Petrographic Report  

on  

Surface and Drill Core Samples  

from the  

North Grid, River Valley Property  

Dana and McWilliams townships, Ontario  

Sudbury Mining District  

Claims 1214638, 1229152, 1229153, 1229154, 1229155, 1231181, 1231265, 1237522  

Prepared by:  

Jon Findlay, PhD  

October 11, 2001
Executive Summary

The River Valley Intrusion (RVI) is a layered mafic complex situated approximately 70 km east of Sudbury, Ontario. Mustang Minerals Corp. holds a large land position covering parts of the RVI and, along with joint venture partner Impala Platinum Holdings Ltd., is currently evaluating the Platinum Group Element (PGE) potential of the property. As part of the exploration program, a suite of surface and drill core samples from the North Grid area was selected for petrographic examination to document mineralogical and textural variations amongst various key stratigraphic units.

Petrographic study of the sample suite supports the rock classifications and stratigraphic relationships derived from field mapping in the North Grid area. The majority of samples examined exhibit pristine mineralogy and magmatic textures, and are clearly representative of the primary igneous rocks. The Contact Zone of the intrusion is composed of fine to medium grained gabbronoritic rocks which may contain minor quartz, biotite and garnet. Moving into the intrusion, the Contact Zone lithologies give way to fine to medium grained, granular gabbronorites and norites of the Border Zone. These rocks grade into, or are interlayered with, oxide enriched gabbronorites and norites. Both oxide-rich and oxide-poor Border Zone lithologies host country rock and cognate (norite, anorthosite) inclusions. The Chaotic Zone, which hosts much of the PGE mineralization discovered to date on the North Grid, consists of mafic and ultramafic inclusions set in a medium to coarse grained gabbronoritic matrix. The inclusions range from websterite and orthopyroxenite to anorthosite in composition, and include fine to medium grained gabbronoritic lithologies equivalent to those of the Border Zone. The Chaotic Zone is stratigraphically overlain by the Main Series, a repetitive sequence of olivine gabbronorite/troctolite, gabbronorite, leucogabbronorite and anorthosite.

The majority of the samples exhibit cumulate textures, with orthopyroxene, plagioclase, olivine, clinopyroxene and magnetite-ilmenite occurring as cumulus and/or intercumulus phases in different rock types. This observation, coupled with the compositional range of the samples, suggests that all of the rocks reflect fractional crystallization and accumulation of different primocryst species during the evolution of one or more magmas. The occurrence of a more or less continuous range of compositions as inclusions may indicate that a pre-existing mafic/ultramafic succession was disrupted and reworked during subsequent magma influx, thereby forming the inclusion-bearing sequences.
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Appendix I. Petrographic Descriptions
1. Introduction
In the fall of 1999, Mustang Minerals Corp and Impala Platinum Holdings Ltd. entered into a joint venture agreement to explore Mustang’s River Valley property, an area prospective for Platinum Group Element (PGE) mineralization. The property covers part of the River Valley Intrusion (RVI), a layered, mafic-ultramafic intrusion situated approximately 70 km east of Sudbury, Ontario (Figure 1). Mapping programs were completed on the property during the 1999 (Wood, 2000a; Wood 2000b) and 2000 (Findlay, 2001) field seasons, and these led to the identification of an extensive zone of PGE mineralization along the northeast contact of the intrusion. As part of the 2000-2001 work programs, a suite of surface and drill core samples was collected for petrographic study from the North Grid portion of the property. The purpose of the study was primarily to document the compositional range of rock types in the area, and to confirm mineral and rock identifications from drill core. This report provides petrographic descriptions of the samples. Wood (2000a and 2000b) and Findlay (2001) should be consulted for further property details and geological interpretations.

2. Location
The Mustang-Impala River Valley joint venture property is located roughly 70km east of Sudbury, with the southern boundary of the claim block lying immediately north of the village of River Valley, Ontario (Figures 1 and 2). The claims lie within Dana, McWilliams, Gibbons, Crerar and Henry townships in the Sudbury Mining District (Figure 2). The property is centered on latitude 49° 36’ N and longitude 80° 17’ W (554892mE, 5160746mN, UTM Zone 17, NAD 27) and is covered by NTS sheet 411/09 (Glen Afton). The North Grid is situated in the northeastern portion of claim block, in Dana and McWilliams townships.

3. General Geology
The River Valley intrusion is a member of the East Bull Lake Suite (EBLS), which also includes the East Bull Lake, Agnew, Drury, May, Falconbridge and Wisner intrusive complexes (Figure 1). The individual intrusions range in age from 2.491Ga to 2.475 Ga (Easton 1998, and references therein) and are thus essentially coeval with the volcanic rocks of the Huronian Supergroup. The EBLS intrusions have been described as predominantly gabbroic to anorthositic in composition, with plagioclase as the predominant cumulus phase. The members of the suite share a number of common characteristics in addition to lithology, one of the most interesting of which is the occurrence of sulphide-associated PGE mineralization.

With the exception of the RVI, members of the EBLS occur along the Superior Province-Southern Province boundary in central Ontario. The RVI, which is the most easterly of the EBLS intrusions, lies within the Grenville Front Tectonic Zone. Recent geochemical and geochronological work indicates that the EBLS formed as part of a major magmatic event that was associated with, and may have initiated, Paleoproterozoic rifting of the Superior proto-continent. This rifting event gave rise to the volcano-sedimentary succession of the Huronian Supergroup, which defines the Southern
**Figure 1.** Location of the East Bull Lake suite of mafic layered intrusions in the Huronian-Nipissing Magmatic Belt, central Ontario. Modified after Peck et al. (1995).
Figure 2. Location of the North Grid on the Mustang-Impala River Valley joint venture property.
Province in the area. Rift-related magmatic activity is also manifested in the gabbroic rocks of the Hearst-Matachewan dyke swarm.

The EBLS igneous rocks exhibit geochemical characteristics (high Al, relatively low Mg#, and LIL-enriched extended trace element profiles) consistent with derivation from fractionated tholeiitic or high-alumina tholeiitic parental magmas (Peck et al. 1993, Peck et al. 1995, and Vogel et al. 1998). The estimated parental magma compositions for the EBLS are thus broadly similar to those postulated for the intrusive suite in the world class Noril'sk-Talnakh Ni-Cu-PGE camp of Siberia.

The EBLS intrusions are typically hosted by 2.75 - 2.65 Ga granitoids and granitic gneisses of the Algoma Plutonic Terrane and the Algoma Gneiss Terrane (Peck et al. 1993). The intrusions may be disconformably overlain by Huronian sedimentary rocks or, less commonly, by lower Huronian volcanic rocks. The Sudbury Intrusive Complex forms the hanging wall in the Wisner, Falconbridge and Drury intrusions.

4. Methods

The samples described in this report were obtained from surface outcrops during the 2000 field program, and from drill core during a 17,000m program conducted during the winter months of 2000 and 2001. The majority of samples were submitted for preparation of covered thin sections to document silicate mineralogy and rock types. Polished thin sections were prepared from selected, sulphide or oxide enriched samples to identify the principal opaque phases. Compositional classifications are based on visual modal estimates and interpretations regarding the source of secondary minerals. Petrographic examinations and photomicrographs were completed using equipment supplied by the Earth Sciences Department of Laurentian University, for the use of which the author is grateful.

5. Discussion of Results

Surface sample locations and drill hole collar locations are illustrated in Figure 3. Petrographic descriptions of individual samples are provided in Appendix I, and Table 1 summarizes this information. Modal proportions reported represent the averages of estimates from multiple fields of view. Due to time constraints, identification of the compositions of solid solution phases was not attempted.

5.1 Rock Types

The field mapping programs of 1999 and 2000 documented extensive lithological variations in the stratigraphic sequence exposed on the North Grid (Findlay, 2001). All of the samples examined in the current study were obtained from that portion of the stratigraphy that is of interest in terms of PGE mineralization. Figure 4 illustrates a generalized stratigraphic column for the North Grid area on which the relationships of the petrographic samples are indicated.

5.1.1 Country Rocks

The country rocks to the RVI consist predominantly of various types of granitoids, interbanded with lesser quantities of quartzo-feldspathic gneiss and
Figure 3. North Grid geology and petrographic sample locations
Figure 4. Idealized stratigraphic column illustrating the PGE-bearing interval on the North grid, River Valley property. The stratigraphic positions of the petrographic samples are also shown.
Table 1. Location and classification of River Valley samples.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Location</th>
<th>Stratigraphic Zone</th>
<th>Rock Code Modal Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>NZ-1</td>
<td>L50+21E/2+15S</td>
<td>Border Zone</td>
<td>11c magnetite gabbronorite</td>
</tr>
<tr>
<td>NZ-2</td>
<td>L49+88E/1+15S</td>
<td>Border Zone</td>
<td>11 gabbronorite</td>
</tr>
<tr>
<td>NZ-3</td>
<td>L49+92E/7+27N</td>
<td>Country Rock Dyke</td>
<td>18 biotite-granodiorite</td>
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<tr>
<td>NZ-4</td>
<td>L52+10E/6+50S</td>
<td>Contact or Border Zone</td>
<td>11c magnetite gabbronorite</td>
</tr>
<tr>
<td>NZ-5</td>
<td>L38+00E/6+15S</td>
<td>Chaotic Zone (inclusion)</td>
<td>11 gabbronorite</td>
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<tr>
<td>NZ-6</td>
<td>L39+95E/7+67S</td>
<td>Chaotic Zone (matrix)</td>
<td>10a melagabbronorite</td>
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<tr>
<td>NZ-7</td>
<td>L40+20E/7+23S</td>
<td>Main Series</td>
<td>9 troctolite</td>
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<tr>
<td>NZ-8</td>
<td>unknown</td>
<td>Main Series</td>
<td>8a olivine melanorite</td>
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<td>L36+00E/5+25S</td>
<td>Main Series</td>
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</tr>
<tr>
<td>NZ-10</td>
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<td>L16+00E/5+72N</td>
<td>Main Series</td>
<td>9 troctolite</td>
</tr>
<tr>
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<td>NZ-14</td>
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<td>Main Series</td>
<td>8 olivine norite</td>
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<td>NZ-15</td>
<td>L39+35E/5+95S</td>
<td>Border Zone</td>
<td>11c magnetite leuconorite</td>
</tr>
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<td>MR1-121</td>
<td>L40+25E/6+08S</td>
<td>Chaotic Zone (inclusion)</td>
<td>6b orthopyroxenite</td>
</tr>
<tr>
<td>MR2-20</td>
<td>L40+31E/5+64S</td>
<td>Border Zone</td>
<td>11c magnetite norite</td>
</tr>
<tr>
<td>MR2-21</td>
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<td>MR3-75</td>
<td>L42E/7+25S</td>
<td>Border Zone</td>
<td>16a anorthosite</td>
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<td>MR3-178</td>
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<td>Chaotic Zone (matrix)</td>
<td>10 gabbronorite</td>
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<td>MR3-181</td>
<td>L42E/7+25S</td>
<td>Main Series</td>
<td>9 troctolite</td>
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<td>MR3-205</td>
<td>L42E/7+25S</td>
<td>Main Series</td>
<td>16 anorthosite</td>
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<td>MR4-116</td>
<td>L42E/7+75S</td>
<td>Chaotic Zone (inclusion)</td>
<td>12 norite</td>
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<tr>
<td>MR12-231a</td>
<td>L38E/4+50S</td>
<td>Main Series</td>
<td>7b olivine-websterite (?)</td>
</tr>
<tr>
<td>MR12-231b</td>
<td>L38E/4+50S</td>
<td>Main Series</td>
<td>7b amphibolite gneiss, possibly from olivine websterite</td>
</tr>
<tr>
<td>MR16-67</td>
<td>L38E/1+50S</td>
<td>Country Rocks</td>
<td>3a granite gneiss</td>
</tr>
<tr>
<td>MR16-78</td>
<td>L38E/1+50S</td>
<td>Country Rocks</td>
<td>3 granodiorite</td>
</tr>
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<td>MR16-79a</td>
<td>L38E/1+50S</td>
<td>Country Rocks</td>
<td>2 (?) quartz metagabbro/metadiorite gneiss</td>
</tr>
<tr>
<td>MR16-79b</td>
<td>L38E/1+50S</td>
<td>Country Rocks</td>
<td>2 (?) quartz metadiorite</td>
</tr>
<tr>
<td>MR16-81</td>
<td>L38E/1+50S</td>
<td>Country Rocks</td>
<td>2 (?) meta-monzodiorite</td>
</tr>
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<td>MR16-83</td>
<td>L38E/1+50S</td>
<td>Country Rocks</td>
<td>4 quartz syenite</td>
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<td>MR16-93</td>
<td>L38E/1+50S</td>
<td>Country Rocks</td>
<td>3 biotite granite</td>
</tr>
<tr>
<td>MR16-95</td>
<td>L38E/1+50S</td>
<td>Country Rocks</td>
<td>2 quartzo-feldspathic biotite gneiss</td>
</tr>
<tr>
<td>MR16-101</td>
<td>L38E/1+50S</td>
<td>Country Rocks</td>
<td>2 quartzo-feldspathic biotite gneiss</td>
</tr>
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<td>MR16-119</td>
<td>L38E/1+50S</td>
<td>Country Rocks</td>
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<td>MR16-121</td>
<td>L38E/1+50S</td>
<td>Country Rocks</td>
<td>5 monzonite</td>
</tr>
<tr>
<td>MR31-165</td>
<td>L38E/1+50S</td>
<td>Chaotic Zone (inclusion)</td>
<td>6b orthopyroxenite</td>
</tr>
<tr>
<td>MR32-49</td>
<td>L38E/1+50S</td>
<td>Contact Zone</td>
<td>11a/11b quartz-bearing noritic gneiss</td>
</tr>
<tr>
<td>MR32-213</td>
<td>L38E/1+50S</td>
<td>Chaotic Zone (inclusion)</td>
<td>6b orthopyroxenite</td>
</tr>
</tbody>
</table>
amphibolite gneiss. The granitoids include massive to gneissic granite (MR16-67, MR16-93, MR16-119), granodiorite (NZ-3), quartz syenite (MR16-83) and monzonite (MR16-81). Quartzo-feldspathic gneiss (MR16-95, MR16-101) of uncertain origin, and amphibolite gneiss (MR16-79a, MR16-79b, MR16-81) possibly derived from Archean mafic dykes, are interbanded with the granitoids.

