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Physical property measurements on rock samples from the Mount Isa Inlier, northwest Queensland

I. G. Hone, V. P. Carberry, & H. G. Reith

Bureau of Mineral Resources, Geology and Geophysics

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PHYSICAL PROPERTY MEASUREMENTS ON ROCK SAMPLES FROM THE MOUNT ISA INLIER, NORTHWEST QUEENSLAND

by

I.G. Hone, V.P. Carberry, & H.G. Reith

(Division of Geophysics)

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ABSTRACT

Physical properties of rocks in the Mount Isa Inlier have been determined in order to provide constraints for the interpretation of magnetic and gravity data: the porosity, density, magnetic susceptibility, and remanence of over 200 surface and drillhole samples were measured; and the magnetic susceptibility of core from six drillholes was logged.

The measurements indicate that the physical properties differ not only between units but also within units. Many mafic intrusives are magnetic, though some are not. The Kalkadoon Granite has different density characteristics from those of other granites.

Silver-lead-zinc ore from the Mount Isa mine, copper ore from the Mount Isa mine, and silver-lead-zinc ore from the Hilton mine have contrasting physical properties. The copper ore is non-magnetic, but the silver-lead-zinc ore is magnetic, falling within the range of magnetisation of basalt of the Eastern Creek Volcanics. Whereas magnetisation of the silver-lead-zinc ore from the Mount Isa mine is mainly from remanence, from the Hilton mine it is mainly from induction.

INTRODUCTION

A knowledge of the density and magnetic properties of rock units provides constraints when gravity and magnetic data are interpreted. During a review of geophysical data from over the Mount Isa Inlier, the number of physical property measurements was found to be insufficient to allocate density and magnetic properties to most rock units. Consequently, porosity, density, magnetic susceptibility, and remanence measurements were made on over 200 surface and drillhole samples collected during detailed systematic mapping of the inlier by geologists from the Bureau of Mineral Resources (BMR) and the Geological Survey of Queensland (GSQ) between 1969 and 1979. In addition, core from holes drilled by BMR was logged for magnetic susceptibility. This Report compiles these physical property measurements and also includes, for completeness, density and magnetic susceptibility measurements on about 70 samples made by Sampath & Ogilvy (1974), and Mutton & Almond (1979). The summaries of physical property measurements relating to rocks occurring in the Duchess-Urandangi Sheet area presented by Blake & others (1984) are based on data set out in this Report.

Physical property measurements made before 1969 on rocks from the Mount Isa Inlier frequently cannot be used with confidence because definitions and boundaries of many rock units changed during the detailed mapping by BMR and GSQ. Consequently, samples whose physical properties were measured and reported on before 1969 might now be allocated to units different from those to which they were previously allocated. In this Report, we have defined the sample locations (latitudes and longitudes, or eastings and northings, on standard 1:100 000 Sheets) so that any future changes in definitions and boundaries of rock units will not invalidate the physical property measurements on the samples, and also so that geographic groupings of the samples can be readily isolated for studies of specific parts of the Mount Isa Inlier.

Density measurements on rock samples from the Mount Isa Inlier have been reported previously by Neumann (1959), Gardener (1964), Smith (1966a, b), and Gibb (1967); most of these measurements were summarised into broad lithological groupings, and details of each sample - including location - were not provided. Smith (1968) reported density measurements made on drill core from a hole in the Dobbyn 1:250 000 Sheet area. Density, susceptibility, and electrical measurements were reported by Sampath & Ogilvy (1976) and Mutton & Almond (1979), and electrical measurements by Gardener (1964) and Hone & Spies (1974).

MEASUREMENT PROCEDURES

Density and porosity measurements

Present work. A mercury porosimeter was used to determine the porosities and the dry, saturated, and grain densities of cores (25 mm diameter x 25 mm long) cut from samples. The saturated density listed in the tables 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 - that is, the density if the porosity were zero.

Previous work. Measurements reported by Sampath & Ogilvy (1974) and Mutton & Almond (1979) were made on cylindrical specimens 25 mm in diameter x 26-104 mm long drilled from samples. The specimens were dried for over twelve hours at 100°C, weighed, then evacuated in a bell jar for about five hours. Tap water was then introduced into the bell jar, and the vacuum broken after the specimens were submerged. The specimens were left submerged for several hours; then their weight was measured in air and while submerged in water.

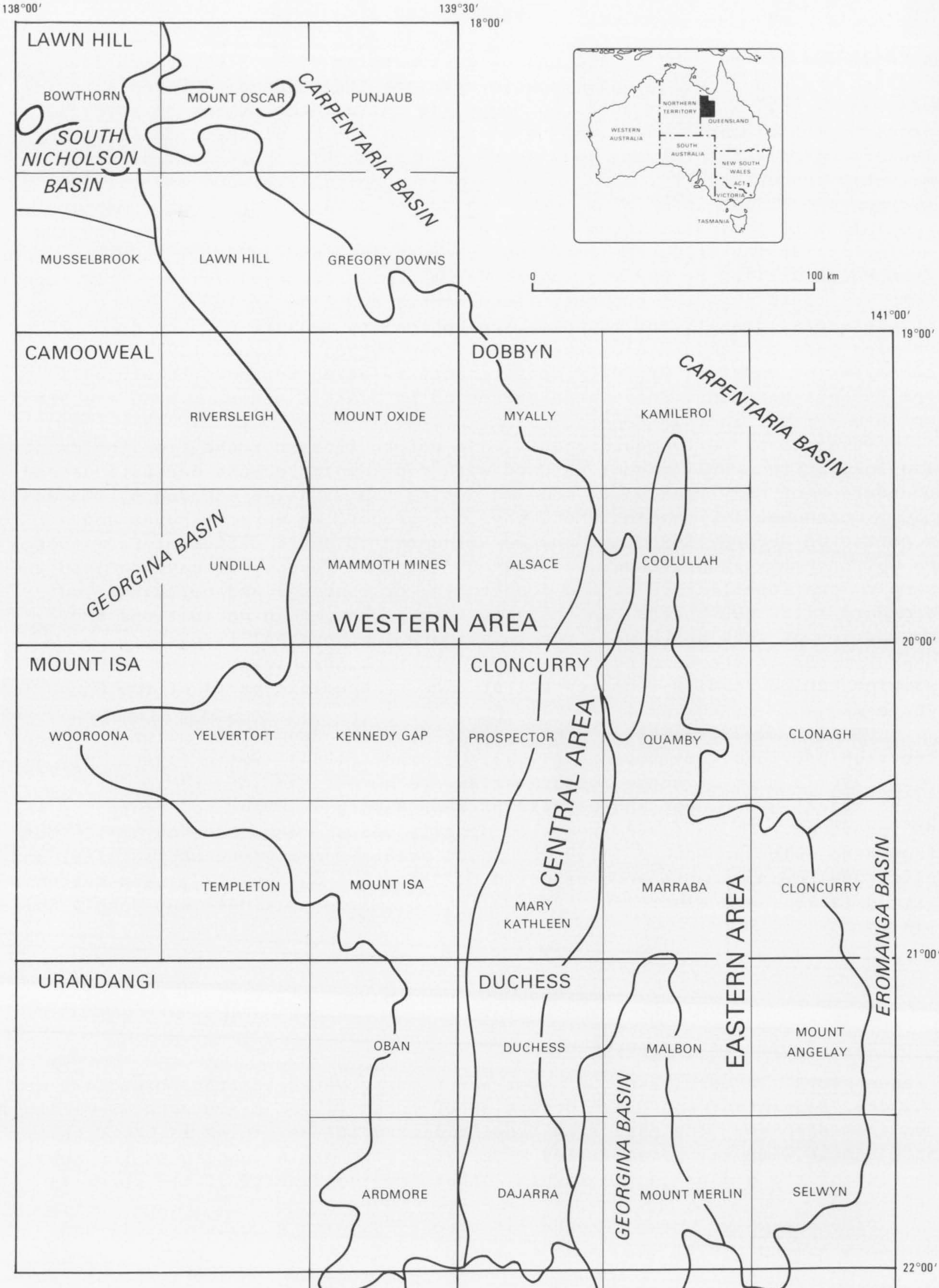


Fig. 1. Tectonic units and index to 1:250 000 and 1:100 000 Sheet areas in the Mount Isa Inlier.

Magnetic measurements

Present work. A Scintrex SM-4 susceptibility bridge was used to measure the susceptibilities, and a Digico magnetometer the remanences, of the core samples whose densities were measured. The Koenigsberger ratio for each sample was calculated for an ambient field strength of 50 000 nT. Drill core was logged on a Bison susceptibility meter, Model 3101A, with an external coil.

Previous work. A Scintrex SM-4 susceptibility bridge was used to determine the previously reported measurements of susceptibility on cores of 25 mm diameter and 25 mm length cut from samples.

GEOLOGY

Following a systematic reconnaissance by geologists from BMR and GSQ during the 1950s, Carter & others (1961) published the first comprehensive description of the stratigraphy and general geology of the Mount Isa Inlier. More detailed geological surveys took place from 1969 to 1979. Maps have been produced at 1:100 000 scale, and the results of the surveys have been described in numerous publications. The results of the detailed surveys are synthesised by Blake & others (1984) and Blake (in press).

The inlier is made up of Lower and Middle Proterozoic sedimentary and volcanic rocks which have been intruded by numerous granite plutons and mafic bodies, and regionally metamorphosed to the greenschist and amphibolite facies. The main rock types of stratigraphic units in the inlier - as described by Derrick & others (1977), Derrick (1980), Blake (1980), and Blake & others (1984), and on the 1:100 000 map Sheets - are summarised in Tables 1-3.

Carter & others (1961), Plumb & Derrick (1975), Derrick & others (1977), and Plumb & others (1980) considered that the inlier consists of a central north-trending, largely igneous basement belt flanked on either side by stratigraphically equivalent younger cover rocks commonly known as the western and eastern successions. An alternative interpretation proposed by Blake (1980) is that the oldest units in the west have no stratigraphic equivalents in the east; that some of the basement (Magna Lynn Metabasalt and Argylla Formation) of the first interpretation may be younger than the oldest rocks (Haslingden Group) of the western succession; and that much of the Corella Formation in the eastern succession may be part of the pre-Haslingden Group basement.

The rocks of the Mount Isa Inlier are intensely deformed in the south, and least deformed in the northwest (Lawn Hill Platform), where they are overlain unconformably by the Middle Proterozoic rocks of the South Nicholson Basin. Elsewhere the rocks of the inlier are unconformably overlain by flat-lying sedimentary rocks of the Late Proterozoic to Palaeozoic Georgina Basin to the west and southwest, the Mesozoic Eromanga Basin to the south and southeast, and the Mesozoic Carpentaria Basin to the east and north (Fig. 1).

RESULTS

Laboratory measurements on surface and drillhole samples

In the tabulated results of physical property measurements on samples of rock (Tables 4-6) and ore (Table 7) from the Mount Isa Inlier, the physical properties in column headings are referred to by standard symbols: saturated density (ρ_s), porosity (φ), grain density (ρ_g), magnetic susceptibility (χ_m), remanence (M_R), and Koenigsberger ratio (Q).

