Lithology Logging

PURPOSE

This document contains the procedure for lithology logging at Rocklands and gives detailed descriptions of the lithologies, mineralisation and alteration minerals present in the area.

SCOPE

This procedure applies to all geologists employed by or contracted to CuDeco Ltd.

ACTION

Quantifiable geology

Quantifiable Lithology logs record metre by metre the colour, lithology, percent of alteration minerals related to mineralisation, percent of ore minerals and oxidation state. Further to this, reverse circulation drilling requires fields for magnetic susceptibility, sample wetness and bulk weight of the recovery bags to be completed.

The following fields are emphasized in the quantifiable geology log. Tables 2 to 3 list the codes:

- Lithology: Major and, if relevant, minor lithology is required (Lith1, Lith2), these are described in the Rocklands Project Logging Kit.

- Colour: A single colour that summarizes the chips over the 1 metre is required. Only colour codes in the Explorer 3 library are used. These are derived from the Munsell colour chart and are concise but comprehensive for natural rocks. A colour chart is employed to standardise observations, generally only up to 2 colours need to be recorded (Colour1, Colour2). Emphasis is placed on the more important obvious colour changes related to oxidation, primary rock lithology and alteration, rather than worrying about subtle variations. The second colour is used if rock is speckled or mottled.

- Main Alteration and Mineralization Minerals: The minerals that are related directly to oxidation, alteration and mineralization are the ones that are important to be quantified. It is not relevant to quantify rock forming mineral content in unmineralized, unaltered rock. As an example close to 100% of the minerals associated with infill vein and hydrothermal breccia are recorded eg. Calcite (CAL), quartz (QZ), pyrite (PY), chalcopyrite (CCP), actinolite (ACT), magnetite (MGT), biotite (BT). Whereas generally 0% of the mineral content of massive unaltered dolerite is recorded. Within the oxide zone, iron oxide (FEOX) content is recorded as a means of delineating oxidized and partially oxidized and fresh zones.

- The level of oxidation (Oxidation State) is recorded as: OX (oxidised), POX (partially oxidised), FR (fresh). Magnetic Susceptibility is an important aid to logging the lithologies. To be of most benefit, mag sus data needs to be collected as the holes are drilled, so the logger can make use of the information. Mag sus can be collected by geotechs or field hands as long as there is supervision and quality control by the geologist.

The tables below list the codes utilized across the Rocklands Project, Las Minerale Central data set.

Lithology Logging

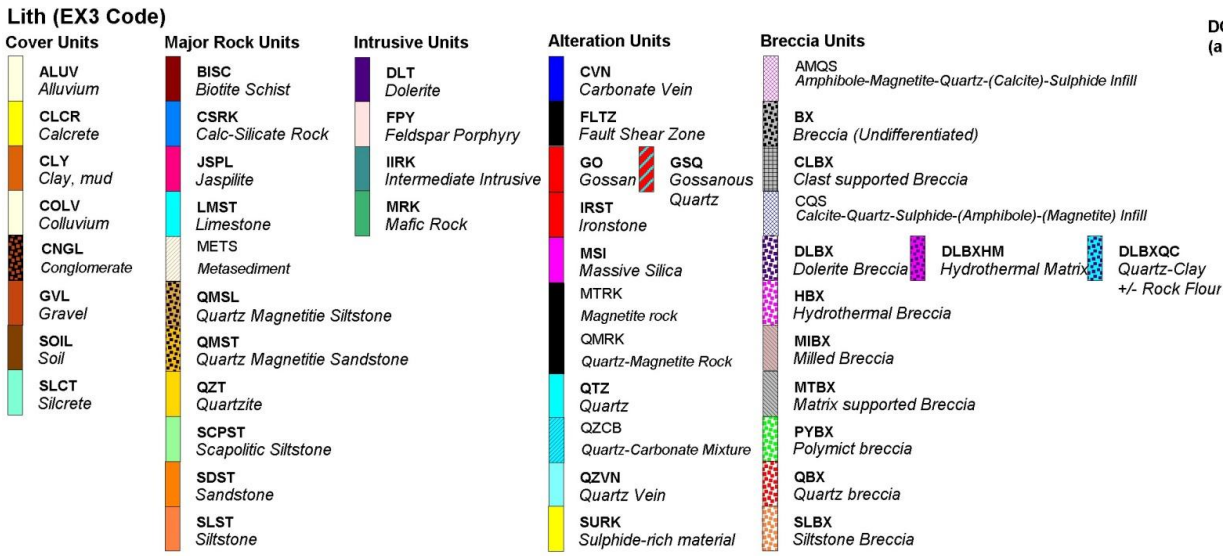
Code	Cudeco Rocklands Explorer 3 Lithology Codes
LITH	Lithology
ALUV	Alluvium
AMQS	Amphibole-magnetite-quartz-(calcite)-sulphide vein/infill
BISC	Biotite Schist
BX	Breccia (undifferentiated)
CAV	Cavity
CLCR	Calcrete
CLY	Clay
COLV	Colluvium
CQS	Calcite-quartz-sulphide-(amphibole)-(magnetite)-(red feldspar) vein/infill
CSRK	Calc silicate rock
CVN	Carbonate vein
DLBXHM	Dolerite breccia, hydrothermal matrix
DLBXQC	Dolerite breccia, quartz,clay,+/- rock flour matrix
DLT	Dolerite
DYKE	Dyke
FLTZ	Fault-shear zone
GO	Gossan
GSQ	Gossanous quartz
HBX	Hydrothermal breccia
IRST	Ironstone
JSPL	Jaspilite
LMST	Limestone
METS	Metasediment
MTRK	Magnetite rock
PYBX	Polymict breccia
QBX	Quartz breccia
QHBX	Quartz hematite breccia
QMRK	Quartz magnetite rock
QMSL	Quartz magnetite silstone
QMST	Quartz magnetite sandstone
QTZ	Massive quartz
QZCB	Quartz carbonate mixture
QZT	Quartzite
QZVN	Quartz vein
SCPST	Scapolitic siltstone
SDST	Sandstone
SLBX	Siltstone breccia
SLCT	Silcrete
SLST	Siltstone
SND	Sand
SOIL	Soil
SURK	Sulphide rich material
CALBX	Calcareous Breccia

List of Explorer 3 Lithocodes

Lithology Logging

	Cudeco Rocklands Explorer 3 Colour Codes				
Code	Colour	Code	Colour	Code	Colour
BK	Black	GYYE	Grey Yelllow	ORPI	Orange Pink
BR	Brown	LBLGR	Light Blue Green	OV	Olive
DBR	Dark Brown	LBLGY	Light Blue Grey	PI	Pink
DGR	Dark Green	LBR	Light Brown	PIGY	Pink Grey
DGRYE	Dark Green Yellow	LBRGY	Light Brown Grey	RE	Red
DGY	Dark Grey	LGRGY	Light Green Grey	REBR	Red Brown
DRE	Dark Red	LGRYE	Light Green Yellow	REOR	Red Orange
GR	Green	LGY	Light Grey	WH	White
GRBK	Green Black	LOR	Light Orange	YE	Yellow
GRBR	Green Brown	LOV	Light Olive	YEGR	Yellow Green
GY	Grey	LPI	Light Pink	YEGY	Yellow Grey
GYBL	Grey Blue	LRE	Light Red	YEOR	Yellow Orange
GYGR	Grey Green	LYEBR	Light Yellow Brown		
GYOR	Grey Orange	OR	Orange		

List of Explorer 3 Colour codes



Legend and Explorer 3 lithocodes, used on Rocklands project, Las Minerale Central.

Lithology Logging

Detailed Descriptions

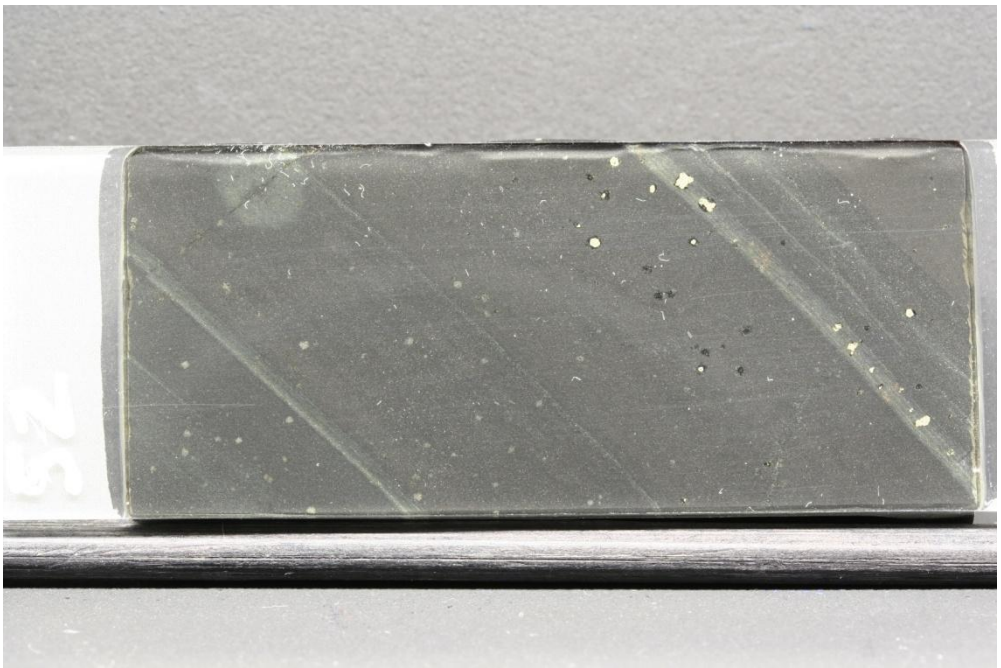
This section documents the logging codes used at Rocklands. Each lithology, alteration, mineralisation type is described and illustrated.

Lithology

Dolerite (DLT) – Colour : generally dark green (DGR), green brown (GRBR) , green grey (GYGR), green black (GRBK). Grainsize: generally medium to coarse grained. Mag Sus: generally high (20 – 100). Distinguishing Features: Well formed plagioclase laths (1-3mm), intergrown with irregular ferromagnesian minerals, mostly amphibole. Percussion chips are sub angular to sub rounded.