5.1.2 Quartz-Dioritic Rocks

The granitoid country rocks locally grade through quartz-, biotite- and garnet-bearing dioritic to monzonitic rocks (MR16-121) of uncertain stratigraphic relationships. In some drill holes there appears to be a more or less complete continuum between country rock granitoids and quartz-bearing gabbronorites, which are clearly part of the RVI. This may indicate that, at least locally, the dioritic rocks represent the crystallization products of highly contaminated RVI magmas. In some areas, however, the dioritic rocks form the matrix to a magmatic breccia in which the predominant fragment type is fine grained, chloritized, gabbroic rock. This may indicate that the quartz diorite matrix represents melted country rock material back-injected into the chilled margin of the intrusion.

5.1.3 Contact Zone

The Contact Zone of the RVI is composed of fine grained granular quartz-bearing gabbronorite to norite (Plates 1A and 1B; MR32-49) with variable quartz, biotite and alkali feldspar contents. These may grade to quartz diorite moving toward the contact, and to granular gabbronorite and norite of the Border Zone moving into the intrusion. The Contact Zone commonly shows country rock xenoliths and infrequent altered gabbroic inclusions.

5.1.4 Border Zone

The Border Zone of the RVI is composed primarily of two main rock types. In most areas, this unit consists predominantly of fine to medium grained anhedral granular gabbronorite, which may locally contain minor biotite and quartz (Plates 1C and 1D, NZ-2). This rock type is gradationally interlayered with magnetite gabbronorite, magnetite norite and magnetite leuconorite (NZ-1, NZ-4, NZ-15, MR2-20), in which cumulus and intercumulus magnetite-ilmenite intergrowths occupy 5-10% of the rock (Plates 2A and 2B). The Border Zone lithologies contain country rock xenoliths, as well as anorthosite and norite inclusions and layers (Plates 2C, 2D, 3A, 3B; MR2-21, MR2-23, MR3-75).

5.1.5 Chaotic Zone

The Chaotic Zone consists predominantly of mafic to ultramafic inclusions set in a texturally variable gabbronoritic matrix. The matrix ranges from gabbronorite (Plate 3C and 3D; NZ-12, MR3-96, MR3-178) to melagabbronorite (NZ-6, MR3-94) in composition. Texturally, the matrix rocks range from medium grained equigranular to pegmatitic and poikilitic varieties. Orthopyroxene in particular commonly forms very large oikocrysts in the rocks. The inclusions range from websterite (Plates 4A and B; NZ-13, MR3-141) and orthopyroxenite (Plates 4C and D; MR1-121, MR31-165, MR32-213), through melagabbronorite, gabbronorite, norite (MR4-116), and magnetite.
gabbronorite/norite, to anorthosite. All of the inclusions show cumulate textures, with orthopyroxene, orthopyroxene + clinopyroxene and orthopyroxene + plagioclase as the predominant cumulus assemblages.

5.1.6 Main Series

The Main series consists of a layered sequence of repetitive rock types ranging from olivine gabbronorite/troctolite and gabbro/gabbronorite, through leucogabbro and leucogabbronorite to anorthosite (MR3-205). A layer of olivine-bearing rocks immediately overlies the Chaotic Zone, and marks the start of the Main Series. This unit ranges from rare olivine-websterite (MR12-231a, MR12-231b) and olivine melanorite (NZ-8) to olivine gabbronorite, troctolite (Plate 5; NZ-7, NZ-9, NZ-11, MR3-181) and olivine norite (NZ-14) in composition. Olivine is a cumulus phase, and may be accompanied by cumulus orthopyroxene, cumulus orthopyroxene + clinopyroxene or cumulus orthopyroxene + plagioclase.

5.2 Sulphide Mineralization

Localized sulphide concentrations occur in most of the rock types identified on the North Grid to date, but significant, laterally continuous, mineralization appears to be confined to the Contact, Border and Chaotic zones. Of these, only the Chaotic Zone hosts PGE-enriched sulphide mineralization. The predominant sulphide phase in the Chaotic Zone is pyrrhotite, which occurs as a net-textured matrix to cumulus silicate grains in some sulphide-rich samples (Plate 4C and D; MR32-213), as interstitial grains, as very fine inclusions generally concentrated along the margins of silicate grains, and as fracture fillings. Chalcopyrite is also a common constituent of sulphide-bearing rocks, and may occur as isolated interstitial grains and inclusions, or may be intergrown with, or exsolved from, pyrrhotite. Pentlandite is a common but very minor component of the sulphide assemblage, usually occurring as irregular rinds on, or as small inclusions in, pyrrhotite. In some samples, pentlandite also occurs as exsolution lamellae in pyrrhotite. No platinum group minerals were identified in the samples, although a substantial suite of such minerals were identified by Cabri (2001) using electron microscopy and microprobe techniques.
6. References


Statement of Qualifications

I, Jonathan M. Findlay, of Vancouver, BC, Canada, do hereby certify that:

1) I am a practising consulting geologist with Cuesta Geoscience Ltd., with an office at 148 W. 23rd Ave, North Vancouver, BC.

2) I am a graduate of the University of Western Ontario, London, Ontario with an Honours Bachelor of Science Degree in Geology, and of the University of Ottawa, Ottawa, Ontario, with a Doctorate of Philosophy in Geology.

3) I have been practising my profession as a geologist in North and South America since 1987.

4) I am a member of the Society of Economic Geologists, the Geological Association of Canada, and the Canadian Institute of Mining and Metallurgy.

5) The information contained in this report is based directly on personal observations.

6) I hold no interests in the properties or securities of Mustang Minerals Corp.

Dated this 11th day of October, 2001 at Sudbury, Ontario

Jon Findlay, PhD.
Plates 1A and 1B. Plane polarized (A) and cross polarized (B) transmitted light photomicrographs of quartz-bearing norite from the Contact Zone of the RVI. The rock is predominantly composed of strained and somewhat granulated plagioclase and orthopyroxene, with abundant biotite and minor quartz. Sample MK32-49. Field of view is 8.5 mm.

Plates 1C and 1D. Plane polarized (C) and cross polarized (D) transmitted light photomicrographs of granular gabbronorite from the Border Zone of the RVI. The rock is composed primarily of plagioclase, orthopyroxene and clinopyroxene, with minor interstitial magnetite-ilmenite. Sample NZ-5. Field of view is 4.25 mm in width.
Plates 2A and 2B. Plane polarized transmitted light photomicrographs of magnetite norites from the Border Zone of the RVI. The rocks are composed of plagioclase, orthopyroxene, minor clinopyroxene and abundant magnetite-ilmenite, with secondary biotite, actinolite and chlorite. Plate 1B also shows abundant apatite as small, clear, subhedral to anhedral equant grains. Samples MR2-20 (A) and NZ-15 (B). Fields of view are 4.25 mm.

Plates 2C and 2D. Plane polarized (C) and cross polarized (D) transmitted light photomicrographs of an anorthosite inclusion in the Border Zone of the RVI. The rock is essentially a plagioclase adcumulate, with intercumulus spaces filled by overgrowths on the plagioclase primocrysts. Sample MR2-23. Field of view is 8.5mm in width.
Plate 3A and 3B. Plane polarized (A) and cross polarized (B) transmitted light photomicrographs of a norite inclusion from the Border Zone of the RV1. The rock is predominantly composed of cumulus plagioclase and orthopyroxene, with minor magnetite-ilmenite. Sample MR32-19. Field of view is 8.5 mm.

Plate 3C and 3D. Plane polarized (C) and cross polarized (D) transmitted light photomicrographs of a coarse grained gabbronorite forming the matrix in the Chaotic Zone of the RV1. The rock is composed of cumulus orthopyroxene and clinopyroxene, with intercumulus plagioclase. Orthopyroxene shows exsolution blebs and lamellae of clinopyroxene. Sample MR3-178. Field of view is 8.5 mm in width.
Plates 4A and 4B. Plane polarized (A) and cross polarized (B) transmitted light photomicrographs of a websterite inclusion from the Chaotic Zone of the RVI. The rock is predominantly composed of cumulus orthopyroxene and clinopyroxene, with rare intercumulus plagioclase. Sample NZ-13. Field of view is 8.5 mm.

Plates 4C and 4D. Transmitted (C) and reflected (D) light photomicrographs of an orthopyroxenite inclusion from the Chaotic Zone of the RVI. The rock is composed almost exclusively of cumulus orthopyroxene grains set in a net-textured matrix of sulphides (predominantly pyrrhotite). Sample MR32-213. Field of view is 8.5 mm in width.
Plates 5A and 5B. Plane polarized (A) and cross polarized (B) transmitted light photomicrographs of an olivine gabbronorite from the Main Series of the RV1. The rock is predominantly composed of cumulus orthopyroxene (not visible in this view), plagioclase and olivine, with intercumulus clinopyroxene. Sample NZ-7. Field of view is 8.5 mm.

