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PHYSICAL PROPERTY MEASUREMENTS ON MINERALISED AND UNMINERALISED SAMPLES FROM THE CLEVELAND MINE, TASMANIA

by

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ABSTRACT

Density, porosity, and electrical and magnetic properties have been determined for samples of mineralisation, Deep Creek Volcanics basalt, and Crescent Spur Sandstone from the Cleveland tin/copper mine, Tasmania, as part of a Bureau of Mineral Resources' project to document the physical properties and geophysical response of Australian mineral deposits. The mineralised samples were grouped into those from the Hall's Lenses and those from the B-South Lens. The Hall's Lenses appear to be more magnetic and chargeable, and less resistive than the B-South Lens, the Deep Creek Volcanics, and the Crescent Spur Sandstone.

Samples from the Hall's Lenses have an average susceptibility of 0.05 (SI) and Koenigsberger ratio of 7, whereas those from the B-South Lens, Deep Creek Volcanics, Crescent Spur Sandstone, and Foley Quartz Porphyry Dyke have average susceptibilities of less than 0.002 (SI) and Koenigsberger ratios of less than 1.5. The average chargeability of Hall's Lenses samples was about fifteen times those of samples from the other units. The median resistivity of Hall's Lenses samples was 80 ohm-m; other units sampled have median resistivities of 2000-5000 ohm-m. The average saturated specific gravity of Hall's Lenses samples was 3.3, B-South lens 3.1, Deep Creek Volcanics 3.0, Crescent Spur Sandstone 2.6, and Foley Quartz Porphyry Dyke 2.9. High average porosities of 6.6 and 9.0 recorded in samples of hangingwall basalt (Deep Creek Volcanics) and footwall sandstone (Crescent Spur Sandstone) respectively may result from weathering or the action of fluids during mineralisation.

CONTENTS

	Page
ABSTRACT	
INTRODUCTION	1
MEASUREMENT PROCEDURES	
Density and porosity measurements	1
Electrical measurements	1
Magnetic measurements	3
GEOLOGY OF THE CLEVELAND DEPOSIT	3
DISCUSSION OF RESULTS	
Hall's Lenses	4
B-South Lens	5
Foley Quartz Porphyry Dyke	5
Deep Creek Volcanics and ~~Crescent~~ Spur Sandstone	5
Comparison of Hall's Lenses and Deep Creek Volcanics and Crescent Spur Sandstone	6
Comparison of B-South Lens and Deep Creek Volcanics and Crescent Spur Sandstone	6
Zoning within the deposit	6
CONCLUSIONS	6
ACKNOWLEDGEMENTS	7
REFERENCES	8

APPENDIX

Geological description of samples and physical property measurements	11

TABLE

Summary of physical properties of mineralisation and unmineralised rock	9

FIGURES

1. Locality map	2
2. Diagrammatic summary of physical property measurements	10

INTRODUCTION

Density, porosity, and electrical and magnetic properties of rock samples from the Cleveland Mine, Tasmania (Fig. 1), have been measured as part of a Bureau of Mineral Resources' project to document the physical properties and geophysical responses of Australian mineral deposits. The samples were selected by Cleveland Tin Limited as being representative of ore, the hangingwall Deep Creek Volcanics, the footwall Crescent Spur Sandstone, and the Foley Quartz Porphyry Dyke. The ore samples have been divided into those coming from what Cleveland Tin Limited call the B-South Lens, and those coming from what are called the Hall's Lenses. Samples from the B-South Lens were collected about 350 m southwest of the samples from the Hall's Lenses.

MEASUREMENT PROCEDURES

Density and porosity measurements

A mercury porosimeter was used to determine the porosities, and dry, saturated, and grain densities of cores of 25 mm diameter x 25 mm length cut from samples. The saturated density is the density of a sample with all pores filled with water. The grain density is the mean density of the grains in the sample - i.e. the density if the porosity were zero.

Electrical measurements

Core samples of 25 mm diameter x 80 mm length were cut and saturated with salt-water solutions prepared in the laboratory. The

