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

Klondike Gold Rush National Historical Park

GRI Ancillary Map Information Document

Produced to accompany the Geologic Resources Inventory (GRI) Digital Geologic Data for Klondike Gold Rush National Historical Park

klgo_geology.pdf

Version: 7/9/2021

Geologic Resources Inventory Map Document for Klondike Gold Rush National Historical Park

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Geologic Resources Inventory Map Document

Klondike Gold Rush National Historical Park, Alaska

Document to Accompany Digital Geologic-GIS Data

klgo_geology.pdf

Version: 7/9/2021

This document has been developed to accompany the digital geologic-GIS data developed by the Geologic Resources Inventory (GRI) program for Klondike Gold Rush National Historical Park, Alaska (KLGO).

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 Citations** – A listing of all GRI digital geologic-GIS maps produced for this project along with sources used in their completion. In addition, a brief explanation of how each source map was used is provided.

3) **Map Unit List** – A listing of all geologic map units present on maps for this project, generally listed from youngest to oldest.

4) **Map Unit Descriptions** – Descriptions for all geologic map units. If a unit is present on multiple source maps the unit is listed with its source geologic unit symbol, unit name and unit age followed by the unit's description for each source map.

5) **Ancillary Source Map Information** – Additional source map information presented by source map. For each source map this may include an index map, map legend, and/or map notes.

6) **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:

Stephanie O'Meara
Geologist/GIS Specialist/Data Manager
Colorado State University Research Associate, Cooperator to the National Park Service
Fort Collins, CO 80523
phone: (970) 491-6655
email: stephanie_o'meara@partner.nps.gov

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:

Jason Kenworthy
Inventory Coordinator
National Park Service Geologic Resources Division
P.O. Box 25287
Denver, CO 80225-0287
phone: (303) 987-6923
fax: (303) 987-6792
email: Jason_Kenworthy@nps.gov

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 Klondike Gold Rush National Historical Park, Alaska (KLGO):

Digital Geologic-GIS Map of Klondike Gold Rush National Historical Park and Vicinity, Alaska (*GRI MapCode KLGO*)

GIS data was converted to the NPS GRI digital geologic-GIS geodatabase data model (v. 2.3) from U.S. Geological Survey Scientific Investigations Map SIM-3340. For geologic units the USGS NSAClass field and its values were preserved, and for surficial units used to divide the unit into more detailed sub-units. The extent of the data converted includes a portion of one 1 degree x 3 degree quadrangle, the Skagway 1' x 3' quadrangle, that covers Klondike Gold Rush National Historical Park.

> 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 (Geologic Map of Alaska). (*GRI Source Map ID 76064*).

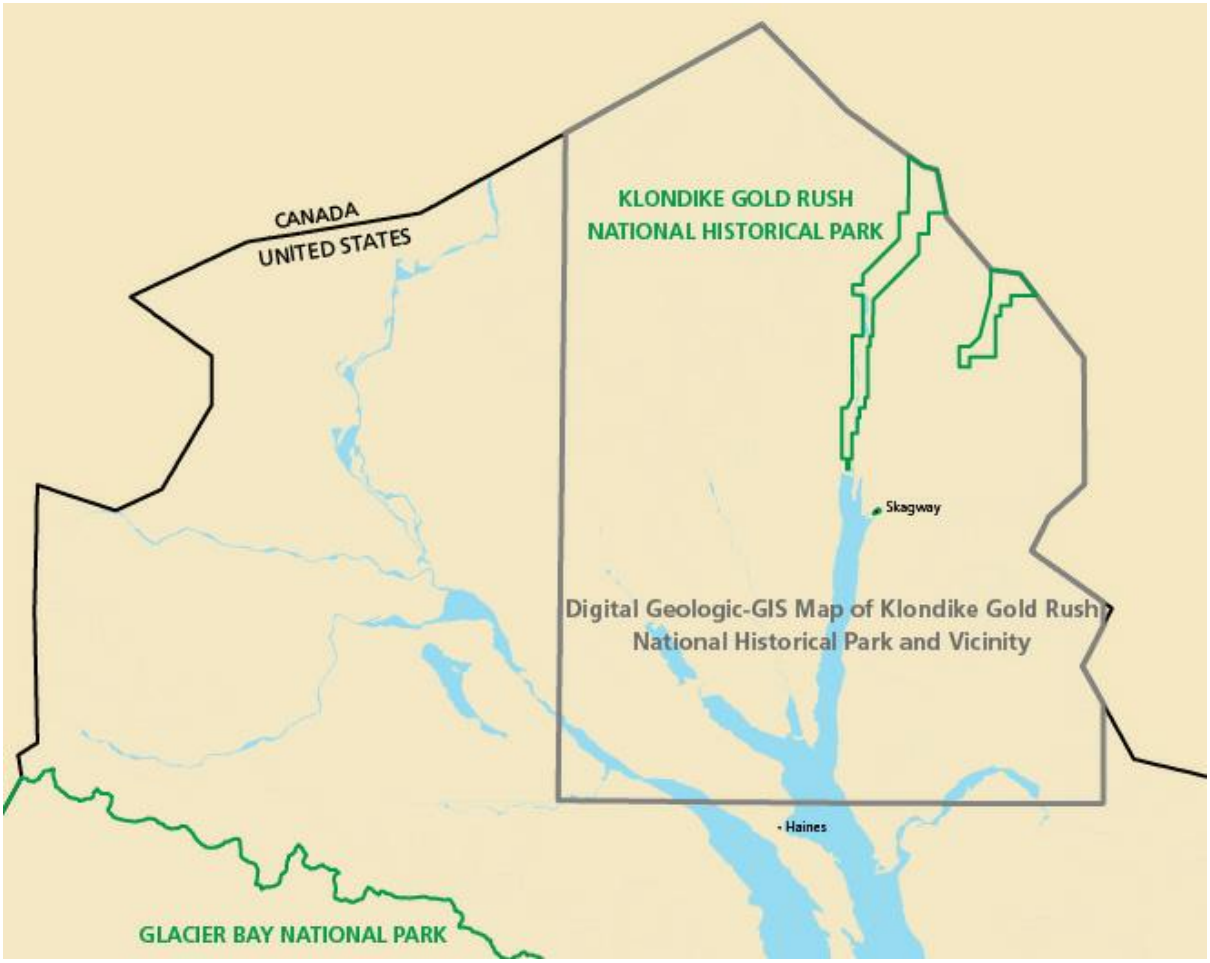
Digital data for a portion of one Alaska Resource Data File (ARDF) report were converted and are also represented in the GRI digital geologic-GIS data. The source is listed below.

> Crafford, T.C., 2001, Alaska Resource Data File, Skagway Quadrangle: U.S. Geological Survey, Open-File Report OF-2001-193, 1:250,000 scale (ARDF, 1' x 3' Skagway Quadrangle). (*GRI Source Map ID 2605*).

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

Index Map

The following index map displays the extent (outlined in gray) of the GRI digital geologic-GIS map produced for Klondike Gold Rush National Historical Park (KLGO). The boundary for the three Alaska units (Skagway Historic District, the White Pass Trail, and the Chilkoot Trail/Dyea Townsite) of Klondike Gold Rush National Historical Park are outlined in green, as is the nearby boundary of Glacier Bay National Park (all as of June 2021).



Index map by Ron Karpilo (Colorado State University).

