from: [USGS SIM-3340](#)

Pzrcs - Calcsilicate rocks (Late Ordovician to middle Devonian) Chena River sequence. Thin- to thick-bedded, light green to white units of diopside-bearing quartzite, diopside-calcite quartzite, and diopside-quartz marble. Most beds are somewhat calcareous with pod-like or lenticular calcite concentrations. Typically laminated or banded. Boudinage of quartz rich layers common. Interbedded with pelitic schists, amphibolites and siliceous marbles. Garnet, biotite, muscovite, K-feldspar, and plagioclase (An30-33) are present in some calcsilicate beds. Diopside content is typically 20-50 percent. Contains rare tourmaline-rich horizons (former borosiliceous evaporites?). The Pzrcs rocks probably represent original dolomitic quartzites and siliceous dolomites. Tungsten skarn deposits are present in the upper Chena River area where Pzrcs and associated marbles (Pzrm) are cut by younger granitic bodies. Unit description source: BD004, CI004

Pzrm - Marble (Devonian? to Cambrian?) Chena River sequence. Cream-colored, gray, or pale-green marble layers to 180 feet thick. Massive to thinly bedded. Contains zones with quartz-rich horizons. Marbles grade compositionally to calcschists (Pzrc) with paper-thin bedding and layers of garnet muscovite- biotite quartz schist. Gray and greenish marbles contain varying amounts of garnet,

diopside, and clinozoisite. Limonitic pits and stains along bedding are locally present. Commonly associated with calcsilicate beds (Pzrcs) and amphibolite (Pzrp). Unit description source: BD004, CI004

Pzm - Marble (Paleozoic) Light gray marble with thin (cm-thick) metachert lenses. Unit forms discontinuous beds in a predominantly siliciclastic sequence (Pzq) and undivided metasedimentary rocks (Pzms). Unit is more massive in the northern part of the map area, whereas marble layers become more interlayered with micaceous units farther south. Age is unknown. Fossils in the region are extremely rare and include only the possible Mississippian conodont occurrence described above for unit Pzmv and Late Mississippian to Early Permian conodonts from marble in the Fortymile River assemblage in the southeastern Eagle quadrangle (Dusel-Bacon and Harris, 2003). Alternatively, the unit may predate Early Mississippian orthogneiss that intrudes a similar marble-bearing sequence (Fortymile River assemblage) in the eastern Eagle quadrangle (Day and others, 2002; Dusel-Bacon and others, 2006), and (or) the Late Devonian to Early Mississippian age of the augen gneiss and orthogneiss in the southwestern edge of the map area. Unit description source: EA015

PZmi - Orthogneiss and amphibolite of igneous origin (Paleozoic)

Pzymi - Orthogneiss and amphibolite of igneous origin (Mississippian, Devonian, and older?)
See [Pzymi](#) for unit description from: [USGS SIM-3340](#)

Pzg - Biotite gneiss (Paleozoic) Medium- to dark-gray, medium-grained, foliated, equigranular biotite gneiss of sedimentary origin interlayered with gray trondhjemitic to granodioritic orthogneiss. Unit is distinguished from unit Pzg by darker color, relatively weaker foliation, presence of sillimanite, and a higher biotite content. Unit is distinguished from unit Dog by presence of sillimanite. Unit description source: BD003

Pzg - Biotite gneiss (pre-Late Devonian) Medium-gray, medium-grained, quartzofeldspathic biotite gneiss. Unit description source: BD006

Dog - Biotite orthogneiss (Late and Middle Devonian) Predominantly light to medium gray, medium-grained, layered tonalitic, trondhjemitic to granodioritic orthogneiss; lesser amounts of biotite schist, quartzite, and paragneiss. Unit description source: BD006

Dog - Granodioritic orthogneiss (Middle to Late Devonian) Predominantly light to medium gray, medium-grained, layered trondhjemitic to granodioritic orthogneiss with lesser amounts of biotite schist, quartzite, and paragneiss. Occurs in northern and western parts of map area and is distinguished from unit Pzgn. Unit description source: BD003

PZg - Gneiss (Paleozoic)

PzPxygs - Gneiss, schist, and quartzite (Mississippian, Devonian, and older) See [PzPxygs](#) for unit description from: [USGS SIM-3340](#)

Pzg - Gneiss (Paleozoic) Gray and weathers tan; locally orange brown where altered; mostly medium grained equigranular; representative mineralogy is strained quartz, plagioclase, potassium feldspar, red-brown biotite and sillimanite; garnet, tourmaline, zircon, and apatite are common accessory minerals. Age unknown. Unit description source: BD002

PZI - Tahkandit Limestone (Paleozoic)

Ptl - Tahkandit Limestone (lower Permian) See [Ptl](#) for unit description from: [USGS SIM-3340](#)

Pzl - Limestone and dolomite (Paleozoic) Limestone and dolomite. Contains a few poorly preserved brachiopods. A few hundred feet thick. Unit description source: CY003

Pt - Tahkandit Limestone (Permian) Very pale orange, coarse-grained bioclastic limestone. Forms massive cliffs. Grayish-green glauconitic sandstone and chert-pebble conglomerate in basal 75 feet. Contains abundant brachiopods and a few corals, arenaceous foraminifers and bryozoa. Unit description source: CY003

Pt - Tahkandit Limestone (Permian) Coarse-grained bioclastic limestone, Canada and U.S. Unit description source: CY005

PZqsg - Quartz-mica schist and greenstone (Paleozoic)

Pks - Klondike Schist (Permian) See [Pks](#) for unit description from: [USGS SIM-3340](#)

Pzh - Hornfels (Paleozoic) Gneiss, schist, amphibolite and phyllite altered to hornfels. Assigned to this unit based on surrounding polygons. Unit description source: EA002

Pzqc - Quartz-chlorite-white mica schist (Paleozoic) Light-green or light greenish gray quartz-chlorite-white mica schist commonly calcareous and interlayered with quartzite, phyllite, and mafic to felsic metavolcanic rocks. Unit description source: EA003

Pzq - Quartz-mica schist and greenstone (Paleozoic) Quartz-mica schist and greenstone. Also includes quartzite, marble, quartz phyllite, phyllite, and quartz-graphite schist, quartz-muscovite schist, chlorite schist, calcareous schist, and greenstone. Unit description source: EA002

Pkf - Rocks metamorphosed to upper greenschist facies: Nasina and Klondike Series - Klondike Metafelsite (Permian) Fine-grained, greenschist-facies, feldspar-rich felsic to intermediate-composition metavolcanic rocks, commonly with relict igneous texture, up to 300 m thick. Most commonly present as chlorite-clinzoisite-phengite-albite-quartz metafelsite and schist (locally with minor biotite); clinzoisite-phengite-quartz schist; and phengite-albite-quartz-K-feldspar metarhyolite. Mineral proportions vary considerably; those of apparently meta-intermediate composition contain abundant chlorite, clinzoisite, albite, and phengite. X-ray diffraction analysis indicates the unit locally contains pyrophyllite in addition to phengite. Disseminated pyrite and quartz lenses are locally common. Albite and K-feldspar are present in variable proportions, and are fine-grained to porphyroclastic (up to 2 mm in size); some rocks appear to be metaporphyrific. Magnetic susceptibility is low, $0.02\text{--}0.2 \times 10^{-3}$ SI. Unit description source: EA009

Pks - Rocks metamorphosed to upper greenschist facies: Nasina and Klondike Series - Klondike Schist (Permian) Predominantly rusty-weathering, fine- to medium-grained, albite-chlorite-phengite-quartz schist and lesser albite-phengite-quartz schist, with an apparent thickness of ~500 m. Pks is distinguished from Pkf based on abundance of metafelsites—rare in Pks and abundant in Pkf. Magnetic susceptibility is low, $0.03\text{--}0.25 \times 10^{-3}$ SI, with sporadic higher values. In the southeast Eagle A-1 Quadrangle this unit was explored in the 1970s for volcanogenic massive sulfide deposits, and a polymetallic (Pb-Zn-Cu-Ag) soil anomaly was defined (Resource Associates of Alaska, 1977; Smit, 2000). Several short core holes drilled in upper Brophy Creek drainage did not encounter massive sulfide, although highly pyritic zones were intersected, with rare galena and sphalerite (Resource Associates of Alaska, 1977). Galena from this core displayed lead isotope ratios indistinguishable from those of syngenetic Klondike schist-hosted prospects in Yukon Territory (J.K. Mortensen, written commun., 2002). Rocks in upper Arkansas Creek and, to a lesser extent, Brophy Creek, are heavily iron-stained. Phengite yielded a $40\text{Ar}/39\text{Ar}$ plateau age of 157.5 ± 1.2 Ma (sample

A10; table 1), which represents cooling from peak metamorphism. Unit description source: EA009

PZqs - Quartz-mica schist, greenstone, dolomite, and limestone (Paleozoic)

Pks - Klondike Schist (Permian) See [Pks](#) for unit description from: [USGS SIM-3340](#)

uPzl - Chicken metamorphic complex - limestone (Late Paleozoic) Limestone, subunit of uPzst. White, gray, and yellowish-brown colored, fine- to medium-grained limestone. Limestone varies from thin-bedded units interbedded with phyllite to massive beds up to 46 m thick. Commonly forms cliffs where exposed. Limestone varies from fairly pure calcium carbonate to impure varieties with quartz, muscovite, epidote, and opaque (carbonaceous) material. Fragments of crinoid stems present in limestone cropping out on the South Fork of the Fortymile River just below the mouth of Napoleon Creek (Prindle, 1909). Unit is dolomitized and/or brecciated near high-angle faults. Magnetic susceptibility is $<0.1 \times 10^{-3}$ SI. Unit description source: EA012

Pzq - Quartz-mica schist, greenstone, dolomite, and limestone (Paleozoic) Marble subunit of quartz-mica schist and greenstone. Also includes quartzite, marble, quartz phyllite, phyllite, and quartz-graphite schist, quartz-muscovite schist, chlorite schist, calcareous schist, and greenstone. Unit description source: EA002

Pzq - Quartz-mica schist and greenstone, dolomite outcrops (Paleozoic) Dolomite outcrops within quartz-mica schist and greenstone. Also includes quartzite, marble, quartz phyllite, phyllite, and quartz-graphite schist, quartz-muscovite schist, chlorite schist, calcareous schist, and greenstone. Unit description source: EA002

PZgc - Greenstone and Chert (Paleozoic)

TrMsm - Seventymile assemblage (Triassic to Mississippian) See [TrMsm](#) for unit description from: [USGS SIM-3340](#)

Pzg - Greenstone (Paleozoic) Greenstone, dark-green mafic rocks of igneous origin, mostly massive but locally foliated. Unit description source: EA002

Pgc - Greenstone and Chert (Permian) Greenstone is light to dark green or greenish gray, greenish red, or greenish black; fine to coarse grained; mostly massive with weakly developed foliation in places. Chert is green, light, and dark gray, red, and mottled green and gray; massive, closely fractured, and commonly sugary texture. Unit description source: BD002

Pzgr - Greenstone with tuff and silica-carbonate lenses (Late(?) Paleozoic) Massive greenstone bodies, originally mostly basaltic pillow lavas and mafic lava flows; generally associated with peridotite bodies. Locally red, gray, or green tuff and silicified tuff is interlayered. White and orange-brown silica-carbonate lenses crop out in the northern Big Delta quadrangle. At one locally in Eagle quadrangle, blueschist facies metamorphic basalt is included. Unit description source: CY007

Pst - Step and Tahkandit Formations (Permian)

Ptl - Tahkandit Limestone (lower Permian) See [Ptl](#) for unit description from: [USGS SIM-3340](#)

Pst - Step and Tahkandit Formations (Permian) Undifferentiated Step and Tahkandit Formations. Unit description source: CY005

Pq - Quartzite with some phyllite, micaceous quartzite, marble and calcareous quartz schist (Permian)

TrMsm - Seventymile assemblage (Triassic to Mississippian) See [TrMsm](#) for unit description from: [USGS SIM-3340](#)

Pq - Quartzite with some Phyllite, Micaceous Quartzite, Marble, and Calcareous Quartz Schist (Permian) Quartzite and lesser phyllite, micaceous quartzite, marble, and calcareous quartz schist. Quartzite is tan, red, maroon to purple, and black and commonly finely banded. Mostly fine-grained and in places closely folded. Locally has abundant, fine, disseminated sulfides. Age unknown but considered Permian because of association with unit Pgc. Unit description source: BD002

Pstc - Step Conglomerate (Permian and Late Devonian (?))

Pstc - Step Conglomerate (lower Permian) See [Pstc](#) for unit description from: [USGS SIM-3340](#)

Dnrc - Conglomerate (Late Devonian (?)) Pebble- to boulder-sized quartzite and chert clasts and interbedded quartz-chert-arenite and wacke and siltstone. Mapped by Brabb and Churkin, 1969, as Step Conglomerate (Permian). Unit description source: CY002

Pc - Sandstone and conglomerate (Permian (?)) Sandstone and conglomerate. Sandstone and wacke composed of chert and quartz grains cemented by calcite. Unit description source: EA002

Ps - Step Conglomerate (Permian) Chert-pebble conglomerate and chert arenite. Minor siltstone, bioclastic limestone, and quartz arenite. Has Tahkandit fauna in Step Mountains area. Nonfossiliferous and uncertain age in western and northern part of quadrangle except for single Permian fauna from sandstone near Takoma Bluff. Thickness and about 2,000 feet. Names and described by Brabb (1969). Unit description source: CY003

Ps - Step Conglomerate (Permian) Chert-pebble conglomerate and chert arenite, U.S. Unit description source: CY005

PNMcb - Calico Bluff Formation (Pennsylvanian and Mississippian)

IPDcf - Calico Bluff and Ford Lake Shale, undivided (Lower Pennsylvanian to Devonian) See [IPDcf](#) for unit description from: [USGS SIM-3340](#)

Ccb - Calico Bluff Formation (Carboniferous) Limestone and shale. Unit description source: CY005

IPMc - Calico Bluff Formation (Early Pennsylvanian and Late Mississippian) Dark-brownish-gray, rhythmically interbedded bioclastic limestone and shale. Unit description source: EA002

PNMDf - Ford Lake Shale (Carboniferous and Devonian)

IPDcf - Calico Bluff and Ford Lake Shale, undivided (Lower Pennsylvanian to Devonian) See [IPDcf](#) for unit description from: [USGS SIM-3340](#)

CDf - Ford Lake Shale (Carboniferous and Devonian) Laminated shale and chert. Unit description source: CY005

MDf - Ford Lake Shale (Late Mississippian to Early Devonian) Grayish-black laminated siliceous shale and chert. Unit description source: EA002

MDts - Totatlanika Schist (Late Devonian to Early Mississippian)

MDts - Totatlanika Schist (Early Mississippian to Late Devonian) See [MDts](#) for unit description from: [USGS SIM-3340](#)

Pztc - Calcschist (Late Devonian to early Mississippian) Totatlanika Schist: Thinly layered, schistose calcareous rocks. Composition varies from impure micaceous marbles to biotite-sericite-calcite-quartz schist with accessory tourmaline, ilmenite(?), and apatite. Interlayered with and gradational to Pztm. Most abundant near contact with Blackshell unit. Unit description source: BD004

Pztp - Gray phyllite and semischist (Late Devonian to early Mississippian) Totatlanika Schist: Light- to dark-gray rocks, identical in texture and mineral content to Pztg but without green coloration. Mainly sericite-quartz with minor feldspar and trace chlorite. Small-scale folds and crenulations prevalent. Unit description source: BD004

Pztg - Green phyllite and semischist (Late Devonian to early Mississippian) Totatlanika Schist: Pale- to dark-green phyllite, semischist, and phyllitic quartz arenite (grits) with foliated chlorite-sericite-plagioclase-quartz groundmass. Subrounded to angular quartz clasts typically compose 35-50 percent of the rock and are poorly sorted to bimodal with clast sizes to one-eighth inch in diameter. Plagioclase composition is An33-35. Unit includes some banded green chert with thin white carbonate laminations. Crenulations and kink folds are common. Abundant quartz veins and limonitic clots on foliation surfaces. Intricately folded near the contact with Pzbp. Unit description source: BD004

Pztm - Marble (Late Devonian to early Mississippian) Totatlanika Schist: Massive- to thin-bedded, gray to creamy white marble interbedded with Pztg and Pstp. Garnet and epidote locally present. Siliceous webs and veinlets common in massive beds. Compositionally gradational to Pztc. Unit description source: BD004

Pzsg - Semischist, greenschist, quartzite, phyllite, marble, and greenstone (Paleozoic) Semischist or sheared grit; greenish gray or gray and fine to coarse grained; very quartzitic to very feldspathic; clear, gray, or bluish-gray quartz grains 1 to 5 mm in diameter characteristic; interlayered with quartz-chlorite mica schist and others combinations of greenschist rocks, tan quartzite, gray and tan phyllite, marble, and greenstone. Possibly equivalent to the Totatlanika Schist in the northern Alaska Range. Unit description source: BD002

Pztt - Tan phyllite and semischist (Late Devonian to early Mississippian) Totatlanika Schist: Tan-weathering phyllite, semischist, and meta-arenite. Identical to Pztg and Pztp except for more abundant feldspar and minor biotite, and disseminated limonite throughout the rock imparts a tan coloration. Unit description source: BD004

Pztu - Undifferentiated Totalanika Schist (Late Devonian to early Mississippian) Includes several Pzt lithologies described above. Confined to east trending ridge in the southeastern part of the map area. Unit description source: BD004

MDag - Augen gneiss and orthogneiss (Devonian to Mississippian)

MDag - Augen gneiss and orthogneiss (Early Mississippian and Late Devonian) See [MDag](#) for unit description from: [USGS SIM-3340](#)

PzpCa - Augen gneiss (Paleozoic or Precambrian) Augen most commonly of white potassium

feldspar, range in size from 1 to 10 cm long, most about 4 cm long. Biotite is scarce to abundant. Foliation layers containing biotite bend around augen. Age unknown. Unit description source: BD002

Dag - Augen gneiss (Late Devonian) Inhomogeneous orthogneiss dominated by light- gray, medium- to coarse-grained, strongly foliated biotite-muscovite±sillimanite quartzofeldspathic augen gneiss with zones of relatively augen-free biotite gneiss of granodioritic to granitic bulk composition. Unit description source: BD003

Pzra - Augen gneiss (Late Devonian to early Mississippian) Chena River sequence: Mottled gray or brown and white, mainly concordant, granitic augen gneiss bodies in Chena River sequence, upper Clinky quartzite, and West Point Complex. Typically weathers as flaggy plates or blocks, a few inches to several feet in diameter. Thickness of augen gneiss layers varies from a few inches to tens of feet; multiple thin layers are common. Composition ranges from quartz-rich varieties with 10-20 percent K-feldspar megacrysts (augen quartzite) to biotite -plagioclase- quartz-feldspar gneisses with 40-50 percent K-feldspar megacrysts. Augens up to 2 inches are lenticular, rounded, or subangular; consist of Carlsbad- and grid-twinned K-feldspar with plagioclase (An38-40) inclusions and local relict perthitic textures. Small quartz grains are present in pressure shadows adjacent to megacrysts. Schistose groundmass consists of biotite-plagioclase- K-feldspar and quartz in varying proportions with accessory sphene, apatite, and ilmenite(?). Secondary chlorite and sericite are common, garnet is locally present. Major-element chemistry of selected augen gneiss samples is granitic. Although less calcic in composition (table 2), the augen gneiss bodies in the map area are similar to those in the central Big Delta Quadrangle, which are considered to be metamorphosed sill-like granitic intrusives of Mississippian age (Dusel-Bacon and Aleinikoff, 1985). Field localities of the upper Chena River augen gneisses are enigmatic, however, in that (1) locally, many multiple units are delicately interlayered with metasedimentary host rocks, (2) in some cases, they appear gradational with enclosing host rocks, and (3) individual augen gneiss layers a few feet thick extend laterally over the same stratigraphic horizon for up to 15 miles. Thus, the field occurrence and geometry of many augen gneiss layers in the map area are more typical of recrystallized felsic volcanic rocks than of deep-seated intrusives. Unit description source: BD004, CI004

Da - Augen gneiss (Devonian) Biotite-bearing felsic augen gneiss. Unit description source: CI002, CI011

PzpCg - Augen gneiss (Paleozoic and (or) Precambrian) Cataclastic, sheared, augen gneiss. Includes mylonite gneiss, porphyroblastic augen gneiss, proto mylonite gneiss, and blastomylonite. Unit description source: EA002

MDag - Augen gneiss (Early Mississippian to Late Devonian) Inhomogeneous orthogneiss dominated by light-gray, medium- to coarse-grained, strongly foliated biotite-muscovite augen gneiss with zones of relatively augen-free biotite gneiss of granodioritic to granitic bulk composition. Unit is characterized by lent Unit description source: EA015

Dag - Augen gneiss of Central Creek (Late and Middle Devonian) Multiphase orthogneiss dominated by light-gray, medium- to coarse-grained, strongly foliated biotite-muscovite +/- sillimanite quartzofeldspathic augen gneiss; lesser relatively augen-free biotite gneiss of granodioritic to granitic bulk composition. Unit is characterized by lenticular-shaped augen made up of quartz, feldspar, mica +/- garnet mineral aggregates set in medium-grained foliated to granoblastic matrix of granodioritic composition. Unit description source: BD006

Dog - Biotite orthogneiss (Late Devonian) Predominantly light to medium gray, medium-grained, layered trondhjemitic to granodioritic orthogneiss with lesser amounts of biotite schist, quartzite, and paragneiss. Undated in the map area, but similar rocks in the Big Delta quadrangle yielded Late Devonian (367 +/- 7 Ma) U-Pb SHRIMP dates on zircon cores (Day and others, 2007). That study also showed that U-Pb SHRIMP ages on zircon rims showed two populations: (1) an older group at 114 +/- 2 Ma and (2), a younger group at 109 +/- 2 Ma. The U-Pb SHRIMP data on zircons from the sample indicate that the protolith intrusion (or intrusive complex?) inherited zircons from a crustal

source that was in part Precambrian, was emplaced during the Devonian, and was recrystallized twice during pulses of regional Cretaceous tectonism at ~114 Ma and at ~109 Ma. The younger age is coeval with the Early Cretaceous intrusions in the western Fortymile district mapped in this study (Kgc). Unit description source: EA015

Ddg - Dioritic orthogneiss (Late Devonian) Dark-green, medium-grained, foliated, hornblende-biotite±garnet dioritic orthogneiss. Interpreted to be a cognate mafic phase of the Devonian augen gneiss (unit Dag); contact zone with augen gneiss is apparently not faulted and is a typical igneous contact. Unit description source: BD003

MDag - Fortymile River Assemblage - augen gneiss (Mississippian to Devonian) Medium- to coarse-grained, biotite-quartz-feldspar gneiss with relict igneous K-feldspar megacrysts that now form porphyroclasts (augen) to 3.5 cm in a matrix of quartz, feldspar, biotite (commonly chloritized), and lesser white mica. Generally has a granodioritic to granitic bulk composition. Present as ellipsoidal bodies generally <2 km in surface area generally displaying sheared contacts with surrounding amphibolite-facies metamorphic rocks. Magnetic susceptibility variable, but commonly $1-10 \times 10^{-3}$ SI. There are no published dates for this unit in the Eagle Quadrangle, but similar appearing bodies elsewhere in the Yukon-Tanana region yield Mississippian (Aleinikoff and others, 1986; Newberry and others, 1998a) and uppermost Devonian (Mortensen, 1986) U-Pb ages. Unit description source: EA012

MDog - Fortymile River Assemblage - orthogneiss (Mississippian to Devonian) Medium- to coarse-grained, variably foliated, biotite-quartz-feldspar gneiss. Lacks K-feldspar porphyroclasts but possesses relict equigranular to slightly porphyritic igneous textures and granitic to granodioritic to trondhjemitic bulk composition and mineralogy. Typical modal mineralogy is 20–30 percent quartz, 0–20 percent K-feldspar, 30–80 percent plagioclase, 0–15 percent biotite (typically chloritized), and 0–6 percent white mica. Spatial association with augen gneiss (MDag) and igneous composition implies a plutonic origin for this rock type. Present as irregular bodies, generally <8 km in surface area; interlayering with surrounding metamorphic rocks suggests a sill morphology for most bodies. Locally cut by quartz iron carbonate veins with pyrite. Magnetic susceptibility generally low to moderate, $0.02-3 \times 10^{-3}$ SI. There are no published dates for this unit, but spatial association with augen gneiss (MDag) suggests a similar age. Unit description source: EA012

Pzh - Hornfels (Paleozoic) Gneiss, schist, amphibolite and phyllite altered to hornfels. Assigned to this unit based on surrounding polygons. Unit description source: EA002

Mog - Rocks metamorphosed to amphibolite facies: Fortymile River Assemblage - felsic orthogneiss (Mississippian) Bodies consisting primarily of fine- to coarse-grained, biotite-quartz-feldspar gneiss with granite or granodiorite mineralogy and bulk composition and some remnant igneous texture. Typical grain size is 1–4 mm, but quartz grains especially are granulated remnants of larger (commonly 3–8 mm) phenocrysts. Feldspar augen are occasionally present, but most feldspar is finer-grained than quartz. Major mineral abundances: 20–55 percent plagioclase (average 39), 7–40 percent K-feldspar (average 23), 15–42 percent quartz (average 28), 1–25 percent biotite (average 9), 0–7 percent hornblende, 0–10 percent muscovite, and 0–15 percent epidote. Apatite, zircon, sphene, and opaques are present in trace amounts. Myrmekite is commonly present. Magnetic susceptibility is usually low (average 0.2×10^{-3} SI), but ranges up to 1.5×10^{-3} SI. A sample from the Moose Creek granodiorite orthogneiss, 3 km to the east of the Eagle A-1 Quadrangle, gave a U-Pb (zircon) age of 348.2 ± 0.7 Ma (Mortensen, 1988b). Unit description source: EA009

Motn - Rocks metamorphosed to amphibolite facies: Fortymile River Assemblage - tonalitic orthogneiss (Mississippian) Bodies consisting primarily of medium-grained, (hornblende)-biotite-quartz-feldspar gneiss with tonalitic composition and remnant plutonic textures. Includes some granodiorite and quartz diorite. Typical grain size is 1–3 mm, with evidence for granulated quartz phenocrysts of originally 3–6 mm size. Major mineral abundances: 40–75 percent plagioclase (average 50), 0–20 percent K-feldspar (average 3), 15–40 percent quartz (average 27), 10–30 percent biotite (average 15), 0–10 percent hornblende (average 3), 0–5 percent garnet, 0–7 percent

epidote, and 0–2 percent oxides. Plagioclase is typically oligoclase-andesine; zoning is sometimes present and myrmekite is rare. Magnetic susceptibility is moderate, typically $0.2\text{--}0.5 \times 10^{-3}$ SI. A tonalitic orthogneiss sample from the Eagle A-1 Quadrangle (sample A12; table 1) gave a U–Pb (zircon) age of 343 ± 4 Ma (Da y and others, in press). Unit description source: EA009

