GEOLOGY AND MINERALIZATION, TATSAMENIE LAKE DISTRICT, NORTHWESTERN BRITISH COLUMBIA (104/K)

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INTRODUCTION

This report presents the preliminary results of a second year of study of the geology and mineral occurrences of the Tatsamenie–Muddy Lake district, northwestern British Columbia. The project area is located approximately 140 kilometres west of Dease Lake (Figure 1-16-1). One producing gold mine, the Golden Bear, and several other base and precious metal occurrences are hosted dominantly by the Upper Paleozoic and Mesozoic rocks of this region.

During the 1989 field season, 1:10 000-scale geological mapping was completed along the north side of Tatsamenie Lake and south towards the Golden Bear deposit. Mapping focused on the three major structural features of the area: the Tatsamenie antiform, the Tatsamenie alteration zone, and the West Wall fault and associated ultramafic rocks south of Tatsamenie Lake.

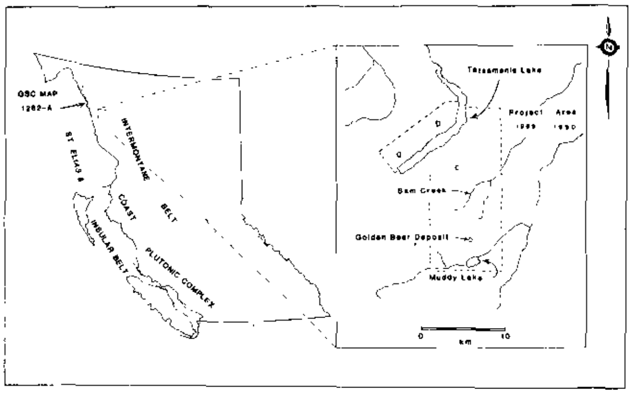

Figure 1-16-1. Location of the Tatsamenie Lake map area within the tectonic framework of the Canadian Cordillera. The location of major structural features, the Tatsamenie antiform (a), The Tatsamenie alteration zone (b), and West Wall fault (c), are also shown.

PREVIOUS WORK

The geology of the Tatsamenie Lake area was examined in a field program conducted by Souther between 1958 and 1960 (Souther 1971). His report and accompanying map established the general stratigraphic and structural relationships of the Upper Paleozoic and Mesozoic rocks of this area. The Paleozoic section exposed along the shores of Tatsamenie Lake was used by Monger (1970) in his development of an island arc tectonic model for Stikine assemblage rocks.

Selected mineral occurrences in this area have been briefly described by Schroeter (1986). The area was the focus of a broad precious metal reconnaissance program conducted by Chevron Minerals Ltd. in the early 1980s. The results of its field programs are documented in a series of assessment reports (Brown and Walton, 1983; Brauset, 1984; Shannon, 1982; Shaw 1984; and others). Parts of this region, principally the main Tatsamenie alteration zone, were explored for their base metal potential, prior to 1980. In a B.Sc. thesis Hewgill (1980) described the alteration and dated a large albite dike exposed above treeline south of Tatsamenie Lake.

The geology and structural features of rocks south of Sam Creek, and the Golden Bear deposit, have been described by Oliver and Hodgson (1989).

REGIONAL GEOLOGY

Much of the project area is underlain by an 800-metre-thick sequence of thick-bedded limestones and lesser interbedded cherts, shales and sandstones of Permian age (Souther, 1971). The Permian succession is conformably overlain by a sequence of Lower Triassic mafic pyroclastics and lesser flows, several hundreds of metres thick (Figure 1-16-2).

Unconformably lying on Lower Triassic rocks are weakly metamorphosed and deformed Middle Triassic volcanic rocks of the Stuhuni and King Salmon Groups; a pre-Middle Triassic unconformity is found throughout the North American Cordillera (Read and Okulitch, 1977, Siberling, 1973).

In the Stikine Terrane, late Triassic volcanic rocks are dominantly fragmental and commonly alkalic. Based on bulk rock chemistry, both extensional, back-arc, and fore-arc tectonic settings have been suggested for these rocks (Mortimer, 1986; Souther, 1977). It is probable that both fore-arc and back-arc lithologies may have evolved to form the larger composite that is the Stikine Terrane.

Within the project area, supracrustal rocks are flanked, to west and south, by intrusions which form the core of the Stikine arc. These intrusions trend northeast across the north-northwest grain of the Cordillera. They are typically Triassic to early Jurassic in age and are believed to be coeval with late Triassic volcanic rocks. Late Triassic felsic plutonic rocks have an extremely limited distribution in the Cordillera, occurring only in the northwestern Stikine arc (Anderson, 1984; Armstrong, 1988).