Map Unit List

The geologic units present in the digital geologic-GIS data produced for Klondike Gold Rush National Historical Park, Alaska (KLGO) are listed below. Units are listed with their assigned unit symbol and unit name (e.g., Qs - Unconsolidated surficial deposits, undivided). Units are 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 (KLGOUNIT) table included with the GRI geology-GIS data.

Cenozoic Era

Quaternary Period
g - Glaciers
Qs - Unconsolidated surficial deposits, undivided
Qa - Alluvium
Qaf - Alluvial fan and talus deposits
Qc - Colluvium
Qrg - Rock glacier deposits
Qhg - Neoglacial drift

Tertiary Period
Tmi - Younger granitic rocks
Tod - Granodiorite, quartz diorite, and diorite
Tcp - Younger phase, Coast plutonic complex of Brew and Morrell (1979b)
Tcpp - Porphyritic granodiorite phase of Coast plutonic complex of Brew and Morrell (1979b)

Cenozoic and Mesozoic Eras

Tertiary Period and Cretaceous Period
TKg - Felsic granitic rocks
TKts - Foliated tonalite sill of Coast plutonic complex of Brew and Morrell (1979b)

Mesozoic Era

Cretaceous Period
Kmgr - Granitic rocks of central and southeast Alaska
Kmqm - Quartz monzonite, monzonite, and syenite
Keg - Granodiorite and other plutonic rocks
Kgb - Gabbro and diorite of southeast Alaska
Kum - Ultramafic rocks of southeast Alaska

Triassic Period
TRb - Mafic volcanic rocks of Chilkat Peninsula

Paleozoic Era

PZgn - Roof pendants of the Coast plutonic complex of Brew and Morrell (1979b)

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. SK003) 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.

g - Glaciers (Holocene)

No additional description provided on source map.

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. Description from source map: Geologic Map of Alaska

Qs - Undivided alluvial and colluvial deposits (Quaternary)
Undivided alluvial and colluvial deposits. Description from source map: SK003

Qu - Quaternary deposits (Quaternary)
Undifferentiated unconsolidated surficial deposits. Description from source map: SK008

Qs - Surficial undivided (Quaternary)
Poorly sorted to well-sorted, massive, lenticular, and laminated clay, silt, sand, gravel, and boulders locally cover bedrock, sometimes to depths of many meters. Sediments represent tidal mudflat, alluvial, colluvial, and glacial deposits, undivided. Glacial outwash deposits, peat, and unsorted till locally overlie, underlie, or include thin layers of volcanic ash and lapilli tuff. Description from source map: SK021

Qa - Alluvium (Quaternary)

Alluvial deposits, undifferentiated. Description from source maps: SK005 and SK007

Unit compiled into Qs on Geologic Map of Alaska.

Qaf - Alluvial fan and talus deposits (Quaternary)

Qaf - Alluvial Fan (Quaternary)
Alluvial fan deposits. Description from source map: SK006

Unit compiled into Qs on Geologic Map of Alaska.

Qc - Colluvium (Quaternary)

Qct - Talus (Quaternary)
Talus and colluvial deposits. Description from source map: SK005

Unit compiled into Qs on Geologic Map of Alaska.

Qrg - Rock glacier deposits (Quaternary)

No additional description provided on source map. Unit present on source map: SK005

Unit compiled into Qs on Geologic Map of Alaska.

Qhg - Neoglacial drift (Quaternary)

Qd - Drift (Quaternary)
Glacial deposits, undifferentiated. Description from source maps: SK005 and SK007

Unit compiled into Qs on Geologic Map of Alaska.

Tmi - Younger granitic rocks (Tertiary, Miocene to Pliocene)

Medium- to coarse-grained, equigranular, granodiorite to quartz diorite plutons and stocks that have hornblende, biotite, and pyroxene as mafic minerals typically surrounded by well-developed hornfels zones and sporadic hydrothermal alteration in country rocks. Includes finer grained plutons and phases. Along the Alaska Peninsula and Aleutian Islands, plutons are typically located along Pacific coast and include, but are not limited to, large plutons on Unalaska Island at Captains Bay, and at Moss Cape on the southern Alaska Peninsula, American Bay, Mitrofania Island, Devils Bay (Devils batholith, Detterman and others, 1981), Agripina Bay, Cape Igvak, and Cape Douglas (Wilson and others, 1999, 2015). In the McCarthy quadrangle of east-central Alaska, includes fine- to medium-grained hypidiomorphic granular rocks of granodiorite, subordinate granite, and local dioritic or gabbroic border zones (MacKevett, 1978; Richter and others, 2006). In southern southeast Alaska, includes a suite of alkalic granite largely in the Petersburg quadrangle, plutons of varying composition in the Petersburg, Bradfield Canal, Ketchikan, Craig, and Port Alexander quadrangles (Eberlein and others, 1983; Brew and others, 1984; Koch and Berg, 1996; Karl and others, 1999), and small, undated plugs of leucocratic, medium-grained quartz monzonite in the Skagway quadrangle (Redman and others, 1984). Radiometric ages range from about 23.5 Ma to as young as 2.1 Ma (Carr and others, 1970; Marlow and others, 1973; Citron and others, 1980; Wilson and others, 1981; Douglas and others, 1989; Wilson and Shew, 1992). Description from source map: Geologic Map of Alaska

Tlqm - Leucocratic quartz monzonite (Tertiary)
Small plugs of leucocratic quartz monzonite, medium-grained, color index 3 or less. Average composition is 25% quartz, 30% K-feldspar, and 45% plagioclase. Contains biotite and red garnets in dikes. Scattered miarolitic cavities. Intrudes Mount Kashagnak granodiorite; Tlqm contains K-feldspar phenocrysts to 2 cm and doubly terminated beta quartz crystals near contact. Description from source map: SK003

Tod - Granodiorite, quartz diorite, and diorite (Tertiary, Oligocene and late Eocene)

Compositionally variable suite of medium- to coarse-grained, grayish-white, mafic granitic rocks exposed along the southern coastal region of the state. Unit occurs as far west as the Seguam quadrangle to as far east as the Ketchikan quadrangle and as far north as the McCarthy quadrangle. Commonly granodiorite and quartz diorite; also includes diorite and tonalite. Along the west side of Cook Inlet, the plutons are considered part of the Tertiary phase of the Alaska-Aleutian Range batholith of Reed and Lanphere (1969, 1972) and tend to be exposed along its western margin. On the Alaska Peninsula, these plutons are associated with the Meshik magmatic arc and, in the Aleutian Islands, with the “Lower Series” magmatic rocks of Vallier and others (1994). In the eastern Gulf of Alaska area and northern southeast Alaska, associations are not as readily apparent; plutons of this age and composition intrude a variety of terranes. Potassium-argon ages for these plutons range from about 39 to 25 Ma. Hornblende diorite in the Skagway quadrangle is undated but may be Oligocene in age (Gilbert and others, 1987). On generalized map, included as part of unit Toeg. Description from source map: Geologic Map of Alaska

Tqgv - Quartz diorite and granodiorite (Tertiary)
Cataclastic hornblende-biotite quartz diorite and granodiorite. Medium-grained, subhedral, color index 20. Takhin block. Large andesitic roof pendants are andesitic, massive, usually porphyritic, gray-green. Description from source map: SK003

Tcp - Younger phase, Coast plutonic complex of Brew and Morrell (1979b) (Tertiary, Eocene)

