REPORT ON A SUITE OF 22 PETROGRAPHIC SAMPLES

LONE CONE GROUP

MEARES ISLAND PROJECT

LEMMENS INLET, MEARES ISLAND, B.C.

ALBERNI MINING DIVISION

LAT. 49 12.2'N, LONG. 125 52.5'W

NTS 92F\4W

BY

K.E. NORTHCOТЕ, PH.D., P.ENG. & DAN P. BERKSHIRE

SUB-RECORD OWNER: IRON RIVER RESOURCES LTD.
VANCOUVER, B.C.

M.R. # $ VANCOUVER, B.C.

APR 2 7 1990
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INTRODUCTION

This report describes a petrographic study on a suite of 20 samples collected from the Lone Cone Group of claims during months of January and June of 1989 and January of 1990. This study was conducted to verify the existence of ultramafic rocks which are located throughout the claim group.

This project was also initiated to gain a clearer understanding of the geological setting of this complicated region. "The ultramafic rocks are thought to be dyke of sill-like bodies derived from a deep-seated source, emplaced in Sicker Group rocks, and subsequently intruded by acid Island Intrusions. The petrographic description of the samples submitted support this conclusion." (K.E. Northcote Ph.D., P.Eng.)

The property consists of one 20 unit and two 15 unit claim blocks for a total grouping of 50 units. This group is located on Meares Island approximately 6 km northeast of Tofino, Vancouver Island, B.C. The property is owned by Iron River Resources Ltd.

Pavonine Explorations Ltd. was engaged by Iron River Resources Ltd. to collect a suite of representative samples of the varied geology of the claim group and submit them to Vancouver Petrographics Ltd. for study. These sample were collected during the course of three trips to the property, two during 1989 and one in January of 1990.
CLAIM MAP
1/50000

NTS 92F/4

PAVONINE EXPLORATION LTD.
FIG. 3
PROPERTY DESCRIPTION

The property is located approximately 6 km northeast of Tofino, British Columbia. The PT 1 & 2 claims share a common legal corner post which is located above tidewater on a small headland point located southeast of the outlet of Lemay Creek, Meares Island. This creek empties into a small bay known as God's Pocket which is located halfway up the western side of Lemens Inlet. The bay is bounded on the south by Lagoon Island. The PT 3's LCP is to be found on the northwestern shore of Meares Island just south of Ritchie Bay. Tofino is located on the West Coast of Vancouver Island in the Alberni Mining Division (NTS 92F/4W). The group's location is Latitude 49 12.2'N., Longitude 125 52.5'W. The claims consists of 50 units, divided into three claim blocks consisting of the PT 1; (LCP Tag no. 111237) 20 units, 4 unit lengths north and 5 unit lengths west, the PT 2; (LCP Tag no. 111236) 15 units, 3 unit lengths south and 5 unit lengths west, and the PT 3; (LCP Tag no. 111235) 15 units, 5 unit lengths south and 3 unit lengths west. (See Figure: #3).

<table>
<thead>
<tr>
<th>Claim Name</th>
<th>Units</th>
<th>Record Date</th>
<th>Record No.</th>
<th>Expiry Date</th>
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<tr>
<td>PT 1</td>
<td>20</td>
<td>JAN.29,1987</td>
<td>3110</td>
<td>JAN.29,1991*</td>
</tr>
<tr>
<td>PT 2</td>
<td>15</td>
<td>JAN.29,1987</td>
<td>3111</td>
<td>JAN.29,1991*</td>
</tr>
<tr>
<td>PT 3</td>
<td>15</td>
<td>JAN.29,1987</td>
<td>3112</td>
<td>JAN.29,1991*</td>
</tr>
</tbody>
</table>

* On approval of this report.

The property was grouped on October 19,1987 - N/G 1256 - M.R. 368446H. The group is known as the LONE CONE.

PHYSIOGRAPHY

The property occupies the slopes of Lone Cone Mountain and a valley extending from God's Pocket, a bay north of Lagoon Island, to Ritchie Bay on the northwestern side of Meares Island as well as a series of rocky hills and bluffs which extend north and east from the bay. Some low lying areas contain swamps, marshes, and small lakes or ponds.

Outcrop is best along the shoreline, steeper creek bottoms and cliffs. It is relatively poor elsewhere. The main outcroppings investigated were located on the eastern slope of Lone Cone Mountain, a former drill access road, and along a unnamed creek.

The forest cover within the claim is typical of west coast rain forest. It is forested mainly by coniferous cedar, fir, hemlock, and balsam. Shoreline and low elevation areas contain extremely thick underbrush composed of salal interspersed with deciduous maple and alder. Blow-down areas occur in some parts of the claim.
Shoreline areas show evidence of past logging operations. Clear cut logging has taken place on both the northwest and southwest slopes of Lone Cone Mountain during the past 30 years.

Elevations reach from a low of sea level to 752 meters. The climate is mild, often wet, and typical of the west coast rain forest environment. Snow rarely reaches tidewater in winter. Higher elevation rarely suffer substantial accumulations. Waterways and creeks remain ice free year round.

ACCESS

Access to the property is by boat or float plane from Tofino. Considerable caution should be exercised when using a boat due to numerous tidal flats, oyster farm boom moorings, and crab pot anchor ropes (when in season). A former drill access road exists extending west from sea level at God’s Pocket along the northern base of Lone Cone Mountain. This road and other old trails were brushed out in 1987. An unknown extent of old overgrown logging roads exists on the west side of Meares Island near Ritchie Bay. Trails must be cut through thick undergrowth to gain access to other interior regions.

The closest major supply centre (in addition to Tofino) is Port Alberni, which is 110 kilometers by paved highway to the east; or Nanaimo (on the east side of Vancouver Island), an additional 100 kilometers.

HISTORY

The earliest reference to the area in which the property is situated is to be found in the Annual Report of the Minister of Mines for the year 1898. It is reported on page 1133 that "The Iron Cap Group situated on this Inlet (Lemmens) has had a lot of work done. About 20 tons of ore have been shipped, the proceeds of which more than paid for the work done on the group. The owners are now working with a view to making regular shipments." This would make the Iron Cap the first hard rock mine in the "West Coast of Vancouver Island Mining Division" to ship payable ore.

Note: In later years this Mining Division was incorporated into the Alberni Mining Division.

The original district came into official being in July of 1898. A Mining Recorder's office was opened at Clayoquot, Stubbs Island, (the oldest settlement in the West Coast District of Vancouver Island).

-4-
SKETCH MAP SHOWING
Southern End of Vancouver Island
REFERENCE LIST OF MINERAL CLAIMS.

<table>
<thead>
<tr>
<th>Claim Name</th>
<th>Owner</th>
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<td>Iron River Resources Ltd.</td>
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The Report of the Minister of Mines for 1901 showed a marked decrease in activity (Boer War) along the West Coast of Vancouver Island. The following was reported in regards to the Iron Cap on page 924. "On the Kalappa claim, owned by Messrs. Jacobsen et al., a large amount of work has been done with encouraging results. There are several other promising claims in this vicinity, notably the Iron Cap; a good deal of prospecting has also been done and ore samples obtained which have assayed well." This is the last mention of the Iron Cap. The BCDM Minfile reports that in 1898, 17 tonnes of gold ore was shipped from this property to the Tacoma, Wash. smelter, which returned a grade of 1.60 oz/ton Au, 1.39 oz/to Ag, and 0.99% copper. (Note: This showing was relocated in 1988 by Pavonine Explorations and found not to be located within the boundaries of the Lone Cone Group of claims and therefore a new claim block was staked on behalf of Iron River Resources under the name of Iron Cap.)

After the turn of the century, exploration work was concentrated on the Kalappa Property (which is also located on Meares Island). This property eventually became a producer. In 1902, Mr. Chester F. Lee, M.E., reported that "The mining boom of a couple years ago has been succeeded by a marked depression in the West Coast of Vancouver Island Mining Division."

By 1906, mining activity in the region had dropped to the point where Walter T. Dawley, the Mining Recorder, reported that activity was quieter than any year since the office had opened. Provincial Assayer, H. Carmichael visited the district during 1906 and attempted to visit the properties on Meares Island, he reported that he "was not able to find the claims as the trails were not traceable, being so overgrown with underbrush."

However, by 1910 activity had again resumed within the district and Tofino pioneer, John Chestman, restaked and began development of the Kalappa Group on the eastern side of Lemmens Inlet. By 1912 this property was bonded and full scale mine development was undertaken. In 1913, the Kalappa Mining Company Ltd. was formed to further the development of the property and shortly thereafter the first shipments commenced. As a result of financial difficulties arising out of the First World War the property closed in 1915.

Local discoveries, however, did continue to be made. The first mineral discovery reported on what is now the Lone Cone Group was recorded in 1917. All efforts to develop the property appear to have died from a lack of risk capital.

Note: A report written in 1917 by J.F. Coats, M.E., on this group of claims for the Grandby Consolidated Mining, Smelting & Power Co., Ltd. was obtained during the course of researching this project in 1987 by Pavonine Explorations.
It was not until the late 1930's, with the success of the Zeballos gold camp, that sustained mining and exploration activity returned to the district. A number of claims were recorded on Meares Island during 1939. These claims were in part to cover old showings uncovered as prospectors and promoters searched previous claim records and geological reports for opportunities. This boom was ended, as had twice previously happened as the result of War, by 1942. After the end of World War II, with post war inflation and a continued fixed price for gold at $35 an oz., the mines that had reopened soon closed.

The next resurgence of activity occurred in the mid 1950's, as a revitalized Japanese industry demanded ever increasing resources of Iron and Copper. A renewed interest in prospecting and mining was recorded throughout Vancouver Island.

As a result of the mining boom, Meares Island's mineral potential once again came to the attention of prospectors, such as Mr. A.C. Farrell. The known showings of Meares Island were thought to be narrow high grade gold quartz veins, and as these didn't fit the popular (porphyry copper) criteria, interest waned. However, Mr. Farrell applied for and was granted reinstatement (for the cost of back taxes and interest) of the Crown Grants of the Kalappa Group.

During the early 1960's copper exploration was in strong favour with the major mining companies. In 1960 Falconbridge Ltd. optioned Catface Mountain (see index map), just northeast of Meares Island. In 1963, Catface Copper Mines Limited (a wholly owned subsidiary of Falconbridge Nickel Mines Limited) was incorporated to hold the property. The Catface ore body proved to be a substantial copper-molybdenum porphyry deposit. Current reserves stand at 181,440,000 mt at 0.45% - 0.50% Copper. This discovery initiated a period of serious mineral exploration for the region.

