DEPARTMENT OF THE INTERIOR

U.S. GEOLOGICAL SURVEY

Preliminary reconnaissance geologic map of the Juneau, Taku River, Atlin, and part of the Skagway 1:250,000 quadrangles, southeastern Alaska

By

David A. Brew [1] and Arthur B. Ford [1]

Open-File Report 85-395

This map is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards and stratigraphic nomenclature.

[1] Menlo Park

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United States Department of the Interior

GEOLOGICAL SURVEY

Branch of Alaskan Geology
345 Middlefield Road/MS 904
Menlo Park, CA 94025

September 3, 1985

MEMORANDUM

To: Recipients of OF 85-395

From: Sue Douglass

Subject: ERRATA

ERRATA: U.S. Geological Survey Open-File Report 85-395

Page 10 - Left side of page Triassic unit symbols should read: "TR hh and TR hp" (see below)

HYD GROUP (Upper Triassic)--Named by Loney (1964) from exposures in Gambier and Pybus Bays on Admiralty Island; extended to the Keku Islets area and redefined by Muffler (1967); as mapped, divided into: (This division has not yet been made on the map, all currently included in Phyllite, etc., unit).

TR hh — Hound Island Volcanics--Basaltic pillow breccia and pillow lava flows, andesitic volcanic breccia, aquagene tuff, tuff breccia, minor thin-bedded limestone; outcrops extensively on northern Admiralty Island.

TR hp — Phyllite, Limestone, Slate and Chert--Unnamed and undivided unit interpreted (Lathram and others, 1959) to underlie the rocks here referred to as the Hound Island Volcanics on northern Admiralty Island.

PRELIMINARY RECONNAISSANCE GEOLOGIC MAP OF THE JUNEAU, TAKU RIVER, ATLIN, AND PART OF THE SKAGWAY 1:250,000 QUADRANGLES, SOUTHEASTERN ALASKA

By
David A. Brew and Arthur B. Ford

INTRODUCTION

This compilation of the geology of the Juneau quadrangle and some contiguous areas is based on both published and unpublished maps, as shown in the small-scale index map on sheet 2 of this report. It is being released in this form at this time to: 1) make available in a generalized way some detailed information that will not otherwise be published for some time, 2) provide a starting point for the U.S. Geological Survey geologists, geochemists, and geophysicists now undertaking a comprehensive study of the project area as part of the U.S.G.S.'s Alaskan Mineral Resources Assessment Program, and 3) provide a regional geologic base map for a recently started U.S. Bureau of Mines program in approximately the same area.

The scheme used in organizing the map units and preparing the "Correlation of Map Units" (see sheet 2) and the "Description of Map Units" (this pamphlet) follows that developed by Brew and others (1984) for the Petersburg project area, some 120 km to the south. The rocks are classified into six informally named geographically and stratigraphically defined belts; from west to east they are 1) the Alexander belt of Paleozoic rocks, together with the overlapping 2) Icy Strait sub-belt of Tertiary, volcanic rocks and 3) Mansfield sub-belt of Paleozoic, Mesozoic and Mesozoic(?) rocks; 4) the Gravina belt of upper Mesozoic rocks, which probably also overlaps the Alexander Belt; and 5) the Mainland belt of metamorphic and plutonic rocks. This last belt contains the Tulsequah sub-belt of rocks near the International Boundary. As in the case of the Petersburg area map, these belts do not correspond exactly to the tectonostratigraphic terranes inferred to be present in the region by Berg and others (1978). In addition to these belts, the plutonic belts defined by Brew and Morrell (1983) are referred to where appropriate.

The information given below for each map unit in the Brief Description of Map Units is intentionally terse and brief. The main facts conveyed concern the general lithologic make-up of the unit; the currently accepted age, as based on published (and in a few cases, unpublished) information; and references to previous publications with more information than has been incorporated into the descriptions given here.

Except where specifically noted, the age information given does not include any unpublished paleontologic data acquired as the result of recent collections, nor are any of the as-yet-unpublished potassium-argon age determinations cited specifically. Finally, some of the areas labeled on the map as "unmapped" really are mapped, but not yet to the point that we feel comfortable about including them.

A complete bibliography of the geological literature concerned with this map area has been recently compiled by Douglass and Cobb (1984), the mineral deposits have been catalogued by Wells and Pittman (1985), and an aeromagnetic survey released (U.S. Geological Survey, 1984).

We wish to thank Raymond L. Elliott for his careful and thorough technical review, and Susan L. Douglass and Erik Lundin for their dedicated assistance in preparing the report for release.

BRIEF DESCRIPTION OF MAP UNITS

Qs SURFICIAL DEPOSITS (Holocene and(or) Pleistocene)--Includes alluvium, colluvium, tidal mudflat deposits, and some glaciofluvial deposits. The distribution of most large areas of surficial deposits was mapped in the field, but the deposits have not been studied in detail; many small areas are not shown.

ICY STRAIT BELT

Belt informally named here.

EXTRUSIVE AND INTRUSIVE ROCKS OF ICY STRAIT VOLCANIC-PLUTONIC BELT (Quaternary(?) and Tertiary)--Volcanic rocks exposed on islands in Icy Strait east of Glacier Bay and plutonic rocks exposed east of Glacier Bay proper; as mapped, divided into:

QTa Andesite and Other Intermediate Extrusive Rocks--Described by Lathram and others (1959) as: "Flows, tuff and breccia--Medium to light-gray, purple and green andesite, dacite, dacite obsidian, rhyodacite, aegerine-augite soda trachyte, and less abundant dark-gray basalt;" exposed on Pleasant Island.

QTb Basalt and Other Mafic Extrusive Rocks--Described by Lathram and others (1959) from The Sisters as: "Basalt--Flows, flow breccia of dark greenish-gray basalt; rocks slightly epidotized; less than 100 feet exposed;" and on Hanus Reef as: "Basalt and andesite flows, agglomerates, and tuff." Augite basalt is exposed on The Knob on Pleasant Island.

Tsan Porphyritic Andesite (Pliocene(?) and Miocene(?)--Medium gray, phenocrysts of quartz-feldspar, magnetite, and chloritized hornblende; age based on interpretation of unpublished K-Ar data (M. L. Lanphere, written commun., 1967); exposed on the north side of Adams Inlet, Glacier Bay.

