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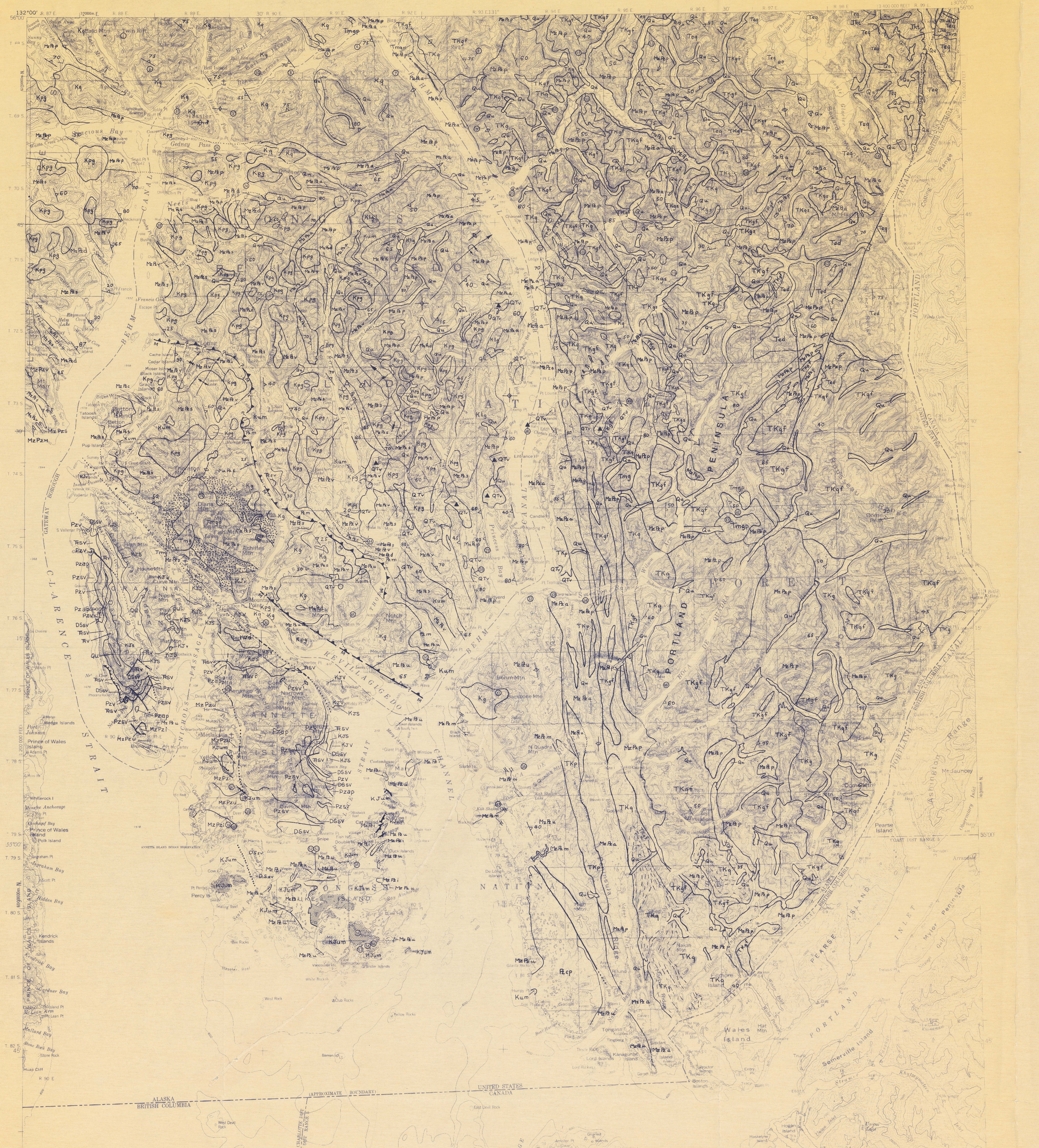
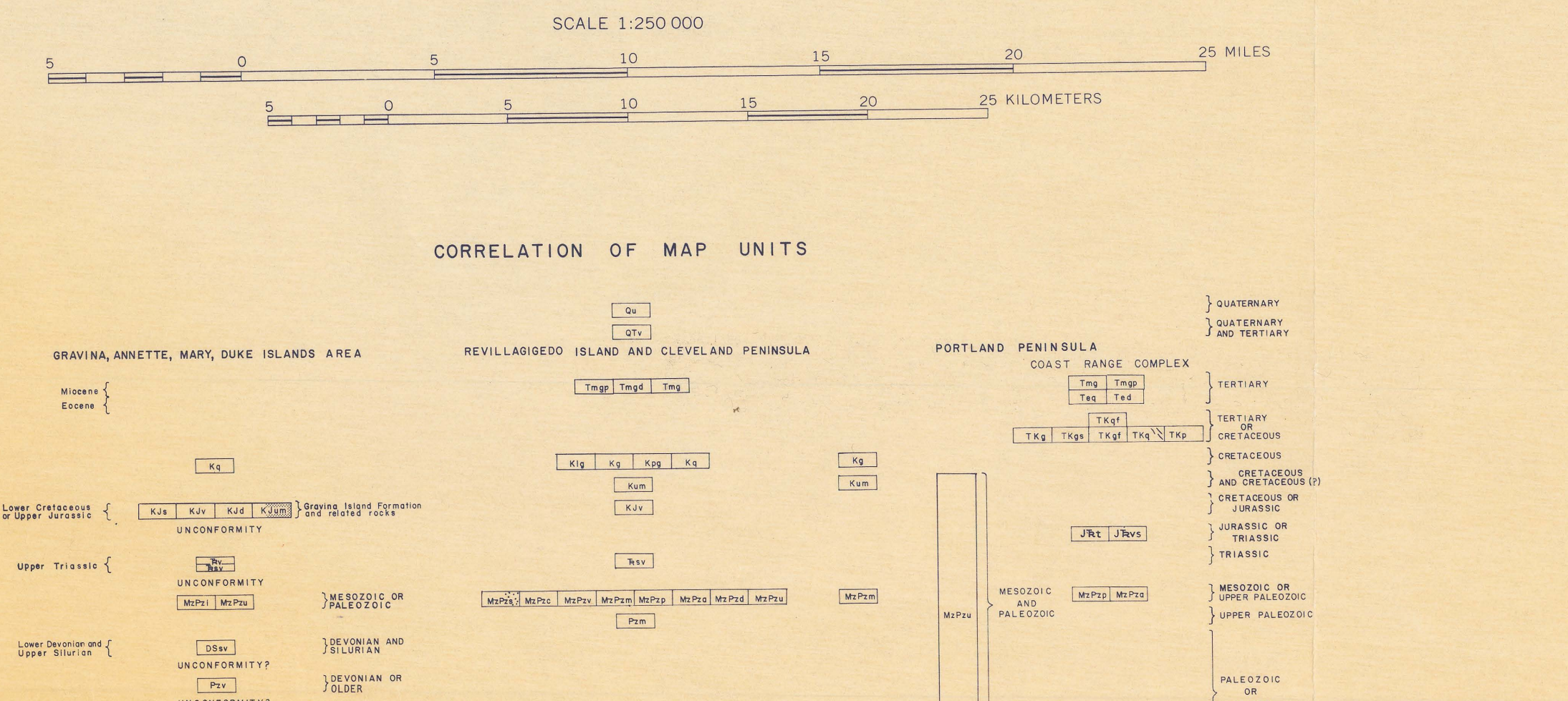
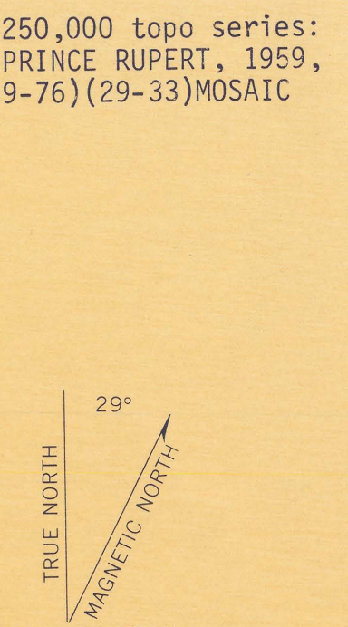


Base from USGS 1:250,000 topo series:
KETCHIKAN, 1955; PRINCE RUPERT, 1959,
ALASKA-CANADA. (9-76)(29-33)MOSAIC

Geology by H. Berg, R. Carten, J. Childs, A. Clark, W. Condon, M. Diggles, G. Dunne, R. Elliott, C. Holloway, J. Houghton, R. Koch, R. Miller, R. Rudser, J. Smith, B. Wiggins, 1966-1977

CORRELATION OF MAP UNITS





APPROXIMATE MEAN
DECLINATION, 1959

This report is preliminary and has not been edited or reviewed for conformity with Geological Survey standards and nomenclature.

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GEOLOGIC MAP OF THE KETCHIKAN AND PRINCE RUPERT QUADRANGLES, ALASKA

BY

H.C. BERG, R.L. ELLIOTT, J.G. SMITH, AND R.D. KOCH

1978

DESCRIPTION OF MAP UNITS

Qu GLACIAL, ALLUVIAL, AND TALUS DEPOSITS, UNDIVIDED (Quaternary) - Unconsolidated, poorly sorted deposits of clay, silt, sand, gravel, and boulders. Includes alluvium and talus; partly reworked glacial drift, till, and moraine; and glacial marine deposits

QTv [1]OLIVINE ANDESITE, TRACHYANDESITE, AND BASALT (Quaternary and Tertiary) - Forms volcanic cones, columnar-jointed lava flows, and rubbly flows of pumice and scoria. Unit also includes thin (few cm to few m thick) patches of ash and lapilli too small to show on map. The unit is assigned an age of Quaternary and Tertiary because: (1) volcanic cones at Painted Peak and elsewhere still retain their constructional shape with only minor modification by stream erosion. On eastern Revillagigedo Island, unconsolidated pumice, lapilli, and ash deposits locally cover portions of glaciated ridge tops, indicating postglacial eruption; and (2) flows locally show glacial striae and grooves, indicating pre-glacial eruption. A Tertiary eruptive age also is supported by a radiometrically (K-Ar)-dated 4.9 m.y. lava flow northwest of Rudyerd Island

GRAVINA, ANNETTE, MARY, DUKE ISLANDS AREA

Kq METAMORPHOSED QUARTZ DIORITE (Cretaceous) - Brownish gray medium-grained foliated quartz diorite containing albite, quartz, and subordinate muscovite, chlorite, epidote-clinozoisite, calcite, sphene, apatite, and pyrite. Intrudes Jurassic or Cretaceous phyllite that near contact of pluton is thermally metamorphosed to andalusite-bearing hornfels and schist. 87 ± 3 m.y. potassium-argon date on muscovite from Spire Island (Berg, 1972) indicates that pluton was regionally metamorphosed to [1]greenschist facies in Cretaceous time. Pluton is assigned a Cretaceous emplacement age based on these intrusive and metamorphic relations

GRAVINA ISLAND FORMATION AND RELATED ROCKS (Lower Cretaceous or Upper Jurassic)

KJs Pelitic sedimentary rocks and minor andesitic volcanic and volcaniclastic rocks. Includes unnamed sedimentary rocks on western Gravina Island (Berg, 1973), sedimentary members of the Gravina Island Formation (Berg, 1973) on eastern Gravina Island, and unnamed correlative rocks on Annette Island (Berg, 1972). On NE Gravina Island, the formation is intruded by bodies of Cretaceous or Tertiary diabase, gabbro, and porphyritic diorite too small to show on the map.

