

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



Kenai Fjords National Park

GRI Ancillary Map Information Document

Produced to accompany the Geologic Resources Inventory (GRI) Digital Geologic Data for Kenai Fjords National Park

kefj_geology.pdf

Version: 3/31/2026

Geologic Resources Inventory Map Document for Kenai Fjords National Park

Table of Contents

Geologic Resources Inventory Map Document.....	1
About the NPS Geologic Resources Inventory Program.....	3
GRI Digital Map and Source Map Citations.....	5
Index Map.....	6
Map Unit List	7
Map Unit Descriptions.....	8
g - Ice fields or glaciers (Quaternary)	8
Qs - Unconsolidated surficial deposits (Quaternary).....	8
Qat - Alluvial and terrace deposits (Quaternary).....	8
Qb - Beach deposits (Quaternary).....	8
Qm - Glacial deposits, undivided (Quaternary).....	8
Qao - Outwash of the Neoglacial age (Holocene).....	9
Qgn - Glacial deposits of the Naptowne and Brooks Lake Glaciations (Pleistocene).....	9
Qogo - Outwash associated with older glacial deposits (Pleistocene).....	9
Qch - Moraine of the Caribou Hills Glaciation (Pleistocene)	9
Tgh - Granitic rocks of Harding Icefield region (Eocene and Paleocene).....	9
Top - Orca Group, pillow basalt (Eocene).....	10
Tod - Orca Group, sheeted basalt dikes (Eocene).....	10
Togb - Orca Group, gabbro (Eocene).....	11
TKd - Dikes (Early Cretaceous to early Tertiary).....	11
Kvs - Valdez Group, metasedimentary rocks, undivided (Upper Cretaceous).....	12
Kvvs - Valdez Group, interbedded metavolcanic and metasedimentary rocks (Upper Cretaceous).....	12
Kvt - Valdez Group, aquagene tuff (Upper Cretaceous).....	12
Kvm - Valdez Group, Melange of Iceworm Peak of Kusky and others (1997) (Upper Cretaceous).....	12
Kvgs - Valdez Group, schist (Upper Cretaceous).....	13
KMm - McHugh Complex, undivided (Mississippian to Cretaceous).....	13
KJms - McHugh Complex, graywacke and conglomerate (Early Jurassic (Pliensbachian) to Early Cretaceous).....	14
KTRmc - McHugh Complex, basalt and chert (Middle Triassic (Ladinian) to Early Cretaceous (Albian)).....	14
MZg - Gabbro (Mesozoic).....	14
MZu - Ultramafic plutonic rocks (Mesozoic).....	14
Ancillary Source Map Information.....	15
USGS OF 2008-1002 (Blying Sound, Kenai, Seldovia, and Seward 1 x 3 Sheets).....	15
Geologic Report.....	15
Digital Data and Map PDF.....	15
Table of Radiometric Ages.....	15
Index Map	16
Correlation of Map Units.....	17
Map Legend	17
References.....	18
ARDF, 1 x 3 Blying Sound Quadrangle.....	27
ARDF Report.....	27
ARDF Data.....	27
Index Map	27
Mineral Occurrence Map.....	28

References.....	28
ARDF, 1 x 3 Seldovia Quadrangle.....	30
ARDF Report.....	30
ARDF Data.....	30
Index Map.....	30
Mineral Occurrence Map.....	31
References.....	31
ARDF, 1 x 3 Seward Quadrangle.....	35
ARDF Report.....	35
ARDF Data.....	35
Index Map.....	35
Mineral Occurrence Map.....	36
References.....	36
GRI Digital Data Credits.....	45

Geologic Resources Inventory Map Document



Kenai Fjords National Park, Alaska

Document to Accompany Digital Geologic-GIS Data

[kefj_geology.pdf](#)

Version: 3/31/2026

This document has been developed to accompany the digital geologic-GIS data developed by the Geologic Resources Inventory (GRI) program for Kenai Fjords National Park, Alaska (KEFJ).

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

This document contains the following information:

- 1) **About the NPS Geologic Resources Inventory Program** – A brief summary of the Geologic Resources Inventory (GRI) Program and its products. Included are web links to the GRI GIS data model, and to the GRI products page where digital geologic-GIS datasets, scoping reports and geology reports are available for download. In addition, web links to the NPS Data Store and GRI program home page, as well as contact information for the GRI coordinator, are also present.
- 2) **GRI Digital Map and Source Map Citations** – A listing of the GRI digital geologic-GIS map produced for this project along with sources used in the completion of the map. 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 a stratigraphic column, 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:

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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 Kenai Fjords National Park, Alaska (KEFJ):

Digital Geologic-GIS Map of Kenai Fjords National Park and Vicinity, Alaska (*GRI MapCode KEFJ*)

A partial extent of the following four source maps were used, and all geologic features within the GRI map extent were captured.

Wilson, F.H., Hults, C.P., Labay, K.A., and Shew, N., 2008, Digital Data for the Reconnaissance Geologic Map for Prince William Sound and the Kenai Peninsula, Blying Sound 1 x 3 Sheet, Alaska: U.S. Geological Survey, OF 2008-1002, v. 1.0, scale 1:250,000 ([Blying Sound 1 x 3 Sheet \(Digital Data\)](#)). (*GRI Source Map ID 74910*).

Wilson, F.H., Hults, C.P., Labay, K.A., and Shew, N., 2008, Digital Data for the Reconnaissance Geologic Map for Prince William Sound and the Kenai Peninsula, Kenai 1 x 3 Sheet, Alaska: U.S. Geological Survey, OF 2008-1002, v. 1.0, scale 1:250,000 ([Kenai 1 x 3 Sheet \(Digital Data\)](#)). (*GRI Source Map ID 74908*).

Wilson, F.H., Hults, C.P., Labay, K.A., and Shew, N., 2008, Digital Data for the Reconnaissance Geologic Map for Prince William Sound and the Kenai Peninsula, Seldovia 1 x 3 Sheet, Alaska: U.S. Geological Survey, OF 2008-1002, v. 1.0, scale 1:250,000 ([Seldovia 1 x 3 Sheet \(Digital Data\)](#)). (*GRI Source Map ID 74911*).

Wilson, F.H., Hults, C.P., Labay, K.A., and Shew, N., 2008, Digital Data for the Reconnaissance Geologic Map for Prince William Sound and the Kenai Peninsula, Seward 1 x 3 Sheet, Alaska: U.S. Geological Survey, OF 2008-1002, v. 1.0, scale 1:250,000 ([Seward 1 x 3 Sheet \(Digital Data\)](#)). (*GRI Source Map ID 74907*).