On Meares Island, Falconbridge staked and/or optioned a large land position comprising 49 units. These claims encompassed the area now included within the Lone Cone Group. In 1965, exploration resulted in the recognition of copper/nickel mineralization associated with pyrrhotite occurring as disseminations and as massive replacements in a host of olivine gabbro. Work included geological mapping, self-potential and magnetometer surveys, and diamond drilling. Six EX holes totalling 220 feet were diamond drilled. However, Falconbridge eventually let the claims lapse. (See Assessment Report #739)

In the early 1970's, after another resurgence in copper exploration, the ground was again staked. Texada Mines Ltd. consolidated the holdings and carried out an extensive exploration program. Andesite and hornblende gneiss were found to be successively intruded by gabbro and quartz diorite stocks.
The program's objective was to discover another "Catface" type porphyry ore body. Mineralization was discovered including chalcopyrite and molybdenite in fractures and disseminations within a host of andesite, hornblende gneiss, and quartz diorite. A second type of deposit was also noted, consisting of chalcopyrite and pentlandite in association with pyrrhotite as disseminations and massive replacements within a gabbro, hence a similarity to the mineralization found by Falconbridge a decade earlier. Results would probably have been considered encouraging if a political event, the election of an NDP Provincial Government, had not put a virtual halt to most mineral exploration within the province. (See Assessment Report #4175)

Options were dropped and the ground was again allowed to lapse. In subsequent years land positions have been staked from time to time, but no assessment work was recorded with EMPR. The next wave of activity came to the Island as gold exploration revived as the result of the high prices for precious metals in the early 1980s.

In 1982 the Lagoon Claim was staked by Mr. D. Melrose covering ground on Lone Cone Mountain. This claim was purchased by Noramex Minerals Inc. and a report was prepared for the company by Pamicon Developments Ltd., whom on the basis of their research, concluded that the Lagoon Claim should contain the location of the Iron Cap Mine as well as the more recently discovered copper-moly and copper-nickel showings.

Based on a program to rediscover the location of the Iron Cap Mine, Noramex then used the claim as their escrow property. A PROSPECTUS for a public underwriting on the Vancouver Stock Exchange was prepared and executed. The results of a follow up program, if any occurred, are unknown to this author and the property has subsequently been reduced to a single claim unit.

In January 1987, Iron River Resources Ltd. contracted Skoda Mining Services to stake 50 units in 3 claim blocks covering this geologically favorable environment. These claims are known as the Lone Cone Group. This area also encompasses the former site of the Lagoon Claim as well as most of the ground covered earlier by Texada Mines Ltd. After an intensive ground search, evidence of old workings fitting the reported mineralogical model for the Iron Cap Mine could not be found. However, workings which fit the description and general location of the original Lone Cone discovery were found on the east slope of Lone Cone Mountain.
Beginning in July 1988, Pavonine Exploration Ltd. (on behalf of Iron River Resources Ltd.) undertook a prospecting survey of a massive sulfide discovery which fit the description of the original (1917) Lone Cone showing as well as a general survey of the whole claim group. The survey was to ascertain the extent of any workings, map their locations, and obtain samples of any mineralization.

This work resulted in the recognition of occurrences of anorthosite, pyroxenite, and dunite. These rocks occur in association with gabbros as layered stocks, dikes, and/or sills. Gabbro intrusives have previously been thought to be a more basic phase of the Tertiary Catface Intrusives.

The recognition of these mafic rocks has led the author to the conclusion that this region is partially underlain by a differentiated ultrabasic intrusive complex of unknown age and tectonic origin. Evidence compiled during the course of the 1988-89 investigation also suggested this complex hosts a potential for the discovery of platinum group element (PGE) and other precious and base metal mineralization.

The petrographic study reported on in the present document was initiated as a result of recommendations made by Dan P. Berkshire, in his (1989) assessment report.

GEOLOGICAL THEORY

REGIONAL:

The general geology of the Meares Island area was mapped on a scale of 1 to 250,000 by J.E. Muller (Muller and Carson, 1968 and Muller, 1977). A more detailed map of the Geology of the Meares Island and adjacent shorelines was mapped on a scale of 1 to 25,000 by Clark Isachen (Isachsen, Clark, MSc. 1984, U.B.C.) Muller's maps show northwesterly trending fault blocks cut off and/or offset by northerly and northeasterly trending fault systems. The oldest rocks on Vancouver Island, Pennsylvanian and older Sicker Group, occur on and around Meares Island and have suggested gradational and fault contacts with migmatites, amphibolites and basic rocks of the West Coast Crystalline Complex as well as Island Intrusions of Jurassic age. The western most margin of Vancouver Island at this point is underlain by the Pacific Rim Complex, a melange of greywacke, black argillite, ribbon chert, and minor volcanics which are in fault contact (West Coast Fault) on the northeast with older rocks (Brandon 1984, 1985). All of these units are intruded by or are in fault contact with small Tertiary plutons.
Muller concluded, with some exchange of field observation with other workers and 2 available isotopic age determinations that the West-coast Crystalline Complex is the result of varied degrees of anatexis or partial melting, mobilization and recrystallization of Sicker and/or Karmutsen rocks. He has proposed that the intensity of anatexis passed through amphibolitic to migmatite and basic phases of the West-coast Complex culminating in Island Intrusions and related volcanism of the Bonanza group. These interrelationships are discussed by Muller in his description of the geology of the Nootka Sound area (Muller, Cameron and Northcote, 1981).

However, recent work backed up with extensive isotopic age determinations and trace-element chemistry (Isachsen, 1984) has shown the West-coast Crystalline Complex to be a belt of plutonic rocks composed mainly of heterogeneous amphibolitic country rock (West-coast amphibolite), granitoids of trondhjemitic to gabbroic composition (West-coast diorite), and variable mixtures of these two components (West-coast migmatite). Isachsen believes although the protolith of some deformed enclaves may be Paleozoic, most of these rocks were generated in a magmatic-arc setting and intruded in Jurassic time. Isachsen has shown that the trace element chemistry of the complex to be sub-alkaline tholeiitic to calc-alkaline. He has further stated that the exponential cooling curves derived for the West-coast diorites are not consistent with in situ crustal magma genesis but instead indicate that these rocks intruded relatively cool country rock. His study also showed a calc-alkaline chemistry and rapid initial cooling to characterize the Tertiary Catface Intrusion dated at 41 Ma.

In summary, the West-coast Crystalline Complex is interpreted as the deeper crustal equivalent of the more differentiated Island Intrusions and Bonanza Volcanics.

GEOLOGY OF MEARES ISLAND:

Muller's mapping shows Meares Island to be mainly underlain by West-coast migmatite in contact along the West-coast Fault with the Pacific Rim Complex to the southwest. Isachsen's mapping gives a far more detailed look at the shoreline geology, but can be misleading as the Island's geology is far more diverse than is indicated by the shoreline.

Isachsen proposed 9 basic rock units; the following descriptions are for the most part after (Isachsen, 1987):

01 West-coast amphibolite, predominantly amphibolite, which ranges from massive, medium to coarse grained epidiorite to fine grained, well-lineated amphibolite gneiss.

02 West-coast migmatite, which includes all gradations between banded gneiss, schlieren gneiss, schorliten gneiss, stockwork, and agmatite.
03 West-coast diorite, massive to faintly foliated dioritic and tonalitic stocks and plutons.

04 Gabbro-peridotite, Isachsen describes several isolated dike-like masses of uralitized gabbroic rock which outcrop near the central part of Lemmens Inlet. The rock is allotriomorphic granular, medium to coarse grained, and unfoliated. He also mentions a group of extremely sheared mafic to ultramafic rocks which outcrop in the northwest corner of Lemmens Inlet. He further states (Can.J.Earth Sci. 24, 2047 - 2064 [1987]) that these mafic to ultramafic rocks are of similar chemistry and of low grade of metamorphism which suggests they may be coeval and younger than the West-coast amphibolites and gneisses. Isachsen's thesis (1984, page 36) showed the trace-element chemistry of these rocks to be well within the alkaline field. He offers the suggestion that they may be cumulates from a more silica rich magma. This lends supports to the theory that these rocks represent a unknown and unrecognized ultramafic intrusive complex (Meares Island Complex).

05 West-coast metasediments, pendants and xenoliths of metasedimentary rocks are encountered within the West-coast Crystalline Complex and include metapsammitic and calc-silicate assemblages of probable Sicker group origin.

06 Diabase and aplite dikes, dikes and dikelets are common in the West-coast Complex. The aplite dikes generally crosscut the diabase. Both appear to postdate deformation.

07 Felsic volcanics, Isachsen describes a highly fractured felsic volcanic unit which outcrops in the southwestern part of Meares Island near the West-coast Fault. He suggests it may be a sliver of exotic material possibly correlative with the Pacific Rim Complex or Ucluth Volcanics. I have observed a similar unit to the east of the ridge with hosts the Kalappa mineral deposit on the east arm of Meares Island. P.T. McCullough and J.DeLeen, P.Eng., describe andesitic volcanics and sediments which lie in northwest trending belts and are in contact with various Lithologies of the West-coast Complex including rock of olivine gabbro composition on the west arm of Meares Island (Assessment Report 4175). This unit would therefore appear to be far more extensive than the shoreline geology would suggest.

08 Pacific Rim Complex, is located west of the West-coast Fault and is a melange of greywacke, black argillite, ribbon chert, and minor volcanics.

09 Catface Intrusions, a large body of massive quartz diorite, mapped by Muller as part of the Tertiary Catface Intrusions (Muller and Carson 1969), intrudes the West-coast Crystalline Complex on the southern side of Ritchie Bay.
On January 30 and June 2, 1989 and January 27 and 28, 1990, Dan P. Berkshire and Robert A. Hunter a collected suite of 22 different rock samples from various areas of the property for petrographic study. Sample locations are shown on figure #5.

The full suite of 22 samples were then provided to K.E. Northcote Ph.D., P.Eng. of Vancouver Petrographics Ltd. for Study:

-11-
LC-1 Thin section
Hornblendite

Composed primarily of interlocking hornblende with minor remnants of augite. Some deuteric alteration to second amphibole. Porous, friable, drusy as a result of weathering.

Opaques Magnetic. Composed of interstitial magnetite, pyrite and chalcopyrite. Iron stained

Stained slab shows no K-feldspar.

Microscopic description
Transmitted light

Minerals present

Hornblende; 35%, subhedral/anhedral, (<.05 to >2.0 mm), bladed, interlocking. Dark green to yellow pleochroic.

Amphibole (2); <5%, subhedral, (<.05 to 0.3 mm), bladed. Associated with hornblende.

Augite; <10%, anhedral, (<.05 to 0.2 mm), aggregates of grain remnants. Associated with opaques.

Undetermined "A", (Chlorite/biotite); <5%, anhedral, (<.01 to 0.1 mm), altered bladed/fibrous, felted, masked by iron staining. Alteration product of augite.

Veinlets; hematite/limonite.


Magnetite; 35%

Pyrite; 10%

Chalcopyrite; 5%

Note: section contains abundant open spaces filled with epoxy and opaque and translucent mineral dusting.
LC-2 Thin section, polished thin section

Peridotite mineralized by magnetite, pyrite, chalcopyrite.

