QUATSINO - SAN JOSEF MAP AREA, NORTHERN VANCOUVER ISLAND: GEOLOGICAL OVERVIEW (92L/12W, 102I/8, 9)

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INTRODUCTION

Regional mapping (1:50000) this past summer on northern Vancouver Island covered the ground north of Quatsino Sound and west of Holberg Inlet. The map area extends through the western half of the Quatsino sheet (92L/12) to Cape Parkins (102I/8) at the entrance of Quatsino Sound, north to San Josef Bay (102I/9) at the southern boundary of Cape Scott Provincial Park, and east to adjoin mapping done north of Holberg in the 1993 field season. In all, some 750 square kilometres of hilly terrain were traversed along a system of largely well maintained logging roads, and over 200 kilometres of coastline was examined by boat.

Previous work in the map area includes studies of the surficial geology and till geochemistry (Kerr, 1992; Kerr and Sibbick, 1992; Kerr *et al.*, 1992), and regional geochemistry (Sibbick and Laurus, 1995, this volume). In addition, recent results of isotopic dating using the $^{40}Ar/^{39}Ar$ technique on igneous and hydrothermal minerals (Archibald and Nixon, 1995, this volume; Panteleyev *et al.*, 1995, this volume), in conjunction with new paleontological control (Haggart and Tipper, 1994), provide fresh insights into the most probable relationships between Jurassic volcanism and plutonism on northern Vancouver Island. In this brief interim report, we present the most notable results of the 1994 field season.

GENERAL GEOLOGY

Generalized aspects of the geology of northern Vancouver Island are shown in Figure 1. The region forms part of the Wrangellia tectonostratigraphic terrane of the Insular Belt. The oldest rocks encountered in the Quatsino Sound area belong to the Upper Triassic Vancouver Group and comprise tholeiitic flood basalts (Karmutsen Formation) at the base overlain by thinly bedded to massive limestone (Quatsino Formation) and intercalated marine shale, siltstone and impure limestone (Parson Bay Formation). The Lower to Middle Jurassic Bonanza Group (Archibald and Nixon, 1995, this volume) is composed of mafic to felsic volcanic and lesser intercalated sedimentary rocks laid down in both submarine and subaerial environments. The Bonanza group is unconformably overlain by marine to nonmarine Upper Jurassic(?) to Cretaceous clastic sequences and localized Tertiary volcanic rocks. The Mesozoic strata are intruded by Lower to Middle Jurassic granitoids of the Island Plutonic Suite, and mafic to felsic dikes and sills of Karmutsen, Bonanza and Tertiary age. Further descriptions of the geology of the Quatsino Sound region may be found in Jeletsky (1976), Muller *et al.* (1974) and Nixon *et al.* (1993a, 1994).

NEW STRATIGRAPHIC INSIGHTS

UPPER TRIASSIC PARSON BAY FORMATION

Sedimentary rocks of the Parson Bay Formation are *restricted to the eastern margin of the map area south of* Holberg Inlet. They are predominantly composed of well bedded, argillaceous lime mudstone and calcareous to noncalcareous siltstone and minor sandstone, and, as such, resemble the typically calcareous 'western facies' of the Parson Bay Formation (Nixon *et al.*, 1994; Hammack *et al.*, 1994)

UPPER TRIASSIC SUTTON LIMESTONE EQUIVALENT

A pale grey weathering, thin to medium-bedded, fairly pure limestone, believed to be equivalent to the Sutton Formation (uppermost Triassic), forms the tip of the southeastern peninsula of Drake Island (Figure 2). The base of this limestone unit, exposed on the eastern side of the peninsula, rests conformably on dark grey

