

**1545.8'-3143' T.D.** Light to medium grey, recrystallized metadolomitic-calcareous quartzarenite and siliceous dolomitic marble. Lithology often laminated. Much folding, flattening, pseudobrecciation, and brecciation; yet rock is massive-recrystallized with breccia usually well healed. Much pressure solution, occasional stylolites. Breccia largely tectonic, although some may be sedimentary. Coloration variation due to graphite, pyrite, minor silt. Graphite occasionally concentrated into slip surfaces. Breccia's often associated with relatively undeformed tectonic slivers of rock. Mode is 0-90% quartz (average 35%); 0-30% calcite (15% average); 5-80% dolomite (45% average); and 0-80% graphite (5% average). Average 1/2% (?) pyrite. Siliceous intervals may be quartzarenite, chert, or silicified carbonate. Recrystallization makes textures obscure. Deformation increases downward from 1599'-1783.5' and is fairly continuous to 3143'. From 2689'-2727', 3029'-3043', core is somewhat broken and leached; with breccia not as well healed as usual. More siliceous (scattered) from 1701.5'-1748', 2115'-3143'. Local calcite-dolomite porphyroblasts to 1 cm are found locally 1559'-1654' and 1862'-1863.3'. Minor yellow tuff laminae from 1628.9'-1629'. Local minor pyrite (to 5%) associated with some argillitic marble, graphitic slip surfaces and breccia matrix. Veining is variable and is typically quartz-dolomite-calcite with complex cross-cutting relations that grade into pseudobreccia-breccia. Veins contain local vugs, with pyrite and chalcopryrite(?). Veining in general lessens below 1884'. They are locally brecciated, indicating continuing or multiple deformation. Some fold closures are very complex. Bedding measures at all angles to core axis. Schistosity-flattening most prominent feature, and is often superimposed on bedding, and measures 20-80° (increase downward?) with values predominantly 55-70°. Minor fold axial planes are 30-80° with most from 55-58°.

### Acid Test-Eastman Whipstock Survey Results

Footage	Acid Test Angle of Hole from Horizontal	Bedding-Structure Angle with Core Axis	Eastman-Whipstock Survey	
			Azimuth	Vertical Drift (from Horizontal)
50'	47°	-	-	-
53'	-	-	6°	46°
143'	-	53°S <sub>0</sub> -S <sub>1</sub>	356°	45°
343'	-	-	355°	43°
350'	44°	57°S <sub>0</sub> -S <sub>1</sub>	-	-
543'	-	-	354°	43°
650'	43°	62°S <sub>0</sub> -S <sub>1</sub>	-	-
743'	-	52°S <sub>1</sub> -S <sub>1</sub> Schistosity	351°	45°
943'	-	-	345°	49°
950'	48°	68°S <sub>0</sub> -S <sub>1</sub>	-	-
1143'	-	75°S <sub>0</sub> -S <sub>1</sub>	343°	49°
1250'	48°	48°S <sub>0</sub> -S <sub>1</sub> 0-5°S <sub>2</sub>	-	-
1343'	-	65°Ax Plane	340°	50°
1543'	-	43°S <sub>0</sub> -S <sub>1</sub>	338°	53°
1550'	53°	42°S <sub>0</sub> -S <sub>1</sub>	-	-

Footage	Acid Test Angle of Hole from Horizontal	Bedding-Structure Angle with Core Axis	Eastman-Whipstock Survey	
			Azimuth	Vertical Drift (from Horizontal)
1743'	-	39°S <sub>0</sub> -S <sub>1</sub>	336°	52°
1850'	53°	43°Ax Plane	-	-
1943'	-	62°S <sub>1</sub>	335°	51°
2143'	-	68°S <sub>1</sub>	333°	50°
2150'	51°	45°S <sub>0</sub>	-	-
2343'	-	30°Ax Plane	331°	49°
2450'	51 1/2°	0°S <sub>0</sub>	-	-
2543'	-	66°S <sub>1</sub> -S <sub>0</sub>	330°	49°
2743'	-	-	326°	49°
2750'	52°	45°S <sub>1</sub>	-	-
2943'	-	65°Qtz Vein	324°	48°
3143'	-	0-40°Vns	322°	48°

S<sub>0</sub> = Bedding

S<sub>1</sub> = 1st Folding Schistosity

S<sub>2</sub> = 2nd Folding Schistosity

**Notes:** Lithologic and structural logs are available for study, as are 156 thin sections and 48 other cut heels. Twelve individual and 95 composite samples were sent in for chemical analysis, with analytical results following in Table BM-1. Analytical results of rock samples taken in the area may be found in Table BM-2.