Plates 5C and 5D. Plane polarized (A) and cross polarized (B) transmitted light photomicrographs of a troctolite from the Main Series of the RV1. The rock is composed almost exclusively of cumulus olivine and intercumulus plagioclase. Sample NZ-9. Field of view is 8.5 mm in width.
Appendix I: Petrographic Descriptions
North Grid Surface Samples

Sample Number: NZ-1
Location: North Grid, L
Classification: magnetite gabbro
Map Unit: 11c

Principal Mineralogy:
Plagioclase (53%): anhedral, equant, crystals up to 5 mm in longest dimension; shows moderate to strong granulation; shows turbid cores due to numerous minute opaque inclusions; clear rims reflect late sodic overgrowths; local weak sausseritization.
Clinopyroxene (21%): anhedral, equant, equigranular crystals showing local strong granulation; crystals generally < 3mm in longest dimension; may subophitically enclose plagioclase; commonly shows minor actinolitic alteration.
Orthopyroxene (8%): anhedral, weakly elongated to equant crystals generally < 3mm in longest dimension, commonly shows embayments, may enclose small plagioclase crystals; may show partial replacement by biotite, actinolite and chlorite.
Biotite (9%): irregular prismatic crystals interstitial to plagioclase and pyroxenes; up to 2 mm in longest dimension; locally encloses plagioclase; appears primary although this phase also occurs as an alteration product of pyroxene.
Fe-Ti Oxides (5%): irregular grains interstitial to silicates and as inclusions in silicates; also as minute inclusions (probably hematite) in plagioclase.

Accessory Mineralogy: apatite, sphene, quartz, alkali feldspar

Description: The rock is a fine to medium grained, holocrystalline, anhedral granular magnetite gabbro, composed primarily of plagioclase, clinopyroxene and orthopyroxene, with lesser biotite and Fe-Ti oxides. The rock is relatively unaltered, although the principal silicates, particularly plagioclase, appear to have undergone some degree of deformational granulation. The abundance of Fe-Ti oxides, as well as the common occurrence of accessory apatite and sphene, suggests derivation from a fairly evolved magma.

Sample Number: NZ-2
Location: North Grid, L
Classification: gabbro-norite
Map Unit: 11c

Principal Mineralogy:
Plagioclase (60%): very fine to coarse (> 10mm) anhedral equant to tabular crystals, locally granulated, clear albitic rims; turbid interiors due to numerous minute inclusions; may show minor sausseritization.
**Clinopyroxene (13%):** irregular anhedral crystals ophitically enclosing small plagioclase grains; also intergrown with or interstitial to coarser plagioclase grains; maximum grain size ~ 5 mm; replaced by actinolite, biotite and chlorite.

**Orthopyroxene (15%):** corroded subhedral prismatic crystals generally < 2mm in longest dimension; poikilitically encloses small plagioclase grains; replaced by actinolite and biotite.

**Biotite (8%):** irregular prismatic grains intergrown with pyroxenes and plagioclase; also as an alteration product of pyroxenes; generally < 1mm in longest dimension.

**Fe-Ti Oxides (4%):** irregular interstitial grains or inclusions in silicates.

**Accessory Mineralogy:** apatite, sphene, quartz

**Description:** The rock is a fine grained, holocrystalline, granular magnetite gabbronorite, with anhedral pyroxenes intergrown with, or interstitial to plagioclase. Pyroxenes locally form oikocrysts enclosing small plagioclase grains. The rock is fresh, with only minor replacement of the principal silicates.

**Sample Number:** NZ-3

**Location:** North Grid, L

**Classification:** biotite granodiorite

**Map Unit:** 18

**Principal Mineralogy:**

**Plagioclase (38%):** anhedral equant to tabular crystals, generally < 1mm in longest dimension; heavily fractured; turbid with minute inclusions; weak sausseritization.

**Orthoclase (20%):** anhedral equant to slightly elongate crystals; generally < 0.5mm in longest dimension; minor sericitization.

**Quartz (20%):** anhedral equant grains; generally < 0.5mm; undulose extinction.

**Biotite (17%):** ragged prismatic crystals 0.2mm to 1mm in longest dimension; interstitial to feldspars and quartz; also secondary after amphibole; contains numerous zircon and sphene inclusions.

**Hornblende (2%):** irregular elongate crystals generally < 1mm; may poikilitically enclose feldspars; may be replaced by biotite.

**Fe-Ti Oxides (2%):** very fine grained irregular magnetite; occasionally intergrown with, or showing exsolution lamellae of, ilmenite; interstitial to silicates.

**Sphene (1%):** subhedral to euhedral primary crystals interstitial to, or as inclusions in, primary silicates; also as somewhat amorphous intergrowths with biotite (?) and hematite after oxides.

**Accessory Mineralogy:** zircon, chalcopyrite

**Description:** The rock is a fine grained, holocrystalline, anhedral granular biotite granodiorite with significant Fe-Ti oxide content. Much of the oxide component has been replaced by an amorphous assemblage involving sphene, biotite and
hematite. Zircon and chalcopyrite occur as accessory phases interstitial to the principal silicates.

Sample Number: NZ-4
Location: North Grid, L
Classification: magnetite metagabbro
Map Unit: 11c

Principal Mineralogy:
Plagioclase (50%): anhedral equant inequigranular crystals, up to 10mm but most grains < 2mm; heavily fractured; turbid with inclusions.
Biotite (24%): subhedral prismatic crystals and somewhat amorphous aggregates associated with amphibole and Fe-Ti oxides; generally << 1 mm in longest dimension; at least in part a replacement of primary pyroxenes.
Amphibole (Hornblende?) (19%): occurs generally as very fine aggregates pseudomorphing pyroxene; partially replaced by chlorite.
Fe-Ti Oxides (5%): very fine grained (< 0.2mm) irregular crystal intergrown with biotite and amphibole; less commonly as inclusions in plagioclase; consist of individual grains of magnetite and magnetite-ilmenite intergrowths.
Apatite (1%): abundant small euhedral to anhedral inclusions in plagioclase, biotite and amphibole.

Accessory Mineralogy: zircon, garnet

Description: The rock is a fine grained, holocrystalline, magnetite metagabbro, consisting of an anhedral granular intergrowth of primary plagioclase and secondary biotite+amphibole after pyroxenes. Fe-Ti oxides occur as abundant irregular interstitial grains, and the rock is characterized by an unusually high apatite content. The rock has undergone upper amphibolite grade metamorphism in which primary pyroxenes have been replaced by amphibole, biotite and garnet.

Sample Number: NZ-5
Location: North Grid, L
Classification: gabbnorite
Map Unit: 11

Principal Mineralogy:
Plagioclase (54%): anhedral equant to subhedral tabular crystals, generally 0.5mm to 1mm in longest dimension; turbid with minute inclusions; minor saussuritization and sericitization.
Clinopyroxene (25%): large (up to 10mm) irregular crystals poikilitically enclosing small plagioclase grains; also as smaller equant grains intergrown with plagioclase; shows narrow amphibole (actinolite) reactions rims at contacts with plagioclase; minor replacement by actinolite, biotite and chlorite.
Orthopyroxene (21%): large poikilitic crystals and smaller equant anhedra as in clinopyroxene; shows amphibole reaction rim with plagioclase; replaced by actinolite and chlorite

Accessory Mineralogy: Fe-Ti oxides, pyrrhotite, apatite

Description: The rock is a fine to medium grained, holocrystalline, anhedral granular to poikilitic gabbronorite showing only minor metamorphic/alteration effects.

Sample Number: NZ-6
Location: North Grid, L
Classification: melagabbronorite
Map Unit: 10a

Principal Mineralogy:
Orthopyroxene (38%): fine grained (< 0.5mm) anhedral crystals intergrown with plagioclase and clinopyroxene; also as coarser (> 10 mm) irregular crystals poikilitically enclosing plagioclase and clinopyroxene; shows clinopyroxene exsolution blebs and lamellae; shows amphibole+chlorite reaction rims with plagioclase; minor replacement by amphibole, biotite and chlorite.

Plagioclase (33%): anhedral equant to subhedral prismatic grains intergrown with, or enclosed by, pyroxenes; maximum grain size ~ 5 mm; turbid with minute inclusions; locally shows myrmekitic intergrowths with quartz at grain boundaries; shows minor sericite-epidote-chlorite alteration.

Clinopyroxene (27%): generally forms interlocking aggregates of anhedral equant crystals; most grains are < 0.5 mm in longest dimension; shows amphibole-chlorite reaction rims with plagioclase; minor replacement by amphibole and chlorite.

Fe-Ti Oxides (1%): oxides occur as very fine inclusions in pyroxenes and as a minor interstitial phase.

Garnet (1%): highly irregular grains generally developed at the boundaries between plagioclase and pyroxenes; generally < 0.5 mm in longest dimension.

Accessory Mineralogy: quartz

Description: The rock is a medium grained, holocrystalline, inequigranular melagabbronorite with local coarse orthopyroxene oikocrysts. The rock is relatively fresh, although the presence of garnet is probably indicative of upper amphibolite grade metamorphism.

Sample Number: NZ-7
Location: North Grid, L
Classification: troctolite
Map Unit: 9
Principal Mineralogy:

*Plagioclase (59%):* subhedral tabular to prismatic crystals generally 2-6mm in longest dimension; shows numerous epidote-sericite-chlorite filled fractures; turbid with minute inclusions; shows minor sausseritization.

*Olivine (28%)*: inequigranular anhedral grains up to 8mm, invariably shows zoned corona structure involving orthopyroxene, brownish amphibole, epidote and actinolitic amphibole where in contact with plagioclase; shows characteristic serpentine/iddingsite + magnetite alteration which is best developed along fractures.

*Orthopyroxene (7%):* forms anhedral equant grains intergrown with plagioclase and coarser crystals partially enclosing plagioclase and olivine; shows clinopyroxene exsolution blebs; forms part of corona structure around olivine; may show minor replacement by actinolite and chlorite.

*Clinopyroxene (6%):* typically forms small (< 1mm) angular interstitial grains; may be enclosed by larger orthopyroxene crystals; minor replacement by actinolite and chlorite.

Accessory Mineralogy: Fe-Ti oxides

Description: The rock is a medium grained, holocrystalline, inequigranular troctolite, consisting predominantly of plagioclase and olivine, with relatively minor pyroxenes. Olivine displays moderate pseudomorphic replacement by serpentine and magnetite, but the rock is otherwise fresh.

Sample Number: NZ-8
Location: North Grid, L
Classification: olivine melanorite
Map Unit: 8a

Principal Mineralogy:

*Orthopyroxene (37%):* coarse irregular crystals up to 3 cm in longest dimension; poikilitically enclosing plagioclase and olivine; minor actinolite-chlorite alteration.

*Plagioclase (31%):* anhedral equant to subhedral prismatic crystals up to 5mm in longest dimension; shows minor sericite-epidote alteration.

*Olivine (28%):* anhedral irregular grains up to 6 mm in longest dimension intergrown with plagioclase and locally enclosed by orthopyroxene; shows zoned corona structure at boundaries with plagioclase; minor serpentine/iddingsite/talc + magnetite alteration generally confined to fractures

*Clinopyroxene (4%):* irregular angular crystals interstitial to plagioclase; generally < 1mm in longest dimension; minor replacement by actinolite.

