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Thermal conductivity of core specimens MRT051-MRT083

Prepared for Mineral Resources Tasmania

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Executive Summary

Mineral Resources Tasmania (MRT) commissioned Hot Dry Rocks Pty Ltd (HDR) to measure the thermal conductivity of thirty-three rock specimens delivered to HDR in November 2010. Measurements were made on the specimens using a steady state divided bar apparatus calibrated for the range 0.5–12 W/mK. Up to three samples were prepared from each specimen to investigate variation in thermal conductivity over short distance scales and to determine mean conductivity and uncertainty. All values were measured at a standard temperature of 25°C (± 2°C).

HDR considers the following points to be important:

- HDR had no role in selecting the core specimens and takes no responsibility towards ensuring that the specimens measured were representative of the overall geological formations from which they came.
- It is to be expected that the thermal conductivity of a given formation will vary from place to place if the porosity of the formation varies.
- Thermal conductivity of rocks is sensitive to temperature. This should be kept in mind when developing models of in situ thermal conductivity.

Author
This report was prepared by Anson Antriasian. Anson Antriasian and Catherine Tuxen carried out thermal conductivity sample preparation and measurement, and observations of foliation.

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1. Introduction

Thermal conductivity is the physical property that controls the rate at which heat energy flows through a material in a given thermal gradient. In the S.I. system of units, it is measured in watts per metre-kelvin (W/mK). In the Earth, thermal conductivity controls the rate at which temperature increases with depth for a given heat flow. The thermal conductivity distribution within a section of crust must be known in order to calculate crustal heat flow from temperature gradient data, or to predict temperature distribution from a given heat flow.

Mineral Resources Tasmania (MRT) commissioned Hot Dry Rocks Pty Ltd (HDR) to undertake thermal conductivity measurements on thirty-three core specimens[1] in November 2010 (Table 1). These specimens were measured for thermal conductivity using a steady state divided bar apparatus calibrated for the range 0.5–12 W/mK.

Thermal conductivity is sensitive to temperature (e.g. Vosteen and Schellschmidt, 2003[2]), in general decreasing as temperature increases. The measurements contained in this report were made within ± 2°C of 25°C.

Where appropriate, HDR converted depth information provided by MRT from feet to metres. Depths in feet as provided by MRT are included on Table 1, in addition to other sample data provided by MRT such as sample names, geologic ages and formations, well names, coordinates, pallet number, and lithologies.

[1] In this report the word “specimen” refers to a raw piece of rock delivered to HDR, while “sample” refers to part of a specimen prepared for conductivity measurement. In general, three samples are prepared from each specimen.

[2] **Vosteen, H.-D. and Schellschmidt, R.** (2003). Influence of temperature on thermal conductivity, thermal capacity and thermal diffusivity for different types of rock. *Physics and Chemistry of the Earth*, 28, 499–509.

Table 1. Well names, geologic ages and formations, lithological descriptions, coordinates, pallet number, depths, and MRT sample names as provided by MRT. HDR converted depths from feet to metres where appropriate.