Digital data for three Alaska Resource Data File (ARDF) reports (listed below) were used and all ARDF localities within GRI map extent were captured.

Huber, J.A., 1999, Alaska Resource Data File, Blying Sound Quadrangle, Alaska: U.S. Geological Survey, Open-File Report OF-99-392, scale 1:250,000 ([ARDF, 1 x 3 Blying Sound Quadrangle](#)). (*GRI Source Map ID 2709*).

Huber, J.A., 1999, Alaska Resource Data File, Seldovia Quadrangle, Alaska: U.S. Geological Survey, Open-File Report OF-99-391, scale 1:250,000 ([ARDF, 1 x 3 Seldovia Quadrangle](#)). (*GRI Source Map ID 2710*).

Huber, J.A., and Huber, C.S., 2005, Alaska Resource Data File, Seward Quadrangle, Alaska: U.S. Geological Survey, Open-File Report OF-2005-1045, digital data, scale 1:250,000 ([ARDF, 1 x 3 Seward Quadrangle](#)). (*GRI Source Map ID 75205*).

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

Index Map

The following index map displays the extent (outer solid black line) of the GRI digital geologic-GIS map produced for Kenai Fjords National Park (KEFJ). The GRI map boundary is a ten mile buffer around the park. The boundary for Kenai Fjords National Park (as of March 2026) is outlined in green and labeled. 1x3 quadrangle source maps are labeled and shown with light gray lines.



Index map by Ron Karpilo (Colorado State University)

Map Unit List

The geologic units present in the digital geologic-GIS data produced for Kenai Fjords National Park, Alaska (KEFJ) are listed below. Units are listed with their assigned unit symbol and unit name (e.g., Qs - Unconsolidated surficial 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 (KEFJUNIT) table included with the GRI digital geologic-GIS data.

Quaternary Period

[q](#) - Ice fields or glaciers

[Qs](#) - Unconsolidated surficial deposits

[Qat](#) - Alluvial and terrace deposits

[Qb](#) - Beach deposits

[Qm](#) - Glacial deposits, undivided

[Qao](#) - Outwash of the Neoglacial age

[Qgn](#) - Glacial deposits of the Naptowne and Brooks Lake Glaciations

[Qogo](#) - Outwash associated with older glacial deposits

[Qch](#) - Moraine of the Caribou Hills Glaciation

Tertiary Period

[Tgh](#) - Granitic rocks of Harding Icefield region

[Top](#) - Orca Group, pillow basalt

[Tod](#) - Orca Group, sheeted basalt dikes

[Togb](#) - Orca Group, gabbro

Tertiary to Cretaceous Periods

[TKd](#) - Dikes

Cretaceous Period

[Kvs](#) - Valdez Group, metasedimentary rocks, undivided

[Kvvs](#) - Valdez Group, interbedded metavolcanic and metasedimentary rocks

[Kvt](#) - Valdez Group, aquagene tuff

[Kvm](#) - Valdez Group, Melange of Iceworm Peak of Kusky and others (1997)

[Kvqs](#) - Valdez Group, schist

Cretaceous to Mississippian Periods

[KMm](#) - McHugh Complex, undivided

Cretaceous to Jurassic Periods

[KJms](#) - McHugh Complex, graywacke and conglomerate

Cretaceous to Triassic Periods

[KTRmc](#) - McHugh Complex, basalt and chert

Mesozoic Era

[MZg](#) - Gabbro

[MZu](#) - Ultramafic plutonic rocks

Map Unit Descriptions

Descriptions of all geologic map units, generally listed from youngest to oldest, are presented below. All unit descriptions from source map: [USGS OF 2008-1002 \(Blying Sound, Kenai, Seldovia, and Seward 1 x 3 Sheets\)](#).

g - Ice fields or glaciers (Quaternary)

No description.

Qs - Unconsolidated surficial deposits (Quaternary)

Mainly unsorted boulders, cobbles, gravel, sand, and silt produced, deposited, and reworked by action of wind, water, glaciers, and frost, including solifluction. Includes deposits of present streams, colluvial and alluvial fans; glaciofluvial, glaciolacustrine, and deltaic deposits; unsorted material of morainal deposits; glacial-lake silt, clay, and muskeg deposits; and locally interstratified beach gravel, sand, and clay (Tysdal and Case, 1979; Nelson and others, 1985; Winkler and Plafker, 1993).

In the vicinity of the Drift River delta, this unit contains a significant proportion of volcanic debris derived from air fall, mudflows, and lahars from Mt. Redoubt and Iliamna Volcano (Till and others, 1993; Waythomas and Miller, 1999; F.H. Wilson, unpublished data). Includes artificial fill at the Drift River and West Foreland oil production facilities on the west side of Cook Inlet (Riehle and Emmel, 1980; Till and others, 1993).

Qat - Alluvial and terrace deposits (Quaternary)

Flood-plain alluvium and stream terrace deposits. Consists of poorly- to well-sorted silt, sand, pebbles, cobbles, and boulders. Also includes abandoned channel deposits in outwash above modern floodplains or underfit stream channels, inferred to be relict glacial melt water channels; may include some glacial deposits (Detterman and Hartsock, 1966; Riehle and Emmel, 1980; Till and others, 1993; Richter and others, 2005; F.H. Wilson, unpublished data). Rare natural levee deposits on deltaic or fan delta deposits occur on the west side of Cook Inlet (F.H. Wilson, unpublished data).

Qb - Beach deposits (Quaternary)

Sand, gravel, and cobbles of present and former beaches, beach ridges, spits, and tidal flats (Tysdal and Case, 1979; Winkler and Plafker, 1993; Detterman and Hartsock, 1966; Riehle and Emmel, 1980; F.H. Wilson, unpublished data). Wave-deposited, coarse-grained material and driftwood along seacoast; includes fine-grained sediment in mud flats of Copper River Delta; and uplifted marine terraces. Successive spit-building episodes of progressive gradation are preserved in beach sequences along coastal lowland between Cape Yakataga and Bering Glacier (Richter and others, 2005). Includes beaches uplifted by the 1964 Alaska Earthquake; most notably stranded beaches on southeastern side of Montague Island (Tysdal and Case, 1979).

Qm - Glacial deposits, undivided (Quaternary)

Glacial drift consisting of sand, gravel, and boulders. Includes ground, recessional, end, medial, and lateral moraine deposits; as well as colluvium, talus, landslide debris, alluvium, and silt, locally (Riehle and Emmel, 1980; F.H. Wilson, unpublished data). As shown also includes active and recently active

rock glaciers consisting chiefly rubble and coarse rock debris (F.H. Wilson, unpublished data) as well as fresh, poorly sorted, debris on surfaces of glaciers (Detterman and Hartsock, 1966; Winkler and Plafker, 1993). In the vicinity of Mount Redoubt and Mount Iliamna, may include a significant component of ash and other air-fall debris from eruptions (F.H. Wilson, unpublished data).