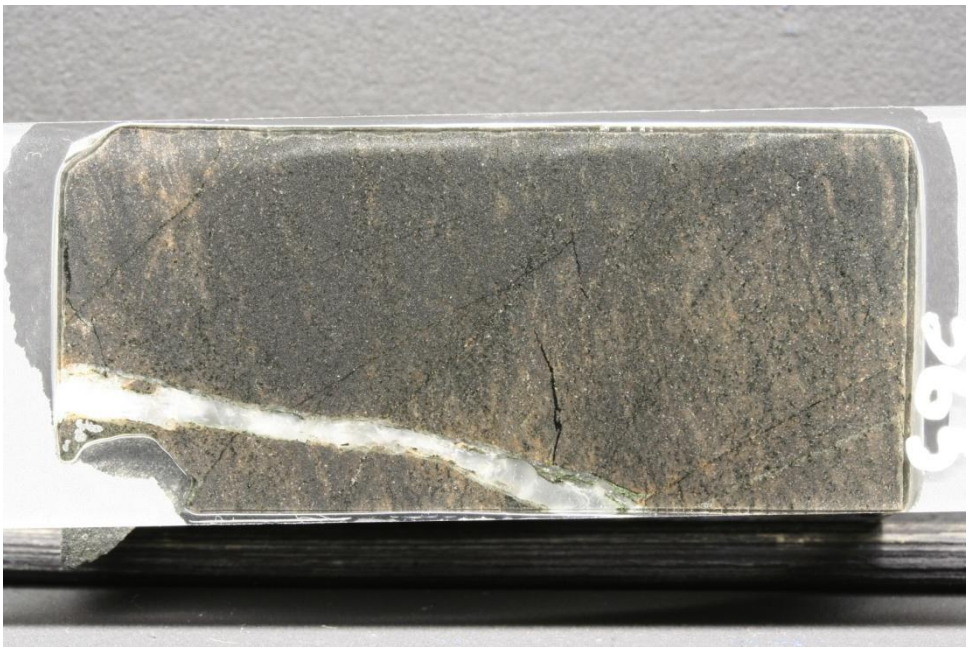
Lithology Logging

Siltstone (SLST) – Colour: generally grey (GY), greenish black (GRBK), green grey (GRGY), Light brownish grey (LBRGY). Grainsize: fine grained. Mag Sus: generally low (<5), although can be high if magnetite bands are present (>100). Distinguishing Features: Often difficult to determine any minerals. Can be banded. Percussion chips are angular with chonchoidal fracture. Often silicified.



Lithology Logging

Sandstone (SDST) /Quartzite (QZT) – Colour: generally grey (GY) or pinkgrey (PIGY). Grain size: medium grained. Mag Sus: generally low (<10), although can be high if magnetite bands are present (>100). Distinguishing Features: Can usually make out rounded quartz grains. Sub-Angular to angular chips, chonchoidal fracture. Often silicified.

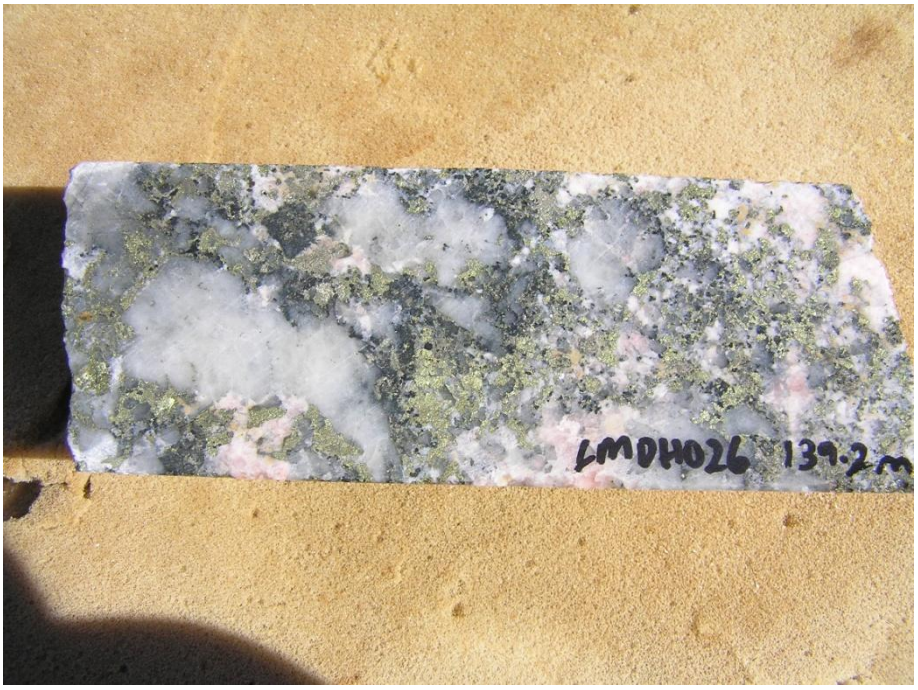


Lithology Logging

Quartz Magnetite Sandstone (QMST) – Colour: black (BK) Grey (GY). Grainsize: medium grained. Mag Sus: high (>100). Distinguishing Features: Highly magnetic, black bands granular magnetite.

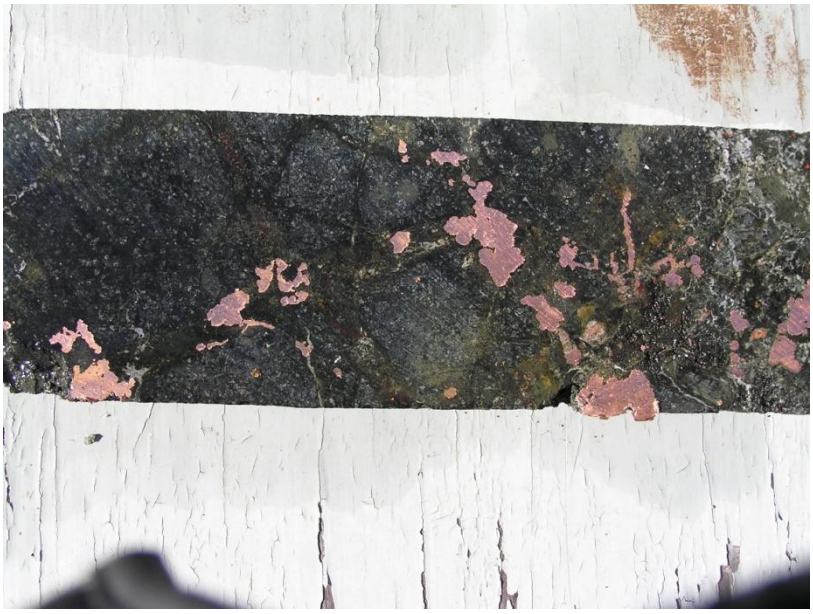
Lithology Logging

Hydrothermal Breccia (HBX) – Colour: Light Grey (LGY),Grey (GY), Light Pink (LPI) . Grainsize: coarse grained. Mag Sus : can be low (<10) but if coarse magnetite present can be very high (>100). Distinguishing Features: Sulphides present as coarse well formed pyrite and splashes of chalcopyrite. Sulphide occurs as coarse infill with calcite and quartz, coarse magnetite. These minerals often occur as breccia infill to green amphibole, black flakes of magnetite



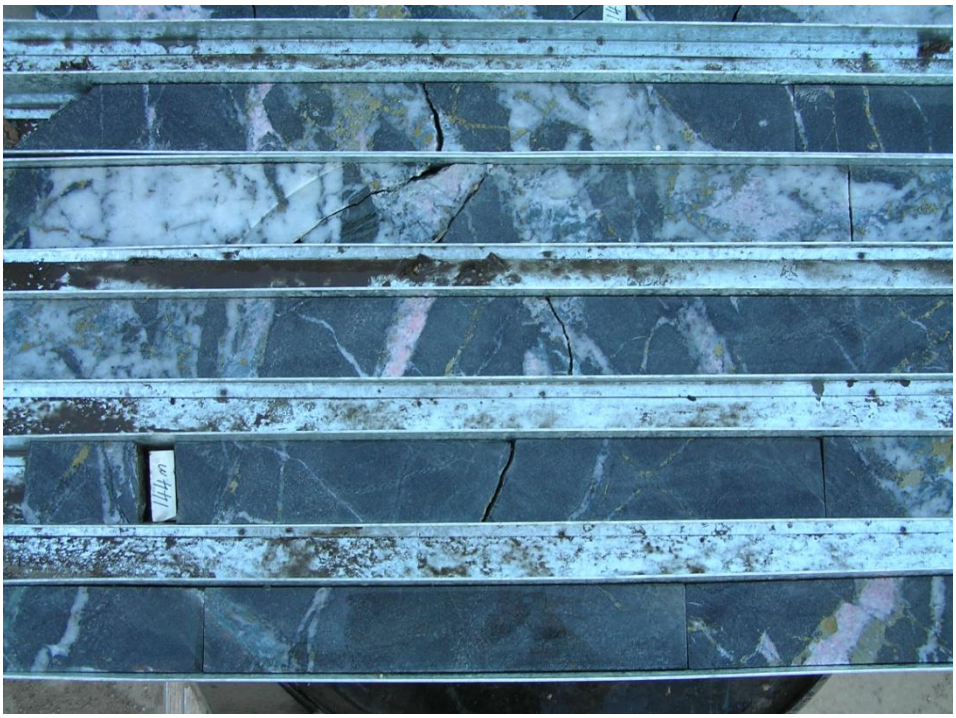
Lithology Logging

Dolerite Breccia with Quartz Clay (+/- Rock flour) Matrix (DLBXQC) – Colour: generally green grey (GRGY), light olive (LOV), Green brown (GRBR). Grainsize: coarse grained. Mag Sus: mostly low (<10). Distinguishing Features: Generally dolerite clasts, occasionally polymict clasts which are clast supported in a matrix dominated by quartz, green clay. Green clay (nontronitic) is derived from supergene weathered biotite-albite-amphibole and some rock flour. This dolerite breccia is generally partially oxidized and associated with native copper. May be difficult to detect in chips, but abundance of quartz and abundant clay are strong indicators.



