U.S. DEPARTMENT OF THE INTERIOR

U.S. GEOLOGICAL SURVEY

Reconnaissance Geologic Map of the Petersburg B-2 Quadrangle, Southeastern Alaska

By

David A. Brew[1]

Open-File Report 97-156-D

[1]Research Geologist *emeritus*
USGS, MS 904
Menlo Park, California 94025

RECONNAISSANCE GEOLOGIC MAP OF THE PETERSBURG B-2 QUADRANGLE, SOUTHEASTERN ALASKA

By David A. Brew

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); that map is based on reconnaissance field mapping and therefore the individual maps in this series of 1:63,360-scale maps (Brew, 1997a-m; Brew and Koch, 1997) do 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. 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, 1996; 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 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) Kuiu-Etolin 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 the larger areas are shown as mapped mapped in the field, but the deposits were not been studied in detail; many small areas are not shown.

KUIU-ETOLIN BELT

Belt informally named by Brew and others (1979), redefined by Brew and Morrell (1983), and its age revised by Brew and others (1985).

EXTRUSIVE AND INTRUSIVE VOLCANIC ROCKS OF KUIU-ETOLIN VOLCANIC-PLUTONIC BELT (Quaternary and Tertiary)--Diverse volcanic rocks exposed in a broad area extending from northeastern Kuiu southeastward through Kupreanof and Zarembo Islands; one unit mapped in this quadrangle:

QTr Rhyolite, Rhyodacite, and Related Siliceous Extrusive and Intrusive Rocks--

In general, aphanitic to finely crystalline, generally quartz and feldspar porphyritic; C.I. less than 1. Locally layered, spherulitic, and(or) miarolitic; light gray on fresh surfaces; buff, white, green lavendar, maroon, or pink where altered; generally rusty weathering. Pyrite and zeolites common. Many exposures are texturally complicated mixtures of discontinuous mm-scale flow layered, brecciated, spherulitic, and phenocrystic rocks. Heterogeneous; includes lava flows, obsidian flows, lahars, welded and nonwelded ash, tuff, and lapilli, all cut locally by porphyritic rhyolite and rhyodacite dikes. Extreme alteration, brecciation, attitudes of layering, and abundance of dikes define vents and domes; massive structureless isolated rhyolite bodies suggest plugs; columnar-jointed cliff exposures in excess of 100 m thick are interpreted as cooling units. Exposed as dikes on Red Mountain, northwestern Etolin Island, in southwestern part of this quadrangle.

INTRUSIVE GRANITIC AND OTHER ROCKS OF KUIU-ETOLIN VOLCANIC PLUTONIC BELT (Miocene and(or) Oligocene--Preliminary K-Ar determinations of about 20-22 Ma obtained on rocks from the "Granite of Central and Northern Etolin Island" (Tmge) (M. A. Lanphere, U.S. Geological Survey, written communs., 1981, 1982); preliminary descriptions given by Hunt (1984); as mapped in this quadrangle, divided into:

Tmge Granite of Central and Northern Etolin Island--

Hornblende-biotite granite, alkali granite, quartz syenite, and alkali quartz syenite; massive, nonfoliated; allotriomorphic to hypidiomorphic; equigranular to seriate; medium- to coarse-grained; C.I. 01 to 07; weathers to a distinctive pale orange to white; miarolitic cavities common, often rusty weathering; generally homogeneous at outcrop scale. Feldspar mineralogy consists of common, but only rarely pervasive, graphic and micrographic intergrowths of quartz and well-developed microperthitic alkali feldspar; mafic minerals are dark brown to greenish-brown biotite and generally subordinate green to blue-green hornblende, both of which are often partially altered to chlorite; accessories include sphene, allanite, and locally abundant magnetite; epidote fills miarolitic cavities in several places. Minor amounts of fine- to medium-grained, porphyritic biotite-hornblende quartz monzonite, quartz syenite, and granite (C.I. 03-10), frequently containing up to 10 percent rounded, very fine grained mafic (about C.I. 40) inclusions occur, generally near the margins. Unit forms the core of the large composite pluton on central Etolin Island, and is best exposed there along Burnett Inlet; also exposed as small bodies on Brownson Island, near Fisherman's Chuck, in the Niblack Islands, and in numerous small unmapped plugs and dikes within the migmatitic rocks surrounding the core; on northern Etolin Island, it forms the pluton at Bessie Peak in the southern part of this quadrangle. The body at Bessie Peak has a more homogeneous composition and carries more fine-grained mafic inclusions than does the body at Burnett Inlet in the Petersburg A-2 quadrangle (Brew, 1997a).