Consists of biotite-dominant, hornblende- and sphene-bearing granodiorite and subordinate quartz monzonite, quartz diorite, and leucogranite found in Coast Mountains of southeast Alaska (Berg and others, 1978, 1988; Elliott and Koch, 1981; Brew and others, 1984; Webster, 1984; Brew and Grybeck, 1984; Brew and Ford, 1977, 1985; Souther and others, 1979; Redman and others, 1984; Barker and others, 1986, Gehrels and Berg, 1992, Karl and others, 1999; Brew and Friedman, 2002). These plutons are found in a belt adjacent to the international border along the east side of southeast Alaska. Associated is migmatite that consists of schist, gneiss, tonalite, and granodiorite that is invaded by the plutonic rocks of this unit. The migmatite includes stockwork agmatite and banded hornblende gneiss and biotite-hornblende gneiss, amphibolite, biotite quartz schist, and some calc-silicate rocks (Brew and Grybeck, 1984; Koch and Berg, 1996). Radiometric ages vary; K/Ar ages on biotite and hornblende yield both concordant and discordant Eocene ages, whereas U/Pb analyses (Barker and others, 1986; Alldrick and others, 1987; Berg and others, 1988) yield Eocene ages. Age determinations primarily reflect timing of intrusions; the original country rock many have been significantly older. On generalized map, included as part of unit TKcp. Description from source map: Geologic Map of Alaska

Tegd - Granite and granodiorite (Tertiary to Eocene)
Sphene-hornblende-biotite granodiorite and granite. Color index 5-20 Coast Mountains. In Atlin area, includes fine- to medium-grained brownish gray weathering, garnet-muscovite-biotite granite, CI about 5 of the White Pass plutonic suite. Locally K-feldspar porphyritic, massive to weakly foliated. In Juneau area, homogeneous, nonfoliated to poorly foliated; medium to coarse grained; color index 6 to 25; light gray to buff fresh, weathers darker gray; euhedral sphene crystals (to 4 mm) common; biotite locally dominant over hornblende; varies to quartz monzonite; minor biotite alaskite and magnetite; petrographic features include slightly inequigranular, hypidiomorphic granular texture; zoned (An40-An25) subhedral plagioclase. In Ketchikan area, Consists mainly of massive to weakly foliated granodiorite and quartz monzonite; the map unit also encompasses outcrops of paragneiss, dikes, and other intrusive rocks too small to show on the map. Typical specimens are medium grained and hypidiomorphic granular, and

their average mineral composition is plagioclase (45 percent), potassium feldspar (23 percent), quartz (22 percent), biotite (6 percent), and hornblende (4 percent); the most prominent accessory mineral is sphene, which occurs as golden yellow euhedra as large as 5 mm. Description from source map: SK021

Tcpp - Porphyritic granodiorite phase of Coast plutonic complex of Brew and Morrell (1979b) (Tertiary, Eocene)

Consists mainly of weakly foliated to massive, medium-grained, hornblende-biotite granodiorite, and locally of foliated and gneissic granodiorite as well as distinctive porphyritic, coarse-grained, homogeneous, biotite-hornblende granodiorite that locally grades into quartz diorite and quartz monzonite; typically contains about 5 percent euhedral phenocrysts of potassium feldspar that are as large as 5 cm. Mafic minerals generally make up as much as 25 percent of this pluton. Intrudes foliated tonalite (unit TKts) and is intruded by leucocratic granodiorite (unit Tcp) (Berg and others, 1988; S.M. Karl, unpublished data). Includes associated pervasively intruded migmatite that consists of tonalitic to granodioritic gneiss and orthogneiss of diverse migmatitic fabrics; agmatitic metabasite and ultramafic rocks; quartzite; quartz-biotite schist and gneiss; and marble and irregularly banded calc-silicate rocks. The age of the migmatite primarily reflects timing of intrusions, and original country rock many have been significantly older. In the western part of the unit, in the Ketchikan and Prince Rupert quadrangles, part of this unit may more properly be associated with the tonalite sill (unit TKts). Radiometric ages vary; K/Ar ages on biotite and hornblende are early Eocene and commonly discordant (Smith and Diggles, 1981; Berg and others, 1988; Douglass and others, 1989), whereas U/Pb analyses (Berg and others, 1988; Gehrels and others, 1991), largely multigrain analyses, yielded Eocene and latest Cretaceous discordant ages. Description from source map: Geologic Map of Alaska

Tbgd - Euhedral biotite granodiorite of the Burro Creek pluton (Tertiary)
Granodiorite, medium-grained, subhedral, seriate, with hexagonal books of biotite, euhedral hornblende, and a color index of about 15. Quartz ranges from 15-20%, K-feldspar up to 10%. Intrudes Ferebee pluton and migmatite unit. Description from source map: SK003

Tbqm - Biotite quartz monzonite of the Burro Creek pluton (Tertiary)
Biotite quartz monzonite, fine-grained, subhedral, with 10-15% biotite, 15-20% quartz, and 10-30% K feldspar. Poikilitic plagioclase to 1.5 cm. Intrudes Ferebee pluton and migmatite; gradational to euhedral biotite granodiorite. Description from source map: SK003

Tgdp - K-feldspar porphyritic granodiorite (Tertiary to Eocene)
Locally porphyritic; unfoliated to foliated; medium-grained granodiorite in the Coast Mountains. Color Index 4 to 25; gray to buff fresh, weathers to medium gray; with rare mafic inclusions; petrographic features include slightly inequigranular, hypidiomorphic granular texture; biotite more abundant than hornblende; as much as 20 percent euhedral to subhedral K-spar phenocrysts locally as long as 6 cm. Intrudes Coast plutonic-metamorphic complex rocks as sill-like bodies. In Atlin area, includes homogeneous, nonfoliated to poorly foliated; medium to coarse grained granodiorite of the Skagway-Sloko plutonic suite; color index 6 to 25; light gray to buff fresh, weathers darker gray; euhedral sphene crystals (to 4 mm) common; biotite locally dominant over hornblende; varies to quartz monzonite; minor biotite alaskite and magnetite; petrographic features include slightly inequigranular, hypidiomorphic granular texture; zoned (An40-An25) subhedral plagioclase. In Skagway quadrangle, unit includes medium-grained, subhedral, seriate, granodiorite with hexagonal books of biotite, euhedral hornblende, and a color index of about 15. Quartz ranges from 15-20%, K-feldspar up to 10%. Intrudes Ferebee pluton and associated migmatite unit. In Petersburg quadrangle, gray to buff, foliated and banded, gneissic, fine- to medium-grained, biotite granodiorite and quartz monzonite; porphyritic, and characterized by K-feldspar phenocrysts to 3.5 cm. Locally contains garnet. Also includes granodiorite that is foliated, generally leucocratic, locally porphyritic and banded; medium-grained; light gray fresh,

weathers darker gray; with K-feldspar phenocrysts or porphyroblasts up to 3x5 cm, locally augen-like; locally containing inclusions of quartz and hornblende. Differs from other granodiorites by gneissic structure. In Ketchikan quadrangle, consists mainly of weakly foliated to massive, medium-grained, hornblende biotite granodiorite, and locally of foliated and gneissic granodiorite. Mafic minerals generally make up 15 to 25 percent of this pluton. Hornblende is predominant in its southern part; biotite generally equals or locally exceeds hornblende in most of its northern part. Sparse euhedral phenocrysts of potassium feldspar to 2 cm. Intrudes foliated tonalite (TKtg) and is intruded by leucocratic granodiorite (Tegd). Also includes Consists of porphyritic, coarse-grained, homogeneous, biotite hornblende granodiorite that locally grades into quartz diorite and quartz monzonite. It typically contains about 5 percent of euhedral phenocrysts of potassium feldspar as large as 5 cm. Approximate average composition of the pluton is plagioclase (50 percent), quartz (25 percent), potassium feldspar (15 percent), and mafic minerals (10 percent). Intrudes TKft; intruded by Tegd correlative bodies. Description from source map: SK021