Table 1. Main rock types of stratigraphic units in the Mount Isa Inlier, western area

Unit	Main rock type
Unnamed mafic intrusives	metadolerite and amphibolite
Pilpah Sandstone	sandstone
Kamarga Volcanics	basalt, sandstone
Mount Isa Group	siltstone, shale, dolomite
Mount Albert Group	quartzite, sandstone, siltstone
McNamara Group	siltstone, sandstone, shale, dolomite, greywacke
Surprise Creek Formation	sandstone, siltstone
Fiery Creek Volcanics	metabasalt, acid volcanics, sandstone, siltstone
Quilalar Formation	sandstone, shale, dolomite
Garden Creek Porphyry	porphyritic biotite microgranite
Carters Bore Rhyolite	porphyritic rhyolite
Weberra Granite	leucogranite
Yeldham Granite	leucogranite
Sybella Granite	biotite granite
Makbat Sandstone	sandstone, siltstone, basal conglomerate
Stanbroke Sandstone	sandstone, dolomite, limestone, siltstone, basal conglomerate
Haslingden Group	sandstone, metabasalt, quartzite, felsic volcanics, amphibolite
Jayah Creek Metabasalt	metabasalt, amphibolite, quartzite, schist
Big Toby Granite	adamellite
Oroopo Metabasalt	metabasalt, quartzite, metasiltstone, limestone
Kallala Quartzite	quartzite
Saint Ronans Metamorphics	schist, quartzite, amphibolite
Sulieman Gneiss	gneiss, amphibolite, quartzite
Yaringa Metamorphics	schist, porphyry

Other symbols and abbreviations have been used as space savers in Tables 4-6. Identification numbers of samples (column 1) are quoted where they are known; they are a mixture of BMR registered numbers (geological and geophysical), field numbers, and holes drilled by BMR and the Geological Survey of Queensland (LH and Clo are the abbreviations for Lawn Hill and Cloncurry, referring to the names of 1:250 000 Sheet areas). The names of stratigraphic units (column 2) are accompanied in parentheses by their standard symbols referred to on the 1:100 000 first-edition geological maps. The full names of 1:100 000 Sheet areas abbreviated in column 4 are listed in Table 8. For all but a few samples, either an eight-figure grid reference (E and N) or latitude/longitude are annotated in columns 5-8. The depth in metres of subsurface samples is listed in column 9, which has no annotation for surface samples. The categories of weathering (W) abbreviated in column 10 are: fresh (F), slightly weathered (SW), moderately weathered (MW), and highly weathered (HW). The sources (S, column 17) of the tabulated data are identified in footnotes to Tables 4, 5, and 6.

Table 9 summarises the specific gravities (reported by Smith, 1968) measured on core from a vertical hole drilled into a basic body in the Dobbyn 1:250 000 Sheet area.

The Mount Isa Inlier comprises a large number of stratigraphic units, of which many are lithologically diverse. Although not all lithologies of each stratigraphic unit are adequately represented in this study, sufficient

Table 2. Main rock types of stratigraphic units in the Mount Isa Inlier, central area

Unit	Main rock type
Unnamed mafic intrusives	metadolerite and amphibolite
Hardway Granite	granite
Burstall Granite	granite, microgranite, pegmatite
Lunch Creek Gabbro	gabbro, diorite
Wonga Granite	granite
Mount Philp Breccia	intrusive breccia
Overlander Granite	leucocratic hornblende-biotite granite
Myubee Igneous Complex	gabbro, leucocratic granite
Revenue Granite	leucocratic hornblende-biotite granite
Mount Erle Igneous Complex	leucocratic granite, dolerite, diorite, hybrid rocks
Birds Well Granite	biotite granite
Bowlers Hole Granite	foliated biotite-hornblende granite
Mairindi Creek Granite	foliated biotite-hornblende granite
Bushy Park Gneiss	quartzofeldspathic gneiss, augen gneiss
Saint Mungo Granite	porphyritic hornblende-biotite granite
Mary Kathleen Group	calc-silicate rocks, metavolcanics, quartzite
Ewen Granite	leucocratic diorite-tonalite
Wills Creek Granite	leucocratic biotite granite
Woonigan Granite	leucocratic biotite granite
One Tree Granite	biotite granite
Unnamed granite	porphyritic monzonite
Kalkadoon Granite	biotite granite
Tewinga Group	acid metavolcanics, metabasalt, gneiss, schist, quartzite
Plum Mountain Gneiss	felsic gneiss, augen gneiss, foliated granite

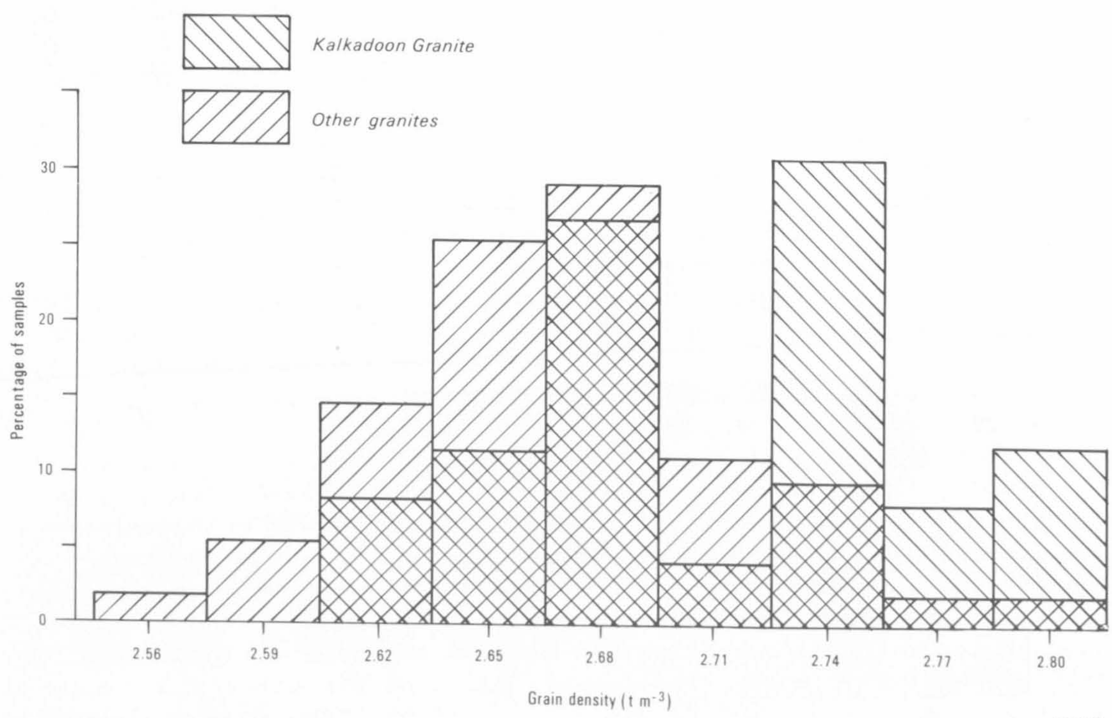


Fig. 2. Density distribution: samples of Kalkadoon Granite compared with samples of all other granites.

Table 3. Main rock types of stratigraphic units in the Mount Isa Inlier, eastern area

Unit	Main rock type
Unnamed mafic intrusives	metadolerite and amphibolite
Quamby Conglomerate	conglomerate, sandstone, greywacke
Tommy Creek Microgranite	leucocratic microgranite
Naraku Granite	leucocratic granite
Mount Margaret Granodiorite	granodiorite
Wimberu Granite	biotite and hornblende-biotite granite
Gin Creek Granite	biotite and hornblende-biotite granite
Williams Batholith	biotite and hornblende-biotite granite
Mount Dore Granite	biotite and hornblende-biotite granite
Cowie Granite	foliated leucocratic granodiorite, granite, and tonalite
Blackeye Granite	foliated leucocratic granodiorite, granite, and tonalite
Maramungee Granite	foliated leucocratic granodiorite, granite, and tonalite
Unnamed granite	granite
Mount Albert Group	quartzite
Mary Kathleen Group	metasiltstone, slate, calc-silicate rocks, calcareous siltstone, sandstone, amphibolitic siliceous calc-silicate granofels, phyllite, metavolcanics, jaspilite
Soldiers Cap Group	mica schist, quartzite, gneiss, metasiltstone, amphibolite
Malbon Group	sandstone, metabasalt, siltstone, limestone
Tewinga Group	felsic volcanics, quartzite
Double Crossing Metamorphics	gneiss, schist, amphibolite, quartzite

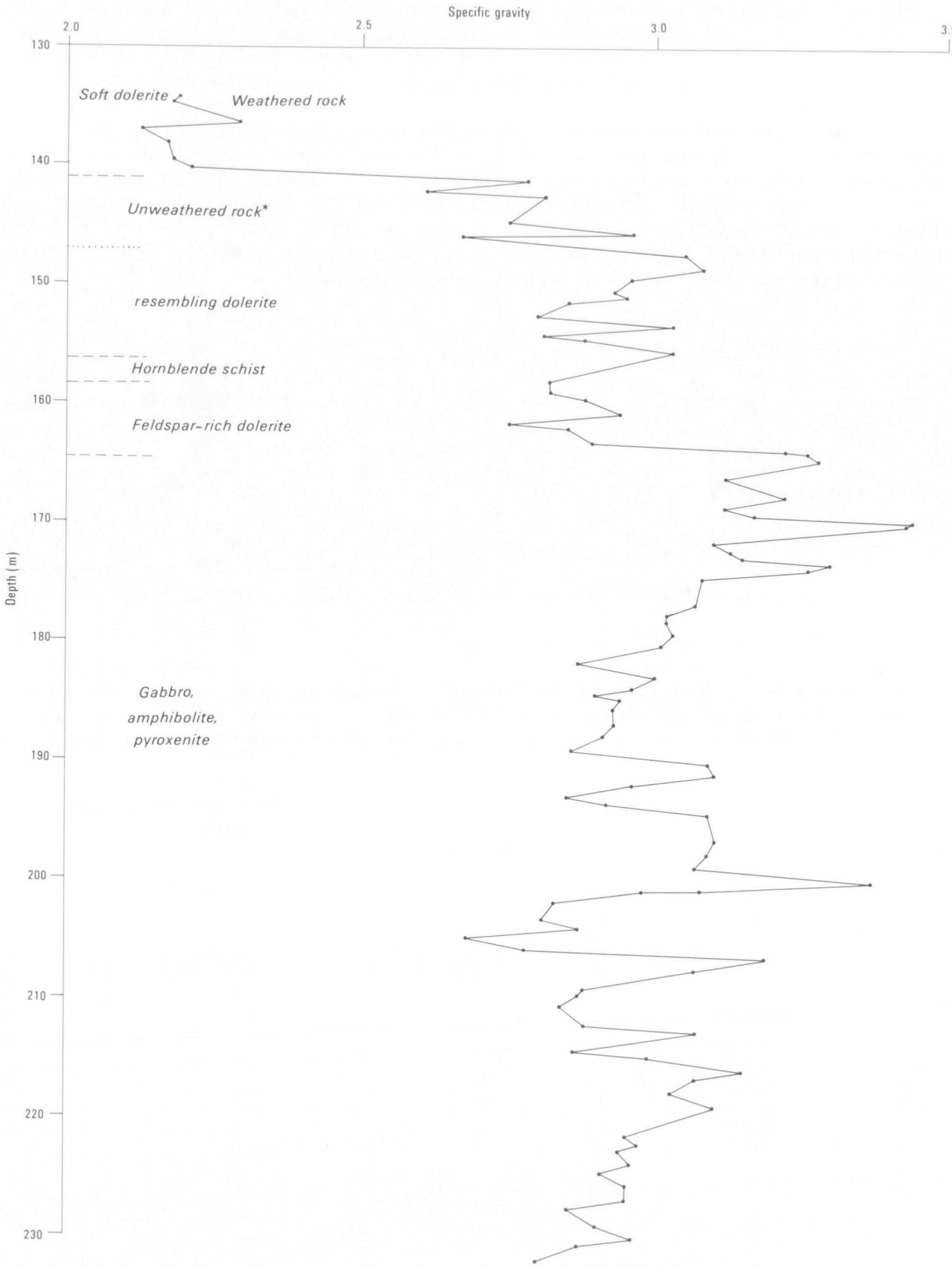
information is available to identify characteristic densities and magnetic properties for some lithologies and stratigraphic units.

Rock densities. The densest samples are skarn from the Corella Formation, quartz-magnetite and hematite rock from the Mount Norna Quartzite, and jaspilite from the Overhang Jaspilite, all having densities more than 3.4 t m^{-3}. Ironstone, mafic intrusives, basalt, and some dolomite and calc-silicate samples also have high densities of more than 3.0 t m^{-3}.