Tmaz Alkali Granite of Northwestern Etolin and Southeastern Zarembo Islands--

Amphibole-biotite alkali granite and subordinate granite. Massive, nonfoliated; allotriomorphic to hypidiomorphic; equigranular to seriate, some porphyritic; medium- to coarse-grained; C.I. averages 04; miarolitic cavities common and locally abundant; quite homogeneous at outcrop scale, but with locally abundant hornfels inclusions. Feldspars are perthitic alkali feldspar, a variety of exotic (and in places pervasive) graphic and micrographic textures, and rare occurrence of plagioclase as a separate feldspar phase; the mafic minerals are distinctive and include green, blue-green, and blue (sodic) amphibole (hornblende to riebeckite), dark brown to reddish-brown biotite, and locally abundant green (iron-rich) pyroxene; the mafic minerals are altered and partially replaced by chlorite; accessories include locally abundant sphene, allanite, apatite(?), magnetite, and minor hematite; epidote fills some miarolitic cavities. Unit on Zarembo Island includes minor coarse-grained, subophitic, hornblende-biotite-pyroxene diorite (C.I. 40-45) that resembles diorites within the "Migmatitic Granitic Rocks of Central and Northern Etolin Island" (Tmme) as well as the diorites associated with the granites of Kupreanof and Kuiu Islands. Unit exposed in two possibly interconnected bodies at Quiet Harbor on northwestern Etolin Island and at Round Point on southeastern Zarembo Island, as well as in several small plugs and dikes that invade the adjacent country rocks on Zarembo Island. Resembles the "Granite of Central and Northern Etolin Island" (Tmge) in composition and texture, while the mafic mineralogy is similar to the "Alkali Granite Satellitic to Granite of Central Etolin Island" (Tmae) in the Petersburg A-2 quadrangle (Brew, 1997a).

Tsh HORNFELSED SEYMOUR CANAL FORMATION ROCKS (Miocene and(or) Oligocene)–

Albite-epidote hornfels facies rocks in aureoles on Etolin Island which generally preserve the original protolith structures and textures as well as the metamorphic minerals related to older Cretaceous metamorphic events. The contacts are, as described under the heading "Metamorphosed Stephens Passage Rocks" in the section on the Gravina belt, poorly defined and the unit may not be as extensive as presently shown. Age of protoliths is Late Jurassic to middle Cretaceous, based on on an ammonite of Albian age (D. L. Jones, U.S. Geological Survey, written commun., 1979) collected on the northwest shore of Etolin Island and on obvious derivation from the "Seymour Canal Formation" (KJss). Unit is exposed in the southern part of this quadrangle.

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 and other rocks intrusive into that section) in the east-central part of the Petersburg-Wrangell map area. As used here, the term also includes rocks of indeterminate Mesozoic age in a broad zone to the west of and adjoining the Jurassic and Cretaceous rocks. This zone is called the "Duncan Canal-Zarembo Island-Screen Island sub-belt" and it has within it blocks of Paleozoic and Mesozoic rocks unlike any elsewhere in the Gravina belt, but similar to some in the Alexander belt. The Gravina belt as used here more or less corresponds to the Gravina belt as defined by Berg and others (1978).

INTRUSIVE ROCKS OF ADMIRALTY-REVILLAGIGEDO PLUTONIC BELT AND ASSOCIATED MIGMATITE (Upper Cretaceous)--Belt informally named by Brew and Morrell (1983) and described by Burrell (1984abc); preliminary K-Ar determinations by M. A. Lanphere (written communs., 1981, 1982) interpreted to be applicable to the whole suite, including the rocks in this quadrangle, 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 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:

Ktef Hornblende-Biotite Tonalite and Granodiorite, Quartz Monzodiorite, and Quartz Diorite--Foliated to massive equigranular; average grain size is medium, fine-grained near some margins; C.I. 17 to 50; light to medium gray on fresh surfaces, 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. Occurs as generally concordant sills in country rock along the margin of the body. Mineralogy includes zoned, complexly twinned plagioclase with minor alteration to sericite; mafic minerals are biotite in much greater amounts 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) by presence of pyroxene and garnet, and biotite as the dominant mafic phase. Unit is exposed in the southern part of this quadrangle on Etolin Island.

Ktif Hornblende-Biotite Tonalite, Granodiorite, Quartz Monzodiorite, and Quartz Diorite--
Equigranular to sparsely porphyritic, massive to weakly foliated; medium-grained; C.I. 14 to 52; light gray on fresh surfaces, weathers yellowish-gray. Rounded, elongate very fine-grained dioritic and some ultramafic inclusions. Mineralogic features include oscillatory zoned seriate plagioclase, both discrete and small clumps of biotite and hornblende, subhedral epidote or clinozoisite, rare garnet, and accessory sphene, allanite, and apatite. Plagioclase altered to sericite and mafic minerals to epidote. Unit differs from "Hornblende-Biotite Tonalite and Granodiorite, etc." (Ktef) by lack of pyroxene and garnet and better development of seriate plagioclase. "Hornblende-Biotite Tonalite" (Ktop) is a porphyritic variation of this unit. Exposed on Mitkof, Zarembo, and Woronkofski Islands (Burrell, 1984ab) in this quadrangle.

