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Thermal conductivity of core specimens MRT001-MRT050

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 fifty rock specimens delivered to HDR in September 2010. At the time of the writing, HDR expects this batch to be followed at a later date by a second batch of fifty specimens. This report only includes the initial batch. Measurements were made on the specimens using a steady state divided bar apparatus calibrated for the range 1.4–12.2 W/mK. Up to three samples were prepared from each specimen to investigate variance in thermal conductivity over short distance scales. All values were measured at a temperature of 25°C ($\pm 2^\circ\text{C}$).

HDR considers the following points to be important:

- HDR had no role in selecting the core specimens to be measured for thermal conductivity, so HDR does not warrant that the specimens are representative of the geological formations from which they came.
- The thermal conductivity of a given formation is likely to 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.
- Thermal conductivity can be anisotropic. All specimens in this report were measured parallel to the drill core axis. The conductivity of strongly cleaved specimens may be significantly different in other orientations.

Author

This report was prepared by Anson Antriasian. Sample preparation and measurement, and foliation observations were undertaken by Anson Antriasian and Catherine Tuxen. MRT provided lithological descriptions, depths, coordinates, drillhole names, pallet information, and geologic units and ages on Table 1 and Table 2.

Disclaimer

The information and opinions in this report have been generated to the best ability of the author, and Hot Dry Rocks Pty Ltd (HDR) hope they may be of assistance to you. However, neither the author nor any other employee of HDR guarantees that the report is without flaw or is wholly appropriate for your particular purposes, and therefore we disclaim all liability for any error, loss or other consequence which may arise from you relying on any information in this publication.

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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 fifty specimens¹ in September 2010 (Table 1). Thermal conductivity measurements were made on these specimens using a steady state divided bar apparatus calibrated for the range 1.4–12.2 W/mK.

Thermal conductivity is sensitive to temperature (e.g. Vosteen and Schellschmidt, 2003²), in general decreasing as temperature increases. The measurements contained in this report were made within $\pm 2^\circ\text{C}$ of 25°C .

Where appropriate, depth information provided by MRT was converted from feet to metres by HDR. Depths in feet as provided by MRT, in addition to other sample data provided by MRT such as sample names, geologic ages and formations, well names, coordinates, pallet information, and lithologies, are included in Table 1 and Table 2.

Many rocks are anisotropic, with different thermal conductivity in different directions (e.g. Beardsmore and Cull, 2001³). All measurements in this report were made in a direction parallel to the axis of the core. HDR notes, however, that many of the specimens were strongly cleaved. Those specimens could be significantly anisotropic and care should be taken when applying the results in this report to regions of varying cleavage orientation.

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.

³ Beardsmore, G.R. and Cull, J.P. (2001). *Crustal heat flow: A guide to measurement and modeling*. Cambridge University Press, Cambridge. 324pp.

Table 1. Specimens presented for thermal conductivity measurement. Well names, geologic ages and formations, lithological descriptions, coordinates, pallet information, and depths were provided by MRT. Depths were converted from feet to metres by HDR where appropriate.