Although most samples of granite have densities less than 2.7 t m^{-3}, several samples of some granites have moderate densities of 2.75 t m^{-3} or more, and different granites have contrasting densities and density distributions. The Kalkadoon Granite, for example, appears to be bimodal, and is denser than other granites (Fig. 2).

The specific gravity log of Eastern Prospectors vertical drillhole at latitude 19°21.4'S, longitude 140°07.7'E in the Dobbyn 1:250 000 Sheet area (Fig. 3) shows that the basic mass intersected has components of higher and lower-density material. The contrasting densities are probably due to differences in mineralogical content. To correctly assess the overall density of such a basic mass, sufficient samples must be taken so that the density distribution of the material composing the mass is adequately represented.

Magnetic properties of rock. The samples measured exhibit a wide range of susceptibilities, remanences, and Koenigsberger ratios. The most magnetically susceptible samples are an acid metavolcanic from the Argylla Formation (Tewinga Group), quartz-magnetite rock from the Mount Norna Quartzite (Soldiers Cap



* *Specific gravity log suggests rocks are partly weathered in the interval 140-146 m, though this is not obvious in hand specimen*

17/Q/4

Fig. 3. Specific gravity log of Eastern Prospectors drillhole.

Group), and jaspilite from the Overhang Jaspilite (Mary Kathleen Group). When remanence is taken into account, the most magnetic samples are basalts from the Eastern Creek Volcanics (Haslingden Group), acid metavolcanic from the Argylla Formation (Tewinga Group), and a banded iron from the Kuridala Formation (Mary Kathleen Group).

Few samples of sedimentary units from the upper part of the stratigraphic column (such as the Mount Isa, McNamara, and Mount Albert Groups) are magnetic, whereas many samples from other units are magnetic. Except for the one sample of the Gin Creek Granite, samples of granites from the easternmost parts of the inlier are magnetic, whereas only a small proportion of samples of granites from the western part of the inlier are magnetic. Granite samples which have a low susceptibility usually have a low Koenigsberger ratio.

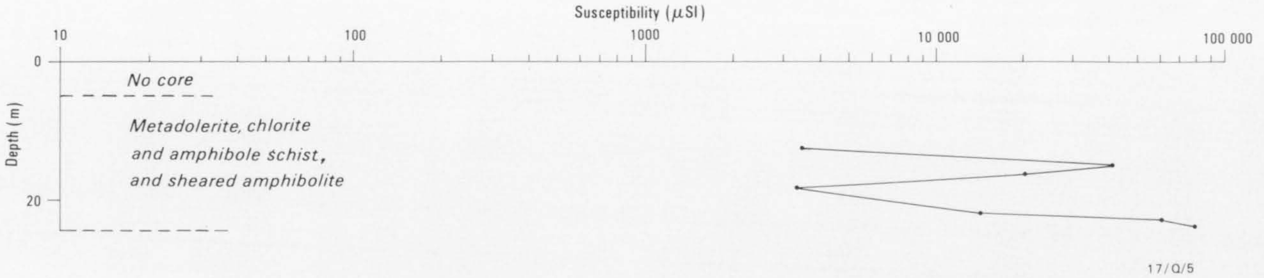


Fig. 4. Susceptibility log of BMR Cloncurry 3 diamond-drillhole.

Relatively non-magnetic samples, coming from the southern central parts of the inlier, make up about one-quarter of the mafic intrusive samples measured. These non-magnetic samples may represent a suite of relatively non-magnetic mafic intrusives.

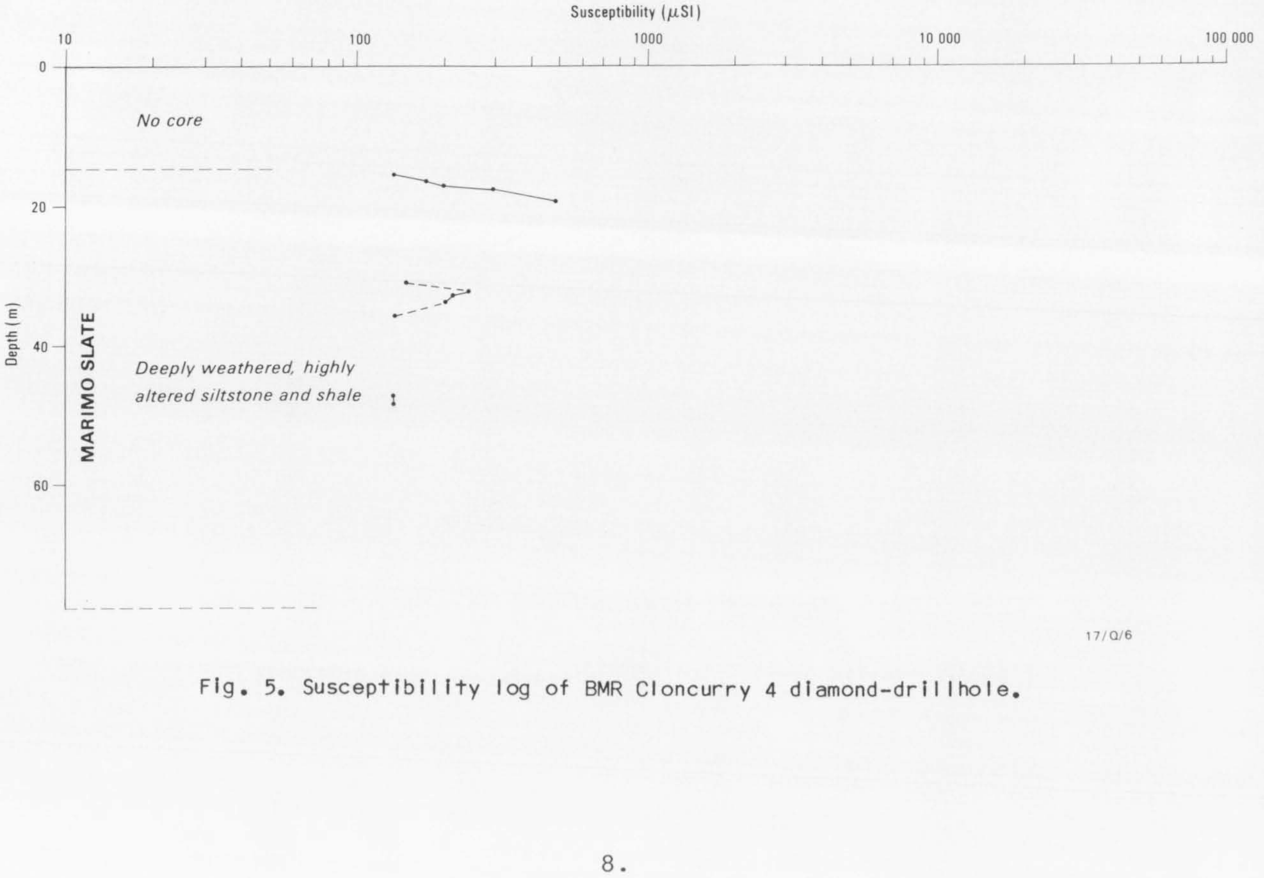


Fig. 5. Susceptibility log of BMR Cloncurry 4 diamond-drillhole.

Physical properties of ore from Mount Isa and Hilton mines. The copper ore appears less dense and less magnetic than the silver-lead-zinc ore. The magnetic measurements indicate that Hilton mine ore (silver-lead-zinc) has a lower Koenigsberger ratio than the silver-lead-zinc ore from the Mount Isa mine: the Hilton ore appears magnetised mainly by induction, whereas the Mount Isa mine ore appears mainly permanently magnetised.

The copper ore, like the Mount Isa Group, is non-magnetic. The magnetisation of the silver-lead-zinc ore lies within the range of magnetisation of rocks of the Eastern Creek Volcanics (Table 4), which crop out close to the Mount Isa and Hilton mines.

Susceptibility logging of core from drillholes in the Cloncurry 1:250 000 Sheet area

Susceptibility logs are shown in Figures 4-10. Details of the drillholes are presented in Table 10 and the logs summarised in Table 11.

The susceptibility logs of core from six holes (DDH Cloncurry 3-8) drilled by BMR in the Cloncurry 1:250 000 Sheet area reveal large changes in susceptibility over short intervals (Figs. 4-10); thus, to closely define the susceptibility distribution in a rock unit a very short sampling interval is necessary - for example, the 10-cm interval used to log DDH7 (Fig. 9) appears to be the largest interval which can be used to define closely the susceptibility distribution encountered in that hole (cf. the susceptibility distribution in Fig. 8, representing a larger sampling interval in the same drillhole).

The log of DDH6 (Fig. 7) demonstrates the inhomogeneous distribution of magnetic material within the Overhang Jaspilite, a comparatively magnetic unit. The magnetic material forms layers up to 10 m thick; between these layers, susceptibilities are low over intervals of similar thickness to that of the magnetic layers.

The high susceptibilities recorded on the core of DDH3 (Fig. 4) - located near a magnetic anomaly (anomaly 7 in area 2 of Lambourn & Shelley, 1972) - indicate that the mafic intrusives intersected in the drillhole could have made a substantial contribution to the generation of the anomaly.

CONCLUSIONS

The physical property measurements tabulated in this Report provide a start for defining characteristic properties of rock units constituting the Mount Isa Inlier. Characteristic properties can be identified for some units, and likely properties estimated for others.

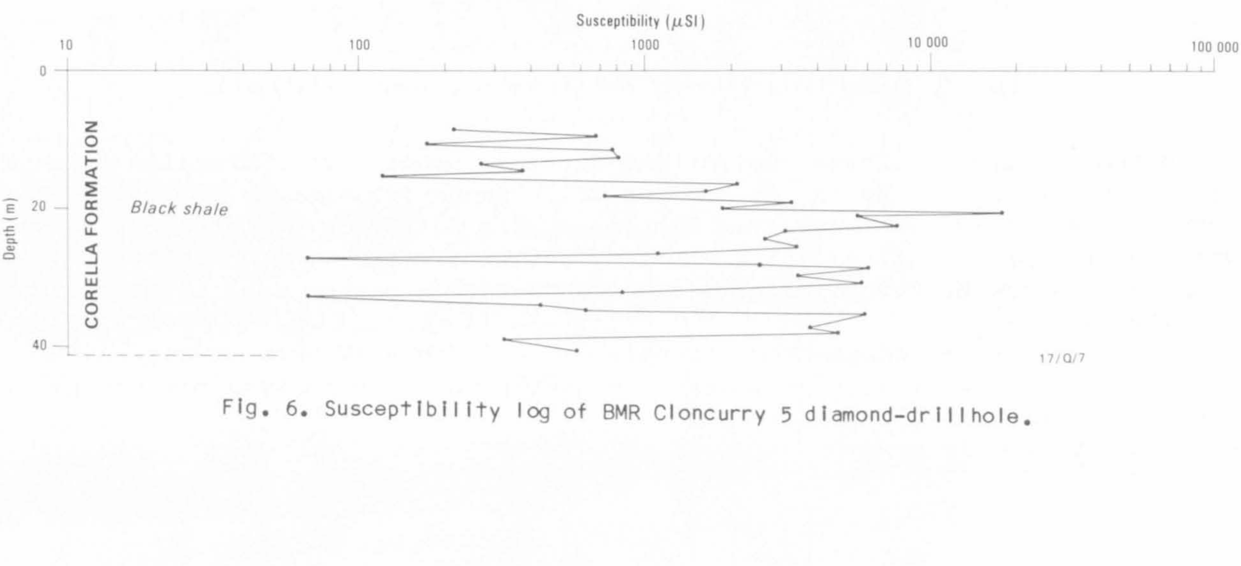


Fig. 6. Susceptibility log of BMR Cloncurry 5 diamond-drillhole.

