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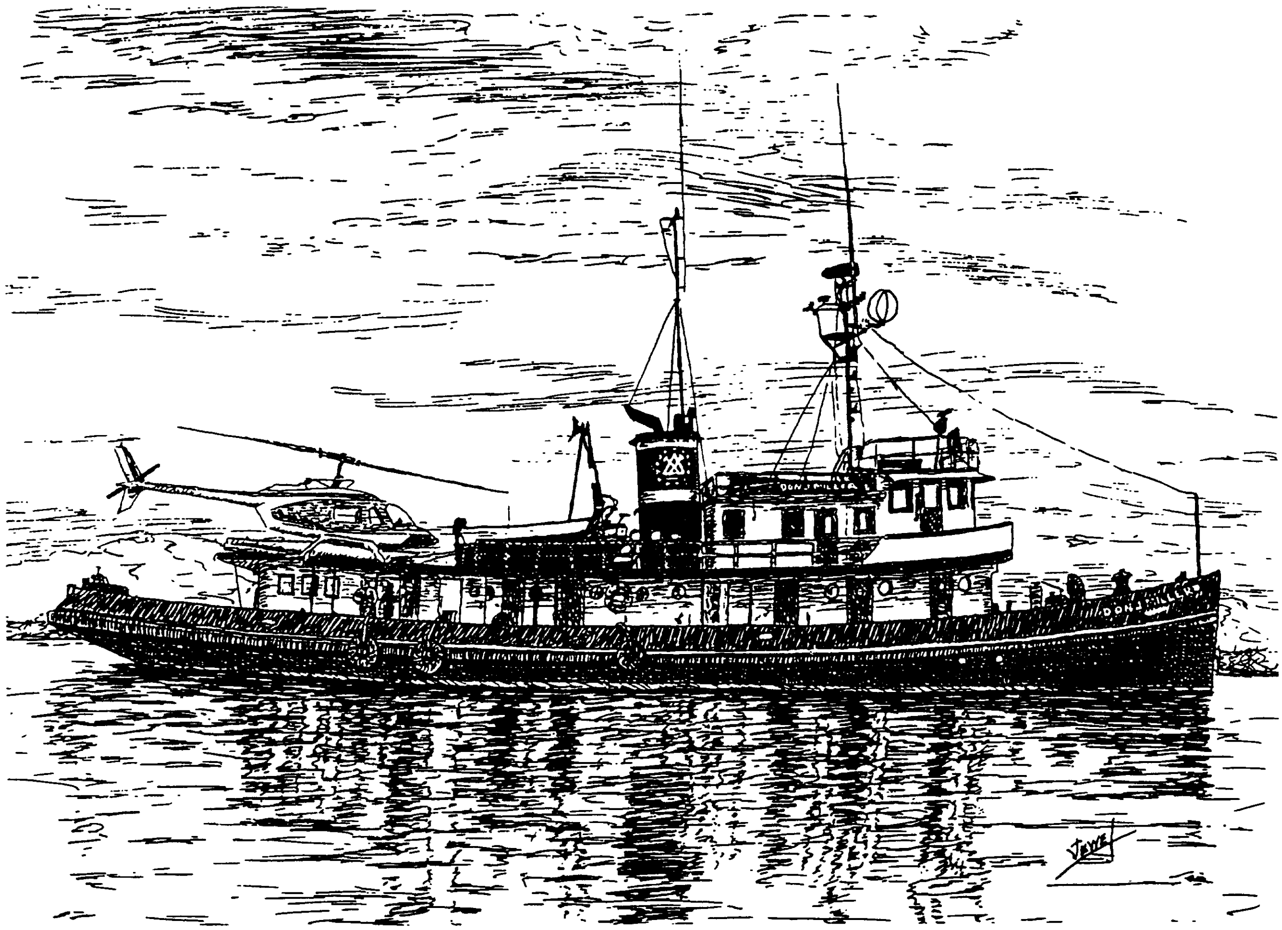

[U.S.G.S. R/V Don J. Miller II]