MzPzgm - Gneiss and migmatite (Mesozoic and Paleozoic)
High-grade paragneiss, migmatite, and orthogneiss. Includes strongly deformed quartzofeldspathic gneiss, amphibolite, diopside-garnet marble, and strongly foliated orthogneiss that is probably derived from the Ferebee plutonic complex. Description from source map: SK008

Tgdpm - Migmatite (Tertiary to Eocene)
Migmatite consisting of schist, gneiss, and marble pervasively intruded by Eocene K-feldspar porphyritic granitic to tonalitic leucosomes in the Coast Mountains plutonic-metamorphic complex. Paleosomes include tonalitic to granodioritic gneiss and orthogneiss with diverse migmatitic fabrics, agmatitic metabasite and ultramafic rocks, quartzite, quartz-biotite schist and gneiss, marble and irregularly banded calc-silicate rocks. Locally paleosomes contain garnet and sillimanite. Description from source map: SK021

TKg - Felsic granitic rocks (Tertiary, 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 40Ar/39Ar 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 SiO2 contents, having as much as 6 percent K2O at 60 percent SiO2 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. Description from source map: Geologic Map of Alaska

Tgr - Clifford granite (Tertiary)
Pink to buff, medium- to fine-grained, equigranular biotite granite. Near margins includes xenoliths of fine-grained diorite, diabase, and biotite gneiss, and is intruded by pegmatite dikes. Description from source map: SK008

TKts - Foliated tonalite sill of Coast plutonic complex of Brew and Morrell (1979b) (Tertiary, Paleocene, and latest Cretaceous)

Homogeneous, well foliated, non-layered; locally lineated; medium- to coarse-grained, hornblende-dominant, biotite-bearing tonalite and subordinate quartz diorite found as steeply dipping, foliated, and locally lineated sills along the west side of the Coast plutonic complex of Brew and Morrell (1979b). Commonly referred to as “The Great Tonalite Sill” (see, for example, Brew and Grybeck, 1984 or Brew and Friedman, 2002). Gray on fresh surfaces and weathering darker gray, it has an average color index of 25, has equigranular to seriate texture, and locally contains hornblende phenocrysts up to 2 cm in length; some bodies have distinctive skeletal garnet. Inclusions and schlieren of dioritic composition are common; gneiss inclusions occur locally (Brew and Ford, 1985). Associated migmatite consists of intimately intermixed paragneiss and orthogneiss and has widespread lit-par-lit injection gneiss (Redman and others, 1984). Paleosomes include amphibolite, metamorphic grade hornblende and biotite schist and gneiss, calc-silicate gneiss, and granodioritic to dioritic meta-intrusive rocks (Karl and others, 1999). Field and U/Pb zircon data indicate emplacement in Late Cretaceous and Paleocene time, during waning stages of deformation and metamorphism in Coast Mountains (Gehrels and others, 1991; Brew and Ford, 1985). Radiometric ages vary; K/Ar ages on biotite and hornblende tend to be early Eocene and Paleocene and significantly discordant, whereas U/Pb analyses (Barker and others, 1986; Berg and others, 1988; Saleeby, 2000; Rubin and Saleeby, 2000), largely multigrain analyses, yielded Paleocene and latest Cretaceous discordant ages. On generalized map, included as part of unit TKtsp. Description from source map: Geologic Map of Alaska

TKfgd - Foliated hornblende granodiorite of the Ferebee pluton (Tertiary and Cretaceous)
Foliated hornblende-biotite granodiorite, with related hornblende diorite to biotite quartz monzonite. Medium-grained, subhedral seriate, color index 15-20, biotite usually more abundant than hornblende. Quartz 15-20%, K feldspar 5-15%. Magnetite is common, locally common sphene and zircon. Correlated with the tonalite sill plutons of the Coast plutonic complex. Description from source map: SK003

TKfgd - Ferebee plutonic complex (Tertiary and Cretaceous)
Multi-phase complex of medium-grained, anhedral, seriate hornblende-biotite granodiorite, with lesser tonalite, quartz diorite, and quartz monzodiorite. Weak to moderate foliation, strongly foliated near margins. Description from source map: SK008

TKtf - Foliated tonalite (Tertiary and Cretaceous)
In Skagway area, foliated hornblende-biotite granodiorite and tonalite, with related hornblende diorite to biotite quartz monzonite. Medium-grained, subhedral seriate, color index 15-20, biotite usually more abundant than hornblende. Quartz 15-20%, K feldspar 5-15%. Magnetite is common, locally common sphene and zircon. Correlated with the tonalitic plutons that form thick sills extending for at least 800 km along the west margin of the Coast Mountains plutonic metamorphic complex. In Juneau area, homogeneous, well foliated, non-layered; locally lineated; medium to coarse grained; color index averages 25, range 12 to 40; gray fresh, weathers darker gray; locally hornblende porphyritic with phenocrysts up to 2 cm; some bodies have distinctive skeletal garnet; inclusions and schlieren of dioritic composition common; gneiss inclusions occur locally; petrographic features include equigranular to seriate texture. In Tracy Arm, biotite-hornblende and hornblende-biotite tonalite, quartz diorite, and minor granodiorite. In the Petersburg area, the tonalite is medium gray, medium-grained, biotite-hornblende tonalite. CI 16-40. Homogeneous, foliated, non-layered; medium- to coarse-grained; gray fresh, weathers darker gray; locally hornblende porphyritic with Seriate, commonly lineated, phenocrysts up to 2 cm; inclusions and schlieren of dioritic composition common; gneiss inclusions occur locally. Syndeformational magmatic foliation. In the Ketchikan area, about 60 percent of the unit is undifferentiated bodies of dark gray weathering, uniformly foliated to gneissic quartz diorite; the rest consists of paragneiss (21 percent), granodiorite (11 percent), and subordinate migmatite, amphibolite, pegmatite, and quartz monzonite. The quartz diorite commonly is at least weakly foliated. Thin sections of typical samples of quartz diorite show medium grained granular to planar aggregates of andesine (54

percent), quartz (18 percent), hornblende (13 percent), biotite (12 percent), and accessory apatite, augite, garnet, magnetite, muscovite, potassium feldspar, and sphene. Mapped with Quattoon pluton in British Columbia, and foliated tonalitic bodies forming the eastern margin of the Coast batholith in southeast Alaska. Color Index 20-30. Description from source map: SK021

