Granitoids

Granophyric alkalifeldspar granite

These rocks occur mainly between 66′ and 423′. The *PLAGIOCLASE* seems to be replaced by *ORTHOCLASE*. The *QUARTZ* content goes up to about 60%. At 361.5′ almost complete replacement by *PUMPELLYITE* (X-ray diffraction) was observed. *BROWN BIOTITE* and *OPAQUE* minerals are associated with short, rounded, prismatic *ZIRCON, EPIDOTE/ZOISITE*, and *ALLANITE* (?) aggregates.

Amphibole granite.

These hypidiomorphic granular rocks occur mainly between 730′ and 760′. The *PLAGIOCLASE* phenocrysts, composition An 20-30%, are rounded, corroded, and twinned following albite, Carlsbad and acline laws. They also display patchy saussuritization. *ORTHOCLASE* is anhedral and twinned following Carlsbad law. *QUARTZ* is lensoid and graphically intergrown. *OLIVE-GREEN* to *BROWN HORNBLENDE* has a slightly porphyroblastic and graphic appearance. *BIOTITE* is of the brown variety.

Diorite.

A cross-cutting intrusion was observed between 999.5′ and 1006.70′ in sharp contact with gabbroic anorthosite. The *PLAGIOCLASE* is strongly zoned, composition An 20%(rim) to An 50%, and twinned following the albite and Carlsbad laws. *QUARTZ*, up to 5% present, is intergranular and intergrown with *PLAGIOCLASE*. *ORTHOPYROXENE* occurs as large crystals and is rimmed by *OLIVE-GREEN HORNBLENDE*. *CLINOPYROXENE* is granular and the exsolved phase is partly replaced by *HORNBLENDE*. *OLIVE-GREEN HORNBLENDE* forms large oikocrysts enclosing *PLAGIOCLASE*. *RED-BROWN BIOTITE* forms poikiloblasts and encloses *APATITE*. *APATITE* occurs as short euhedral to subhedral prisms. *OPAQUE* minerals occur as evenly distributed anhedral crystals.

Alkali zircon granite.

One sample of this rock was described at 920.8′ overlying an oxide-rich gabbro lens. *QUARTZ* and *ORTHOCLASE* occur in these rocks as symplectic intergrowths. *CLINOPYROXENE* is a greenish-greyish variety and *BIOTITE* has yellow-brown colours. *ZIRCON* occurs as a major mineral along the contact with the oxide-rich gabbro in the form of medium to coarse-grained euhedral prisms. *APATITE* is present as small prisms. *ILMENITE* is the main oxide and occurs in symplectic intergrowth with *SILICATES* along the contact. *CHALCOPYRITE* is intergrown with *PYRRHOTITE* and occurs mainly along the contact with oxide-rich gabbro and is intergrown with *ZIRCON* and *OXIDES*.

Acid Tests

Footage	Angle with Horizontal
100′	49°
200′	47°
500′	42°
800′	40°
1000′	36°
1345′	34°

Notes: Twenty-nine thin sections and fourteen polished thin sections were made from this drill hole. A total number of sixteen rock samples were assayed. Analytical results follow in Table SE-1.

CONDENSED GEOLOGIC LOG AND PETROGRAPHY FOR DDH FHL-1

The hole was drilled at an angle of 61° and an azimuth of 263°.

0′-129′ Overburden.

129′-189′ Fine-grained and medium-grained mottled troctolite. This unit is made up of layered alternations and subtle mixtures of fine and medium-grained mottled troctolite transected by partly saussuritized anorthosite veins and pegmatoidal intercalations showing hydrothermal alteration. *PLAGIOCLASE*, composition An 62-80%, is cumulus textured with normal, patchy and occasionally inversed zoning and twinning following albite, Carlsbad, acline and pericline laws. This pattern of twinning is repeated in the rock types described below. *OLIVINE* cumulus is *FORSTERITE*, -2V = 80-90°. Pink *CLINOPYROXENE* is anhedral and developed as oikocrysts against the basic rims of plagioclase in mottled troctolite. *ILMENITE* is present as oikocrysts and replaces part of the *OLIVINE*. *MAGNETITE* surrounds and is intergrown with *ILMENITE*. The fine-grained anorthosite has *PLAGIOCLASE* with an anorthite content of 65%, and is found in subparallel recrystallization. Intercalations of hydrothermally altered pegmatoids constitute about 10% of this unit. These are distinguished by reddish-brown *BIOTITE* poikiloblasts with inclusions of *APATITE* and *PREHNITE*, overgrowing secondary formed *CUMMINGTONITE, ACTINOLITIC AMPHIBOLE* and *CHLORITE*. Disseminated *PYRRHOTITE* and *CHALCOPYRITE*, grading up to 10% in the pegmatoids, replace altered *PLAGIOCLASE*. *PYRRHOTITE* is replaced by *PYRITE* and *MARCASITE*. *ILMENITE* occurs as poikiloblasts in *BIOTITE*. Veins of hydrous Fe-Mg silicate transecting fresh troctolite reflect hydrothermal conduits. The average sulfide content is about 0.5%.