Tgqm Hornblende Quartz Monzonite (Miocene(?) and Oligocene(?)--Medium grained; K-feldspar porphyritic; color index 5-10; accessory minerals are sphene, chlorite, and epidote; age based on interpretation of unpublished K-Ar data (M. A. Lanphere, written commun., 1967); exposed in two small bodies at Sandy Cove and west of Sitth-gha-ee Peak, and in a large body near Casement Glacier.

ALEXANDER BELT

Belt informally named to denote those rocks that form a coherent stratigraphic section (including the pre-Cenozoic granitic and other rocks intrusive into that section) in the western part of the map area, ranging in age from Silurian to Permian. As used here, includes one intrusive rock unit of Tertiary and(or) Cretaceous age. Includes Mansfield sub-belt described separately.

TKgd HORNBLENDE-BIOTITE AND BIOTITE-HORNBLENDE GRANODIORITE (Tertiary and(or) Cretaceous)--Unfoliated medium- to coarse-grained, very light gray to medium gray, color index 7-19; sphene and chlorite common; age based on regional considerations and interpretation of unpublished K-Ar data, including one biotite age of 27 Ma (M. A. Lanphere, oral commun., 1980) from the body; exposed east and west of Casement Glacier; also exposed on northeastern Admiralty Island.

INTRUSIVE ROCKS OF THE MUIR-CHICHAGOF PLUTONIC BELT I (Cretaceous)--Plutonic belt informally named by Brew and Morrell (1983); age based on interpretation of K-Ar data (Loney and others, 1967). Part of the large complex of intermediate composition granitic and gabbroic rocks between the Sitkoh Bay and Peril Strait faults (Loney and others, 1975). As mapped, divided into:

Kmdt Uralitized Biotite-Pyroxene Diorite, Biotite-Hornblende Diorite, and Biotite-Hornblende Melatonalite--Foliated, heterogeneous; exposed only in body at head of Tenakee Inlet, Chichagof Island.

Kmto Hornblende Tonalite, Hornblende Diorite, Biotite-Hornblende Diorite, and Biotite-Hornblende Tonalite--Foliated, heterogeneous; exposed mainly southwest of Mud Bay River and Neka River, Chichagof Island.

INTRUSIVE ROCKS OF THE CHILKAT-PRINCE OF WALES PLUTONIC PROVINCE (Cretaceous)--Plutonic province informally named by Sonnevil (1981); preliminary K-Ar determinations from rocks in the province (which is synonymous with the Muir-Chichagof plutonic belt II of Brew and Morrell (1983)), on Kosciusko and Prince of Wales Islands by M. A. Lanphere (written communs., 1981, 1982) give about 100 Ma; one preliminary K-Ar determination on hornblende from the Nun Mountain body in the Chilkat Mountains is 103 Ma, and one from Bear Track Cove body is 114 Ma (M. A. Lanphere, oral communs., 1967, 1983). As mapped, divided into:

Kwmg Migmatite and Biotite-Quartz-Feldspar Gneiss--Most is associated with large body of biotite-hornblende granodiorite north of the Casement Glacier in Glacier Bay National Park and Preserve; one other outcrop area south and east of Casement Glacier on Snow Dome.

Kwgd Biotite-Hornblende Granodiorite--Also biotite-hornblende granite, quartz monzonite, quartz diorite, and diorite; most individual bodies are foliated; accessory minerals include pyrite, epidote, sphene, and chlorite; very light gray to dark gray, felsic types locally pinkish gray; color index 4-30, averaging 15; fine- to coarse-grained; dark fine-grained inclusions common; widely exposed north of Casement Glacier, in scattered small bodies in the Chilkat Mountains, and in the large Nun Mountain body in the southern Chilkat Mountains, which is described by Lathram and others (1959) as: "Granodiorite--Hornblende granodiorite, biotite-hornblende granodiorite; local variants include hornblende diorite, diorite porphyry, hornblende syenodiorite, hornblende-garnet syenodiorite, hornblende quartz diorite, biotite-hornblende quartz diorite containing abundant fine-grained hornblende diorite inclusions."

Kwan Andesite--Described by Lathram and others (1959) as: "Andesite dikes and sills--Altered hornblende basaltic andesite, hornblende-pigeonite andesite, and hornblende andesite;" age inferred from Lathram and others (1959), but could be as young as Tertiary and therefore correlative with the Tertiary andesite unit (Tsan); exposed in one small body between Endicott River and Excursion River in the Chilkat

Mountains.

Kwqd Biotite-Hornblende Quartz Diorite and Tonalite--Also granodiorite and diorite; foliated, locally gneissic; fine- to coarse-grained; very light gray to dark, grayish green; color index 3-68, averaging 25; accessory minerals include pyrite, epidote, sphene, and chlorite; locally abundant dark fine-grained inclusions; exposed in bodies near Bear Track Cove, Glacier Bay, on the Porpoise Islands in Icy Strait, and near Excursion Inlet.

Kwdi Biotite-Hornblende and Hornblende-Biotite Diorite--Described by Lathram and others (1959) as: "Diorite and quartz diorite--Hornblende-biotite diorite, hornblende-biotite quartz diorite, lesser amounts quartz monzonite, quartz monzonite gneiss, granodiorite, and hornblendite. Plutons west of William Henry Bay mostly sheared augite-biotite diorite, augite diorite. Small pluton Central Chilkat Mountains augite diorite cut by diabase or andesite dikes. At Sullivan Island biotite quartz diorite gneiss, granodiorite gneiss, biotite diorite;" small bodies on northeastern Chichagof Island described by Loney and others (1975) as chloritized biotite-hornblende diorite porphyry and chloritized diorite.

Kwdb Diabase--described by Lathram and others (1959) as: "Diabase and basalt--Intrusions northwest of William Henry Bay are diabase, locally may contain fine-grained diorite..."

Kwgb Gabbro--poorly exposed and poorly documented small plugs on Snow Dome, Glacier Bay.