Lithology Logging

Dolerite Breccia with Hydrothermal Matrix (DLBXHM) – Colour: generally green grey (GRGY), white (WH). Grainsize: coarse grained. Mag Sus: variable can be low when dominated by calcite-quartz-sulphide (<10), but also high when dominated by dolerite clasts (>100). Distinguishing Features: Dolerite clasts, broken up by hydrothermal matrix of calcite, quartz and sulphide (chalcopyrite and pyrite)

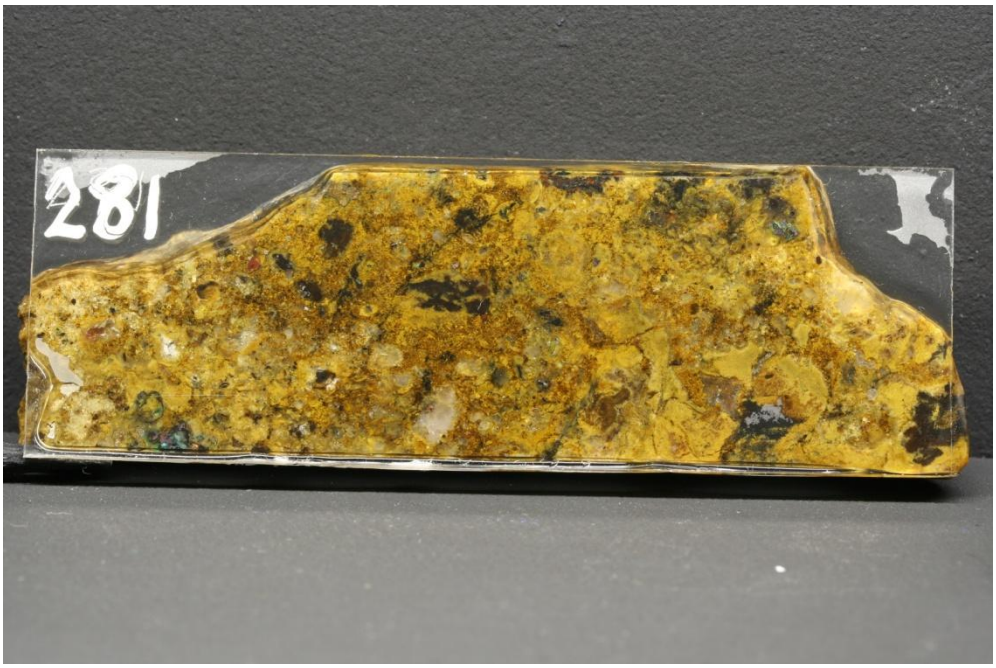


Lithology Logging

Polymict Breccia (PYBX) – Colour: generally green grey (GRGY). Grainsize: coarse grained. Mag Sus: mostly low (<10). Distinguishing Features: Wide variety of clasts, including coarse quartz, siltstone, quartz magnetite, and dolerite occur in a green clay matrix (possible dolerite rock flour matrix). May be difficult to detect in chips, but abundance of quartz, polymict fragments and abundant clay are strong indicators. Closely packed suggesting formed by collapse in places.

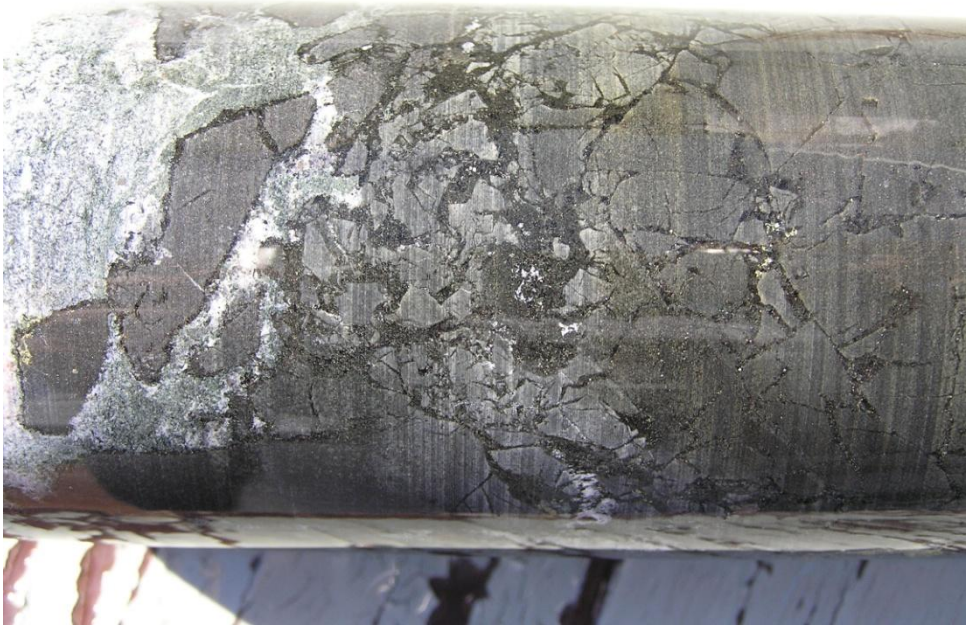
Lithology Logging

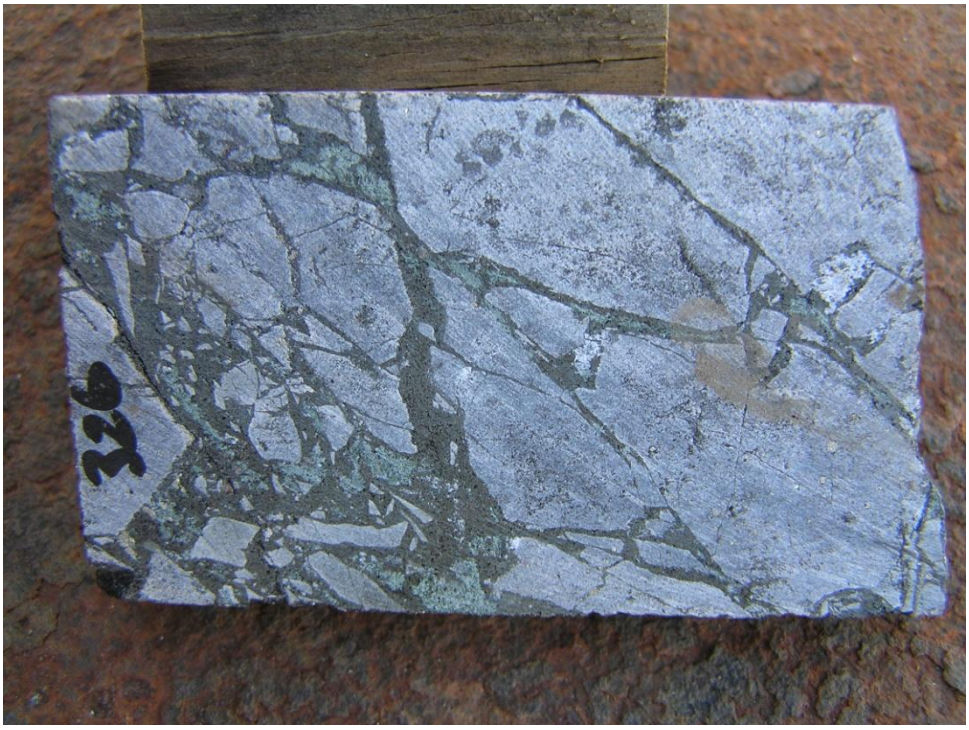
Quartz Breccia (QBX) – Colour: generally grey (GY) or various browns where oxidized. Grainsize: coarse grained. Mag Sus: mostly low (<5). Distinguishing Features: Angular quartz clasts, with intensely silica altered clasts. Matrix can be fine grained silica, clays or weathered products. May be difficult to detect in chips but abundance of quartz and silicified matrix are good indicators



Lithology Logging

Siltstone Breccia (SLBX) – Colour: generally Black (BK). Grainsize: fine grained. Mag Sus: mostly low (<5).. Distinguishing Features: Siltstone clasts, secondary biotite selvedges. May be difficult to detect in chips, siltsone fragments and alteration minerals are good indicators.





Lithology Logging

Mafic Dyke Rocks (MRK, DYKE) – Colour: generally grey or green grey (GY, GRGY), Grainsize: fine grained. Mag Sus: generally high (20 – 100). Distinguishing Features: Fine grain size, sharp contacts with dolerite and sediments. Difficult to pick out minerals.

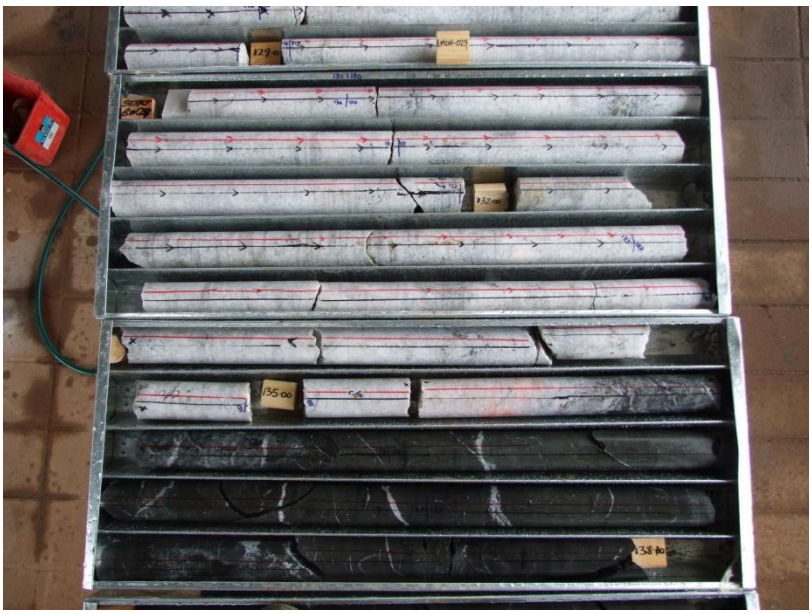
Calcrete (CLCR) – Colour: various light browns, white and grey Grainsize: fine grained, massive textured. Mag Sus: low (<1). Distinguishing Features: Forms in surficial environment, often as nodules. Best developed on weathered dolerites. Fizzes in acid.

