

0'-69' Overburden.

69'-207.3' T.D. Amphibole schist. Generally medium-grained to coarse-grained, moderately magnetic, composed of medium to dark greenish-black prismatic amphibole crystals in a white to gray plagioclase feldspar matrix. Amphibole crystals exhibit foliation of approximately 20° to core axis. Fracturing and alteration is fairly common. Fracture angles generally are either approximately parallel or perpendicular to foliation or both. Traces of sulfide occur as scattered disseminated grains. The mineral mode is somewhat variable and is in the range of: 57-74% amphibole; 20-35% plagioclase; 3-7% opaques; trace-3% biotite as individual flakes and as alterations of amphiboles; trace of chlorite alteration of amphiboles and biotite; and a trace of apatite.

Altered fracture zones occur at 73.3'-83.5', 83.5'-84.5', 113.5'-114.7', and 131.9'-154.4'. They are generally fractured or brecciated in appearance and lighter dull green in color. Fracture surfaces are often coated with minerals which differ somewhat from those forming the matrix. The mineral mode of the matrix has the following range in composition: Amphibole, 15-66%; plagioclase, 30-35%; biotite and biotite/chlorite, 1-50%; opaques, 3-5%; sulfides, trace as (py?)(cpy?). The mineral mode of the fracture coatings is: Calcite, up to 97%; quartz, 2-3%; biotite/chlorite, trace-1%; opaques, 1-2%; apatite, trace.

Basalt and porphyritic basalt dikes are present from 98.4'-99.7'; 154.4'-157.1'; 166.1'-182.0'. They are very fine-grained, porphyritic, mostly greenish gray, slightly magnetic, locally fractured and exhibit slight to moderate alteration. The approximate range of mineral mode is: Ferro-magnesian (probably actinolite), 45-54%; plagioclase (combined phenocrysts and groundmass), 35-40%; opaques, 5-20%; chlorite, trace-1%. The phenocrysts are mostly subhedral to euhedral plagioclase and occasional opaque minerals. Sulfide is occasionally visible and amounts to probably less than 1% as pyrite and chalcopyrite(?).

Several veins occur at 69.1', 83.5', 161.4', 191.8' and at 198.7' and range in thickness from a fraction of an inch to just under one foot. Two of these are filled with calcite and lesser amounts of highly sericitized plagioclase and dark reddish-brown biotite. One is bounded by very fine-grained quartz and the contact zone is a highly altered "grungy" red-brown biotite(?). The other veins are composed primarily of pegmatitic plagioclase (up to 30 mm crystals), quartz and biotite (books up to 12 mm across). The veins are both high and low angle and the mineral mode of the thickest vein is approximately: Plagioclase, 57-62%; quartz, 35-40%; biotite, 3%; opaques, trace. Epidote and chlorite alteration is occasionally present in some of the veins as well as are traces of pyrite and chalcopyrite.

Notes: Ten thin sections were made. A detailed log is available for study. Three rock samples were assayed. The analytical results follow in Table R-1.

CONDENSED GEOLOGIC LOG FOR DDH NE-2

The hole was drilled at an angle of 48° and an azimuth of 90°.

0'-36' Overburden.

36'-269' **Mainly fine-grained olivine-bearing oxide gabbro and mela-olivine gabbro** with zones of plagioclase lamination, plagioclase xenocrysts, plagioclase veins and conformable and cross-cutting pyroxenite-oxide veins. Locally fine to medium-grained and medium-grained to coarse-grained members occur in the upper 50'. Joints have been observed with coatings of *THOMPSONITE* and *ANALCIME* both determined by X-Ray Diffraction. The fluorine, phosphorous, chromium, cobalt, vanadium and TiO₂ contents are slightly elevated compared with the underlying rocks.

269'-354' **Mainly brecciated coarse-grained oxide gabbro with pyroxenite and oxide veins** and clots and higher chromium, nickel and cobalt values than the remaining part of the drill core.