Qao - Outwash of the Neoglacial age (Holocene)

Outwash deposits associated with modern and Holocene glaciers (Karlstrom, 1964; F.H. Wilson, unpublished data). Consist of poorly- to well-sorted silt, sand, and gravel in terraces and outwash fan plains (Detterman and Hartsock, 1966; Riehle and Emmel, 1980).

Qgn - Glacial deposits of the Naptowne and Brooks Lake Glaciations (Pleistocene)

Terminal, recessional, lateral, medial, and ground moraine and other deposits. Moderately weathered moraine along Cook Inlet shoreline; heavily spruce and brush covered (Detterman and Hartsock, 1966; F.H. Wilson, unpublished data). Internal contacts on west side of Cook Inlet reflect subdivisions of the Brooks Lake Glaciation; the Iliuk, Newhalen, and Iliamna advances. On the east side of Cook Inlet, includes prominent and little modified morainal deposits, mantled by 2 to 6 feet of loess (Karlstrom, 1964).

Qogo - Outwash associated with older glacial deposits (Pleistocene)

Silt, sand, and gravel graded to moraines of Knik and Eklutna age on the Kenai Peninsula (Karlstrom, 1964).

Qch - Moraine of the Caribou Hills Glaciation (Pleistocene)

Highly modified morainal deposits in the Caribou Hills and exposed as remnant deposits elsewhere on the Kenai Peninsula (Karlstrom, 1964). These deposits are terraced below elevations of about 305 m (1,000 ft) and discontinuously mantled by proglacial lake sediment deposits (Karlstrom, 1964).

Tgh - Granitic rocks of Harding Icefield region (Eocene and Paleocene)

Primarily medium- to dark-gray foliated medium- to coarse-grained biotite-muscovite-(hornblende) granite and granodiorite; marginal phases are locally biotite-muscovite-(hornblende) tonalite (Tysdal and Case, 1979). Consists of a large batholith extending from Nuka and Aialik Bays and offshore islands northward more than 60 km into the Harding Icefield where it is exposed in many nunataks and westward into the Seldovia quadrangle around Harris Bay; mafic minerals, almost wholly biotite, constitute 20 to 30 percent of minerals in tonalitic rocks, 15 to 20 percent of granodiorite, and 5 to 10 percent of granite; muscovite, a late but primary mineral, commonly makes up less than 2 percent (Tysdal and Case, 1979). Unit includes the Nuka, Aialik, and Tustumena plutons, as well as the Chernof stock of Bradley and others (1999). A K-Ar date from a sample collected at Aialik Cape yielded 61.0 ± 1.8 Ma on biotite and 56.0 ± 1.6 Ma on muscovite (Tysdal and Case, 1979, ages recalculated using constants of Steiger and Jager, 1977), whereas a sample of the Aialik pluton from Harris Bay yielded a weighted mean $40\text{Ar}/39\text{Ar}$ age of 52.2 ± 0.9 Ma (Bradley and others, 2000) and the Paguna stock of Bradley and others (1999) yielded a $40\text{Ar}/39\text{Ar}$ plateau age of 53.4 ± 1.5 Ma. The apparent large size of the pluton and wide ranging age determinations, from 52.2 to 61.0 Ma, which

overlap that of unit Tgg (granite and granodiorite), suggest these rocks are part of a multiphase batholith rather than a single pluton. Lytwyn and others (2000) described a suite of dikes (part of map unit TKd, herein) that they associated with the same ridge subduction related system thought responsible for these plutons.

Top - Orca Group, pillow basalt (Eocene)

Pale- to dark-green aphyric to porphyritic, frequently amygdaloidal, pillow basalt composed of plagioclase and clinopyroxene; plagioclase commonly replaced by albite and epidote, and clinopyroxene by hornblende, actinolite, and (or) chlorite; vesicles mostly filled with chlorite; pillow basalt in some areas is interlayered with subordinate pillow breccia and tuff (Tysdal and Case, 1979). Discrete pillows average 2 ft [50 cm] in diameter on the Resurrection Peninsula and average about 1 m where they were mapped in the Orca Group by Nelson and others (1985) and are metamorphosed to as high as low greenschist facies (Nelson and others, 1985). The pillows have fractured surfaces, chilled margins, palagonitic coatings, and cracks that radiate outward from pillow centers, indicating rapid cooling (Tysdal and others, 1977; Tysdal and Case, 1979). Altered brown-colored volcanic glass makes up much of the matrix, especially in the outer parts of pillows (Nelson and others, 1985). Inter-pillow material consists of extrusive breccia, agglomerate, and hyaloclastite; and locally, thin sequences of siliceous mudstone and argillite, sandstone, and carbonate rocks, and minor red, green, and gray chert (Capps, 1915; Tysdal and others, 1977; Tysdal and Case, 1979; Miller, 1984; Nelson and others, 1985). Interbedded sedimentary layers locally display crossbedding and graded beds (Tysdal and others, 1977; Tysdal and Case, 1979). Pillow basalt and lesser massive basalt and broken pillow breccia make up most of the western flank of the mafic complex on the Resurrection Peninsula (Nelson and others, 1985; Tysdal and Case, 1979) where flows dip westward roughly 30° and are as much as 1000-m-thick (Tysdal and others, 1977). Flows dip west on the west side of Knight Island and eastward on the east side of the island and are more than 5000-m-thick (Tysdal and others, 1977). This unit is gradational into and cut by sheeted dikes of unit Tod over a wide zone on Glacier and Knight Islands and interbedded with volcanic and sedimentary rocks of unit Tovs in eastern Prince William Sound (Nelson and others, 1985; Tysdal and Case, 1979).