189′-323′ Igneous and hornfelsic troctolites

This unit is composed of a mixture of medium to coarse-grained olivine gabbronorite and troctolite, fine-grained hornfelsic olivine gabbronorite and troctolite, with intercalations of pegmatoidal norite, orthopyroxenite, picrite, olivine gabbro-norite, contaminant rock and sulfide lenses. Apart from the occurrences in lenses as matrix and massive *PYRRHOTITE + CHALCOPYRITE + PENTLANDITE, SULFIDES* in this unit occur as blebs and clots. The pegmatoidal and contaminant rocks are frequently hydrothermally altered.

Medium to coarse-grained troctolites and olivine gabbronorites.

The *PLAGIOCLASE*, composition An 70-85%, is twinned following the albite and Carlsbad laws. *OLIVINE* is developed as fair-sized cumulus crystals. *ORTHOPYROXENE* is present as large oikocrysts, enclosing *PLAGIOCLASE* and *OLIVINE*. *CLINOPYROXENE* with numerous opaque needles may surround *OLIVINE* as well. A slightly differing variety includes pericline and acline twinning of *PLAGIOCLASE* with An contents down to 62%, and has

slightly granulated *OLIVINE* oikocrysts. *PYRRHOTITE* oikocrysts are intergrown with plagioclase.

Hornfelses.

PLAGIOCLASE in these rocks is fine-grained to very fine-grained with an An content of 67 to 78%, and is poorly twinned. *OLIVINE* is equant and developed as anhedral poikiloblasts. *ORTHOPYROXENE* is present as poikiloblasts and as granulated oikocrysts, and may form rims on *OLIVINE*. *CLINOPYROXENE* occurs as poikiloblasts. Rocks with clearer igneous textures as oikocrysts and lath-shaped plagioclase are included in this subunit. *PYRRHOTITE* is observed in small amounts in the igneous rocks and hornfelses and is surrounded by a *SPINEL*.

Hydrothermally altered pegmatoids with contaminant aspects.

PLAGIOCLASE, composition An 47-74, is partially destroyed as result of incipient alteration. Oscilatory as well as patchy zoning is observed. Resorbtion by *QUARTZ* and replacement by SULFIDE is common, preceeded by alteration into masses of *SPHERULITIC CHLORITE, SERPENTINE, MUSCOVITE* and *LEUCOXENE*. *OLIVINE*, originally present, can be recognized as pseudomorphs of *SERPENTINE* in poikilitic intergrowths. *ORTHOPYROXENE* is developed as oikocrysts and intergrown with partly resorbed *PLAGIOCLASE* and replaced at the outside by *CUMMINGTONITE*. *CLINOPYROXENE* is developed as oikocrysts and smaller crystals surrounding *OLIVINE*. *QUARTZ, RED-BROWN BIOTITE* and *GREEN-BROWN AMPHIBOLE* form poikiloblastic overgrowths ±*APATITE* and *CUMMINGTONITE* and *SULFIDE* on alteration products of the formerly mentioned primary silicates. Contaminant rock can be recognized in this subunit for its rather acid *PLAGIOCLASE* (An 27%) which is graphically inter-grown with *QUARTZ*. *CHALCOPYRITE* replaces secondary *AMPHIBOLE* and *PYRRHOTITE* replaces *SERPENTINE*. *PYRRHOTITE* also seems to replace *CHALCOPYRITE* through graphic intergrowth. The intergrowth bears rounded inclusions of an unknown mineral having pink-blue-grey tones and a reflectance estimated at 25. This mineral has been tentatively labeled a *SPINEL* variety. When the replacement of *CHALCOPYRITE* by *PYRRHOTITE* is almost completed *PENTLANDITE* appears. *ILMENITE* and *MAGNETITE* have inclusions of *CHALCOPYRITE* and *PYRRHOTITE* along cracks and borders. *ILMENITE* occurs as prisms in *PLAGIOCLASE*, parallel to (010), is also intergranular with respect to *PLAGIOCLASE*, and occasionally is associated with *APATITE*. *MAGNETITE* is surrounded by probably a *SPINEL* having a reflectance estimated about 10. Finely scaled symplectitic intergrowths in *ORTHOPYROXENE* of an *OPAQUE* have yellow-violet-purple-greenish reflectance and bright yellow, blue and red anisotropic colors.