Motr - Rocks metamorphosed to amphibolite facies: Fortymile River Assemblage - trondhjemitic orthogneiss (Mississippian) Bodies consisting primarily of leucocratic, medium- to coarse-grained, (K-feldspar)–biotite–quartz–sodic plagioclase gneiss with trondhjemitic composition and remnant plutonic textures. Typical grain size is 2–5 mm, and texture is sub-equigranular; K-feldspar porphyroclasts are consistently absent. Major mineral abundances: 45–80 percent plagioclase (average 63), 0–10 percent K-feldspar (average 4), 15–40 percent quartz (average 26), 0–10 percent biotite (average 6), 0–10 percent muscovite (average 2), and 0–3 percent garnet. Plagioclase is typically An₅₋₁₅ with little obvious zoning; albite replacement textures are seen in some samples. Myrmekite is commonly present. Total mafic mineral abundances of 10 percent or less give this rock a very white appearance; foliation may be difficult to discern in very low mafic samples. Magnetic susceptibility is low, rarely more than 0.2×10^{-3} SI. A sample from the Eagle A-2 Quadrangle gave a U–Pb (zircon) age of approximately 335–340 Ma (J. Mortensen, written commun., 2001). Unit description source: EA009

Mo - Rocks metamorphosed to amphibolite facies: Fortymile River Assemblage - undifferentiated orthogneiss (Mississippian) Composite orthogneiss bodies or bodies with considerable compositional variability, as indicated by chemical analyses and feldspar staining. Individual bodies can range through the spectrum of granite–granodiorite–trondhjemite–tonalite–quartz diorite, but more commonly exhibit a smaller range in composition. Also locally includes schist, gneiss, and other metamorphic rock types present in minor abundance. Nearly always contain 15–40 percent quartz and more than 50 percent total feldspar; the remainder is mostly biotite $\pm$ muscovite or hornblende. Fine-grained orthogneiss, of potentially metavolcanic origin, constitutes up to one-third of a given body. Many bodies appear sill-like, either because they were intruded as sills or because they were deformed into sub-parallelism with the surrounding layered rocks. Magnetic susceptibility varies with rock type; $0\text{--}0.5 \times 10^{-3}$ is typical but values up to 3×10^{-3} SI. These composite bodies presumably possess the same Mississippian ages as displayed by less compositionally diverse ones. Unit description source: EA009

Dbr - Blackshell rhyolite (Late Devonian)

MDag - Augen gneiss and orthogneiss (Early Mississippian and Late Devonian) See [MDag](#) for unit description from: [USGS SIM-3340](#)

Pzbr - Blackshell rhyolite (Late Devonian) Light- to dark-brown weathering, quartz-K-feldspar porphyry dome and associated aphanitic vitreous muscovite- feldspar-quartz beds (metatuff, metaexhalite) near top of Pzbp unit. Rhyolite is porphyritic with white, Carlsbad-twinning, subhedral K-feldspar and rounded or embayed, gray beta-quartz phenocrysts in an aphanitic groundmass of sericite, feldspar, and quartz with disseminated pyrite blebs. Associated aphanitic, vitreous quartzite beds (metaexhalites?) in same stratigraphic horizon are finely laminated, muscovite-feldspar-quartz rock with altered feldspar and pyrite clots. Unit description source: BD004

Dnr - Nation River Formation (Devonian)

Dnr - Nation River Formation (Upper and Middle? Devonian) See [Dnr](#) for unit description from: [USGS SIM-3340](#)

Dnr - Nation River Formation (Late Devonian) Rhythmically interbedded, mudstone, sandstone, gritstone, and conglomerate. Graded beds common. Mudstone is olive gray and nearly everywhere

contains plant fragments and spores of Late Devonian age. Sandstone is olive-gray chert-arenite and wacke, commonly with carbonate cement. Gritstone and conglomerate composed mostly of varicolored chert granules and pebbles. Thickness approximately 2,000 to 4,000 feet. Unit description source: CY003

Dnr - Nation River Formation (Devonian) Mudstone, sandstone, and conglomerate. Unit description source: CY005

Dn - Nation River Formation (Late Devonian) Rhythmically interbedded mudstone, sandstone, gritstone, and conglomerate. Unit description source: EA002

Dof - Ogilvie Formation (Devonian)

Dof - Ogilvie Formation (Middle to Lower Devonian) See [Dof](#) for unit description from: [USGS SIM-3340](#)

DI - Limestone (Devonian) Medium-gray limestone and calcareous shale. Contains a few brachiopods, corals, and bryozoa of Devonian age. Thickness a few hundred feet. Unit description source: CY003

Do - Ogilvie Formation (Devonian) Massive bioclastic limestone. Unit description source: CY005

Dsl - Schwatka unit--Limestone (Middle and Early Devonian) Limestone. Unit description source: CI003

Dwd - Woodchopper Volcanics, dolomite (Middle Devonian) Dark-gray laminated dolomite with minor interbeds of chert. Probably a several hundred feet thick. Age uncertain. Unit description source: CY003

Dwl - Woodchopper Volcanics, limestone (Middle Devonian) Dark-gray bioclastic limestone with brachiopods, corals and other fossils of Middle Devonian age. The relation of the limestone to the volcanic rocks is uncertain. A few hundred feet thick. Unit description source: CY003

Dka - McCann Hill Chert (Devonian)

DOka - McCann Hill Chert, Road River Formation, and Troublesome unit of Weber and others (1992) (Lower Devonian to Ordovician) See [DOka](#) for unit description from: [USGS SIM-3340](#)

Dm - McCann Hill Chert (Devonian) Chert, often weathers yellowish-red. Unit description source: CY005

Dm - McCann Hill Chert (Late, Middle, and Early Devonian) Thin-bedded and laminated, dark- to light-gray chert, siliceous shale, and minor chert gritstone. Unit description source: EA002

Dwv - Woodchopper Volcanics (Middle Devonian)

Dvec - Woodchopper Volcanics, and Schwatka unit of Weber and others (1992) (Devonian) See [Dvec](#) for unit description from: [USGS SIM-3340](#)

Dwv - Woodchopper Volcanics (Middle Devonian) Mostly dark-greenish-gray spilitic basalt and lapilli tuff. Amygdules and pillow structures common. Minor thin interbeds(?) of shale, chert, sandstone, siltstone, limestone, and dolomite. Probably a few thousand feet thick. Age uncertain. Unit description source: CY003

Dws - Woodchopper Volcanics, shale (Middle Devonian) Dark-gray laminated shale with minor interbeds of limestone. Age uncertain. Several hundred feet thick. Unit description source: CY003

Dsv - Schwatka unit, mafic volcanic rocks (Middle and Early Devonian)

Dvec - Woodchopper Volcanics, and Schwatka unit of Weber and others (1992) (Devonian) See [Dvec](#) for unit description from: [USGS SIM-3340](#)

Dsv - Schwatka unit--Mafic volcanic rocks (Middle and Early Devonian) Mafic volcanic rocks and minor clastic sedimentary rocks. Unit description source: CI003

DSd - Dolomite and argillite (Devonian and/or Silurian)

DZkb - Older carbonate strata of the Porcupine River sequence of Brosge and Reiser (1969) and equivalent units (Middle Devonian to Neoproterozoic?) See [DZkb](#) for unit description from: [USGS SIM-3340](#)

DSd - Dolomite and argillite (Devonian and/or Silurian) Mostly yellow-gray dolomite and mostly gray and dark-gray to black argillite, shale, and siltstone. Interlayered with light- and dark-gray chert, yellow-gray dolomite, gray marble, and gray, fine-grained quartzite. Unit description source: CI002, CI003

DSOr - Road River Formation (Devonian, Silurian and Ordovician)

DOka - McCann Hill Chert, Road River Formation, and Troublesome unit of Weber and others (1992) (Lower Devonian to Ordovician) See [DOka](#) for unit description from: [USGS SIM-3340](#)

DSOr - Road River Formation (Devonian, Silurian and Ordovician) Gray graptolitic shale with subordinate chert and limestone. Unit description source: CY005

DOR - Road River Formation (Early Devonian to Early Ordovician) Dark-gray graptolitic shale with lesser amounts of grayish-black laminated chert and very minor dark-gray limestone, greenish-gray dolomite, grayish-black chert arenite and chert conglomerate. Unit description source: EA002

DSOdc - Dan Creek calcphyllite, marble and schist (Late Ordovician to Middle Devonian)

Pzkp - Keevy Peak Formation and similar rocks (early Paleozoic) See [DOka](#) for unit description from: [USGS SIM-3340](#)

Pzdp - Dan Creek calcphyllite (Late Ordovician to middle Devonian) Interbedded silvery gray, calcareous phyllite; brown, gray, or black laminated quartzite, noncalcareous gray phyllite, and minor green phyllite and marble (unit Pzdm). Typical mineralogy is 80-85 percent quartz, 5 percent white mica, and 5-10 percent chlorite and graphite. Porphyroblastic biotite clasts present in some semischistose layers near gradational contact with Pzdc. White efflorescent coatings on weathered surfaces and abundant orange or brown weathering pits and laminations are characteristic. Quartz boudins, crenulations and crenulation cleavage are common features. Unit description source: BD004, CI004

Pzdm - Dan Creek marble (Late Ordovician to middle Devonian) Gray to white or greenish gray marble in Pzdc-Pzdp section. Coarsely crystalline with varying amounts of chlorite, muscovite, and quartz. Thinly laminated and fine-grained to massive and granoblastic. Unit description source: BD004

Pzdc - Dan Creek schist (Late Ordovician to middle Devonian) Basal part of the Dan Creek unit, present mainly in the western part of the map area along the Middle Fork of the Chena River. Consists primarily of medium- to dark-gray muscovite-biotite-calcite-quartz schist with interbeds of white and gray marble (Pzdm), gray or black quartzite, and garnet-muscovite-quartz schist. Quartz boudins and veins common. Gradational to Chena River sequence below. Differentiated from Pzdp by the presence of coarse-grained white mica in schists. Unit description source: CI004

DSOdc - Dan Creek marble (Late Ordovician to Middle Devonian)

Oc - Chert of Interior Alaska (Ordovician) See [Oc](#) for unit description from: [USGS SIM-3340](#)

Pzdm - Dan Creek marble (Late Ordovician to middle Devonian) Gray to white or greenish gray marble in Pzdc-Pzdp section. Coarsely crystalline with varying amounts of chlorite, muscovite, and quartz. Thinly laminated and fine-grained to massive and granoblastic. Unit description source: CI004

SOs - Siltstone, dolomite, chert, and mafic igneous rocks (Silurian and/or Ordovician)

OCv - Fossil Creek Volcanics and similar rocks (Ordovician and Cambrian) See [OCv](#) for unit description from: [USGS SIM-3340](#)

SOs - Siltstone, dolomite, chert, and mafic igneous rocks (Silurian and/or Ordovician) Gray, black, or olive-gray siltstone and argillite and mudstone. Tan dolomite, gray to dark-gray fine-grained limestone, gray or dark-gray chert. Mafic igneous rocks are dikes, sills, and small lenses-like bodies of dark-greenish-black gabbro and basalt. Two areas of exposure, northern contains chert, southern mafic igneous rocks. This NSAcass assignment is for the southern of the two areas. Unit description source: CI003

OCjru - Jones Ridge Formation (Ordovician and Cambrian)

OCjr - Jones Ridge Limestone and related units (Ordovician to Cambrian) See [OCjr](#) for unit description from: [USGS SIM-3340](#)

OCjrd - Jones Ridge Formation (Ordovician and Cambrian) Dolomite. Unit description source: CY005

OCjrds - Jones Ridge Formation, silicified dolomite (Ordovician and Cambrian) Silicified dolomite in upper Jones Ridge Formation. Unit description source: CY005

OCjru - Jones Ridge Formation, undifferentiated (Ordovician and Cambrian) Undifferentiated upper and lower Jones Ridge Formation. Massive limestone and dolomite. Upper part of unit highly silicified. Unit description source: CY005

OCh - Hillard Limestone (Ordovician and Cambrian)

OCjr - Jones Ridge Limestone and related units (Ordovician to Cambrian) See [OCjr](#) for unit description from: [USGS SIM-3340](#)

OCh - Hillard Limestone (Ordovician and Cambrian) Gray to yellow-brown limestone with minor dolomite chert and shale. Unit description source: CY005

OCh - Hillard Limestone (Early Ordovician to Early Cambrian) Very fine- to medium-grained pale-yellowish-brown laminated, thick bedded limestone. Interbedded with limestone conglomerate and oolitic and sandy limestone. Unit description source: EA002

Ca - Adams Argillite (Cambrian)

Ca - Adams Argillite (Cambrian) See [Ca](#) for unit description from: [USGS SIM-3340](#)

Ca - Adams Argillite (Cambrian) Argillite, siltstone, and quartzite. Unit description source: CY005

Ca - Adams Argillite (Early Cambrian) Light-olive-gray argillite, siltstone, and cross laminated quartzite, containing worm(?) burrows. Unit description source: EA002

Cf - Funnel Creek Limestone (Cambrian)

OCjr - Jones Ridge Limestone and related units (Ordovician to Cambrian) See [OCjr](#) for unit description from: [USGS SIM-3340](#)

Cf - Funnel Creek Limestone (Cambrian) Light-gray limestone and dolomite. Unit description source: CY005

Cf - Funnel Creek Limestone (Early Cambrian) Light-gray, fine- to medium-grained laminated limestone, dolomitic limestone, and dolomite. Unit description source: EA002

PZPCch - Chert, argillite, and quartzite (Paleozoic and/or Precambrian)

TrDtz - Sedimentary rocks (Triassic to Devonian) See [TrDtz](#) for unit description from: [USGS SIM-3340](#)

ch - Chert (Paleozoic and or preCambrian) Various chert symbols shown on Circle map in a variety of rock units. No further description in text. Assigned to Rampart-Tozitna sedimentary rock unit on the basis of location. Unit description source: CI002

IPMc - Chert, argillite, and quartzite (Penn. and/or Mississippian) Mostly black, gray, and dark-gray chert, also includes light-gray, green and white banded chert. Rare gray, dark-gray, and black argillite, shale, slate, and siltstone and gray quartzite. Unit form east trending belt in east Crazy Mountains. May be part of Circle Volcanics, or in contact (conformable, unconformable or fault). Unit description source: CI002

PZPCe - Garnet-muscovite schist (Paleozoic and/or Precambrian)

Pze - Eclogite and associated rocks (Paleozoic) See [Pze](#) for unit description from: [USGS SIM-3340](#)

PzpCms - Garnet-muscovite schist (Paleozoic and/or Precambrian) Medium- to coarse-grained muscovite-garnet-quartz-plagioclase schist. Unit description source: CI003

PZPCm - Mylonite and mylonite gneiss (Paleozoic and/or Precambrian)

MDts - Totatlanika Schist (Early Mississippian to Late Devonian) See [MDts](#) for unit description from: [USGS SIM-3340](#)

Pzc - Cataclastic rocks (Paleozoic) Mostly mylonite schist and mylonite gneiss; gray, light green and tan; fine to coarse grained; dense and hard to soft and crumbly; fluxion structure common; neomineralization and crystallization evident. Rocks mostly quartzitic and feldspathic with minor amounts of mica, amphiboles, and epidote group minerals. Augen gneiss with perthitic microcline augen common. Unit description source: BD002

PzpCm - Mylonite and mylonite gneiss (Paleozoic and (or) Precambrian) Primarily mylonite gneiss, proto mylonite, and blastomylonite. Includes augen gneiss and granitic gneiss. Unit description source: EA002

PZPCcr - Chert, conglomerate and limestone (Paleozoic and/or Precambrian)

Dcr - Cascaden Ridge and Beaver Bend combined correlative units (Devonian) See [Dcr](#) for unit description from: [USGS SIM-3340](#)

unk - Chert (Paleozoic and or preCambrian) Various chert symbols shown on Circle map in a variety of rock units. No further description in text. Assigned to Cascaden on the basis of location. Unit description source: CI002

Pzcg - Chert pebble conglomerate (Paleozoic) Mostly gray chert pebble conglomerate. Conglomerate clasts dominantly chert but include minor quartz, quartzite and rare argillite and siltstone fragments. Unit description source: CI002

Pzcc - Chert, conglomerate and limestone (Paleozoic) Chert and chert-pebble conglomerate most characteristic. Chert is dominantly gray or black, locally massive, commonly brecciated. Unit description source: CI002

Dq - Quail unit, revised (Late Devonian?) Conglomerate, phyllite, calc-phyllite, siltstone, and sandstone. Part of unit re-correlated to Cascaden Ridge equivalent. Unit description source: CI003

PZPClc - Limestone and chert (Paleozoic and Precambrian)

DSld - Shallow-marine carbonate-dominated rocks (Devonian and Silurian?) See [DSld](#) for unit description from: [USGS SIM-3340](#)

DI - Limestone (Devonian) Medium-gray, generally massive, locally recrystallized limestone. Correlative with Tolovana limestone? Unit description source: CI002

pClIt - Limestone along Tintina fault zone (Precambrian (?)) Dark-gray medium-grained limestone

interbedded with dark-gray shale, argillite, siliceous shale, chert, calcareous siltstone, dolomite, tuff, and greenstone. Unit description source: EA002

Pzl - Limestone and chert (Paleozoic) Two separate(?) units. Eastern unit is light-gray to medium-dark-gray at top, mostly fine-grained, partly recrystallized, blocky fracturing limestone. Possible algal structures. Western unit ranges from light- to dark-gray limestone apparently interlayered with black, gray, and mottled chert, tan and gray argillite, amygdaloidal basalt, and gabbro. Unit description source: CI002

PZPCI - Wickersham unit, limestone (Paleozoic and/or Precambrian)

CPxwn - Wickersham and Neruokpuk units (Cambrian and Proterozoic) See [CPxwn](#) for unit description from: [USGS SIM-3340](#)

unk - Limestone (Paleozoic and or preCambrian) Various limestone symbol shown on Circle map in a variety of rock units. No further description in text. Includes only northern polygons of unit. Unit description source: CI002, CI003

PZPCag - Argillite, grit, and quartzite (Paleozoic and/or Precambrian)

CPxwn - Wickersham and Neruokpuk units (Cambrian and Proterozoic) See [CPxwn](#) for unit description from: [USGS SIM-3340](#)

PzpCa - Argillite, grit, and quartzite (Paleozoic and/or Precambrian) Gray, maroon, and green slaty argillite interlayered with gray and greenish-gray grit and quartzite. Minor limestone in southern part of exposure. Unit description source: CI002, CI003

PzpCgr - Grit and quartzite (Paleozoic and/or Precambrian) Tan or gray grit and quartzite. Lower metamorphic grade and more calcareous than unit PzpCgq, but thought correlative. Unit description source: CI002

CZwg - Wickersham unit--Grit (Early Cambrian and Late Proterozoic) Grit, quartzite, phyllite, and slate. Differs from other grit units in that it contains chert. Includes limestone interbeds (I) that lithologically resemble subunit CZwl Livengood Area. Unit description source: CI003

PZPCa - Maroon and green argillite (Paleozoic and/or Precambrian)

CPxwn - Wickersham and Neruokpuk units (Cambrian and Proterozoic) See [CPxwn](#) for unit description from: [USGS SIM-3340](#)

PzpCa - Argillite, grit, and quartzite (Paleozoic and/or Precambrian) Gray, maroon, and green slaty argillite interlayered with gray and greenish-gray grit and quartzite. Minor limestone in southern part of exposure. Western exposures in part. Unit description source: CI003

PZPCls - Limestone (Paleozoic and/or Precambrian)

Pzls - Limestone and marble (Paleozoic) See [Pzls](#) for unit description from: [USGS SIM-3340](#)

unk - Limestone (Paleozoic and or preCambrian) Various limestone symbol shown on Circle map in a variety of rock units. No further description in text. Includes only southern polygons of unit. Unit description source: CI002

PZZm - Gabbro and diorite (Paleozoic or Precambrian)

PzPxmi - Mafic igneous rocks, central and northeast Alaska (early Paleozoic and (or) late Proterozoic) See [PzPxmi](#) for unit description from: [USGS SIM-3340](#)

PzZm - Gabbro and diorite (Paleozoic or preCambrian) Gabbro and diorite and some sedimentary rocks of unknown affinity. Unit description source: CI003

PZPCdm - Dolomite and marble (Paleozoic and/or Precambrian)

PzPxyqs - Quartzite and pelitic schist (Devonian and older) See [PzPxyqs](#) for unit description from: [USGS SIM-3340](#)

PzpCd - Dolomite and marble (Paleozoic and/or Precambrian) Gray to cream-colored massive dolomite, gray or greenish-gray marble interlayered in calcareous greenish-gray and gray quartzite and phyllite and greenish-gray calc-silicate. Unit description source: CI003

pCcm - Marble (Proterozoic) Interbedded with pCcq. Forms beds of gray, white, or pale-green marble to 20 feet thick. Variations include gray weathering, banded, coarse-grained marble; brown and white, laminated, sugary-textured nonschistose marble; and fine-grained, greenish-gray, impure marble containing feldspar, quartz, and diopside to 20 percent. Limonitic clots are common in marble. Presence of diopside indicates metamorphism in amphibolite facies. Unit description source: BD004, CI004

PZPCps - Pelitic schist and quartzite (Paleozoic and/or Precambrian)

PzPxyqm - Pelitic schist, including Chena River sequence (Devonian and older) See [PzPxyqm](#) for unit description from: [USGS SIM-3340](#)

Pzrc - Calcschist (Devonian? to Cambrian?) Chena River sequence: White to gray, thin-layered quartz-muscovite-biotite-calcite schist. Typically very schistose fabric with "streaked out" muscovite or biotite. Clinozoisite and plagioclase are minor minerals; tourmaline and sphene are accessories. Unit description source: CI004

pMq - Fortymile River Assemblage - quartzite (Pre-Mississippian) Fine-grained quartzite. Dark gray and greenish-gray, locally color banded, foliated, relatively pure quartzite with minor white mica, biotite (up to 3 percent; +/-chloritized), feldspar, and carbonate, and occasional pyrite and limonite disseminations and fracture fillings. Contains occasional slightly carbonaceous-rich and (or) magnetite-rich layers, and locally interlayered with lesser quartz-feldspar gneiss (+/- garnet, +/-biotite, +/-amphibole), marble, and schist. Magnetic susceptibility for quartzite is generally very low (0.01–0.11 x 10⁻³ SI) except in magnetite-rich areas (up to 9 x 10⁻³ SI). Unit description source: EA012

Pzrg - Graphitic schist (Devonian? to Cambrian?) Chena River sequence: Gray to black, micaceous quartz schist with abundant graphite. Grades compositionally to slightly graphitic pelitic schist (Pzrs). Unit description source: CI004

PzZqps - Greenschist facies quartzite, pelitic schist, marble and amphibolite (Paleozoic and/or

Proterozoic) Intermediate pressure greenschist facies quartzite, pelitic, felsic, and mafic schist, calc-silicate rocks, marble and amphibolite. According to Dusel-Bacon and others (1993), protolith is Proterozoic and Paleozoic, volcanic protoliths thought to be Devonian in part. Metamorphism bracketed between Paleozoic and late Early Cretaceous and may have occurred during Early Cretaceous time. Unit description source: EA014

ms - Mica schist (Paleozoic? and Precambrian?) Mostly quartz-plagioclase-biotite or muscovite schist. Includes a few beds of white marble as much as 25 feet thick. Schist has thin interlayers of, or is closely associated with amphibolite that has the chemical composition of basalt. Chlorite is a common constituent in all of the rocks, garnet, andalusite, and staurolite occur locally, particularly near adamellite. Unit is probably a sandstone or graywacke sequence with interbeds of limestone, shale, tuffaceous sedimentary rock and basalt that has been regionally metamorphosed. Unit description source: CY003

PzpCs - Pelitic schist (Paleozoic and/or Precambrian) Mostly medium- to coarse-grained pelitic schist and gneiss, having minor interlayered quartzite and quartzitic schists and subordinate white and cream-colored, coarse-grained marble. Unit description source: CI002, CI003

Pzrs - Pelitic schist and quartzite (Late Ordovician to middle Devonian) Chena River sequence: Medium- to coarse-grained, silvery to bronze weathering pelitic schist and gray or brown micaceous quartzite. Schist-quartzite ratios in the Chena River sequence are about 4:1. Most commonly, garnet-feldspar-biotite-muscovite-quartz schist with varying amounts of minor minerals staurolite, kyanite, sillimanite, hornblende, graphite, and secondary chlorite, biotite, or sericite. Accessory tourmaline, apatite, and sphene. Plagioclase is andesine (An33-40); K-feldspar is grid twinned and perthitic; garnets are sieve textured or contain helictic inclusions of quartz and feldspar; biotites have pleochroic halos around zircon and allanite(?). Quartzites in unit are foliated with biotite and muscovite to 20 percent; small reddish garnets and lenticular feldspar grains are present locally. Common textural features include crenulations, kink folds, crenulation cleavage, and small wavy or isoclinal folds. Garnet porphyroblasts to one-half inch in diameter form knobby foliation surfaces. Unit description source: BD004, CI004

Pzq - Quartzite and metapelite (pre-Late Devonian) Light-gray, equigranular, muscovite-bearing feldspathic quartzite interlayered with micaceous schist (metapelite). Protolith was immature sandstone interlayered with pelite. Age uncertain, but protolith assumed to be part of now structurally disrupted sedimentary sequence that included the protolith for Pzgn. Unit description source: BD006

pMq - Rocks metamorphosed to amphibolite facies: Fortymile River Assemblage - quartzite (Pre-Mississippian) Fine- to medium-grained quartz-rich (>70–90 percent quartz) metamorphic rock. Greenish-gray to pure white, locally color banded, foliated, relatively pure quartzite with minor white mica and (or) feldspar; variable garnet and magnetite; and occasional pyrite and limonite disseminations and fracture fillings. Contains occasional slightly carbonaceous or magnetite-rich layers; locally interlayered with marble, lesser feldspar-quartz paragneiss ($\pm$ garnet, $\pm$ biotite), and schist. Forms bold, massive outcrops where not strongly jointed. Highly fractured quartzite is quarried near Jack Wade Junction for road aggregate and used throughout the Eagle A-1 Quadrangle. Magnetic susceptibility for quartzite is generally very low ($0.01\text{--}0.11 \times 10^{-3}$ SI) except in magnetite-rich areas (up to 9×10^{-3} SI). Unit description source: EA009

Pzs - Schist (Paleozoic) Quartz-mica schist with marble and quartzite, calcareous diopside schist, quartz-feldspar rock; and amphibolite. Sillimanite is locally abundant near the Salcha River and staurolite, andalusite and kyanite also occur. Unit description source: BD002