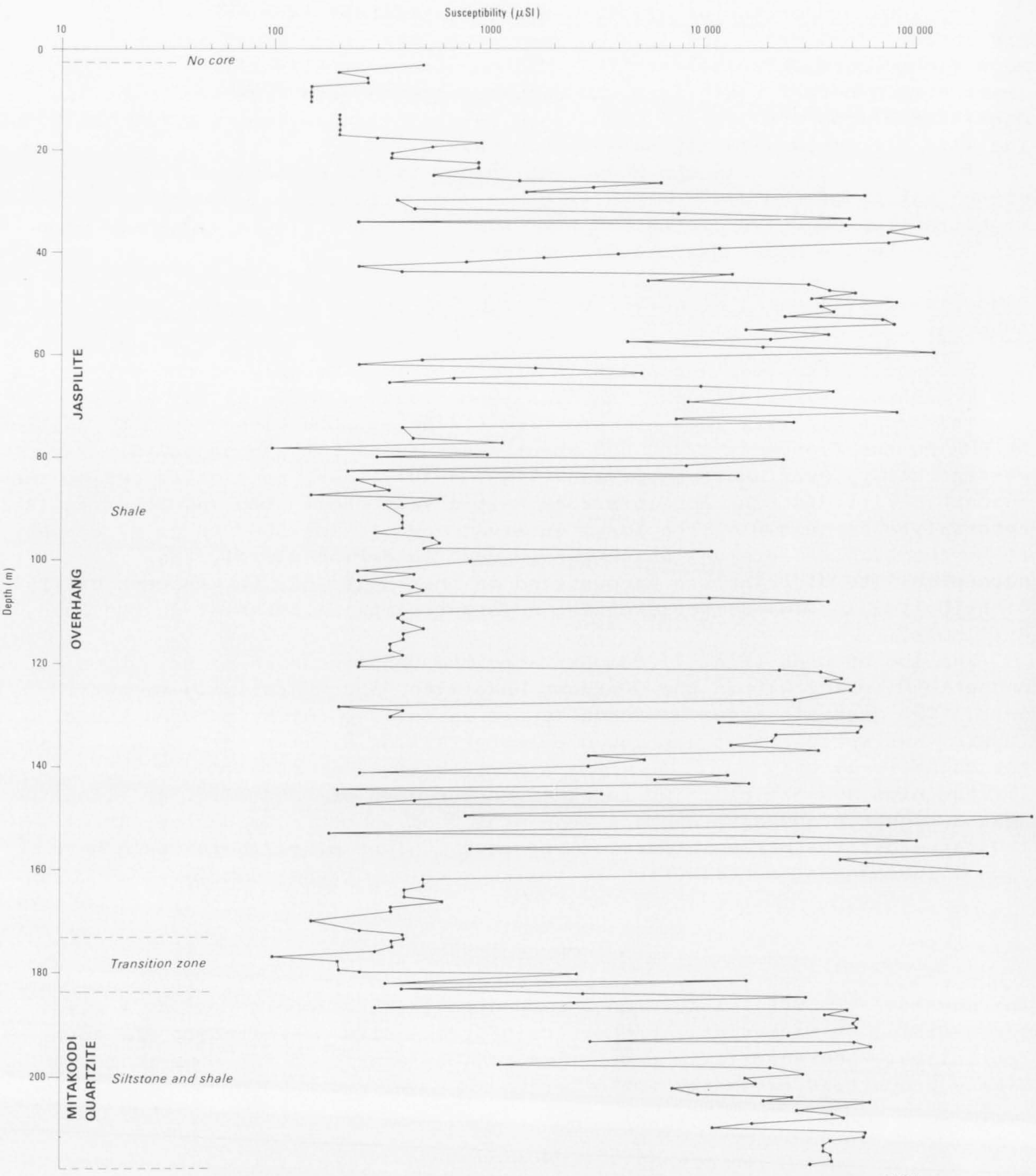


Fig. 7. Susceptibility log of BMR Cloncurry 6 diamond-drillhole.

Different granites have contrasting physical properties. Granites from the eastern parts of the inlier are generally magnetic, whereas those from the west are generally non-magnetic. Samples of the Kalkadoon Granite have a distribution of densities different from that of all the other granites sampled, and the Kalkadoon Granite appears to have a higher density than other granites sampled.

Mafic intrusives range from strongly magnetic to only very weakly magnetic. A suite of only very weakly magnetic mafic intrusives may occupy the central part of the inlier.

Silver-lead-zinc ore from the Hilton mine, and silver-lead-zinc ore and copper ore from the Mount Isa mine have different physical properties. The silver-lead-zinc ore is more dense and more magnetic than the copper ore; and ore from the Hilton mine has a lower Koenigsberger ratio than ore from the Mount Isa mine.

Susceptibility logging of core from holes drilled into sedimentary units indicates a strongly inhomogeneous distribution of magnetite within the units. Magnetite is concentrated into layers; between these layers the rock can be almost non-magnetic.

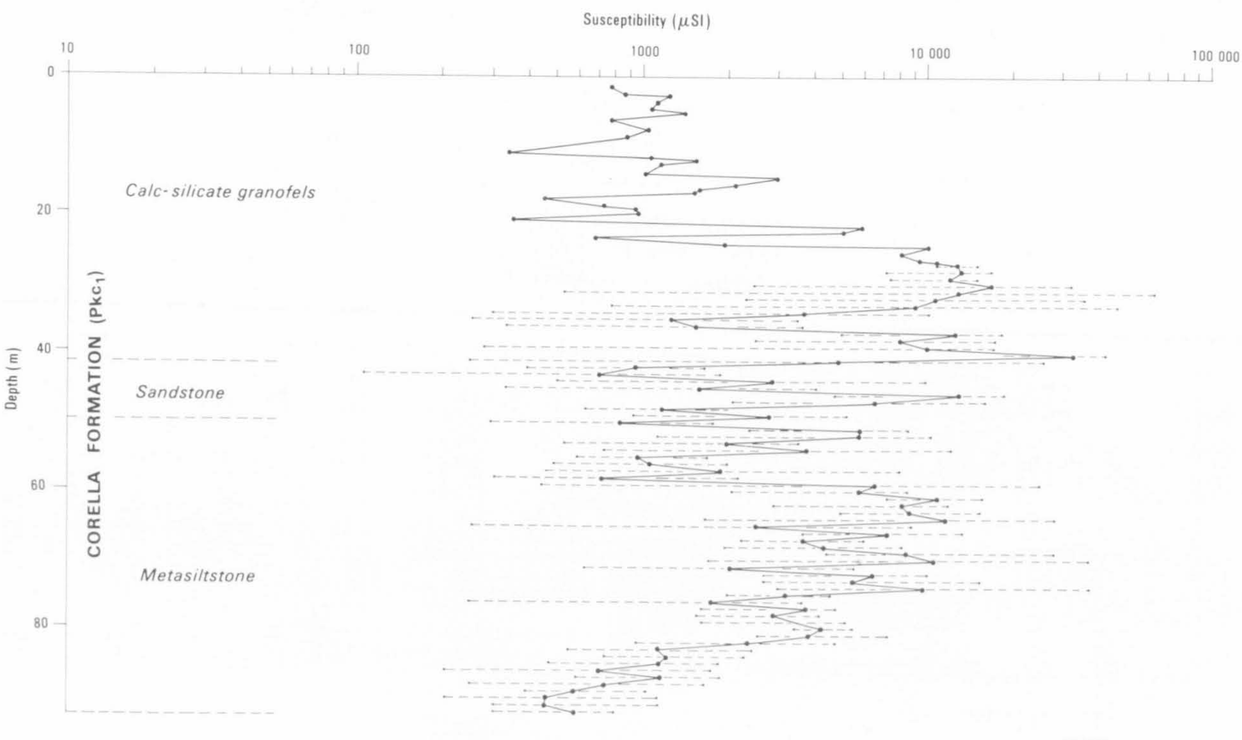


Fig. 8. Susceptibility log of BMR Cloncurry 7 diamond-drillhole (sample interval ca 1 m).

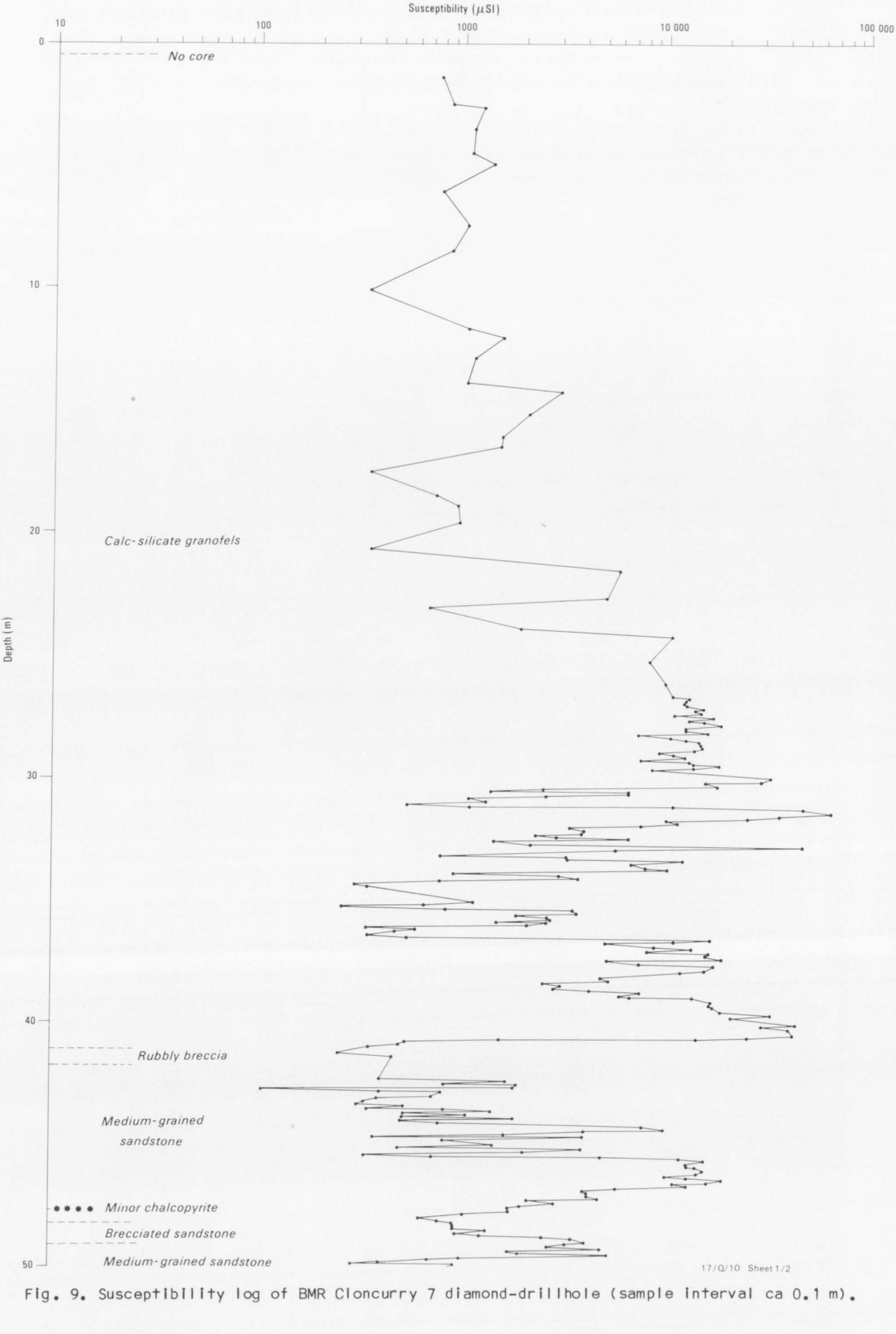


Fig. 9. Susceptibility log of BMR Cloncurry 7 diamond-drillhole (sample interval ca 0.1 m).

