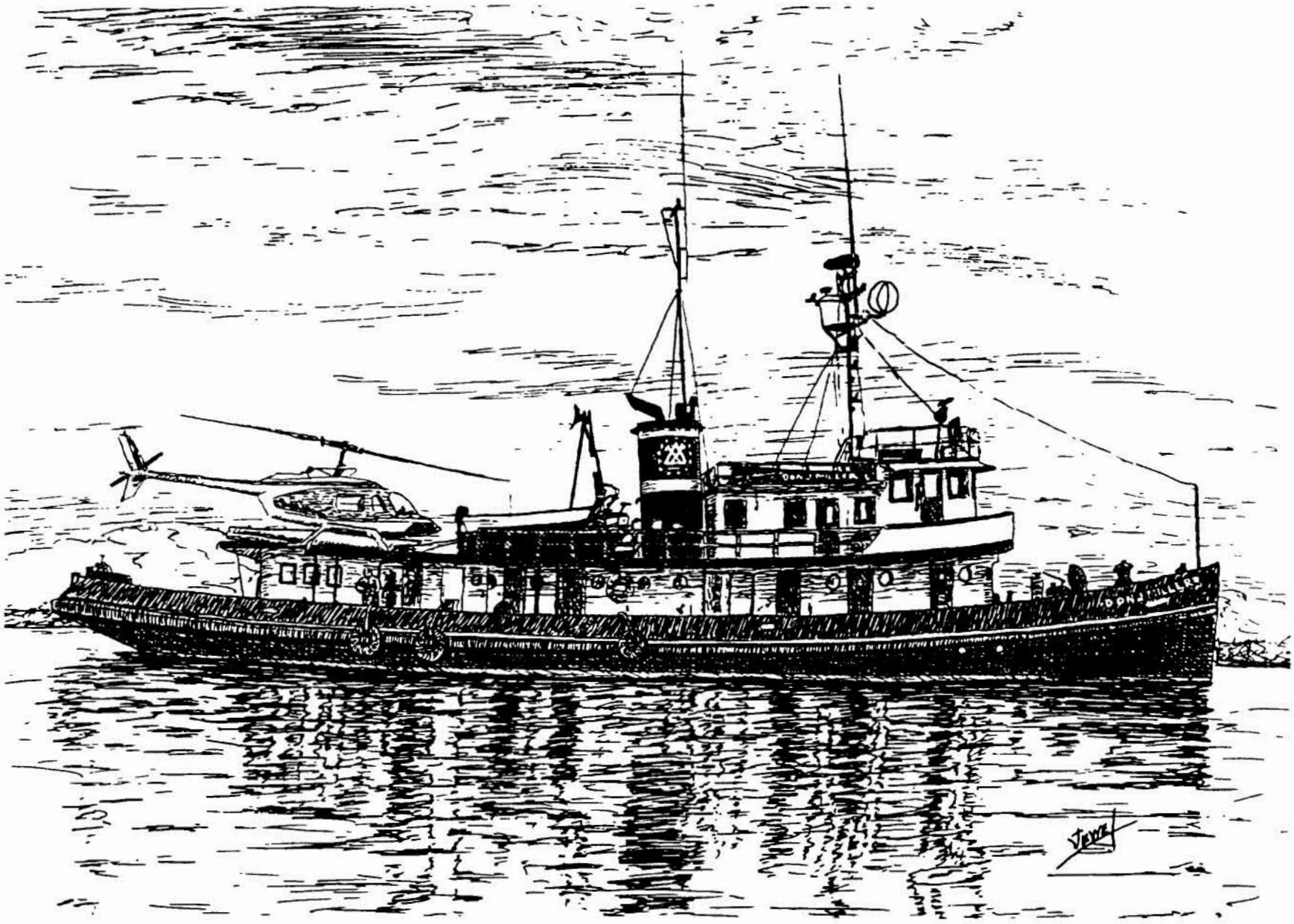
U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY
GEOLOGIC DIVISION



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

RECONNAISSANCE GEOLOGIC MAP OF THE PETERSBURG D-4 QUADRANGLE, SOUTHEASTERN ALASKA

Open-File Report 97-156-L

By David A. Brew

U.S. DEPARTMENT OF THE INTERIOR

U.S. GEOLOGICAL SURVEY

Reconnaissance Geologic Map of the Petersburg D-4 Quadrangle, Southeastern Alaska

By

David A. Brew[1]

Open-File Report 97-156-L

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

RECONNAISSANCE GEOLOGIC MAP OF THE PETERSBURG D-4 QUADRANGLE, SOUTHEASTERN ALASKA

By David A. Brew

INTRODUCTION

This map and its accompanying information were prepared specifically as part of the 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. These studies are a direct follow-up to the U.S. Geological Survey studies in the area in the 1980's, which are cited below.