Well name	Age	Formation	Lithological description	Easting (m; MGA94)	Northing (m; MGA94)	Pallet	Depth (ft)	Depth (m)	MRT sample name	HDR sample ID
CSB1 South Bischoff	Devonian	Wombat Flat Granite	Granite	371044	5402037	20F01B		49.6	TC-51	MRT051
RED5 Redwater	Devonian	Dg: Housetop	Granite	410732	5426283	26B08		196.7	TC-52	MRT052
EAF-13	Cambrian	Mount Read Volcanics (NCVC)	Tuff	377613	5383765	20G06A		173.7	TC-53	MRT053
EAF-13	Cambrian	Mt Read Volcanics (NCVC)	Breccia, volcanic	377613	5383765	20G06A		220.2	TC-54	MRT054
DR2	Cambrian	Dove Granite	Granite	427912	5397933	16D10B		330.0	TC-55	MRT055
DMS-1 Mt Stronach	Devonian	Mt Stonach Granite	Granite	547197	5443278	12F11A		28.2	TC-56	MRT056
SP-2 St Pauls	Devonian	Royal George Granite	Granite	573912	5367683	12G08A	397.0	121.0	TC-57	MRT057
BLD-1 Bald Hill	Devonian	Mt Paris Granite	Granite	571912	5435183	12H01A	393.5	119.9	TC-58	MRT058
BT166 Blue Tier	Devonian	Poimena Granite	Granite	585125	5438015	12C05B		194.8	TC-59	MRT059
BT51 Blue Tier	Devonian	Blue Tier Granite	Granite (coarse)	585070	5435488	12B02A		78.0	TC-60	MRT060
BT51 Blue Tier	Devonian	Blue Tier Granite	Granite (fine)	585070	5435488	12B02A		184.7	TC-61	MRT061
BOOB-3 Boobyalla	Tertiary	Tertiary sediments	Sandstone	576025	5472382	12A04A		192.5	TC-62	MRT062
BOOB-3 Boobyalla	Tertiary	Tertiary sediments	Conglomerate	576025	5472382	12A04A		249.9	TC-63	MRT063
BOOB-3 Boobyalla	Tertiary	Tertiary sediments	Sandstone, pebbly	576025	5472382	12A04A		305.2	TC-64	MRT064
S2 Salisbury Hill	Ordivician	Cabbage Tree Fm	Conglomerate, silicaceous	486956	5433838	11A02B	200.0	61.0	TC-65	MRT065
S2 Salisbury Hill	Ordivician	Cabbage Tree Fm	Sandstone, quartzose	486956	5433838	11A02B	259.0	78.9	TC-66	MRT066
BEA-A16 Beaconsfield	Cambrian	Cambrian ultramafics	Serpentenite	471032	5439063	11B04B	93.5	28.5	TC-67	MRT067

Well name	Age	Formation	Lithological description	Easting (m; MGA94)	Northing (m; MGA94)	Pallet	Depth (ft)	Depth (m)	MRT sample name	HDR sample ID
GV1 Golden Valley	Permain	Quamby Mudstone	Mudstone	475023	5391515	11C05A	585.2		TC-68	MRT068
RG145 Turnbridge	Permain	Wynyard Tillite	Diamictite	524622	5335053	11D01B		868.7	TC-69	MRT069
RG145 Turnbridge	Precambrian	Precambrian undiff	Phyllite	524622	5335053	11D01B		912.6	TC-70	MRT070
CM1	Precambrian	Precambrian undiff	Slate	505517	5220803	11H02B		549.1	TC-71	MRT071
Lisle-01 Lisle	Devonian	Lisle Granodiorite	Granodiorite	528002	5434883	12I05B		72.2	TC-72	MRT072
WA3	Cambrian	Luina Group	Komatite	381212	5417883	10A10A		254.3	TC-73	MRT073
WA3	Cambrian	Luina Group	Breccia, volcanic	381212	5417883	10A10A		274.5	TC-74	MRT074
WA5	Precambrian	Oonah Formation	Siltstone	380512	5409783	10A10B		143.0	TC-75	MRT075
CK1 Copper King Cuprona	Precambrian	Oonah (Burnie) Formation	Phyllite	412602	5446153	10B07B	270.0	82.3	TC-76	MRT076
CK1 Copper King Cuprona	Precambrian	Oonah (Burnie) Formation	Sandstone	412602	5446153	10B07B	294.0	89.6	TC-77	MRT077
Storeys-1 Storeys Creek	Devonian	Henbury Granite	Granite	560362	538233	01E06B	87.0	26.5	TC-78	MRT078
Shittim 1B	Precambrian	Precambrian undiff	Phyllite	534042	5216183	04B03A		1706.3	TC-79	MRT079
Shittim 1B	Precambrian	Precambrian undiff	Phyllite	534042	5216183	04B03A		1739.6	TC-80	MRT080
LF4 Lefroy	Ordivician	Stony Head Sandstone	Sandstone	499865	5448257	04A05B		163.0	TC-81	MRT081
LF4 Lefroy	Ordivician	Stony Head Sandstone	Phyllite	499865	5448257	04A05B		172.5	TC-82	MRT082
FED-25 Federation	Devonian	Heemskirk Granite	Granite	351983	5358938	04E06B		144.0	TC-83	MRT083

