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Geologic Map of Southern Prince of Wales Island, Southeastern Alaska

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This report is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards and stratigraphic nomenclature.

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INTRODUCTION

Southern Prince of Wales Island is underlain by stratified, intrusive, and metamorphic rocks of Cretaceous through pre-Middle Ordovician age and by surficial deposits. The region was mapped originally in reconnaissance fashion by Buddington and Chapin (1929) and subsequently by W.H. Condon and I.L. Tailleur (unpublished U.S.G.S. report, 1960) primarily with the use of aerial photographs. More recently, MacKevett (1963) studied the geology of the Bokan Mountain-Stone Rock Bay area, Herreid and others (1978) and G. Donald Eberlein, Michael Churkin Jr., and Walter Vennum (Eberlein and others, 1983; unpublished data) mapped Kassa and Klakas Inlets and regions to the north, and Thompson and others (1982) and B. Collot (in Saint-Andre and others, 1983) studied the Bokan Mountain Granite. The inset map of Plate 1 shows where this published and unpublished mapping has been incorporated into our geologic map.

The rocks on southern Prince of Wales Island have been subdivided into map units based on guidelines recommended by the North American Commission on Stratigraphic Nomenclature (1983). The main categories of map units include:

SEDIMENTARY AND (OR) VOLCANIC ROCKS, which consist of stratified rocks, and in some areas their moderately deformed and (or) metamorphosed equivalents, that obey the law of superposition. These units include sedimentary and (or) volcanic rocks herein correlated with the Karheen Formation (Early Devonian) and the Descon Formation (Early Silurian and Ordovician).

REGIONALLY METAMORPHOSED AND (OR) DEFORMED ROCKS, which consist of metasedimentary, metavolcanic, and (or) metaplutonic rocks that do not obey the law of superposition. These rocks include the Wales metamorphic suite (pmOw), and rocks herein assigned to the complex of Klakas Inlet (DSk), complex of Kendrick Bay (SOk), and complex of Ruth Bay (Or). The ages assigned to these units reflect the age of formation of the complex or suite rather than the protolith age of the rocks included.

INTRUSIVE ROCKS, which consist of plutonic and hypabyssal rocks that have been subdivided on the basis of their composition and emplacement age. Compositional terms follow recommendations by the International Union of Geological Sciences Subcommission on Systematics of Igneous Rocks (Streckeisen, 1976). All radiometric ages have been calculated or recalculated with the decay constants and abundances recommended by the International Union of Geological Sciences Subcommission on Geochronology (Steiger and Jager, 1977). The Decade of North American Geology Time Scale (Palmer, 1983) has been used in relating these radiometric dates to the geologic time scale.

The rocks belonging to each map unit are described below in the Description of Map Units. Geologic units that have not been assigned to map units include surficial deposits and widespread basaltic to dacitic(?) dikes. Surficial deposits are described at the beginning of the Description of Map Units and the dikes are described at the beginning of the section on intrusive rocks. Major faults in the area are described in the following section on Structural Geology. Tables 1 and 2 outline each of the paleontologic and geochronologic samples analyzed during this study. Discussion of the geologic and tectonic history of the region, tables with geochemical data determined from samples of volcanic and intrusive rocks, and documentation of our U-Pb geochronologic data are presented in Gehrels and Saleeby (in press). The Early Devonian conodonts identified from samples collected during this study have been described by Savage and Gehrels (1984).

DESCRIPTION OF MAP UNITS

COLLUVIUM, ALLUVIUM, AND BEACH DEPOSITS (QUATERNARY) -- Surficial deposits consist of beach deposits along the shores of many bays, colluvium and soil in the interior of the island, and alluvium along some creeks. Bedrock is moderately to well exposed along most beaches: beach deposits are extensive only in the interior parts of some bays that have very gentle topography. These beach deposits are shown with a stipple pattern on Plate I where the bedrock is obscured. Surficial deposits are widespread in the interior of the island but are generally less than a few meters thick. These deposits have not been shown on Plate I because of their limited thickness and discontinuous distribution.

SEDIMENTARY AND (OR) VOLCANIC ROCKS

KARHEEN FORMATION (EARLY DEVONIAN) -- Strata herein correlated with the Karheen Formation constitute a fining-upward sequence of clastic sedimentary and subordinate volcanic rocks. These strata unconformably overlie Early Silurian and Ordovician rocks, and are the youngest sedimentary and volcanic rocks in the map area. The stratigraphic sequence generally ranges from coarse conglomerate (Dcg) or breccia (Dbx) at the base, through sandstone (Ds), mudstone and siltstone (Dms), and limestone (Dls) in the middle, into laminated black graptolitic shale (Dsh) at the top. Plagioclase-porphyritic and basaltic to andesitic volcanic rocks (Dpv and Dbv) are interlayered with the coarser clastic strata in the southern part of the area.

A middle Early Devonian age for rocks in upper parts of the section is indicated by conodonts in limestone layers (Savage and Gehrels, 1984) and graptolites in black shale (Churkin and others, 1970). Coarser clastic rocks in the lower part of the section grade into these strata and are interpreted to be Early Devonian in age (Gehrels and Saleeby, in press). Similarities in lithic types, stratigraphic position, and depositional age indicate that these strata are correlative with the Early Devonian Karheen Formation on west-central Prince of Wales Island (Eberlein and Churkin, 1970; Eberlein and others, 1983; Gehrels and Saleeby, in press). The thickness of the section in the area averages approximately 2 km but is quite variable.

Dsh SHALE (EARLY DEVONIAN) — Dark-gray to black shale and subordinate slate and slaty argillite with mm-scale laminations and slight cm-scale compositional layering. These strata are distinguished from Early Silurian(?) and Ordovician argillite and shale (SOa) by the more siliceous composition of the older strata and greater fissility of the Devonian rocks. Layers up to several tens of centimeters in thickness of gray mudstone, brown carbonate-rich siltstone, and leucogranodiorite-clast conglomerate locally occur in the section. Fine laminations and a slight fining-upwards in individual shale layers record transportation by turbidite flows and deposition in a submarine fan system. The presence of conglomeratic horizons and a large slide(?) block of leucogranodiorite in the section indicate that there was significant topographic relief within or adjacent to the basinal system.

In most areas the shale grades downsection into tan to gray mudstone and siltstone (Dms) over a stratigraphic distance of several meters: the contact is drawn where shale dominates over mudstone and siltstone. The stratigraphic thickness is known to be at least 250 m along the east shore of Klakas Inlet but could be considerably greater along the west shore. North of the study area, the shale and underlying mudstone and siltstone (Dms) have been mapped together as a section of dark-gray siltstone (about 600 m) and dark-gray argillite (about 1200 m) by Herreid and others (1978).

The age of strata in this unit is indicated by several occurrences of graptolites of probable Pragian age (paleontologic sample localities labeled "1": Churkin and others, 1970). Morphologically similar graptolites were recognized at the localities indicated with a "G" on Plate I, but these have not been formally identified as the same fauna described by Churkin and others (1970).

Dms MUDSTONE AND SILTSTONE (EARLY DEVONIAN) — Tan, dark- to light-gray, and bluish-gray mudstone and siltstone in beds from 2 to 20 cm in thickness. Individual beds commonly show a slight size gradation from silty to more shaly detritus upsection, and low-angle cross-stratification is common. These characteristics and the general stratigraphic relations of this unit indicate transportation of detritus by turbidity currents and deposition in distal marine environments — probably in a submarine fan. Orange- to brown-weathering beds up to 10 cm in thickness constitute about 10% of the section and consist of sandy siltstone with a carbonate-rich matrix. These beds commonly weather more rapidly than the adjacent mudstone and siltstone, forming recessed horizons. In some layers the sandy siltstone changes along strike from this orange-brown, deeply recessed character to a gray siltstone with weathering characteristics similar to that in the adjacent mudstone and siltstone. Cobbles and lenses of sandy siltstone that occur within the mudstone and siltstone also show this style of weathering. The difference in weathering characteristics is interpreted to be the result of a greater amount of carbonate matrix material in the sandy siltstone layers.

These strata grade upsection into black shale (Dsh) over a distance of several meters: the contact is drawn where shale dominates over mudstone and siltstone. Downsection the strata grade into coarser-grained siltstone and locally into sandstone. The basal contact is drawn where mudstone becomes subordinate to sandstone. In Max Cove and west of Klakas Inlet the underlying Devonian sandstone (Ds) is too thin to distinguish on the map and is included in this unit. The thickness of the mudstone and siltstone is approximately 400 m between Max Cove and Klakas Inlet: to the south and on the west side of Klakas Inlet the thickness may be considerably greater. North of the study area these strata and the overlying shale (Dsh) are included in an argillite and siltstone map unit consisting of about 600 m of dark-gray siltstone overlain by about 1200 m of dark-gray argillite (Herreid and others, 1978). On the unnamed island west of Klinkwan in southern Klakas Inlet, nondeformed mudstone, siltstone, and shale overlies a thin layer of cross-bedded sandstone which overlies moderately deformed Devonian sedimentary breccia (Dbx). This relationship places an important constraint on the age of movement on the Anchor Island thrust fault and deformation in the complex of Klakas Inlet (DSk), as described below.

The age of strata in this unit is constrained by graptolites of probable Pragian (middle Early Devonian) age in overlying shale (Dsh), and by middle Early Devonian conodonts in limestone (Dls) lower in the section.

Ds SANDSTONE (EARLY DEVONIAN) -- Tan- to reddish-brown-weathering sandstone, siltstone, and subordinate mudstone and pebbly conglomerate interbedded locally with volcanic rocks (Dpv and Dbv) and fossiliferous limestone (Dls). The sandstone varies from massive beds several meters in thickness to thin-bedded sandstone and siltstone with ripple marks and high-angle cross beds and channels. Plagioclase-porphyritic volcanic rocks (Dpv) are widespread south of Hunter Bay. Some volcanic rocks, particularly along the southern shoreline of the island, have not been mapped separately from the clastic strata. North of Tah Bay, detritus in these strata consists predominantly of monocrystalline quartz and plagioclase with subordinate lithic fragments of fine-grained quartz and plagioclase (leucogranodiorite?) and of a cryptocrystalline rock with trachytic feldspar microphenocrysts (volcanic rock?). To the south the lithic grains and their matrix are more highly altered with secondary carbonate and clay minerals. Lithic fragments from southern areas consist of feldspar phenocrysts in an altered cryptocrystalline matrix (hypabyssal or volcanic rock?) or highly altered cryptocrystalline rock of intermediate to basic composition (volcanic rocks?). Monocrystalline quartz and plagioclase grains are subordinate. The dominant source for the detritus in this unit is interpreted to have varied from Early Silurian and Ordovician intrusive and stratified rocks in the northern part of the area to intraformational volcanic rocks along the southern shoreline of the island.

In most areas this unit contains or is interbedded with a thin horizon of fossiliferous limestone (Dls). Associated with the limestone in a few areas are sections of interbedded maroon and green shale and chert-pebble conglomerate. Megafossils in the limestone, the presence of interbedded maroon and green shale, and sedimentary structures in the sandstone all suggest that these strata were deposited in shallow marine to fluvial environments.

Strata in this unit generally coarsen downsection, grading through pebbly sandstone into cobble and boulder conglomerate. The basal contact is drawn where conglomerate becomes the dominant lithology. Upsection siltstone predominates, and the contact with overlying mudstone and siltstone (Dms) is drawn where mudstone dominates over siltstone. The thickness of this unit varies from over a kilometer at the south end of the island to several meters or less in the Max Cove region (Gehrels and Saleeby, in press). Much of this thinning apparently occurs near Klinkwan Cove.

The age of the sandstone is well constrained by the occurrence of interbedded limestone (Dls) with middle Early Devonian conodonts, and graptolites of probable Pragian (middle Early Devonian) age in overlying shale (Dsh).

Dls LIMESTONE (EARLY DEVONIAN) -- Light- to medium-gray fossiliferous limestone breccia and subordinate massive to thin-bedded limestone. Thin layers of darker gray siliceous limestone are common in both the breccia and the bedded limestone. North of Tah Bay the limestone forms a single bed 1 to 3 m in thickness. In Max Cove it is underlain by, and locally interbedded with, chert-pebble conglomerate with cm-scale rounded clasts of black to dark-gray chert. Strata above and below the limestone in Max Cove consist of sandstone and siltstone. South of Tah Bay there are commonly two layers of limestone up to several meters in thickness which are interbedded with and separated by sandstone and siltstone. Limestone in this unit apparently belongs to a single horizon that extends continuously throughout the study area: limestone has not been recognized in other parts of the Early Devonian section. In contrast, Herreid and others (1978) report that similar limestone just north of the study area is laterally discontinuous.

Conodonts recovered from limestone at several localities (paleontologic samples 4 through 11) demonstrate a middle Early Devonian age for the limestone throughout the area (Savage and Gehrels, 1984) and may record a slight younging of the section to the south (Gehrels and Saleeby, in press). Megafossils recovered by Theodore Chapin and identified by Edwin Kirk (cited in Buddington and Chapin, 1929) were assigned a Middle Devonian age. These fauna include:

Cladopora sp. and crinoid columnals from a locality in Hessa Inlet (which may be the same as paleontologic sample locality 9 in Buschman Pass),

Atrypa reticularis, Favosites hemisphericus, Alveolites sp., Cyathophyllum sp., and Syringopora sp. from paleontologic sample locality 7 in Hunter Bay,

Favosites hemisphericus and Alveolites sp. from paleontologic sample locality 5 in Max Cove.