Ktop Hornblende-Biotite Tonalite--
Porphyritic, locally foliated; medium- to coarse-grained; C.I. 15 to 40; medium to dark gray where fresh, brownish-gray where weathered; alignment of plagioclase laths defines foliation; rare hornfels inclusions; aplitic granite dikes, pegmatite veins, and tonalite dikes into country rock at margins produce interfingering contacts. Plagioclase porphyritic with local reddish-brown garnet phenocrysts; garnet-rich and -poor zones locally define layers. Mineralogic features include zoned seriate plagioclase with minor alteration to sericite; mafic minerals mostly in clumps; epidote and zoned garnet present; accessory sphene, apatite, and allanite, some biotite alteration to chlorite. Body on southwestern Mitkof Island is quartz monzodiorite in composition. Unit is gradational with "Hornblende-Biotite Tonalite, Granodiorite, etc." (Ktif), but differs in its porphyritic texture and ubiquitous garnet. Unit differs from "Biotite-Epidote-Hornblende Quartz Monzodiorite" (Kqop) by the dominance of biotite over hornblende, larger hornblendes with less well developed crystal form and (locally) abundant inclusions, presence of garnet, and clumps of mafics as opposed to discrete mafics. Unit differs from "Biotite Tonalite, Quartz Diorite and Granodiorite" (Ktgp) exposed in other quadrangles in abundance of hornblende and a higher color index. Exposed on Lindenberg Peninsula, Mitkof, Rynda, Kadin, Woronkofski, and Wrangell Islands (Burrell, 1984b).

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 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 similar to "Biotite Tonalite, Quartz Diorite, and Granodiorite" (Ktgp) mapped elsewhere mineralogically, but differs texturally by its finer grain size and lack of large phenocrysts. 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, fine- to medium-grained groundmass, and a C.I. range of 17 to 48; weathers brownish-gray, gray and white where fresh; margins of bodies are commonly more mafic and have a very fine- to fine-grained groundmass. Muscovite-biotite garnet-epidote aplite dikes of granitic and granodioritic composition are common. 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. Where mapped on northern Dry Island and eastern Mitkof Island, the compositions range from quartz monzodiorite to tonalite (Burrell, 1984ab).

METAMORPHOSED STEPHENS PASSAGE GROUP ROCKS (Upper Cretaceous)--In general, these units are associated with the Upper Cretaceous and Tertiary plutons (of the Kuiu-Etolin Belt) in the Gravina Belt. The rocks have been rather arbitrarily assigned a Late Cretaceous age or assigned a Tertiary age and described elsewhere as "Hornfelsed Seymour Canal Formation Rocks" (Tsh) based on the known or inferred age of the pluton(s) nearby. This results in a potentially misleading map pattern, however, because the metamorphic rocks adjacent to Tertiary plutons may have undergone previous Upper Cretaceous metamorphism as well and the units that are defined by Tertiary metamorphic effects alone are poorly delineated. The Cretaceous age assignment used here is also not entirely satisfactory from either a field mapping or petrographic study viewpoint; this is due to both the complexity of spatial overlapping metamorphic effects and the apparent lack of an unmetamorphosed protolithic unit for one of the metamorphic units mapped outside of this quadrangle. 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" (KJss) rocks; 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 calc-silicate and intermediate composition layers and lenses locally. Age of metamorphism varies as described in headnote above; age of protolith is Late Jurassic to middle Cretaceous based on derivation of this unit from the "Seymour Canal Formation". Exposed in northern and northeastern part of this quadrangle.

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; 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). Exposed in northeastern part of this quadrangle.

INTRUSIVE ROCKS OF KLUKWAN-DUKE PLUTONIC BELT (Cretaceous): Belt informally named by Brew and Morrell (1983); rocks interpreted to be 100-110 Ma on the basis of their similarity to dated rocks elsewhere (Lanphere and Eberlein, 1966) and on a preliminary K-Ar age of 107 Ma from the pluton at Turn Mountain on Kupreanof Island (M. A. Lanphere, U.S. Geological Survey, oral commun., 1983). See also Taylor and Noble (1960), Taylor (1967), and Himmelberg and Loney (1995). One unit mapped in this quadrangle:

Khb Hornblendite--

Hornblendite and hornblende gabbro; locally compositionally layered, fine- to medium-grained, weathers dark grayish-green to black; C.I. 70 to 100. Locally cut by granitic rocks like those of nearby Upper Cretaceous plutons, but on Sukoi Islets appears to cut some granitic bodies. Also exposed on northeast shore Mitkof Island, in a large body on northwestern Kupreanof Island at Turn Mountain that is interpreted by Brew and others (1984) to be the outer envelope of an Alaska-type mafic/ultramafic pluton (Taylor, 1967), and in this quadrangle on the southeast side Woronkofski Island, the east side of Zarembo Island, and on islets in Zimovia Strait.

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 south and east of Admiralty Island (Souther and others, 1979) and extends southward into the map-area described here. Information presented by Brew and others (1984) showed that the Group is as young as Albian or Cenomanian, i.e., late Early and early Late Cretaceous, in this area. The "Brother's Volcanics"/"Douglas Island Volcanics" probably intertongue with the "Seymour Canal Formation", probably near the top of the latter (Loney, 1964). Cohen and Lundberg (1993) reported on details of the "Seymour Canal Formation" north of this quadrangle. As mapped in this quadrangle consists of:

KJsv Brothers Volcanics/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 the Petersburg-Wrangell map area; its age is based on its close association with the locally fossiliferous "Seymour Canal Formation". The "Brothers Volcanics" named by Loney (1964) from exposures just north of this map area; the "Douglas Island Volcanics" named by Lathram and others(1965) on Admiralty Island from exposures on Douglas Island to the north. Exposed in the eastern part of this quadrangle on Etolin Island; the best and least deformed or metamorphosed outcrops are on southwestern Mitkof Island and near Steamer Bay on Etolin Island. See also Berg and others (1972); Ford and Brew (1977, 1978) and Page and others (1977).