Tod - Orca Group, sheeted basalt dikes (Eocene)

Mafic sheeted-dike complexes consisting of dark-green, gray, and brown, aphanitic to porphyritic; chiefly basaltic, but locally gabbroic to dioritic, dikes (Tysdal and others, 1977; Tysdal and Case, 1979). In the Knight Island area, felsic plagioclase-quartz dikes occur locally and plagioclase-clinopyroxene-olivine dikes are present but not common (Tysdal and Case, 1979). On the Resurrection Peninsula, olivine is present in a few dikes (Tysdal and Case, 1979). The dikes are commonly 1- to 2-m-thick, vertical or nearly so, and generally strike north (Tysdal and others, 1977; Tysdal and Case, 1979). The dikes contain greenschist facies mineral assemblages ascribed to ocean-floor metamorphism by Bradley and Miller (2006); according to Tysdal and Case (1979), plagioclase replaced by albite, clinopyroxene by hornblende and actinolite, and olivine partly altered to serpentine. The dikes crosscut one another, intrude the adjacent pillow basalt (map unit Top), and on Knight Island, locally intrude sedimentary rocks of the Orca Group (Tysdal and others, 1977). Double- and single-sided chilled margins were observed on the dikes, indicating a spreading center setting (Bradley and Miller, 2006; Tysdal and Case, 1979). Pillow basalt screens are common in the up to 2000 m wide transition zone between the pillow basalt and sheeted dike units (Top and Tod) (Tysdal and others, 1977; Tysdal and Case, 1979; Miller, 1984; and Bradley and Miller, 2006). Xenoliths of gabbro and peridotite are present locally on Knight Island (Richter, 1965; Nelson and others, 1985). Small irregular pods, veins, and dikes of plagiogranite are also present in the dike complex north of Bay of Isles on Knight Island (Nelson and others, 1985). The dikes are intruded by and also intrude the gabbro in the transition zone between the gabbro and sheeted dike units (Togb and Tod) (Tysdal and Case, 1979; Tysdal and others, 1977). The dikes make up the topographically high and rugged cores of the Resurrection Peninsula, Knight Island, and Glacier Island (Tysdal and others, 1977). Whole rock K-Ar ages on greenstone reported by Miller (1984) are 35.0±1.3 Ma and 38.8±1.9 Ma on Knight Island;

and 49.6 ± 2.5 Ma, 45.7 ± 2.3 Ma, and 47.3 ± 2.4 Ma on the Resurrection Peninsula. Miller (1984) interpreted these ages as representing minimum ages for accretion due to heating during the event that caused argon loss.

Togb - Orca Group, gabbro (Eocene)

Medium- and dark-gray to green coarse-grained chiefly clinopyroxene-plagioclase rocks with ophitic to subophitic texture and gabbroic to dioritic composition; locally pegmatitic with clinopyroxene crystals as much as 5 cm long; clinopyroxene commonly is partly replaced by uraltic amphibole and chlorite; plagioclase is partly replaced by albite; epidote and minor opaque minerals are common (Tysdal and Case, 1979). Several small intrusive bodies of gabbro occur on Knight Island, the largest of which crops out east of Drier Bay, where it intrudes sheeted dikes (Nelson and others, 1985). Other gabbro bodies are too small to show at the scale of this map, but most are elongate parallel to the trend of the sheeted dikes. At the north end of Latouche Island a 30-m-wide exposure of gabbro intrudes slate and sandstone and is itself cut by several small gabbro-pegmatite dikes (Grant and Higgins, 1910, p. 49-50; Tysdal and Case, 1979; Nelson and others, 1985). On the Resurrection Peninsula, Miller (1984) described local occurrences of west dipping magmatic mineral layering and cumulate textures within the gabbro. Dikes and plugs of fine- to medium-grained plagiogranite are also present (Miller, 1984; Bradley and Miller, 2006), the largest of which crop out northwest of the head of Drier Bay on Knight Island and south side of Killer Bay on the Resurrection Peninsula (Tysdal and Case, 1979; Miller, 1984). The gabbro grades into the sheeted dike map unit (Tog herein) and is generally elongate and parallel to the sheeted dikes, but it also crosscuts the dikes locally (Tysdal and Case, 1979; Miller, 1984). Tysdal and Case (1979) state that on the Resurrection Peninsula, The gabbro intrudes slate and sandstone of the Valdez Group, crosscuts the bedding, and forms aphanitic sills in other places. A blue-gray and whitish thermal aureole, at least 200 m wide, marks the contact zone with the sedimentary rocks. Nelson and others (1985) and Bradley and Miller (2006) instead interpreted the contacts between the gabbro and Valdez metasedimentary rocks on the Resurrection Peninsula as faults. On Knight Island, the gabbro intrudes rocks of the Orca Group. Nelson and others (1989) reported a 57 Ma U-Pb zircon age on a plagiogranite intruding the gabbro on the Resurrection Peninsula.

TKd - Dikes (Early Cretaceous to early Tertiary)

Dikes of dacite, rhyolite, andesite, and rare basalt intrude rocks of the Valdez Group (Kvs) and McHugh Complex (KMm) (Bradley and others, 1999). Analyzed samples of dikes yield a wide range of ages, as shown in [Table 1](#). A basaltic-andesite dike intruding McHugh Complex yielded an $40\text{Ar}-39\text{Ar}$ hornblende plateau age of 115 ± 2 Ma, whereas an intermediate composition dike yielded an $40\text{Ar}-39\text{Ar}$ isochron(?) age of 57.0 ± 0.22 Ma (W. Clendenin, written commun., cited in Bradley and others, 1999) whereas felsic dikes mapped by Nelson and others (1999) yielded a $40\text{Ar}-39\text{Ar}$ isochron age as young as 31.1 ± 0.2 Ma on potassium feldspar, as well as a $40\text{Ar}-39\text{Ar}$ plateau of 38.6 ± 0.6 Ma on biotite and a $40\text{Ar}-39\text{Ar}$ disturbed age of 40 ± 1 Ma, also on biotite. Lytwyn and others (2000) described a suite of dikes ranging in composition from basalt to rhyolite that they associated with the near-trench intrusions commonly related to the subduction of the Kula-Farallon spreading center. A $40\text{Ar}-39\text{Ar}$ plateau amphibole age on andesite from this suite of dikes yielded an age of 58.64 ± 0.52 Ma. Lytwyn and others (2000) considered the dikes they studied to represent the same system as the plutons we have included in map unit Tgh here. Even discounting the potassium feldspar age as a minimum age, the data indicate that the dikes this map unit include rocks of multiple ages, possibly representing multiple events throughout the region.