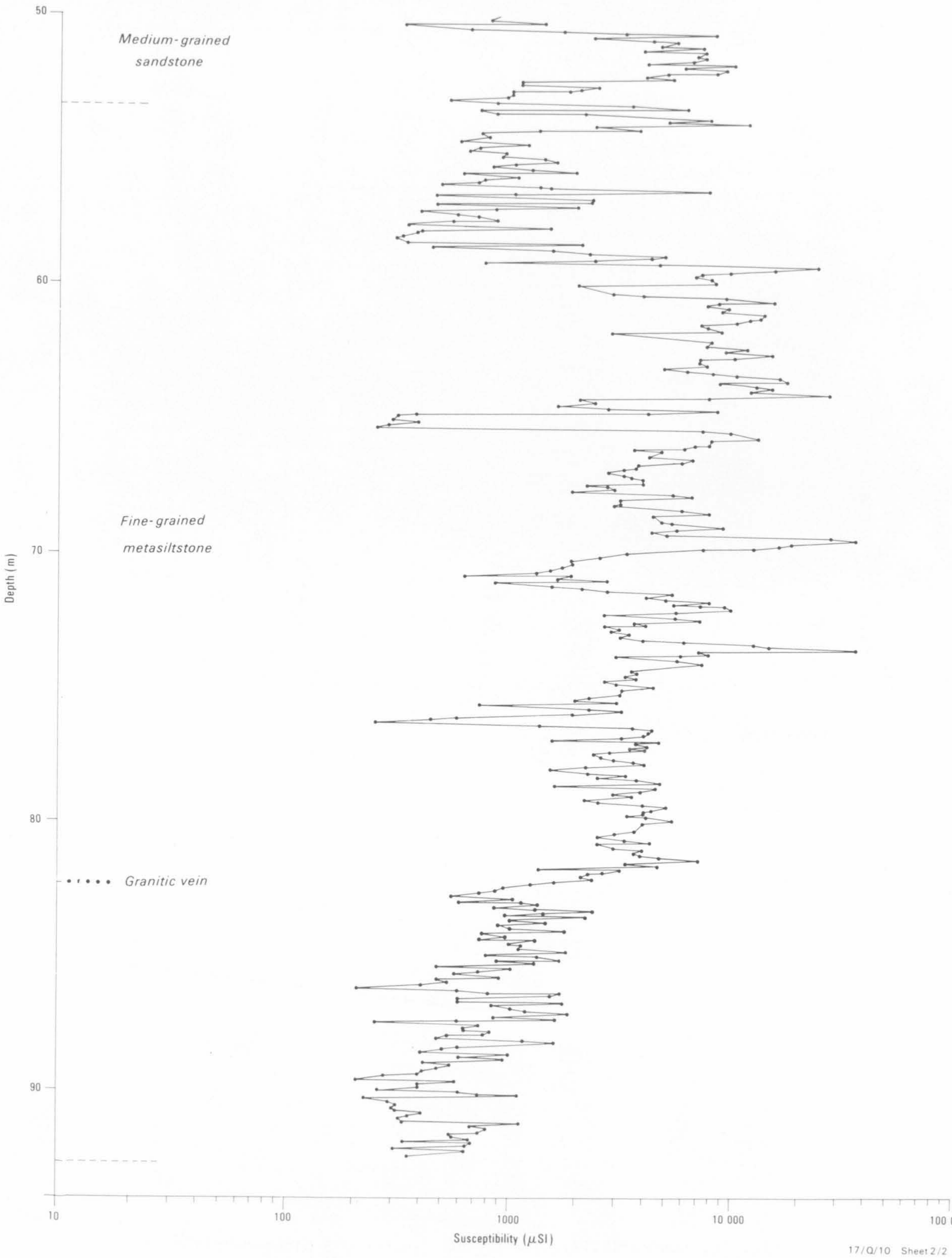


Fig. 9 (continued).

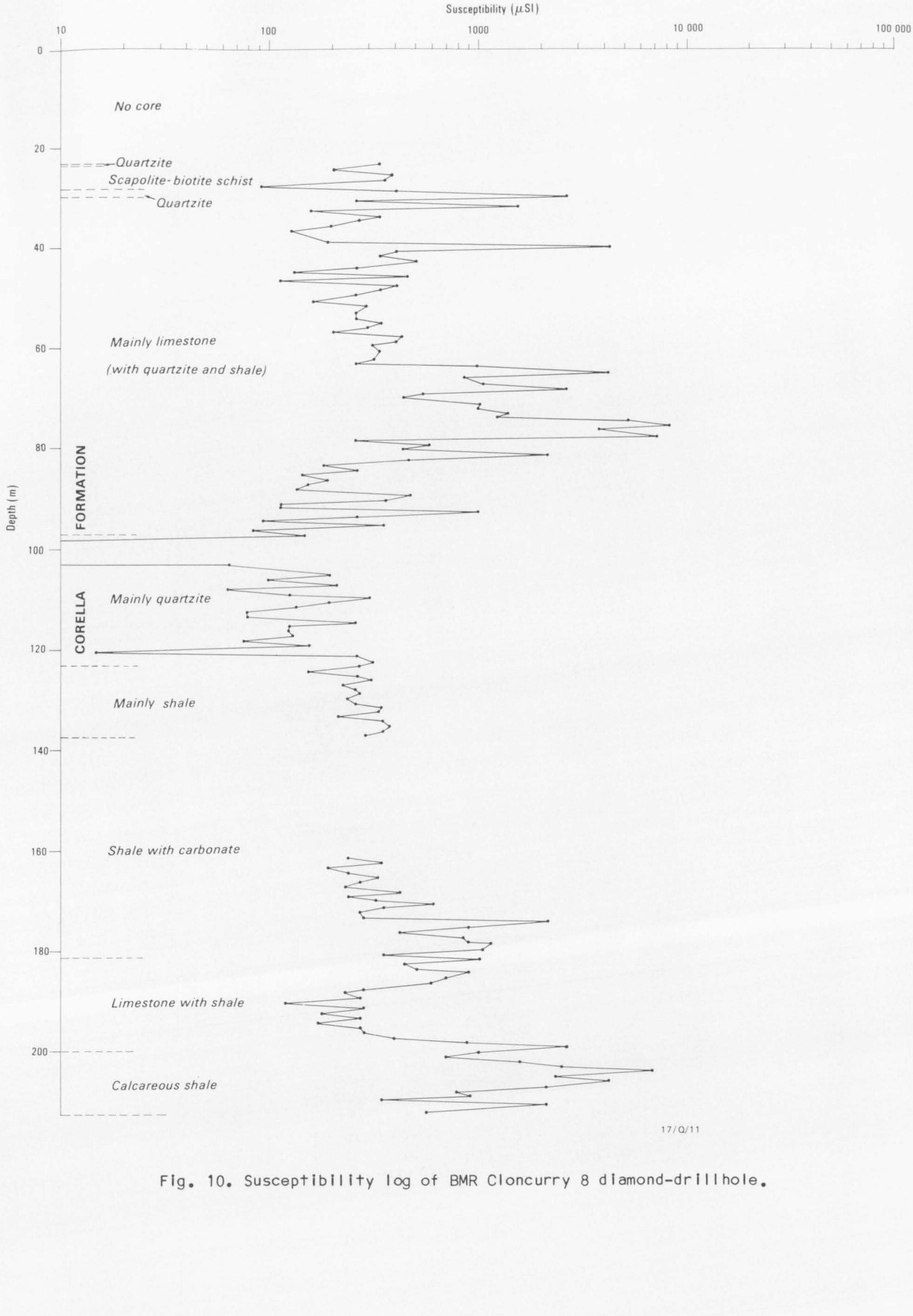


Fig. 10. Susceptibility log of BMR Cloncurry 8 diamond-drillhole.

Table 4. Physical property measurements on metasediments and volcanics

Ident.	Unit	Rock type	Sheet	E	N	Latitude °S	Longitude °E	D m	W	ρ_s t m^{-3}	φ %	ρ_g t m^{-3}	χ_m μSI	M_R mA m	Q	S
	McNAMARA GP	dolomitic siltstone	MaM	3086	7992			200	MW	2.78	2.9	2.83	130	0.7	0.14	1
	Paradise Creek Fm	siltstone, dolomite	MaM	3086	7992			400		2.71	1.6	2.74	0	0.1		1
	(Ᵽmx)	dolomitic siltstone	MaM	3086	7992			600		2.73	1.2	2.75	0	0.05		1
GSQLH3		dolomitic siltstone	LH	2760	9275			94		2.72	0.7	2.73		0.2		1
GSQLH4		dolomite	LH	2748	9263			75		2.74	2.8	2.78	0	0.3		1
GSQLH4		dolomite	LH	2748	9263			100		2.73	0.4	2.74		0.1		1
GSQLH4		dolomite	LH	2748	9263			200		2.87	0.0	2.87	90	0.2	0.06	1
GSQLH4		dolomite	LH	2748	9263			300		2.86	0.0	2.86	90	0.3	0.09	1
GSQLH4		dolomite	LH	2748	9263			400		2.86	0.0	2.86	0	0.1		1
			KG	3070	7675			221		2.72	2.4	2.77	130	0.8	0.16	1
	Gunpowder Creek Fm	fine siltstone	MaM	3080	7992			99		2.67	1.5	2.70	130	0.4	0.08	1
	(Ᵽmw3)	fine siltstone	MaM	3080	7992			250		2.74	2.0	2.77	130	0.1	0.02	1
	(Ᵽmw2)	micaceous siltstone	MaM	3080	7992			364		2.72	0.5	2.72	130	0.3	0.06	1
GSQLH3	(Ᵽmwa)	sandstone	LH	2760	9275			410		2.62	0	2.62	310	1	0.08	1
GSQLH3		carbonaceous pyritic shale	LH	2760	9275			430		2.63	0	2.63	190	2	0.26	1
GSQLH3		sandstone	LH	2760	9275			407		2.68	1.4	2.71				
GSQLH3	(Ᵽmwb)	siltstone	LH	2760	9275			370		2.83	0	2.83	380	10	0.66	1
GSQLH3		dolomitic siltstone	LH	2760	9275			390		2.70	0.4	2.70	250	0.7	0.07	1
GSQLH3		dolomite	LH	2760	9275			395		3.03	0.9	3.06	16340	290	0.45	1
GSQLH3	(Ᵽmwc)	siltstone	LH	2760	9275			102		2.75	0.0	2.75	130	0.8	0.02	1
GSQLH3		siltstone	LH	2760	9275			126		2.67	0.0	2.67	310	0.8	0.06	1
GSQLH3		dolomite	LH	2760	9275			130		2.81	0.9	2.82	250	0.1	0.01	1
GSQLH3		dolomitic siltstone	LH	2760	9275			140		2.65	0.0	2.65	100	0.3	0.08	1
GSQLH3		carbonaceous shale	LH	2760	9275			153		2.61	0.0	2.61	190	0.6	0.08	1
GSQLH3		carbonaceous shale	LH	2760	9275			160		2.64	0.9	2.65	130	0.2	0.04	1
GSQLH3		dolomite	LH	2760	9275			175		2.76	0.5	2.77	190	1.5	0.20	1
GSQLH3		dolomite	LH	2760	9275			201		2.81	0.1	2.82	50	0.4	0.02	1
GSQLH3		dolomitic siltstone	LH	2760	9275			301		2.81	0.0	2.81	100	0.3	0.08	1
GSQLH3		dolomitic siltstone	LH	2760	9275			350		2.83	0.0	2.83	250	0.7	0.07	1
GSQLH3	Torpedo Creek Qtzite (Ᵽmp)	arkosic sandstone	LH	2760	9275			440		2.69	0	2.64	310	1	0.08	1
GSQLH4		dolomitic siltstone	LH	2748	9263			430		2.72	0.0	2.72	130	0.4	0.08	1
GSQLH4		dolomitic siltstone	LH	2748	9263			445		2.75	0.0	2.75	0	0.7		1
	MT ISA GP															
	Moondarra Siltstone (Ᵽim)	laminated siltstone	Pro	3687	7420				HW	2.66	4.5	2.75	0	1		1

Table 4. Physical property measurements on metasediments and volcanics (continued)