Composed predominantly of hornblende and augite with strong interstitial/fracture controlled magnetite, pyrite and chalcopyrite mineralization.
Similar to LC-1 but has much more abundant augite.
Mineralized by magnetite, pyrite, chalcopyrite.
Stained slab indicates no K-feldspar.

Microscopic description
Transmitted light
Minerals present

Hornblende; 30%, subhedral/anhedral, (<.01 to 1.0 mm), bladed, felted interlocking.

Amphibole (2); <5%, subhedral, (<.01 to 1.0 mm), bladed, alteration of hornblende, colourless. Biaxial (-). Inclined extinction.

Augite; 30%, anhedral, (<.01 to 0.2 mm), aggregates of granules among hornblende grains and with interstitial opaques. Confirmed by biaxial (+) 2V 50° interference figures. Some patched show microgranular alteration dusting obscuring birefringence.

Undetermined alteration product; <5%, masked by iron stain.

Reflected light

Opaque; 35%, magnetite, pyrite, chalcopyrite
Veinlets; hematite, limonite.

Magnetite; 10%, anhedral, (<.01 to >1.0 mm). Interstitial to rock forming minerals. Cut by pyrite veinlets.

Chalcopyrite; 10%, anhedral, (<.01 to >1.0 mm). Generally very irregular grains; aggregates of grains (to several mm) interstitial to rock forming minerals, magnetite and pyrite, discontinuous, irregular aggregates locally between gangue grains. Traces as blebs in pyrite. No veining relationships to pyrite or magnetite.

Pyrite; 5%, subhedral/euhedral, (<.05 to 1.0 mm).
(a) interstitial to rock forming minerals as single grains, aggregates of grains and (b) hair line veinlets cutting gangue and cutting and rimming magnetite. Blebs of chalcopyrite and magnetite occur in a few pyrite grains.
LC-3 (Polished thin section)

Hornblendite

Composed predominantly of hornblende/actinolite, with lesser pyroxene (augite/diopside).

Alteration products include abundant epidote, and very minor chlorite.

Microscopic
Transmitted light
Minerals present

Hornblende/Actinolite; 60%, anhedral/subhedral, (0.01 to 2.0 mm), bladed/acicular, felted/radiating.

Amphibole (2); <5%, anhedral (<0.05 to 0.5 mm) colourless.

Augite; 5%, anhedral (<0.05 to 0.5 mm) remnants associated with hornblende.

Garnet(?); <5%, subhedral, (0.5 mm), anomalous birefringence, shows diamond shaped zoned pattern.

Epidote; 25%, anhedral (<0.01 to mm), irregular grains, aggregates of grains forming interstitial masses among hornblende/actinolite.

Chlorite; <5%, anhedral, (<0.05 to 0.4 mm), felted and plumose masses interstitial to amphibole.

Reflected light

Opaque; <5%, disseminated and in veinlets.

Pyrite; 2%, anhedral, (<0.01 to 0.5 mm). As veinlets filling fractures with hematite and in hair line crackle fracture systems in wall rock following veinlets. Traces in crackle zones in rock matrix.

Chalcopyrite; <1%, anhedral, (<0.01 to 0.3 mm), as clusters of irregular grains in crackle zones in rock matrix.

Hematite; <2%, anhedral, (<0.01 to several mm), with pyrite in veinlets.

Ilmenite/sphene; traces, confirmed, disseminated among rock forming minerals.
LC-4 (Polished thin section)

Pyroxenite/hornblendite

The rock is composed of partially altered pyroxene. Deuteric alteration to hornblende and epidote.

Irregular weakly layered. Masses of fine granular pyroxene (augite) some areas showing networks of fine amphibole (hornblende), patches/irregular layers of felted amphibole and of epidote.

Microscopic description

Transmitted light

Minerals present.

Hornblende; 30%, anhedral, (0.01 to 0.5 mm) irregular grains/bladed, forms veinlet networks through augite masses and irregular felted layers. Forms strong green pleochroic crystals and indistinct (chloritic) networks.

Pyroxene(augite); 30%, anhedral, (0.01 to 0.3 mm), groundmass of aggregates of irregular fine grains. Deuteric alteration to hornblende and epidote.

Epidote; 30%, anhedral, (0.01 to 0.2 mm), irregular clusters of grains. Similar in appearance to augite but has yellowish pleochroism and anomalous bluish grey birefringence in some orientations.

Undetermined "E" sphene(?); <1%, subhedral/anhedral (<0.01 to 0.05 mm), very irregular grains. High relief, high birefringence.

Veins

Hornblende
Epidote
Opales
Hematite

Reflected light

Opales; <10% fracture controlled veinlets.

Chalcopyrite; 3%, anhedral, (<0.01 to >1.0 mm).
(a) beaded clusters of grains with hematite in fractures forming veinlets. Some segregation into chalcopyrite-rich and pyrite-rich veinlets.

(b) coarser aggregates forming localized elongate interstitial masses (>1.0 mm) among hornblende grains. In crushed zones? forms hematite network.
LC-4 Continued

Pyrite; 2%, euhedral/anhedral, (≤0.01 to 1.0 mm), banded clusters of grains with hematite and minor chalcopyrite in fractures forming veinlets. Also in microfracture networks along margins of veinlets.

Hematite; ≤5%, anhedral, as coatings on fracture walls forming veinlets with chalcopyrite and with pyrite. Late crushing forms hematite network.
LC-5 (Polished thin section)

Metavolcanic (?), intense alteration, impregnation.

A diffuse mosaic of:

(a) Felted masses of predominantly bladed hornblende with patchy microgranular alteration (sphene/leucoxene).

(b) Felted masses of serpentine/antigorite with associated irregular clusters of pyroxene (augite), and microgranular sphene/leucoxene, and epidote/clinozoisite.

Impregnated by:
Clusters of epidote/clinozoisite grains, and diffuse clusters/clots of plagioclase and K-feldspar (confirmed by stained slab), forming a very patchy mosaic.

Veined by:
Recrystallized amphibole hornblende, epidote/clinozoisite, serpentine/antigorite.

Opaques include hematite, chalcopyrite, pyrite.

Microscopic description
Transmitted light
Minerals present

Groundmass:
Felted masses:

Amphibole (hornblende); 30%, anhedral, (<.01 to 0.1 mm), bladed/plumose, felted masses, weak poikilitic texture (pyroxene (augite)). Patchy mosaic of alteration to microgranular sphene/leucoxene with iron-staining which obscure original textures. Cut by veinlets and fracture controlled masses of recrystallized amphibole (hornblende).

Serpentine/antigorite; 20%, anhedral, (<.01 to 0.1 mm), irregular subfibrous/plumose grains, felted. Associated with clusters of grains of pyroxene (augite), aggregates of microgranular grains of sphene/leucoxene.

Sphene/leucoxene; <10%, anhedral, (microgranular), aggregates of grains forming diffuse masses scattered throughout groundmass but in close association with altered pyroxene.

Pyroxene (augite); 10%, anhedral, (<.01 to 0.3 mm), very irregular grains. As poikilitic granules in hornblende and clusters of grains in serpentine/antigorite-rich groundmass. Colourless, moderate birefringence, inclined extinction. Confirmed by biaxial (+) interference figure, 2V about 50°. Altered to uralite (hornblende/actinolite). Associated with serpentine/antigorite.
Epidote/clinozoisite; <10%, anhedral, (<.01 to 0.1 mm), aggregates of irregular grains forming diffuse clots.

Impregnations/segregations

Plagioclase; 10%, anhedral, (<.01 to 0.2 mm), aggregates of irregular grains forming diffuse segregations. Microgranular alteration dusting confirmed by etching.

K-feldspar; <10%, anhedral, (<.01 to 0.1 mm), aggregates of irregular grains forming diffuse segregations. Microgranular alteration dustings. Confirmed by stained slab.

Epidote/clinozoisite; <5%, anhedral/subhedral, (<.01 to 0.2 mm), clusters of coarser grains forming segregations.

Veinlets

Epidote/clinozoisite
Amphibole/hornblende
Serpentine/antigorite
Patches of iron staining.

Reflected light

Opaques; <2%

Chalcopyrite; <1%, anhedral, (<.01 to 0.5 mm), aggregates of grains in vein-like structure intestitial to hornblende and deuteric amphibole. Associated with hematite. Fracture controlled.

Pyrite; traces

Hematite; <1%, anhedral, forming vein-like structures interstitial to hornblende,
(a) associated with but segregated from chalcopyrite
(b) minute rims around chalcopyrite margins.
(c) late hair line fracture filling.
LC-7 (Polished thin section)

Peridotite

Composed primarily of altered olivine and pyroxene. Olivine alteration ranging from antigorite and magnetite in fractures to antigorite-magnetite masses containing small remnant grains of olivine. Augite altered to amphibole with minor augite remaining as granular cores in amphibole.

Magnetic, opaques composed of magnetite, pyrrhotite, chalcopyrite, hematite, pyrite, pentlandite(?). Stained slab shows no evidence of K-feldspar.

Microscopic description

Transmitted light

Minerals present

Olivine; <15%, anhedral, (<.01 to aggregate remnants >2.0 mm). Small remnant granules have similar appearance to augite/diopside. Alteration to serpentine/antigorite-magnetite in fractures.

Amphibole (a) 20%, anhedral, (<.01 to remnants >1.0 mm). Clusters of coarse grains. Ragged/shredded, partially replaced, altered appearance. Augite remnants. Amphibole biaxial (-) 2V 70°.

Amphibole (b) 30%, subhedral, (<.01 to .02 mm), felted masses, in patches making up much of the groundmass. Deuteric. Some intermixing with serpentine/antigorite.

Serpentine/antigorite; 25%, anhedral, (<.01 to 0.2 mm), fibrous/bladed radiating, in fractures in olivine with magnetite and as felted masses in groundmass and with some intermixing with amphibole (b).

Reflected light

Opaques; <10% (i) clusters of grains with hematite associated with serpentine/antigorite. (ii) in minute tension fractures (iii) clusters of minute grains in amphibole (a).

Magnetite; <5%, anhedral, (<.01 to 0.2 mm), very irregular clusters of grains associated with pyrrhotite, very minor chalcopyrite, hematite and pentlandite(?).

Pyrrhotite; <5%, anhedral, (<.01 to 0.2 mm), very irregular grains, aggregates of grains. Partial dusting of alteration to intermediate product to pyrite/marcasite.

Chalcopyrite; traces, anhedral, (<.01 to 0.1 mm), irregular grains, associated with pyrrhotite, and pentlandite(?).
LC-7 Continued

Hematite; <1%, anhedral, (<.01 to 0.1 mm). As colloform rims, encrustations associated with magnetite and pyrrhotite.