Well	Age	Formation	Lith. Description	mE MGA94	mN MGA94	Pallet	Depth (ft)	Depth (m)	MRT sample name	HDR sample ID
Duckbay-1	Proterozoic	Rocky Cape Group	pale fine sandstone	346157	5478213	05H10B		199.10	TC-01	MRT001
Duckbay-1	Proterozoic	Rocky Cape Group	dark siltstone	346157	5478213	05H10B		319.50	TC-02	MRT002
Duckbay-1	Proterozoic	Rocky Cape Group	dark siltstone	346157	5478213	05H10B		484.30	TC-03	MRT003
SMI-2 Smithton	Cambrian	Scopus Formation	mudstone with 20% fine sandstone	333728	5480608	07A05B		117.90	TC-04	MRT004
SMI-2 Smithton	Cambrian	Scopus Formation	coarse sandstone	333728	5480608	07A05B		225.00	TC-05	MRT005
Forest-1	Neo-proterozoic	Kanunnah Subgroup	basalt	352850	5480294	07A02B		41.30	TC-06	MRT006
Forest-1	Neo-proterozoic	Kanunnah Subgroup	coarse sandstone	352850	5480294	07A03B		364.50	TC-07	MRT007
Forest-1	Neo-proterozoic	Kanunnah Subgroup	mudstone	352850	5480294	07A03B		467.10	TC-08	MRT008
Forest-1	Neo-proterozoic	Black River Dolomite	dolostone	352850	5480294	07A05A		1034.40	TC-09	MRT009
Forest-1	Neo-proterozoic	Black River Dolomite	black shale	352850	5480294	07A05A		1039.70	TC-10	MRT010
Forest-1	Neo-proterozoic	Black River Dolomite	dolodstone	352850	5480294	07A05A		1054.30	TC-11	MRT011
BH2 Macquarie Hbr	Proterozoic	Rocky Cape Group correlate	phyllite	358920	5311691	07C08A		121.60	TC-12	MRT012
BH2 Macquarie Hbr	Proterozoic	Rocky Cape Group correlate	quartzite	358920	5311691	07C08A		102.20	TC-13	MRT013
SBDP2	Tertiary	Tertiary basalt	basalt	391921	5406191	10A05A		297.60	TC-14	MRT014
SBDP2	Ordovician	Gordon Group	limestone	391921	5406191	10A05A		340.90	TC-15	MRT015
SBDP2	Ordovician	Moina Sandstone	red gritty sandstone	391921	5406191	10A05A		379.00	TC-16	MRT016
SBDP6	Tertiary	Tertiary basalt	basalt	392756	5402916	10A06B		197.20	TC-17	MRT017

SBDP6	Devonian	Bell Shale	fine quartz sanstone	392752	5402916	10A06B		304.40	TC-18	MRT018
SBDP6	Devonian	Bell Shale	mudstone	392756	5402916	10A06B		271.50	TC-19	MRT019
SBDP6	Devonian	Bell Shale	mudstone	392756	5402916	10A06B		278.10	TC-20	MRT020
SBDP9	Devonian	Florence Quartzite	quartz sanstone	388025	5402089	10A07A		339.20	TC-21	MRT021
SBDP9	Devonian	Florence Quartzite	quartz sanstone	388025	5402089	10A07A		313.60	TC-22	MRT022
DLR7	Ordovician	Gordon Group	limestone	488817	5187738	11H08B		354.60	TC-23	MRT023
DLR7	Ordovician	Gordon Group	limestone	488817	5187738	11H08B		376.30	TC-24	MRT024
Colesbay1	Devonian	Coles Bay Granite	granite	606312	5336783	12G02A		137.60	TC-25	MRT025
Colesbay1	Devonian	Coles Bay Granite	granite	606312	5336783	12G01A		563.00	TC-26	MRT026
Colesbay1	Devonian	Coles Bay Granite	granite	606312	5336783	12F11A		923.00	TC-27	MRT027
FAL-1	Devonian	St Mary's Porphyry	porphyry	603332	5401545	12H06B		46.40	TC-28	MRT028
King Island Salinity Sutto'	Neo- proterozoic	King Island Granite	coarse granite	245002	5605341	17G09B		30.00	TC-29	MRT029
King Island Salinity Payne	Neo- proterozoic	King Island Granite	fine granite	245059	5598308	17G09B		14.30	TC-30	MRT030
HEAZ-H1	Cambrian	Ultramafics	pyroxenite	359312	5408983	20A05B	598.5	182.42	TC-31	MRT031
HEAZ-H1	Cambrian	Ultramafics	serpentinite	359312	5408983	20A05B	356.0	108.51	TC-32	MRT032
PD85HF1	Proterozoic	Oonah Formation	mudstone	359362	5367583	20B10B		61.50	TC-33	MRT033
PD85HF1	Proterozoic	Oonah Formation	mudstone	359362	5367583	20B10B		69.00	TC-34	MRT034
PD85HF1	Proterozoic	Oonah Formation	black shale	359362	5367583	20B10B		99.50	TC-35	MRT035
TYN006	Cambrian	Comstock Tuff	coarse volcanic sandstone	381449	5357129	03G02B		163.80	TC-36	MRT036
TYN006	Cambrian	Mt Reed Volcanics	andesite	381449	5357129	03G03A		350.60	TC-37	MRT037