2. Methodology

HDR employed two different methods to preparation the thirty-three specimens (MRT051—MRT083) for thermal conductivity measurement, depending on specimen quality and quantity. In this report, these methods are referred to as 'Whole rock' and 'Hollow cell, whole rock'. In each case, up to three samples were prepared from each specimen to investigate variation in thermal conductivity over short distance scales and to determine mean conductivity and uncertainty.

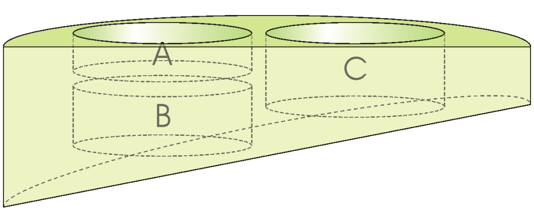
For all specimens except MRT062 and MRT064, three prisms were cut from each core specimen, each approximately ⅓ to ½ the diameter of the sample in thickness, and the ends of each prismatic sample were ground flat and polished. Samples prepared in this manner are indicated on Table 2 by the description 'Whole rock'.

Specimens MRT062 and MRT064 were relatively unconsolidated, and susceptible to deterioration during water saturation. HDR prepared samples of these specimens using hollow cells—vessels of transparent plastic with copper end-caps, used to confine the sample during saturation and thermal conductivity measurement. Samples prepared in this manner are indicated on Table 2 by the description 'Hollow cell, whole rock'.

All samples were evacuated under >95% vacuum for a minimum of three hours. Samples were then submerged in water prior to returning to atmospheric pressure. Saturation continued at atmospheric pressure for a minimum of sixteen hours, and all samples were left submerged in water until just prior to conductivity measurement.

In all cases, thermal conductivity was measured along the long axis of the core provided. Values were measured at a mean temperature of 25°C (± 2°C). Harmonic mean conductivity (Figure 1) and one standard deviation uncertainty were calculated for each specimen. Results are presented in the next section.

Figure 1. The average conductivity of samples in series (e.g. A and B) is found using the harmonic mean. The average conductivity of samples in parallel (e.g. A and C) is found using the arithmetic mean.



3. Results

Table 2 displays the measured thermal conductivity of each individual sample, and the harmonic mean conductivity and standard deviation for each specimen. All values are for a standard temperature of 25°C (± 2°C). Measurement uncertainty[3] for individual samples is ± 2.0% W/mK.

Table 2. Thermal conductivity of samples at 25°C, with harmonic mean and standard deviation for each specimen. MRT provided well names, formations, depths, and MRT sample names. HDR provided HDR sample ID's, foliation angle, sample preparation method, and thermal conductivity results. Foliation angle is the average dip of the foliation relative to a plane normal to the core axis.

