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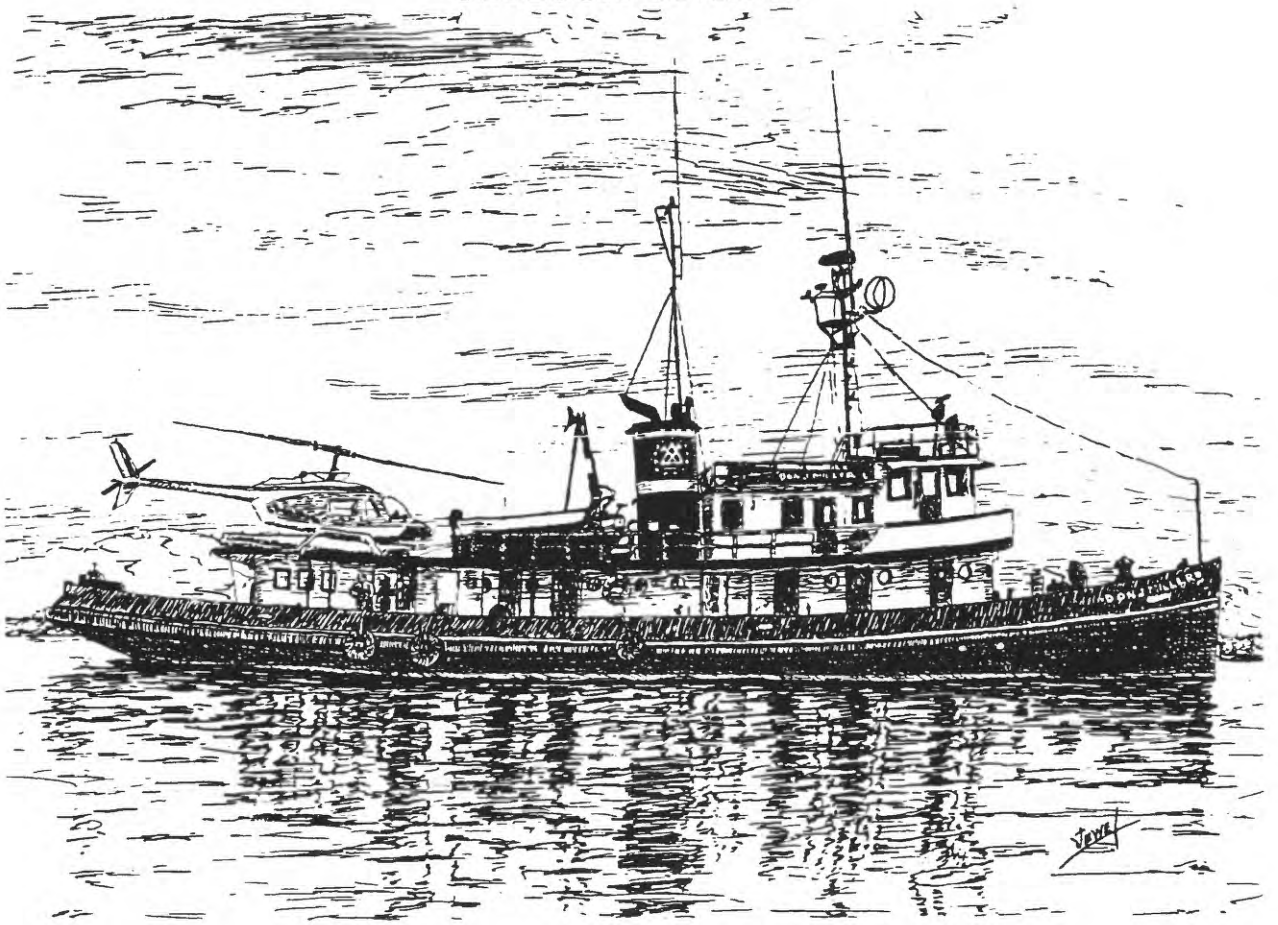

[U.S.G.S. R/V Don J. Miller II]

COMBINED DESCRIPTION OF MAP UNITS AND CORRELATION OF MAP UNITS FOR THE PETERSBURG-WRANGELL AREA 1:63,360-SCALE GEOLOGIC MAPS, SOUTHEASTERN ALASKA

Open-File Report 97-156-O

By David A. Brew and Donald J. Grybeck

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Combined Description of Map Units and Correlation of Map Units for the Petersburg-Wrangell Area 1:63,360-Scale Geologic Maps, Southeastern Alaska

By

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Open-File Report 97-156-O

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COMBINED DESCRIPTION OF MAP UNITS AND CORRELATION OF MAP UNITS FOR THE PETERSBURG-WRANGELL AREA 1:63,360-SCALE GEOLOGIC MAPS, SOUTHEASTERN ALASKA

By

David A. Brew and Donald J. Grybeck

INTRODUCTION

This report is designed to aid the users of the 1:63,360-scale reconnaissance bedrock geologic maps (Brew, 1997a-m; Brew and Koch, 1997) that were produced by the U.S. Geological Survey as a contribution to the City of Wrangell, Alaska; U.S. Bureau of Land Management Minerals Section (Juneau); and State of Alaska Division of Geological and Geophysical Surveys joint study of the mineral resources of the Petersburg-Wrangell area, southeastern Alaska. This report does so by combining the information contained in the "Correlation of Map Units" diagrams, in the "Brief Description of Map Units", in the "Descriptions of Map Units", and "References" sections of those fourteen (14) maps into single entities of the same name. Use of the combined material is facilitated by a two-way index that alphabetically (1) keys the map-unit symbols on the individual maps to the descriptions and their pages in this report, and (2) keys the map-unit names to the pages in this report and gives their map-unit symbols. As with the fourteen maps noted above and their map-unit descriptions, this material is based on and revised from the material used in Brew and others (1984). This report, however, contains some added material, particularly concerning isotopic ages and geologic and tectonic setting, that is not in the above-mentioned reports.

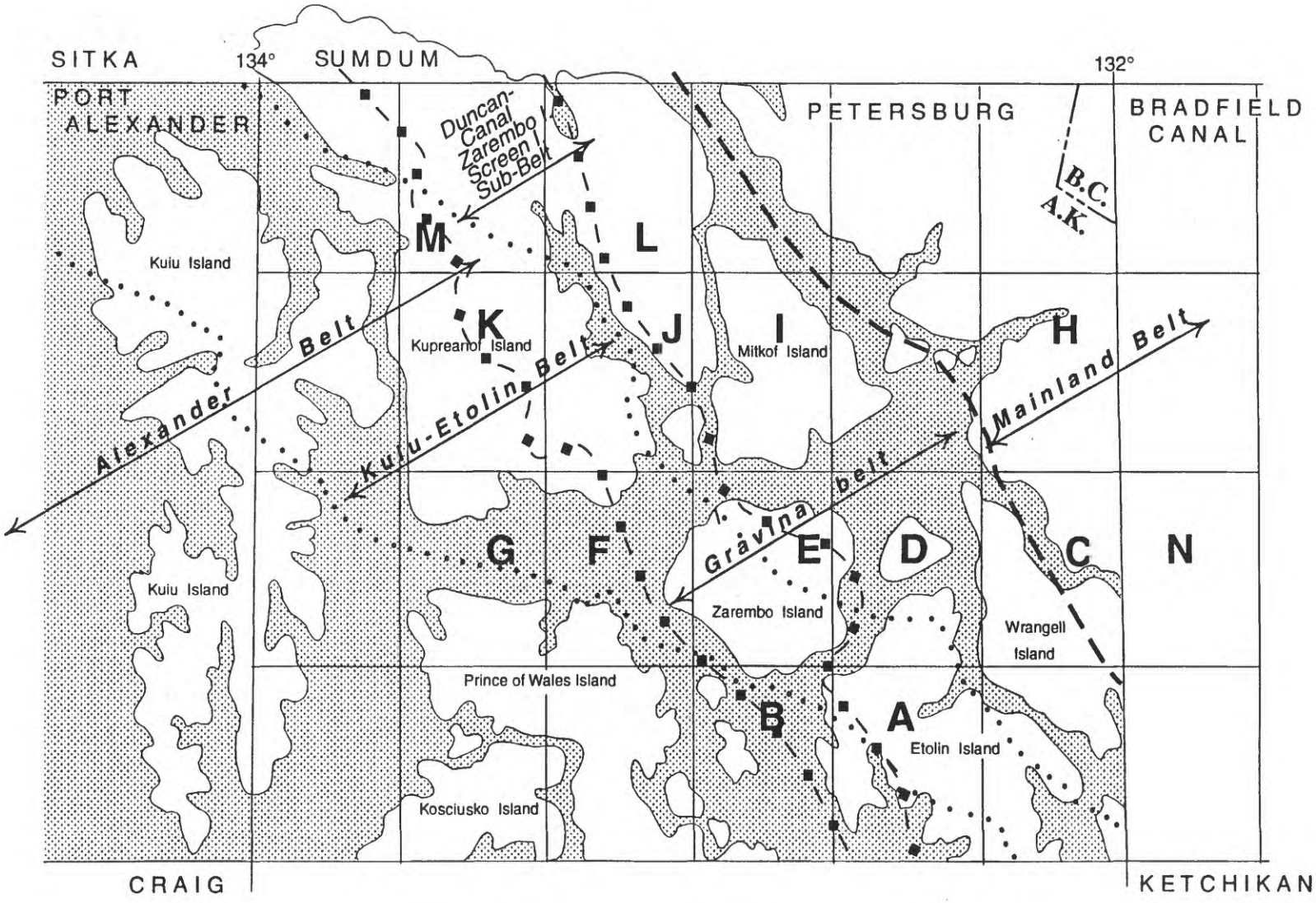

Figure 1. Index map of Petersburg project area (Brew and others, 1984) showing locations of belts mentioned in this text and on Correlation of Map Units diagram (p. 108) and the locations of 1:250,000- and 1:63,360-scale quadrangles. The 1:63,360-scale quadrangles in the Open-File Report map series (OFR 97-156a-n) are indicated by capital letters. The different types of lines bounding the belts have no special significance.

SKETCH OF GEOLOGIC AND TECTONIC SETTING

Figure 1 shows the major geological elements, or belts, 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. The lower to middle Tertiary Kuiu-Etolin volcanic-plutonic belt is younger than almost all parts of all of these belts, and extends from the Alexander belt across the Gravina and onto the Mainland belt. The Kuiu-Etolin belt 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. The Mainland belt corresponds to their Taku and Tracy Arm terranes, but is interpreted below to have very different significance. The Wrangellia terrane, as used by Berg and others (1978) and by Monger and others (1987), is not present at this latitude in southeastern Alaska, but the Carboniferous and younger rocks included in the Alexander terrane (or belt) are interpreted here (Brew and Ford, 1994) to be a facies of the Wrangellia terrane.

The original and present contacts between these belts vary. The Wrangellia part of the Alexander terrane stratigraphically, and probably unconformably, overlies the older part of the Alexander terrane. The Gravina belt overlap assemblage is interpreted to stratigraphically overlie the Alexander belt rocks, but that contact is not exposed (Brew and Karl, 1984a,b). In the area covered by these maps, slightly metamorphosed Gravina belt rocks are everywhere in contact with a group of older rocks, assigned to the Duncan Canal-Zarembo sub-belt of the Gravina belt, but the nature of that contact is uncertain; nevertheless, it has been mapped as stratigraphic in this series of maps. In this area the rocks east of the Gravina belt are considered to be part of the Nisling terrane of Wheeler and McFeely (1991).The contact of the Gravina belt rocks with the Nisling terrane rocks is also uncertain, but in most places it has been mapped as a gradational metamorphic contact. Some of these such contacts, such as the Fanshaw fault of Gehrels and others (1992), are interpreted to have been faults that have been obliterated and obscured by later metamorphism to the point that they are no longer recognizable as faults in the field. These faults are part of the Behm Canal structural zone as defined by Brew and Ford (1998; see fig. 2). That zone is one of the five major structural zones that are associated with the collision of the Insular superterrane to the west with the Intermontane superterrane to the east (Brew and Ford, 1998).

The sequence of tectonic events recorded by these features is, briefly: (1) deposition of the Late Jurassic to Early Cretaceous Gravina belt overlap assemblage turbidites and volcanic rocks in an arc setting along the eastern margin of the minicontinent made up of the Alexander terrane and stratigraphically overlying Wrangellia-terrane-affinity rocks; (2) collision of the rocks of that minicontinental margin overlap assemblage (namely the Insular superterrane), with the Late Proterozoic(?) and early to middle Paleozoic rocks of the Nisling terrane and other terranes to the east (namely the Intermontane superterrane) in the middle Cretaceous; (3) westward-vergent thrusting in middle to Late Cretaceous time of Gravina belt rocks in what Brew and Ford (1998) called the Gravina belt structural zone; (4) westward-vergent thrusting in the Late Cretaceous of Gravina, Nisling, and perhaps Stikine terrane rocks in what Brew and Ford (1998) called the Behm Canal structural zone; and (5) still younger development of the shear zone that localized the Latest Cretaceous and Paleocene Great Tonalite Sill family of plutons, of the mylonite zone along the footwalls of those composite plutons, and of the final adjustments and differential uplift along the Eocene to Holocene Coast Range Megalineament structural zone (Brew and Ford, 1998).

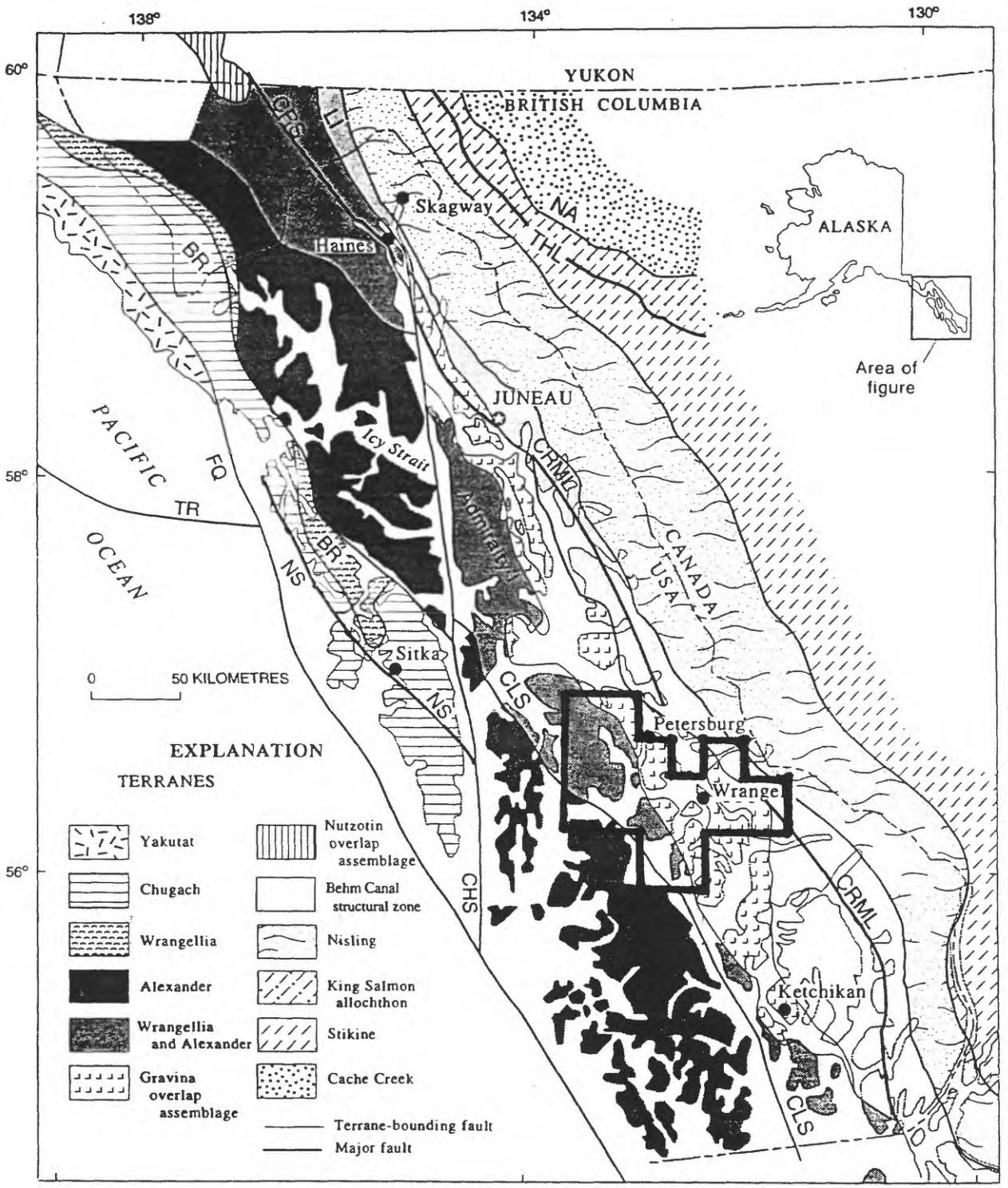

Figure 2. Lithotectonic terrane map of southeastern Alaska, showing area covered by the Petersburg-Wrangell area 1:63,360-scale geologic maps (Brew, 1997a-m; Brew and Koch, 1997). Adapted from Brew (1996).

BRIEF DESCRIPTION OF MAP UNITS

Qi GLACIAL ICE AND PERMANENT SNOWFIELDS (Holocene)--Almost exclusively in Mainland Belt.