Pyrite/marcasite; <1%, anhedral/subhedral, (<.01 to 0.1 mm), irregular grains and rims on altered hematite. Associated with magnetite.

Pentlandite (?); traces, anhedral, (<.01 to .05 mm). Lath-like inclusions in pyrrhotite and magnetite, pale yellow, possible faint anisotropism (but may be result of strong light/dark anisotropism of pyrrhotite). Requires SEM identification.

Assays indicate 250 and 100 ppm Cr. Chromite was not noted in polished thin section.
LC-8 (Polished thin section)

Hornblende diorite/gabbro

Phaneritic, equigranular composed of interlocking grains of hornblende and plagioclase (labradorite). Some grains speckled by weak alteration. Hornblende contains diffuse remnant cores of augite and shows partial alteration to deuteritic (secondary) amphibole.

Weakly magnetic, opaques include pyrrhotite, chalcopyrite, pyrite/marcasite.

Microscopic description

Transmitted light

Minerals present

Amphibole (a) hornblende: 35%, anhedral, (< .05 to >1.0 mm), generally very irregular interlocking grains brownish green, showing partial alteration to "secondary" amphibole. Weak poikilitic texture enclosing plagioclase and opaque grains. Augite remnants.

Augite: 10%, anhedral, (< .01 to 0.3 mm), as diffuse partially resorbed cores in hornblende grains.

Plagioclase: 40%, anhedral/subhedral, (< .05 to 1.0 mm), irregular laths, unzoned but show deuteritic alteration of some margins. Cores generally unaltered. Twinning indicates composition in low labradorite range. Moderate (+) relief.

Deuteritic alteration

Amphibole (b): <10%, anhedral, (< .01 to 0.2 mm), bright blue-green irregular grains, partially replacing hornblende.

Chlorite: <1%, anhedral.

Reflected light

Opaques: >5%, anhedral grains, clusters of grains associated with mafics.

Chalcopyrite: <1%, anhedral, (< .01 to 0.2 mm), very irregular grains, free grains in gangue or associated with or as blebs in pyrrhotite. Most grains have very poor polish and have appearance of native gold but lack characteristic bright reflectance. Tarnishes easily.

Pyrite/marcasite <1%, (< .01 to >1.0 mm)
(a) poikilitic masses, anisotropic, pale cream with greenish tint.
(b) veinlet fracture fillings, discontinuous stringers.
LC 8  Continued

Pyrrhotite; 2%, anhedral, (<.01 to 0.2 mm), isolated irregular grains and associated with hematite.

Hematite; 3%, anhedral, (<.01 to >1.0 mm), light/medium grey, distinct anisotropism. Free grains and clusters of grains scattered throughout matrix. Associated with but not an alteration product of pyrrhotite. Not associated with sphene, therefore probably not ilmenite (although ilmenite is also present).

Ilmenite; traces, associated with sphene. Similar appearance to hematite.
LC-9

Impregnated diorite/quartz diorite(?)

Composed of a groundmass network of fine plagioclase containing irregular clusters of aggregates of quartz grains and lithic remnants of clusters of featureless plagioclase and very minor hornblende.

Minor opaque grains; pyrite, marcasite, pyrrhotite, chalcopyrite, hematite, ilmenite.
Stained slab shows no evidence of K-feldspar.

Microscopic description

Transmitted light

Minerals present

Quartz; 40%, anhedral/subhedral, (<<.05 to >1.0 mm, generally 0.2 to 0.3 mm), interlocking grains, fairly uniform extinction, and lack recrystallized margins.

Plagioclase; 55%, anhedral, (<<.01 to >1.0 mm)
(a) clusters of coarser grains, remnants forming irregular clots. Featureless, some remnants of polysynthetic twinning. Slight speckling by alteration. Relief>quartz, therefore probably high Ca content.
(b) fine granular branching network, (<<.01 to 0.05 mm), aggregates of grains. Cuts through quartz clusters and lithic remnants.

Hornblende; <<5%, anhedral, (<<.01 to 0.5 mm), clusters of a few irregular grains associated with plagioclase. Associated with feldspar clots but many grains appear to be interstitial to (partially replaced by ?) quartz.

Epidote; traces, anhedral, (<<.01 to 0.2 mm), clusters of grains associated with plagioclase-hornblende clots.

Reflected light.

Opaques; <<5%, anhedral, non magnetic, iron-stained.

Pyrite; traces, anhedral, (<<.01 to 0.2 mm), beaded aggregates scattered along hair line hematitic veinlets.

Pyrite/marcasite; traces, anhedral (<<.01 to 0.1 mm), skeletal layered remnants of altered pyrrhotite (?)

Pyrrhotite; traces, anhedral, (<<.01 to 0.2 mm) scattered grains

Chalcopyrite; traces, anhedral, (<<.01 to 0.2 mm), scattered grains isolated or associated with pyrrhotite. Traces in hematitic veinlets.
LC 9  Continued

Hematite; 2%, anhedral grains, (< .01 to 0.3 mm),
(a) forming veinlets, orange-red internal reflection.
Encrustations within veinlets. Pale bluish grey colour.
(b) Light/medium grey, anisotropic, scattered, through rock
matrix. No obvious association with sphene therefore
probably not ilmenite.

Ilmenite/sphene; <1%, anhedral/skeletal, (< .01 to 0.1 mm),
associated with sphene. Anisotropic.
LC-10 (Polished thin section)

Peridotite

Mottled medium and dark green-grey. Composed of well rounded remnants of olivine in an optically continuous coarse interstitial groundmass of pale brown pleochroic hornblende and lesser anthophyllite. Crackle fractures (especially in olivine) filled with serpentine (antigorite) and magnetite.

Opaques; magnetite associated with serpentine (antigorite) in fractures (especially in olivine), ilmenite, hematite, pyrrhotite, chalcopyrite, pentlandite(?).

Stained slab; no evidence of K-feldspar.

Microscopic description

Transmitted light

Minerals present

Olivine; 30%, anhedral, (to mm), rounded remnants. Crackles filled with serpentine (antigorite) and magnetite.

Amphibole (a) (hornblende) 45%, anhedral, (0.1 to several mm), optically continuous groundmass interstitial to olivine. Shows characteristic amphibole cleavage. Pale colour. Pleochroic from light reddish brown to lighter reddish brown.

Anthophyllite (?) 10%, anhedral (0.1 to several mm), optically continuous groundmass, interstitial to olivine. Ragged, subfibrous. Parallel extinction.

Alteration

Serpentine (antigorite), 10%, anhedral (0.01 to 0.05 mm), filling crackle fractures in olivine and around hornblende and anthophyllite (?) grains.

Reflected light.

Opaque <10% (magnetic), anhedral (<0.01 to 0.5 mm), very irregular grains.

Magnetite; >5%, anhedral, (<0.01 to 0.5 mm), beaded aggregates filling relic fractures in altered olivine. Irregular interstitial masses. Isotropic. Magnetic. Light brownish grey.

Pyrrhotite; <1%, anhedral, (<0.01 to 0.2 mm), irregular clusters of grains associated with magnetite, minor hematite, chalcopyrite and undetermined "F". Shrinkage cracks. Pale cream yellow lighter than chalcopyrite faint pinkish tint, pleochroic. Strong anisotropic dark purplish grey/medium
LC-10 Continued

grey.

Hematite; <1%, anhedral, (<<0.01 to 0.1 mm), associated with hematite, pyrrhotite and pentlandite(?).

Chalcopyrite; trace, anhedral, (<<0.01 to 0.1 mm) clusters of irregular grains in hematite, rimmed by magnetite (?).

Pentlandite(?); trace, anhedral, (<<0.05 mm), irregular grains, very pale yellow, paler than chalcopyrite, weak anisotropic. Associated with pyrrhotite magnetite, chalcopyrite, hematite. Requires SEM identification.

Ilmenite(?); <1%, anhedral, (0.3 mm), irregular grains intergrown with and similar in appearance to magnetite but: Pleochroic light brownish grey colour as for magnetite, but with distinct purplish pleochroism. Strong anisotropism, medium grey to dark purplish grey. Twin lamellae.
LC-11 (Polished thin section)

Pyroxenite; altered

Consists predominantly of rounded partially altered pyroxene (augite) and deuteric (secondary) amphibole with felted interstitial serpentine (antigorite). Minor interstitial plagioclase.

Pyroxene shows dusting of microgranular opaque and alteration to amphibole at grain margins.

Opaque; magnetic, includes pyrrhotite, pyrite/marcasite, magnetite, chalcopyrite, ilmenite. Stained slab shows no evidence of K-feldspar.

Microscopic description
Transmitted light

Minerals present

Pyroxene (augite); 50%, anhedral (<.05 to >1.0 mm), subrounded, moderate dusting of microgranular opaques. Altered to secondary amphibole on grain margins. Confirmed by biaxial (+) 2V >60°. Inclined extinction. Second order birefringence.

Amphibole; >15%, anhedral (<.01 to >1.0 mm), irregular grains, clusters of grains. Deuteric. Pale green pleochroism. Inclined extinction, biaxial (-) with large 2V.

Plagioclase; <5%, anhedral (to 1.0 mm) interstitial, mottled by alteration dusting, twinning indicates labradorite composition.

Serpentine (antigorite); 25%, anhedral/subhedral, (<.01 to 0.6 mm), fine and coarse felted masses, interstitial to pyroxene and amphibole. Contains scattered clusters of very fine amphibole, remnant augite and very minor clusters of epidote grains.

Epidote; traces, anhedral, (<.05 mm), clusters of irregular grains.

Olivine; suspected but not confirmed.

Reflected light

Opaques; >5% anhedral, (<.01 to 0.3 mm),
(a) microgranular dusting in augite
(b) coarser irregular grains in serpentine rich matrix.

Pyrrhotite; 2%, anhedral, (<.01 to 0.2 mm), very irregular grains, clusters of grains, pale pinkish cream, strong anisotropism. Shows varied degrees of alteration from
LC-11 Continued

pyrrhotite through intermediate stage to pyrite/marcasite rims. Associated with chalcopyrite.

Chalcopyrite; traces, anhedral, (<0.01 to 0.1 mm), scattered free grains in rock matrix, associated with pyrrhotite and pyrite grains.

Pyrite/marcasite; 3%, subhedral/anohedral, (<0.01 to 0.2 mm), irregular clusters of grains/filigree. Partially pitted surfaces, irregular margins. Filling hair line and anastomosing crackle fractures. Pale cream-yellow, isotropic. Weak anisotropism indicating mixing with marcasite. Contains few blebs of pyrrhotite.

Ilmenite/sphene; <1% anhedral, (<0.01 to 0.2 mm), grains similar in appearance to magnetite but appear anisotropic. Not confirmed.

Magnetite; 1%, anhedral, (<0.01 to 0.1 mm), as cores surrounded by pyrite/marcasite. Medium blue/grey, brownish tint. Crackled and veined and rimmed by pyrite/marcasite.
LC-12 (Polished thin section)

Quartz diorite; crushed, stressed, sheared.