## CONDENSED GEOLOGIC LOG OF DDH A-2

Hole Drilled at a 45° angle and an azimuth of 180°.

0'-34' Overburden.

34'-40' No core.

**40'-194.5'** Fine-medium-grained, medium-dark grey brown-green brown, altered, recrystallized metabasalt-andesite flows and tuffs. Generally massive to semi-schistose. Some flattening evident. Mode: 20-65% calcite (partially in voids), 5-45% chlorite, 5-25% hornblende (needles to 5 mm), 5-35% biotite, 5-20% quartz and plagioclase and 0-5% pyrite-pyrrhotite(?), with a trace of chalcopryrite. Calcite, quartz, and sulfides occur as disseminations and in thin veinlets. Rock alternates between darker, more mafic, and lighter grey, more siliceous-calcareous intervals. Unit contains local pseudobreccia-breccia with scattered black ultramylonite bands. Minor thick veining and flow top breccia(?), with quartz-calcite-chlorite-pyrite and local traces of Mn oxides and rhodochrosite. Some veins appear brecciated and healed. Local pillows and flow tops. Layering-bedding-flattening oriented about 20-35° to core axis.

**194.5'-292.1' Fine-medium-grained, medium-dark grey-green, altered, recrystallized meta-andesite-dacite tuffs and agglomerate(?).** Appears more siliceous than previous unit. Quite calcareous. Mode: 20-65% calcite, 5-20% hornblende, 5-30% chlorite, 5-20% biotite(?), 20-60% quartz; and fine plagioclase, some quartz eyes, and 2-7% pyrite-pyrrhotite with a trace chalcopyrite. Coarse fragments to 1/2' within 194.5'-230.5', 239'-283'(?), and 192'-292'(?). These may be brecciated flow tops, boudinaged beds, and/or agglomerate with a matrix of similar material. Below 224' unit contains up to 30% round-flattened calcite-quartz grains to 1 cm. Probably felsic tuff fragments with few scattered quartz eyes. Basal 3' of unit is more mafic. Minor, scattered, thin calcite-quartz veins with local folding or brecciation. 3 mm quartz-calcite-pyrite-ankerite(?) veinlet at 229'. Bedding-stretching direction is 7-27° to core axis.

**292.1'-367' Very fine to medium-grained, dark green grey, diabase-gabbro dike.** Grain size increases toward center. Coarsest 304'-342'. Mode of center: 40-50% plagioclase, 30-40% medium green hornblende (chloritized?), 15-25% dark green pyroxene (uralitized?), and 1-2% pale pyrite. Carbonate alteration and minor veining more common near contacts. Rock approaches 50% calcite near contacts. Base of unit may be contact metamorphosed tuffs.

**367.0'-387.7' Fine-medium-grained, medium-dark grey-green altered-recrystallized meta-andesite-dacite tuffs-agglomerate.** Volcaniclasts to several cm. Not agglomeratic below 375', with tuffs getting more laminated, folded, silicified with depth. Some quartz eyes. Mode: 20-55% calcite, 5-20% hornblende, 5-30% chlorite, 5-20% biotite(?), 20-60% quartz and fine plagioclase, and 2-5% pyrite-pyrrhotite. Similar to 194.5'-292.1'.

**387.7'-402.1' Fine-medium-grained, medium-dark grey-green and light grey-pink-grey banded intermediate-felsic tuffs with agglomerate(?) and minor dark grey, slightly graphitic siliceous metasediments.** Local silicification and pseudobreccia veining. Felsic tuffs may be somewhat potassic. Biotite-chlorite somewhat coarser than usual. Intermediate tuff mode: 40-50% biotite, 40-50% chlorite, 5-20% calcite pseudobreccia veins, hornblende, quartz(?), and 0-10% pyrite-pyrrhotite. Felsic tuff mode: 5% actinolite, 40% calcite, 55% quartz and very fine-grained plagioclase and K-feldspar, and trace pyrite. Metasediment mode: 55% quartz, cherty, tuffaceous; 30% calcite; 0-5% very fine-grained graphite; 0-5% very fine-grained pyrite-pyrrhotite and 10% silt and clay. Flattening-bedding is 0-30° to core axis. Pseudobreccia veining largely tectonic(?); although some quartz-calcite veining and silicification (and sulfides?), chlorite may be hydrothermal, although original cross-cutting(?) relationships now tectonically obscured. Most sulfides in biotite-chlorite tuff.