RECONNAISSANCE GEOLOGIC MAP OF THE PETERSBURG B-1 QUADRANGLE, SOUTHEASTERN ALASKA

Open-File Report 97-156-C

By David A. Brew

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Reconnaissance Geologic Map of the Petersburg B-1 Quadrangle, Southeastern Alaska

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Open-File Report 97-156-C

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INTRODUCTION

This map and its accompanying information were prepared specifically as a U.S. Geological Survey contribution to the joint State of Alaska Division of Geological and Geophysical Surveys and the U.S. Department of Interior Bureau of Land Management Alaska Minerals Section (Juneau, Alaska) mineral-resource studies of part of the Petersburg, Alaska 1:250,000-scale quadrangle. Those studies are a direct follow-up to geological, geochemical, and geophysical studies (cited below) done in the region by the Alaskan Branch of the U.S. Geological Survey in the 1970's and 1980's.

The geologic information presented here has been released previously in generalized form (Brew and others, 1984); the information is based on reconnaissance field mapping and thus does not have the density of field-station control, samples, or field observations that are expected in most U.S. Geological Survey 1:63,360-scale geologic maps. This map is one of a series that share the same format and general information (Brew, 1997a-m; Brew and Koch, 1997). There are both a combined description and a combined correlation of the map units for this whole series of maps (Brew and Grybeck, 1997).

The available information on known mineral deposits in the whole Petersburg/Wrangell area was released previously (Grybeck and others, 1984) and Brew and others (1989, 1991). Bedrock, stream-sediment, and other geochemical data were released and interpreted by Karl and others (1985), Karl and Koch (1990), Cathrall and others (1983a-w), and Tripp and Cathrall (1984). Aeromagnetic and aeroradioactivity surveys information was released by the U.S. Geological Survey (1978, 1979) and Bouguer gravity information by Barnes and others (1989). Remotely-sensed features were described by LeCompte (1981). Burrell and others (1982) released a preliminary bibliography of Petersburg and Port Alexander quadrangles-related items.

Assessments of the undiscovered mineral resources for the whole Petersburg/Wrangell area are also available (Brew and others, 1989, 1991; Brew and Drinkwater, 1991). Some of the mineral-resource-assessment tract information in neighboring areas was revised by Brew and others (1996). Brew (1993) presented a generalized view of metallogenic belts that includes this area.

Detailed information on the Late Cretaceous plutonic rocks in the Petersburg 1:250,000-scale quadrangle is found in Burrell (1984abc); major-element chemical and other data for the area were reported by Douglass and others (1989), and relatively young volcanic features were described by Brew and others (1984) and by Brew (1990). McClelland and Gehrels (1990) reinterpreted some of the geology in and around the Duncan Canal area, which lies to the west-northwest of this quadrangle.

The index map on the over-size sheet shows the major geological elements of the Petersburg-Wrangell area. They are, from west to east, (1) the Alexander belt, consisting of generally unmetamorphosed Lower Paleozoic through Upper Triassic rocks intruded by scattered mid-Cretaceous plutons, (2) the Gravina belt, consisting of unmetamorphosed to highly metamorphosed, variably deformed Upper Jurassic(?) through mid-Cretaceous flysch and volcanic rocks intruded by both mid- and Upper Cretaceous plutons, and (3) the Mainland belt, consisting of metamorphic rocks intruded by Upper Cretaceous, lower Tertiary, and mid-Tertiary plutons. Younger than almost all parts of all of these belts, and extending from the Alexander belt across the Gravina and onto the mainland belt, is the lower to middle Tertiary Kuiu-Etolin belt that consists largely of varied volcanic rocks, associated plutons, and minor sedimentary rocks. The Alexander belt corresponds more or less to the Alexander terrane of Berg and others (1978), the Gravina belt is a refined interpretation of their Gravina belt. This quadrangle includes only rocks of the (1) Duncan Canal-Zarembo Island-Screen Islands sub-belt of the Gravina belt, (2) Gravina belt itself, and (3) Mainland belt (see Correlation of Map Units diagram on the oversize sheet).

DESCRIPTION OF MAP UNITS

[Note: All formational and descriptive map-unit names in the text of the following descriptions are set off with quotation marks to make them easier to identify.]