Based on the diagnostic conodont fauna and the probable Pragian (middle Early Devonian) graptolites in overlying shale (Churkin and others, 1970), the limestone is assigned a middle Early Devonian age.

Dpv PLAGIOCLASE-PORPHYRITIC VOLCANIC ROCKS (EARLY DEVONIAN) -- Volcanic and subordinate hypabyssal rocks that consist of tan, reddish, and gray plagioclase-porphyritic dacite(?). These rocks occur as porphyritic tuff, tuff breccia, and flows interbedded with Devonian conglomerate (Dcg) and sandstone (Ds), and as hypabyssal dikes, sills, and small intrusive bodies. Dominant minerals include subhedral altered grains of andesine in a matrix of altered plagioclase microlites, opaque minerals, calcite, iron oxides, and other secondary minerals. Small, highly altered ferromagnesian grains with cores of pigeonite are preserved in a few samples. The age of these rocks is constrained by middle Early Devonian fossils in adjacent clastic strata. Hypabyssal plagioclase-porphyritic diorite (Dph) bodies in the Klakas Inlet region and north of the study area (Herreid and others, 1978) are interpreted to be subvolcanic to these rocks based on their similar mineralogy and texture, and the close spatial association of the hypbyssal bodies and Devonian strata.

Dbv BASALTIC TO ANDESITIC ROCKS (EARLY DEVONIAN) -- Basaltic to andesitic rocks that occur as flows, breccia, dikes, and small intrusive bodies in the Tah Bay region and as a thin pillow flow just west of Bert Millar Cutoff. In thin section these rocks consist of highly altered, millimeter-scale plagioclase phenocrysts in a matrix of very fine grained opaque minerals, chlorite, calcite, epidote, and other secondary minerals. These rocks resemble andesitic breccia and flows that overlie the Early Devonian clastic strata north of the area (Herreid and others, 1978; Gehrels and Saleeby, in press). Their age in the study area is constrained by middle Early Devonian fossils in adjacent clastic strata.

Dcg CONGLOMERATIC STRATA (EARLY DEVONIAN) -- Tan- to reddish-brown-weathering pebble, cobble, and boulder conglomerate, conglomeratic sandstone, and subordinate sandstone, siltstone, and undifferentiated volcanic rocks. The stratigraphic section varies considerably in thickness and in clast composition from north to south. On the west shore of Klakas Inlet and in Max Cove the conglomerate is several meters thick and consists of well-rounded cobbles of intrusive, volcanic, and hypabyssal rocks in a sandstone matrix. In both areas the conglomerate is massive and overlies brecciated leucogranodiorite (Ogd). The basal contact can be located to within a meter at its northern extent in Max Cove, but is not actually exposed. In the Klinkwan Cove region the conglomerate thickens rapidly southward, reaching a thickness of over 500 m on the northeast side of the Klinkwan Cove fault. Clasts in this area are well rounded and consist of approximately equal proportions of intrusive and volcanic rocks. High-angle cross-beds and channels and the presence of clasts over a meter in diameter suggest that these strata were deposited in subaerial to shallow marine environments within or adjacent to an area with significant topographic relief.

South of Hunter Bay, volcanic clasts become predominant, the section increases in thickness to over 1500 m, and plagioclase-porphyritic volcanic rocks (Dpv) constitute a locally significant part of the section. The composition of the volcanic clasts changes southward also, from aphyric basalt-andesite to the north, to plagioclase-porphyritic andesite-dacite to the south. The volcanic and plutonic clasts to the north were apparently derived from underlying Early Silurian and Ordovician rocks, whereas the porphyritic clasts to the south were derived from intraformational volcanic rocks (Dpv and Dbv). The basal contact of conglomerate overlying Early Silurian(?) and Ordovician rocks is exposed just east of Seagull Island (southern Buschmann Pass), along the west shore of Brownson Bay, and near Bert Millar Cutoff. In most areas the conglomerate grades upsection into sandstone: the contact is drawn where conglomerate dominates over sandstone.

The minimum age of the conglomeratic strata is constrained by middle Early Devonian fossils in limestone (Dls) which locally grades into strata in the upper part of this unit.

Dbx SEDIMENTARY BRECCIA (EARLY DEVONIAN) -- The basal Devonian unit in southern Klakas Inlet is a sedimentary breccia consisting of nonsorted angular clasts (up to 50 cm across) of brecciated leucogranodiorite (Ogd) and diorite (Od), and highly deformed volcanic, sedimentary, and intrusive rocks derived from the subjacent complex of Klakas Inlet (DSk). The breccia is moderately flattened, brecciated, and locally semischistose, but is not as strongly deformed or altered as rocks in the underlying structural complex. The basal contact of the breccia is exposed in several areas on these islands, but the degree of deformation in both overlying and underlying rocks makes its recognition difficult. The breccia is locally overlain unconformably by up to a meter of cross-bedded sandstone, which is in turn overlain by Devonian mudstone, siltstone, and shale (Dms). These strata are only slightly deformed, which demonstrates that deformation in the breccia and the underlying structural complex occurred prior to middle Early

Devonian time. The breccia is interpreted to be Early Devonian in age because it grades laterally into conglomerate (Dcg) which locally contains limestone (Dls) with middle Early Devonian fossils.

The stratigraphic and structural relations described above suggest that deformation in the southern Klakas Inlet region continued into Early Devonian time, but ceased prior to the deposition of middle Early Devonian sandstone, siltstone, mudstone, and shale. Because deformation in this zone is attributed to movement on the Anchor Island thrust system (as described in the Structural Geology section) we interpret the breccia to have been deposited and deformed as a talus breccia within this active system. These relations indicate that movement on the Anchor Island fault system continued into earliest Devonian time.

DESCON FORMATION (EARLY SILURIAN AND ORDOVICIAN) — Strata herein correlated with the Descon Formation include volcanic and sedimentary rocks that are similar in lithic types, stratigraphic position, and age to Early Silurian and Ordovician rocks in the Descon Formation on central and northern Prince of Wales Island (Eberlein and Churkin, 1970; Eberlein and others, 1983; Gehrels and Saleeby, in press). Volcanic rocks dominate in most of the study area and consist of basaltic to andesitic pillow flows, pillow breccia, and tuff breccia (SObv) with subordinate intermediate-composition and silicic tuff and tuff breccia (SOiv and SOsv). These rocks locally interfinger with marine clastic strata south of the Frederick Cove fault: north of the fault the strata consist primarily of interbedded argillite and shale (SOa), banded mudstone and siltstone (SOms), and graywacke (SOgw). Limestone (SOls) is a minor component of the Descon Formation in the study area.

Sedimentary and volcanic rocks of the Descon Formation are overlain unconformably by Early Devonian clastic strata of the Karheen Formation, and are in fault contact with pre-Middle Ordovician rocks of the Wales metamorphic suite. The age of the clastic strata south of the Frederick Cove fault is indicated by early Middle Ordovician conodonts and by latest Early Ordovician graptolites recovered from the east shore of Klakas Inlet (Eberlein and others, 1983). Middle Ordovician graptolites have also been recovered from argillite interbedded with basaltic to andesitic volcanic rocks in Moira Sound (Eberlein and others, 1983). Volcanic rocks south of the Klakas Inlet-Moira Sound region are interpreted to be Ordovician and perhaps locally Early Silurian in age based on correlation with rocks of known Ordovician age, and intrusive relations which suggest that they are coeval with Ordovician plutonic rocks.

SOa ARGILLITE AND SHALE (EARLY SILURIAN AND ORDOVICIAN) — Black, well-bedded siliceous argillite and dark-gray to black shale. North of the Frederick Cove thrust fault, black shale and argillite with millimeter-scale laminations and 1- to 3-cm-scale layering are the dominant lithic types. Interbedded with these strata are layers of dark-gray mudstone and siltstone, and several beds up to a meter in thickness of gray laminated limestone. Along strike to the northwest the argillite and shale are interbedded with dark-gray and brownish-gray banded mudstone and siltstone (SOms). The contact between the two units is drawn where shale and argillite dominate over mudstone. The rhythmically bedded nature of these strata, combined with graded beds in adjacent mudstone and siltstone, indicate that they were deposited in a basin plain to distal submarine fan system environment. Sedimentary structures indicate that these strata face to the southwest.

South of the Frederick Cove fault, siliceous argillite is interbedded with volcanic rocks of the Descon Formation in many areas. Between Klakas Inlet and West Arm (Moira Sound), thick sections of argillite and shale are interlayered with basaltic to andesitic and minor silicic volcanic rocks. Thin beds of siliceous (locally cherty) argillite are common in the volcanic rocks in Winter Bay, Johnson Cove, South Arm (Moira Sound), and in the Barrier Islands. In the Barrier Islands and in Winter Bay, these beds commonly contain disseminated pyrite and are stained with red- and orange-weathering iron oxides (Gehrels and others, 1983a)

The age of the fine-grained clastic strata south of the Frederick Cove fault is known from graptolites of latest Early Ordovician age (paleontologic sample locality 3) and Middle Ordovician age (localities 12 and 13) (Eberlein and others, 1983). Early Middle Ordovician conodonts have also been recovered from a limestone lens at locality 3 (Anita Harris, written commun., 1980). North of the Frederick Cove fault the strata are interbedded with limestone layers that have been sampled for conodonts but none have been recovered (N.M. Savage, written commun., 1985). These strata are interpreted to belong to the Descon Formation based on similarities in lithic types and their occurrence beneath strata of known Devonian age (Herreid and others, 1978; Gehrels and Saleeby, in press).

SOms BANDED MUDSTONE AND SILTSTONE (EARLY SILURIAN AND ORDOVICIAN) -- Rhythmically bedded gray, greenish gray, light-green, and locally tan mudstone and siltstone turbidites with well-developed size grading. Graywacke and argillite also occur in this unit in some areas. Individual beds generally range from 2 to 6 cm in thickness and are finely laminated and laterally continuous. These stratigraphic characteristics are typical in both the thick sections of mudstone and siltstone north of the Frederick Cove fault, and also in thin layers interbedded with other clastic strata or volcanic rocks to the south. The greenish color, strong compositional layering, and lack of tan-weathering carbonate-rich layers distinguish these strata from Devonian mudstone and siltstone (Dms). Size grading, low-angle cross stratification, and the rhythmically bedded nature of the strata record deposition by turbidity currents in a submarine fan system.

These strata are interlayered with and grade into argillite and shale (SOa) north of West Arm (Moira Sound) and along the east shore of Klakas Inlet. The contact is drawn where banded mudstone and siltstone become the dominant lithology. In Hunter Bay and south of Nichols Bay, mudstone and siltstone are interbedded with layers of light-colored limestone (SOls) in a section of predominantly basaltic to andesitic volcanic rocks. At the north end of Nichols Bay, mudstone is interbedded with gray, carbonate-rich mudstone (mapped as SOls on Plate 1) and silicic volcanic rocks (SOsv). Thin sulfide-rich layers occur in the mudstone and siltstone and in the adjacent volcanic rocks in Nichols Bay (Gehrels and others, 1983a). The strata in Hunter Bay and to the south are moderately deformed and are metamorphosed to low greenschist facies. Metamorphism and deformation of these rocks occurred prior to deposition of the superjacent Early Devonian strata. In most regions these strata display meter-scale open folds with shallow-plunging, northwest-trending axes.

The age of strata in this unit south of the Frederick Cove fault is constrained by latest Early and Middle Ordovician fossils in interbedded argillite (SOa). To the north the strata are interpreted to be correlative with the Descon Formation based on similarities in lithic types and stratigraphic position: they are overlain unconformably by Early Devonian strata (Herreid and others, 1978), and have not experienced the Early Ordovician-Middle Cambrian metamorphism and deformation of rocks in the Wales metamorphic suite (pmOw).

SOgw GRAYWACKE (EARLY SILURIAN AND ORDOVICIAN) -- Gray and greenish-gray graywacke consisting of silt-, sand-, and pebble-size grains of volcanic lithic fragments and subordinate feldspar. Individual beds range from several centimeters to over a meter in thickness and commonly are size graded. These strata are interbedded with and grade into banded mudstone, siltstone, argillite, and shale (SOms and SOa) north of the Frederick Cove fault, and are interbedded with basaltic to andesitic volcanic rocks of the Descon Formation in Moira Sound. The age of the graywacke along South Arm (Moira Sound) is indicated by Middle Ordovician graptolites in argillite (SOa) interbedded with volcanic rocks (paleontologic sample localities 12 and 13: Eberlein and others, 1983). North of the study area, massive to thick-bedded graywacke constitutes a major component of the Descon Formation (Herreid and others, 1978).