Qs SURFICIAL DEPOSITS (Holocene and (or) Pleistocene)--Alluvium, colluvium, tidal mudflat deposits, and some glaciofluvial deposits.

KUIU-ETOLIN BELT

EXTRUSIVE AND INTRUSIVE VOLCANIC ROCKS OF KUIU-ETOLIN VOLCANIC-PLUTONIC BELT (Quaternary and Tertiary)

Qb Extrusive Basaltic Rocks and Underlying Sediments

QTv Vent Breccia

QTa Andesite and Other Intermediate Extrusive Rocks

QTc Volcaniclastic Deposits

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

QTb Basalt and Other Mafic Extrusive Rocks

QTd Dikes, Sills, and Extrusive Rocks

QTx Breccia and Agglomerate

INTRUSIVE GRANITIC AND OTHER ROCKS OF KUIU-ETOLIN VOLCANIC-PLUTONIC BELT (Miocene and (or) Oligocene)

Tmae Alkali Granite Satellitic to Granite of Central Etolin Island

Tmge Granite of Central and Northern Etolin Island

Tmme Migmatitic Granitic Rocks of Central and Northern Etolin Island

Tmaz Alkali Granite of Northwestern Etolin and Southeastern Zarembo Islands

Tmqk Heterogeneous Granitic Rocks of Central Kupreanof and Northeastern Kuiu Islands

Tmdk Heterogeneous Dioritic Rocks of Northern Kuiu Island

Tmgb Gabbro and microgabbro

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

Tk KOOTZNAHOO FORMATION(?) (Paleogene)--Nonmarine arkosic sandstone, sandstone, shale, and conglomerate.

ALEXANDER BELT

INTRUSIVE ROCKS OF THE CHILKAT-PRINCE OF WALES PLUTONIC PROVINCE (Cretaceous)

Kwqo Hornblende Quartz Monzodiorite with Minor Tonalite, Granodiorite, Quartz Diorite, Diorite, Quartz Monzonite, and Monzodiorite

BRIEF DESCRIPTION OF MAP UNITS--CONTINUED

METAMORPHIC ROCKS IN THE CHILKAT-PRINCE OF WALES PLUTONIC PROVINCE (Cretaceous)

Kch — Biotite-Quartz-Feldspar Hornfels: Meta-polymictic conglomerate

Kbh — Biotite-Quartz-Feldspar Hornfels: Meta-graywacke and mudstone turbidites

Kdh — Biotite-Feldspar-Quartz Hornfels: Meta-graywacke of Descon Formation

ULTRAMAFIC-MAFIC COMPLEX AT BLASHKE ISLANDS AND RELATED ROCKS (Cretaceous)

Kbdu — Dunite

Kbwh — Wehrlite

Kbgb — Clinopyroxene-Hornblende Gabbro

Kbqd — Magnetite-Bearing Chlorite-Hornblende-Pyroxene Monzodiorite

METAMORPHIC ROCKS ADJACENT TO COMPLEX AT BLASHKE ISLANDS (Cretaceous)

Kph — (Garnet-)(Pyroxene-)Biotite-Quartz-Feldspar Hornfels

Kpch — Biotite-Quartz-Feldspar Hornfels

HYD GROUP (Upper Triassic)

Thl — Hamilton Island Limestone

Thb — Burnt Island Conglomerate

Pp — PYBUS FORMATION (Lower Permian)

PPsy — PORPHYRITIC SYENITE (Inferred Early Permian And Late Pennsylvanian)

MDc — CANNERY FORMATION (Mississippian and Devonian)

Dls — FOSSILIFEROUS LIMESTONE (Lower and Middle Devonian)--

BRIEF DESCRIPTION OF MAP UNITS--CONTINUED

ALEXANDER BELT--CONTINUED

PRINCE OF WALES ISLAND SEQUENCE (Devonian to Ordovician)

Carbonate Rocks and Associated Conglomerates (Upper to Lower Silurian)

Sch — Heceta Limestone

Schc — Polymictic Conglomerate Intercalated with Heceta Limestone

Scp — Polymictic Conglomerate

Turbidites and associated rocks (Upper Silurian to Lower Devonian)

Bay of Pillars Formation on Kuiu and western Prince of Wales Islands (Upper to Lower Silurian)

Stbg — Graywacke, Mudstone, Turbidites, and Limestone

Stbc — Polymictic Conglomerate

Stbo — Olistostrome Blocks of Heceta Limestone in Turbidite Matrix

Bay of Pillars Formation on Northeastern Prince of Wales Island (Upper(?) to Lower Silurian).

Stpg — Graywacke, Slate, and Limestone

Stpc — Conglomerate, Agglomerate, and Volcanic Breccia

Descon Formation (Lower Silurian to Lower Ordovician)

SOtdg — Graywacke

SOtdl — Limestone

GRAVINA BELT

METAMORPHOSED STEPHENS PASSAGE GROUP ROCKS (Upper Cretaceous)

Kss — Schist and Hornfels

Ksp — Phyllite

Ksg — Greenstone and Greenschist

BRIEF DESCRIPTION OF MAP UNITS--CONTINUED

GRAVINA BELT--CONTINUED

INTRUSIVE ROCKS OF ADMIRALTY-REVILLAGIGEDO PLUTONIC BELT AND ASSOCIATED MIGMATITE (Upper Cretaceous)

Kmgf	Migmatite
Ktef	Hornblende-Biotite Tonalite and Granodiorite, Quartz Monzodiorite, and Quartz Diorite
Ktif	Hornblende-Biotite Tonalite, Granodiorite, Quartz Monzodiorite, and Quartz Diorite
Ktop	Hornblende-Biotite Tonalite
Ktoc	Garnet-Biotite Tonalite and Minor Granodiorite
Ktgp	Biotite Tonalite, Quartz Diorite, and Granodiorite
Kqop	Biotite-Epidote-Hornblende Quartz Monzodiorite
Kqo	Pyroxene-Biotite-Hornblende-Quartz Monzodiorite, Quartz Diorite, Monzodiorite, and Diorite
Kdi	Hornblende Diorite
Kgb	Metagabbro

INTRUSIVE ROCKS OF KLUKWAN-DUKE PLUTONIC BELT (Cretaceous)

Kuk	Ultramafic Complex at Kane Peak
Khb	Hornblendite

BRIEF DESCRIPTION OF MAP UNITS--CONTINUED

GRAVINA BELT--CONTINUED

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

METAMORPHOSED STEPHENS PASSAGE GROUP AND OTHER ROCKS (Upper(?) Mesozoic)

Mzs Semischist and Phyllite

Mzl Massive Limestone

Mzv Greenschist and Greenstone Metamorphosed From Intermediate to Mafic Volcanic Rocks

Mzm Greenschist, Chert, Limestone, and Argillite

Mzc Quartzite Metamorphosed From Chert

Mzr Schist and Semischist Metamorphosed From Felsic Volcanic Rocks

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

Mzg Metamorphosed Gabbro

Mzgb Gabbro

Mzum Ultramafic Rock

GRAVINA BELT--CONTINUED

STEPHENS PASSAGE GROUP (Upper Cretaceous/Cenomanian to Upper Jurassic(?))

KJsv Brothers Volcanics/Douglas Island Volcanics

KJss Seymour Canal Formation

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

HYD GROUP(?) (Upper Triassic)

Trhv Felsic and Intermediate Volcanic Flows and Breccia, Limestone, and Argillite

Dsls MIXED SILTSTONE, GRAYWACKE, AND FOSSILIFEROUS LIMESTONE (Lower and Middle Devonian; some may be Pennsylvanian)

Dls FOSSILIFEROUS LIMESTONE (Lower and Middle Devonian)

BRIEF DESCRIPTION OF MAP UNITS--CONTINUED

MAINLAND BELT AND GRAVINA BELT

INTRUSIVE ROCKS OF ADMIRALTY-REVILLAGIGEDO PLUTONIC BELT AND ASSOCIATED MIGMATITE (Upper Cretaceous)

Kmgf	Migmatite
Ktef	Hornblende-Biotite Tonalite and Granodiorite, Quartz Monzodiorite, and Quartz Diorite
Ktoc	Garnet-Biotite Tonalite and Minor Granodiorite
Ktgp	Biotite Tonalite, Quartz Diorite, and Granodiorite
Kgb	Metagabbro

MAINLAND BELT

INTRUSIVE ROCKS OF BEHM CANAL PLUTONIC BELT (Miocene and (or) Oligocene)

Tdr	Rhyolite and Related Rocks
Tmr	Foliated Rhyolite and Related Rocks
Tag	Chlorite Granite

GRANODIORITE OF CENTRAL COAST MOUNTAINS COMPLEX AND ASSOCIATED MIGMATITES (Eocene)

Tmgz	Migmatite Consisting of Schist, Gneiss, Tonalite, and Granodiorite Invaded by Biotite Granodiorite
Tgdp	Porphyritic Biotite-Hornblende Granodiorite
Tgrg	Gneissic Biotite Granite and Granodiorite
Tgdb	Hornblende-Biotite Granodiorite and Quartz Diorite
Tlgm	Migmatite associated with Leucocratic Granodiorite
Tlg1	Leucocratic Porphyritic Biotite Granodiorite and Adamellite [Granite]
Tlg2	Leucocratic Granodiorite

INTRUSIVE ROCKS OF THE GREAT TONALITE SILL BELT AND ASSOCIATED MIGMATITE (Upper Cretaceous and(or) Paleocene)

Tmgx	Migmatite Consisting of Schist and Gneiss Invaded by Tonalite
Ttos	Biotite-Hornblende and Hornblende-Biotite Tonalite, Quartz Diorite, and Minor Granodiorite
Tgdg	Gneissic Biotite Granodiorite and Quartz Monzodiorite

BRIEF DESCRIPTION OF MAP UNITS--CONTINUED

MAINLAND BELT--CONTINUED

METAMORPHIC ROCKS OF COAST MOUNTAINS COMPLEX (Upper Cretaceous and(or) Paleocene)

TKp	Phyllite
TKbs	Biotite Schist
TKbsc	Schistose metamorphosed polymictic conglomerate
TKhs	Hornblende Schist and Semischist
TKmb	Marble and Calc-Silicate Granofels
TKbg	Biotite Gneiss
TKhg	Hornblende Gneiss
TKgn	Garnet-Biotite Gneiss and Schist, and Amphibolite

INTRUSIVE ROCKS OF ADMIRALTY-REVILLAGIGEDO PLUTONIC BELT AND ASSOCIATED MIGMATITE (Upper Cretaceous)

Kmgf	Migmatite
Ktef	Hornblende-Biotite Tonalite and Granodiorite, Quartz Monzodiorite, and Quartz Diorite
Ktgp	Biotite Tonalite, Quartz Diorite, and Granodiorite
Kgb	Metagabbro

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.]

Qi GLACIAL ICE AND PERMANENT SNOWFIELDS (Holocene)--Occurs only in the Mainland Belt, with the exception of one small glacier on Kupreanof Island.

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 VOLCANIC-PLUTONIC 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:

KUIU-ETOLIN VOLCANIC-PLUTONIC BELT--CONTINUED

Qb Extrusive Basaltic Rocks and Underlying Sediments (Holocene and(or) Pleistocene)--Fresh, locally polygonally jointed, dark greenish-gray, dense, very fine-grained to aphanitic, magnetite-bearing olivine basalt and minor pyroxene basalt. 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 Petersburg C-4 quadrangle (Brew, 1997j), exposes polymictic glacial till in a small lens under dense aphanitic basalt that is mapped with this unit; whole unit is interpreted to be Pleistocene or younger (Brew and others, 1985). Three whole-rock K-Ar ages on basalts in the northern part of this quadrangle on southern Kupreanof Island gave K-Ar ages of 0.279±0.085, 0.269±087, and 4.15±6.95 Ma (M. A. Lanphere, U.S. Geological Survey, written commun., 1972; Douglass and others, 1989, p. 63). Unit is exposed along south shore of Kupreanof Island from Kah Sheets Bay to Douglas Bay and from west of Totem Bay to beyond Point Barrie and at Indian Point and on High Castle Island in Duncan Canal. Equivalent rocks may be included with "Basalt and Other Mafic Extrusive Rocks" (QTb), particularly along Rocky Pass and near the mouth of Irish Creek.

KUIU-ETOLIN VOLCANIC-PLUTONIC BELT--CONTINUED

Extrusive and Intrusive Volcanics and Volcaniclastic Rocks (Quaternary(?) and Tertiary)--Complicated intrusive and extrusive volcanic pile best exposed on southwestern Kupreanof Island and on Zarembo Island: may include rocks that should be assigned to "Extrusive Basaltic Rocks and Underlying Sediments" (Qb) but cannot be distinguished in the field from older basalts. Originally considered to be the southeastern, and more varied extension of "Admiralty Island Volcanics" named by Loney (1964) and assigned a late Eocene to Oligocene age on Admiralty Island (Ford and others, 1996). That age revised to Eocene to Miocene(?) by Lathram and others (1965); K-Ar dating (G. Plafker, U.S. Geological Survey, oral commun., 1982) of volcanic rocks there indicates a Miocene age. However, the "Admiralty Island Volcanics" are now considered to be a different but possibly time-equivalent unit. Time- and litho-stratigraphic relations are uncertain, but the rhyolites and basalts appear to have erupted at different times and in no obvious or simple sequence during the time from Paleocene (as indicated by the age of the locally underlying "Kootznahoo Formation") to Holocene (as inferred from the possible inclusion of Quaternary volcanic rocks in the unit). The unit may include rocks erupted throughout the Tertiary and Quaternary, but it is believed that there is a significant Oligocene break in the deposition. The unit is stratigraphically complicated with major lithologic types occurring repeatedly throughout the section. Some suggestion that "Altered Dellenite, etc. " (QTf), and the "Gabbro and Microgabbro" (Tmgb) exposed elsewhere in the Petersburg-Wrangell area occur only low in the section. "Siliceous Volcaniclastic Rocks" (QTc) occur in and around "Rhyolite, Rhyodacite, etc." (QTr); see also Muffler (1967). Divided into:

QTv Vent Breccia--

Angular to subangular blocks of fine-grained, light gray, silicic volcanic rock with fragments that range from 5 mm to 15 cm with either no matrix or little (less than 15 percent) matrix of very fine grained, dark-gray volcanic rock or chalcedony. Crops out on southeast shore of Zarembo Island southwest of Round Point; and on Kuiu Island in the Kadake Creek drainage west of Kadake Bay, and north of Washington Bay.

KUIU-ETOLIN VOLCANIC-PLUTONIC BELT--CONTINUED

QTa Andesite and Other Intermediate Extrusive Rocks--

Dark gray where fresh, green to maroon where altered; blocky weathering. Pyroxene and feldspar porphyritic, massive to vesicular and amygdaloidal flows 10-50 cm thick. A K-Ar age of 21.2±0.6 Ma was obtained from a sample in the Petersburg C-5 quadrangle and one of 21.5±0.6 Ma was obtained from a sample in the Petersburg C-6 quadrangle, just west of this map area (Douglass and others, 1989, p. 63). Apparently intercalated with basalts in southern Rocky Pass area between Kuiu and Kupreanof Islands, also occurs in south central Kupreanof Island, and near exposures of "Rhyolite, Rhyodacite, etc.," (QTr) near Kah Sheets Lake, and on southwestern Zarembo Island.

QTc Volcaniclastic Deposits--

Unsorted and sorted pyroclastic deposits, felsic to mafic tuff, lapilli tuff, tuff breccia, and block and ash deposits. Also includes felsic to mafic lahars and oligomictic conglomerates. Deposits range from matrix-supported massive beds, 10's of meters thick, to cm-scale well-bedded turbidite-like deposits with graded beds, and thinning and fining upwards cycles. Tuffaceous deposits are generally altered to pale green clay; ashy horizons are locally silicified. Coaly plant material is rare, but present where bedding is well-developed. Mafic material subordinate to felsic material, quartz is subordinate to feldspar, and pyrite is spare but ubiquitous. Deposits lap onto volcanic centers in the vicinity of Tunehean, Lovelace, and Kushneahin Creeks on southwestern Kupreanof Island, and are intercalated with extrusive rocks at several horizons.

KUIU-ETOLIN VOLCANIC-PLUTONIC BELT--CONTINUED

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 fresh; 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 stratigraphy 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 identify 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. A K-Ar age of 20.4±0.6 Ma was obtained from a sample in the Petersburg C-5 quadrangle (Douglass and others, 1989, p.63). Exposed near Steamer Bay on northwest Etolin Island and on southern Kupreanof Island.

QTb Basalt and Other Mafic Extrusive Rocks--
Platy, blocky, or columnar jointed basalt flows 50 cm to several meters thick. Dark-gray where fresh, rusty weathering. Commonly vesicular and amygdaloidal; amygdule fillings include calcite, epidote, chalcedony, chlorite, and zeolites, in order of decreasing abundance. Platy flows are pyroxene microporphyritic; massive flows may contain magnetite, pyroxene, and olivine. Intercalated mafic tuff and flow breccia of variable thickness, but generally less than 1 meter thick. Mafic dikes and small localized flows occur higher in the section. Section of gently east-dipping flows greater than 500 m thick extends from Port Camden on Kuiu Island, across Rocky Pass to western Kupreanof Island; also exposed on northwestern Zarembo Island in this quadrangle. It is the most extensive volcanic unit in the Kuiu-Etolin belt; and may also underlie much of exposed extrusive-volcanic section on Kuiu, Kupreanof and Zarembo Islands.