PzpCsq - Schist and Quartzite (Paleozoic or Precambrian) Quartz-muscovite-biotite schist, quartz-muscovite schist, quartzite, and amphibole schist; locally garnetiferous. Upper greenschist to lower amphibolite facies. Age unknown. Unit subdivided on published OFR98-133 into PzZysa and PzZysq. Unit description source: BD002

PzpCs - Schist, quartzite, gneiss, blastomylonite, marble, and amphibolite (Paleozoic? and

Proterozoic) Schist, quartzite, gneiss, blastomylonite, marble, and amphibolite. Consists of medium- to coarse-grained pelitic schist with interlayers of quartzitic schist, quartzite, and marble as the dominant lithology of unit. Other interlayered rocks include augen gneiss, calc-silicate rocks, amphibolite, and ultramafic rocks. Pelitic gneiss, orthogneiss, and blastomylonite are also present. Locally subdivided into gneiss and blastomylonite units. Unit description source: CY007

PZPCs - Biotite-sillimanite gneiss (Paleozoic and/or Precambrian)

PzPxygs - Gneiss, schist, and quartzite (Mississippian, Devonian, and older) See [PzPxygs](#) for unit description from: [USGS SIM-3340](#)

Pzgn - Biotite +/- sillimanite gneiss (pre-Middle Devonian) Medium- to dark-gray, medium-grained, foliated equigranular, biotite-rich gneissic migmatite. Migmatite is made up of a paleosome of medium-gray, equigranular, medium- to fine-grained, quartzofeldspathic biotite +/- sillimanite schist invaded by a neosome of biotite trondhjemitic to granodioritic orthogneiss. Metamorphic mineral assemblage includes biotite, muscovite, garnet, and, locally, sillimanite. Protolith was graywacke to muddy siliciclastic sediment and sandstone. Unit description source: BD006

Pzgn - Biotite-sillimanite gneiss (Paleozoic) Medium- to dark-gray, medium-grained, foliated, equigranular biotite gneiss of sedimentary origin interlayered with gray trondhjemitic to granodioritic orthogneiss. Unit is distinguished from unit Pzg by darker color, relatively weaker foliation, presence of sillimanite, and a higher biotite content. Unit is distinguished from unit Dog by presence of sillimanite. Unit description source: BD003

PzpCs - Pelitic schist, sillimanite gneiss subunit (Paleozoic and/or Precambrian) Mostly medium- to coarse-grained pelitic schist and gneiss, having minor interlayered quartzite and quartzitic schists and subordinate white and cream-colored, coarse-grained marble. Unit description source: CI002

PZPCbg - Biotite gneiss, marble, schist, quartzite, and amphibolite (Paleozoic and/or Precambrian)

PzPxybg - Biotite gneiss, marble, schist, quartzite, and amphibolite (Devonian or older) See [PzPxybg](#) for unit description from: [USGS SIM-3340](#)

Pzam - Amphibolite and metagabbro, undivided (Middle Paleozoic or older) Dark green, fine- to medium-grained strongly foliated to gneissic amphibolite and metagabbro commonly interlayered with biotite schist, dark gray siliciclastic metasedimentary rocks and foliated, medium-grained leucogranite, granite and tonalite (Jt). Textures indicating primary depositional environment have been obliterated during regional Mesozoic ductile deformation; pillow structures not observed. Protolith was basalt and gabbro interlayered with argillaceous siliciclastic sediments. Unit occurs west of the main Mount Veta ridge and becomes more common in southwestern part of map area. Northeastward along structural trend, the unit is interlayered with the metasedimentary sequence suggesting paleoenvironment was dominated by an emergent mafic volcanic sequence in the south that graded into a near-shore sedimentary sequence (Pzq) to the north of exposed area. Unit description source: EA015

PzpCb - Biotite gneiss and amphibolite (Paleozoic and (or) Precambrian) Biotite gneiss and amphibolite. Also includes quartz-biotite gneiss and schist, quartzite, marble, and feldspathic gneiss. Unit description source: EA002

PzpCb - Biotite gneiss and amphibolite, marble subunit (Paleozoic and (or) Precambrian) Biotite gneiss and amphibolite. Also includes quartz-biotite gneiss and schist, quartzite, marble, and

feldspathic gneiss. Unit description source: EA002

Pzbg - Biotite gneiss, marble, schist, quartzite, and amphibolite (Paleozoic?) Biotite gneiss, marble, schist, quartzite, and amphibolite. Most common rock type is quartz-biotite gneiss +/- garnet +/- hornblende. Marble is white, light-gray, or pinkish, mostly coarse-grained and is abundant in layers, lenses, and pods. Quartzite Unit description source: EA003

pMaf - Fortymile River Assemblage – amphibole-feldspar gneiss (Pre-Mississippian) Mixed unit defined by amphibole–feldspar gneiss. Typical modal mineralogy consists of 30–70 percent hornblende, 30–50 percent plagioclase, 0–6 percent biotite. Commonly altered to epidote, locally cut by quartz veins with 1–3 percent pyrite, and occasionally pyrrhotite, limonite, and carbonate. Magnetic susceptibility is $0.29\text{--}2 \times 10^{-3}$ SI. In north-central map area, a less deformed portion exhibits relict volcanoclastic texture (clasts to 7.5 cm), which supports an interpreted andesitic-arc protolith. Interlayered on varying scales with amphibolite (pMa), fine- to coarse-grained biotite–quartz–feldspar gneiss (+/-hornblende, +/-garnet) and lesser schist, quartzite, and marble. Unit description source: EA012

pMam - Fortymile River Assemblage - amphibolite (Pre-Mississippian) Mixed unit defined by amphibolite with within-plate chemistry (Dusel-Bacon and Cooper, 1999), and lesser gneiss and quartzite. Amphibolite is green to dark green, fine- to coarse-grained, locally plagioclase–porphyroblastic, and consists of hornblende, +/-plagioclase, +/-garnet, +/-biotite. Magnetic susceptibilities are generally low, $0.1\text{--}0.8 \times 10^{-3}$ SI, with locally high values ($1\text{--}50 \times 10^{-3}$ SI). Interlayered with fine- to coarse-grained biotite (1–10 percent)–feldspar–quartz gneiss +/-garnet +/- hornblende. Gneiss locally compositionally banded with thin amphibolite- and biotite-rich layers. Includes minor layers of biotite–feldspar–quartzite +/-carbonate, +/-white mica, +/-garnet, and biotite–quartz–feldspar schist +/-garnet +/-hornblende. Rarely contains siliceous and (or) calc-silicate-bearing marble. Unit description source: EA012

pMa - Fortymile River Assemblage - amphibolite and gneiss (Pre-Mississippian) Mixed unit defined by amphibole–feldspar gneiss. Typical modal mineralogy consists of 30–70 percent hornblende, 30–50 percent plagioclase, 0–6 percent biotite. Commonly altered to epidote, locally cut by quartz veins with 1–3 percent pyrite, and occasionally pyrrhotite, limonite, and carbonate. Magnetic susceptibility is $0.29\text{--}2 \times 10^{-3}$ SI. In north-central map area, a less deformed portion exhibits relict volcanoclastic texture (clasts to 7.5 cm), which supports an interpreted andesitic-arc protolith. Interlayered on varying scales with amphibolite (pMa), fine- to coarse-grained biotite–quartz–feldspar gneiss (+/-hornblende, +/-garnet) and lesser schist, quartzite, and marble. Unit description source: EA012

pMm - Fortymile River Assemblage - marble, marble-rich gneiss, and schist (Pre-Mississippian) Coarse-grained, light gray, massive outcrops of non-fossiliferous calcite marble. Mapped as a separate unit where near-continuous, massive marble outcrops or float are abundant within other amphibolite-facies units. Magnetic susceptibility $<0.01 \times 10^{-3}$ SI. Mostly light gray with lesser green, reddish brown, and pink color variations, folded and discontinuous, with granoblastic polygonal texture. Locally contains veins, bands, and (or) disseminated crystals of clinopyroxene, epidote, tremolite, garnet, apatite, quartz, plagioclase, white mica, and (or) iron sulfides/oxides. Most calc-silicates were produced by local metasomatism at the interface between marble and either schist or gneiss, although hydrothermal skarns are locally developed in pMm adjacent to Jurassic intrusions. Unit description source: EA012

pMoq - Fortymile River Assemblage - orthogneiss and quartzite (Pre-Mississippian) Float of trondhjemitic orthogneiss (MDog) and quartzite (pMq). Well-mixed float could suggest abundant sills and (or) dikes of MDog within pMq. Orthogneiss is fine- to medium-grained, locally finely foliated, equigranular to porphyritic, and has an estimated modal mineralogy of 1–2 percent chlorite (after biotite?), 5–10 percent white mica, 5–10 percent quartz, and 85 percent feldspar. Quartzite is fine-grained and consists of quartz and minor white mica. Contains minor highly magnetic, biotite–quartz–feldspar gneiss. Unit description source: EA012

pMqgs - Fortymile River Assemblage - quartzite, gneiss, and schist (Pre-Mississippian) Mixed unit consisting of, in decreasing order of abundance, interlayered quartzite, gneiss, and schist. Quartzite is fine grained, contains +/- garnet, +/- feldspar, muscovite (1–20 percent), biotite (+/- chloritized), and is locally calcareous and (or) marble bearing. Magnetic susceptibility for quartzite is bimodal, $0.01\text{--}0.5 \times 10^{-3}$ SI and $5\text{--}30 \times 10^{-3}$ SI. Gneiss varies from a fine- to medium-grained, locally banded, equigranular biotite–quartz–feldspar tonalite(?) gneiss (+/- white mica, +/- chlorite) to a locally schistose, garnet–biotite muscovite quartz feldspar gneiss. Magnetic susceptibility for gneiss is generally $0\text{--}0.6 \times 10^{-3}$ SI, but occasionally as high as 16×10^{-3} SI. Schist is fine- to coarse-grained, and varies from a +/- kyanite +/- staurolite +/- garnet–biotite–muscovite schist to a +/- muscovite, biotite (+/- chloritized)–quartz–feldspar schist. Locally asymmetrically folded. Magnetic susceptibility for schist is generally $0.1\text{--}0.4 \times 10^{-3}$ SI, but rarely can be as high as 45×10^{-3} SI. Unit description source: EA012

pMsg - Fortymile River Assemblage - schist and gneiss (Pre-Mississippian) Mixed unit defined by the abundance of schist. Contains interlayered, medium- to coarse-grained schist and gneiss, with minor local biotite quartzite and marble. Although mineralogically similar, the schist is distinguished from gneiss by its lepidoblastic (schistose) texture and a greater proportion of biotite and white mica. Typical mineralogy includes local garnet and occasional staurolite porphyroblasts in a matrix that includes biotite (10–15 percent in schist; 0–5 percent in gneiss), white mica (15–20 percent in schist; 0–5 percent in gneiss), feldspar, and quartz. Schist in this unit is commonly crenulated and folded. Unit description source: EA012

pMu - Fortymile River Assemblage - undifferentiated (Pre-Mississippian) Undifferentiated pre-Mississippian-age metamorphic rocks. Unit description source: EA012

Pzqm - Quartzite and mafic volcanoclastic metasediment, undivided (pre-Late Devonian) Light gray fine-grained micaceous quartzite intermixed with dark green layers of mafic metavolcanic to volcanoclastic metasedimentary rocks and biotite schist. Protolith thought to be mixture of siliciclastic sedimentary units interspersed with volcanoclastic sediments predominantly of mafic composition. Age uncertain but a pre-Late Devonian age is based on the interpretation that this unit is intruded by unit Dog of assumed Late Devonian age. Unit description source: EA015

Pzq - Quartzite-rich metasediments, undivided (middle Paleozoic or older) Predominantly light gray, fine-grained, laminated micaceous quartzite with lesser amounts of dark green micaceous layers of metamorphosed shale, amphibolite, micaceous schist, metagraywacke, and minor metapelite. Interlayered with white to light-gray marble (Pzm). Section exposed on western part of map area progresses up structural section (west to east) and seemingly forms an upward coarsening sequence from micaceous schist and metagraywacke up through dark green phyllite, argillite, light gray to white, medium-grained platy, and laminated quartzite; to light gray cherty marble, laminated, white to light gray fine-grained quartzite; to light gray thinly bedded marble; to tan to light brown fine-grained, platy micaceous quartzite interlayered with massive marble. Metamorphic grade is uppermost greenschist facies to lower amphibolite facies. Protolith was sequence of sandstone with variable clay content, mudstone, graywacke, locally mafic (tuff?) interlayers, and limestone horizons in a relatively shallow, near-shore environment. Unit description source: EA015

pMag - Rocks metamorphosed to amphibolite facies: Fortymile River Assemblage - amphibolite and gneiss (Pre-Mississippian) Amphibolite with a MORB-like trace element signature (Dusel-Bacon and Cooper, 1999) grading into fine-grained hornblende–epidote–plagioclase gneiss. The amphibolite characteristically contains significant amounts of magnetite with trace biotite and garnet and has a high magnetic susceptibility (average 3.5×10^{-3} with values to 20×10^{-3} SI). The gneiss commonly contains magnetite and sphene and also has a high magnetic susceptibility (average 2×10^{-3} , with values to 10×10^{-3} SI). Mineralogical and major oxide composition of the gneiss indicates a basaltic andesite or graywacke protolith. This unit appears to underlie the schist and gneiss unit (pMsg). Unit description source: EA009

pMa - Rocks metamorphosed to amphibolite facies: Fortymile River Assemblage - amphibolite, gneiss, and schist (Pre-Mississippian) Mixed unit defined by amphibolite, with arc chemistry (Dusel-Bacon and Cooper, 1999), plagioclase-rich gneiss, and minor schist. Amphibolite is dark green, foliated, fine- to medium-grained, with typical mineralogy of $\pm$ epidote, $\pm$ garnet, $\pm$ quartz, $\pm$ biotite, and plagioclase ($\pm$ sericite altered). Magnetite is locally abundant and titanium-rich minerals (sphene, rutile, ilmenite) are notably absent or nearly so. Locally quartz-veined and bearing disseminated iron sulfides. Amphibolite grades into and (or) is banded with fine-grained, hornblende—epidote—biotite—quartz—feldspar ($\pm$ garnet, magnetite) gneiss on various scales. Typical modal mineralogy for the unit as a whole is 10–70 percent hornblende, 30–50 percent plagioclase, 0–10 percent biotite, 0–20 percent quartz, 0–5 percent garnet, and 0–5 percent epidote. Typical grain sizes are 0.5–1 mm, with locally coarser hornblende (1–2 mm). Commonly altered to epidote, locally cut by quartz veins with 1–3 percent pyrite, and occasionally contains pyrrhotite, limonite, and carbonate. Locally contains kyanite-bearing garnet—quartz—muscovite schist and muscovite—quartz schist. Compositions, mineralogy and mineral abundances suggest this unit consists primarily of arc basalt, basaltic andesite, and andesite protoliths, with some graywacke and minor aluminous sediment. Magnetic susceptibilities are quite variable, generally $0.1\text{--}2.5 \times 10^{-3}$ SI, with locally high values ($5\text{--}50 \times 10^{-3}$ SI). Unit description source: EA009

pMg - Rocks metamorphosed to amphibolite facies: Fortymile River Assemblage - gneiss (Pre-Mississippian) Predominantly fine-grained, typically plagioclase-rich gneiss, including rocks with apparently sedimentary and volcanic/volcaniclastic protoliths, and includes local orthogneiss and minor amphibolite. Primary mineralogy consists of garnet, biotite, plagioclase, and quartz $\pm$ muscovite $\pm$ hornblende, and all minerals with grain sizes of 0.5–1 mm. Rock types present suggest a protolith package of mixed arenites, possibly graywackes, with some volcanic rocks. Magnetic susceptibilities are generally moderate to low ($0.1\text{--}1 \times 10^{-3}$ SI), with some high values. Unit description source: EA009

pMm - Rocks metamorphosed to amphibolite facies: Fortymile River Assemblage - marble and calcareous rocks (Pre-Mississippian) Massive outcrops of non-fossiliferous, fine- to coarse-grained, light gray, usually calcite, marble. Coarse-grained (5 mm), graphitic, dolomite marble occurs locally in the southeastern part of the Eagle A-1 Quadrangle. Mapped as a separate unit where semi-continuous, massive marble outcrops or float are abundant within other amphibolite-facies units. Also includes minor calcareous quartzite and calcareous or calc-silicate gneiss and schist. Magnetic susceptibility $<0.01 \times 10^{-3}$ SI. Mostly light gray with lesser green, reddish brown, and pink color variations, folded and discontinuous, with granoblastic polygonal texture. Locally contains veins, bands, and (or) disseminated crystals of quartz, clinopyroxene, epidote, tremolite, garnet, apatite, plagioclase, white mica, and (or) iron sulfides/oxides. Most calc-silicates were produced by regional metamorphism of impure carbonates; hydrothermal skarn is locally developed in pMm adjacent to Jurassic intrusions. The common presence of diopside and absence of wollastonite is compatible with regional metamorphism at epidote—amphibolite facies. Unit description source: EA009

pMqgs - Rocks metamorphosed to amphibolite facies: Fortymile River Assemblage - quartzite, paragneiss, and schist (Pre-Mississippian) Mixed unit consisting of, in decreasing order of abundance, interlayered quartzite, paragneiss, and schist. Quartzite is fine grained, contains $\pm$ garnet, $\pm$ feldspar, muscovite (1–20 percent), biotite ($\pm$ chloritized), and is locally calcareous and (or) marble bearing. Magnetic susceptibility for quartzite is bimodal, $0.01\text{--}0.5 \times 10^{-3}$ SI and $5\text{--}30 \times 10^{-3}$ SI. Gneiss varies from a fine- to medium-grained, locally banded, equigranular biotite—muscovite—feldspar—quartz paragneiss grading into a locally schistose, garnet—biotite $\pm$ muscovite feldspar quartz paragneiss. Magnetic susceptibility for gneiss is generally $0\text{--}0.6 \times 10^{-3}$ SI, but occasionally as high as 16×10^{-3} SI. Schist is fine- to coarse-grained, and varies from a $\pm$ garnet—biotite—muscovite schist to a $\pm$ muscovite, biotite ($\pm$ chloritized)—feldspar—quartz—schist. Locally asymmetrically folded. Magnetic susceptibility for schist is generally $0.1\text{--}0.4 \times 10^{-3}$ SI. Unit description source: EA009

pMsg - Rocks metamorphosed to amphibolite facies: Fortymile River Assemblage - schist and paragneiss (Pre-Mississippian) Mixed unit characterized by abundant aluminous metasedimentary

rocks. Small-scale isoclinal folds are locally visible, suggesting that the entire unit is isoclinally folded. Primarily interlayered, medium- to coarse-grained, schist (commonly crenulated and folded) and paragneiss, with minor local biotite quartzite, marble, and fine-grained plagioclase-rich (metavolcanic?) gneiss. The schist contains a minimum of 30 percent mica and typically contains 1–10 percent rotated, poikiloblastic garnet, 10–15 percent biotite, 15–75 percent muscovite, 2–20 percent plagioclase, 20–50 percent quartz, and 0–5 percent K-feldspar. Garnets are commonly 1–5 mm, other minerals typically 1–2 mm in size. Kyanite (0.2–0.5 mm, to 5 percent), staurolite (0.3–1 mm, to 5 percent), and tourmaline (0.1 mm, to 1 percent) are variably present, especially in the northwestern part of the Eagle A-1 Quadrangle. Staurolite, kyanite, and tourmaline are more abundant than shown on the geologic map, as they are virtually never identifiable in hand specimen. The common occurrence of staurolite with kyanite and tourmaline suggests that their occurrence is caused by aluminum–boron-rich bulk composition and not variations in metamorphic grade within the Fortymile River Assemblage. The paragneiss contains less than 30 percent micas and typically 40–60 percent quartz, 5–20 percent biotite, 1–20 percent muscovite, 10–25 percent plagioclase and 0–2 percent garnet, all with average grain sizes of 0.5–1 mm. The plagioclase-rich gneiss contains mineral abundances similar to that of the tonalite gneiss (Motn), but grain sizes of 0.20.5 mm suggest it may represent local (andesitic?) metavolcanic layers within a largely metasedimentary sequence. Magnetic susceptibilities for rocks of this unit are highly variable, with values between 0 and 20×10^{-3} SI, although low values ($< 0.3 \times 10^{-3}$ SI) are more common. Unit description source: EA009

PZPCms - Mafic schist and amphibolite (Paleozoic and/or Precambrian)

Pzmys - Mafic schist and amphibolite (Devonian or older Paleozoic) See [Pzmys](#) for unit description from: [USGS SIM-3340](#)

Pzam - Amphibolite gneiss (Late Devonian and older) Dark-green, fine- to medium-grained, strongly foliated, hornblende-biotite amphibolite gneiss interlayered with foliated, medium-grained, equigranular calc-silicate schist and, locally, quartzite. Protolith may have been mafic tuff or volcanic horizon intercalated with sediments. Occurs as rafts within augen gneiss (Dag) and within Black Mountain tectonic zone. Unit description source: BD006

Pzrf - Banded amphibolite and felsite (Devonian (?) to Cambrian (?)) Chena River sequence: Dark green, coarse-grained, schistose, hornblende- diopside -plagioclase-quartz amphibolite interlayered or interlaminated with muscovite-feldspar-quartz felsite. Garnet, biotite, and vesuvianite are minor minerals; sphene and ilmenite(?) are common accessories. Banded amphibolite sections locally include beds 2-6 inches thick of white laminated micaceous quartzite or beds of silvery-brown pelitic schist. Pzrf rocks were probably recrystallized from mafic, intermediate, and felsic tuffs. Unit description source: BD004

Pzrf - Banded amphibolite and felsite (Devonian? to Cambrian?) Chena River sequence: Dark green, coarse-grained, schistose, hornblende- diopside -plagioclase-quartz amphibolite interlayered or interlaminated with muscovite-feldspar-quartz felsite. Garnet, biotite, and vesuvianite are minor minerals; sphene and ilmenite(?) are common accessories. Banded amphibolite sections locally include beds 2-6 inches thick of white laminated micaceous quartzite or beds of silvery-brown pelitic schist. Pzrf rocks were probably recrystallized from mafic, intermediate, and felsic tuffs. Unit description source: CI004

uPzmg - Chicken Metamorphic Complex - hornblende metagabbro and metadiabase (Late Paleozoic) Moderately- to non-foliated, fine- to medium-grained, hornblende metagabbro and metadiabase. The bulk of this unit is interpreted to represent a volcanic arc upon which more extrusive volcanic-dominated (uPzv) and sediment-dominated (uPzst, uPzl) units were deposited. Possibly a sill- or dike-swarm, as suggested by fine-grained intra-unit contacts and common occurrence of this unit as sills or dikes in unit uPzst. These rocks are nearly indistinguishable in major- and trace-element composition from the metabasalt of unit uPzst. In thin section, these rocks display a variably strong greenschist facies overprint, with primary igneous (?) hornblende and clinopyroxene replaced by fine-grained actinolite + chlorite + calcite and plagioclase replaced by albite + carbonate + sericite. Magnetic susceptibility is usually high, $5\text{--}20 \times 10$ SI, but considerably lower

where sheared. Abundant dikes of Taylor Mountain batholith-type quartz diorite are locally present in this unit on both sides of the South Fork of the Fortymile River east of Chicken; however, abrupt, sheared contacts suggest that original intrusive contacts have been displaced by high-angle faults. Similarly, although dikes and sills of metagabbro/metadiabase are present in unit uPzst, the contact between uPzmg and uPzst is mostly faulted. Amphibole from uPzmg and from a dike of this unit in greenstone yielded disturbed Ar/Ar spectra, with highest-temperature fraction ages of 227 and 225 Ma and pseudo-plateau ages of 213 and 201 Ma (Cushing, 1984). The spectra indicate a pre-mid Triassic magmatic age with a thermal reset caused by intrusion of the Taylor Mountain Batholith and younger plutons. Unit description source: EA012

Pzrn - Greenschist (Late Ordovician to middle Devonian) Chena River sequence: Greenish-gray actinolite greenschists with variable mineralogy. Varieties include garnet-chlorite-muscovite-actinolite schist, biotite-muscovite-actinolite quartz schist, plagioclase-quartz-biotite-actinolite schist, and porphyroblastic garnet-chlorite-calcite-actinolite schist. Unit grades compositionally to micaceous amphibolite (Pzrp) and amphibolite (Pzrf). Contains zones of abundant white quartz veins and lenses. Unit description source: BD004, CI004

MzPzmg - Mafic and ultramafic rocks metamorphosed to lower greenschist facies: Seventymile Terrane - metagabbro (Mesozoic to Paleozoic) Green and white, medium- to coarse-grained, slightly- to unfoliated rock consisting of sub-equal clinopyroxene and plagioclase entirely pseudomorphically replaced by fine-grained actinolite + chlorite + epidote-clinozoisite + albite + sphene. Primary silicates were 3–15 mm, but locally several centimeters, in size. Includes sparse coarse-grained actinolite ± chlorite schist and rare very coarse-grained chlorite rock. Magnetic susceptibility is variable, between 0.1 and 6, but averaging 0.3×10^{-3} SI. Like the serpentinite, interpreted to occur as imbricate wedges in thrust faults. Unit description source: EA009

Pzmg - Mafic gneiss (Paleozoic) Dark-green, fine- to medium-grained, strongly foliated, hornblende-biotite amphibolite gneiss interlayered with foliated, medium-grained, equigranular calc-silicate schist. Calc-silicate schist contains hornblende, biotite, and diopside. Bodies represent structural klippe resting upon the augen gneiss (unit Dag). Unit description source: BD003

PzpCm - Mafic schist (Paleozoic and/or Precambrian) Green, chlorite-quartz-carbonate schist, associated with amphibolitic schist and minor marble, quartzite, and pelitic schist. Unit description source: CI002

Pzrp - Massive amphibolite (Devonian? to Cambrian?) Chena River sequence: Dense, fine- to medium- grained, dark-green, schistose amphibolite with varying amounts of biotite, garnet, plagioclase, calcite, and quartz. Associated with thin foliated marble layers and pelitic schist. Accessory sphene and ilmenite. Calcite veinlets common. Unit probably recrystallized from mafic volcanic flows and calcareous mafic tuffs. Unit description source: BD004, CI004

MzPzg - Metagabbro (Mesozoic and (or) Paleozoic) Dark greenish black, coarse- to fine-grained, metagabbro. Unit description source: EA002

pMam - Rocks metamorphosed to amphibolite facies: Fortymile River Assemblage - amphibolite (Pre-Mississippian) Mixed unit defined by epidote amphibolite with within-plate chemistry (Dusel-Bacon and Cooper, 1999), with lesser quartzite, paragneiss, schist, and minor marble. Amphibolite is green to dark green, fine- to coarse-grained, locally plagioclase–porphyroblastic, and consists of hornblende, epidote, plagioclase, sphene (to 3 percent), and minor biotite. Magnetic susceptibilities are generally low, $0.1\text{--}0.4 \times 10^{-3}$ SI, with locally high values ($1\text{--}2 \times 10^{-3}$ SI). Interlayered with biotite–feldspar–quartzite ± carbonate, ± white mica, ± garnet, fine- to coarse-grained muscovite–biotite (1–10 percent)–feldspar–quartz paragneiss, muscovite–biotite–quartz schist ± garnet, and rarely, with siliceous and (or) calc–silicate-bearing marble. Spatially associated with a thick quartzite unit (Pmq) and apparently restricted to the central part of the Eagle A-1 Quadrangle and occasional fault slivers. Stratigraphic setting is unclear, but the restricted

occurrence suggests it either underlies or overlies the other, more abundant, pre-Mississippian units. Unit description source: EA009