Pyroxenite

Feldspatic orthopyroxenite has *PLAGIOCLASE*, composition An 52-67%, which is twinned following the albite law. *ORTHOPYROXENE* crystals display cumulus textures and *OLIVINE* oikocrysts enclose *PLAGIOCLASE* and *ORTHOPYROXENE*.

Sulfide lenses

Three *SULFIDE* lenses are present in this section. The uppermost one (224.5′-225.5′) is hosted by a contaminated orthopyroxene-bearing pegmatoidal diorite (223′-226.4′), which is underlain by about 3′ of contaminated feldspathic orthopyroxenite to diorite. This lense is characterized by patchy replacement of *PYRRHOTITE* with *MARCASITE* + *PYRITE*, probably induced by hydrosilicate veins. *PENTLANDITE* occurs as rounded blebs in *PYRRHOTITE* with many silicate inclusions. *CHALCOPYRITE* occurs as local concentrations along the fringes of *PYRRHOTITE* and also replaces *SPHERULITIC CHLORITE*. *PYRITE* ± *CHALCOPYRITE*, the former locally displaying a cubic crystal form, replace *PLAGIOCLASE* along cracks and cleavage. The lower two sulfide lenses at 255′-257.8′ are associated with olvine-bearing orthopyroxenite.

The uppermost of these lower two sulfide lenses (255′-256.20′) is composed of *PYRRHOTITE* having rather strong anisotropic colors in grey-green tones. *PYRRHOTITE*, the major sulfide, occurs as larger crystals, as matrix and as smaller prisms radiating from cracks in an anisotropic unknown mineral (*SPINEL* ?). The latter resembles *MAGNETITE* but has too low a reflection, namely 10, and it is pseudomorphic after *OLIVINE*. *PENTLANDITE* blebs in *PYRRHOTITE* have a strongly cracked habit and are typically dissected and surrounded by an isotropic unknown mineral having a reflectance of 25, pink-blue-grey tones, and provisionally labeled as a *SPINEL*. *PENTLANDITE* also occurs as unmixed parallel veinlets in *PYRRHOTITE*, parallel to the extinction position. *CHALCOPYRITE* is found as smaller blebs in *PYRRHOTITE* and frequently is associated with *PENTLANDITE*. *ARSENOPYRITE* is observed as rounded inclusions in *PYRRHOTITE* and as a discontinuous core in a *SPINEL* veinlet. *SPINEL* (?) vein systems are cross-cutting, and have *ILMENITE* (?) centers that are fringed by silicates. *ILMENITE* and *MAGNETITE* occur as symplectic intergrowths with *OLIVINE*, *ORTHOPYROXENE* and *PYRRHOTITE*. The average sulfide content in the unit is about 2.8%.

The unit is further characterized by an increase of TiO_2, Cu/Cu + Ni ratio, Pd and Sr, as well as a decrease in anorthite content of the plagioclase with depth.

323′-387′ Subophitic medium to coarse-grained troctolite.