TKtm - Migmatite (Tertiary and Cretaceous)
In Skagway area, complexly intermixed paragneiss, orthogneiss, and migmatite. Paragneiss consists of quartzofeldspathic gneiss, with marble, quartzite, amphibolite, and biotite schist. The orthogneiss resembles the Ferebee pluton except it has a stronger foliation. Migmatite consists of intimately intermixed paragneiss and orthogneiss, with widespread lit-par-lit injection gneiss. In Juneau area, Amphibolite facies (hornblende) biotite quartz feldspar schist and gneiss invaded and deformed by tonalite; schist and gneiss are fine to medium grained, locally include calc-silicate layers, and typically weather rusty; invader is generally the Biotite-Hornblende and Hornblende-Biotite Tonalite, etc. unit (TKto), characterized by its foliation and local aligned hornblende phenocrysts. Successively invaded by younger neosomes to the east and can be recognized as paleosomes in almost all migmatites of the Coast plutonic metamorphic complex. In Petersburg area, migmatite consisting of deformed, wavy-banded gneiss with raft structures and mafic inclusions, invaded by tonalitic neosomes, associated with Tto. Paleosomes include amphibolite, metamorphic grade hornblende and biotite schists and gneisses, calc-silicate gneiss, and granodioritic to dioritic meta-intrusive rocks. Description from source map: SK021

MzPzgm - Gneiss and migmatite (Mesozoic to Paleozoic)
Complexly intermixed paragneiss, orthogneiss, and migmatite. Paragneiss consists of quartzofeldspathic gneiss, with marble, quartzite, amphibolite, and biotite schist. The orthogneiss resembles the Ferebee pluton except it has a stronger foliation. Migmatite consists of intimately intermixed paragneiss and orthogneiss, with widespread lit-par-lit injection gneiss. Description from source map: SK003

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 40Ar/39Ar 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). Description from source map: Geologic Map of Alaska

Kkgd - Porphyritic hornblende granodiorite of the Mt. Kashagnak pluton (Cretaceous)
Hornblende granodiorite with zoned pink K feldspar megacrysts up to 6 cm long, with cores of granodiorite. Rock contains 5-10% hornblende, 10% quartz, 20% K feldspar, subhedral seriate groundmass, accessory sphene, primary epidote, and magnetite. Intrudes the diorite phase. Description from source map: SK003

Kqd - Quartz diorite (Cretaceous)
Hornblende-biotite quartz diorite, with subordinate tonalite and granodiorite, quartz monzodiorite, and diorite. Foliated to massive equigranular; average grain size is medium, locally fine grained near some margins; locally plagioclase porphyritic; color index 15 to 30; light to medium gray fresh, weathers medium gray to dark gray, exposed on the mainland south of Taku Inlet. Includes monzodiorite phases of bodies at Jualin and Treadwell in Juneau quadrangle. In Petersburg area Quartz monzodiorite and tonalite. Locally foliated, plagioclase porphyritic. Interstitial quartz, K-feldspar, hornblende, biotite, epidote. CI 17-48. In Ketchikan quadrangle, generally massive hornblende quartz diorite and granodiorite. In places is weakly foliated or contains abundant ellipsoidal dark inclusions that commonly are parallel to aligned hornblende crystals and impart a pronounced lineation. Garnet partially replaced by chlorite occurs in many outcrops, and all samples of the pluton examined in thin section contain magmatic epidote. Description from source map: SK021

Kgd - Granodiorite (Cretaceous)
Gray, medium-grained, hornblende biotite tonalite and granodiorite, with seriate plagioclase and primary epidote and garnet. Correlated with similar epidote and garnet-bearing plutons that also intrude Gravina belt rocks. Foliated to massive equigranular; average grain size is medium, fine grained near some margins; color index 15 to 30; light to medium gray fresh, weathers medium gray to dark gray; locally distinctively plagioclase porphyritic. Mineralogy includes zoned, complexly twinned plagioclase with minor alteration to sericite; mafic minerals usually hornblende greater than biotite; euhedral and subhedral epidote; and local garnet. Accessory minerals are sphene, apatite, opaque minerals, and allanite. In Petersburg quadrangle, Tonalite, granodiorite, and quartz diorite. Equigranular to sparsely porphyritic. Zoned, seriate plagioclase, interstitial biotite and hornblende, epidote, and rare garnet; porphyritic tonalite, containing zoned and seriate plagioclase up to 1.5 cm, biotite, hornblende, epidote, and garnet, sphene, apatite, and allanite. CI 15-40. Accessory sphene, allanite, apatite. CI 14-52. In Ketchikan quadrangle, massive, medium-grained, plagioclase porphyritic, biotite- and garnet-bearing, hornblende epidote quartz diorite. Typically characterized by crowded centimeter-size subhedral plagioclase phenocrysts separated by a fine to medium grained granular aggregate of the other minerals. Magmatic mineral include essential plagioclase and quartz, accessory epidote and green hornblende, and minor amounts of brown biotite, garnet, potassium feldspar, apatite, and opaque minerals. Typical samples contain conspicuous white plagioclase phenocrysts as large as 3 cm that make up 50 - 60 percent of the rock. The groundmass consists of fine grained quartz (8-20 percent), potassium feldspar (<1-10 percent), biotite (5-25 percent) and hornblende (0-15 percent). Contains magmatic anhedral to euhedral garnet and epidote in groundmass and in cores of plagioclase phenocrysts. Epidote commonly forms 2-5 percent, and locally forms over 10 percent, of the rock. Composition of the epidote varies from sample to sample, but at least some is the iron free variety (clinozosite). Secondary minerals locally include clinozoisite epidote, white mica, and chlorite. Magmatic foliation most conspicuous near margins. On Revillagigedo Island, dominantly medium- to fine-grained, hypidiomorphic granular granodiorite. Locally it is foliated to gneissic, and has thin muscovite or biotite partings evenly spaced 2-

10 mm apart. Color index ranges from 0 to 15, but it is mainly between 0 and 2. The abundance of leuocratic aplite varies from sparse patches to more than 70 percent of some outcrops; aplite contains pink garnet. Near Mount Reid this unit forms two stocks of foliated leucocratic biotite quartz monzonite containing 1 to 2 percent dark red garnet. Biotite, the only mafic mineral, makes up as much as 10 percent of the rock, and forms thin films, layers, streaks, and, locally, clots as large as 2 cm in diameter. Description from source map: SK021

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

Large quartz monzonite plutons occur in three general areas of the state. The largest exposures are found in the Ruby terrane north of the Kaltag Fault in west-central Alaska. Plutons, such as the large Melozitna pluton, are largely quartz monzonite, but also have granite and monzonite phases. Locally, the Melozitna pluton intrudes granitic augen gneiss that has yielded a protolith emplacement age of 117.5 Ma (Roeske and others, 1995). On the southeastern Seward Peninsula, an elongate pluton 80 km long and 3 to 8 km wide extends along the crest of the Darby Mountains in the southeast part of the peninsula (Till and others, 2011). Other plutons of this unit are exposed in the Yukon–Koyukuk Basin in the Candle, Selawik, and Shungnak quadrangles, spatially associated with similar age syenite and nepheline syenite of unit Ksy. Additional exposures occur on the islands offshore of the Seward Peninsula—Little Diomede, King, and Sledge Islands. Plutons in these two areas range in age between about 112 and 85 Ma. In the transition zone between the Tintina and Kaltag Fault Systems in north-central Alaska, a number of 92- to 88-Ma quartz monzonite plutons lie in a belt parallel to the structural trend. In eastern Alaska, a number of large quartz monzonite plutons are found in the Tanacross and Nabesna quadrangles and extend into the Yukon of Canada. Age determinations on these plutons, of which there have been very few, are more restricted in age, between about 98 and 91 Ma. Included here is a small syenite body located just a few miles north of Fairbanks in central Alaska, which has been described by Newberry and others (1998a) and yielded a nearly concordant TIMS U/Pb date of 110.6±0.6 Ma. Also included is the quartz monzonite phase of the Mount Kashagnak pluton of the Skagway quadrangle, which is undated. On generalized map, included as part of unit Kmgr. Description from source map: Geologic Map of Alaska