**402.1'-430.1' Dark brown, dark green-grey-brown, fine-medium-grained semi-schist with fragmental texture. Originally lithic lapilli tuff, breccia flow, or tectonic breccia?** Original fragments to 2 cm. Mode: 20-40% muscovite, increasing with depth; 10-40% calcite; 20-40% bi-

otite; 0-20% chlorite; decreasing with depth; 3% K-feldspar phenocrysts(?) and felsic fragments; 10-30% quartz, with local silicification(?); 5% pyrite and pyrrhotite, trace chalcopyrite; and up to 30% argillic altered feldspar(?). Similar to other tuffs but mica recrystallization slightly coarser. Weak schistosity almost parallel to core axis. If breccia was tectonic, recrystallization has obscured deformational fabric.

**430.1'-601.5' Predominantly green-gray, fine-medium-grained andesitic-dacitic semischistose tuffs, tuffaceous metasediments and minor sulfide-graphitic argillite iron formation.** Typically chloritic, argillitic and somewhat calcareous; with quartz-calcite felsic fragments and plagioclase, quartz phenocrysts. Mode similar to above unit but with varying sulfide-graphitic argillite component and locally laminated in 430.1'-522.3'. Interval 522.3'-590.6' is a tuff with little graphitic argillitic dilution. Interval 590.6'-601.5' is a fine-coarse-grained, light-medium grey calcareous, tuffaceous, siliceous sandstone.

Unit is recrystallized, with flattening-shearing. Fabric is semi-schistose, locally phacoidal. Local boudinage and brecciation. Veining is very minor, quartz, calcite, pyrite. Sulfide amounts vary from 2-20% (average 5-7%) pyrite and trace-1/2%(?) chalcopyrite. Sulfides disseminated. Bedding occurs at various angles to core axis. Orientation of sheet silicates (schistosity) roughly 65° to core axis.

**601.5'-848.4' Black graphitic argillite and sulfide iron formation with locally tuffaceous intervals.** Textures grade from laminated to folded to brecciated intervals. Much flowage. Locally phyllitic. Argillite often slightly tuffaceous. Local scattered coarse-grained intraclasts-tuff fragments. Unit contains laminae of syngenetic sulfides (up to 60% of rock). Pyrrhotite predominates, with pyrite replacement 747'-793' and 820'-848.8'. Minor sulfide oxidation below 820'. Trace chalcopyrite. Locally broken 834'-844' with minor veinlets of pyrrhotite, pyrite, chlorite, calcite, chalcopyrite(?) and bornite(?). 720'-722' is quartz-pyrrhotite-calcite-pyrite-chalcopyrite vein. Other smaller scattered masses-attenuated veins 654'-678'.

Bedding occurs at all angles to core axis, while schistosity and shearing typically run 0-30° to core axis. Crystalline, shiny graphite often occurs on slip surfaces and slickensides.

**848.4'-1008' T.D. Interbedded black graphitic argillite-sulfide iron formation, green-grey tuffs and light grey siliceous tuffaceous sandstone.** Scattered lamination of lithotypes occur within each other. Iron formation similar to above unit (up to 60% sulfide), but gets more calcareous toward base. Tuffs and tuffaceous sandstone varies from green, more chloritic, to light grey, more siliceous coarser volcanoclastic-clastic. These beds contain up to 10% pyrite-pyrrhotite. Some of the more quartz-rich areas may be recrystallized cherts, or siliceous tuffs (namely 898'-899.7' 905.6'-906.3', 907'-907.6, 987'-989'). Other tuff beds with local very coarse lapilli-agglomerate are 848.4'-869', 928'-938.1' 945'-963.5' with scattered laminae, 982.5'-983.6' and 991.8'-1006.1'. Other intervals are graphitic argillite-sulfide iron formation. Below 873' unit contains scattered 1-

3 mm chloritic-calcareous fragments, with porphyroblastic growth(?).

Unit locally folded. Tuffs below 902' have local strain slip cleavage, 0-15° from core axis.

## Acid Test Results

Footage	Angle of Hole from Horizontal	Bedding Angle with Core Axis	Schistosity Angle with Core Axis
50	40	22	26
500	43	13?	13
792	46	45	45
1008	44	54	54

**Notes:** Twenty-six thin section heels have been cut. Forty-nine composite and thirteen individual samples have been assayed for gold. Analytical results follow in Table A-2. Detailed log is available for study.