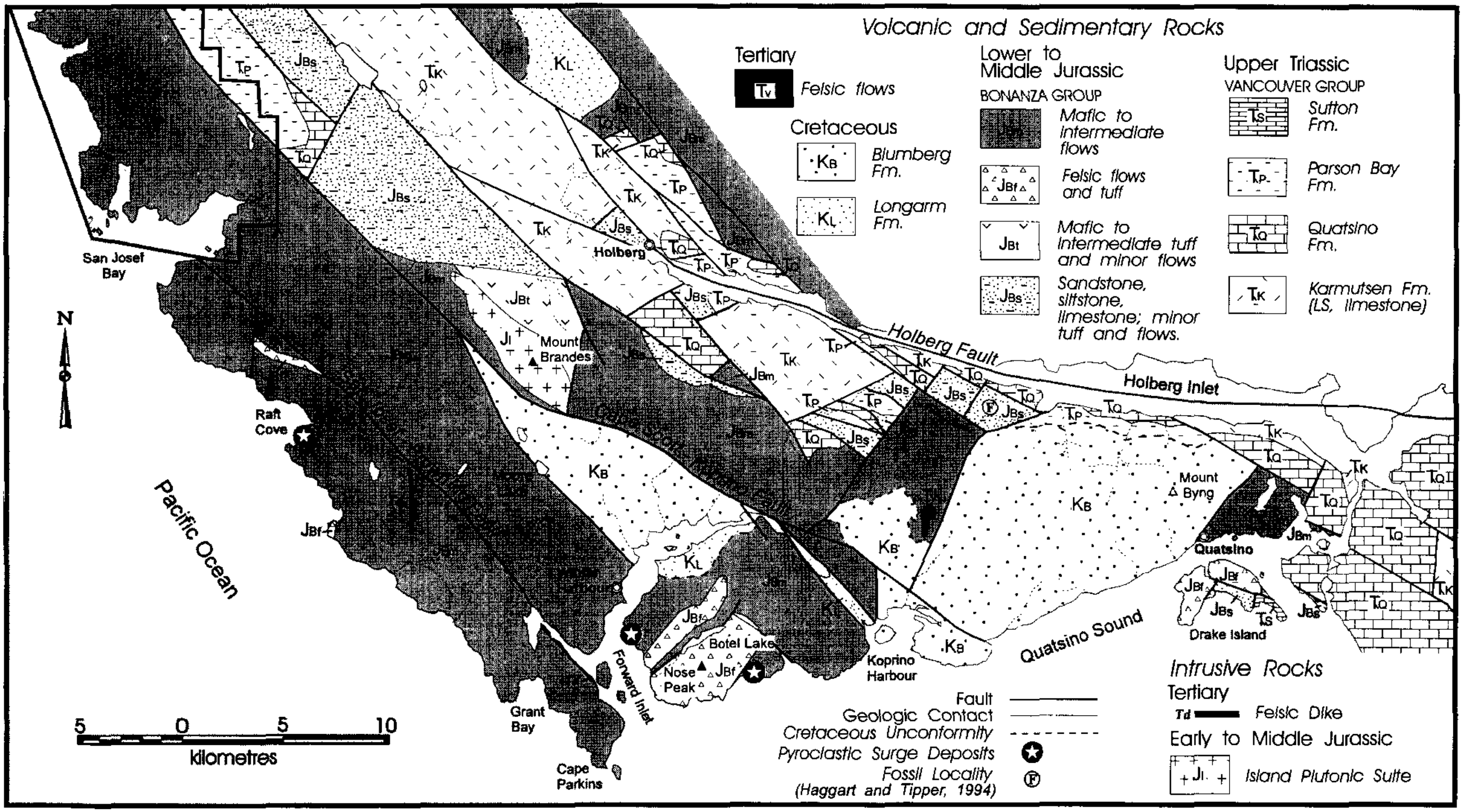

Figure 2. Generalized geology of the Quatsino - San Josef map area.

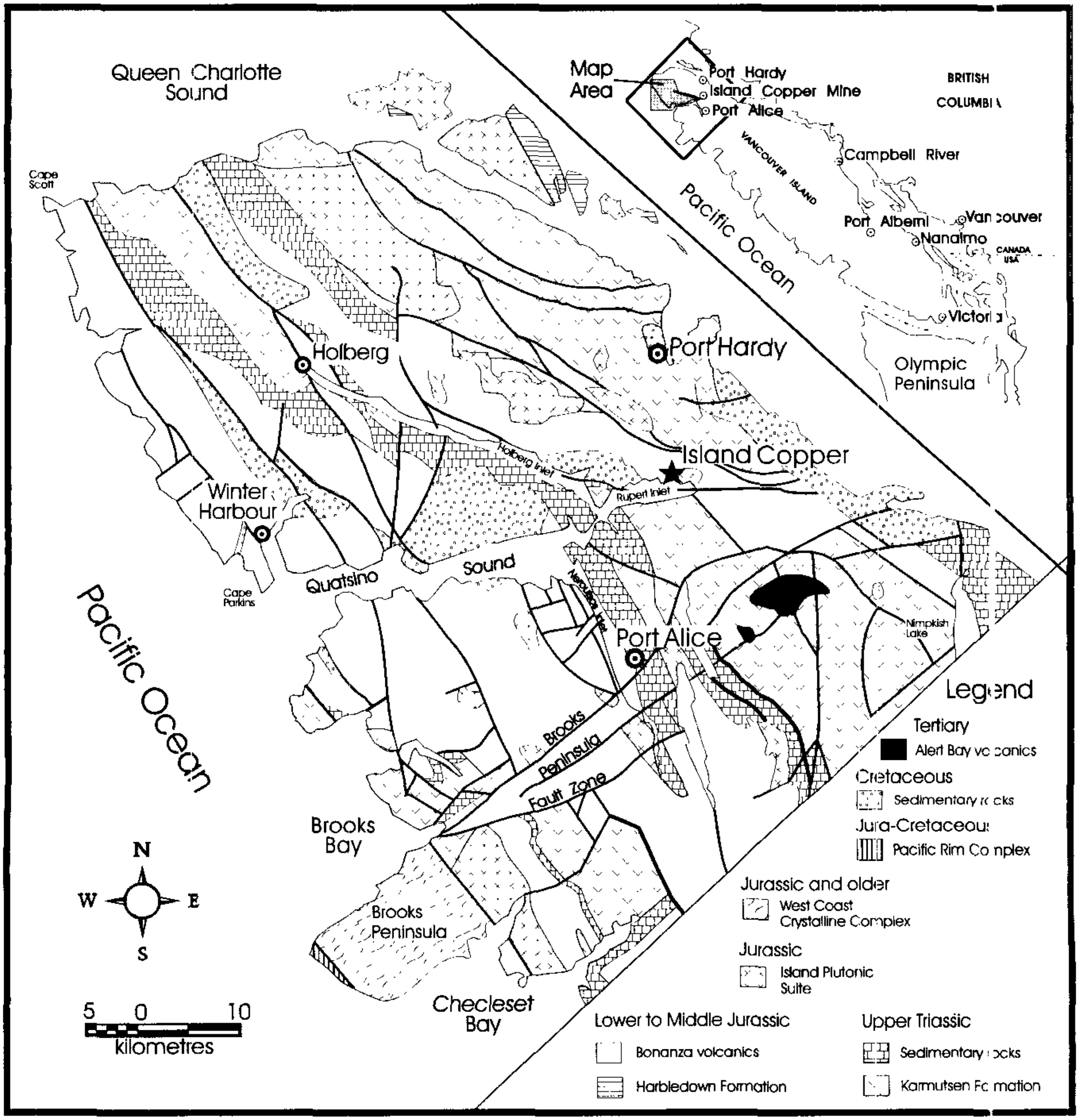

Figure 1. Regional geology of northern Vancouver Island (modified after Roddick and Muller, 1983). Shaded inset shows location of project area.

argillaceous limestone and limestone breccia which in turn passes down into laminated to thinly bedded, weakly calcareous shale, mudstone and interbedded impure limestone of the Parson Bay Formation. At one locality, bivalves (Halobia?) were recovered from the shales. This limestone was formerly included in the Quatsino Formation by Jeletzky (1976), but he also recognized Sutton limestone equivalents (up to about 80 m thick) on the south shore of Quatsino Sound opposite Drake Island (not shown in Figure 2).

LOWER JURASSIC SEDIMENTARY STRATA OF THE BONANZA GROUP

Sedimentary strata provisionally assigned to the Lower Jurassic are also exposed south of Holberg Inlet and on Drake Island where they form westerly dipping, westerly facing sequences locally disrupted by faulting and folding.

The top of the Sutton limestone equivalent on Drake Island is separated from a sequence of dark grey, thinly bedded argillaceous limestones, calcareous siltstones and mafic to intermediate lithic tuffs and lavas(?) by a feldspar porphyry dike and a bedding-plane-parallel fault, displacement across which may not be significant. The overlying strata comprise fine-grained clastics and impure to fairly pure limestones and limestone breccias (debris flows) interbedded with intermediate to mafic, waterlain crystal and lithic tuffs. All of these lithologies were placed in the Parson Bay Formation by Roddick and Muller (1983). This decision may well have been influenced by Jeletzky (1976), who noted an occurrence of what he considered to be Sutton limestone equivalent on the southwestern shore of Drake Island (*i.e.* at the top of the succession and underlying a felsic flow-dome complex described below). Although fossil control is currently lacking in these sedimentary strata, we have tentatively placed them in the lowermost part of the Bonanza Group, based on lithological considerations and the occurrence of Sutton limestone at the base of the succession.