Well	Formation	Depth (ft)	Depth (m)	Foliation angle	Sample preparation method	MRT sample name	HDR sample ID		Conductivity (W/mK), harmonic mean, standard deviation	
CSB1 South Bischoff	Wombat Flat Granite		49.6	No strong foliation	Whole rock	TC-51	MRT051	A	3.26	3.34 ± 0.07
								B	3.35	
								C	3.39	
RED5 Redwater	Dg: Housetop		196.7	No strong foliation	Whole rock	TC-52	MRT052	A	3.27	3.32 ± 0.05
								B	3.33	
								C	3.37	
EAF-13	Mount Read Volcanics (NCVC)		173.7	No strong foliation	Whole rock	TC-53	MRT053	A	3.49	3.48 ± 0.03
								B	3.49	
								C	3.45	
EAF-13	Mt Read Volcanics (NCVC)		220.2	No strong foliation	Whole rock	TC-54	MRT054	A	3.86	3.64 ± 0.23
								B	3.41	
								C	3.66	
DR2	Dove Granite		330.0	No strong foliation	Whole rock	TC-55	MRT055	A	3.79	3.85 ± 0.05
								B	3.87	
								C	3.88	
DMS-1 Mt Stronach	Mt Stonach Granite		28.2	No strong foliation	Whole rock	TC-56	MRT056	A	3.50	3.50 ± 0.01
								B	3.51	
								C	3.49	
SP-2 St Pauls	Royal George Granite	397.0	121.0	No strong foliation	Whole rock	TC-57	MRT057	A	3.52	3.38 ± 0.13
								B	3.33	
								C	3.29	
BLD-1 Bald Hill	Mt Paris Granite	393.5	119.9	No strong foliation	Whole rock	TC-58	MRT058	A	3.32	3.39 ± 0.07
								B	3.47	
								C	3.38	
BT166 Blue Tier	Poimena Granite		194.8	No strong foliation	Whole rock	TC-59	MRT059	A	3.36	3.32 ± 0.10
								B	3.39	
								C	3.21	
BT51 Blue Tier	Blue Tier Granite		78.0	No strong foliation	Whole rock	TC-60	MRT060	A	3.23	3.28 ± 0.12
								B	3.19	
								C	3.42	

[3] Measurement uncertainty incorporates calibration precision and the uncertainty in the absolute value of thermal conductivity of the calibration standards. It does not incorporate random errors due to variance in sample preparation.

Well	Formation	Depth (ft)	Depth (m)	Foliation angle	Sample preparation method	MRT sample name	HDR sample ID		Conductivity (W/mK), harmonic mean, standard deviation
BT51 Blue Tier	Blue Tier Granite		184.7	No strong foliation	Whole rock	TC-61	MRT061	A 3.54 B 3.65 C 3.47	3.55 ± 0.09
BOOB-3 Boobyalla	Tertiary sediments		192.5	No strong foliation	Hollow cell, whole rock	TC-62	MRT062	A 1.98 B 1.98 C 1.95	1.97 ± 0.02
BOOB-3 Boobyalla	Tertiary sediments		249.9	No strong foliation	Whole rock	TC-63	MRT063	A 1.48 B 1.59 C 1.83	1.62 ± 0.18
BOOB-3 Boobyalla	Tertiary sediments		305.2	No strong foliation	Hollow cell, whole rock	TC-64	MRT064	A 1.42 B 1.44 C 1.41	1.43 ± 0.01
S2 Salisbury Hill	Cabbage Tree Fm	200.0	61.0	No strong foliation	Whole rock	TC-65	MRT065	A 6.18 B 6.09 C 6.23	6.17 ± 0.07
S2 Salisbury Hill	Cabbage Tree Fm	259.0	78.9	No strong foliation	Whole rock	TC-66	MRT066	A 6.99 B 7.06 C 7.02	7.02 ± 0.04
BEA-A16 Beaconsfield	Cambrian ultramafics	93.5	28.5	No strong foliation	Whole rock	TC-67	MRT067	A 2.61 B 2.61 C 2.58	2.60 ± 0.02
GV1 Golden Valley	Quamby Mudstone	585.2		No strong foliation	Whole rock	TC-68	MRT068	A 1.92 B 1.95 C 2.03	1.96 ± 0.06
RG145 Turnbridge	Wynyard Tillite		868.7	No strong foliation	Whole rock	TC-69	MRT069	A 3.61 B 3.35 C 3.34	3.43 ± 0.15
RG145 Turnbridge	Precambrian undiff		912.6	35°, cleavage along undulating foliation	Whole rock	TC-70	MRT070	A 3.50 B 4.20 C 3.39	3.66 ± 0.44
CM1	Precambrian undiff		549.1	55°	Whole rock	TC-71	MRT071	A 2.93 B 2.70 C 2.91	2.84 ± 0.13
Lisle-01 Lisle	Lisle Granodiorite		72.2	No strong foliation	Whole rock	TC-72	MRT072	A 2.83 B 2.91 C 2.85	2.86 ± 0.04
WA3	Luina Group		254.3	No strong foliation	Whole rock	TC-73	MRT073	A 1.76 B 1.83 C 1.79	1.79 ± 0.03
WA3	Luina Group		274.5	No strong foliation	Whole rock	TC-74	MRT074	A 1.91 B 1.99 C 1.92	1.94 ± 0.05
WA5	Oonah Formation		143.0	35°, cleavage along foliation	Whole rock	TC-75	MRT075	A 3.59 B 3.56 C 3.43	3.53 ± 0.08
CK1 Copper King Cuprona	Oonah (Burnie) Formation	270.0	82.3	55°, cleavage along foliation	Whole rock	TC-76	MRT076	A 2.65 B 2.70	2.67 ± 0.04
CK1 Copper King Cuprona	Oonah (Burnie) Formation	294.0	89.6	50°, weakly visible foliation	Whole rock	TC-77	MRT077	A 5.55 B 5.51 C 5.58	5.55 ± 0.04
Storeys-1 Storeys Creek	Henbury Granite	87.0	26.5	No strong foliation	Whole rock	TC-78	MRT078	A 3.25 B 3.18 C 3.37	3.26 ± 0.10
Shittim 1B	Precambrian undiff		1706.3	70°, cleavage along foliation	Whole rock	TC-79	MRT079	A 4.16 B 4.27 C 4.12	4.18 ± 0.08

