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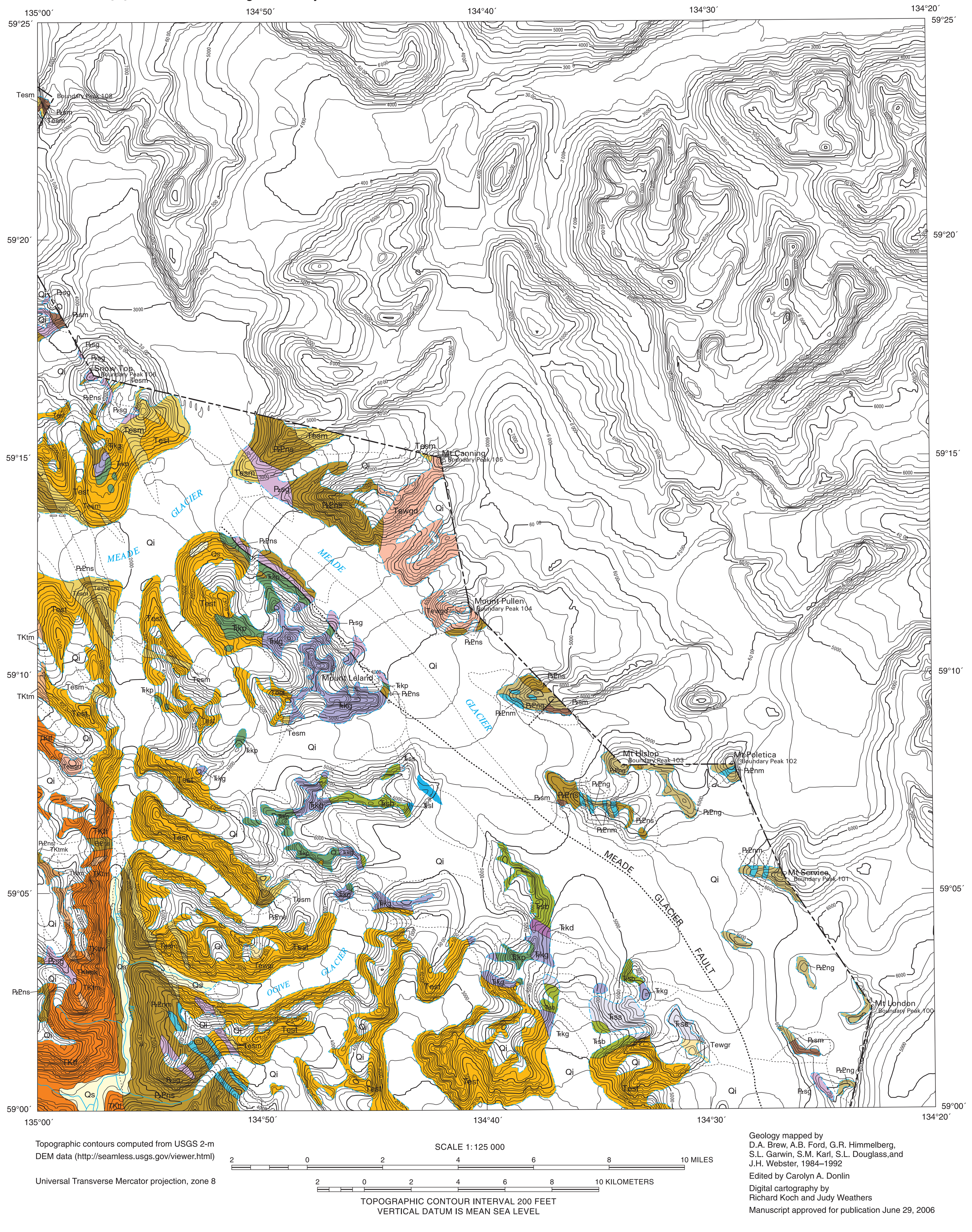

Topographic contours computed from USGS 2-m DEM data (http://seamless.usgs.gov/viewer.html)

Universal Transverse Mercator projection, zone 8

SCALE 1:125 000

TOPOGRAPHIC CONTOUR INTERVAL 200 FEET
VERTICAL DATUM IS MEAN SEA LEVEL

Geology mapped by D.A. Brew, A.B. Ford, G.R. Himmelberg, S.L. Garwin, S.M. Karl, S.L. Douglass, and J.H. Webster, 1984–1992
Edited by Carolyn A. Donlin
Digital cartography by Richard Koch and Judy Weathers
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Table 1. Isotopic and age data for sample 84DB087A

Weight (mg)	Zircon type	Concentration (ppm) U	Concentration (ppm) Pb	Isotopic Composition $^{204}Pb/^{206}Pb$	Isotopic Composition $^{207}Pb/^{206}Pb$	Isotopic Composition $^{208}Pb/^{206}Pb$	Apparent ages (Ma) $^{206}Pb/^{238}U$	Apparent ages (Ma) $^{207}Pb/^{238}U$	Apparent ages (Ma) $^{207}Pb/^{206}Pb$
0.0055	Non-magnetic	461.7	3.481	.0014	.0679	.1486	53.8	54.0	63.6
0.0064	More magnetic	412.7	3.170	.0020	.768	.1761	54.8	54.9	58.2
0.0062	Magnetic	410.8	3.148	.0013	.661	.1767	54.7	54.1	28.8

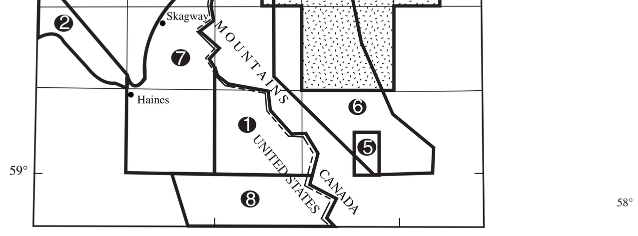

Figure 1. Index map showing part of southeastern Alaska, location of this map (1), and selected nearby areas mapped by others. These areas are (2) Redman and others, 1984; (3) Gilbert and others, 1990; (4) Mihalynuk, 1997; (5) Currie and others, 1996; (6) Currie, 1994; and Currie and Parrish, 1997; (7) Brew, Himmelberg and Ford, unpub. data; (8) Brew and Ford, 1985.