Shittim 1B	Proterozoic	Precambrian	phyllite	534042	5216183	04B03A		1700.80	TC-38	MRT038
Hunterston-1	Proterozoic	Precambrian	dolostone	495612	5326583	04H08A		1227.80	TC-39	MRT039
Hunterston-1	Proterozoic	Precambrian	sandstone	495612	5326583	04H08A		1290.90	TC-40	MRT040
BLHY-1 (Black Harry)	Cambrian	Mt Reed Volcanics	dacite	390438	5399663	07C07A		100.70	TC-41	MRT041
BLHY-1 (Black Harry)	Cambrian	Mt Reed Volcanics	black shale	390438	5399663	07C07A		181.70	TC-42	MRT042
BLHY-1 (Black Harry)	Cambrian	Mt Reed Volcanics	sandstone	390438	5399663	07C07A		127.20	TC-43	MRT043
Glenorchy-1	Permian	Woody Island Siltstone	baked volcanics	521012	5256383	11E06A	360.0	109.73	TC-44	MRT044
Glenorchy-1	Cambrian	Mt Reed Volcanics	andesitic volcanics	521012	5256383	11E07B	1965.0	598.93	TC-45	MRT045
Granton-1	Permian	Woody Island Siltstone	mudstone	515726	5266675	11E08B		298.40	TC-46	MRT046
Woodbridge-1	Permian	Truro Tillite	phyllite	519400	5222751	11G05B		1008.80	TC-47	MRT047
Woodbridge-1	Cretaceous	Cretaceous	syenite	519400	5222751	11G08A		989.20	TC-48	MRT048
Woodbridge-1	Proterozoic	Precambrian	tillite	519400	5222751	11G08A		20.80	TC-49	MRT049
Rowella-2	Tertiary	Tertiary basalt	basalt	492212	5440983	12I02A		133.20	TC-50	MRT050

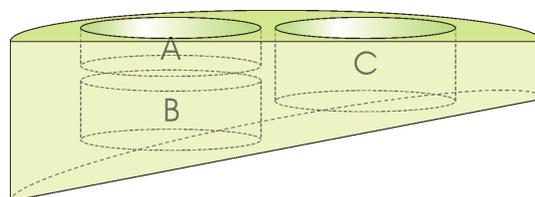
2. Methodology

HDR prepared each of the fifty core specimens provided by MRT for thermal conductivity measurement in a divided bar apparatus⁴. Three prism-shaped samples were cut from each core specimen, each being approximately $\frac{1}{3}$ to $\frac{1}{2}$ the length of the sample in thickness. Each sample was ground flat and polished. Three samples were prepared from each specimen to investigate variance in thermal conductivity over short distance scales and to determine mean conductivity and uncertainty.

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 axis of the core provided. Values were measured at a standard temperature of 25°C ($\pm 2^{\circ}\text{C}$). 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.



⁴ Divided bar apparatus: An instrument that places an unknown sample in series with a standard of known thermal conductivity, then imposes a constant thermal gradient across the combination in order to derive the conductivity of the unknown sample

3. Results

Table 2 displays the thermal conductivity for each individual sample, and the harmonic mean conductivity and standard deviation for each specimen. All values are for a standard temperature of 25°C. Instrument uncertainty on individual samples is approximately $\pm 3.5\%$. Where appropriate, depths were converted from feet to metres by HDR. Depths in feet as provided by MRT are included in Table 2.

Table 2. Thermal conductivity of samples at 25°C, with harmonic mean and uncertainty⁵ for each specimen. Well names, geologic ages and formations, depths, and MRT sample IDs were provided by MRT. HDR sample IDs, foliation angle, and thermal conductivity information was provided by HDR. Foliation angles were measures with respect to the core axis, i.e. relative to the normal of the long axis of the core.