Kkqm - Hornblende-biotite quartz monzonite of the Mt. Kashagnak pluton (Cretaceous)
Quartz monzonite, foliated, medium-grained, subhedral, seriate, with 10-15% biotite, 5% hornblende, 10-15% quartz, and 20-30% K feldspar. K feldspar megacrysts range up to 7 cm long are zoned with cores of quartz monzonite in pink feldspar, and outer zones of white feldspar with biotite inclusions. Accessory sphene and magnetite. Description from source map: SK003

Keg - Granodiorite and other plutonic rocks (Early Cretaceous, Hauterivian to Aptian)

Fine- to medium-grained hornblende granodiorite, hornblende diorite, and biotite-hornblende monzodiorite and minor quartz diorite and tonalite, generally massive but locally foliated. Unit primarily exposed in southeast and eastern south-central Alaska. In eastern south-central Alaska and the southwest Yukon, granodiorite plutons of this unit are largely exposed along the southwestern side of the Denali Fault System. In the Nabesna quadrangle, a few small plutons of the unit are exposed to the northeast of the Denali Fault System and are much more extensively exposed in the Yukon (Gordey and Makepeace, 2003). In southeast Alaska, these plutons are exposed on either side of the Chatham Strait Fault, most commonly west of the fault in the Mount Fairweather, Sitka, and Juneau quadrangles. Tonalite and trondhjemite of this unit are found on both sides of the Chatham Strait Fault in southeast Alaska as well as in the Anchorage quadrangle. Also includes minor quartz-feldspar porphyry in the Nabesna

quadrangle. Radiometric dating of the rocks in this unit is sparse and many of the available K/Ar dates, as young as 91 Ma, are cooling ages and are thought to not be reflective of emplacement; other K/Ar and 40Ar/39Ar ages are as old as 128 Ma. Trondhjemite and tonalite within the Border Ranges Fault Zone of the Anchorage quadrangle has yielded multiple K/Ar, 40Ar/39Ar, and U/Pb ages between 132 and 110 Ma (Winkler, 1992; Barnett and others, 1994; Amato and Pavlis, 2010); similar trondhjemite in the Bering Glacier quadrangle is undated, but is spatially associated with rocks of the Jurassic-Cretaceous Saint Elias Suite. The isolated Khotol pluton in the Nulato quadrangle of western Alaska is a large (12 km by 20 km), poorly exposed, coarsely porphyritic granite that has large K-feldspar phenocrysts in a moderately coarse groundmass and has yielded an age of 112 Ma K/Ar (Patton and others, 1984). Description from source map: Geologic Map of Alaska

Kmz - Quartz monzonite (Cretaceous)
Light gray, medium-grained quartz monzonite with K-feldspar phenocrysts, locally altered to yellow. Contains secondary epidote. On Mount Kashagnak in Skagway quadrangle elongate body has steeply dipping magmatic foliation that strikes northwest. Description from source map: SK021

Kgb - Gabbro and diorite of southeast Alaska (Cretaceous)

Primarily gabbro, hornblende gabbro, hornblendite, leucogabbro, and subordinate norite, syenite, and pyroxenite on Prince of Wales Island (Eberlein and others, 1983), Kuiu Island (Brew and others, 1984), and Chichagof Island (also described as the layered gabbro near the head of Tenakee Inlet by Loney and others[1975]), where it is associated with Early Cretaceous granodiorite and diorite (units Keg and KJse) (Loney and others, 1975; Johnson and Karl, 1985). Also includes hornblende diorite and gabbro in the Haines area that grades laterally into granodiorite and quartz diorite. Potassium-argon ages are Late Cretaceous (Redman and others, 1984). Hornblende and biotite diorite of the Jualin Diorite (Knopf, 1911) along east shore of Lynn Canal in the northern Juneau quadrangle has produced a hornfels aureole in adjacent metasedimentary and metavolcanic rocks. Gehrels (2000) reported a U/Pb zircon age of 105 Ma on this pluton. At an unusual occurrence in the Craig quadrangle, epidote replaces the gabbro in irregular masses up to several meters in diameter or as veinlets cutting the rock (Herreid and others, 1978). In thin section, the replacement origin of the epidote is clearly shown by gradational embayed contacts with gabbro. The gabbro, which is a small border phase of Cretaceous granodiorite, contains medium-sized subhedral crystals of sericitized labradorite and subordinate hornblende, pyroxene, ilmenite, sphene, and apatite (Herreid and others, 1978). On generalized map, included as part of unit K|um. Description from source map: Geologic Map of Alaska

Kkhd - Hornblende diorite (Cretaceous)
Hornblende diorite, subhedral, seriate, medium-grained, color index 15-20. Inhomogenous texture results form variations in color index. Orbicular texture at peak 4412, zoned orbicules 10-40 cm long. Hornblende is dominant mafic mineral, with rare augite, some hornblende is cored by augite. Hornblende is lineated, trending 140 degrees, plunging moderately NW or SE. Quartz is 5-10%, 5% K feldspar, but locally as much as 30% K feldspar. Accessory sphene, magnetite, epidote. Description from source map: SK003

Kdqd - Diorite and quartz diorite (Cretaceous)
Diorite and quartz diorite with subordinate tonalite and gabbro. Steeply dipping NW foliation. Metamorphosed. Description from source map: SK005

Kum - Ultramafic rocks of southeast Alaska (Early Cretaceous)

“Ultramafic intrusive bodies of magnetite-bearing hornblende clinopyroxenite and subordinate dunite, peridotite, and hornblendite (Taylor, 1967). Several complexes are concentrically zoned from a core of dunite to rocks containing progressively less olivine and more hornblende and magnetite. Zoned bodies commonly intrude a two-pyroxene gabbro known to be of Late Triassic age on Duke Island (Gehrels and others, 1987). Geologic and geochemical considerations suggest that rocks in these bodies may be genetically related to some Cretaceous and Jurassic volcanic rocks (Berg and others, 1972; Irvine, 1973). Potassium-argon apparent ages of the ultramafic rocks indicate emplacement during Early Cretaceous time (Lanphere and Eberlein, 1966)” Gehrels and Berg (1992). Himmelberg and Loney (1995) also provide extensive information on the characteristics and petrogenesis of many of these ultramafic intrusions. On generalized map, included as part of unit K|um. Description from source map: Geologic Map of Alaska