## CONDENSED GEOLOGIC LOG FOR DDH A-5

Hole drilled at a 45° angle and an azimuth of 150°.

**0'-200' Overburden.**

**200'-280' No Core.**

**280'-430' Dark grey pyritic siltstone.** Somewhat phyllitic. Often laminated. Very slightly sideritic-calcareous. Core is locally broken and locally has limonite staining. Rock contains 1-5% pyrite, with higher amounts in 301'-310', 312'-322', 330'-337', 367'-368', 392'-430'. Minor weathered out grains-crystals smaller than 1 mm (carbonate? sulfides? evaporites??). White, siliceous, fine-grained sand laminae in basal 20'. Bedding measures 0-40° to core axis. Schistosity and tight fold axial planes measure 65-70° to core axis.

**430'-463' Dark-light grey siltstone grading into laminated siliceous (chert-chamosite) iron formation.** Somewhat sideritic laminated and pyritic (to 5%) in basal 30'. Both contacts have laminations with 50% dissolved out crystals. Basal 16' contains intraclastic conglomerate or boundinaged laminae.

**463'-547.7' Laminated chamosite-stilpnomelane(?) chert iron formation.** Typically dark green-light grey. Iron silicate to chert ratio equals about nine. Core locally broken. Laminae with dissolved out grains decrease downward. Magnetite lamina at 513.2'. Locally sideritic in laminae and few, thin veins. Locally several % (largely syngenetic) pyrite. This occurs as disseminations in chert (locally migrated toward chert rims), and in thin scattered veinlets. Quartz-sider-

ite veinlets also scattered. Most veins late, except 3 mm quartz vein with grunerite margins at 532.9'. Local coarse-grained clastic laminae at 471'.

**547.7'-811.3' Laminated-bedded, black-green-white, magnetite-chamosite-chert iron formation with lesser stilpnomelane and siderite.** Unit contains roughly 18% magnetite laminae (varies from 0% to 40% locally); 13% chert-siderite laminae (varies from 0%-40% locally); and 69% chamosite-stilpnomelane laminae (varies from 0%-95% locally). Below 622', lighter colored beds are more sideritic, less cherty. Basal 40' is fairly sideritic (20%?, with some as porphyroblasts) and slightly graphitic. 799.8'-800.1' and 804.4-804.7' is black, somewhat vuggy and leached(?). These intervals and scattered intervals below 703.5' have white crystals (sulfates) growing on core. Local load casting and soft sediment deformation. Laminae truncate others at 711' (younging downhole?). Basal 17' with disrupted beds-brecciation. Minor dissolved out grains 615.8'-616.4'. Bedding subparallel to flowage with associated en echelon fractures (and quartz-siderite veins) increasing downward. Local bed disruption-brecciation in basal 16'. Minor quartz-siderite ± pyrite ± calcite veins locally throughout.

**811.3'- 827' Brecciated, silicate iron formation (above 819') grading into sulfide iron formation (below 819'). 811.3'-819' largely interbedded green chamositic(?) and white-light grey cherty iron formation.** Brecciated, with deformation increasing downward. Chert tends to behave more brittlely, while iron silicates flow. Unit contains local disrupted argillite fragments-laminae (less ductile than iron silicates). Chert and disseminated-laminated pyrite (0-7%) increase downward. Minor pyrite, quartz, siderite veins. Unit 10% siderite in general. Chert may be clastic.

**819'- 827' deformed, medium-dark grey-brown siliceous pyritic argillite (sulfide iron formation) with minor chert.** Brecciated at top, grading into rock with much flattening (mylonitic) and flowing. Locally recrystallized-silicified. Local chert, solutioned out crystals, and/or poor core recovery. Pyrite varies from 7% to 25% as very fine-grained pyritic mud; scattered, coarse, deformed crystals; and minor pyrite veinlets.

**827'-1332' T.D. Black, sulfide iron formation (pyritic-graphitic argillite).** Both pyrite and graphite decrease with depth, while rock becomes more sideritic, clastic, siliceous, and lighter colored. Local very coarse-grained graded beds become finer downhole. Rock is somewhat phyllitic with generally conformable bedding and moderately developed schistosity. Slip laminae, flattening and boudinage are common, with scattered, local, minor fold closures. Pyrite ranges from 50% at top of unit to 7% at base. Pyrite occurs as syngenetic laminations (some brecciated-vuggy); disseminations; local very coarse-grained concretionary(?) masses, with a slight green tinge (marcasitic appearing), minor gypsum growth on core; and minor cross-cutting pyrite-sideritic veinlets.