On western Gravina Island, unit consists of dark gray thinly interbedded slaty, but otherwise unmetamorphosed, mudstone, siltstone, graywacke, grit, and conglomerate; locally contains Buchia, a fossil clam of Late Jurassic age. On Annette Island and eastern Gravina Island, rocks in unit differ from those on western Gravina Island by showing greater intensity of penetrative deformation and regional metamorphism, by containing gradationally intertonguing andesitic volcanic and volcaniclastic rocks, and by containing poorly preserved fossil belemnoids and pectinid clams probably of Jurassic or Cretaceous age. The intertonguing volcanic rocks are lithically identical to those in the metavolcanic members of the Gravina Island Formation (KJv). The Gravina Island Formation was regionally metamorphosed to greenschist facies probably in Cretaceous time. Metamorphic grade increases from SW to NE. In this report, unit is assigned a stratigraphic range of Jurassic or Cretaceous, based on fossil evidence

KJv Metamorphosed andesitic and basaltic volcanic and volcaniclastic rocks. Minor pelitic metasedimentary rocks. Includes metavolcanic member of Gravina Island Formation (Berg, 1973) and unnamed correlative rocks on Annette Island (Berg, 1972).

Unit consists of locally massive but generally foliated and schistose green metavolcanic rocks derived from andesitic and basaltic tuff and agglomerate. It also contains minor grayish-green and black phyllite and phyllitic siltstone that gradationally intertongue with the metavolcanic rocks. Most abundant rock type is andesitic lithic and crystal-lithic metatuff containing relict cm-or-smaller-sized euhedral phenocrysts of feldspar and dark ferromagnesian minerals. Thin section studies show that phenocrysts are moderately to strongly saussuritized plagioclase, colorless augite, and pale green amphibole; groundmass is fine-grained and microgranular aggregate of relict augite and hornblende, and metamorphic actinolite, chlorite, epidote, albite, quartz, muscovite, prehnite, calcite, and leucoxene. Metamorphic textures and minerals (except prehnite) indicate greenschist facies regional metamorphism that is inferred to be Cretaceous in age, based on radiometrically-dated Cretaceous regional metamorphism elsewhere in the Ketchikan and Prince Rupert quadrangles.

On Annette Island, unit is intruded by probably Cretaceous quartz diorite (Kq), and by probably Jurassic or Cretaceous diorite and quartz diorite (KJd).

Volcanic rocks of Gravina Island Formation intertongue with sedimentary members containing fossils of Jurassic or Cretaceous age. Based on these fossils, unit is assigned a stratigraphic age of Jurassic or Cretaceous

KJd Metamorphosed diorite and quartz diorite. Moderately to strongly foliated elongate stock that apparently is zoned from hypidiomorphic granular core to porphyritic margin. Core typically contains approximately equal parts of relict plagioclase and ferromagnesian crystals, up to about 10% quartz, and accessory sphene, apatite and pyrite. Margin contains up to cm-long relict plagioclase phenocrysts as individual crystals and in clumps; amphibole(?) pseudomorphs of hornblende or pyroxene; and up to about 10% interstitial quartz, pyrite, and metamorphic minerals. Pluton is regionally metamorphosed to greenschist facies: plagioclase is converted almost entirely to very fine-grained albite, epidote-clinozoisite, and sericite, and the ferromagnesian minerals to actinolite, chlorite, and epidote.

Pluton intrudes metasedimentary parts of KJv country rocks with sharp, locally migmatitic contacts. Its contact with metavolcanic part, however, apparently is gradational, suggesting that the pluton and metavolcanic rocks are cogenetic (Berg, 1972). Based on these relations, pluton is assigned a Jurassic or Cretaceous age

KJum Ultramafic and related mafic rocks. Areas of ultramafic rocks on Duke and Percy Islands are shown by stipple pattern on map. Unit includes dunite and peridotite, clinopyroxenite and hornblendite, and gabbro that probably is genetically related to the ultramafic rocks. Dunite and peridotite locally are intensely serpentinized, especially near fault zones. The dunite and peridotite contain minor amounts of chromite; the clinopyroxenite locally contains accumulations of titaniferous magnetite. The ultramafic bodies on Duke and Percy Islands have been prospected for iron and chromite.

Body on Duke Island (Irvine, 1974) is an outstanding example of a concentrically-zoned ultramafic complex and shows remarkable cumulate features. The complex has a core of dunite and peridotite and a margin of clinopyroxenite and hornblendite. The olivine-bearing units locally show rhythmic layering and other sedimentation structures. The ultramafic rocks intrude the enclosing gabbro. In places near the ultramafic contact, the gabbro is metamorphosed to amphibolite and is intruded by dikes of coarse hornblende-plagioclase pegmatite.

On Duke Island, the ultramafic and gabbroic rocks intrude metamorphosed volcanic and sedimentary rocks (MzPzu), but contact relations with granitic country rocks (MzPzi) are ambiguous (Irvine, 1974, p. 13). On Percy, Cat, and Mary Islands, ultramafic and related rocks are mainly in fault contact with adjacent map units.

The ultramafic rocks are assigned a Cretaceous age based on K-Ar ages ranging from 106 to 112 m.y. measured on hornblende from three samples of hornblendite and hornblende pegmatite from the Duke Island body (M. A. Lanphere, personal commun., 1977). A K-Ar age of 177 m.y. for biotite from gabbro collected from Pond Bay suggests that at least some of the gabbro is Jurassic or older (Irvine, 1974, p. 13). In this report the unit is assigned a Jurassic or Cretaceous age

Ʀv CHAPIN PEAK FORMATION (Upper Triassic) - Basaltic and minor andesitic pillow flows and breccia, and subordinate calcareous tuff and tuffaceous limestone (Berg, 1973). Lenses and thin beds of slate, siltstone, graywacke, limestone, and calcareous grit and conglomerate are locally interbedded with the volcanic rocks. Thickness of formation ranges from about 150 m to 500 m. Most of the sedimentary and less massive volcanic rocks have distinct slaty cleavage. Formation disconformably overlies Ʀsv; unconformably overlain by KJs. Sedimentary members of formation locally contain moderately well preserved marine fossils of Late Triassic age

Ʀsv SEDIMENTARY AND VOLCANIC ROCKS (Upper Triassic) - Includes Nehenta Formation on Gravina Island (Berg, 1973) and unnamed correlative rocks on Annette Island (Berg, 1972).

Nehenta Formation is divided into 3 intertonguing members: (1) carbonaceous limestone and siltstone that grades upward into calcareous conglomerate, grit, and sandstone; (2) coarse conglomerate and grit mainly in lower part of formation; and (3) basaltic pillow flows and tuff that also occur mainly in lower part of formation. Correlative rocks on Annette Island are too metamorphosed to subdivide. The sedimentary members of unit locally contain moderately well preserved marine fossils of Late Triassic age. Unit unconformably overlies Paleozoic rocks, and is disconformably overlain by the Upper Triassic Chapin Peak Formation. Rocks of unit are complexly folded and faulted. On Gravina Island, they locally are slaty or phyllitic. On Annette Island, they commonly are recrystallized to phyllite and fine-grained schist having texture and mineralogy that indicate greenschist facies regional metamorphism

MzPzi UNDIVIDED METAMORPHOSED INTRUSIVE ROCKS (Mesozoic or Paleozoic) - On Duke Island, unit consists mainly of foliated quartz diorite and granodiorite, and minor dikes of massive to locally sheared quartz monzonite, granite, and pegmatite (Irvine, 1974). Irvine (p. 16-17) interprets the foliation in these rocks to be mainly primary flow foliation; our field studies indicate that at least some of these rocks are metamorphic gneisses. On Cat and Mary Islands, unit is foliated quartz diorite and granodiorite and, mainly on Mary Island, schistose cataclastic trondhjemite. On Metlakatla Peninsula of Annette Island, unit includes south Metlakatla and central Metlakatla plutons (Berg, 1972). South Metlakatla pluton is mainly foliated to gneissic hornblende-biotite quartz diorite and diorite; central Metlakatla pluton is foliated leucocratic quartz diorite or trondhjemite. On southern Gravina Island unit is foliated and gneissic diorite (Berg, 1973).

Rocks contain various combinations of [1]plagioclase (andesine/oligoclase), quartz, hornblende, biotite, muscovite, and garnet. Metamorphic textures and mineralogy indicate regional metamorphism ranging from epidote-amphibolite to amphibolite grade. At least some retrograde minerals are nearly always present in the higher grade rocks, and include actinolite, albite, epidote/clinozoisite, chlorite, sericite, and prehnite. Some of the rocks show evidence of more than one episode of deformation and metamorphism (Berg, 1972). Preliminary petrographic and radiometric studies have not shown any uniform metamorphic gradient, nor has it been possible to determine the ages of the metamorphism(s) or the emplacement ages of the plutons. K-Ar determinations on biotite and hornblende from the stocks on Metlakatla Peninsula give apparent metamorphic ages ranging from about 182 m.y. to 306 m.y. (J. C. Von Essen, written commun., 1972). A K-Ar determination on biotite from quartz diorite on northern Duke Island gave an apparent age of about 315 m.y. (M. A. Lanphere, personal commun., 1977). In this report this complex unit is assigned an age of Mesozoic or Paleozoic

MzPzu UNDIVIDED METAMORPHOSED ROCKS (Mesozoic or Paleozoic) - On southern Gravina Island, unit includes amphibolite facies gneiss and schist derived from interbedded mafic and quartzofeldspathic rocks, at least some of which were igneous (Berg, 1973). On Metlakatla Peninsula on Annette Island, unit is mainly hornfels and greenschist-to-amphibolite-grade phyllite, schist and gneiss derived from an unknown thickness of interbedded sodic and calcalkaline volcanic, volcaniclastic, and pelitic rocks. Metavolcanic rocks are characterized by relict feldspar and less common ferromagnesian phenocrysts, and by relict amygdules and fragmental textures. Metamorphic grade decreases northward, apparently as a result of increasing distance from the south Metlakatla pluton. (Berg, 1972). On Hemlock Island and on the peninsula south of Sylburn Harbor (Annette Island), unit consists of outcrop areas too small to distinguish on the map of the following rock units: Pzsv, Pzap, Pzv, Ʀsv, Ʀv. On Duke Island (Irvine, 1974) unit includes greenschist to amphibolite grade schist and gneiss derived from mafic volcanic and volcaniclastic rocks with interbedded graywacke and tuffaceous sedimentary rocks. Metamorphic grade apparently increases from greenschist facies on NW Duke Island to amphibolite (or possibly hornblende-hornfels) facies on southeast shore. On Mary Island, unit is mainly hornfels and greenschist-to-epidote-amphibolite grade phyllite and schist (including minor [2]"feather schist") derived at least partly from interbedded tuff and agglomerate, and (volcanic) graywacke, siltstone, and mudstone. Some of the beds contain relict cm-sized feldspar and ferromagnesian phenocrysts and some show relict fragmental textures.

With few exceptions, the absolute ages of metamorphism, number of metamorphic events, patterns of regional and thermal metamorphism, and premetamorphic ages and stratigraphic correlation of the protoliths in this complex unit are unknown or speculative. The following four examples illustrate what presently (1977) is known about its metamorphic history and stratigraphic correlation: (1) petrographic studies of samples from Metalkatla Peninsula indicate that at least some of the rocks have undergone more than one episode of metamorphism (Berg, 1972), but the ages of the episodes have not been determined; (2) stratigraphic and preliminary radiometric studies of the unit on southern Gravina Island indicate 2 metamorphic events: a Cretaceous event, inferred from a K-Ar determination on biotite of about 79 m.y. (J. C. Von Essen, written commun., 1970); and a Late Triassic or older event, inferred from the occurrence of amphibolite clasts in unmetamorphosed conglomerate in the upper Triassic Chapin Peak Formation (Berg, 1973); (3) Irvine (1974) attributes at least the high grade metamorphism of the bedded rocks on southeastern Duke Island to the intrusion of (Jurassic?) gabbro (KJum); and (4) low-grade metamorphosed sedimentary and tuffaceous rocks on northwestern Duke Island closely resemble fossiliferous Devonian and Silurian rocks on Werlick and Hotspur Islands (DSsv).