QTd Dikes, Sills, and Extrusive Rocks--
Mutually cross-cutting network of dikes, flows, sills, and breccias that range in composition from basalt to rhyolite. Extremely complicated, heterogenous outcrops; may include xenoliths of metamorphic country rock. Best exposures associated with granitic intrusion west of Threemile Arm on Kuiu Island, and on Conclusion and Zarembo Islands. Interpreted to be feeder system of volcanics in these areas.

KUIU-ETOLIN VOLCANIC-PLUTONIC BELT--CONTINUED

QTx Breccia and Agglomerate--

Poorly exposed, enigmatic light- and dark-gray, interlayered volcanic graywacke and mafic tuff breccia of basaltic(?) composition. Crops out on isolated reefs in Kashevarof Passage off northeast Prince of Wales Island.

INTRUSIVE GRANITIC AND OTHER ROCKS OF THE KUIU-ETOLIN VOLCANIC-PLUTONIC BELT (Miocene and(or) Oligocene--K-Ar determinations of about 20-22 Ma cited below were obtained on rocks from the "Granite of Central and Northern Etolin Island" (Tmge) (M. A. Lanphere, U.S. Geological Survey, written communs., 1981, 1982; Douglass and others, 1989, p. 63); descriptions given by Hunt (1984). Divided into:

Tmae Alkali Granite Satellitic to Granite of Central Etolin Island--

Biotite-amphibole alkali granite, granite, and alkali quartz syenite with minor amounts of quartz syenite to syenite. Massive, nonfoliated; allotriomorphic to hypidiomorphic; equigranular to seriate; medium- to very coarse-grained; C.I. 01 to 13. Weathers a distinctive pale orange to white. Generally homogeneous at outcrop scale. Feldspar mineralogy consists of well developed perthitic alkali feldspar, commonly intergrown with quartz in a coarse graphic texture, and general absence of plagioclase as a separate feldspar phase; distinctive mafic mineralogy includes blue-green to blue (sodic) amphibole (hornblende and riebeckite), dark brown, often reddish-brown, biotite, and locally abundant green (iron-rich) pyroxene which may also be associated with rare iron-rich olivine (fayalite); accessory minerals are fresh and coarse-grained and include sphene, allanite, rare fluorite, and magnetite which is locally either rare or abundant. A K-Ar age of 18.5±0.6 was obtained on a sample from the Petersburg A-2 quadrangle (Douglass and others, 1989, p. 63). Unit is exposed in several bodies and numerous unmapped dikes and small plugs satellitic to the main bodies of the "Granite of Central Etolin Island" (Tmge). Similar to that same body in general appearance, but is coarser-grained, more granular, lacks miarolitic cavities, and has an unusual mafic mineralogy.

KUIU-ETOLIN VOLCANIC-PLUTONIC BELT--CONTINUED

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 a distinctive pale orange to white; miarolitic cavities common, often rusty weathering. Generally quite 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 mineralogy consists of 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 are present, generally near the margins of larger bodies. K-Ar ages of 19.9±0.6 Ma, 20.3±0.6 Ma, and 21.5±0.9 Ma were obtained on samples from the Petersburg A-2 and B-2 quadrangles (Douglass and others, 1989, p. 63). 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 just north of this quadrangle adjacent country rocks and the migmatite at Anita Bay. The body at Bessie Peak has a more homogeneous composition and carries more fine-grained mafic inclusions than does the body at Burnett Inlet.

KUIU-ETOLIN VOLCANIC-PLUTONIC BELT--CONTINUED

Tmme Migmatitic Granitic Rocks of Central and Northern Etolin Island--Hornblende-biotite-pyroxene quartz monzodiorite, quartz monzonite, granodiorite, quartz diorite, and diorite paleosomes invaded by neosomes of these same compositions as well as of granite, alkali granite, and quartz syenite. Massive, extremely heterogeneous, and generally nonfoliated; hypidiomorphic to allotriomorphic; equigranular to seriate to porphyritic; generally fine- to medium-grained; C.I. 10 to 50 (paleosomes), 03 to 25 (neosomes). Feldspar mineralogy consists of zoned plagioclase, in places rimmed by potassium feldspar, abundant "clots" of interstitial potassium feldspar, and generally rare micrographic intergrowths. Highly intergrown and generally subophitic mafic minerals in the more dioritic phases consist of abundant pale clinopyroxene, local additional orthopyroxene, both occurring as cores in green-brown hornblende; associated pale-green fibrous secondary amphibole, brown biotite, and very rare olivine. Accessory minerals include sphene, apatite, magnetite, and rare allanite. K-Ar ages of 19.3±0.6 Ma and 21.4±0.6 Ma were obtained on samples from the Petersburg A-1 quadrangle to the east of the map area. (Douglass and others, 1989, p. 63). Unit makes up the outer portion of the large composite pluton on central Etolin Island at Burnett Inlet, as well as a smaller body at Anita Bay associated with the granite at Bessie Peak, and an irregular zone associated with the granite on the Niblack Islands in Ernest Sound. Dioritic phases resemble rocks within the outer portions of the pluton at Washington Bay on northwestern Kuiu Island, and rocks comparable to other phases can also be found associated with the granitic plutons on Zarembo, Kupreanof and northeastern Kuiu Islands.

KUIU-ETOLIN VOLCANIC-PLUTONIC BELT--CONTINUED

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. Feldspar mineralogy consists of 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. Mafic mineralogy is distinctive and includes green, blue-green, and blue (sodic) amphibole (hornblende to riebeckite), dark brown to reddish-brown biotite, and locally abundant green (iron-rich) pyroxene; mafic minerals are altered and partially replaced by chlorite. Accessory minerals 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 on 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).

KUIU-ETOLIN VOLCANIC-PLUTONIC BELT--CONTINUED

Tmqk Heterogeneous Granitic Rocks of Central Kupreanof and Northeastern Kuiu Islands--Biotite-hornblende granite, quartz syenite, quartz monzonite, and quartz monzodiorite. Poorly exposed, nonfoliated; hypidiomorphic, inequigranular to porphyritic. Fine- to medium-grained; C.I. 02 to 20. Miarolitic cavities common and locally abundant, as are fine-grained mafic inclusions. Feldspar mineralogy consists of microperthitic alkali feldspar which commonly rims plagioclase grains, common and locally pervasive micrographic intergrowths, and some potassic alteration of plagioclase. Mafic mineralogy consists of brown biotite (often partially replaced by chlorite), green-brown to blue-green hornblende (commonly associated with a pale-green fibrous secondary amphibole), and rare pale pyroxene. Accessory minerals include locally abundant sphene, magnetite, and rare allanite; epidote occurs as miarolitic cavity fillings. Includes minor amounts of pyroxene-rich, coarse- to medium-grained quartz monzodiorite (C.I. 25-35), and of medium-grained, subophitic, pyroxene-biotite diorite (C.I. 40-50) similar to "Diorites associated with the granitic rocks on northwestern Kuiu and Zarembo Islands" (Tmaz and Tmdk). Unit is exposed in a plug on Kah Sheets Creek on Kupreanof Island, on northwestern Kuiu Island southwest of Threemile Arm (where it also forms dikes which invade the adjacent country rocks), and as small plugs on Horseshoe and Monte Carlo Islands in Keku Strait. Various phases of these plutons have counterparts among all of the other coeval plutons in the quadrangle; they differ from various granitic units on Etolin Island in generally lower quartz and greater plagioclase content, finer grain size, and generally higher C.I.

KUIU-ETOLIN VOLCANIC-PLUTONIC BELT--CONTINUED

Tmdk Heterogeneous Dioritic Rocks of Northern Kuiu Island--

Biotite-hornblende-pyroxene diorite, quartz diorite, quartz monzodiorite, and gabbro. Massive, nonfoliated; allotriomorphic to hypidiomorphic. Seriate; medium- to coarse-medium-grained; C.I. 17 to 50. Extensively diked and locally migmatitic with granitic to dioritic neosomes invading dioritic paleosomes. Feldspar mineralogy includes zoned plagioclase with local potassic alteration; locally abundant "clots" of interstitial potassium-feldspar; rare micrographic intergrowths; and abundant subophitic mafics. Mafic minerals are generally intergrown and consist of pale clinopyroxene, some orthopyroxene, green-brown hornblende (associated with a pale-green, fibrous secondary amphibole), minor brown biotite, and rare olivine. Accessory minerals include sphene, apatite, magnetite, and rare allanite. Unit exposed in a stock at the northern edge of this quadrangle; elsewhere in the outer portion of the pluton at Washington Bay on northwestern Kuiu Island and as a small plug at the head of Threemile Arm on northeastern Kuiu. A K-Ar age of 19.5±0.6 Ma was obtained on a sample from the former locality in the Port Alexander C-1 quadrangle west of this map area (Douglass and others, 1989, p. 63). Resembles the more dioritic phases of the "Migmatitic Granitic Rocks of Central and Northern Etolin Island " (Tmme).

Tmgb Gabbro and microgabbro--

Medium-grained, dark gray fresh and weathered, olivine- and clinopyroxene-bearing, locally deuterically altered; forms now-gently-dipping sills up to about 500 m thick; cuts "Kootznahoo Formation" and older rocks; well exposed on Hamilton Island, on Kuiu Island north of Kadak Bay and at Saginaw Bay in the Keku Islets, and at Big John Bay on Kupreanof Island. Inferred by Muffler (1967) to be genetically related to the "Basalt and Other Mafic Extrusive Rocks" (QTb) to the south.

Tsh HORNFELSED SEYMOUR CANAL FORMATION ROCKS (Miocene and(or) Oligocene)--Albite-epidote hornfels facies rocks, generally preserving both original structures and textures and (or) the metamorphic effects of Cretaceous metamorphic events, in aureoles on Etolin Island. The limits 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).

Tk KOOTZNAHOO FORMATION (Paleogene)--Nonmarine arkosic sandstone, sandstone, shale, and conglomerate.

Medium- to very thick-bedded; locally cross-bedded; dominant rock type is medium- to very coarse-grained lithic feldspathic quartz arenite. Conglomerate contains clasts up to 10 cm of granitic rock, slate, schist, chert, felsic volcanics. Minor shale is locally carbonaceous and contains plant fossils; rare thin coal beds. Greater than 300 m thick near Dakaneek Bay on Kupreanof Island (K. A. Dickinson, U.S. Geological Survey, oral commun., 1980). Available fossil evidence suggests that all of this unit in the northern part of the Petersburg-Wrangell map area near Keku Strait is Paleocene in age and that in the southern part on Zarembo Island is early Eocene, whereas the type Kootznahoo Formation on Admiralty Island (Lathram and others, 1965) is now considered latest Eocene through early Miocene age (Wolfe, 1966; J.A. Wolfe, U.S. Geological Survey, written communs., 1979, 1983). The similarities in depositional environment, stratigraphic position, and lithology suggest that the name "Kootznahoo Formation" is appropriate although the depositional basins may not have been connected. Unit is inferred to underlie most, if not all, of the "Extrusive and Intrusive Volcanic Rocks of Kuiu-Etolin Volcanic-Plutonic Belt" in the Petersburg-Wrangell map area and locally intertongues with at least the lower part of those units. The largest outcrop of the unit is south and southeast of Hamilton Bay on Kupreanof Island, another large area is on the southwest side of Zarembo Island and Bushy Island, small outcrops are at California Bay on Prince of Wales Island, east of Point Nesbitt on Zarembo Island, in the divide between Port Camden and Threemile Arm on Kuiu Island, at Kadake Bay on Kuiu Island, and in the upper drainage of Hamilton Creek on Kupreanof Island. Buddington and Chapin (1929) reported an occurrence at Kah Sheets Bay on Kupreanof Island which Brew and others (1984) could not find. See Muffler (1967), Dickinson (1979), Dickinson and Campbell (1982), Wright and Wright (1908), and Loney (1964) for further information.

ALEXANDER BELT

Belt informally named by Brew and others (1984) to denote those rocks that form a coherent stratigraphic section (including the pre-Cenozoic granitic and other rocks intruded into that section) in the western part of the map area, ranging in age from Ordovician to Cretaceous; as defined here does not correspond exactly to the Alexander terrane of Berg and others (1978).

ALEXANDER BELT--CONTINUED

INTRUSIVE ROCKS OF THE CHILKAT-PRINCE OF WALES PLUTONIC PROVINCE (Cretaceous)--Province informally named by Sonnevil (1981). K-Ar determinations of 99-112 Ma on hornblende and biotite from the "Hornblende Quartz Monzodiorite, etc." on Kosciusko and Prince of Wales Islands are cited below. Locally hornblende porphyritic; local rounded fine-grained mafic inclusions; includes common aplite, less common pegmatite, and several mafic dikes. Typical petrographic features are: seriate twinned and zoned plagioclase with minor alteration; K-feldspar interstitial to plagioclase and occasionally in poikilitic clots. Hornblende anhedral to subhedral with some plagioclase inclusions and ubiquitous opaque inclusions. Pyroxene and biotite locally present and subordinate to hornblende; respectively.

Kwqo Hornblende Quartz Monzodiorite with Minor Tonalite, Granodiorite, Quartz Diorite, Diorite, Quartz Monzonite, and Monzodiorite--

Massive to foliated, equigranular to locally porphyritic; medium-grained; C.I. 2 to 48, averaging about 15. Pyroxene commonly altering to hornblende and biotite to chlorite. Accessory minerals are apatite and sphene. K-Ar ages of 100±3.0 Ma, 108±3.5 Ma, 98.7±3.5 Ma, and 112.0±3.4 Ma were obtained on samples of biotite and hornblende from the former locality in the Petersburg A-5 quadrangle and in the Port Alexander A-1 quadrangle west of this map area (Douglass and others, 1989, p. 64). Unit differs in general from the Upper Cretaceous plutons of the Admiralty-Revillagigedo plutonic belt in the Gravina and Mainland Belts to the east by lack of epidote and garnet, lower color index, and by lack of local plagioclase porphyry phase. Unit differs from the "Biotite-Pyroxene-(Hornblende-) Monzodiorite, etc." (Kqo) mapped on northeastern Kupreanof Island in having ubiquitous hornblende. Exposed on Prince of Wales Island.

METAMORPHIC ROCKS IN THE CHILKAT-PRINCE OF WALES PLUTONIC PROVINCE (Cretaceous)--Aureoles around plutons of the Chilkat-Prince of Wales plutonic province on Kosciusko and northern Prince of Wales Islands; age is that of the plutons (about 100 Ma) based on K-Ar dating (M. A. Lanphere, U.S. Geological Survey, written commun., 1982).

Kch Biotite-Quartz-Feldspar Hornfels--

Metapolymictic conglomerate with 1 to 35 cm diameter rounded clasts of syenite(?), granodiorite, feldspar porphyry, chert, intermediate volcanic rock, and mudstone in 1- to 10-m thick beds. Metamorphosed from "Polymictic Conglomerate in Bay of Pillars Formation" mapped elsewhere in the Petersburg-Wrangell area.

ALEXANDER BELT--CONTINUED

METAMORPHIC ROCKS IN THE CHILKAT-PRINCE OF WALES PLUTONIC PROVINCE--CONTINUED

Kbh Biotite-Quartz-Feldspar Hornfels--

Fine- to medium-grained, brownish-gray where fresh; original sedimentary structures and bedding of graywacke and mudstone turbidite sequence locally preserved. Includes minor metaconglomerate like that described above (Kch). Metamorphosed from the "Graywacke and Mudstone Turbidite" in "Bay of Pillars Formation" mapped elsewhere in the Petersburg-Wrangell area.

Kdh Biotite-Feldspar-Quartz Hornfels--

Fine- to coarse-grained, brown and gray; original textures and structures obliterated; includes minor calc-silicate hornfels layers. Metamorphosed equivalent of the "Graywacke" subunit of the "Descon Formation" near Coffman Cove on northern Prince of Wales Island.

ULTRAMAFIC-MAFIC COMPLEX AT BLASHKE ISLANDS AND RELATED ROCKS (Cretaceous)--K-Ar dating (Lanphere and Eberlein, 1966) suggests an age of 110 Ma for this complex (Kennedy and Walton, 1946; Walton, 1951a,b), which is considered to be a westward outlier of the Klukwan-Duke plutonic belt informally named by Brew and Morrell (1983); reported on by Himmelberg and others (1986). Divided into:

Kbdu Dunite--

Massive, partially (25 to 100 percent) serpentinized; medium-grained; C.I. 100; fresh surfaces gray to dark gray; weathers yellowish-brown; forms smooth, rounded outcrops. Consists of 98 to 99 percent olivine and 1 to 2 percent chromite in very sparse, thin streaks, except near "Wehrlite" (Kbwh) contact where clinopyroxene increases to as much as 5 percent; primary fabric generally preserved.

Kbwh Wehrlite--

Massive; medium-grained; C.I. 100; xenomorphic granular; fresh surfaces dark green; weathers to rough yellowish-brown to dark gray with yellowish-brown patches; clinopyroxene increases outward from "Dunite" (Kbdu) contact near which the wehrlite grades to olivine clinopyroxenite.

Kbgb Clinopyroxene-Hornblende Gabbro--

Massive to locally flow banded on cm scale; medium-grained; C.I. 65-75; hypidiomorphic granular; fresh surfaces are medium gray; weathers dark gray. Locally 5 percent mafic inclusions 2 to 3 cm maximum dimension; fine grained mafic dikes common; grades from clinopyroxene gabbro at sharp contact with "Wehrlite" (Kbwh) contact to hornblende gabbro at country rock contact.