PLAGIOCLASE, composition An 62-67%, has cumulus textures and is dusted with semi-opaque inclusions. *OLIVINE* occurs as anhedral cumulus crystals and is rimmed with *CLINOPYROXENE* symplectite and also occurs as oikocrysts. *CLINOPYROXENE* is in the form of post-cumulus crystals which are intergranular with respect to *PLAGIOCLASE* and as oikocrysts. *ORTHOPYROXENE* is observed locally as discrete crystals. *OLIVE-GREEN AMPHIBOLE* replaces *CLINOPYROXENE*. *RED-BROWN BIOTITE* + *SULFIDE* replace *OLIVINE* and are surrounded by *CLINOPYROXENE* symplectite. *BIOTITE* can also occur in voids within subophitic texture and with *CLINOPYROXENE*, *PLAGIOCLASE*, BROWNISH *AMPHIBOLE* and *OPAQUES*. *ILMENITE* forms part of large oikocrysts intergrown with *CHALCOPYRITE* and *PYRRHOTITE*, up to 0.2′ size. It is also found as smaller crystals, probably replacing *OLIVINE* and surrounded by *RED-BROWN BIOTITE* which is, in turn, rimmed by *CLINOPYROXENE* symplectite. The replacement by *ILMENITE* is preceded by

invasion of *SERPENTINIZED OLIVINE* by *SPINEL* (?) along fractures. *MAGNETITE* dissects and surrounds *ILMENITE*. *PYRRHOTITE* AND *CHALCOPYRITE* occur in voids in subophitic texture and replace serpentinized *OLIVINE*. *PYRRHOTITE* encloses *CHALCOPYRITE* and is in turn rimmed by *RED-BROWN BIOTITE*. *PYRRHOTITE* can occur as symplectite-like intergrowths with *PLAGIOCLASE* reflecting segregated droplets and can invade *ILMENITE*. *CHALCOPYRITE* also is observed as inclusions and veinlets in *BIOTITE*. The average sulfide content of this unit is estimated to be about 4%. Discontinuous zones of alteration with secondary Fe-Mg hydrosilicates and greenish-white plagioclase are mostly associated with this unit.

The lithochemistry of the unit distinguishes it from the overlying and underlying rock units by the sharp breaks that result from reversed trends. These are expressed by a strong decrease of TiO_2, Sr, Cu/Cu + Ni ratios and constant low Pd contents with depth.

The two sulfide layers that straddle the boundary with the underlying rock unit will be described in that section. There, the enclosing rock shows considerable contamination and a break in lithochemistry for several elements at 400′-415′ indicating that the boundary might well be lower.

387′-492′ Mixed rocks

This unit is a mixture composed of from top to bottom the following rock types: mainly contaminant rock; an assemblage of hornfelsic metasediments with sulfide lenses and recrystallized microgabbro; olivine-bearing gabbronorite; and troctolite with hornfelsic aspects. The lower-most 35′ are composed of a mixture of the above rocks with pegmatoidal and picrite intercalations.

Sulfide Lenses

Three *SULFIDE* lenses have been observed; two at the top in a mixed zone of contaminant rock with overlying troctolite at 384.4′-385′ and 386.10′-387′, and a lower lens from 399′-400.5′ associated with metasedimentary hornfels in contaminant rock. The *SULFIDE* lens at the boundary of the troctolite and the underlying contaminant rock at 386.5′ is in pyroxenite and shows considerable similarity to the *SULFIDE* lens at 256.20′. *PENTLANDITE*, however, has more of a resemblance to that found in the uppermost *SULFIDE* layer in the contaminant rock at 224.50′. *PENTLANDITE* seems to concentrate in the margins of transecting *QUARTZ-CARBONATE-SERPENTINITE* veins in company with some *MARCASITE* that probably replaces of *PYRRHOTITE*. *CHALCOPYRITE* is dispersed as rounded inclusions in *PYRRHOTITE*. *MAGNETITE* occurs as anhedral blebs in *PYRRHOTITE* and *ILMENITE* is only occasionally observed.

The lowermost *SULFIDE* layer at 399.2′ is in pyroxenite and is very similar to the previously described lenses in pyroxenite. *CHALCOPYRITE* occurs frequently along contacts with *SILICATES*.