The complex and apparently disjunct relations of this map unit suggest that the different outcrop areas may be tectonically juxtaposed fragments of fundamentally different geologic terranes having dissimilar origins and histories (Berg, Jones, and Richter, 1972)

DSsv RECRYSTALLIZED SEDIMENTARY AND MINOR VOLCANIC ROCKS (Lower Devonian and Upper Silurian) - Gravina Island (Berg, 1973): calcite and dolomite marble and minor metachert and conglomerate; felsic and intermediate or mafic metatuff. Annette Island (Berg, 1972): massive dolomitic limestone and marble. Phyllite and semischist derived from: feldspathic to arkosic siltstone, sandstone, and conglomerate; calcarenite and limestone breccia; tuffaceous silty to sandy dolomite; felsic tuff. Hotspur and Harris Islands: slate and phyllite derived from calcareous siltstone and feldspathic sandstone, limestone, limestone-clast conglomerate, and concretion-bearing dolomite. Degree of deformation and metamorphism is variable: rocks assigned to this unit on Gravina, Hotspur, and Harris Islands are slaty and phyllitic; those on Annette Island are regionally metamorphosed to greenschist facies phyllite, semischist, and fine-grained schist. Limestone and dolomite on Gravina and Annette Island locally contain poorly preserved Devonian and possible Silurian fossils. On Hotspur and Harris Islands fossils are better preserved, and range in age from Late Silurian to mid-Devonian. In this report, unit is assigned an age of Devonian and Silurian. Where it is possible to determine stratigraphic relations, unit conformably overlies Devonian or older rocks, locally with slight structural discordance; tuffaceous rocks assigned to this unit may intertongue with parts of Pzv. In most places, unit is unconformably overlain by upper Triassic sedimentary and volcanic rocks

Pzv FELSIC METAVOLCANIC ROCKS (Devonian or older) - Unit includes Puppets Formation on Gravina Island (Berg, 1973), and unnamed correlative rocks on Annette Island (Berg, 1972). Puppets Formation is divided into two intertonguing members: massive-appearing, thinly layered metarhyolite; and felsic metatuff ranging in composition from latite to rhyolite. The metatuff member occurs in discontinuous layers and lenses, generally at or near the base of the formation. At Driest Point on Annette Island, unit includes rhythmically bedded tuffaceous marble and calcareous metatuff that probably record marine deposition of rhyolitic ash and lapilli. The metarhyolite typically consists of thin layers, interpreted as relict flowbands, of aphanite containing minute relict phenocrysts of quartz and feldspar; variants have conspicuous fragmental and spherulitic textures. The metatuff ranges from massive to schistose fragmental rock that locally contains conspicuous angular clasts of trondhjemite. Degree of deformation and recrystallization varies markedly throughout unit and seems to depend at least as much on susceptibility of original lithologies as on intensity of regional greenschist-facies metamorphism. Chemical analyses show that the composition of the unit also ranges widely, especially in alkali content (H. C. Berg, unpub. data). The cause of this variation is not known. Unit occurs in variety of colors, most typically pink or bright red. The color is caused by abundant disseminated hematite, especially near the base of the unit and in some of the adjacent rocks. Metarhyolite near Nehenta Bay contains veinlets of bright red "jasper". The hematite locally is accompanied by pyrite, chalcopyrite, and other sulfide minerals, partly in disseminated grains and partly in fissure veins with barite, calcite, and quartz. Many of these lodes have been prospected for gold, copper, and other metals since about 1900 (Berg and Cobb, 1967).

In the type area on Gravina Island, the Puppets Formation unconformably overlies Silurian or older Paleozoic rocks and appears to conformably underlie dolomitic limestone of probable Devonian age; elsewhere it unconformably underlies the Triassic Nehenta Formation or its unnamed correlatives. Fossils were not found in this unit. Its stratigraphic position indicates a probable minimum age of Devonian. In this report it is assigned an age of Devonian or older

Pzap TRONDHJEMITE AND RELATED PLUTONIC ROCKS (Silurian or older) - Includes Annette Pluton on Annette Island (Berg, 1972), and unnamed correlative plutonic rocks on Gravina Island (Berg, 1973). On Annette Island forms zoned pluton that grades from core of leucocratic trondhjemite and minor leucocratic granite, quartz monzonite, and granodiorite, to discontinuous border zone of trondhjemite, quartz diorite, and minor diorite. Leucocratic trondhjemite in core typically has medium-grained hypidiomorphic granular to weakly feldspar-porphyritic texture and consists of sodic albite, quartz, and only traces of other minerals, chiefly muscovite and chlorite. The leucocratic granite, quartz monzonite, and granodiorite are identical to the leucotrondhjemite except that they contain significant K-feldspar. Trondhjemite and quartz diorite in border zone contain up to about 15 percent hornblende and biotite, or their alteration products, and a little K-feldspar. Degree of deformation and recrystallization increases from mild cataclasis in core to mylonitic schist, gneiss, and breccia at and near periphery. On Gravina Island, unit consists of trondhjemite similar in mineralogy and texture to that on Annette Island, except that it commonly is pink, owing to impalpable hydrothermal ferric oxide. Unit is assigned an age of Silurian or older based on (probably partly reset) single radiometric (K-Ar) determination of 416 ± 12 m.y. on hornblende from Annette Pluton on Annette Island. Pluton intrudes regionally metamorphosed schist and gneiss without significant thermal effects

Pzsv METAMORPHOSED SEDIMENTARY, VOLCANIC, AND MINOR INTRUSIVE ROCKS (Silurian or older) - On Gravina Island (Berg, 1973), unit forms 2 belts: a southern belt containing phyllite, schist, gneiss, and hornfels derived from interbedded fine-grained clastic, carbonate, and volcanic bedded rocks, and from dioritic intrusive rocks; and a northern belt of less intensely deformed and recrystallized rocks including feldspar and ferromagnesian porphyries, basaltic pillow flows and volcanic breccia, fine-grained metasedimentary rocks, marble, and diorite. Unit locally contains disseminations of hematite and of pyrite and other sulfide minerals. In places the rocks are pink owing to presence of impalpable hydrothermal ferric oxide. Unit also contains numerous fissure veins of quartz, calcite, barite, hematite, and, locally, pyrite, chalcopyrite, and other sulfides. Many of the veins have been prospected for gold, copper, and other metals since about 1900 (Berg and Cobb, 1967). On Annette Island (Berg, 1972) unit consists of phyllite and schist derived mainly from intermediate to mafic volcanic, volcaniclastic, and intrusive rocks, and from subordinate felsic volcanic rocks and interbedded mudstone, siltstone, graywacke, limestone and quartzite. Metamorphic textures and mineralogy indicate regional metamorphism of varying intensity ranging from greenschist to amphibolite facies.

In places, contact metamorphism up to hornblende-hornfels facies postdates the regional metamorphism. Retrograde metamorphism is ubiquitous. The absolute ages of these metamorphisms are uncertain. If some of the thermal metamorphism is related to the intrusion of Upper Triassic plugs (Berg, 1973), then at least some of the regional metamorphism must be pre-late Triassic. Other evidence of pre-Upper Triassic regional metamorphism includes the occurrence of clasts of amphibolite in relatively unmetamorphosed conglomerate in Upper Triassic Chapin Peak Formation (also see unit MzPzu). Fossils have not been found in this unit. It is assigned a pre-metamorphic stratigraphic age of Silurian or older because it is intruded by the radiometrically-dated Silurian or older Annette Pluton (Pzap)

REVILLAGIGEDO ISLAND AND CLEVELAND PENINSULA

Tmgp PORPHYRITIC GRANITE AND QUARTZ MONZONITE (Miocene) - Includes a massive quartz- and feldspar-porphyritic stock 1 km in diameter and a swarm of quartz porphyry dikes in the surrounding country rocks. The stock and the dikes intrude amphibolite (MzPza) and hornblende-biotite quartz diorite (Kq). The granite and quartz monzonite consist of euhedral phenocrysts of K-feldspar (to 1.5 cm) and quartz (to 3 mm) in a fine-grained groundmass of quartz, plagioclase, K-feldspar, and minor biotite. Pyrite is disseminated throughout the pluton and molybdenite occurs locally as thin films coating fracture surfaces. The dikes are mainly aphanite and very fine grained quartz porphyry containing 1/2-3 mm euhedral quartz phenocrysts, and disseminated pyrite in an aphanitic groundmass. Assigned a Miocene emplacement age based on lithologic, textural, and structural correlation with radiometrically-dated Miocene plutons (Tmgp) elsewhere in Ketchikan quadrangle

Tmgd GRANODIORITE (Miocene) - Medium-grained hypidiomorphic-granular biotite-hornblende granodiorite, quartz diorite, and pyroxene gabbro(?); pluton is crudely zoned in that order from NW to SE. Rocks are massive, nonfoliated, with few dark inclusions; fresh except for minor deuteric(?) epidote. Locally cut by dikes of fine-grained leucocratic biotite quartz monzonite. K-Ar determinations on a biotite and hornblende pair from granodiorite at the northern end of the pluton gave respective dates of 22.6 and 24.3 m.y. These concordant dates indicate a Miocene emplacement age

Tmg GABBRO (Miocene) - Massive, nonfoliated leucogabbro (CI=15-20). Preliminary thin-section examination shows medium-grained hypidiomorphic granular aggregate of plagioclase, pyroxene, hornblende, biotite, and, in one sample, scapolite. Rock is fresh. Gabbro may be comagmatic with, but slightly younger than, Tmgd. Gabbro is assigned an age of Miocene based on freshness, absence of foliation and its apparent genetic relation with Tmgd

Klg METAMORPHOSED LEUCOCRATIC GRANODIORITE, APLITE, AND QUARTZ MONZONITE (Cretaceous) - East of Manzanita Lake consists of an elongate (18 x 7 km) pluton of metamorphosed leucocratic granodiorite that locally grades into gneissic biotite granodiorite. This pluton is dominantly medium- to fine-grained, foliated to hypidiomorphic granular, with thin muscovite partings evenly spaced 2 to 10 mm apart. Dark brown, fresh biotite occurs both as discrete flakes and locally as thin parting layers. Color index ranges from 0 to 15, but mainly it is between 0 and 2. Medium-grained aplite (CI=approximately 0) ranges in abundance from sparse patches to more than 70% of some outcrops. Near its margins the pluton contains structurally concordant inclusions of amphibolite to several meters long. Most outcrops are cut by K-feldspar-poor pegmatite dikes that locally contain very coarse muscovite and/or biotite. In some places, these dikes constitute most of an outcrop. North of Manzanita Creek outcrops composed almost entirely of this pegmatite were mapped with this pluton. The pegmatite is probably a metamorphic segregation from the amphibolite unit (MzPza) and equivalent to the trondhjemitic pegmatite and aplite within the amphibolite unit and mapped separately as pegmatite (TKp) on Portland Peninsula. Near Mt. Reid the unit forms 2 stocks of foliated, metamorphosed leucocratic biotite quartz monzonite containing 1-2% of dark red garnet. Biotite (up to 10% of the rock) is the only mafic mineral and forms thin films, layers, streaks, and, locally, clots up to 2 cm in diameter. Pegmatite dikes in the country rocks appear to be spatially and genetically related to the stocks. Between Manzanita Lake and Mt. Reid, unit consists of unmapped aplite dikes and tongues ranging from a few cm to more than 100 m thick that cut paragneiss and amphibolite. The aplite dikes occur in swarms that locally dominate outcrops within this area. Subhorizontal sheets of aplite cap some ridge tops and form prominent bands across nearly vertical cliff walls. The rock ranges from massive to moderately foliated and is characterized by sugary texture, low color index (0 to 5% biotite), and a few small pink garnet euhedra.