Accessory Mineralogy: Fe-Ti oxides
**Description:** The rock is a medium to coarse grained, holocrystalline, anhedral inequigranular olivine melanorite. It consists predominantly of oikocrystic orthopyroxene enclosing, or partially enclosing, plagioclase and olivine, with only minor interstitial clinopyroxene. Olivine displays the zoned corona structure characteristic of the olivine-bearing rocks of the River Valley suite. The rock is relatively fresh, with only minor alteration of olivine and orthopyroxene.

**Sample Number:** NZ-9  
**Location:** North Grid, L  
**Classification:** troctolite  
**Map Unit:** 9

**Principal Mineralogy:**

*Plagioclase (57%):* anhedral equant to subhedral tabular grains generally 1-5 mm in longest dimension; turbid with minute inclusions; local moderate to strong sausseritization.

*Olivine (36%):* anhedral irregular crystals generally 1-10 mm in longest dimension; shows zoned corona structure at boundaries with plagioclase; moderate to strong alteration – iddingsite at rims and in fractures, serpentine+magnetite in interior of grains.

*Clinopyroxene (4%):* anhedral equant grains intergrown with plagioclase and olivine; also as small, angular interstitial grains; locally shows inclusions or exsolution of orthopyroxene; minor replacement by actinolite and biotite.

*Orthopyroxene (3%):* anhedral equant grains intergrown with plagioclase and olivine; also as small interstitial grains; shows minor serpentine alteration and may show talc-filled fractures.

**Accessory Mineralogy:** Fe-Ti oxides

**Description:** The rock is a medium to coarse grained, holocrystalline troctolite consisting predominantly of plagioclase and olivine. Clinopyroxene and orthopyroxene are relatively minor phases, and typically occupy interstices between the principal silicates. Minor Fe-Ti oxides also occur as interstitial grains, and magnetite is an abundant secondary phase after olivine. All of the silicates show moderate local alteration, with olivine displaying the most pronounced alteration effects. As in other olivine-bearing rocks in the intrusion, olivine exhibits a pronounced, zoned, corona structure where in contact with plagioclase.

**Sample Number:** NZ-10  
**Location:** North Grid, L  
**Classification:** gabbronorite  
**Map Unit:** 10

**Principal Mineralogy:**
**Plagioclase (54%)**: anhedral equant to subhedral prismatic grains; prismatic grains reach 1 cm in longest dimension; grains are turbid with minute inclusions but show clear sodic rims; shows minor sericite-epidote alteration, particularly along fractures.

**Orthopyroxene (24%)**: anhedral equant grains typically > 5mm in longest dimension; may poikilitically enclose plagioclase and clinopyroxene; commonly shows clinopyroxene exsolution; may show replacement by biotite, actinolite and chlorite.

**Clinopyroxene (22%)**: generally forms 1-5 mm sized anhedral granular grains intergrown with plagioclase; also as angular interstitial grains; commonly shows oxide inclusions; locally shows orthopyroxene exsolution; locally shows oxide exsolution (?); may be replaced by actinolite and chlorite.

**Accessory Mineralogy**: Fe-Ti oxides

**Description**: The rock is a medium to coarse grained, holocrystalline gabbronorite consisting of plagioclase and subequal amounts of clinopyroxene and orthopyroxene. The rock is inequigranular, with orthopyroxene commonly forming large crystals poikilitically enclosing the other principal silicates. Alteration effects are limited to minor actinolite+biotite+chlorite replacement of pyroxenes, and localized sericite+epidote replacement of plagioclase.

**Sample Number**: NZ-11
**Location**: North Grid, L
**Classification**: troctolite
**Map Unit**: 9

**Principal Mineralogy**:

**Olivine (43%)**: anhedral equant to irregular elongate grains, 1-10mm in longest dimension; olivine grains form irregular chains or layers separated by plagioclase rich layers; shows characteristic zoned corona structures where in contact with plagioclase; shows moderate to strong replacement by iddingsite, serpentine and magnetite.

**Plagioclase (42%)**: anhedral equant to subhedral tabular crystals; generally < 6mm in longest dimension; shows turbid cores due to inclusions and clear sodic rims; shows minor sercite + epidote alteration, typically concentrated along fractures.

**Clinopyroxene (10%)**: anhedral equant to angular irregular grains; 1-4 mm in longest dimension; intergrown with, or interstitial, to plagioclase and olivine; locally shows orthopyroxene exsolution lamellae; locally shows oxide exsolution; minor actinolite + chlorite alteration.

**Orthopyroxene (5%)**: infrequent anhedral grains intergrown with, or interstitial to, olivine and plagioclase; 0.5 mm to 2 mm in longest dimension; may show clinopyroxene exsolution; may be cut by serpentine/talc-filled fractures; shows minor biotite+chlorite alteration.
Accessory Mineralogy: none

Description: The rock is a medium grained, holocrystalline, layered troctolite, with layering defined by concentration of olivine. Pyroxenes are relatively minor components of the rock, and typically fill interstices between plagioclase and olivine grains. The rock is relatively fresh, although olivine shows moderate to strong serpentine/iddingsite/magnetite alteration.

Sample Number: NZ-12
Location: North Grid, L
Classification: gabbronorite
Map Unit: 11

Principal Mineralogy:

Plagioclase (46%): anhedral equant to subhedral prismatic grains; up to 6 mm in longest dimension but generally < 2mm; crystals are fractured and some elongate grains are bent; shows turbid interiors due to minute inclusions, and clear sodic rims; commonly shows abundant Fe-Ti oxide inclusions, and fractures may be partially filled by pyrrhotite; shows minor sericite+epidote alteration.

Orthopyroxene (22%): anhedral equant grains intergrown with plagioclase, and irregular angular grains interstitial to plagioclase; occasionally as larger (up to 10 mm) poikilitic crystals; shows actinolitic reaction rim at boundaries with plagioclase; locally replaced by talc+biotite.

Clinopyroxene (20%): anhedral equant grains intergrown with plagioclase, and irregular angular grains interstitial to plagioclase; may subophitically enclose plagioclase; grains are up to 5mm in longest dimension; generally rimmed and replaced by actinolite+chlorite.

Pyrrhotite/Chalcopyrite (6/4): anhedral equant to irregular grains intergrown with silicates; also as inclusions in all silicate phases and as fracture fillings; the sulphide assemblage is predominantly pyrrhotite (4%), and chalcopyrite (2%), with very minor pentlandite.

Biotite (2%): small, irregular, interstitial grains which appear to be primary; also as replacement of orthopyroxene and overgrowths on Fe-Ti oxides.

Quartz (2%): small anhedral interstitial grains generally < 0.25mm in longest dimension; also as vermicular grains in myrmekitic intergrowth with plagioclase and grain boundaries.

Accessory Mineralogy: apatite, magnetite-ilmenite

Description: The rock is a medium grained, holocrystalline, poikilitic gabbronorite; with plagioclase intergrown with, or enclosed by, orthopyroxene and clinopyroxene. The rock is enriched in pyrrhotite and chalcopyrite, both of which occur interstitial to and enclosed by silicates, as well as in fine fractures. Accessory magnetite-ilmenite grains occupy interstices between silicates or occur as
inclusions in these phases. The silicate grains are typically heavily fractured and elongate crystals may be bent.

Sample Number: NZ-13  
Location: North Grid, L  
Classification: websterite  
Map Unit: 6a

Principal Mineralogy:  
Orthopyroxene (66%): anhedral equant to irregular grains up to 5mm in longest dimension; shows clinopyroxene exsolution blebs; shows extensive fracturing with talc infilling; may be replaced by talc, actinolite, chlorite and biotite.

Clinopyroxene (26%): anhedral equant grains intergrown with orthopyroxene; less commonly as larger (up to 7mm) grains partially enclosing orthopyroxene; shows heavy fracturing; shows moderate actinolite+chlorite alteration.

Plagioclase (3%): irregular angular grains interstitial to pyroxenes; up to 5mm in longest dimension; turbid with minute inclusions; alters to epidote, sericite and calcite.

Pyrrhotite/Chalcopyrite (2%): irregular blebs up to 0.5mm in diameter interstitial to pyroxenes; also as smaller inclusions within pyroxenes; all secondary phases also show a fine dusting of sulphides.

Garnet (2%): euhedral equant to highly irregular grains generally < 2mm in longest dimension; typically formed at plagioclase-pyroxene boundaries.

Accessory Mineralogy: sphene, magnetite-ilmenite

Description: The rock is a medium grained, holocrystalline, anhedral granular websterite, with relatively minor plagioclase interstitial to pyroxenes. The rock is mineralized, with pyrrhotite and lesser chalcopyrite occurring as interstitial grains, as inclusions in the pyroxenes, and as a fine dusting of inclusions in all secondary phases. Minor magnetite-ilmenite intergrowths also occur as interstitial grains and as inclusions in the silicates. The rock exhibits a well preserved primary cumulate texture, but the presence of garnet attests to relatively high grade metamorphic effects.

Sample Number: NZ-14  
Location: North Grid, L  
Classification: olivine norite  
Map Unit: 8

Principal Mineralogy:  
Plagioclase (52%): anhedral equant to subhedral prismatic grains, generally < 2.5mm in longest dimension; turbid with abundant minute inclusions; shows clear sodic rims; locally shows peripheral myrmekitic intergrowths with quartz; generally unaltered.
Orthopyroxene (26%): occurs as small anhedral granules intergrown with plagioclase, and as coarser (up to 10mm) oikocrysts enclosing plagioclase and olivine; may show minor clinopyroxene exsolution blebs; commonly shows minor to moderate replacement by biotite, talc, actinolite and chlorite; fractures typically filled by talc + magnetite.

Olivine (10%): relatively coarse (up to 6mm) anhedral grains; shows typical corona structure; generally completely pseudomorphed by iddingsite, serpentine and magnetite.

Clinopyroxene (8%): angular interstitial grains generally << 1mm in longest dimension; occurs exclusively as an interstitial phase; partially to completely replaced by actinolite and chlorite.

Fe-Ti Oxides (1-2%): small, irregular blebs interstitial to, or as inclusions in, plagioclase and orthopyroxene; magnetite also occurs as an alteration product of olivine.

Accessory Mineralogy: quartz, pyrrhotite, chalcopyrite

Description: The rock is a medium grained, holocrystalline, olivine norite, with plagioclase and olivine enclosed or partially enclosed by coarser orthopyroxene grains. Clinopyroxene is a relatively minor interstitial phase. Relatively coarse olivine crystals exhibit typical corona structure where in contact with plagioclase, and are generally completely pseudomorphed by serpentine and magnetite. Sulphides occur as minor interstitial blebs.

Sample Number: NZ-15
Location: North Grid, L
Classification: magnetite leuconorite
Map Unit: 11c

Principal Mineralogy:
Plagioclase (66%): anhedral, equant, inequigranular crystals ranging from 0.2mm to 3 mm; turbid with minute inclusions; clear sodic rims; locally contains apatite and clinopyroxene inclusions; shows minor sericite+epidote alteration.

Orthopyroxene (19%): small (< 0.5mm) anhedral equant grains intergrown with plagioclase; shows minor replacement by biotite, actinolite and chlorite.

Clinopyroxene (8%): small (< 0.5mm) anhedral granules intergrown with, and interstitial to, plagioclase and orthopyroxene; rimmed and partially replaced by actinolite and chlorite.