A fossiliferous package of sedimentary rocks is found at the base of the Bonanza Group south and west of Holberg Inlet (unit $\mathrm{JB_S}$, Figure 2). These rocks contain abundant marine fauna including ammonites, bivalves, corals, belemnites and gastropods. Fossil age determinations are pending. However, Haggart and Tipper (1994) have tentatively assigned a late Pliensbachian age to these strata, based on fossils collected approximately 20 kilometres southeast of the community of Holberg (Figure 2).

Lithologies include sandstone, limestone and debris-flow (laharic?) breccias with minor tuffs. The dominant rock type is a well bedded to massive, calcareous and noncalcareous arkosic to lithic wacke which is typically tuffaceous (Photo 1). The clastic rocks are locally interbedded with pure and impure lime mudstones which reach thicknesses greater than 6 metres. In structurally complex areas (*e.g* 4 km due south of Holberg and 5 km due west of Haggart and Tipper's (1994) fossil locality; Figure 2), fossil control is needed to confidently determine their stratigraphic identity.

Debris-flow breccias containing abundant clasts of impure and pure limestone are common locally, particularly near the base of the Lower Jurassic succession (Photo 2). These breccias were largely deposited in a marine basin and commonly display an erosive base with soft-sediment load structures. Typically these deposits are very poorly sorted with fragments ranging from pebble to cobble size supported in a mud matrix. The coarse material fines upward into fossiliferous sandstones. In areas of more abundant outcrop, multiple debris-flow breccia - sandstone cycles can be seen. Clasts within the breccia are composed of both volcanic and sedimentary rocks including sandstone, siltstone and limestone. The limestone clasts may have been derived from underlying Upper Triassic limestone (Quatsino or Sutton Formation) or consolidated Jurassic limestones observed to be intercalated with the breccias.

The basal contact of this sedimentary succession is typically faulted. However, sandstone of probable Early Jurassic age appears to conformably overlie calcareous and noncalcareous siltstone of the Parson Bay Formation along the southern shore of Holberg Inlet, approximately 3 kilometres southeast of Holberg. The upper contact of this package is well exposed near Haggart and Tipper's (1994) fossil locality (Figure 2) where tuffaceous sandstones grade upward into reworked waterlain tuffs (Photo 3) and minor plagioclase-phyric pillow lavas.

LOWER TO MIDDLE JURASSIC BONANZA GROUP VOLCANIC ROCKS

Volcanic rocks of the Bonanza Group in the Quatsino - San Josef area appear to form a largely bimodal rhyolite-basalt association similar to that documented previously south of Quatsino Sound in the Mahatta Creek map area (92L/5; Nixon *et al.*, 1993a, b). As with previous map areas, we have been able to subdivide the Bonanza Group into felsic and mafic to intermediate lithostratigraphic units, and marine and rare nonmarine sedimentary strata. Both submarine and subaerial volcanic environments are represented. The tectonic complexity of the map area and rapidly changing nature of volcanic facies prevent firm stratigraphic correlations at this time; age assignments await fossil identification and ongoing U-Pb zircon geochronometry. However, from ongoing work in the Quatsino - Port McNeill map area to the east, it is apparent that subaerial volcanism in the Bonanza Group extended into the Middle Jurassic (Archibald and Nixon, 1995, this volume).

PYROCLASTIC SURGE DEPOSITS

Previously unrecognized pyroclastic surge deposits, all of mafic composition, are preserved in coastal exposures on the south shore of Raft Cove near the mouth of the Mackjack River, on the north shore of