SOls LIMESTONE (EARLY SILURIAN AND ORDOVICIAN) — Limestone is a subordinate component of the Descon Formation in the study area and is quite variable in character. Along the north shore of West Arm (Moira Sound), limestone occurs as light- to dark-gray beds up to a meter in thickness of cross-laminated sandy limestone in a section of shale, argillite, and subordinate mudstone and siltstone. Sedimentary structures in these beds and in adjacent clastic strata suggest that they were deposited by turbidity flows. Limestone along the south shore of West Arm (Moira Sound) and the east shore of Klakas Inlet consists of thin layers of massive, dark-gray limestone interbedded with siliceous black argillite. In Hunter Bay and southern Nichols Bay, massive, light-colored layers of recrystallized limestone up to several meters in thickness are interlayered with volcanic and subordinate volcaniclastic rocks. Limestone along the north shore of Nichols Bay consists of gray calcareous mudstone interbedded with moderately deformed and metamorphosed mudstone and siltstone (SOms) and silicic volcanic rocks (SOsv). Dark-gray limestone along the east shore of Klakas Inlet yields Middle Ordovician conodonts (Anita Harris, written commun., 1980). Samples of limestone from West Arm (Moira Sound), Hunter Bay, and southern Nichols Bay have not yielded conodonts (N.M. Savage, written commun., 1985): the assigned age of these strata is based on the interpreted age of the adjacent sedimentary and volcanic rocks.

SObv BASALTIC TO ANDESITIC VOLCANIC ROCKS (EARLY SILURIAN AND ORDOVICIAN) — Dark- to light-green basaltic to andesitic pillow flows, pillow breccia, and tuff breccia with subordinate tuff, volcaniclastic strata, and volcanic rocks of more silicic composition. Pillow flows (P on Plate 1) display variably deformed pillows that average 30 cm across (ranging from 10 cm to as much as 1 m). Interpillow carbonate and chert are quite rare. Of approximately equal abundance is volcanic breccia locally distinguished as pillow breccia (PB) or tuff breccia (TB) on Plate 1. Bedding in the breccia is well developed and is commonly parallel to a slight flattening of protolith features. Thin layers of tuff (T on Plate 1), volcaniclastic graywacke (SOgw), and banded mudstone and siltstone (SOms) are interbedded with the volcanic breccia throughout the area. Also present are layers of silicic volcanic rock (SOsv) and siliceous argillite (SOa) that contain disseminated and locally massive sulfides.

Rocks in this unit generally consist of spilitic basalt to andesite with highly altered plagioclase phenocrysts. The plagioclase grains are of andesine composition, have variable albitic and sericitic alteration, and range up to 4 mm in length. Millimeter-scale clots of chlorite, epidote, and opaque minerals are probably alteration products of ferromagnesian phenocrysts. Matrix minerals consist of plagioclase microlites, chlorite, epidote, leucoxene, and opaque minerals that formed during lower greenschist- to sub-greenschist-facies metamorphism. Adjacent to the Early Silurian and Ordovician intrusive bodies, the rocks are locally metamorphosed to biotite- or hornblende-bearing hornfels. Deformation of the volcanic rocks is quite variable: in many areas protolith features such as pillows and breccia fragments are only slightly flattened, the rocks do not have a foliation, and plagioclase microlites in the matrix are randomly oriented. In other areas, particularly along the trace of the Anchor Island fault, the volcanic rocks are brecciated and semischistose, and protolith features have been obscured.

Features of these rocks that distinguish them from metavolcanic rocks of the Wales metamorphic suite (pmOw) include: 1) the lack of both schistosity and outcrop-scale, asymmetric folds 2) the abundance of well-preserved protolith features such as pillows, breccia fragments, etc., and 3) the tendancy for pillows and breccia fragments to weather differentially from their matrix.

The depositional age of basaltic to andesitic volcanic rocks in the Klakas Inlet-Moira Sound region is indicated by latest Early and Middle Ordovician fossils recovered from interbedded argillite (SOa). A minimum age in other parts of the map area is derived from cross-cutting Early Silurian and (or) Late Ordovician quartz monzonite and granite (SOqm). Dioritic and quartz dioritic intrusive rocks of Middle and Late Ordovician age (Od and Oqd) are interpreted to be the intrusive equivalents of these volcanic rocks.

SOiv INTERMEDIATE COMPOSITION (ANDESITIC TO DACITIC) VOLCANIC ROCKS (EARLY SILURIAN AND ORDOVICIAN) -- Gray, greenish-gray, greenish-white, and tan plagioclase- and quartz-porphyritic tuff and subordinate tuff breccia. Banded mudstone and siltstone (SOms), volcanic rocks of basaltic to andesitic and more silicic composition, and hypabyssal bodies of intermediate composition are also common in this unit. Widespread cm-scale layering in the tuff is locally due to flow banding, but is more commonly due to a change in grain size and a slight change in composition within the individual layers. Compositionally these volcanic rocks probably fall within the andesite to dacite range. They have been distinguished from the generally coeval basaltic to andesitic (SObv) volcanic rocks on the basis of their more silicic composition, abundant plagioclase and quartz phenocrysts, and characteristic cm-scale layering. The silicic volcanic rocks (SOsv) are more silicic and are commonly fragmental. Volcanic rocks of intermediate composition constitute a major component of the Descon Formation in the northeastern part of the study area, and occur as thin layers in the volcanic rocks in other parts of the area.

Most rocks belonging to this unit are plagioclase- and quartz-porphyritic keratophyre. Plagioclase phenocrysts constitute 5% to 15% of the rock and commonly occur as glomerocrysts of large plagioclase and smaller opaque crystals. Individual plagioclase grains range up to 6 mm in length and are generally tabular, unzoned, albitized, and moderately sericitized. Most grains were originally of andesine composition. Quartz phenocrysts are subordinate to plagioclase in abundance, and occur as sub-rounded grains up to 5 mm in diameter. Anhedral opaque grains up to 3 mm long constitute up to several percent of the rock. Matrix minerals consist of microcrystalline quartz, plagioclase, and alteration products including chlorite, leucoxene, epidote, opaque minerals, and calcite.

These rocks are interbedded with clastic strata in Moira Sound from which Eberlein and others (1983) have recovered Middle Ordovician graptolites. Cross-cutting intrusive bodies of Early Silurian and (or) Late Ordovician quartz monzonite and granite (SOqm) indicate a minimum depositional age of Early Silurian. Based on compositional similarities, these volcanic rocks may be correlative with the breccia of Luck Creek on central Prince of Wales Island (Eberlein and others, 1983), and may be genetically related to the leucogranodioritic (Ogd and Oqgd) and quartz dioritic intrusives (Oqd) in the study area.

SOsv SILICIC (DACITIC TO RHYOLITIC) VOLCANIC ROCKS (EARLY SILURIAN AND ORDOVICIAN) -- Light-green, light-gray, tan, and white plagioclase-porphyritic silicic tuff, tuff breccia, and breccia. Tuffaceous strata commonly have mm-scale laminations formed by slight changes in composition and probably grain size. Tuff breccia occurs both as m-scale layers throughout the Descon volcanics in the area, and as km-thick layers in the northeastern part of the area. Clasts in the breccia range from several cm to 50 cm in length and consist of massive to finely laminated silicic and subordinate intermediate-composition volcanic rock. The clasts are supported in a matrix of laminated tuff and locally argillaceous strata. Silicic breccia also occurs in bodies that map out as lenses up to several hundred meters in length in both the Barrier Islands and the Ingraham Bay region. These breccias consist entirely of 10- to 50-cm-scale angular blocks of laminated silicic volcanic rock and are interpreted to have been extrusive domes. Layers of intermediate-composition (SOiv) and basaltic to andesitic (SObv) volcanic rocks are common in this map unit, as are sedimentary interbeds of argillite and shale (SOa) and banded mudstone and siltstone (SOms).

Sulfide-rich horizons are common in these silicic volcanic rocks and in adjacent sedimentary and volcanic strata (Gehrels and others, 1983a). In the Barrier Islands, several thin sulfide-rich layers occur at or near contacts between silicic breccia and either basaltic to andesitic volcanic rocks or argillaceous strata. The sulfides tend to occur in thin rinds around pillows or breccia fragments or in thin layers in the argillaceous strata. These relations and an occurrence in Nichols Bay where massive sulfide minerals show sedimentary layering and lamination similar to that in the banded siltstone host-rock indicate that the mineralization was syn-volcanic and presumably volcanogenic.

Most rocks in this unit consist of plagioclase-porphyritic quartz keratophyre. Plagioclase phenocrysts range up to 8 mm in length, are andesine in composition, and commonly occur in glomerocrysts with smaller opaque grains. The phenocrysts are generally tabular in shape and nonzoned, and have thin albitic rims and variable secondary alteration. Phenocrysts constitute up to 20% of some rocks but are more commonly less than 10%. Matrix minerals include primary microcrystalline quartz and albitized plagioclase, and secondary chlorite, epidote, leucoxene, calcite, sericite, and opaque minerals. Although these volcanic rocks are more silicic and leucocratic than the intermediate-composition volcanic rocks (SOiv) with which they are interbedded, quartz phenocrysts have not been recognized in the more silicic rocks.

The silicic volcanic rocks are regionally interbedded with strata in Moira Sound and in Klakas Inlet from which Eberlein and others (1983) have recovered latest Early and Middle Ordovician fossils. Cross-cutting intrusive bodies of Early Silurian and (or) Late Ordovician quartz monzonite and granite (SOqm) indicate a minimum depositional age of Early Silurian for these rocks. The silicic volcanic rocks in the Barrier Islands and along Klakas Inlet are interbedded with basaltic to andesitic volcanic rocks (SObv) of probable Ordovician age, and may be genetically related to the Ordovician quartz-porphyritic granodiorite (Oqgd) and leucogranodiorite (Ogd) in the area.

REGIONALLY METAMORPHOSED AND (OR) DEFORMED ROCKS

DSk COMPLEX OF KLAKAS INLET (EARLY DEVONIAN AND SILURIAN)[1] -- Highly altered and brecciated intermediate-composition semischist, greenstone, silicic semischist, and leucogranodiorite derived from stratified and intrusive rocks of Early Silurian(?) and Ordovician age. This complex occurs in the southern Klakas Inlet region and is referred to informally herein as the complex of Klakas Inlet. Much of the unit consists of orange- to gray-weathering, green to tan semischist surrounding cm-scale elongate blocks of fractured greenstone. Relict volcanic or sedimentary structures and textures in some blocks indicate protoliths of basaltic to andesitic volcanic rock (SObv), mudstone and siltstone (SOms), and graywacke (SOgw). Protoliths of the intermediate-composition semischist and greenstone are intruded by dikes of leucogranodiorite (Ogd) that have been deformed into fine-grained silicic semischist and leucogranodiorite breccia. A foliation is only rarely developed in the various rock types due to the cataclastic style of deformation, and to the pervasive orange-weathering dolomitic alteration. These rocks are mapped as a complex because the original depositional and intrusive relations between constituent rock types have been obliterated by the penetrative deformation and alteration.

The age of deformation is constrained by the Ordovician age of the intrusive and stratified rocks included, and by the nondeformed middle Early Devonian sandstone, mudstone, and shale (Dms) that overlies the complex. Deformation of rocks in this complex is interpreted to have been related to earliest Devonian-Silurian movement on the Anchor Island and associated thrust faults (Gehrels and Saleeby, in press).

SOk COMPLEX OF KENDRICK BAY (EARLY SILURIAN AND ORDOVICIAN)[1] -- A heterogeneous complex of dark- to medium-brown and gray schistose gneiss in the Kendrick Bay-McLean Arm area that was mapped originally by MacKevett (1963) and is referred to informally herein as the complex of Kendrick Bay. Layering in the gneiss ranges from several mm to 50 cm in thickness and is defined by variations in the abundance of ferromagnesian minerals versus quartz and plagioclase. Ferromagnesian minerals consist of green hornblende and brown biotite which record amphibolite-facies metamorphism. The composition of the gneiss, combined with rare exposures of deformed pillows, volcanic breccia fragments, rhythmic sedimentary layering, and plutonic textures indicate that these metamorphic rocks have been derived from basaltic to andesitic volcanic rocks (SObv), volcaniclastic strata (SOgw and SOms), and subordinate dioritic to quartz dioritic intrusive rocks (Od and Oqd).

Sills of variably layered and foliated quartz monzonite (SOqm) and quartz diorite (Oqd) are also common. Layering and foliation in these sills and in adjacent quartz monzonite and granite (SOqm), quartz diorite (Oqd), and granite (SOgr) bodies are nearly everywhere parallel to the compositional layering and foliation in the complex. These relations plus gradational contacts between metadiorite belonging to this unit and adjacent quartz dioritic and dioritic rocks (Oqd) indicate that the metamorphism and deformation occurred during, and probably as a result of, emplacement of the Early Silurian and Ordovician intrusive rocks. Regional relations and relict protolith features indicate that the metasedimentary and metavolcanic components of this complex were derived from rocks of the Descon Formation rather than the Wales suite.