Silcrete (SLCT) – Colour: various light browns, white and grey. Grainsize : fine grained, massive textured. Mag Sus: low (<1). Distinguishing Features: Very hard, massive silica replacement and cement. Forms in surficial environment, often as boulders.

Lithology Logging

Colluvium (COLV) – Colour: various reds, browns, yellows eg. REBR, DBR, REOR, YEOR. Grainsize: Coarse grained. Mag Sus: low (<10). Distinguishing Features: Polymict character, clay matrix, oxidized.resistant rocks eg. Quartzite, quartz vein. Usually a thin layer of resistant rocks carried down from higher ground and overlying bedrock.

Carbonate Vein (CVN) – Colour: white (WH), Light pink (LPI). Grainsize: Coarse grained. Mag Sus: low (<10). Distinguishing Features: Coarse sparry calcite, some minor sulphide.



Lithology Logging

Quartz Vein (QZVN) – Colour: white (WH), Light grey (LGY). Grainsize: Coarse grained. Mag Sus: low (<10). Distinguishing Features: Coarse quartz, some minor sulphide.

Calcite-Quartz-Sulphide (CQS) – Colour: Grey (GY) or White (WH). Grainsize: coarse grained. Mag Sus: can be moderate (<1-30) but if coarse magnetite present can be very high (>100). Distinguishing Features: Vein and breccia infill dominated by carbonate with prominent quartz and sulphides. Can have associated amphibole, magnetite and red feldspar. Sulphides present as coarse well formed pyrite and splashes of chalcopyrite. These minerals often occur as breccia infill to amphibole rich sections and country rock (dolerite or siltstone) breccias. This lithology is a subtype of hydrothermal breccia.

Lithology Logging

Amphibole-Magnatite-Quartz-Carbonate-Sulphide (AMQS) – Colour: Green (GR) or Black (BK). Grainsize: coarse grained. Mag Sus: generally high, particularly if magnetite present (30 to >100). Distinguishing Features: Vein and breccia infill dominated by masses of fibrous actinolite, coarse granules of magnetite, quartz, with sulphide and plus/minus carlcite. Can be associated with carbonate-sulphide infill. Sulphides present as coarse well formed pyrite and splashes of chalcopyrite. This lithology is a subtype of hydrothermal

Calcareous Breccia (CALBX) – Colour: Mostly red-brown clasts with a white or dark green matrix. Grainsize: The clasts vary from fine grained sandstone to siltstone. Distinguishing Features: This lithology contains clasts of red-feldspar altered siltstone in a matrix of calcite and/or amphibole. Small (~5mm) specular hematite crystals are locally present in the calcite matrix. This breccia is thought to be part of the Corella formation.

Lithology Logging

Calc-arenite (CALR) – Colour: Mostly white to light grey. Grainsize: Sandstone sized grains. Distinguishing Features: Calcareous sandstone dominated by grains of quartz and calcite. The main distinguishing feature of this lithology with calc-silicate is the lack of abundant fibrous actinolite and other calc-silicate minerals (scapolite, diopside, epidote etc.). The below example contains magnetite, amphibole and red-feldspar alteration and has been moderately silicified.

Lithology Logging

Alteration and Mineralization Minerals

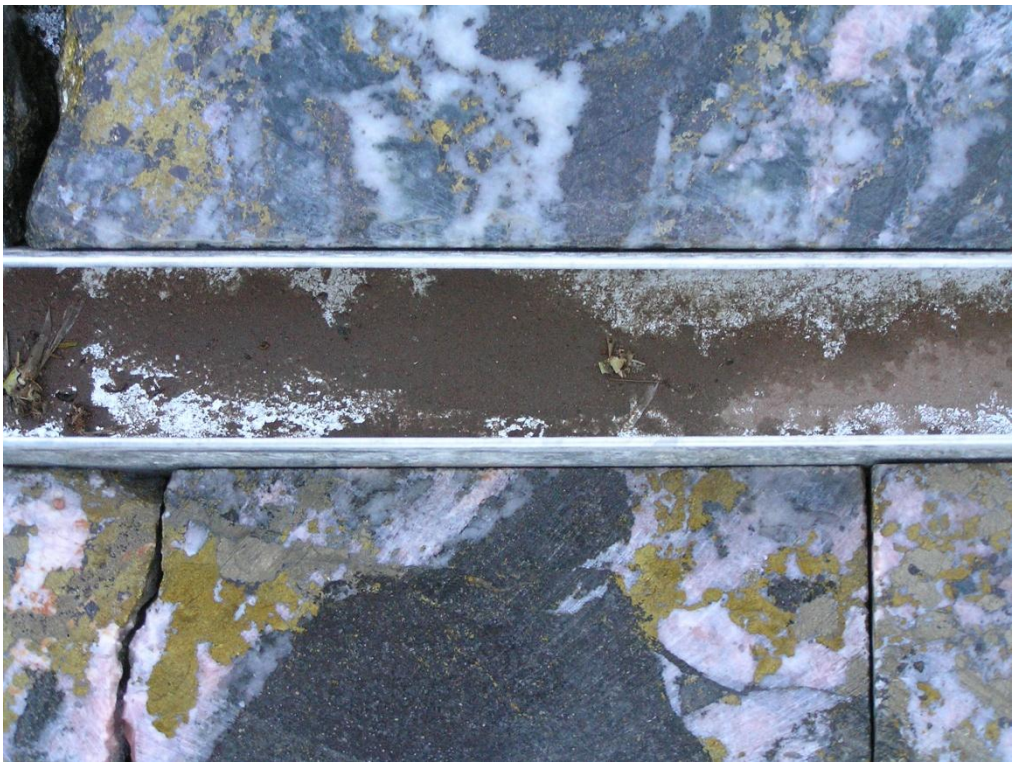
Undifferentiated Feldspar (FELD) This is red feldspar that is probably mostly albite but could be K-feldspar in places. It probably relates to early phase mineralization as it tends to be found in calcite-quartz-sulphide veins in dolerite and not in the mineralized infill within the structure itself. As it is conspicuously red it is not difficult to count in chips as a percentage.

Lithology Logging

Pyrite (PY) This is often the most abundant sulphide. It is mostly coarse, well formed and more silvery than chalcopyrite. It is a very good indicator of the level of hydrothermal activity. Go through the chips and establish the level of pyrite development as ranges: For example: trace amounts which can be recorded as 0.1-0.2%; 0.5-3% for weakly mineralized, 5-10% for moderately mineralized and 25-50% for massive and semi massive mineralization. Then settle on a final percentage for each meter.

Chalcopyrite (CCP) Everyone should ensure that they can confidently distinguish chalcopyrite from pyrite. It has a more golden colour, forms ragged interstitial grains and is common down to trace amounts but usually associated with veining, hydrothermal brecciation. Go through the chips and establish the level of chalcopyrite development as ranges: For example: trace amounts which can be recorded as 0.1-0.2%; 0.5-3% for weakly mineralized, 5-10% for moderately mineralized and 20-30% for massive and semi massive mineralization. Then settle on a final percentage for each meter.

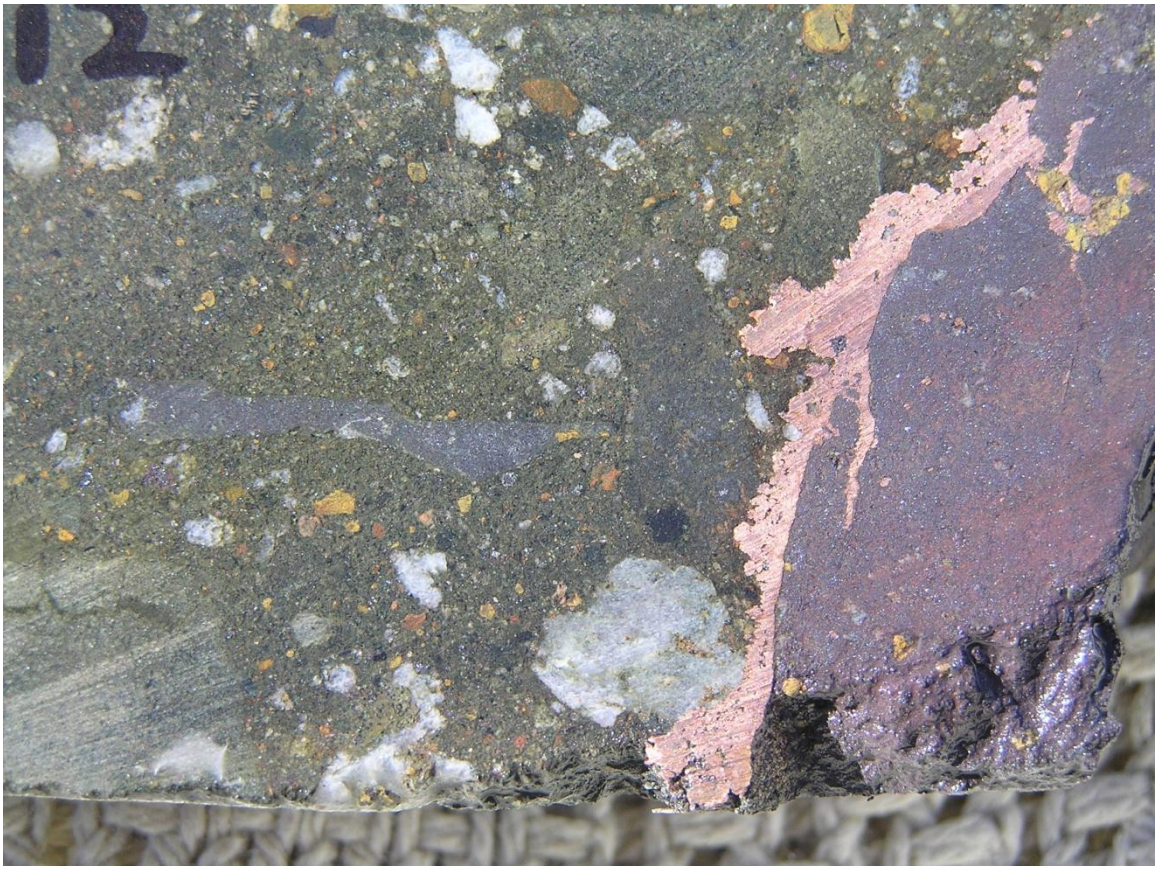
Lithology Logging



Lithology Logging

Native Copper (NATCU) Native copper is often nuggety, it is usually associated with green clay or deep oxidation, particularly in the dolerite or dolerite breccias Native Copper can also be found as veinlets in fresh dolerite in primary zone. When coarse grained, it is often easily spotted. However if native copper is suspected but not noted in the chip trays, the fines have often to be re-sieved. Detection of native copper is one of the reasons that the geologist should be at the rig during drilling, they are then on hand to re-sieve or pan potential native copper zones. Native copper is recorded as visual estimated volume percentages. Trace percentages are recorded as 0.1-0.2%. The presence of iron as blocks of magnetite or hematized magnetite can trigger the precipitation of native copper. Similarly native copper grows in clay altered dolerite breccia with a rock flour matrix as there often has been a fine dusting of largely oxidized magnetite. Copper being a strong chalcophile element will combine with any sulphide present to form supergene chalcocite before any native copper is formed. Therefore native copper and sulphides tend to be mutually exclusive.