Pza - Rocks metamorphosed to amphibolite facies: Fortymile River Assemblage - amphibolite, paragneiss, and schist (Paleozoic) Mixed unit, approximately half epidote amphibolite, and half muscovite-quartz-rich paragneiss grading into garnet-biotite-muscovite-quartz schist. Layers of amphibolite 1-50 m thick alternate with schist-gneiss layers of similar thickness. The Unit description source: EA009

PZPCgs - Gneiss, schist, and quartzite (Paleozoic and/or Precambrian)

PzPxygs - Gneiss, schist, and quartzite (Mississippian, Devonian, and older) See [PzPxygs](#) for unit description from: [USGS SIM-3340](#)

pMg - Fortymile River Assemblage - gneiss (Pre-Mississippian) Fine- to medium-grained gneiss. Primary mineralogy consists of +/-kyanite, +/-garnet, +/-muscovite, biotite, feldspar, and quartz. Small-scale isoclinal folds are locally visible, suggesting that the entire unit is isoclinally folded. Metasedimentary protoliths appear to predominate. Locally abundant banded quartzo-feldspathic gneiss interlayered on a cm-to-meter scale with biotite- and amphibole-rich gneiss suggests volcanic protoliths. Magnetic susceptibilities are generally moderate to low ($0.1-1 \times 10^{-3}$ SI). Unit description source: EA012

gn - Gneiss (Paleozoic? and Precambrian?) Quartz-plagioclase-biotite or muscovite gneiss. Unit description source: CY003

PzpCg - Gneiss and granitic rocks, intermixed (Paleozoic and (or) Precambrian) Mesozoic and (or) Tertiary granitic rocks intermixed with gneissic rocks. Unit description source: EA002

PzpCg - Gneiss and Quartzite (Paleozoic or Precambrian) Coarse to fine grained gneiss and quartzite; well foliated and banded to massive without banding; locally cataclastic; ranges from pelitic with abundant sillimanite to gneisses of probable igneous origin. All rocks are well foliated, and dominant foliation is folded. Protoliths may include both Paleozoic and preCambrian sedimentary and igneous rocks. Unit description source: BD002

Pzms - Metasediments, undivided (Middle Paleozoic or older) Predominantly metapelite and argillite with lesser amounts of quartzite, graywacke, greenstone and sand-rich marble horizons intermixed with volcanoclastic metasedimentary rocks. Interlayered with white to light-gray marble (Pzm). Differs from map unit Pzq exposed to the west of the Kechumstuk fault in that unit contains less quartzite. Metamorphic grade is uppermost greenschist. Protolith was sequence of mudstone, shale, and graywacke with interlayers of sandstone and volcanoclastic sediments. Regional relations suggest unit was deposited on the continental margin of North America during the early Paleozoic (Dusel-Bacon and others, 2006). Unit description source: EA015

Pzpg - Paragneiss (Paleozoic) Medium-gray, equigranular, medium- to fine-grained quartzofeldspathic biotite schist with lesser amounts of metapelite and quartzite. Metamorphic mineral assemblage includes biotite, muscovite, garnet, and, locally, sillimanite. Protolith for unit was graywacke to muddy siliciclastic sediment and sandstone. Unit description source: BD003

pCwp - Paragneiss (Proterozoic) Light- to dark-gray, gray- or tan weathering paragenesis, includes thin- to thick-bedded quartzite and interbedded pelitic gneiss, granitic augen gneiss, marble (pCwm), and abundant igneous and metaigneous rocks. Layering of paragneiss is planar to highly contorted; individual layers are usually dismembered, boudinaged, or lenticular. Quartz boudins are common. Schists contain varying amounts of quartz, plagioclase, biotite, muscovite, and garnet with minor sillimanite, amphibole, and tourmaline. Plagioclase (An25-30) is typically unzoned, garnet is sieve

textured; quartz is sutured to polygonal; chlorite locally replaces biotite and garnet. Disseminated chalky, white-weathering feldspar grains are present in some quartzites. Unit is cut by numerous tourmaline-quartz veins and with loss of gneissic character around margins is gradational to Clinky quartzite (pCcq). Northern part of the complex contains sparse augen gneiss layers to 10 feet thick that are similar to augen gneiss (Pzra) units upsection. Unit description source: BD004, CI004

PzpCs - Pelitic schist, quartzite subunit (Paleozoic and/or Precambrian) Mostly medium- to coarse-grained pelitic schist and gneiss, having minor interlayered quartzite and quartzitic schists and subordinate white and cream-colored, coarse-grained marble. Unit description source: CI002

PzpCs - Schist, quartzite, gneiss, blastomylonite, marble, and amphibolite, gneiss unit (Paleozoic? and Proterozoic) Schist, quartzite, gneiss, blastomylonite, marble, and amphibolite. Consists of medium- to coarse-grained pelitic schist with interlayers of quartzitic schist, quartzite, and marble as the dominant lithology of unit. Other interlayered rocks include augen gneiss, calc-silicate rocks, amphibolite, and ultramafic rocks. Pelitic gneiss, orthogneiss, and blastomylonite are also present. Locally subdivided into gneiss and blastomylonite units. Unit description source: CY007

PZPCgq - Grit, quartzite and argillite (Paleozoic and/or Precambrian)

CPxwn - Wickersham and Neruokpuk units (Cambrian and Proterozoic) See [CPxwn](#) for unit description from: [USGS SIM-33403340](#)

PzpCgq - Grit, quartzite and argillite (Paleozoic and/or Precambrian) Mostly gray or greenish-gray, but may be tan, brown, or dark-gray grit and quartzite. Ranges from fine- to coarse-grained, rarely conglomeratic, and equigranular to bimodal. Weakly metamorphosed. Gray to black, or greenish-gray, olive-gray, tan or brown argillite. Rare thin layers of gray and dark-gray limestone. Unit description source: CI002, CI003

PZPCq - Quartzite and quartzitic schists (Paleozoic and/or Precambrian)

PzPxyqs - Quartzite and pelitic schist (Devonian and older) See [PzPxyqs](#) for unit description from: [USGS SIM-3340](#)

PzpCq - Quartzite and quartzitic schists (Paleozoic and/or Precambrian) Gray or greenish-gray quartzite and quartzitic schists are dominant rock types. Minor pelitic schist, calc-silicate, mafic schist, and rare marble are interlayered with quartzite and quartzitic schists. Unit description source: CI002, CI003

PzpCq - Quartzitic schist and quartzite (Paleozoic (Devonian and older) and Proterozoic?) Quartzitic schist and quartzite and minor pelitic schist, calc-silicate rock, mafic schist, and uncommon marble. Quartzitic schist and quartzite are generally gray, tan or greenish gray, fine- to coarse-grained and equigranular or fine- to coarse-grained with rare to abundant megacrysts of quartz and less abundant feldspar. Unit locally sub-divided into a "greenschist" subunit in Circle quadrangle. Unit description source: CY007

pCu - Undifferentiated quartzite and schist (Proterozoic) Exposed in northern part of the map area. Thickness at least 4,000 feet. Consists dominantly of platy- or blocky-weathering, gray or tan, slightly feldspathic quartzite and medium- to coarse-grained pelitic schist. Quartzite is typically micaceous with muscovite and biotite to 25 percent; some horizons, which may represent channel fills in a submarine fan, contain several percent feldspar as grid-twinned K-feldspar and untwinned plagioclase. Bimodal quartzites (grits) with clear to smoky quartz "eyes" to one-quarter inch in diameter are present locally. Pelitic schists are medium gray, brownish gray, or silvery gray, garnet-biotite-feldspar-muscovite-quartz schists. Retrograde chlorite and muscovite replace garnet, biotite,

and plagioclase locally; tourmaline and graphite are common accessory minerals; staurolite is present locally. Crenulations, kink folds, crenulation cleavages and small isoclinal folds are prevalent structural elements in outcrop. Quartz veins and tourmaline-quartz veins are locally abundant, especially near granitic plutons. Although bedding attitudes in pCu appear to be parallel with those in the overlying Chena River sequence, the unit is considered to be in thrust fault contact with the sequence as suggested by Foster and others (1983). Unit description source: CI004

PZPCqm - Quartzite and quartzitic schists, magnetic chlorite schist subunit (Paleozoic and/or Precambrian)

PzPxyqs - Quartzite and pelitic schist (Devonian and older) See [PzPxyqs](#) for unit description from: [USGS SIM-3340](#)

PzpCqm - Quartzite and quartzitic schists, magnetic chlorite schist subunit (Paleozoic and/or Precambrian) Magnetic chlorite schist subunit of unit PzpCq, consisting of gray or greenish-gray quartzite and quartzitic schists are dominant rock types. Minor pelitic schist, calc-silicate, mafic schist, and rare marble are interlayered with quartzite and quartzitic schists. Similar lithologically to Cleary sequence of Bundtzen (1982). Unit description source: CI002, CI003

PZPCcq - Clinky quartzite (Paleozoic and/or Precambrian)

PzPxyqs - Quartzite and pelitic schist (Devonian and older) See [PzPxyqs](#) for unit description from: [USGS SIM-3340](#)

pCcq - Clinky quartzite (Proterozoic) Thickness 3,000-10,000 feet. Dominantly thin- to medium-bedded, gray quartzite with lesser bronze- or silvery- weathering pelitic schist and minor marble (pCcm). The proportion of schist in the unit varies both laterally across the area and vertically within the section; uppermost part of the unit has quartzite schist ratio of about 1:1, lower part about 6 or 8:1. Quartzite typically thin-bedded, banded, gray rocks; a few contain "streaky" chalky-weathering feldspar and sparse gray quartz "eyes." Muscovite and biotite content of quartzite ranges to 10 percent; small red garnets are present locally. Pelitic schist is typically medium- to coarse-grained, garnet-biotite-muscovite quartz schist. Garnet porphyroblasts to one-half inch in diameter form knobby schistosity surfaces. K-feldspar and untwinned plagioclase are minor minerals; tourmaline is a common accessory; chlorite and sericite replace garnet, biotite, and feldspar. Crenulations in two directions, minor folds, crenulation cleavage, and ribbon-textured quartz are ubiquitous structural elements. Quartz veins are rare; aplites and tourmaline-bearing pegmatites are present locally. Bedding in unit is parallel to that in the overlying Chena River sequence. Unit description source: BD004, CI004

PzpCq - Quartzite and quartzitic schists, quartzite subunit (Paleozoic and/or Precambrian) Light green to greenish-gray calc-silicate containing thin interlayers of crumbly, greenish-gray marble, light-green calcareous quartzite, gray and greenish-gray phyllite, and fine-grained quartzitic schist subunit of unit PzpCq, consisting of gray or greenish-gray quartzite and quartzitic schists are dominant rock types. Minor pelitic schist, calc-silicate, mafic schist, and rare marble are interlayered with quartzite and quartzitic schists. Unit too small to capture Unit description source: CI002

PZPCqs - Quartzite and schist (Paleozoic and/or Precambrian)

PzPxyqs - Quartzite and pelitic schist (Devonian and older) See [PzPxyqs](#) for unit description from: [USGS SIM-3340](#)

Pzb - Biotite schist, quartzite, and marble (Paleozoic) Also includes muscovite schist, quartz-epidote schist, quartz-graphite schist, quartz-amphibolite schist and some greenschist with interlayered greenstone. Locally includes quartz-biotite gneiss, retrograded gneiss, amphibolite, and hornfelsic gneiss and schist. Biotite abundant and garnet locally abundant. Probably mostly epidote-amphibolite facies but may include rocks of greenschist and amphibolite facies. Probably mostly Paleozoic age with metamorphism in Paleozoic or Mesozoic time. Unit description source: EA002

Pzh - Hornfels (Paleozoic) Gneiss, schist, amphibolite and phyllite altered to hornfels. Assigned to this unit based on surrounding polygon. Unit description source: EA002

PzpCs - Quartzite and Schist (Paleozoic or Precambrian) Quartzite, feldspathic quartzite and quartz-mica schist, medium light gray to medium gray. Quartzite, some shows original bedding, dominates the section. Quartz-biotite schist is common; most of the unit is garnetiferous; Upper greenschist to lower amphibolite facies. Age unknown. Unit description source: BD002

Pzq - Quartzite and metapelite (Paleozoic) Light-gray, equigranular, muscovite-bearing quartzite and metapelite. Protolith was an immature graywacke interlayered with pelite. Age uncertain, but protolith assumed to be part of now structurally disrupted sedimentary sequence that includes the protoliths for units Pzpg, Pzg, and Pzgn. Unit description source: BD003

PzpCq - Quartzite and quartzitic schists (Paleozoic and/or Precambrian) Gray or greenish-gray quartzite and quartzitic schists are dominant rock types. Minor pelitic schist, calc-silicate, mafic schist, and rare marble are interlayered with quartzite and quartzitic schist. Unit description source: CI002

PzpCsq - Schist and Quartzite (Paleozoic or Precambrian) Quartz-muscovite-biotite schist, quartz-muscovite schist, quartzite, and amphibole schist; locally garnetiferous. Upper greenschist to lower amphibolite facies. Age unknown. Unit subdivided on published OFR98-133 into PzZysa and PzZysq. Unit description source: BD002

PZPCId - Chert and dolomite (Paleozoic or Proterozoic)

Oc - Chert of Interior Alaska (Ordovician) See [Oc](#) for unit description from: [USGS SIM-3340](#)

Old - Chert and dolomite (Paleozoic or Proterozoic) Dark-gray and black chert and dolomite F.R. Weber recognized nowhere else. Tentatively assigned to Livengood Dome Chert. Unit description source: CI003

PZPCun - Undifferentiated sedimentary or slightly metamorphosed sedimentary and igneous rocks (Paleozoic (?) and Proterozoic (?))

CPxwn - Wickersham and Neruokpuk units (Cambrian and Proterozoic) See [CPxwn](#) for unit description from: [USGS SIM-3340](#)

PzpCun - Undifferentiated sedimentary or slightly metamorphosed sedimentary and igneous rocks (Paleozoic? and Proterozoic?) Includes limited exposures of at least four different rock units within Tintina fault zone: chert and argillite; limestone and chert; maroon and green argillite with minor interlayered greenstone, grit, and quartzite; and limestone associated with basalt. Appear to have affinities with rocks in the Livengood quadrangle and with rocks north of the Tintina fault in Alaska and Canada. Unit description source: CY007

PZPCbq - Biotite schist, quartzite, and marble (Paleozoic and Proterozoic)

PzPxyqs - Quartzite and pelitic schist (Devonian and older) See [PzPxyqs](#) for unit description from: [USGS SIM-3340](#)

Pzb - Biotite schist, quartzite, and marble (Paleozoic) Marble of unit consisting of biotite schist, quartzite, and marble. Also includes muscovite schist, quartz-epidote schist, quartz-graphite schist, quartz-amphibolite schist and some greenschist with interlayered greenstone. Polygon interpreted as roof-pondant of unit on Tf, Felsic igneous rocks unit. Unit description source: EA002

Pzb - Biotite schist, quartzite, and marble (Paleozoic) Marble of unit consisting of biotite schist, quartzite, and marble. Also includes muscovite schist, quartz-epidote schist, quartz-graphite schist, quartz-amphibolite schist and some greenschist with interlayered greenstone. Unit description source: EA002

Pzg - Greenstone (Paleozoic) Marble included within unit; may represent inlier of unit Pzb. Greenstone, dark-green mafic rocks of igneous origin, mostly massive but locally foliated. Unit description source: EA002

pCwm - Marble (Proterozoic) White to light gray, buff weathering, coarse-grained, diopside- and quartz-bearing marble. Typically present in contorted layers with boudinaged and stretched quartzite or diopside-bearing quartzite interbeds. Marble is generally associated with pelitic paragneiss. Unit description source: BD004

PCtsl - Tindir Group, Dolomite and shale, stromatolite-bearing limestone (Late Precambrian and Precambrian Y)

CPxt - Tindir Group (Cambrian? and Proterozoic) See [CPxt](#) for unit description from: [USGS SIM-3340](#)

dsl - Tindir Group, Dolomite and shale, stromatolite-bearing limestone (Late PreCambrian) Medium-gray stromatolite-bearing limestone with slabby and massive parting. seems to be a lentil with dolomite and shale unit. Thickness approximately 100 to 500 feet. Light- to medium-gray laminated dolomite and grayish-black shale. Minor chert, dolarenite, and dolomite-chert gritstone. The dolomite weathers very pale orange and is cut by diabase dikes. Thickness is about 8,000 feet. Unit description source: CY003

Ytl - Tindir Group, limestone member (Precambrian Y) Laminated dark-gray limestone with slabby and platy parting containing interbeds of greenish-gray shale, siltstone, and sandstone. Unit description source: EA002

PCTb - Tindir Group, basalt and red beds (Late Precambrian, Precambrian Y and Precambrian)

Pxtnm - Basalt and red beds member (Tindir Group) (Proterozoic) See [Pxtnm](#) for unit description from: [USGS SIM-3340](#)

pCtbs - Basalt and gray shale, Upper Tindir Group (Precambrian) Basalt and gray shale - Red-orange sandstone present at base of basalt. Unit description source: CY005

pCTb - Basalt, Upper Tindir Group (Precambrian) Gray to green-gray tholeiitic basalt. Amygdules and pillow structures common, locally calcareous. Unit description source: CY005

pCg - Greenstone (Precambrian ??) Altered fine-grained andesitic or basaltic rocks interlayered with tuff, volcanic conglomerate, laminated quartzite, argillite, siliceous shale, and chert. Unit description source: EA002

pCtrbu - Red beds and basalt, Upper Tindir Group (Precambrian) Undifferentiated redbeds and basalt. Unit description source: CY005

br - Tindir Group, basalt and red beds (Late preCambrian) Dark-greenish-gray basalt, commonly amygdaloidal and with pillow structures. Feldspar and pyroxene mainly unaltered but at a few localities they are chloritized and the rock is a greenstone. Minor basaltic tuff with pebbles and cobbles of basalt. Unit description source: CY003

Ytb - Tindir Group, basalt and red beds member (Precambrian Y) Dark-greenish-gray basalt and tuff and red beds consisting of grayish-red shale and siliceous shale. Unit description source: EA002

pCv - Volcanic rocks (preCambrian?) Amygdaloidal basalt flows, pillow lavas, tuff breccia, tuff, and minor interbeds of dolomite, limestone, chert, argillite, and quartzite. Probably preCambrian but could be Paleozoic. A few thousand feet thick. Unit description source: CY003

PCtu - Tindir Group (Late Precambrian and Precambrian)

CPxt - Tindir Group (Cambrian? and Proterozoic) See [CPxt](#) for unit description from: [USGS SIM-3340](#)

pCu - Sedimentary rocks, undivided (preCambrian?) Dark-gray laminated limestone and sandy limestone; olive-gray and grayish-red shale, argillite, and phyllitic argillite; chert, chert-gritstone, and quartzite; and laminated dolomite. Includes a diabase dike along Edwards Creek. Probably preCambrian but could be Paleozoic. A few thousand feet thick. Unit description source: CY003

pCtu - Tindir Group (Precambrian) Undifferentiated Tindir Group. Unit description source: CY005

pCt - Tindir Group, undivided (Late preCambrian) Mainly dolomite and shale. Unit description source: CY003

PCt - Upper Tindir Group, shale, limestone, and dolomite (Precambrian and Precambrian Y)

CPxt - Tindir Group (Cambrian? and Proterozoic) See [CPxt](#) for unit description from: [USGS SIM-3340](#)

pCtds - Dolomite and shale, Upper Tindir Group (Precambrian) Dolomite and shale - Cream-colored, thinly laminated dolomite forms conspicuous yellow-weathering hills. Includes yellow-weathering, thinly bedded gray, cherty mudstone near Mt. Slipper. Unit description source: CY005

pCtss - Dolomitic sandstone, Upper Tindir Group (Precambrian) Dolomitic sandstone. Unit description source: CY005

pCtr - Grayish-red shale, Upper Tindir Group (Precambrian) Grayish-red shale and siliceous shale. Unit description source: CY005

pCtsslu - Shale, limestone, and dolomite, Upper Tindir Group (Precambrian) Undifferentiated

shale, limestone and dolomite. Unit description source: CY005

Yts - Tindir Group, dolomitic sandstone and shale member (Precambrian Y) Light-gray, thin- to medium-bedded sandstone (dolarenite), and olive-gray shale. Unit description source: EA002

PCtd - Lower Tindir Group, dolomite, dolomitic limestone, and limestone (Precambrian)

CPxt - Tindir Group (Cambrian? and Proterozoic) See [CPxt](#) for unit description from: [USGS SIM-3340](#)

pCd - Dolomite (preCambrian?) Light-gray laminated dolomite. Chert laminae common. Minor dolomite-cobble conglomerate, sandy dolomite, laminated limestone, sandy limestone, shale, argillite, and quartzite. Probably preCambrian but could be Paleozoic. A few thousand feet thick. Unit description source: CY003

pCtsd - Dolomite, dolomitic limestone, and limestone, Lower Tindir Group (Precambrian) Upper part of unit is gray-yellow-weathering dolomite and dolomitic limestone. Lower part of unit is gray-weathering blocky limestone. Stromatolites are well-developed near middle of unit. Unit description source: CY005

PCts - Upper Tindir Group, shale (Precambrian)

CPxt - Tindir Group (Cambrian? and Proterozoic) See [CPxt](#) for unit description from: [USGS SIM-3340](#)

pCts - Shale, Upper Tindir Group (Precambrian) Shale - Black, fissile shale with red iron staining, interfingers with underlying stromatolitic limestone. Contains abundant quartzite in the northeastern part of the Yukon Thrust. Unit description source: CY005

PCtlc - Lower Tindir Group, quartzite and dolomite (Precambrian)

CPxt - Tindir Group (Cambrian? and Proterozoic) See [CPxt](#) for unit description from: [USGS SIM-3340](#)

pCtlc - Lower clastic unit, Lower Tindir Group (Precambrian) Gray, medium-bedded quartzite in upper part of unit, locally replaced by hematite. Gray to black, thinly bedded mudstones in lower part of unit. Unit description source: CY005

pCtqsd - Quartzite and dolomite, Lower Tindir Group (Precambrian) Interbedded quartzite and dolomite. Unit description source: CY005

pCtq - Quartzite and quartzitic sandstone, Lower Tindir Group (Precambrian) Gray to light-gray, quartzite and quartzitic sandstone. Trough crossbeds locally developed. Typically weathers dark gray with black lichens on weathered surfaces. Thin-bedded limestone at top of unit. Locally present at Cathedral Creek. Unit description source: CY005

Pctl - Upper Tindir Group, limestone (Precambrian)

CPxt - Tindir Group (Cambrian? and Proterozoic) See [CPxt](#) for unit description from: [USGS SIM-3340](#)

pCtl - Limestone, Upper Tindir Group (Precambrian) Limestone - Locally includes quartzite, commonly fetid. Unit description source: CY005

pCtsl - Stromatolitic limestone, Upper Tindir Group (Precambrian) Stromatolitic limestone - Gray, massive limestone with thick stromatolitic intervals in middle of unit. Interfingers to the southwest with shale and to the east with shale and quartzite. Unit description source: CY005

PCq - Quartzite and argillite (Precambrian (?))

Ca - Adams Argillite (Cambrian) See [Ca](#) for unit description from: [USGS SIM-3340](#)

pCq - Quartzite and argillite (Precambrian (?)) Greenish-gray laminated quartzite having interbeds of greenish-gray and dark-gray argillite. Minor grayish-red argillite, siliceous shale, chert, and dark-gray sandy limestone. Unit description source: EA002

PCm - Quartzite and quartzitic schist, calc-silicate and marble subunit (Proterozoic)

PzPxyqs - Quartzite and pelitic schist (Devonian and older) See [PzPxyqs](#) for unit description from: [USGS SIM-3340](#)

pCm - Marble (Proterozoic) Massive, cream to white, coarse grained, diopside-tremolite- or actinolite-bearing marble. Weathers medium gray to chalky white; locally laminated with biotite and pink or brown garnet. Marbles grade compositionally to calcite-bearing pelitic schist. Unit description source: CI004

PCo - Orthogneiss (Proterozoic)

MDag - Augen gneiss and orthogneiss (Early Mississippian and Late Devonian) See [MDag](#) for unit description from: [USGS SIM-3340](#)

pCwo - Orthogneiss (Proterozoic) Foliated, muscovite-biotite granitic orthogneiss bodies within metamorphic complex. Contacts with paragneiss (pCwp) usually gradational. Most bodies contain muscovite and garnet; some contain blastophenocrysts of K-feldspar. Microtextures are cataclastic with deformed or granulated feldspar and quartz, numerous micaceous slip surfaces and secondary white mica replacing biotite. Plagioclase is normally zoned (An35-55), K-feldspars are mainly grid twinned. Unit description source: BD004

bu - Bedrock (unknown age)

bu - Bedrock of unknown type or age or areas not mapped (unknown) See [bu](#) for unit description from: [USGS SIM-3340](#)

Unknown bedrock Unit description source: BD002

Geologic Map of Alaska Unit Descriptions

Unit descriptions from the Geologic Map of Alaska (USGS SIM-3340) are provided for units present in the GRI digital geologic-GIS data. As previously mentioned, many units on SIM-3340 are subdivided based on USGS NSA Class values into two or more units in the GRI digital geologic-GIS data. For example, unit Qs (on SIM-3340, see listing and description below) is divided into units Qsl, Qca and many other units, whereas unit QTs (on SIM-3340, see listing and description below) is represented by just one unit, QTs. The descriptions for the SIM-3340 units present in the YUCH map area are presented below. Following each unit description is a list of the GRI subdivided units.

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: [Qsl](#), [Qca](#), [Qc](#), [Qls](#), [Qsp](#), [Qht](#), [Qd5](#), [Qdo5](#), [Qd4](#), [Qm](#), [Qt](#), [Qaf](#), [Qa](#), [Ql](#), [Qdo](#), [Qd1](#), [Qdo1](#), [Qfp](#), [Qac](#), [Qs](#), [Qsu](#), [Qrg](#), [Qcg](#), [Qdr](#), [Qdo3](#), and [QTd](#) 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 [QTs](#) in the GRI digital geologic-GIS data.