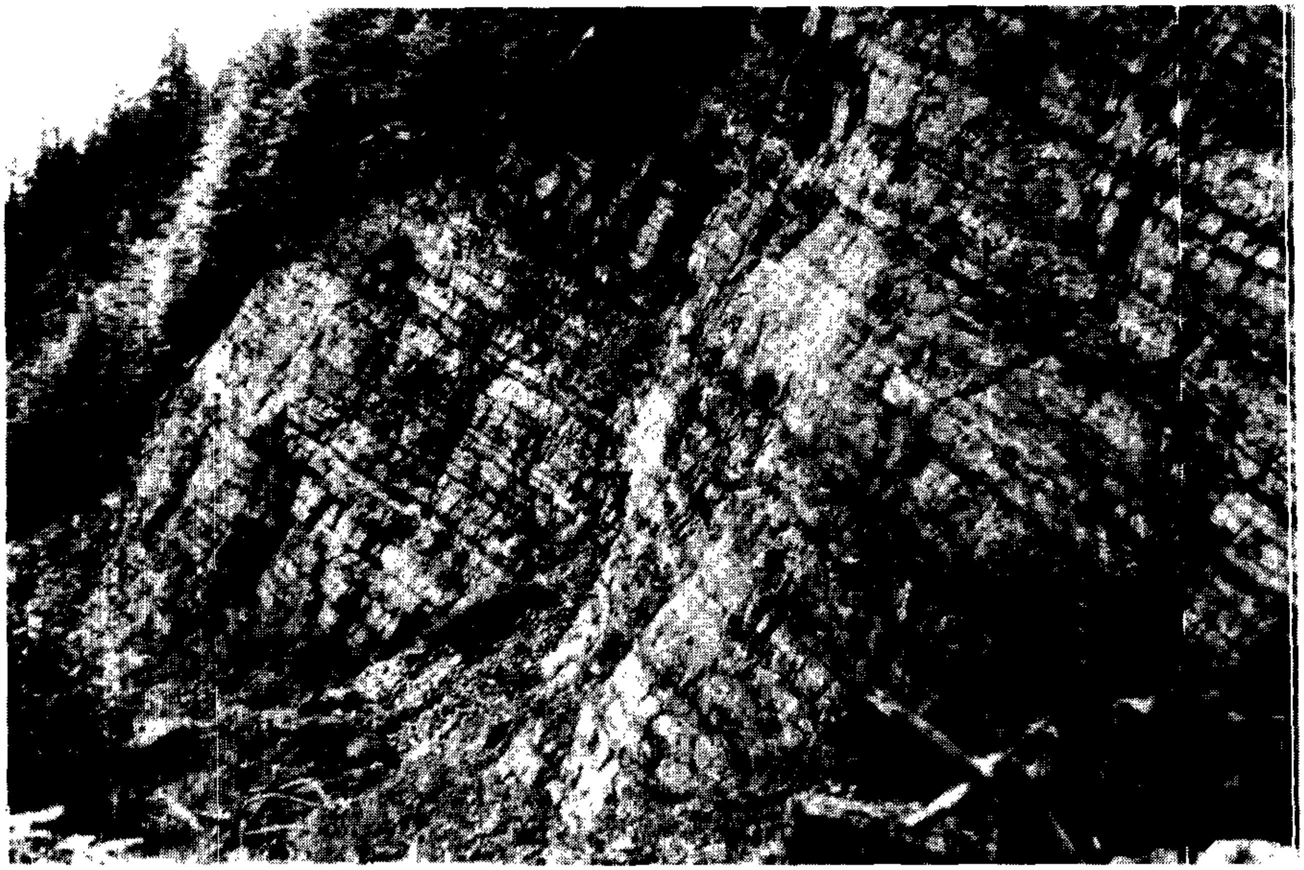

Photo 1. Well bedded Lower Jurassic sandstone and siltstone near fossil locality F in Figure 2.

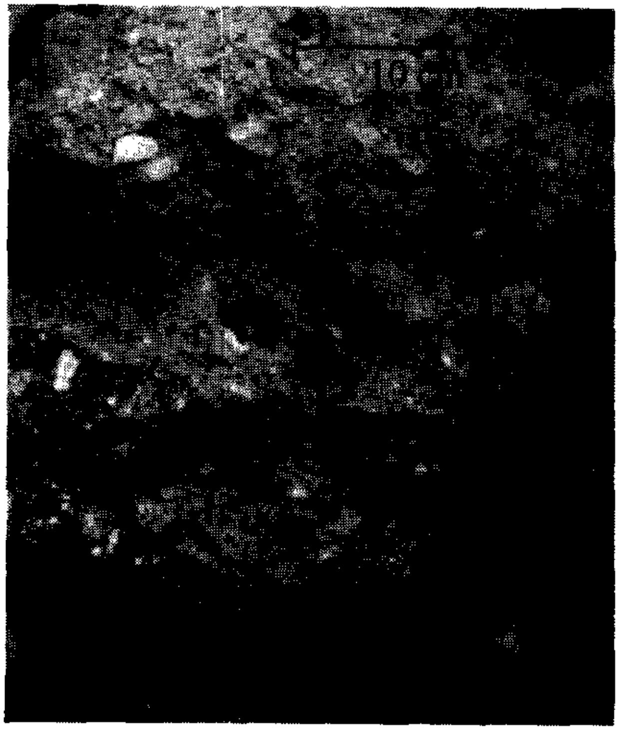

Photo 2. Debris-flow (laharic?) breccia containing volcanic and sedimentary clasts including angular limestone fragments (pale grey). Basal Jurassic strata involved in complex folding and thrusting approximately 13 kilometres southeast of Holberg.

Quatsino Sound due east of Nose Peak, and south of Winter Harbour in Foreward Inlet (Figure 2). The most extensive exposures are at the latter two localities.

Excellently preserved sequences of pyroclastic surge deposits are exposed at shoreline on the east coast of Forward Inlet. These deposits were formally included in the Waterlain Tuff Member of the Mathews Island Formation (about 250 to 400 m thick) by Jeletzky (1976). The strata strike nearly east-west, dip moderately (30 to 60°) to the north and are cut by northerly trending high-angle faults and northerly to northeasterly striking mafic aphanitic dikes. Several coarsening-upward stratigraphic sequences are exposed. The base of the lowest sequence is marked by laminated to thinly bedded, dark to medium grey, argillaceous micritic limestone intercalated, and eventually passing into, grey-green, very thinly bedded to thinly laminated, noncalcareous to calcareous tuffaceous siltstone and fine mafic tuff, most of which appears to be airfall in origin. Load and flame structures and convolute soft-sediment folds are locally prolific at this horizon. These fine-grained layers pass gradationally upward into well to moderately sorted fine lithic tuffs and lapilli tuffs with angular clasts generally less than a centimetre across. Although contacts between layers are usually planar, low-angle cross-stratification is not uncommon (Photo 4). Lapilli tuffs higher in the sequence are thin to thickly bedded, more poorly sorted, and have a coarser average grain