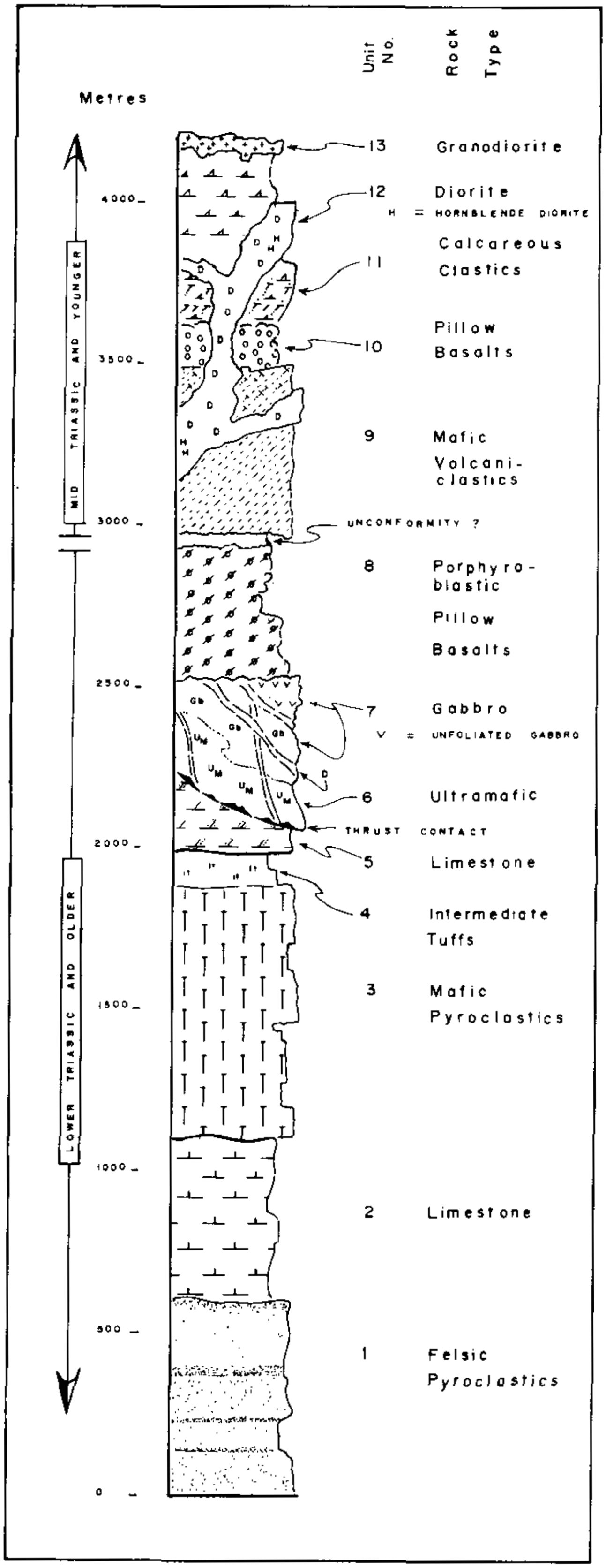

Figure 1-16-2. *Generalized stratigraphic column*, Tatsamenie Lake area. Additional subdivisions and modifiers of these major rock units are detailed and expanded in the text.

Three major deformations have influenced the form and distribution of supracrustal rocks in this area. The youngest structures are Eocene extensional faults which cut all rock types and locally are intruded by Tertiary diabase and felsic dikes. Volumous basaltic volcanism associated with Eocene extension, produced lavas of the Level Mountain Group; the youngest rocks in the project area. The late extension in the region was related to a transtensional tectonic environment caused by a change in plate convergence direction at 54 Ma (Engerbretson *et al.*, 1985).

The second deformation was related to a mid-Jurassic accretionary event. The deformation involved the formation of southwest-verging thrust faults, for example the King Salmon fault, coupled with the development of broad, open fold structures, and weak penetrative deformation. Many of the older southwest-verging tight to overturned folds in the penetratively deformed rocks below the mid-Triassic unconformity were refolded in the second deformation. The marked change in deformational style between post and pre-Middle Triassic rocks has been used as a field criterion for locating the Middle Triassic unconformity in the area (Souther, 1971; Kerr 1948).

SUPRACRUSTAL ROCKS

PERMIAN AND OLDER

UNIT 1: FELSIC TUFFS AND LESSER FELSIC FLOWS

Pale cream to pink-buff-weathering, fine-grained felsic tuffs and lesser flows occupy the core of the Tatsamenie antiform. This unit is intensely foliated and usually displays well-developed bedding-cleavage intersection lineations. The thickness of the combined pyroclastic and flow sequence may exceed 500 metres.

In the flows, primary feldspar phenocrysts occur in a matrix composed of greater than 40 per cent potassic feldspar. In tuffs, well-developed compositional layering is defined by variations in the ratio and size of quartz and feldspar. Layers average 0.5 to 2.5 centimetres in width. Unabraded primary zircon phenocrysts are abundant in thin section and establish the primary pyroclastic origin of this unit.

UNIT 2: LIMESTONE AND DOLOMITIC LIMESTONE

Massive to weakly bedded pale cream to dark grey limestone conformably overlies the felsic tuff unit in the core of the Tatsamenie antiform. This rock is moderately to strongly recrystallized and weakly foliated with the foliation being defined by the alignment of muscovite porphyroblasts. Quartz grains, some of detrital origin, average 15 to 20 per cent of the rock volume. Quartz content appears to increase towards the top of the section, as does the abundance of thin argillite beds. Stromatolitic mounds are developed at one locale near the upper contact of the limestone with the overlying tuffaceous units.

The carbonate sequence is approximately 450 to 500 metres in true thickness. Midway through the section, a mafic tuff bed, 20 to 40 metres thick, forms a useful internal marker horizon.

PERMIAN TO LOWER TRIASSIC

UNIT 3: BEDDED MAFIC TUFFS

A 600 to 650-metre sequence of thin bedded mafic tuffs, with minor calcareous interbeds, conformably overlies Unit 2. These rocks are characterized by 30 to 40 per cent porphyroblasts of actinolite and lesser hornblende, and may show well-developed compositional layers of actinolite-calcite-quartz and feldspar, 2 centimetres or less in thickness. They may also carry up to 15 per cent disseminated pyrite and magnetite. The rocks weather buff to grey-green, and locally are friable due to a well-developed foliation.

Tuffaceous beds range in thickness from 2 to less than 20 centimetres thickness. Plagioclase crystal tuff horizons can be recognized at the outcrop scale, but appear to have little lateral continuity and do not form mappable units. Flows have not been recognized in this unit.

UNIT 4: INTERMEDIATE TUFFS

This unit has only been recognized above 2000 metres elevation south of Tatsamenie Lake. It occurs as lenticular beds with little lateral continuity. The unit is well bedded with discrete compositional layering visible on all scales, and is blue to grey-green weathering. Highly strained quartz and potassic feldspar fragments are usually less than 1 centimetre on the long axis and may show asymmetric quartz and feldspar pressure shadows. Clasts composed of quartz and feldspar are strongly recrystallized and often deformed into isoclinal microfolds. Porphyroblastic biotite, and lesser chlorite, are present in the matrix and replace primary mafic minerals. The rock contains 15 per cent magnetite and pyrite, which is commonly rimmed by porphyroblastic biotite.

UNIT 5: LIMESTONES, INTERBEDDED ARGILLITES AND MINOR CALCAREOUS TUFFS

This unit consists of thin interbeds of chemical and clastic sedimentary rocks, and directly overlies either Unit 3 or Unit 4 (Figure 1-16-2). It does not exceed 150 metres in true thickness. A clean white limestone unit, 50 to 60 metres thick, forms the base of the section and is in turn overlain by a mixed sequence of argillites, minor siliceous phyllites, and extremely calcareous mafic tuffs. Calcareous mafic tuff members are very thin bedded, highly crenulated and disharmonically folded. The entire rock package appears to have reacted to deformation in a ductile fashion.

UNIT 8: PORPHYROBLASTIC PILLOW BASALTS

Diagnostic field criterion for this flow sequence are abundant, prominent, medium-grained actinolite porphyroblasts and highly strained chloritic pillow remnants. Morphologically the pillows are consistently elongate and of moderate to small size, seldom exceeding 75 centimetres along the long axis. Radial fracture patterns are present but strongly rotated. Estimates of thickness are difficult to make due to the high strain, but the unit appears to be approximately 350 metres in true thickness. Massive flows, lacking pillows, may form about 50 per cent of the section.