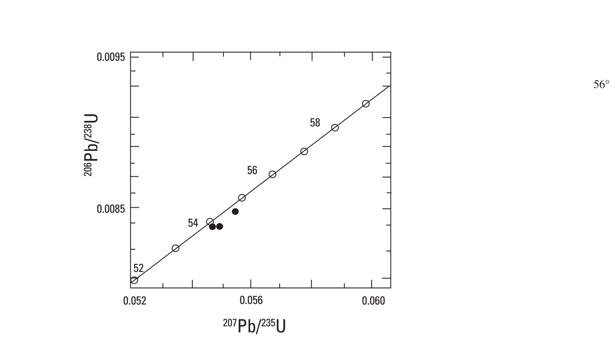

Figure 3. U-Pb concordia diagram of three fractions analyzed (black dots) from sample 84DB087A. Errors not known. Geochronologic determinations by G.R. Tilton, University of California, Santa Barbara, in 1986. Numbers 52–58 indicate approximate age in millions of years.

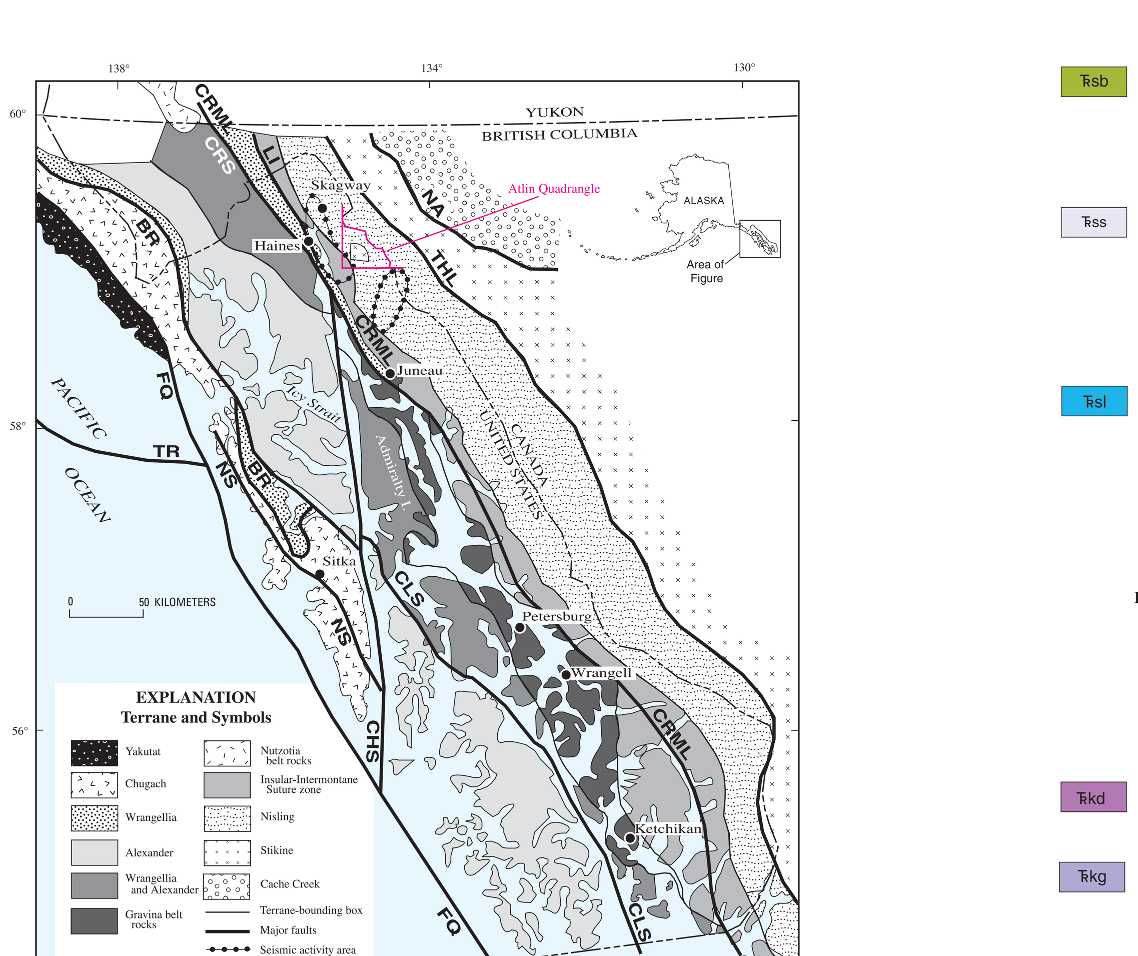

Figure 2. Map showing lithotectonic terranes of southeastern Alaska and the United States part of the Atlin 1:250,000-scale quadrangle (magenta outline). Lithotectonic terranes from Brew and others (1991), Brew and Ford (1994), and D.A. Brew in Nokleberg and others (1994). Major faults shown with heavy lines are: BR, Border Ranges; CHS, Chatham Strait; CRS, Chilkat River; CLS, Clarence Strait; CRML, Coast Range megalineament; FQ, Fairweather-Queen Charlotte; LI, Lutak Inlet-Chilkoot River; NA, Nahlin; NS, Neva Strait-Sitka; THL, Tally Ho-Llewellyn; and TR, Transitional. CHS, CRS, and LI are parts of the Denali Fault System. Nearby areas with current seismic activity are outlined with heavy dotted line (Brew and others, 1995).