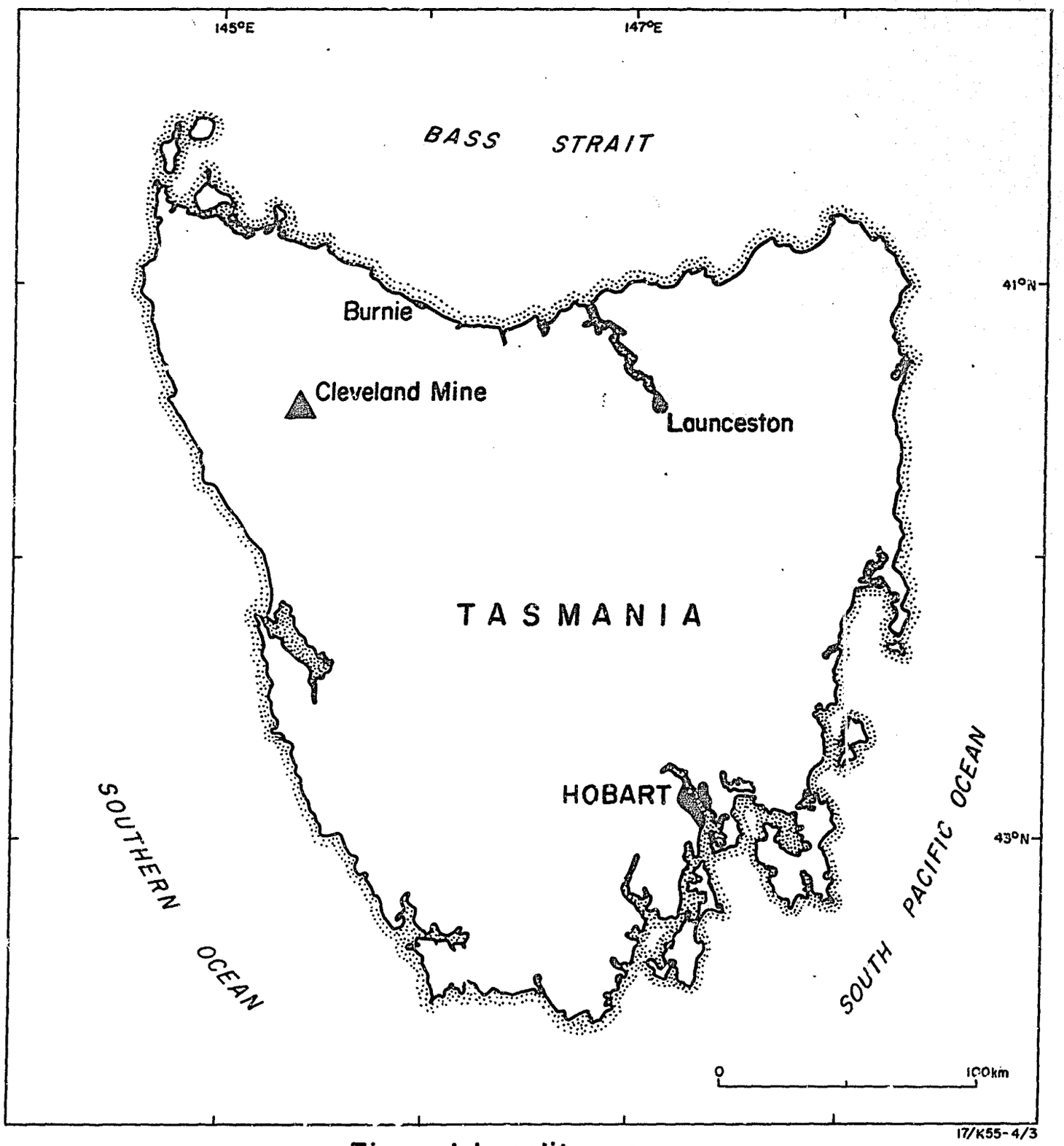

Figure I. Locality map

salt water used to saturate ore and Foley Quartz Porphyry Dyke samples had a conductivity of 0.05 S/m, which was the conductivity of groundwater collected in an adit on 3 Level. That used to saturate samples of hangingwall Deep Creek Volcanics and footwall Crescent Spur Sandstone had a conductivity of 0.77 S/m, which was the conductivity of groundwater collected from a drillhole near the mine.

Magnetic measurements

The magnetic susceptibilities of the core samples used for the density measurements were measured using a Scintrex SM-4 susceptibility bridge; a Digico magnetometer was used to measure remanences. The Koenigsberger ratio, Q, for each sample was calculated for an ambient magnetic field strength of 62 500 nT.

GEOLOGY OF THE CLEVELAND DEPOSIT

Ransom & Hunt (1975), Palmer (1976), and Collins (1981) have described the Cleveland deposit, which is located 60 km southwest of Burnie in northwestern Tasmania. It occurs in rocks of probably Late Precambrian or Early Cambrian age, dominated by basic volcanics, sandstones, and argillites. The Devonian Meredith Granite intrudes the rocks and is thought to be the source of the mineralisation. In the immediate vicinity of the Cleveland Mine the sequence comprises basic volcanics, a predominantly argillitic unit which hosts the tin bearing lodes, and mica sandstones.

The lodes, which are subparallel and nearly vertical, are mineralogically complex. Sulphides with grain sizes between 0.5 and

3.0 mm normally comprise 20 to 30 percent by volume of the mineralised rocks. Quartz and carbonates are the most common gangue minerals, usually comprising 30 to 40 percent of the volume. Pyrrhotite is the most common sulphide. Other minerals include pyrite, marcasite, fluorite, actinolite, chlorite, and tourmaline. Accessory minerals are arsenopyrite, sphalerite, hematite, and tetrahedrite. Ore minerals are cassiterite, stannite, and chalcopyrite. Mineable ore reserves in 1982 were 1 100 000 tonnes grading 0.73% Sn and 0.33% Cu. Production in 1982 was about 370 000 tonnes at an ore grade of 0.65% Sn and 0.29% Cu.

DISCUSSION OF RESULTS

The results of the physical measurements, geological descriptions of samples provided by Cleveland Tin Limited, and the approximate depth of the samples below the surface are tabulated in the Appendix Summaries of these results are presented in the table and illustrated in Figure 2.

Although all rock types produced a moderate-to-large range in the values of each physical property measured, and the value of the physical properties of samples of one rock type commonly overlap those of others, some generalisations can be deduced about bulk physical properties of units at the Cleveland Mine, and physical property contrasts between them.

Hall's Lenses

Samples from the Hall's Lenses have a wide range in all physical properties measured. However, the Hall's Lenses are generally of low to moderate resistivity and moderate to high chargeability, and are dense and magnetic.