Fe-Ti Oxides (4%): equant anhedral grains generally < 0.5 mm in diameter; intergrown with, interstitial to, and as inclusions within, plagioclase and pyroxenes; commonly shows biotite coronas/alteration.

Quartz (2%): minor, irregular, interstitial grains.

Accessory Mineralogy: apatite, sphene
Description: The rock is a fine grained, holocrystalline magnetite gabbronorite, consisting of an anhedral granular intergrowth of plagioclase and orthopyroxene, with lesser clinopyroxene and Fe-Ti oxides. Apatite (~1%) is an abundant accessory phase as inclusions in plagioclase, and intergrown with pyroxenes and oxides. Plagioclase tends to form monomineralic domains with triple point junctions, separated by concentrations of pyroxenes, oxides and apatite. The rock is relatively unaltered.

North Grid Drill Core Samples

Sample Number: MR1-121
Hole #: MR-00-01
Collar Location: L40+25E/6+08S
Sample Depth: 121m
Classification: orthopyroxenite
Map Unit: 6b

Principal Mineralogy:

Orthopyroxene (92%): anhedral equant grains to stubby lath-like crystals; generally 0.5mm to 2mm in longest dimension; occasional larger crystals; minor talc + Fe-Ti oxides along fractures and grain boundaries; shows actinolite-chlorite reaction rims at boundaries with plagioclase.

Fe-Ti Oxides (4%): irregular intercumulus grains generally < 0.5mm in longest dimension; also as inclusions in orthopyroxene and clinopyroxene.

Plagioclase (2%): irregular grains interstitial to orthopyroxene; generally < 1mm in longest dimension; unaltered

Clinopyroxene (2%): irregular grains interstitial to orthopyroxene; in part these may be in optical continuity and therefore represent large grains enclosing orthopyroxene; minor actinolite-chlorite alteration.

Accessory Mineralogy: none

Description: The rock is a medium grained, holocrystalline, orthopyroxenite consisting of an anhedral granular intergrowth of orthopyroxene primocrysts. Interstices are filled by orthopyroxene overgrowths on primocrysts, smaller irregular orthopyroxene grains, and very minor plagioclase, clinopyroxene and Fe-Ti oxides. The rock is essentially a well-preserved orthopyroxene adcumulate.

Sample Number: MR2-20
Hole #: MR-01-16
Collar Location: L38E/1+50S
Sample Depth: 20m
Classification: magnetite norite
Map Unit: Ilec

**Principal Mineralogy:**

*Plagioclase* (57%): anhedral equant to subhedral tabular crystals; up to 2mm in length but most < 1mm; intergrown with, or poikilitically encloses, orthopyroxene; cores are turbid with numerous minute inclusions; shows minor sericitic alteration; locally shows concentrations of minute Fe-Ti oxide inclusions.

*Orthopyroxene* (35%): anhedral equant grains generally < 0.5mm in diameter; shows actinolite+chlorite reaction rims against plagioclase; shows very minor replacement by actinolite+chlorite.

*Fe-Ti Oxides* (8%): abundant small (< 0.3mm) equant granules and occasional larger irregular grains; anhedral to subhedral; occur as both cumulus and intercumulus material; usually associated with orthopyroxene; overgrown/replaced by biotite+amphibole.

**Accessory Mineralogy:** apatite

**Description:** The rock is a fine grained, holocrystalline, magnetite-norite primarily composed of an anhedral granular intergrowth of cumulus plagioclase, orthopyroxene and Fe-Ti oxides. Interstices are filled by small grains of the same material and by overgrowths on the cumulus phases. Fine grained aggregates of actinolite, biotite and chlorite locally fill interstices, and may be replacements of intercumulus clinopyroxene. The rock is relatively unaltered.

**Sample Number:** MR2-21  
**Hole #:** MR-00-02  
**Collar Location:** L40+31E/5+64S  
**Sample Depth:** 21m  
**Classification:** anorthosite  
**Map Unit:** 16a

**Principal Mineralogy:**

*Plagioclase* (98%): equant anhedral to subhedral tabular grains; up to 7mm in longest dimension but most grains 1-3mm; plagioclase forms the principal cumulus and intercumulus material, showing triple point grain boundaries and overgrowths filling interstices; shows numerous minute inclusions giving a turbid appearance; commonly shows very fine Fe-Ti oxide exsolution lamellae; locally shows minor sericite+clays+chlorite alteration generally confined to fractures and grain boundaries.

*Chlorite* (1%): locally occupies small interstices to plagioclase; possibly secondary after pyroxene; also occurs with sericite and clays in fractures in plagioclase.

**Accessory Mineralogy:** Fe-Ti oxides, biotite, apatite
Description: The rock is a medium grained, holocrystalline, anorthosite composed primarily of an anhedral granular intergrowth of cumulus plagioclase crystals. Interstices are occupied by small anhedral to irregular plagioclase grains, and by overgrowths on the cumulus crystals. Rarely, interstices are filled by fine grained aggregates of chlorite +/- biotite, which may be secondary after intercumulus pyroxene. Fe-Ti oxides and apatite occur as intercumulus phases as well as inclusions within plagioclase primocrysts. The rock is sensibly monomineralic, and is a classic plagioclase adcumulate.

Sample Number: MR2-23  
Hole #: MR-00-02  
Collar Location: L40+31E/5+64S  
Sample Depth: 23m  
Classification: anorthosite  
Map Unit: 16a  

Principal Mineralogy:  
**Plagioclase (96%):** equant anhedral, to subhedral tabular, grains; up to 5mm in longest dimension but most grains 1-3mm; plagioclase forms the principal cumulus and intercumulus material, showing triple point grain boundaries and overgrowths filling interstices; shows numerous minute inclusions giving a turbid appearance; commonly shows very fine Fe-Ti oxide exsolution lamellae; locally shows minor sericite+clays+chlorite alteration generally confined to fractures and grain boundaries.  
**Biotite-Actinolite-Chlorite (2%):** these minerals form fine grained aggregates locally occupying interstices between plagioclase grains; they likely represent alteration of a primary intercumulus pyroxene.  
**Fe-Ti Oxides (2%):** generally form anhedral equant to irregular intercumulus grains; generally < 0.3mm in longest dimension; also present as inclusions in plagioclase.

Accessory Mineralogy: apatite

Description: The rock is a medium grained, holocrystalline anorthosite very similar to sample MR02-21. It is composed primarily of an anhedral granular intergrowth of cumulus plagioclase crystals. Interstices are occupied by small anhedral to irregular plagioclase grains, and by overgrowths on the cumulus crystals. Less commonly, interstices are filled by fine grained aggregates of chlorite, biotite and actinolite, which may be secondary after intercumulus pyroxene. Fe-Ti oxides and apatite occur as intercumulus phases as well as inclusions in plagioclase primocrysts.

Sample Number: MR3-75  
Hole #: MR-00-03  
Collar Location: L42E/7+25S
**Sample Depth:** 75m  
**Classification:** anorthosite  
**Map Unit:** 16a

**Principal Mineralogy:**

*Plagioclase (98%):* equant anhedral, to subhedral tabular, grains; generally 1-3mm in longest dimension; plagioclase forms the principal cumulus and intercumulus material, showing triple point grain boundaries and clear overgrowths filling interstices; shows numerous minute inclusions giving a turbid appearance; commonly shows very fine Fe-Ti oxide exsolution lamellae and blebs; locally shows minor sericite+clays+chlorite+quartz alteration generally confined to fractures and grain boundaries.  
*Hornblende-Actinolite-Chlorite (1%):* these minerals form fine grained aggregates locally occupying interstices between plagioclase grains; hornblende also occurs as rare inclusions in plagioclase; they likely represent metamorphic alteration of a primary intercumulus pyroxene.

**Accessory Mineralogy:** apatite, Fe-Ti Oxides, sphene, quartz, biotite

**Description:** The rock is a medium grained, holocrystalline anorthosite very similar to samples MR2-21 and MR2-23. It is composed primarily of an anhedral granular intergrowth of cumulus plagioclase crystals. Interstices are occupied by small anhedral to irregular plagioclase grains, and by overgrowths on the cumulus crystals. Less commonly, interstices are filled by fine grained aggregates of amphibole, chlorite, biotite and actinolite, which may be secondary after intercumulus pyroxene. Fe-Ti oxides, sphene and apatite occur as intercumulus phases as well as inclusions within plagioclase primocrysts. Quartz is an accessory phase present in some interstitial spaces.

**Sample Number:** MR3-94  
**Hole #:** MR-00-03  
**Collar Location:** L42E/7+25S  
**Sample Depth:** 94m  
**Classification:** melagabbronorite  
**Map Unit:** 10a

**Principal Mineralogy:**

*Clinopyroxene (55%):* equant anhedral to irregular elongate grains; generally < 1.5mm in longest dimension; some crystals show weak zonation; locally encloses small orthopyroxene grains; rimmed and partially replaced by actinolite, biotite and chlorite.  
*Orthopyroxene (20%):* equant anhedral to subhedral prismatic grains; generally < 0.5mm in longest dimension; rimmed and partially replaced by actinolite, chlorite and talc.
Plagioclase (25%): anhedral equant to irregular crystals; interstitial to, and locally enclosing, pyroxenes; up to 4mm in longest dimension; minor saussuritization.

Accessory Mineralogy: Fe-Ti oxides

Description: The rock is a fine grained, holocrystalline melagabbroonorite composed almost exclusively of cumulus orthopyroxene and clinopyroxene with intercumulus plagioclase. Fe-Ti oxides occur as small inclusions in clinopyroxene, as fracture infillings, and rarely as interstitial material.

Sample Number: MR3-96
Hole #: MR-00-03
Collar Location: L42E/7+25S
Sample Depth: 96m
Classification: gabbroonorite
Map Unit: 10

Principal Mineralogy:
Plagioclase (53%): equant anhedral to subhedral tabular cumulus grains; also as somewhat irregular intercumulus material; most grains are < 1.5mm in longest dimension; locally shows myrmekitic intergrowths with quartz at grain boundaries; locally encloses small pyroxene grains; may show opaque (Fe-Ti oxide) inclusions; shows minor clinzoisite-sericite-albite alteration.
Orthopyroxene (34%): anhedral equant to subhedral prismatic cumulus grains; generally < 1mm but locally up to 3mm in longest dimension; locally enclosed by plagioclase and clinopyroxene; locally shows clinopyroxene exsolution; shows actinolite/chlorite reaction rims against plagioclase; shows minor replacement by actinolite/chlorite.
Clinopyroxene (12%): anhedral equant primocrysts and irregular intercumulus grains; generally < 1mm in longest dimension; some crystals poikilitically enclose small plagioclase and orthopyroxene; shows actinolite/chlorite rims against plagioclase; shows local replacement by actinolite/chlorite.

Accessory Mineralogy: Fe-Ti oxides, pyrrhotite, chalcopyrite, biotite (possibly secondary after pyroxene)

Description: The rock is a fine to medium grained, holocrystalline, gabbroonite. Plagioclase, orthopyroxene and lesser clinopyroxene form an anhedral granular to subophitic intergrowth, with irregular plagioclase and clinopyroxene grains filling interstices. Actinolite, biotite and chlorite occur as intergrowths interstitial to the principal silicates, and these minerals may reflect alteration of primary intergranular clinopyroxene. Fe-Ti oxides occur as inclusions within silicates and as irregular interstitial grains. Pyrrhotite and very minor chalcopyrite occur as irregular interstitial disseminations.
Principal Mineralogy*:
Orthopyroxene (74%): coarse anhedral equant to slightly elongated crystals; generally > 1cm in longest dimension; shows clinopyroxene exsolution blebs and lamellae which may be partially to completely replaced by tremolite-actinolite; heavily included by oxides; rimmed by actinolite-chlorite where in contact with plagioclase; shows moderate replacement by a complex secondary assemblage that may include talc, biotite, actinolite, chlorite and oxides.
Clinopyroxene (20%): coarse equant anhedral to irregular grains up to 1cm in longest dimension; also as small irregular interstitial grains; may enclose small orthopyroxene grains; weak to complete replacement by actinolite and chlorite.
Plagioclase (4%): minor irregular intercumulus grains; generally < 1mm in longest dimension; unaltered.
Fe-Ti Oxides (2%): occur as small inclusions in both pyroxenes; rarely as relatively coarse interstitial crystals or aggregates.