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 published 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.

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 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 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.

KUIU-ETOLIN BELT

Belt informally named by Brew and others (1979), redefined by Brew and Morrell (1983), and the 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; as mapped, divided into:

Qb Extrusive Basaltic Rocks and Underlying Sediments (Holocene and(or) Pleistocene)--Fresh, locally polygonally jointed, dense, very fine-grained to aphanitic magnetite-bearing olivine basalt and minor pyroxene basalt. Dark greenish gray on fresh surfaces. Individual flows are as much as 10 m thick and are columnar jointed; most flows are less than 1-m thick. Underlain locally by aa flows and mafic volcanic breccia in layers up to 0.5-m thick and by locally derived, poorly sorted, well-bedded brown- to gray-weathering conglomerate, pebbly sandstone, sandstone and minor siltstone deposited in fluvial or beach environment. Quarry on peninsula in Kah Sheets Bay in the southern part of Petersburg C-4 quadrangle exposes a small lens of polymictic glacial till under dense aphanitic basalt that is mapped with this unit; whole unit is interpreted to be Pleistocene or younger. Three whole-rock K-Ar ages on basalts from a few miles south of Kah Sheets Bay gave ages of 0.272±0.085, 0.262±087, and 4.04±6.95 Ma (M. A. Lanphere, U.S. Geological Survey, written communs., 1972). Exposed at Indian Point and on High Castle Island in Duncan Canal in this quadrangle and elsewhere along south shore of Kupreanof Island from Kah Sheets Bay to Douglas Bay and from west of Totem Bay to beyond Point Barrie . Equivalent rocks may be included with "Basalt and Other Mafic Extrusive rocks" (QTb) mapped elsewhere in the Petersburg-Wrangell area, particularly along Rocky Pass and near the mouth of Irish Creek.

GRAVINA BELT

The term Gravina belt is used here to denote sedimentary and volcanic rocks of Late Jurassic and Early Cretaceous age, as well as 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 that are unlike any elsewhere in the Gravina belt, but are 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), 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)--Belt informally named by Brew and Morrell (1983) and described by Burrell (1984abc); K-Ar determinations by M. A. Lanphere, U.S. Geological Survey, (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 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--

Varied migmatitic rocks, mainly agmatite and irregular banded gneiss. Generally, but not always, occurs in zones between the "Hornblende-Biotite Tonalite and Granodiorite, etc." (Ktef) and the "Metamorphosed Stephens Passage Group Rocks" mapped elsewhere in the Petersburg-Wrangell area (see below) The granitic leucosomes generally resemble the main rock types in the above-mentioned (Ktef) unit; the metamorphic melasomes are fine- to medium-grained (garnet-)(sillimanite-) biotite hornfels, schist, and semischist. Crops out in the northern part of this quadrangle in the Missionary Range and elsewhere on southwestern Wrangell, southeastern Etolin, and nearby small islands.

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, yellowish-gray on weathered surfaces. Contains rounded, elongate very fine-grained dioritic and local ultramafic inclusions. Mineralogy includes oscillatory zoned seriate plagioclase, both discrete and small clumps of biotite and hornblende, mutually exclusive subhedral epidote and clinozoisite, rare garnet, and accessory sphene, allanite, and apatite. Alteration includes plagioclase to sericite and mafic minerals to epidote. Unit differs from "Hornblende-Biotite Tonalite and Granodiorite, etc." (Ktef) mapped elsewhere in the Petersburg-Wrangell area by lack of pyroxene and garnet and better development of seriate plagioclase. The "Hornblende-Biotite Tonalite" (Ktop) mapped elsewhere in the Petersburg-Wrangell area is a porphyritic variant of this unit. Exposed in the northern part of this quadrangle in the Missionary Range and elsewhere on Mitkof, Zarembo, and Woronkofski Islands (Burrell, 1984ab).

Kqop Biotite-Epidote-Hornblende Quartz Monzodiorite--

Locally foliated; plagioclase porphyritic with medium- and coarse-grained phenocrysts (to 12 mm), fine- to medium-grained groundmass (to 3 mm) and a C.I. range of 17 to 48. Weathers brownish-gray, gray and white on fresh surfaces. 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 also common. Mineralogy includes 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 in the eastern part of this quadrangle on the Lindenberg Peninsula and elsewhere on Kupreanof Island and on Woewodski 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).