B-South Lens

Only a few samples were available from the B-South Lens. Where these show a wide range in values of a physical property, the bulk value of that property for the lode is difficult to deduce. In particular, only two samples were measured for electrical properties. The B-South Lens appears to have an overall moderate resistivity and a low chargeability; it also appears to be more resistive and less chargeable than the Hall's Lenses. The B-South Lens appears to be moderately dense and not very magnetic, being slightly less dense and less magnetic than the Hall's Lenses. Differences in physical properties between the Hall's Lenses and the B-South Lens are probably because the B-South Lens contains a lower concentration of sulphides, and has a different mineralogy: the Hall's Lenses are pyrrhotite-chlorite ore types, whilst the B-South Lens is a pyrite-siderite ore type.

Foley Quartz Porphyry Dyke

Only three samples of the Foley Quartz Porphyry Dyke, which intrudes the footwall zone, were measured. The samples were of moderate density, non-magnetic, and had a wide range in electrical properties.

Deep Creek Volcanics and Crescent Spur Sandstone

The hangingwall Deep Creek Volcanics is moderately dense and magnetic, whereas the footwall Crescent Spur Sandstone is of low density and is not very magnetic. Overall both the basalt and the sandstone appear to be resistive and to have low chargeabilities.

Average porosities greater than 5 percent are associated with samples of the basalt and sandstone. Part of this porosity may possibly be due to the action of fluids associated with mineralisation, but weathering may contribute particularly in near-surface samples.

Comparison of Hall's Lenses and Deep Creek Volcanics and Crescent Spur Sandstone

Overall, the Hall's Lenses have strong electrical, density, and magnetic contrasts with the basalt and the sandstone. The Hall's Lenses are less resistive, more chargeable, denser, and have a higher susceptibility and remanence.

Comparison of B-South Lens and Deep Creek Volcanics and Crescent Spur Sandstone

The samples measured indicate that resistivity and chargeability of the B-South Lens may be similar to those of the basalt and the sandstone. This is surprising because the sulphides in the B-South Lens would be expected to make it less resistive and more chargeable; additional samples from the B-South Lens would need to be measured to indicate whether or not this is the case. The B-South Lens overall is more dense than the basalt and the sandstone. It appears to be about as magnetic as the basalt, and more magnetic than the sandstone.

Zoning within the deposit

The B-South Lens forms a zone of mineralisation with physical properties different from those of the Hall's Lenses. In an attempt to define further zones, resistivity, chargeability, susceptibility, and remanence values of samples were plotted on a vertical section of the Mine, but no additional zoning was identified.

CONCLUSIONS

The Hall's Lenses of the Cleveland deposit appear to be more magnetic, more chargeable, and less resistive than the B-South Lens

and the surrounding host rocks. The differences in properities between the Hall's Lenses and the B-South Lens are probably due to a higher concentration of sulphides in the Hall's Lenses, but different texture and form of minerals in the rocks of each unit may also be significant. Strong physical property contrasts occur between the Hall's Lenses and the surrounding rocks: the Hall's Lenses are less resistive, more chargeable, denser, and more magnetic. A smaller physical property contrast exists between the B-South Lens and the surrounding rocks. The B-South Lens is more dense, but measurements on more samples are needed to accurately define differences in the electrical and magnetic properties.

High average porosities recorded in the samples of hanging wall basalt and footwall sandstone may result from weathering or the action of fluids during mineralisation.

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Table : Summary of physical properties of mineralisation and unmineralised rock

Rock type	Susceptibility (SI x 10^6) N	Range	Median	Mean	Resistivity at 1000 Hz (ohm-m) N	Range	Median	Mean
Hall's Lenses - lode	43	1510-306620	37700	53310	44	2-8080	80	563
" " - lode/shale	1	-	-	11940	1	-	-	593
" " - lode/chert	1	-	-	6660	-	-	-	-
B-South Lens	4	750-3020	1695	1790	2	70-8275		4173
Deep Creek Volcanics	7	750-4340	1380	1660	7	70-7585	2555	2586
Crescent Spur Sandstone	5	250-690	380	450	5	117-5272	2139	2434
Foley Quartz Porphyry Dyke	3	50-190	100	110	3	150-14 000	5100	6417
	Remanence (mA/m)				**Koenigsberger ratio**			
Hall's Lenses - lode	35	0.3-27 500	6000	7796	35	0.0006-84.76	1.90	6.61
" " - lode/shale	1	-	-	2200	1	-	-	3.71
B-South Lens	4	2.0-300	43	97	4	0.1-2.0	1.02	1.02
Deep Creek Volcanics	5	0.5-1240	4	251	5	0.007-5.75	0.11	1.21
Crescent Spur Sandstone	5	0.3-5	0.8	2	5	0.009-0.27	0.04	0.08
Foley Quartz Porphyry Dyke	3	2.0-2.5	2.5	2	3	0.27-0.8	0.50	0.52
	Chargeability*							
	Vs (0.78)/Vp (mV/V)				**M (0.24-1.14) (ms)**			
Hall's Lenses - lode	43	11-437	130	174	43	12-414	127	170
" " - lode/shale	1	-	-	46	1	-	-	49
B-South Lens	2	2-7	-	5	2	3-7	-	5
Deep Creek Volcanics	7	0-25	5	9	7	0-25	5	9
Crescent Spur Sandstone	5	5-23	7	12	5	5-25	7	13
Foley Quartz Porphyry Dyke	3	90	50	122	3	28-283	50	120
	S.G. dry				**S.G. saturated**			
Hall's Lenses - lode	40	2.78-4.02	3.23	3.22	40	2.79-4.18	3.25	3.25
" " - lode/shale	1	-	-	2.98	1	-	-	2.98
B-South Lens	4	2.72-3.22	3.10	3.04	4	2.81-3.23	3.12	3.07
Deep Creek Volcanics	4	2.76-2.97	2.93	2.90	4	2.82-3.05	2.99	2.96
Crescent Spur Sandstone	5	2.11-2.75	2.60	2.49	5	2.33-2.76	2.64	2.58
Foley Quartz Porphyry Dyke	3	2.82-2.89	2.88	2.86	3	2.85-2.93	2.90	2.89
	Porosity				**Grain density (t/m^3)**			
Hall's Lenses - lode	40	0.0-16.3	1.0	2.3	40	2.81-4.80	3.27	3.31
" " - lode/shale	1	-	-	0.0	1	-	-	2.98
B-South Lens	4	0.5-8.9	1.6	3.1	4	2.99-3.25	3.15	3.13
Deep Creek Volcanics	4	0.7-14.9	5.4	6.6	4	2.95-3.40	3.04	3.11
Crescent Spur Sandstone	5	1.4-22.4	5.9	9.0	5	2.65-2.79	2.72	2.73
Foley Quartz Porphyry Dyke	3	1.8-3.5	2.7	2.7	3	2.90-3.00	2.94	2.95