354'-470' **Slightly brecciated medium to coarse-grained oxide gabbro with plagioclase xenocrysts.**

470'-1038' T.D. Layered medium to coarse-grained and fine-grained oxide, olivine bearing gabbro, oxide olivine gabbro, troctolite, and anorthosite are the major rock types. They are mixed with zones of patchy pyroxene concentrations, olivine and clinopyroxene oikocrysts, plagioclase xenocrysts and ophitic textures. Brecciated intercalations with coarse-grained pyroxenite and oxide veins and clots occur as well. Approximately the last 50' are cataclastic and epimetamorphic with *LAUMONTITE* veins, determined by X-Ray Diffraction. 450'-477' contains intercalated zones exhibiting pink staining on plagioclase with relatively high potash (K₂O = 1.88%) and veinlets having the following composition: MgO = 26.00%, Al₂O₃ = 11.18%, SiO₂ = 49.68%, CaO = 2.77% and FeO = 10.43%. Analyses by Energy Disperser Spectrometer. The plagioclase lamination at 220' and the layering at 825' have an angle of respectively 60 and 90° with core axis.

PETROGRAPHY DDH NE-2

The following major rock types were found in this drill hole.

Fine-grained oxide gabbro

Fine-grained oxide gabbro, and occasionally oxide-rich olivine-bearing gabbro and mela-olivine gabbro are found between 36 and 268.5'. These are composed of anhedral to subhedral crystals with laminated to equant texture and isomodal layering of the coarser-grained oxide pyroxenite and fine-grained oxide gabbro.

The composition of the *PLAGIOCLASE* is An 42-47%, and occurs as lensoid aggregates which accentuate the layering. The crystals, like those in the other parts of the drill core, are twinned following albite, Carlsbad, and acline laws. *AP-*

ATTITE and fine-grained *OPAQUE* prisms and rods occur as inclusions. *CLINOPYROXENE* with *APATITE*, *ILMENITE*, *MAGNETITE* AND *RUTILE* inclusions occur as oikocrysts up to 10 mm across and as fine-grained cumulus crystals with simple twinning. *OLIVINE* occurs as cumulus crystals as well as oikocrysts. The oxides are postcumulus, enclosing the above mentioned silicates and contain up to 10% *APATITE* inclusions. *MAGNETITE* is the main *OXIDE* (about 90%) and surrounds *ILMENITE*. *OLIVINE* rims *MAGNETITE*. The average composition of these rocks is 10-45% plagioclase, 30-45% clinopyroxene, trace to 10% olivine and 15-45% oxide.

Igneous beccias

These are mainly coarse-grained polyschematic rocks most frequently found between 256' and 354'. They are composed of plagioclase and mafic mineral-rich parts, and display cross-cutting relationships and varying degrees of mixing. Their compositions vary from anorthosite to oxide gabbro, oxide pyroxenite and peridotite.

The *PLAGIOCLASE* ranges in composition from An 26-54%, is mostly anhedral and displays a subparallel to subophitic texture. Xenocrysts have patchy zoning with relatively abundant *OPAQUE* and semi-opaque needles, scattered *CLINOPYROXENE* and *BROWN HORNBLende* inclusions. Smaller equant aggregates of *PLAGIOCLASE* occur with *OXIDE* and *CLINOPYROXENE* in vicinity of ultramafic veins. *CLINOPYROXENE* has purple-brownish and greenish-greyish-yellowish tones with numerous inclusions of *OPAQUE* needles and rods. *OLIVINE* occurs as oikocrysts with rounded inclusions of *PLAGIOCLASE*, simple twinned *CLINOPYROXENE*, and *OXIDE*. The *OLIVINE* crystals are rimmed by *CLINOPYROXENE* and brown *HORNBLende* and are part of ultramafic veins. *MAGNETITE*, the main oxide, shows exsolution lamellae of *ILMENITE* and probably a *SPINEL*, which has a gray colour with reflection of about 15 and a grey-brown anisotropic colour. *CHALCOPYRITE*, intergrown with *BORNITE* and *PYRRHOTITE* is mostly associated with *CLINOPYROXENE*-rich veins and clots. Minor amounts of *APATITE* and red brown *BIOTITE* are observed as well. The composition of this rock varies from 60-70% *PLAGIOCLASE*, 20-25% *CLINOPYROXENE*, 0-5% *OLIVINE* and 5-15% *OXIDE*.