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 are 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 (Berg and others, 1972), who collected an Albian ammonite, a Valanginian(?) pelecypod, and Berriasian pelecypods from the western Etolin Island area and by collections made by Brew and others (1984), including an Albian or Cenomanian ammonite (D. L. Jones and J. W. Miller, U.S. Geological Survey, written commun., 1979) from hornfelsed "Seymour Canal Formation" and by Kimmeridgian to Tithonian pelecypods from the western Etolin Island area (R. W. Imlay, written commun., 1982). The "Seymour Canal Formation" was named by Loney (1964) from exposures at the mouth of Seymour Canal on Admiralty Island; the name was extended to the rest of Admiralty Island by Lathram and others (1965) and to northern Kupreanof Island by Muffler (1967). Probably grades into the more deformed and generally finer grained "Semischist and Phyllite, Etc." (Mzs) and the "Phyllite and Slate, Etc." (Mzp) to the west. Exposed in the northwestern part of this quadrangle.

DUNCAN CANAL-ZAREMBO ISLAND-SCREEN ISLAND SUB-BELT OF THE GRAVINA BELT

See "Gravina belt" heading (above) for background information.

METAMORPHOSED STEPHENS PASSAGE GROUP AND OTHER ROCKS (Upper(?) Mesozoic)– Currently interpreted to be mostly metamorphic equivalents of the "Stephens Passage Group", but in part may be derived from" Cannery Formation" (Muffler, 1967; Brew and others, 1984), some from a different facies of the "Stephens Passage Group", and some from a previously unrecognized facies of Triassic rocks. As mapped in this quadrangle, includes:

Mzs Semischist and phyllite--

Metamorphosed from graywacke and siltstone: low grade (probably sub-greenschist facies) metamorphic rocks; locally highly folded; generally poorly foliated but finer-grained phases have good cleavage; brownish-gray where fresh, gray to brown where weathered; relict textures and sedimentary structures indicate derivation from a graywacke and siltstone or mudstone turbidite sequence. Unit in some places encloses several large lenses of the "Fossiliferous Limestone" (Dls) of Devonian age, but there is no direct indication of the age. Proximity to "Seymour Canal Formation" (KJss) outcrops and compatibility of the protoliths with that formation suggest that this unit is a metamorphic and deformed equivalent of that formation. Unit contrasts with the "Phyllite and Slate Metamorphosed From Mudstone and Minor Graywacke" (Mzp) mapped elsewhere in the Petersburg-Wrangell area in the proportion of originally coarse-grained sediments, and in the general absence of volcanic(?) protolith phyllite in this unit. The two units probably intertongue much more complexly than is shown on the maps. Exposed on eastern Zarembo Island in this quadrangle.

Mzv Greenschist and Greenstone Metamorphosed From Intermediate to Mafic Volcanic Rocks--

Greenschist, greenstone, phyllite, minor semischist; weathers light to dark green, locally brownish pillow breccia, agglomerate flows, and possible tuffs; appears less deformed and less metamorphosed than other nearby rock units; probably several thousand meters thick. Locally abundant relict pyroxene phenocrysts suggest that the protolith is the "Douglas Island Volcanics" (KJsv). Inferred upper Mesozoic age based on association with other units. Unit contrasts with the "Phyllite and Slate Metamorphosed From Mudstone and Minor Graywacke" (Mzp) mapped elsewhere in the Petersburg-Wrangell area in its apparent lesser metatuff and its higher proportion of rocks of volcanic origin. Exposed along and near Duncan Canal and on Woewodski Island, on Key Reef in Clarence Strait, and, in this quadrangle, on Zarembo Island in the southwestern corner of the map area.

Mzgb Gabbro--

Hornblende gabbro and pyroxene-hornblende gabbro; medium to very coarse grained; C.I. 60 to 80; weathers dark greenish black and very dark green, some interstitial indeterminate sulfide opaque minerals noted; cut by numerous dikes of medium-grained, C.I. 05 to 25, quartz diorite like that in adjacent pluton. Crops out on east shore of Zarembo Island.

ACKNOWLEDGEMENTS

This report could not have been produced without the efforts of my mapping colleagues, all of whom are identified in the note on the map; the supportive and enthusiatic crew of the former U.S. Geological Survey research vessel, the R/V Don J. Miller II; the several helicopter pilots and mechanics who provided efficient air transport during the field mapping; the reviewer, D.J. Grybeck, Computer Graphics Specialist J. B. Weathers, and Illustrator Kevin Ghequiere. I thank them all.

REFERENCES CITED FOR THE PETERSBURG B-2 QUADRANGLE

Barnes, D.F., Brew, D.A., and Morin, R.L., 1989, Bouguer gravity map of the Petersburg quadrangle and parts of the Port Alexander, Sitka, and Sumdum quadrangles, Alaska: U.S. Geological Survey Miscellaneous Field Studies Map MF-1970-A , scale 1:250,000, 21 p. pamphlet.

Berg, H. C., Jones, D. L., and Coney, P.J., 1978, Pre-Cenozoic tectonostratigraphic terranes of southeastern Alaska and adjacent areas: U.S. Geological Survey Open-File Report 78-1085, scale 1:1,000,000, 2 sheets.