Contaminant rock

These are multicoloured medium-grained rocks of diorite composition, having macroscopically visible *BIOTITE* booklets, pink *FELDSPARS*, greenish *FE-MG HYDROSILICATES* and "milky" silicates (probably *CORDIERITE*). *PLAGIOCLASE* has an anorthite content varying from 37 to 80%, with patchy and cyclic zoning. The crystals are resorbed by *QUARTZ* and *ALKALI FELDSPAR*. *ORTHOPYROXENE* occurs in pyroxenitic aggregates, including *CLINOPYROXENE*, and is surrounded by *SECONDARY FE-MG HYDROSILICATES*. Porphyroblasts of *ORTHOPYROXENE* and graphic *QUARTZ* + *PLAGIOCLASE* are observed along the fringes with hornfels. *ALKALIFELDSPAR* is represented by the variety *ORTHOCLASE* (-2V = ±50°), which encloses *PLAGIOCLASE* and, in turn, is itself enclosed by *QUARTZ*. *CORDIERITE* has been observed, partly or completely altered into *CHLORITE*. *BIOTITE* is present as red-brown poikiloblasts.

Hornfelses

This subunit is a locally brecciated mixture of metasediments (pelitic, arenitic and arkosic) and igneous rocks of anorthosite to gabbronorite composition.

Very fine-grained metasedimentary hornfels:

PLAGIOCLASE has an anorthite content of 49-62% and is twinned following the albite law. It has an euhedral basic core and may locally be perthitic. Poikiloblastic intergrowths with *QUARTZ*, *OPAQUE* minerals and *ORTHOPYROXENE* are observed. *CORDIERITE* is present as euhedral to subhedral porphyroblasts showing simple and sector twinning with trillings (-2V = ±80°). *ORTHOPYROXENE* occurs as small, strongly pleochroic anhedral poikiloblasts following layering. It is also observed as prisms in pyroxenite, often associated with matrix sulfide and having many translucent *BIOTITE* inclusions. *ALKALIFELDSPAR*, with a small axial-2V, is probably a variety of *SANIDINE*. *QUARTZ* in the fine- to medium-grained clastic hornfelses is subrounded and encloses *PLAGIOCLASE*, *SECONDARY SILICATES* and *SULFIDE*. *RED-BROWN BIOTITE* forms large poikiloblasts. The secondary silicates *CHLORITE, ZOISITE, SERICITE* and *CUMMINGTONITE* are intergranular in arenites and arkoses and seem to be replaced by *MATRIX SULFIDE*. *PYRRHOTITE* forms matrix sulfide with prismatic *ORTHOPYROXENE* and is relatively strongly anisotropic. *PENTLANDITE* and *CHALCOPYRITE* blebs in *PYRRHOTITE* are veined with *SPINEL*. *PYRITE* + *PYRRHOTITE* + *CHALCOPYRITE* + *MARCASITE* replace *MG-FE HYDROSILICATES* and *PLAGIOCLASE*, forming the matrix of arenite and arkose.

Igneous hornfels:

These rocks are very fine to medium-grained equant to subophitic textured showing layered(?) alternation of quartz-bearing olivine gabbronorite to anorthosite compositions. *PLAGIOCLASE*, composition An 37-79%, is twinned following albite, Carlsbad and acline laws and has patchy zoned, euhedral basic cores. Sieve textured *CLINOPYROXENE*, *ORTHOPYROXENE* and *CHLORITE* are also present. *ORTHOPYROXENE* has a prismatic as well as equant habit with relict poikilitic texture. *OLIVINE* is present as poikiloblasts with relict poikilitic texture. *ANDRADITE* is occassionally observed in clusters with *PLAGIOCLASE* and *OPAQUE*S. *QUARTZ* forms graphic intergrowths with *PLAGIOCLASE*.

Recrystallization was observed at 433.70′ in the form of euhedral to subhedral *PLAGIOCLASE* in fine-grained equant plagioclase rock with secondary *FE-MG HYDROSILICATES*, which seems to intrude metasedimentary hornfels.

Olivine bearing gabbronorite and troctolite

A rather continuous stretch of this rock is found from 440'-457' and it macroscopically resembles the overlying troctolite unit at 323'-387'.