METAMORPHIC ROCKS IN THE MUIR-CHICHAGOF PLUTONIC BELT I AND CHILKAT-PRINCE OF WALES PLUTONIC PROVINCE (Cretaceous)--Aureoles around plutons of the Muir-Chichagof plutonic belt I and Chilkat-Prince of Wales plutonic province in the Chilkat Mountains and on northern Chichagof Island; age is that of the plutons (about 100-110 Ma) based on preliminary K-Ar dating (M. A. Lanphere, written communs., 1967); as mapped, divided into:

Kch Marble--Medium- to coarse-grained, white fresh, light gray weathering; original bedding and structures largely obliterated. Metamorphosed from adjacent limestone units. (Unit not yet delineated on map in Chilkat Mountains).

Kth Biotite-Quartz-Feldspar Hornfels--Fine- to medium-grained, brownish-gray; original sedimentary structures and bedding of graywacke and mudstone turbidite sequence locally preserved; metamorphosed from graywacke and mudstone of adjacent units. (Unit not yet delineated on map in Chilkat Mountains).

UNNAMED PERMIAN FORMATION(S) IN GLACIER BAY-CHILKAT MOUNTAINS AREA (Lower Permian)--Age based on several fossil collections from different localities in the Chilkat Mountains and north of Casement Glacier and south of Adams Inlet, Glacier Bay. As mapped, divided into:

Pua Argillite and Limestone--Includes some phyllite, slate, shale, and graywacke; limestone is thin-bedded and interbedded with other rock types; exposed north of Casement Glacier and south of Adams Inlet, Glacier Bay.

Puv Amygdaloidal Basalt or Andesite--Includes some greenstone, greenschist, and phyllite; exposed north of Casement Glacier and south of Adams Inlet, Glacier Bay.

Pul Limestone and Siltstone--Thin- to thick-bedded, locally cherty, light- to dark-gray; exposed north of Casement Glacier and south of Adams Inlet, Glacier Bay, and near William Henry Bay in the Chilkat Mountains where it was described by Lathram and others (1959) as: "Limestone--Light to medium brownish gray, fine to medium crystalline, contains sparse paper-thin reddish-brown separations, fossiliferous, 50(?) feet thick; overlain by limestone, nodular-bedded, light-brownish-gray, fine- to medium grained, interbedded with light-greenish-brown chert, which varies along strike from interbedded sequence to apparent limestone-chert conglomerate; in turn overlain by dark-gray slate, interbedded with very fine grained calcareous graywacke and silty calcareous graywacke. Medium total thickness 1,000 feet." Some megafossil collections from this unit are interpreted by J. T. Dutro, Jr. (written commun., 1984) to be like those from the Pybus Dolomite (Loney, 1964) and Pybus Formation (Muffler, 1967; Brew and others, 1984).

Pcl LIMESTONE AND MARBLE (Permian(?) and Carboniferous(?)--poorly defined unit; northern exposures of the unit described by Lathram and others (1959) as: "Limestone and marble--Light- to medium-gray, thick-bedded, contains interbeds of phyllite and lenses and layers of basalt near top. Approximately 3,000 feet thick, thins rapidly northward. Unfossiliferous, except probable equivalent limestone, ...contains chain corals, brachiopods, giant cephalopods." A collection of corals, crinoids, bryozoa, and brachiopods from light-gray limestone was examined by W. A. Oliver, Jr. (written commun., 1959) and called "post-Devonian Paleozoic" and by H. Duncan (written commun., 1959) and called Permian(?) but with some waffling about a possible Carboniferous age. Exposed in the Chilkat Mountains north of Endicott River.

Mi IYOUKEEN FORMATION (Mississippian)--Upper cherty fossiliferous limestone member and lower fossiliferous shale with minor limestone member; described and named by Loney and others (1963); exposed on northeastern Chichagof Island.

Df FRESHWATER BAY FORMATION (Upper Devonian)--Andesite and basalt flows, volcanic breccia, tuff, minor graywacke, and limestone; described and named by Loney and others (1963); exposed on northeastern Chichagof Island.

CEDAR COVE FORMATION (Upper Devonian)--Described and named by Loney and others (1963); exposed on northeastern Chichagof Island; as mapped, divided into:

Dc Cedar Cove Formation--Undivided

Dcc Clastic Member--Conglomerate, graywacke, argillite, and minor limestone.

Dcl Limestone Member--Thin- to medium-bedded limestone, minor shale.

Dbcl BLACK CAP LIMESTONE (Middle Devonian)--Light gray, thick-bedded upper member and dark gray, thin-bedded lower member; described and named by Rossman (1963); exposed north and south of Adams Inlet, Glacier Bay.

GLACIER BAY SEQUENCE (Devonian and(or) Silurian)--Informally named here to emphasize the complex island-arc depositional situation that persisted from Late Silurian into Middle Devonian time; as mapped, divided into:

Carbonate Rocks (Devonian and(or) Silurian)--These extensive carbonate units--the Willoughby, Pyramid Peak, and Kennel Creek--are interpreted to have formed as fringing reefs or carbonate banks in an island-arc environment dominated by volcanic turbidites. They probably range in age and are not a single stratigraphic horizon. Divided into:

DScw Willoughby Limestone--Massive, bluish-gray to light gray limestone and marble; described and named by Rossman (1963); exposed north of Endicott River in Chilkat Mountains.

DScp Pyramid Peak Limestone--Light gray, very thin- to thick-bedded nonfossiliferous limestone with some interbedded argillite near the top; lower part is thin-bedded dark gray to black limestone; described and named by Rossman (1963); exposed south of Adams Inlet, Glacier Bay.

DSck Kennel Creek Limestone--Light- to medium-gray, thin- to very thick-bedded limestone; minor dolomite, limestone breccia, shale, siltstone, and conglomerate; described and named by Loney and others (1963); the name extended by Loney and others (1975); exposed on northeastern Chichagof Island.

Volcanic and Associated Rocks (Devonian and(or) Silurian)--Divided into:

DSbv Greenstone and Greenschist--Exposed near Berg Mountain in Chilkat Mountains; described there by Lathram and others (1959) as part of their "Siliceous argillite and volcanic rocks" unit: "Basalt and andesite flows, agglomerates, and tuff, ...increase in abundance...laterally and predominate in north-central Chilkat Range;" and west of Casement Glacier, Glacier Bay.

DSbl Limestone associated with Greenstone and Greenschist--Thin, discontinuous, nonfossiliferous limestones in central part of Chilkat Mountains.