Berg, H. C., Jones, D. L., and Richter, D. H., 1972, Gravina-Nutzotin belt--Tectonic significance of an upper Mesozoic sedimentary and volcanic sequence in southern and southeastern Alaska, *in* Geological Survey Research 1972: U.S. Geological Survey Professional Paper 800-D, p. D1-D24.

Brew, D.A., 1990, Volcanoes of Alaska--Duncan Canal, Tlevak Strait and Suemez Island, Behm Canal and Rudyerd Bay, *in* Wood, C.A., and Kienle, J., eds., Volcanoes of North America: United States and Canada: Cambridge, University Press, p. 94-96.

____ 1993, Regional geologic setting of mineral resources in southeastern Alaska, *in* Godwin, L.H., and Smith, B. D., eds., Economic mineral resources of the Annette Islands Reserve, Alaska: U.S. Dept. of the Interior, Bureau of Indian Affairs, Division of Energy and Mineral Resources Publication, p. 13-20.

____ 1997a, Reconnaissance geologic map of the Petersburg A-2 quadrangle, southeastern Alaska: U.S. Geological Survey Open-File Report 97-156-A, scale 1:63,360, one sheet, 20 p. pamphlet.

____ 1997b, Reconnaissance geologic map of the Petersburg A-3 quadrangle, southeastern Alaska: U.S. Geological Survey Open-File Report 97-156-B, scale 1:63,360, one sheet, 24 p. pamphlet.

____ 1997c, Reconnaissance geologic map of the Petersburg B-1 quadrangle, southeastern Alaska: U.S. Geological Survey Open-File Report 97-156-C, scale 1:63,360, one sheet, 20 p. pamphlet.

____ 1997d, Reconnaissance geologic map of the Petersburg B-2 quadrangle, southeastern Alaska: U.S. Geological Survey Open-File Report 97-156-D, scale 1:63,360, one sheet, 21 p. pamphlet. (This report)

____ 1997e, Reconnaissance geologic map of the Petersburg B-3 quadrangle, southeastern Alaska: U.S. Geological Survey Open-File Report 97-156-E, scale 1:63,360, one sheet, __ p. pamphlet.

____ 1997f, Reconnaissance geologic map of the Petersburg B-4 quadrangle, southeastern Alaska: U.S. Geological Survey Open-File Report 97-156-F, scale 1:63,360, one sheet, __ p. pamphlet.

____ 1997g, Reconnaissance geologic map of the Petersburg B-5 quadrangle, southeastern Alaska: U.S. Geological Survey Open-File Report 97-156-G scale 1:63,360, one sheet, __ p. pamphlet.

____ 1997h, Reconnaissance geologic map of the Petersburg C-1 quadrangle, southeastern Alaska: U.S. Geological Survey Open-File Report 97-156-H, scale 1:63,360, one sheet, __ p. pamphlet.

____ 1997i, Reconnaissance geologic map of the Petersburg C-3 quadrangle, southeastern Alaska: U.S. Geological Survey Open-File Report 97-156-I, scale 1:63,360, one sheet, __ p. pamphlet.

____ 1997j, Reconnaissance geologic map of the Petersburg C-4 quadrangle, southeastern Alaska: U.S. Geological Survey Open-File Report 97-156-J, scale 1:63,360, one sheet, __ p. pamphlet.

____ 1997k, Reconnaissance geologic map of the Petersburg C-5 quadrangle, southeastern Alaska: U.S. Geological Survey Open-File Report 97-156-K, scale 1:63,360, one sheet, __ p. pamphlet.

____ 1997l, Reconnaissance geologic map of the Petersburg D-4 quadrangle, southeastern Alaska: U.S. Geological Survey Open-File Report 97-156-L, scale 1:63,360, one sheet, __ p. pamphlet.

____ 1997m, Reconnaissance geologic map of the Petersburg D-5 quadrangle, southeastern Alaska: U.S. Geological Survey Open-File Report 97-156-M, scale 1:63,360, one sheet, __ p. pamphlet.

Brew, D. A., Berg, H. C., Morrell, R. P., Sonnevil, R. S., and Hunt, S. J., 1979, The mid-Tertiary Kuiu-Etolin volcanic-plutonic belt, southeastern Alaska, *in* Johnson, K. M., and Williams, J. R., eds., The United States Geological Survey in Alaska: Accomplishments during 1978: U.S. Geological Survey Circular 804-B, p. B129-B130.

Brew, D.A., Drew, L.J., Schmidt, L.M., Root, D.H., and Huber, D.F, 1991, Undiscovered locatable mineral resources of the Tongass National Forest and adjacent areas, southeastern Alaska: U.S. Geological Survey Open-File Report 91-10, 370 p., 15 maps at 1:250,000, 1 map at 1:500,000, 11 figs.

Brew, D.A., and Drinkwater, J.L., 1991, Tongass Timber Reform Act Wilderness Areas supplement to U.S. Geological Survey Open-File Report 91-10 (Undiscovered locatable mineral resources of the Tongass National Forest and adjacent lands, southeastern Alaska): U.S. Geological Survey Open-File Report 91-343: 56 p.

Brew, D.A., and Grybeck, D.J., 1997, Combined description of map units and correlation of map units for the Petersburg-Wrangell area 1:63,360-scale geologic maps, southeastern Alaska: U.S. Geological Survey Open-File Report 97-156-O, __ p.