Tvu - Volcanic rocks of southern Alaska (Pliocene (?) and older)

Widely distributed throughout southern Alaska, unit is composed of andesite, basalt, and dacite lava flows, tuff, lahar deposits, volcanic breccia, and hypabyssal intrusions, typically poorly age constrained, and all locally hydrothermally altered or hornfelsed. Rocks of this unit tend to fall within two groups on the basis of age, where it has been determined. In south central Alaska, unit includes subaerial flows and associated pyroclastic rocks that range in composition from rhyolite to basalt. These rocks tend to be dominantly moderately altered rhyolite and basalt, but andesite, dacite, and latite also occur. Similar volcanic rocks are mapped in the Anchorage and Talkeetna Mountains quadrangles (unit Tv, Winkler, 1992; Csejtey and others, 1978, respectively), where they also include small lenses of fluvial conglomerate. Flows possibly correlative with this unit occur within the Arkose Ridge Formation (included in unit Ttk here) and yield K/Ar ages that range from 56.2 ± 1.7 to 39.2 ± 2.4 Ma (Csejtey and others, 1992; Winkler, 1992). A crude stratification is described (Csejtey and others 1978; Winkler, 1992), where felsic rocks and pyroclastic rocks occur stratigraphically lower and basaltic and andesitic flows occur in the upper part of the section. Unit includes rhyolitic breccia, ash-flow tuff, flows, and intrusive rocks and subordinate mafic and intermediate flows in the Lake Clark quadrangle and is thought to encompass entire Tertiary and may include Jurassic rocks of the Talkeetna Formation. Much of this unit was included in map unit Tv of Nelson and others (1983), but those rocks that we believe correspond in age with the Oligocene to Eocene Meshik Arc (Wilson, 1985) were placed within map unit Tmv here. In the Sleetmute quadrangle, brownish black olivine basalt that locally displays columnar jointing and possibly pillow structures (Miller and others, 1989) is included here, as well as olivine basalt in the Livengood, Fairbanks, and Lime Hills quadrangles. On Kavalga, Ogluiga, Ulak, and Skagul Islands (Fraser and Barnett, 1959), basaltic or andesitic lava and pyroclastic deposits were undivided in mapping; however, K/Ar age determinations suggest a bimodal age distribution of these rocks. Dates on altered rock samples from Ulak Island were 33.9 ± 1.1 Ma and 43.4 ± 4.6 Ma (DeLong and others, 1978; Marvin and Cole, 1978), whereas samples from Skagul and Kavalga Islands yielded 5.2 ± 0.9 Ma and 6.2 ± 0.4 Ma on andesite (Marvin and Cole, 1978). Marine deposits of volcanic breccia, tuff, and a few pillow lava flows, all of basaltic composition, with a few interbeds of conglomerate and sandstone of similar material are found on Kiska Island (Coats and others, 1961). Samples from flows, a dike, and a basalt boulder within the Vega Bay Formation yielded K/Ar ages that range from 55.3 to 14.7 Ma (DeLong and others, 1978; Marvin and Cole, 1978); the oldest age is inconsistent with the presumed stratigraphic position of the Vega Bay Formation and is therefore viewed as incorrect. The next oldest age of 29.2 ± 4.4 Ma is on an olivine-basalt boulder within the sedimentary rocks of the unit and clearly indicates a protolith age. An age of 17.8 ± 1.1 Ma was determined on a dike cutting the unit, presumably suggesting a minimum age for the unit; however, a flow within the unit yielded an age of 14.7 ± 1.2 Ma, resulting in some doubt as to the age of the unit. Scattered outcrops of felsic to mafic volcanic rocks and related shallow intrusive bodies in the northwest part of the Talkeetna Mountains quadrangle (unit Tv of Csejtey and others, 1978) are also included here; other parts of Csejtey and others' (1978) unit Tv have been assigned to unit Tepv. Finally, includes "basaltic pyroclastic and flow rocks, including minor pillowed lava flows; locally interbedded with marine sedimentary rocks, including tuffaceous or glauconitic strata, probably related genetically to mafic dikes, sills, and plugs on Middleton Island" (Winkler and Plafker, 1993). On generalized map, included as part of unit Tv; locally subdivided into the following seven units Twv, Tpv, Tvm, Tob, Tca, Tmv, and Tev.

This unit is [Tb](#) and [Ti](#) in the GRI digital geologic-GIS data.

Tng - Nenana Gravel (Pliocene and upper Miocene)

Yellowish-gray to reddish-brown, well-sorted, poorly to moderately consolidated conglomerate and coarse-grained sandstone that contains interbedded mudflow deposits, thin claystone layers, and local thin lignite beds widely distributed on the north side of the Alaska Range. Unit is more than 1,300

m thick and moderately deformed (Csejtey and others, 1992; Bela Csejtey, Jr., written commun., 1993).

This unit is [Tcs](#) in the GRI digital geologic-GIS data.

Tcb - Coal-bearing sedimentary rocks (Pliocene to Eocene (?))

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 [Tcb](#) in the GRI digital geologic-GIS data.

TKs - Conglomerate, sandstone, and lignite (Upper Cretaceous to lower Tertiary)

Sandstone, mudstone, thin coal seams, and conglomerate exposed in the Charley River and Rampart areas. In the Charley River area, the unit consists of poorly consolidated sandstone, grit, pebble-to cobble-conglomerate, and carbonaceous mudstone with coal seams and occurs just east of the Kandik basin and along the Tintina Fault Zone. Late Cretaceous, Paleocene, and Eocene pollen have been recovered from exposures within and immediately south of the map area (Miyaoka, 1990) and from shallow core holes (unpublished oil industry data, 2002, cited in Till and others, 2006a). In the western Rampart area, along the Victoria Creek Fault Zone, quartz- and chert-rich fluvial conglomerate, sandstone, and mudstone are typical, and palynoflora of probable Maastrichtian age (Farmer and others, 2003) as well as of early Tertiary age (Chapman and others, 1982) have been collected. Younger part of the unit likely correlative to rocks of unit Tsu, sedimentary rocks, undivided. Rocks of this unit also occur in a 25-m-thick section along the Sethkokna River in the northeast Medfra quadrangle (Patton and others, 1980). There, the conglomerate contains clasts of quartz, chert, felsic volcanic rocks, and talc schist, which Patton and others (1980) provisionally assigned a latest Cretaceous age (Campanian-Maastrichtian) on the basis of pollen in the lignite beds. Unit is overlain by rhyolite and dacite flows. On the Seward Peninsula, Till and others (2011) mapped two separate sedimentary sequences as their unit TKs. Here, only the more northern Late Cretaceous to Tertiary rocks are included; the older middle-Cretaceous rocks are assigned to map unit Kcc of this

map. The rocks included here from the unit TKs of Till and others (2011) consist of gray and brown siltstone, mudstone, sandstone, coal, and minor conglomerate poorly exposed in narrow slices along the Kugruk Fault Zone in the northeastern and southeastern Bendeleben quadrangle; it has been explored for coal and uranium (Retherford and others, 1986; Dickinson and others, 1987). Pollen assemblages of Late Cretaceous and Tertiary (Eocene to early Miocene?) ages have been found in finer grained parts of the sequence (Till and others, 1986; Haga, in Retherford and others, 1986).

This unit is [Tks](#) in the GRI digital geologic-GIS data.

Tsu - Sedimentary rocks, undivided (Tertiary)

Widely distributed around Alaska, unit typically consists of nonmarine, moderately to poorly consolidated deposits of variable composition that range from conglomerate to sandy gravel, gravelly sand, sand, and pebbly mud. Locally, in northern Alaska (Reiser and others, 1971), may include some marine beds and, in southeast Alaska, includes marine calcareous sandstone and siltstone (Gehrels and Berg, 1992). Unit is lithologically similar to unit Tcb below except coal is generally not reported. In the Healy quadrangle, consists of poorly consolidated fluvial dark-gray shale, yellowish-gray sandstone, siltstone, and pebble conglomerate of possible Eocene to Miocene age (Csejtey and others, 1992). In the Mount Hayes quadrangle, (Nokleberg and others, 1992a), unit consists of brown sandstone and graywacke and interbedded conglomerate and argillite of possible Oligocene to Pliocene age, and light-colored, fine-grained, poorly sorted sandstone of Eocene to Miocene age, which locally contains interbedded siltstone, pebbly sandstone, pebble to cobble conglomerate, and sparse, thin coal layers, as well as poorly sorted, crudely bedded to massive, polymictic conglomerate and subordinate sandstone. In the Circle quadrangle (Foster and others, 1983), unit consists of gray or tan conglomerate that grades into gray, tan, or iron-oxide-stained sandstone. In the Big Delta quadrangle (Weber and others, 1978), unit consists of light-gray, poorly consolidated, poorly bedded, fine to very coarse conglomerate, olive-gray, brown, or orange-brown coarse- to fine-grained sandstone and olive-gray siltstone. In the Talkeetna Mountains quadrangle (Csejtey and others, 1978), unit consists of fluvial conglomerate, sandstone, and claystone greater than 160 m thick, which contains a few interbeds of lignitic coal. These rocks lithologically resemble the Chickaloon Formation (included in unit Ttk here), which outcrops to the south, but lack fossil evidence for definitive correlation (Csejtey and others, 1978). In the McGrath quadrangle (Bundtzen and others, 1997a), consists of thick- to thin-bedded, moderately indurated sandstone interbedded with poorly indurated, laminated, fissile, carbonaceous shale and fine-grained sandstone as well as limestone conglomerate. Age range from unit inferred to be Paleocene to Miocene, but is largely Eocene.

This unit is [Tcs](#) 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 (Reifenstuhl and others, 1997) and Big Delta quadrangles (Weber and others, 1978; Day and others, 2007); described by Reifenstuhl 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 [Tpt](#) in the GRI digital geologic-GIS data.

TKg - Felsic granitic rocks (Paleocene or Late Cretaceous, Maastrichtian)

Fine- to coarse-grained or porphyritic, light- to dark-gray, rarely pink, granitic rocks. Unit ranges in composition from granite to quartz diorite, and includes syenite, granodiorite, and quartz monzonite. Biotite and hornblende are locally common; muscovite is uncommon. K/Ar and $^{40}\text{Ar}/^{39}\text{Ar}$ ages range from about 76 Ma to about 57 Ma; the vast majority of samples yielded ages in the range 70 to 59 Ma. Available U/Pb zircon ages fall within the same ranges. Unit includes many of the plutons shown on various source maps for this map that are commonly labeled TKg. These plutons tend to be small and are exposed in a broad belt from southwest Alaska through interior Alaska and into the Yukon. They tend to be potassium-rich, even at lower SiO_2 contents, having as much as 6 percent K_2O at 60 percent SiO_2 in the Dillingham quadrangle (F.H. Wilson, unpub. data). Plutons of this unit are common in the western Dillingham quadrangle (Wilson, 1977) and are unusual in that they tend to have biotite and pyroxene, often orthopyroxene, as their mafic minerals, regardless of the overall pluton composition. Unit consists of hundreds of individual plutons. Many of the hot springs of interior Alaska are spatially associated with these plutons (Motyka and others, 1983). Associated mineralization includes gold, tin, and mercury (see <http://ardf.wr.usgs.gov> for more information about mineral resources in Alaska). On generalized map, included as part of unit TKgi.

This unit is: [TKg](#), [TKgd](#), [TKJg](#), and [Mza](#) in the GRI digital geologic-GIS data.

TKgd - Granodiorite to quartz monzodiorite (Paleocene, or Late Cretaceous, Maastrichtian)

Typically described as granodiorite, quartz diorite, tonalite, monzonite, and quartz monzodiorite, these plutons compositionally overlap with unit TKg, described above, but are the more mafic plutons in this

age range. Also widespread, they tend lie at the periphery of the TKg belt of plutons. They are locally weakly foliated and hypidiomorphic-granular or seriate in texture. K/Ar ages on biotite and hornblende range between 73.5 and 60.0 Ma—very slightly older than unit TKg. An outlier to the belt, a fine-grained hornblende granodiorite, is found on Saint Matthew Island and yielded a K/Ar age on hornblende of 62.3 ± 2.0 Ma (Patton and others, 1975). On generalized map, included as part of unit TKgi.

This unit is [TMZd](#) 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. Volcanoclastic 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. Palynoflora 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: [Tb](#), [TMZmi](#), and [Kr](#) in the GRI digital geologic-GIS data.

TKwt - Welded tuff and other felsic volcanic rocks (early Tertiary (?)) and early Late Cretaceous)

Unit consists of at least two ages of tuff, welded tuff, volcanic breccia, rhyolitic volcanic rocks, and shallow intrusive rocks in the Big Delta, Eagle, and Tanacross quadrangles of east-central Alaska. Existing mapping is not adequate to reliably distinguish the Paleocene tuffaceous units that properly belong in unit Tpt from the older Cretaceous rocks. The older part of the unit is represented by the West Fork and Sixtymile Butte calderas (Bacon and others, 1990), which yield K/Ar ages of

approximately 93 Ma. U/Pb zircon dating (LA-ICPMS) by Mortensen (2008), however, yielded ages of 107.8 ± 0.5 and 108.6 ± 1.5 Ma for the Sixtymile Butte and the Dennison Fork calderas, respectively (note that Mortensen [2008] suggested that the West Fork and Dennison Fork exposures may represent a single caldera complex). Unit also includes the South Fork Volcanics of Yukon, which yield K/Ar and U/Pb ages between about 108 and 90 Ma; most ages were between 95 and 90 Ma (Gordey and Makepeace, 2003). Bacon and Lanphere (1996) reported an $40\text{Ar}/39\text{Ar}$ biotite age from tuff on the Middle Fork complex of 69.10 Ma and obtained zircon ages from rhyolitic tuff and a granite porphyry intrusion of 71.1 ± 0.5 to 69.7 ± 1.2 Ma and a revised age of 69.94 ± 0.52 Ma for the previously dated biotite (Bacon and others, 2014). Most rocks of unit are highly altered (Bacon and others, 1990). Age of both parts of this unit, as well as unit Tpt, correspond to times of extensive plutonic intrusions in the Yukon-Tanana Upland and mostly likely represent the extrusive equivalent of these plutons. On generalized map, included as part of unit Tkpr.

This unit is [Tw](#) 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 [Klgr](#) in the GRI digital geologic-GIS data.

Klqm - Quartz monzonite and monzonite (Late Cretaceous)

Massive, coarse-grained, light-gray porphyritic quartz monzonite (Detterman and Reed, 1980; Nelson and others, 1983) is associated spatially with the Alaska-Aleutian Range batholith in the Iliamna and Lake Clark quadrangles. K/Ar ages range from 85.5 to 75.6 Ma (Reed and Lanphere, 1972). In northern Tyonek quadrangle, fine- to medium-grained pink monzonite or syenite intrudes sedimentary rocks of unit Kfy and contains primary pyroxene and has yielded a concordant U/Pb zircon age of 80.3 ± 0.1 Ma (P.J. Haeussler, unpub. data). Pluton is distinctive in being more potassium-feldspar-rich and quartz-poor than other granitic rocks in the region. Unit also includes undated plutons in the Talkeetna Mountains quadrangle. In the west-central Dillingham quadrangle, an unusual highly potassic coarse-grained biotite-pyroxene granite or syenite yielded an $40\text{Ar}/39\text{Ar}$ age of 84.49 Ma; this pluton is similar to other potassium-rich rocks in the Dillingham area (see unit TKg) except for age. On generalized map, included as part of unit Klgr.

This unit is [Klqm](#) 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 [Kdm](#) 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 [PZPCi](#) in the GRI digital geologic-GIS data.

Kmgr - Granitic rocks of central and southeast Alaska (Cretaceous, Albian to Coniacian)

Primarily granodiorite and lesser quartz diorite, granite, and quartz monzonite that is widely exposed in central and southeastern Alaska. Exposed primarily in four areas: (1) southern southeast Alaska west of the Coast plutonic complex; (2) in the Yukon-Tanana Upland of east-central Alaska and northern Alaska Range; (3) on Saint Lawrence Island in western Alaska; and (4) in southwest Alaska in the Bethel and Russian Mission quadrangles. In southeast Alaska, the plutons tend to be more mafic than other areas and consist of granodiorite and quartz diorite and lesser tonalite; most rocks are medium-grained and moderately foliated and lineated parallel to the fabric in country rocks. Some bodies are tabular and oriented parallel to the foliation; epidote is a common accessory mineral, and garnet is less common. Radiometric ages (K/Ar) are commonly discordant and range from 112 Ma to as young as 22.8 Ma, but most age determinations yielded Coniacian (~86 Ma) or older ages. Mid-Cretaceous plutons in the Yukon-Tanana Upland tend to be biotite granite and biotite-hornblende granodiorite with minor diorite phases and are relatively well dated. Some bodies are batholithic in size, like the Goodpaster and Mount Harper batholiths. Analyses, such as those by Wilson and others (1985), have demonstrated that emplacement of these plutons postdate regional metamorphism and reflect relatively slow cooling. Gold mineralization is commonly associated with these plutons, such as at the Fort Knox and Pogo deposits. In the Eagle and Tanacross quadrangles, radiometric dating is sparse and many of the plutons shown as part of this unit are undated. Limited dating in the adjacent northeastern Big Delta quadrangle suggests that at least some of these plutons may be of latest Cretaceous or earliest Tertiary age. A significant part of Saint Lawrence Island is made of these plutons, which consist of fine- to coarse-grained granite and subordinate granodiorite, monzonite, syenite, and alaskite (Patton and others, 2011). In southwest Alaska, this unit includes the Nyac and nearby plutons. Age control on these plutons is somewhat imprecise; K/Ar and $^{40}\text{Ar}/^{39}\text{Ar}$ ages vary between 120 and 101 Ma, and the only available U/Pb age was reported as an upper intercept on concordia described as between 129 and 104 Ma (Box and others, 1993). Atypical occurrences of the rocks of this unit are a granodiorite body associated with the Pebble

copper deposit in southwest Alaska, dated to 90 Ma, and a coarse-grained biotite granite in the northern Tyonek quadrangle that was dated to 96.9 Ma (Wilson and others, 2009, 2012).

This unit is: [TKMZmgr](#), [Kgsp](#), and [Kd](#) in the GRI digital geologic-GIS data.

Kkg - Flysch and quartzite, Kandik Group and equivalents (Lower Cretaceous, Valanginian to Albian)

Kandik Group consists of the Keenan Quartzite, Biederman Argillite, and Kathul Graywacke in the Charley River quadrangle of east-central Alaska. Keenan Quartzite (Brabb, 1969) is medium-gray, white-weathering, massive, resistant, ridge-forming quartzite and sandstone containing a few interbeds of dark-gray siltstone and argillite. Thickness varies from 30 to 300 m and it locally contains abundant *Buchia sublaevis* of Valanginian age. Biederman Argillite (Brabb, 1969) is at least 1,500 m thick, rhythmically interbedded, dark-gray argillite and medium-gray, quartz arenaceous, carbonate-cemented siltstone and sandstone. Includes a few beds of chert-pebble conglomerate, siliceous shale, chert-limestone breccia and limestone. Convolute structures and cross-laminations are common. Contains very few pelecypods of Valanginian age near base. Kathul Graywacke (Brabb, 1969) consists of several thousand feet dark-greenish-gray, feldspathic graywacke, conglomerate, and dark-gray argillite and minor olive-gray shale and mudstone. Conglomerate clasts include chert, volcanic rocks, argillite, and sandstone in a matrix of graywacke or argillite. Contains a few stratigraphically long-ranging marine pelecypods. May be correlative with nonmarine rocks in Eagle quadrangle that contain plants of probable Albian age. Unit includes Wilber Creek unit of Weber and others (1992) in the Livengood quadrangle, which consists of interlayered siltstone, shale, sandstone,

and conglomerate originally subdivided into coarse- and fine-grained units in the Livengood quadrangle. Siltstone and sandstone are medium- to medium-dark-gray and greenish-gray, moderately sorted, and very fine- to medium-grained. Conglomerate is dark-olive-gray to medium-dark-gray, iron-stained, polymictic, unsorted, subangular to well rounded, and grain size ranges from granules to cobbles. Clasts are of local derivation and consist of quartzite, limestone, mafic and felsic igneous rocks, greenstone, diorite and other intrusive rocks, sandstone, siltstone, phyllite, chert, rare grit, shale rip-ups, and very rare carbonatite. Beds are typically internally massive, thick- to medium-bedded, graded, and amalgamated and have planar tops and bases. Local small-scale trough-crossbeds internally fill large-scale troughs and fining-upward cycles are common. Conglomeratic graywacke occurs within lenses in unit. Minor small-scale scour fills locally fine upward into ripple-laminated medium-gray to black siltstone and dark-gray to black shale. Presence of *Paragastrolites flexicostatus* indicates an Albian age. Graywacke rich in volcanic detritus is locally characteristic of the Kathul Graywacke (Dover and Miyaoka, 1988). Wolverine quartzite of Weber and others (1992), which is exposed in the Livengood, western Circle, and eastern Tanana quadrangles, is light- to dark-gray, very fine- to medium-grained, well-sorted quartzite that contains interbedded black to dark-gray shale and medium-light- to medium-gray siltstone. Rare coquina-like beds contain poorly preserved fragments of *Buchia* and other fossils that provide limited age control. Includes Vrain unit of Weber and others (1992), which consists of dark-gray to black, pyritiferous shaly slate, or black fissile shale and minor medium- to dark-gray, olive- or greenish-gray siltstone. Closely resembles upper part of the Glenn Shale in the Charley River quadrangle, which is also included here. Upper part of Glenn Shale is a carbonaceous shale that contains minor thin beds (up to 5 m thick) of fine-grained sandstone. Early Cretaceous megafossils have been collected from several localities within the unit (Miyaoka, 1990). The Wilber Creek, Wolverine quartzite, and Vrain units are thought to be offset from the Kandik Group along the Tintina Fault System.

This unit is: [Ku](#), [Kka](#), [Kke](#), [Kb](#), [KJqa](#), [KJTRa](#), and [MZPZat](#) in the GRI digital geologic-GIS data.

JMpu - Younger strata of the Porcupine River sequence of Brosge and Reiser (1969), undivided (Mississippian to Jurassic)

Unit consists of poorly known clastic rocks and limestone in the Coleen quadrangle in the northeastern part of the state. Youngest part of the sequence included here is red and green laminated chert; partly silicified siltstone and shale; and ferruginous very fine-grained sandstone of presumed Jurassic age. The most common unit of the Porcupine River sequence is gray to black, locally pyritic siltstone and silty shale that has nodules of siltstone of Jurassic and Permian age; Brosge and Reiser (1969) estimated that it is about 300 m thick. Underlying this is Permian and Carboniferous gray, cherty limestone and dark-gray shaly limestone and chert about 60 to 180 m thick that contains a local basal shale and sandstone. This basal shale and sandstone may be equivalent to unit C5s of Brosge and Reiser (1969), which they describe as yellow, coarse-grained conglomeratic, poorly sorted, partly carbonaceous sandstone and fine-grained hematitic sandstone; as much as 60 m thick; Carboniferous in age. Also includes thick beds of gray chert breccia and minor very fine-grained limonitic sandstone of Jurassic or Permian age. They thought that this part of the unit, which is at least 60 m thick, may be, in part, a silicified dolomite breccia. A Permian brachiopod-bearing gray nodular siltstone and yellow-weathering silty limestone at least 120 m thick is the remaining part of unit. Also included here are several thousand feet of poorly described quartzite or chert, argillite, and dark-gray limestone in the Black River and Charley River quadrangles (Brabb and Churkin, 1969; Brabb, 1970). Till and others (2006a) noted lithologic and faunal similarities of parts of this map unit to the Siksikpuk (unit TrPNeg) and Kuna Formations (part of the Lisburne Group, unit PNMIg) as described in Dumoulin and others (2004), which suggests ties between this unit and correlative rocks of northern Alaska. Faunal similarities also tie this unit to strata to the south, such as the Tahkandit Limestone (unit Ptl). On generalized map, included as part of unit JMps.

This unit is [PZca](#) 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 Jäger, 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 [MZPZc](#) in the GRI digital geologic-GIS data.

Jg - Plutons of the Yukon-Tanana Upland (Early Jurassic)

The plutons range from granite to granodiorite and also include more potassic phases that are exposed primarily in the Eagle, and to a lesser extent, the Tanacross quadrangles of east-central Alaska. Includes the hornblende syenite porphyry of Mount Veta of Foster (1976), which has been shown by Day and others (2014) to include quartz monzonite and diorite phases. Radiometric ages, including K/Ar, ⁴⁰Ar/³⁹Ar plateau, and U/Pb zircon, are generally between 193.2 and 178.7 Ma, but several other U/Pb ages have been published, both older and younger than this range (Foster, 1976; Newberry and others, 1998b; Dusel-Bacon and others, 2002; Weldon and others, 2001; Szumigala and others, 2002; Dusel-Bacon and others, 2009; Day and others, 2014). Unit includes rocks mapped as “gabbro, associated basalt and andesite(?), minor diorite and diabase, and undifferentiated mafic- and intermediate composition igneous rocks” by Foster (1992) and since shown to include a significant proportion of granodiorite of Early Jurassic age. Triassic parts of Foster’s unit are included in unit TRgd. In the Eagle

quadrangle, unit includes migmatitic border phases of the plutons as mapped by Day and others (2014). On generalized map, included as part of unit Jegr.

This unit is: [TMZm](#), [KJg](#), [Jga](#), [Js](#), and [Jmig](#) in the GRI digital geologic-GIS data.

Trqd - Quartz diorite and granodiorite (Triassic)

Granodiorite and similar rocks of Triassic age occur primarily in three parts of Alaska.

In southwest Alaska, the Afognak pluton is the largest exposure, but small exposures of rocks of similar age and composition are found in the Barren Islands of the Afognak quadrangle and in the Seldovia quadrangle of south-central Alaska. The Afognak pluton is exposed on the west side of the Kodiak Island archipelago in the Karluk, Kodiak, and Afognak quadrangles. It is a large, multiphase hornblende diorite, quartz diorite, and tonalite pluton that has a well-developed contact-metamorphic aureole in the Shuyak Formation; its boundary with the schist of Kodiak Island (unit Js) is apparently a fault (Roeske and others, 1989). In the Seldovia quadrangle, unit includes the diorite of Point Bede of Bradley and others (1999), which is a fine- to medium- grained quartz diorite, and the tonalite of Dogfish Bay of Bradley and others (1999), a medium-grained tonalite that shows chloritic alteration similar to that found in diorite of Point Bede and, hence, was assigned a similar age. Bradley and others (1999) originally assigned plutons in the Seldovia quadrangle a Jurassic age on the basis of correlation with the pluton in the Barren Islands that had yielded a K/Ar hornblende age of 191 ± 1.3 Ma (Cowan and Boss, 1978). A Triassic age of 227.7 ± 0.6 Ma was determined on zircon from the diorite of Point Bede (Bradley and Miller, 2006). Unit also includes diabasic hypabyssal intrusions in the Shuyak Formation (Connelly and Moore, 1979). A fission-track age determination on zircon yielded 153 ± 10 Ma (Clendenen, 1991). K/Ar ages on hornblende from the Afognak pluton and associated migmatite range from 197 ± 5.8 to 187.5 ± 5.5 Ma (Roeske and others, 1989), which we interpret as a cooling age; a U/Pb age of 217 ± 10 Ma is interpreted as the emplacement age (Roeske and others, 1989). We infer a similar history for the plutons of the Barren Islands.