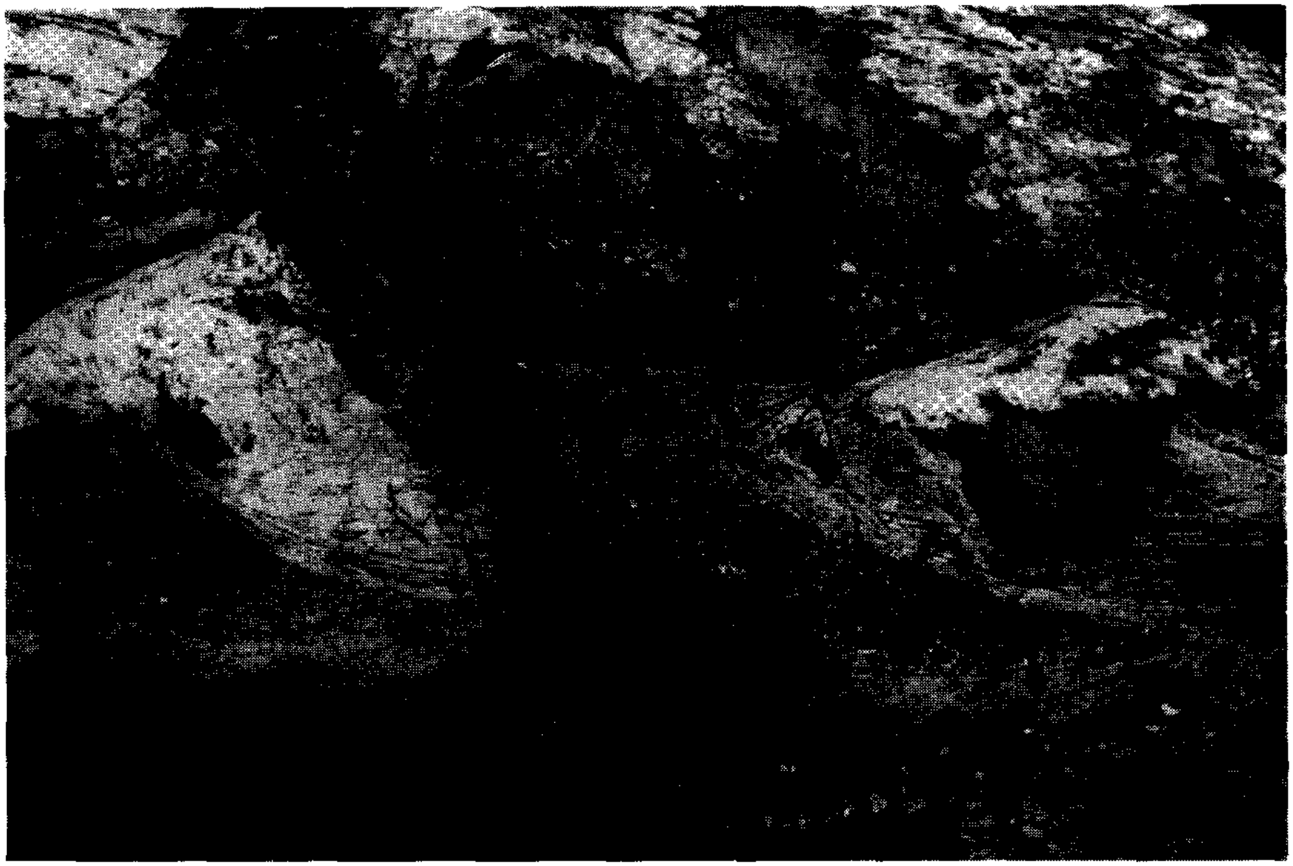

Photo 3. Trough cross-laminae in reworked tuffs near the top of the basal Bonanza sedimentary package near fossil locality F in Figure 2.

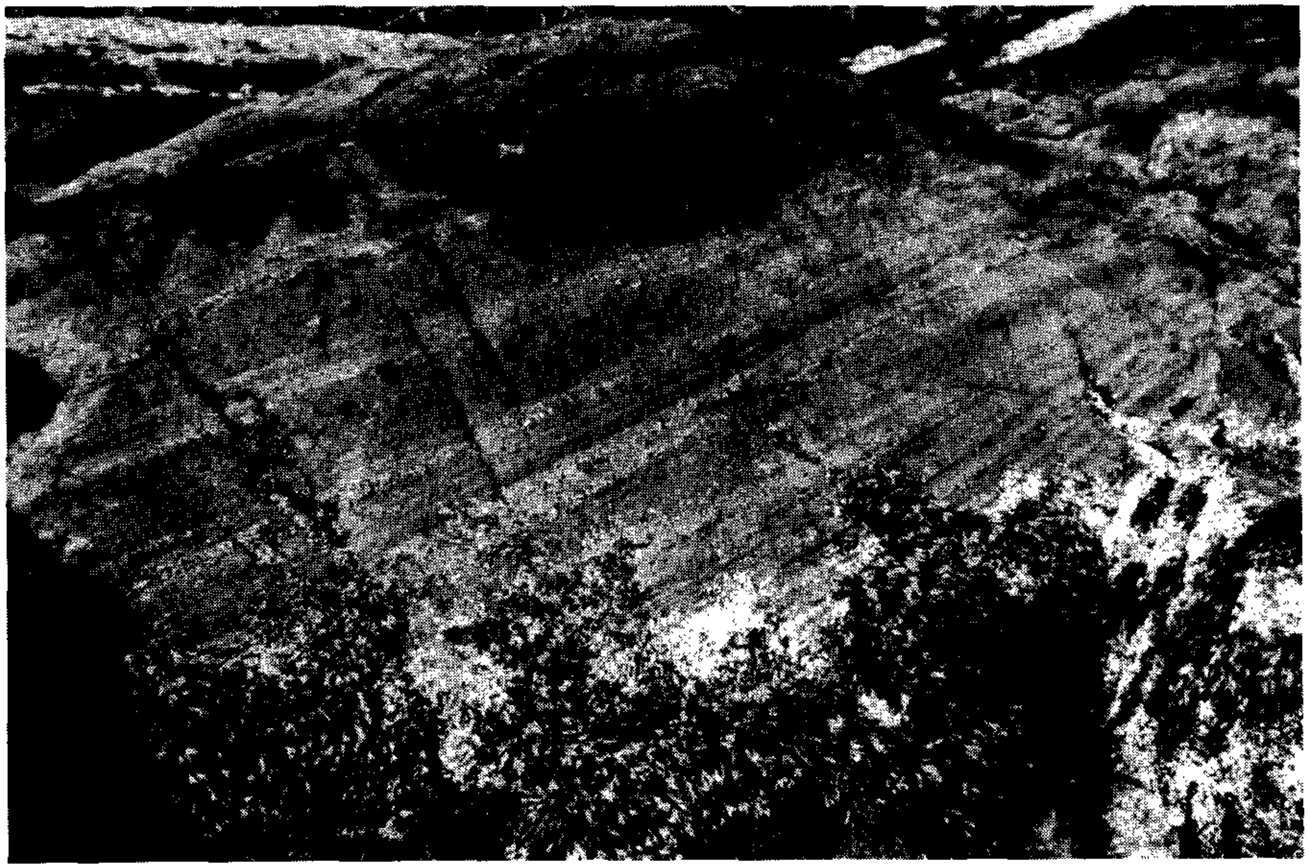

Photo 4. Thinly bedded, pyroclastic surge deposits studded with angular basaltic lapilli and showing low-angle cross-stratification. East shore of Foreward Inlet.

size (Photo 5). The thicker units may represent high-energy, high particle concentration, pyroclastic flow deposits, rather than low particle concentration, pyroclastic surge phenomena. Angular lapilli and blocks of mafic lava in these more thickly bedded layers reach 20 centimetres in diameter, and some have weakly vesiculated cores. They represent volcanic bombs either ballistically emplaced (Photo 6), or picked up and laid down (by saltation) in ground surge deposits. The pyroclastic sequence is capped by a mafic amygdaloidal aphanitic flow with a locally well developed basal breccia. Although there are structural complications, two more such cycles appear to stratigraphically overlie the lowest sequence.