MIDDLE TRIASSIC AND YOUNGER

UNIT 9: MAFIC VOLCANICLASTICS

The map unit consists of 10 to 15 per cent fine-grained black clastic sedimentary rocks, 20 per cent carbonate-rich sedimentary rocks, 30 per cent mafic pyroclastics and flows, and 20 per cent volcanic wacke. This sequence is exposed along the north shore of Tatsamenie Lake. In this area, rocks are extensively hydrothermally altered and the original protolith is usually difficult to determine. The rocks are not strongly porphyroblastic, actinolite is absent and penetrative deformation is weak. Soft-sediment deformational features and fault-related drag-folds are the principle structures identified.

UNIT 10: PILLOW BASALTS

Unlike Unit 8, flows in this 100 to 150-metre-thick unit are moderately altered and unfoliated. Pillows have about 3 per cent vesicles by volume. The vesicles tend to be relatively large (2 to 4 millimetres) and are commonly filled with epidote with lesser analcime. The rock matrix is composed of 60 per cent fine-grained, unaligned plagioclase microliths, in a carbonatized pyroxene and lesser olivine matrix. The rock mineralogy is consistent with a basaltic rather than andesitic origin. The mineralogy also indicates that these rocks have only experienced very low-grade metamorphism, zeolite facies or burial metamorphism. The unit has the internal stratigraphy characteristic of subaqueous basaltic flows. The stratigraphic column consists of massive flows at the base, overlain by pillow flows and topped by well-defined pillow breccias.

UNIT 11: CALCAREOUS CLASTIC ROCKS, MINOR LITHIC WACKES

This unit forms the upper parts of the steep cliffs in the Tatsamenie alteration zone. The unit as a whole is red-buff weathering and is locally strongly altered. It consists of varying proportions of volcanic clasts, quartz grains and carbonate-rich mud. Angular, poorly sorted lithic fragments weather in relief against the buff-orange carbonate-rich matrix. Shaly limestone interbeds are present locally and provide excellent markers. Soft-sediment deformational features and large-scale slump structures are common. The unit may be slightly more tuffaceous at the base, grading upwards into a more clastic rock.

INTRUSIVE ROCK UNITS

UNIT 6: ULTRAMAFIC ROCKS

Ultramafic intrusive rocks are exposed at two localities south of Tatsamenie Lake. At both locations, they appear to be spatially associated with, and likely bounded by, large faults. In their unaltered form, the intrusions are coarsely phenocrystic with hypidiomorphic olivine and lesser pyroxene cut by small serpentine veinlets. Magnetite and other oxide phases average 10 per cent of the rocks by volume. Within 50 metres of large faults, the rocks become increasing serpentinized and carbonatized with steatite visible in both hand specimen and in thin section. Closer to the main faults significant grain-size reduction develops, producing well-

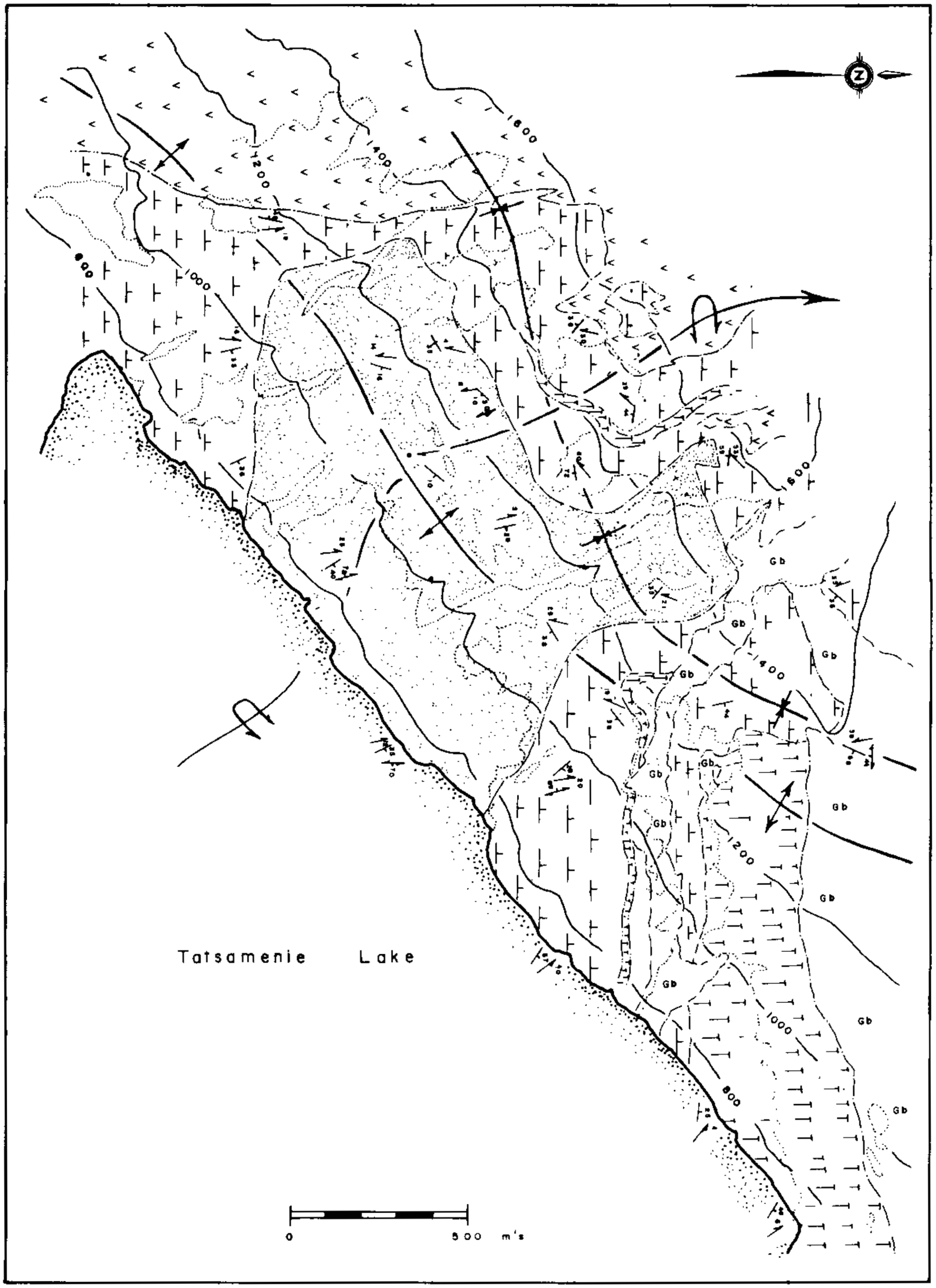

Figure 1-16-3. Geological plan of the Tatsamenie antiform. Lithologic patterns correspond to those of the stratigraphic column, Figure 1-16-2.

defined deformation bands. No contact aureoles or compositional zonation of the ultramafic rocks were mappable at these locations.