DSbb Basal Graywacke and Volcanic Rock Unit--Poorly documented (as yet) basal part of the thick volcanic pile; exposed only in central part of Chilkat Mountains.

Turbidites and Associated Rocks (Devonian and(or) Silurian and Upper Silurian)--These very extensive turbidite, argillite, limestone, and conglomerate units--the Rendu and Point Augusta Formations--are interpreted to be the dominant feature of a long-lived island-arc environment. The two formations may grade into one another. The limestones that are mapped separately probably vary in age and do not represent persistent stratigraphic horizons. Divided into:

DSr Rendu Formation (Devonian and(or) Silurian)--Thin-bedded argillite, limestone, and limy mudstone; described and named by Rossman (1963); exposed south of Adams Inlet, Glacier Bay.

Point Augusta Formation (Upper Silurian)--Dominantly graywacke, mudstone, and calcareous mudstone turbidites, with subordinate conglomerate, and limestone, described and named by Loney and others (1975) on northeastern Chichagof Island; extended here northwards into the Chilkat Mountains and Glacier Bay and re-interpreted to include a thick siliceous argillite section considered Silurian(?) to Devonian age by Lathram and others (1959). Sedimentary features in sandstone turbidites include massive, amalgamated beds, channelized beds, graded beds with Bouma sequences, and chaotically deformed slump deposits. Sandstones are dominantly calcareous graywacke. Probably originally continuous with the Bay of Pillars Formation named and defined by Muffler (1967) from exposures on Kuiu Island and extended on Kuiu, Kosciusko, and northern Prince of Wales Islands by Brew and others (1984). Unit thickness probably exceeds a few thousand meters. Graptolite collections made in 1966 are Late Silurian (M. Churkin, Jr., oral commun., 1967). Exposed on northeastern Chichagof Island and in the Chilkat Mountains. As mapped, divided into:

Stag Graywacke, Mudstone, Turbidites, and Limestone--Grayish-brown to gray fresh, tan to gray weathering graywacke, mudstone and calcareous mudstone; graywackes typically very thin- to medium-bedded, with some thicker and amalgamated beds. Soft sediment deformation is common. The dominant rock type is calcareous graywacke with carbonate clasts, fossil fragments, subordinate feldspar, quartz, and volcanic rock fragments, and patchy recrystallized carbonate matrix.

Stal Limestone--Thin- to medium-bedded light-gray limestone and minor limestone turbidites. The limestone turbidites are probably interchannel and overbank deposits. The more massive limestones may represent slope facies deposits or carbonate banks like other carbonate units in the Glacier Bay sequence.

Staa Argillite and Graywacke--As yet poorly understood thick unit in the Chilkat Mountains; described by Lathram and others (1959) as: "Argillite--Dark-gray, siliceous, weathers dark brownish-red, contains large lenses of pebble to cobble conglomerate and layers of gray-green graywacke in lower part. Includes thin-bedded black, gray, and dark-green chert near top. At least 3,000 feet thick. Contains plant fragments."

Pzsp Schist and Phyllite (Paleozoic)--As yet poorly understood unit in the central Chilkat Mountains; described by Lathram and others (1959) as: "Schist, phyllite, and slate--Reddish-brown weathering chlorite schist, sericite schist, phyllite, and black slate. Upper 200 to 300 feet medium dark-gray weathering slate and phyllite, thin limestone layers near top. Minimum thickness

2,500 feet. Unfossiliferous." May be metamorphosed equivalent of the Argillite and Graywacke unit (Staa) described above.

MANSFIELD SUB-BELT

The term Mansfield sub-belt is used here to denote metamorphic rocks of indeterminate Mesozoic(?) age and several better-defined stratigraphic units of Paleozoic and Mesozoic age in a narrow north-south zone near the middle of the map area. Within the rocks of indeterminate age are at least a few large blocks of limestone that contain fossils of Paleozoic age; thus part of this sub-belt is analogous to the Duncan Canal-Zarembo Island-Screen Island sub-belt of the Gravina belt in the Petersburg map area (Brew and others, 1984) and may actually be continuous with that sub-belt. The remaining part of the sub-belt is like the Mesozoic section of the Alexander belt in the Keku Strait area of the Petersburg map-area.

HYD GROUP (Upper Triassic)--Named by Loney (1964) from exposures in Gambier and Pybus Bays on Admiralty Island; extended to the Keku Islets area and redefined by Muffler (1967); as mapped, divided into: (This division has not yet been made on the map, all currently included in Phyllite, etc., unit).

T hh — Hound Island Volcanics--Basaltic pillow breccia and pillow lava flows, andesitic volcanic breccia, aquagene tuff, tuff breccia, minor thin-bedded limestone; outcrops extensively on northern Admiralty Island.

T hp — Phyllite, Limestone, Slate and Chert--Unnamed and undivided unit interpreted (Lathram and others, 1959) to underlie the rocks here referred to as the Hound Island Volcanics on northern Admiralty Island.

METAMORPHOSED SEDIMENTARY VOLCANIC, GRANITIC, AND ULTRAMAFIC ROCKS (Mesozoic?)--The age of the protoliths is not known nor is the relation of this group of rocks to the Alexander belt rocks adjacent to the east.

Mzps — Phyllite and Semischist--Metamorphosed from mudstone, siltstone, tuff, and graywacke; low grade (probably sub-greenschist facies) metamorphic rocks; commonly highly folded and well foliated; locally graphite-rich; brownish-gray to very dark gray fresh, gray to brown weathered; probably several thousand meters thick; unit encloses a few large lenses of Limestone unit (DSl) of Devonian and(or) Silurian age, but there is no direct indication of its age; contrasts with the Phyllite and Slate unit (Mzpv) in the proportion of originally coarse-grained sediments, and in the lesser amount of volcanic(?) protolith phyllite in this unit; the two units may intertongue much more complexly than is shown on the map; equivalent to the Retreat Group, described and named by Barker (1957), who described the rocks as: "Sericite schist, greenschist, slate, and graywacke", and extended by Lathram and others (1965) who describe the main rock types as: "...the most common varieties of schist are chlorite-albite-epidote schist, calc-silicate schist, sericite-chlorite-albite schist, graphitic quartz-muscovite schist, sericite schist, amphibole schist, and garnet-muscovite-quartz-feldspar schist. Graphitic schist is commonly pyritiferous, and pyrite crystals an inch in maximum dimension may be found." Exposed on northern Admiralty Island.