The second major area of exposure of Triassic plutonic rocks is the Taylor Mountain batholith in the Eagle and Tanacross quadrangles of east-central Alaska (Foster, 1970, 1976). The batholith is medium- to coarse-grained, subequigranular biotite–hornblende quartz monzodiorite, tonalite,

granodiorite, and quartz diorite that ranges from slightly foliated in its interior to strongly foliated at its margins (Werdon and others, 2001). Contacts with surrounding rocks are complex; zones of intimately foliated quartz dioritic dikes and sills are locally present in the country rocks near the batholith, but sheared contacts apparently predominate: Jurassic deformation, and later high-angle faulting, has disrupted most of the original contacts (Werdon and others, 2001). Rocks of the Taylor Mountain batholith have yielded a U/Pb (sphene) age of 214 Ma and zircon ages between 215.7 ± 3.1 and 196 ± 4 Ma (Aleinikoff and others, 1981; Dusel-Bacon and others, 2009; Day and others, 2014); K/Ar ages of 183 to 177 Ma (Wilson and others, 1985); and $40\text{Ar}/39\text{Ar}$ plateau ages of 209 ± 3 Ma on hornblende and 204 ± 9 Ma on biotite (Cushing and others, 1984a, b, written commun., 1992), and 210 Ma on biotite and 211 Ma on hornblende (P.W. Layer, University of Alaska-Fairbanks, unpub. data; see Werdon and others, 2001). The most likely magmatic age is about 214 Ma, with younger apparent ages caused by heating and deformation during the Early Jurassic (Werdon and others, 2001).

In southeast Alaska, the primary exposure of Triassic plutonic rocks is the Texas Creek granodiorite of Berg and others (1988) in the Ketchikan and Bradfield Canal quadrangles and adjacent British Columbia. The pluton consists mainly of recrystallized, locally cataclastically deformed granodiorite and minor quartz diorite. In general, the unit is relatively massive and lacks pronounced primary or metamorphic foliation. Where present, the intensity of the cataclastic texture generally is low, but locally the granodiorite is converted to mylonite (Berg and others, 1988). The Texas Creek granodiorite yields latest Triassic apparent ages, but discordant K/Ar dates on hornblende (Smith, 1977). U/Pb zircon age determinations by Alldrick and others (1987) on the pluton in adjacent British Columbia yield Early Jurassic apparent ages, which they interpreted to be metamorphic ages. Other small plutons, exposed on northern Admiralty Island, described as very light- to medium-gray, nonmagnetic, locally foliated, lineated, garnet-bearing granodiorite have reported U/Pb zircon ages of 227.3 ± 2.0 and 221.8 ± 3.0 Ma and an $40\text{Ar}/39\text{Ar}$ age of 236.3 ± 3.8 Ma on hornblende; the plutons are locally migmatitic and some contacts are mylonitic (S.M. Karl, unpub. data). In the Skagway quadrangle, a number of dioritic dikes and small stocks mapped by Redman and others (1985) and Gilbert and others (1987) are of presumed Triassic age

This unit is [JTRqd](#) in the GRI digital geologic-GIS data.

Trgsl - Glenn Shale, lower unit (Triassic)

Grayish and brownish-black carbonaceous and calcareous shale (Van Kooten and others, 1996) and thin-bedded fossiliferous limestone in lower part of unit; rare thin oil shale (Brabb and Churkin, 1969); unit exposed in east-central Alaska. Unit overlies Tahkandit Limestone (unit Pkl) or the Step Conglomerate (unit Pstc) with a significant time gap and is overlain unconformably by the upper member of the Glenn Shale (included here in unit Kkg). Unit is abundantly fossiliferous, containing *Monotis*, *Halobia*, *Daonella* cf. *D. degeeri*, *Discophyllites*, and *Nathorsites* of Middle (Ladinian) and Late (Norian) Triassic age (Brabb, 1969). A similar and possibly equivalent unit of calcareous phosphatic shale, limestone, and minor calcareous sandstone and granule conglomerate was mapped in the Livengood quadrangle (Weber and others, 1992). The lower unit of the Glenn Shale is possibly equivalent to the Shublik Formation (unit Trgs) of northern Alaska. In the Livengood quadrangle the exposures that are lithologically similar to the lower Glenn Shale have yielded Permian to Triassic conodonts (Weber and others, 1994), which Weber and others (1992) had interpreted were most likely Triassic; these conodonts support correlation with the lower Glenn Shale. Unit may locally include rocks of the Tahkandit Limestone (unit Ptl); on generalized map, included as part of unit Trgs

This unit is [TRgsl](#) in the GRI digital geologic-GIS data.

TrMsm - Seventymile assemblage (Mississippian to Triassic)

Massive greenstone, amygdaloidal pillow basalt and metatuff and associated peridotite, metachert, quartzite, phyllite, silica-carbonate lenses, and other low metamorphic grade sedimentary rocks. White and orange-brown silica-carbonate lenses crop out in the northern Big Delta quadrangle (Weber and others, 1978). Foster (1992) interpreted the massive greenstone as “originally mostly basaltic pillow lava and mafic lava flows; generally associated with peridotite bodies. In places, the greenstone contains amygdules (generally filled with calcite) and pillows. Locally tuff and silicified tuff, commonly red, gray, or green, are interlayered.” Foster (1992) reported that basalt metamorphosed to blueschist facies is included and also reported that a glaucophane-bearing sample associated with greenstone yielded a late Permian $40\text{Ar}/39\text{Ar}$ age, based on a G.W. Cushing written communication in 1991 (Foster, 1992, p. 9); however, this age can not be confirmed. Cushing (written commun., 1992), the apparent source of the Permian date, does not report any age determinations on glaucophane-bearing rocks. Elsewhere the greenstone is intercalated with chert that yields Radiolaria and rare shelly fossils of Mississippian through Triassic age (Foster, 1976, 1992; Weber and others, 1978; Dusel-Bacon and Harris, 2003) of similar age and composition as rocks of the Angayucham and Tozitna assemblages (unit TrDtz). Beranek and Mortensen (2011) analyzed detrital zircon samples of Triassic rocks from this assemblage as defined here; these zircon populations contain a significant number of Carboniferous and older Paleozoic zircons, as well as a smaller number of Proterozoic and rare Archean zircons. Includes units Pgc and Pq of Weber and others (1978) in the Big Delta quadrangle, unit Pzg of Foster and others (1983) in the Circle quadrangle, units Pq and MzPzb of Foster (1976) in the Eagle quadrangle, and units gs and gsi of Brabb and Churkin (1969) in the Charley River quadrangle

This unit is: [TRMsm](#), [MZPZt](#), [MZPZCb](#), [PZgc](#), and [Pq](#) 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 Reifenstuhl 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 [PZPCch](#) in the GRI digital geologic-GIS data.

MzPzyo - Peridotite of dismembered ophiolite of the Yukon-Tanana region (Triassic (?) or older)

Serpentinized peridotite, harzburgite, and dunite. Unit restricted to small outcrops in the Eagle, Charley River, Big Delta, Fairbanks, and Circle quadrangles (Foster, 1992; Foster and others, 1994). Corresponds to units assigned by many workers to the Seventymile terrane, which is thought to be a dismembered ophiolite. In the Big Delta quadrangle, unit includes units Pzd and Pzu of Weber and others (1978), and, in the Eagle quadrangle, unit Mzp of Foster (1976). Unit occurs as a klippe or is structurally infolded with mafic and pelitic schist of the Yukon-Tanana crystalline complex. Unit has not been dated, but age is inferred from association with sedimentary rocks of the Seventymile terrane, which contain early Late Triassic and late Paleozoic fossils (Dusel-Bacon and Harris, 2003). In the Eagle quadrangle, metagabbro mapped by Foster (1976) may be a component of the ophiolite; it is included in unit Pzys here, mafic schist and amphibolite. The Joseph ultramafic body in the Eagle quadrangle yielded discordant hornblende and biotite dates of 174.7 ± 5.1 Ma and 185.1 ± 5.4 Ma, respectively (Foster, 1976). On generalized map, included as part of unit JZu.

This unit is [MZPZs](#) in the GRI digital geologic-GIS data.

TrPzig - Gabbro and diabase (Triassic or Late Paleozoic)

Light- to medium-green, medium- to coarse-grained, equigranular gabbro and diabase or diorite sills and dikes. Intrudes Globe quartzite unit (Mgq, here) in the Livengood quadrangle and is associated with one of the thrust splays of the Tintina Fault System. U/Pb zircon age of 232.1 ± 4.5 Ma by J.K. Mortensen (Geological Survey of Canada, later at University of British Columbia, written commun., 1991), reported by Weber and others (1992). Also includes undated small exposures of green to greenish-brown, medium- to very coarse-grained, porphyritic diorite that intrudes the Cascaden Ridge and Beaver Bend combined unit (Dcr) in the Circle quadrangle (Foster and others, 1983). Apparently equivalent rocks are present in the Kantishna River and Ruby quadrangles (Wilson and others, 1998). On generalized map, included as part of unit JZu.

This unit is [MZPZd](#) 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 [PZPCls](#) in the GRI digital geologic-GIS data.

Pze - Eclogite and associated rocks (Paleozoic)

Garnet- and omphacite-bearing biotite-muscovite schist, micaceous marble, black quartzite, and amphibolite in thin interlayers within a metamorphic sequence, described as allochthonous, garnet-bearing, quartz-biotite-muscovite schist and quartzite (Swainbank and Forbes, 1975; Brown and Forbes, 1986; Weber and others, 1992; Foster and others, 1994) and designated as the Chatanika assemblage by Robinson and others (1990). The Chatanika assemblage is primarily epidote-amphibolite facies rocks, but also includes eclogitic rocks and has some lithologic similarities with the structurally underlying quartz and pelitic schist (unit l-yqs). Protolith of eclogite was predominantly quartz-rich and pelitic to calcareous pelitic sedimentary rocks, impure limestone, and associated mafic volcanic and volcanoclastic rocks. Pressure and temperature conditions of 11 kbar and 600 to 700 °C were cited by Newberry and others (1996) on the basis of microprobe analyses and are supported by the high-pressure eclogite-facies mineral assemblage. Other estimates of pressure-temperature conditions range from 590 °C and 5.5 to 7.5 kbar (Swainbank and Forbes, 1975) to 600±50 °C and 13–15 kbar (Brown and Forbes, 1986) on the basis of mineral-pair geothermometers and geobarometers. Newberry and others (1996) inferred a Mississippian to Devonian protolith age from unspecified ⁴⁰Ar/³⁹Ar, K/Ar, and Pb-Pb studies; Forbes (1982) reported a questionable K/Ar protolith age of 487±35 Ma on low-potassium amphibole and K/Ar ages on mica that range from 170.1±2.3 to 108.7±3.5 Ma, which he attributed to Mesozoic metamorphism. Includes parts of the Chatanika assemblage, units Pce and Pcu of Robinson and others (1990); unit PDe of Newberry and others (1996), unit Pzc of Weber and others (1992) in the Livengood quadrangle, and unit PzpCms of Foster and others (1983) in the Circle quadrangle.

This unit is [PZPCe](#) in the GRI digital geologic-GIS data.

Pks - Klondike Schist (Permian)

Poorly understood assemblage of generally low-grade metamorphosed pelitic and volcanic rocks and minor marble. Primarily exposed in the Eagle quadrangle in Alaska (Szumigala and others, 2002; Dusel-Bacon and others, 2006) and more broadly exposed in the Yukon (Gordey and Ryan, 2005; Beranek and Mortensen, 2011), it consists of gray-green to dark-greenish-black massive greenstone, amygdaloidal pillow basalt and metatuff and associated metachert, quartzite, phyllite, silica-carbonate lenses, and other low-grade metasedimentary rocks. Mortensen (1999) reported that the Klondike Schist yielded mid-Permian protolith ages as determined by U/Pb zircon analysis, and more recent analyses by Beranek and Mortensen (2011) bracket intrusion and metamorphism to between 260 and 252.5 Ma. In the Tanacross quadrangle, quartz-muscovite, quartzite, quartz-muscovite schist, actinolite schist, chert and other fine-grained silicic rocks, phyllite, metagraywacke, and schistose greenstone are also included here (Foster, 1970). On this map, assignment of rocks in the eastern Eagle quadrangle to the Klondike Schist or the Keevy Peak Formation (unit Pzkip) must be considered

tentative; Permian (~255 Ma) U/Pb zircon ages, as well as Mississippian and Devonian zircon ages are reported by Dusel-Bacon and others (2006) for the Nasina assemblage, here assigned to the Keevy Peak map unit (unit Pzkn). On generalized map, included as part of unit Pzkn.

This unit is [PZqsg](#), and [PZqs](#) in the GRI digital geologic-GIS data.

Ptl - Tahkandit Limestone (Lower Permian)

Tan to light-gray, fine- to coarse-grained bioclastic limestone that weathers to gray to dark-gray. Locally cryptocrystalline and nonfossiliferous, but generally contains abundant brachiopods, solitary corals, crinoids, and bryozoan fragments (Brabb and Grant, 1971). Unit is a facies equivalent of the Step Conglomerate (unit Pstc). Where interbedded with Step Conglomerate, unit contains abundant rounded chert pebbles (Clough and others, 1995). As shown here, includes gray nodular siltstone and yellow-weathering silty limestone, at least 120 m thick, as mapped by Brosgé and Reiser (1969) in the Coleen quadrangle. On generalized map, included as part of unit Ptl.

This unit is [PZI](#), and [Pst](#) in the GRI digital geologic-GIS data.

Pstc - Step Conglomerate (Lower Permian)

Chert-pebble conglomerate that grades upward to light-gray, very fine-grained chert arenite and contains minor bioclastic limestone in lower part of unit (Brabb, 1969; Clough and others, 1995). Conglomerate is clast-supported and chert clasts are subangular to rounded, medium-gray, dark-gray, and black. Clasts include fossil debris (coral, crinoid, brachiopod, pelecypod, and bryozoan) and organic imprints to 8 cm long (Clough and others, 1995). Unit is facies equivalent of Tahkandit Limestone. Western and northern exposures are nonfossiliferous and generally of uncertain age. Thickness about 600 m. Unit originally named and described by Brabb (1969).

This unit is [Pstc](#) in the GRI digital geologic-GIS data.

IPDcf - Calico Bluff and Ford Lake Shale, undivided (Devonian to Lower Pennsylvanian)

Calico Bluff Formation consists of rhythmically interbedded, dark-brownish-gray and brownish-black limestone and shale, and laminated siliceous shale and chert. Its thickness is about 450 m. Ford Lake Shale is predominantly grayish-black siliceous shale and laminated grayish-black chert. Brownish-black phosphate concretions, some as large as 4 inches (10 cm) in maximum dimension and very pale orange carbonate concretions a few feet (~1 m) in length are common. Several limestone and dolomite beds and lenses occur in the upper part of the formation" (Brabb, 1969). Ford Lake Shale is about 600 m thick and grades upward to Calico Bluff Formation. Calico Bluff Formation is equivalent to Hart River Formation of the Yukon and is Late Mississippian to Early Pennsylvanian in age, whereas Ford Lake Shale is Late Devonian to Late Mississippian in age. Unit is restricted to the Charley River and northeast Eagle quadrangles.

This unit is [PNMcb](#), and [PNMDf](#) 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 [MZPZaq](#) in the GRI digital geologic-GIS data.

Pzymi - Orthogneiss and amphibolite of igneous origin (Mississippian, Devonian, and older (?))

Most common lithologies are granitic to trondhjemitic orthogneiss and lesser amphibolite. Includes quartz-biotite $\pm$ garnet gneiss, amphibolite, and minor pelitic gneiss, quartzite, schistose gneiss, augen gneiss, and quartz-mica schist (Weber and others, 1978; Foster, 1992; Dusel-Bacon and others, 2006). Unit is most extensive in the northern Alaska Range in the Tanacross quadrangle and sparsely exposed in the Yukon-Tanana Upland. Largely metamorphosed to amphibolite facies (Dusel-Bacon and others, 1993), locally unit has been retrograded to greenschist facies in the Mount Hayes quadrangle (Nokleberg and others, 1992a). Whole-rock trace-element data indicate a within-plate origin for most amphibolite (Dusel-Bacon and Cooper, 1999). Where possible, augen gneiss mapped separately as unit MDAg. This unit is gradational with unit PzPygs, which is largely of metasedimentary origin, but includes some metigneous components. On generalized map, included as part of unit MPNGs.

This unit is [PZmi](#) in the GRI digital geologic-GIS data.

PzPxys - Gneiss, schist, and quartzite (Mississippian, Devonian, and older)

Coarse- to fine-grained gneiss and quartzite; well-foliated and banded to massive; locally cataclastic; ranges from pelitic schist that contains abundant sillimanite to gneisses of probable igneous origin. All rocks are well foliated, and dominant foliation is folded. Protolith may include both Paleozoic and Precambrian sedimentary and igneous rocks (Weber and others, 1978). Unit is widespread throughout the Yukon-Tanana Upland and the included meta-plutonic rocks may be equivalent to the Pelly Gneiss in Yukon, Canada. Also includes gray, medium-grained, mylonitic, quartzofeldspathic biotite-sillimanite gneiss that forms core of a gneiss dome in the central Big Delta quadrangle (Dusel-Bacon and Foster, 1983). Several U/Pb zircon ages have been determined on this unit, and Mississippian to Devonian crystallization ages are common for the metigneous rocks within this unit and within unit lymi (Aleinikoff and Nokleberg, 1985; Aleinikoff and others, 1986). Day and others (2003), Dusel-Bacon and Williams (2009), Aleinikoff and Nokleberg (1985) all indicate that inheritance of zircon grains is common. Detrital zircon analyses by Aleinikoff and others (1984, 1986) and Dusel-Bacon and Williams (2009) from quartzite in the unit yielded Proterozoic and Archean zircons. On generalized map, included as part of unit MPNGs.

This unit is: [PZg](#), [PZPCs](#), and [PZPCgs](#) in the GRI digital geologic-GIS data.

MDts - Totatlanika Schist (Late Devonian to Early Mississippian)

Low-grade, multiply-deformed, locally mylonitic assemblage of gritty semischist that contains clear to bluish-gray quartz "eyes," chloritic quartzofeldspathic schist and augen gneiss, phyllitic schist and semischist, phyllite, metavolcanic rocks, quartzite, marble, and greenstone. Porphyritic volcanic and sedimentary textures preserved in places; metavolcanic compositions range from mafic to felsic. Fossil age is poorly defined; conodonts collected from one marble interbed were Middle Devonian to Early Mississippian, and crinoids, corals, and gastropods were less precisely dated (Wahrhaftig, 1968). Meta-andesite from the northeastern Big Delta quadrangle yields an upper intercept U/Pb zircon age of 375 Ma that is interpreted as an extrusive age of the protolith (Dusel-Bacon and others,

1993; revised to 374 ± 3 Ma, Cynthia Dusel-Bacon, written commun., 2014). Dusel-Bacon and others (2006) report U/Pb (SHRIMP) zircon ages between 372 ± 3 and 360 ± 5 Ma for meta-igneous rocks included in the Totatlanika Schist. Unit consists of the Totatlanika Schist of the Fairbanks and Healy quadrangles (Péwé and others, 1966; Csejtey and others, 1992), various units of the Totatlanika Schist in the Chena River area

(Smith and others, 1994), unit Pzsg of Weber and others (1978) in the Big Delta quadrangle, and the blastomylonite subunit of unit PzpCs of Foster (1992).

This unit is [MDts](#) and [PZPCm](#) 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 [MDag](#), [Dbr](#), and [PCo](#) in the GRI digital geologic-GIS data.

Pzkp - Keevy Peak Formation and similar rocks (early Paleozoic)

Multiply deformed siliceous and carbonaceous assemblage of phyllite, meta-argillite, quartzite, metachert(?), and lesser amounts of interlayered calcareous phyllite, marble, and mafic and felsic metavolcanic rocks at lower to upper greenschist facies (Foster, 1992; Dusel-Bacon and others, 1993). Includes rocks in the northern Big Delta and southern Circle quadrangles that are referred to as the Blackshell quartzite and phyllite and the Blackshell calcschist and marble (Smith and others, 1994). Contains minor stretched pebble conglomerate in the Healy and Denali quadrangles. In the Big Delta quadrangle, U/Pb zircon ages from felsic metatuff interlayers yielded dates of 372 ± 5 and 353 ± 7 Ma, indicating Early Mississippian and Late Devonian extrusion ages and, therefore, the depositional age for at least part of the sequence (Dusel-Bacon and others 2004); Pb-isotope data from syngenetic galena in a carbonaceous, phyllite-hosted, stratiform zinc-lead deposit also indicate a Mississippian or Devonian age for mineralization (Dusel-Bacon and others, 1998, 2004; Mortensen and others, 2006). Late and Middle Devonian fossils have been reported in rocks of this unit in the Denali quadrangle (Gilbert and Redman, 1977). Regionally, unit appears to occupy a stratigraphic position between the Totatlanika Schist and unit |<yqs of this map. As mapped, it includes the Keevy Peak Formation as originally defined by Wahrhaftig (1968) in the Healy and Denali quadrangles; new age data support extension of the unit to the Big Delta, Circle, and Fairbanks quadrangles (Dusel-Bacon and others, 2004) and correlation with the Nasina assemblage in Yukon, as proposed by Weber and others (1978). Dusel-Bacon and others (2006) wrote that the Blackshell unit of Smith and others (1994) was previously correlated with the Nasina assemblage in Canada (Foster and others, 1994; Smith and others, 1994), but Dusel-Bacon and others (1996) proposed that the use of the Nasina assemblage name in Alaska be restricted "to the rocks in the eastern Yukon-Tanana Upland that contain Permian and Mississippian felsic rocks and appear to grade into the Fortymile River assemblage." The Permian U/Pb zircon dates reported by Dusel-Bacon and others (2006) are unusual for this map unit and are coeval with ages determined for the Klondike Schist (unit Pks here) and, as mentioned in the Klondike Schist map unit description, Dusel-Bacon and others (2006) also reported Mississippian and Devonian zircon ages. Other rocks included in this map unit are units Pzq and Pzm of Weber and others (1978) in the Big Delta quadrangle, units Pzq and Pzm of Foster and others (1983) in the Circle quadrangle, units Pzgs Pzcp, and Pzq of Foster (1992) in the Eagle and Tanacross quadrangles, units MDq, MDkq, and MDda of Szumigala and others (2002) in the Eagle quadrangle, units uPzst, and uPzv of Weldon and others (2001) also in the Eagle quadrangle, unit Pzk of Csejtey and others (1992) in the Healy quadrangle (which Bela Csejtey, Jr. [written commun., 1993] has indicated also occurs in the Denali quadrangle and we include here), and the Birch Hill sequence (units Dbs and Dbc of Newberry and others, 1996) in the Fairbanks mining district of the southeastern Livengood and northeastern Fairbanks quadrangles, as well as units Pzbc, Pzbp, and Pzbr of Smith and others (1994). Unit is typically exposed in close proximity to the Totatlanika Schist (MDts). On generalized map, included as part of unit Pzkn.

This unit is [DSOdc](#) in the GRI digital geologic-GIS data.

Dnr - Nation River Formation (Upper and Middle (?) Devonian)

Commonly graded, rhythmically interbedded mudstone, sandstone, gritstone, and conglomerate. Mudstone is olive-gray and nearly everywhere contains plant fragments and spores of Late Devonian age. Sandstone is olive-gray chert arenite and wacke, commonly with carbonate cement. Gritstone and conglomerate are mostly composed of varicolored chert granules and pebbles. Total thickness ranges from approximately 650 to 1,300 m (Brabb and Churkin, 1969). According to Clough and others (1995), in the northern part of the Charley River quadrangle, the Nation River Formation is yellow-brown to light-brownish to medium-gray chert arenite sandstone and chert pebble to cobble conglomerate. Conglomerate is clast-supported, contains rounded to subangular clasts, and has gray, dark-gray, and black chert in a quartz and chert sand-size matrix; locally white-weathering tripolitic chert clasts are common. Nation River conglomerate is less sorted, has more rounded clasts, more chert clasts, is more siliceous, and is more clast-supported than Step Conglomerate (unit Pstc). Dover and Miyaoka (1988) mapped a large expanse of the western Charley River quadrangle as

conglomerate of the Nation River Formation, whereas Brabb and Churkin (1969) considered these rocks to more likely be the Permian

Step Conglomerate (Pstc), which is how they are shown here. On generalized map, included as part of unit DZyf.

This unit is [Dnr](#) in the GRI digital geologic-GIS data.

Dvec - Woodchopper Volcanics, and Schwatka unit of Weber and others (1992) (Devonian)

Woodchopper Volcanics are described as amygdaloidal basalt, pillow basalt, and aquagene tuff, subordinate interbedded chert, argillite, quartzite, and limestone of Late(?) to Early Devonian age in the Charley River quadrangle (Brabb and Churkin, 1969). Brabb and Churkin (1969) also mapped several hundred feet of dark-gray laminated shale that contains minor interbeds of limestone associated with the Woodchopper Volcanics, which we have included here; Dover and Miyaoka (1988) included these sedimentary rocks in their redefined Nation River Formation, which we do not believe is an appropriate assignment, as the Nation River Formation is a plant- and coal-bearing clastic unit. Schwatka unit of Weber and others (1992) is included here; it is mapped in Livengood and Circle quadrangles, offset from the Woodchopper Volcanics by the Tintina Fault System. The Schwatka consists of massive basalt flows, agglomerate, tuff, fine-grained volcanoclastic rocks, minor thin lenses of laminated platy impure limestone, and local lenticular bodies of calcite-cemented conglomerate interbedded with Devonian limestone (Weber and others, 1992). The Schwatka unit is metamorphosed to greenschist facies.

This unit is [Dwv](#) and [Dsv](#) in the GRI digital geologic-GIS data.