Well	Formation	Depth (ft)	Depth (m)	Foliation angle, with respect to core axis	MRT sample ID	HDR sample ID	Conductivity (W/mK), harmonic mean, standard deviation		
Duckbay-1	Rocky Cape Group		199.10	no strong foliation	TC-01	MRT001	A	3.99	3.86 ± 0.11
							B	3.82	
							C	3.77	
Duckbay-1	Rocky Cape Group		319.50	60°, cleavage along intermittent foliation	TC-02	MRT002	A	3.44	3.42 ± 0.06
							B	3.47	
							C	3.36	
Duckbay-1	Rocky Cape Group		484.30	no strong foliation	TC-03	MRT003	A	4.27	4.17 ± 0.09
							B	4.11	
							C	4.13	
SMI-2 Smithton	Scopus Formation		117.90	10°, cleavage weakly follows foliation	TC-04	MRT004	A	2.76	2.76 ± 0.13
							B	2.63	
							C	2.89	
SMI-2 Smithton	Scopus Formation		225.00	no strong foliation	TC-05	MRT005	A	5.75	5.63 ± 0.11
							B	5.63	
							C	5.52	
Forest-1	Kanunnah Subgroup		41.30	no strong foliation	TC-06	MRT006	A	2.35	2.35 ± 0.01
							B	2.35	
							C	2.37	
Forest-1	Kanunnah Subgroup		364.50	no strong foliation	TC-07	MRT007	A	2.58	2.66 ± 0.07
							B	2.71	
							C	2.69	
Forest-1	Kanunnah Subgroup		467.10	no strong foliation	TC-08	MRT008	A	2.67	2.55 ± 0.10
							B	2.49	
							C	2.50	
Forest-1	Black River Dolomite		1034.40	no strong foliation	TC-09	MRT009	A	4.64	4.73 ± 0.12
							B	4.86	
							C	4.70	

⁵ Uncertainty of the thermal conductivity for each specimen is one standard deviation of the measured values.

Forest-1	Black River Dolomite		1039.70	52°, cleavage along strong foliation	TC-10	MRT010	A	3.26	3.22 ± 0.07
							B	3.26	
							C	3.14	
Forest-1	Black River Dolomite		1054.30	no strong foliation	TC-11	MRT011	A	5.12	5.08 ± 0.04
							B	5.06	
							C	5.05	
BH2 Macquarie Hbr	Rocky Cape Group correlate		121.60	50°, variable/wavy foliation	TC-12	MRT012	A	8.27	9.35 ± 1.02
							B	10.19	
							C	9.83	
BH2 Macquarie Hbr	Rocky Cape Group correlate		102.20	70°, weakly visible foliation	TC-13	MRT013	A	6.45	6.54 ± 0.13
							B	6.68	
							C	6.48	
SBDP2	Tertiary basalt		297.60	no strong foliation	TC-14	MRT014	A	1.55	1.55 ± 0.00
							B	1.55	
							C	1.55	
SBDP2	Gordon Group		340.90	no strong foliation	TC-15	MRT015	A	3.02	3.02 ± 0.06
							B	2.96	
							C	3.08	
SBDP2	Moina Sandstone		379.00	no strong foliation	TC-16	MRT016	A	3.88	3.69 ± 0.17
							B	3.63	
							C	3.57	
SBDP6	Tertiary basalt		197.20	no strong foliation	TC-17	MRT017	A	1.70	1.71 ± 0.01
							B	1.72	
							C	1.70	
SBDP6	Bell Shale		304.40	no strong foliation	TC-18	MRT018	A	5.25	5.17 ± 0.08
							B	5.09	
							C	5.18	
SBDP6	Bell Shale		271.50	45°, weakly visible foliation	TC-19	MRT019	A	2.96	2.89 ± 0.07
							B	2.84	
							C	2.86	
SBDP6	Bell Shale		278.10	35°, cleavage weakly follows foliation	TC-20	MRT020	A	2.55	2.58 ± 0.03
							B	2.61	
							C	2.57	
SBDP9	Florence Quartzite		339.20	no strong foliation	TC-21	MRT021	A	5.85	5.85 ± 0.06
							B	5.80	
							C	5.91	
SBDP9	Florence Quartzite		313.60	no strong foliation	TC-22	MRT022	A	6.06	6.08 ± 0.02
							B	6.11	
							C	6.08	
DLR7	Gordon Group		354.60	no strong foliation	TC-23	MRT023	A	3.14	3.12 ± 0.03
							B	3.09	
							C	3.14	
DLR7	Gordon Group		376.30	no strong foliation	TC-24	MRT024	A	3.23	3.24 ± 0.02
							B	3.26	
							C	3.23	
Colesbay1	Coles Bay Granite		137.60	no strong foliation	TC-25	MRT025	A	3.78	3.72 ± 0.12
							B	3.81	
							C	3.58	
Colesbay1	Coles Bay Granite		563.00	no strong foliation	TC-26	MRT026	A	3.70	3.79 ± 0.08
							B	3.85	
							C	3.82	
Colesbay1	Coles Bay Granite		923.00	no strong foliation	TC-27	MRT027	A	3.81	3.72 ± 0.09
							B	3.74	
							C	3.62	