Mzpv Phyllite and Greenschist--Metamorphosed intermediate to mafic volcanic rocks; phyllite, greenschist, greenstone, minor semischist; weathers light to dark green; probably several thousand meters thick; originally described by Barker(1957) as Barlow Cove Formation, consisting of "Chlorite-albite-epidote schist, with minor augite-bearing volcanic flow breccia and andesite flows, ...greenschist, graywacke, slate, and conglomerate;" revised by Lathram and others (1959) in part and described in general as: "volcanic rocks, argillite, and chert, undifferentiated" and more specifically as "...albite-epidote-chlorite schist, schistose graywacke, slate, conglomerate, phyllite, and minor augite-bearing schistose volcanic flow breccia and andesite flows ...marble ...quartz conglomerate and breccia." The protoliths of this unit are considered to be Permian and(or) Triassic by Lathram and others (1965).

Mzm Marble and Limestone--Marble, limestone and minor shale; weathers light to medium gray, light gray fresh; poorly bedded at 10-50 cm scale in a few places; most is fine- to medium-grained and most is recrystallized. No fossils (including conodonts) found, so age assigned is Mesozoic(?) based on association with the enclosing phyllite and semischist (Mzps) unit; it is equally likely that (as predicted from analogy with the other limestone lenses) these lenses are somehow related to the Limestone unit (DSl) of Devonian and(or) Silurian age. Unit crops out on the Kittens and Naked Island, near Funter Bay.

Mzgd Gneiss, Schist, and Semischist--Metamorphosed from an intermediate composition granitic rock; described by Barker (1957) and again by Lathram and others (1959, 1965) as: "Quartz diorite--Lineated, foliated, sheared albite-oligoclase-quartz-biotite quartz diorite;" exposed on northwestern Admiralty Island.

Mzum Ultramafic Rock--Serpentinized peridotite and dunite; fine- to medium-grained; greenish-gray fresh or orangish-brown weathered; exposed in three medium-sized bodies several hundred meters across on the ridge north of Greens Creek and one body at Point Marsden, both on northern Admiralty Island.

MzPzm MIGMATITE, GNEISS, AND FELDSPATHIC SCHIST (Mesozoic and(or) Paleozoic)--According to Lathram and others (1959) this relatively poorly exposed unit on northern Admiralty Island is complicated, and contains the following greenschist to amphibolite facies rock types: quartz-andesine-hornblende-biotite amphibolite, andesine-garnet-pyroxene gneiss, quartz-andesine-diopside-microcline-calcite gneiss, quartz-albite-chlorite-epidote schist, and quartz-albite-chlorite-biotite-epidote schist.

Pc CANNERY FORMATION (Lower Permian)--Graywacke, slate, phyllite, and conglomerate; originally described by Loney (1964) from southeastern Admiralty Island, extended into northern Admiralty (where it occurs on this map) by Lathram and others (1965), and to the south to Kupreanof Island by Muffler (1967); the Kupreanof rocks are now known to be Mississippian and Devonian (Jones and others, 1981; Brew and others, 1984), but a few fossil collections establish that some of the northern Admiralty rocks are Permian. As mapped, this unit is shown as the host rock for the Greens Creek massive sulfide deposit.

DSl LIMESTONE (Devonian and(or)Silurian)--Medium-bedded to massive, fine- to medium-grained; light to medium gray fresh and weathered; two large lenses or blocks up to several hundred meters thick on northern Admiralty Island; one lense contains corals determined by W. A. Oliver (written commun., 1981) to be Devonian or Silurian.

GRAVINA BELT

The term Gravina belt is used here to denote sedimentary and volcanic rocks of Late Jurassic and Early Cretaceous age (and the pre-Cenozoic granitic rocks intrusive into that section) in the central part of the map area. The Gravina belt as used here more or less corresponds to the Gravina belt as defined by Berg and others (1978), but the map distribution does not correspond because of newer information and differing interpretations.

INTRUSIVE ROCKS OF ADMIRALTY-REVILLAGIGEDO PLUTONIC BELT AND ASSOCIATED MIGMATITE (Upper Cretaceous)--Plutonic belt informally named by Brew and Morrell (1983); no isotopic age determinations are yet available but regional information suggests that these rocks in this map area are about 90 Ma, as are lithically similar, K-Ar dated rocks in the Tracy Arm-Fords Terror area to the southeast (Brew and Grybeck, 1984). As mapped, divided into:

Kmgf Migmatite--Varied migmatitic rocks, mainly agmatite and irregular banded gneiss, within the Hornblende-Biotite-Tonalite and Granodiorite, etc. unit (Kgd); the granitic leucosomes generally resemble the main rock types in the above-mentioned (Kgd) unit; the metamorphic melasomes are fine- to medium-grained (garnet-) biotite hornfels, schist, and semischist. Crops out only on northeastern Admiralty Island.

Kgd Hornblende-Biotite-Tonalite and Granodiorite, Quartz Monzodiorite, Quartz Diorite, and Diorite--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.

Kmdi Hornblende Diorite--Hornblende diorite, quartz diorite, and minor gabbro; medium- to very-coarse-grained; color index 15 to 50; weathers light to dark green; highly altered to epidote- and chlorite-rich rock. Crops out southeast of Berners Bay, south of Herbert River, and on Douglas and Lincoln Islands. Differs from other Cretaceous granitic rocks in the high degree of alteration and(or) metamorphism. Body on Lincoln Island described by Barker (1957) as: "Gabbro--Sericitized hornblende-uralite gabbro."