Lithology Logging



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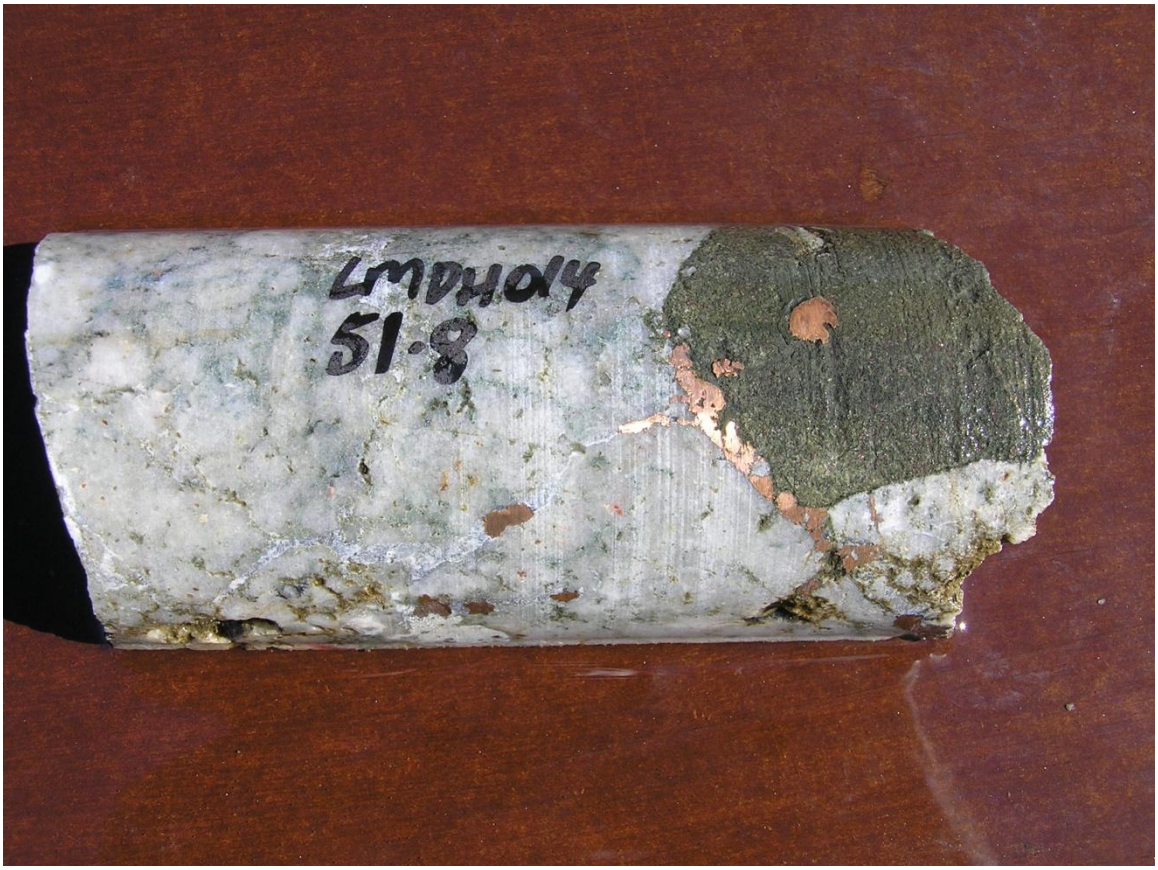
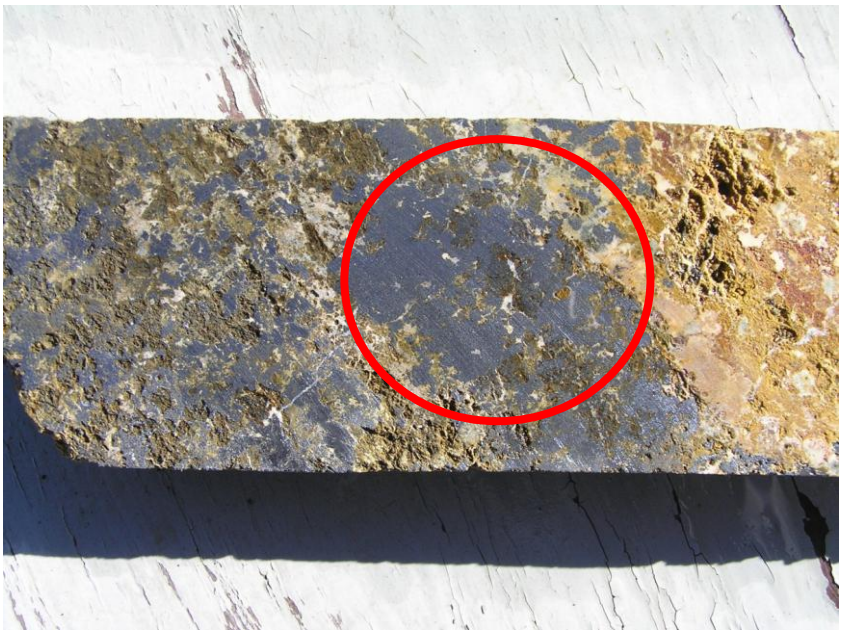


Lithology Logging

Malachite (MAL), Cuprite (CUP), These secondary copper minerals can be occasionally present in oxidized zone. Cuprite is grey, metallic and has ruby red internal reflections in strong light. Malachite is green and can be associated with aqua chrysocholla .They can all be logged as estimated percentages.

Lithology Logging

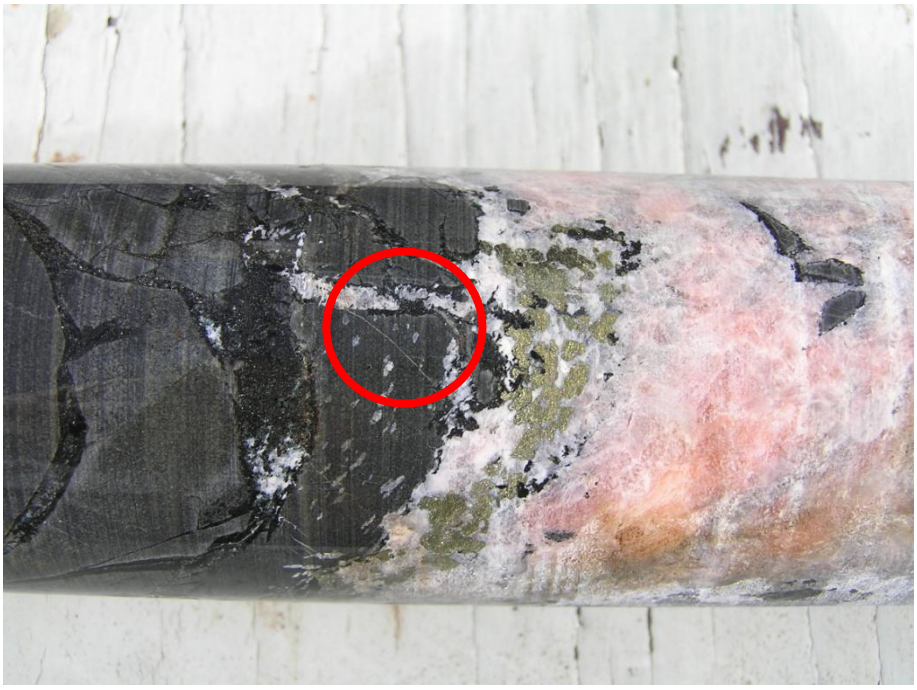
Chalcocite (CC), Supergene copper mineral which can be present associated with structurally controlled deep oxidation. Often adjacent to partially oxidized native copper bearing zones, also replacing sulphides just below oxidation interface. Note that some of the massive chalcocite indicates late replacement of pyrite by chalcocite and bornite which suggests that this portion of chalcocite may be late hypogene rather than supergene (as discussed in Dr. Ashley's Petrographic report). Black sooty mineral, often massive but can form squat crystals. Chalcocite is logged as estimated percentages. Can occur in Oxidized, Partially Oxidized and Fresh sections of core.