ALEXANDER BELT--CONTINUED

ULTRAMAFIC-MAFIC COMPLEX AT BLASHKE ISLANDS AND RELATED ROCKS--CONTINUED

Kbqd Magnetite-Bearing Chlorite-Hornblende-Pyroxene Monzodiorite--
Massive, well-jointed, medium- to coarse-grained; C.I. 30-35, weathers grayish-green and gray. Up to 20 percent subangular mafic inclusions: generally altered appearance; abundant diorite and gabbro(?) dikes. Unit crops out only on Rose Rock, Rose Island, and Seal Rock in Kashevarof Passage. Inferred from aeromagnetic anomaly pattern (U.S. Geological Survey, 1979) to be related to the ultramafic complex described above but could be related to the granodiorite of probable Cretaceous age (Kwqo) at Coffman Cove on Prince of Wales Island to the south.

METAMORPHIC ROCKS ADJACENT TO COMPLEX AT BLASHKE ISLANDS (Cretaceous)--Aureole around ultramafic-mafic complex at Blashke Islands; age is that inferred for the complex on the basis of K-Ar dating (Lanphere and Eberlein, 1966); as mapped, includes:

Kph (Garnet-)(Pyroxene-)Biotite-Quartz-Feldspar Hornfels--
Fine- to medium-grained, grayish-brown; forms ragged outcrops; original sedimentary structures and 2-cm to 15-cm-thick alternating graywacke and mudstone turbidite beds preserved; includes minor metapolymictic conglomerate with 3-30 cm diameter rounded cobbles of volcanic and granitic rock. Metamorphosed from the "Graywacke, Slate, and Limestone" of "Bay of Pillars Formation on northeastern Prince of Wales Island".

Kpch Biotite-Quartz-Feldspar Hornfels--
Metapolymictic conglomerate and agglomerate with 3 to 50 cm diameter subrounded to clasts of volcanic and granitic rock, and rounded clasts of volcanic rock in 50 cm to 2 m thick beds. Metamorphosed from the "Conglomerate, Agglomerate, and Volcanic Breccia" of "Bay of Pillars Formation on northeastern Prince of Wales Island".

HYD GROUP (Upper Triassic)--Named by Loney (1964) from exposures in Gambier and Pybus Bays on Admiralty Island; extended to the Keku Islets area and redefined by Muffler (1967). The term Hyd Group was extended to the Clarence Strait area by Brew and others (1984) and to the Screen Islands in Clarence Strait (Karl, 1984), where the name Burnt Island Conglomerate was applied to the whole unit.

ALEXANDER BELT--CONTINUED

HYD GROUP--CONTINUED

Thl Hamilton Island Limestone--

Regionally consists of limestone, mudstone, and calcarenite; generally very thin-bedded (1-30 cm), dark-gray aphanitic limestone (locally dolomitic). Minor black claystone layers and thin to medium beds of dark-green calcarenite; highly folded, but probably only a few 100 m thick. Age is late Karnian to perhaps earliest Norian based on 16 fossil collections from the Keku Strait area (Muffler, 1967) and one from the Screen Islands (Karl, 1984). Most outcrops are on Hamilton Island, the north side of Hamilton Bay, or on the northeastern Keku Islets--all in the Keku Strait area. On the Screen Islands the unit consists of cross-bedded to massive, amalgamated buff-colored sandstones overlying the Burnt Island Conglomerate. Above the sandstones are thin to medium (4-30 cm) bedded, calcisiltite and limestone, along with intraformational limestone conglomerate and sedimentary breccia.

Thb Burnt Island Conglomerate--

Regionally consists of conglomerate, calcarenite, and limestone; crudely bedded, poorly sorted calcite-matrix pebble conglomerate with clasts of either bluish-green and black argillite, graywacke, and chert derived from the Cannery Formation, or of chert and limestone from the Pybus Formation, depending on which unit it overlies. Minor interbedded calcarenite and fossil-fragmental limestone with abundant terrigenous debris are both medium- to very thick-bedded, light-brown-weathering, medium gray on fresh surfaces. Also some minor light-brown-weathering limestone and dark-gray fetid sandy and silty limestone similar to that in the overlying Hamilton Limestone. Up to 50-m thick. Age is early to perhaps early late Karnian based on two fossil collections from the Keku Strait area (Muffler, 1967) and three collections from the Screen Islands (Karl, 1984). Unit is exposed on East Island in Clarence Strait and on the Screen Islands; it also crops out elsewhere in the Petersburg-Wrangell area on the northwestern Keku Islets, near Cape Bendel on Kupreanof Island, and in the Hamilton Bay/Hamilton Island area. Available information is ambiguous about the presence of volcanic rocks in the unit on East Island. On the Screen Islands the conglomerate is massive to cross-bedded, bimodal and polymictic; clasts include well-rounded green or white chert cobbles and angular to plastically deformed masses of limestone, locally Permian-brachiopod-bearing sandstone, and siltstone, as well as angular to subrounded felsic to mafic volcanic clasts; no plutonic or metamorphic clasts have been recognized in the conglomerates or sandstones.

DESCRIPTION OF MAP UNITS--CONTINUED

ALEXANDER BELT--CONTINUED

Pp PYBUS FORMATION (Lower Permian)--Limestone, dolomite, and chert. Conspicuous cliff-forming, medium-bedded to massive non-bedded coarsely crystalline, white to very light gray dolomitic limestone;. Contains light gray replacement chert as thin beds, nodules, fragments, and crosscutting masses. Minor coarse-grained light-gray limestone and fetid medium-gray dolomite near top of unit. Unit is 80- to 160-m thick. Abundant silicified brachiopod fauna has been studied extensively (Buddington and Chapin, 1929; R. E. Grant, U.S. Geological Survey, written commun., 1968; Grant, 1971). Collections noted by Muffler (1967) indicate a Leonardian age as do four collections made during our study (J. T. Dutro, Jr., U.S. Geological Survey, written commun., 1983). Named by Loney (1964) and redefined by Muffler (1967). Crops out on Cornwallis Peninsula of Kuiu Island south to head of Saginaw Bay, on Keku Islets, in Hamilton Bay area and adjacent part of Kupreanof Island, near Cape Bendel on Kupreanof Island, and on the Middle Islands.

PPsy PORPHYRITIC SYENITE (Inferred Early Permian And Late Pennsylvanian)--Poorly known porphyritic syenite inferred to be similar to the "Leucosyenite of Klawock and Sukkwan Island" described by Brew (1995, 1996, unit PPsy) and by Churkin and Eberlein (1975, unit Psy). That unit consists of biotite- and hornblende-bearing syenite with C.I. 15 exposed near Klawock in the Craig 1:250,000-scale quadrangle to the south; there that unit has a K-Ar age on biotite of 276±8 Ma (Churkin and Eberlein, 1975). Exposed in a small stock near the headwaters of Baker Creek on northwestern Prince of Wales Island.

ALEXANDER BELT--CONTINUED

MDc CANNERY FORMATION (Mississippian and Devonian)--

Thin-bedded gray tuffaceous volcanic argillite and fine-grained gray tuffaceous volcanic graywacke; both weather bluish-green or reddish-brown and are intensely fractured. Some very thin-bedded dark gray chert, silicified argillite, pillow flows, and gray clastic limestone. At least 600 m, and possibly 1,200 to 1,500 m thick. Age considered Permian by Muffler (1967) based on two fossil localities; one of which is Permian in age but is from rocks now mapped as "Pybus Formation", and on the original age assigned by Loney (1964). More recent studies (Jones and others, 1981) have shown that the "Cannery Formation" in this map area is Late Devonian to Early Mississippian in age. Four collections reported by Brew and others (1984) contain Late Devonian to Mississippian radiolarians (D. L. Jones, U.S. Geological Survey, written communs., 1981, 1982). One new collection from rocks mapped as "Cannery Formation" on upper Hamilton Creek, Kupreanof Island, contains Upper Triassic conodonts (B. Wardlaw and A. G. Harris, U.S. Geological Survey, written commun., 1983) and those rocks probably should be mapped as the "Greenschist, Chert, Limestone, and Argillite" (›m) of the Gravina Belt; however, they lack the structural features that typify that unit. Named by Loney (1964) for exposures at Cannery Bay on Admiralty Island.

DIs 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 in the region, 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 northwest of 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). Smaller lenses in Clarence Strait (Key Reef and Abraham Island) in the Duncan Canal-Zarembo sub-belt of the Gravina belt contain Lower(?) Devonian corals (W. A. Oliver, Jr., U.S. Geological Survey, written communs., 1978, 1983). This unit is also described in the section on the Gravina Belt.

ALEXANDER BELT--CONTINUED

PRINCE OF WALES ISLAND SEQUENCE (Devonian to Ordovician)--Informally named by Brew and others (1984) to emphasize the island-arc depositional environment that persisted from Ordovician through Early Devonian time; consists of two dominant lithologic associations, "Carbonate Rocks and Associated Conglomerates" and "Turbidites and Associated Rocks".

Carbonate Rocks and Associated Conglomerates (Upper to Lower Silurian): Extensive carbonate units--the Kuiu Limestone and the Heceta Limestone--are interpreted to have formed as fringing reefs or carbonate banks in an island-arc environment dominated by volcanic turbidites. They probably range in age and are not a single stratigraphic horizon. The associated polymictic conglomerates probably represent several separate channels at different horizons carrying material from distant sources.

Sch Heceta Limestone--

Massive or thick-bedded, fine-grained limestone, minor limestone breccia, sandstone, mudstone, and pods of polymictic conglomerate. Commonly fractured, locally fossiliferous, light- to medium-dark gray on fresh surfaces, buff weathered; forms rough pockety surfaces in tidal zone and karst topography inland. Probably greater than 4,000 m thick in some exposures. Age is Middle and Late Silurian according to Eberlein and Churkin (1970) based on analyses of several collections. Susequently, Eberlein and others (1983) extended the lower age limit to include late Early Silurian; several new collections confirm this assignment. Named by Eberlein and Churkin (1970) for exposures on Heceta Island in the Craig quadrangle to the south; other exposures discussed in detail by Ovenshine and Webster (1970). Exposed in the Clarence Strait area.

Schc Polymictic Conglomerate Intercalated with Heceta Limestone--

Pebble and cobble conglomerate, sedimentary breccia, fine- to coarse-grained graywacke, siltstone, and mudstone. Occurs in discontinuous lenses and large pod-like bodies. Some oligomictic chert pebble or limestone pebble conglomerate, but commonly polymictic, with clasts to 20 cm of porphyritic andesite, gray-green and black chert, limestone, vein quartz, graywacke, granitic and gabbroic composition. Thickness highly variable but must be in excess of 2,000 m in places. Age is inferred from the age of the related "Heceta Limestone". Occurs adjacent to Sumner Strait on northwestern Prince of Wales Island.

ALEXANDER BELT--CONTINUED

PRINCE OF WALES ISLAND SEQUENCE --CONTINUED

Scp Polymictic Conglomerate--

Pebble and cobble conglomerate and other clastic rocks like those described elsewhere (Brew and others, 1984) as the "Polymictic Conglomerate Intercalated with Heceta Limestone" (Schc), but which occur instead between the "Heceta Limestone" (Sch) and the "Graywacke, Mudstone, Turbidites, and Limestone" (Stbg) or other units of the "Bay of Pillars Formation". Thickness probably greater than several thousand m locally. Age is not known directly, but is inferred from the age of the adjacent units noted above. Exposed in the Snow Passage-Clarence Strait area.

Turbidites and associated rocks (Upper Silurian to Lower Ordovician): These very extensive turbidite, conglomerate, and volcanic units--the "Bay of Pillars Formation" and the "Descon Formation "--are interpreted to be the dominant feature of a long-lived island-arc environment. The two formations probably grade into one another. The limestones, conglomerates, and volcanic units that are mapped separately probably vary in age and do not represent persistent stratigraphic horizons. Karl and Giffen (1992) considered some sedimentologic aspects of the "Bay of Pillars Formation". Three main units are present: the "Bay of Pillars Formation on Kuiu and western Prince of Wales Islands", "Bay of Pillars Formation on northeastern Prince of Wales Island ," and the "Descon Formation":

ALEXANDER BELT--CONTINUED

PRINCE OF WALES ISLAND SEQUENCE --CONTINUED

Bay of Pillars Formation on Kuiu and western Prince of Wales Islands (Upper to Lower Silurian)--

Dominantly graywacke, mudstone, and calcareous mudstone turbidites, with subordinate conglomerate, limestone, and intermediate to mafic volcanic flows, breccia, and tuff. Sedimentary features in sandstone turbidites include massive amalgamated beds, channelized beds, graded beds with Bouma sequences, and chaotically deformed slump deposits. Associated polymictic conglomerates are massive to channelized and cross-bedded. Ubiquitous limestone turbidites are rhythmically bedded with carbonaceous partings. Isolated exposures of volcanic rocks are massive and generally brecciated. Sandstones are extremely variable in composition. Three dominant varieties include calcareous graywacke, volcaniclastic graywacke, and quartzofeldspathic graywacke. Sediment immaturity and rapid local changes in sandstone composition suggest local sources. Proximal turbidite facies and cross-bedding in conglomerates suggest shallow to moderate water depths; map pattern suggests local volcanic centers with associated carbonate reefs, and a dominant regime of graywacke turbidite deposition, with calcareous turbidites occupying interchannel areas. The Bay of Pillars Formation was named and defined by Muffler (1967) from exposures on Kuiu Island. It is mapped on Kuiu, Kosciusko, and northern Prince of Wales Islands. Stratigraphic intercalation as well as incorporation of large angular boulders of limestone similar to the Heceta suggests a facies relationship with that unit. Well rounded syenite porphyry cobbles indicate a distinctive source terrane for the conglomerates. Preliminary structural and paleocurrent data suggests deposition of Bay of Pillars sediments in basins between a syenite-bearing landmass to the west and volcanic/carbonate centers to the east. Unit thickness probably greater than a few thousand meters. Bay of Pillars rocks are locally hornfelsed by Mesozoic and Tertiary plutons. Graptolite collections made during the study of Brew and others (1984) range in age from middle Llandoverian to early Ludlovian (Claire Carter, U.S. Geological Survey, written commun., 1980). Differs from the "Descon Formation" (Brew and others, 1984) because it has significantly less volcanic debris, both in stratigraphic horizons and as individual clastic grains. It also is mostly younger than the Descon.Divided into:

ALEXANDER BELT--CONTINUED

PRINCE OF WALES ISLAND SEQUENCE --CONTINUED

Stbg Graywacke, Mudstone, Turbidites, and Limestone--

Buff, green, or gray, tan to maroon weathering graywacke, mudstone and calcareous mudstone. Graywackes typically medium- to thick-bedded or massive, with amalgamated beds as well as full Bouma sequences. Mutti and Ricchi-Lucci turbidite facies represented are dominantly B and C "inner fan" channel facies, with associated A conglomerates and E overbank deposits. Soft sediment deformation is common. The graywackes are immature, consisting of poorly sorted angular clasts with extreme compositional variability over short distances laterally and vertically. The three dominant varieties are: 1) calcareous graywacke with carbonate clasts, fossil fragments, subordinate feldspar, quartz, and volcanic rock fragments; and patchy recrystallized carbonate matrix; 2) volcaniclastic graywacke consisting mainly of felted intermediate to mafic volcanic rock fragments, with subordinate grains of feldspar, monocrystalline, embayed quartz, occasional fossil fragments, and chloritic or clayey matrix; and 3) quartzofeldspathic graywacke with detrital biotite and potassium feldspar, and with locally calcareous or clayey matrix. In all three types three rock types, rare grains of microcrystalline quartz, epidote, volcanic shards, and felsite may be found. No white mica or metamorphic rock fragments were seen. Calcareous graywackes are ubiquitous, and often grade to limestone interbeds. The volcaniclastic graywackes are most characteristic around northernmost Affleck Canal, Port Malmesbury, Bay of Pillars, and Security Bay on Kuiu Island. Quartzofeldspathic graywackes occur in the vicinity of Table Bay and Explorer Basin on the west side of Kuiu Island. Exposed in these quadrangles on northeastern Prince of Wales Island.

ALEXANDER BELT--CONTINUED

PRINCE OF WALES ISLAND SEQUENCE --CONTINUED

Stbc Polymictic Conglomerate--

Polymictic conglomerate; typically massive or thick-bedded and channelized; occasionally cross-bedded. Clast populations vary as do the graywacke compositions, but generally include, in order of decreasing abundance: graywacke, mudstone, volcanic rock, limestone, and syenitic to dioritic intrusive rock. Well-rounded syenite cobbles are distinctively pink and K-feldspar porphyritic. Graywacke and mudstone clasts vary in degree of roundness. Volcanic and carbonate clasts are generally large and angular relative to other clasts. Conglomerates tend to map as NNW-SSE trending belts, such as from the head of the Bay of Pillars to Alvin Bay on Kuiu Island, suggesting paleochannels.

Stbo Olistostrome Blocks of Heceta Limestone in Turbidite Matrix--Disrupted blocks of Heceta(?) limestone in massive calcareous sandstone matrix, and intraformational limestone conglomerate, interpreted as olistostromes (Ovenshine and Webster, 1970). Best exposed south of Alvin Bay on Kuiu Island and on islands in Sumner Strait; exposed also on the northern shore of Prince of Wales Island.