UNIT 7: GABBRO

Gabbroic intrusions are abundant on both the north and south sides of Tatsamenie Lake, and appear to have been emplaced in at least two intrusive events. The earliest gabbros are moderately to strongly foliated and partially carbonatized. Contact relationships between these intrusions and the overlying mafic flows and pyroclastic rocks suggest that the gabbros may in part be subvolcanic and coeval with the mafic volcanic rocks of Units 3 and 4 (Figure 1-16-2). Younger gabbros are unfoliated and essentially unaltered plagioclase-pyroxene-hornblende phenocrystic rocks which intrude all lower Triassic and Permian strata.

UNIT 12: DIORITE

Rocks of dioritic composition predominate among the intrusions in the area. They range from coarse-grained potassic hornblende diorites, to strongly plagioclase-porphyritic diorites (Map Unit PD), to well-foliated and weakly compositionally layered dioritic gneisses. Hornblende diorites and dioritic gneisses may have a weak igneous fabric, defined by aligned hornblende, but it seldom coincides with the regional penetrative foliation in the supracrustal rocks. Diorites form the core and flank the main alteration zone at Tatsamenie Lake. In this zone, they are extensively sheared and chloritized (Map Unit Dc). The margins of the intrusions are commonly sericitized (Map Unit Ds). Intrusive breccias, with fragments displaying well-developed hydrothermal reaction rims, and potassic alteration occur in this zone (Plate 1-16-1). Fine-grained plagioclase-phyric diorites, with well-defined chilled margins occur as numerous dikes which invade ultramafic intrusions. Larger dioritic bodies show clear crosscutting relationships with ultramafic and gabbroic intrusions.

UNIT 13: GRANODIORITE

Small felsic intrusions occur as dikes and minor sills across the property. They are orange-buff weathering, typically strongly plagioclase porphyritic, and locally albitized or extensively carbonatized. Chlorite-pyrite veinlets and microveinlets, sometimes with chalcopyrite, occur locally (Plate 1-16-2). Alteration is most intense within the Tatsamenie alteration zone. In thin section, dikes of felsic appearance, and other types of intrusions in the alteration zone, appear quartz deficient; compositionally some of them may be monzonites to syenomonzites.

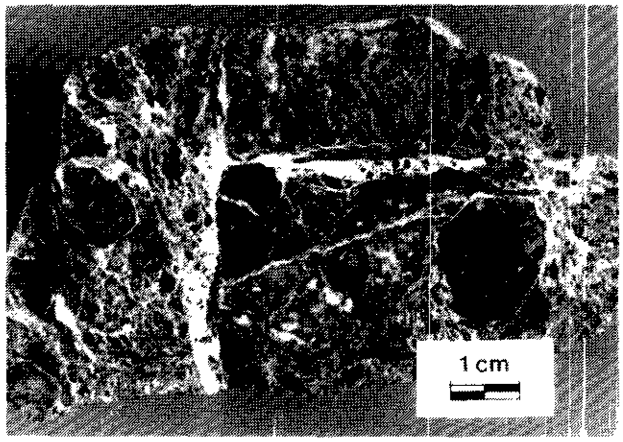

Plate 1-16-1. Example of an intrusion breccia from the Tatsamenie alteration zone. Veins are dominantly carbonate and the lighter flecks within fragments are green mica.

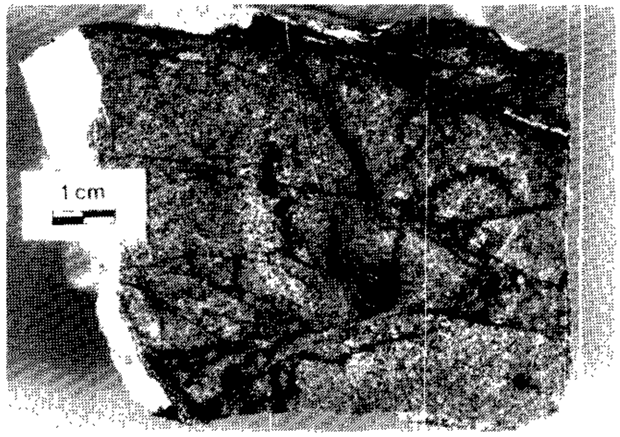

Plate 1-16-2. The sample is of a quartz-free, strongly carbonatized potassic intrusion from the Tatsamenie alteration zone. Small veinlets are chlorite-pyrite. Bleached halos adjacent to the veinlets are carbonate.

MAJOR STRUCTURAL FEATURES

TATSAMENIE ANTIFORM

The structure of the Tatsamenie antiform is shown on Figures 1-16-3 and 1-16-4. This large antiform is west verging, slightly overturned and plunges north at 10° to 15° with felsic tuffs and flows (Unit 1) in the core. A north-trending asymmetric lobe in the core of the structure is the result of upright cross-folding which trends east across the northerly trend of the earlier overturned antiform. Early bedding-cleavage intersection lineations are strongly rotated in the hinge regions of these east-west folds. The core of the antiform is cut by a single north-trending, east-side-down normal fault with an apparent offset of 50 to 75 metres. On the east limb of the antiform, the limestones of Unit 2 are strongly disrupted by numerous small-scale faults, and by early gabbroic intrusions. Most of these faults strike 045° and dip subvertically; many of them host iron-stained quartz-ankerite veins, locally well brecciated and up to 1.5 metres wide. Disseminated malachite is found in limestone talus near the gabbro contacts. Minor amounts of copper staining were noted on the steep cliffs which form the east limb of the antiform.