Lithology Logging

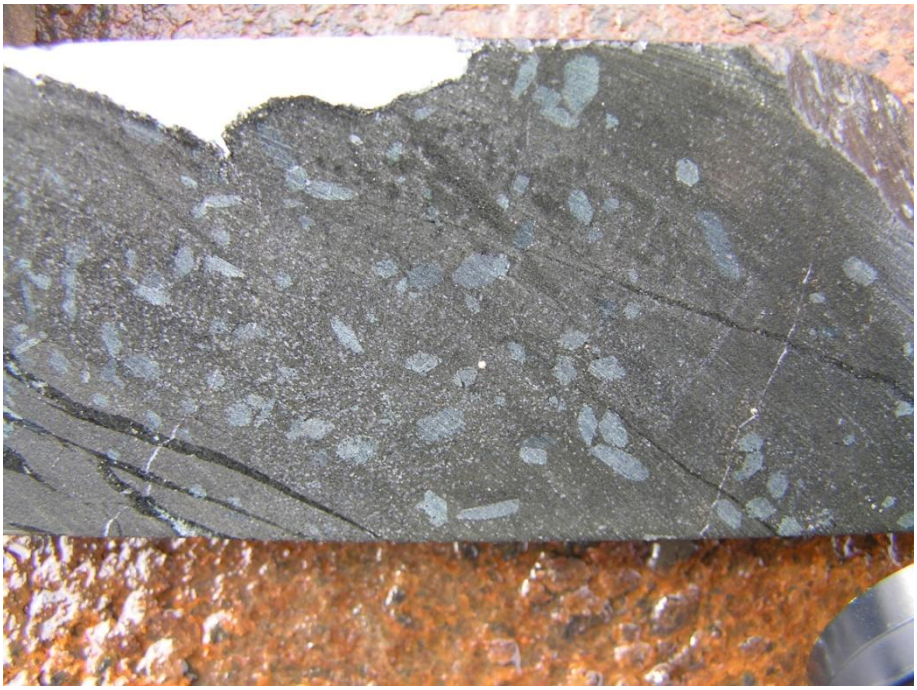
Lithology Logging

Biotite (BT). Secondary biotite is an important early stage of alteration. It appears during the early formation of jigsaw breccias. It is black in colour. Forms coarse flakes often mantling clasts. Note that some of the biotite is actually stilpnomelane but it will be difficult to distinguish from biotite as it is just mica (iron rich end member).



Lithology Logging

Actinolite (ACT). Actinolitic amphibole is an early phase of infill along the mineralized structure. It forms green fibrous masses. It is often broken up and infilled with quartz-carbonate sulphide. Actinolite is also associated with calcite-sulphide –red feldspar veins cutting the country rock units.

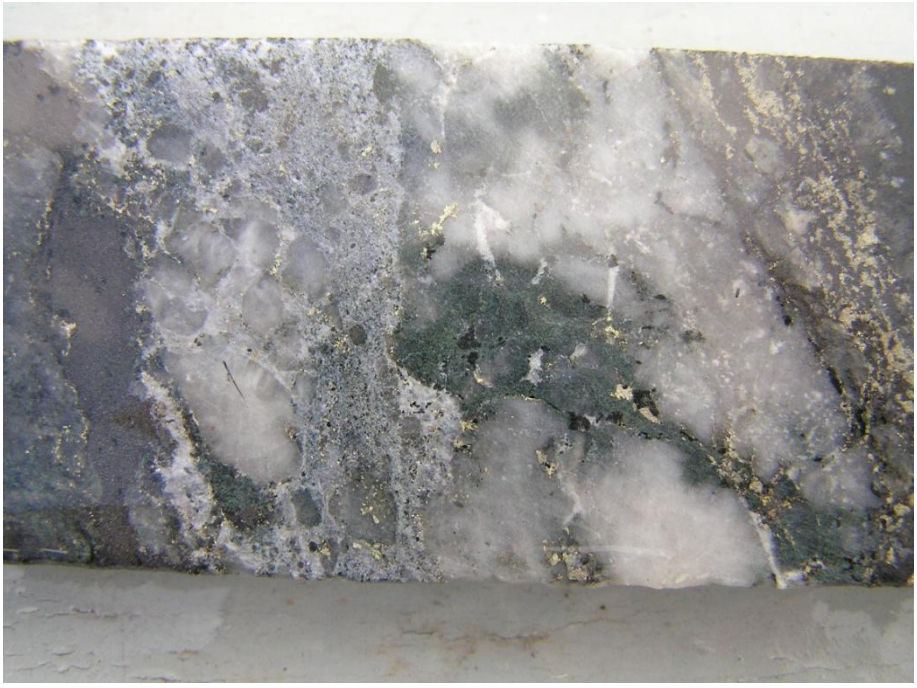


Lithology Logging

Scapolite (SCP). The presence of scapolite is probably both a regional metamorphic and a local hydrothermal feature. It is used as evidence of evaporites in the sequence and is argued as a strong indication for the mineralising fluids being developed from basinal brines. It is most conspicuous as prominent spots developed in dolerite peripheral to the mineralized structure. This relationship suggests that scapolite is part of the alteration story at Las Minerale and should be recorded for future modeling of the mineralizing system.

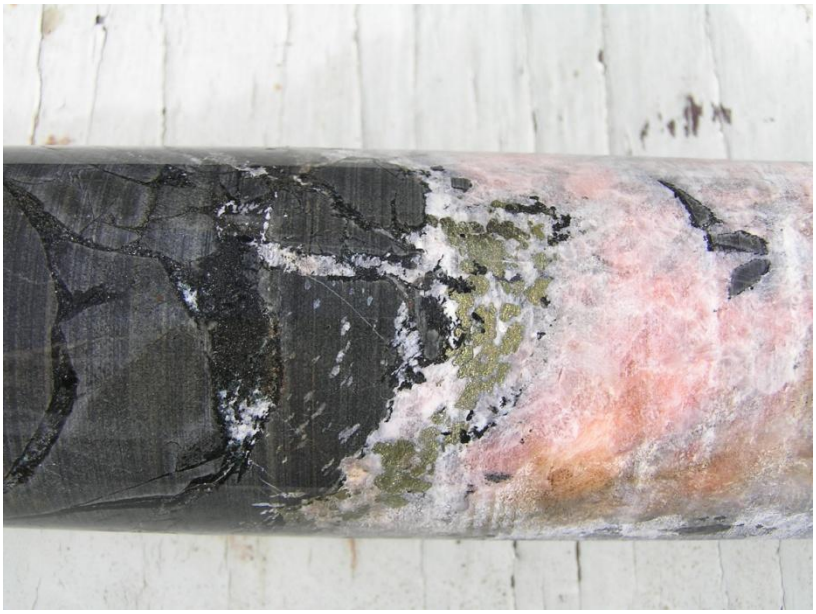
Lithology Logging

Quartz (QZ) This is coarse quartz related to alteration, mineralization and/or fissure and breccia matrix filling. As it is conspicuously white or milky, it is not difficult to count in chips as a percentage. All coarse quartz should be entered into this field. At Rocklands, I don't see any advantage separating quartz vein material from other coarse hydrothermal quartz (eg, breccia infill). Note that we are ignoring normal rock forming quartz, eg. Original quartz grains in a sandstone.



Lithology Logging

Calcite (CAL) This is coarse sparry calcite related to alteration, mineralization and/or fissure and breccia matrix filling. As it is conspicuously white or light pink, it is not difficult to count in chips as a percentage. It gets up to 90% in calcite veins and vein infill. All coarse hydrothermal calcite should be entered into this field. At Rocklands, I don't see any advantage separating calcite vein material from other coarse hydrothermal calcite (eg, breccia infill). Note that we are ignoring normal rock forming carbonate, eg. Original carbonate in a limestone.



Lithology Logging

Silicification (SI) This is fine grained silica introduced during alteration and mineralization by hydrothermal solutions. Note that it is separate from coarse quartz vein material and rock forming mineral quartz present in original quartz grains in the rock. At Rocklands, I have been recording SI in relation to silicified siltstone and siltstone breccia. Accurate visual estimates can be difficult as they are quite subjective. My suggestion is 10% for silicification where the rock is obviously indurated with secondary silica, 30-40%, perhaps higher, where the original texture has largely been replaced by fine grained silica. Bear in mind that you have to allow for the other components of the rock that take it up to 100%.

Iron Oxide (FEOX). This is iron oxide that is worthwhile recording, as it quantifies the impact of oxidation. It is various shades of red, yellow or brown. Accurate visual estimates are difficult. My suggestion is 1-3% (say 2%) for weak fracture controlled oxidation. 5-10% for moderately weathered rock and 25-40% for strongly weathered rock. Bear in mind that you have to allow for the other components of the rock that take it up to 100%.

Clay (CLAY). The only clay that appears relevant to the mineralizing system at Rocklands is the green clay/green rock flour associated with the supergene and native copper zones within deeply oxidized dolerite/dolerite breccia. To be useful in modeling it will be important to restrict the recording of clay to this green clay. In other words ignore clay due to weathering of unaltered rocks.

Magnetite (MGT). Magnetite is present at Rocklands as both a normal rock forming mineral (particularly as bands in quartz magnetite sandstone and as granules in dolerite), it also occurs as a hydrothermal mineral within the hydrothermal breccia. It is the latter hydrothermal magnetite that we wish to quantify in terms of the mineralization model. It is typically coarse grained and forms black masses associated with secondary biotite, amphibole, sulphide, carbonate and quartz. Hydrothermal magnetite needs to be emphasized in the quantifiable geology logging. No attempt should be made to quantify rock forming magnetite, as this will confuse the issue. Magnetic susceptibility measurements will help delineate all magnetite rich zones throughout the rocks of the project area. Hydrothermal magnetite can be distinguished by its mineral associations.

Lithology Logging

Other Important Quant Geology fields

Magnetic Susceptibility. Mag Sus is an important aid to logging the lithologies as well as a tool to determine the appropriate RC downhole survey intervals. To be of most benefit, data needs to be collected as the holes are drilled so the logger can make use of the information. Mag sus can be collected by geotechs or field hands as long as there is supervision and quality control by the geologist. The important steps are to ensure that the instrument is zeroed between readings and the reading is taken before the second beep. On the basis of existing data it is obvious that mag sus is a good discriminator between lithologies. Note that here is a wide variation in total magnetite content in some lithologies (eg. Dolerites due to oxidation states and sandstone/ siltstone due to magnetite abundances).