Bay of Pillars Formation on Northeastern Prince of Wales Island (Upper(?) to Lower Silurian)--Graywacke and siliceous mudstone turbidites.

Amalgamated beds, full Bouma sequences, and high sand/shale ratios suggest a proximal turbidite facies association. Rhythmically bedded limestones, polymictic conglomerate, and volcanic agglomerate and breccia are intercalated with the graywackes. Sandstones and conglomerates are volcaniclastic, immature, and probably reflect local sources (Claire Carter, U.S. Geological Survey, written commun., 1980). All graptolite collections to date are of Early Silurian age. The unit is distinguished from Bay of Pillars rocks on Kuiu and western Prince of Wales Islands by a more volcaniclastic and less calcareous composition. Mapped in the Clarence Strait area. Divided into:

ALEXANDER BELT--CONTINUED

PRINCE OF WALES ISLAND SEQUENCE --CONTINUED

Bay of Pillars Formation on Northeastern Prince of Wales Island (Upper(?) to Lower Silurian)--Continued

Stpg Graywacke, Slate, and Limestone--

Greenish gray, buff weathering, volcaniclastic graywacke and argillite turbidites. Massive to amalgamated, graded, and rhythmic beds corresponding to Mutti and Ricchi-Lucci A, B, C, and E turbidite facies, suggest a proximal depositional environment in moderate water depths. Graptolites may be found on argillaceous bed parting surfaces. Local soft sediment deformation is typically associated with calcareous layers or lenses.

Stpc Conglomerate, Agglomerate, and Volcanic Breccia--

Predominantly volcaniclastic polymictic conglomerate, and volcanic breccia and agglomerate of intermediate to mafic composition. Feldspar and clinopyroxene porphyritic clasts are common. Massive occurrences of coarse volcaniclastic rock may be found on some of the islands in Clarence Strait north and west of the Blashke Islands.

DESCON FORMATION (Lower Silurian to Lower Ordovician)--Massive graywacke, graywacke and argillite turbidites.

Also siliceous graptolitic shale, polymictic conglomerate, bedded limestone and limestone breccia, and mafic volcanic sills, flows, and tuffs. Sandstone and conglomerates range from predominantly volcaniclastic to polymictic, the latter includes graywacke, shale, chert, limestone, and felsic to gabbroic lithic fragments together with the volcanic grains. The Descon Formation crops out on northeastern and northwestern Prince of Wales Island and in the vicinity of Davidson Inlet, Kosciusko Island. These rocks are locally metamorphosed to greenschist facies. Thickness exceeds 3,000 meters. Graptolites from the Descon Formation yield ages ranging from Tremodocian (Early Ordovician) to Llandoverian (late Early Silurian) (Claire Carter, U.S. Geological Survey, written commun., 1980; Eberlein and others, 1983). This unit is more siliceous and contains more volcanic material than the Bay of Pillars Formation. Unit named by Eberlein and Churkin (1970).

ALEXANDER BELT--CONTINUED

PRINCE OF WALES ISLAND SEQUENCE --CONTINUED

DESCON FORMATION--Continued

SOtdg Graywacke--

Grayish green, buff weathering, volcaniclastic graywacke and siliceous shale. Massive amalgamated beds, graded beds, full Bouma sequences, thin rhythmic beds, slump deposits, sedimentary breccia and conglomerate suggest a proximal depositional environment. Sandstones and conglomerates include mainly mafic volcanic rock fragments, with feldspar, quartz, graywacke, mudstone, chert, limestone, and plutonic rock fragments in a chloritic matrix. Graptolites are found on partings in siliceous argillite. Some greenschist facies sandstones are pyritic.

SOtdl Limestone--

Intraformational calcareous breccia and conglomerate, including fossil hash, occurs stratigraphically above polymictic conglomerate at Port Protection on northwestern Prince of Wales Island.

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 intruded into them, 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), but the map distribution does not correspond because of newer information and differing interpretations.

GRAVINA BELT--CONTINUED

METAMORPHOSED STEPHENS PASSAGE GROUP ROCKS (Upper Cretaceous)--In general, these units are associated with the Upper Cretaceous and Tertiary plutons (of the Kuiu-Etolin and Admiralty-Revillagigedo plutonic belts, respectively) in the Gravina Belt. The rocks have been rather arbitrarily assigned a Late Cretaceous age and are described here 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 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 the "Phyllite" (Ksp) metamorphic unit.

Kss Schist and Hornfels--

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

GRAVINA BELT--CONTINUED

METAMORPHOSED STEPHENS PASSAGE GROUP ROCKS–CONTINUED

Ksp Phyllite--

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

Ksg Greenstone and Greenschist--

Subgreenschist to greenschist facies rocks mapped outside this quadrangle within the "Phyllite Unit" (Ksp) on Lindenberg Peninsula, Kupreanof Island. Dominantly fine- to medium-grained, relict pyroxene-phenocryst-bearing epidote-albite-chlorite greenstone; poorly foliated, weathers dark greenish gray, grayish-green fresh. 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 Unit" (Ksp) in other parts of the Petersburg-Wrangell area. Age inferred from this units relation to that same unit. Exposed on the north side of Anita Inlet on Etolin Island and on eastern Kupreanof Island.

GRAVINA BELT--CONTINUED

INTRUSIVE ROCKS OF ADMIRALTY-REVILLAGIGEDO PLUTONIC BELT AND ASSOCIATED MIGMATITE (Upper Cretaceous)--Belt informally named by Brew and Morrell (1983) and described by Burrell (1984a,b,c). K-Ar determinations by M. A. Lanphere, U.S. Geological Survey, (written communs., 1981, 1982; reported in Brew and others, 1984; and Douglass and others, 1989, p. 64) interpreted to be applicable to the whole suite are as follows:

Map unit	Quadrangle	Biotite age	Hornblende age
Ktif unit	Petersburg B-2	90.4±2.7 Ma	93.0±2.5 Ma
" "	Petersburg C-3	89.6±2.7 Ma	89.1±2.7 Ma
Ktef unit	Petersburg B-2	83.2±2.5 Ma	91.6±2.7 Ma
" "	Petersburg C-1	79.9±2.4 Ma	88.6±2.7 Ma
Ktop unit	Petersburg A-1 (SE of map area)	71.4±2.1 Ma	-
Kqop unit	Petersburg D-4	87.3±2.6 Ma	89.3±2.7 Ma
	(This body provided a noninterpretable zircon Pb-U result (McClelland and Gehrels, 1990, p.1389))		
" "	Petersburg C-3	91.0±2.7 Ma	87.3±2.6 Ma
Kqo unit	Petersburg D-4	91.0±2.7 Ma	89.4±2.7 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, U.S. Geological Survey, oral commun., 1982; Koch and Berg, 1996). Some of these units are also described in the section on the Mainland Belt. Divided into:

GRAVINA BELT--CONTINUED

INTRUSIVE ROCKS OF ADMIRALTY-REVILLAGIGEDO PLUTONIC BELT AND ASSOCIATED MIGMATITE--CONTINUED

Kmgf Migmatite (Upper Cretaceous)--

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

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. Color is light to medium gray fresh; weathers brownish to dark gray. Foliation varies both in direction and development; it is moderately developed on the west side 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 intrusions as sills with country rock and screens of country rock in margin of body. Mineralogy includes zoned, complexly twinned plagioclase with minor alteration to sericite; mafic minerals usually biotite greater than hornblende; subhedral epidote; and local garnet and pyroxene. Accessory minerals are sphene, apatite, opaque minerals and allanite. Unit differs from "Hornblende-Biotite Tonalite, Granodiorite, etc." (Ktif) by presence of pyroxene and garnet, and biotite as the dominant mafic phase. Unit is exposed on Wrangell and Etolin Islands and on the mainland.

GRAVINA BELT--CONTINUED

INTRUSIVE ROCKS OF ADMIRALTY-REVILLAGIGEDO PLUTONIC BELT AND ASSOCIATED MIGMATITE--CONTINUED

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, and rare garnet. Accessory minerals are sphene, allanite, and apatite. Plagioclase is 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, 1984a,b).

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 minerals are 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) in the abundance of hornblende and a higher color index. Exposed on Lindenberg Peninsula, Mitkof, Rynda, Kadin, Woronkofski, and Wrangell Islands (Burrell, 1984b).

GRAVINA BELT--CONTINUED

INTRUSIVE ROCKS OF ADMIRALTY-REVILLAGIGEDO PLUTONIC BELT AND ASSOCIATED MIGMATITE--CONTINUED

Ktoc Garnet-Biotite Tonalite and Minor Granodiorite--

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

Ktgp Biotite Tonalite, Quartz Diorite, and Granodiorite--

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

GRAVINA BELT--CONTINUED

INTRUSIVE ROCKS OF ADMIRALTY-REVILLAGIGEDO PLUTONIC BELT AND ASSOCIATED MIGMATITE--CONTINUED

Kqop Biotite-Epidote-Hornblende Quartz Monzodiorite--

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

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, weathers brownish-gray to orangish-gray. Mafic inclusions, quartz and pegmatite veins and diabase dikes present. Mineralogy includes include anhedral, commonly poikilitic, hornblende with pyroxene; biotite and plagioclase inclusions; anhedral biotite; and pyroxene. Plagioclase is twinned, zoned,and grains are very closely packed. Plagioclase, K-feldspar, and quartz form the groundmass. Biotite, opaques and clinopyroxene are common in the Missionary Range body on the northern Lindenberg Peninsula. Hornblende appears and increases in abundance as pyroxene and opaque minerals decrease in abundance southwards. Hornblende, when present, is usually the dominant mafic mineral. Unit is exposed in the Missionary Range on the northern Lindenberg Peninsula of Kupreanof Island, west of Portage Arm on Kupreanof Island, and on central Mitkof Island (Burrell, 1984a).

GRAVINA BELT--CONTINUED

INTRUSIVE ROCKS OF ADMIRALTY-REVILLAGIGEDO PLUTONIC BELT AND ASSOCIATED MIGMATITE--CONTINUED

Kdi Hornblende Diorite--

Hornblende diorite, quartz diorite, and minor tonalite. Medium- to very-coarse-grained; C.I. 15 to 50. Equigranular, except for local crowded plagioclase porphyry like the "Hornblende-Biotite Tonalite" (Ktop). Weathers light to dark green; highly altered to epidote- and chlorite-rich rock. Crops out on Mitkof Island and on Woewodski Island to the west. Differs from other Cretaceous granitic rocks in the relatively high degree of alteration.

Kgb Metagabbro--

Biotite-plagioclase-hornblende granofels or semischist. Fine- to medium-grained; C.I. 70; dark green where fresh, weathers grayish-green. Crops out as a small plug on the ridge above the headwaters of Government Creek south of the Stikine River.

INTRUSIVE ROCKS OF KLUKWAN-DUKE PLUTONIC BELT (Cretaceous): Belt informally named by Brew and Morrell (1983); rocks interpreted to be 100-118 Ma on the basis of their similarity to dated rocks elsewhere (Lanphere and Eberlein, 1966; Himmelberg and Loney (1995) and on a K-Ar age of 107.0±3.2 Ma from the pluton at Turn Mountain on Kupreanof Island west of this map area (M. A. Lanphere, U.S. Geological Survey, oral commun., 1983; Douglass and others, 1989, p. 65). See also Taylor and Noble (1960), Taylor (1967), and Himmelberg and Loney (1995).

GRAVINA BELT--CONTINUED

INTRUSIVE ROCKS OF KLUKWAN-DUKE PLUTONIC BELT--CONTINUED

Kuk Ultramafic Complex at Kane Peak--

This complex (Kennedy and Walton, 1946; Walton, 1951a, b)is not dated but is inferred to be similar in age to Blashke Islands complex. It 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; 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 5 cm scale; medium-grained; C.I. 100; weathers dark green, greenish-gray on fresh surfaces; tends to form narrow discontinuous zone around margin of complex, but interrupted by massive, hornblendite along northern contact. Zonation poorly developed, no evidence of homogeneous dunite core or gabbro margin; above major rock types are gradational. Intruded by Upper Cretaceous granitic body adjacent to north.

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 on the southeast side Woronkofski Island, the east side of Zarembo Island, and on islets in Zimovia Strait.

GRAVINA BELT--CONTINUED

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), and some from a previously unrecognized facies of Triassic rocks.

Mzs Semischist and phyllite--

Metamorphosed From graywacke and siltstone; now low grade (probably sub-greenschist facies) metamorphic rocks; locally highly folded; generally poorly foliated but finer-grained phases have good cleavage. Brownish-gray fresh, gray to brown 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 in the Mosman Inlet area on Etolin Island and elsewhere.

Mzl Massive Limestone--

Limestone and minor shale; weathers light to medium gray, light gray fresh; poorly bedded at 10-50 cm scale in a few places Most is fine- to medium-grained and much may be recrystallized. No fossils (including conodonts) found, so age assigned is Upper(?) Mesozoic based on association with the enclosing units; it is equally likely that (as predicted from analogy with the other limestone lenses) these lenses are somehow related to the "Fossiliferous Limestone" (Dls) of Devonian age exposed elsewhere in the Wrangell-Petersburg area. Unit crops out at Mosman Inlet on Etolin Island, where it is medium-grained marble and also in Duncan Canal.

GRAVINA BELT--CONTINUED

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

METAMORPHOSED STEPHENS PASSAGE GROUP AND OTHER ROCKS--CONTINUED

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 a close link to 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 and Zarembo Islands, on Key Reef in Clarence Strait, and beneath the waters of Clarence Strait in the southwestern corner of the map area.

GRAVINA BELT--CONTINUED

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

METAMORPHOSED STEPHENS PASSAGE GROUP AND OTHER ROCKS--CONTINUED

Mzm Greenschist, Chert, Limestone, and Argillite--

Greenstone, greenschist, pelitic and quartzofeldspathic phyllite, and marble. Locally very folded and internally faulted; dominantly light- to medium-green on fresh surfaces, grayish-green to reddish-gray where weathered; probably several thousand meters thick. Depositional environment uncertain but may have been in part a chaotic slope facies sequence adjacent to a volcanic arc. Now metamorphosed to albite-muscovite chlorite-subfacies of the greenschist facies according to Muffler (1967). Greenstone and greenschist probably derived from porphyritic basalt and basaltic tuff. Mapped as Gambier Bay Formation of Devonian age by Muffler (1967) on the basis of the fossiliferous limestone-marble lenses within the unit. Those lenses are mapped here as the "Fossiliferous Limestone" (Dls) and are interpreted to be exotic blocks within this unit. A collection of conodonts from thin marble layers in north-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). The relation of the unit to the Cannery Formation to the west and south is obscure; in most places the two units have been differentiated by the contrasting degrees of metamorphism and folding. Similar criteria, together with lithologic contrast, have been used to separate this unit from the "Phyllite and Slate Metamorphosed From Mudstone and Minor Graywacke" (Mzp), exposed near Pinta Point on northwestern Kupreanof Island, south of the Bohemia Range, and on Hamilton Creek. See also (Loney, 1964; Muffler, 1967)

Mzc Quartzite Metamorphosed From Chert--

Quartzite and minor phyllite. White or light gray where fresh and weathered, fine-grained, "ribbon" appearance common with relict beds 0.5 to 3.0 cm thick with very thin phyllitic partings. Individual outcrops are highly folded, but some lenses must have been at least several 10's of m thick originally, others may have been only a few m thick. No direct evidence of age; no Radiolaria recovered from several samples collected for that purpose. Crops out in Little Duncan Bay and in central Kupreanof Island.

GRAVINA BELT--CONTINUED

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

METAMORPHOSED STEPHENS PASSAGE GROUP AND OTHER ROCKS--CONTINUED

Mzr Schist and Semischist Metamorphosed From Felsic Volcanic Rocks--

Quartz-feldspar schist and semischist, minor phyllite and greenstone; fine-grained. Light grayish green on fresh surfaces, orangish-brown where weathered. Thickness unknown; relations to adjacent units uncertain. Age not known directly, but inferred from spatial association with other units. Exposed on Woewodski Island and nearby in Duncan Canal.

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 both on fresh and weathered surfaces 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 the unit contains less chert and is more deformed ; it contrasts with the "Greenschist, Chert, Limestone, and Argillite" (Mzm) mapped elsewhere because that 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.

GRAVINA BELT--CONTINUED

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

METAMORPHOSED STEPHENS PASSAGE GROUP AND OTHER ROCKS--CONTINUED

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. Locally cut by numerous dikes of medium-grained, C.I. 05 to 25, quartz diorite. Crops out on east shore of Zarembo Island.

Mzg Metamorphosed Gabbro--

Chlorite-amphibole-plagioclase rock interpreted to have been gabbro bodies, but could be highly metamorphosed mafic volcanic rocks. Dark grayish-green where fresh and weathered. 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 and on Woewodski Island.

Mzum Metamorphosed Ultramafic Rock--

Serpentinized peridotite and dunite; fine- to medium-grained; greenish-gray on fresh surfaces, orangish-brown where weathered; two small bodies several meters across in upper Duncan Canal intruded into the "Semischist and Phyllite, Etc." (›s).

GRAVINA BELT--CONTINUED

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 likely 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 the Wrangell-Petersburg area. Includes:

GRAVINA BELT--CONTINUED

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" was named by Loney (1964) from exposures just north of this map area; the "Douglas Island Volcanics" was named by Lathram and others(1965) on Admiralty Island with the name taken from Douglas Island to the north. The best and least deformed and 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).