Anorthosite

Layers have a thickness up to 10' and are found below 470'. The texture is laminated and subophitic. Two kinds of *PLAGIOCLASE* are distinguished:

A) Larger crystals, having a composition of An 67%, make up about 20% of the rock. They are strongly zoned and contain interesting composite *PLAGIOCLASE* crystals, with zones of basic *PLAGIOCLASE-CLINOPYROXENE* symplectite along the inner crystal boundaries. These zones may coincide with patchy zoning and cut across the crystals. The zones seem to precede recrystallization of larger crystals into smaller ones, preferably along Carlsbad composition planes, and are part of vein systems.

B) Smaller crystals, having a composition of An 54%, showing less zonal variation and occur as anhedral to equant clusters in voids between the larger crystals.

CLINOPYROXENE surrounds larger plagioclase crystals as part of the *PLAGIOCLASE* symplectite and transects pla-

gioclase along zones. *REDDISH-BROWN BIOTITE* surrounds *OXIDE*.

Medium to coarse-grained olivine-bearing gabbro and oxide olivine gabbro.

These layered rocks alternate with oxide troctolite and anorthosite. They display laminated and subophitic textures and occur below 470'. The *PLAGIOCLASE* crystals, which have a composition of An 35-65, are clouded with semi-*OPAQUE* dots that coincide with patchy zoning and display a parallel orientation of *CLINOPYROXENE* inclusions. The cumulus crystals are slightly bent and exhibit wavy extinction. Large variations in composition can be observed in the same thin section. *CLINOPYROXENE* is strongly zoned in places, has purple tones, extinction dispersion and a + 2V 50-60°. Cumulus crystals show wavy extinction as a result of strain. Post cumulus *MAGNETITE* and *ILMENITE* occur in roughly equal amounts and the magnetite tends to surround *ILMENITE*. Exsolution lamellae of *ILMENITE* and *SPINEL* are observed in *MAGNETITE*. To a far lesser degree oxides also occur as discrete cumulus crystals. *OLIVINE* forms rims on the *OXIDES*. Minute specks of intergrown *CHALCOPYRITE*, *BORNITE* and *PYRRHOTITE* are associated with *CLINOPYROXENE-PLAGIOCLASE* symplectite and *SPINEL* along cracks in *PLAGIOCLASE*. These rocks are characterized by complex embayments of *OXIDES*, *PLAGIOCLASE*, *CLINOPYROXENE* and *OLIVINE* with reaction rims of *PLAGIOCLASE-CLINOPYROXENE SYMPLECTITE* and *OLIVINE*. The composition of these rocks averages 50-70% plagioclase, 25-35% clinopyroxene, trace to 20% olivine and 10-20% oxides.

Troctolite

The *PLAGIOCLASE* has an An-content of 47-55%, has a subophitic texture and is anhedral to subhedral. Relatively basic *PLAGIOCLASE* forms symplectic intergrowths with *CLINOPYROXENE* in embayments of *OLIVINE* and *OXIDES*. Simple accline twins are observed as well. The cumulus tablets and prisms are slightly bent and molded between cumulus *OLIVINES*. Larger *PLAGIOCLASE* crystals may envelope earlier silicates as oikocrysts. *CLINOPYROXENE* is present as oikocrysts. *OLIVINE* is both cumulus and poikilitic and has wavy extinction. *ILMENITE* and *MAGNETITE* occur in roughly equal amounts and are associated with redbrown *BIOTITE*. *MAGNETITE* has *SPINEL* exsolution lamellae. *CHALCOPYRITE* and *BORNITE* intergrowths occur in direct contact with *PLAGIOCLASE-CLINOPYROXENE* symplectites.

Acid Tests Results

Footage	Angle from Horizontal
100'	51°
400'	52°
700'	55.5°
1030'	52°

Notes: A total of ten polished thin sections and ten analytical samples were prepared from this hole. A detailed graphic log is available for study. The analytical results follow in Table NE-2.