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 are shown as mapped in the field, but the deposits have not been studied in detail; many small areas are not shown.

MAINLAND BELT

This belt was informally named by Brew and others (1984) 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 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 (1984abc), which has been redefined as the Coast Mountains Complex by Brew and others (1995).

Qi GLACIAL ICE AND PERMANENT SNOWFIELDS (Holocene)

INTRUSIVE ROCKS OF BEHM CANAL PLUTONIC BELT (Miocene and(or) Oligocene)--Belt informally named by Brew and Morrell (1983); as mapped in this quadrangle includes one unit:

Tdr Rhyolite and Related Rocks--

Generally flow banded, locally quartz porphyritic; weathers light brown and yellowish-brown, light gray on fresh surfaces. Occurs in broad swarm of dikes from 0.5 to a few m wide with little included country rock that is more or less centered on the granite stock at Groundhog Basin (see below); a few small isolated plugs occur along strike. Several exposures within the unit of vent breccia similar to the Vent Breccia unit (QTv) in the Kuiu-Etolin belt to the west of this quadrangle; the breccias consist of dominant 5-20 cm angular rhyolite and some granitic and metamorphic rock fragments with essentially no matrix of any kind; see Gault (1954) and Gault and others (1953) for some further information. Age of the rhyolites is inferred from that of the closely associated granite stock at Groundhog Basin in the Persburg C-1 quadrangle to the north. The dike swarm has been prospected for both molybdenite and base metals, but no economic occurrences are known within it.

METAMORPHIC ROCKS OF COAST METAMORPHIC-PLUTONIC COMPLEX (Upper Cretaceous and(or) Paleocene)--These rocks comprise the progressively metamorphosed belt that forms the western edge of the Coast Mountains Complex; the westernmost part adjoins the metamorphic rocks of the Gravina Belt. The rocks are in general so metamorphosed that no original textures or structures remain. The protoliths must have included a variety of clastic rocks, dominantly fine-grained, but including some sandstones and conglomerates. The fine-grained sediments probably occurred in thicker units than the coarser-grained. Other protoliths are limestones, 10's to 100's of m thick, sediments, volcanic rocks of intermediate to mafic composition, and probably some intermediate to mafic sill-like intrusions. No fossils have been found in any of these rocks in this map area, but proximity to the Gravina belt suggests that some of the protoliths may have been of Jura-Cretaceous age; fossils collected in somewhat similar rocks to the northwest in the Tracy Arm area (Brew and Grybeck, 1984) and in the Juneau area (Ford and Brew, 1977b; Brew and Ford, 1977) suggest that Lower Permian and Upper Triassic rocks may also be present. Brew (1983a) and Brew and Ford (1983, 1984a) argued that these rocks are the metamorphosed equivalent 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). Nevertheless, isotopic evidence summarized by Brew and Ford (1994) and Brew and others (1994) indicates the some of the protoliths are Late Proterozoic or Early Paleozoic in age and belong to the Nisling assemblage, or lithotectonic terrane of Wheeler and McFeely (1995?). The age of metamorphism is interpreted to be Late Cretaceous and(or) Early Tertiary (Brew and Ford, 1984ab; Gehrels and others (1983, 1984). No obvious contrast, other than metamorphic grade, exists between the metamorphic rocks west of the Coast Range Megalineament and those engulfed in the plutons between there and the International Boundary, even though more than one lithotectonic terrane may be present. As mapped, divided into:

TKp 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 fine grained clastic rocks; the latter from either tuffs or fine-grained volcanogenic sediments. Both form alternately rounded and serrated ridge tops and cliffy slopes. Metamorphic grade generally increases from prehnite-pumpellyite/low greenschist facies in the southwest to upper greenschist facies in the northeast. The common prehnite-pumpellyite/greenschist facies mineral assemblage of the semischist is (epidote-)albite-white mica-chlorite-quartz. Presence of foliation and spatial relationship to the well defined Barrovian metamorphic sequence, together with lack of actinolite or biotite, support assignment to the prehnite-pumpellyite facies. Typical greenschist metamorphic facies mineral assemblages in the dark gray semischists and phyllites are (garnet-)muscovite-chlorite-biotite-albite-quartz and in the green phyllites (biotite-)(actinolite-)(sphene-)clinozoisite-albite-quartz-chlorite-calcite-muscovite. With increase in grade, clastic and other relict textures disappear, grain size increases, and crenulation cleavage and transposition become well developed. Foliation in general is defined by parallel, intergrown laths of actinolite, biotite, chlorite, or white mica. Garnet is porphyroblastic, epidote and clinozoisite subidioblastic, calcite is xenomorphic interstitial, and quartz and albite form a subgranoblastic matrix. This unit is enigmatic in that its distribution pattern includes semi-isolated areas almost surrounded by the "Biotite Schist and Semischist" (TKbs) unit; this is currently interpreted to mean that this unit (TKp) actually records two metamorphic episodes that are difficult to distinguish from each other. The first is a post-Early Cretaceous and pre-Late Cretaceous, (110 to 90 Ma), low grade regional event. The second overprints the first and is part of the low- to high-grade Late Cretaceous-Early Tertiary metamorphic and deformational event that is closely related to the emplacement of the Great Tonalite Sill Belt rocks (Ttos, Tgdg) in the Petersburg C-1 quadrangle to the north. Commonly observed polydeformation textures such as multidirection crenulation cleavage and nearly complete transposition are compatible with this interpretation. Where the 90 Ma Admiralty-Revillagagedo Belt plutons intruded the unit staurolite-biotite-garnet hornblende hornfels facies thermal aureoles formed. Porphyroblasts of staurolite and garnet, and decussate biotite laths have been rotated and realigned by development of the post-aureole foliation. Only rarely can an early foliation be detected through the superposed thermal and later dynamic-thermal metamorphic effects. The unit is exposed along the eastern shore of Frederick Sound and, in this quadrangle, east of Eastern Passage.

TKbs Biotite Schist--

Dominantly well foliated and lineated biotite schist, with lesser amounts of interlayered biotite semischist and hornblende schist and semischist. Fine- to medium-grained; weathers grayish-brown, brownish-gray where fresh; forms craggy ridges and steep slopes. Metamorphic mineral assemblages suggest derivation from the same protoliths as the "Phyllite, Slate, and Semischist" (TKp) described above. Metamorphic grade generally increases from greenschist facies to upper amphibolite facies from southwest to northeast, in a Barrovian facies series. Mineral isograds marking the first occurrence of biotite, garnet, staurolite, and kyanite trend north-northwest and appear to steepen northeastward towards the Coast Range Megalineament which coincidentally locally marks the sillimanite isograd. Typical greenschist mineral assemblages are (epidote-)(clinozoisite-)(calcite-)(garnet-)biotite-muscovite-chlorite-albite-quartz and (actinolite-)epidote-calcite-sphene-chlorite-muscovite-albite-quartz. Higher grade pelitic assemblages include (kyanite-) quartz-muscovite-plagioclase (oligoclase to andesine)-biotite-garnet-staurolite. More mafic assemblages include (clinopyroxene-)hornblende-biotite-quartz-garnet-plagioclase. East of the Coast Range Megalineament, sillimanite-potassium feldspar-muscovite-biotite-garnet-quartz-plagioclase assemblages represent the highest grade of regional metamorphism. The above assemblages may or may not contain the following accessory minerals: graphite, magnetite, ilmenite, apatite, and tourmaline. I interpret four different metamorphic episodes to be recorded in different parts of this map unit: 1) a higher grade phase of the post-Early Cretaceous, pre-Late Cretaceous regional metamorphism discussed above, 2) a superposed thermal effect from the 90 Ma Admiralty-Revillagigedo Belt intrusions on those previously deformed rocks, 3) a "main" Late Cretaceous to Early Tertiary event that is the most likely cause of the features in this unit, and 4) a thermal effect of the Eocene age Granodiorite of central Coast Mountains Complex units (Tgdb, Tgdp, Tgrg) that occur to the north and norteast of this quadrangle. Textural and mineralogical evidence of the post-Early Cretaceous, pre-Late Cretaceous regional metamorphism have for the most part been obscured by local amphibolite facies porphyroblastic, dicussate, and granoblastic recrystallization caused by 2) above, and the effects of 3) above, both of which caused deformation crenulations, shattered porphyroblasts with fragment trains, and in places totally disrupted foliation. Foliation is defined primarily by alignment of mica laths and amphibole prisms that wrap around pre-existing garnet, biotite, staurolite, and/or kyanite grains. Recrystallized quartz and plagioclase are most commonly subgranoblastic, polygonal, and slightly elongate parallel to the foliation. Local zones of cataclasis in rocks exposed along the Coast Range Megalineament include blastomylonites, rare mylonites, and exhibit late greenschist facies recrystallization. This unit is exposed along the eastern shores of Frederick Sound and, in this quadrangle, from Eastern Passage east to the Great Tonalite Sill Belt, and also in a few screens and pendants between there and the International Boundary.