Ident.	Unit	Rock type	Sheet	E	N	Latitude °S	Longitude °E	D m	W	ρ_s t m^{-3}	φ %	ρ_g t m^{-3}	χ_m μSI	M_R mA m^{-1}	Q	S
	Fiery Creek Volcanics (Ꝑfc)	rhyolitic ignimbrite	MtO	3177	8416					2.53	0.8	2.54	130	20	4.00	1
	MT ALBERT GP															
	Knapdale Quartzite (Ꝑpks)	scapolitic metasiltstone	Qua	4089	7571				HW	2.55	8.0	2.68	250	2	0.20	1
77530119	Mt Philp Breccia (Ꝑdb)	breccia	Duc							2.62	1.9	2.65	500	7100	355	1
77530040		porphyry	Duc										46300			1
	MARY KATHLEEN GP															
72/114	Marimo Slate (Ꝑkm)	black shale	Clo			20°52°	140°31'		SW	2.45	9	2.69				3
72/125,6		calc. siltstone	Mar			20°55'	140°25'		MW	2.10	22	2.69				3
72/120,1	(Ꝑkm2)	siltstone	Mar			21°00'	140°25'		HW	1.96	27	2.68				3
72/122,3		chert	Mar			20°59'	140°26'		MW	2.60	5.1	2.74				3
72/117	(Ꝑkmls)	slate	Mal, Mar			21°00'	140°26'		MW	2.68	3.3	2.77				3
72/118		slate	Mar			21°00'	140°30'		MW	2.30	13.2	2.65				3
72/119		slate	Mar			21°00'	140°26'		SW	2.57	6.5	2.75				3
72/124		manganese limonite concretion	Mar			20°55'	140°25'		HW	2.86	18	3.49				3
72/127,8		silicified slate	Mar			20°54'	140°25'		MW	2.58	2.2	2.64				3
78535244	Staveley Fm (Ꝑksb)	metabasalt	Sel						HW	2.63	10.8	2.96	6780	100	0.37	1
78531216	Kuridala Fm (Ꝑkrg)	banded ironstone	Sel							3.13	1.7	3.16	880	12400	354	1
78531320		banded ironstone	Sel							3.12	4.3	3.21	10050	102700	256	1
BMRClo6	Overhang Jaspilite (Ꝑkj)	shale	Mar			20°45'20"	140°21'5"	10		2.65	7.4	2.78	190	50	6.54	1
BMRClo6		jaspilite, shale	Mar			20°45'20"	140°21'5"	25		2.78	2.8	2.83	14700	50	0.08	1
BMRClo6		shale	Mar			20°45'20"	140°21'5"	33		2.79	4.4	2.87	630	0.2	0.01	1
BMRClo6		shale	Mar			20°45'20"	140°21'5"	50		2.93	3.4	3.01	6280	80	0.31	1
BMRClo6		qtzite in shale	Mar			20°45'20"	140°21'5"	67		2.78	1.3	2.81	130	0.5	0.10	1
BMRClo6		shale	Mar			20°45'20"	140°21'5"	93		2.80	0.1	2.80	12570	10	0.02	1
BMRClo6		shale containing magnetite	Mar			20°45'20"	140°21'5"	114		2.98	0.3	2.99	1510	95	1.55	1
BMRClo6		jaspilite	Mar			20°45'20"	140°21'5"	114		3.46	0.2	3.46	206090	1700	0.20	1
		jasperoidal impure limestone	Mar	3360	7045					2.93	1.4	2.96	32670	1700	1.31	1

Table 4. Physical property measurements on metasediments and volcanics (continued)

Ident.	Unit	Rock type	Sheet	E	N	Latitude °S	Longitude °E	D m	W	ρ_s $t\,m^{-3}$	φ %	ρ_g $t\,m^{-3}$	χ μSI	M_R $mA\,m^{-1}$	Q	S
76/148	Corella Fm (Ꝑkc; east of Wonga Belt)	coarse-grained bedded limestone	Clo	4465	7707	20°44'	140°40'		F	2.73	0		280			2/3
76/159, 160		quartz-feldspar rock	Clo	4450	7705	20°45'	140°31'		SW	2.84	0		3500			2/3
76/161		brecciated calcareous shale with veinlets of limestone	Clo	4450	7698	20°49'	140°31'		F	2.68	0		10			2/3
76/162		impure limestone	Clo	4450	7698	20°49'	140°31'		F	2.70	0.2		10			2/3
75/577		calc. quartzite	Clo	4644	7180				MW	2.69			220			2
75/578		granofels	Clo	4644	7180				F	2.98			132100			2
75/587		granofels	Clo	4599	7190				MW	2.82			2200			2
75/588		granofels	Clo	4641	7239				MW	2.72			28300			2
75/589		granofels	Clo	4641	7239				HW	2.76			43300			2
75/590		epidote-hornblende-plagioclase-quartz rock	Clo	4641	7239				SW	2.80			25900			2
75/591		granofels	Clo	4648	7260				F	2.90			38700			2
75/607		calc. quartzite	Clo	4729	7210				SW	2.63			520			2
75/612		amphibolite	Clo	4536	7178				SW	2.86			620			2
75/616		calc-silicate rock	Clo	4612	7085				SW	2.66			80			2
75/621		quartzite	Clo	4600	7260				SW	2.61			280			2
75/626		granofels	Clo	4542	7184				SW	2.71			1200			2
75/628		quartz-plagioclase-hornblende rock	Clo	4546	7185				SW	2.85			900			2
75/630		granofels	Clo	4649	7180				SW	2.64			330			2
75/631		diopside limestone	Clo	4643	7180				SW	3.01			430			2
75/635		quartz-hornblende-plagioclase rock	Clo	4599	7190				SW	2.89			38000			2
75/627		metadolerite	Clo	4544	7184				SW	3.01			27000			2
75200533		pink calc-silcate granofels	Clo	4649	7180					2.68	0.4	2.69	500	550	28	1
75200534		calc-silicate rock	Clo	4643	7180					3.06	0.5	3.07	500	0.1	0.005	1
	(Ꝑkc2)	diopsidic pyrrhotitic marble	Mar	4200	7105					2.88	0.4	2.88	130	1	0.20	1
		actinolitic marble	Mar	4208	7077					2.84	0.5	2.85	500	4	0.20	1
	(Ꝑkc2s)	black shale	Mar	4173	7042					2.61	0.2	2.62	0	0.1		1

Table 4. Physical property measurements on metasediments and volcanics (continued)

Ident.	Unit	Rock type	Sheet	E	N	Latitude °S	Longitude °E	D m	W	ρ_s $t\,m^{-3}$	φ %	ρ_g $t\,m^{-3}$	χ_m µSI	M_R mA m	Q	S
72/133	(Ꝑkc1)	calc-silicate rock	Mar			20°46'	140°26'		SW	2.79	0.6					3
72/138		micaceous siltstone	Mar			20°47'	140°06'		MW	2.62	2.5					3
BMRClo7		scapolite-mica-diopside-hornblende rock	Mar			20°53'50"	140°05'50"	1	HW	2.69	4.7	2.77	630	10	0.39	1
BMRClo7		calc-silicate rock	Mar			20°53'50"	140°05'50"	15		2.66	0.6	2.67	1700	560	8.13	1
BMRClo7		calc-silicate rock	Mar			20°53'50"	140°05'50"	31		2.74	0.6	2.74	35190	135	0.09	1
BMRClo7		metasiltstone	Mar			20°53'50"	140°05'50"	46		2.73	1.1	2.75	2510	50	0.49	1
BMRClo7		metasiltstone	Mar			20°53'50"	140°05'50"	61		2.71	1.7	2.73	6280	20	0.08	1
BMRClo7		metasiltstone	Mar			20°53'50"	140°05'50"	71		2.80	0.5	2.80	130	10	1.96	1
76/163,4	(Ꝑkcr)	calc-silicate rock	Clo	4448	7693	20°52'	140°30'		SW	2.70			9200			2
77530014	(Ꝑkc; in Wonga Belt)	metavolcanic rock	Duc	3849	6335				HW	2.70	3.80	2.76	190	650	86	1
	(Ꝑkc3)	granofels	Mar	4021	7242					2.75	2.2	2.79	630	30	1.2	1
	(Ꝑkc2)	calc-silicate granofels	Mar	3995	7025					2.87	0.3	2.87	880	150	4.29	1
		biotite schist	Mar	3926	7024					2.69	0	2.69	15080	100	0.17	1
	(Ꝑkc2g)	skarn	Mar	3973	7052					3.48	0.8	3.50	7540	1300	4.53	1
		skarn	Mar	3973	7052					3.63	1.6	3.69	1630	0.2	0.003	
5	(Ꝑkc2e)	granofels	Mar	3970	7053					2.83	1.3	2.85	380	0.5	0.03	1
K11.44.19		wollastonite marble	Mar	3991	6993					2.73	2.4	2.78	0	0.8		1
	(Ꝑkc2n)	calc-silicate metaconglomerate	Mar	3974	7060					2.73	2.2	2.77	250	3	0.30	1
	(Ꝑkc1)	para-amphibolite	Mar	3992	7258					3.08	1.3	3.11	1260	0.1	0.002	1
		calc-silicate rock	Qua	3990	7589					3.06	0	3.06	1000	0.3	0.008	1
BMRClo8	(Ꝑkc3; west of Wonga	massive limestone	MaK			20°46'20"	139°52'25"	35		2.79	1.1	2.82	7790	40	0.13	1
BMRClo8	Belt)	laminated limestone and shale	MaK			20°46'20"	139°52'25"	69		2.69	0.4	2.71	440	10	0.56	1
BMRClo8		pyrite in qtzite	MaK			20°46'20"	139°52'25"	104		2.65	0.3	2.66	310	0.5	0.04	1
BMRClo8		pyritic shale	MaK			20°46'20"	139°52'25"	139		2.82	0.5	2.82	500	0.05	0.002	1
BMRClo8		massive calc. shale	MaK			20°46'20"	139°52'25"	173		2.74	0	2.74	1450	20	0.34	1
		marble, granofels	MaK	3825	7034					2.71	0.8	2.72	880	2	0.06	1
BMRClo5	(Ꝑkc3s)	black shale with disseminated pyrite	MaK			20°46'45"	139°52'50"	8		2.61	2.1	3.65	130	5	0.98	1
BMRClo5		black shale	MaK			20°46'45"	139°52'50"	10		2.66	1.8	2.69	380	5	0.33	1

Table 4. Physical property measurements on metasediments and volcanics (continued)

Ident.	Unit	Rock type	Sheet	E	N	Latitute °S	Longitude °E	D m	W	ρ_s $t\,m^{-3}$	φ %	ρ_g $t\,m^{-3}$	χ_m μSI	M_R mA m	Q	S
BMRClo5		black shale with minor chalcopyrite and pyrite	MaK			20°46'45"	139°52'50"	15		2.69	1.2	2.72	500	50	2.45	1
BMRClo5		black shale with pyrrhotite and chalcopyrite	MaK			20°46'45"	139°52'50"	20		2.70	0.2	2.70	500	340	16.67	1
BMRClo5		black shale	MaK			20°46'45"	139°52'50"	25		2.70	1.3	2.73	1510	80	1.31	1
BMRClo5		black shale with disseminated pyrrhotite	MaK			20°46'45"	139°52'50"	30		2.69	1.6	2.71	250	35	3.43	1
BMRClo5		black shale	MaK			20°46'45"	139°52'50"	35		2.69	2.0	2.72	130	5	0.98	1
BMRClo5		black shale chalcopyrite	MaK			20°46'45"	139°52'50"	40		2.70	0.3	2.71	440	45	2.52	1
BMRClo5		black shale	MaK			20°46'45"	139°52'50"	41		2.73	1.3	2.75	500	1	0.05	1
	(Ꝑkcl)	calc-silicate granofels	MaK	3934	6912					2.71	0.9	2.72	130	1	0.20	1
76535025	Ballara Quartzite (Ꝑkb)	conglomerate	Duc	3740	6651				HW	2.82	5.5	2.93	126900	2750	0.54	1
	MALBON GP															
BMRClo6	Mitakoodi Quartzite (Ꝑnm3)	shale	Mar			20°45'20"	140°21'05"	158		2.79	0.5	2.79	14700	20	0.003	1
BMRClo6		shale	Mar			20°45'20"	140°21'05"	162		2.81	2.6	2.85	49000	20	0.001	1
72/91	(Ꝑnm1)	coarse-grained feldspathic quartzite	Mar			20°57'	140°19'		SW	2.63	0.2					3
72/94,95		laminated micaceous siltstone/fine-grained sandstone	Mar			20°54'	140°20'		MW	2.83	1.2					3
72/92	Wakefield Metabasalt Member (Ꝑnm2)	massive basalt	Mar			20°50'	140°20'		SW	2.87	0		47000			3
72/93		amygdaloidal basalt	Mar			20°54'	140°20'		MW	2.84	0		52000			3
	Marraba Volcanics															
80530058	Timberoo Member (Ꝑnt)	basic schist	Mal	4278	6300					2.71	4.9	2.79	2500	1050	10.5	1
72/86	Cone Creek Metabasalt Member (Ꝑnc)	med-grained metabasalt	Mar			20°59'	140°17'		SW	2.84	0.4		12000			3