STEPHENS PASSAGE GROUP (Upper Cretaceous/Cenomanian to Upper Jurassic(?))--Name proposed by Lathram and others (1965) for the "...sequence of slate, graywacke, conglomerate, and augite-bearing volcanic flow breccia, Late Jurassic and Early Cretaceous in age, which forms a well-defined northwest-trending belt of rocks exposed along the eastern slopes and shores of Admiralty Island..." This sequence also occurs northeast of Admiralty Island within this map area, south and east of Admiralty Island (Brew and

Grybeck, 1984; Souther and others, 1979) and extends southward into the Petersburg map-area where new information (Brew and others, 1984) shows that the Group there is as young as Albian or Cenomanian, i.e., late Early and early Late Cretaceous. The Brother's Volcanics/Douglas Island unit probably intertongues with the Seymour Canal Formation, probably near the top of the latter (Loney, 1964). As mapped, includes:

KJss Seymour Canal Formation--Graywacke, slate, and minor conglomerate; composed largely of volcanic debris, except for the conglomerates, which are polymictic and contain granitic clasts; most graywacke and slate were turbidites, but nothing more is known of the depositional environment; weathers dark greenish-gray, brownish gray, and very dark gray; graywacke and slate/argillite are locally calcareous and lighter colored; sedimentary structures common, although few directional features have been noted; probably a few thousand meters thick; some individual graywacke units are massive and 10's of meters thick, but most are 1 to 20 cm thick. Numerous fossil collections by Loney (1964) established a Late Jurassic and Early Cretaceous age for the unit on Admiralty Island; that age has been confirmed by subsequent collections from Douglas Island (Ford and Brew, 1977), elsewhere in the Petersburg map area (Brew and others, 1984; Berg and others, 1972); named by Loney (1964) from exposures at the mouth of Seymour Canal on Admiralty Island; name extended to the rest of Admiralty Island by Lathram and others (1965), to northern Kupreanof Island by Muffler (1967), and to other parts of the Petersburg map area by Brew and others (1984); exposed on the mainland, on islands in Stephens Passage, and on Douglas and Admiralty Islands. On Douglas Island this unit encloses the Treadwell "albite diorite" sill which is the host rock for the Treadwell gold deposits. As mapped, includes:

KJsc Conglomerate Member of Seymour Canal Formation--Massive to thick-bedded; pebble- to cobble-size well-rounded clasts; poorly sorted; according to Lathram and others (1959) the matrix is graywacke and the most common clasts are dark gray to black argillite, bedded graywacke, light- to medium-gray limestone, marble, felsite, quartz, chert, granite, and quartz diorite; exposed on Shelter Island (as the Shelter Formation of Barker (1957) and on northeastern Admiralty Island.

KJsd Douglas Island Volcanics--Augite-bearing flows, volcanic breccia, and intercalated tuff, volcanic graywacke, phyllite and slate; andesitic to probably basaltic composition; weathers dark greenish-gray, gray, and green, generally lighter colored where fresh; relict augite phenocrysts conspicuous in most outcrops; probably a few thousand meters thick; individual flow or breccia units as much as a few hundred meters thick and graywacke, tuff, and slate lenses may also be that thick. No fossils have been found in this unit in this map area; its age is based on its close association with the locally fossiliferous Seymour Canal Formation; named by Lathram and others (1965) on Admiralty Island from exposures on Douglas Island and the correlative Brothers Volcanics on southern Admiralty Island named by Loney (1964); exposed on the mainland, several islands in Stephens Passage, and on Douglas and Admiralty Islands; the best and least deformed or metamorphosed outcrops are on the mainland coast just south of Berners Bay. See also Berg and others (1972); Ford and Brew

(1977a, 1978); and Page and others (1977).

KJsu — Undifferentiated Greenstone, Metapelitic Rocks, and Metasandstone--Mixed and undifferentiated rocks, generally representing intertonguing of the Seymour Canal Formation (KJss) and the Douglas Island Volcanics (KJsd); exposed on the mainland, on a few islands in Stephens Passage, and on Douglas Island.

MAINLAND BELT

This belt is informally named to facilitate discussion of 1) rocks that have been metamorphosed to the extent that the age and nature of their protoliths is highly uncertain, and 2) the granitic and other rocks that intrude them. The belt occupies the northeastern corner of the map-area. The rocks in this belt, as well as some of those to the west in the Gravina belt, make up the Coast plutonic-metamorphic complex as defined by Brew and Ford (1984a,b,c). As mapped, includes the Tulsequah sub-belt described below.

GRANODIORITE OF CENTRAL COAST METAMORPHIC-PLUTONIC COMPLEX AND ASSOCIATED MIGMATITES (Eocene)--Age is based on preliminary K-Ar age determinations by J.G. Smith (written communs., 1974, 1975) reported in Brew and Grybeck (1984), and on K-Ar determinations by Forbes and Engels (1970), and Pb-U determinations by G. E. Gehrels (Gehrels and others, 1983, 1984). The units are similar in petrographic and field characteristics to similarly dated units to the south in the Sumdum, Taku River, Bradfield Canal and Ketchikan quadrangles (Webster, 1984) and to the north in the Skagway area (Barker and others, 1984). As mapped, divided into:

Temg — Migmatite Consisting of Tonalite, Granodiorite, Schist, and Gneiss Invaded by Sphene-Bearing Biotite-Hornblende Granodiorite, etc.--Tonalitic gneiss, tonalite, and amphibolite facies hornblende-biotite quartzofeldspathic schist and gneiss, and calc-silicates invaded by the homogeneous Sphene-Bearing Biotite-Hornblende Granodiorite Unit (Tegd); exposed mainly in the Taku Glacier part of the Juneau Icefield.

Tegd — Sphene-Bearing Biotite-Hornblende Granodiorite--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 (An_{40}-An_{25}) subhedral plagioclase; unit is widely exposed adjacent to the International Boundary in the eastern part of the map area; probably a series of undifferentiated composite plutons.

Teqm — Porphyritic Hornblende-Biotite Quartz Monzonite, Monzodiorite and Granodiorite--Locally porphyritic; unfoliated to slightly foliated; medium-grained; color index 4 to 25; gray to buff fresh, weathers to darker gray; 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 up to 3.5 cm locally; unit exposed in northeastern part of the map area not far from the International Boundary.

GRANODIORITE AND TONALITE OF COAST PLUTONIC-METAMORPHIC COMPLEX AND ASSOCIATED MIGMATITES (Paleocene)--Age is based on Pb-U determination on zircons by G. E. Gehrels (Gehrels and others, 1983, 1984); as mapped, divided into:

<u>Tpmg</u> Migmatite and Gneiss--Complex of homogeneous biotite-hornblende and hornblende-biotite tonalitic and granodioritic gneiss with local areas of diverse migmatite;exposed in western part of the Juneau Icefield.