PLAGIOCLASE, with an anorthite content of 55-85%, is fine to medium-grained and patchy zoned with basic overgrowth on cores. Smaller crystals are subhedral to euhedral and larger crystals are anhedral. *ORTHOPYROXENE* is slightly prismatic and surrounds *OLIVINE*. It also occurs as large postcumulus crystals. *CLINOPYROXENE* forms anhedral equant *PYROXENITIC* "spots" and surrounds *OLIVINE*, which has been mostly *SERPENTINIZED*. The *OLIVINE* occurs as oikocrysts up to 6 mm across and as discrete, medium-grained cumulus crystals. Spherulitic textured *CHLORITE* forms pseudomorphs after *PLAGIOCLASE*. *RED-BROWN BIOTITE* forms poikiloblasts up to 6 mm across, overgrowing white-coulored altered *PLAGIOCLASE*, and scavenging *APATITE* and *OPAQUE MINERALS*. *PREHNITE* and *CARBONATE* are also formed during this phase of growth. *OPAQUE MINERALS* occur along cracks and as blebs.

Pegmatoidal diorite

These biotite-rich rocks with contaminated appearance occur over the about lower 30' of this unit.

PLAGIOCLASE, having an anorthite content of 47%, is coarse-grained, subhedral and twinned following the albite and Carlsbad laws. *CLINOPYROXENE* is postcumulus and forms a mixture of semi-opaque needles with *ORTHOPYROXENE*, possibly representing inverted *PIGEONITE*. *QUARTZ* occurs in graphic intergrowths with *PLAGIOCLASE*. *APATITE* is present as euhedral inclusions in *PLAGIOCLASE, SECONDARY HORNBLENDE*, and is also associated with *QUARTZ, REDDISH-BROWN BIOTITE* and *SULFIDE* poikiloblasts. Secondary *GREEN-BROWN AMPHIBOLE* is an alteration product of *CLINOPYROXENE*. *REDDISH-BROWN BIOTITE* surrounds *OPAQUE MINERALS*. *PYRRHOTITE* occurs as subhedral oikocrysts and anhedral clots, enclosing altered *PLAGIOCLASE, BIOTITE, BROWN-GREEN AMPHIBOLE* and *APATITE*. *CHALCOPYRITE* occurs in masses of altered silicates, enclosing *APATITE* and *PENTLANDITE*. It is also intergrown with *ILMENITE* sheets, and as rounded crystals enclosing *ILMENITE*. *ILMENITE* occurs as sheets intergrown with *BIOTITE* and as oikocrysts intergrown with *BROWN-GREEN AMPHIBOLE*, altered *PLAGIOCLASE* and *QUARTZ*. The textures described above point to the following hydrothermal processes.

1. Alteration of *PLAGIOCLASE* and *FE-MG SILICATES* to *CHLORITE-CUMMINGTONITE-SAUSSURITE-SERICITE-ZOISITE-LEUCOXENE-CARBONATE* masses. Replacement of *PYRRHOTITE* by *MARCASITE + PYRITE*. These processes seem to be spatially related to *CHLORITE - SERPENTINITE* veins.

2. Blastic growth under static conditions of *RED-BROWN BIOTITE* poikiloblasts, *BROWN-GREEN AMPHIBOLE, QUARTZ* and *SULFIDE* ±*PREHNITE*, enclosing euhedral *APATITE*. Replacement of *OLIVINE* by opaque minerals (*OXIDE + SULFIDE*). Replacement of *PLAGIOCLASE* in clastic hornfels by *SULFIDE*. The average sulfide content of this unit is estimated to be 5.3%.

The lithochemistry of this unit shows no clear trends except for an increase of Cu/Cu + Ni ratios and Pd with depth and C contents≥ 0.3%. Pd shows a peak value of 190 ppb at the base of the contaminant rock (399-405') that separates this unit from the overlying unit.

492'-576' Altered micaceous hornfels composed of alternating layers of arenitic, arkosic and pelitic sediments with very fine-grained trachytic(?) lenses.

Altered mafic to ultramafic flows, quartzites and rhyolite to andesite tuff occur as intercalations. Pink-buff granite veins are present near the base of this unit and these show graphic intergrowths of *QUARTZ-ALKALIFELDSPAR* and *QUARTZ-TOURMALINE*.

Arkose, arenite and wacke.