CORRELATION OF MAP UNITS

Map units	Epoch	Period	Era
Qi	Holocene	QUARTERNARY	CENOZOIC
Qs	Holocene and Pleistocene	QUARTERNARY	CENOZOIC
Tewgr, Tewgd, Test, Tesm	Eocene	TERTIARY	CENOZOIC
TKtf, TKtmk, TKtm		TERTIARY AND CRETACEOUS	CENOZOIC AND MESOZOIC
Ŧsb, Ŧss, Ŧsl	Late(?), Middle, and Early Triassic	TRIASSIC	MESOZOIC
Ŧkd, Ŧkg, Ŧkp	Early Triassic(?)	TRIASSIC	MESOZOIC
P̵zsg, P̵zsm			PALEOZOIC(?)
P̵zP̵nm, P̵zP̵ns, P̵zP̵ng		EARLY PALEOZOIC AND LATE PROTEROZOIC	PALEOZOIC AND PROTEROZOIC

DESCRIPTION OF MAP UNITS

Surficial Deposits—Not all mapped in detail; two units mapped in this quadrangle, namely:

Qi **Glaciers and permanent snowfields (Holocene)**—Boundaries as shown the topographic base map, which is based on 1960 and older surveys; printed (2006) limits are different in many places because of glacier recession; many areas are not labeled because of the density of other map units and their labels.

Qs **Alluvial and morainal deposits (Holocene and Pleistocene(?))**—Many lower elevation valley sides have colluvium that is not shown; outwash at valley glacier termini generally not shown

Intrusive Rocks of White Pass (Eocene)—Unit named informally by Brew and Ford (1994) in the Skagway area and extended to the Atlin quadrangle in this report. General information is in the description of plutonic suites. Two subunits are mapped in this quadrangle, described as follows:

Tewgr **Biotite granite**—Fine- to medium-grained, brownish-gray weathering, C.I. (Color Index) about 05; locally K-feldspar porphyritic, garnet-muscovite-biotite granite; massive to weakly foliated; occurs in two small plugs in southeastern and southwestern parts of map area; tentatively correlated with White Pass plutonic rocks (Brew and Ford, 1994), which includes the 48-Ma Clifton and 54-Ma Summit plutons of Barker and others (1986); no age determinations are available for this unit in the Atlin map area. Occurs in two small bodies in the southern part of the map area

Tewgd **Sphene-biotite granodiorite**—Medium- to coarse-grained, gray weathering, C.I. 10-30, sphene-hornblende-biotite granodiorite. Occurs in a small plug near western boundary of map area and along the international boundary

Intrusive Rocks of Skagway (Eocene)—Unit named informally by Brew and Ford (1994) in the Skagway area and extended to the Atlin quadrangle in this report. General information is in the description of plutonic suites. One age determination is available for these units in the Atlin map area (table 1). These rocks were included in the descriptions of "Biotite granodiorite and biotite tonalite" (Tegt) and "Gneiss and migmatite" (Tegm) by Brew and Ford (1994) in the Skagway area and they extend into the eastern and western parts of the Turner Lake batholith as described most recently by Drinkwater and others (1995). Two units are mapped in this quadrangle:

Test **Sphene-biotite-hornblende tonalite and granodiorite**—Locally foliated, medium- to coarse-grained, gray weathering, C.I. 10-30, rarely K-feldspar porphyritic, commonly hexagonal-biotite-book porphyritic, locally hornblende-dominant, sphene-hornblende-biotite granodiorite and tonalite that locally varies abruptly in amount of plagioclase feldspar; occurs in a large, probably composite, pluton that extends from northwest to southeast across all of map area; forms steep walls and generally rounded ridges

One U-Pb age determination is available on zircon from a rock in this unit (table 1; sample 84DB087A; 59°09'28" N., 134°50'40" W.; coarse-grained light-gray hornblende-biotite granodiorite, C.I. 15; determination by G.R. Tilton, University of California Santa Barbara, written commun., 1986). The available basic data and a concordia plot are shown in table 1 and figure 3; they indicate an age of about 54 Ma with some inheritance from an older source

Tesm **Migmatite that consists of varying amounts of granitic rock in schist, gneiss, and migmatitic country rock adjacent to and within Skagway intrusive rock plutons**—Generally biotite-quartz-feldspar schist and gneiss and minor garnet-diopside calcsilicate rock cut by biotite granodiorite and minor granite; but some areas with similar metamorphic rocks cut in turn by magnetite-biotite granodiorite and hornblende-biotite granodiorite and granite; metamorphic rocks inferred to have been part of Snowtop/Nisling lithotectonic units

Intrusive Rocks of the Great Tonalite sill (Latest Cretaceous, Paleocene, and Eocene)—Informally named unit described by Brew (1994) and Brew and Ford (1994). General information is in the description of plutonic rocks and in Ford and Brew (1977b), Brew and others (1976), Gehrels and others (1991), Hutton and Ingram (1992), and Ingram and Hutton (1994). The two nearby age determinations noted below apply to these units in this map area. These rocks were included in the the Foliated biotite-hornblende tonalite and hornblende-biotite granodiorite (TKto) unit in the Skagway area by Brew and Ford (1994). Three units mapped in this quadrangle, described as follows:

TKtf **Foliated biotite-hornblende tonalite**—Consists of generally foliated, locally lineated, medium- to coarse-grained, gray weathering, C.I. 12-30, locally sphene-bearing biotite-hornblende tonalite and minor granodiorite; aligned mafic inclusions are locally abundant. Unit occurs along southwestern boundary of map area. No age determinations are available for this unit in this map area, but the unit maps to the southeast (into the Juneau quadrangle) to sample 83GJ03 with a zircon U-Pb age of 61.5$\pm$1.5 Ma (Gehrels and others, 1991) and to the northwest (in Skagway quadrangle) to sample AK-223 with a single-fraction zircon ^{206}Pb-^{238}U age of about 68.2 Ma (Barker and others, 1986); and beyond to sample 88GC275 with an age of 82.6$\pm$2.6 Ma (Gehrels and others, 1991). Sample 88GC275 is from a xenolith according to our unpublished mapping in that area

TKtmk **Migmatite consisting of K-feldspar megacrystic sphene-biotite-hornblende granite, granodiorite and schist and gneiss**—Foliated K-feldspar megacrystic sphene-biotite-hornblende granite and hornblende-biotite granodiorite; C.I. 5-10; light gray weathering; invades and crosscuts foliation in adjacent garnet-biotite schist and gneiss; occurs in single poorly exposed elongate mass along western boundary of map area; the K-feldspar megacrystic invading phase differentiates it from the migmatite described below

TKtm **Migmatite consisting of varying amounts of granitic rock in schist and gneiss country rock adjacent to and within plutons of the Great Tonalite sill**—Locally consists of foliated biotite-hornblende tonalite (C.I. 15-25) and minor unfoliated biotite granodiorite (C.I. 08-20) cutting metamorphic rocks inferred to have been part of Nisling terrane units: wollastonite-bearing marble, calc-silicate rock, and biotite-quartz-feldspar schist and gneiss

Sedimentary, Volcanic, and Ophiolitic Rocks of the Stikine Terrane (Upper, Middle, and Lower Triassic)—Terrane defined by Monger and others (1982).

Stuhini Group(?) (Upper to Lower Triassic)—The following three units of Early and Middle Triassic age are tentatively assigned to the Stuhini Group(?) as described by Aitken (1959), Souther (1971), and Wheeler and McFeely (1991) mainly on the basis of lithologic similarity and secondarily on fossil age. However, most of the Stuhini Group is dated as Late Triassic. The rocks are described in detail (including some of the fossil-based ages) by Brew and others (1985a, b). They are best exposed in an overturned steeply southwest-dipping section exposed on two adjacent mountain spurs in the central part of the map area. The only other Middle Triassic rocks known in southeastern Alaska are in the Ketchikan quadrangle (Berg and others, 1988). The stratigraphically uppermost part (unit Ŧsb) of the exposed section is unfossiliferous, but it consists of slightly metamorphosed volcanic rocks similar to those mapped as Stuhini in the Atlin Lake area (Aitken, 1959) and is inferred to be Upper Triassic(?). Divided into the following subunits:

Ŧsb **Slightly metamorphosed pillow basalt and volcanic sandstone and mudstone—**Metamorphosed pillow basalt with relict pillows as much as 1.5 m maximum dimension in a 30-m-thick bed within a few hundred-meter-thick sequence of metatuff, metamudstone, and minor pebbly metamudstone. Most is now epidote-chlorite-feldspar greenstone. Occurs on western side of Meade Glacier Fault in central to southeastern part of map area; stratigraphically above the Slightly metamorphosed tuffaceous sandstone, volcanic wacke, tuff, mudstone, and minor conglomerate unit (Ŧss)

Ŧss **Slightly metamorphosed tuffaceous sandstone, volcanic wacke, tuff, mudstone, and minor conglomerate**—Several hundred-meter-thick section of semischistose metagraywacke, locally pebbly metagraywacke, metatuff, metamudstone, and lithic fragment-quartz-feldspar clast conglomerate in centimeter to meter thick beds. As mapped, it both overlies and underlies the Slightly metamorphosed limestone, sandy limestone, and mudstone unit (Ŧsl) and is stratigraphically overlain by the Slightly metamorphosed pillow basalt and volcanic sandstone and mudstone unit (Ŧsb). Metamorphosed to biotite-quartz-feldspar hornfels adjacent to granitic units; occurs on western side of Meade Glacier Fault in central to southeastern part of map area

Ŧsl **Slightly metamorphosed limestone, sandy limestone, and mudstone**—About 90-m thick section of massive, locally laminated gray dolomite; dark-gray metamudstone; light-gray dolomite; and lesser dark-gray limestone in beds from one centimeter to several decimeters thick. Locally fossiliferous, with middle Early Triassic (late Scythian) conodonts (identified by A.G. Harris and K.E. Denkler, U.S. Geological Survey, written commun., 1985, 1989) occurring stratigraphically below Middle Triassic (middle and late Ladinian) ammonites (identified by N.J. Silberling, U.S. Geological Survey, written commun., 1984) and conodonts (identified by A. G. Harris and K.E. Denkler, U.S. Geological Survey, written comm., 1985, 1989). Occurs in central part of map area within the Slightly metamorphosed tuffaceous sandstone, volcanic wacke, tuff, mudstone, and minor conglomerate unit (Ŧss)