* modal composition difficult to estimate in thin section due to pegmatitic grain size

Accessory Mineralogy: garnet, zircon, pyrrhotite, chalcopyrite

Description: The rock is a pegmatitic, holocrystalline, websterite. It is composed primarily of an anhedral, somewhat granular, intergrowth of cumulus orthopyroxene and clinopyroxene. Both pyroxenes are heavily included by Fe-Ti oxides. Smaller irregular clinopyroxene crystals, and relatively minor plagioclase and oxides, fill intercumulus spaces. Pyrrhotite and chalcopyrite occur as interstitial disseminations. Garnet occurs as a minor intercumulus phase at boundaries between pyroxenes and plagioclase. Zircon occurs as tiny inclusions in interstitial (secondary?) biotite and amphibole.
clinopyroxene exsolution, which may be replaced by actinolite and chlorite; shows a peripheral alteration/reaction rim composed of actinolite, biotite and chlorite, and some grains are partially pseudomorphed by these phases.

**Plagioclase (39%)**: anhedral equant grains to subhedral laths; up to 1.5cm in longest dimension; larger grains are intercumulus to, and partially enclose pyroxenes; turbid with numerous fine inclusions; may show alteration rosettes composed of epidote, albite and quartz.;

**Clinopyroxene (15%)**: anhedral equant to subhedral tabular grains; generally 1-2mm in longest dimension but locally up to 5mm; may enclose orthopyroxene and small plagioclase grains; shows alteration/reaction rims of actinolite/chlorite, and may be partially replaced by these phases.

**Garnet (3%)**: small (generally < 0.25mm) euhedral to subhedral crystals occurring at contacts between plagioclase and pyroxenes.

**Accessory Mineralogy**: Fe-Ti oxides, pyrrhotite, chalcopyrite

**Description**: The rock is a medium grained, holocrystalline gabbronorite. It is an anhedral inequigranular intergrowth of cumulus orthopyroxene, clinopyroxene and plagioclase, with intercumulus clinopyroxene and plagioclase. Garnet occurs as a minor constituent at pyroxene-plagioclase grain boundaries, and oxides and sulphides occur as minor intergranular material. Oxides also occur as fine granular aggregates associated with garnet, and as abundant inclusions in pyroxenes.

**Sample Number**: MR3-181
**Hole #:** MR-00-03
**Collar Location**: L42E/7+25S
**Sample Depth**: 181m
**Classification**: troctolite
**Map Unit**: 9

**Principal Mineralogy**:

**Plagioclase (50%)**: equant anhedral to subhedral prismatic grains up to 5mm in length; also as finer grained intercumulus material; turbid with minute inclusions; locally encloses garnet; generally unaltered with minor local saussertization.

**Olivine (35%)**: coarse equant anhedral to irregular grains up to 1cm in longest dimension; shows characteristic corona structure where in contact with plagioclase; may show coarse orthopyroxene mantle; partially to completely pseudomorphed by serpentine and magnetite; locally appears to have been recrystallized to fine grained granular intergrowths of orthopyroxene.

**Orthopyroxene (7%)**: irregular intergranular crystals; also as overgrowths on olivine; up to 3mm in longest dimension; coarser grains show clinopyroxene exsolution; rimmed, and locally replaced, by actinolite, biotite and chlorite.

**Clinopyroxene (5%)**: irregular interstitial grains up to 3mm in longest dimension; rimmed, and partially replaced, by actinolite and chlorite.
Garnet (3%): small (< 0.25mm) subhedral to euhedral crystals occurring at boundaries between plagioclase and olivine or orthopyroxene.

Accessory Mineralogy: Fe-Ti oxides, sphene

Description: The rock is a medium to coarse grained, holocrystalline, troctolite. It is composed primarily of an anhedral granular intergrowth of plagioclase and olivine, with smaller irregular plagioclase grains and relatively minor pyroxenes filling interstices. Minor garnet occurs as well formed crystals at the boundaries between plagioclase and olivine or orthopyroxene. Olivine grains exhibit a complex corona structure where in contact with plagioclase. Olivine is locally mantled by coarse grained orthopyroxene. Oxides occur as primary intercumulus grains and replacements of olivine. Interstitial oxides locally show biotite +/- sphene overgrowths.

Sample Number: MR3-205
Hole #: MR-00-03
Collar Location: L42E/7+25S
Sample Depth: 205m
Classification: anorthosite
Map Unit: 16a

Principal Mineralogy:
Plagioclase (91%): anhedral equant to subhedral tabular crystals; generally 1-4mm in length, but locally up to 8mm; also as small irregular intercumulus grains; commonly shows more sodic overgrowths; may show myrmekitic intergrowths with quartz along grain boundaries; very heavily included with minute amphibole, oxide and clinozoisite (?) crystals; locally shows minor sausseritization.
Orthoclase (3%): small (< 1mm) irregular interstitial grains
Clinopyroxene/Hornblende (3%): clinopyroxene occurs as rare remnant granules overgrown or replaced by hornblende; the two minerals occur in interstices of plagioclase grains.

Accessory Mineralogy: Fe-Ti oxides, clinozoisite-epidote, garnet, quartz

Description: The rock is a medium grained, holocrystalline anorthosite composed primarily of cumulus plagioclase. Interstices are filled by small plagioclase grains, by overgrowths on plagioclase primocrysts, and by orthoclase, clinopyroxene/hornblende aggregates and Fe-Ti oxides. Quartz occurs in myrmekitic intergrowths with plagioclase, and occasional euhedral garnet grains are associated with the mafic phases interstitial to plagioclase. Clinozoisite-epidote grains also occur interstitial to plagioclase, although these crystals may be derived from breakdown of the latter.
Sample Number: MR4-116
Hole #: MR-00-04
Collar Location: L42E/7+75S
Sample Depth: 116m
Classification: norite
Map Unit: 12

Principal Mineralogy:

Plagioclase (59%): anhedral equant grains up to 1.5mm in diameter, but generally < 0.5mm; also as smaller, irregular intercumulus grains; shows myrmekitic intergrowths with quartz at grain boundaries; shows minor saussuritization along grain boundaries.

Orthopyroxene (40%): equant anhedral to tabular grains generally < 1.5 mm in longest dimension; locally encloses small plagioclase grains; shows actinolite rims/alteration where in contact with plagioclase.

Accessory Mineralogy: Fe-Ti oxides, quartz

Description: The rock is a fine grained, holocrystalline norite, composed predominantly of an anhedral granular intergrowth of plagioclase and orthopyroxene. Interstices are filled by overgrowths on plagioclase and by small irregular orthopyroxene grains. Accessory Fe-Ti oxides occur interstitially, and as inclusions in plagioclase and orthopyroxene. The rock is essentially a plagioclase-orthopyroxene adcumulate, with these two phases and their alteration assemblages constituting ~99% of the rock.

Sample Number: MR12-231a
Hole #: MR-00-12
Collar Location: L38E/4+50S
Sample Depth: 231 m
Classification: olivine-websterite (?)
Map Unit: 7b

Principal Mineralogy:

Olivine (21%): anhedral equant to oblong grains, 0.5 to 6mm in diameter, mainly replaced by talc, serpentine and magnetite, although some remnant olivine is preserved; locally part of the zone corona structure is also preserved; olivine grains occur as “knots” in a fine grained, foliated/lineated talc-actinolite-chlorite-oxide groundmass.

Orthopyroxene (3%): ragged tabular grains generally < 2mm in length; partially to completely replaced by actinolite, biotite, chlorite and oxides.

Clinopyroxene (3%): anhedral equant granules intergrown in aggregates; generally < 0.3mm in diameter; replaced by actinolite and chlorite.

Actinolitic Amphibole-talc-chlorite (61%): amphibole occurs as acicular, prismatic and anhedral equant grains intimately intergrown with fine grained shredded talc +
chlorite aggregates; these minerals appear to be metamorphic/secondary in origin, and probably replace primary pyroxenes and olivine.

*Calcite (2%):* irregular crystals and aggregates intergrown with fine grained amphibole-talc-chlorite assemblage; may reflect replacement of minor original plagioclase.

*Fe-Ti Oxides (10%):* fine granules and aggregates intergrown with amphibole-talc-chlorite assemblage; also as replacement of olivine.

**Accessory Mineralogy:** sphene

**Description:** The rock is a highly altered, fine grained, holocrystalline ultramafic which may originally have been an olivine websterite. Olivine and pyroxenes are infrequently preserved, and the rock is now predominantly a fine grained foliated assemblage dominated by actinolitic amphibole, talc, chlorite and Fe-Ti oxides. Calcite forms part of this assemblage, and may indicate that plagioclase was a minor component of the original igneous rock. The fine grained foliated assemblage, and locally individual grains, show microscopic kink folding.

**Sample Number:** MR12-231b
**Hole #:** MR-00-12
**Collar Location:** L38E/4+50S
**Sample Depth:** 231 m
**Classification:** amphibolite gneiss; probably developed from olivine websterite.
**Map Unit:** 7b (?)

**Principal Mineralogy:**
* Tremolite-Actinolite (44%):* anhedral equant to subhedral tabular grains, generally < 1 mm in longest dimension; elongate grains show a subparallel arrangement
* Talc+Chlorite (43%):* talc and chlorite form a fine grained intimately intergrown aggregate of fibrous to irregular grains, generally < 0.5 mm in length.
* Serpentine (5%):* irregular, very fine grained aggregates of fibrous crystals intimately intergrown with Fe-Ti oxides; forms "knots" in a foliated matrix composed of amphibole, talc and chlorite; probably replaces olivine.
* Fe-Ti Oxides (5%):* very fine grained equant inclusions in amphibole; also as slightly larger, irregular crystals and aggregates intergrown with serpentine; aggregates are elongated parallel to general foliation in the rock.
* Calcite (3%):* irregular crystals and aggregates intergrown with fine grained amphibole-talc-chlorite assemblage; may reflect replacement of minor original plagioclase.

**Accessory Mineralogy:** sphene

**Description:** The rock is a fine grained, holocrystalline amphibolite gneiss. The rock is composed primarily of serpentine and Fe-oxide "knots", probably derived from olivine, set in a well foliated fine grained matrix of talc, chlorite, amphibole and Fe-Ti oxides which may be secondary after pyroxenes. Calcite also occurs in the matrix, and this phase may reflect the original presence of some plagioclase. No primary phases are preserved,
and the rock is essentially an amphibolite gneiss which has undergone retrograde (?) chloritization. As with sample MR12-231a, the secondary mineralogy suggests the rock was originally an olivine-bearing ultramafic rock, possibly olivine websterite.