Table 4. Physical property measurements on metasediments and volcanics (continued)

Ident.	Unit	Rock type	Sheet	E	N	Latitude °S	Longitude °E	D m	W	ρ_s t m^{-3}	φ %	ρ_g t m^{-3}	χ_m μSI	M_R mA m^{-1}	Q	S
	SOLDIERS CAP GP															
7853E671A	undivided (Ꝑo)	amphibolite	MtA	4842	6516					3.00	1.4	3.10	940	1	0.03	1
78530550		garnet gneiss	MtA	4871	6341					2.78	1.6	2.83	188500	2400	0.32	1
78531672	(Ꝑod)	amphibolite	Sel							3.10	0.3	3.11	750	1	0.03	1
76/147	Toole Creek Volcanics (Ꝑot)	fine to medium-grained dolerite	Clo	4467	7707	20°44'	140°41'		F	3.02			1300			2
75/619		metabasalt	Clo	4697	7167				SW	3.11			1300			2
76/150	(Ꝑot4)	impure quartzite	Clo	4474	7700	20°48'	140°45'		SW	2.67			60			2
76/151		impure quartzite	Clo	4474	7700	20°48'	140°45'		MW	2.97			430			2
76/157	(Ꝑot1)	massive metabasalt	Clo	4451	7709	20°43'	140°32'		SW	3.11	0.5		900			2
75/617		epidote quartzite	Clo	4637	7150				MW	3.02			5800			2
75/623		garnet amphibolite	Clo	4668	7188				S-MW	2.80			940			2
75200518		vesicular metabasalt	Clo	4697	7167				F	3.10	0	3.10	2510	2	0.02	1
75/583	Mt Norna Quartzite (Ꝑond)	metadolerite	Clo	4647	7170				F	3.05			780			2
76/152,3	(Ꝑon)	fine to medium-grained quartzite	Clo	4469	7691	20°53'	140°42'		SW	2.66	0		90			2
76/154,5		siltstone	Clo	4469	7687	20°55'	140°42'		MW	2.70			130			2
76/156		quartzite/greywacke	Clo	4451	7705	20°55'	140°42'		MW	2.67			20			2
75/582		porphyritic rhyolite	Clo	4655	7180				SW	2.57			60			2
75/584		labile quartzite	Clo	4647	7169				MW	2.65			4400			2
75/615		feldspathic quartzite	Clo	4569	7132				SW	2.64			3400			2
75/622		feldspathic quartzite	Clo	4657	7181				SW	2.64			120			2
75/624		laminated shale	Clo	4668	7188				MW	2.78			3600			2
75/632		siltstone	Clo	4656	7180				SW	2.74			1000			2
75/633		rhyolite	Clo	4657	7180				SW	2.60			20			2
75/634		white quartzite	Clo	4647	7169				MW	2.70			1400			
75/579	(Ꝑonj)	banded quartz-magnetite	Clo	4644	7180				HW	3.56			220000			2
75/580		banded hematite rock	Clo	4654	7180				HW	3.73			2100			2
75/614		calc. quartzite	Clo	4566	7136				MW	2.63			5100			2
75/629		banded ironstone	Clo	4627	7188				MW	3.14			150000			2
	HASLINGDEN GP															
	Eastern Creek Volcanics (Ꝑhe)	chlorite-albite-quartz rock	MtI	3404	7074			900	F	2.77	1.6	2.80	2610	300	2.90	1
		chlorite-albite-quartz rock	MtI	3404	7074			900	F	2.70	0	2.70	360	30	2.07	1

Table 4. Physical property measurements on metasediments and volcanics (continued)

Ident.	Unit	Rock type	Sheet	E	N	Latitude °S	Longitude °E	D m	W	ρ_s $t\,m^{-3}$	φ %	ρ_g $t\,m^{-3}$	χ_m µSI	M_R $mA\,m^{-1}$	Q	S
78203537	Pickwick Metabasalt	basalt	MaM	3349	8191					3.01	3.2	3.08	7920	3600	11.43	1
78203539	Member (Ᵽhp)	basalt	MaM	3343	8198					2.97	0.7	2.98	50270	300000	150	1
78203551		basalt	MaM	3344	8197					2.96	2.0	3.00	56550	390000	173	1
78203522	Cromwell Metabasalt	basalt	MaM	3364	8167					3.07	1.4	3.10	77910	4470	1.44	1
78203525	Member (Ᵽhc)	basalt	MaM	3359	8175					2.95	3.9	3.02	86710	2500	72	1
78203534		basalt	MaM	3346	8149					2.87	2.5	2.91	106810	93000	21.88	1
	Mount Guide Quartzite															
77531100	Yappo Member (Ᵽhy)	conglomerate	Daj	3509	5777					2.75	3.2	2.81	500	10	0.50	1
77530370	Bottletree Fm (Ᵽht)	metadacite	Duc	3492	6756					2.65	1.9	2.68	50270	580	0.29	1
	TEWINGA GP															
80530056C	Argylla Fm (Ᵽeam)	amphibolite	Mal	4255	6299					2.95	0.03	2.96	500	15	0.75	1
76535067	(Ᵽea)	gneiss	Duc	3758	6556					2.68	1.5	2.70	21990	6000	6.86	1
77535050		gneiss	Duc	3769	6585					2.68	1.4	2.71	1890	60	0.80	1
		metarhyolite	MaK	3920	7075					2.65	0.4	2.66	23930	820	0.61	1
		acid metavolcanic	MaK	3936	7047					2.66	0.6	2.67	7540	100	0.33	1
		acid metavolcanic	MaK	3940	7099					2.69	1.9	2.72	37700	10800	7.20	1
		acid metavolcanic	MaK	3913	7050					2.66	0.3	2.66	3644250	750	0.05	1
72/87	(Ᵽea3)	porphyritic rhyolite	Mar			20°57'	140°14'		F	2.69	0.0		47000			3
72/89	(Ᵽea4)	microporphyritic														
		rhyolite	Mar			20°57'	140°15'		F	2.68	0.0					3
72/90	(Ᵽea5)	feldspathic sandstone														
		or quartzite	Mar			20°57'	140°16'		SW	2.62	0.1					3
78531785	Undivided Tewinga Gp	banded gneiss	Daj							2.55	2.5	2.59	0	0.8		1
79530117	(Ᵽe)	conglomerate	Daj							2.75	0.6	2.75	28900	160	0.14	1
77530301A		gneiss	Duc							2.69	2.5	2.73	250	0.3	0.03	1
77530196		metagreywacke-														
		conglomerate	Duc	3517	6248					2.79	1.90	2.82	66600	420	0.16	1
77530262		meta-ignimbritic gneiss	Duc	3561	6327					2.65	1.50	2.67	28900	20500	17	1
77530720		meta-agglomerate	Daj	3518	6037					2.72	0.40	2.73	1130	2950	5	1
77530018A		gneiss	Daj	3565	5773					2.63	4.8	2.71	310	1	0.08	1
77531107		augen gneiss	Daj	3555	5764					2.64	0.5	2.64	50	7	3.50	1
77530242		gneiss	Duc	3547	6299					2.61	1.5	2.63	1820	4	0.06	1
77530179		gneiss	Duc	3527	6230					2.59	0.3	2.60	500	10	0.50	1
77530304		gneiss	Daj	3552	6193					2.67	0.4	2.68	190	10	1.32	1
77530306		gneiss	Daj	3544	6195					2.61	1.1	2.63	100	50	12.50	1

Table 4. Physical property measurements on metasediments and volcanics (continued)

Ident.	Unit	Rock type	Sheet	E	N	Latitude °S	Longitude °E	D m	W	ρ_s $t\,m^{-3}$	φ %	ρ_g $t\,m^{-3}$	χ_m µSI	M_R $mA\,m^{-1}$	Q	S
K42930	Leichhardt Volcanics (Ꝑel)	quartz-feldspar porphyry dyke	MaK	3833	7200					2.66	0.5	2.67	6280	2200	8.80	1
		ignimbrite	My	3714	8512				F	2.64	0	2.64	1630	4100	63.00	1
77530569	(Ꝑels)	quartz-feldspar porphyry	Daj	3683	5964				SW	2.63	0.2	2.63	380	2	0.13	1
7953 C45	(Ꝑel)	porphyry	Daj	3575	5890				SW	2.68	1.3	2.71	2010	460	5.75	1
7953 C98		meta-ignimbrite	Daj	3690	6060				SW	2.64	0.1	2.64	15830	1700	2.70	1

1 Measured during present study

2 Extracted from Mutton & Almond (1979)

3 Extracted from Sampath & Ogilvy (1974)

Table 5. Physical property measurements on mafic intrusives

Ident.	Unit	Rock type	Sheet	E	N	Latitude °S	Longitude °E	D m	W	ρ_s $t\,m^{-3}$	φ %	ρ_g $t\,m^{-3}$	χ_m μSI	M_R $mA\,m^{-1}$	Q	S
77530004	Mt Erle Igneous	dolerite	Duc	3824	6346					3.04	0.6	3.05	750	40	1.33	1
77530609	Complex	metadolerite	Duc	3818	6378					2.98	0.6	3.00	310	1	0.08	1
72/88	Metadolerite	coarse to med-grained														
	and	dolerite				20°51'	140°15'		F	2.98	0		2800			3
76/158	amphibolite	fine to med-grained														
		metadolerite	Clo	4480	7090	20°43'	140°30'		SW	2.99	0		29000			2
76/618		dolerite	Clo	4709	7165				F	2.71			29000			2
BMRClo3		metadolerite/amphibolite	Mar			20°45'50"	140°24'40"	15.2		2.73	5.0	2.82	20740	270	0.32	1
BMRClo3		metadolerite/amphibolite	Mar			20°45'50"	140°24'40"	21.3		2.62	10.6	2.80	31790	470	0.36	1
BMRClo3		metadolerite/amphibolite	Mar			20°45'50"	140°24'40"	24.2		2.90	1.5	2.92	111840	2550	0.56	1
80530102		dolerite	Mal	4468	6622					3.03	1.0	3.05	2510	3160	31.00	1
7953 C14		metadolerite	Daj	3541	5772					2.99	2.2	3.03	1130	20	0.44	1
79535307A		metadolerite	Sel	4465	6076					2.96	2.2	3.00	38570	860	0.56	1
77530447		gabbro	Daj	3606	5889					2.93	2.3	2.97	500	35	1.75	1
7853E670A		dolerite	Sel	4825	6085					2.99	1.9	3.02	49260	12000	6.12	1
		dolerite	Mar	3987	6966					3.07	2.0	3.11	60320	1400	0.58	1