Kum - Ultramafic and associated mafic intrusive rocks (Cretaceous)
Cretaceous mafic and ultramafic rocks. Clinopyroxinite, hornblendite, gabbro, and pegmatite. At Klukwan, fine- to very coarse-grained pyroxenite and hornblendite with inhomogenous distribution of magnetite, and up to 5% biotite, wherlite, and coarse-grained, cumulate clinopyroxenite, with subhedral hornblende and augite crystals from 1-10 cm long, high-temperature Abukuma alteration of augite to hornblende, up to 10% magnetite, trace malachite, fractures healed by pegmatite containing hornblende, plagioclase, and thulite. At Mole Harbor, hornblendite associated with gabbro and diorite. Clinopyroxenite and subordinate hornblendite. Pyroxenite in Port Snettisham contains clinopyroxene, magnetite and subordinate hornblende and predates adjacent quartz diorite. The Windham Bay ultramafic body includes very coarse- to fine-grained sulfide-bearing ultramafic rocks along the shore west of the mouth of the Chuck River for about 3 km. The body is layered in part, and consists largely of clinopyroxenite with secondary amphibole-rich rock. Locally several-cm-size plates of biotite are present. On northeastern Kupreanof Island, ultramafic rocks are dominantly wherlite, gradational into dunite and clinopyroxenite; dark green, brown-weathering, partly serpentinized. No dunite core or gabbro margin; intruded by massive hornblendite at north margin. On Blashke Islands, massive, medium-grained, tan- to gray-weathering, dark green wherlite grades to olivine clinopyroxenite near contact with dunite. Dunite is massive, medium-grained, tan-weathering, dark gray to black, partly serpentinized; olivine locally contains minor thin chromite veinlets. At Union Bay, clinopyroxenite, peridotite, and dunite. On Revillagigedo Island, ultramafic bodies consist chiefly of rusty weathering, massive appearing dark greenish black biotite or clinopyroxene bearing hornblendite and hornblende clinopyroxenite. Thin section studies show coarse xenomorphic aggregates of hornblende and clinopyroxene and accessory sphene, apatite, and opaque minerals; some samples also contain accessory biotite. The clinopyroxene commonly is partly altered to pale green hornblende. Hydrothermal or metamorphic minerals include biotite, chlorite or antigorite, talc(?), actinolite(?), epidote, and calcite. At Duke Island, Dunite, peridotite, clinopyroxenite, and hornblendite, locally serpentinized. The dunite and peridotite in these ultramafic rocks contain small amounts of chromite, asbestose, and platinum group metals, and the clinopyroxenite locally contains accumulations of titaniferous magnetite. Ultramafic complex on Duke Island is zoned and layered. The ultramafic bodies on Duke and Percy Islands have been prospected for iron and chromite. Description from source map: SK021

TRb - Mafic volcanic rocks of Chilkat Peninsula (Late Triassic)

Dark green, massive to pillowed and amygdaloidal mafic volcanic flows and minor tuff. Amygdules are undeformed and contain calcite and epidote. Massive, flow-banded, and locally pillowed or amygdaloidal metabasalt (Plafker and Hudson, 1980). Up to 3.4 km thick, unit also contains magnetite, traces of malachite, pods and veins of epidote and has associated tuffaceous metasediment. Metamorphosed to low greenschist facies and intruded by the Mount Kashagnak pluton of inferred mid-Cretaceous age

(included in unit Kmqm here) (Redman and others, 1984). On generalized map, included as part of unit TRmb. Description from source map: Geologic Map of Alaska

Kmb - Metabasalt (Cretaceous) PZog - Orthogneiss (Paleozoic)
Massive, flow-banded, and locally pillowed or amygdaloidal metabasalt. Contains magnetite, traces of malachite, pods and veins of epidote. Associated tuffaceous metasediments. Metamorphosed to low greenschist facies and intruded by the Mt. Kashagnak pluton. Up to 3.4 km thick. Description from source map: SK003

PZgn - Roof pendants of the Coast plutonic complex of Brew and Morrell (1979b) (Paleozoic)

Dominantly grayish- brown-weathering, well foliated, well layered, locally lineated, fine- to coarse-grained quartz-biotite- feldspar gneiss and lesser amounts of garnet-quartz-biotite-plagioclase schist, as well as greenish-gray or grayish-green-weathering, moderately to poorly foliated and layered, medium- to coarse-grained hornblende gneiss and subordinate hornblende and biotite schist; largely consists of roof pendants of or large xenoliths within the Coast plutonic complex of Brew and Morrell (1979b) in eastern southeast Alaska. Unit crops out as irregular and elongate masses within the Coast plutonic complex of Brew and Morrell (1979b) (Brew and Ford, 1985). In the Ketchikan quadrangle, unit is characterized by rusty-brown-weathering pelitic paragneiss and schist that has conspicuous root-beer-brown biotite and by subordinate quartzofeldspathic gneiss distinguished mainly by its light color and low content of mafic minerals. Unit also includes migmatite, gneissic plutonic rocks, marble and calcsilicate gneiss, pegmatite, quartzite, amphibolite, and aplite (Berg and others, 1988). Widely distributed throughout unit is light-gray-weathering marble and calcsilicate rock in lenses associated with minor muscovite-quartz gneiss and biotite gneiss (Brew and others, 2009). Marble is fine- to coarse-grained and locally occurs in marble several hundreds of meters thick, which may have been reefs and (or) may be large detached fold hinges (S.M. Karl, unpub. data). Marble also occurs as 1-cm- to 10-cm-scale layers intercalated with equal amounts of biotite schist (Brew and Grybeck, 1984; S.M. Karl and D.A. Brew, unpub. data). In the Atlin quadrangle, well-foliated, homogeneous biotite-hornblende-plagioclase orthogneiss and heterogeneous migmatite are present in minor amounts (Brew and others, 2009). Metamorphic grade ranges from amphibolite to granulite facies (Gehrels and others, 1992). In the Sumdum quadrangle, quartzite layers adjacent to marble in western Tracy Arm contain detrital zircons that have a variety of Precambrian ages: 1.24 to 1.0 Ga and 1.68 Ga for multigrain fractions, and 1.40 to 1.37 Ga for a single grain (Gehrels and others, 1991). Quartzite in eastern Tracy Arm contains detrital zircons that yielded U/Pb zircon ages of 2.0–1.79 Ga, ~2.31 Ga, 2.75–2.53 Ga, and ~3.0 Ga (Gehrels and others, 1991). Rocks of this unit have been correlated with rocks of the Yukon-Tanana terrane, but the multigrain detrital zircon data are of limited value in this analysis and the lithologic correlation is equivocal. On generalized map, included as part of unit MzPzcp. Description from source map: Geologic Map of Alaska

PZog - Orthogneiss (Paleozoic)
Heterogeneous migmatite consisting of biotite-quartz-feldspar gneiss and schist and calcsilicate marble cut by hornblende diorite and biotite granodiorite. Atlin quadrangle. Associated with orthogneiss that intrudes the Stikine terrane. Description from source map: SK021

PZZym - Marble (Paleozoic and Precambrian)
Marble in the coast plutonic complex. In northern Coast Mountains includes poorly foliated, rarely lineated marble, calc-silicate granofels and schist interlayered with highly variable amounts of calcareous slate, phyllite, biotite and hornblende schist. Marble is fine to coarse grained, white and light gray or yellowish gray, some marble masses are several hundreds of m thick and may have been reefoid

limestones and/or may be large detached fold hinges. Marble also occurs as 1 cm to 10 cm scale layers intercalated with equal amounts of biotite schist. Description from source map: SK021