Dcr - Cascaden Ridge and Beaver Bend combined correlative units (Devonian)

Cascaden Ridge unit of Weber and others (1992) is chiefly rhythmically interbedded gray and olive-gray shale, gray siltstone, and graywacke exposed in Livengood quadrangle. Less abundant components are gray limestone and polymictic granule- and pebble-conglomerate that has a graywacke matrix. Conglomerate clasts include mafic and ultramafic rocks, chert, dolomite, and shale (Weber and others, 1992). Limestone interbeds contain Middle Devonian gastropods, conodonts, brachiopods, and corals (Blodgett, 1992; Weber and others, 1992). Beaver Bend unit of Weber and others (1992) is conglomerate, graywacke, siltstone, and slate in the Livengood quadrangle. Conglomerate is polymictic, clast-supported granule- to pebble-sized and has clasts that include chert, quartz, quartzite, mafic and felsic volcanic rocks, argillite, slate, siltstone, and sandstone. Graywacke is fine- to medium-grained; framework grains are mostly chert and quartz, and subordinate slate. The Beaver Bend unit has yielded unidentifiable plant fragments; it was assigned a probable Devonian age by Weber and others (1992). In the western Circle quadrangle, nonfossiliferous chert-pebble conglomerate that was mapped as part of the MzPzat unit by Foster and others (1983) was considered to be equivalent to the Beaver Bend unit of Weber and others (1992) (F.R. Weber, unpub. data, cited in Wilson and others, 1998). In the north-central Circle quadrangle, north of the Tintina Fault, two units mapped by Foster and others (1983) are included here: unit Pzcg, chert-pebble conglomerate; and unit Pzcc, chert, chert-pebble conglomerate, and minor limestone. Limestone of unit Pzcc yielded Late Devonian (Famennian) conodonts. On generalized map, included as part of unit DZyf.

This unit is [PZcr](#) in the GRI digital geologic-GIS data.

DSld - Shallow-marine carbonate-dominated rocks (Devonian and Silurian (?))

Limestone, dolostone, and lime mudstone of Late Devonian and possibly as old as Silurian age in central Alaska. These limestone bodies occur between strands of the Tintina Fault System in the so-called Preacher Block in the Circle quadrangle (Foster and others, 1983) as well in the eastern Eagle quadrangle (Foster, 1976). These generally appear to be shallow-marine, carbonate-dominated rocks. In the Circle quadrangle, medium-gray, generally massive, locally recrystallized limestone is found in scattered outcrop belts between strands of the Tintina Fault System (Foster and others, 1983). It has yielded Early Devonian conodonts from several localities (Foster and others, 1983) and is thought to possibly correlate with the Tolovana Limestone (unit DSt). In the Tanana quadrangle, includes a number of units mapped by J.N. Dover (unpub. data, 1997) that consist of light- to medium-gray or tan, sandy, platy limestone, gray bioclastic limestone, and massively bedded silicified limestone and dolostone of Late Devonian (Famennian) age and the informally named limestone of Raven Ridge, which consists of gray micritic and brecciated limestone, also of Late Devonian(?) age. In the Kantishna River quadrangle, medium- to dark-gray limestone, in part dolomitic, and medium-gray shaly to phyllitic siltstone has yielded Late Devonian (Frasnian) corals from one locality (Chapman and others, 1975). On generalized map, included as part of unit DSsm.

This unit is [PZPClc](#) in the GRI digital geologic-GIS data.

PzPxyqm - Pelitic schist, including Chena River sequence (Devonian and older)

Medium- to high-grade pelitic schist that contains subordinate quartzite, quartz schist, calc-silicate rocks and calc-schist, marble, amphibolite, graphitic schist, and augen gneiss interlayers. Compared to unit PzPyqs, this unit contains less quartzite and quartz schist, more marble interlayers, and is of generally higher grade; however, it may have strong similarities in lithology, polymetamorphic history, and metamorphic grade with unit PzPyqs. The contact with PzPyqs was interpreted as a thrust fault by Foster and others (1983) in the Circle quadrangle and was also locally mapped as such by Smith and others (1994). In the Eagle quadrangle, unit is closely associated with metaplutonic rocks of unit M Dag, possibly as roof pendants to the original plutons. On generalized map, included as part of unit DPNSq.

This unit is [PZrm](#) and [PZPCps](#) in the GRI digital geologic-GIS data.

PzPxyqs - Quartzite and pelitic schist (Devonian and older)

Dominantly quartzite, schistose quartzite, and quartz-mica schist; also contains subordinate gritty quartzite, chlorite schist, calc-silicate schist, marble, magnetite-biotite schist, amphibolite, and greenstone. Ranges from amphibolite to upper greenschist facies and locally retrograded to lower greenschist facies (Nokleberg and others, 1992a; Smith and others, 1994). Corresponds, in part, to the Fairbanks schist of Newberry and others (1996) of the Fairbanks mining district and surrounding areas of the southeastern Livengood and northeastern Fairbanks quadrangles (Robinson and others, 1990; Weber and others, 1992; Newberry and others, 1996) as well as a large portion of the Circle quadrangle (Foster and others, 1983). Smaller areas of exposure occur in the southern Big Delta quadrangle (Weber and others, 1978) and in the Eagle quadrangle (Foster, 1976). In the Circle quadrangle and northern Big Delta quadrangle, small exposures of gray or greenish-gray marble and gray to cream-colored dolomitic marble are included in this unit; diopside is present locally, indicating amphibolite facies metamorphism. No age control exists for these carbonate rocks. On generalized map, included as part of unit DPsq.

This unit is [PZPCdm](#), [PZPCq](#), [PZPCqm](#), [PZPCcq](#), [PZPCqs](#), [PZPCbq](#), and [PCm](#) in the GRI digital geologic-GIS data.

PzPxybg - Biotite gneiss, marble, schist, quartzite, and amphibolite (Devonian or older)

Primarily exposed in the southeastern Eagle and northeastern Tanacross quadrangles, this unit is considered part of the Fortymile River assemblage (Werdon and others, 2001; Szumigala and others, 2002; Dusel-Bacon and others, 2006). Dominantly a metasedimentary unit, according to Foster (1992), the most common rock type is quartz-biotite gneiss. The unit also includes a component of amphibolite they interpreted as metamorphosed mafic volcanic rocks. Important metasedimentary components include quartzite, paragneiss, biotite and muscovite schist, and marble. As shown here, map unit includes the PzpCb of Foster (1976) and the Pzgn and Pzbg units of Foster (1992). Foster had included abundant orthogneiss in these units; more detailed mapping by Werdon and others (2001) and Szumigala and others (2002) separated the orthogneiss, which is here included in unit MDag. Werdon and others (2001) and Szumigala and others (2002) described these rocks as the amphibolite-facies units of the Fortymile River assemblage and subdivided them on lithologic grounds. Among their units is a mixed unit, (pMa of Werdon and others [2001] and Szumigala and others [2002]), that is dominantly amphibolite. Dusel-Bacon and Cooper (1999) reported that this amphibolite has arc chemistry. Rocks of this map unit that have metasedimentary origin contain small amounts of staurolite or kyanite (Werdon and others, 2001; Szumigala and others, 2002). Werdon and others (2001) describe a coarse-grained, mostly light-gray marble that Foster (1992) reports is abundant and found in layers, lenses, and pods, including some large masses 1 km² or more in area. The rocks were regionally metamorphosed to amphibolite facies under moderate- to high-pressure conditions (Dusel-Bacon and others, 1995). Locally, retrograde contact metamorphic effects are superimposed on the regional metamorphism (Foster, 1992). The ages of the protoliths are unknown, but a few poorly preserved echinoderm fragments (Foster, 1976) suggests that they are Paleozoic in age. U/Pb zircon dating of the associated metaigneous rocks yields Mississippian and Devonian ages, providing a minimum age for the metasedimentary rocks (Dusel-Bacon and others, 2006). The major regional metamorphism is believed to have occurred in Late Triassic to Early Jurassic time on the basis of incremental heating experiments (Cushing and others, 1984a, b; Foster and others, 1987; Hansen and others, 1991; Dusel-Bacon and others, 2002). On generalized map, included as part of unit DPga.

This unit is [PZPCbq](#) in the GRI digital geologic-GIS data.

Pzmys - Mafic schist and amphibolite (Devonian or older Paleozoic)

"Green, quartz-chlorite-carbonate schist, commonly having abundant plagioclase porphyroblasts. Associated with amphibolitic schist and minor marble, quartzite, and pelitic schist. Thought to represent metamorphosed mafic pyroclastic rocks interbedded with schists of unit PzPyqs" in the Circle quadrangle (Wilson and others, 1998; see also Foster and others, 1983). In the south-central Circle and adjacent Big Delta quadrangle unit varies from greenish-gray actinolitic greenschist to dark green, fine- to coarse-grained, schistose amphibolite of unit PzPyqm, which is interlayered or interlaminated with muscovite-feldspar-quartz felsite (Smith and others, 1994). In the southeast Big Delta quadrangle, unit is similarly composed of dark-green, fine- to medium-grained, strongly foliated, hornblende-biotite amphibolite gneiss associated with augen gneiss of unit MDag or interlayered with foliated, medium-grained, equigranular calc-silicate schist and, locally, quartzite of unit Jymi (Day and others, 2007). In the southeastern Eagle quadrangle, unit consists of moderately- to nonfoliated, fine- to medium-grained hornblende metagabbro and metadiabase (Werdon and others, 2001). Unit also contains a green and white, medium- to coarse-grained, slightly- to nonfoliated metaigneous rock that has pseudomorphs after clinopyroxene and plagioclase of fine-grained actinolite, chlorite, epidote,

clinozoisite, albite, and (or) sphene (Szumigala and others, 2002). On generalized map, included as part of unit DPga.

This unit is [PZPCms](#) in the GRI digital geologic-GIS data.

Dof - Ogilvie Formation (Middle to Lower Devonian)

Massive, medium-gray, bioclastic limestone contains coral- stromatoporoid buildups. Thickness ranges from 60 to 1,100 m (Clough and Blodgett, 1984, cited by Dover, 1992; see also Clough and Blodgett, 1987). Unit has a similar distribution to the shallow-marine carbonate rocks of unit DSld above, but its upper limit may be slightly older than DSld. Unit was originally defined in Yukon of Canada by Norris (1967) and "Consists of medium-brown to grey, fine-grained, in part skeletal and reefal, thin-bedded to massive, resistant, cliff-forming limestones generally weathering light grey. Scattered argillaceous material and silt and chert are present in some beds. Dolomite is present in the lower part of the formation in the Nahoni Range area and in some sections east of the Blackstone River." It contains a "moderately abundant fauna [that] includes sponges, stromatoporoids, tabulate corals, brachiopods, cephalopods, gastropods, pelecypods, goniatites, cricoconarids, ostracodes, trilobites, echinoderm fragments and conodonts" (Norris, 1967). Also included here is the Schwatka unit of Weber and others (1992), which consists of slightly recrystallized, dark-gray, sparsely fossiliferous, medium-bedded to massive lime mudstone or wackestone. Conodonts and two-holed crinoid ossicles constrain age to Emsian to Eifelian (Weber and others, 1992). Interfingers with volcanic rocks of unit Dvec. Weber and others (1992) interpreted the depositional environment as shallow marine. North of the Tintina Fault, the unit crops out in the Charley River quadrangle and in the Yukon; south of the Tintina Fault, it occurs in the Circle and Livengood quadrangles. On generalized map, included as part of unit DSsm.

This unit is [Dof](#) in the GRI digital geologic-GIS data.

DZkb - Older carbonate strata of the Porcupine River sequence of Brosge and Reiser (1969) and equivalent units (Middle Devonian to Neoproterozoic?)

Poorly known unit that consists of a thick sequence of limestone and dolostone and minor calcareous shale and black chert, located largely on the northeast side of the Yukon Flats basin. The only formally defined unit of the sequence is the Salmontrout Limestone (Churkin and Brabb, 1965; Oliver and others, 1975), a dark-gray, massive, biohermal limestone of Early or Middle Devonian age that is about 600 ft thick. Brosge and Reiser (1969) also included several other carbonate rock units in the Porcupine River sequence, which cover much of the southern part of the Coleen quadrangle and which likely extend into the northern Black River quadrangle. These consist of their unit Dd, about 300 m of dark-gray, fine- to medium-grained dolostone that contains minor black chert; light-gray limey dolostone and limestone; and yellow and gray very fine-grained laminated dolostone and chert that contains minor red and green shale and sandstone; as well as their unit SOCl, which is an interbedded gray, laminated-to-mottled limey dolostone and dark gray dolostone that contains minor black chert, light gray coarse-grained dolostone, and light- to dark-gray calcilutite. This subunit, SOCl, which includes light-gray coral and limestone cobble conglomerate, is at least 600 m thick and includes Silurian and Ordovician corals and snails and Cambrian(?) trilobites. Gray, foliated, thin-bedded, platy, and recrystallized micritic limestone of early(?) Paleozoic age in the Table Mountain quadrangle (C.G. Mull, written commun., 2012) was suggested by Mull to possibly be equivalent to the Ogilvie Formation of the adjacent Yukon (which is mapped here as unit Dof), but seems a better fit here. Other map units included here are (1) unit Pzl of Brosge and Reiser (1969), which consists about 120 m of black silty calcareous shale, black fine-grained, thin-bedded limestone, and brown siltstone which contain siltstone concretions and nodular cherty dolostone; (2) unit DCI of Brabb (1970) that consists mainly of massive limestone and dolostone several thousand feet thick, minor red and green argillite, and black chert that includes a few hundred feet of quartzite along Lower

Ramparts of Porcupine River; and (3) units DI and SI of Brabb (1970), which are medium-gray to grayish-black, fine- to coarse-grained, locally dolomitic, crinoidal limestone. The Amy Creek unit of Weber and others (1992) is tentatively included here, but it also bears some affinity with units on this map such as the Jones Ridge Limestone (OCjr) and possibly the Nanook Limestone (included in unit DZnl) and Katakturuk Dolomite (Pls) of northern Alaska. As defined by Weber and others (1992), the Amy Creek unit of inferred Silurian to Proterozoic age consists of light- to medium-gray, medium-grained; mudstone, wackestone, and packstone that all contain interbedded chert; black carbonaceous argillite; and dolostone. The Amy Creek unit contains interbedded and interlayered minor lime mudstone, light- and dark-gray chert, gray marble, gray, fine-grained quartzite, basaltic greenstone, lenses of tuff, tuffaceous siltstone, shale, and minor volcanoclastic graywacke. Basaltic flows and flow breccia at least 100 m thick occur locally in shaly rocks. Lithology and algae strongly resemble Proterozoic or early Paleozoic dolostone of the western part of the Charley River quadrangle. In the Circle quadrangle (Foster and others, 1983), the igneous part of the unit consists of dark-greenish- or bluish-gray, medium-fine-grained calcareous basalt that locally has well-developed pillows. Thin limestone layers at the base of the basalt. Upper units in basalt are amygdaloidal, overlain by greenish-brown breccia of calcareous basalt that has an opaline matrix. Black, moderately coarsely crystalline limestone overlies basaltic portion of unit. Much of this unit corresponds to unit DCpu of Till and others (2006a), who stated that "lithofacies and faunal data suggest that most of DCpu formed in a relatively shallow-water shelf or platform setting, but upper Silurian and Lower Devonian graptolitic shale, limestone, and chert in the Porcupine River area (Churkin and Brabb, 1967; Coleman, 1987) accumulated in a slope or basin environment and may correlate with the Road River Formation (Churkin and Brabb, 1965; Brabb and Churkin, 1969), which is included in unit DOka in the southern part of the province. Conodonts and megafossils in DCpu have chiefly Laurentian (North American) affinities (Oliver and others, 1975; Rohr and Blodgett, 1994; Dumoulin and others, 2002; Blodgett and others, 2002)." On generalized map, included as part of unit DZyf.

This unit is [PZbl](#) and [DSd](#) in the GRI digital geologic-GIS data.

PzPxmi - Mafic igneous rocks, central and northeast Alaska (early Paleozoic and/or late Proterozoic)

Unit consists primarily of gabbro and diabase sills(?) and serpentinite exposed in a linear belt in the Livengood and northwest Circle quadrangles. Gabbro and diabase are dark olive green and greenish-gray to dark greenish-black, medium- to coarse-grained, and very fine-grained on outer margins of sills; locally grades into diorite. These rocks are associated with greenstone and basalt, interbedded slate, siliceous shale, chert, and argillite of the Amy Creek unit of Weber and others (1992) (unit D_kb, here). Serpentinite is intruded by dikes of clinopyroxene gabbro, microgabbro, and diorite. Attempts to date these rocks have yielded ⁴⁰Ar/³⁹Ar (high temperature fraction) and K/Ar ages that range from 643 to 390 Ma (Weber and others, 1988, 1992; Reifenhuth and others, 1998a; Athey and others, 2004). Unit also includes very small outcrops of poorly known, dense, dark-grayish-green, chloritized, locally schistose dikes and sills reported by (Reiser and others, 1980) in the Demarcation Point quadrangle, whose occurrence is restricted to within the Cambrian phyllite unit (included in CPwn, here). On generalized map, included as part of unit JZu.

This unit is: [PZd](#), [PZug](#), and [PZZm](#) in the GRI digital geologic-GIS data.

DOka - McCann Hill Chert, Road River Formation, and Troublesome unit of Weber and others (1992) (Lower Devonian to Ordovician)

McCann Hill Chert consists of "thin-bedded and laminated dark- to light-gray chert, siliceous shale, and minor chert gritstone. Contains plant fragments, poorly preserved spores, and rare conodonts, gastropods, and cephalopods. Basal part of formation has beds of dark-gray bioclastic limestone with remarkable varied fauna including corals, brachiopods, trilobites, tentaculitids, fish, and ostracodes of

Early Devonian (Emsian) age" (Brabb and Churkin, 1969). Thickness 200 to 800 feet except near Jones Ridge in the Charley River quadrangle, where the basal part of the McCann Hill Chert was placed in the Ogilvie Formation (Blodgett, 1978; Clough and Blodgett, 1984, 1987). Road River Formation consists of "dark-gray graptolitic shale with lesser amounts of grayish-black laminated chert and very minor dark-gray limestone, greenish-gray dolomite, chert arenite, and conglomerate. Chert, chert arenite, and chert conglomerate occur mainly in basal part of formation. Graptolites indicate that most series of Ordovician and Silurian are represented, and that the youngest rocks are Early Devonian (pre-Emsian). Thickness 400 to 900 feet" (Brabb and Churkin, 1969). The Troublesome unit of Weber and others (1992) consists of rhythmically interbedded dark-gray to black cherty argillite to chert, and thin beds of black to gray siliceous slate in the Livengood quadrangle. Associated with extensive mafic intrusive and extrusive rocks. Unidentified Radiolaria are the only reported fossils (Weber and others, 1992). Depositionally overlain by Frasnian carbonate buildups at base of Quail unit of Weber and others (1992), unit Dq here, hence Middle Devonian or older. As mapped here, also includes Pzc unit of Foster and others (1983) in the Circle quadrangle, which consists of chert interlayered with argillite, and rare marble and quartzite, intruded by diorite and gabbro (Foster and others, 1983). Radiolaria from unit Pzc are not age-diagnostic but are reported as "possibly of Mississippian age" (Foster and others, 1983); this constraint is, however, less compelling than the pre-Frasnian age for the Troublesome unit in its type area. On generalized map, included as part of unit DOsc.

This unit is: [PZca](#), [Dka](#), and [DSOr](#) in the GRI digital geologic-GIS data.

Oc - Chert of Interior Alaska (Ordovician)

Dark-gray and black banded chert, siliceous slate, argillite, and less abundant greenstone, and fine-grained, thin-bedded, impure limestone and dolostone. Beds separated by carbonaceous partings. Unit interpreted to be a deep-water sequence composed of turbiditic and hemipelagic deposits (Patton and others, 2009). Unit locally contains conodonts and graptolites of Early and Middle Ordovician age in the Medfra quadrangle (Patton and others, 2009) and in adjoining parts of the Denali quadrangle and has graptolites in the Livengood quadrangle occurrences (Weber and others, 1992). Includes the Livengood Dome Chert in the Livengood, Circle, and Tanana quadrangles (Foster and others, 1983; Weber and others, 1992; J.N. Dover, written commun., 1997), the Nilkoka Group in Fairbanks quadrangle (Péwé and others, 1966), and chert and slate in the Denali and Kantishna River quadrangles (unit Doc of Bela Csejtey, Jr., written commun., 1993; Chapman and others, 1975). Locally, also included is a distinctive marker bed of lime mudstone within the chert unit, locally characterized by coated ooids in the Tanana and Circle quadrangles (J.N. Dover, written commun., 1997). Thickness varies from 10 to several tens of meters, probably in part due to structural thickening and repetition. Unit exposed in two areas and assigned to three different terranes. The northern exposures of this unit are in the Circle, Livengood, and Tanana quadrangles between thrust splays associated with the Tintina Fault System and are typically considered part of the Livengood terrane (Dover, 1994). The southern exposures are in the Medfra, Ruby, Denali, and Kantishna quadrangles and are considered part of the Minchumina and Farewell terranes (Patton and others, 2009). Unit may correlate with part of the Road River Formation of eastern Alaska and Yukon. Unit is exposed near the Amy Creek unit of Weber and others (1992), included here in unit DIPkb.

This unit is [DSOdcn](#) and [PZPCld](#) in the GRI digital geologic-GIS data.

OCv - Fossil Creek Volcanics and similar rocks (Ordovician and Cambrian)

Unit includes the Fossil Creek Volcanics of east-central Alaska, which is divided into two members: one largely volcanic, one largely sedimentary. The volcanic member consists of alkali basalt, agglomerate, and volcanoclastic conglomerate. Agglomerate and conglomerate contain well-rounded clasts of basalt, granite, quartzite, limestone, chert, and phyllite. Sedimentary member consists of

shale, chert, and limestone and is intruded by gabbro. Late Ordovician brachiopods, trilobites, gastropods, and conodonts have been recovered from sedimentary rocks in the volcanic member (Blodgett and others, 1987); Early Ordovician conodonts and trilobites have been recovered from the sedimentary member (Weber and others, 1992). Unit occurs in the White Mountains stratigraphic belt of the Livengood, Circle, and Tanana quadrangles (Dover, 1994) and is laterally equivalent to the Livengood Dome Chert. In northeast Alaska, unit includes dark-grayish-green to greenish-black and brown mafic vesicular flows, basaltic tuffs, agglomerate(?), pebble- to cobble-sized volcanic conglomerate, calcareous volcanic wacke, tuffaceous limestone, and tuffaceous dolostone of Cambrian age (Reiser and others, 1980). Weathers dark-olive-brown and dark-gray, except the dolomitic facies, which weathers yellowish brown. Minor gray, dark-gray-weathering chert, chert conglomerate, and silicified chert breccia. Locally includes basaltic tuff and mafic intrusive rocks. Probably correlates with the upper part of the Marmot Formation and Dempster Volcanics of Yukon (Gordey and Makepeace, 2003). May be age and lithologically correlative with unit OCdv, which is found in the Doonerak Window of the Brooks Range.

This unit is [SOs](#) in the GRI digital geologic-GIS data.

OCjr - Jones Ridge Limestone and related units (Cambrian to Ordovician)

Map unit includes three formally defined formations in the Charley River and Black River quadrangles of eastern Alaska: the Jones Ridge Limestone, the Hillard Limestone, and the Funnel Creek Limestone. The Jones Ridge Limestone is about 915 m thick and is divided into two members; lower 610 m of the lower member is mainly very light-gray, massive, extensively silicified and commonly oolitic, pisolitic, or laminated limestone and dolostone. Upper 285 m of lower member is pale-yellowish-brown, very fine-grained, thin- to thick-bedded limestone. Upper member, about 18 m thick, is pale-yellowish-brown, thick-bedded, bioclastic limestone (Dover, 1992; Van Kooten and others, 1996). Hillard Limestone is very fine- to medium-grained, thick-bedded, pale-yellowish-brown, laminated limestone interbedded with limestone conglomerate and oolitic and sandy limestone (Dover, 1992). Funnel Creek Limestone consists of light-gray, fine- to medium-grained, extensively silicified and commonly oolitic, cliff-forming, laminated limestone and dolostone approximately 1,300 ft (400 m) thick (Brabb and Churkin, 1969). Unit is not fossiliferous, but age is considered Early Cambrian on the basis of stratigraphic position. Also included in map unit is dark-gray, fine-grained, medium- to thick-bedded, partly silicified limestone in the Demarcation Point quadrangle (Reiser and others, 1980). It contains minor dolostone, conglomeratic sandstone, and fossiliferous orange-weathering shaly limestone that has interlaminated calcareous sandstone as well as minor tuffaceous limestone and black bedded, locally conglomeratic chert (Reiser and others, 1980). Late Cambrian brachiopods and trilobites are reported from the unit (Reiser and others, 1980). This unit is associated with an argillite unit in eastern Alaska that is herein correlated with the Adams Argillite (unit Ca). In northeast Alaska, the limestone is also associated with much more extensive volcanic rock unit (unit Cv). No similar volcanic rock unit is known from east-central Alaska.

This unit is [OCjru](#), [OCh](#), and [Cf](#) in the GRI digital geologic-GIS data.

Ca - Adams Argillite (Cambrian)

Light-gray argillite, siltstone, and cross-laminated quartzite with an oolitic and sandy limestone near base of unit (Brabb and Churkin, 1969). Age control derives from worm(?) burrows in the quartzite, *Oldhamia* in the argillite and, in the limestone near the base of the unit, archaeocyathids and trilobites of Early Cambrian age (Brabb and Churkin, 1969). Unit thickness is 90 to 180 m. In Eagle quadrangle, correlative units (included in this map unit) include greenish-gray laminated quartzite that has interbeds of greenish-gray and dark-gray argillite and minor grayish-red argillite, siliceous shale, chert, and dark-gray sandy limestone (Foster, 1976). Unit includes type area of the Adams Argillite in the Charley River

quadrangle of east-central Alaska (Brabb and Churkin, 1969) as well as rocks that are apparently correlative in the Demarcation Point quadrangle of northeast Alaska (Reiser and others, 1980).

This unit is [Ca](#) and [PCq](#) in the GRI digital geologic-GIS data.