Locally, it contains quartz and feldspar phenocrysts. The aplite is cut by abundant K-feldspar-poor pegmatite dikes that locally contain coarse biotite and(or) muscovite, and a trace of garnet. Foliation in the unit increases northward, apparently as a result of decreasing distance from the Cretaceous Coast Range batholith (Kq). In places, intrusive contacts of apophyses of this unit are less penetratively deformed than the enclosing metamorphic country rocks (MzPzp, etc.). These relations suggest that at least some of the unit was emplaced after, or during the waning stages of, the Cretaceous regional metamorphism of the country rocks, and early in the same magmatic-metamorphic event that produced the Coast Range batholith.

Kg METAMORPHOSED BIOTITE-HORNBLENDE GRANODIORITE (Cretaceous) - Map unit also includes minor amounts of quartz diorite. The unit is characterized by nearly ubiquitous apple-green epidote. Textures and compositions range widely depending on original rock type and amount of metamorphic deformation. Relatively massive to semi-schistose textures are common in the interiors of plutons. Along some margins the rocks grade to fine-grained quartzofeldspathic schist (blastomylonite and mylonite schist) containing only barely recognizable relicts of granitic rocks. The unit is most schistose along Revillagigedo Channel, although schistose zones occur elsewhere in the map unit. Based on K-Ar ages of 96.4 ± 3 m.y. (biotite) and 109 ± 3 m.y. (hornblende) from a sample collected 2 km NE of Moth Bay, pluton is assigned a Cretaceous emplacement age

Kpg PORPHYRITIC BIOTITE GRANODIORITE (Cretaceous) - Forms generally equant or elliptical stocks less than 5 km across, and dikes and sills too small to show on the map. Rocks are often slightly crushed and recrystallized by metamorphism, but the plutons are never as strongly metamorphosed as the surrounding country rocks; primary features always predominate. Typical samples contain conspicuous white plagioclase phenocrysts as large as 3 cm that make up from 50 to 60 percent of the rock. The interstitial groundmass consists of fine-grained quartz (8 to 20%), potassium feldspar (1 to 10%), and biotite (5 to 25%). Primary garnet occurs as euhedral crystals as large as 3 mm, commonly in the cores of plagioclase phenocrysts. Garnet rarely makes up more than a percent or two of any sample. Metamorphic minerals include clinozoisite-epidote, white mica, and chlorite. Some plutons appear to be crudely zoned from massive, porphyritic garnet-bearing quartz diorite cores, to foliated to massive, equigranular quartz monzonite and more mafic rocks along the margin. Metamorphic effects are better developed near the margins and it commonly is difficult to distinguish primary from metamorphic features. The unit includes a few small, otherwise unassigned plutons that lack the typical characteristics of this unit but may be extreme compositional variants of it. Compositions include aplite, pegmatite, diorite and quartz diorite. K/Ar determinations on a biotite-hornblende mineral pair yielded 80.3 ± 3 my and 87.4 my, respectively. The mild discordance and the fact that the sample is slightly metamorphosed suggest that the emplacement age is probably older than the apparent ages, but not much older

Kq QUARTZ DIORITE (Cretaceous) - Foliated, lineated, and gneissic hornblende-biotite quartz diorite and minor granodiorite that locally contain conspicuous euhedral crystals of red garnet up to 1 cm in diameter. Pluton also contains abundant ellipsoidal dark inclusions that commonly are parallel to aligned hornblende crystals, imparting a lineation that may be more pronounced than the planar fabric. Locally prominent features include zones of angular agmatite, and dikes and veins of light-gray weathering quartz-feldspar-(biotite-garnet) pegmatite. K-Ar ages in the eastern part of the pluton range from 47 to 52 m.y. for biotite, and from 54 to 77 m.y. for hornblende, and are generally discordant for any particular sample. K-Ar ages in the western part range from 70 to 72 m.y. for biotite, and from 77 to 84 m.y. for hornblende. Ages in any particular sample are concordant or mildly discordant, with the amount of discordance increasing to the east. This pattern of K-Ar ages is interpreted to mean that the pluton was emplaced about 72 to 84 m.y. ago, and that K-Ar mineral ages in the eastern part were partially reset by a younger thermal event

Kum ULTRAMAFIC ROCKS (Cretaceous) - Chiefly rusty-weathering, massive-appearing dark greenish-black pyroxene hornblendite and hornblende clinopyroxenite. Preliminary thin-section studies show coarse xenomorphic aggregate of hornblende and clinopyroxene and accessory sphene, apatite, and opaque minerals; some samples also contain accessory biotite. Clinopyroxene commonly partly altered to pale green hornblende. Deuteric or metamorphic minerals include biotite, chlorite and(or) antigorite, talc(?), actinolite(?), epidote, and calcite. Hornblendite intrudes regionally metamorphosed bedded and granitic rocks at Alava Bay. Contacts of ultramafic rocks mapped elsewhere where on Revillagigedo Island are not exposed. Aeromagnetic characteristics (U.S. Geol. Survey, 1977) suggest that body near Clover Passage may be intrusive; and that bodies east and west of Thorne Arm may be thin, relatively flat-lying thrust sheets or slabs (Griscom, oral commun., 1977). Unit is assigned a Cretaceous age based on discordant K-Ar ages for biotite and hornblende from hornblendite at Alava Bay that indicate a minimum age of 99 m.y. for the hornblendite (M. A. Lanphere, personal commun., 1977)

KJv METAVOLCANIC ROCKS (Cretaceous or Jurassic) - Metamorphosed andesitic tuff, agglomerate, and volcanic siltstone and graywacke; minor semi-pelitic metasedimentary rocks. Chiefly dark green, silvery green, and greenish gray. Unit ranges from thick, massive layers or lenses of coarse blocky breccia, to semischist and thinly laminated and lineated very fissile phyllite. Minerals identified in thin section indicate greenschist facies regional metamorphism and typically include albite(?), quartz, chlorite, epidote, actinolite, calcite, pyrite, and sphene. Much of the unit is distinguished by euhedral relict ferromagnesian phenocrysts (now hornblende or actinolite pseudomorphs) up to 2 cm long. Provisionally assigned a Jurassic or Cretaceous age based on lithologic correlation with fossiliferous Upper Jurassic or Lower Cretaceous volcanic members of the Gravina Island Formation nearby on Gravina Island (Berg, 1973)

Ʀsv METAMORPHOSED SEDIMENTARY AND VOLCANIC ROCKS (Upper? Triassic) - Sedimentary rocks. Locality 4.5 km north of Gem Cove: thinly (average <25 cm) interbedded pyrite-bearing dark gray graphitic phyllite and fine-grained marble containing spheroidal concretions of black argillite to 3 cm diameter. Marble contains very sparse, poorly-preserved impressions of fossil clams tentatively identified as Upper(?) Triassic halobiid bivalves (N. J. Silberling, written commun., 4/28/77). Fossil occurrence consists of a few square meters of outcrop(?) in intertidal zone. Unit is probably in thrust fault contact with overlying upper Paleozoic crinoidal marble (Pzm). Locality at Coon Cove (too small to show on geologic map): dark gray and dark brown phyllite, phyllitic siltstone, and silty limestone containing very sparse and obscure markings suggestive of ribbing of Halobia (N. J. Silberling, written commun., 4/28/77), an Upper Triassic fossil clam. Contact with nearby upper Paleozoic strata (Pzm) not exposed.

Volcanic rocks. Dark green recrystallized basaltic pillow flows and tuff. Pillows moderately to strongly deformed; largest are 1 m long. Preliminary thin section study of pillows shows fine-grained aggregate of actinolite, quartz, plagioclase, epidote, chlorite, biotite, calcite, apatite, sphene, and pyroxene. Some of the calcite occurs in pinhead-sized relict amygdules. North of Gem Cove volcanic rocks adjoin fossiliferous Upper Triassic and upper Paleozoic strata. Assigned to Upper Triassic based on lithologic correlation with fossiliferous Upper Triassic pillow flows nearby on Annette and Gravina Islands (Berg, 1972 and 1973), and elsewhere in southeastern Alaska (Muffler, 1967; Brew and others, 1966)

MzPzs METASEDIMENTARY ROCKS (Mesozoic or upper Paleozoic) - Areas of hornfels are stippled on map. Dark gray and silvery-gray phyllite, and fine-grained semischist and schist, and subordinate layers of green phyllite and schist. Probably derived from interbedded pelitic sedimentary rocks, and from subordinate andesitic and basaltic volcanic or volcaniclastic rocks. Prevailing rock type is dark gray fine-grained schist containing quartz, feldspar, biotite, garnet, muscovite, and pyrite; and minor graphite, hornblende or actinolite, and chlorite. The micaceous minerals commonly have 2 habits: as platy crystals aligned parallel to schistosity, and as idioblasts (or chlorite pseudomorphs) up to 1/2 cm long that intersect the foliation at all angles. Preliminary examination of thin sections of green layers shows fine-grained schist containing hornblende, subordinate quartz or plagioclase and minor to trace amounts of biotite, pyrite, garnet, and epidote/clinozoisite. In some samples hornblende metacrysts to 1 cm long crosscut the foliation. Map unit also contains minor "feather schist", fine-grained quartz-muscovite schist possibly derived from quartzite or chert; and phyllitic polymictic grit and conglomerate that in places contain relict clasts of leucocratic plutonic rocks. Locally conspicuous layers to 2-3 m thick of rusty-weathering schist contain quartz, plagioclase, calcite, biotite, muscovite, garnet, epidote/clinozoisite, chlorite and pyrite. These may be relict beds of calcareous felsic or intermediate metatuff. Locally this schist carries abundant pyrite and minor chalcopyrite, and has been prospected for copper, gold, and other metals. Unit is intruded by dikes and sills of massive to schistose, locally garnet-bearing and feldspar-porphyritic aphanite, aplite, and fine-grained granodiorite; by radiometrically-dated Tertiary (Tmgd, Tmg) and Cretaceous (Kpg, Kg) stocks; and by metamorphosed mafic plutons (MzPzd). Metamorphic minerals and textures indicate greenschist and epidote-amphibolite facies regional metamorphism. Regional metamorphic grade of unit increases from southwest to northeast, where it passes transitionally into amphibolite facies paragneiss (MzPzp) that radiometric dating indicates was regionally metamorphosed in Cretaceous time. Contact aureoles near Tertiary and Cretaceous plutons locally contain metacrysts of garnet, staurolite, sillimanite, cordierite, andalusite, biotite, muscovite, and actinolite that overprint the regional metamorphic fabric. Unit grades lithically into MzPzv by increase in green phyllite and semischist. Locally it is identical in protolith with lower grade metamorphosed sedimentary and minor volcanic rocks of Jurassic or Cretaceous age (KJs) on Annette and Gravina Islands. Nearest fossiliferous strata on Revillagigedo Island are apparently structurally underlying upper Paleozoic marble (Pzm) and Upper Triassic rocks (Ʀsv). These relations are inconclusive, but suggest a maximum stratigraphic range for the unit of upper Paleozoic to Mesozoic

MzPzc METAMORPHOSED ROUNDSTONE CONGLOMERATE (Mesozoic or upper Paleozoic) - Characterized by prominent spheroidal to ellipsoidal relict clasts as much as 20 cm in diameter of fine- to coarse-grained leucocratic plutonic rocks. Other relict clasts are strongly flattened, and are mainly phyllite and semischist derived from fine-grained sedimentary and possibly volcanic rocks. Preliminary thin section studies show that the matrix is fine-grained schist containing quartz, plagioclase, biotite, epidote/clinozoisite, garnet, calcite, muscovite, and pyrite. Some of the biotite and garnet crystals are partly altered to chlorite. Some chlorite pseudomorphs (of biotite?) are perpendicular to foliation. Thin sections of representative plutonic clasts show fine- to medium-grained (relict) xenomorphic, granoblastic, and interlocking mosaics of quartz and plagioclase, and minor biotite, muscovite, epidote/clinozoisite, calcite, chlorite, and garnet. Chemical analyses combined with the petrographic data suggest that these clasts probably are metamorphosed trondhjemite. The metaconglomerate occurs in layers up to 2 m thick. Unit also contains thin layers of gray phyllite and semischist containing relatively sparse pebbles of leucocratic plutonic rocks. Unit grades structurally upward into gray phyllite containing diminishing numbers of granitic clasts; grades downward into intercalated green and gray phyllite and semischist. At Gnat Cove, structurally lowermost part of unit contains a few lenses of brown-weathering marble. A radiometric date of 84.3 ± 3 m.y. on metamorphic biotite from metaconglomerate in Thorne Arm indicates that unit was regionally metamorphosed to greenschist and epidote-amphibolite facies in Cretaceous time. The premetamorphic age and correlation of unit are not known. Nearest fossiliferous strata are apparently structurally underlying Paleozoic marble (Pzm) in Carroll Inlet and Thorne Arm. In both areas, however, unfossiliferous metavolcanics, some of which closely resemble recrystallized pillow flows and tuff assigned to Ʀsv, crop out between the marble and the metaconglomerate. These relations are inconclusive, but suggest a maximum stratigraphic range for the metaconglomerate of upper Paleozoic to upper Mesozoic. In this report, the unit is assigned an age of Mesozoic or late Paleozoic