Two pale cream chert horizons, 20 to 30 metres thick, occur in felsic rocks of Unit 1 in the core of the antiform. These rocks are extensively sheared along sericitic foliation surfaces, and display the characteristic yellow-brown weathering product of arsenopyrite, scorodite. They have

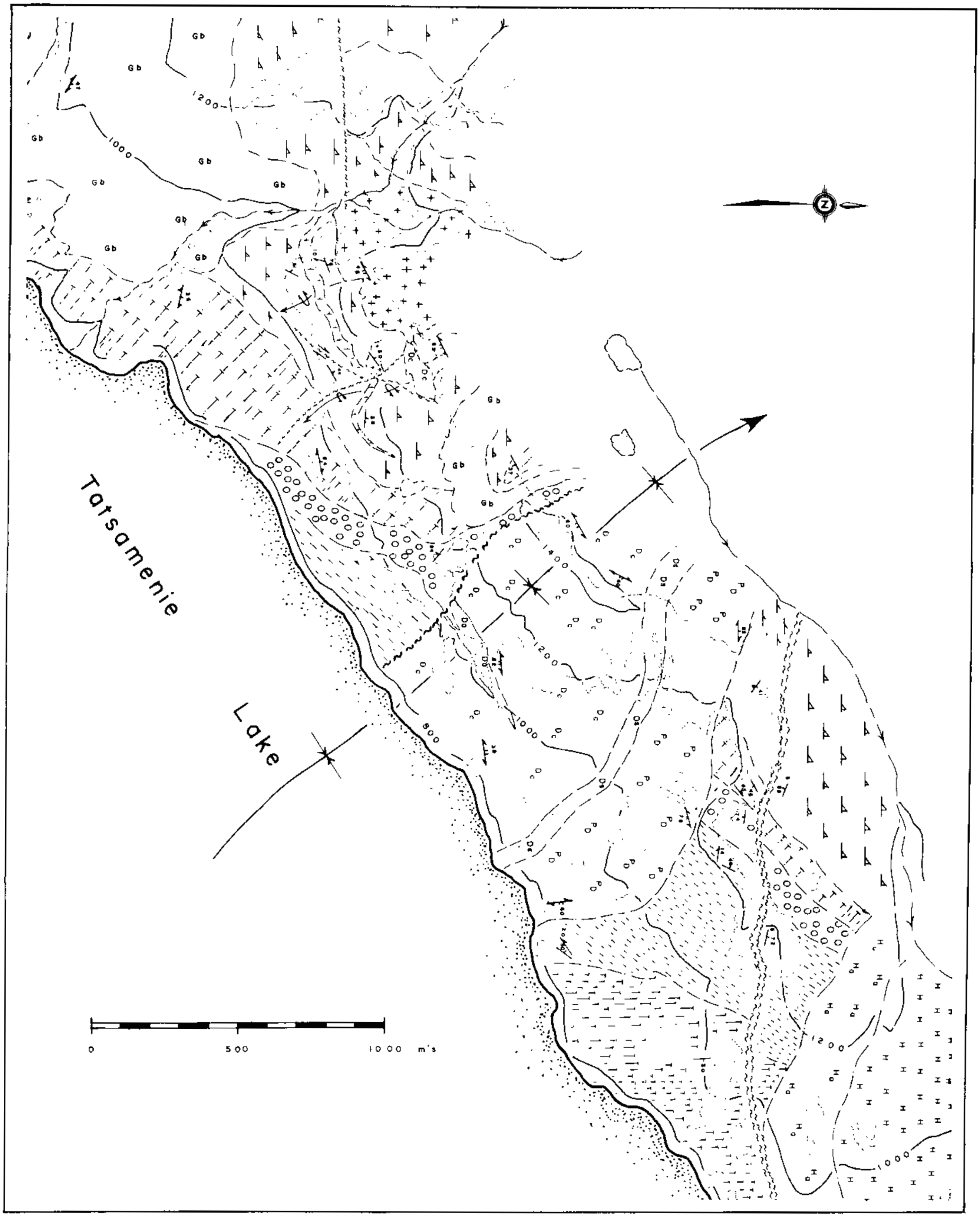

Figure 1-16-5. Geological plan of the Tatsamenie alteration zone. Lithologic patterns correspond to those of the stratigraphic column, Figure 1-16-2.

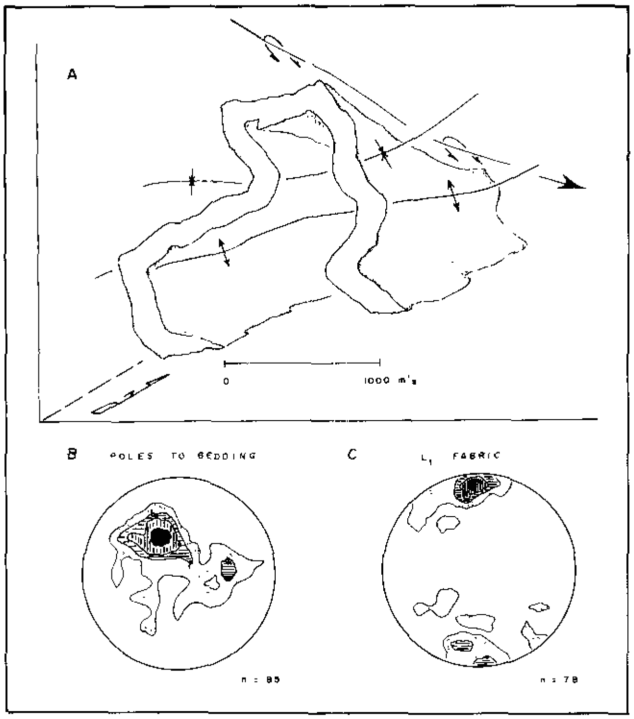

Figure 1-16-4. *Isometric down-plunge projection through* the Tatsamenie antiform (4A), sterographic equal-area contoured poles to bedding (4B) and contoured linear fabric (4c). Sterographic contour intervals are in area increments of 2%.

many of the field characteristics of cherts which occur distally to volcanogenic massive sulphide deposits. The felsic tuffs and flows of Unit 1 are cut by many white quartz veins. These veins do not have well-developed selvedges and are not sulphide bearing; they may have been formed by the *migration of metamorphic fluids during deformation.*

Limestones of Unit 2 on the western limb of the antiform are intruded by a massive to weakly foliated gabbro (Unit 7). Calcsilicate-magnetite alteration occurs on the northwestern contacts of this and other smaller intrusions. No copper skarn mineralization was identified on the gabbro contacts.

TATSAMENIE ALTERATION ZONE

The Tatsamenie alteration zone is an area of bright orange-buff weathering, carbonate and potassium alteration exposed on the north side of Tatsamenie Lake and exceeds 14 square kilometres in area. Primary textures in supracrustal rocks are only occasionally preserved. The principal structural features are shown on Figure 1-16-5.