**Sample Number:** MR16-67  
**Hole #:** MR-01-16  
**Collar Location:** L38E/1+50S  
**Sample Depth:** 67.63m  
**Classification:** granite gneiss  
**Map Unit:** 3a

**Principal Mineralogy:**  
*Microcline (33%):* anhedral equant to stubby elongated crystals; generally < 1mm in longest dimension, but occasionally up to 6mm; minor alteration to sericite + clays.  
*Plagioclase (28%):* anhedral equant grains generally << 0.5mm; pinkish tinge due to hematite inclusions; local myrmekitic intergrowths with quartz; strong alteration to sericite, albite, epidote and clays.  
*Quartz (28%):* anhedral, equant, granulated crystals; generally << 0.5mm but locally up to 1.5mm.  
*Chlorite (9%):* irregular aggregates of very fine fibrous grains; commonly encloses very fine Fe-Ti granules.  
*Fe-Ti Oxides (2%):* very fine granules disseminated throughout but typically concentrated in chlorite masses.

**Accessory Mineralogy:** biotite/phlogopite, epidote, garnet, zircon

**Description:** The rock is a fine grained holocrystalline granite with weakly developed gneissic fabric defined by subparallel elongation of chlorite-oxide concentrations. Biotite and phlogopite occur as rare isolated crystals intergrown with quartz and feldspars. Garnet and epidote occur as minor subhedral accessory crystals intergrown with the principal silicates. Zircon occurs as small subhedral to euhedral crystals throughout the rock.

**Sample Number:** MR16-78  
**Hole #:** MR-01-16  
**Collar Location:** L38E/1+50S  
**Sample Depth:** 78.64m  
**Classification:** granodiorite  
**Map Unit:** 3a

**Principal Mineralogy:**  
*Plagioclase (54%):* small, anhedral equant, interlocking crystals generally << 0.5mm; also as coarse anhedral, often ragged/irregular, grains up to 4 mm in longest
dimension; shows strong to complete replacement by sericite, epidote, calcite and clay minerals.

Quartz (21%): anhedral equant to irregular grains generally < 1mm in diameter.
Orthoclase (15%): anhedral equant grains < 0.2mm to 1.5mm in diameter; minor sericitic alteration.
Chlorite (8%): irregular elongate/prismatic crystals generally << 0.5mm in length; rarely encloses remnant (?) amphibole.
Fe-Ti Oxides (2%): irregular grains and aggregates generally associated with chlorite.

Accessory Mineralogy: microcline, epidote, sphene, zircon

Description: The rock is a fine grained, holocrystalline, inequigranular granodiorite in which larger orthoclase and plagioclase crystals are embedded in a fine grained matrix composed of these feldspars plus quartz, chlorite and Fe-Ti oxides. Microcline occurs as a minor phase within the finer grained “matrix”, and zircon is a common accessory as minute euhedral to subhedral crystals. Fe-Ti oxides are partially replaced by what appears to be amorphous sphene +/- biotite.

Sample Number: MR16-79a
Hole #: MR-01-16
Collar Location: L38E/1+50S
Sample Depth: 79.3m
Classification: quartz metagabbro/metadiorite gneiss
Map Unit: 5

Principal Mineralogy:
Chlorite (35%): irregular fine grained masses, flakes and prismatic crystals; in places pseudomorphing amphibole; shows weak subparallel orientation where crystals are elongate.
Epidote (24%): fine irregular to subhedral crystals intergrown with chlorite and plagioclase; may largely reflect recrystallization of feldspar.
Plagioclase (24%): generally occurs as anhedral equant grains < 0.25mm in longest dimension; locally as relatively large isolated grains reaching 4mm in length; shows strong replacement by sericite, epidote and hematite.
Quartz (12%): equant anhedra generally < 0.25mm; occasionally as larger grains in pressure shadows of large plagioclase crystals.
Fe-Ti Oxides (2%): abundant fine granules and larger irregular grains generally associated with chlorite.

Accessory Mineralogy: biotite, garnet,

Description: The rock is a fine grained, holocrystalline, gneissic quartz metagabbro or quartz metadiorite, with minor garnet porphyroblasts. Gneissosity is defined by both compositional and textural variations, and by subparallel arrangement of elongate chlorite crystals. Pressure shadows surrounding larger plagioclase
crystals, gneissosity, and garnet porphyroblasts indicate the rock has undergone significant deformation and metamorphism.

Sample Number: MR16-79b
Hole #: MR-01-16
Collar Location: L38E/1+50S
Sample Depth: 79.46m
Classification: quartz metadiorite
Map Unit: 5

Principal Mineralogy:

Plagioclase (39%): equant anhedral to corroded tabular grains ranging from < 0.5mm to 4mm in longest dimension; partially to completely replaced by very fine grained to cryptocrystalline sericite, epidote, biotite, and hematite;

Chlorite (35%): prismatic to irregular grains, << 0.1mm to 0.5mm in longest dimension; also as fibrous masses; probably secondary after metamorphic amphibole; shows weak alignment and locally wraps around coarser plagioclase crystals.

Quartz (13%): very fine (< 0.2mm) anhedral equant interlocking crystals intergrown with chlorite in a fine grained matrix to coarser feldspar crystals.

Orthoclase (9%): generally equant anhedral grains similar in size to plagioclase; minor to moderate sericitization.

Epidote/Clays (2%): these phases appear to be the principal components of an almost cryptocrystalline assemblage associated with chlorite and quartz in a fine grained “matrix” to larger feldspar grains.

Fe-Ti Oxides (2%): irregular grains, 0.1mm to 0.5mm in size, distributed throughout the rock; also as very fine granules associated with cryptocrystalline epidote/clays.

Accessory Mineralogy: actinolite, muscovite, garnet, zircon

Description: The rock is a fine grained, holocrystalline, inequigranular quartz metadiorite in which plagioclase, orthoclase and rare garnet form larger, somewhat isolated grains in a very fine grained matrix composed of quartz, chlorite and lesser feldspar. The rock has clearly undergone grain size reduction through deformation. A weak gneissosity is defined by the subparallel alignment of elongate chlorite crystals and aggregates, and by the alignment of coarser crystals into bands separated by fine grained “matrix”.

Sample Number: MR16-81
Hole #: MR-01-16
Collar Location: L38E/1+50S
Sample Depth: 81.42m
Classification: meta-monzodiorite
Map Unit: 5
Principal Mineralogy:

Plagioclase (46%): equant to slightly elongated anhedral grains, ranges from < 0.2mm to 2mm in size, but generally < 0.5mm; locally shows oriented alkali feldspar (?) exsolution blebs or inclusions; partially replaced by sericite, epidote and biotite.

Chlorite (27%): irregular fine grained masses to larger prismatic crystals; commonly shows remnant amphibole cores; contains numerous zircon inclusions.

Orthoclase (13%): equant anhedral grains from < 0.2mm to 2 mm in longest dimension; weak to moderate sericitic alteration.

Garnet (6%): relatively coarse (> 1mm) equant anhedral to highly irregular porphyroblasts; encloses very abundant quartz, feldspar and Fe-Ti oxide inclusions.

Quartz (5%): very fine grained (< 0.3mm) interlocking anhedral equant grains.

Fe-Ti Oxides (3%): small irregular crystals intergrown with, and inclusions within, the silicates phases; may be partially replaced by cryptocrystalline sphene +/- biotite

Accessory Mineralogy: zircon, biotite, epidote

Description: The rock is a fine grained, holocrystalline, meta-monzodiorite in which plagioclase, orthoclase and garnet form larger, porphyroblastic crystals in a finer grained matrix of feldspar, quartz, chlorite and Fe-Ti oxides. The grain size variations define a poorly developed gneissosity. The rock is similar to sample MR16-79b, but with slightly higher alkali feldspar and garnet contents.

Sample Number: MR16-83
Hole #: MR-01-16
Collar Location: L38E/1+50S
Sample Depth: 83.02m
Classification: quartz syenite
Map Unit: 4

Principal Mineralogy:

Orthoclase (42%): equant anhedral grains generally < 0.5mm in diameter; generally unaltered.

Plagioclase (18%): equant anhedral crystals generally < 0.5mm in diameter; minor sericitization.

Quartz (16%): equant anhedral to irregular grains; commonly interstitial to feldspars; generally < 0.5mm in diameter.

Amphibole/Biotite/Chlorite (16%): amphibole (hornblende?) forms prismatic to acicular crystals, generally < 0.3mm in length, intimately intergrown with, and replaced by, biotite and chlorite; the resultant aggregates show a subparallel arrangement of elongate crystals which wrap around garnet porphyroblasts.

Garnet (5%): subhedral poikiloblastic crystals enclosing quartz and feldspar grains; generally 1-4mm in diameter.
Opaques (3%) - irregular grains (oxides) and euhedral cubes (pyrite) distributed throughout the rock.

Accessory Mineralogy: Zircon, sphene

Description: The rock is a fine grained, holocrystalline quartz syenite consisting of an anhedral granular intergrowth of feldspar and quartz, with interstitial aggregates of amphibole, biotite and chlorite. Garnet forms large, relatively abundant, porphyroblastic crystals which enclose small feldspar and quartz grains. There is a weak alignment of the mafic phases, which imparts a vague lineation/foliation to the rock.

Sample Number: MR16-93
Hole #: MR-01-16
Collar Location: L38E/1+50S
Sample Depth: 93.15m
Classification: Biotite granite
Map Unit: 3

Principal Mineralogy:
- Perthite (43%): anhedral equant grains generally < 0.5mm in diameter; minor sericitic alteration.
- Quartz (23%): Equant anhedral grains generally < 0.5mm in diameter.
- Plagioclase (22%): Equant anhedral grains generally < 0.5mm in diameter; shows moderate sericite+epidote alteration.
- Biotite (7%): Prismatic to irregular grains interstitial to feldspars and quartz.
- Hornblende (3%): Small irregular interstitial crystals; replaced by biotite and chlorite.

Accessory Mineralogy: Fe-Ti oxides, muscovite, phlogopite (?), zircon, sphene

Description: The rock is a fine grained, holocrystalline, biotite granite consisting of an anhedral granular intergrowth primarily of the two feldspars and quartz. Biotite forms prismatic to irregular interstitial grains, along with relatively minor hornblende, muscovite and secondary chlorite. Oxides also occur as a minor interstitial phase, and commonly show minor replacement by sphene +/- biotite. Subhedral zircon crystals occur as inclusions in biotite as well as the feldspars. The rock displays a vague banding defined by a weak concentration of the mafic phases in layers.

Sample Number: MR16-95
Hole #: MR-01-16
Collar Location: L38E/1+50S
Sample Depth: 95.23m
Classification: Quartzo-feldspathic biotite gneiss
Map Unit: 2

Principal Mineralogy:
Orthoclase (34%): anhedral equant grains forming two populations—coarser (0.5mm to 3mm) crystals showing irregular/granulated borders, and small (<0.5mm) grains intergrown with orthoclase, quartz and biotite in a fine grained matrix; unaltered to weak sericitic alteration.
Plagioclase (26%): equant anhedral grains showing the same type of distribution as orthoclase, but more prevalent as coarser “framework” grains; shows moderate to strong sericite/muscovite, epidote and chlorite alteration.
Quartz (22%): small (<0.5mm) anhedral equant grains intergrown with feldspars and biotite in fine grained matrix; some crystals show undulose extinction due to strain.
Biotite (15%): small subhedral laths to prismatic crystals up to 1mm in length; also as irregular foliated masses; elongate grains show parallel arrangement and flow around larger feldspar grains.
Garnet (2%): rare irregular anhedral grains, 0.5mm to 2mm in diameter; shows numerous inclusions of plagioclase and quartz.