<u>Tpgd</u> Hornblende-Biotite Granodiorite and Tonalite--Generally homogeneous, slightly to well foliated; fine- to coarse-grained; color index 8-20; weathers light gray, light to medium gray fresh; exposed as stubby sill-like bodies in the Juneau Icefield area between the large Sphene-Bearing Biotite-Hornblende Granodiorite bodies and the "sill belt" rocks (see below); almost always engulfed with Associated Migmatite and Gneiss unit (Tpmg).

INTRUSIVE ROCKS OF COAST PLUTONIC-METAMORPHIC COMPLEX SILL BELT AND ASSOCIATED MIGMATITE (Upper Cretaceous and(or) Paleocene)--Belt informally named by Brew and Morrell (1983); located northeast of Coast Range megalineament (Brew and Ford, 1978). Regional aspects of this belt discussed by Brew and others (1976); Brew and Ford (1981, 1984c; Ford and Brew (1981); belt is currently interpreted to be 62-69 Ma on the basis of Pb-U determinations by G. E. Gehrels on zircons from rocks in this map area and in the Sumdum quadrangle to the southeast (Gehrels and others, 1983, 1984). As mapped, divided into:

<u>TKmg</u> Migmatite Consisting of Schist and Gneiss Invaded by Tonalite--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; mapped mainly in the eastern margin of the Coast plutonic-metamorphic complex sill belt and extends several kilometers to the east; successively invaded by younger neosomes to the east and can be recognized as paleosomes in almost all migmatites of the Coast plutonic-metamorphic complex; see Karl and Brew (1983, 1984) for further information.

<u>TKto</u> Biotite-Hornblende and Hornblende-Biotite Tonalite, Quartz Diorite, and Minor Granodiorite--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; unit trends northwest through the northeast part of the map-area and includes the Mount Juneau, Mendenhall, Lemon Creek Glacier, and Carlson Creek plutons of Ford and Brew (1973, 1977b) and Brew and Ford (1977).

METAMORPHIC ROCKS OF COAST PLUTONIC-METAMORPHIC COMPLEX (Upper Cretaceous and(or) Paleocene)--This progressively metamorphosed belt forms the western edge of the Coast plutonic-metamorphic complex; the western part adjoins the low-grade metamorphic rocks of the Gravina Belt. The rocks are in general sufficiently metamorphosed that no original textures or structures remain. The protoliths must have included a variety of clastic rocks, dominantly fine-grained, but also some sandstones and conglomerates. The fine-grained sediments probably occurred in thicker units than the coarser-grained. Other protoliths were limestones 10's to 100's of m thick, sediments and volcanic rocks of intermediate to mafic composition, and probably some intermediate to mafic sill-like intrusions. Fossils collected in the vicinity of Juneau (Ford and Brew, 1977b; Brew and Ford, 1977) and in the Tracy Arm area (Brew and Grybeck, 1984) suggest that Lower Permian and Upper Triassic rocks form part of the protolith; proximity to the Gravina belt suggests that some of the protoliths may have been of Jura-Cretaceous age. Brew (1983) and Brew and Ford (1983, 1984a) argue that these rocks are the metamorphosed equivalents of rocks in the upper part (Permian and Triassic) of the Alexander Belt section, rather than a separate tectonostratigraphic terrane (or terranes) as espoused by Berg and others (1978). The age of metamorphism is interpreted to be Late Cretaceous and(or) Early Tertiary (Brew and Ford, 1984a, b, c); Gehrels and others (1983, 1984). As mapped, divided into:

<u>TKp</u> Phyllite--Dominantly well foliated and commonly lineated dark gray very fine- to fine-grained phyllite with minor thin dark gray semischist interlayers, weathers medium- to dark gray; some extensive areas of interlayered green phyllite that weathers light green; the former are probably derived from a fine grained clastic section; the latter from either tuffs or fine-grained volcanogenic sediments; metamorphic grade generally increases from prehnite-pumpellyite/low greenschist facies in the southwest to upper greenschist facies in the northeast; exposed discontinuously between the Coast Range megalineament and the Intrusive Rocks of Coast Plutonic-Metamorphic Complex Sill Belt, etc. unit. This unit is the host rock for the A-J gold-quartz stringer lode deposits.

<u>TKcs</u> Chlorite Schist, Greenschist, and Greenstone--Chlorite- and hornblende-schist; minor green semischist, slate, metagraywacke, and fine-grained black marble and limestone; exposed between Coast Range megalineament and the Intrusive Rocks of Coast-Plutonic-Metamorphic Complex Sill Belt, etc. unit between Mendenhall Glacier and Taku Inlet and between Stephens Passage and that same unit southeast of Taku Inlet.

<u>TKs</u> Schist, Undivided--Includes chlorite schist, greenschist, biotite- and garnet-biotite schist, hornblende and garnet-hornblende schist, calc-silicate schist, marble, and quartzite; exposed between the Coast Range megalineament and the Intrusive Rocks of the Coast Plutonic-Metamorphic Complex Sill Belt, etc. unit.

<u>TKbs</u> Biotite Schist--Dominantly well foliated and lineated biotite schist, lesser amounts of interlayered biotite semischist and hornblende schist and semischist; fine- to medium-grained; weathers grayish-brown, brownish-gray fresh; forms craggy ridges and steep slopes; metamorphic grade generally increases from southwest to northeast, in a Barrovian facies series, from greenschist facies to upper amphibolite facies; mineral isograds marking the first occurrence of biotite, garnet, staurolite, and kyanite trend north-northwest and appear to steepen northeastward; exposed between the Coast Range

megalineament and the Sill Belt to the northeast and in screens and pendants between there and the International Boundary.

TKhs — Hornblende Schist and Semischist--Poorly to well foliated, locally lineated, interlayered hornblende schist, semischist, and lesser amounts of biotite schist; fine- to coarse-grained; weathers greenish-gray, dark greenish-gray fresh; probably derived from intermediate to mafic volcanic flows, tuffs, or volcanic sediments, but some may be from fine-grained sills; metamorphic grade increases towards the northeast from upper greenschist facies to amphibolite facies and is compatible with metamorphic facies of nearby Biotite Schist and Semischist unit (TKbs); exposed only in relatively small elongate masses more or less in or on either side of the Sill Belt near Juneau.