FAL-1	St Mary's Porphyry		46.40	no strong foliation	TC-28	MRT028	A	2.96	2.94 ± 0.02
							B	2.93	
							C	2.91	
King Island Salinity Sutto'	King Island Granite		30.00	no strong foliation	TC-29	MRT029	A	3.72	3.74 ± 0.14
							B	3.89	
							C	3.61	
King Island Salinity Payne	King Island Granite		14.30	no strong foliation	TC-30	MRT030	A	3.15	3.19 ± 0.05
							B	3.24	
							C	3.19	
HEAZ-H1	Ultramafics	598.5	182.42	65°, may not be actual foliation	TC-31	MRT031	A	3.65	3.03 ± 0.51
							B	2.94	
							C	2.65	
HEAZ-H1	Ultramafics	356.0	108.51	no strong foliation	TC-32	MRT032	A	2.46	2.48 ± 0.05
							B	2.44	
							C	2.54	
PD85HF1	Oonah Formation		61.50	28° cleavage along weakly visible foliation	TC-33	MRT033	A	1.80	2.17 ± 0.46
							B	2.18	
							C	2.73	
PD85HF1	Oonah Formation		69.00	no strong foliation	TC-34	MRT034	A	2.11	2.12 ± 0.01
							B	2.11	
							C	2.13	
PD85HF1	Oonah Formation		99.50	65° cleavage along moderate foliation	TC-35	MRT035	A	3.05	3.07 ± 0.03
							B	3.04	
							C	3.10	
TYN006	Comstock Tuff		163.80	no strong foliation	TC-36	MRT036	A	2.88	2.89 ± 0.02
							B	2.89	
							C	2.91	
TYN006	Mt Reed Volcanics		350.60	30°, weak bedding planes?	TC-37	MRT037	A	2.91	2.91 ± 0.01
							B	2.90	
							C	2.93	
Shittim 1B	Precambrian		1700.80	70°, cleavage along strong foliation	TC-38	MRT038	A	3.75	4.01 ± 0.28
							B	4.01	
							C	4.32	
Hunterston-1	Precambrian		1227.80	no strong foliation	TC-39	MRT039	A	4.90	4.89 ± 0.07
							B	4.81	
							C	4.96	
Hunterston-1	Precambrian		1290.90	approx. 35°, variable foliation	TC-40	MRT040	A	3.18	3.24 ± 0.12
							B	3.37	
							C	3.16	
BLHY-1 (Black Harry)	Mt Reed Volcanics		100.70	no strong foliation	TC-41	MRT041	A	4.16	4.22 ± 0.07
							B	4.30	
							C	4.21	
BLHY-1 (Black Harry)	Mt Reed Volcanics		181.70	44°, strong foliation	TC-42	MRT042	A	3.59	3.28 ± 0.46
							B	2.80	
							C	3.60	
BLHY-1 (Black Harry)	Mt Reed Volcanics		127.20	18°, intermittent foliation	TC-43	MRT043	A	3.21	3.00 ± 0.18
							B	2.93	
							C	2.88	
Glenorchy-1	Woody Island Siltstone	360.0	109.73	no strong foliation	TC-44	MRT044	A	2.82	2.85 ± 0.04
							B	2.84	
							C	2.89	

Glenorchy-1	Mt Reed Volcanics	1965.0	598.93	28°, variable foliation	TC-45	MRT045	A	2.07	2.21 ± 0.16
							B	2.19	
							C	2.40	
Granton-1	Woody Island Siltstone		298.40	0°, weakly visible foliation	TC-46	MRT046	A	2.80	2.77 ± 0.17
							B	2.60	
							C	2.93	
Woodbridge-1	Truro Tillite		1008.80	32°, cleavage along strong foliation	TC-47	MRT047	A	2.02	1.98 ± 0.09
							B	2.05	
							C	1.89	
Woodbridge-1	Cretaceous		989.20	no strong foliation	TC-48	MRT048	A	2.28	2.27 ± 0.03
							B	2.24	
							C	2.28	
Woodbridge-1	Precambrian		20.80	no strong foliation	TC-49	MRT049	A	2.52	2.52 ± 0.01
							B	2.54	
							C	2.51	
Rowella-2	Tertiary basalt		133.20	no strong foliation	TC-50	MRT050	A	1.95	1.92 ± 0.02
							B	1.90	
							C	1.93	