Brew, D.A., Grybeck, D.J., Cathrall, J.B., Karl, S.M., Koch, R.D., Barnes, D.F., Newberry, R.J., Griscom, A., and Berg, H.C., 1989, Mineral-resource map of the Petersburg and parts of the Port Alexander and Sumdum 1:250,000 quadrangles, southeastern Alaska: U.S. Geological Survey MF-1970-B, scale 1:250,000, 1 sheet, 47 p. pamphlet.

Brew, D.A, Grybeck, D.J., Taylor, C.D., Jachens, R.C., Cox, D.P., Barnes, D.F., Koch, R.D., Morin, R.L., and Drinkwater, J.L., , 1996, Undiscovered mineral resources of southeastern Alaska--Revised mineral-resource-assessment-tract descriptions: U.S. Geological Survey Open-File Report 96-716, 131 p.; one map, scale 1:1,000,000.

Brew, D.A., Karl, S.M., and Tobey, E.F., 1985, Re-interpretation of age of Kuiu-Etolin belt volcanic rocks, Kupreanof Island, southeastern Alaska, *in* Bartsch-Winkler, S., ed., The U.S. Geological Survey in Alaska: Accomplishments during 1983: U.S. Geological Survey Circular 945, p. 86-88.

Brew, D.A., and Koch, R.D., 1997, Reconnaissance geologic map of the Bradfield Canal B-6 quadrangle, southeastern Alaska: U.S. Geological Survey Open-File Report 97-156-N, scale 1:63,360, one sheet, __ p. pamphlet.

Brew, D.A., and Morrell, R.M., 1983, Intrusive rocks and plutonic belts in southeastern Alaska, *in* Roddick, J. A., ed., Circum-Pacific plutonic terranes: Geological Society of America Memoir 159, p. 171-193.

Brew, D.A., Ovenshine, A.T., Karl, S.M., and Hunt, S.J., 1984, Preliminary reconnaissance geologic map of the Petersburg and parts of the Port Alexander and Sumdum 1:250,000 quadrangles, southeastern Alaska: U.S. Geological Survey Open-File Report 84-405, 2 sheets, 43 p. pamphlet.

Burrell, P.D., 1984a, Map and table describing the Admiralty-Revillagedo intrusive belt plutons in the Petersburg 1:250,000 quadrangle, Alaska: U.S. Geological Survey Open-File Report 84-171, scale 1:250,000, 6 p. pamphlet.

Burrell, P.D., 1984b, Cretaceous plutonic rocks, Mitkof and Kupreanof Islands, Petersburg quadrangle, southeastern Alaska, *in* Coonrad, W.L., and Elliott, R.L., eds., The United States Geological Survey in Alaska: Accomplishments during 1981: U.S. Geological Survey Circular 868, p. 124-126.

Burrell, P.D., 1984c, Late Cretaceous plutonic rocks, Petersburg quadrangle, southeastern Alaska, *in* Reed, K.M., and Bartsch-Winkler, eds., The United States Geological Survey in Alaska: Accomplishments during 1982: U.S. Geological Survey Circular 939, p. 93-96.

Burrell, P.D., Cobb, E.H., and Brew, D.A., 1982, Geologic bibliography of the Petersburg project area, Alaska: U.S. Geological Survey Open-File Report 82-483, 30 p.

Cathrall, J.B., Day, G.W., Hoffman, J.D., and McDanal, S.K., 1983a, A listing and statistical summary of analytical results for pebbles, stream sediments, and heavy-mineral concentrates from stream sediments, Petersburg area, southeast Alaska: U.S. Geological Survey Open-File Report 83-420-A, 48p., I sheet, scale I:250,000.

____ 1983b, Distribution and abundance of copper, determined by spectrographic analysis, in the minus-80-mesh fraction of stream sediments, Petersburg area, southeast Alaska: U.S. Geological Survey Open-File Report 83-420-B, I sheet, scale I:250,000.

____ 1983c, Distribution and abundance of copper, determined by spectrographic analysis, in the nonmagnetic fraction of heavy- mineral concentrates from stream sediments, Petersburg area, southeast Alaska: U.S. Geological Survey Open-File Report 83-420-C, I sheet, scale I:250,000.

____ 1983d, Distribution and abundance of lead, determined by spectrographic analysis, in the minus-80-mesh fraction of stream sediments, Petersburg area, southeast Alaska: U.S. Geological Survey Open-File Report 83-420-D, I sheet, scale I:250,000.

____ 1983e, Distribution and abundance of lead, determined by spectrographic analysis, in the nonmagnetic fraction of heavy- mineral concentrates from stream sediments, Petersburg area, southeast Alaska: U.S. Geological Survey Open-File Report 83-420-E, I sheet, scale I:250,000.

____ 1983f, Distribution and abundance of zinc, determined by spectrographic analysis, in the minus-80-mesh fraction of stream sediments, Petersburg area, southeast Alaska: U.S. Geological Survey Open-File Report 83-420-F, I sheet, scale I:250,000.

____ 1983g, Distribution and abundance of zinc, determined by spectrographic analysis, in the nonmagnetic fraction of heavy- mineral concentrates from stream sediments, Petersburg area, southeast Alaska: U.S. Geological Survey Open-File Report 83-420-G, I sheet, scale I:250,000.