Well	Formation	Depth (ft)	Depth (m)	Foliation angle	Sample preparation method	MRT sample name	HDR sample ID			Conductivity (W/mK), harmonic mean, standard deviation
Shittim 1B	Precambrian undiff		1739.6	80°, cleavage along undulating foliation	Whole rock	TC-80	MRT080	A	4.42	4.44 ± 0.09
								B	4.36	
								C	4.54	
LF4 Lefroy	Stony Head Sandstone		163.0	40°, cleavage along foliation	Whole rock	TC-81	MRT081	A	4.34	3.99 ± 0.31
								B	3.74	
								C	3.93	
LF4 Lefroy	Stony Head Sandstone		172.5	40°, cleavage along foliation	Whole rock	TC-82	MRT082	A	1.69	1.61 ± 0.08
								B	1.61	
								C	1.52	
FED-25 Federation	Heemskirk Granite		144.0	No strong foliation	Whole rock	TC-83	MRT083	A	3.43	3.13 ± 0.26
								B	3.05	
								C	2.95	

4. Discussion and Conclusions

The variation in thermal conductivity between individual samples taken from a specimen was low for all specimens except MRT063 and MRT070. This indicates that for most specimens measured, variation in thermal conductivity on the scale of centimetres was low.

The conductivity of samples of MRT063, described by MRT as conglomerate, varied by up to 12% from the mean conductivity of 1.62 W/mK. This specimen showed large variability in grainsize, with particle sizes ranging from less than 1 mm to over 50 mm in length. HDR also observed variability in the matrix lithology. These heterogeneities in grainsize and mineralogical distribution are the likely cause of the thermal conductivity variability over the scale of centimetres.

The conductivity of samples of MRT070, described by MRT as phyllite, varied by up to 14% from the mean conductivity of 3.66 W/mK. This specimen showed strong undulating foliation dipping at an average angle of approximately 35° relative to a plane normal to the axis of the core, indicating likely thermal conductivity anisotropy. This specimen also showed variation in grainsize and mineralogy over the scale of centimetres. It is likely that both factors contributed to the variability in measured thermal conductivity.