Quartz diorite cut by cataclasis zones branching into cataclasis networks and crackle fracture systems. Rock is composed of plagioclase, lesser quartz with fine felted biotite in crackle fracture networks. Plagioclase shows varied degrees of sericitic alteration. Cataclasis (protomylonite) zones microgranular feldspathic, sericitic, biotitic.

Opaques, slightly magnetic, include: pyrite/marcasite, pyrrhotite, chalcopyrite. Stained slab; shows no evidence of K-feldspar stain.

Microscopic description
Transmitted light
Minerals present

Plagioclase; 45%, anhedral, (<<.01 to >2.0 mm), interlocking grains abundant crystal fragments. Weak to moderate sericitic alteration. Remnant polysynthetic twinning, warped grains. Composition in oligoclase range.

Quartz; 25%, anhedral, (<<.01 to 1.0 mm) irregular grains interlocking with plagioclase and other quartz grains. Strained extinction. Abundant broken crystal.

Biotite; 10%, anhedral, (<<.01 to 0.1 mm), diffuse felted interstitial networks. Filling crackles. Minor alteration to chlorite.

Amphibole 5%
(a) Hornblende, trace, anhedral, (0.1 mm), subrounded grain included in plagioclase.
(b) Amphibole (b); <5%, anhedral, (<<.01 to 1.0 mm), ragged bladed felted clusters of grains, weak green pleochroism, altered to:
(c) Amphibole (c) <<5%, anhedral, (<<.01 to 0.3 mm), colourless, secondary.

Alteration
Sericite; 10%, anhedral, (<<.01 to .05 mm),
(a) alteration of plagioclase
(b) associated with biotite in feldspathic cataclasis zones.

Chlorite; <<5%, anhedral associated with biotite.

Amphibole (c); see above.
LC-12 Continued

Reflected light

Opaques; <5%, disseminated throughout rock matrix but also showing strong fracture control. Clusters of minute to very fine grains.

Pyrite; 3%, anhedral/euhedral, (<0.01 to >1.0 mm), clusters of grains
(a) disseminated through rock matrix
(b) in veins, shatter zones (coarsest grains)

Pyrite/marcasite; 1%, anhedral, (<0.01 to 0.3 mm), pitted filigree masses, encrustations in voids and surrounding gangue grains in shatter zones.

Pyrrhotite; >1%, anhedral, (<0.01 to 0.3 mm), very irregular grains disseminated through rock matrix and in shatter zones. Some grains show various stages of alteration to pyrite/marcasite.

Chalcopyrite; traces, anhedral, (<0.01 to 0.05 mm), disseminated grains and associated with pyrite, pyrrhotite.
LC-13 (Polished thin section)

Pyroxenite; shear/granulation foliation.

Composed of interlocking grains of pyroxene (augite) with partial to intensive deuteric alteration to pale green pleochroic amphibole. Minor plagioclase.

Intense shearing/crushing, local "mylonitic" zones. Contains granulated grains of minerals comprising the rock, granules of epidote/clinozoisite forming localized masses, interstitial and fracture fillings of bladed/plumose amphibole and serpentine (antigorite).

Opaques; irregular aggregates of grains, weakly magnetic, includes pyrrhotite, pyrite and chalcopyrite. Stained slab shows no evidence of K-feldspar.

Microscopic description
Transmitted light
Minerals present

Pyroxene (augite); 40%, anhedral, (<.05 to >1.0 mm) interlocking grains, with minor plagioclase. Partial deuteric alteration to amphiboles. Comprises much of the crushed granulated material in shear zones, with amphibole and epidote/clinozoisite.

Plagioclase; 5%, anhedral, (<.05 to 0.3 mm), few irregular grains Remnant twinning indicates composition in upper andesine range.

Amphibole; 25%, anhedral, (<.01 to >1.0 mm) bladed/plumose, abundant warped grains. Deuteric alteration of pyroxene (augite) and granulated material in crushed zones. (a) Pale green pleochroic and (b) medium green pleochroic.

Epidote/clinozoisite; >10%, anhedral, (microgranular to 0.5 mm), as coarser grains (lensoids) in very fine granular mixture of pyroxene (augite) and epidote/clinozoisite.

Serpentine/antigorite; >10%, anhedral, (<.01 to >0.5 mm)
(a) Fine felted masses
(b) coarse bladed/plumose felted. Fracture/shear and granulation control produces weak foliation and swirling.

Reflected light

Opaques; 5%, disseminated through rock matrix but most grains form diffuse stringers associated with fractures/crushed zones.

Pyrite; 2%, euhedral and anhedral, (<.01 to 0.5 mm), (a) coarser grains euhedral finer grains irregular. Coarse pyrite contains traces blebs of chalcopyrite.
LC-13 (Continued)

(b) Filigree pyrite/marcasite rims/encrustations around altered pyrrhotite cores forming diffuse clouds of sieve texture in crushed zones. Traces of associated chalcopyrite. Strong fracture/breccia control.

Pyrrhotite; >2%, anhedral (<0.01 to 0.2 mm), very irregular grains, widely disseminated but shows fracture control.

Chalcopyrite; <<1%, anhedral, (<0.01 to 0.2 mm), irregular grains, as clusters associated with pyrite and filigree pyrite/marcasite.
LC-14 (Polished thin section)

Quartz impregnated, sheared, altered quartz diorite(?).

Primary textures are obliterated. Most of the groundmass is comprised of altered plagioclase forming patchy diffuse optically continuous mosaics. Adjacent to cataclasis zones the rock has a "crystal tuff" appearance with diffuse irregular fragments of plagioclase in a very fine granular matrix. Broken up quartz veins/impregnations comprise approximately 1/3 of section. Original and introduced quartz indistinguishable.

Traversed by cataclasis zones accompanied by fracture networks containing amphibole clusters with lesser epidote and opaques. Iron stained.

Opaques; weak magnetic, pyrrhotite, pyrite/marcasite, trace chalcopyrite.
Stained slab; shows no evidence of K-feldspar.

Microscopic description
Transmitted light
Minerals present

(a) Feldspathic mosaic
Plagioclase; 35%, anhedral, (to several mm in optical continuity), mottled. Intermixed with and partially replaced (?) by quartz. Altered by patchy red-brown semiopaque dusting. Contains clusters of small grains of epidote.
Quartz; 10% (?) anhedral, (< .05 to >3.0 mm), very irregular grains, broken, strained. Indistinguishable from introduced quartz.

(b) Cataclasis margins have appearance of crystal tuff.
Plagioclase; 15%, anhedral, (< .05 to 0.2 mm), very irregular diffuse outlines. In diffuse very fine granular matrix.

(c) Cataclasis zones (protomylonite).
Microgranular feldspathic granules showing layered aspect. Contain diffuse lensoidal clusters of augite and epidote grains.

Segregations/veins
Quartz; 20% (?) anhedral, (< .05 to >3.0 mm), very irregular grains, broken, strained. Indistinguishable from introduced quartz.

Amphibole; <10%, anhedral, (< .01 to 1.0 mm), altered remnants, clusters of irregular grains in fracture/cataclasis zones. Associated with quartz, opaques and epidote. Cataclasis and fracture control.
Epidote; 5%, anhedral, (<.01 to >1.0 mm), irregular clusters of grains associated with quartz, amphibole and opaques. Fracture and cataclasis control.

Reflected light

Opaque; >5%, anhedral, (<.01 to 0.4 mm), very irregular grains, clusters of grains. Fracture controlled (mainly). Strong association with amphibole.

Pyrrhotite; 2%, anhedral, (<.01 to 0.3 mm), irregular grains, single grains and clusters. Alteration to intermediate/pyrite-marcasite/hematite. Traces associated with chalcopyrite. Altered to:
(a) intermediate material between pyrrhotite and marcasite/pyrite
(b) hematite

Chalcopyrite; <<1%, anhedral (<.01 to 0.2 mm), irregular grains disseminated through groundmass; associated with pyrrhotite, altered pyrrhotite/pyrite-marcasite. Fracture control.

Sphene/ilmenite; <<1%, anhedral, (<.01 to .05 mm), confirmed.

Pyrite/marcasite; 2%, anhedral/subhedral, (<.01 to 0.4 mm), filigree encrustations in leached voids, alteration of pyrrhotite. Few associated chalcopyrite grains.
LC-15 (polished thin section)

**Pyroxene/hornblende diorite/gabbro**

Composed of medium grained calcic (labradorite) plagioclase crystals interlocked with coarse amphibole (hornblende). Very minor remnant augite. Abundant deuteric (recrystallized) amphibole, (colourless and green), alteration of pyroxene (augite) and hornblende.

Opaques; associated with deuteric and fracture filling amphibole. Include pyrrhotite, pyrite/marcasite, chalcopyrite. Stained slab indicates no K-feldspar.

**Microscopic description**

**Transmitted light**

**Minerals present**

- **Plagioclase;** 35%, subhedral, (<0.05 to 2.0 mm), clusters of interlocking grains with primary and deuteric amphibole (hornblende). Twinning indicates high Ca content, in labradorite range.

- **Augite;** <10%, anhedral, (<0.01 to 0.5 mm), clusters of irregular grain remnants, partially altered to amphibole (b). Biaxial (+) 2V 50°

- **Amphibole (a) (hornblende);** 15%, anhedral, (<0.05 to >2.0 mm), generally coarse irregular grains, pale green-brown pleochroism. Weak poikilitic texture enclosing plagioclase. Deuteric alteration to (b) and (c?).

- **Amphibole (b) (hornblende);** 20%, anhedral, (<0.01 to 0.2 mm), very irregular/subfibrous, felted masses green/green brown pleochroic. Associated opaques. Also as diffuse fracture fillings (see below).

- **Amphibole (c) (actinolite/tremolite);** 5%, anhedral, (<0.01 to 0.1 mm), very irregular prismatic, felted.

**Veins/fracture fillings.**

- **Amphibole (b) (hornblende);** 10%, subhedral, (<0.05 to >1.0 mm), slender prismatic felted. Associated opaque.

**Reflected light.**

**Opaques;** 5%, anhedral, (<0.01 to 2.0 mm), very irregular grains. Associated with amphibole (b) and (c) and with amphibole in veins.
LC-15 Continued

Pyrrhotite; 3%, anhedral, (<0.01 to >1.0 mm), disseminated irregular grains, clusters of grains. Disseminated clusters but show strong fracture control as elongated beaded clusters. Coarser grains and aggregates show concentric alteration rims through intermediate material to pyrite/marcasite. Associated chalcopyrite.

Pyrite/marcasite; 1%, anhedral, (<0.01 to 0.2 mm) irregular to filigree encrustations resulting from alteration of pyrrhotite. Associated chalcopyrite grains.