* The chargeability (Vs(0.78)/Vp) is the ratio of secondary voltage in millivolts to primary voltage in volts across the sample 0.78 seconds after termination of the current pulse.

The chargeability (M (0.24-1.14)) is given by the integral $\int_{0.24}^{1.14} Vs(t)/Vp \, dt$ where t is in seconds.

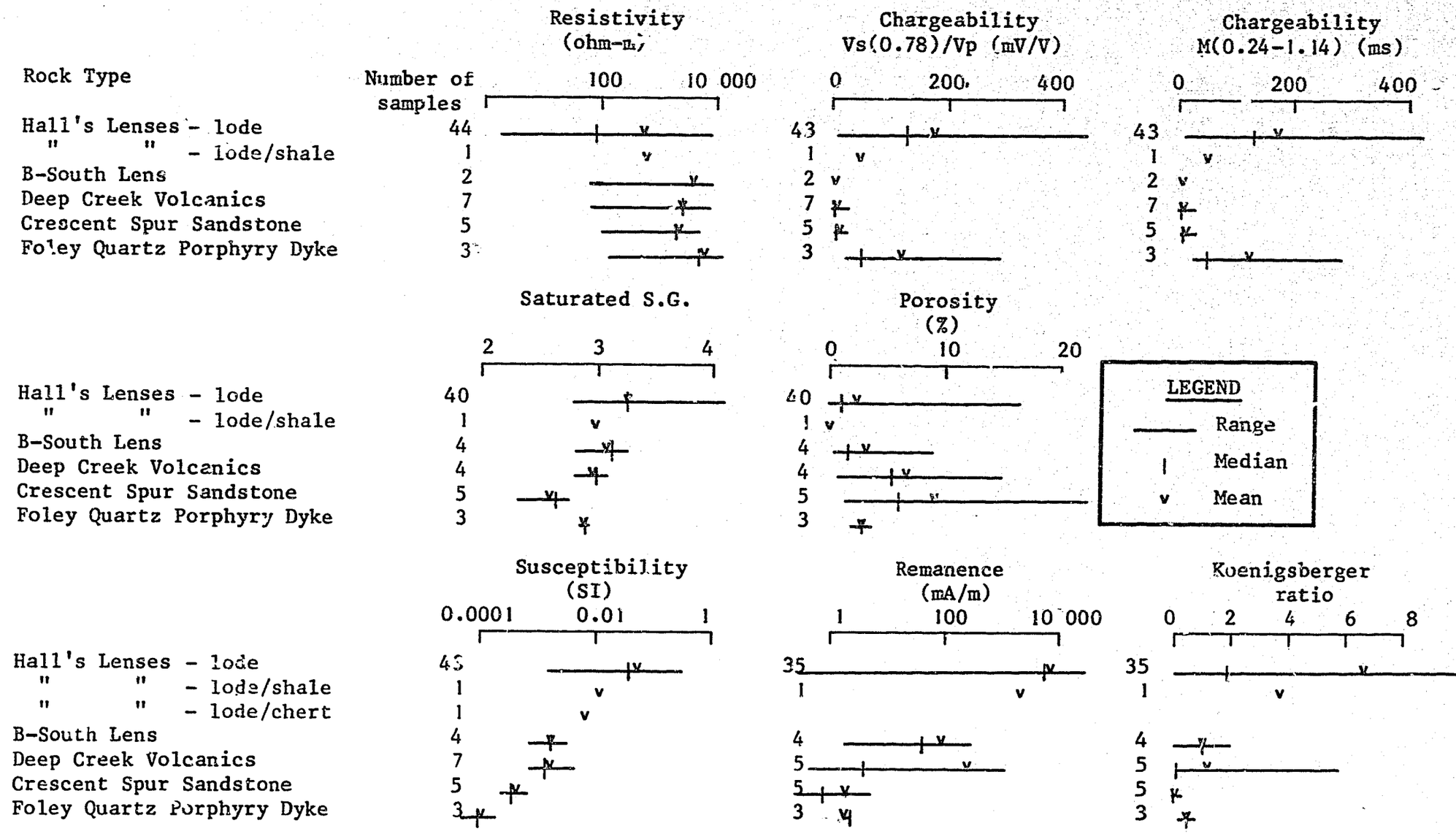

Figure 2. Diagrammatic summary of physical property measurements

Appendix. Geological description of samples and physical property measurements

Lab. number	Sampler's number	Approx. depth (m)	Geological description	Resistivity @ 1000 Hz ohm-m	Vs (0.78)/Vp mV/V	H^{X}_{1140} 240+	SG dry	SG saturated	Porosity	Grain density t/m³	Susceptibility (x 10⁶ SI)	Remanence mA/m	Q
Hall's Lenses													
80/753	223801	50	Lode. 20% pyrrhotite; 5% chalcopyrite as fine disseminated spots, minor clots and veinlets in a light grey quartz-carbonate matrix containing minor chlorite and tourmaline.	5	230	229	3.32	3.33	1.1	3.36	10 810	27 300	50.79
80/754	223802	50	Lode. Fine-grained light green quartz-carbonate matrix containing lesser chlorite. A few fine-grained siliceous bands. 12% pyrrhotite, 8% pyrite as fine disseminated spots, clots and blebs.	2	338	334	3.05	3.12	5.9	3.24	1 608	7 340	0.92
80/755	223803	50	Lode. Fine-grained grey green quartz-carbonate matrix containing minor chlorite. Very fine-grained disseminated pyrite (5%) as spots, and traces of chalcopyrite.	8087	60	52	3.15	3.15	0	3.15	6 790	160	0.47
80/756	223804	50	Lode. Brown heavily iron, oxide, stained coarse-grained quartz-carbonate matrix with minor chlorite veins. Fine disseminated pyrite (4%), lesser chalcopyrite spots (1%).	35	94	98	2.92	2.95	2.9	3.01	1 570	124	1.59
80/757	223805	60	Lode. Mottled grey medium-grained quartz-carbonate-chlorite matrix with fine disseminated and minor veined pyrrhotite (20%) with traces chalcopyrite.	2	259	252	3.69	3.69	0	3.69	90 480	27 500	6.11
80/758	223806	60	Lode. Light grey fine-grained quartz-carbonate and minor tourmaline and chlorite matrix, with disseminated fine spots and minor irregular clots and veins of pyrrhotite (40%) with chalcopyrite (3%).	2	410	388	3.72	3.72	0.1	3.72	182 210	22 500	2.48
80/759	223807	60	Lode. Irregularly layered grey quartz-carbonate-tourmaline-chlorite matrix with fine disseminated and minor cross veined pyrrhotite (15%) and minor chalcopyrite (3%).	75	159	160	3.25	3.25	0	3.25	27 830	6 100	4.41
80/760	223808	60	Lode. 25% pyrrhotite as fine disseminated spots and minor veins with traces chalcopyrite in a fine-grained medium grey quartz-carbonate and minor chlorite matrix.	2	437	414	3.36	3.37	0.7	3.38	127 550	18 100	2.85