The alteration zone is both cored and frequently dissected by several intrusive phases. An intensely chloritized and *highly sheared dioritic intrusion (Unit Dc) is exposed in the* central part of the zone. This early intrusion is in fault contact with supracrustal rocks on its western margin. Movement on this fault displaces rusty weathering alteration zones 50 to 75 metres down to the west. A younger porphyritic diorite stock (Unit PD) lies to the east of the earlier diorite. Strongly sericitic alteration zones may be developed (Unit Ds) over distances of 40 to 60 metres along this contact.

Heavily carbonatized plagioclase-porphyritic granodiorites to monzonites (Unit 13) are best exposed in the northwestern parts of the alteration zone. They do not contain significant free quartz and some may be syenitic. Many of them carry discrete chlorite-pyrite and potassium feldspar veinlets. Quartz veins are also present, but much less common. Extensive replacement by carbonate minerals has obliterated many of the textures in the igneous rocks.

Several faults cut the main alteration zone. Strong silicification, development of green micas (fuchsite?) and multistage veins are common within and marginal to these faults (Plate 1-16-3). The largest fault dips subvertically and is exposed for over a kilometre on the northeastern margin of the alteration zone, (Figure 1-16-5). It is marked by a zone of alteration and deformation at least 50 metres wide. Alteration consists of abundant graphite, extensive silicification and fuchsite-sericite alteration assemblages in mafic rocks (Plate 1-16-4). Large-scale overturned drag-folds are developed in a zone up to 100 metres wide either side of this fault. Stratigraphic offsets and minor structures suggest that the fault is normal and the movement is south side down. This fault and related structures offset and flatten the limbs of a broad, open synform trending through the core of the alteration zone.

THE WEST WALL FAULT AND ULTRAMAFICS SOUTH OF TATSAMENIE LAKE

Two ultramafic bodies are exposed on the higher plateaus south of Tatsamenie Lake; the geology and structural relationships of the more westerly of the two are shown on Figure 1-16-6. The rocks range from anorthositic gabbro to peridotites. The larger of the two crops out 2.5 kilometres east of the ultramafic body shown on Figure 1-16-6. At this location, a coarse-grained, pyroxene-rich peridotite is truncated and invaded by younger dioritic intrusions (Unit 12). The intrusion is fault bounded to the east, where a prominent zone of orange carbonatization defines the contact. The fault is a relatively old structure and is truncated by younger dioritic

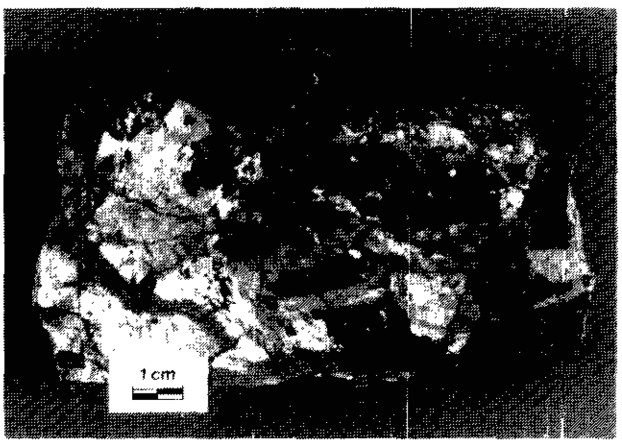

Plate 1-16-3. *The hand specimen is taken from the fault* breccias exposed in a major east-west fault bordering the Tatsamenie alteration zone. Graphitic sediments are intensely disrupted by carbonate (white) and potassium silicate veinlets (light grey).