Kvs - Valdez Group, metasedimentary rocks, undivided (Upper Cretaceous)

Dark-gray thin- to thick-bedded, laumontite to mid-greenschist facies metamorphosed, moderately to poorly sorted sandstone, siltstone, and mudstone flysch; sandstone is fine- to coarse-grained and mainly composed of plagioclase, quartz, and igneous rock fragments (Tysdal and Case, 1979; Dumoulin, 1987). Unit is a thick sequence of rhythmically alternating, multiply-deformed, metamorphosed sandstone-siltstone turbidites having beds generally ranging from a few centimeters to a few meters thick and locally, massive beds as much as tens of meters thick (Winkler and Plafker, 1981; Nelson and others, 1985; Winkler and Plafker, 1993; Bradley and others, 1999). Point count analysis by Dumoulin (1987) showed Valdez Group sandstone contains between 6 to 30 percent quartz, 23 to 45 percent feldspar, and 28 to 68 percent lithic fragments; lithic fragments are dominantly volcanic rocks. Proportion of lithic fragments decreases from west to east, as feldspar and quartz increases (Nelson and others, 1985). Conglomeratic sandstone containing clasts of quartzite, intermediate and felsic volcanic rocks, and rare sandstone, limestone, and granitic rocks is uncommon but widely distributed, occurring at base of some sandstone beds (Bradley and others, 1999; Bradley and Miller, 2006). In some places, primary sedimentary structures such as graded bedding, current-ripple cross-lamination, convolute bedding, and sole markings are preserved (Nelson and others, 1985; Winkler and Plafker, 1993). *Inoceramus kusiroensis*, *Inoceramus ulrichi*, and *Inoceramus concentrica* of Maastrichtian or Late Cretaceous age have been reported (Tysdal and Plafker, 1978; Tysdal and Case, 1979; Nelson and others, 1985; Bradley and others, 1999). A K-Ar date on biotite semischist of 51.5 ± 1.5 Ma was reported by Nelson and others (1985). D.C. Bradley (USGS, oral communication, 2007) reported 70 Ma detrital zircons from unit near Anchorage.

Kvvs - Valdez Group, interbedded metavolcanic and metasedimentary rocks (Upper Cretaceous)

Approximately equal portions of interbedded metavolcanic and metasedimentary rocks (Winkler and Plafker, 1981; Nelson and others, 1985; Winkler and Plafker, 1993). Metavolcanic rocks include semischistose volcanic breccia, tuff, tuffaceous sediment, and minor pillow basalt; metasedimentary rocks include slate and phyllite, although metamorphosed sandstone, siltstone, and chert are interbedded in many places (Winkler and Plafker, 1981; Nelson and others, 1985; Winkler and Plafker, 1993). Unit crops out in two locations; in the north central Cordova quadrangle, and on the east side of the Resurrection Peninsula in the Seward quadrangle. Winkler and Plafker (1993) report unit tends to be variably metamorphosed regionally from zeolite to lower greenschist facies, although near Cordova, Woodworth, and Schwan Glaciers rocks are transitional to amphibolite facies.

Kvt - Valdez Group, aquagene tuff (Upper Cretaceous)

Metamorphosed aquagene tuff is green to dark-gray, fine-grained, and finely laminated containing plagioclase phenocrysts; metamorphosed to chlorite and biotite zones of greenschist facies; chlorite, epidote, and locally, actinolite are abundant; remnants of glossy shards are present (Tysdal and others, 1977; Tysdal and Case, 1979). Whole rock age for metatuff on Fox Island of 54.4 ± 2.7 Ma was interpreted by Miller (1984) as possibly reset during a thermal event; alternatively, the metatuff on Fox Island (formerly Renard) is closely associated with the ophiolitic rocks of the Resurrection Peninsula, now considered to be of Eocene age. In any case, a whole-rock age determination on a metamorphosed rock must be considered suspect.

Kvm - Valdez Group, Melange of Iceworm Peak of Kusky and others (1997) (Upper Cretaceous)

Tectonic *mélange* consisting of blocks of graywacke in a phacoidally cleaved matrix of slate having a Valdez Group protolith for both matrix and blocks (Bradley and others, 1999; Bradley and Wilson,

2000). Mapped only in the Seldovia and Kenai quadrangles but may be more extensive along the McHugh Complex and Valdez Group contact (Kusky and others, 1997). Intruded by Paleocene dikes (Kusky and others, 1997) not shown here.

Kvgs - Valdez Group, schist (Upper Cretaceous)

In the Valdez Group, schistose metamorphic rocks are found in two general modes of occurrence. In the Cordova quadrangle, Winkler and Plafker (1993) describe a chiefly homogenous pelitic schist and minor amphibolite; [unit which] also includes spotted biotite-plagioclase-quartz ($\pm$ muscovite) schist containing porphyroblasts of cordierite, andalusite, garnet, and staurolite in several places. Common banding probably represents original layering inherited from protoliths; transitional into gneissose rocks to the east and into greenschist-facies rocks of the metasedimentary rocks unit (Kvs) to the west. In contrast with these rocks, in the Seward and Blying Sound quadrangles, Tysdal and Case (1979) describe a schist unit as consisting interbedded siltstone, graywacke, and less abundant tuff, tuffaceous sandstone, and basalt (pillow basalt?). These rocks are primarily localized on the west side of the Placer River fault and metamorphosed chiefly to biotite zone of greenschist facies, but locally to chlorite zone; typical metamorphic-mineral assemblages of biotite zone are biotite-muscovite-chlorite-quartz-epidote-calcite-albite (Tysdal and Case, 1979). Nelson and others (1985) chose to not distinguish the schistose rocks mapped by Tysdal and Case (1979) as a distinct map unit because they reported them to be only semi-schistose and interlayered with rocks that have no penetrative deformation; Nelson and others (1985) reported that rocks such as these were common throughout the Valdez Group, especially near faults and in areas of finer-grained sedimentary protolith. However, we have retained the belt of schistose rocks along the Placer River fault by Tysdal and Case (1979), which they reported as being conspicuously schistose and the only extensive area of schistose rocks in their map area. Nelson and others (1985) reported other areas of schistose rocks are common in the Valdez Group, yet none been distinguished on maps to date except for areas on Fox [Renard] Island and the Resurrection Peninsula by Tysdal and Case (1979); the Resurrection Peninsula occurrence is included in map unit Kvs here, following the mapping of Bradley and Miller (2006).

KMm - McHugh Complex, undivided (Mississippian to Cretaceous)

Mélange of siltstone, sandstone, mud-chip sandstone, conglomeratic sandstone, tuff, and less abundant gabbro, serpentinite, bedded chert, and pillow basalt; fine-grained sedimentary strata commonly streaked out; sedimentary and igneous rocks are broken and discontinuous; metamorphic minerals include muscovite, epidote, calcite, chlorite, albite, and veinlets of prehnite (Tysdal and Case, 1979). Paraphrasing Clark (1981), the McHugh Complex is a heterogeneous, chaotic assemblage that includes metamorphosed clastic and volcanic rocks of diverse ages. Clastic rocks, which are the most abundant, comprise thick, fault-bounded sequences of weakly metamorphosed graywacke, arkose, siltstone, and conglomeratic sandstone. Bedding is rarely seen and commonly discontinuous. Volcanic rocks in the McHugh Complex, also in fault-bounded sequences, are greenstone, mostly of basaltic composition, and are associated with radiolarian metachert, metasiltstone, and argillite. Clark (1981) thought the volcanic rocks represent oceanic crust and that the clastic sedimentary rocks were deposited in an oceanic trench. Sedimentary rocks of the matrix of the mélange have yielded Early Cretaceous (Valanginian) fossils, whereas protolith ages on blocks in the mélange have yielded radiolarians of Cretaceous (Albian-Aptian), Jurassic, and Triassic age (Bradley and others, 1999; Winkler and others, 1981), Permian conodonts and fusulinids (Bradley and others, 1999), and Mississippian to Pennsylvanian conodonts (Nelson and others, 1986). D.C. Bradley (USGS, oral communication, 2007) reported 70 Ma detrital zircons from metasandstone within the McHugh Complex collected along Turnagain Arm in the Anchorage quadrangle to the north of the map area. Bradley and others (1999) locally subdivided the McHugh Complex into distinct lithologic packages.