Pyroclastic surge deposits east of Nose Peak do not appear to exhibit this coarsening-upward cycle. However, they too form part of a shallowing-upward sequence as they overlie a relatively thick succession of variably palagonitized pillow lavas, pillow breccias and bedded hyaloclastite deposits that stretches from this locality over a kilometre east to Nordstrom Cove (Photo 7). Inland, these deposits appear to interfinger with, and become replaced by, more massive lavas. The surge deposits are variably oxidized, medium to very thinly bedded, coarse lithic tuffs and lapilli tuffs containing dense to amygdaloidal, angular to subangular basaltic clasts up to 30 centimetres across. Contacts between surge layers are mostly planar. To the west, these deposits are overlain by a thin succession of massive to partly pillowed, strongly amygdaloidal basalt flows.

The recognition of volcanic sequences containing pyroclastic surge deposits in the Bonanza Group improves our understanding of the environment of explosive phreatomagmatic activity. The earliest strata in the sequence were clearly laid down in very shallow seas. Small volcanic edificies, probably of low relief (maars, tuff rings), eventually breached sea level as recorded by the pyroclastic surge deposits. Some of these deposits were wet (base surge) whereas others may have been essentially free of seawater (hot and dry); the latter may be represented in part by thin pyroclastic flow layers. Explosive activity culminated when subaerial lavas plugged the vent. The dormant centre(s) was eventually eroded, or subsided beneath sea level. Some time later, volcanic activity resumed to generate the next pyroclastic-effusive cycle.

RHYOLITES

New felsic (dacite-rhyolite) map units in the Bonanza Group are shown in Figure 2. By far the largest concentration of rhyolitic lavas is in the area of Nose Peak, overlooking the entrance to Quatsino Sound. The Nose Peak rhyolite is well exposed in steep sea cliffs at the entrance to Foreward Inlet, and it may extend farther south beneath the waters of Quatsino Sound to the Gillam Islands, which are almost entirely composed of rhyolite. The rhyolite unit overlies amygdaloidal basalt flows and pyroclastic surge deposits to the east (described above), and is intercalated with mafic to intermediate lavas and tuffs along strike to the northeast. A younger(?) rhyolitic unit to the northwest, on the other side of Botel Lake, extends northwards towards the Cretaceous unconformity (Figure 2).

The Nose Peak rhyolite is fairly typical of other Bonanza rhyolites. It constitutes a viscous flow-dome complex in which the amount of felsic pyroclastic material is relatively minor. This unit appears to reach a maximum thickness of about 2 kilometres in shoreline outcrops south of Nose Peak. Judging from the predominance of flow material and lack of pillows or hyaloclastite debris, the complex is believed to have been extruded subaerially. The lavas weather shades of grey, cream and pink and are strongly hematitic in places. The rock is generally aphanitic but may contain up to several percent euhedral feldspar phenocrysts (<2 mm). Millimetre-scale viscous flow laminations are usually strongly developed and intra-flow pumiceous layers up to 1 metre thick may also be preserved. Rare mafic to intermediate dikes are observed in coastal exposures.

Rhyolites north of Botel Lake appear to consist almost entirely of subaerial flows that are variably altered (discussed later). Minor flow breccias are best observed on weathered surfaces. The fresher rocks are grey aphanitic rhyolite or rhyodacite with distinctive platy jointing parallel to flow laminations; the latter locally delineate mesoscopic viscous flow folds. Rarely, euhedral plagioclase phenocrysts (up to 1 cm long by 2 mm wide) with hiatal textures form up to about 5 % of the rock.

A distinctive dacitic to rhyolitic flow-dome complex is well exposed on the northern and western parts of Drake Island where it is cut by a high-angle easterly trending fault (Figure 2). The complex overlies a westerly dipping succession of basal(?) Jurassic sedimentary and volcanic strata (described previously). Thinly bedded to massive waterlain(?) tuffs at the base of the complex appear to rest conformably on impure limestones and fine-grained marine clastics. The tuffs are overlain by felsic flows and flow breccias, which form the main mass of the complex, and lesser volumes of volcanic breccias composed of accumulations of moderately sorted, lapilli to block-size angular clasts. The latter deposits appear to have irregular depositional contacts and may represent talus aprons of hyaloclastite debris formed during extrusion of felsic flows into shallow seawater; no pillows were observed. The uppermost parts of the complex exposed on the western shores of Drake Island contain laharic breccias and a densely welded ash-flow tuff that was deposited subaerially. The Drake Island flow-dome complex, therefore, appears to be an example of the emplacement of silicic lavas and pyroclastic deposits essentially at sea level in Early Jurassic time.

CRETACEOUS STRATA

LONGARM FORMATION EQUIVALENTS

Sandstones of the Longarm Formation are exposed at

Photo 5. Thinly bedded surge deposits overlain by high-energy, diffusely bedded, coarse pyroclastic flow deposits containing angular basaltic lapilli and bomb fragments. East shore of Foreward Inlet.

Photo 6. Bomb sag in basaltic pyroclastic (base) surge deposits exposed on the south shore of Raft Cove. Pencil magnet shows bomb trajectory.

Photo 7. Basaltic pillow breccia with palagonitized pillow rims and hyaloclastite matrix, north shore of Quatsino Sound.

Photo 8. Typical Blurnberg Formation cobble conglomerate with well rounded plutonic clasts, approximately 10 kilome res north of Winter Harbour near Moore Lake.

five localities within the map area: north and east of Winter Harbour; northwest of Koprino Harbour; north of Holberg; and at Grant Bay and Raft Cove. At all of these localities, the rocks are arkosic to lithic wackes and arenites, and are typically fossiliferous. Coquinas within this unit commonly include the Early Cretaceous (late Valanginian) bivalve *Buchia crassicollis* (Jeletzky, 1976; Muller *et al.*, 1974; Haggart and Tipper, 1994). The distribution of this unit is largely confined to individual fault blocks, and deposition may have been partly controlled by grabens. East of Winter Harbour, this sandstone lies with angular unconformity on Bonanza Group volcanic rocks (Haggart and Tipper, 1994). Elsewhere, however, contacts between these lithologies are defined by high-angle faults, many of which were active after deposition of the youngest Cretaceous strata.

BLUMBERG FORMATION

Extensive outcrops of conglomerate and lesser sandstone and shale of the Blumberg Formation (Jeletzky, 1976) are found north and west of Quatsino, and north of Winter Harbour (Figure 2). The conglomerates contain abundant well rounded clasts of plutonic rocks believed to represent Coast Mountain intrusions (Jeletzky, *ibid.*; Photo 8).