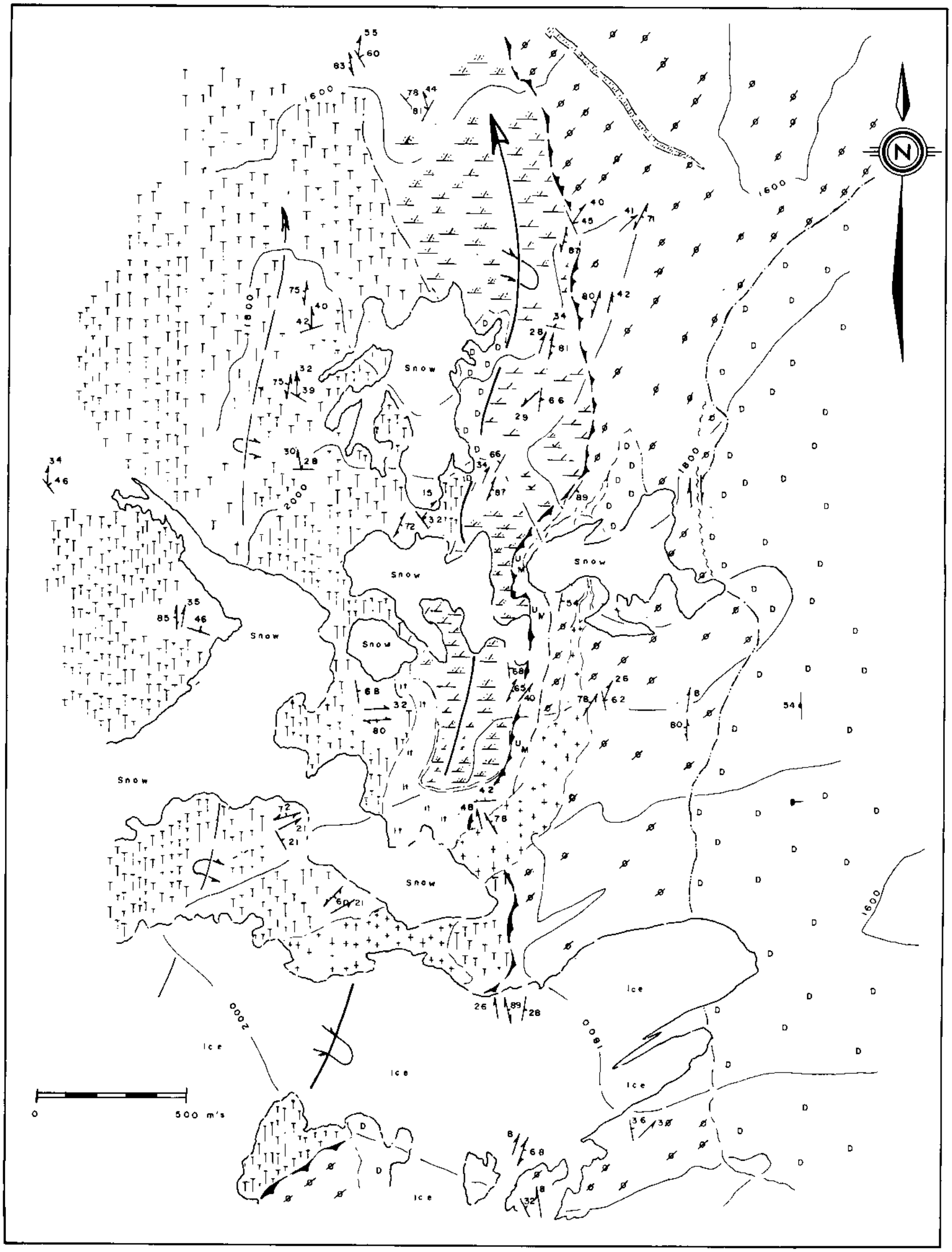

Figure 1-16-6. Geological plan of the West Wall fault and ultramafic zone. Lithologic patterns correspond to those of the stratigraphic column, Figure 1-16-2.

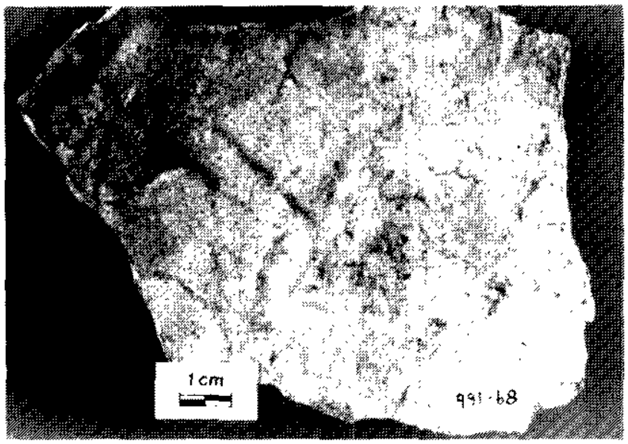

Plate 1-16-4. The protolith of this sample is a fine-grained mafic pyroclastic from the Tatsamenie alteration zone. The sample is pervasively carbonatized; the darker grey flecks are pyrite and green mica.

intrusions to the north and south. This ultramafic has been partially serpentinized, but primary igneous textures are easily discernible.

The ultramafic shown on Figure 1-16-6 ranges from a completely serpentinized peridotite to coarse-grained anorthositic gabbro. This rock is generally extensively tectonized including the development of mlyonitic bands within 25 metres of the bounding fault. Grain size reduction occurs not only in extensively serpentinized ultramafics, but also in extremely coarse grained anorthositic gabbros.

The distribution of the more westerly ultramafic body, closely corresponds to the surface expression of a major structure, the West Wall fault, first identified by geologists with Chevron Minerals Ltd. (Wober and Shannon, 1985). Across this fault, intensely porphyroblastic, highly strained pillow flows in the hangingwall are in contact with fine-grained mafic and intermediate tuffaceous rocks in the footwall. The strike of argillite marker beds in the hangingwall flows appears discordant with the strike of the fault and with bedding in the footwall. Stratigraphic and structural relationships, and the presence of gabbroic to ultramafic bodies aligned along the fault, all indicate that this fault is a west-verging thrust.

Closely associated with the fault, and principally developed on the footwall side, is a north-plunging, west-verging overturned synform, mapped for over 3 kilometres of strike. The intensely deformed, overturned limb appears to be truncated by the West Wall fault. Close to the highly altered ultramafic body splays from the West Wall fault are mineralized (10 to 20 grams per tonne gold) over relatively narrow (0.6 metre) widths (Barr, 1989). A zone in which penetrative linear fabrics show a marked rotation coincides with a dilational zone and a gold showing named the "Two Ounce Notch" (Schroeter, 1986). The rotation of these lineations may be due to superposition of a later fold across the overturned synform, or by fault deflections.

DISCUSSION

REGIONAL GEOLOGY

The geological relationships described in this preliminary report have significant implication for interpretation of the regional geology. Several geological features must be explained:

(1) There is a marked decrease in the state of strain in the rocks which form the Tatsamenie alteration zone relative to the surrounding rocks. Within the alteration zone, the rocks lack a strong penetrative fabric, and contain porphyroblastic zeolites, consistent only with very low grade (burial) metamorphism. Pillows are relatively undeformed and the quartz and carbonate components of the clastic sediments are not recrystalized. Rocks to the west and south of the alteration zone are, in contrast, strongly porphyroblastic, contain the metamorphic mineral assemblage amphibole (actinolite)-albite-biotite and are strongly recrystalized. Small-scale kinematic indicators suggest these rocks record more than one high-strain event. It appears likely that rocks within the alteration zone lie above the mid-Triassic unconformity and belong to the Stuhuni group. The large extensional faults mapped in the area of the alteration zone may be part of a major graben.

(2) Rocks south of Tatsamenie Lake cannot be correlated with those exposed in the Tatsamenie alteration zone. This discontinuty of rock types and structural style is best explained by inferring an unconformity between the two rock packages. Stratigraphy south of Tatsamenie Lake, and west of the alteration zone, appears to be Lower Triassic and older.

(3) The distribution of ultramafic rocks south of Tatsamenie Lake suggests that these rocks are part of a dismembered and poorly preserved ophiolite assemblage. This interpretation is based on the following evidence:
   (a) The ultramafic rocks form long. linear bodies, confined virtually exclusively to the hangingwall of the West Wall fault. They are found in only one instance to the west of this fault, and at this exposure which is less than 10 square metres in area, they may not be in place.
   (b) These rocks are directly overlain by a highly strained mafic pillowed-flow sequence.
   (c) The ultramafic rocks are peridotites which are texturally and mineralogically consistent with alpine-type ultramafic bodies.
   (d) The ultramafic intrusions lack signifcant contact aureoles and field data strongly suggest that the contacts are tectonic rather than intrusive.
   (e) One of the intrusions is cut by numerous mafic dikes. However, the dikes have chilled margins and appear to be dioritic as opposed to gabbroic in composition. The diorites may have been emplaced in a mid-Mesozic intrusive event, rather than feeders to the pillowed flows.
   (f) The orientation and indicated sense of movement on the northern parts of the West Wall fault is consistent

with the orientation of other larger west-verging ultramafic bounded faults, for example the Nahlin fault.