TKmb Marble and Calc-Silicate Granofels--

Poorly foliated, rarely lineated marble, calc-silicate granofels and schist interlayered with highly variable amounts of biotite and hornblende schist. Fine- to coarse-grained; weathers white and light gray or yellowish-gray; white and light gray where 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, alternatively they may simply have been large detached fold hinges or a combination of the two). Other outcrops consist of equal amounts of 1-cm to 10-cm scale marble and biotite schist layers; in this case they are mapped as this unit to emphasize the presence of the metacarbonates. Typical greenschist and amphibolite facies mineral assemblages are (quartz-)(white mica-)calcite-tremolite-chlorite, and (diopside-)(scapolite-)calcite-wollastonite-quartz. These are compatible with metamorphic facies assignments of nearby "Biotite-Schist" (TKbs) and "Hornblende Schist and Semischist" (TKhs) units (the latter is exposed in quadrangles to the north and east). The assemblages are also typical of thermal aureoles formed adjacent to 90 Ma, Admiralty-Revillagigedo Belt plutons. Lower temperature recrystallization has commonly introduced tremolite and chlorite into these hornblende hornfels or amphibolite facies assemblages. Petrographic features include abundant lamellar twinned xenoblastic calcite, interstitial xenoblastic quartz, subidioblastic tabs of white mica, and decussate clusters, blades, and needles of tremolite and wollastonite. Mapped as elongate lenses within"Phyllite" (TKp), "Biotite Schist" (TKbs), and (to the north) "Hornblende Schist and Semischist" (TKhs) units and as screens within the intrusive bodies to the northeast of the Megalineament. Several outcrops were sampled for conodonts, but none were recovered.

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 where fresh. Probably derived from same protolith as "Hornblende Schist and Semischist" (TKhs) mapped in quadrangles to the north and east. Metamorphic mineral assemblages are consistent with a Barrovian metamorphic-facies series that increases in grade towards the northeast: epidote-amphibolite facies assemblages such as hornblende-biotite-plagioclase-epidote and hornblende-biotite-garnet-plagioclase-quartz typify the lower grade portion of unit while (clinopyroxene-garnet-hornblende-biotite-plagioclase-quartz and (potassium feldspar-)(hornblende-)clinopyroxene-biotite-plagioclase-quartz assemblages represent the northeastern higher grade portions. Accessory magnetite, sphene, zircon, and apatite occur in most assemblages. Foliation is commonly anastomosing or lenticular and is defined by parallel schlieren of biotite and sparse hornblende. Intergrown biotite, hornblende, garnet, and(or) pyroxene also occurs in sparse patches, clusters, and swirls which show minor chlorite and rarely calcite alteration. Where poikiloblastic, hornblende includes biotite, apatite, and quartz. Porphyroblastic garnet has xenomorphic, partially resorbed, outlines. Clinopyroxene is subidioblastic. Subidioblastic plagioclase and xenomorphic interstitial potassium feldspar show minor alteration to sericite. Quartz is xenomorphic to subidioblastic and commonly exhibits undulose extinction. This unit crops out as elongate masses on the west side of the Coast Range Megalineament.