Or COMPLEX OF RUTH BAY (ORDOVICIAN)[1] -- A distinctive complex of metagabbro-metadiorite with subordinate metagranodiorite sills (approximately 20%) and screens of amphibolite-facies metavolcanic and metasedimentary rocks (5%). The complex occurs in the Ruth Bay region west of Klakas Inlet and is referred to informally herein as the complex of Ruth Bay. The relative proportions of various rock

[1] Age designation refers to the age of metamorphism and (or) deformation.

types are quite consistent between the Keete Inlet fault and the Bird Rocks fault and on southern Klakas Island. On small islands south of Klakas Island, however, the complex consists almost entirely of 10- to 50-cm-thick layers of foliated gabbro, diorite, and quartz diorite. The complex is juxtaposed to the east along the Keete Inlet fault against brecciated and deformed Early Silurian(?) and Ordovician stratified and intrusive rocks (Ogd, Od, SObv, and DSk) and to the west along the Bird Rocks fault against amphibolite-facies rocks of the Wales metamorphic suite (pmOw). The Bird Rocks thrust fault and rocks on either side of the fault are intruded by Silurian leucodiorite (Sd) and Cretaceous granodiorite (Kgd), which indicates that the Bird Rocks fault moved prior to the end of Late Silurian time. The age of movement on the Keete Inlet fault is constrained only as post-middle Early Devonian and pre-mid-Cretaceous (Herreid and others, 1978; Gehrels and Saleeby, in press).

Metavolcanic and metasedimentary rocks occur in this complex as several-m-thick, lens-shaped screens that are enveloped in metagabbro, metadiorite, and metagranodiorite. These metamorphic rocks are recognized by their compositional layering, relict pyroclastic fragments, and, in Clam Cove, the existence of a thin marble layer. The best exposures of protolith features occur near the narrow part of the large island in Ruth Bay. In most areas the metasedimentary and metavolcanic rocks consist of medium-grained green hornblende, brown biotite, plagioclase, opaque minerals, and minor quartz. The lack of penetrative deformation of protolith features in metavolcanic rocks suggests that these rocks were derived from the Descon Formation rather than the Wales suite.

The metagabbro-metadiorite generally consists of dark-gray to black, highly foliated and locally schistose amphibolite. Its color index ranges from 40 to 70, consisting primarily of green hornblende, plagioclase, sphene, opaque minerals, and minor quartz. The rocks are more highly altered to the east and are overprinted by secondary chlorite, epidote, calcite, and white mica. Contacts between various intrusive components in the complex are generally parallel to the pervasive regional foliation, which is defined by elongation and alignment of metamorphic minerals, and by slight cm-scale variations in the relative proportions of hornblende and plagioclase. The degree to which the ferromagnesian minerals are elongated and aligned varies, and in some rocks a plutonic texture is well preserved.

Both the metasedimentary-metavolcanic rocks and the metagabbro-metadiorite are intruded by sills and dikes of metagranodiorite which are generally 10 to 40 cm in thickness and up to several tens of meters in length. The sills commonly taper out along strike, but locally have abrupt, angular terminations or are truncated by ductile shear zones. These sills commonly intrude the other rocks along contacts that are parallel to the foliation in the country rocks and in the granodiorite itself. The metagranodiorite locally cuts across the foliation in adjacent rocks, but in such cases the granodiorite has a foliation which is parallel to, but not as strongly developed as the foliation in the country rocks. These rocks consist predominantly of quartz, plagioclase, K-feldspar, 5% to 15% brown biotite, up to 5% green hornblende that occurs in long narrow grains, sphene, and trains of opaque grains — all of which are elongated and aligned parallel to the foliation. Although the rocks commonly have a penetrative foliation defined by alignment of ferromagnesian minerals and elongation of quartz and plagioclase, a relict plutonic texture is preserved in most areas. Toward the east these rocks are moderately altered, with chlorite and epidote replacing ferromagnesian minerals, and secondary calcite, white mica, and epidote overprinting plagioclase.

The intrusive and structural relations described above indicate that the metaplutonic rocks were emplaced during deformation and amphibolite-facies metamorphism of the metasedimentary and metavolcanic rocks. The age of this deformation and metamorphism, and formation of the complex, is constrained by a U-Pb apparent age of 465 ± 7 Ma (Middle Ordovician) on a metagranodiorite sill (sample locality 5) which cuts across the foliation in metagabbro-metadiorite, yet contains the regional foliation. Age relations and compositional similarities suggest that the foliated intrusive rocks in this complex may be the deeper-level equivalents of Ordovician diorite (Od) and leucogranodiorite (Ogd) above the Keete Inlet fault (Gehrels and Saleeby, in press).

pmOw WALES METAMORPHIC SUITE (PRE-MIDDLE ORDOVICIAN)[1] -- A metamorphic suite of greenschist- to amphibolite-facies metavolcanic and metasedimentary rocks referred to originally as the Wales Group by Buddington and Chapin (1929). We have renamed these rocks the Wales metamorphic suite in accordance with guidelines recommended by the North American Commission on Stratigraphic Nomenclature (1983) (Gehrels and Saleeby, in press). In most areas this suite consists of light- to dark-green, fine-grained greenschist and greenstone derived from basaltic to andesitic volcanic rocks and volcaniclastic strata. Pillows and cm-scale pyroclastic fragments are locally preserved in the metavolcanic rocks, and metasedimentary rocks locally show relicts of rhythmic and graded bedding. The metavolcanic and metasedimentary rocks are interlayered over structural thicknesses of tens of meters. In most areas protolith features are obscured by metamorphic recrystallization, penetrative foliation, a high degree of flattening, and moderate elongation. Black phyllite and schist derived from argillaceous strata (A on Plate I) are interlayered with the greenschist and greenstone along the shoreline between Kassa Inlet and Mabel Bay. Meter-thick layers of silicic metavolcanic rocks (S on Plate I) and light-colored, coarsely recrystallized marble (L on Plate I) constitute a minor part of this metamorphic suite.

The Wales suite is metamorphosed to greenschist facies north of the study area (Eberlein and others, 1983; Herreid and others, 1978) and north and west of Kassa Inlet. The dominant metamorphic mineral assemblage in the greenschist-facies rocks consists of chlorite, actinolite, albite, epidote, and opaque minerals. South of Kassa Inlet the metamorphic grade increases eastward from greenschist to amphibolite facies. Along Ship Island Passage the rocks are similar in metamorphic grade and structural style to rocks north and west of Kassa Inlet. To the east the rocks become progressively higher in metamorphic grade, with brown biotite replacing chlorite, and almandine garnet occurring just west of the Shipwreck Point fault. Between the Shipwreck Point and Bird Rocks faults, the rocks are amphibolite facies and consist of fine- to medium-grained garnet, plagioclase, and hornblende and (or) biotite. In addition to this regional metamorphism, rocks in the suite have been metamorphosed to hornblende-hornfels facies adjacent to the Silurian leucodiorite (Sd) body in Kassa Inlet.

Rocks in the Wales metamorphic suite have a penetrative metamorphic foliation which is generally parallel to compositional layering and to the flattening of protolith features. Most rocks also have a strong linear fabric defined by the elongation of protolith features and by strong mineral lineations along foliation surfaces. Isoclinal folds in protolith features occur in some outcrops and have axes which are parallel to the mineral lineation and the elongation direction. The regional foliation generally forms the axial surface of these folds. Relations between the dominant fabric elements and these isoclinal folds, combined with the high degree of flattening of protolith features, indicate that the primary stratigraphic relations in these rocks have been transposed into the metamorphic foliation.

Superimposed on this metamorphic foliation and lineation are several sets of folds that do not have an axial planar foliation, and are interpreted to have formed after the main phase of deformation and metamorphism. Outcrop-scale folds generally plunge less than 30°, have wavelengths of 10 cm to several meters, and are highly asymmetric. Along the shoreline northwest of Shipwreck Point the metamorphic foliation dips to either the southeast or northwest in domains that define a synform-antiform pair with shallow-plunging, northeast-trending axes (Plate I). Asymmetric folds along this shoreline are coaxial with the synform-antiform pair and show both "s" and "z" asymmetry, with the

[1] Age designation refers to the age of metamorphism and (or) deformation.

direction of overturning in the up-dip direction of the foliation. This suggests that the outcrop-scale "s" and "z" folds along this shoreline, and common throughout the Wales metamorphic suite, may be parasitic to a series of shallow-plunging, upright antiforms and synforms with wavelengths of several tens to several hundreds of meters. These preliminary observations indicate that the outcrop-scale asymmetric folds common throughout the Wales suite may not have direct regional kinematic significance.

Relations north of the study area indicate that rocks in the Wales metamorphic suite were metamorphosed and deformed during Early Ordovician-Middle Cambrian time, and that their protoliths are pre-Late Cambrian in age. The maximum age of metamorphism and deformation has been determined north of the study area (in Cholmondeley Sound), where Middle and Late Cambrian metaplutonic rocks have been metamorphosed and deformed along with rocks in the Wales metamorphic suite (J. Saleeby, unpublished data; Gehrels and Saleeby, in press). These relations also demonstrate that the protoliths of rocks in the Wales metamorphic suite must be pre-Late Cambrian in age. An Early Ordovician age of metamorphism has been proposed by Turner and others (1977) based on an ^{40}Ar-^{40}K isochron apparent age of 483 Ma determined from hornblende with tremolite overgrowths. The occurrence of relatively nondeformed latest Early Ordovician and younger strata in the Descon Formation in many areas of southern Prince of Wales Island suggests that the metamorphism and deformation occurred prior to the end of Early Ordovician time. Thus, available constraints indicate that rocks in the Wales suite were deposited prior to Late Cambrian time, and were regionally deformed and metamorphosed during Middle Cambrian-Early Ordovician time.

Eberlein and others (1983) report that the Wales metamorphic suite may be overlain by a several-kilometer-thick section of south-dipping strata near the head of Klakas Inlet (several kilometers north of the study area). They argue that these strata are Cambrian in age and that the Wales suite is at least in part Precambrian because late Early to Middle Ordovician fossils have been recovered from the top of the section in southern Klakas Inlet (paleontologic sample locality 3). Our mapping in Klakas Inlet has shown, however, that the Ordovician strata at sample locality 3 are separated from rocks to the north by the Frederick Cove thrust fault, and that the strata north of the fault are moderately deformed, highly folded, and cut by many high- and low-angle faults. In addition, Herreid and others (1978) report that these strata are separated from the Wales suite near the head of Klakas Inlet by the Keete Inlet fault. Thus, a Precambrian age for rocks in the Wales metamorphic suite has not been demonstrated by stratigraphic relations or geochronometric determinations.

INTRUSIVE ROCKS

BASALTIC TO DACITIC(?) DIKES (CRETACEOUS TO ORDOVICIAN) — Dikes of basaltic to dacitic(?) composition are widespread in the study area. They have not been mapped separately on Plate I because of their narrow width and poorly constrained length, and also because of their abundance: in many areas there are several tens of dikes per kilometer. There are at least two sets of dikes in the area: an early set that is coeval with the Silurian and (or) Ordovician intrusive rocks, and a younger set that intrudes Devonian strata. The older dikes commonly have schistose borders and are tabular to irregular in shape, up to a meter in thickness, and laterally discontinuous. They consist predominantly of fine-grained, moderately chloritized hornblende, highly altered plagioclase, and abundant secondary epidote, chlorite, white mica, calcite, and other minerals. Younger dikes are generally tabular, laterally continuous, up to several meters in thickness, and steeply dipping, and they have sharp planar contacts with their country rocks. They commonly are more resistant to erosion than their country rocks and consist of fine-grained green hornblende and plagioclase (andesine) with minor opaque minerals and secondary epidote, chlorite, and calcite in the interstices. Hornblende phenocrysts are common in the younger dikes.

Cross-cutting relations indicate that dikes belonging to the second set were emplaced after middle Early Devonian time. These dikes apparently do not intrude mid-Cretaceous intrusive rocks (Herreid and others, 1983) and their relations with the Jurassic Bokan Mountain Granite (Jgr) are ambiguous. MacKevett (1963) reports that dikes of this set are less common in the granite than in adjacent Paleozoic country rocks, which indicates that they may be in part pre-Jurassic in age. Some dikes are apparently post-Jurassic, however, as albitization associated with the Jurassic granite has affected some dike rocks. These relations suggest that most dikes in the area were emplaced between middle Early Devonian and Jurassic time. We speculate that they may have been emplaced during a latest Paleozoic(?)-Triassic rifting event which affected rocks throughout the Prince of Wales Island region (Gehrels and Saleeby, in press).

Kgd GRANODIORITE (CRETACEOUS) — Massive, medium-grained granodiorite that intrudes Devonian and older rocks and several thrust faults west of Klakas Inlet. The color index of these rocks ranges from 5 to 25, with ferromagnesian minerals consisting of green hornblende and subordinate light-green augite and chloritized brown biotite. Anhedral opaque minerals (generally magnetite) constitute up to several percent of some samples, are commonly anhedral, and range up to a millimeter in diameter. Sphene is ubiquitous and locally over a millimeter in length. Plagioclase forms 2- to 5-mm-long, tabular, strongly zoned grains with moderately altered cores. The outer parts of the grains are oligoclase in composition. K-feldspar commonly grows in large (locally over a centimeter in diameter) anhedral grains around plagioclase, and also occurs as small grains intergrown with quartz in the interstices of larger plagioclase grains. Locally associated with these bodies are small masses of gabbro similar to rocks in the Cretaceous gabbro unit (Kgb).