Rocks of the Ophiolite at Katzehin River (Early Triassic(?))—The following units are tentatively assigned to a previously unrecognized ophiolite that may underlie the Stuhini Group(?) units and are therefore assigned a tentative Early Triassic age. These rocks have been described by Brew and others (1985a, b), and by Himmelberg and others (1985a, b; 1986); the informal name is taken from the Katzehin River, the headwaters of which are near the complex. The relations of these three units to each other are not entirely clear, but they do not appear to be a series of separate plutons. The ultramafites are locally intruded and thermally metamorphosed by the granitoid rocks described previously. Also, the ultramafites have the characteristics of residual mantle harzburgite and are thus interpreted as part of a dismembered ophiolite package. Unit divided into:

Ŧkd **Hornblende diorite and hornblende gabbro**—Medium- to coarse-grained, C.I. 15-30, dark-green hornblende diorite and medium- to coarse-grained, C.I. 50, dark gray-green hornblende gabbro. Some minor greenstone lenses present. Occurs in single mass in south-central part of map area

Ŧkg **Hornblende gabbro, hornblendite, plagioclase-hornblende pegmatite, and amphibolite**—Medium- to coarse-grained hornblende gabbro, C.I. 40-60, and related hornblendite and pegmatite; some greenstone and amphibolite. Locally metamorphosed by Tertiary-age granitic bodies. Occurs in broad northwest-trending discontinuous band across entire map area

Ŧkp **Peridotite (harzburgite) and serpentine**—Locally highly tectonized along west strand of Meade Glacier Fault; elsewhere free of the fault-tectonite imprint. Close to the fault, the highly tectonized rocks consist of several 100- to 200-m thick tectonites interleaved with biotite schist, quartzofeldspathic orthogneiss, and amphibolite; the tectonites consist of relict forsterite, tremolite, talc, minor chlorite, and magnetite, and were derived from harzburgite and minor dunite. Away from the fault zone, the rocks are mostly peridotite. They were mapped in the field (before they were recognized as an ophiolite) as intruding the Orthogneiss, schist and gneiss unit (P̵zgn) and are intruded by the Sphene-biotite-hornblende tonalite and granodiorite unit (Test). Their apparent mantle origin and unrecrystallized nature suggests that the intrusive interpretation is incorrect. As discussed in the section titled "Tectonic Setting," this discrepancy was recognized by M.G. Mihalynuk (written commun., 2000), who proposed that the Triassic and related rocks are in a folded thrust package overlying the Nisling rocks. It has not been possible to re-examine the contact relations in the field. The peridotite consists of generally massive and homogeneous harzburgite with some wehrlite, dunite, and olivine-pyroxene layers. It occurs in a broad discontinuous northwest-trending band across entire map area. Most, but not all, outcrops trend into the Hornblende gabbro, hornblendite, plagioclase-hornblende pegmatite, and amphibolite unit (Ŧkg) to the east, but the details of the contact are not known

Intrusive Rocks in the Stikine Terrane (late? or early? Paleozoic?)—Units tentatively assigned to the Stikine Terrane, but which may instead be related to the Snowtop/Nisling assemblage unit. This tentative Stikine assignment follows the synthesis by Currie and Parrish (1997) in which they delineated both Nisling and Stikine crystalline units to the northeast across the international boundary. Two units are mapped in this quadrangle:

P̵zsg **Orthogneiss, schist and gneiss**—Consists of well-foliated, homogeneous biotite-hornblende-plagioclase feldspar orthogneiss in southeast part of map area; consists of porphyroblastic biotite gneiss, quartz-rich meta-aplite, biotite schist, and calc-silicate-amphibole schist in north-central part of map area between strands of the Meade Glacier Fault. The orthogneiss is tentatively interpreted as derived from Permian, mainly dioritic or gabbroic intrusions, analogous to the Wann River gneiss unit of Currie and Parrish (1997)

P̵zsm **Migmatite**—Very heterogeneous; consists of biotite-quartz-feldspar gneiss and schist and calc-silicate-bearing marble cut by hornblende-biotite diorite of uncertain affinity and by biotite granodiorite of the intrusive rocks at Skagway. Occurs in three small outcrop areas close to Snowtop/Nisling assemblage units near the international boundary and the nonplutonic parts may be derived from those units.

Metamorphic Rocks of the Snowtop/Nisling Assemblage (early Paleozoic and Late Proterozoic)—The following units are assigned to the Snowtop/Nisling assemblage. The assignment of these rocks to this Late Proterozoic and early Paleozoic assemblage follows the general criteria used by Gehrels and others (1990) and Samson and others (1991a, b) in defining the ancient continental margin assemblage rocks along the western flank of the Coast Mountains, even though most of the rocks studied by those authors are less quartz rich than the units described here. These units correlate with and map into some of the rocks of the Tulsequah sub-belt of Brew and Ford (1985) and the unfortunately named Tracy Arm terrane of Currie and Parrish (1997). Unit divided into:

P̵zP̵nm **Marble and calc-silicate rock**—Light-gray weathering marble and calc-silicate rock in lenses tens of meters thick, together with minor muscovite-quartz gneiss and biotite gneiss. Occurs associated with quartz-rich schist and gneiss unit (P̵zP̵ns) in southwest part of map area and along the international boundary.

P̵zP̵ns **Quartz-rich schist and gneiss**—Pyrite-muscovite-quartz schist, biotite-hornblende schist, biotite-quartz gneiss, and biotite-hornblende schist; occurs in southwest part of map area, along the Meade Glacier Fault, and along the international boundary.