QUARTZ in these rocks is well rounded and sorted. *ALKALIFELDSPAR* occurs intergranular to *QUARTZ*. *MUSCOVITE* (*PENNINE*?) is found as porphyroblasts along the contact with trachyte. It occurs in aggregates with *CHLORITE*, probably as pseudomorphs after *CORDIERITE*. Disseminated *PYRITE* and locally *PYRRHOTITE* make up to about 5% of the rock. *PYRITE* is locally connected through veins. The *SULFIDES* with anhedral to sub-cubic crystal forms are intergranular with respect to *QUARTZ* and seem to replace *FELDSPAR* and *MICA*. *CHALCOPYRITE* is locally present as a few specks. *RUTILE* is associated with aggregates of *MUSCOVITE*.

Trachyte.

These are very fine-grained lenses of euhedral to subhedral ALKALI-FELDSPAR, that appear to be the same as the intergranular feldspar in the metasediments.

Altered mafic to ultramafic basalts and cherts (529.6'-531.8')These are indicated by lenses of *CHLORITE + CARBONATE, COLOURLESS MICA, BIOTITE, FELDSPAR, CHLORITE* and *BIOTITE* bearing cherts, containing up to 30% *SULFIDE*. The ore minerals occur as a *PYRITE* matrix, as lenses in altered mafic to ultramafic layers, as *PYRITE + PYRRHOTITE + CHALCOPYRITE* in *QUARTZITIC LENSES* and as a few very fine-grained *PYRITE + PYRRHOTITE + CHALCOPYRITE + MAGNETITE GRAINS* in a tuffaceous layer of probably andesitic composition. The tuffs are very fine-grained and are composed of *QUARTZ, SERICITE, CHLORITE* and *BIOTITE*. *ORE* minerals include *PYRITE*, *PYRRHOTITE*, *CHALCOPYRITE* and *MAGNETITE*. The average sulfide content of this unit is about 1.5%.

576'-837' Pelitic schist, gneiss, arenite and arkose.

These rocks are part of a thinly layered sequence. Plastic deformation, flowage and contortion of layering is evident from 623'-783'. This unit contains intercalations of *DRAVITIC TOURMALINE, SAPONITE, DIOPSIDE and GROSSULARITE* (X-Ray Diffraction)-bearing calcsilicate rocks (628.3'-653'), (660'-668') topped by *SULFIDE*-bearing foliated quartzite. This quartzite is very fine-grained and laminated as the result of graded(?) bedding and variable *SULFIDE*, *BIOTITE* and *TOURMALINE* content. Pseudo anisotropic *GROSSULARITE* inclusions are observed in medium to coarse-grained euhedral *QUARTZ* with *DRAVITIC TOURMALINE*. PYROXENE ± *BASIC PLAGIOCLASE* ±*CHLORITE* ±*HORNBLENDE* ±*ZOISITE*

with accessory *ZIRCON* show lamination in the calcsilicate rock. The *SULFIDES* show a laminated *PYRRHOTITE* network with semi-massive *PYRITE* blebs, veins and layers with lower sulfide content. *CHALCOPYRITE* specks are present locally. *CHLORITE* constitutes about 40% of the rock in the schists of the upper part of this unit. *OLIGOCLASE* and *CORDIERITE* poikiloblasts appear with *REDDISH—BROWN BIOTITE ± TOURMALINE* in schist and gneiss at a depth of about 750′. The arkose and arenite, with intergranular *ALKALIFELDSPAR*, tend to decrease in volume downhole and are replaced by veins with *CORDIERITE* pseudomorphs exhibiting both conformable and cross-cutting relationships to layering. These veins are conformable with respect to foliation of the surrounding metasediments.

837′-1003′ T.D. Biotite-chlorite gneiss, biotite schist and metawacke.
This unit consists of intercalated arkosic, *TOURMALINE* bearing, fine-grained biotite-chlorite gneiss, biotite schist, and metawacke with *GROSSULARITE* bearing calcsilicate, metavolcanic and *KAOLINITE* (894′-895.3′) (X-Ray Diffraction) components. Cataclastic intervals and joints cemented with *LAUMONITE* (X-Ray Diffraction) occur from 822.60′ downwards. *PLAGIOCLASE*, *ALKALIFELDSPAR* and *CHLORITE* content varies across layering with the colour of *BIOTITE* ranges from green-brown to red-brown. *TOURMALINE* and *ZIRCON* are present as accessories. Two directions of foliation are present, one parallels layering, the other crosscuts it. *GROSSULARITE*-bearing calcsilicate inclusions are observed in *QUARTZ* veins. These are associated with metavolcanics and are reflected by *CHLORITE + SERICITE + ALBITE + SECONDARY AMPHIBOLE INTERCALATIONS*.