MzPzv METAVOLCANIC ROCKS (Mesozoic or upper Paleozoic) - Dark green, silvery green, and greenish gray phyllite, semischist, and schist; minor marble and gray phyllite and semischist. Locally well-preserved pillow structures and related volcanic-fragmental textures. On southern Cleveland Peninsula, unit mainly comprises massive coarse blocky volcanic breccia containing euhedral relict ferromagnesian phenocrysts up to 2 cm long. Unit probably derived from marine andesitic to basaltic volcanic and volcaniclastic rocks and subordinate interbedded pelitic sedimentary rocks. Map unit also contains minor "feather schist", and fine-grained quartz-muscovite schist possibly derived from quartzite or chert. Preliminary thin section studies show that unit is mainly fine-grained schist containing varying amounts of blue-green hornblende and actinolite, albite, chlorite, quartz, plagioclase, epidote, and pyrite. The amphibole crystals occur both parallel to schistosity and as poikiloblastic euhedra up to 1 cm long that intersect the foliation at all angles.

The gray phyllite members are lithically identical to the prevailing rock type described in unit MzPzs. Unit is intruded by dikes and sills of massive to schistose, locally garnet-bearing and feldspar-porphyritic aphanite, aplite, and fine-grained granodiorite, by stocks of radiometrically-dated Cretaceous granodiorite (Kpg, Kg), and by metamorphosed mafic plutons (MzPzd). Metamorphic minerals and textures indicate greenschist and epidote-amphibolite facies regional metamorphism. Regional metamorphic grade of unit increases northeastward, where unit passes into amphibolite-facies paragneiss (MzPzp) and amphibolite (MzPza) that K-Ar dating shows were regionally metamorphosed in Late Cretaceous time. Contact aureoles near Cretaceous plutons (Kpg) locally contain metacrysts of garnet, biotite, and actinolite that overprint the regional metamorphic fabric. Unit grades lithically into MzPzs by increase in gray phyllite and semischist. Locally it is identical in protolith with lower grade metamorphosed volcanic and minor sedimentary rocks of Jurassic or Cretaceous age (KJv), and of Late Triassic age (Ʀv, Ʀsv) on Annette, Gravina, and Revillagigedo Islands. Nearest fossiliferous strata on Revillagigedo Island are apparently structurally underlying upper Paleozoic marble (Pzm). These relations are inconclusive, but suggest a maximum stratigraphic range for the unit of upper Paleozoic to Mesozoic

MzPzm MARBLE (Mesozoic or upper Paleozoic) - Tan-weathering, sugary, white calcite and dolomite marble, intercalated with subordinate green metavolcanic and gray metasedimentary phyllites and schists. Only occurrence of this unit large enough to show on map is in approximately 50-m wide zone near Caamano Point. This occurrence is about 2 km from a zone of marble too small to show on the map that is host to stibnite-bearing veins (Sainsbury, 1957). Unfossiliferous. Assigned a Mesozoic or late Paleozoic age because it is intercalated with unit MzPzv

MzPzp PARAGNEISS (Mesozoic or upper Paleozoic) - Mainly rusty-weathering amphibolite-facies crystalline gneiss and schist consisting of alternate layers 1 cm to 2 m thick of pelitic and quartzofeldspathic rocks. Unit also contains subordinate dark gray gneiss, dark green amphibolite, and minor marble. Commonly contains numerous quartz veins and lenses to a meter or so thick parallel to gneissic layering. Preliminary thin section studies of pelitic paragneiss show strongly schistose, granoblastic, and idioblastic textures. Typical specimens contain quartz, plagioclase, biotite, garnet and muscovite; accessory clinopyroxene, calcite, sphene, apatite, and pyrite; and retrograde chlorite, epidote and sericite. Sillimanite occurs mainly in a km-wide zone adjacent to Coast Range quartz diorite (Kq); kyanite and staurolite occur in a zone at least 2 km wide beyond the sillimanite zone. The quartzofeldspathic component of the paragneiss is distinguished by stronger granoblastic fabric than the pelitic component, and by greater abundance of quartz and plagioclase. The dark gray gneiss is similar in mineralogy and fabric to the rusty-weathering pelitic gneiss, but is distinguished by greater abundance of hornblende. The amphibolite gneiss members are distinguished by contrasting alternating layers of dark greenish black hornblende-biotite-quartz-plagioclase schist and light-gray quartz-plagioclase schist. Unit is characterized by ubiquitous veins and dikes to several meters thick of leucocratic quartz-plagioclase-biotite-garnet pegmatite and aplite. Locally, these rocks form swarms of randomly oriented dikes that make up as much as half of the outcrop. Paragneiss is also intruded by K-Ar-dated Cretaceous quartz diorite (Kq), by stocks of granodiorite (Kpg) and leucocratic granodiorite and aplite (Klg), and by metamorphosed mafic plutons (MzPzd). K-Ar dating shows that the paragneiss was regionally metamorphosed to amphibolite facies in Cretaceous time. Unit grades into MzPza by increase in hornblende-rich schist and gneiss, and into MzPzs and MzPzv by decrease in regional metamorphic grade. The premetamorphic age and stratigraphic correlation of the paragneiss protolith probably are the same as those of lower grade metamorphic units (MzPzs, MzPzv) with which it correlates to the southwest on Revillagigedo Island and Cleveland Peninsula. The paragneiss unit thus is assigned a premetamorphic age of Mesozoic or late Paleozoic

MzPza AMPHIBOLITE (Mesozoic or upper Paleozoic) - Mainly dark green and dark gray amphibolite-grade crystalline schist and gneiss consisting of alternating layers a few cm to a few m thick of mafic and subordinate quartzofeldspathic rocks. Unit also contains sparse layers of marble and rusty-weathering pelitic gneiss. Preliminary petrographic studies of the amphibolite show strongly schistose and idioblastic textures. Typical specimens contain hornblende, biotite, quartz, and plagioclase; accessory sphene, apatite, K-feldspar, and pyrite; and retrograde chlorite and epidote. The quartzofeldspathic component is distinguished by granoblastic fabric and by greater abundance of quartz and plagioclase. The mineralogy and fabric of the pelitic gneiss component is identical to those of the pelitic paragneiss in unit MzPzp. The amphibolite is characterized by ubiquitous veins and dikes to several m thick of leucocratic quartz-plagioclase-biotite-garnet pegmatite and aplite that contrast strikingly with dark hues of enclosing amphibolite. Locally, the leucocratic rocks form spectacular swarms of randomly-oriented dikes that make up as much as half of the outcrop. The amphibolite also is intruded by K-Ar-dated quartz diorite (Kq), by granodiorite (Kpg), by leucocratic granodiorite and aplite (Klg), and by metamorphosed mafic plutons (MzPzd). K-Ar dating also shows that the unit was regionally metamorphosed to amphibolite facies in Late Cretaceous time. The amphibolite unit grades into MzPzp by increase in rusty-weathering pelitic schist and gneiss, and into MzPzv (and MzPzs) by decrease in regional metamorphic grade. The premetamorphic age and stratigraphic correlation of the amphibolite protolith probably are the same as those of the lower grade metamorphic units (MzPzv and MzPzs) with which it correlates to the southwest on Revillagigedo Island and Cleveland Peninsula. The amphibolite thus is assigned a premetamorphic age of Mesozoic or Late Paleozoic

MzPzd METAMORPHOSED DIORITE, QUARTZ DIORITE, AND GABBRO (Mesozoic or upper Paleozoic) - Body at Smugglers Cove consists of dark greenish gray hypidiomorphic granular to ferromagnesian-porphyritic diorite containing hornblende(?), plagioclase, and metamorphic epidote, chlorite, and calcite. Porphyritic phase closely resembles some of the enclosing metavolcanic rocks (MzPzv). West of Port Stewart, consists of massive to foliated hornblende-biotite diorite, quartz, diorite, and gabbro. Coincides with aeromagnetic anomaly (U.S. Geol. Survey, 1977). May be structurally detached fragment of Cretaceous ultramafic body at Union Bay (Ruckmick and Noble, 1959; Lanphere and Eberlein, 1966). North of Coon Cove, consists of fine-grained diorite(?) containing quartz, plagioclase and biotite, and metamorphic actinolite, chlorite, and epidote. Southwest of Lake Grace consists mainly of massive-appearing dark greenish gray coarse schist containing equant clumps up to 2 cm in diameter of hornblende, and interstitial hornblende-biotite-plagioclase-quartz schist. Bodies south of Neets Bay and north of Emma Lake consist mainly of massive amphibolite containing hornblende, plagioclase, and variable minor amounts of biotite, garnet, pyrite, pyroxene, and quartz. Outcrops of relatively unmetamorphosed hornblende-plagioclase diorite and gabbro locally occur with the amphibolite. Field relations suggest that the plutonic rocks grade into the amphibolite by increase in metamorphism. Body near mouth of Carroll Creek consists of relatively massive metadiorite(?) and fine-grained hornblende-plagioclase schist possibly derived from it. Plutons assigned to this unit probably were regionally metamorphosed in Cretaceous time, along with the enclosing country rocks (see descriptions of MzPzv, MzPzp, etc.). Except for body west of Port Stewart that may correlate with Cretaceous ultramafic at Union Bay, premetamorphic ages of rest of plutons assigned to this unit are unknown. In this report they are assigned a premetamorphic age of Mesozoic or (late) Paleozoic, along with the enclosing country rocks

MzPzu UNDIVIDED METAMORPHIC ROCKS (Mesozoic or upper Paleozoic) - Chiefly phyllite, semischist, and schist derived from diverse sedimentary, volcanic, and intrusive rocks. Because the unit is so heterogeneous, each map area and its principal lithologies are listed separately. Rock types are listed in approximate order of decreasing abundance.

Point Alava area: muscovite-calcite (or dolomite) schist; phyllitic siltstone, mudstone, graywacke; massive blastomylonitic granodiorite (rock type is described under unit Kg); phyllitic to schistose intermediate/mafic volcanic or volcaniclastic rocks; "feather schist"; marble; clinopyroxenite.

Coastal area southeast of Carroll Point to Moth Bay: blastomylonitic granodiorite (described under Kg); phyllitic siltstone, mudstone, graywacke; phyllitic to schistose intermediate/mafic volcanic or volcaniclastic rocks; "feather schist"; granitic-clast metaconglomerate.

Bold and Round Islands: phyllitic siltstone, graywacke, and grit; laminated andesitic(?) metatuff; cataclastic graywacke semischist; cataclastic (blastomylonitic) granodiorite (described under Kg); granitic-clast metaconglomerate

Eve Point area (Thorne Arm): rusty-weathering schistose calcareous metatuff(?); phyllitic to schistose siltstone, mudstone, graywacke, and intermediate/mafic volcanic or volcaniclastic rocks; massive to schistose, locally garnet-bearing and feldspar-porphyritic aphanite, aplite, and granodiorite sills and dikes; hornblendite and pyroxenite.