GRAVINA BELT--CONTINUED

STEPHENS PASSAGE GROUP--CONTINUED

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. Generally 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, U.S. Geological Survey, 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 on western Etolin Island.

GRAVINA BELT--CONTINUED

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

HYD GROUP(?) (Upper Triassic)--

Trhv Felsic and Intermediate Volcanic Flows and Breccia, Limestone, and Argillite--

Dominantly very-fine to fine-grained, chlorite-quartz-muscovite-feldspar phyllite. Light to dark green where fresh, rusty and green where weathered. Locally chertlike; interpreted by Berg and Grybeck (1980) and Berg (1981) to be felsic metatuff. Also thinly-layered to laminated quartz-feldspar phyllite or semischist interpreted by the same workers to be metarhyolite. Associated with dark-gray, thin-bedded carbonaceous mudstone, siltstone, and limestone. Thickness unknown, but probably at least several hundred meters. Age of Late Triassic-early Karnian for the unit is inferred from one collection of halobiid pelecypods from exposures on the west side of Duncan Canal (N. J. Silberling, U.S. Geological Survey, written commun., 1980). Host unit for massive sulfide deposits. Exposed along and near Duncan Canal, on the Castle Islands, Woewodski Island, and on northwestern Zarembo Island. The exposures on Rookery Island in Duncan Canal and on the northeast side of East Island in the Kashevarof Islands are well-bedded silty limestone of different and more uniform character.

Dsls MIXED SILTSTONE, GRAYWACKE, AND FOSSILIFEROUS LIMESTONE (Lower and Middle Devonian; some may be Pennsylvanian)--

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

GRAVINA BELT--CONTINUED

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

DIs FOSSILIFEROUS LIMESTONE (Lower and Middle Devonian)--

Medium-bedded to massive, fine- to medium-grained; light to medium gray fresh and weathered; locally fetid. Individual lenses up to several hundred m thick; contains brachiopods, corals, crinoids, and (locally) fusulinids. Northwesternmost exposures in the area (mapped by Muffler, 1967, as part of the Gambier Bay Formation) contain corals or stromatoporoids of Middle Devonian or possibly Late Silurian age (Muffler, 1967). Abundant old and new collections from the several fossiliferous lenses at and near the head of Duncan Canal northwest of 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). All of the above fossil and age information reported previously by Brew and others (1984). One limestone lens of indeterminate size on the eastern shore of upper Duncan Canal was reported by McClelland and Gehrels (1994) to contain Pennsylvanian fossils. This unit is also described in the section on the Alexander Belt.

MAINLAND BELT AND GRAVINA BELT

The intrusive rock units listed below occur in both the Mainland and Gravina Belts and are described in both sections. They are mentioned here simply to call attention to that fact.

INTRUSIVE ROCKS OF ADMIRALTY-REVILLAGIGEDO PLUTONIC BELT AND ASSOCIATED MIGMATITE (Upper Cretaceous)

Kmgf	Migmatite
Ktef	Hornblende-Biotite Tonalite and Granodiorite, Quartz Monzodiorite, and Quartz Diorite
Ktoc	Garnet-Biotite Tonalite and Minor Granodiorite
Ktgp	Biotite Tonalite, Quartz Diorite, and Granodiorite
Kgb	Metagabbro

MAINLAND BELT

This belt was informally named by Brew and others (1984) to facilitate discussion of 1) rocks that have been metamorphosed to the extent that the age and nature of their protoliths is highly uncertain, and 2) the granitic and other rocks that intrude them. The rocks in this belt, as well as some of those to the west in the Gravina belt, make up the Coast plutonic-metamorphic complex as defined by Brew and Ford (1984a,b,c), which has been redefined as the Coast Mountains Complex by Brew and others (1995).

MAINLAND BELT--CONTINUED

INTRUSIVE ROCKS OF BEHM CANAL PLUTONIC BELT (Miocene and(or) Oligocene)--Belt informally named by Brew and Morrell (1983).

Tdr Rhyolite and Related Rocks--

Generally flow banded, locally quartz porphyritic; weathers light brown and yellowish-brown, light gray on fresh surfaces. Occurs in broad swarm of dikes from 0.5 to a few m wide with little included country rock that is more or less centered on the granite stock (Tag) at Groundhog Basin (see below); a few small isolated plugs occur along strike. Several exposures within the unit of vent breccia similar to the Vent Breccia unit (QTv) in the Kuiu-Etolin belt to the west of this quadrangle; the breccias consist of dominant 5-20 cm angular rhyolite and some granitic and metamorphic rock fragments with essentially no matrix of any kind; see Gault (1954) and Gault and others (1953) for some further information. Age of the rhyolites is inferred from that of the previously mentioned closely associated granite stock at Groundhog Basin and from a K-Ar age of 15.0±0.6 Ma on muscovite (Douglass and others, 1989, p.65). The dike swarm has been prospected for both molybdenite and base metals, but no economic occurrences are known within it.

Tmr Foliated Rhyolite and Related rocks--

The rocks of this unit are interpreted to be the same as those of the "Rhyolite and Related Rocks" (Tdr) unit, except that they are foliated and appear metamorphosed in outcrop. The foliation is so marked that field mappers were not sure if the rocks had been subjected to the same metamorphism as the enclosing rocks or if they were part of the dike swarm that extends northwest and southeast from the outcrop of "Chlorite Granite" (Tag). Their location within the boundaries of that swarm and the absence of distinctive metamorphic minerals indicates that their foliation is due to intrusive processes.

MAINLAND BELT--CONTINUED

INTRUSIVE ROCKS OF BEHM CANAL PLUTONIC BELT--CONTINUED

Tag Chlorite Granite--

Homogeneous, fine- to medium-grained, C.I. 03 to 06; very light gray to yellow where fresh, yellow to yellowish-gray where weathered. Chlorite replaces biotite; generally seriate texture, but some samples are distinctly bimodal with a very fine-grained mosaic interstitial to larger biotite/chlorite, quartz, plagioclase, and K-feldspar grains. Age is based on a 17 Ma K-Ar determination on chlorite (Ken Fink, Amax Minerals, oral commun., 1978) and on a K-Ar biotite age of16.3±0.6 Ma (Douglass and others, 1989, p. 65). Exposed only on the north side of Groundhog Basin (Gault and others, 1953) and in a possible small plug (not shown on map) that outcrops along Porterfield Creek about 1 km downstream from where the Groundhog Basin creek joins it. The body on the north side of Groundhog Basin has been the target of exploratory drilling for molybdenite.

GRANODIORITE OF CENTRAL COAST MOUNTAINS COMPLEX AND ASSOCIATED MIGMATITES (Eocene)--Age is based on K-Ar age determinations by M. A. Lanphere (U.S. Geological Survey, written commun., 1984; Douglass and others, 1989, p. 65) on a unit north of the map area that is interpreted to be part of and to be applicable to the whole suite, as follows:

Map unit	General location	Biotite age	Hornblende age
Tgdb	Mount Pratt	51.3±1.5 Ma	49.3±1.5 Ma
Tgdb	Castle Mountain	51.2±1.5 Ma	-

MAINLAND BELT--CONTINUED

GRANODIORITE OF CENTRAL COAST MOUNTAINS COMPLEX AND ASSOCIATED MIGMATITES--CONTINUED

These units are similar in petrographic and field characteristics to similarly dated units in the Sumdum, Taku River, Bradfield Canal and Ketchikan quadrangles (Webster, 1984). Age is also based on a K-Ar age determination from the Bradfield Canal quadrangle near the International Boundary (J.G. Smith, U.S. Geological Survey, unpub. data, cited by Koch and Berg, 1996).

Map unit	General location	Biotite age	Hornblende age
Tlg1	Not Available	51.0	53.5

Tmgz Migmatite Consisting of Schist, Gneiss, Tonalite, and Granodiorite Invaded by Biotite Granodiorite--

Mixture of amphibolite facies hornblende-biotite quartzofeldspathic schist and gneiss, calc-silicates, mafic agmatite, tonalitic gneiss, tonalite, and K-feldspar-megacrystic biotite granodiorite that has been invaded and deformed by leucocratic (C.I. 1-8) biotite granite, granodiorite, and granodiorite gneiss. Deformation is intense and shows no consistent structural trends. The neosome is heterogeneous in texture and composition and is gradational to the homogeneous "Sphene-Bearing Biotite-Hornblende Granodiorite" (Tgdb). This migmatite is mapped along the western margins of this granodiorite, and to the east of the family of tonalite sill plutons. It usually, but not always, occurs to the east of the K-feldspar-megacrystic migmatite (Tmgx) described below. Inclusions of both that migmatite unit (Tmgx) and the K-feldspar-megacrystic-neosome (Tmgy) can be recognized within the leucocratic granite-granodiorite neosome. Schist and gneiss portions of some outcrops are conspicuously iron-stained, some portions of most other outcrops are visibly iron-stained. Most outcrops have an extremely heterogeneous appearance. See Karl and Brew (1983, 1984) for further information.

MAINLAND BELT--CONTINUED

GRANODIORITE OF CENTRAL COAST MOUNTAINS COMPLEX AND ASSOCIATED MIGMATITES--CONTINUED

Tgdp Porphyritic Biotite-Hornblende Granodiorite--

Homogeneous to slightly foliated; medium-grained; C.I. 9 to 22. Gray to buff where fresh, weathers to darker gray. Faint foliation defined by biotite and hornblende; rare mafic inclusions. Petrographic features include slightly inequigranular, hypidiomorphic-granular texture; biotite more abundant than hornblende and always chloritized. Euhedral to subhedral K-spar phenocrysts up to 3.5 cm normally constitute a small percentage of the rock; myrmekite common. Unit differs from "Sphene-bearing Biotite-Hornblende Granodiorite" (Tgdb) by the presence of phenocrysts and slight foliation. Unit is exposed immediately southwest of the International Boundary.

Tgrg Gneissic Biotite Granite and Granodiorite--

Foliated, generally leucocratic, locally porphyritic and banded. Medium-grained, C.I. 3 to 30; light gray on fresh surfaces, weathers darker gray. K-spar phenocrysts or porphyroblasts up to 3x5 cm are locally augen-like. Locally has inclusions of quartz and hornblende. Petrographic features include inequigranular, hypidiomorphic-granular texture; biotite more abundant than hornblende and shows only slight alteration to chlorite; sphene found locally; myrmekite intergrowths are common. Unit differs from "Sphene-bearing Biotite-Hornblende Granodiorite" (Tgdb) and the "Porphyritic Biotite-Hornblende Granodiorite" (Tgdp) units by gneissic structure.

The following three units in the Bradfield Canal quadrangle are interpreted in this report to be closely related, and the second two are revised from the interpretation given by Koch and Berg (1996). This reinterpretation was done on the basis of the field relations and compositional similarities and on the available geochronologic information. The original unit names and map symbols used by Koch and Berg (1996) are cited to facilitate comparison and evaluation of our reinterpretation.

MAINLAND BELT--CONTINUED

GRANODIORITE OF CENTRAL COAST MOUNTAINS COMPLEX AND ASSOCIATED MIGMATITES--CONTINUED

Tgdb Hornblende-Biotite Granodiorite and Quartz Diorite in this quadrangle (mapped as "Sphene-Bearing Biotite-Hornblende Granodiorite" in the Petersburg quadrangle)--Includes three massive, medium-grained, C.I. 10 to 20, hypidiomorphic-granular phases: (1) nonfoliated, equigranular hornblende-biotite quartz diorite with 2- to 4-mm anhedral biotite grains; (2) K-spar porphyritic granodiorite with phenocrysts up to 1.5 cm in maximum dimensions; and (3) slightly foliated hornblende-biotite granodiorite characterized by conspicuous 3 to 6-mm-diameter books of fresh blackish-brown biotite. In the Petersburg C-1 quadrangle, correlative rocks are homogeneous, nonfoliated; medium- to coarse-grained; and have a C.I. 4 to 20. They are light gray to buff on fresh surfaces and weather darker gray. Euhedral sphene crystals to 4 mm are common. Petrographic features in the Petersburg C-1 quadrangle include a slightly inequigranular, hypidiomorphic-granular texture; biotite more abundant than hornblende, and invariably chloritized, abundant zoned (An_{38}-An_{28}) subhedral plagioclase; and myrmekite intergrowths are ubiquitous. Unit is exposed, as part of the Mount Fawcett body, in the northeastern corner of this quadrangle. Mapped by Koch and Berg (1996) as "Granodiorite and Quartz Diorite" (their Tgq).

Tlg1 Leucocratic Porphyritic Biotite Granodiorite and Adamellite [or Granite]--Homogeneous to slightly foliated; K-feldspar porphyritic, and medium-grained; C.I. 0-5. Faint foliation defined by biotite. Petrographic features include slightly inequigranular, hypidiomorphic-granular texture. Euhedral to subhedral K-spar phenocrysts up to 7 cm normally constitute a significant percentage of the rock. Unit is exposed in an irregular-shaped body immediately southwest of the Coast Range Megalineament in the central part of this quadrangle. Mapped by Koch and Berg (1996) as "Leucocratic Granodiorite and Adamellite" (their Tlg); which grades into the "Leucocratic Granodiorite" (Tlg2) described below.

MAINLAND BELT--CONTINUED

GRANODIORITE OF CENTRAL COAST MOUNTAINS COMPLEX AND ASSOCIATED MIGMATITES--CONTINUED

Tlg2 Leucocratic Granodiorite--

Hornblende-biotite granodiorite; compositionally, texturally, and structurally heterogeneous. Locally massive, foliated, schlieric, and gneissic. Light tan to light gray on weathered surfaces. Mafic minerals and K-spar grains generally irregularly distributed; locally K-spar porphyritic. Differentiated from unit described above by being more foliated and less porphyritic. Mapped by Koch and Berg (1996) as "Leucocratic Granodiorite" (their TKlg); which grades into the "Leucocratic Porphyritic Biotite Granodiorite and Adamellite" (Tlg1) described previously.

Tlgm Migmatite associated with Leucocratic Granodiorite--

Dark gray on weathered surfaces; consists of mostly "Garnet- Biotite Gneiss and Schist, and Amphibolite" (TKgn) rocks invaded by magnetite-bearing hornblende quartz monzonite and granodiorite like the "Leucocratic Granodiorite" (Tlg2) and by rhyolite dikes and sills that may be like those mapped in the Petersburg C-1 quadrangle to the northwest (Brew, 1997h).

INTRUSIVE ROCKS OF THE GREAT TONALITE SILL PLUTONIC BELT AND ASSOCIATED MIGMATITE (Upper Cretaceous and(or) Paleocene)--Belt informally named the "Coast Complex Sill Belt" by Brew and Morrell (1983) and now re-named; located northeast of Coast Range Megalineament (Brew and Ford, 1978). Regional aspects of this belt discussed by Brew and others (1976), Brew and Ford (1981), Ford and Brew (1981), and Brew (1994). Rocks in the belt are currently interpreted to be 62-69 Ma old on the basis of Pb-U analyses of zircons from rocks in the Sumdum and Juneau map areas to the northwest (Gehrels and others, 1983, 1984, 1991; Brew, 1994). A biotite K-Ar age of 51.2±1.5 Ma and a hornblende K-Ar age of 51.6±1.5 were obtained from this unit north of the map area and a biotite K-Ar age of 50.4±1.5 Ma and a hornblende K-Ar age of 49.1±1.5 were obtained from this unit in the Petersburg C-1 quadrangle (M. A. Lanphere, U.S. Geological Survey, written commun., 1984; Douglass and others, 1989, p.65) These ages are interpreted to be the result of complete thermal resetting of the K-Ar system by the thermal effects of the Eocene granodiorites (Tgdp, and Tgrg). Divided into:

MAINLAND BELT--CONTINUED

INTRUSIVE ROCKS OF THE GREAT TONALITE SILL PLUTONIC BELT AND ASSOCIATED MIGMATITE--CONTINUED

Tmgx Migmatite Consisting of Schist and Gneiss Invaded by Tonalite--

Amphibolite facies (hornblende-) biotite-quartz-feldspar schist and gneiss that has been invaded and deformed by tonalite. The schist and gneiss are fine grained, thinly layered (1-30 cm), may include calc-silicate layers (calcite, epidote, diopside, tremolite, garnet), and typically weather rusty. The tonalite invader is the "Biotite-Hornblende- and Hornblende-Biotite Tonalite, etc." (Ttos) characterized by its uniform C.I. (20-35), medium grain size, and local aligned hornblende phenocrysts. Biotite, sphene, epidote, and magnetite are common accessory minerals. This migmatite includes wavy deformed gneisses and raft structures, but on a large scale conforms to regional structural trends. It is mapped on the eastern margin of the Great Tonalite Sill Belt of tonalitic plutons and extends several kilometers to the east. It is successively invaded by younger neosomes to the east and can be recognized as paleosomes in almost all migmatites west of the homogeneous "Sphene-Bearing Biotite-Hornblende-Granodiorite" (Tgdb). Schist and gneiss portions of small outcrops are conspicuously iron-stained, some portions of most other outcrops are visibly iron-stained. See Karl and Brew (1983, 1984) for further information.