Implications For Exploration

The data presented in this report suggest that the following type of exploration targets may occur in the Tatsamenie Lake area:

- The felsic tuffs and flows in the core of the Tatsamenie antiform contain chert horizons which carry disseminated arsenopyrite and pyrite. They may be the lateral equivalents of massive sulphide horizons, similar to those mined at the Tulsequah Chief. The outcrop area of the felsic sequence should increase to the south of Tatsamenie Lake and north of Sam Creek, up the plunge of the Tatsamenie anticline. Mineralized cobbles and boulders carrying disseminated lead and zinc sulphides have long been documented in the upper drainage of Sam Creek (Souther, 1971).
- The Tatsamenie alteration zone, and other similar alteration zones in the area, are an impressive target for precious metals exploration. The large-scale extension faults, the presence of numerous quartz-bearing and quartz-free intrusions, the development of intrusive and fault breccias, widespread carbonatization, fuchsitic and potassic alteration, are all suggestive of a highly favorable precious metal environment.
- The association of intensely altered ultramafic rocks and large-scale low-angle faults, south of Tatsamenie Lake, favours the formation of shear-related gold veins. Zones of dilatancy within these linear faults are prime targets and these will generally occur where second-order fault structures intersect the major faults; where changes in rock competency occur at depth along the fault trace; and in areas where different fold systems are superimposed near the faults. Careful geological mapping and interpretation is the best way of outlining these targets.

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NOTES

GEOLOGIC AND ISOTOPIC ANALYSIS OF THE NISLING – NORTHERN STIKINE TERRANE BOUNDARY NEAR ATLIN, BRITISH COLUMBIA (104M/8)

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KEYWORDS: Regional geology, Nisling Terrane, Stikine Terrane, Stuhini Group, Laberge Group, neodymium isotopes.

INTRODUCTION

Three tectonic assemblages underlie the eastern flank of the Coast Range batholith in northern British Columbia: from west to east, the Nisling, northern Stikine and northern Cache Creek terranes (Figure 1-17-1). Each assemblage preserves a unique stratigraphy and geologic history, and the boundaries between these assemblages are marked by faults along much of their lengths. One of the goals for understanding the accretionary history of western North America is to document the time at which adjacent crustal fragments first came together. This study examines the age of juxtaposition of the Nisling and northern Stikine assemblages, and is part of a larger project focused on assessing the early Mesozoic tectonic relationships between the Nisling, northern Stikine and northern Cache Creek terranes.

The Nisling Terrane comprises metamorphosed sedimentary and volcanic rocks interpreted to belong to a Proterozoic to Paleozoic pericratonal basinal assemblage (Wheeler and McFeely, 1987). Nisling rocks lie west of volcanic and sedimentary strata of the Upper Triassic Stuhini Group, part of the northern Stikine Terrane. In northern British Columbia and southern Yukon, these two assemblages are separated by the north-northwest-striking Llewellyn fault zone (Bultman, 1979; Mihalynuk and Rouse, 1988; Mihalynuk *et al.*, 1989) and Tally Ho shear zone (Doherty and Hart, 1988; Hart and Pelletier, 1989; see Figure 1-17-1).

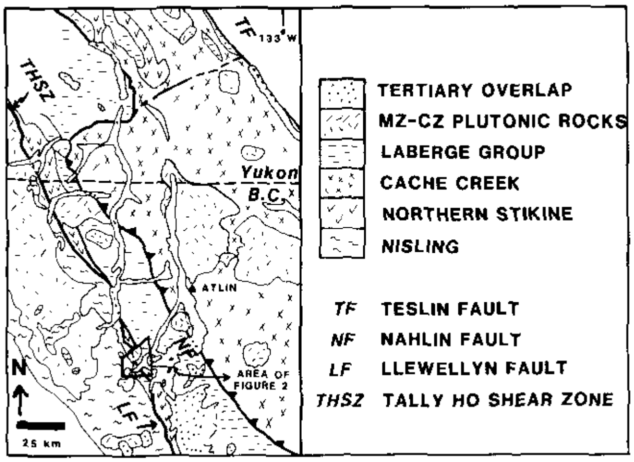

Figure 1-17-1. Generalized geology of the area around Atlin, British Columbia (modified after Wheeler and McFeely, 1987). Refer to the text for discussion of map units and structures. Note location of the Willison Bay study area.

Although northern Stikine lithologies are nowhere preserved in demonstrable primary depositional contact with Nisling rocks, several authors have discussed evidence pointing toward a Late Triassic link. Bultman (1979) noted: (1) the presence within Stuhini conglomerates of metamorphic clasts that resemble Nisling lithologies and of porphyritic granodiorite clasts that resemble a Late Triassic plutonic suite that intrudes Nisling rocks; (2) the presence within Nisling rocks of augite porphyry dikes that are similar to augite porphyry flows within the Stuhini succession; and (3) a zone of weathering, interpreted to be pre-Stuhini, within the porphyritic granodiorite near its contact with Stuhini strata. Werner (1978) also discussed the possibility of an original unconformity separating Nisling and Stuhini rocks, on the basis of similar chemical composition of pyroxenes in Stikine augite porphyry flows and in an augite porphyry dike that intrudes the Nisling assemblage. Mihalynuk and Rouse (1988) believe that an unconformity may be preserved in the Tutshi Lake map area (104M/15) due to a lack of deformational features within strata adjacent to the contact.

The goal of this research project is to evaluate geologic relationships noted previously along the Nisling-Stuhini contact, and to provide more quantitative constraints on the nature of the contact through analysis of the neodymium and strontium isotopic signatures of rocks near the contact. We chose to begin the study in Willison Bay at the south end of Atlin Lake (104M/8) where excellent exposures of Nisling and Stuhini rocks are preserved. In this report, we first describe the geology of the Willison Bay area, then discuss the isotopic studies in progress at the University of Arizona.

GEOLOGY OF THE WILLISON BAY AREA

Figure 1-17-2 shows a geologic map of the Willison Bay shoreline, illustrating the major rock units found along the Nisling-northern Stikine contact. General descriptions of these rocks are given below, as are relevant structural observations and interpretations of relationships between units. All descriptions are based on field observations only, as thin section analysis and quantitative petrography are in progress. This geologic framework was assembled as a basis for collecting and interpreting isotopic samples. For a more detailed account of the geology of the region, the reader is referred to Mihalynuk and Mountjoy. (1990, this volume).

LAYERED ROCKS

NISLING ASSEMBLAGE (PPZn)

The western end of the study area is underlain by Nisling assemblage rocks composed of biotite-quartz-feldspar