K-Ar determinations indicate that rocks assigned to this unit were regionally metamorphosed to greenschist and epidote-amphibolite facies in Late Cretaceous time. K-Ar studies also show that they were intruded by granodiorite plutons (Kg, Kpg) during the same period. The premetamorphic age and stratigraphic correlation of originally sedimentary and volcanic components of this complex assemblage are speculative. However, we infer a maximum range of Mesozoic to late Paleozoic, based on lithologic correlation of most rock types in this unit with identical rocks in other Mesozoic or upper Paleozoic units mapped elsewhere on Revillagigedo Island and Cleveland Peninsula

Pzm MARBLE (Upper Paleozoic) - Light brown-weathering, massive to laminated light gray and bluish gray marble locally containing sparse, poorly preserved crinoid columnals and possible fusulinids (R. C. Douglas, written commun., 11/2/73). Commonly contains laminae and thin layers of dark green and dark gray pyritic phyllite and semischist. The marble consists typically of sugary- to coarsely granoblastic-textured calcite or dolomite, and minor quartz, muscovite, graphite, and pyrite. Near contacts of some plutons, the marble also contains wollastonite, diopside, and garnet. Unit is assigned an age of late Paleozoic based on correlation with well-dated crinoidal and fusulinacean strata elsewhere in southeast Alaska (see, for example, Muffler, 1967, p. C19-C26)

PORTLAND PENINSULA

COAST RANGE COMPLEX

Tmg Augite-hypersthene gabbro (Miocene). Forms 10 km^2 roughly circular stock that intrudes paragneiss and granodiorite of Coast Range complex about 10 km SSE of Punchbowl Cove (Berg and others, 1977). A K-Ar date determination on accessory biotite indicates an emplacement age of 23.2 ± 0.9 m.y.

Tmgp Biotite granite, granite porphyry, and minor quartz monzonite (Miocene). Between heads of Boca de Quadra and Wilson Arm forms two roughly oval composite stocks and suite of related quartz and feldspar-porphyritic dikes that intrude paragneiss and foliated and gneissic granodiorite of Coast Range complex (Elliott, Smith, and Hudson, 1976). The stocks are 5 and 2 km in outcrop diameter. A potentially major porphyry molybdenum deposit (Quartz Hill) is in the smaller northern stock. A K-Ar determination on biotite indicates an emplacement age for the pluton of 26.2 ± 2.5 m.y. At Fitzgibbon Cove consists of light gray medium-grained hypidiomorphic granular biotite quartz monzonite. Locally contains subhedral phenocrysts of plagioclase up to a cm long. Minor secondary chlorite and sericite. Except for minor local milling rock is not deformed

Teq Massive to weakly foliated quartz monzonite and subordinate granodiorite (Eocene). Includes southern part of Hyder Quartz Monzonite (Smith, 1976; Berg and others, 1977) and areas of paragneiss, dikes, and other intrusive rocks too small to map separately. Texture typically is medium-grained hypidiomorphic granular. Outcrops generally are free of inclusions; aplite and pegmatite dikes are common. Average mineral composition is plagioclase (45%), potassium feldspar (23%), quartz (22%), biotite (6%), hornblende (4%), and minor accessory minerals, the most noticeable of which is euhedral golden sphene, as large as 5 mm. Intrudes Tertiary and older plutonic and metamorphic rocks of the Coast Range complex. Contacts with Davis River pluton (Ted) are sharp, the two units being separated by a discontinuous thin septum of amphibolite. Eocene emplacement age is based on concordant hornblende and biotite K-Ar dates of about 50 m.y. for the Hyder Quartz Monzonite

Ted Davis River pluton (Eocene). Porphyritic coarse-grained homogeneous biotite-hornblende granodiorite. Locally, the pluton grades into quartz diorite and quartz monzonite. Euhedral phenocrysts of potassium feldspar as large as 5 cm are a characteristic feature. They rarely constitute more than 5 percent of an outcrop, although they appear more abundant. The texture of the groundmass is hypidiomorphic granular with the mafic minerals interstitial to and finer grained than the felsic minerals. Approximate average composition of the pluton is potassium feldspar (15%), plagioclase (50%), quartz (25%) and mafic minerals (10%). The Davis River pluton intrudes paragneiss (MzPzp), amphibolite (MzPza), foliated granodiorite, foliated quartz monzonite, and schlieren granodiorite (TKgf, TKqf, and TKgs), and is intruded by Hyder Quartz Monzonite. K-Ar determinations on biotite-hornblende pairs from 2 samples gave biotite 43.7 ± 1 m.y., hornblende 52.5 ± 2 m.y. for one pair and biotite 42.4 ± 1 m.y., hornblende 47.2 ± 2 m.y. for the other. Both mineral pairs are discordant and the cause of the discordance is unknown; it may be a result of weak reheating by a post-intrusive thermal event or intrusion of nearby Hyder Quartz Monzonite. The small value of the discordance and the hornblende age of 52.5 ± 2 m.y. suggest an early Tertiary, probably Eocene age of emplacement (Smith, 1976)

TKqf Inhomogeneous to migmatitic foliated leucocratic quartz monzonite (Tertiary or Cretaceous). Unit locally grades into granodiorite, migmatite, and granodiorite and quartz monzonite gneisses. Large changes in texture and composition take place over short distances. Schlieren are common throughout the unit and layers of amphibolite and paragneiss are present in many areas. Foliation is also expressed by layers of different grain size and mafic mineral content. Mafic minerals generally make up less than 10% of the plutonic rock. Fine-grained biotite is much more abundant than hornblende in the southern part of the unit; hornblende is common in the north. The unit intrudes foliated granodiorite (TKgf) and paragneiss (MzPzp) so it is no older than Cretaceous. It is intruded by Davis River pluton (Ted) so it is no younger than mid-Tertiary

TKg Weakly foliated to massive medium-grained hornblende-biotite granodiorite (Tertiary or Cretaceous). Unit locally includes foliated and gneissic granodiorite. Foliation, where present, is expressed by indistinct layers with slightly different total mafic contents and, locally, by sparse schlieren. Mafic minerals generally make up 15 to 25% of this unit. Hornblende is predominant in the southern part of the unit; biotite generally equals, and locally exceeds, hornblende in most of the northern part. Euhedral phenocrysts of potassium feldspar as large as 2 cm are present in many areas, but are rarely abundant. The contact with foliated granodiorite (TKgf) is gradational by increase in foliate and gneissic texture. The unit intrudes paragneiss (MzPzp) and is intruded by foliated quartz monzonite (TKqf). The unit is assigned an age of Tertiary or Cretaceous based on its apparently transitional relation with unit TKgf

TKgs Schlieren granodiorite (Tertiary or Cretaceous). Heterogeneous granodiorite marked by foliated, irregularly banded, gneissoid and migmatitic structures, and by ubiquitous elongate and swirled dark streaks (schlieren). Widely varying amounts of dark inclusions of paragneiss and amphibolite form stretched, twisted, bent, and broken blocks. Inclusions locally blend imperceptibly into indistinct streaks in granodiorite. Unit is intruded by Eocene Hyder Quartz Monzonite and Davis River pluton and is transitional with unit TKgf. It is assigned an age of Tertiary or Cretaceous based on these regional relations (Berg and others, 1977)

TKgf Foliated and gneissic heterogeneous granodiorite (Tertiary or Cretaceous). Unit includes significant amounts of other rock types including quartz monzonite, quartz diorite, various metamorphic rocks, granodiorite and quartz diorite, gneiss, augengneiss, and migmatite. Rapid changes in texture and composition take place over a short distance. Most changes are gradational, and indications of relative age are conflicting. Locally the unit contains euhedral megacrysts of K-feldspar as large as 2.5 cm. Contact relations with other units are complex. In most places the unit intrudes adjacent older rocks, often across a wide zone of sills and dikes. Elsewhere, wide migmatitic transition zones are present and the unit grades imperceptibly into other units. The unit is intruded by Ted, Teq, Tmgp, Tmq, and TKqf. K-Ar determinations on mineral pairs give discordant mid-Tertiary ages. The distribution pattern of the ages indicates they were reset from older ages. Based on the K-Ar data and on regional intrusive and metamorphic relations, the unit is assigned an age of Tertiary or Cretaceous (Berg and others, 1977)

TKq Quartz diorite (Tertiary or Cretaceous). Patterned where gneissic. About 70% of map unit is dark gray foliated to gneissic quartz diorite and subordinate granodiorite; the rest consists of paragneiss, migmatite and other plutonic rocks. Typical quartz diorite is foliated and contains plagioclase (55%), quartz (20%), hornblende (15%), and biotite (10%). Augite and garnet are locally conspicuous accessories. Most samples also contain small amounts of secondary chlorite and epidote-clinozoisite. The granodiorite is distinguished from the quartz diorite by K-feldspar crystals up to 1 cm long, and by marked preponderance of biotite over hornblende. Gneissic parts of the unit locally contain dark schlieren and inclusions aligned parallel to the foliation. Contacts between TKq and adjacent units are gradational. It grades into foliated granodiorite (TKgf) by increase in K-feldspar, and into paragneiss and amphibolite (MzPzp, MzPza) by increase in gneiss layers and inclusions. Based on regional intrusive and metamorphic relations, unit is assigned an age of Tertiary or Cretaceous (Berg and others, 1977)

TKp Coarse-grained to very coarse grained sodic plagioclase(70%) - quartz(25%) pegmatitic plutons (Tertiary or Cretaceous). Contains only minor amounts of potassium feldspar, biotite, hornblende and other accessory minerals. Plagioclase, biotite, and quartz crystals are as large as 10 cm. Unit is always adjacent to amphibolite (MzPza). Alternating layers of coarser and finer grained pegmatite, schlieren, screens of amphibolite and gradational, diked contacts with adjacent units suggest that TKp formed by intrusion of numerous pegmatite dikes into country rock. The unit is no younger than mid-Tertiary based on a K-Ar determination on biotite of 44.5 ± 2 m.y. The regional pattern of K-Ar ages indicates that this age was reset. Regional intrusive and metamorphic relations indicate that the unit is no older than Cretaceous

JƦt Texas Creek Granodiorite (Jurassic or Triassic). Only southernmost part of pluton crops out in Ketchikan quadrangle. Consists mainly of recrystallized, cataclastically deformed granodiorite and minor quartz diorite. Pluton is characterized by euhedral phenocrysts of K-feldspar and hornblende up to 2 cm long. Typically, these phenocrysts are set in a hypidiomorphic granular goundmass of andesine or oligoclase, quartz, K-feldspar, hornblende, and biotite, accessory sphene, and secondary albite, muscovite, epidote-clinozoisite, actinolite, chlorite, and calcite. The Texas Creek Granodiorite intrudes recrystallized Mesozoic volcaniclastic and sedimentary rocks (JƦvs) and in turn is cut by mid-Tertiary quartz monzonite (Teq) (Smith, 1976). It is assigned a Jurassic or Triassic age of emplacement based on hornblende K-Ar ages of 206 and 200 m.y.