____ 1983h, Distribution and abundance of barium, determined by spectrographic analysis, in the minus-80-mesh fraction of stream sediments, Petersburg area, southeast Alaska: U.S. Geological Survey Open-File Report 83-420-H, I sheet, scale I:250,000.

____ 1983i, Distribution and abundance of barium, determined by spectrographic analysis, in the nonmagnetic fraction of heavy- mineral concentrates from stream sediments, Petersburg area, southeast Alaska: U.S. Geological Survey Open-File Report 83-420-I, I sheet, scale I:250,000.

____ 1983j, Distribution and abundance of determinable silver by spectrographic analysis, in nonmagnetic fraction of heavy- mineral concentrates from stream sediments and in the minus- 80-mesh fraction of stream sediments, Petersburg area, southeast Alaska: U.S. Geological Survey Open-File Report 83-420-J, 1 sheet, scale I:250,000.

____ 1983k, Distribution and abundance of detectable gold, arsenic, bismuth, and antimony in the nonmagnetic fraction of heavy- mineral concentrates and in the minus-80-mesh fraction from stream sediments, Petersburg area, southeast Alaska: U.S. Geological Survey Open-File Report 83-420-K, 1 sheet, scale I:250,000.

____ 1983l, Distribution and abundance of tin, determined by spectrographic analysis, in nonmagnetic fraction of heavy-mineral concentrates from stream sediments, Petersburg area, southeast Alaska: U.S. Geological Survey Open File Report 83-420-L, 1 sheet, scale I:250,000.

____ 1983m, Distribution and abundance of cadmium, determined by spectrographic analysis, in nonmagnetic fraction of heavy- mineral concentrates from stream sediments, Petersburg area, southeast Alaska: U.S. Geological Survey Open-File Report 83-420-M, 1 sheet, scale I:250,000.

____ 1983n, Distribution and abundance of molybdenum, determined by spectrographic analysis, in the minus-80-mesh fraction of of stream sediments, Petersburg area, southeast Alaska: U.S. Geological Survey Open-File Report 83-420-N, 1 sheet, scale I:250,000.

____ 1983o, Distribution and abundance of molybdenum, determined by spectrographic analysis, in nonmagnetic fraction of heavy- mineral concentrates from stream sediments, Petersburg area,southeast Alaska: U.S. Geological Survey Open-File Report 83-420-O, 1 sheet, scale I:250,000.

____ 1983p, Distribution and abundance of nickel, determined by spectrographic analysis, in the minus-80-mesh fraction of stream sediments from the Petersburg area, southeast Alaska: U.S. Geological Survey Open-File Report 83-420-P, 1 sheet, scale I:250,000.

____ 1983q, Distribution and abundance of nickel, determined by spectrographic analysis, in nonmagnetic fraction of heavy- mineral concentrates from stream sediments, Petersburg area, southeast Alaska: U.S. Geological Survey Open-File Report 83- 420-Q, 1 sheet, scale I:250,000.

____ 1983r, Distribution and abundance of cobalt, determined by spectrographic analysis, in the minus-80-mesh fraction of stream sediments, Petersburg area, southeast Alaska: U.S. Geological Survey Open-File Report 83-420-R, 1 sheet, scale I:250,000.

____ 1983s, Distribution and abundance of cobalt, determined by spectrographic analysis, in the nonmagnetic fraction of heavy- mineral concentrates from stream sediments, Petersburg area, southeast Alaska: U.S. Geological Survey Open-File Report 83-420-S, 1 sheet, scale I:250,000.

____ 1983t, Distribution and abundance of chromium, as determined by spectrographic analysis, in the minus-80-mesh fraction of stream sediments, Petersburg area, southeast Alaska: U.S. Geological Survey Open-File Report 83-420-T, 1 sheet, scale I:250,000.

____ 1983u, Distribution and abundance of chromium, as determined by spectrographic analysis, in the nonmagnetic fraction of heavy-mineral concentrates from stream sediments, Petersburg area, southeast Alaska: U.S. Geological Survey Open-File Report 83-420-U, 1 sheet, scale I:250,000.

____ 1983v, Distribution and abundance of tungsten, determined from colorimetric and spectrographic analysis, in the minus- 80-mesh fraction of stream sediments, Petersburg area, southeast Alaska: U.S. Geological Survey Open-File Report 83-420-V, 1 sheet, scale I:250,000.

____ 1983w, Distribution and abundance of tungsten, determined by spectrographic analysis, in nonmagnetic fraction of heavy- mineral concentrates from stream sediments, Petersburg area, southeast Alaska: U.S. Geological Survey Open-File Report 83-420-W, 1 sheet, scale I:250,000.

Cohen, H.A., and Lundberg, N., 1993, Detrital record of the Gravina arc, southeastern Alaska: Petrology and provenance of Seymour Canal Formation sandstones: Geological Society of America Bulletin, v. 105, p. 1400-1414.

Douglass, S.L., Webster, J.H., Burrell, P.D., Lanphere, M.L., and Brew, D.A., 1989, Major element chemistry, radiometric values, and locations of samples from the Petersburg and parts of the Port Alexander and Sumdum quadrangles, southeastern Alaska: U.S. Geological Survey Open-File Report 89-527, map at 1: 250,000, 66 p. pamphlet.