TKq — Micaceous and Non-micaceous Quartzite--Quartzite and quartzitic schist commonly containing white mica and locally conspicuous pyrite; minor biotite schist and calc-silicate rock; some quartzite probably is metachert; exposed in relatively thin units associated with the Schist (TKs) and Phyllite (TKp) units near Juneau.

TKmb — Marble and Calc-Silicate Granofels--Poorly foliated, rarely lineated marble, calc-silicate granofels and schist interlayered with highly variable amounts of calcareous slate, phyllite, biotite and hornblende schist; fine- to coarse-grained; weathers white and light gray or yellowish-gray, white, and light gray fresh; commonly forms distinctive, poorly vegetated outcrops; derived from limestone and varying amounts of intercalated sediments; some marble masses are several hundreds of m thick and may have been reefoid limestones (or alternatively may simply be large detached fold hinges or a combination of the two); others consist of 1-cm to 10-cm scale layers intercalated with equal amounts of biotite schist; in the latter case they are mapped as this unit to emphasize the presence of the metacarbonates; mapped as elongate lenses within Schist (TKs), Biotite Schist (TKbs), and Biotite Gneiss (TKbg) units and as screens within the intrusive bodies to the northeast of the Sill Belt.

TKbg — Biotite Gneiss--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; weathers grayish-brown, gray fresh; probably derived from the same protoliths as the Phyllite (TKp) and Biotite Schist (TKbs) units; generally, but not exclusively, lies to the northeast of those units; exposed in isolated screens within the granitic rocks northeast of the Sill Belt.

TKhg — Hornblende Gneiss--Moderately to poorly foliated and layered medium- to coarse-grained hornblende gneiss with lesser amounts of hornblende and biotite schist; weathers greenish-gray or grayish-green, dark greenish-gray fresh; probably derived from same protolith as Hornblende Schist and Semischist unit (TKhs); crops out as irregular and elongate masses within the granitic rocks that extend to the International Boundary.

TKmm — Mica-Quartz Schist and Gneiss--Distinctive light colored muscovite-rich foliated rock; gneissic only in higher-metamorphic-grade areas;

probably derived from some kind of felsic volcanic or granitic rock; exposed only southeast of Juneau in association with the Phyllite (TKp) and Schist (TKs) units.

TKgm — Migmatitic Gneiss--Migmatitic schistose layered biotite- and hornblende-biotite gneiss; exposed in west-central and northwestern part of Juneau Icefield.

TKmd — Metamorphosed and Unmetamorphosed Diabase, Gabbro, Hornblende Diorite, Metadiorite, and Amphibolite--Exposed only west of Point Bishop on Taku Inlet, and on Picket Gate Crags and south of Vaughan Lewis Glacier, Juneau Icefield.

TKum — Ultramafic Rocks, Undifferentiated--Small intrusive plug of medium-grained peridotite exposed west of North Branch of Norris Glacier.

INTRUSIVE ROCKS OF ADMIRALTY-REVILLAGIGEDO PLUTONIC BELT AND ASSOCIATED MIGMATITE (Upper Cretaceous)--General age relations alluded to previously under Gravina Belt. As noted in that section, these plutons are about 90 Ma; in general, they have narrow thermal metamorphic aureoles that are superposed on deformed and low-grade regionally metamorphosed country rocks. Here in the Mainland Belt a further complication is locally present: parts (but not all) of some of this same family of plutons may have been involved in the deformation and progressive low- to high-grade metamorphism in latest Cretaceous and earliest Tertiary time that gave rise to the Metamorphic Rocks of the Coast Plutonic-Metamorphic Complex unit described above. Thus, the metamorphic age given for those rocks differs from the emplacement age given for this family of plutons. An alternative would be to assign the same metamorphic age to these plutons, but that is equally inadequate because not all of them show metamorphic features. As mapped, divided into:

Kmgf — Migmatite--Varied migmatitic rocks, mainly agmatite and irregular banded gneiss, within the Hornblende-Biotite Tonalite and Granodiorite, etc. unit (Kgd); the granitic leucosomes generally resemble the main rock types in the below-mentioned unit (Kgd); the metamorphic melasomes are fine- to medium-grained (garnet-) biotite hornfels, schist, and semischist; crops out only southeast of Taku Inlet.

Kgd — Hornblende-Biotite Tonalite and Granodiorite, Quartz Monzodiorite, Quartz Diorite, 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.

TULSEQUAH SUB-BELT

This belt is informally named to facilitate discussion of the low-pressure, high temperature metamorphic facies series rocks and unmetamorphosed volcanic rocks that occur near the International Boundary in the eastern part of the Coast plutonic-metamorphic complex (Brew and Ford, 1984c). These rocks occur in association with the Sphene-Bearing Biotite-Hornblende Granodiorite (Tegd), Porphyritic Hornblende Quartz Monzonite, Monzodiorite, and Granodiorite (Tegm), and Migmatite (Temg) units described previously near the beginning of the Mainland Belt unit descriptions. As mapped, divided into:

Tesv SLOKO GROUP (Eocene)--Pyroclastic volcanic rocks, ranging from tuff to coarse ash-fall breccias; minor sedimentary rocks; andesite, trachyte, dacite, rhyolite, minor andesite and basalt flows; weather dark purple, green, gray, reddish brown, and white; unit first described by Aitken (1959) from exposures south of Atlin, B.C.; age is inferred from the intimate association of the volcanics with the Sphene-Bearing Biotite-Hornblende Granodiorite (Tegd) unit on the north side of Mount Nelles, discussed by Souther (1971); exposed only close to the International Boundary in the Juneau Icefield (Forbes, 1959) and possibly in an area south of the Vaughan Lewis Glacier that is not shown on the map.

Tehq BIOTITE-QUARTZ HORNFELS (Eocene)--Protolith interpreted to be a quartz-rich sediment probably unlike those of any of the units described previously among the Metamorphic Rocks of the Coast Plutonic-Metamorphic Complex; exposed discontinuously along the International Boundary in the Juneau Icefield.

Tehv HORNBLENDE AND ALBITE-EPIDOTE-CHLORITE HORNFELS (Eocene)--Protolith interpreted to be relatively undeformed intermediate to mafic volcanic rocks of "map-unit 4" of Souther (1971); relict breccias, tuff-breccias, and tuffs locally recognizable; exposed quite extensively in the upper Hades Highway-Devils Paw part of the Juneau Icefield

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