INTRUSIVE ROCKS OF ADMIRALTY-REVILLAGIGEDO PLUTONIC BELT AND ASSOCIATED MIGMATITE (Upper Cretaceous)--General age relations are described for the Peterburg B-2 quadrangle (Brew, 1997d) under Gravina Belt. As discussed in that section, these plutons are about 90 Ma; in general, they have narrow thermal metamorphic aureoles that are superposed on deformed, low-grade regionally metamorphosed country rocks. Here in the Mainland Belt a further complication is present: parts of some of this same family of plutons 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 Mountains Complex super unit described above. Thus, the metamorphic age given for those rocks differs from with the emplacement age given for this family of plutons. The alternative was to assign the same metamorphic age to these plutons, but that is equally inadequate because not all of them show metamorphic features. The belt was informally named by Brew and Morrell (1983) and is described by Burrell (1984abc); preliminary K-Ar determinations by M. A. Lanphere (U.S. Geological Survey, written communs., 1981, 1982) interpreted to be applicable to the whole suite are as follows:

Map unit	General location	Biotite age	Hornblende age
Ktif unit	Wrangell Is.	83.2 Ma	91.6 Ma
" "	Mitkof Is.	-	89.1 Ma
Ktef unit	Zarembo Is.	90.4 Ma	93.0 Ma

Somewhat similarly dated rocks occur in lithically correlative units to the east in the Bradfield Canal quadrangle (R. L. Elliott and R. D. Koch, oral commun., 1982; Koch and Berg, 1996). As mapped in this quadrangle, divided into:

Kmgf Migmatite (Upper Cretaceous)--

Varied migmatitic rocks, mainly agmatite and irregular banded gneiss, in zones between the "Hornblende-Biotite Tonalite and Granodiorite, etc." (Ktef) and "Biotite Tonalite, Quartz Diorite, etc." (Ktgp) units and the "Biotite Schist" (TKbs). The granitic leucosomes generally resemble the main rock types in the above-mentioned units (Ktef and Ktgp); the metamorphic melasomes are fine- to medium-grained (garnet-)(sillimanite-)biotite hornfels, schist, and semischist. Crops out only south of the Stikine River, between Government Creek and South Fork (of Andrews Creek); and on the ridge southeast of Porterfield Creek, in the northeastern part of the quadrangle.

Ktef Hornblende-Biotite Tonalite and Granodiorite, Quartz Monzodiorite, and Quartz Diorite--

Foliated to massive equigranular; generally medium-grained, but fine-grained near some margins; C.I. 17 to 50. Light to medium gray where fresh, weathers brownish to dark gray. Foliation varies both in direction and development: moderately developed in west to very well developed on east side of Wrangell Island; locally semischistose and cataclastic. Contains aplite dikes, pegmatite dikes and veins, and rounded very fine-grained hornblende diorite inclusions. Generally concordant intrusions as sills with country rock and screens of country rock in margin of body. Mineralogy includes zoned, complexly twinned plagioclase with minor alteration to sericite; mafic minerals usually biotite greater than hornblende; subhedral epidote; and local garnet and pyroxene. Accessory minerals are sphene, apatite, opaque minerals and allanite. Unit differs from "Hornblende-Biotite Tonalite, Granodiorite, etc. " (Ktif) mapped in other quadrangles by the presence of pyroxene and garnet, and biotite as the dominant mafic phase. Unit is exposed in the northeastern part of this quadrangle on Etolin Island.

Ktoc Garnet-Biotite Tonalite and Minor Granodiorite--

Nonfoliated, crowded-plagioclase rock; inequigranular to porphyritic; very fine- to medium-grained; C.I. 14 to 29. Medium gray where fresh,weathers to light gray. Forms small elongate bodies less than 3 square km in area; also makes up one larger body on northern Wrangell Island. Mineralogy includes reddish-brown garnet, clinozoisite (or rarely epidote) and local muscovite. Biotite and quartz commonly interstitial to closely spaced plagioclase laths. Unit is mineralogically similar to "Biotite Tonalite, Quartz Diorite, and Granodiorite" (Ktgp) mapped in Mainland belt, but differs texturally by its finer grain size and lack of large phenocrysts. Unit is exposed on northern Wrangell, Mitkof, Woronkofski, and Etolin Islands (Burrell, 1984b).