Kqo Pyroxene-Biotite-Hornblende-Quartz Monzodiorite, Quartz Diorite, Monzodiorite, and Diorite--

Locally foliated; equigranular; medium-grained, fine- to medium-grained near margins; C.I. 20 to 61. Black and white to medium gray on fresh surfaces, brownish-gray to orangish-gray on weathered surfaces. Mafic inclusions, quartz and pegmatite veins and diabase dikes present. Mineralogy includes anhedral, commonly poikilitic, hornblende with pyroxene, biotite, and plagioclase inclusions; and anhedral biotite and pyroxene. Plagioclase is twinned, zoned,and crystals are very closely packed. Plagioclase, K-feldspar, and quartz form the groundmass. In the northern part of the Missionary Range body, n the northern Lindenberg Peninsula in this quadrangle, biotite, opaques and clinopyroxene are common. Hornblende appears and increases in abundance as pyroxene and opaque minerals decrease in abundance to the south. Hornblende, when present, is usually the dominant mafic mineral. Unit is exposed both on northern Lindenberg Peninsula and on central Mitkof Island (Burrell, 1984a).

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" unit probably intertongues 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. Not mapped in this quadrangle, however there are:

METAMORPHOSED STEPHENS PASSAGE GROUP ROCKS (Upper Cretaceous)--In general, these units are associated with the Upper Cretaceous plutons of the Admiralty-Revillagigedo plutonic belt and with 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 and are described here or are 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 Upper Cretaceous metamorphism as well and the units that are based on Tertiary metamorphic effects alone are poorly defined. 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. Three units mapped in this quadrangle, namely:

Ksg Greenstone and Greenschist--

Subgreenschist to greenschist facies rocks within the "Phyllite" (Ksp) on Lindenberg Peninsula and Kupreanof Island in the central part of this quadrangle. Dominantly fine- to medium-grained, relict pyroxene-phenocryst-bearing epidote-albite-chlorite greenstone; poorly foliated. Weathers dark greenish gray, grayish-green on fresh surfaces. Probably derived from intermediate composition volcanic breccias; forms poor rounded outcrops. Some greenschist and green phyllite, although most of the latter has been mapped with the "Phyllite" (Ksp). Age inferred from relation to that same unit.

Kss Schist and Hornfels--

Greenschist and albite-epidote to hornblende-hornfels facies metamorphic rocks derived from "Seymour Canal Formation" (KJss); original textures and structures generally preserved. Dominantly fine- to medium-grained and grayish-brown and reddish-brown weathering. 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".

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) mapped elsewhere in the Petersburg-Wrangell area. Original textures and structures generally obscure. Dominantly very-fine-grained, dark-gray on weathered surfaces, 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 are 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).

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 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) and Taylor (1967). One unit mapped in this quadrangle:

Kuk Ultramafic Complex at Kane Peak--

This complex (Kennedy and Walton, 1946; Walton, 1951ab) is not dated but probably is similar in age to Blashke Islands complex. Consists of undivided wehrlite, dunite, and clinopyroxenite. Wehrlite: most abundant; massive to locally layered on 1- to 10-cm scale; medium-grained; C.I. 100; weathers brown, greenish-gray to dark gray on fresh surfaces; partially serpentinized; contains scattered inclusions of clinopyroxenite and sparse hornblendite dikes. Dunite: next most abundant rock type; grades from wehrlite; massive, partially serpentinized; medium-grained; C.I. 100; weathers yellowish-brown, fresh surfaces are gray to dark gray. Olivine pyroxenite: massive to locally layered on 1- to 5cm scale; medium-grained; C.I. 100; weathers dark green, greenish-gray on fresh surfaces; tends to form narrow discontinuous zone around margin. Interrupted by massive, hornblendite along northern contact. Zonation poorly developed, no evidence of homogeneous dunite core or gabbro margin; above major rock types gradational. Exposed in northeastern corner of this quadrangle. Intruded by Upper Cretaceous granitic body to the northwest.

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 some 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 on fresh surfaces, gray to brown on weathered surfaces. Relict textures and sedimentary structures indicate derivation from a graywacke and siltstone or mudstone turbidite sequence. Unit in othe quadrangles encloses several large lenses of "Fossiliferous Limestone" (Dls) of Devonian age, but there is no direct indication of the age. Proximity to "Seymour Canal Formation" (KJss) outcrops in other quadrangles 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) in the proportion of originally coarse-grained sediments, and in the general absence of volcanic(?) protolith phyllite in this unit, and the two units probably intertongue much more complexly than is shown on the map. Exposed in this quadrangle in Duncan Canal, and elsewhere on Woewodski, Zarembo, and Etolin Islands.