KJms - McHugh Complex, graywacke and conglomerate (Early Jurassic (Pliensbachian) to Early Cretaceous)

Consists of fault-bounded blocks of massive conglomerate and graywacke that range up to several kilometers in structural thickness (Bradley and others, 1999). Bradley and others (1999) reported that deformation has generally obliterated primary sedimentary features; they interpreted the conglomerate and massive graywacke to be of turbiditic origin and locally noted the presence of thin- and medium-bedded turbiditic graywacke. Graywacke is matrix-supported, poorly sorted, and has clasts consisting primarily of chert and volcanic rock fragments (Bradley and others, 1999). Bradley and others (1999) reported Pliensbachian radiolaria in conformably underlying ribbon chert at one locality and considered this McHugh Complex unit to range in age regionally from Early Jurassic, Pliensbachian to as young as Early Cretaceous.

KTRmc - McHugh Complex, basalt and chert (Middle Triassic (Ladinian) to Early Cretaceous (Albian))

Pillow and massive basalt, depositionally overlain by complexly folded and faulted radiolarian chert (Bradley and others, 1999). Bradley and others (1999, citing a C.D. Blome, USGS written communication of 1994) reported radiolaria in bedded chert ranging in age from Middle Triassic, Ladinian to Early Cretaceous, Albian.

MZg - Gabbro (Mesozoic)

Dark-green, medium- to coarse-grained gabbro and minor leucogabbro and plagiogranite (Bradley and others, 1999). Occurs as fault-bounded bodies in the McHugh Complex; following Bradley and others (1999), only the larger bodies are shown here; others are too small to map. Associated with McHugh Complex basalt and chert unit (KTRmc), which Bradley and others (1999) suggested may indicate a genetic relationship and therefore they thought may indicate a Triassic to mid-Cretaceous age. However, they assigned an undifferentiated Mesozoic age to the unit. Bradley and Karl (2000) reported a concordant U-Pb zircon age of 227.7 ± 0.6 Ma from this unit.

MZu - Ultramafic plutonic rocks (Mesozoic)

Predominantly layered, variably serpentinized dunite containing rare to locally abundant layers of chromite and pyroxenite and fault slices of garnet pyroxenite and serpentinite (Bradley and others, 1999). Bradley and others (1999) reported at least 7 fault-bounded bodies, all associated with the McHugh Complex. Most bodies are bounded by low angle thrust faults. This was originally suggested for the Red Mountain body, but as discussed in Bradley and others (1999), it is not a klippe as interpreted by Magoon and others (1976), but rather is bounded by late stage, sub-vertical faults. However, Bradley and others (1999) did suggest a thrust may bound the Red Mountain body at depth. They also inferred that the gabbro (MZg) and ultramafic rocks, while not spatially associated are comagmatic and therefore by extension may be of Triassic to mid-Cretaceous age; nonetheless, they assigned a Mesozoic to these rocks.

Ancillary Source Map Information

The following sections present ancillary source map information associated with sources used for this project.

USGS OF 2008-1002 (Blying Sound, Kenai, Seldovia, and Seward 1 x 3 Sheets)

The formal citation for this source.

Wilson, F.H., Hults, C.P., Labay, K.A., and Shew, N., 2008, Digital Data for the Reconnaissance Geologic Map for Prince William Sound and the Kenai Peninsula, Blying Sound, Kenai, Seldovia, and Seward 1 x 3 Sheets, Alaska: U.S. Geological Survey, OF 2008-1002, v. 1.0, scale 1:250,000

Seward 1 x 3 Sheet (*GRI Source Map ID 74907*)

Kenai 1 x 3 Sheet (*GRI Source Map ID 74908*)

Blying Sound 1 x 3 Sheet (*GRI Source Map ID 74910*)

Seldovia 1 x 3 Sheet (*GRI Source Map ID 74911*)

Prominent graphics and text associated with this source:

Geologic Report

The report titled "Digital data for Geology of the Prince William Sound and Kenai Peninsula Region, Alaska, Including the Kenai, Seldovia, Seward, Blying Sound, Cordova, and Middleton Island 1:250,000-scale quadrangles" (OF 2008-1002) is available for download at the following link: [Report PDF](#)

Digital Data and Map PDF

Digital data and a PDF of the Reconnaissance Geologic Map for Prince William Sound and the Kenai Peninsula, Alaska are available for download at the following link: [Digital data and Map PDF](#)

Table of Radiometric Ages

Table of radiometric ages from the Prince William Sound and Cook Inlet region: [Table PDF](#)

Index Map



Graphic from source map: [USGS OF 2008-1002 \(Blying Sound, Kenai, Seldovia, and Seward 1 x 3 Sheets\)](#).

[illegible]

Map Legend

	Contact , dashed where approximate and inferred, dotted where concealed
	Fault , dashed where approximate and inferred, dotted where concealed
	Thrust fault , dashed where approximate, dotted where concealed; teeth on upper plate
	Shoreline or riverbank
	Ice contact
	Internal contact
	Dikes and Sills
	Lineament
	Major Roads

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ARDF, 1 x 3 Blying Sound Quadrangle