CPxwn - Wickersham and Neruokpuk units (Cambrian and Proterozoic)

Three widely distributed and similar units in east-central and northeast Alaska and Yukon are included here. Known locally as the Hyland Group in Yukon (see Gordey and Makepeace, 2003), the Neruokpuk Schist of Leffingwell (1919) (see, for example, Reiser and others 1980; Lane, 1991) or, in some sources, Neruokpuk Formation or Neruokpuk Quartzite in Alaska and Yukon, the Nilkoka Group (Péwé and others, 1966) in central Alaska, and the informal Wickersham unit in Alaska (Weber and others, 1992). The unit is distinctly characterized by the presence of maroon and green slate and grit; however, it is quite variable in lithology and metamorphic grade. It is a dominantly clastic sequence of poorly sorted quartzite, feldspathic quartzite, grit, calcareous siltstone and fine-grained sandstone, and subordinate dark limestone and chert, locally, that contains maroon and green (Cambrian) Oldhamia-bearing slate in its upper part. The lower part of the Wickersham has been described as a dominantly poorly sorted to bimodal quartzite, gritty quartzite, and granule conglomerate that characteristically contains sparse, single-crystal milky white to blue quartz granules ("eyes") in a slightly cherty quartzofeldspathic-wacke matrix (Weber and others, 1992). In central Alaska, unit typically consists of gray, maroon, and green slaty argillite interlayered with gray and greenish-gray grit and quartzite, phyllite, slate, minor limestone, and chert. Potassium or sodium feldspar grains are locally abundant, and rare argillite rip-up clasts have been reported (Foster and others, 1983; Weber and others, 1992). In northeast Alaska, the Neruokpuk Schist of Leffingwell (1919) (Reiser and others, 1980) can be described as undergoing a lithologic transition from south to north. Southern exposures consist of interbedded thin- to thick-bedded, resistant massive quartz wacke and semischist, subordinate phyllite and argillite, and rare calcareous sandstone. In northern exposures, unit is generally less metamorphosed and consists of mostly greenish to brownish gray and grayish black, fine- to coarse-grained quartz wacke that locally grades to sublitharenite and lithic graywacke and local granule grit conglomerate. Unit also includes siltstone of similar composition, as well as red, green, and black phyllitic slate and rare limy beds (Reiser and others, 1980). In both central and northeastern Alaska, Cambrian limestone and dolostone of similar description is present. In the Livengood quadrangle, the limestone is dense to very finely crystalline, nonfossiliferous, micaceous, sandy, or sparsely sandy. It contains monocrystalline, rounded to subrounded, matrix-supported quartz grains and is discontinuously thinly and horizontally bedded or platy to shaly (Weber and others, 1992). In the Demarcation Point quadrangle, the limestone is dark-gray to grayish-black, thick- to medium-bedded, and medium- to light-gray-weathering. It is, in part, pelletal, pisolitic, and recrystallized, and it commonly contains abundant floated rounded quartz grains. Locally it grades to coarse-grained calcareous sandstone and calcareous grit conglomerate that has a distinctive intricate net of white calcite veins (Reiser and others, 1980). Unit also includes red, green, and orange partly calcareous slate and argillite, quartzite, and greenstone of the Strangle Woman Creek sequence of Brosigé and Reiser (1969) in the Coleen quadrangle. The Strangle Woman Creek sequence also includes minor greenstone, which is included here. Rocks adjacent to the Coleen quadrangle outcrops, in Yukon, are the country rock to the Old Crow batholith (unit MDgi) and are described as "red, green and grey slaty argillite; fine grained, light grey quartzite; dolomite"; they have been tentatively assigned to the Pinguicula or Fifteen Mile units of Mesoproterozoic age (Gordey and Makepeace, 2003), which here is considered equivalent to the Wickersham or Neruokpuk units. In east-central Alaska, the Wickersham is exposed south of or within strands of the Tintina Fault System; north of the fault system in Yukon the Wickersham equivalent unit is the Hyland Group (Gordey and Makepeace, 2003). Unit also includes a very small area of mafic intrusive rocks in the Black River quadrangle that are possibly equivalent to Hart River Volcanics of the Yukon. On generalized map, included as part of unit CPwn.

This unit is [PZPCI](#), [PZPCag](#), [PZPCa](#), [PZPCgg](#), and [PZPCun](#) in the GRI digital geologic-GIS data.

CPxt - Tindir Group (Cambrian (?) and Proterozoic)

The Tindir Group is commonly divided into upper and lower parts (see Young, 1982; MacDonald and others, 2010). The lower Tindir Group is as much as 2 km thick and divided into several informal units. As the base of the lowest unit is nowhere exposed, true thickness is unknown. The lower shale unit is gray to black mudstone overlain by light-gray quartzite that contains discontinuous stromatolite bioherms. The lower shale is unconformably overlain by a lower dolostone unit (Van Kooten and others, 1996), which is less than 350 m thick and is dominated by branching to massive domal stromatolites. An upper shale unit consists of less than 500 m of fissile black shale with interbedded quartzite and carbonate beds. The uppermost unit of the lower Tindir Group, an upper dolostone, consists of yellow-weathering dolostone that has intraclast breccia, black chert nodules, shale interbeds, and molar tooth structures (Young, 1982). All units in the lower Tindir Group are intruded by north-northwest-trending mafic dikes. Young (1982) separated the upper Tindir Group into five informal units. Unit 1 is "as much as 200 m of green and gray, commonly amygdaloidal pillow basalts and locally cupriferous tuffs and volcanic breccias" (Young, 1982) and minor tuff, shale, sandstone, and conglomerate. Young (1982) described unit 2 as purple mudstone and minor gray and green mudstone and siltstone, as well as thin beds (less than 50 cm) of purple diamictite and graded purple and gray sandstone in a generally coarsening-upward sequence that varies from less than 200 m to more than 700 m thick. Iron formation is locally present near the top of unit 2; elsewhere unit is capped by an orange-weathering diamictite that has a dolomite-rich matrix. Unit 3 of Young (1982) "is composed mainly of crudely stratified purple and red diamictite with much thinner interbeds of purple mudstone and red and orange beds and lenses of chert," which MacDonald and others (2010) divided into two parts: a lower planar-laminated siltstone and sandstone more 100 m thick that contains minor dolomite marl, and an upper massive diamictite that has clasts as large as boulders. Young's (1982) unit 4, as thick as 600 m, is highly lithologically variable, generally it consists primarily (about 70 percent of unit) of gray and green shale, which is interbedded with turbiditic dolomitic sandstone, siltstone, and incidental amounts of gray diamictite and volcanic breccia. Locally, a fine-grained buff to gray, locally cherty dolostone constitutes the bulk of unit 4. Young's (1982) unit 5, the uppermost unit of the upper Tindir Group, is also highly lithologically laterally variable and is primarily described as gray wavy-bedded limestone and calcareous siltstone that has channels filled with granule to pebble conglomerate of largely limestone clasts. Structures indicating deposition by turbidites are common. Elsewhere, parts of the unit stratigraphically above the conglomeratic layers suggest deposition in a shallow-marine, tidally influenced(?) environment (Young, 1982). Locally, the unit is composed largely of dark-gray to black carbonaceous shale that contains minor quartz sandstone and slumped dolostone beds. In contrast to the lower Tindir Group, none of the upper Tindir Group exposures above unit 1 contain mafic intrusions (MacDonald and others, 2010). Age control is limited and open to interpretation. Allison (1981) thought the microfossils she examined from the upper Tindir Group to be of Cambrian age; Young (1982) seems to imply that a hiatus in deposition is likely present between the upper Tindir Group and overlying well dated late Early Cambrian units, making the Tindir Group entirely Proterozoic. Kaufman and others (1992), on the basis of geochemical evidence, interpreted the microbiota of the upper Tindir Group to be of late Riphean age (780 to 620 Ma, middle Neoproterozoic) and therefore also suggested that the Tindir Group is entirely of Proterozoic age. MacDonald and Cohen (2011) suggested abandoning the Tindir nomenclature and placing parts of the lower Tindir Group into the Pinguicula and Fifteen Mile groups, which form the Mackenzie Mountains Supergroup of Turner (2011), putting the uppermost part of the lower Tindir Group and lowermost unit of the upper Tindir Group into the Coates Lake Group of Eisbacher (1981) and placing the remaining parts of the upper Tindir Group into the Windermere Supergroup of Ross (1991). [For a proposal regarding the Canadian stratigraphic nomenclature relative to these units, see MacDonald and others (2011)].

This unit is [PCTsl](#), [PCTu](#), [PCT](#), [PCTd](#), [PCTs](#), [PCTlc](#), and [PCTl](#) in the GRI digital geologic-GIS data.

Pxtnm - Basalt and red beds member (Tindir Group) (Proterozoic)

Dark-greenish-gray basalt, commonly amygdaloidal and displaying pillow structures; unit ranges from 90 m to at least 750 m thick in the Charley River and Eagle quadrangles. Feldspar and pyroxene are mainly unaltered but, at a few localities, are chloritized and rock is greenstone. Minor basaltic tuff contains pebbles and cobbles of basalt. Red beds mostly grayish-red shale and siliceous shale. Minor greenish-gray shale and siliceous shale, jasper, greenstone-dolostone conglomerate, hematitic doloarenite, vitric tuff, and some occurrences of basalt have been largely replaced by hematite and carbonate (Brabb and Churkin, 1969). Similar rocks are also found in the Mount Michelson (Robinson and others, 1989) and Demarcation Point quadrangles (Reiser and others, 1980). On generalized map, included as part of unit Pv.

This unit is [PCTb](#) in the GRI digital geologic-GIS data.

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

No description.

This unit is [bu](#) in the GRI digital geologic-GIS data.

Ancillary Source Map Information

The following sections present ancillary source map information associated with sources used for this project.

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 source GIS data were retained in the GRI digital geologic-GIS data to provide users with the ability to relate back to the USGS source 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 source GIS data files.

BD002 Weber, F.R., Foster, H.L., Keith, T.E.C., and Dusel-Bacon, Cynthia, 1978, Preliminary geologic map of the Big Delta quadrangle, Alaska: U.S. Geological Survey Open-File Report 78-529A, scale 1:250,000.

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BD004 Smith, T.E., Robinson, M.S., Weber, F.R., Waythomas, C.W., and Reifensstuhl, R.R., 1994, Geologic map of the Upper Chena River area, eastern interior Alaska: Alaska Division of Geological and Geophysical Surveys Professional Report 115, 1 sheet, scale 1:63,360, pamphlet, 19 p.

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- CY002 Dover, J.H., and Miyaoka, R.T., 1988, Reinterpreted geologic map and fossil data, Charley River quadrangle, east-central, Alaska: U.S. Geological Survey Miscellaneous Field Studies Map MF-2004, 2 sheets, scale 1:250,000.
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- CY005 Van Kooten, G.K., Watts, A.B., Coogan, James, Mount, V.S., Swenson, R.F., Daggett, P.H., Clough, J.G., Roberts, C.T., and Bergman, S.C., 1996, Geologic investigations of the Kandik area, Alaska, and adjacent Yukon Territory, Canada: Alaska Division of Geological and Geophysical Surveys Report of Investigations 96-6a, 3 sheets, scale 1:125,000.
- CY007 Foster, H.L., 1992, Geologic map of the eastern Yukon-Tanana region, Alaska: U.S. Geological Survey Open-File Report 92-313, 26 p., 1 plate, scale 1:500,000.
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Geologic Map of Alaska

The formal citation for this source.

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*).

Prominent text and web links associated with this source.

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 four 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, 1' x 3' Big Delta Quadrangle

The formal citation for this source.

Rombach, C. 1999, Alaska Resource Data File, Big Delta Quadrangle, Alaska: U.S. Geological Survey: Open-File Report OF-99-354, scale 1:250,000 (*GRI Source Map ID 3040*).

Prominent graphics and text associated with this source.

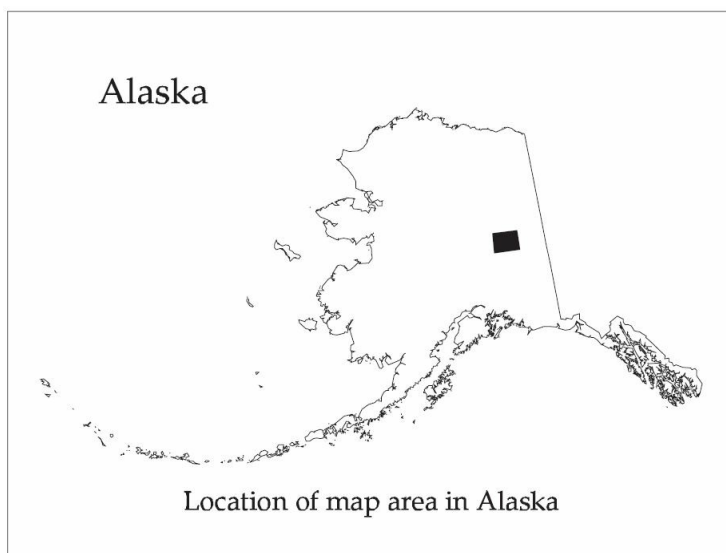
Report

The Alaska Resource Data File (ARDF) report for the Big Delta Quadrangle, Alaska (OF-99-354) is available for download at the following link: [Report PDF](#).

Data

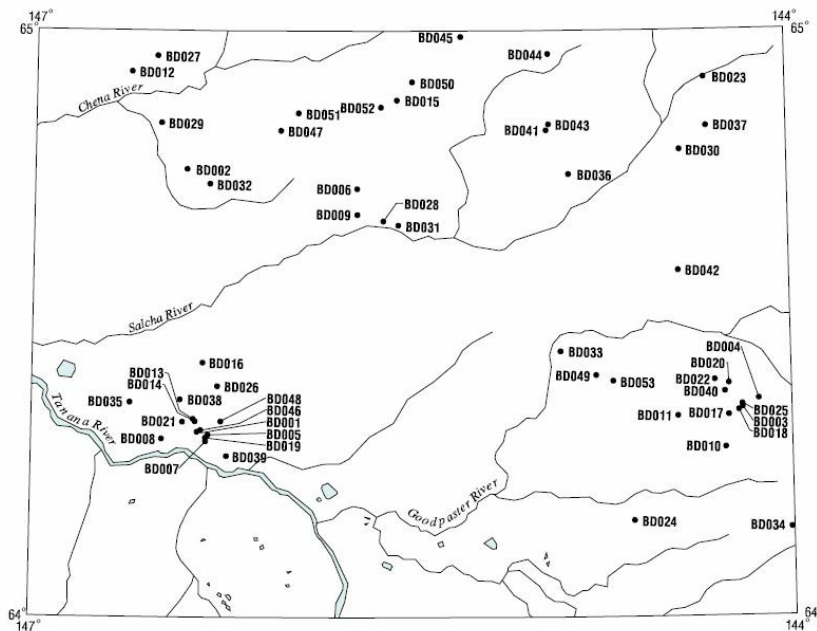
The Alaska Resource Data File (ARDF) data for the Big Delta Quadrangle, Alaska (OF-99-354) are available for download at the following link: [Data](#).

Index Map



Graphic from source map: [ARDF, 1' x 3' Big Delta Quadrangle](#)

Mineral Occurrence Map



*Distribution of mineral occurrences in the Big Delta
1:250,000-scale quadrangle, Alaska*

Graphic from source map: [ARDF, 1' x 3' Big Delta Quadrangle](#)

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ARDF, 1' x 3' Charley River Quadrangle

The formal citation for this source.

Cameron, C.E., 2000, Alaska Resource Data File, Charley River Quadrangle, Alaska: U.S. Geological Survey, Open-File Report OF-2000-290, scale 1:250,000 (*GRI Source Map ID 3033*).

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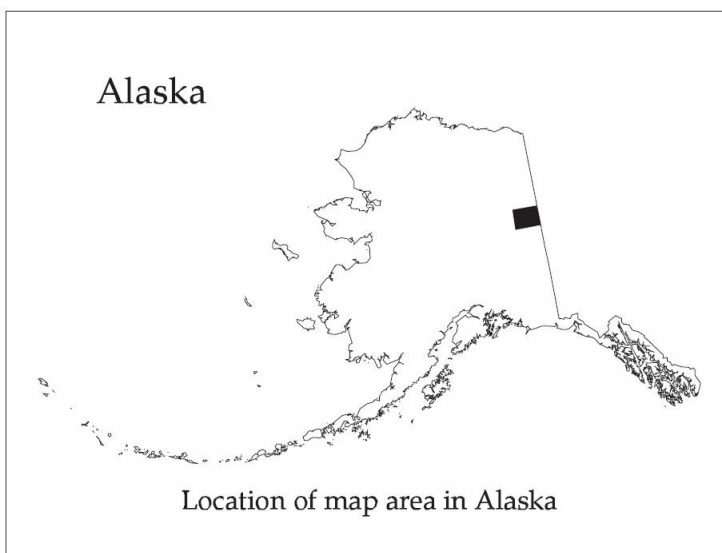
Report

The Alaska Resource Data File (ARDF) report for the Charley River Quadrangle, Alaska (OF-2000-290) is available for download at the following link: [Report PDF](#).

Data

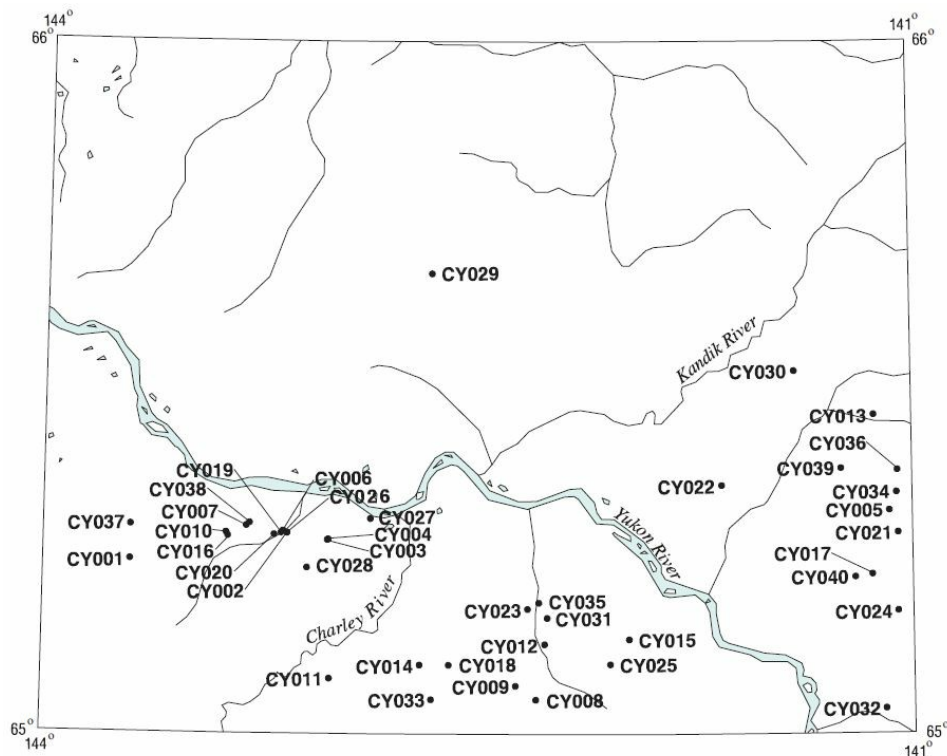
The Alaska Resource Data File (ARDF) data for the Charley River Quadrangle, Alaska (OF-2000-290) are available for download at the following link: [Data](#).

Index Map



Graphic from source map: [ARDF, 1' x 3' Charley River Quadrangle](#)

Mineral Occurrence Map



*Distribution of mineral occurrences in the Charley River
1:250,000-scale quadrangle, Alaska*

Graphic from source map: [ARDF, 1' x 3' Charley River Quadrangle](#)

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ARDF, 1' x 3' Circle Quadrangle

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Prominent graphics and text associated with this source.

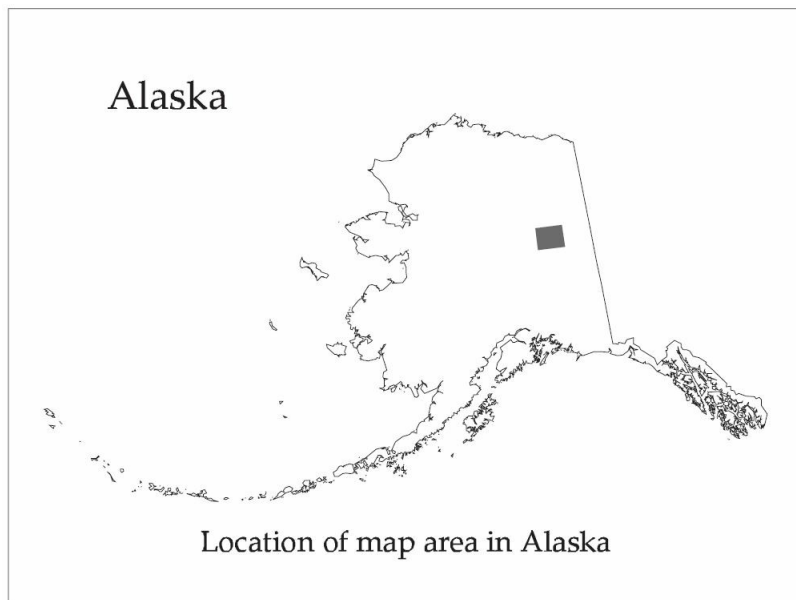
Report

The Alaska Resource Data File (ARDF) report for the Circle Quadrangle, Alaska (OF-98-783) is available for download at the following link: [Report PDF](#).

Data

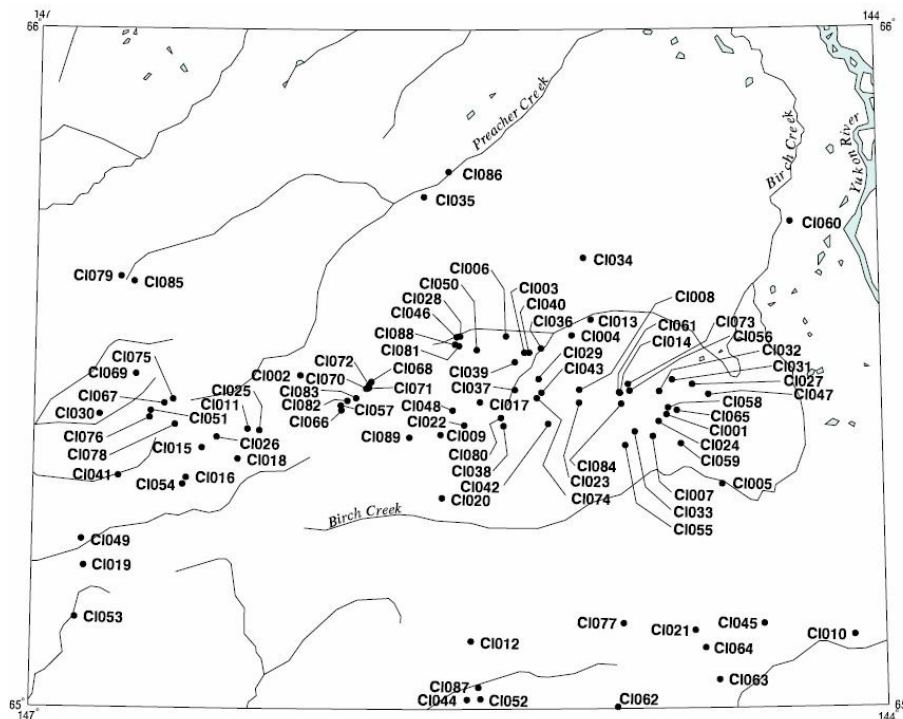
The Alaska Resource Data File (ARDF) data for the Circle Quadrangle, Alaska (OF-98-783) are available for download at the following link: [Data](#).

Index Map



Graphic from source map: [ARDF, 1' x 3' Circle Quadrangle](#)

Mineral Occurrence Map



*Distribution of mineral occurrences in the
Circle 1:250,000-scale quadrangle, Alaska*

Graphic from source map: [ARDF, 1' x 3' Circle Quadrangle](#)

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ARDF, 1' x 3' Eagle Quadrangle

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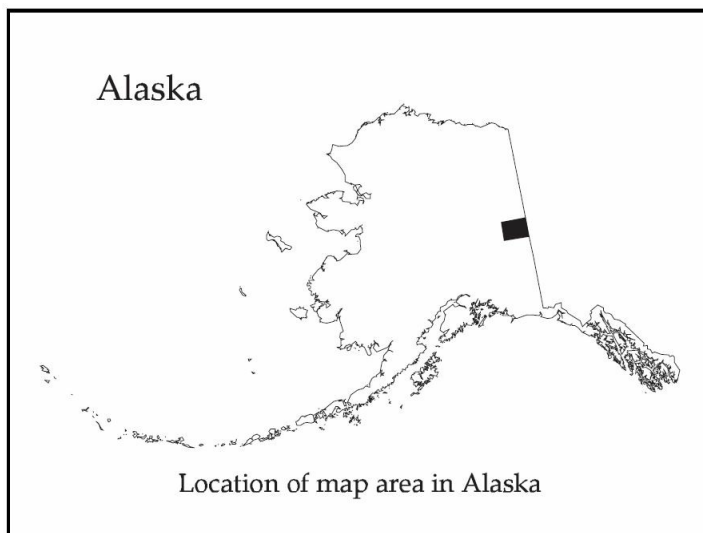
Report

The Alaska Resource Data File (ARDF) report for the Eagle Quadrangle, Alaska (OF-2004-1056) is available for download at the following link: [Report PDF](#).

Data

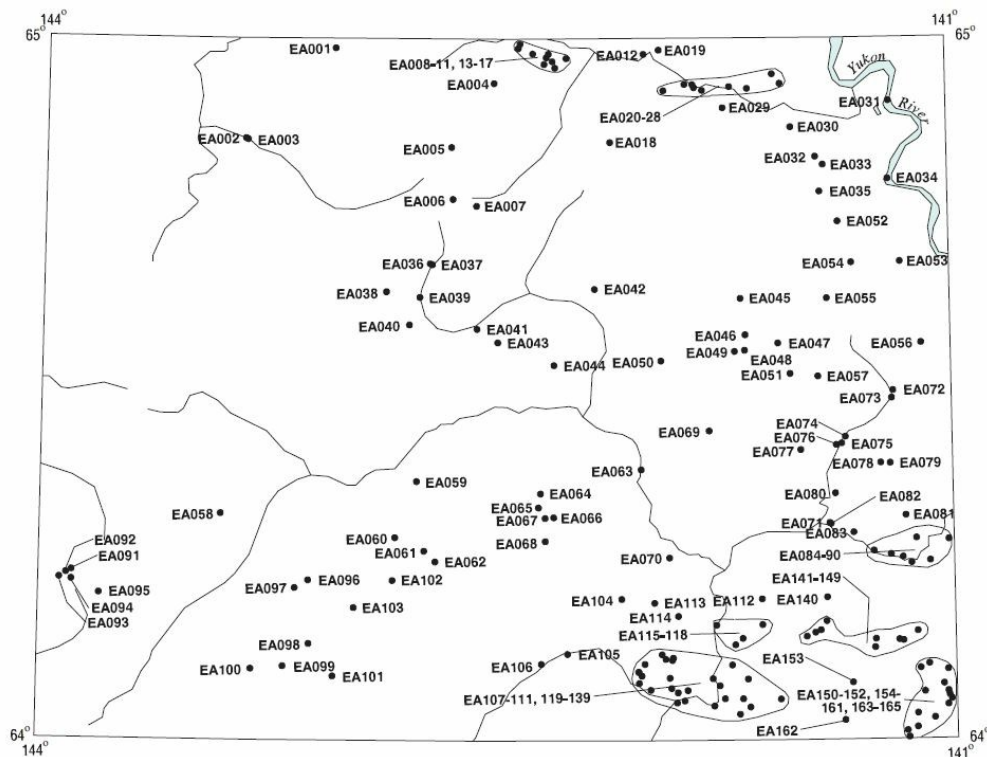
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Index Map



Graphic from source map: ([ARDF, 1' x 3' Eagle Quadrangle](#)

Mineral Occurrence Map



*Distribution of mineral occurrences in the Eagle
1:250,000-scale quadrangle, Alaska*

Graphic from source map: [ARDF, 1' x 3' Eagle Quadrangle](#)

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References from source map: [ARDF, 1' x 3' Eagle Quadrangle](#)

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Data

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