Several specimens were strongly foliated (Table 2), often an indicator of thermal conductivity anisotropy. Anisotropy can cause significant variations in thermal conductivity and/or heat refraction over the scale of 100's of metres, despite the appearance of an otherwise consistent lithology throughout the formation. Although thermal conductivity measurements were all along the long axis of the core, the resulting values might not fully characterize the vertical conductivity of the relevant formations if the foliation angle varies across the formation.

The following additional points must be considered if extrapolating the results in this report to *in situ* formations:

1. The samples upon which the thermal conductivity measurements were made are only several square centimetres in surface area. While the specimens were presumably chosen to represent the geological sections from which they

came, HDR makes no guarantee that the sections themselves are typical of the overall geological formations. This is especially true for heterogeneous formations. This introduces an unquantifiable random error into the results.

2. Porosity exerts a primary influence on the thermal conductivity of a rock. Water is substantially less conductive than typical mineral grains[4], and water saturated pores act to reduce the bulk thermal conductivity of the rock. Gas-filled pores reduce the bulk conductivity even more dramatically. Results reported in this document are whole-rock measurements. No adjustments were made for porosity. It is to be expected that the thermal conductivity of a given formation will vary from place to place if the porosity of the formation varies (conductivity decreases with increasing porosity).

3. Thermal conductivity of rocks is sensitive to temperature[2], typically decreasing at a rate of around 0.16% per °C. This should be kept in mind when developing models of *in situ* thermal conductivity.

[4] **Beardsmore, G.R. and Cull, J.P.** (2001). *Crustal heat flow: A guide to measurement and modelling*. Cambridge University Press, Cambridge. 324pp.

Well	Formation	Depth (ft)	Depth (m)	Foliation angle, with respect to radial axis of core	MRT sample ID	HDR sample ID		Conductivity (W/mK), harmonic mean, standard deviation
CSB1 South Bischoff	Wombat Flat Granite		49.60	No strong foliation	TC-51	MRT051	A 3.26 B 3.35 C 3.39	3.34 ± 0.07
RED5 Redwater	Dg: Housetop		196.70	No strong foliation	TC-52	MRT052	A 3.27 B 3.33 C 3.37	3.32 ± 0.05
EAF-13	Mount Read Volcanics (NCVC)		173.70	No strong foliation	TC-52	MRT053	A 3.49 B 3.49 C 3.45	3.48 ± 0.03
EAF-13	Mt Read Volcanics (NCVC)		220.20	No strong foliation	TC-54	MRT054	A 3.86 B 3.41 C 3.66	3.64 ± 0.23
DR2	Dove Granite		330.00	No strong foliation	TC-55	MRT055	A 3.79 B 3.87 C 3.88	3.85 ± 0.05
DMS-1 Mt Stronach	Mt Stonach Granite		28.20	No strong foliation	TC-56	MRT056	A 3.50 B 3.51 C 3.49	3.50 ± 0.01
SP-2 St Pauls	Royal George Granite	397.0	121.00	No strong foliation	TC-57	MRT057	A 3.52 B 3.33 C 3.29	3.38 ± 0.13
BLD-1 Bald Hill	Mt Paris Granite	393.5	119.90	No strong foliation	TC-58	MRT058	A 3.32 B 3.47 C 3.38	3.39 ± 0.07
BT166 Blue Tier	Poimena Granite		194.80	No strong foliation	TC-59	MRT059	A 3.36 B 3.39 C 3.21	3.32 ± 0.10
BT51 Blue Tier	Blue Tier Granite		78.00	No strong foliation	TC-60	MRT060	A 3.23 B 3.19 C 3.42	3.28 ± 0.12
BT51 Blue Tier	Blue Tier Granite		184.70	No strong foliation	TC-61	MRT061	A 3.54 B 3.65 C 3.47	3.55 ± 0.09
BOOB-3 Boobyalla	Tertiary sediments		192.50	No strong foliation	TC-62	MRT062	A 1.98 B 1.98 C 1.95	1.97 ± 0.02
BOOB-3 Boobyalla	Tertiary sediments		249.90	No strong foliation	TC-63	MRT063	A 1.48 B 1.59 C 1.83	1.62 ± 0.18
BOOB-3 Boobyalla	Tertiary sediments		305.20	No strong foliation	TC-64	MRT064	A 1.42 B 1.44 C 1.41	1.43 ± 0.01
S2 Salisbury Hill	Cabbage Tree Fm	200.0	61.00	No strong foliation	TC-65	MRT065	A 6.18 B 6.09 C 6.23	6.17 ± 0.07
S2 Salisbury Hill	Cabbage Tree Fm	259.0	78.90	No strong foliation	TC-66	MRT066	A 6.99 B 7.06 C 7.02	7.02 ± 0.04
BEA-A16 Beaconsfield	Cambrian ultramafics	93.5	28.50	No strong foliation	TC-67	MRT067	A 2.61 B 2.61 C 2.58	2.60 ± 0.02