Ttos Biotite-Hornblende- and Hornblende-Biotite Tonalite, Quartz Diorite, and Minor Granodiorite-

Homogeneous, foliated and non-layered;. Medium- to coarse-grained; C.I. averages 29, ranges 16 to 40. Gray where fresh, weathers darker gray. Locally hornblende porphyritic with phenocrysts up to 2 cm; inclusions and schlieren of dioritic composition common; gneiss inclusions occur locally. Petrographic features include: equigranular to seriate texture, hornblende as the dominant mafic, biotite replaces hornblende and is chloritized, plagioclase (An_{35}-An_{50}) is subhedral to euhedral and rarely zoned, poikilitic hornblende with inclusions of quartz and plagioclase are common, and epidote minerals rare.

Tgdg Gneissic Biotite Granodiorite and Quartz Monzodiorite--

Homogeneous at outcrop scale, foliated, locally banded/layered. Fine- to medium-grained; C.I. 5 to 25,. Light gray to gray where fresh, weathers darker gray. Local K-spar augen and K-spar phenocrysts up to 2.5 cm. Petrographic features include inequigranular texture, local disseminated garnet, subhedral plagioclase that is unzoned and usually altered, local myrmekite, biotite is usually unaltered. Exposed along the Stikine River.

MAINLAND BELT--CONTINUED

METAMORPHIC ROCKS OF COAST MOUNTAINS COMPLEX (Upper Cretaceous and(or) Paleocene)--These rocks comprise the progressively metamorphosed belt that forms the western edge of the Coast Mountains Complex; the westernmost part adjoins the metamorphic rocks of the Gravina Belt. The rocks are in general so metamorphosed that no original textures or structures remain. The protoliths must have included a variety of clastic rocks, dominantly fine-grained, but including some sandstones and conglomerates. The fine-grained sediments probably occurred in thicker units than the coarser-grained. Other protoliths are limestones, 10's to 100's of m thick, sediments, volcanic rocks of intermediate to mafic composition, and probably some intermediate to mafic sill-like intrusions. No fossils have been found in any of these rocks in this map area, but proximity to the Gravina belt suggests that some of the protoliths may have been of Jura-Cretaceous age; fossils collected in somewhat similar rocks to the northwest in the Tracy Arm area (Brew and Grybeck, 1984) and in the Juneau area (Ford and Brew, 1977b; Brew and Ford, 1977) suggest that Lower Permian and Upper Triassic rocks may also be present. Brew (1983a) and Brew and Ford (1983, 1984a) argued that these rocks are the metamorphosed equivalent of rocks in the upper part (Permian and Triassic) of the Alexander Belt section, rather than a separate tectonostratigraphic terrane (or terranes) as espoused by Berg and others (1978). Nevertheless, isotopic evidence summarized by Brew and Ford (1994) and Brew and others (1994) indicates the some of the protoliths are Late Proterozoic or Early Paleozoic in age and belong to the Nisling assemblage, or lithotectonic terrane, of Wheeler and McFeely (1991). The age of metamorphism is interpreted to be Late Cretaceous and(or) Early Tertiary (Brew and Ford, 1984ab; Gehrels and others (1983, 1984). No obvious contrast, other than metamorphic grade, exists between the metamorphic rocks west of the Coast Range Megalineament and those engulfed in the plutons between there and the International Boundary, even though more than one lithotectonic terrane may be present. As mapped, divided into:

MAINLAND BELT--CONTINUED

METAMORPHIC ROCKS OF COAST MOUNTAINS COMPLEX-CONTINUED

TKp Phyllite--

Dominantly well foliated and commonly lineated, dark gray very fine- to fine-grained phyllite with minor thin-dark gray semischist interlayers, weathers medium- to dark-gray; some extensive areas of interlayered green phyllite that weathers light green. The former are probably derived from fine grained clastic rocks; the latter from either tuffs or fine-grained volcanogenic sediments. Both form alternately rounded and serrated ridge tops and cliffy slopes. Metamorphic grade generally increases from prehnite-pumpellyite/low greenschist facies in the southwest to upper greenschist facies in the northeast. The common prehnite-pumpellyite greenschist facies mineral assemblage of the semischist is (epidote-)albite-white mica-chlorite-quartz. Presence of foliation and spatial relationship to the well defined Barrovian metamorphic sequence, together with lack of actinolite or biotite, support assignment to the prehnite-pumpellyite facies. Typical greenschist metamorphic facies mineral assemblages in the dark gray semischists and phyllites are (garnet-)muscovite-chlorite-biotite-albite-quartz and in the green phyllites (biotite-)(actinolite-)(sphene-)clinozoisite-albite-quartz-chlorite-calcite-muscovite. With increase in grade, clastic and other relict textures disappear, grain size increases, and crenulation cleavage and transposition become well developed. Foliation in general is defined by parallel, intergrown laths of actinolite, biotite, chlorite, or white mica. Garnet is porphyroblastic, epidote and clinozoisite subidioblastic, calcite is xenomorphic interstitial, and quartz and albite form a subgranoblastic matrix. This unit is enigmatic in that its distribution pattern includes semi-isolated areas almost surrounded by the "Biotite Schist and Semischist" (TKbs) unit; this is currently interpreted to mean that this unit (TKp) actually records two metamorphic episodes that are difficult to distinguish from each other. The first is a post-Early Cretaceous and pre-Late Cretaceous, (110 to 90 Ma), low grade regional event. The second overprints the first and is part of the low- to high-grade Late Cretaceous-Early Tertiary metamorphic and deformational event that is closely related to the emplacement of the Great Tonalite Sill Belt rocks (Ttos, Tgdg).

MAINLAND BELT--CONTINUED

METAMORPHIC ROCKS OF COAST MOUNTAINS COMPLEX-CONTINUED

TKp Phyllite--Continued

Commonly observed polydeformation textures such as multidirection crenulation cleavage and nearly complete transposition are compatible with this interpretation. Staurolite-biotite-garnet hornblende-hornfels facies thermal aureoles formed where the 90 Ma Admiralty-Revillagagedo Belt plutons intruded the unit. Porphyroblasts of staurolite and garnet, and decussate biotite laths have been rotated and realigned by development of the post-aureole foliation. Only rarely can an early foliation be detected through the superposed thermal and later dynamic-thermal metamorphic effects. The unit is exposed along the eastern shore of Frederick Sound and east of Eastern Passage.

MAINLAND BELT--CONTINUED

METAMORPHIC ROCKS OF COAST MOUNTAINS COMPLEX-CONTINUED

TKbs Biotite Schist--

Dominantly well foliated and lineated biotite schist, with lesser amounts of interlayered biotite semischist and hornblende schist and semischist. Fine- to medium-grained; weathers grayish-brown, brownish-gray where fresh; forms craggy ridges and steep slopes. Metamorphic mineral assemblages suggest derivation from the same protoliths as the "Phyllite, Slate, and Semischist" (TKp) described above. Metamorphic grade generally increases from greenschist facies to upper amphibolite facies from southwest to northeast, in a Barrovian facies series. Mineral isograds marking the first occurrence of biotite, garnet, staurolite, and kyanite trend north-northwest and appear to steepen northeastward towards the Coast Range Megalineament which coincidentally locally marks the sillimanite isograd. Typical greenschist mineral assemblages are (epidote-)(clinozoisite-)(calcite-) (garnet-) biotite-muscovite-chlorite-albite-quartz and (actinolite-)epidote-calcite-sphene-chlorite-muscovite-albite-quartz. Higher grade pelitic assemblages include (kyanite-)quartz-muscovite-plagioclase (oligoclase to andesine)-biotite-garnet-staurolite. More mafic assemblages include (clinopyroxene-)hornblende-biotite-quartz-garnet-plagioclase. East of the Coast Range Megalineament, sillimanite-potassium feldspar-muscovite-biotite-garnet-quartz-plagioclase assemblages represent the highest grade of regional metamorphism. Four different metamorphic episodes are interpreted to be present in different parts of this map unit: 1) a higher grade phase of the post-Early Cretaceous, pre-Late Cretaceous regional metamorphism discussed above, 2) a superposed thermal effect from the 90-95 Ma Admiralty-Revillagigedo Belt intrusions on those previously deformed rocks, 3) a "main" Late Cretaceous to Early Tertiary event that is the most likely cause of the most obvious features in this unit, and 4) a thermal effect of the Eocene age Granodiorite of central Coast Mountains Complex units (Tgdb, Tgdp, Tgrg) that occur to the north and northeast of this quadrangle. Textural and mineralogical evidence of the post-Early Cretaceous, pre-Late Cretaceous regional metamorphism have for the most part been obscured by local amphibolite facies porphyroblastic, dicussate, and granoblastic recrystallization caused by 2) above, and the effects of 3) above, both of which caused deformation crenulations, shattered porphyroblasts with fragment trains, and in places totally disrupted foliation.

MAINLAND BELT--CONTINUED

METAMORPHIC ROCKS OF COAST MOUNTAINS COMPLEX-CONTINUED

TKbs Biotite Schist--Continued

Recrystallized quartz and plagioclase are most commonly subgranoblastic, polygonal, and slightly elongate parallel to the foliation. Local zones of cataclasis in rocks exposed along the Coast Range Megalineament include blastomylonites, rare mylonites, and exhibit late greenschist facies recrystallization. This unit is exposed along the eastern shores of Frederick Sound and from Eastern Passage east to the Great Tonalite Sill Belt, and also in a few screens and pendants between there and the International Boundary.

TKbsc Schistose metamorphosed polymictic conglomerate--

Large lenses of foliated, locally lineated, biotite schist-matrix polymictic conglomerate and biotite schist like the above unit. Conglomerate clasts are flattened cobbles and pebbles of granitic, quartzitic, and pelitic metamorphic rock, and some marble. Unfortunately, this unit has not been studied intensely.

TKhs Hornblende Schist and Semischist--

Poorly to well foliated, locally lineated interlayered hornblende schist, semischist, and lesser amounts of biotite schist; fine- to coarse-grained. Weathers greenish-gray, dark greenish-gray where fresh. Probably derived from intermediate to mafic volcanic flows, tuffs, or volcanic sediments, but some may be from fine-grained sills. Metamorphic grade increases towards the northeast from upper greenschist facies to amphibolite facies and is compatible with metamorphic facies of nearby "Biotite Schist and Semischist" (TKbs). Typical greenschist facies mineral assemblages are (garnet-)(zoisite-)(epidote-)plagioclase-(albite-oligoclase)-hornblende-quartz-biotite-chlorite-sphene, and amphibolite facies assemblages are (clinopyroxene-)(garnet-)(potassium feldspar)-plagioclase-(andesine)-hornblende-quartz-biotite. In outcrops east of the Coast Range Megalineament chlorite-actinolite-calcite-epidote-white mica alteration assemblages are locally present. Petrographic features include poikiloblastic hornblende and garnet. Hornblende and biotite laths define foliation with leucocratic and mafic minerals commonly segregated into bands. Protoclastic, quartz-ribbon, and augen textures are present within the Coast Range Megalineament zone. Exposed only in relatively narrow elongate masses adjacent to the Coast Range Megalineament.

MAINLAND BELT--CONTINUED

METAMORPHIC ROCKS OF COAST MOUNTAINS COMPLEX-CONTINUED

TKmb Marble and Calc-Silicate Granofels--

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

MAINLAND BELT--CONTINUED

METAMORPHIC ROCKS OF COAST MOUNTAINS COMPLEX-CONTINUED

TKbg Biotite Gneiss--

Dominantly well-foliated, well-layered, locally lineated, fine- to coarse-grained quartz-biotite-feldspar gneiss with lesser amounts of garnet-quartz-biotite-plagioclase schist and still less hornblende-plagioclase schist and gneiss. Weathers grayish-brown, gray where fresh. Probably derived from the same protoliths as the "Phyllite, Slate, and Semischist" (TKp) and "Biotite Schist and Semischist" (TKbs) units. Generally, but not exclusively, lies to the northeast of those units. Metamorphic characteristics are spatially dependent, as follows: Near the Coast Range Megalineament the unit is well foliated; commonly exhibits protomylonitic to phyllonitic, quartz-ribbon, and myrmekitic textures. Epidote-amphibolite facies synkinematic assemblages are (hornblende-)plagioclase-chlorite-biotite-epidote-quartz and (garnet-)biotite-muscovite-quartz-plagioclase-chlorite. Typically these 'sheared' rocks are strongly altered with abundant late chlorite, white mica, and calcite. East of, and locally to the west of, the Coast Range Megalineament the unit exhibits less cataclasis, and the foliation becomes poorer as grain size increases. Metamorphic mineral assemblages indicate the kyanite and sillimanite zones of the amphibolite facies. Typical mineral assemblages are (kyanite-)(staurolite-)biotite-muscovite-plagioclase-quartz-garnet and (sillimanite-)(potassium feldspar-) plagioclase-quartz-biotite-garnet. To the west of the Coast Range Megalineament, sillimanite (fibrolitic) rarely occurs in kyanite-bearing gneisses. "Regional" prismatic sillimanite occurs only east of the megalineament. Segregation is well developed between mafic biotite-rich and leucocratic layers; garnet, kyanite, and staurolite are poikiloblastic. An anastomosing foliation is defined by sub-equant-stubby laths of biotite outlining partially recrystallized porphyroblasts of plagioclase. Exposed both as elongate masses within the "Biotite Schist and Semischist" (TKbs) and as isolated screens within the granitic rocks northeast of the Coast Range Megalineament.

MAINLAND BELT--CONTINUED

METAMORPHIC ROCKS OF COAST MOUNTAINS COMPLEX-CONTINUED

TKhg Hornblende Gneiss--

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

TKgn Garnet- Biotite Gneiss and Schist, and Amphibolite--

A belt of heterogeneous gneiss and schist in the Bradfield Canal quadrangle; most of the gneisses of which were developed from older and undated intrusive silicic to intermediate plutonic units. The schist components are like the rocks of the "Biotite Schist" (TKbs). The belt is approximately parallel to the Coast Range Megalineament and to the the Great Tonalite Sill (Ttos). Metamorphic mineral assemblages including sillimanite and cordierite indicate higher temperatures than in the "Biotite Schist" (TKbs) to the west. Mapped by Koch and Berg (1996) as "Paragneiss and Orthogneiss" (their MzPzpo).

MAINLAND BELT--CONTINUED

INTRUSIVE ROCKS OF ADMIRALTY-REVILLAGIGEDO PLUTONIC BELT AND ASSOCIATED MIGMATITE (Upper Cretaceous)--General age relations are described for the Gravina Belt units of the plutonic belt. As discussed in that section, these plutons are about 90-95 Ma. In general they have narrow thermal metamorphic aureoles that are superposed on deformed and low-grade regionally metamorphosed country rocks. Here in the Mainland Belt a further complication is present: parts of some of this same family of plutons have been involved in the deformation and progressive low- to high-grade metamorphism in latest Cretaceous and earliest Tertiary time that gave rise to the Metamorphic Rocks of the Coast Mountains Complex super unit described above. Thus, the metamorphic age given for those rocks differs from with the emplacement age given for this family of plutons. The alternative was to assign the same metamorphic age to these plutons, but that is equally inadequate because not all of them show metamorphic features. The belt was informally named by Brew and Morrell (1983) and is described by Burrell (1984abc). K-Ar age determinations by M. A. Lanphere (U.S. Geological Survey, written communs., 1981, 1982; Douglass and others, 1989), interpreted to be applicable to the whole suite in the Petersburg-Wrangell area, including the rocks in this quadrangle, are tabulated on page 43 in the Gravina Belt section of this report.

Similar rocks occur in lithically correlative units to the east in this part of the Bradfield Canal quadrangle (R. L. Elliott and R. D. Koch, U.S. Geological Survey, oral commun., 1982; Koch and Berg, 1996), but some, like the Marten Lake body in the Bradfield Canal B-6 quadrangle, and other bodies, are interpreted to have had their K-Ar systems reset by younger intrusive events.

Map unit	General location	Biotite age	Hornblende age
Ktef unit	Marten Lake body	58.6 Ma	83.2 Ma
"	Elsewhere in Bradfield Canal quadrangle	67.8 Ma	71.8 Ma
"	"	71.8 Ma	80.0 Ma

MAINLAND BELT--CONTINUED

INTRUSIVE ROCKS OF ADMIRALTY-REVILLAGIGEDO PLUTONIC BELT AND ASSOCIATED MIGMATITE--CONTINUED

Divided into:

Kmgf Migmatite (Upper Cretaceous)--

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

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, which is in this quadrangle; locally semischistose and cataclastic. Contains aplite dikes, pegmatite dikes and veins, rounded very fine-grained hornblende diorite inclusions. Generally concordant intrusions as sills with country rock and screens of country rock in the margins of the bodies. Mineralogy includes zoned, complexly twinned plagioclase with minor alteration to sericite; mafic minerals usually biotite greater than hornblende; subhedral epidote; and local garnet and pyroxene. Accessory minerals are sphene, apatite, opaque minerals and allanite. Unit differs from "Hornblende-Biotite Tonalite, Granodiorite, etc." (Ktif) mapped in other quadrangles by presence of pyroxene and garnet, and biotite as the dominant mafic phase. Unit is exposed in the western part of this quadrangle on Wrangell Island and the mainland. Mapped by Koch and Berg (1996) as "Biotite-Hornblende Quartz Diorite" (their Kqd).