JƦvs Metavolcaniclastic and metasedimentary rocks (Jurassic or Triassic). Semischist, schist, and phyllite derived from interbedded andesitic metatuff, siltstone, and shale (argillite). Tightly folded and regionally metamorphosed to albite-epidote facies. Locally contact metamorphosed to hornfels where intruded by JƦt and Teq. Based on lithology and regional distribution, may correlate at least in part with rocks assigned to the Jurassic Hazelton Group nearby in B.C. (Buddington, 1929; Grove, 1971; Smith, 1976). Assigned an age of Jurassic or Triassic in this report

MzPzp Paragneiss (Mesozoic or upper Paleozoic). Mainly rusty-weathering coarsely crystalline pelitic, semi-pelitic, and quartzofeldspathic gneiss and schist. Map unit also includes areas too small to map of migmatite, gneissic plutonic rocks, marble and calcsilicate gneiss, pegmatite, quartzite, amphibolite, and aplite. A single rock type may underlie wide areas or several different rocks types may be interlayered over a short distance, suggesting a fragment of pre-metamorphic stratigraphy. The unit has been complexly folded and recrystallized more than once. More than one set of mesoscopic structures is present at most outcrops. Sillimanite or kyanite is present in rocks of suitable composition throughout much of the unit. All of the rocks are above the garnet isograd. The pelitic gneiss consists of alternating light and dark layers ranging from about 1 cm to 1 m thick. A typical specimen contains plagioclase (50%), quartz (15%), biotite (15%); up to 10% combined K-feldspar, garnet, sillimanite, and muscovite; and up to 10% combined accessory and retrograde minerals. The paragneiss grades lithically into MzPza; it also grades into TKgf, TKgs, and TKq, but is sharply intruded by other plutons of the Coast Range complex. K-Ar measurements show that the paragneiss was regionally metamorphosed to the sillimanite zone of the amphibolite facies in Eocene time. In this report, the paragneiss is assigned a premetamorphic Mesozoic or late Paleozoic age based on assumptions derived from regional geologic studies (Berg and others, 1977). The maximum age of most of the paragneiss protolith is assumed to be late Paleozoic, but locally the unit may include tectonically incorporated rocks at least as old as early Paleozoic (Koch and others, 1977)

MzPza Amphibolite (Mesozoic or upper Paleozoic). Dark colored, prominently layered mafic and intermediate schist and gneiss. Map unit also contains minor amounts of marble, pelitic gneiss, and aplitic to pegmatitic quartz-feldspar-(biotite-garnet) veins and dikes. Individual compositional layers range in thickness from a few mm to a few cm for amphibolite to several hundred meters for marble and for pegmatite dikes. Typical outcrops of amphibolite consist of layered coarse schist and gneiss containing hornblende, plagioclase, biotite, and minor quartz. Accessory minerals include clinopyroxene, garnet, magnetite, sphene, apatite, and pyrite. Retrograde minerals include small amounts of chlorite and epidote. The amphibolite grades laterally into units MzPzp and MzPzu; it is intruded by plutons of the Coast Range complex. K-Ar determinations on biotite-hornblende pairs average about 44 m.y. for biotite and 52 m.y. for hornblende. The regional pattern of discordancy suggests that all the ages were set by a mid-Tertiary (Eocene) thermal-metamorphic event. Unit is assigned a premetamorphic Mesozoic or late Paleozoic age based on assumptions derived from regional geologic studies (Berg and others, 1977)

Kg GRANODIORITE (Cretaceous) - Heterogeneous, massive to weakly foliated medium-grained hornblende-biotite granodiorite. Feldspathized joints, pyrite, sericitized plagioclase and partial recrystallization of mafic minerals to chlorite, epidote, and iron oxides indicate post-intrusive alteration and recrystallization. The pluton intrudes the surrounding metamorphic rocks with a sharp contact. Dikes of granodiorite extend into country rock and the pluton is surrounded by a hornfels contact metamorphic aureole several hundred meters wide. The pluton is assigned a Cretaceous age based on a discordant K-Ar age of 55.9 ± 2 m.y. (biotite) and 77.5 ± 3 m.y. (hornblende) and on its intrusion into, and contact metamorphism of, rocks dynamothermally metamorphosed in the late Mesozoic

Kum ULTRAMAFIC ROCKS (Cretaceous?) - Medium- to very coarse-grained biotite clinopyroxenite and subordinate hornblendite and gabbro. Locally abundant secondary chlorite. Pyroxenite intrudes gabbro, which probably is genetically related to the ultramafic rocks. Outcrops are massive and apparently not foliated. At Humpy Point, ultramafic rocks intrude Cape Fox pluton with sharp contacts and no apparent thermal effects. Unit is provisionally assigned a Cretaceous age based on correlation with radiometrically-dated Cretaceous ultramafic rocks at Duke Island and Alava Bay (Lanphere and Eberlein, 1966)

MzPzm MARBLE (Mesozoic or upper Paleozoic) - Light-brown weathering, massive to thinly laminated white, gray, and bluish-gray marble. Locally contains laminae of dark green and gray phyllite and schist. Marble is sugary to coarse-grained aggregate of calcite or dolomite, with subordinate to minor muscovite, phlogopite, quartz, graphite, garnet, and pyrite. In Very Inlet contains sparse objects doubtfully identified as crinoid columnals. In this report assigned an age of Mesozoic or Paleozoic, but more likely to be (upper) Paleozoic than Mesozoic based on: (1) doubtful crinoids at Very Inlet; and (2) lithologic correlations with upper Paleozoic crinoidal marble nearby on Revillagigedo Island

Pzcp METAMORPHOSED TRONDHJEMITE (Paleozoic or older) - Informally named Cape Fox pluton (Koch and others, 1977). Elongate (9 x 23 km) regionally metamorphosed trondhjemite pluton exposed between Very Inlet and Cape Fox. The body originally crystallized as leucocratic coarse-grained hypidiomorphic granular biotite trondhjemite. Extensive recrystallization has reduced almost all the biotite to chlorite. Most outcrops contain abundant metamorphic epidote. Pervasive fracturing and shearing increases outward from the core of the pluton. Parts of the pluton have been reduced to quartzofeldspathic semischist and schist, especially the northern portion. At least some of this metamorphism probably coincided with the Cretaceous regional metamorphism of the surrounding country rocks (MzPzu). The pluton intrudes unit MzPzu and is intruded by pyroxenite (Kum). It is assigned a premetamorphic age of Paleozoic or older based on correlation with radiometrically-dated trondhjemite stocks of Silurian or greater age on Annette Island (Berg, 1972), and of Precambrian age on Prince of Wales Island (Churkin and Eberlein, 1977)

MzPzu UNDIVIDED METAMORPHIC ROCKS (Mesozoic and Paleozoic or older) - Map unit includes diverse sedimentary, volcanic, and intrusive rocks regionally metamorphosed to greenschist- and epidote-amphibolite-facies schists containing quartz, plagioclase, chlorite, epidote/clinozoisite, biotite, muscovite, actinolite, garnet, kyanite, and calcite. Especially noteworthy rock types include "feather schist", muscovite-quartz schist possibly derived from felsic volcanic or volcaniclastic rocks, quartzite, marble, ultramafic rocks, and sheared intrusive rocks ranging in composition from felsic to intermediate.

The lithology and regional distribution of this unit suggest that at least in part it is a lower grade metamorphic equivalent of paragneiss (MzPzp) and amphibolite (MzPza). Discordant K-Ar ages were determined on biotite-hornblende pairs from two samples. The ages of 52.7 m.y. (biotite) and 75.0 m.y. (hornblende) for one pair, and 67.3 m.y. (biotite) and 84.1 m.y. (hornblende) for the other fit a regional pattern that indicates regional dynamothermal metamorphism in Late Cretaceous time and partial resetting by a mid-Tertiary event. The unit is also intruded by a pluton near Sykes Lake (Kg) that was dated as Late Cretaceous by the potassium-argon method. The premetamorphic ages of the protoliths of this complex metamorphic unit are uncertain. Intrusive relations and regional metamorphism indicate a minimum age of Late Cretaceous. Objects doubtfully identified as upper Paleozoic crinoid columnals occur at Very Inlet in marble layers (MzPzm) intercalated with schist assigned to this unit. At Foggy Bay, the unit tectonically includes unmapped metamorphosed blocks of trondhjemite and its intruded country rocks at least as old as early Paleozoic (Koch and others, 1977). These relations suggest a maximum premetamorphic stratigraphic age range of Paleozoic or older to Cretaceous

[1] Rock nomenclature and classification used in this report follows that of Williams, Turner, and Gilbert (1954) and of Turner and Verhoogen (1960). Unless otherwise noted, mineral assemblages are given in estimated order of decreasing abundance.

[2] In this report, "feather schist" is a term applied to amphibole-muscovite (± garnet) schist containing randomly-oriented individual crystals or bowtie-shaped clumps of hornblende or actinolite crystals much larger than the average size of other crystals in the schist. Most of the amphibole needles are 1 cm to a few cm long; rarely they are as much as a meter long. Term is synonymous with "feather amphibolite" and "Garbenschiefer".

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U.S. GEOLOGICAL SURVEY
OPEN FILE REPORT 78-73-A
FOLIO OF THE KETCHIKAN AND PRINCE RUPERT QUADRANGLES, ALASKA
BERG AND OTHERS--GEOLOGY

SYMBOLS

Contact. Approximately located; dotted where concealed

High-angle fault, showing direction of dip, where known. Dashed where inferred; dotted where concealed

Thrust fault. Dotted where concealed. Sawteeth on upper plate

Metamorphosed thrust fault inferred from stratigraphic and structural relations and from distribution of map units; unrecognized metamorphosed thrust faults probably occur throughout map area northeast of Tongass Narrows-Revillagigedo Channel. Dashed where concealed; queried where assumed. Sawteeth on upper plate

Regional structures inferred from distribution of map units and from attitudes of foliation or schistosity. Showing trend of axial surface and direction of plunge. Approximately located

- Antiform
- Synform
- Overturned synform

Strike and dip of foliation or schistosity

- 27 Inclined
- Vertical
- Horizontal

⑤ K-Ar date locality (see table)