80/761	223809	80	Lode. Very fine-grained dark grey-brown massive hard silicified shale. Fine chalcopyrite-pyrite vein.	271	29	34	3.00	3.00	0.1	3.00	1 510	1.3	0.02
80/763	223811	80	Lode. Medium-grained light grey quartz-carbonate with minor chlorite and traces of tourmaline as streaks as the matrix for fine disseminated pyrrhotite (35%) with minor clots and veinlets, and chalcopyrite (3%).	2	242	238	3.12	3.14	1.7	3.30	70 560	6 000	1.71
80/764	223812	105	Lode. Light grey granular quartz-carbonate and minor chlorite with fine oblique tourmaline-rich bands locally. Fine blebs, pips and disseminated pyrite (15%) with minor chalcopyrite (1%).	-	130	127	-	-	-	-	-	-	-
80/765	223813	100	Lode. Medium-grained granular light grey quartz-carbonate and minor chlorite, with thin tourmaline-rich black spotted veins/fractures and clots. Disseminated, blebs and minor veins of pyrrhotite (20%) and chalcopyrite (2%).	4	213	211	3.55	3.59	4.2	3.70	37 950	4 000	2.12
80/767	223815	120	Lode. Very fine-grained foliated quartz-carbonate-tourmaline-rich layered grey matrix (80%) with minor light grey chert/shale (20%) with fine disseminated vuggy pyrite (5%), lesser chalcopyrite (1%), and traces pyrrhotite.	96	102	104	3.25	3.37	13.6	3.76	1 700	10	0.12
80/768	223816	130	Lode/Chert. Light grey banded chert (70%) with lesser quartz-carbonate-tourmaline layered and veined matrix with fine vuggy pyrite (3%) and irregular blebs and clots of chalcopyrite (3%) and pyrrhotite (2%).	-	-	-	-	-	-	-	6 660	-	-
80/769	223817	120	Lode. Fine-grained light yellow-grey quartz-carbonate massive matrix with thin tourmaline-rich veins, bands and zones. Irregular veins and blebs of coarse crystalline pyrrhotite (15%) and chalcopyrite (5%).	220	44	44	3.02	3.16	13.6	3.49	3 490	-	-
80/770	223818	130	Lode. Fine-grained granular quartz-carbonate with a trace of chlorite. Pyrrhotite (25%) and chalcopyrite (1%) as fine disseminated spots, irregular blebs and veins. Traces of pyrite spots.	2	-	-	4.02	4.18	16.3	4.80	146 400	-	-
80/771	223819	130	Lode. Fine-grained broad banded light grey quartz-carbonate and dark grey tourmaline-quartz-carbonate matrix with very fine disseminated pyrrhotite (12%) and chalcopyrite (1%) patches of pyrite (1%).	3	255	243	-	-	-	-	50 260	-	-
80/772	223820	130	Lode /Shale. Fine-grained light grey quartz-carbonate-tourmaline layered lode (60%) with grey very fine-grained silicified sh le (40%) with fine vuggy crystalline pyrite (25%) and minor disseminated and blebby pyrrhotite (10%) and chalcopyrite (3%).	593	46	49	2.98	2.98	0	2.98	11 940	2 200	3.71