4. Discussion and Conclusions

In most cases, thermal conductivity measurements showed low variability between individual samples taken from the same specimen. Exceptional cases were: MRT012, MRT031, MRT033, and MRT042.

MRT012 showed exceptionally high thermal conductivity, with a mean conductivity of 9.35 W/mK between the three samples. This specimen also showed significant variability in conductivity between samples—approximately 12% variation from the mean—likely due to the observed variability in foliation direction that can lead to thermal conductivity anisotropy. Variability in conductivity may also be due to heterogeneities in mineralogical distribution.

MRT031 showed variability between samples up to approximately 18% from the mean conductivity of 3.03 W/mK. Upon inspection, HDR observed that variability in veining, mineralogy, and grainsize distribution were the likely sources of variability in thermal conductivity.

MRT033 showed variability between samples up to approximately 21% from the mean conductivity of 2.17 W/mK. Upon inspection, HDR observed that variability in veining and grainsize distribution were the likely sources of variability in thermal conductivity. These samples fractured after testing, indicating the presence of either natural or drilling induced planes of weakness that may also have influenced variability in thermal conductivity.

MRT042 showed variability between samples up to approximately 16% from the mean conductivity of 3.28 W/mK. Upon inspection, HDR observed variability in the mineralogy of the foliation layers of this specimen, and small-scale faulting which had also altered the mineralogical distribution within the specimen. Both of these factors likely contributed to the measured variability in thermal conductivity.

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 chosen to represent the geological sections from which they came, there

is 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 grains³, 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. The thermal conductivity of a given formation will likely 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 temperature², 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. All measurements in this report were made parallel to the axis of the core specimen. HDR notes, however, that many of the specimens were strongly cleaved. Those specimens could be significantly anisotropic and care should be taken when applying the results in this report to regions of varying cleavage orientation.

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			
							A	B	C	
Duckbay-1	Rocky Cape Group		199.10	no strong foliation	TC-01	MRT001	A 3.99	B 3.82	C 3.77	3.86 ± 0.11
Duckbay-1	Rocky Cape Group		319.50	60°, cleavage along intermittent foliation	TC-02	MRT002	A 3.44	B 3.47	C 3.36	3.42 ± 0.06
Duckbay-1	Rocky Cape Group		484.30	no strong foliation	TC-03	MRT003	A 4.27	B 4.11	C 4.13	4.17 ± 0.09
SMI-2 Smithton	Scopus Formation		117.90	10°, cleavage weakly follows foliation	TC-04	MRT004	A 2.76	B 2.63	C 2.89	2.76 ± 0.13
SMI-2 Smithton	Scopus Formation		225.00	no strong foliation	TC-05	MRT005	A 5.75	B 5.63	C 5.52	5.63 ± 0.11
Forest-1	Kanunnah Subgroup		41.30	no strong foliation	TC-06	MRT006	A 2.35	B 2.35	C 2.37	2.35 ± 0.01
Forest-1	Kanunnah Subgroup		364.50	no strong foliation	TC-07	MRT007	A 2.58	B 2.71	C 2.69	2.66 ± 0.07
Forest-1	Kanunnah Subgroup		467.10	no strong foliation	TC-08	MRT008	A 2.67	B 2.49	C 2.50	2.55 ± 0.10
Forest-1	Black River Dolomite		1034.40	no strong foliation	TC-09	MRT009	A 4.64	B 4.86	C 4.70	4.73 ± 0.12
Forest-1	Black River Dolomite		1039.70	52°, cleavage along strong foliation	TC-10	MRT010	A 3.26	B 3.26	C 3.14	3.22 ± 0.07
Forest-1	Black River Dolomite		1054.30	no strong foliation	TC-11	MRT011	A 5.12	B 5.06	C 5.05	5.08 ± 0.04
BH2 Macquarie Hbr	Rocky Cape Group correlate		121.60	50°, variable/wavy foliation	TC-12	MRT012	A 8.27	B #####	C 9.83	9.35 ± 1.02
BH2 Macquarie Hbr	Rocky Cape Group correlate		102.20	70°, weakly visible foliation	TC-13	MRT013	A 6.45	B 6.68	C 6.48	6.54 ± 0.13
SBDP2	Tertiary basalt		297.60	no strong foliation	TC-14	MRT014	A 1.55	B 1.55	C 1.55	1.55 ± 0.00
SBDP2	Gordon Group		340.90	no strong foliation	TC-15	MRT015	A 3.02	B 2.96	C 3.08	3.02 ± 0.06
SBDP2	Moina Sandstone		379.00	no strong foliation	TC-16	MRT016	A 3.88	B 3.63	C 3.57	3.69 ± 0.17
SBDP6	Tertiary basalt		197.20	no strong foliation	TC-17	MRT017	A 1.70	B 1.72	C 1.70	1.71 ± 0.01