MAINLAND BELT--CONTINUED

INTRUSIVE ROCKS OF ADMIRALTY-REVILLAGIGEDO PLUTONIC BELT AND ASSOCIATED MIGMATITE--CONTINUED

Ktoc Garnet-Biotite Tonalite and Minor Granodiorite--

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

Ktgp Biotite Tonalite, Quartz Diorite, and Granodiorite--

Porphyritic and foliated; medium- to coarse-grained; C.I. 11 to 35; cut by pegmatite and basalt dikes; local cataclastic texture; inclusions of country rock; foliation parallels that of the country rock. Garnet-bearing crowded plagioclase porphyry with magmatic epidote is common in the eastern part of the body at Marten Lake and well-developed foliation and hornblende are more common in the western part; an internal contact separating these two phases is shown on the map. Petrographic features include zoned, complexly twinned plagioclase, quartz, interstitial K-feldspar, partly chloritized biotite, epidote, minor local hornblende; and garnet, sphene, apatite and allanite as accessories. Unit differs from "Biotite-Epidote-Hornblende Quartz Monzonite" (Kgop) mapped in other quadrangles by lack of hornblende and presence of garnet. Unit occurs on the mainland in the vicinity of Marten Lake, in the southwestern part of this quadrangle. Mapped by Koch and Berg (1996) as "Porphyritic Granodiorite" (their Kgp in text on p. 20, their Kgd on map, so one or the other is an unintended error).

Kgb Metagabbro--

Biotite-plagioclase-hornblende granofels or semischist. Fine- to medium-grained; C.I. 70; dark green where fresh, weathers grayish-green. Crops out as a small plug on the ridge above the headwaters of Government Creek south of the Stikine River.

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CITED AND SELECTED REFERENCES

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, T., 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, D., 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 Coney, P. J., 1978, Map showing pre-Cenozoic tectonostratigraphic terranes of southeastern Alaska and adjacent areas: U.S. Geological Survey Open-File Report 78-1085, 2 sheets, scale 1:1,000,000.

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.

Berg, H.C., and Monger, J.W.H., 1987, Lithotectonic terrane map of western Canada and southeastern Alaska: U.S. Geological Survey Miscellaneous Field Studies Map MF-1874-B, scale 1:2,500,000,12 p. pamphlet.

Brew, D. A., 1983, Evaluation of suspect terranes in the Coast plutonic-metamorphic complex, southeastern Alaska and part of British Columbia (abs.): Geological Society of America, Abstracts with Programs, v. 15, no. 5, p. 324.

____ 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.

_____1994, Latest Mesozoic and Cenozoic magmatism in southeastern Alaska, *in* Plafker, G., and Berg, H.C., eds., The geology of Alaska: Boulder, Colorado, Geological Society of America, The Geology of North America, v. G-1, Chap. 19, p. 621-656.

____ (Compiler), 1995, Geologic map of the Craig, Dixon Entrance, and parts of the Ketchikan and Prince Rupert quadrangles, southeastern Alaska: U.S. Geological Survey Open-File Report 95-215, 1 sheet, scale: 1:250,000.

____ 1996, Geologic map of the Craig, Dixon Entrance, and parts of the Ketchikan and Prince Rupert quadrangles, southeastern Alaska: U.S. Geological Survey Miscellaneous Field Investigations Series Map MF-2319, 2 sheets, scale: 1:250,000, 53 p. pamphlet.

____ 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, 21 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, 23 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, 20 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, 20 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, 22 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 Ford, A. B., 1977, Preliminary geologic and metamorphic-isograd map of the Juneau B-1 quadrangle, Alaska: U.S. Geological Survey Miscellaneous Field Studies Map 846.

_____1978, Megalineament in southeastern Alaska marks southwest edge of Coast Range batholithic complex: Canadian Journal of Earth Science, v. 15, no. 11, p. 1763-1772.

_____1981, The Coast plutonic complex sill, southeastern 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. B96-B99.

_____1983, Comment on Monger, J. W. H., Price, R. A., and Tempelman-Kluit, D. J., 1982, Tectonic accretion and the origin of the two major metamorphic and plutonic welts in the Canadian Cordillera: Geology, v. 11, p. 427-429.

_____1984a, Tectonostratigraphic terrane analysis in the Coast plutonic-metamorphic complex, southeastern Alaska (abs.), *in* Bartsch-Winkler, S., and Reed, K. M., eds., The United States Geological Survey in Alaska: Accomplishments during 1982: U.S. Geological Survey Circular 939, p. 90-93.

_____1984b, Timing of metamorphism and deformation of the Coast plutonic metamorphic complex near Juneau, Alaska (abs.): Geological Society of America, Abstracts with Programs, v. 16, no. 5, p. 272.

_____1984c, The northern Coast plutonic complex, southeastern Alaska and northwestern British Columbia, *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. 120-124.

_____1994, The Coast Mountains plutonic-metamorphic complex between Skagway, Alaska, and Fraser, British Columbia--Geologic sketch and road log: U.S. Geological Survey Open-File Report 94-268, 25 p.

____1998, The Coast Mountains structural zones in southeastern Alaska--Descriptions, relations, and lithotectonic terrane significance, *in* Gray, J.E., and Riehle, J.R., eds., The U.S. Geological Survey in Alaska: Geologic Studies in Alaska by the U.S. Geological Survey in 1996: U.S. Geological Survey Professional Paper 1595 (In press).

Brew, D. A., Ford, A. B., Grybeck, D., Johnson, B. R., and Nutt, C. J., 1976, Key foliated quartz diorite sill along southwest side of Coast Range complex, northern southeastern Alaska, *in* Cobb, E. H., ed., The United States Geological Survey in Alaska: Accomplishments during 1975: U.S. Geological Survey Circular 733, p. 60.

Brew, D.A., Ford, A.B., and Himmelberg, G.R., 1994, Jurassic accretion of Nisling terrane along the western margin of Stikinia, Coast Mountains, northwestern British Columbia: Comment; Geology, v. 22, no. 1, p. 89-90.

Brew, D.A., Ford, A.B., Himmelberg, G.R., and Drinkwater, J.L., 1995, The Coast Mountains Complex of southeastern Alaska and adjacent regions, *in* Koozmin, E.D., ed., Stratigraphic notes--1994: U.S. Geological Survey Bulletin 2135, p. 21-28.

Brew, D. A., and Grybeck, D.J., 1984, Geology of the Tracy Arm-Fords Terror Wilderness Study Area and vicinity, *in* U.S. Geological Survey and U.S. Bureau of Mines, Mineral resources of Tracy Arm-Fords Terror Wilderness Study Area and vicinity: U.S. Geological Survey Bulletin 1525, P. 19-52.

_____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, 108 p. (This report)

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 Karl, S.M., 1988a, A reexamination of the contacts and other features of the Gravina belt, southeastern Alaska, *in* Galloway, J.P., and Hamilton, T.D., eds., Geologic studies in Alaska by the U.S. Geological Survey during 1987: U.S. Geological Survey Circular 1016, p. 143-146.

Brew, D.A., and Karl, S.M., 1988b, A reexamination of the contacts and other features of the Gravina belt, southeastern Alaska, Supplemental data: U.S. Geological Survey Open-File Report 88-652, 8 p.

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, 21 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.

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

Burchard, E. F., 1914, A barite deposit near Wrangell: U.S. Geological Survey Bulletin 592, p. 109-117.

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 1:250,000.

____ 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 1:250,000.

____ 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 1:250,000.

____ 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 1:250,000.

____ 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 1:250,000.

____ 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 1:250,000.

____ 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 1:250,000.

____ 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 1:250,000.

____ 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.

Churkin, M., Jr., and Eberlein, G.D., 1975, Geologic map of the Craig C-4 quadrangle, Alaska: U.S. Geological Survey Geologic Quadrangle Map GQ-1169, scale 1:63,360.

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.

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.

Elliott, R.L., and Koch, R.D., 1982, Mines, prospects, and selected metalliferous mineral occurrences in the Bradfield Canal quadrangle, Alaska: U.S. Geological Survey Open-File Report 81-728-B, 23 p., 1 sheet, scales 1:250,000 and 1:63,360.

Ford, A.B., and Brew, D.A., 1977a, 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.

_____ 1977b, Preliminary geologic and metamorphic-isograd map of parts of the Juneau A-1 and A-2 quadrangles, Alaska: U.S. Geological Survey Miscellaneous Field Studies Map MF-847.

_____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.

_____1981, Orthogneiss of Mount Juneau--an early phase of coast mountain plutonism involved in Barrovian regional metamorphism near Juneau, *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.

Ford, A.B., Palmer, C.A., and Brew, D.A., 1996, Geochemistry of the Oligocene andesitic Admiralty Island Volcanics, a rift-related basalt to rhyolite volcanic suite of southeastern Alaska, *in* Moore, T.E, and Dumoulin, J.A., eds., The U.S. Geological Survey in Alaska: Geologic studies in Alaska by the U.S. Geological Survey in 1994: U.S. Geological Survey Bulletin 2152, p. 177-204.

Gault, H. R., 1954, Explosion-breccia in the Wrangell district, southeastern Alaska (abs.): American Geophysical Union Transactions, v. 26, no. 3, p. 389-390.

Gault, H. R., Rossman, D. L., Flint, G. M., Jr., and Ray, R. G., 1953, Some lead-zinc deposits of the Wrangell district, Alaska: U.S. Geological Survey Bulletin 998-B, p. 15-58.

Gehrels, G. E., Brew, D. A., and Saleeby, J. B., 1983, U-Pb zircon ages of major intrusive suites in the Coast plutonic-metamorphic complex near Juneau, southeastern Alaska (abs.): Geological Association of Canada, Program with Abstracts, v. 8, p. A26.

_____1984, Progress report on U/Pb (zircon) geochronologic studies in the Coast plutonic-metamorphic complex east of Juneau, southeastern Alaska (abs.), *in* Bartsch-Winkler, S., and Reed, K. M., eds., The United States Geological Survey in Alaska: Accomplishments during 1982: U.S. Geological Survey Circular 939, p. 100-102.

Gehrels, G.E., McClelland, W.C., Samson, S.D., Patchett, P.J., and Brew, D.A., 1991, U-Pb geochronology and tectonic significance of Late Cretaceous-early Tertiary plutons in the northern Coast Mountains batholith: Canadian Journal of Earth Sciences, v. 28, no. 6, p. 899-911.

Gehrels, G.E., McClelland, W.C., Samson, S.D., and Patchett, P.J., 1992, Geology of the western flank of the Coast Mountains between Cape Fanshaw and Taku Inlet, southeastern Alaska: Tectonics, v. 11, no. 3, p. 567-585.

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, 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.

Hillhouse, J. W., and Grommé, 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.

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.

Himmelberg, G.R., Loney, R.A., and Craig, J.T., 1986, Petrogenesis of the ultramafic complex at the Blashke Islands,southeastern Alaska: U.S. Geological Survey Bulletin 1662, 14 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.

Jones, D.L., Berg, H.C., Coney, P., and Harris, A., 1981, Structural and stratigraphic significance of Upper Devonian and Mississippian fossils from the Cannery Formation, Kupreanof Island, southeastern Alaska, *in* Albert, N.R.D., and Hudson, T., eds., United States Geological Survey in Alaska: Accomplishments during 1979: U.S. Geological Survey Circular 823-B, p. B109-B112.

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 Brew, D. A., 1983, Four Paleocene to Eocene migmatite units in the central metamorphic belt of the Coast plutonic-metamorphic complex, southeastern Alaska (abs.): Geological Association of Canada, Program with Abstracts, v. 8, p. A36.

_____1984, Migmatites of the Coast plutonic-metamorphic complex, southeastern Alaska, *in* Bartsch-Winkler, S., and Reed, K. M., eds., The United States Geological Survey in Alaska: Miscellaneous Geologic Research 1982: U.S. Geological Survey Circular 939, p. 108-111.

Karl, S.M., and Giffen, C.D., 1992, Sedimentology of the Bay of Pillars and Point Augusta Formations, Alexander Archipelago, Alaska: *in* Bradley, D.W., and Dusel-Bacon, C., eds., The United States Geological Survey in Alaska: Accomplishments during 1991: U.S. Geological Survey Bulletin 2041, p. 171-185.

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

Koch, R.D., and Elliott, R.L., 1981a, Maps showing distribution and abundance of gold and silver in geochemical samples from Bradfield Canal quadrangle, southeastern Alaska: U.S. Geological Survey Open-File Report 81-728-C 2 sheets, scale I:250,000.

_____1981b, Maps showing distribution and abundance of copper in geochemical samples from Bradfield Canal quadrangle, southeastern Alaska: U.S. Geological Survey Open-File Report 81-728-D, 4 sheets, scale I:250,000.

_____1981c, Maps showing distribution and abundance of lead in geochemical samples from Bradfield Canal quadrangle, southeastern Alaska: U.S. Geological Survey Open-File Report 81-728-E, 4 sheets, scale 1:250,000.

_____1981d, Maps showing distribution and abundance of zinc in geochemical samples from Bradfield Canal quadrangle, southeastern Alaska: U.S. Geological Survey Open-File Report 81-728-F, 4 sheets, scale 1:250,000.

_____1981e, Maps showing distribution and abundance of molybdenum in geochemical samples from Bradfield Canal quadrangle, southeastern Alaska: U.S. Geological Survey Open-File Report 81-728-G, 2 sheets, scale 1:250,000.

_____1981f, Maps showing distribution and abundance of tin in geochemical samples from Bradfield Canal quadrangle, southeastern Alaska: U.S. Geological Survey Open-File Report 81-728-H, 2 sheets, scale 1:250,000.

_____1981g, Maps showing distribution and abundance of beryllium in geochemical samples from Bradfield Canal quadrangle, southeastern Alaska: U.S. Geological Survey Open-File Report 81-728-I, 2 sheets, scale 1:250,000.

_____1981h, Maps showing distribution and abundance of niobium in geochemical samples from Bradfield Canal quadrangle, southeastern Alaska: U.S. Geological Survey Open-File Report 81-728-J, 2 sheets, scale 1:250,000.

_____1981i, Maps showing distribution and abundance of yttrium in geochemical samples from Bradfield Canal quadrangle, southeastern Alaska: U.S. Geological Survey Open-File Report 81-728-K, 2 sheets, scale 1:250,000.

Koch, R.D., Elliott, R.L., Berg, H.C., and Smith, J.G., 1976, Analyses of rock and stream-sediment samples from the southern Bradfield Canal quadrangle, southeastern Alaska: U.S. Geological Survey Open-File Report 76-486, 136 p., 1 sheet, scale 1:250,000.

Koch, R.D., Elliott, R.L., O'Leary, R.M., and Risoli, D.A., 1980a, Trace-element data for stream-sediment samples from the Bradfield Canal quadrangle, southeastern Alaska: U.S. Geological Survey Open-File Report 80-910-B, 174 p, 1 sheet, scale 1:250,000

_____1980b, Trace element data for stream-sediment heavy-mineral concentrate samples from Bradfield Canal quadrangle, southeastern Alaska: U.S. Geological Survey Open-File Report 80-910-C, 70 p., I sheet, scale I:250,000.

_____198Ia, Trace-element data for rock samples from the Bradfield Canal quadrangle, southeastern Alaska: U.S. Geological Survey Open-File Report 80-910-A, 258 p., 1 sheet, scale I:250,000.

Koch, R.D., Elliot, R.L., and Rossiter, R., 1981b, Total gamma ray intensities at ground stations in the Bradfield Canal quadrangle, southeastern Alaska: U.S. Geological Survey Open-File Report 81-840, 2 sheets, scale I:I25,000, and 1:250,000.

Lanphere, M.A., and Eberlein, G. D., 1966, Potassium-argon ages of magnetite bearing ultramafic complexes in southeastern Alaska (Abs.): Geological Society of America Special Paper 87, p. 94.

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., 1981a, 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.

_____1981b, 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.

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.

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.

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, 1976, Aeromagnetic maps of Granite Fiords wilderness study area, Ketchikan and Bradfield Canal quadrangles, southeastern Alaska: U.S. Geological Survey Open-File Report 76-558, 15 sheets, scale I:63,360.

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

_____1979a, Aeroradioactivity map of Cone Mountain, Alaska: U.S. Geological Survey Open-File Report 79-830, 1 sheet, scale 1:63,360.

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

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.

Webster, J. H., 1984, Preliminary report on a large granitic body in the Coast Mountains, northeast Petersburg quadrangle, southeastern Alaska, *in* Bartsch-Winkler, S., and Reed, K. M., eds., The United States Geological Survey in Alaska: Accomplishments during 1982: U.S. Geological Survey Circular 939, p. 116-118.

Wheeler, J.O., and McFeely, P., 1991, Tectonic assemblage map of the Canadian Cordillera and adjacent parts of the United States of America: Geological Survey of Canada Map 1712 A, scale 1:2,000,000.

Wolfe, J. A., 1966, Tertiary plants from the Cook Inlet region, Alaska: U.S. Geological Survey Professional Paper 398-B, p. B1-B32.

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

ALPHABETICAL INDEX OF OF MAP UNIT SYMBOLS, GIVING THEIR UNIT NAMES AND DESCRIPTIONS

[Notes: 1. Page numbers are for the complete map-unit descriptions, and not for the brief descriptions

2. Units are in the Alexander Belt unless otherwise noted.]

ALPHABETICAL INDEX OF OF MAP UNIT SYMBOLS--CONTINUED

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ALPHABETICAL INDEX OF OF MAP UNIT NAMES, GIVING PAGE NUMBERS OF THEIR DESCRIPTIONS

[Notes: 1. Page numbers are for the complete map-unit descriptions, not for the brief descriptions
2. Units are in the Alexander Belt unless otherwise noted.
3. Belts and major units are in capital letters]

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