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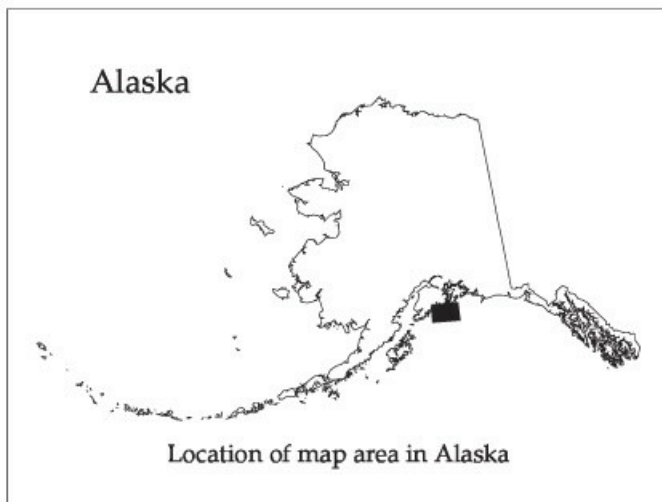
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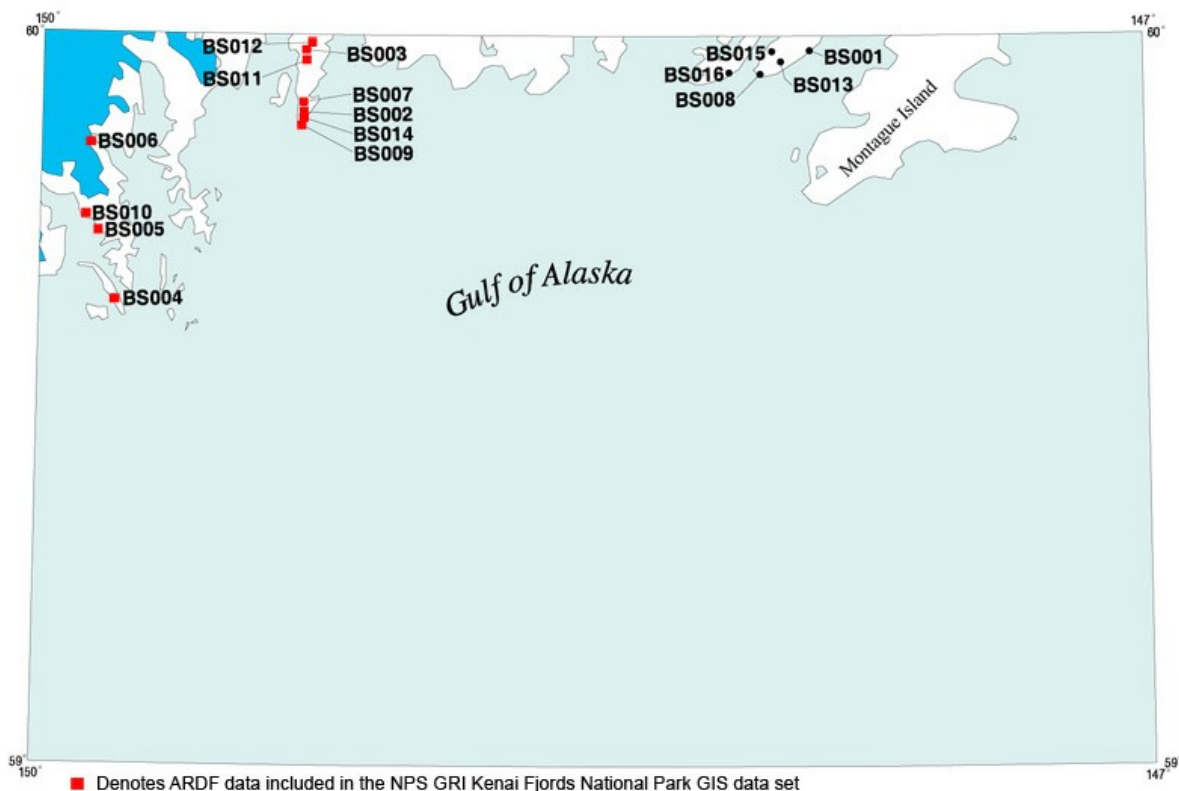
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Index Map



Graphic from source map: [ARDF, 1 x 3 Blying Sound Quadrangle](#)

Mineral Occurrence Map



Distribution of mineral occurrences in the Blying Sound
1:250,000-scale quadrangle, southcentral Alaska

Graphic from source map: [ARDF, 1 x 3 Blying Sound Quadrangle](#)

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ARDF, 1 x 3 Seldovia Quadrangle

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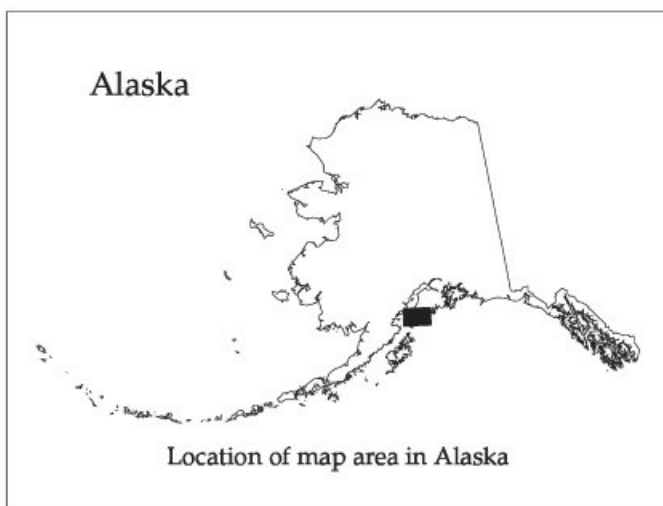
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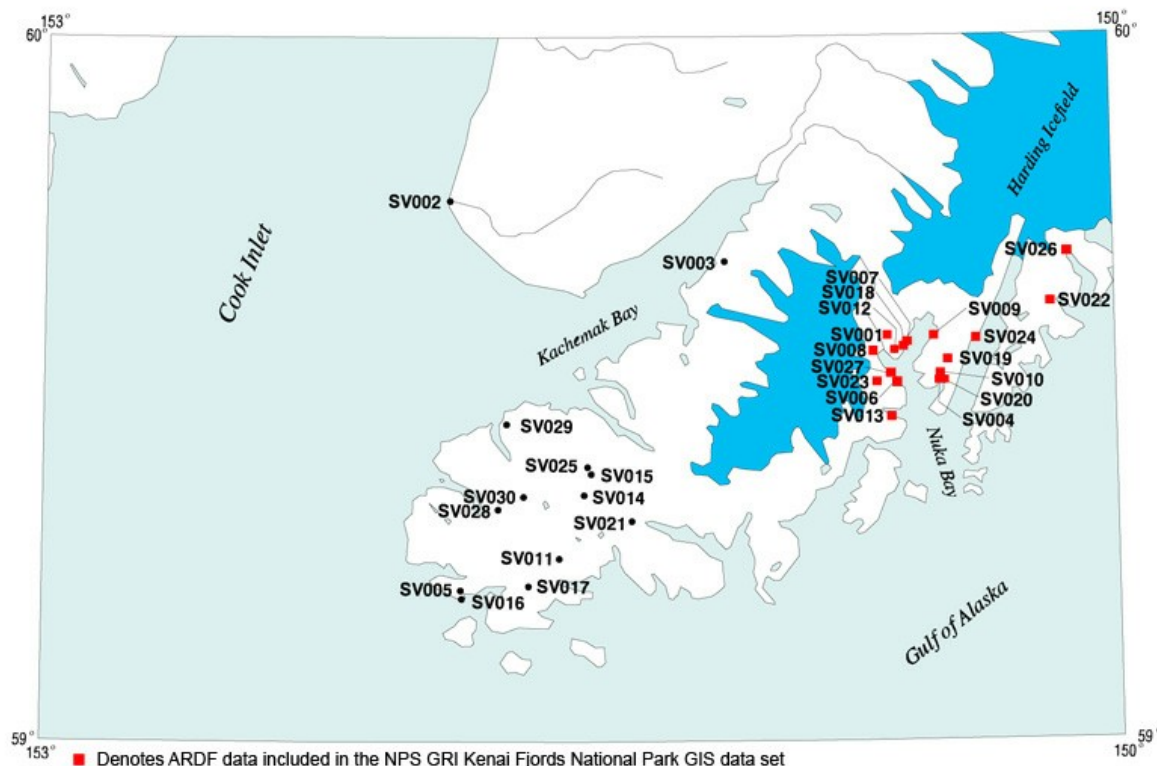
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Index Map