Mzp Phyllite and Slate Metamorphosed From Tuff, Mudstone and Minor Graywacke--

Chlorite phyllite, slate and semischist, minor conglomerate, limestone and quartzite. Fine- to very fine-grained; highly folded, especially in northern Kupreanof Island. Some phyllite is light green on fresh surfaces and medium green where weathered and is inferred to have been derived from intermediate composition tuffaceous rocks. Other phyllite is dark gray fresh and weathered and is inferred to have been derived from fine-grained clastic sediments, as are the dark gray fresh and weathered slates. Dark gray rocks are locally graphitic. Locally polymictic conglomerate layers less than 1-m thick occur on northwestern Kupreanof Island only. Thickness unknown, but probably great. One collection of conodonts from the limestone layers in west-central Kupreanof Island indicates that the unit is at least in part Upper Triassic (B. R. Wardlaw and A. G. Harris, U.S. Geological Survey, written commun., 1983). Unit contrasts with the "Cannery Formation" (MDc) elsewhere in the Petersburg-Wrangell area because this unit contains less chert and is more deformed and also contrasts with the "Greenschist, Chert, Limestone, and Argillite" (Mzum) because this unit is of lower metamorphic grade and contains no limestone. Unit probably grades into the "Phyllite" (Ksp) to the east. Muffler (1967) mapped the exposures of this unit on northwestern Kupreanof Island as "Seymour Canal Formation" (KJss in this series of maps) on the basis of lithologic correlation with that unit on Admiralty Island to the north. Those rocks have been assigned to this unit because of difficulty in mapping them southward as a separate unit. Unit is exposed very widely as the most common unit in the northern part of the Duncan Canal-Zarembo Island-Screen Island sub-belt; exposed in the southwestern part of this quadrangle.

Mzg Metamorphosed Gabbro--

Chlorite-amphibole-plagioclase rocks interpreted to have been gabbro bodies, but could be more highly metamorphosed mafic volcanic rocks. Dark grayish-green on fresh and weathered surfaces; medium- to fine-grained; thickness uncertain. Some local suggestion of relict layering. No direct evidence of age. Crops out at Indian Point in Duncan Canal at the southern edge of this quadrangle.

Mzum Ultramafic Rock--

Serpentinized peridotite and dunite. Fine- to medium-grained; greenish-gray on fresh surfaces; organgish-brown where weathered. Two small bodies several meters across in upper Duncan Canal are intruded into the "Semischist and Phyllite, Etc." (Mzs) unit.

Dsls MIXED SILTSTONE, GRAYWACKE, AND FOSSILIFEROUS LIMESTONE (Lower and Middle Devonian)--

Siltstone, graywacke, fossiliferous limestone, and tuff intercalated with "Fossilferous Limestone" (Dls) at point between Tower Arm and the Main Arm of Duncan Canal in southwestern corner of quadrangle.

Dls FOSSILIFEROUS LIMESTONE (Lower and Middle Devonian)--

Medium-bedded to massive, fine- to medium-grained. Light to medium gray on fresh and weathered surfaces. Locally fetid; individual lenses up to several hundred m thick. Contains brachiopods, corals, crinoids, and (locally) fusulinids. Northwesternmost exposures (mapped by Muffler, 1967, as part of the "Gambier Bay Formation") contain corals or stromatoporoids of Middle Devonian or possibly Late Silurian age. Abundant old and new collections from the several fossiliferous lenses at and near the head of Duncan Canal in this quadrangle contain Lower and Middle Devonian corals, brachiopods, and conodonts (Buddington and Chapin, 1929; A.G. Harris, U.S. Geological Survey, written communs., 1979, 1980, 1983; W.A. Oliver, Jr., U.S. Geological Survey, written commun., 1979; J.T. Dutro, Jr., U.S. Geological Survey, written communs., 1979, 1980) and the smaller lenses in Clarence Strait (Key Reef and Abraham Island) contain Lower(?) Devonian corals (W.A. Oliver, Jr., U.S. Geological Survey, written communs., 1978, 1983). Part of large exposure in the quadrangle to the south at Castle Islands in Duncan Canal was the host for a sulfide-barite deposit of significant size (Burchard, 1914). However, some workers (D.J. Grybeck, U.S. Geological Survey, written commun, 1997) interpret this exposure instead to be of Triassic age limestone.