Chalcopyrite; <1%, anhedral, (<0.01 to 0.2 mm), irregular grains, isolated but more commonly mutual boundaries with pyrrhotite. Fracture control.
LC 16 (Polished thin section)

Pyroxene (augite), hornblende gabbro

Composed of medium/coarse grained plagioclase (labradorite) and altered augite, and amphibole.

Varied intensity of deuteric alteration of pyroxene to amphibole ranging from weak to almost total with diffuse augite remnants forming fine sieve texture.

Opaques include: pyrrhotite, pyrite/marcasite, chalcopyrite, ilmenite, hematite.
Stained slab indicates no K-feldspar.

Microscopic description
Transmitted light
Minerals present

Plagioclase; 25%, anhedral, (<<.05 to >2.0 mm), irregular interlocking grains. Weak dusting of red-brown alteration. Remnant twinning indicates Ca-rich in labradorite range.

Pyroxene (augite); 15%, anhedral (<<.05 to >2.0 mm), ragged outlines. Fine sieve texture resulting from inclusions of plagioclase, alteration to clusters of microgranular sphene (?) granules and microgranular alteration dusting. Alteration to deuteric amphibole, ranging from weak to strong. Biaxial (+), 2V 50°, inclined extinction.

Amphibole (a); >10%, anhedral, (to >1.0 mm), irregular grains, clusters of grains, colourless criss crossed by regular fracture pattern/cleavage (amphibole) filled with sphene and ilmenite. Some serpentine (antigorite)?

Olivine; suspected, not confirmed.

Alteration

Amphibole (b); 20%, anhedral, (<<.01 to >1.0 mm), as diffuse masses which have replaced augite. Green pleochroism. Intensity ranges from weak to almost total leaving diffuse remnants forming a sieve texture in amphibole.

Sphene; 5%, anhedral, (microgranular), as abundant clusters of a few grains disseminated throughout pyroxene and plagioclase and aggregates of microgranules forming irregular clouded masses (to >1.0 mm). Also occurs as alteration of rims and fractures in olivine and opaque (ilmenite).

Segregations/veinlets

Plagioclase; <5%, minor fine granular, recrystallized.
Amphibole (c): <<5%, colourless, granular/fibrous, felted.

Epidote/clinozoisite: <5%, colourless, felted, acicular anomalous blue-grey birefringence, associated with amphibole(c).

Reflected light

Opaques; 15% subhedral/anhedral (<0.01 to >1.0 mm), some subhedral grains, most irregular, abundant (ilmenite) associated with sphene and leucoxene.

Pyrrhotite; <5%; anhedral, (<0.01 to >1.0 mm), irregular clusters of grains. Associated with chalcopyrite. Contains clusters of pyrite marcasite. Altered, (crystallographic control) fractures filled by sphene (?). Cores of grains show dusting of intermediate alteration with margins of layers (encrustations) of pyrite/marcasite.

Pyrite/marcasite; <5%, euhedral/anhedral, (<0.01 to aggregates several mm).
(a) irregular clusters of grains, contains irregular masses pyrrhotite, lesser chalcopyrite.
(b) veinlets, fracture fillings.
(c) encrustations pyrite/marcasite around altered pyrrhotite.

Chalcopyrite; <1%, anhedral, (<0.01 to 0.4 mm), irregular grains, isolated grains and associated with pyrrhotite and as blebs in pyrite/marcasite.

Hematite; <<1%, anhedral, (<0.01 to 0.2 mm), irregular grains, blue grey colour, red orange internal reflection.

Ilmenite; 3%, anhedral, (<0.01 to >1 mm), clusters of irregular grains in sphene/leucoxene.
Peridotite;

Composed of intensely altered olivine, hornblende, and very minor plagioclase. Olivine (and to lesser extent hornblende) have been altered to fibrous and bladed/plumose varieties of amphibole, serpentine/antigorite, and iddingsite. Pseudomorphs after olivine. Relic fractures in olivine are magnetite-filled.

Opaques consist of pyrrhotite, magnetite, chalcopyrite, undetermined Ni bearing minerals and hematite.

Stained slab shows no K-feldspar.

Microscopic description

Transmitted light

Minerals present

Olivine; 10%, anhedral, (<.01 to ?), olivine grain remnants with alteration pseudomorphs composed of amphibole, serpentine/antigorite, iddingsite and magnetite in relic fractures.

Pyroxene (augite); suspected but not confirmed.

Plagioclase; <5%, anhedral, (<.05 to >1.0 mm), twinning remnants indicates composition in the andesine/labradorite range.

Amphibole
(a) Hornblende (a) 15%, anhedral, (<.05 to >1.0 mm). Outgrowth, from and interstitial to altered olivine. Altered to amphibole (c). Biaxial (-), 2V 75°. Two varieties (i) colourless, (ii) pale green pleochroic.

Alteration products
(b) Amphibole (b); 15%, anhedral, (<.01 to 1.0 mm), irregular (shredded) bladed/plumose, felted, alteration of olivine.

(c) Amphibole (c); 20%, anhedral, (<.01 to >1.0 mm) acicular/fibrous, parallel or radiating clusters of grains. Inclined extinction at about 10°. Alteration of hornblende (and olivine?).

(d) Amphibole (d); 10%, anhedral, (<.05 to >1.0 mm), broad blades, lower relief than hornblende, inclined extinction. Biaxial (-) large 2V.

Serpentine/antigorite; 15%, anhedral, (<.01 to 1.0 mm), bladed/plumose, very fine and slightly coarser felted masses. alteration of olivine and hornblende(?).

Iddingsite; 5%, anhedral, (<.01 to 0.1 mm), altered margins and cores of remnant olivine. Very fine bladed/felted, reddish
brown colour. High birefringence.

Magnetite; 5%, anhedral, (<.01 mm) aggregates of grains in fractures of alteration pseudomorphs of olivine.

Accessories

Green undetermined "C"; traces, anhedral, (<.05 to 0.4 mm), clusters of grains. Clear medium green, isotropic, moderate high relief.

Blue undetermined "D"; 1%, subhedral/anhedral, (<0.1 to >1.0 mm), clusters of grains. Hexagonal? Deep blue/light blue/pale purplish blue mottled pleochroism. Birefringence about .04. Uniaxial (-).

Reflected light;

Opaques; <20%

Magnetite; 5%, anhedral, (<.01 to 0.3 mm), in irregular interstitial clusters but most abundantly in fracture fillings in altered pseudomorphs of olivine with minor pyrrhotite and lesser chalcopyrite.

Chalcopyrite; >2%, anhedral, (<.01 to 0.6 mm), irregular grains interstitial to gangue and in fractures in altered olivine with magnetite and lesser pyrrhotite.

Altered pyrrhotite: 10%, anhedral, (<.01 to several mm).

Abundantly altered to intermediate product between pyrrhotite and marcasite/pyrite. Poor polish, well developed cleavage, anisotropic blue-grey/yellow brown.

Pyrite/marcasite occurs around margins of altered grains, in fractures and along cleavages.

Note: Ni-bearing minerals would be obscured by the abundance of the intermediate alteration product of pyrrhotite. Assays indicate 0.2% Ni.

Undetermined "D"; <1%, anhedral, (<.01 to 0.2 mm), irregular grains associated with altered pyrrhotite, alteration dusting, blue grey margins, very pale pinkish cream cores, isotropic/weak anisotropic. This is the same blue unidentified mineral described under transmitted light above.

Hematite; <1%, anhedral, (<.01 to 0.2 mm), fragmental, mottled light blue-grey colliform encrustations/fracture fillings. Red internal reflection.

Note: Assays indicate 380 ppm Pd. Pd minerals were not noted in polished section.
LC-18 (Polished thin section)

Amphibole, olivine, peridotite

Composed of irregular interlocking crystals of plagioclase, olivine and two amphiboles. Olivine shows abundant magnetite-filled fractures. Altered to pale green pleochroic and colourless varieties of amphibole. Also serpentine/antigorite rimming olivine remnants and bladed/felted interstitial masses.

Opaques: magnetic, includes: pyrrhotite, magnetite, pyrrhotite, chalcopyrite, pentlandite, violarite(?).

Stained slab; no evidence of K-feldspar.

Microscopic description

Transmitted light

Minerals present

Plagioclase; 25%, anhedral, (0.05 to >3.0 mm), irregular interlocking grains, diffuse margins. Contains abundant small clusters of epidote/clinozoisite granules; minor amphibole.

Twinning indicates composition in labradorite range.

Olivine; 10%, anhedral, (0.05 to >2.0 mm), irregular grains.

Remnant grains. Abundantly fractured, magnetite (?) filled. Partial to strong alteration by mixtures of bladed/felted amphibole and fine felted serpentine (antigorite). Biaxial (-) large 2V.

Deuteric alteration:

Amphibole (a); 25%, anhedral, (0.01 to >2.0 mm), very pale green tint/colourless. Shows characteristic amphibole cleavage. Biaxial (-), large 2V.

Amphibole (b); 5%, anhedral, (0.01 to >2.0 mm), colourless, subfibrous. Inclined extinction. Biaxial (-) large 2V, therefore not pyroxene.

Pyroxene; suspected, but not confirmed.

Epidote/Clinozoisite; 15%, anhedral, (<.01 to 0.5 mm), minute granules in plagioclase but more abundantly interstitial clusters of felted grains with serpentine/antigorite and amphibole.

Serpentine/antigorite; 15%, anhedral (<.01 to 0.2 mm), irregular bladed/subfibrous, felted masses surrounding olivine remnants, interstitial masses.
Green Undetermined; traces, anhedral, (<.01 to 0.3 mm), aggregates of grains. Bright medium green, isotropic. As for LC-17.

**Reflected light**

**Opaques;** 5%, anhedral, (<.01 to 0.5 mm), very irregular grains, aggregates of grains. In fractures and as irregular clots in altered olivine. Pyrrhotite.

**Magnetite;** 3%, anhedral, (<.01 to 0.2 mm), Irregular interstitial blebs and crackle fracture filling in altered olivine. Associated with pyrrhotite and chalcopyrite.

**Pyrrhotite;** <2%, anhedral, (<.01 to 0.2 mm), Irregular interstitial blebs and with magnetite and chalcopyrite in fractures in altered olivine. Associated very minor pentlandite and violarite.

**Chalcopyrite;** <1%, anhedral, (<.01 to 0.3 mm), Irregular interstitial blebs and associated with magnetite and lesser pyrrhotite in fractures in altered olivine.

**Pentlandite;** <<<1%, anhedral, (<.01 to 0.1 mm), irregular inclusions in pyrrhotite, irregular remnants in violarite. Very pale yellow colour as compared to pyrrhotite, isotropic. Alteration to violarite (?) Requires SEM analysis for confirmation.