Oxidation. This is a simple code OX = oxidized, POX = partially oxidized, FR = Fresh. The content of estimated Iron Oxide (FEOX) together with colour, particularly Reds, oranges, browns, should be consistent with the oxidation codes. The Base of Complete Oxidation (BOCO) has been recorded for all holes on the hole location table. It relates to the surface above which all minerals are oxidized, particularly pyrite. The Base of Partial Oxidation (BOPO) relates to the surface below which the partial oxidation of certain minerals or certain intervals stops. Deeper oxidation occurs along some structures and can extend to considerable depth. The point in a hole where the final depth of oxidized or partially oxidized rock occurs has been labeled FDOX (Final depth of Oxidation).

Bulk Weight. This is given as a percentage of the recovery bag. A hundred percent recovery is approximately ninety percent of the recovery bags capacity.

Example Logging Sheets

Below are some hand written and spreadsheet versions of quantifiable geology logs.

Log 1: LMDH007: 60-90m: Oxidised native copper bearing breccia. Fields logged include Lithology, colour, calcite (as vein and infill), quartz (as vein and infill), iron oxide, oxidation type, mag sus, native copper, and chalcocite.

Log 2: LMDH006: 120-150m: Mineralised fresh hydrothermal and dolerite breccia. Fields logged include Lithology, colour, colour2, calcite (as vein and infill), quartz (as vein and infill), actinolite, biotite, pyrite, chalcopyrite, oxidation type, mag sus

Log 3: LMDH002: 0-30m: Top of hole, oxidized colluvium and dolerite. Fields logged include Lithology, colour, calcite (as vein and infill), quartz (as vein and infill), undifferentiated red feldspar, iron oxide, pyrite, oxidation type, mag sus.

Lithology Logging

Log 1: LMDH007: 60-90m: Oxidised native copper bearing Breccia

Terra Search Pty. Ltd. QUANTIFIABLE GEOLOGY LOG

Company: Cudeco | Project: ROCKLANDS
Hole ID: LMDH007 | Geologist: SMB | Date Logged: 2/4/2007

Depth		Character					(%) Alteration Minerals Related to Mineralization												Vein Minerals		Ore Minerals										
From	To	Colour	Lith 1	Lith 2	Geo Unit	Alt 1	Chlorite	Sericite	Epidote	~~Carbonate~~ Calcite	Silicification	~~Massive~~ Quartz infill Veins	Clay	Magnetite	Albite	Kspar	Amphibole	Feldspar Undiff	Pyrite	Vein Carbonate	Vein Quartz	Malachite	Chalcopyrite	Cuprite	Native Copper	Sphalerite	~~Galena~~ Oxidised	Oxidised	Hematite	Fe-oxides	Grainsize	Colour 2	Mag Sus
60.00	61.00	GRBR	DLBX									2	20												3			OX		20			1.16
61.00	62.00	DBR										10	30												5		2	OX		30			10.2
62.00	63.00	DBR										5	30												5		2	OX		25			1.34
63.00	64.00	DBR										2	30												2		5	OX		25			34.1
64.00	65.00	GYGR								10		5	20												2		1	POX		3			8.04
65.00	66.00	WH	CUN							90																		FR					0.25
66.00	67.00	WH								90																		FR					0.37
67.00	68.00	GRBX	DLBX	MMBX						5		10	15											0.2			1	POX		5			20.8
68.00	69.00	GYGR								5		5	15												2		2	POX		5			21.0
69.00	70.00									5		3	15												5		1			3			13.7
70.00	71.00									10		5	10												3		1			3			11.9
71.00	72.00									10		5	30												5		1			5			11.0
72.00	73.00	GRBR								10		5	30												15		2	POX		15			7.72
73.00	74.00	GRBR								10		5	15												3		3			5			6.53
74.00	75.00	GRBR										2	15												5		5			10			7.08
75.00	76.00											5	15												3		5	POX		5			11.6
76.00	77.00											5	20												3		10	POX		5			6.04
77.00	78.00	YEOR										20	30												3		3	OX		20			5.50
78.00	79.00	GRBR								10		10	30												2		2	OX		20			8.07
79.00	80.00	GRBR										20	40												10		2			15			1.45
80.00	81.00	YEOR		MMBX						10		10	40												8		3			1.5		YEOR	0.87
81.00	82.00	GRBR								10		20	30												10		2			10			0.93
82.00	83.00	YEOR								30		30	20												10		2			20			-0.45
83.00	84.00	GYGR										15	30												10		2			20			0.31
84.00	85.00											10													0.5			FR					50.2
85.00	86.00											10							1					2				FR					48.2
86.00	87.00	WH										60	20															POX		10		GYGR	0.74
87.00	88.00	GYGR	MMBX									40	15																	2			17.5
88.00	89.00	~~GYGR~~	WH									60	20																	13		GYGR	3.28
89.00	90.00	GYGR										10	20															FR					3.95

Lithology Logging

Hole_ID	From_Depth	To_Depth	Geologist	Lith1	Lith2	Colour1	Colour2	Qz	Si	Cal	Feox	Clay	ACT	Bt	Py	CCP	CU	CUP	CC	Mag Sus	Ox_State
LMDH007	60	61	Simon Beams	DLBX		GRBR		2			20	20					3			1.16	OX
LMDH007	61	62	Simon Beams	DLBX		DBR		10			30	30					5		2	10.2	OX
LMDH007	62	63	Simon Beams	DLBX		DBR		5			25	30					5		2	1.34	OX
LMDH007	63	64	Simon Beams	DLBX		DBR		2			25	30					2		5	34.1	OX
LMDH007	64	65	Simon Beams	DLBX		GYGR		5		10	3	20					2		1	8.09	POX
LMDH007	65	66	Simon Beams	CVN		WH				90										0.25	FR
LMDH007	66	67	Simon Beams	CVN		WH				90										0.37	FR
LMDH007	67	68	Simon Beams	DLBX	HBX	GRBK		10		5	5	15					0.2		1	20.8	POX
LMDH007	68	69	Simon Beams	DLBX	HBX	GYGR		5		5	5	15					2		2	21	POX
LMDH007	69	70	Simon Beams	DLBX	HBX	GYGR		3		5	3	15					5		1	13.7	POX
LMDH007	70	71	Simon Beams	DLBX	HBX	GYGR		5		10	3	10					3		1	11.9	POX
LMDH007	71	72	Simon Beams	DLBX	HBX	GYGR		5		10	5	30					5		1	11	POX
LMDH007	72	73	Simon Beams	DLBX	HBX	GRBR		5		10	15	30					15		2	7.72	POX
LMDH007	73	74	Simon Beams	DLBX	HBX	GRBR		5		10	5	15					0.3		3	6.53	POX
LMDH007	74	75	Simon Beams	DLBX	HBX	GRBR		2		10	10	15					5		5	7.08	POX
LMDH007	75	76	Simon Beams	DLBX	HBX	GRBR		5		10	5	15					3		5	11.6	POX
LMDH007	76	77	Simon Beams	DLBX	HBX	GRBR		5		10	5	20					3		10	6.04	POX
LMDH007	77	78	Simon Beams	DLBX	HBX	YEOR		20		10	20	30					3		3	5.5	OX
LMDH007	78	79	Simon Beams	DLBX	HBX	GRBR		10		10	20	30					2		2	8.07	OX
LMDH007	79	80	Simon Beams	DLBX	HBX	GRBR		20			15	40					10		2	1.45	OX
LMDH007	80	81	Simon Beams	DLBX	HBX	YEOR		10		10	15	40					8		5	0.87	OX
LMDH007	81	82	Simon Beams	DLBX	HBX	GRBR		20		10	10	30					10		2	0.93	OX
LMDH007	82	83	Simon Beams	DLBX	HBX	YEOR		30		30	20	20					10		2	0.45	OX
LMDH007	83	84	Simon Beams	DLBX	HBX	GYGR		15			20	30					10		2	0.31	OX
LMDH007	84	85	Simon Beams	DLBX	HBX	GYGR		10									0.5			50.2	FR
LMDH007	85	86	Simon Beams	DLBX	HBX	GYGR		10							1			2		48.2	FR
LMDH007	86	87	Simon Beams	DLBX	HBX	WH	GYOR	60			10	20								0.74	POX
LMDH007	87	88	Simon Beams	PYBX		GYGR		40			2	15								17.5	POX
LMDH007	88	89	Simon Beams	PYBX		WH	GYGR	60			3	20								3.28	POX
LMDH007	89	90	Simon Beams	PYBX		GYGR		10				20								3.95	FR

Lithology Logging

Log 2 : LMDH006 : 120-150m : Mineralised fresh hydrothermal and dolerite breccia.

Terra Search Pty. Ltd. QUANTIFIABLE GEOLOGY LOG 5 of .....

Company: Cudeco | Project: ROCKLANDS
Hole ID: LMDH006 | Geologist: JDB | Date Logged: 22/5/2007

Depth From	Depth To	Colour	Lith 1	Lith 2	Geo Unit	Alt 1	Chlorite	Sericite	Epidote	Carbonate	Silicification	Massive Quartz	Clay	Magnetite	Albite	Kspar	Amphibole	Feldspar Undif	Pyrite	Vein Carbonate	Vein Quartz	Malachite	Chalcopyrite	Cuprite	Native Copper	Sphalerite	Galena	Hematite	Fe-oxides	Grainsize	Colour 2	Mag Sus	Comments
120.00	121.00	GR	HMBX	AMQS						20		30					30		5				1				FR				GY		
121.00	122.00	↓	↓	↓						↓		↓					↓		5				1				↓				WH		
122.00	123.00																		3				2								WH		
123.00	124.00	WH								35		25					25		3				2								GY		
124.00	125.00	WH								20		35					20		5				1								GR		
125.00	126.00	GY								10		40					20		5				2								GR		
126.00	127.00	WH		↓						10		50					5		10				5								GR		
127.00	128.00	LBRGY		DLBX						10	30	30					5		5				1								WH		
128.00	129.00	LBRGY	↓	DLBX						15	20	20		2			10		8				1								WH		
129.00	130.00	GY	HMBX	DLBX						10	10	30		5			10		5				1										
130.00	131.00	GRBK	DLBX	HMBX	HBX					25		20		2			10		7		15		0.5								GY		
131.00	132.00	GRBK								25		10					5		5				2								WH		
132.00	133.00	GRBK								15		10					5		5				5										
133.00	134.00	GRBK								10		10					5		5				5										
134.00	135.00	↓								25		20					5		2				2										
135.00	136.00	WH								15		35					10		1				1								GRBK		
136.00	137.00	GRBK								10		10					15		5				2								WH		
137.00	138.00	↓								20		15					10		5				2										
138.00	139.00	↓								15		20					10		1				1										
139.00	140.00	GRBK								10		25					10		1				1										
140.00	141.00	GRBK	↓	↓						10		15					10		2				3								↓		
141.00	142.00	PI	HMBX	DLBX						30		5					5		5				15										
142.00	143.00	GRBK	DLBX	HMBX	HBX					20		10					5		5				3								WH		
143.00	144.00									5		20					5		3				3										
144.00	145.00	↓								10		30					10		2				3								PI		
145.00	146.00	WH								10		40					5		3				5								PI		
146.00	147.00	WH								5		30					5		5		↓		3								GRBK		
147.00	148.00	GRBK								15		10					5		5		10		3								GRBK		
148.00	149.00	↓								15		15					5		1		5		1								PI		
149.00	150.00	↓	↓	↓						15		10					5		0.5		5		0.5				↓				PI		
		GRBK																															