Accessory Mineralogy: actinolite, Fe-Ti oxides, apatite, zircon

Description: The rock is a fine grained, holocrystalline, quartzo-feldspathic biotite gneiss of uncertain origin. The rock consists of a framework of relatively coarse feldspar, and rare garnet, crystals surrounded by a fine grained matrix composed of both feldspars, quartz, biotite and accessory phases. Subparallel arrangement of biotite, and occurrence of fine grained quartz-biotite-rich matrix alternating with feldspar-rich coarse framework gives rise to textural and compositional banding.

Sample Number: MR16-101
Hole #: MR-01-16
Collar Location: L38E/1+50S
Sample Depth: 101.6m
Classification: quartzo-feldspathic biotite gneiss
Map Unit: 2

Principal Mineralogy:
Plagioclase (32%): anhedral equant to irregular grains; generally <0.25mm; moderate sericitization.
Orthoclase (16%): anhedral equant to irregular grains; generally <0.4mm; unaltered to weak sericitization.
Biotite (25%): subhedral prismatic crystals; generally <0.4mm; shows weak preferred orientation.
Quartz (16%): equant anhedral grains; generally <0.4mm.
Hornblende (5%): small irregular anhedral crystals; generally <0.25mm; minor chlorite alteration.

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Calcite (3%) : equant anhedral grains to irregular interstitial material (cement?).
Opaques (2%) : equant anhedral grains to irregular grains; generally < 0.2mm in longest
dimension.

Accessory Mineralogy: apatite, zircon, allanite (?)

Description: The rock is a very fine grained, holocrystalline, quartz-feldspathic gneiss
of unknown origin. It is composed of an anhedral granular intergrowth of quartz,
feldspar, biotite, hornblende, and calcite. There is a weak alignment of elongate
biotite grains, and a poorly developed banding defined by alternating quartz-rich
and biotite-rich layers.

Sample Number: MR16-119
Hole #: MR-01-16
Collar Location: L38E/1+50S
Sample Depth: 119.3m
Classification: granite
Map Unit: 3

Principal Mineralogy*:
Plagioclase (40%): anhedral, equant, fine grained crystals (< 0.5mm) in groundmass;
also as coarser (0.5mm to 5mm) corroded tabular phenocrysts/porphyroblasts;
moderate to complete replacement by sericite/muscovite, epidote, calcite and
chlorite.
Orthoclase (20%): equant anhedral groundmass grains; generally < 0.5mm in longest
dimension; minor sericitization.
Quartz (35%): equant anhedral groundmass grains; generally < 0.5mm in diameter.
* modal estimates subject to significant due to optical similarities and fine grain size

Accessory Mineralogy: biotite (≤ 1%), muscovite (≤ 1%), hornblende (≤ 1%), Fe-Ti
oxides (~1%), sphene

Description: The rock is a fine grained holocrystalline granite, with larger plagioclase
crystals forming corroded phenocrysts (?) in a fine grained groundmass consisting
of an anhedral granular intergrowth of quartz, orthoclase and plagioclase. Very
minor biotite and muscovite occur as small isolated flakes throughout the rock,
and hornblende and Fe-Ti oxides occur as minor interstitial phases. Sphene occurs
as small accessory grains typically associated with hornblende and oxides.

Sample Number: MR16-121
Hole #: MR-01-16
Collar Location: L38E/1+50S
Sample Depth: 121.4m
Classification: monzonite

xxviii
Map Unit: 5 (?)

Principal Mineralogy:

Plagioclase (51%): equant anedral grains up to 3mm in longest dimension; coarser grains show moderate to strong sericite, epidote and chlorite alteration.

Orthoclase (29%): anhedral equant grains generally < 0.5mm in diameter; generally unaltered.

Biotite (8%): subhedral prismatic grains to irregular fibrous masses; generally < 0.5mm in length; weak subparallel alignment locally; typically intergrown with hornblende and opaques in mafic layers/bands.

Hornblende (6%): subhedral prismatic to anhedral irregular grains; generally < 0.5mm in longest dimension; weak to moderate chloritic alteration.

Quartz (5%): anhedral equant grains; generally < 0.5mm in diameter.

Opaques (3%): euhedral equant cubes (pyrite) and irregular masses (Fe-Ti oxides?); generally < 0.5mm in longest dimension; principally intergrown with hornblende and biotite, but also intergranular material throughout; locally replaced by a somewhat amorphous mixture of biotite and sphene (?)

Accessory Mineralogy: zircon, sphene, muscovite

Description: The rock is a fine grained, holocrystalline monzonite gneiss, composed primarily of an anhedral granular intergrowth of plagioclase, orthoclase, biotite, hornblende and quartz. Biotite, hornblende and opaques are weakly concentrated in bands, and this, coupled with subparallel arrangement of biotite, defines a crude gneissosity. Muscovite, zircon and sphene occur as accessory phases throughout the rock.

NEED Sulphide vs Oxide details???

Sample Number: MR31-165
Hole #: MR-01-31
Collar Location: L30E/4+10N
Sample Depth: 165m
Classification: orthopyroxenite
Map Unit: 6b

Principal Mineralogy:

Orthopyroxene (82%): anhedral equant to subhedral prismatic grains; locally exceed 2cm in longest dimension; shows clinopyroxene exsolution blebs; heavily included with Fe-Ti oxides; cut by talc-chlorite-sulphide filled fractures; shows reaction rims of actinolite/chlorite where in contact with plagioclase; minor replacement by actinolite+chlorite.

Sulphides (6%): Pyrrhotite, lesser chalcopyrite and very minor pentlandite as interstitial intergrowths and inclusions in silicates.

Plagioclase (5%): anhedral equant to irregular grains; generally < 0.5mm in longest dimension; turbid cores due to numerous minute inclusions; generally interstitial to orthopyroxene; unaltered.
Clinopyroxene (5%): anhedral/irregular grains interstitial to orthopyroxene; generally << 1mm in longest dimension; very abundant oxide and sulphide inclusions; replaced by actinolite and chlorite.

Fe-Ti Oxides (2%): as very fine inclusions in silicates, particularly in clinopyroxene; also as irregular interstitial grains.

Accessory Mineralogy: quartz

Description: The rock is a coarse grained to pegmatitic, holocrystalline orthopyroxenite, composed largely of cumulus orthopyroxene and minor intercumulus plagioclase, clinopyroxene and sulphides. Minor quartz is also present as an intercumulus phase. The rock is relatively unaltered, with only minor secondary actinolite, biotite, talc and chlorite after pyroxenes.

Sample Number: MR32-49
Hole #: MR-01-32
Collar Location: L30E/5+30N
Sample Depth: 48.27m
Classification: quartz-bearing noritic gneiss
Map Unit: 11b (?)

Principal Mineralogy*:

Plagioclase (53%): anhedral equant to irregular crystals up to 5mm in longest dimension; locally shows exsolution (?) of alkali feldspar; minor replacement by sericite, epidote and biotite.

Orthopyroxene (18%): anhedral equant to tabular crystals, rarely subhedral prismatic grains; generally << 1mm in longest dimension; minor biotite/chlorite alteration.

Orthoclase (12%): small irregular grains interstitial to plagioclase-orthopyroxene-garnet intergrowths; generally < 0.5 mm but locally up to 2mm in longest dimension; shows weak pinkish tinge, possibly due to hematite inclusions; locally occurs as overgrowths on plagioclase; minor sericitic alteration.

Quartz (5%): minor irregular interstitial grains.

Garnet (5%): euhedral to subhedral equant grains; may enclose small plagioclase and quartz crystals.

Biotite (5%): predominantly occurs as shredded fine grained aggregates; rarely as prismatic grains up to 0.5mm in length.

Opaques (2%): irregular interstitial grains/aggregates up to 0.5mm in longest dimension; also as inclusions in all major silicate phases.

* the rock is well layered/banded and the modal estimates approximate overall composition.

Accessory Mineralogy: sphene (possibly secondary)

Description: The rock is a fine grained, holocrystalline, quartz-bearing noritic gneiss. The rock is primarily composed of a granular intergrowth of plagioclase, orthopyroxene and garnet, with generally interstitial orthoclase, quartz and biotite.

XXX
Compositional banding is defined by alternating plagioclase-rich and orthopyroxene-garnet-biotite enriched layers.

Sample Number: MR32-213
Hole #: MR-01-32
Collar Location: L30E/5+30N
Sample Depth: 213m
Classification: sulphide-rich orthopyroxenite
Map Unit: 6b

Principal Mineralogy:
Orthopyroxene (61%): equant anhedral to subhedral prismatic grains; typically 1-2mm in longest dimension but occasional grains up to 1cm; shows infrequent plagioclase and clinopyroxene inclusions, and abundant sulphide inclusions; shows minor biotite, talc, actinolite and chloride alteration – predominantly at grain boundaries and along fractures.
Sulphides (35%): predominantly pyrrhotite with lesser chalcopyrite and minor pentlandite; sulphides fill much of the interstitial spaces between orthopyroxene grains; also occur as inclusions in orthopyroxene and plagioclase.
Plagioclase (3%): generally occurs as irregular intercumulus crystals; rarely as subhedral prismatic laths; some grains show abundant oxide inclusions; unaltered to minor sericite-epidote alteration.
Clinopyroxene (1%): rare as small intercumulus grains and exsolution blebs in orthopyroxene; generally shows partial to complete chloritization.

Accessory Mineralogy: pentlandite

Description: The rock is a medium grained, holocrystalline orthopyroxenite in which cumulus orthopyroxene grains are essentially cemented by net-textured pyrrhotite with minor chalcopyrite. Minor plagioclase and clinopyroxene also form intercumulus phases. The rock is relatively unaltered, with only minor secondary talc-biotite-actinolite-chlorite replacing pyroxenes, and local saussuritization of plagioclase.
Work Report Summary

Transaction No: W0270.00074 Status: APPROVED
Recording Date: 2002-JAN-10 Work Done from: 2001-AUG-01
Approval Date: 2002-JAN-18 to: 2001-OCT-15

Client(s):
303851 MUSTANG MINERALS CORP.

Survey Type(s):
MICRO

Work Report Details:

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Status of claim is based on information currently on record.
Submission Number: 2.22748
Transaction Number(s): W0270.00074

Subject: Approval of Assessment Work

We have approved your Assessment Work Submission with the above noted Transaction Number(s). The attached Work Report Summary indicates the results of the approval.

At the discretion of the Ministry, the assessment work performed on the mining lands noted in this work report may be subject to inspection and/or investigation at any time.

If you have any question regarding this correspondence, please contact STEVEN BENETEAU by email at steve.beneteau@ndm.gov.on.ca or by phone at (705) 670-5855.

Yours Sincerely,

Ron Gashinski
Senior Manager, Mining Lands Section

Cc: Resident Geologist
Ken J. Lapierre
(Agent)
Mustang Minerals Corp.
(Claim Holder)

Assessment File Library

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MINING LAND TENURE

MAP

Date / Time of Issue: Jan 3, 2002
06:15h Eastern

TOWNSHIP / AREA
MCWILLIAMS

PLAN
G-2910

ADMINISTRATIVE DISTRICTS / DIVISIONS
Mining Division
Sudbury

Land Title Registry Division
NIPISSING

Ministry of Natural Resources
District
NORTH BAY

TOPOGRAPHIC

LAND TENURE

LAND TENURE WITHDRAWALS

IMPORTANT NOTICES

LAND TENURE WITHDRAWAL DESCRIPTIONS

General Information and Limitations

Template

IMPORTANT NOTICES

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