Between Quatsino and Koprino Harbour, the Blumberg Formation has an estimated thickness of the order of 600 metres (Haggart and Tipper, 1994). Haggart and Tipper interpret these rocks as a prograding submarine fan-delta complex of post-Cenomanian age, rather than Albian as inferred by Jeletzky, and correlate these strata with the Honna Formation of the Queen Charlotte Group.

Blumberg Formation conglomerates and sandstones also occur in a fault-bounded block north of Winter Harbour (Figure 2). Previous work by Jeletzky (1976) placed Cretaceous sandstones exposed at shoreline and in creek beds in a 'coarse arenite unit' which he considered to be Aptian in age, and so underlie the Blumberg Formation. This package is dominated by northeasterly dipping arkosic to lithic wackes with minor tongues of conglomerate. In the vicinity of Moore Lake, however, these sandstones are observed to gradationally overlie a thick succession of Blumberg Formation conglomerates. This upward fining sequence is consistent with that described for the Honna Formation in the Queen Charlotte (Haggart, 1986). The sandstone unit is primarily massive at its basal contact with the conglomerates, and medium to thinly bedded in its upper part. The top of the sandstone unit was not observed, nor was the base of the conglomerate. These sandstones may in part represent a finer grained, distal equivalent to the conglomerates of the thick fan-delta complex west of Quatsino (Haggart and Tipper, 1994).

ISLAND PLUTONIC SUITE: MOUNT BRANDES PORPHYRY

A previously unmapped member of the Island Plutonic Suite, here named the Mount Brandes porphyry, forms some of the highest and most rugged terrain in the map area. The body underlies the area south of Mount Brandes and extends northwesterly beyond the radar facility (Radome), a distance of at least 6 kilometres (Figure 2). The maximum width of the body is about 1.5 kilometres, and it is flanked by mafic to intermediate flows and tuffaceous rocks of the Bonanza Group. Soils overlying this intrusion are a distinctive orange-brown.

The Mount Brandes porphyry contains euhedral phenocrysts of pinkish feldspar (plagioclase?) and lesser hornblende set in a greyish brown fine-grained groundmass. The bulk composition is probably monzonitic. The buff to orange-brown weathering rock is partially to extensively altered to clay minerals and locally propylitized. Feldspars are altered pink to pale green and amphibole is extensively chloritized. Trace amounts of pyrite are found locally.

TERTIARY LAVAS AND DIKES

Outcrops of Tertiary rhyolitic lavas were discovered approximately 5 kilometres north of Koprino Harbour (Figure 2). The lavas form pale grey to cream-weathering crags just south of the headwaters of the Koprino River. Although eroded by glaciers, the remnants of two small viscous flow lobes with steep lateral levees may be identified. The flows travelled south a maximum distance of about 1.3 kilometres from concealed vents at their northern margin. Outcrops of lateral flow levees locally reveal metre-scale interlayering of black, dense devitrified obsidian and buff rhyolite that dip inward away from the margin. The obsidian preserves flow laminations and small-scale flow folds; flow laminations in the rhyolite are generally inconspicuous. Some rhyolite joint surfaces exhibit well developed striae caused by differential movement of adjacent joint blocks during emplacement (Photo 9). The rhyolite contains several percent euhedral feldspar phenocrysts (<5 mm) and trace hornblende(?). A weak flow foliation is enhanced locally by limonite, clay and chlorite-filled vesicles. The presence of obsidian, albeit devitrified, distinguishes these Tertiary rhyolites from their Jurassic counterparts, which typically exhibit a strong flow lamination.

Tertiary dikes occur throughout the map area. They are observed to cut Triassic, Jurassic and Cretaceous lithologies. Practically all of these dikes are felsic, in sharp contrast to the Mahatta Creek map sheet further south where the majority of the dikes are mafic (Nixon *et al.*, 1993a). Locally, the dikes take advantage of pre-existing major fault zones. For example, a large anastomizing rhyolitic dike or dike swarm follows the shore of Browning Inlet for some 5 kilometres parallel to the submerged trace of the San-Josef - Browning fault

Photo 9. Joint surface in Tertiary rhyolite flow showing well developed striae generated by differential movement of lava blocks during flowage.