PZZyp - Paragneiss and marble (Paleozoic and Precambrian)
In Coast Mountains, from Atlin to Ketchikan, includes dominantly well foliated, well layered, locally lineated fine to coarse grained quartz-biotite-feldspar gneiss with lesser amounts of garnet-quartz-biotite-plagioclase schist and still less hornblende-plagioclase schist and gneiss. In Tracy Arm, includes interbedded marble, quartzite, and subordinate metapelite. Proterozoic and Archaean detrital zircons indicate some quartzites must be metaclastic rocks. Some quartzite layers retain fine lamination textures. Association with marble suggests marine protoliths. Rock types alternate on a scale of a meter or less. Amphibolite to granulite facies. In Ketchikan area unit includes rusty brown weathering pelitic paragneiss and schist containing conspicuous root-beer-brown biotite and by subordinate quartzofeldspathic gneiss distinguished mainly by its light color and low content of mafic minerals. Such rocks make up about 66 percent of the unit. The remainder includes migmatite (16 percent), gneissic plutonic rocks (7 percent), marble and calcsilicate gneiss (4 percent), pegmatite (3 percent), quartzite (2 percent), amphibolite (1 percent), and aplite (1 percent). The minerals and textures of the schist and gneiss and the intercalated layers of marble indicate that the metasedimentary protoliths of the paragneiss sequence were deposited in a marine environment. Description from source map: SK021

GRI 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. Features in the GRI digital geologic-GIS data, attributed with the code (in bold; e.g., **SK002**) preceding each reference, can be linked back to references on this page. 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.

SK001 U.S. Geological Survey topographic base for the Skagway 1' x 3' Quadrangle, scale 1:250,000.

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> 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 one 1' x 3' quadrangle 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. Note that as only a portion of the ARDF 1' x 3' quadrangle was used in the GRI digital geologic-GIS data, and therefore not all mineral occurrence localities displayed on the source mineral occurrence map are present in the GRI digital geologic-GIS data.

ARDF, 1' x 3' Skagway Quadrangle

The formal citation for this source.

Crafford, T.C., 2001, Alaska Resource Data File; Skagway Quadrangle, Alaska: U.S. Geological Survey, Open-File Report OF-2001-193, scale 1:250,000 (*GRI Source Map ID 2605*).

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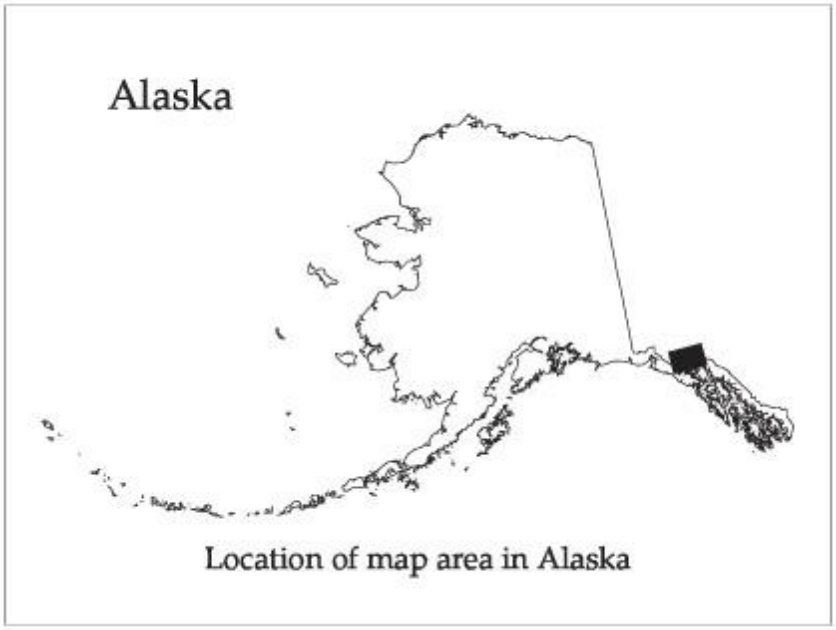
Report

The Alaska Resource Data File (ARDF) report for the Skagway Quadrangle, Alaska (OF-2001-193) is available for download at the following link: Report PDF.

Data

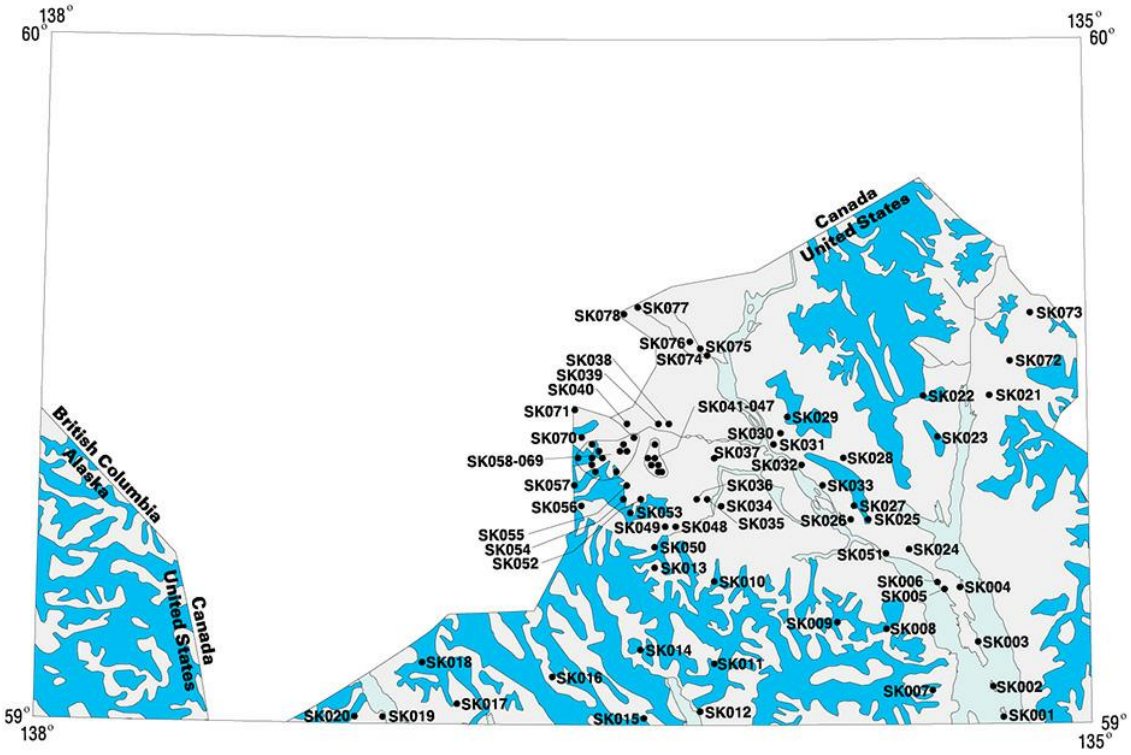
The Alaska Resource Data File (ARDF) data for the Skagway Quadrangle, Alaska (OF-2001-193) are available for download at the following link: Data.

Index Map



Graphic from source map: ARDF, 1' x 3' Skagway Quadrangle

Mineral Occurrence Map



Distribution of mineral occurrences in the Skagway 1:250,000-scale quadrangle, Alaska

Graphic from source map: ARDF, 1' x 3' Skagway Quadrangle

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References from source map: ARDF, 1' x 3' Skagway Quadrangle

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GRI finalization by Stephanie O'Meara (Colorado State University).

GRI program coordination and scoping provided by Bruce Heise, Jason Kenworthy and Tim Connors (NPS GRD, Lakewood, Colorado).