GV1 Golden Valley	Quamby Mudstone	585.2		No strong foliation	TC-68	MRT068	A	1.92	1.96	±	0.06
							B	1.95			
							C	2.03			
RG145 Turnbridge	Wynyard Tillite		868.70	No strong foliation	TC-69	MRT069	A	3.61	3.43	±	0.15
							B	3.35			
							C	3.34			
RG145 Turnbridge	Precambrian undiff		912.60	35°, cleavage along undulating foliation	TC-70	MRT070	A	3.50	3.66	±	0.44
							B	4.20			
							C	3.39			
CM1	Precambrian undiff		549.10	55°	TC-71	MRT071	A	2.93	2.84	±	0.13
							B	2.70			
							C	2.91			
Lisle-01 Lisle	Lisle Granodiorite		72.20	No strong foliation	TC-72	MRT072	A	2.83	2.86	±	0.04
							B	2.91			
							C	2.85			
WA3	Luina Group		254.30	No strong foliation	TC-73	MRT073	A	1.76	1.79	±	0.03
							B	1.83			
							C	1.79			
WA3	Luina Group		274.50	No strong foliation	TC-74	MRT074	A	1.91	1.94	±	0.05
							B	1.99			
							C	1.92			
WA5	Oonah Formation		143.00	35°, cleavage along foliation	TC-75	MRT075	A	3.59	3.53	±	0.08
							B	3.56			
							C	3.43			
CK1 Copper King Cuprona	Oonah (Burnie) Formation	270.0	82.30	55°, cleavage along foliation	TC-76	MRT076	A	2.65	2.67	±	0.04
							B	2.70			
							C	-.--			
CK1 Copper King Cuprona	Oonah (Burnie) Formation	294.0	89.60	50°, weakly visible foliation	TC-77	MRT077	A	5.55	5.55	±	0.04
							B	5.51			
							C	5.58			
Storeys-1 Storeys Creek	Henbury Granite	87.0	26.50	No strong foliation	TC-78	MRT078	A	3.25	3.26	±	0.10
							B	3.18			
							C	3.37			
Shittim 1B	Precambrian undiff		1706.30	70°, cleavage along foliation	TC-79	MRT079	A	4.16	4.18	±	0.08
							B	4.27			
							C	4.12			
Shittim 1B	Precambrian undiff		1739.60	80°, cleavage along undulating foliation	TC-80	MRT080	A	4.42	4.44	±	0.09
							B	4.36			
							C	4.54			
LF4 Lefroy	Stony Head Sandstone		163.00	40°, cleavage along foliation	TC-81	MRT081	A	4.34	3.99	±	0.31
							B	3.74			
							C	3.93			
LF4 Lefroy	Stony Head Sandstone		172.50	40°, cleavage along foliation	TC-82	MRT082	A	1.69	1.61	±	0.08
							B	1.61			
							C	1.52			
FED-25 Federation	Heemskirk Granite		144.00	No strong foliation	TC-83	MRT083	A	3.43	3.13	±	0.26
							B	3.05			
							C	2.95			