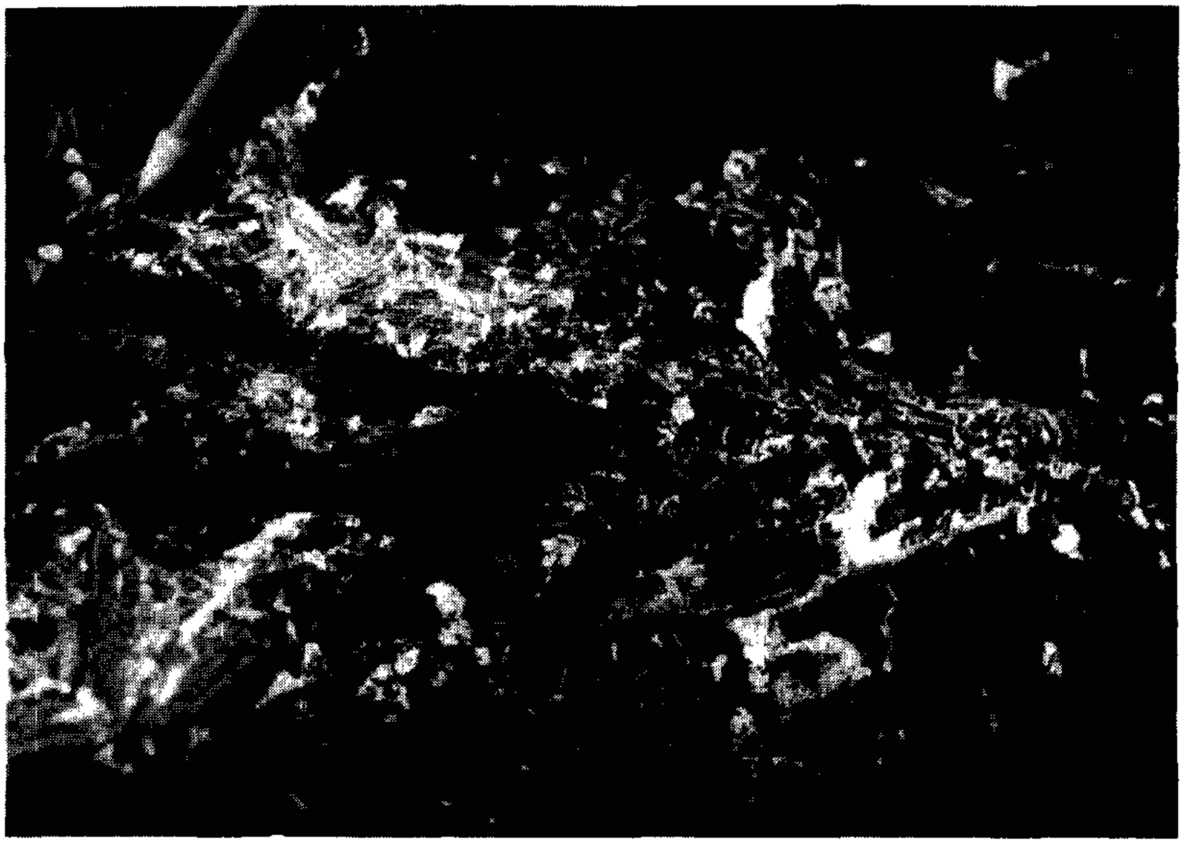

Photo 10. Mesoscopic isoclinal folds in intra-Bonanza calcareous shale approximately 3 kilometres west of Koprino Harbour.

(Figure 2). Jeletsky (1976) previously included this dike with the Island Plutonic Suite (formerly "Coast Intrusions"). Farther north, another Tertiary felsic dike exposed in roadcuts over a distance of some 3 kilometres trends due south away from the same fault zone. Like the lavas described above, felsic dikes are typically aphanitic to weakly porphyritic with euhedral plagioclase phenocrysts (<6 mm) set in a finely crystalline, variably clay-altered groundmass. Angular to subrounded xenoliths of devitrified black obsidian are locally concentrated in the southernmost outcrops of the Browning Inlet dike on the shoreline southwest of Mathews Island.

STRUCTURE

Three phases of deformation have been identified in the rocks of the Quatsino Sound area: a pre-Cretaceous deformation, supported by the presence of an angular unconformity below the base of the Cretaceous clastic succession; Late Cretaceous to Tertiary transpression; and Tertiary extension. Faulting appears to have been an important strain-release mechanism throughout all of these deformational episodes. A more detailed discussion of the structural history may be found in Nixon *et al.* (1993a).

PRE-CRETACEOUS UNCONFORMITY

An angular unconformity is apparent from map relations between the Triassic-Jurassic (Bonanza Group and older) and Cretaceous strata (Longarm Formation equivalents and younger). This unconformity is exposed in Michelson Creek approximately 3 kilometres northwest of Mount Byng. Here, gently dipping Blumberg conglomerates rest with marked angular discordance on moderately dipping thinly bedded sediments of the Parson Bay Formation. At present, it is not clear whether this deformation was the result of rotation of strata during block-faulting or a compressional event.

LATE CRETACEOUS TO EARLY TERTIARY TRANSPRESSION

Pre-Cretaceous deformation was followed by northerly to northeasterly directed transpression which postdates deposition of the Late Cretaceous Blumberg Formation, but certainly predates Tertiary intrusive and extrusive activity. During this deformational episode, strain was largely accommodated along prominent northwesterly trending faults, at least some of which have oblique right-lateral motion (Nixon *et al.*, 1993a). A significant amount of movement may have occurred on the Holberg fault during this phase of deformation (Nixon *et al.*, 1994). Northeasterly trending antithetic faults are also common and tend to exhibit a left-lateral, northwest-up sense of displacement. Minor northwesterly trending thrust faults with a south-up sense of motion have been recognized locally (due west of fossil locality F in Figure 2). Substantial strain has been accommodated by flexural slip folding and bedding parallel shear of well bedded sedimentary strata of the Parson Bay Formation and Bonanza Group, resulting in local tectonic thickening of these units (Photo 10). Folding is particularly evident near the major faults.

TERTIARY EXTENSION

Many northeasterly to east-northeasterly trending normal faults in the area were formed in the Tertiary during extension of the Queen Charlotte Basin (Riddihough and Hyndman, 1991). The southern limit of this extensional province appears to be marked by the northeasterly trending Brooks Peninsula fault zone (Figure 1) which is coincident with felsic to mafic Tertiary dike swarms (Nixon *et al.*, 1993a). Tertiary extension is less obvious in the Quatsino - San Josef map area than further south. Tertiary dikes that intrude fault zones are mainly felsic, and some of the longest dikes were emplaced along northerly or northwesterly striking faults.

MINERAL POTENTIAL

The recently released mineral potential assessment of Vancouver Island rated the Quatsino - San Josef area highly in terms of its peceived potential for undiscovered mineral deposits (Massey, 1995, this volume). However, the extent of alteration and mineralization found in outcrop renders the map area less appealing than ground east of Holberg Inlet. The apparent paucity of intrusions of the Island Plutonic Suite may be a key factor.

The most widespread alteration is associated with rhyolitic and basaltic lavas and dikes exposed on ridges north of Botel Lake. The alteration appears to be centred on a north-northeasterly striking rhyolitic flow unit. The rocks are pastel shades of red, yellow and green and have a weakly developed clay and iron oxide dominated alteration assemblage containing minor pyrite, hematite, epidote, quartz, pale blue-green ?celadonite, and rare native sulphur. Irregular vuggy quartz-rich zones and stringers, textures suggestive of acid leaching, are found locally. However, neither the mineral assemblage nor the textures are as diagnostic of acid sulphate alteration as those associated with rhyolitic stratigraphy north of Holberg Inlet at Mount McIntosh and in the Pemberton Hills (Panteleyev and Koyanagi, 1994; Nixon *et al.*, 1994). Instead, this weak argillic-oxide overprint may reflect low-temperature solfataric activity. Whatever its origin, it does appear to be spatially related to its rhyolitic host.

The west coast of Vancouver Island north of the Brooks Peninsula contains some of the most pronounced mercury anomalies in the province. The highest reported mercury concentrations occur in stream sediments, sampled as part of the Regional Geochemical Survey, that come from tributaries of the Macjack River which flows into Raft Cove (Figure 2). Sibbick and Laurus (1995) conducted further sampling and were able to reproduce these anomalies. Although there appears to be an overall relationship between the trend of the general belt of mercury anomalies and major northwesterly striking faults, the source of the mercury at the Macjack occurrences remains to be satisfactorily explained.

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