**Violeartite(?) ;** <<1%, anhedral, (<.01 to 0.1 mm), irregular shaped grains, alteration of pentlandite which remains as irregular fractures. Paler colour than pyrrhotite, isometric, some grains show octahedral (?) cleavage.
LC-19 (Polished thin section)

Augite (amphibole) gabbro in contact with coarse-grained pyroxenite across a skarnified shear.

(1) Gabbro composed of plagioclase, pyroxene (augite), altered to anthophyllite and lesser hornblende.
Cut by:

(2) Skarnified shear composed of granulated plagioclase, augite, amphibole, containing clots of chlorite, lensoids and coarse radiating clusters of epidote/clinozoisite, and broken quartz. Disrupted quartz-epidote/clinozoisite veins.
Flanked on opposite side by:

(3) Coarse grained pyroxenite composed of augite partially altered to amphibole, and contains minor plagioclase.

Opaques; weak magnetic, include: chalcopyrite, pyrrhotite, ilmenite.
Stained slab indicates no K-feldspar

Microscopic description
Transmitted light
Minerals present

(1) Gabbro
Plagioclase; 35%, anhedral, (<.05 to >1.0 mm), interlocking grains with augite. Weak/moderate microgranular alteration dusting. Remnant twinning indicates compositions ranging from upper andesine to labradorite.

Pyroxene, (augite); 35%, anhedral, (<.05 to 1.0 mm), interlocking grains with plagioclase. Moderate to locally strong alteration to fibrous anthophyllite.

Amphibole
(a) (Anthophyllite); >20%, anhedral, (<.01 to 0.8 mm), sub-fibrous, pale green pleochroic, second order birefringence, parallel extinction. Biaxial (-), 2V 70 + degrees. Alteration of augite.

(b) Hornblende (?); <5 %, anhedral, (<.01 to 0.4 mm), Pale brown pleochroism Inclined extinction. Featureless, biaxial (-) with 2V 75 (+) degrees.

Opaques; 5%, see below.

(2) Skarn; shear/crushed zone. Contains crushed material from and lithic fragments of gabbro and pyroxenite. Crushed zone and slip surfaces contain fragments, clusters of grains of chlorite, (serpentine?), epidote/clinozoisite, quartz
indicating disrupted veins.

Opaques; 5%, see below.

(3) Pyroxenite

Plagioclase; 20%, anhedral, (to >2.5 mm), irregular grains, clusters of grains, moderate microgranular alteration dusting. Crackle fracture filled with amphibole.

Pyroxene (augite); 35%, anhedral, (to several mm), very irregular grains. Weak to locally strong alteration to pale green pleochroic amphibole. Alteration leaves sieve texture augite remnants in amphibole.

Amphibole (hornblende)(a); <10%, anhedral, (<.01 to 0.3 mm), very irregular brown pleochroic patches. Inclined extinction. As grain remnants altered to amphibole (b)

Amphibole (b); >30%, anhedral, (<.01 to several mm), very irregular grains, deuteric alteration of pyroxene. Sieve texture with augite remnants and alteration of augite margins.

Note: Anthophyllite alteration was not confirmed in the coarse grained pyroxenite portion of the thin section.

Opaques; 5%, see below

Reflected light

Opaques; 5%, anhedral (<.01 to 0.4 mm), clusters of irregular grains scattered throughout.

Chalcopyrite; <1%, anhedral, (<.01 to 0.15 mm), irregular grains, clusters of grains, isolated and associated with pyrrhotite. Fracture controlled in part. Random disseminated clusters of minute grains.

Pyrrhotite; 2%, anhedral, (<.01 to 0.2 mm), irregular grains, clusters of grains, zoned "pitted" alteration. Rims of pyrite/marcasite (?). Fracture controlled in part. Random disseminated clusters of minute grains.

Ilmenite; <1%, anhedral, (<.01 to 0.4 mm), irregular grains, veined by gangue. Associated leucoxene. Pale grey with slight pinkish tint, anisotropic.
LC-20 (Polished thin section)

Gabbro

Coarse grained interlocking altered olivine, hornblende and plagioclase. Olivine and olivine pseudomorphs composed of deuteritic amphibole, serpentine/antigorite, lesser talc and very minor iddingsite. Hornblende is altered to deuteritic amphibole, bladed and acicular/fibrous. Interstitial clots of serpentine/antigorite, granular epidote/clinozoisite, lesser talc.

Opaques include: pyrrhotite, chalcopyrite, magnetite, pyrite/marcasite, pentlandite, violarite.

Microscopic description

Minerals present

Olivine; 15%, anhedral, (<<.01 to several mm), aggregates of grain remnants, intensely fractured. Partially to almost completely replaced by fibrous/bladed amphibole. Strong microgranular dusting. Biaxial (-) large 2V, confirmed.

Plagioclase; <10%, anhedral, (<<.05 to several mm). Scattered clusters of coarse grains. Indicated composition in andesine/labradorite range. Contains clusters of epidote/clinozoisite granules. Diffuse grain margins. Varied intensity of microgranular dusting alteration.

Pyroxene, (augite); suspected but not confirmed.

Amphiboles

Hornblende (a) 15%, anhedral, (<<.05 to several mm), irregular grains, interstitial to altered olivine. Very pale green, weak pleochroism. Altered to (b) acicular/fibrous and (c).

Alteration

Amphibole (b); 10%, anhedral, (<<.1 to 1.0 mm), acicular/fibrous, colourless. Rimming and replacing hornblende (a) and olivine. Lower refractive index than hornblende.

Amphibole (c); 10%, anhedral, (<<.01 to 1.0 mm), narrow and broad bladed, otherwise similar to (b), colourless. Lower refractive index than hornblende.

Serpentine/antigorite, 10%, anhedral, (<<.01 to 0.5 mm), very fine felted and coarse radiating felted masses. Mainly interstitial but also with magnetite in fractures in olivine, and replacing hornblende.
Talc; <10%, anhedral, (0.01 to 0.2 mm), bladed/plumose, felted masses in altered olivine and interstitial clots.

Epidote/clinozoisite; <5%, anhedral, (microgranular to 0.3 mm), aggregates of grains forming small clusters in plagioclase and larger interstitial clots.

Green unidentified; traces, anhedral (<0.01 to 0.3 mm), clusters of irregular grains associated with opaque (chromite?). Isometric, isotropic.

Iddingsite; <5%, anhedral, (<0.01 to 0.1 mm), irregular felted masses replacing olivine.

Reflected light

Opaque; 20%

Pyrrhotite; <15%, anhedral, (<0.01 to several mm), irregular grains, clusters of grains. Shows varied stages of alteration through intermediate product to pyrite/marcasite. Pale pinkish cream, anisotropic, some grains show well developed cleavage.

Chalcopyrite; <5%, anhedral, (<0.01 to >1.0 mm), irregular grains, clusters of grains, blebs, clots and following "fractures" in pyrrhotite.

Magnetite; >5%, anhedral, (<0.01 to >1.0 mm), (a) irregular grains clusters of grains, blebs, clots and following fractures in pyrrhotite. (b) Filling networks of fracture systems in altered olivine.

Viofarite (?); <5%, subhedral/euhedral, (0.1 to >1.0 mm), as well shaped grains in pyrrhotite, chalcopyrite. Slightly paler colour than pyrrhotite, isotropic/faint anomalous anisotropism, well developed cleavage (octahedral?), slight mottling by dusting of alteration.

Pyrite/marcasite; <5%, anhedral/subhedral, (<0.01 to 0.1 mm), clusters of grains, encrustations on pyrrhotite margins. Anisotropic/isotropic.

Pentlandite (?); traces, anhedral, (<0.01 to 0.05 mm), very irregular remnants (?) in viofarite; featureless. Very pale cream-yellow, diffuse outlines into surrounding viofarite. Much paler colour than chalcopyrite. Possibly slightly anisotropic. No cleavage.
LC-22 (A Polished thin section: B; thin section)

Gabbro


Opaques; magnetite in relic fractures in olivine pseudomorphs, pyrrhotite, pyrite/marcasite, chalcopyrite, violarite (?). Stained slab indicates no K-feldspar.

Microscopic description
Transmitted light
Minerals present

Olivine; <15%, anhedral, (<0.05 to several mm), remnants, altered to amphiboles and serpentine/antigorite. Moderate to strong microgranular dusting. Crackle fractures filled with very fine granular magnetite.

Amphiboles;

Hornblende (a) <15%, anhedral, (<0.05 to several mm) irregular grains interstitial to altered olivine. Very pale green and weak reddish brown tints in some grains, faint pleochroism. Altered to acicular/fibrous amphibole (b) on margins and as inclusions and (c) bladed colourless amphibole. Also contains scattered grains of undetermined clear green, isotropic mineral.

Plagioclase; <10%, anhedral, (<0.05 to several mm) scattered clusters of very coarse grains. Indicated composition in andesine/labradorite range. Contains clusters of epidote/clinozoisite granules.

Pyroxene (augite); suspected but not confirmed.

Alteration

Amphibole (b); <10%, anhedral, (<0.1 to >1.0 mm), acicular/fibrous, colourless. Rimming and replacing hornblende (a) and olivine. Lower refractive index than hornblende.

Amphibole (c) <10%, anhedral, (<0.01 to >1.0 mm) bladed, otherwise similar to (b), colourless. Lower refractive index than hornblende.
Talc; <5%, anhedral, <.01 to 0.2 mm, fibrous/plumose, felted masses with serpentine/antigorite.

Serpentine/antigorite; 10%, anhedral, (<.01 to 0.5 mm), very fine felted and coarser radiating felted masses. Mainly interstitial but also with magnetite in fractures in olivine and replacing hornblende.

Epidote/clinozoisite; <5%, anhedral, (microgranular to 0.3 mm), aggregates of grains forming very irregular masses. Interstitial dots and clusters of grains in plagioclase.

Iddingsite; <5%, anhedral (<.01 to 0.1 mm) clusters of grains in fractures and replacing olivine.

Green unidentified "C"; <5%, anhedral, (<.01 to 1.0 mm), irregular grains commonly forming cores of serpentine clots. Isotropic, moderate high (+) relief, crackled, with fractures filled with very fine opaque.

Accessory minerals

Quartz; traces, anhedral, (<.05 to 0.2 mm), interstitial associated with epidote.

Reflected light

Opaques; 25%

Pyrrhotite; >10%, anhedral, (<.01 to several mm), irregular grains, clusters of grains. Shows varied stages of alteration through intermediate product to pyrite marcasite.

Pyrite/marcasite; <5%, anhedral/subhedral, (<.01 to 0.1 mm), clusters of grains, encrustations on pyrrhotite margins. Anisotropic/isotropic.

Chalcopyrite; <5%, anhedral, (<.01 to >1.0 mm), irregular grains, clusters of grains, blebs, clots and following fractures in pyrrhotite.