Graphic from source map: [ARDF, 1 x 3 Seldovia Quadrangle](#)

Mineral Occurrence Map



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

Graphic from source map: [ARDF, 1 x 3 Seldovia Quadrangle](#)

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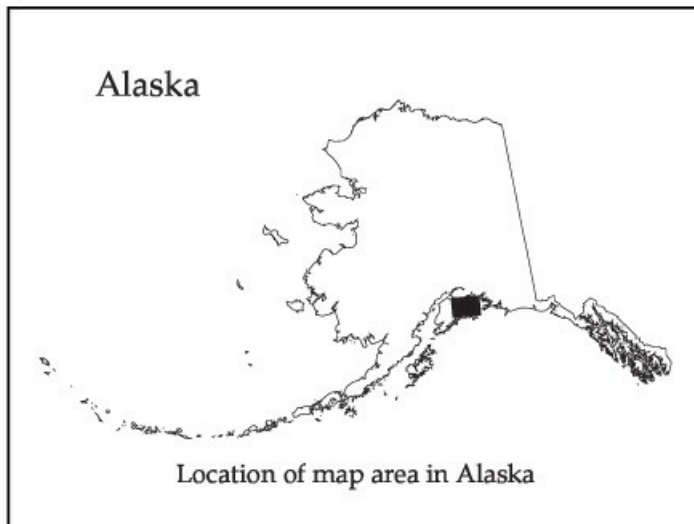
ARDF Report

The Alaska Resource Data File (ARDF) report for the Seward Quadrangle, Alaska (OF 2005-1045) is available for download at the following link: [Report PDF](#)

ARDF Data

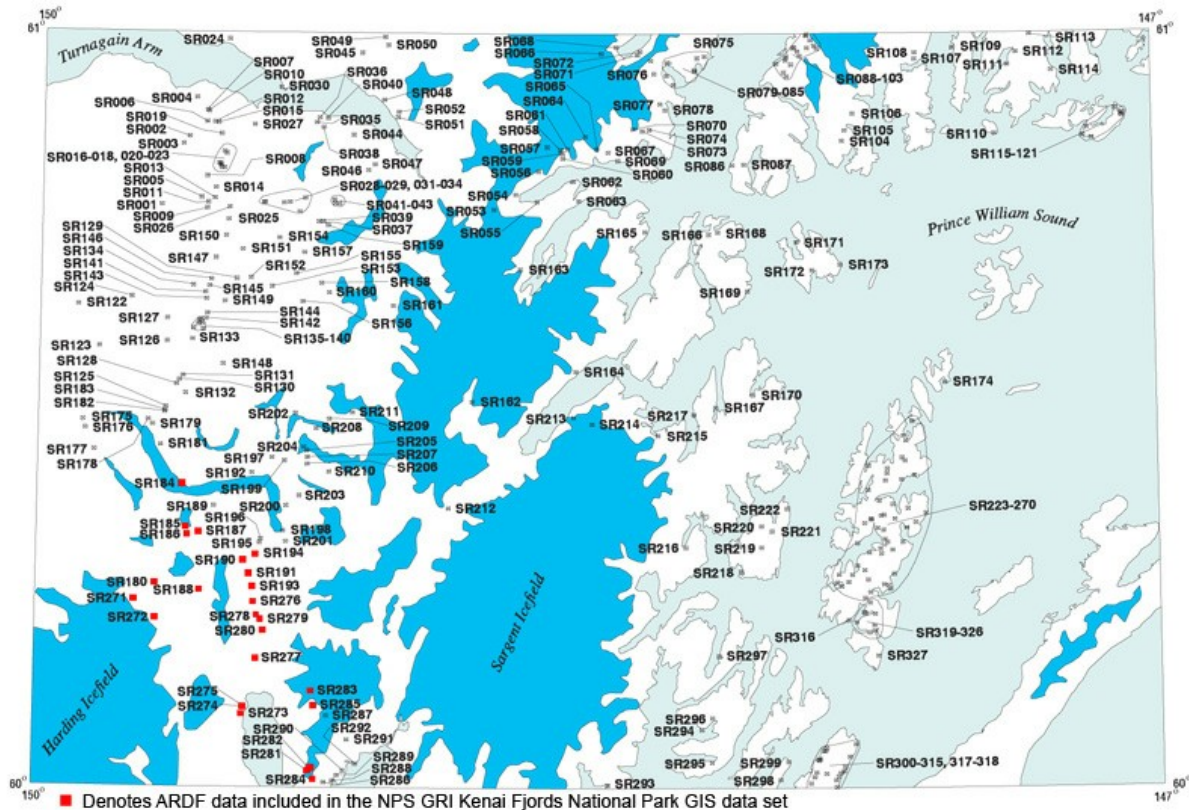
The Alaska Resource Data File (ARDF) data for the Seward Quadrangle, Alaska (OF 2005-1045) is available for download at the following link: [ARDF Data](#)

Index Map



Graphic from source map: [ARDF, 1 x 3 Seward Quadrangle](#)

Mineral Occurrence Map



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

Graphic from source map: [ARDF, 1 x 3 Seward Quadrangle](#)

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References from source map: [ARDF, 1 x 3 Seward Quadrangle](#)

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