(continued)

Lab. number	Sampler's number	Approx. depth (m)	Geological description	Resistivity @ 1000 Hz ohm-m	Vs (0.78)/Vp² mV/V	240² M 1140	SG dry	SG saturated	Porosity	Grain density t/m³	Susceptibility (x 10⁻⁶ SI)	Remanence mA/m	Q
Hall's Lenses (continued)													
80/773	242876	150	Lode. Light to medium grey-green quartz-carbonate and minor chlorite vaguely banded matrix with fine disseminated spots with pips, blebs of pyrite (15%) and traces chalcopyrite. Thin aourmaline-rich layers locally.	52	146	145	3.88	3.90	1.7	3.95	55 290	11 900	4.33
80/774	242877	150	Lode. Light grey fine-grained quartz-carbonate with traces of tourmaline needles with dense disseminated, blebby and minor irregularly veined pyrrhotite (25%), chalcopyrite (3%), and pyrite (½%).	86	90	89	3.35	3.35	0	3.35	38 080	8 300	4.38
80/775	242878	150	Lode. Very fine-grained light grey massive quartz-carbonate matrix with dense disseminated, blebby and irregular veined pyrrhotite (25%) with lesser chalcopyrite (3%).	295	46	45	-	-	-	-	25 130	-	-
80/776	242879	170	Lode. Light grey quartz-carbonate-tourmaline lode with 18% pyrite, 5% pyrrhotite and ½% chalcopyrite as irregular thin veins, blebs and fine disseminations along layers (replacement?). Strong tourmaline (?) layering locally also.	307	156	151	3.30	3.31	0.5	3.32	9 300	880	1.90
80/777	242880	170	Lode. Light grey quartz-carbonate locally tourmaline rich layered and dispersed matrix with disseminated, irregular clots and veins of pyrrhotite (15%), pyrite (3%) and chalcopyrite (1%). Iron oxide stained heavily on fractures.	10	-	-	3.68	3.69	0.5	3.70	16 780	18 600	22.29
80/778	242881	170	Lode. Light grey quartz-carbonate bands (50%) and dark grey black (50%) tourmaline quartz-carbonate layers/bands with dense fine disseminated, minor veins and blebs and clots of pyrite (15%), pyrrhotite (10%), and chalcopyrite (1%).	291	73	72	2.82	2.82	0.2	2.88	6 910	-	-
80/779	242882	190	Lode. Mottled light green grey quartz-carbonate-chlorite, locally yellow carbonate, quartz or chlorite rich massive matrix with fine disseminated and blebby pyrrhotite (15%) and lesser chalcopyrite (1%).	2	356	349	3.01	3.03	1.6	3.06	84 570	4220	1.00
80/780	242883	190	Lode. Predominantly light green quartz-carbonate minor chlorite with fine black (tourmaline) spots disseminated in large zones. Pyrrhotite (5%) with quartz-flour matrix as irregular veins and clots. Traces chalcopyrite (¼%).	664	33	32	2.83	2.84	1.1	2.86	18 350	600	0.66
80/781	242884	190	Lode. Light grey and dark grey quartz-carbonate with many quartz-carbonate tourmaline-rich layers, bands and mottled zones with irregular veins, pips, blebs and disseminated pyrrhotite (5%), pyrite (5%), and chalcopyrite (5%).	84	20	21	3.06	3.07	1.0	3.09	41 660	3 800	1.83
80/782	242885	205	Lode. Light grey to dark grey banded/layered quartz-carbonate, quartz-carbonate-chlorite, tourmaline-quartz-carbonate-chlorite. Tourmaline-rich layers locally and tourmaline needles embedded in sulphide. Disseminated, irregularly veined pyrrhotite (20%), chalcopyrite (4%).	66	154	151	3.58	3.59	0.5	3.60	91 610	26 200	5.75
80/783	242886		Lode. Foliated, banded light grey and light green grey quartz-carbonate and quartz-chlorite-carbonate bands locally with tourmaline, spotted lenses. Minor tourmaline needles in lenses. Fine disseminated, veined, blebby pyrrhotite (5%) with traces chalcopyrite.	700	43	44	3.06	3.07	0.5	3.07	12 570	2 700	4.32
80/784	242887	205	Lode. Massive vaguely banded green-grey quartz-chlorite carbonate matrix with fine disseminated pyrrhotite (15%)	3	319	311	3.23	3.25	1.5	3.28	93 870	6 800	1.46
80/785	242888	220	Lode. Light green-grey quartz-carbonate, minor chlorite, with a trace of tourmaline/ mottled massive fine-grained matrix with traces of pyrrhotite and chalcopyrite as spots and coarse blebs.	866	11	12	3.33	3.34	0.8	3.35	2 320	9 800	84.76
80/787	242890	220	Lode. Light grey-green quartz-carbonate locally chlorite-tourmaline-rich mottled matrix with dense disseminated pyrrhotite (35%) blebs with pyrite (3%) and chalcopyrite (1%).	113	26	26	3.46	3.46	0.3	3.47	62 770	17 300	5.54
80/788	242891	240	Lode. Medium-grained light pink-grey quartz-carbonate with irregular green-black tourmaline-chlorite-rich patches and zones, with disseminated blebby and irregularly veined pyrrhotite (8%) and lesser chalcopyrite (1%).	502	39	40	3.38	3.38	0	3.38	15 020		
80/789	242892	245	Lode. Light grey-yellow fine-grained quartz-carbonate, chlorite, locally siliceous/ matrix with irregular coarse crystalline mesh veins of pyrrhotite (20%) with traces chalcopyrite.	3	376	364	3.17	3.19	1.7	3.22	60 880	6 050	2.00