Magnetite; >5%, anhedral, (<.01 to >1.0 mm). (a) irregular grains, clusters of grains, blebs, clots and following fractures in pyrrhotite. (b) filling networks of fracture systems in altered olivine.
LC-22 Continued

Violarite (?); ≤5%, subhedral/euhedral, (0.1 to >1.0 mm), as idiomorphic grains in pyrrhotite, chalcopyrite. Slightly paler colour than pyrrhotite, isotropic/faint anomalous anisotropism, well developed cleavage (octahedral). Slight mottling by dusting of alteration.

Note: No pentlandite remnants were noted in this section.
Metavolcanic(?); intense alteration and impregnation; pyroxene/hornblende. Coarser felted masses of hornblende, altered pyroxene (uralite) forming a mosaic with diffuse felted masses of intensely altered hornblende.

Impregnated portion of Metavolcanic(?) above. A mosaic of K-feldspar clouded by microgranular alteration dusting associated with plagioclase and altered pyroxene/amphibole, sphene/leucoxene.
Peridotite: olivine altered to serpentine/antigorite and magnetite. Augite altered to amphibole.

Peridotite: as photomicrograph above in polarized light.
Gabbro: composed of plagioclase (labradorite), pyroxene (augite) with conspicuous cleavage, altered to amphibole subfibrous texture.

Gabbro; as above in polarized light.
Peridotite; interlocking crystals of plagioclase, olivine and two amphiboles. Magnetite/serpentine-filled cracks in olivine. Note: dark green anhedral grains, undetermined "C", in serpentine/antigorite clot, centre.

Peridotite; as above, polarized light. Note: dark green anhedral grains, undetermined "C", are isotropic.
Quartz diorite; sheared, altered, quartz impregnated. Most of groundmass is altered plagioclase in patchy diffuse, optically continuous mosaics.

Quartz diorite; as for photomicrograph above, in polarized light. Broken up quartz veins/impregnations comprise approximately 1/2 of section.
Peridotite; altered olivine (magnetite/serpentine-filled fractures), pale hornblende (amphibole cleavage). Alteration: fibrous/felted amphibole (second order birefringence, x-nicols) and felted serpentine/antigorite (low birefringence, x-nicols).

Peridotite; as for photomicrograph above, polarized light.
Altered pyroxenite; predominantly augite (twinned, high birefringence); deuteric amphibole (finer fibrous, rimming some augite); plagioclase (white to pale yellow birefringence, twinned, cleavage); serpentinite (fine felted, low birefringence).

Altered pyroxenite; as above, different section of slide. Clearly shows subfibrous deuteric amphibole; conspicuous bladed felted serpentite/antigorite.
Peridotite; well rounded remnants of olivine in optically continuous groundmass of hornblende and anthophyllite. Fractures in olivine contain magnetite and serpentine/antigorite.

Peridotite; as above, polarized light.
Hornblende diorite; interlocking hornblende and plagioclase crystals. Hornblende contains diffuse cores of remnant augite and partial alteration to deuteritic amphibole.

Hornblende diorite; as above, polarized light.
Quartz diorite; crushed, sheared. Composed of plagioclase and quartz with branching fracture networks from cataclasis zones filled with fine felted biotite and lesser amphibole.

Gabbro; amphibole alteration pseudomorphs after olivine (high blue birefringence), hornblende (pale, amphibole cleavage, serpentine dark grey felted) and epidote/clinozoisite (anomalous blue birefringence).
Pyroxenite/hornblendite. Granular pyroxene (augite) and lesser epidote/clinozoisite on left. Felted deuteritic amphibole (hornblende) and chlorite on right.

Pyroxenite/hornblendite. As for photomicrograph above, polarized light.
Hornblendite: dark green variety hornblende with augite remnants, deuteric alteration to second amphibole. Interstital magnetite, chalcopyrite.

Hornblendite: as for photomicrograph above, polarized light.
Diorite/gabbro, medium grained labradorite, interlocking grains with coarse hornblende, remnant pyroxene (augite). Deuteric alteration to colourless and green amphibole.

Bright blue pleochroic mineral. Unidentified "D". All coarse grains in photomicrographs are the same mineral. Interstitial serpentine/antigorite.
Magnetite (smooth purplish grey), chalcopyrite (pale yellow), pentlandite(?) (pale cream) with violarite(?) (pale pinkish cream with cleavage and fractures).

Magnetite (smooth medium blue-grey), pyrrhotite (pinkish cream), violarite(?) (with altered cores, fractures and cleavage), containing very irregular blebs of pentlandite(?) (very pale yellow as compared to chalcopyrite).
Pyrrhotite (cream-pink, pitted), chalcopyrite (yellow), magnetite (blue-grey), violarite (?) (cream pink, idiomorphic, conspicuous cleavage).

Pyrrhotite (cream-pink, pitted), chalcopyrite (yellow), magnetite, blue grey, violarite (?) (cream pink, idiomorphic, conspicuous cleavage), hematite veinlets (pale blue grey).
CONCLUSIONS

"Because of the deuteric alteration and impregnation by acid plutonic rocks, the suite ranges widely in composition from dunite through pyroxenite, peridotite, hornblende, serpentine, gabbro, diorite, and quartz diorite.

Primary sulphides and oxides include pyrrhotite, magnetite, pyrite, chalcopyrite, pentlandite (?) with alteration products magnetite, ilmenite, violarite (?), hematite. Magnetite and ilmenite are largely a result of deuteric alteration of mafic minerals.

Although assays indicated some anomalous Cr and Pd, chromite and Pd minerals were not observed in the polished sections."

MINERAL POTENTIAL

Prospecting and petrographic studies have resulted in the recognition of ultramafic intrusive rocks which may be part of a much larger complex.

"A recent assessment report, #15447 for the Nickel 1-2-3, Lorne, and Super 1-2-3 claims indicates limited potential for a similar and related occurrence to the east. Each occurrence, however, requires individual assessment of potential. Ultramafic environments such as this afford potential for nickel, copper and platinum group mineralization. The acid component provides potential for copper, gold and silver mineralization."

(K.E.Northcote Ph.d., P.Eng.)

RECOMMENDATIONS

Detailed magnetometer readings over a larger area could confirm the strike of the massive sulfides exposed in the old workings. An expanded magnetometer survey could also be of assistance in locating bodies of similar mineralization either on the surface or at depth if of sufficient size. A detailed mapping survey would be of great assistance in finding other areas of economic potential within the claim group.

"It would be of interest to compare nickel occurrences of the Meares Island-Deer bay area with the nickel producing (Pacific Nickel) ultramafic complex between Hope and Yale and with the Pt bearing ultramafics of the Tulameen." (K.E.N.)

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LIST OF REFERENCES


4. British Columbia Department of Mines and Petroleum Resources Assessment Reports #739, #4175, and #13556


6. Muller, J.E.; Cameron, B.E.B.; Northcote, K.E.; 1981, Geology and Mineral Deposits of the Nootka Sound Map-Area, G.S.C. Paper 80-16

7. Page, Richard James; 1974 Sedimentology and Tectonic History of the Esowista and Ucluth Peninsula, West Coast Vancouver Island, British Columbia


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APPENDIX 1

COST STATEMENT

Pavonine Exploration Limited, (SAMPLE SUITE)

2 men @ $150 per day X 8 man days = $1200.00
boat rental @ $35.00 per day X 4 = $ 140.00
food and accom., 2 men X 8 @ $15 per day = $ 120.00
Report = $ 440.00

TOTAL

$1900.00

Vancouver Petrographics Ltd. (PETROGRAPHY)

(19 K-spar)(4 thin sections) (18 polished thin sections) (1 polished ore mount)

TOTAL

$2140.30

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GRAND TOTAL

$4040.30

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STATEMENT OF QUALIFICATIONS AND CERTIFICATIONS

I, Dan Price Berkshire of 1910 Galerno Road, Campbell River, B.C. do hereby certify that:

1.) I have been a practicing prospector for a period of approximately 10 years for mining and exploration companies, mining engineering consulting companies, and individuals.

2.) I obtained my training under Mr. L.V. Berkshire, a trained prospector with certification from the University of Washington.

3.) I have worked as a geological assistant for K.E. Northcote Ph.D., P.Eng., both in Canada and the United States.

4.) I have been president of Pavonine Exploration Ltd., a mineral exploration contracting company since 1983.

5.) I have been president of Iron River Resources Ltd., a publicly traded natural resource company since 1985.

6.) This report is a result of work done personally on the Lone Cone Group, January & June 1989, and January 1990. Use was made of available pertinent published and unpublished maps and publications.

Dated at Campbell River this 24th day of April, 1990

[Signature]
Dan P. Berkshire
Prospector
D. Berkshire, President
Iron River Resources Ltd.
Suite 120-520 2nd Ave.
Campbell River B.C.
V9W 6G2

April 4, 1990

Dear Dan:

Re: Lone Cone Rock Sample Suite
Meares Island, 92F 4 West
Alberni M.D.

Petrographic descriptions have been completed for a suite of 20 thin sections, polished thin sections and polished sections from the Lone Cone property, Meares Island. Photomicrographs are also provided. The sections were prepared from specimens provided by Iron River Resources Ltd.

The ultramafic rocks are thought to be dyke or sill-like bodies derived from a deep-seated source, emplaced in Sicker Group rocks, (Wilton, 1990, personal communication), and were subsequently intruded by acid Island Intrusions. Petrographic descriptions of samples submitted by Iron River Resources Ltd. support this conclusion.

Most of the rocks of the suite were originally of ultramafic composition. The mafic component shows varied stages of deuteric alteration to secondary amphiboles, talc, serpentine/antigorite, magnetite/ilmenite. The ultramafic rocks were subsequently modified by emplacement of more acidic plutons related to Vancouver Island Plutons. This resulted in impregnation by quartz, plagioclase and K-feldspar.

Because of deuteric alteration and impregnation by acid plutonic rocks, the suite ranges widely in composition from dunite through pyroxenite, peridotite, hornblende, serpentine, gabbro, diorite, quartz diorite.

Primary sulphides and oxides include pyrrhotite, magnetite, pyrite, chalcopyrite, pentlandite(?) with alteration products magnetite, ilmenite, violarite(?), hematite. Magnetite and ilmenite are largely a result of deuteric alteration of mafic minerals.

Although assays indicated some anomalous Cr and Pd, chromite and Pb minerals were not observed in the polished sections.
Mineral Potential:

A recent assessment report, #15447 for the Nickel 1-2-3, Lorne, and Super 1-2-3 claims indicates limited potential for a similar and related nickel occurrence to the east. Each occurrence, however, requires individual assessment of potential. Ultramafic environments such as this afford potential for nickel, copper and platinum group mineralization. The acid component provides potential for copper, gold and silver mineralization.

It would be of interest to compare nickel occurrences of the Meares Island-Deer Bay area with the nickel producing (Pacific Nickel) ultramafic complex between Hope and Yale and with the Pt bearing ultramafics of the Tulameen.

Yours very truly,

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