SBDP6	Bell Shale		304.40	no strong foliation	TC-18	MRT018	A	5.25	5.17 ± 0.08
							B	5.09	
							C	5.18	
SBDP6	Bell Shale		271.50	45°, weakly visible foliation	TC-19	MRT019	A	2.96	2.89 ± 0.07
							B	2.84	
							C	2.86	
SBDP6	Bell Shale		278.10	35°, cleavage weakly follows foliation	TC-20	MRT020	A	2.55	2.58 ± 0.03
							B	2.61	
							C	2.57	
SBDP9	Florence Quartzite		339.20	no strong foliation	TC-21	MRT021	A	5.85	5.85 ± 0.06
							B	5.80	
							C	5.91	
SBDP9	Florence Quartzite		313.60	no strong foliation	TC-22	MRT022	A	6.06	6.08 ± 0.02
							B	6.11	
							C	6.08	
DLR7	Gordon Group		354.60	no strong foliation	TC-23	MRT023	A	3.14	3.12 ± 0.03
							B	3.09	
							C	3.14	
DLR7	Gordon Group		376.30	no strong foliation	TC-24	MRT024	A	3.23	3.24 ± 0.02
							B	3.26	
							C	3.23	
Colesbay1	Coles Bay Granite		137.60	no strong foliation	TC-25	MRT025	A	3.78	3.72 ± 0.12
							B	3.81	
							C	3.58	
Colesbay1	Coles Bay Granite		563.00	no strong foliation	TC-26	MRT026	A	3.70	3.79 ± 0.08
							B	3.85	
							C	3.82	
Colesbay1	Coles Bay Granite		923.00	no strong foliation	TC-27	MRT027	A	3.81	3.72 ± 0.09
							B	3.74	
							C	3.62	
FAL-1	St Mary's Porphyry		46.40	no strong foliation	TC-28	MRT028	A	2.96	2.94 ± 0.02
							B	2.93	
							C	2.91	
King Island Salinity Sutto'	King Island Granite		30.00	no strong foliation	TC-29	MRT029	A	3.72	3.74 ± 0.14
							B	3.89	
							C	3.61	
King Island Salinity Payne	King Island Granite		14.30	no strong foliation	TC-30	MRT030	A	3.15	3.19 ± 0.05
							B	3.24	
							C	3.19	
HEAZ-H1	Ultramafics	598.5	182.42	65°, may not be actual foliation	TC-31	MRT031	A	3.65	3.03 ± 0.51
							B	2.94	
							C	2.65	
HEAZ-H1	Ultramafics	356.0	108.51	no strong foliation	TC-32	MRT032	A	2.46	2.48 ± 0.05
							B	2.44	
							C	2.54	
PD85HF1	Oonah Formation		61.50	28° cleavage along weakly visible foliation	TC-33	MRT033	A	1.80	2.17 ± 0.46
							B	2.18	
							C	2.73	
PD85HF1	Oonah Formation		69.00	no strong foliation	TC-34	MRT034	A	2.11	2.12 ± 0.01
							B	2.11	
							C	2.13	
PD85HF1	Oonah Formation		99.50	65° cleavage along moderate foliation	TC-35	MRT035	A	3.05	3.07 ± 0.03
							B	3.04	
							C	3.10	
TYN006	Comstock Tuff		163.80	no strong foliation	TC-36	MRT036	A	2.88	2.89 ± 0.02
							B	2.89	
							C	2.91	