Lab. number	Sampler's number	Approx. depth (m)	Geological description	Resistivity @ 1000 Hz ohm-m	Vs(0.78)/Vp× 240 + M 1140 mV/V	SG dry	SG saturated	Porosity	Grain density t/m³	Susceptibility (x 10⁶ SI)	Remanence mA/m	Q
Hall's Lenses (continued)												
80/790	24 893	240	Lode. Light grey-green fine-grained quartz-carbonate-chlorite with minor black tourmaline needles as matrix for reticulated mesh veins and minor disseminated pyrrhotite (20%) with chalcopyrite (1%).	100	325	325	3.23	3.26	3.5	3.34	46 370	11 100	4.81
80/791	242894	260	Lode. Light grey quartz-carbonate (with a trace of chlorite) granular medium-grained matrix with fine black tourmaline veinlets. Dense disseminated veined blebby pyrrhotite (35%), chalcopyrite (5%).	4	356	345	-	-	-	-	-	-	
80/792	242895	260	Lode. Dark grey-green fine-grained quartz-carbonate-chlorite finely layered matrix with broad dense massive and finely disseminated minor blebby pyrrhotite (25%) with lesser chalcopyrite (2%).	22	395	381	2.82	2.84	3.5	2.93	306 620	350	0.02
80/793	242896	263	Lode. Light grey-green quartz-carbonate-chlorite (with minor tourmaline) fine-grained massive matrix with dense disseminated blebs of pyrrhotite (35%), pyrite (1%) and chalcopyrite (2%).	2	365	352	3.43	3.44	1.3	3.48	150 800	12 850	1.71
80/794	242897	280	Lode. Grey-to-grey-green medium-grained granular quartz-carbonate and minor chlorite weekly banded with fine disseminated and irregular blebs and veins of pyrrhotite (5%) and traces chalcopyrite.	280	73	75	-	-	-	-	14 760	-	-
80/795	242898	280	Lode. Fine-grained light grey-green quartz-carbonate (with traces of chlorite-tourmaline) massive and banded matrix, with dense disseminated blebs of pyrrhotite (3%) and lesser chalcopyrite (2%) and pyrite (3%).	655	44	44	2.96	2.97	1.0	2.99	6 660	310	0.94
80/796	242899	280	Lode. Medium-grained light to medium green quartz-chlorite-carbonate with a thin regular (½ cm) quartz vein. Fine disseminated, blebs, and clots of pyrrhotite (10%) and traces of chalcopyrite.	2200	25	26	2.78	2.79	1.3	2.81	5 280	1000	3.81
80/797	242900	350	Lode. Fine-grained dark green chlorite-quartz and minor tourmaline matrix with bands and sub-parallel veins of crystalline sulphides - 6% chalcopyrite, 4% pyrrhotite. Thin blue-green chert slivers locally.	17	422	408	2.90	2.90	0.1	2.90	53 850	2700	1.01
80/798	242901	350	Lode. Dark green-grey chlorite-quartz-carbonate massive matrix with large stringers and coarse-grained blebs and pips of chalcopyrite (10%) and pyrrhotite (8%).	830	66	67	3.32	3.33	0.9	3.35	31 420	7160	4.58
80/799	242902	350	Lode. Very fine-grained weakly banded green-grey quartz-chlorite matrix with irregular sub-parallel and cross-cutting veins of sulphides. 10% pyrrhotite, 2% chalcopyrite.	100	98	100	2.81	2.82	0.7	2.83	26 640	360	0.27
80/800	242903	360	Lode. Fine-grained dark green quartz-chlorite lode with irregular sub-parallel and cross-cutting massive pyrrhotite (10%). Thin interbands of dark grey-brown silicified shale, Fine black spots (tourmaline ?) with pyrrhotite locally.	7250	27	28	2.94	2.94	0.3	2.95	10 810	0.3	0.0006
80/801	242904	360	Lode. Very fine green quartz-chlorite matrix with thin dark tourmaline-rich streaks locally. Irregular and regular parallel cross-cutting massive pyrrhotite (10%) as veins and minor clots.	30	298	297	3.24	3.25	0.5	3.26	37 700	750	0.40
B-South Lens												
80/802	242905	360	Lode. Green grey fine-grained quartz-chlorite-carbonate massive matrix with blebs of and disseminated pyrrhotite (10%) and chalcopyrite (5%). Coarse crystalline chlorite with minor tourmaline and quartz band on edge with dense pyrrhotite (39%) and chalcopyrite (10%).	165	96	98	2.94	3.03	8.7	3.22	46 500	-	-
80/803	242906	245	Lode. Light grey and yellow to grey-green, irregularly nottled quartz-carbonate-chlorite-fluorite matrix. Irregular veins and blebs of coarse chalcopyrite (9%), pyrite (2%), and fine brown cassiterite spots (1%). Trace of arsenopyrite.	-	-	-	3.01	3.02	1.3	3.05	750	70	1.87
80/804	242907	245	Lode. Fine-grained, granular, grey with orange-brown patches, essentially quartz-carbonate with minor chlorite-sericite (?). Pyrite (5%) and chalcopyrite (1%) as stringers, fine disseminations and minor veins.	-	-	-	3.19	3.21	1.8	3.25	1 880	15	0.16
80/805	242908	245	Green Lode. Dark green-black fine-grained chlorite-quartz-tourmaline weakly banded with a thin leucocratic quartz-carbonate lens/vein with traces pyrrhotite and cassiterite.	8275	2	3	3.22	3.23	0.5	3.24	3 020	300	2.0