These granodioritic rocks are readily distinguished from the Silurian and Ordovician plutonic rocks by their tabular and strongly zoned plagioclase, large anhedral K-feldspar, and abundant magnetite and sphene. We correlate these rocks with mid-Cretaceous intrusive rocks north of the study area (Herreid and others, 1978) based on their similar mineralogy and texture.

Kd DIORITE (CRETACEOUS) — Massive, medium- to coarse-grained diorite of probable Cretaceous age east of Klakas Inlet. The color index ranges from 15 to 40, with ferromagnesian minerals including moderately chloritized brown biotite (up to 15%), diopsidic(?) augite (5% to 20%) grains up to 5 mm in length, and green hornblende (10% to 25%) locally seen to be in a reaction relationship with clinopyroxene. Large euhedral grains of sphene, anhedral and irregular opaque (primarily magnetite) grains, and a minor proportion of small anhedral apatite constitute up to 5% of the rock. Quartz is a minor constituent, plagioclase occurs in euhedral to subhedral, tabular, strongly zoned grains of andesine composition, and K-feldspar forms large interstitial grains around the other minerals. This intrusive body is similar in mineralogy, texture, weathering characteristics, and aeromagnetic signature to mid-Cretaceous granodiorite and diorite bodies north of the study area (Eberlein and others, 1983; Rossman and others, 1956; Herreid and others, 1978) and is accordingly interpreted herein to be Cretaceous in age.

Kgb GABBRO (CRETACEOUS) -- A small body of medium- to coarse-grained gabbro that intrudes the Shipwreck Point fault and rocks belonging to the Wales metamorphic suite (pmOw) west of Ruth Bay. Green hornblende, moderately altered plagioclase, and chloritized brown biotite constitute most of the rock. Subordinate granodiorite pods are associated with this intrusive body. Dikes of granodiorite and gabbro cut the metamorphic foliation in the Wales suite and also cut cataclastic fabrics in rocks along the trace of the Shipwreck Point fault. This intrusive body is interpreted to be Cretaceous in age based on mineralogical and textural similarities with gabbroic phases of the mid-Cretaceous intrusive bodies north of the study area (Herreid and others, 1978; Eberlein and others, 1983).

Jgr BOKAN MOUNTAIN GRANITE (JURASSIC) -- A fine- to coarse-grained stock of peralkaline granite that occurs between Kendrick Bay and South Arm (Moira Sound). A considerable amount of research has been conducted on the petrology and geochemistry of this body because of its unusual composition and its association with uranium, thorium, and rare-earth-element deposits in the area. MacKevett (1963) originally mapped the stock as silica-rich, riebekite- and aegirine-bearing peralkaline granite. Thompson and others (1982) interpret the body to be a ring-dike complex and subdivide it into twelve separate phases of aegirine- and riebekite-bearing granite, aplite, porphyry, and pegmatite. The four major phases recognized by Thompson and others (1982: their figure 2) are subdivided on Plate 1 as follows: riebekite granite porphyry (Jgr-r), aegirine granite porphyry (Jgr-a), fine-grained riebekite granite porphyry (Jgr-fr), and felty-aegirine granite (Jgr-fa). The other rock-types are grouped into an undivided granite unit (Jgr).

Thompson and others (1982) describe these four phases as follows: Riebekite granite porphyry (Jgr-r) consists of quartz phenocrysts (up to 5 mm in diameter), subhedral riebekite phenocrysts (up to 4 mm in length), albite, and K-feldspar. This rock grades outward through a transition zone of aegirine- and riebekite-bearing granite into aegirine granite porphyry (Jgr-a). Phenocrysts in the aegirine porphyry include quartz and microperthite grains up to 8 mm in diameter. Groundmass and accessory minerals include quartz, microcline, albite, aegirine, sphene, zircon, monazite, muscovite, and fluorite. The fine-grained riebekite granite porphyry (Jgr-fr) consists of microcline, quartz, and riebekite phenocrysts in a groundmass of albite, microcline, quartz, and riebekite. Felty-aegirine granite (Jgr-fa) occurs in the center of the body and consists of fine aegirine needles in an aplitic groundmass of quartz, K-feldspar, albite, and accessory sphene and fluorite.

As reported by Saint-Andre and others (1983), Bernard Collot has divided the granite into three main phases: 1) albitic aegirine granite around the margin of the body, 2) fine-grained albitic arfvedsonite-aegirine granite in the center, and 3) albitic arfvedsonite granite between them. We concur that the sodic amphibole in the rock is arfvedsonite rather than riebekite.

The Bokan Mountain Granite has been dated by a variety of isotopic methods, all of which yield Jurassic apparent dates. Lanphere and others (1964) report K-Ar dates of 185 ± 8 Ma and 190 ± 8 Ma (Middle to Early Jurassic) on riebekite (arfvedsonite?), and Saint-Andre and others (1983) report a U-Pb apparent age of 171 ± 5 Ma (Middle Jurassic) based on analyses of 10 zircon fractions. We consider this U-Pb age suspect, however, because: 1) their (radiogenic lead)/(common lead) is so low that even a small error in the assigned composition of common lead results in a large uncertainty in apparent age, and 2) several fractions plot above concordia on a $^{206}Pb^*/^{238}U$ versus $^{207}Pb^*/^{235}U$ concordia diagram, which indicates that their concentrations of uranium and lead may be incorrect due to incomplete dissolution of the zircon and (or) incomplete equilibration of the sample and spike. This interpretation is supported by their lower intercept with concordia of 0 ± 15 Ma. Rb/Sr analyses of ten whole-rock samples from various phases of the granite yield an $^{87}Sr/^{86}Sr$ versus $^{87}Rb/^{86}Sr$ isochron apparent age of less than 156 Ma (Armstrong, 1986). A selection of seven samples yields an isochron apparent age of 151 ± 5 Ma (Late Jurassic) which Armstrong (1986) interprets to be a minimum age for the granite.

Dph PLAGIOCLASE-PORPHYRITIC HYPABYSSAL ROCKS (EARLY DEVONIAN) — Small intrusive bodies of plagioclase porphyry that occur in association with Devonian strata in the Klakas Inlet region. Similar bodies have been mapped by Herreid and others (1978) in Devonian strata to the north near Keete Inlet. Large (.4 to 1.5 cm long), euhedral, moderately altered, interlocking grains of labradorite and andesine constitute most of the rock. Light-green to light pinkish brown diopsidic(?) augite constitutes from 15% to 30% of most samples and occurs as several-mm-scale, subhedral grains intergrown with plagioclase. In some samples these clinopyroxene grains have rims of green or reddish-brown hornblende and opaque minerals. Microcline and microperthite generally occur as sub-mm-scale grains in the interstices of plagioclase grains. The abundance of K-feldspar is quite variable and opaque minerals occur as skeletal grains up to 3 mm across. Millimeter-scale angular clots of chlorite and subordinate opaque minerals, calcite, and white mica have filled miarolitic cavities in the rock. These cavities and the lack of hornfels aureoles around the intrusive bodies indicate that they were emplaced at shallow levels.

Cross-cutting relations with Early Devonian strata indicate that these rocks are Devonian or younger, and mineralogical and textural similarities suggest that they are related to the Early Devonian plagioclase-porphyritic volcanic rocks (Dpv) in the southwestern part of the area.

Sd LEUCODIORITE (LATE SILURIAN) — Massive, medium- to coarse-grained leucocratic diorite and subordinate monzodiorite and monzonite in Kassa Inlet and inland to the southeast. On Kassa Island the body intrudes across metamorphic fabrics in the Wales metamorphic suite (pmOw), and has a hornblende-hornfels contact aureole which extends for distances of several meters. Dikes also cut the deformational fabrics in Ordovician metaplutonic rocks belonging to the complex of Ruth Bay (Or) south of Kassa Inlet. Map patterns indicate that the body cuts across the northern continuations of the Bird Rocks and Shipwreck Point faults.

These rocks lack quartz, have a color index of less than 25, and include 1- to 6-mm-long anhedral grains of arfvedsonite that in some samples contain cores of aegirine-augite. Melanite(?) garnet constitutes up to 10% of the rock, and is generally medium- to dark-brown, moderately zoned, subhedral to euhedral, and up to 4 mm in diameter. Sphene occurs as euhedral to subhedral grains up to 5 mm in length that are commonly intergrown with garnet and arfvedsonite. Opaque minerals are rare. The grains listed above tend to occur in glomerocrysts up to a centimeter in diameter. Moderately zoned, tabular plagioclase grains up to 7 mm in length constitute most of the rock. The cores of these grains are highly altered whereas the outer parts are fresh and oligoclase in composition. Microperthite is generally less abundant than plagioclase, and forms in the interstices between plagioclase grains and glomerocrysts of the other minerals.

A U-Pb apparent age of 418 ± 5 Ma (Late Silurian) has been determined on a sample of leucodiorite from Kassa Island (geochronologic sample 11: Gehrels and Saleeby, in press).

SOsy QUARTZ SYENITE AND GRANITE (EARLY SILURIAN AND (OR) LATE ORDOVICIAN) — A heterogeneous suite of massive, fine- to medium-grained, gray-, reddish gray-, and maroon-weathering quartz syenite and granite in the McLean Arm-Nichols Bay region. In Stone Rock Bay these rocks intrude, and locally appear to grade into, rocks belonging to the pyroxenite and hornblendite (SOpx) unit. Along the shoreline between Cape Chacon and Nichols Bay, and in the interior of the island between McLean Arm and Nichols Bay, these rocks are difficult to distinguish from rocks belonging to the quartz monzonite and granite (SOqm) unit. More detailed mapping in this area would probably result in designation of a map unit consisting of rocks intermediate in composition and texture between the quartz syenitic and quartz monzonitic rocks. On Plate I, these intermediate rocks have been grouped with rocks in the quartz monzonite and granite (SOqm) map unit. Dikes of maroon to red feldspar-porphyritic syenite cut rocks belonging to all of the units in the McLean Arm-Nichols Bay area and represent the latest phase of syenitic intrusive activity.

The quartz syenitic and granitic rocks have a low color index (generally less than 20) and consist primarily of interlocking, fine- to medium-grained microperthite, quartz, and plagioclase. Plagioclase forms tabular grains up to 3 mm in length that are generally the largest grains in the rock. They are highly altered with secondary white mica, calcite, and epidote, and have albitized rims. Compositionally they range from low-calcium andesine to oligoclase and are not zoned. K-feldspar occurs as sub-mm-scale anhedral grains of microperthite intergrown with quartz around plagioclase grains. These grains are not as highly altered as the plagioclase, but have a slight overprint of fine-grained white mica, calcite, and epidote. The ratio of microperthite to plagioclase is generally about 2:1. Quartz grains are also sub-millimeter in size and constitute from 5% to 30% of most rocks. Ferromagnesian minerals include glomerocrysts of green hornblende and subordinate brown biotite, opaque minerals, and sphene. In most samples the hornblende and biotite are moderately altered to chlorite and opaque minerals. Zircon is an abundant accessory mineral, and medium-brown garnet is locally present. Syenitic rocks described by MacKevett (1963) are quite similar to the rocks described above, except for a greater abundance of quartz in our samples.

We have determined a U-Pb apparent age of 438 ± 5 Ma (earliest Silurian and (or) latest Ordovician) on a sample of quartz syenite from sample locality 10 (Gehrels and Saleeby, in press).

SOpx PYROXENITE AND HORNBLENDITE (EARLY SILURIAN AND (OR) LATE ORDOVICIAN) -- Coarse-grained to pegmatitic pyroxenite, hornblende pyroxenite, and hornblendite that occurs along the eastern shore of southernmost Prince of Wales Island. In McLean Arm, Stone Rock Bay, and at the western end of the elongate body north of Cape Chacon this unit consists of medium- to coarse-grained pyroxenite and hornblende pyroxenite. Hornblende generally occurs around cores of augite grains and is associated with abundant opaque minerals. Plagioclase locally occurs in the interstices of the large grains, and MacKevett (1963) reports that biotite occurs in some samples. The ultramafic body along the shoreline north of Cape Chacon is a coarse-grained hornblendite to hornblende pegmatite with hornblende crystals up to 10 cm in length. Large grains of anhedral opaque minerals are common in this rock and plagioclase occurs in the interstices of the hornblende crystals. The pyroxenite and hornblendite are intruded by quartz monzonite (SOqm) along the shoreline north of Cape Chacon, and by quartz syenite (SOsy) at several localities in Stone Rock Bay. Also in Stone Rock Bay, however, is an exposure of quartz syenite grading into fine-grained pyroxenite over a distance of several meters. MacKevett (1963, p. 17) reports that the contacts between the pyroxenite and quartz monzonite are "gradational through a zone of hybrid rock or intrusive breccia." These relations, plus the close spatial association of ultramafic rocks with quartz syenite and quartz monzonite suggest that rocks in the three units may be coeval and genetically related. We have accordingly assigned an Early Silurian and (or) Late Ordovician age to the ultramafic rocks.