TYN006	Mt Reed Volcanics		350.60	30°, weak bedding planes?	TC-37	MRT037	A	2.91	2.91 ± 0.01
							B	2.90	
							C	2.93	
Shittim 1B	Precambrian		1700.80	70°, cleavage along strong foliation	TC-38	MRT038	A	3.75	4.01 ± 0.28
							B	4.01	
							C	4.32	
Hunterston-1	Precambrian		1227.80	no strong foliation	TC-39	MRT039	A	4.90	4.89 ± 0.07
							B	4.81	
							C	4.96	
Hunterston-1	Precambrian		1290.90	approx. 35°, variable foliation	TC-40	MRT040	A	3.18	3.24 ± 0.12
							B	3.37	
							C	3.16	
BLHY-1 (Black Harry)	Mt Reed Volcanics		100.70	no strong foliation	TC-41	MRT041	A	4.16	4.22 ± 0.07
							B	4.30	
							C	4.21	
BLHY-1 (Black Harry)	Mt Reed Volcanics		181.70	44°, strong foliation	TC-42	MRT042	A	3.59	3.28 ± 0.46
							B	2.80	
							C	3.60	
BLHY-1 (Black Harry)	Mt Reed Volcanics		127.20	18°, intermittent foliation	TC-43	MRT043	A	3.21	3.00 ± 0.18
							B	2.93	
							C	2.88	
Glenorchy-1	Woody Island Siltstone	360.0	109.73	no strong foliation	TC-44	MRT044	A	2.82	2.85 ± 0.04
							B	2.84	
							C	2.89	
Glenorchy-1	Mt Reed Volcanics	1965.0	598.93	28°, variable foliation	TC-45	MRT045	A	2.07	2.21 ± 0.16
							B	2.19	
							C	2.40	
Granton-1	Woody Island Siltstone		298.40	0°, weakly visible foliation	TC-46	MRT046	A	2.80	2.77 ± 0.17
							B	2.60	
							C	2.93	
Woodbridge-1	Truro Tillite		1008.80	32°, cleavage along strong foliation	TC-47	MRT047	A	2.02	1.98 ± 0.09
							B	2.05	
							C	1.89	
Woodbridge-1	Cretaceous		989.20	no strong foliation	TC-48	MRT048	A	2.28	2.27 ± 0.03
							B	2.24	
							C	2.28	
Woodbridge-1	Precambrian		20.80	no strong foliation	TC-49	MRT049	A	2.52	2.52 ± 0.01
							B	2.54	
							C	2.51	
Rowella-2	Tertiary basalt		133.20	no strong foliation	TC-50	MRT050	A	1.95	1.92 ± 0.02
							B	1.90	
							C	1.93	
					TC-51	MRT051	A	0.00	#N/A ± #####
							B	0.00	
							C	0.00	
					TC-52	MRT052	A	0.00	#N/A ± #####
							B	0.00	
							C	0.00	
					TC-52	MRT053	A	0.00	#N/A ± #####
							B	0.00	
							C	0.00	
					TC-54	MRT054	A	0.00	#N/A ± #####
							B	0.00	
							C	0.00	
					TC-55	MRT055	A	0.00	#N/A ± #####
							B	0.00	
							C	0.00	

					TC-94	MRT094	A	0.00	#N/A ± #####
							B	0.00	
							C	0.00	
					TC-95	MRT095	A	0.00	#N/A ± #####
							B	0.00	
							C	0.00	
					TC-96	MRT096	A	0.00	#N/A ± #####
							B	0.00	
							C	0.00	
					TC-97	MRT097	A	0.00	#N/A ± #####
							B	0.00	
							C	0.00	
					TC-98	MRT098	A	0.00	#N/A ± #####
							B	0.00	
							C	0.00	
					TC-99	MRT099	A	0.00	#N/A ± #####
							B	0.00	
							C	0.00	
					TC-100	MRT100	A	0.00	#N/A ± #####
							B	0.00	
							C	0.00	