P̵zP̵ng **Quartz-rich gneiss, quartzite, and quartz-rich schist**—Garnet-biotite-feldspar-quartz gneiss, muscovite-biotite-quartz-feldspar gneiss, biotite-bearing quartzite, biotite-quartz-feldspar gneiss, biotite-hornblende-quartz-feldspar orthogneiss, garnet-biotite-quartz-feldspar schist. Occurs in southeastern part of map area and along the international boundary, especially at and near Boundary Peak 101

Contact—Dotted where concealed

Fault—Dashed where approximately located, dotted where concealed

GEOLOGIC SUMMARY

INTRODUCTION

This map presents the results of U.S. Geological Survey (USGS) geologic bedrock mapping studies in the mostly glacier covered Atlin 1:250,000-scale quadrangle, northern southeastern Alaska (fig.1). These studies are part of a long-term systematic effort by the USGS to provide bedrock geologic and mineral-resource information for all of southeastern Alaska, covering all of the Tongass National Forest (including Wilderness Areas) and Glacier Bay National Park and Preserve. Some contributions to this effort are those concerned with southwesternmost part of the region, the Craig and Dixon Entrance quadrangles (Brew, 1994; 1996) and with the Wrangell-Petersburg area (Brew, 1997a-m; Brew and Grybeck, 1997; Brew and Koch, 1997).

As shown on the index map (fig. 1), the study area is almost entirely in the northern Coast Mountains adjacent to British Columbia, Canada. No previous geologic map has been published for the area, although Brew and Ford (1985) included a small part of it in a preliminary compilation of the adjoining Juneau quadrangle; and Brew and others (1991a) showed the geology at 1:500,000 scale. Areas mapped nearby in British Columbia and the United States are also shown on figure 1. All of the map area is in the Coast Mountains Complex as defined by Brew and others (1995a). A comprehensive bibliography is available for this and adjacent areas (Brew, 1997n).

ACKNOWLEDGMENTS

We thank W.J. Nokleberg of the U.S. Geological Survey and M.G. Mihalynuk of the British Columbia Provincial Ministry of Energy and Mines Geological Survey Branch for very constructive technical reviews of this map and its accompanying material. We also thank L.D. Currie of the Geological Survey of Canada and especially M.G.Mihalynuk for helpful discussions of the regional setting. We thank S.W. Starratt of the U.S. Geological Survey for review of the geologic nomenclature. We also thank our helicopter pilots: the late Ralph Yetka, Charlie McLeod, and Jim Wilson for a safe and efficient field operation.

PHYSIOGRAPHIC PROVINCES AND LANDFORMS

All of the Atlin map area is in the Boundary Ranges Sub-province of the Coast Mountains Province of Wahrhaftig (1965). The landforms present include: river bottoms; moderate and high rounded mountains that were over-ridden by ancient glaciers and now have active valley and carapace glaciers; and high angular mountains that in their higher parts have never been over-ridden by glaciers and now have active hanging, valley, and carapace glaciers. The southeastern part of the map area is the northernmost part of the Juneau Ice Field on the U.S. side of the international boundary. It can be argued that that the Juneau Ice Field extends farther north on the Canadian side of the boundary.

The deep, narrow, linear, south-trending Lace River Valley and river bottom is a channel form in the southwest part of the map area. Although the valley is somewhat of an anomaly within the mountains of the Boundary Ranges Sub-province, it is similar to linear deep valleys that are present in the Boundary Ranges Sub-province north of the latitude of Haines (fig. 1). It is also similar to terrain farther west in the Chilkat-Baranof Mountains Sub-province of the Pacific Border Ranges Province (Wahrhaftig, 1965). To the northeast the Boundary Ranges Sub-province merges into the rugged peaks and intervening deep valleys of the Tagish Highland Sub-province of the Yukon Plateau Province (Holland, 1964).

TECTONIC SETTING

INTRODUCTION

The Atlin quadrangle contains only three of the several lithotectonic terranes and structural zones in southeastern Alaska: the Insular-Intermontane Suture Zone, the Snowtop or Nisling assemblage, and the Stikine terrane (fig. 2). These three features are described briefly herein and their general distribution is shown in figure 2 together with other lithotectonic terranes in the region.

Southeastern Alaska is the type area for lithotectonic terranes, and the original concept was presented by Berg and others (1972, 1978). Subsequent development of the concept, as it applies to southeastern Alaska, includes contributions from Monger and others (1982), Monger and Berg (1987), Wheeler and others (1991), Wheeler and McFeely (1991), Silberling and others (1992) and other workers. As described herein, the terranes are based on those papers as modified by Brew and others (1991a), Brew and Ford (1994), and Brew *in* Nokleberg and others (1994).

INSULAR-INTERMONTANE SUTURE ZONE

The Insular-Intermontane Suture Zone (Brew and Ford, 1998; Brew 2001) is the term used here to denote what has previously been called the Taku terrane (Berg and others, 1978). It is not a lithotectonic terrane, but instead consists of thrust slices composed of different rock units at different places. These are the Gravina overlap assemblage (Berg and others, 1972, 1978); and the Alexander, Wrangellia, Stikine, and Snowtop or Nisling assemblage, the Alava sequence of Rubin and Saleeby (1991), and part of the Kah Shakes sequence and an early Paleozoic gneiss complex (both described by Saleeby and Rubin (1990) and Rubin and Saleeby (1991)). The structural juxtaposition of these elements is interpreted to have occurred in the Late Cretaceous, and the rocks were metamorphosed to greenschist- through amphibolite-facies mineral assemblages in the latest Cretaceous and early Tertiary. This metamorphism was closely related to the emplacement of the Great Tonalite sill plutons (Himmelberg and others, 1991; Brew and others, 1992; Ingram and Hutton, 1994) that obscured most of the original fault features of southeastern Alaska.