▲ Quaternary or Tertiary volcano, plug, or other eruptive site

K-Ar DATES, KETCHIKAN AND PRINCE RUPERT QUADRANGLES

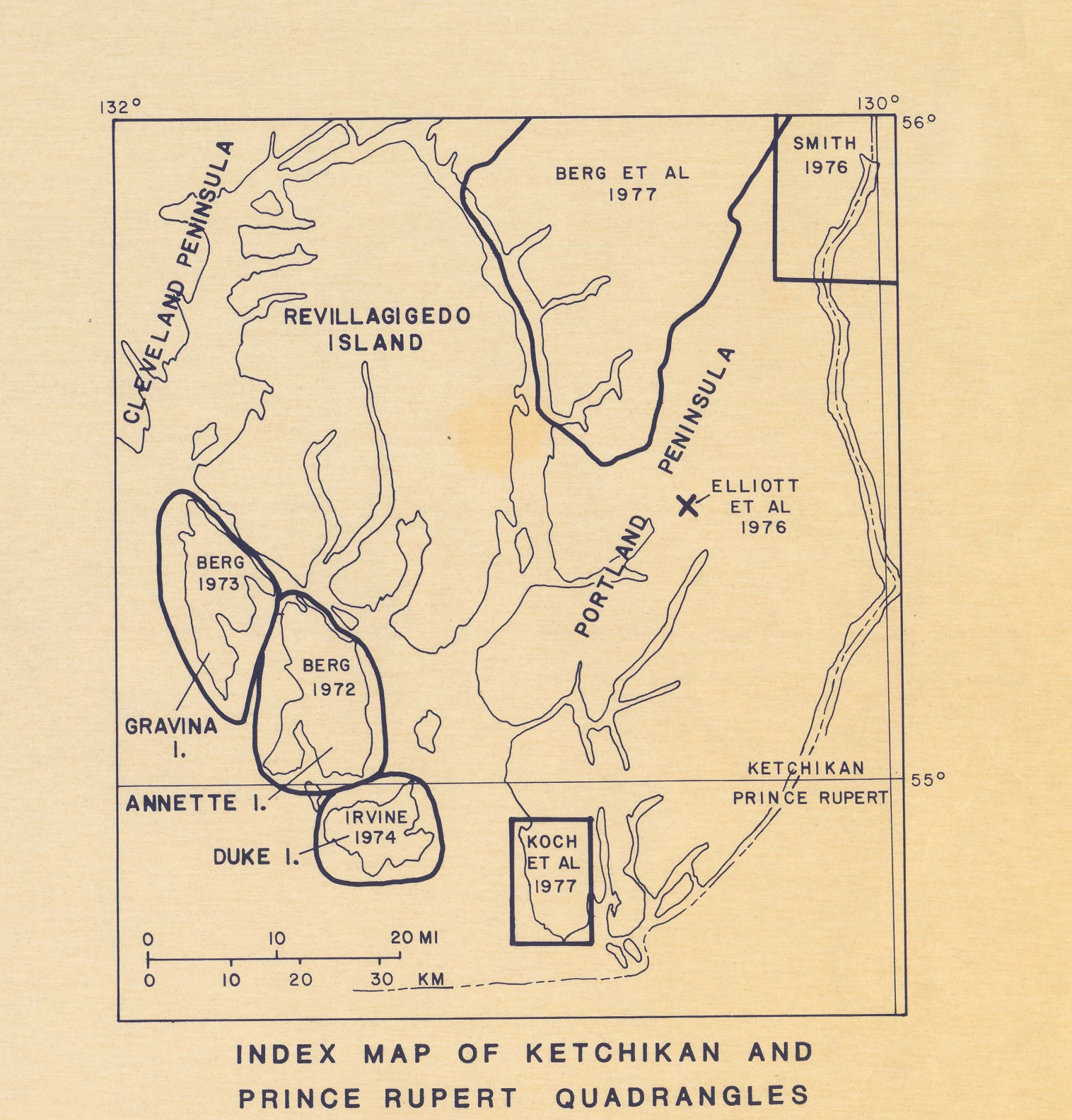
MAP NO.	[1] FIELD STATION NO.	LATITUDE	LONGITUDE	MAP UNIT	AGE (m.y.) MINERAL OR MATERIAL DATED					[4] DATED BY
					Hornblende	Biotite	Muscovite	Plagioclase	Whole rock	
1	75ASJ412	55°58'50"	131°38'40"	Kq	77.5±2	72.2±3				J. G. Smith
2	75ASJ413	55°56'15"	131°44'20"	Kq	83.8±3	72.4±3 72.6±2.5				J. G. Smith
3	0S431	55 53 00	131 33 35	Kq	83.4±3	69.9±3				J. G. Smith
4	3S030	55 56 00	131 26 00	Kq	77.1±3	52.5±2				J. G. Smith
5	3S031	55 57 25	131 21 15	Kq	71.2±2	50.0±2				J. G. Smith
6	3S032	55 58 10	131 16 55	Kq	57.7±2	29.5±1 29.3±1				J. G. Smith
7	3S033	55 55 25	131 12 30	Kq	54.1±2	47.5±3				J. G. Smith
8	3S023	55 57 05	131 02 20	TKgf	51.1±2	44.3±2				J. G. Smith
9	3E324A	55 51 50	131 02 10	TKq	48.5±2	46.3±2				J. C. Von Essen
10	3S014	55 53 20	130 52 55	TKgf	49.1±2	43.6±2				J. G. Smith
11	3S015	55 57 15	130 48 05	MzPzp	52.3±2	45.0±2				J. G. Smith
12	3S025	55 54 15	130 48 05	TKgf	52.1±2	44.0±2				J. G. Smith
13	3S026	55 57 45	130 40 25	TKgf	49.3±2	48.7±2				J. G. Smith
14	2E103	55 55 00	130 31 30	TKgf	63.6±2	44.2±2				J. G. Smith
15	3S029	55 50 50	130 31 50	Teq		44.3±2				J. G. Smith
16	2S129	55 50 00	131 11 00	Teq	52.8±2	47.6±2				J. G. Smith
17	3S038	55 42 00	130 16 55	Ted	47.7±2	42.4±2				J. G. Smith
18	3S036	55 48 40	130 26 35	TKgf	49.1±2	45.0±2				J. G. Smith
19	3S037	55 41 10	130 37 15	MzPzp	45.8±2	45.7±2				J. G. Smith
20	3S022	55 47 50	130 46 30	TKgf		41.8±2				J. G. Smith
21	2B008	55 43 15	130 48 30	TKgf	52.2±2	43.8±2				J. C. Von Essen
22	2E020A	55 43 05	130 54 15	MzPzp	55.6±2	41.8±2				J. C. Von Essen
23	3S035	55 47 10	130 57 45	TKq	51.5±2	44.4±2				J. G. Smith
24	0S341A,B	55 48 08	131 31 30	MzPzp	81.0±3	78.2±4 76.7±4 79.1±4				J. G. Smith
25	0S366A,C	55 50 08	131 35 55	MzPzp	81.8±3 82.2±3	93.5±3	74.9±2			J. G. Smith
26	0S379	55 44 55	131 43 00	Kpg	87.4±3	80.3±3				J. G. Smith
27	0S259	55 21 10	131 01 15	MzPzp	72.3±3		57.4±2			J. G. Smith
28	75ASJ463	55 19 30	131 03 00	QTv				4.9 ±2		J. G. Smith
29	75ASJ417	55 25 15	131 37 30	Tmgd	24.3±1	22.6±1				J. G. Smith
30	68ABg679	55 16 00	131 30 00	Kq			89.1			J. C. Von Essen
31	75ASJ509	55 10 50	131 00 10	Kg	77.5±3	57.9±2				J. G. Smith
32	3S004	55 17 35	130 56 05	MzPzu	59.4±2	46.0±2				J. G. Smith
33	3E001	55 17 50	130 53 10	MzPza	48.6±2	45.9±2				J. G. Smith
34	3S005	55 17 30	130 49 10	MzPza	51.4±2					J. G. Smith
35	69ASJ300A,B	55 05 25	130 57 15	MzPzu	75.0±3	52.7±2				J. G. Smith
36	68ABg553	55 11 10	131 34 50	Pzap	424.0					J. C. Von Essen
37	68ABg247	55 03 40	131 33 50	MzPzi		305.6				J. C. Von Essen
38	68ABg608	55 02 25	131 31 45	MzPzu		79.3				J. C. Von Essen
39	68ABg727	55 01 25	131 34 15	MzPzi		181.8				J. C. Von Essen
40	68ABg724	55 01 20	131 33 35	MzPzi	204.7					J. C. Von Essen
41	75ASJ414A	55 53 30	131 40 35	Kq	79.8±3	72.6±3				J. G. Smith
42	76ASJ565A	55 23 30	130 29 50	Tmgp		26.2±0.9				J. G. Smith
43	76ASJ563	55 23 00	130 30 00	Tmgp						J. G. Smith (in prep
44	76ASJ608	55 21 55	131 17 00	MzPzc						J. G. Smith (in prep
45	76ASJ632	55 16 45	131 18 30	Kg	109±3	96.4±3				J. G. Smith
46	77ASJ661B	55 11 15	130 39 10	TKgf						J. G. Smith (in prep
47	75ASJ473B,C	55 02 40	131 00 20	MzPzu	[2]84.1±3	67.3±2				J. G. Smith
48	2B335	55 30 25	130 56 10	QTv					5.9 ±0.2	J. G. Smith
49	3S042	55 30 40	130 43 40	QTv				0.951±0.4	0.392±.06	J. G. Smith
50	8SC22	55 56 00	131 30 00	Kq	78.2±3	72.4±3				J. G. Smith
51	64ALE49B	[3]55 13 10	131 08 45	Kum	99.0	76.1				M. A. Lanphere
52	64ALE81	[3]54 58 00	131 23 00	MzPzi		315.2	117.3			M. A. Lanphere
53	64ALE82	[3]54 58 00	131 23 00	MzPzi	259.0					M. A. Lanphere
54	64ALE79	[3]54 58 15	131 18 20	KJum		176.9				M. A. Lanphere
55	64ALE65	54 52 50	131 15 40	KJum	129.0 134.4					M. A. Lanphere
56	64ALE66B	54 52 20	131 16 25	KJum	112.0					M. A. Lanphere
57	64ALE59	54 52 35	131 17 25	KJum	105.8					M. A. Lanphere
58	1-28-2	54 53 30	131 18 00	KJum	108.3 111.4					M. A. Lanphere

[1] Chemical analyses and related data for many of these samples are given in a report by J. G. Smith and others (1977).

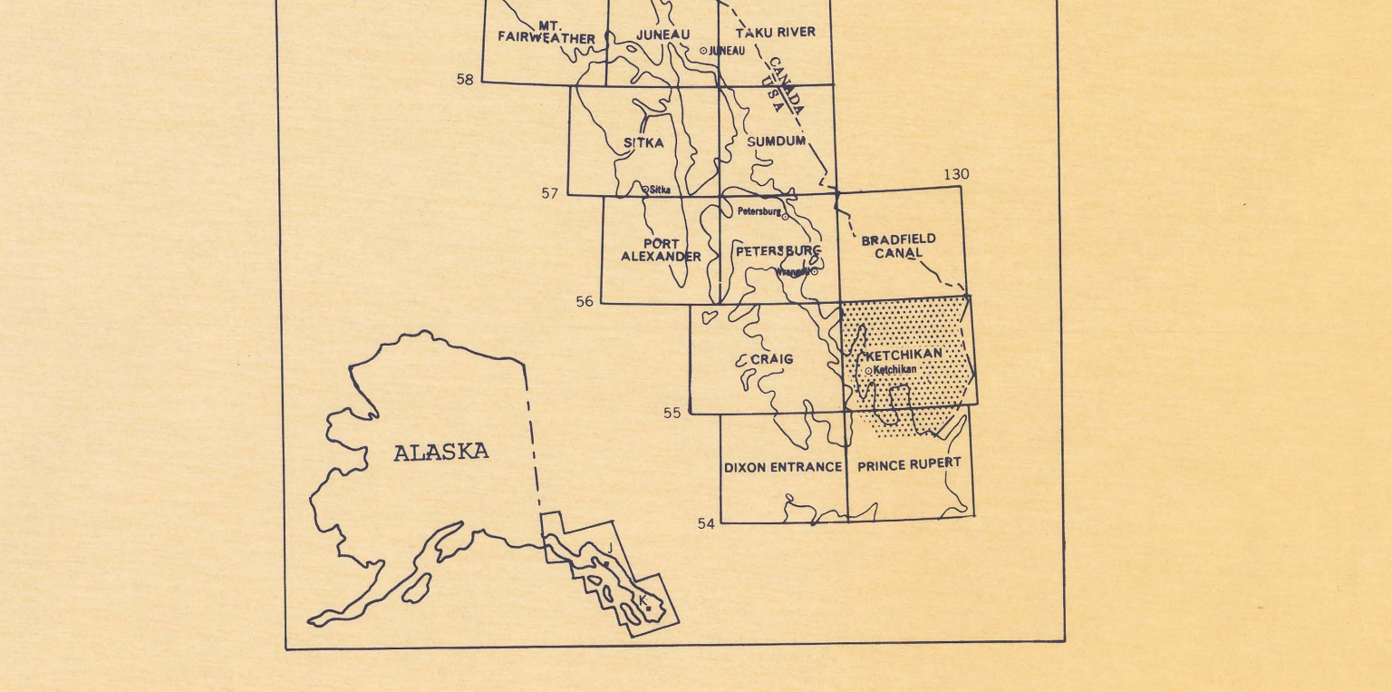
[2] Actinolite

[3] Approximate location

[4] Ages determined by Smith were calculated using the following constants:
$\lambda_\varepsilon = 0.585 \times 10^{-10}\ year^{-1}$; $\lambda_\beta = 4.72 \times 10^{-10}\ year^{-1}$; $^{40}K/K$ total $= 1.19 \times 10^{-4}$ moles/mole
Ages determined by Lanphere and VonEssen were calculated using the following constants:
$\lambda_\varepsilon = 5.72 \times 10^{-2}\ year^{-1}$; $\lambda_\beta = 4.963 \times 10^{-10}\ year^{-1}$; $^{40}K/K$ total $= 1.16 \times 10^{-4}$ moles/mole



INDEX MAP OF KETCHIKAN AND PRINCE RUPERT QUADRANGLES SHOWING AREAS DESCRIBED IN GEOLOGIC REPORTS PUBLISHED SINCE 1957.



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