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 Scientific Illustrator K.A. Ghequiere. I thank them all.

REFERENCES CITED FOR THE PETERSBURG D-4 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., 1981, Upper Triassic volcanogenic massive sulfide metallogenic province identified in southeastern Alaska, *in* Albert, N. R. D., and Hudson, Travis, eds., United States Geological Survey in Alaska: Accomplishments during 1979: U.S. Geological Survey Circular 823-B, p. B104-B108.

Berg, H. C., and Grybeck, Donald, 1980, Upper Triassic volcanogenic Zn-Pb-Ag (-Cu-Au)-barite mineral deposits near Petersburg, Alaska: U.S. Geological Survey Open-File Report 80-527, 11 p.

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, Juergen, 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, 22 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.

____ 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, 23 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, 20 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, 19 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, 23 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, 18 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, 21 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, 18 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, 21 p. pamphlet. (This report)

____ 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., 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., 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 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.

Buddington, A.F., and Chapin, T., 1929, Geology and mineral deposits of southeastern Alaska: U.S. Geological Survey Bulletin 800, 398 p.

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.

Dickinson, K. A., 1979, A uranium occurrence in the Tertiary Kootznahoo Formation on Kuiu Island, southeast Alaska: U.S. Geological Survey Open-File Report 79-1427, 5 p.

Dickinson, K.A., and Campbell, J. A., 1982, The potential for uranium deposits in the Tertiary Kootznahoo Formation of the southern part of the Admiralty trough, southeastern Alaska: U.S. Geological Survey Open-File Report 82-983, 18 p.

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, T., eds., The United States Geological Survey in Alaska: Accomplishments during 1979: U.S. Geological Survey Circular 823-B, p. B99-B101.

Eberlein, G. D., and Churkin, M., Jr., 1970, Paleozoic stratigraphy on the northwest coastal area of Prince of Wales Island, southeastern Alaska: U.S. Geological Survey Bulletin 1284, 67 p.

Eberlein, G.D., Churkin, M., Jr., Carter, C., Berg, H. C., and Ovenshine, A. T., 1983, Geology of the Craig quadrangle, Alaska: U.S. Geological Survey Open-File Report 83-91, 2 sheets, scale 1:250,000, pamphlet.

Grant, R. E., 1971, Taxonomy and autecology of two Arctic Permian rhynchonelloid brachiopods, *in* Dutro, J. T., Jr., ed., Paleozoic perspectives: A tribute to G. Arthur Cooper: Smithsonian Institution Contributions to Paleontology, no. 3, p. 313-335.

Grybeck, D.J., Berg, H.C., and Karl, 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.

Hillhouse, J. W., and Gromme', C. S., 1980, Paleomagnetism of the Triassic Hound Island Volcanics, Alexander Terrane, southeastern Alaska: Journal of Geophysical Research, v. 85, no. B5, p. 2594-2602.

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., 1984, Recognition of Burnt Island Conglomerate on the Screen Islands, southeastern 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. 115-117.

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.

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.

Kennedy, G. C., and Walton, M. S., Jr.,1946, Geology and associated mineral deposits of some ultrabasic rock bodies in southeastern Alaska: U.S. Geological Survey Bulletin 947-D, p. 65-84.

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 l: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.

Ovenshine, A. T., and Webster, G. D., 1970, Age and stratigraphy of the Heceta Limestone in northern Sea Otter Sound, southeastern Alaska, *in* Geological Survey research 1970: U.S. Geological Survey Professional Paper 700-C, p. C170-C174.

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.

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.

Sonnevil, R. A., 1981, The Chilkat-Prince of Wales plutonic province, southeastern Alaska, *in* Albert, N.R. D., and Hudson, Travis, eds., United States Geological Survey in Alaska: Accomplishments during 1979: U.S. Geological Survey Circular 823-B, p. B112-B115.

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 I:63,360.

____1979, Aeromagnetic map of Petersburg area, Alaska: U.S. Geological Survey Open-File Report 79-832, 1 sheet, scale I:250,000.

Walton, M. S., Jr., 1951a, The Blashke Island ultrabasic complex with notes on related areas in southeastern Alaska: U.S. Geological Survey Open-File Report 51-29, 266 p.

_____1951b, The Blashke Island ultrabasic complex; with notes on related areas in southeastern Alaska: New York Academy of Science Transactions, v. 13, p. 320-323.

Wright, F. E., and Wright, C. W., 1908, The Ketchikan and Wrangell mining districts, Alaska: U.S. Geological Survey Bulletin 347, 210 p.

Version 97.08.07.0910