(continued)

Lab. number	Sampler's number	Approx. depth (m)	Geological description	Resistivity @ 1000 Hz ohm-m	Vs(0.78)/Vp[x] mV/V	M 240 + 1140	SG dry	SG saturated	Porosity	Grain density t/m³	Susceptibility (x 10⁶ SI)	Remanence mA/m	Q
B-South Lens (continued)													
80/806	242909	245	Lode. Very pale yellow brown massive softish clayey (?) decomposed mudstone with blebs spots, sprays and irregular veins of black sphalerite (5%) and traces chalcopyrite. Rock possibly decomposed (?) quartz-carbonate-lode.	70	7	7	2.72	2.81	8.9	2.99	1510	2	0.03
80/807	242910	245	Light grey fine-grained quartz-carbonate (or altered siltstone matrix), weakly laminated and banded with dense spots, blebs and minor layers and veins of black sphalerite (25%) and traces of pyrite.	4000	4	7	-	-	-	-	2010	-	-
Deep Creek Volcanics													
80/808	242911	70	Hanging wall basalt. Massive fine-grained grey-green meta-basalt (?) with darker green ragged spots and mottling. Fine pale spots (feldspar-carbonate?) locally. Traces pyrrhotite.	470	16	17	2.76	2.82	6.3	2.95	1380	10	0.15
80/809	242912	70	Hanging wall basalt. Dark blue-green fine-grained metabasalt with irregular thin mesh veins of amphibole-troumaline (?).	7585	2	3	2.90	3.05	14.9	3.40	1380	0.5	0.007
80/810	242913	160	Hanging wall basalt. Dense hard massive fine-grained dark-green metabasalt with traces of thin black veinlets carrying traces of pyrrhotite.	4670	13	13	2.97	3.07	4.4	3.10	4340	1240	5.75
80/811	242914	160	Hanging wall basalt. Dark green dense fine-grained massive metabasalt. Two faces are sheared and have chlorite-talc slickensides. The other face has a thin sphalerite-carbonate-pyrrhotite vein.	2555	25	25	-	-	-	-	1510	-	-
80/812	242915	200	Hanging wall basalt. Green-blue massive dense fine-grained metabasalt with light thin siliceous veins and thin black irregular mesh veins with traces of chalcopyrite.	2575	5	5	2.96	2.97	0.7	2.98	750	4.0	0.11
80/813	242916	200	Hanging wall basalt. Grey-green massive fine-grained metabasalt (?). Dark phenocrysts (?) occur as ragged spots scattered locally.	70	0	0	-	-	-	-	1010	0.8	0.02
80/814*	-	-	" " " " " " " " " "	175	0	0	-	-	-	-	1260	-	-
Crescent Spur Sandstone													
80/815	242917	60	Footwall sandstone. Light grey fine-grained massive quartz-feldspar-mica sandstone.	5272	7	7	2.60	2.64	4.2	2.71	570	0.9	0.03
80/816	242918	60	Footwall sandstone. Light brown/light khaki fine-grained (?) decomposed mica shale/sandstone, with light grey-to-grey very soft inclusions of talc-mudstone (?).	117	23	25	2.11	2.33	22.4	2.72	250	0.8	0.06
80/817	242919	360	Footwall sandstone. Light grey-green medium-grained quartzofeldspathic siltstone, with irregular vague dark green chlorite fractures and mesh veins.	941	19	20	2.63	2.69	5.9	2.79	380	0.8	0.04
80/818	242920	360	Footwall sandstone. Light grey green massive quartz-feldspathic sandstone with irregular vague dark green chlorite(?) mesh veins.	3702	6	6	2.36	2.47	11.0	2.65	380	5	0.27
80/820	242922	330	Footwall sandstone. Massive fine-grained light grey quartz-feldspar sandstone.	2139	5	5	2.75	2.76	1.4	2.78	690	0.3	0.009
Foley Quartz Porphyry Dyke													
C1	-	-	Quartz porphyry. Disseminated and blebs of pyrite.	150	290	283	2.82	2.85	2.7	2.90	100	2.5	0.5
C2	-	-	Quartz porphyry. Disseminated and blebs of pyrite.	5100	50	50	2.89	2.93	3.5	3.00	190	2.5	0.27
C3	-	-	Quartz porphyry. Disseminated and blebs of pyrite.	14 000	27	28	2.88	2.90	1.8	2.94	50	2.0	0.8

* cylindrical core taken perpendicular to 80/813

x The chargeability Vs (0.78)/Vp is the ratio of secondary voltage in millivolts to primary voltage in volts across the sample 0.78 s after termination of the current pulse.

\+ The chargeability M (0.24-1.14) is given by the integral $\int_{0.24}^{1.14} Vs(t)/Vp \, dt$ where t is in seconds.