The eastern margin of the Insular-Intermontane Suture Zone at this latitude is in the southwest corner of the Atlin quadrangle. There it is a post-metamorphism high-angle contractional fault that juxtaposes possible Snowtop/Nisling assemblage schist and gneiss on the northeast against Wrangellia terrane amygdaloidal basalt on the southwest (D.A. Brew, unpub. data). Interestingly, this young fault is featured as a original terrane boundary on the cover of the Stowell and McClelland (2000) volume. The eastern margin of the Insular-Intermontane Suture Zone is defined as the eastern margin of the intrusive rocks belonging to the Great Tonalite sill (fig. 2). Rocks within the zone in the Atlin map area consist of Snowtop/Nisling assemblage units intruded by plutons of the Great Tonalite sill (fig. 2).

SNOWTOP OR NISLING ASSEMBLAGE

The Snowtop or Nisling assemblage (Snowtop is the term now in use according to Colpron (2006), Colpron and Nelson (2006), and D.C. Murphy (2006, oral commun.); Nisling assemblage, the term used earlier by Wheeler and McFeely (1991), underlies almost all of the Atlin map area to the northeast of the Insular-Intermontane Suture Zone and continues to the east into British Columbia. The distribution, as shown by Wheeler and McFeely (1991), has been expanded to the southwest on the basis of Nd-isotopic characteristics by Samson and others (1991a, b). This interpretation has been reinforced by the SNORCLE (Slave Northern Cordillera Lithospheric Evolution) project (Snyder and others, 2002). The metamorphic rocks of the Nisling terrane are likely derived from Late Proterozoic and (or) early Paleozoic sedimentary and minor volcanic rocks that were deposited on the western margin of ancestral North America.

Before the intrusion of the various plutons and their associated metamorphism, the terrane consisted of locally metamorphosed (in pre-Late Triassic time) quartz-rich and pelitic sedimentary rocks, carbonate rocks, ultramafic rocks, and some intermediate- to mafic-composition volcanic rocks. They are now amphibolite-facies mica schist, quartz-rich schist and gneiss, amphibolite, quartzite, marble, and calc-silicate rocks. Elsewhere in the region there are also dated metamorphosed Paleozoic granitoid rocks in this terrane (Currie, 1994). Some of the homogeneous biotite gneisses mapped in the Atlin quadrangle (unit Pzsg) are probably metamorphosed granitoids.

As discussed by Brew and others (1994), Brew and Ford (1994), and Johnston and others (1999), it is uncertain if the Nisling terrane is the substrate to the Stikine terrane, or instead a completely unrelated tectonic element. Nisling terrane rocks have been mapped nearby in British Columbia by Currie and others (1996) and Mihalynuk (1997).

STIKINE TERRANE

We interpret all of the Triassic and Triassic(?) rocks in the Atlin map area as an outlier of the Stikine terrane to the east (Monger and others, 1982). In general, the Stikine terrane consists of Paleozoic and Triassic only slightly metamorphosed sedimentary and volcanic rocks. The base of these rocks is not exposed, but they may be underlain by the Snowtop/Nisling assemblage. The terrane is overlain to the northeast in British Columbia by the Lower Jurassic Laberge overlap assemblage (Currie and Parrish, 1997).

In the Atlin quadrangle, the rocks interpreted to be part of the Stikine terrane are (1) a possible partial ophiolite herein informally called the Katzehin ophiolite (after the Katzehin River). It consists of hornblende gabbro, harzburgite, amphibolite, and hornblende diorite (Himmelberg and others, 1985a, b, 1986) that are close to and may be stratigraphically overlain by (2) fossiliferous carbonate, clastic sedimentary, and volcanic rocks of Early, Middle, and perhaps Late Triassic age (Brew and others, 1985a, b; 1994). Individual bodies of the Katzehin ophiolitic complex are widely separated and have been intruded by the Tertiary-age tonalite and granodiorite plutons; the complex may have been originally of much greater extent. As noted, the original relation between these Stikine terrane rocks and rocks assigned here to the Nisling terrane is not known; at the present they are separated by either the Meade Glacier Fault (Brew and Ford, 1987) or by Tertiary plutons. M.G. Mihalynuk (British Columbia Geological Survey, written commun., 2000) has suggested that all of the Stikine terrane rocks may actually be a folded thrust package that rests on Nisling rocks. In this interpretation, the southwestern part of the thrust has been obscured by younger intrusive rocks and the northeastern part has been re-activated as the Meade Glacier Fault.

FAULTS AND SEISMICITY

As noted, the Atlin map area contains the Meade Glacier Fault, which records post-Triassic(?), pre-middle Tertiary movement (Brew and Ford, 1987) of uncertain sense. Several lineaments with dominantly north and northeast trends are present; they are interpreted to be relatively young brittle deformation features that are antithetic with respect to the major Denali dextral fault that lies not far west of the map area.

Seismic activity has been recorded close to the Atlin map area and in the adjacent parts of the Juneau and Skagway quadrangles (Brew, Horner, and Barnes, 1995b). The seismic events to the south of the quadrangle were generally small, less than Magnitude 4, and cluster in a north-northeast-striking zone (fig. 2) that does not have any obvious fault or other structure exposed at the surface associated with it. All events appear to have occurred to the northeast of the Coast Range Megalineament (Brew and Ford, 1977a).

PLUTONIC ROCKS

The plutonic rocks of the northern Coast Mountains belong to several distinguishable groups (Brew, 1994). Discussions of previous studies of these rocks in both the Klondike Highway transect near Skagway north of the present study area (fig. 1; Barker and others, 1986, Barker and Arth, 1990; Brew and Ford, 1994) and in the Taku River transect to the south (Drinkwater and others, 1990, 1994, 1995) has been somewhat hampered by inconsistent nomenclature.