Ford, A. B., and Brew, D. A., 1977, Chemical nature of Cretaceous greenstone near Juneau, Alaska, *in* Blean, K. M., ed., The United States Geological Survey in Alaska: Accomplishments during 1976: U.S. Geological Survey Circular 751-B, p. B88-B90.

_____1978, Minor metal content of Cretaceous greenstone near Juneau, Alaska, *in* Albert, N. R. D., and Hudson, Travis, eds., The United States Geological Survey in Alaska: Accomplishments during 1979: U.S. Geological Survey Circular 823-B, p. B99-B101.

Grybeck, D.J., Berg, H.C., and Karl, S.M., 1984, Map and description of the mineral deposits in the Petersburg and eastern Port Alexander quadrangles, southeastern Alaska: U.S. Geological Survey Open-File Report 84-837, scale 1:250,000, 87 p. pamphlet.

Himmelberg, G.R., and Loney, R.A., 1995, Characteristics and petrogenesis of Alaskan-type ultramafic-mafic intrusions, southeastern Alaska: U.S. Geological Survey Professional Paper 1564, 47 p.

Hunt, S. J., 1984, Preliminary study of a zoned leucocratic granite body on central Etolin Island, southeast Alaska, *in* Coonrad, W. C., and Elliott, R.L., eds., The United States Geological Survey in Alaska: Accomplishments during 1981: U.S. Geological Survey Circular 868, p. 128-131.

Karl, S.M., Koch, R.D., Hoffman, J.D., Day, G.W., Sutley, S.J., and McDanal, S.K., 1985, Trace element data for rock samples from the Petersburg, and parts of the Port Alexander and Sumdum quadrangles, southeastern Alaska: U.S. Geological Survey Open-File Report 85-146, scale 1:250,000, 698 p.

Karl, S.M., and Koch, R.D., 1990, Maps and preliminary interpretation of anomalous rock geochemical data from the Petersburg quadrangle and parts of the Port Alexander, Sitka, and Sumdum quadrangles, southeastern Alaska: U.S. Geological Survey Miscellaneous Field Studies Map MF 1970-C, 40 p. pamphlet, 7 sheets.

Koch, R.D., and Berg, H.C., 1996, Reconnaissance geologic map of the Bradfield Canal quadrangle, southeastern Alaska: U.S. Geological Survey Open-File Report 81-728-A, scale 1:250,000, 35 p. pamphlet.

Lathram, E. H., Pomeroy, J. S., Berg, H. C., and Loney, R. A., 1965, Reconnaissance geology of Admiralty Island, Alaska: U.S.Geological Survey Bulletin 1181-R, p. B1-R48, 2 pls., scale 1:250,000.

LeCompte, J.R., 1981, Landsat features maps of the Petersburg quadrangle and vicinity, southeastern Alaska: U.S. Geological Survey Open-File Report 81-799, 2 sheets, scale I:250,000.

Loney, R. A., 1964, Stratigraphy and petrography of the Pybus-Gambier area, Admiralty Island, Alaska: U.S. Geological Survey Bulletin 1178, 103 p.

McClelland, W. C., and Gehrels, G.E., 1990, Geology of the Duncan Canal shear zone: Evidence for Early-Middle Jurassic deformation of the Alexander terrane, southeastern Alaska: Geological Society of America Bulletin, v. 102, p. 1378-1392.

Muffler, L. J. P., 1967, Stratigraphy of the Keku Islets and neighboring parts of Kuiu and Kupreanof Islands, southeastern Alaska: U.S. Geological Survey Bulletin 1241-C, p. C1-C52.

Page, N. J., Berg, H. C., and Haffty, J., 1977, Platinum, palladium, and rhodium in volcanic and plutonic rocks from the Gravina-Nutzotin belt, Alaska: U.S. Geological Survey Journal of Research, v. 5, p. 629-636.

Taylor, H. P., 1967, The zoned ultramafic complexes of southeastern Alaska, *in* Wyllie, P. J., ed., Ultramafic and related rocks: J. Wiley and Sons, p. 97-121.

Taylor, H. P., Jr., and Noble, J. A., 1960, Origin of the ultramafic complexes in southeastern Alaska: International Geological Congress, 21st, Copenhagen 1960, pt. 13, p. 175-187.

Tripp, R.B., and Cathrall, J.B., 1984, Mineralogical map showing the distribution of selected minerals in nonmagnetic fraction of heavy-mineral concentrates from stream sediments, Petersburg area, southeast Alaska: U.S. Geological Survey Open-File Report 83-420-X, 1 sheet, scale 1:250,000.

Souther, J. G., Brew, D. A., and Okulitch, A. V., 1979, Sheet 104-114, Iskut River, British Columbia-Alaska: Geological Survey of Canada, Geological Atlas Map 1418A, 3 sheets, scale 1:1,000,000.

U.S. Geological Survey, 1978, Aeroradioactivity of Kosciusko Island, Alaska: U.S. Geological Survey Open-File Report 79-831, 1 sheet, scale l:63,360.

____ 1979, Aeromagnetic map of Petersburg area, Alaska: U.S. Geological Survey Open-File Report 79-832, 1 sheet, scale l:250,000.