The layering of the intrusive rocks in the upper 166′ makes an angle of 20-45° to the core axis, and the angle of the metasediments to the core axis varies from 0-70°.

Acid Test Results

Footage	Angle from Horizontal
133′	58°
300′	58°
500′	58°
700′	58°
900′	56.5°

Notes: A detailed graphic log is available for study. Nine thin and forty-one polished thin sections were made from this drill hole. A total number of 83 rock samples was chemically analyzed. Analytical results follow in Table FHL-1.

CONDENSED GEOLOGIC LOG FOR DDH NR-1

The hole was drilled at an angle of 52° and an azimuth of 40°.

0′-224′ Overburden.

224′-298.6′ Weakly laminated oxide and olivine-bearing gabbro containing plagioclase-rich and plagioclase-olivine lenses, and olivine graded layering.

298.6′-406.3′ Similar to above but with intercalations of oxide gabbro making up about 39% and oxide-rich gabbro making up about 15% of the section. 298.6′-311′, 325.5′-337.9′, 350′-352′, 378.3′-383.4′, 395.6′-406.3′, oxide gabbros. 353′-368.8′and 379.8′-380.5′ are oxide-rich gabbro, assaying 1650 ppm V. 391.7′-395.6′, mesocratic oxide-bearing gabbro.

406.3′-496.3′ Olivine and oxide-bearing gabbro with intercalations of 409.4′-417.8′, 459′-461.8′ mesocratic olivine and oxide-bearing gabbro, and 455.3′-458.2′, 480.5′-486.3′ tonalite and fine-grained granite veins. At 464.6′ a fault occurs with quartz filling.

496.3′-585′ Olivine and oxide-bearing gabbro with intercalations of olivine-bearing oxide gabbro making up about 42% of the section and mesocratic oxide-bearing gabbro. 496′-496.9′, 502′-510.7′, 513′-514.3′, 540.4′-541.4′, 542.3′-544′, 553.6′-556.5′, 556.8′-564.7′, 565′-568.3′, 570′-572.3′,577.4′-585′, intercalations of olivine-bearing oxide gabbro. An intercalation of layered(?) to massive fine-grained diorite-gabbro is found at 544′-553′, with amphibole-bearing coarse-grained plagioclase lenses digesting oxide gabbro at 544.4′-545.3′, 573′-575′ and 581′-581.8′.

585′-647′ Olivine and oxide-bearing gabbro with intercalations of amphibole-bearing granite veins and dikes up to 0.3′ thick.

647′-706′ Layered sequence of mainly oxide-bearing gabbro and mesocratic oxide-bearing gabbro with intercalations of oxide gabbro, making up about 43% of the section. 704.3′-705.3′, intercalation of oxide-rich gabbro, assaying 3600 ppm V, making up about 1.7% of this section.

706′-807.8′ Mainly oxide and olivine-bearing gabbro with graded layering of olivine and intercalations of mesocratic oxide-bearing gabbro at 711.8′-717′, 718′-721′, 725.3′-726′, 779.6′-781.3′. Olivine-bearing oxide gabbro, making up about 7% of the section, is found at 751.7′-757.6′ and 768.9′-769.9′. Amphibole-bearing joints occur at 707.7′-708.1′, 744′-745′, 756′-758.5′, 759.4′-760′ and 773′-774′.

807.8′-827′ Interlayered sequence of olivine-bearing oxide gabbro and olivine and oxide-bearing gabbro. The oxide gabbro makes up about 53% of the section, and assays 2400 ppm V at 816.8′-818.8′.

827′-892.6′ Olivine and oxide-bearing gabbro, with cataclastic zone having secondary Fe-Mg hydrosilicates and quartz veining at 842.3′-871.5′.

892.6′-910.4′ Alternating layers of olivine and oxide-bearing gabbro and olivine-bearing oxide gabbro. The latter makes up about 39% of this section and assays 1700 ppm V, 300 ppb Pd and 150 ppb Pt at 901.8′-903.8′.