SOgr GRANITE (EARLY SILURIAN AND (OR) LATE ORDOVICIAN) -- Weakly foliated, light-pink to light-gray, coarse-grained granite that occurs along the eastern shore of Prince of Wales Island between the Kendrick Islands and McLean Arm. The foliation in this rock is generally parallel to the strong foliation and layering in the complex of Kendrick Bay (SOk) and the weak foliation in adjacent bodies of quartz monzonite and granite (SOqm). Foliated sills of granite are generally parallel to the foliation in these rocks, suggesting that the granite was emplaced during the waning stages of deformation and metamorphism.

The granite has a color index of less than 10 and consists primarily of interlocking plagioclase, quartz, and large K-feldspar grains. Plagioclase is generally oligoclase with moderate zoning from more calcic interiors to more sodic rims. Some grains show oscillatory zoning as well. Their interiors are moderately altered with secondary white mica, calcite, and epidote, and the rims are slightly albitized. They occur both as small grains enclosed in K-feldspar, and as subhedral grains up to 5 mm long that are intergrown with K-feldspar and quartz. Quartz occurs as large anhedral grains intergrown with feldspar and constitutes up to 40% of some samples. K-feldspar occurs both as poikilitic microperthite grains up to 1.5 cm across and as microcline grains less than several millimeters in diameter. Ferromagnesian minerals have been altered to chlorite and opaque minerals in most samples, although large books of brown biotite are preserved in some rocks. Based on the shape of the chlorite masses, it appears that biotite was originally dominant over hornblende. Large subhedral sphene and small euhedral zircon grains are common accessory phases.

A U-Pb apparent age of 438 ± 5 Ma (geochronologic sample 9) indicates that rocks in this map unit were emplaced during earliest Silurian and (or) latest Ordovician time (Gehrels and Saleeby, in press).

SOqm QUARTZ MONZONITE AND GRANITE (EARLY SILURIAN AND (OR) LATE ORDOVICIAN) -- Medium-grained quartz monzonite and granite that underlies much of the eastern and central parts of southern Prince of Wales Island. In most areas these rocks are massive, although along the eastern shore of Prince of Wales Island the rocks are locally foliated. Between Kendrick and Ingraham Bays the foliated rocks are mapped as a separate unit of foliated quartz monzonite (SOfqm). Mafic dikes are widespread in the quartz monzonitic rocks, and locally show evidence of emplacement prior to crystallization of the country rocks. Agmatite with blocks of microdiorite in a quartz monzonite host is also common. The quartz monzonitic rocks intrude the slightly older quartz diorite (Oqd) and are in turn intruded by granite (SOgr) and quartz syenite (SOsy).

Rocks in this unit are quite variable in color index, relative proportions of plagioclase versus K-feldspar, and abundance of quartz, but generally are quartz monzonite, granite, granodiorite, or quartz monzodiorite in composition. Their color index ranges from 5 to as much as 50, with an average of approximately 25. More mafic and more leucocratic phases are in most cases gradational with quartz monzonite, and are interpreted to be cogenetic.

Most rocks consist primarily of interlocking plagioclase, K-feldspar, and quartz. Plagioclase occurs as tabular and subhedral grains that have moderate compositional zoning. Their cores generally are highly altered with secondary white mica, calcite, and epidote, and outer parts of the grains are sodic andesine to calcic oligoclase in composition. In highly altered rocks the plagioclase has albitized rims, but the widespread albitization reported by MacKevett (1963) has not been observed in samples from outside the western Kendrick Bay region. The plagioclase grains are locally up to 7 mm in length and appear to have been among the early minerals to crystallize. K-feldspar occurs both as subhedral grains up to several millimeters in length, and as smaller microperthite grains in the interstices of the ferromagnesian minerals and larger feldspars. K-feldspar is slightly subordinate to plagioclase in abundance in most rocks. Quartz constitutes between 5% and 40% of the rocks and occurs as anhedral grains in the interstices of feldspar and ferromagnesian minerals. Green hornblende (commonly with cores of light-green augite) is slightly more abundant than brown biotite, and both occur together in glomerocrysts up to a centimeter in diameter. Opaque minerals and sphene are common in these glomerocrysts as well. Apatite and zircon are common accessory minerals.

Biotite quartz monzonite from sample locality 8 yields a U-Pb apparent age of 438 ± 4 Ma (earliest Silurian and (or) latest Ordovician: Gehrels and Saleeby, in press). Lanphere and others (1964) report K-Ar apparent ages of 454 ± 22 Ma on hornblende (geochronology sample locality 13) and 379 ± 18 Ma on biotite (geochronology sample locality 14) from quartz monzonite in the South Arm of Kendrick Bay. Armstrong (1986) reports an $^{87}Rb/^{86}Sr$ versus $^{87}Sr/^{86}Sr$ isochron apparent age of 432 ± 19 Ma based on analyses of rocks collected from this map unit, a more foliated quartz monzonite that may or may not belong to this unit, and gabbro which probably belongs with rocks in the diorite (Od) map unit. His samples of quartz monzonite alone do not have a sufficient range in $^{87}Rb/^{86}Sr$ to define a meaningful isochron, and are therefore not reliably dated by this method. Assuming that the biotite date of Lanphere (1964) is not a crystallization age, the various geochronological data and field relations are consistent with emplacement of these rocks during Early Silurian and (or) Late Ordovician time.

SOfqm FOLIATED QUARTZ MONZONITE (EARLY SILURIAN AND (OR) LATE ORDOVICIAN) — Foliated and locally layered quartz monzonite that occurs near large quartz monzonite and granite (SOqm) bodies in the Kendrick Bay region. Contacts between foliated quartz monzonite (SOfqm) and non-foliated quartz monzonite (SOqm) are gradational where exposed, suggesting that rocks in the two units are coeval and genetically related. Between Ingraham and Kendrick Bays these foliated rocks intrude and produce hornblende-hornfels aureoles in adjacent volcanic rocks of the Descon Formation. The foliation in the intrusive rocks is defined by elongation of the quartzo-feldspathic minerals and alignment of hornblende and biotite. On the Kendrick Islands and locally to the north these rocks have a faint cm-scale layering defined by variations in the relative proportion of quartzo-feldspathic versus ferromagnesian minerals.

The mineralogy of these rocks is similar to that in associated quartz monzonite and granite (SOqm): dominant minerals include mm-scale subhedral plagioclase, quartz, K-feldspar, and approximately 25% hornblende and biotite. The primary differences are that quartz tends to be finer-grained and elongate, and hornblende and biotite are generally aligned and commonly occur in elongate masses.

Oqd QUARTZ DIORITE AND DIORITE (LATE ORDOVICIAN) — Fine- to medium-grained quartz diorite and subordinate diorite and quartz monzonite that occurs primarily in the Kendrick Bay region (MacKevett, 1963). Quartz diorite and diorite have not been subdivided in the area mapped by MacKevett (1963) -- outside this area we have mapped them separately into quartz diorite (Oqd) and diorite (Od) units. In the area mapped by MacKevett (1963), the two rock types are gradational and generally similar in mineralogy. They differ primarily in color index, which ranges from 40 to 60 for diorite and from 20 to 40 for quartz diorite. Quartz diorite is commonly massive, although mafic dikes and agmatitic zones are widespread. Dioritic rocks are more heterogenous, with common zones of diorite-basite migmatite and agmatite, and comb-textured dikes of hornblende pegmatite. Rocks in this unit intrude the Descon Formation and are intruded by Early Silurian and (or) Late Ordovician quartz monzonite and granite (SOqm).

Quartz diorite consists primarily of interlocking plagioclase, hornblende, and quartz. Plagioclase occurs as tabular grains of andesine that range in length from less than a millimeter to 6 mm. The grains are slightly zoned, and their interiors commonly are more highly altered with secondary white mica, calcite, and epidote than the margins. K-feldspar is generally absent, although a few samples contain interstitial microperthite. Quartz generally constitutes less that 15% of the rock and occurs as small interstitial grains. Green hornblende forms several-mm-long grains intergrown with subordinate brown biotite (generally chloritized) and opaque minerals. Hornblende grains are commonly poikilitic with many small inclusions of quartz, plagioclase, and accessory minerals. Opaque minerals are locally over a millimeter in diameter and constitute up to several percent of some samples. Sphene occurs as fairly large subhedral grains, and apatite and zircon are minor accessory phases.

The age of the quartz diorite is constrained by a U-Pb apparent age of 445 ± 5 Ma (Late Ordovician: Gehrels and Saleeby, in press) on a sample from Kendrick Bay (geochronologic sample 6). Lanphere and others (1964) report a K-Ar apparent age of 439 ± 21 Ma (Late Ordovician) on hornblende from quartz diorite in western Kendrick Bay (geochronologic sample locality 15).

Ofgd FOLIATED GRANODIORITE (ORDOVICIAN) — Foliated and locally layered leucocratic granodiorite that occurs in the vicinity of Tah Island. These rocks intrude and are interlayered with foliated and layered Ordovician dioritic rocks (Ofd). Contacts between the granodiorite and diorite are nearly everywhere parallel to the foliation and layering in the diorite and the foliation in the granodiorite. Some rocks have only a slight foliation, yielding well-preserved plutonic textures. Highly foliated rocks generally occur in narrow domains interpreted to have been ductile shear zones. Contact relations with the dioritic rocks combined with the style and variability of the foliation in the granodiorite indicate that the granodiorite was emplaced and deformed prior to complete crystallization of the diorite.

Highly foliated members of this unit consist of fine-grained, interlocking quartz, plagioclase, and subordinate K-feldspar and subhedral green hornblende. Their foliation is defined by alignment of elongate hornblende and quartz grains, thin layers of chlorite and epidote aligned parallel to the foliation, and slight cm-scale variations in grain size and relative abundance of the minerals. Opaque minerals tend to be more common in the coarser-grained quartzo-feldspathic layers. The less-foliated rocks retain their primary texture and consist of medium-grained plagioclase (oligoclase), quartz, and microperthite. Up to 15% of the rock consists of hornblende grains that are moderately recrystallized to chlorite and opaque minerals.

The age of rocks in this unit has not been determined directly, as a geochronologic sample of foliated leucogranodiorite from the larger island west of Tah Island did not yield zircons. Intrusive and structural relations suggest, however, that these rocks are generally coeval with the foliated and layered diorite and quartz diorite (Ofd) of known Ordovician age.

Ofd FOLIATED AND LAYERED DIORITE AND QUARTZ DIORITE (ORDOVICIAN) — Moderately to highly foliated and layered diorite and quartz diorite that occurs near Tah Bay and in Max Cove. There is a continuous gradation in this unit from rocks that are moderately foliated and display intrusive relations, to highly layered and foliated rocks that only locally display protolith relations. In highly deformed domains the dioritic and quartz dioritic rocks form strongly foliated, several-cm-thick layers in which the compositional layering is nearly everywhere parallel to the penetrative foliation. Locally, however, quartz dioritic layers intrude at an acute angle across the foliation in more dioritic rocks, yet contain a foliation parallel to that in their country rocks. Cross-cutting relations are common in the moderately deformed rocks, where more silicic rocks generally intrude more basic rocks. In most cases the foliation in the younger intrusive rocks is not as strongly developed as in the rocks they intrude.

A continuous gradation between highly and moderately deformed rocks is seen along the eastern shore of the narrow bay east of Tah Bay. In the northern part of the bay (and inland to the east) the rocks have a strong and laterally continuous foliation and layering. To the south the rocks become less foliated, intrusive contacts between the various layers are well preserved, and the layering and foliation are variable in orientation. In the southern part of this narrow bay the layers are clearly intrusive dikes and sills with well-preserved igneous fabrics, the rocks are not as highly foliated, and the average thickness of compositional units increases to several tens of centimeters. Quartz diorite also replaces diorite as the dominant rock type.

Dioritic to quartz dioritic rocks belonging to this unit consist of varying proportions of green hornblende, plagioclase, and quartz. In the dioritic rocks, elongate green hornblende grains up to 5 mm in length constitute 25% to 50% of the rock. Anhedral plagioclase grains of andesine composition are generally smaller than hornblende. Quartz and K-feldspar are minor components of the dioritic rocks and occur as small grains intergrown with plagioclase. Most rocks are fairly fresh, although in some samples hornblende has been replaced by chlorite, epidote, and opaque grains, and plagioclase has been altered to white mica, epidote, and calcite. Hornblendite is a minor component and consists of interlocking, subhedral, green hornblende grains that are locally over a centimeter in length. Plagioclase occurs in the interstices of the hornblende grains. Quartz dioritic rocks are similar to the diorite except for greater proportions of quartz and K-feldspar, and the presence of large anhedral sphene grains.

A moderately foliated quartz diorite in Tah Bay (geochronologic sample 7) yields a U-Pb apparent age of 446 ± 5 Ma (Late Ordovician: Gehrels and Saleeby, in press). This is interpreted to be the approximate age of formation of the unit based on the intrusive and structural relations described above. Similarities in mineralogy, composition, and apparent age indicate that these rocks may be related to rocks in the quartz diorite and diorite (Oqd) unit.

Intrusive relations indicate that these rocks were deformed prior to and during crystallization. We interpret this deformation to have occurred in response to primarily magmatic processes, as there is no evidence in the area of regional deformation during Late Ordovician time.