To overcome this difficulty, this report uses informal nomenclature that is based on our studies and those of Barker and others (1986) in the Skagway transect. We reject the name "Bennett Suite", which was suggested for most of these rocks by Woodsworth and others (1989). Simply stated, the plutonic rocks in the Skagway transect are assigned to three different groups: 1) the intrusive rocks of the Great Tonalite sill of 84- to 56-Ma tonalite and related rocks; 2) the intrusive rocks of Skagway, which consist of mid-50-Ma tonalites, granodiorites, and related rocks; and 3) the slightly younger intrusive rocks of White Pass, which consist of of 54- to 48-Ma granites and related rocks (see Brew and Ford, 1994). The plutons in the Atlin quadrangle are compared to those of the Skagway transect in brief specific discussions in this report. All three groups of intrusive rocks are present in the Taku River transect (Drinkwater and others, 1995). All three are part of the Coast Mountains Complex (Brew, Himmelberg, and Drinkwater, 1995); the Skagway intrusive rocks, together with coeval volcanic rocks, extend well to the east as far as the Teslin Lake area in British Columbia, where this unit has been informally called the Sloko Suite (M.G. Mihalynuk, written commun., 2000).

The informally named Great Tonalite sill is a composite sill-like plutonic unit composed of a series of *en echelon* and overlapping or adjoining individual foliated and lineated biotite-hornblende tonalite sills. The unit extends the whole length of southeastern Alaska. The name comes from published use by Hooper and others (1990), Hutton and Ingram (1992), and Ingram and Hutton (1994). The Great Tonalite sill has its type area in the Juneau 1:250,000-scale quadrangle to the south of the Atlin quadrangle. Detailed mapping (Ford and Brew, 1973, 1977a; Brew and others, 1976; Brew and Ford, 1977b) and related studies (Gehrels and others, 1991; Hutton and Ingram, 1992; Brew, 1994; Ingram and Hutton (1994); all summarized in Drinkwater and others, 1995) provide a basis for its widespread recognition. The rocks of the "sill" form a belt up to about 10 kilometers wide that extends the complete northwest-southeast dimension of the Juneau quadrangle and beyond to the north-northwest and south-southeast. Individual plutons are as old as 81 Ma and as young as 56 Ma (Gehrels and others, 1991; D.A. Brew, unpub. data). The plutons comprising the suite at Juneau are the Speel River, Mount Juneau, Carlson Creek, Lemon Creek Glacier, Mendenhall, and some smaller unnamed ones. The Mendenhall pluton extends northward into the southwestern part of the Atlin map area, where it is mapped as unit TKtf. Brew and Ford (1994) discuss the equivalent rocks to the north in the Skagway transect.

The intrusive rocks at Skagway are best exposed near Skagway northwest of the Atlin quadrangle; that is their type area. Barker and others (1986) used the term "Tonalite at Skagway" to cover the three individual plutons described below, as did Mihalynuk (1997). Studies by Barker and others (1986) and Barker and Arth (1990), and mapping by Redman and others (1984), Gilbert and others (1990), and Brew and Ford (1994) have delineated a broad area of hornblende-biotite tonalite and granodiorite that underlies most of the Coast Mountains. Mihalynuk (1997) has mapped lithologically similar plutons of about the same age and assigned them to his Sloko Suite in the Tagish Lake area nearby in British Columbia. Individual plutons are all dated as mid-50s Ma (Gilbert and others, 1990; Gehrels and others, 1990; Mihalynuk, 1997). The main plutons making up the suite are the Burro Creek, Mount Cleveland, and Fraser (Redman and others, 1984; Brew and Ford, 1994); these plutons may actually be a single composite mass (Gilbert and others, 1990; D.A. Brew, unpub. data, 1995, 1996). The Burro Creek pluton extends into the central part of the Atlin map area, where it is dated by sample 84DB087A (fig. 3), which is described herein. The name for the unit comes from previous informal use (Brew and Ford, 1994).

The intrusive rocks at White Pass are also best exposed in the Skagway area northwest of the Atlin quadrangle. Studies by Barker and others (1986) and Barker and Arth (1990), and mapping by Gilbert and others (1990), Brew and Ford (1994), and D.A. Brew (unpub. mapping) have delineated several relatively small areas of biotite granite and sphene-biotite granodiorite that underlie part of the Coast Mountains between the Skagway River Valley and the international boundary to the northeast. Two plutons first described by Barker and others (1986) define the unit: the Clifton pluton is dated as 48 Ma and the Summit Lake pluton as 54 Ma (Barker and others, 1986; Gehrels and others, 1991). Two small unnamed biotite granite plugs in the Atlin quadrangle are interpreted to belong to this unit, as is a sphene-biotite granodiorite body on the international boundary. The name for the unit comes from the proximity of the Clifton and Summit Lake plutons to White Pass (Brew and Ford, 1994). The White Pass rocks are easily distinguished from those of the Skagway intrusive rocks by their lack of hornblende and their abundance of K-feldspar. These rocks correlate with the Turner Lake pluton and related rocks in the Juneau Ice Field to the south (Drinkwater and others, 1995).

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Migmatite in the Atlin quadrangle, Alaska. Parallel dikes and associated apophyses of Skagway rocks (55- to 54-Ma hornblende-biotite granodiorite) intrude country rock consisting of biotite-feldspar-quartz hornfels of Nisling (or Snowtop) terrane. Yang Shengwu from the People's Republic of China is the geologist in the photograph.

Geologic Map of the Atlin Quadrangle, Southeastern Alaska

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