Lithology Logging

Hole_ID	From_Depth	To_Depth	Geologist	Lith1	Lith2	Colour1	Colour2	Qz	Si	Cal	Feox	Clay	ACT	Bt	Py	CCP	CU	CUP	CC	Mag Sus	Ox_State
LMDH006	120	121	Simon Beams	HBX	AMQS	GR	GY	30		20			30		5	1					FR
LMDH006	121	122	Simon Beams	HBX	AMQS	GR	WH	30		20			30		5	1					FR
LMDH006	122	123	Simon Beams	HBX	AMQS	GR	WH	30		20			30		3	2					FR
LMDH006	123	124	Simon Beams	HBX	AMQS	WH	GY	25		35			25		3	2					FR
LMDH006	124	125	Simon Beams	HBX	AMQS	WH	GR	35		20			20		5	1					FR
LMDH006	125	126	Simon Beams	HBX	AMQS	GY	GR	40		10			20		5	2					FR
LMDH006	126	127	Simon Beams	HBX	AMQS	WH	GR	50		10			5		10	5					FR
LMDH006	127	128	Simon Beams	HBX	DLBX	LBRGY	WH	30	30	10			5		5	1					FR
LMDH006	128	129	Simon Beams	HBX	DLBX	LBRGY	WH	20	20	15			10		8	1					FR
LMDH006	129	130	Simon Beams	HBX	DLBX	GY		30	10	10			10		5	1					FR
LMDH006	130	131	Simon Beams	DLBX	HBX	GRBK	GY	20		25			10	15	1	1					FR
LMDH006	131	132	Simon Beams	DLBX	HBX	GRBK	WH	10		25			5	15	5	2					FR
LMDH006	132	133	Simon Beams	DLBX	HBX	GRBK		10		15			5	15	5	5					FR
LMDH006	133	134	Simon Beams	DLBX	HBX	GRBK		10		10			5	15	5	5					FR
LMDH006	134	135	Simon Beams	DLBX	HBX	GRBK		20		25			5	15	2	2					FR
LMDH006	135	136	Simon Beams	DLBX	HBX	WH	GRBK	35		15			10	5	1	1					FR
LMDH006	136	137	Simon Beams	DLBX	HBX	GRBK	WH	10		10			15	5	5	2					FR
LMDH006	137	138	Simon Beams	DLBX	HBX	GRBK	WH	15		20			10	5	5	2					FR
LMDH006	138	139	Simon Beams	DLBX	HBX	GRBK	WH	20		15			10	15	1	1					FR
LMDH006	139	140	Simon Beams	DLBX	HBX	GRBK	WH	25		10			10	15	1	1					FR
LMDH006	140	141	Simon Beams	DLBX	HBX	GRBK	WH	15		10			10	10	2	3					FR
LMDH006	141	142	Simon Beams	HBX	DLBX	PI		5		30			5	5	5	15					FR
LMDH006	142	143	Simon Beams	DLBX	HBX	GRBK	WH	10		20			5	8	5	3					FR
LMDH006	143	144	Simon Beams	DLBX	HBX	GRBK		20		5			5	5	3	3					FR
LMDH006	144	145	Simon Beams	DLBX	HBX	GRBK	PI	30		10			10	5	2	3					FR
LMDH006	145	146	Simon Beams	DLBX	HBX	WH	PI	40		10			5	5	3	5					FR
LMDH006	146	147	Simon Beams	DLBX	HBX	WH	GRBK	30		5			5	5	5	5					FR
LMDH006	147	148	Simon Beams	DLBX	HBX	GRBK	GRBK	10		15			5	10	2	3					FR
LMDH006	148	149	Simon Beams	DLBX	HBX	GRBK	PI	15		15			5	5	1	1					FR
LMDH006	149	150	Simon Beams	DLBX	HBX	GRBK	PI	10		15			5	5	0.5	0.5					FR

Lithology Logging

Log 3: LMDH002: 0 - 30m: Oxidised and fresh dolerite at top of hole.

Terra Search Pty. Ltd. QUANTIFIABLE GEOLOGY LOG 1 of ...6

Company: Cudeco | Project: ROCKLANDS
Hole ID: LMDH 02 | Geologist: SJB | Date Logged: 8/3/2007

From	To	Colour	Lith 1	Lith 2	Geo Unit	Alt 1	Chlorite	Sericite	Epidote	Carbonate	Silicification	Massive Quartz	Clay	Magnetite	Albite	Kspar	Amphibole	Feldspar Undiff	Pyrite	Vein Carbonate	Vein Quartz	Malachite	Chalcopyrite	Cuprite	Native Copper	Sphalerite	Galena	Oxidation	Hematite	Fe-oxides	Grainsize	Colour 2	Mag Sus	Comments
0.00	1.00	LRE	SCRE																									OX	10				19.3	Dark Trans patch lower
1.00	2.00	SCRE	GCRE																														31.4	
2.00	3.00	LDR	SDSI																														41.1	
3.00	4.00																																40.6	
4.00	5.00	OV																															14.1	
5.00	6.00																																14.0	
6.00	7.00																																21.2	
7.00	8.00																																34.3	
8.00	9.00																																62.8	
9.00	10.00	GRBR	DLT																									OX	5				31.9	
10.00	11.00																																26.9	
11.00	12.00																																11.6	
12.00	13.00																																33.4	
13.00	14.00																																26.7	BOLO, BOPO
14.00	15.00	DGR																	0.2									FR					41.9	
15.00	16.00																		0.2														65.3	
16.00	17.00																		2				0.2										63.1	
17.00	18.00																																96.3	
18.00	19.00																	2	0.2				0.2										146	
19.00	20.00																		0.1				0.1										150	
20.00	21.00																		0.2				0.1										96.8	
21.00	22.00																						0.2										66.2	
22.00	23.00									5								1					0.2										105	
23.00	24.00																		0.5				0.2										132	
24.00	25.00																		0.5				0.2										154	
25.00	26.00																		0.5				0.2										75.8	
26.00	27.00																																101	
27.00	28.00																																123	
28.00	29.00									10		5					5		05														135	
29.00	30.00																																50.0	

Lithology Logging

Hole_ID	From_Depth	To_Depth	Geologist	Lith1	Lith2	Colour1	Colour2	Qz	Si	Cal	Feox	Clay	ACT	Bt	Py	CCP	FELD	Mag Sus	Ox_State
LMDH002	0	1	Simon Beams	SCRE		LRE					10							19.3	OX
LMDH002	1	2	Simon Beams	SDST		LOR					10							31.4	OX
LMDH002	2	3	Simon Beams	SDST		LOR					10							41.1	OX
LMDH002	3	4	Simon Beams	SDST		LOR					10							40.6	OX
LMDH002	4	5	Simon Beams	SDST		OV					10							14.1	OX
LMDH002	5	6	Simon Beams	SDST		OV					10							14	OX
LMDH002	6	7	Simon Beams	SDST		OV					10							21.2	OX
LMDH002	7	8	Simon Beams	SDST		OV					10							34.3	OX
LMDH002	8	9	Simon Beams	SDST		OV					10							62.8	OX
LMDH002	9	10	Simon Beams	DLT		GRBR					5							37.9	OX
LMDH002	10	11	Simon Beams	DLT		GRBR					5							26.9	OX
LMDH002	11	12	Simon Beams	DLT		GRBR					5							11.6	OX
LMDH002	12	13	Simon Beams	DLT		GRBR					5							33.4	OX
LMDH002	13	14	Simon Beams	DLT		GRBR					5							26.7	OX
LMDH002	14	15	Simon Beams	DLT		DGR									0.2			41.9	FR
LMDH002	15	16	Simon Beams	DLT		DGR									0.2			65.3	FR
LMDH002	16	17	Simon Beams	DLT		DGR									2	0.2		63.1	FR
LMDH002	17	18	Simon Beams	DLT		DGR												96.3	FR
LMDH002	18	19	Simon Beams	DLT		DGR									0.2	0.2	2	146	FR
LMDH002	19	20	Simon Beams	DLT		DGR									0.1	0.1		150	FR
LMDH002	20	21	Simon Beams	DLT		DGR									0.2	0.1		96.8	FR
LMDH002	21	22	Simon Beams	DLT		DGR									0.2	0.2		66.2	FR
LMDH002	22	23	Simon Beams	DLT		DGR				5					0.2	0.2	1	105	FR
LMDH002	23	24	Simon Beams	DLT		DGR									0.2	0.2		132	FR
LMDH002	24	25	Simon Beams	DLT		DGR									0.5	0.2		154	FR
LMDH002	25	26	Simon Beams	DLT		DGR									0.5	0.5		75.8	FR
LMDH002	26	27	Simon Beams	DLT		DGR									0.5	0.2		101	FR
LMDH002	27	28	Simon Beams	DLT		DGR												123	FR
LMDH002	28	29	Simon Beams	DLT		DGR												135	FR
LMDH002	29	30	Simon Beams	DLT		DGR		5		10			5		0.5			50	FR

Lithology Logging

REASON FOR ISSUE

New Procedure