Ogd LEUCOGRANODIORITE (ORDOVICIAN) -- Leucogranodiorite in the Klakas Inlet region which intrudes Ordovician diorite (Od) and rocks of the Descon Formation (SObv and SOa), and is locally overlain by Early Devonian clastic strata (Dcg and Dbx). Contacts between leucogranodiorite and older rocks are commonly agmatitic, with 10-cm-scale clasts of country rock enveloped in leucogranodiorite. In most areas of Klakas Inlet and Max Cove the rocks in this unit are penetratively brecciated and consist of cm-scale angular clasts in a matrix of fine-grained rock fragments, quartz, and plagioclase. Adjacent to the brecciated domains are regions in which the rocks are highly fractured -- only rarely are they not deformed.

Rocks in this unit consist of interlocking and commonly myrmekitic plagioclase, quartz and subordinate interstitial microperthite. Plagioclase occurs as subhedral, nonzoned grains ranging from a few millimeters to over a centimeter in length. Compositionally the plagioclase is oligoclase to calcic albite. In most rocks the plagioclase has been overprinted by fine-grained, secondary white mica, calcite, and epidote. Quartz occurs as large grains with myrmekitic or sutured boundaries against plagioclase, and as small interstitial grains. The leucogranodiorite contains up to 20% microperthite that occurs in most samples as small grains in the interstices of plagioclase and quartz. The original ferromagnesian minerals are totally altered to blocky masses of chlorite and tiny opaque grains, the shape of which suggests that hornblende was probably the original ferromagnesian mineral. These chlorite masses constitute less than 5% of most rocks.

The age of these rocks has been determined by U-Pb apparent ages of 462 ± 15 Ma (Middle Ordovician) from a sample on Klakas Island (sample locality 2) and 468 ± 15 Ma (Middle Ordovician) from a sample in Max Cove (sample locality 3: Gehrels and Saleeby, in press). Turner and others (1977) report a K-Ar (hornblende) apparent date of 428 ± 13 on granodiorite at locality 12, which they interpret to be a minimum age. This granodiorite is intruded by the leucogranodiorite which we have dated at locality 3, which suggests that 428 ± 13 Ma is considerably younger than the emplacement age of the rock. We suggest that their date may alternatively record the timing of deformation and alteration of the pre-middle Early Devonian rocks in the southern Klakas Inlet region (Gehrels and Saleeby, in press).

Od DIORITE (ORDOVICIAN) -- A heterogeneous suite of diorite and subordinate hypabyssal diorite and gabbro that occurs in the western and southern parts of the study area. On Klakas Island, in Ruth Bay, and along the western shore of Max Cove the rocks are medium grained and homogeneous but have a penetrative cataclastic fabric in many areas. Along the east shore of Max Cove they are massive, agmatitic with diorite clasts in a quartz diorite or leucogranodiorite matrix, or moderately layered and foliated. On Middle Island (Barrier Islands), dioritic rocks occur as dikes and as small intrusive bodies of diorite, quartz diorite, and subordinate gabbro that are interpreted to be subvolcanic to adjacent basaltic to andesitic rocks of the Descon Formation (SObv). On southernmost Prince of Wales Island the rocks are massive, homogeneous, and both intrude and are intruded by quartz-porphyritic granodiorite (Oqgd). In the Kendrick Bay-McLean Arm region, MacKevett (1963) maps the dioritic rocks together with quartz diorite, and both are included in the quartz diorite (Oqd) map unit on Plate 1. The rocks shown as diorite (Od) in the Kendrick Bay-McLean Arm area were mapped by MacKevett (1963) as gabbro.

Dioritic rocks belonging to this unit have a color index of approximately 40, with a range from 65 for the more gabbroic rocks to as low as 25. Most rocks are medium grained and consist primarily of green hornblende, moderately altered plagioclase, and subordinate quartz and K-feldspar. Hornblende is several millimeters or less in length, subhedral, and only slightly altered in most rocks. In a few samples, particularly near Max Cove, a small amount of biotite is intergrown with hornblende, and some hornblende grains contain small cores of augite. Small grains of opaque minerals, apatite, and sphene are associated with the ferromagnesian minerals. Plagioclase occurs as slightly zoned, moderately to highly altered subhedral grains up to 5 mm in length. The outer parts of most grains are andesine in composition: their interiors are too highly altered for compositional analysis. Quartz occurs as small interstitial grains in most samples and rarely constitutes over 10% of the rock. K-feldspar is rare except near Max Cove where samples contain up to 10% interstitial microperthite.

Dioritic rocks yield a U-Pb apparent age of 480-460 Ma from Max Cove (sample locality 4: Gehrels and Saleeby, in press). This approximate age combined with the close association between dioritic rocks and quartz-porphyritic granodiorite (Oqgd) and quartz diorite (Oqd) indicate that the diorite is of Middle and perhaps locally Late Ordovician age.

Oqgd QUARTZ-PORPHYRITIC GRANODIORITE (ORDOVICIAN) -- Large bodies of medium-grained, quartz-porphyritic granodiorite that occur on southwesternmost Prince of Wales Island. In the Barrier Islands and along the southeastern shore of Hessa Inlet, the granodiorite contains many small bodies of diorite, the larger ones of which are shown on Plate 1. In proximity to these dioritic bodies the granodiorite is agmatitic, with angular and lens-shaped blocks of diorite, microdiorite, or microgabbro. These rocks are also intruded by dikes and small bodies of fine-grained quartz diorite, diorite, gabbro, and basalt in many areas. Intrusive relations suggest that the dikes were emplaced prior to solidification of the granodiorite. In many areas the granodiorite is also intruded by diorite (Od). Contradictory intrusive relations with diorite and the evidence for syn-igneous emplacement of dioritic dikes indicate that the quartz-porphyritic granodiorite (Oqgd) and diorite (Od) are at least in part coeval.

Rocks in this unit consist primarily of large plagioclase and quartz grains, small, highly altered ferromagnesian minerals, and interstitial microperthite. Plagioclase is generally subhedral, tabular, 2 to 6 mm in length, and oligoclase in composition. Secondary white mica, calcite, and epidote are widespread in the interiors of the grains, and the margins are commonly albitized. Myrmekitic intergrowths with quartz are common along the margins of the grains, and in some samples all of the plagioclase is myrmekitic. In most samples plagioclase occurs in irregular clusters separated by large (up to a centimeter in diameter) bluish quartz grains. Microperthite and subordinate microcline occur in the interstices of plagioclase and quartz. These grains constitute 10% to 20% of most samples, rendering a plagioclase to K-feldspar proportion of about 3:1. In a few samples microperthite grains are quite large and envelop plagioclase. The original ferromagnesian minerals have been entirely altered to millimeter-scale blocky masses of chlorite and opaque minerals. The shape of the masses suggests that the secondary minerals have replaced hornblende rather than biotite. The color index of most rocks ranges from 5 to 20. Sphene and zircon occur as tiny accessory phases in most samples.

A U-Pb apparent age of 472 ± 5 Ma (Middle Ordovician) on a sample from Hessa Inlet (geochronologic sample 1: Gehrels and Saleeby, in press) indicates that these rocks were emplaced during Middle Ordovician time.

pmOgb METAGABBRO (PRE-MIDDLE ORDOVICIAN) — A heterogeneous body of metamorphosed and deformed gabbro that intrudes protoliths of the Wales metamorphic suite (pmOw) near Ship Island Passage (Plate 1). The rocks generally consist of several-mm- to cm-scale grains of clinopyroxene, hornblende, chlorite, and opaque minerals, mm-scale grains of zoned and highly altered plagioclase, and abundant small grains of chlorite, epidote, calcite, and white mica. These rocks intrude protoliths of the Wales metamorphic suite (pmOw) and have experienced the regional greenschist-facies metamorphism. Their minimum age is constrained by the interpretation that regional metamorphism occurred during Early Ordovician-Middle Cambrian time (Gehrels and Saleeby, in press).

STRUCTURAL GEOLOGY

The dominant regional structures in the area include thrust faults, the Keete Inlet fault, and several sets of strike-slip faults. The nature of the faults and their sense and age of displacement are described below. Structures that are restricted to a particular map unit (e.g., folds and deformational fabrics in the Wales metamorphic suite) are described for each unit in the Description of Map Units.

THRUST FAULTS

Shipwreck Point, Bird Rocks, and Ruth Island faults

Thrust faults west of and structurally beneath the Keete Inlet fault dip toward the east at moderate angles and imbricate a variety of Ordovician and older rocks. These faults have been studied primarily along the south shore of the peninsula south of Kassa Inlet -- their trace to the north is inferred from topography and from strong lineaments on aerial photographs. The southern shore of Kassa Inlet has not been revisited to check for the existence of these faults.

The Bird Rocks fault forms a major tectonic boundary in that it juxtaposes Ordovician metaplutonic and subordinate metavolcanic and metasedimentary rocks (complex of Ruth Bay: Or) against amphibolite-facies rocks of the Wales metamorphic suite (pmOw). The fault is recognized along the shoreline west of Ruth Bay as a wide zone of brecciation which separates amphibolite-facies rocks of the Wales suite (pmOw) from rocks belonging to the complex of Ruth Bay. The Ruth Island fault is recognized as a several-m-wide zone in which rocks belonging to the complex of Ruth Bay are brecciated into 10-cm-scale angular blocks. Zones of brecciation associated with both the Ruth Island and Bird Rocks faults are intruded by Cretaceous granodiorite (Kgd) along the shoreline west of Ruth Bay.

The Shipwreck Point fault occurs within rocks of the Wales metamorphic suite (pmOw) and juxtaposes amphibolite-facies rocks to the east against greenschist-facies rocks to the west. Structural trends on either side of the fault are also quite different: to the west the foliation and axes of asymmetric folds strike and trend to the northeast, whereas to the east the structural grain is northwesterly. The fault outcrops in the bay east of Shipwreck Point as a several-m-wide zone of breccia intruded by swarms of gabbro (Kgb) dikes.

These faults are interpreted to dip easterly because slickenside surfaces within the fault zones and in rocks on either side generally dip at moderate angles toward the east, and because their traces inland indicate gently eastward-dipping fault planes. Their slip-line is recorded by an abundance of east-northeasterly trending slickenside striae on minor fault surfaces (Gehrels and Saleeby, in press). A southwestward direction of movement is indicated by: 1) juxtaposition of higher-grade rocks over lower-grade rocks along the Shipwreck Point fault (assuming that higher-grade rocks were at greater depth than lower-grade rocks prior to movement on the fault), and 2) southwestward overturning of a regional antiform in the complex of Ruth Bay (Or) above the above the Ruth Island fault. A detailed study of minor folds along the shoreline west of the Bird Rocks fault demonstrates that asymmetric folds in the Wales metamorphic suite (pmOw) formed prior to movement on the thrust faults.

Toward the north the Shipwreck Point, Bird Rocks, and Ruth Island faults are intruded by a large body of Silurian leucodiorite (Sd) in Kassa Inlet and are apparently cut by the Keete Inlet fault. Rocks of the Wales metamorphic suite (pmOw) north and west of Kassa Inlet and on the large island north of Kassa Island are greenschist facies, and are interpreted to occur structurally beneath the Shipwreck Point fault. In contrast, rocks on the northeastern corner of Kassa Island were apparently of regional amphibolite facies prior to contact metamorphism related to the Silurian leucodiorite (Sd) body. The Shipwreck Point fault is therefore tentatively shown separating these amphibolite-facies(?) rocks from greenschist-facies rocks to the north and west. Because metaplutonic rocks belonging to the complex of Ruth Bay (Or) do not occur on Kassa Island, the northward continuation of the Bird Rocks fault is drawn south and east of Kassa Island.

The minimum age of movement on these faults is constrained by the cross-cutting body of Silurian leucodiorite (Sd) on and adjacent to Kassa Island. Their maximum age is indicated by exposures of brecciated Middle Ordovician metagranodiorite along the Ruth Island and Bird Rocks faults west of Ruth Bay. Regional relations suggest that thrust faults in this system moved primarily during earliest Devonian-Silurian time (Gehrels and Saleeby, in press).

Frederick Cove fault

The Frederick Cove fault juxtaposes two different stratigraphic sections of the Descon Formation along the northern edge of the study area. North of the fault, Early Silurian(?) and Ordovician argillite, shale, mudstone, and siltstone generally dip and face to the southwest. Rocks south of the fault consist of Ordovician volcanic rocks and subordinate marine clastic strata which, based on reconnaissance mapping along the north shore of Moira Sound, probably underlie the clastic strata north of the fault.

The fault is not exposed at the head of Frederick Cove, but strong topographic and vegetational lineaments can be traced inland on aerial photographs from the northern and southern shorelines at the head of the bay. Volcanic rocks along the shore of Frederick Cove near the southern lineament have a strong foliation that dips moderately to the south-southwest. This fabric is interpreted to have formed during movement on the Frederick Cove fault. The two lineaments can be traced westward across the island to the east shore of Klakas Inlet, where a steeply dipping, highly altered shear zone is exposed. Slickenside striae in this shear zone generally plunge steeply to the south or southwest. The westward continuation of the fault has been mapped by Herreid and others (1978) along the west shore of Klakas Inlet just north of the map area. Herreid and others (1978) show this fault as a southwest-dipping thrust that separates Descon Formation volcanic rocks to the south from marine clastic strata to the north. On the ridge west of Klakas Inlet the fault is overlain by Early Devonian clastic strata (Herreid and others, 1978). This fault is significant because it demonstrates that northern Klakas Inlet is not controlled by a major strike-slip fault (as suggested by Herreid and others, 1978), and that the strata along Klakas Inlet do not belong to a continuous, south-dipping section (as suggested by Eberlein and others, 1983).