Kqop Biotite-Epidote-Hornblende Quartz Monzodiorite--

Locally foliated; plagioclase porphyritic with medium- and coarse-grained phenocrysts (to 12 mm) in a fine- to medium-grained groundmass (to 3 mm) and a C.I. range of 17 to 48. Weathers to brownish-gray, gray and white where fresh. Margins of bodies are commonly more mafic and have a very fine- to fine-grained groundmass; also common are muscovite-biotite garnet-epidote aplite dikes of granitic and granodioritic composition. Mineralogical features include oscillatory zoned plagioclase with sericite alteration of the cores, interstitial quartz and K-feldspar, euhedral fine-grained hornblende, minor biotite, and primary (occasionally twinned and zoned) and secondary epidote. Unit is exposed on the Lindenberg Peninsula, Kupreanof Island, and on southwestern Mitkof, Woronofski and northern Zarembo Islands, and, in this quadrangle, at Chichagof peak on Wrangell Island. Where mapped on northern Dry Island and eastern Mitkof Island, the compositions range from quartz monzodiorite to tonalite (Burrell, 1984ab).

Ktgp Biotite Tonalite, Quartz Diorite, and Granodiorite--

Porphyritic and foliated; medium- to coarse-grained; C.I. 11 to 35. Cut by pegmatite and basalt dikes; local cataclastic texture;and inclusions of country rock. Mineralogical features include zoned, complexly twinned plagioclase, quartz, interstitial K-feldspar, partly chloritized biotite, epidote, minor local hornblende; and accessory garnet, sphene, apatite, and allanite. The unit on Etolin Island lacks K-feldspar and shows moderate to extreme alteration of plagioclase, biotite, and garnet. Unit differs from "Biotite-Epidote-Hornblende Quartz Monzonite" (Kqop) by lack of hornblende and presence of garnet. Unit is exposed in the eastern part of this quadrangle in Mainland belt.

METAMORPHOSED STEPHENS PASSAGE GROUP ROCKS (Upper Cretaceous)–Most of these units are associated with the Upper Cretaceous and Tertiary plutons (of the Kuiu-Etolin Belt) in the Gravina Belt. But in this quadrangle they are associated with Intrusive Rocks of the Wrangell-Revillegigedo Plutonic Belt. The rocks have been rather arbitrarily assigned a Late Cretaceous age as described here. Two units are mapped in this quadrangle:

Kss Schist and Hornfels--

Greenschist and albite-epidote to hornblende-hornfels facies metamorphic rocks derived from "Seymour Canal Formation" turbidites and related rocks (KJss) mapped in quadrangles to the west. Original textures and structures generally preserved. Dominantly fine- to medium-grained, grayish-brown and reddish-brown weathering, and locally foliated. Commonly compositionally layered chlorite-biotite-quartz-feldspar schist and semischist; minor phyllite; some strongly hornfelsed rocks close to plutons. Clear-cut aureoles around Upper Cretaceous plutons are (garnet-andalusite-staurolite-)biotite-quartz-feldspar hornfels and schistose hornfels; some local calc-silicate and intermediate composition layers and lenses. Age of metamorphism in this quadrangle is the age of the plutons; age of protolith is Late Jurassic to middle Cretaceous based onthe age of the parent "Seymour Canal Formation'.

Ksp Phyllite--

Subgreenschist and greenschist facies metamorphic rocks inferred to be derived from fine-grained sediments associated with the turbidites of the "Seymour Canal Formation" (KJss); original textures and structures generally obscure;. Dominantly very-fine-grained, dark-gray weathering, carbonaceous chlorite-quartz-feldspar phyllite; some interlayered graywacke and graywacke semischist; also locally extensive layers and lenses of very-fine-grained, light to dark-green weathering chlorite-rich phyllite interpreted to have been metamorphosed from fine-grained volcanic sediments such as tuffs or from highly transposed and tectonized coarser grained intermediate composition rocks. Age interpretation is the same as that given above for the "Schist and Hornfels" (Kss); i.e., Late Jurassic to middle Cretaceous.

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