Anchor Island fault

The Anchor Island fault is recognized as a wide zone of penetrative brecciation in Ordovician rocks south of Tah Island, in the southern Klakas Inlet region, and along the east shore of Kassa Inlet. Along the shoreline south of Tah Island, Ordovician volcanic rocks are strongly brecciated, moderately foliated, and dip at moderate angles to the northeast. In southern Klakas Inlet, Ordovician volcanic, sedimentary, and intrusive rocks are strongly brecciated, locally semischistose, and pervasively altered in a zone which is several kilometers wide. These rocks are mapped as the complex of Klakas Inlet (DSk) where deformation and alteration have obliterated their primary intrusive and stratigraphic relations. The zone of brecciation extends northwestward to the east shore of Kassa Inlet, where it is truncated by the Keete Inlet fault. The distribution of brecciation along the Anchor Island fault zone is shown in a general fashion with small "x"'s, and the distribution and structural grain of the semischistose fabric is shown with a wavy symbol on Plate 1.

The age of movement on this fault zone is constrained by the Middle and Late(?) Ordovician age of rocks which are deformed, and by stratigraphic relations with Early Devonian sedimentary breccia (Dbx) in southern Klakas Inlet. As described above, this breccia unconformably overlies rocks belonging to the complex of Klakas Inlet (DSk), is moderately deformed, and is overlain by nondeformed middle Early Devonian sandstone, mudstone, and shale (Dms). These relations suggest that the fault zone moved prior to, during, and perhaps after deposition of the sedimentary breccia, which is at least in part of Early Devonian age. Regional relations suggest that movement along the fault zone began after middle Early Silurian time (Gehrels and Saleeby, in press).

KEETE INLET FAULT

The Keete Inlet fault is a major structural and stratigraphic boundary in the study area and to the north on south-central Prince of Wales Island (Redman, 1981). In the map area the fault dips moderately to the northeast and juxtaposes Early Silurian(?) and Ordovician stratified and intrusive rocks against rocks in both the Wales metamorphic suite (pmOw) and the complex of Ruth Bay (Or). The fault continues north of the study area through Keete Inlet (Herreid and others, 1978) and then swings eastward toward the North Arm of Moira Sound (Redman, 1981). South of Klakas Island the fault bends westward into Cordova Bay and then turns south toward Dixon Entrance.

The age of movement on the Keete Inlet fault is constrained as post-middle Early Devonian and pre-mid-Cretaceous because the fault cuts Devonian strata and is intruded by Cretaceous granodiorite. The sinuosity of the fault in and north of the study area combined with its regional juxtaposition of younger rocks over older rocks suggests that it is a normal fault (Gehrels and Saleeby, in press) rather than a thrust fault (as suggested by Herreid and others, 1978, and Redman, 1981). Eastward movement on this fault is suggested by our interpretation that rocks in the complex of Ruth Bay (Or) are deeper-level equivalents of Early Silurian(?) and Ordovician rocks in the upper plate to the east. Regional evidence for a latest Paleozoic(?)-Triassic rifting event in the area (Gehrels and Saleeeby, in press) indicates that the fault may have moved during latest Paleozoic(?)-Triassic time.

STRIKE-SLIP FAULTS

Northwest- to north-northwest-striking faults

The dominant set of strike-slip faults in the area consists of anastomosing, curviplanar, and structurally interconnected northwest- to north-northwest-striking faults that have a left-lateral sense of displacement. These faults control the major northwest-trending inlets and valleys on the western and southern parts of the island. Where exposed, the fault zones generally consist of several parallel strands separated by moderately deformed and brecciated rocks. In stratified rocks the zone of deformation along each strand is generally several meters wide, and is manifest as a steeply dipping phyllonitic foliation within which protolith features are disrupted and (or) highly deformed. Intrusive rocks generally show intense cataclastic brecciation in a zone up to several tens of meters in width, and a wider zone in which the rocks are fractured and cut by many narrow shear zones. As seen on Plate 1, the Max Cove and the Tah Bay-Klinkwan Cove-Nichols Bay fault zones consist of several subparallel strands, and are structurally connected by the Biscuit Lagoon fault and by the Hunter Creek, Feikert Claims, and Billy Claims faults.

These faults are known to have predominantly strike-slip displacement because slickenside striae exposed in the fault zones plunge consistently within 20° of horizontal. Offsets of outcrop-scale stratigraphic markers within these zones are common, but indicate both right-lateral and left-lateral senses of offset. Regional offsets of contacts and map units in many areas indicate that the faults have predominantly left-lateral displacement. Along the Max Cove fault in Max Cove the leucogranodiorite-diorite contact near the end of the peninsula and the base of the Devonian section in several areas are offset approximately 1 km in a left-lateral sense. The Klinkwan Cove fault offsets the Devonian sandstone-conglomerate contact by up to a kilometer in a left-lateral sense south of Klinkwan Cove. In Hunter Bay and for over 8 km to the south the Klinkwan Cove fault juxtaposes Devonian strata against pre-Devonian rocks: this apparent offset, combined with shallow-plunging slickenside striae along the fault, indicates at least a component of left-lateral displacement.

The Nichols Bay fault appears to have a larger amount of strike-slip displacement, as indicated by the juxtaposition of different Early Silurian and Ordovician rocks in Nichols Bay. Assuming that the volcanic and sedimentary rocks between Nichols Lake and northern Nichols

Bay are the offset equivalents of volcanic and sedimentary rocks in southern Nichols Bay, the horizontal separation is approximately 7 to 10 km in a left-lateral sense. This sense and amount of offset are also indicated by the separation of the large mass of quartz-porphyritic granodiorite (Oqgd) across the Nichols Bay fault. The lack of syenitic rocks on the southwest side of the fault in Nichols Bay constrains the amount of displacement to greater than 4 km. Patterns of dioritic rocks in Hessa Inlet are most consistent with approximately 4 km of left-slip on the Nichols Bay zone. The stratigraphic relations along the Klinkwan Cove fault are such that most of the displacement on the Nichols Bay zone must continue northward along the Tah Bay fault, the amount of displacement along which is not constrained.

Dioritic intrusive rocks in Hessa Inlet appear to be offset by a kilometer or more in a left-lateral sense along the Biscuit Lagoon fault. The distribution of Early Silurian(?) and Ordovician stratified rocks along the Felkert Claims and Billy Claims faults is consistent with several kilometers of cumulative left-lateral displacement.

The age of displacement on these faults is constrained by offsets of Devonian strata and by the observation that tabular basaltic dikes of probable pre-mid-Cretaceous age locally intrude the fault zones. This is consistent with the observation that the Max Cove, Klinkwan Cove, and Tah Bay faults do not offset the the Keete Inlet fault, which is known to have pre-mid-Cretaceous displacement. Faults in this set cut the north- to north-northeast-striking faults in the area, and are apparently cut by the Cape Chacon fault.

North- to north-northeast-striking faults

These faults control the major north- to north-northeast-trending inlets and valleys along the southern shore of Prince of Wales Island. The Buschmann Pass and Hessa Narrows faults have a structural style similar to the northwest- to north-northwest-striking faults described above, but the other faults in this set have not been studied in detail. Abundant shallow-plunging slickenside striae on the Buschmann Pass and Hessa Narrows faults indicate that they have predominantly strike-slip displacement. A right-lateral sense of displacement on these and most other faults in the set is indicated by the horizontal separation of both Devonian units and the basal contact of the Devonian section. The amounts of right-lateral separation across the major faults are as follows: Buschmann Pass fault north of Buschmann Pass = 4 to 7 km; Hessa Narrows fault = 1 km; Brownson Bay fault = approx. 500 m; Surf Point fault = a few hundred meters(?); and Bert Millar Cutoff fault = over 1 km. In contrast, the Nichols Lake fault has a separation of between .5 and 1.5 km in a left-lateral sense. The only fault belonging to this set that has been recognized on the northeast side of the Nichols Bay fault is the Alice Claims fault, which has a kilometer or less of right-lateral displacement. Other faults belonging to this set probably exist northeast of the Nichols Bay fault but have not been recognized due to lack of geologic control.

Faults belonging to this set cut Devonian strata and are cut by the northwest- to north-northwest-striking faults described above, which are interpreted to have post-middle Early Devonian, pre-mid-Cretaceous displacement.

Cape Chacon fault

This fault is a major north-striking structure that extends from west of Cape Chacon to Kendrick Bay. In McLean Arm it apparently offsets both syenitic rocks and the Max Cove fault by several hundred meters in a right-lateral sense. This indicates that it is younger than the two main sets of strike-slip faults in the area, which moved between middle Early Devonian and mid-Cretaceous time.

TABLE I. PALEONTOLOGIC SAMPLES AND LOCALITIES

1 = Early Devonian (Pragian?) graptolites in black shale (localities 64ACn1171, 1172, 1182, 1183, and 1191 of Churkin and others, 1970)

2 = Early Devonian conodonts in limestone layer (N.M. Savage, verbal commun., 1985)

3 = latest Early Ordovician graptolites in shale and early Middle Ordovician conodonts in limestone lens in shale (locality G-13 of Eberlein and others, 1983) (both at station 72AE221)

4 = middle Early Devonian conodonts in limestone layer (locality 4 of Savage and Gehrels, 1984)

5 = middle Early Devonian conodonts in limestone layer (locality 5 of Savage and Gehrels, 1984)

6 = middle Early Devonian conodonts in limestone layer (locality 6 of Savage and Gehrels, 1984)

7 = Early Devonian conodonts in limestone layer (locality 7 of Savage and Gehrels, 1984)

8 = Early Devonian conodonts in limestone layer (locality 8 of Savage and Gehrels, 1984)

9 = middle Early Devonian conodonts in limestone layer (locality 9 of Savage and Gehrels, 1984)

10 = middle Early Devonian conodonts in limestone layer (locality 10 of Savage and Gehrels, 1984)

11 = middle Early Devonian conodonts in limestone float block at base of cliff with limestone in outcrop (locality 11 of Savage and Gehrels, 1984)

12 = Middle Ordovician graptolites (locality G-14 of Eberlein and others, 1983) (station 74AE167)

13 = Middle Ordovician graptolites (locality G-14 of Eberlein and others, 1983) (station 74AE168)

TABLE 2. GEOCHRONOLOGIC SAMPLES AND LOCALITIES

1 = 472 ± 5 Ma (U-Pb zircon): Middle Ordovician quartz-porphyritic granodiorite (Oqgd) (station 82GP702)

2 = 462 ± 15 Ma (U-Pb zircon): Middle Ordovician leucogranodiorite (Ogd) (station 72AE215)

3 = 468 ± 15 Ma (U-Pb zircon): Middle Ordovician leucogranodiorite (Ogd) (station 82GP48)

4 = 480–460 Ma (U-Pb zircon): Ordovician diorite (Od) (station 82GP40)

5 = 465 ± 7 Ma (U-Pb zircon): Middle Ordovician foliated granodiorite (Or) (station 79AE114)

6 = 445 ± 5 Ma (U-Pb zircon): Late Ordovician quartz diorite (Oqd) (station 82GP28)

7 = 446 ± 5 Ma (U-Pb zircon): foliated and layered Ordovician quartz diorite (Ofd) (station 82GP346)

8 = 438 ± 4 Ma (U-Pb zircon): Early Silurian and (or) Late Ordovician quartz monzonite (SOqm) (station 83GP255)

9 = 438 ± 5 Ma (U-Pb zircon): Early Silurian and (or) Late Ordovician granite (SOgr) (station 83GP335)

10 = 438 ± 5 Ma (U-Pb zircon): Early Silurian and (or) Late Ordovician quartz syenite (SOsy) (station 83GP364)

11 = 418 ± 5 Ma (U-Pb zircon): Late Silurian leucodiorite (Sd) (station 82GP626)

12 = 428 ± 13 Ma (K-Ar hornblende minimum age): locality 5 of Turner and others (1977) (station number DT72-58c)

13* = 454 ± 22 Ma (K-Ar hornblende): locality 7 of Lanphere and others (1964)

14* = 379 ± 18 Ma (K-Ar biotite): locality 6 of Lanphere and others (1964)

15* = 439 ± 21 Ma (K-Ar hornblende): locality 5 of Lanphere and others (1964)

16* = 185 ± 8 Ma (K-Ar riebekite): locality 1 of Lanphere and others (1964), and 190 ± 8 Ma (K-Ar riebekite): locality 4 of Lanphere and others (1964)

17* = samples of Bokan Mountain Granite analyzed for U-Pb analysis by Saint-Andre and others (1983)

* = sample location on Plate 1 is approximate.

(See Gehrels and Saleeby (in press) for more information)

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