1 Measured during present study

2 Extracted from Mutton & Almond (1979)

3 Extracted from Sampath & Ogilvy (1974)

Table 6. Physical property measurements on granites

Ident.	Unit	Rock type	Sheet	E	N	D m	W	ρ_s $t\,m^{-3}$	φ %	ρ_g $t\,m^{-3}$	χ_m μSI	M_R $mA\,m^{-1}$	Q	S
	Tommy Creek Microgranite	rhyolite	Mar	4140	7043		S	2.60	0.9	2.61		0	5	1
78206144	Wimberu Granite	?granite	Mal	4381	6546		F	2.61	2.90	2.65	2510	65	0.65	1
78206146		?granite	Mal	4404	6519		F	2.61	2.90	2.67	1510	20	0.33	1
78206145		?granite	Mal	4387	6532		F	2.65	1.5	2.67	41470	4300	2.61	1
78206143		?granite	Mal	4379	6539		F	2.65	2.1	2.68	1130	30	0.66	1
78206098	Weberra Granite	?granite	MtOx	3327	8843		F-SW	2.54	2.0	2.57	0	2		1
78206100		?granite	MtOx	3282	8852		F-SW	2.59	1.7	2.62	0	1		1
78206101		?granite	MtOx	3282	8850		F-SW	2.55	1.9	2.58	0	10		1
78206102		?granite	MtOx	3282	8882		F-SW	2.56	3.2	2.61	130	20	4	1
78206103		?granite	MtOx	3234	8832		F-SW	2.54	2.2	2.58	250	30	3	1
GSQLH3	Yeldham Granite	granite	LH	2760	9275	453	F	2.67	0.0	2.67	10050	90	0.23	1
GSQLH3		granite	LH	2760	9275	458	F	2.65	0.3	2.66	190	2	0.27	1
80530022	Gin Creek Granite	?granite	MtM	4399	6082			2.56	2.0	2.65	0	0.2		1
78535137	Undifferentiated	adamellite	MtA	4824	6370			2.65	1.2	2.67	50270	1400	0.70	1
78535263	Mount Dore Granite	adamellite	Sel	4489	6131			2.64	1.6	2.66	10050	40	0.10	1
76/146	Naraku Granite	fine-medium-grained granite	Mar	4446	7711		SW	2.63	0.2		6900			2
78206025		?granite	Qua	4439	7438		F-SW	2.62	1.1	2.64	21240	65	0.08	1
78206039		?granite	Mar	4457	7104		F-SW	2.63	1.6	2.65	27270	2200	2.03	1
78206040		?granite	Mar	4373	7167		F-SW	2.61	0	2.61	7140	2	0.01	1
78206042		?granite	Mar	4418	7215		F-SW	2.65	0.3	2.66	29030	640	0.55	1
75200514		granite	Clo	4583	7168			2.68	0.5	2.69	138230	400	0.07	1
78206014		?granite	Qua	4175	7546		F-SW	2.75	0.1	2.75	73640	1460	0.50	1
78206032		?granite	Qua	4212	7550		F-SW	2.71	0.7	2.72	19230	800	1.05	1
78206033		?granite	Qua	4211	7553		F-SW	2.65	2.2	2.69	27520	15	0.01	1
78206023		?granite	Qua	4226	7495		F-SW	2.68	0.8	2.70	44110	110	0.06	1

Table 6. Physical property measurements on granites (continued)

Ident.	Unit	Rock type	Sheet	E	N	D m	W	ρ_s t m^{-3}	φ %	ρ_g t m^{-3}	χ_m μSI	M_R mA m	Q	S
75/593	Mount Margaret Granodiorite	altered granodiorite	Clh	4810	7380		MW	2.66			54100			2
75/594		altered granodiorite	Clh	4810	7380		MW	2.63			59200			2
75/595		altered granodiorite	Clh	4810	7380		MW	2.65			37800			2
75/596		altered granodiorite	Clh	4810	7380		MW	2.62			20500			2
75/597		altered granodiorite	Clh	4810	7380		MW	2.75			75200			2
78206105	Wonga Granite	?granite	MaK	3948	6998		F-SW	2.71	0.8	2.72	500	3	0.15	1
78206106		?granite	MaK	3949	6997		F-SW	2.77	2.1	2.81	750	2	0.07	1
78206107		?granite	MaK	3931	7165		F-SW	2.60	1.8	2.62	130	100	20.0	1
78206108		?granite	MaK	3937	7168		F-SW	2.58	1.6	2.61	3640	250	1.72	1
78206109		?granite	Mar	3973	7327		F-SW	2.56	3.4	2.65	130	20	4	1
78206110		?granite	Mar	3973	7328		F-SW	2.65	2.8	2.69	250	230	23	1
78206114		?granite	MaK	3942	7205		F-SW	2.64	0.5	2.64	20110	3300	4.13	1
		?granite	Pro	3905	7647			2.68	3.7	2.74	250	0.3	0.03	1
78206112		?granite	Qua	4000	7361			2.63	1.4	2.66	130	40	8	1
78206111		?granite	Qua	3966	7335		F	2.70	0.2	2.71	880	50	1.43	1
78206115		?granite	Pro	3910	7648		F	2.67	0	2.67	310	4	0.32	1
72-242A	Burstall Granite	granite	Mar	4004	7112			2.60	0.7	2.61	2260	700	7.78	1
78206069	Big Toby Granite	?granite	MtI	3116	7017			2.64	0	2.64	100	8	2	1
78206070		?granite	MtI	3123	7015			2.68	0	2.68	250	1	0.1	1
78206071		?granite	MtI	3123	7014			2.65	1.0	2.67	250	0.8	0.08	1
78206078		?granite	MtI	3067	6927			2.75	0.8	2.76	380	4	0.27	1
78206079		?granite	MtI	3068	6926			2.63	0.5	2.64	6540	70	0.27	1
78206091	Hardway Granite	?granite	MaK	3877	7059		F-SW	2.63	2.9	2.66	1380	1560	28.00	1
78206093		?granite	MaK	3879	7090		F-SW	2.66	1.0	2.67	380	35	2.33	1
78206094		?granite	MaK	3891	7160		F-SW	2.65	0.9	2.67	11310	70	0.16	1
78206095		?granite	MaK	3894	7161		F-SW	2.72	0.07	2.73	750	20	0.67	1
		?granite	MaK	3894	7161		F-SW	2.71	1.4	2.74	2510	90	0.9	1
78206116		?granite	Als	3693	8068			2.63	0.40	2.64	130	0.2	0.04	1
78206117		?granite	Als	3698	8114			2.70	1.2	2.72	60	0.4	0.16	1
78206051		?granite	My	3595	8527			2.60	0.1	2.60	0	0.4		1

Table 6. Physical property measurements on granites (continued)

Ident.	Unit	Rock type	Sheet	E	N	D m	W	ρ_s t m^{-3}	φ %	ρ_g t m^{-3}	χ_m μSI	M_R mA m	Q	S
7826125	Wills Creek Granite	?granite	Daj	3657	5899		F	2.65	1.2	2.67	130	0.5	0.10	1
77535120	Woonigan Granite	leucogranite	Duc	3728	6640			2.54	4.5	2.61	0	5		1
78206120	One Tree Granite	?granite	Daj	3734	6037		F-SW	2.68	0.8	2.69	310	9	0.72	1
78206122		?granite	Daj	3729	6025		F-SW	2.67	2.6	2.71	310	3	0.24	1
78206123		?granite	Daj	3791	5920		F-SW	2.66	0.7	2.67	250	0.6	0.06	1
78206121		?granite	Daj	3732	6035		F-SW	2.72	1.2	2.74	250	6	0.60	1
78206131		?granite	Daj	3633	5901		F	2.75	2.80	2.80	310	2	0.16	1
78206132		?granite	Daj	3628	5898		F	2.76	1.60	2.78	310	15	1.2	1
78206133		?granite	Daj	3627	5898		F	2.65	2.50	2.69	130	0.3	0.06	1
78206134		?granite	Daj	3623	5898		F	2.77	2.20	2.81	380	0.1	0.01	1
78206138	Kalkadoon Granite	?granite	Duc	3692	6665		F	2.70	2.40	2.75	310	0.5	0.04	1
78206139		?granite	Duc	3685	6668		F	2.69	1.80	2.72	310	0.4	0.03	1
78206140		?granite	Duc	3676	6678		F	2.68	3.20	2.74	190	0.5	0.07	1
78206142		?granite	Duc	3649	6690		F	2.74	1.30	2.76	130	2	0.40	1
76535133		adamellite	Duc	3535	6428		F	2.73	0.1	2.73	250	0.5	0.05	1
77530948		leucogneiss	Daj	3534	5857			2.62	3.9	2.68	380	0.5	0.03	1
78206048		?granite	MaK	3725	7306			2.68	0.9	2.69	630	12	0.48	1
78206084		?granite	MaK	3676	7232			2.62	1.6	2.64	130	0.1	0.02	1
78206043		?granite	MaK	3719	7238		F-SW	2.74	0.4	2.75	1260	12	0.24	1
78206064		?granite	MaK	3721	6914		F-SW	2.66	1.2	2.69	380	20	1.33	1
78206061		?granite	MaK	3680	6948		F-SW	2.66	1.7	2.69	130	10	2.0	1
78206000		?granite	Als	3910	8153		F-SW	2.66	0.1	2.67	130	20	4	1
78206001		xenolith	Als	3911	8152		F-SW	2.71	1.4	2.74	4780	20	0.11	1
78206002		xenolith	Als	3910	8151		F-SW	2.70	1.9	2.73	31420	1200	0.96	1
78206003		?granite	Als	3899	8165		F-SW	2.61	0.2	2.62	60	0.8	0.32	1
78206004		?granite	Als	3905	8161		F-SW	2.60	0	2.61	60	5	2	1
78206005		?granite	Als	3906	8157		F-SW	2.62	1.2	2.64	60	0.2	0.08	1
78206006		?granite	Als	3909	8146		F-SW	2.66	0.4	2.67	250	3	0.3	1
78206052		?granite	Pro	3727	7521		F-SW	2.73	0	2.73	500	1	0.05	1
78206053		?granite	Pro	3747	7517		F-SW	2.75	0	2.75	190	24	3.20	1
78206055		?granite	Pro	3739	7410		F-SW	2.62	1.7	2.64	570	370	16	1
78206056		?granite	Pro	3728	7387		F-SW	2.78	0.7	2.79	380	0.2	0.01	1

1 Measured during present study. 2 Extracted from Mutton & Almond (1979). 3 Extracted from Sampath & Ogilvy (1974).

Table 7. Physical property measurements on ore from Mount Isa and Hilton mines

Mine	Description	Density ($t\ m^{-3}$)	Porosity (%)	Grain density ($t\ m^{-3}$)	Susceptibility (μSI)	Remanence (mA m)	Q
Mount Isa	silver-lead-zinc ore	3.67	0.0	3.67	5030	375	1.88
		4.15	0.0	4.15	2510	300	3.00
		3.69	0.0	3.69	43980	5500	3.14
		3.56	0.2	3.57	11310	900	2.00
	copper ore	2.71	0.1	2.71	50	4	2.00
		3.08	0.1	3.09	90	4	1.14
Hilton	silver-lead-zinc ore	4.21	0.0	4.21	69120	400	0.15
		3.51	0.0	3.51	2010	8	0.10

Table 8. Abbreviations used for the names of 1:100 000 Sheet areas in tables of physical property measurements

Abbreviation	Full name	Abbreviation	Full name
Als	Alsace	Mar	Marraba
Clo	Cloncurry	MtA	Mount Angelay
Clh	Clonagh	MtI	Mount Isa
Daj	Dajarra	MtO	Mount Oscar
Duc	Duchess	MtOx	Mount Oxide
KG	Kennedy Gap	My	Myally
LH	Lawn Hill	Pro	Prospector
Mal	Malbon	Qua	Quamby
MaK	Mary Kathleen	Sel	Selwyn
MaM	Mammoth Mines		

Table 9. Summary of specific gravity measurements on core from Eastern Prospectors diamond-drillhole at latitude 19°21.4'S, longitude 140°07.7'E (extracted from Smith, 1968)

Lithology	Depth range (m)	N	Specific gravity Range	Median	Mean	SD
Soft weathered doleritic rock	134-140	7	2.13-2.29	2.18	2.19	0.05
Unweathered rock resembling dolerite	(141-146	6	2.61-2.96	2.77	2.76	0.12
	(147-156	11	2.80-3.08	2.95	2.94	0.10
Hornblende schist	158	1			2.82	
Feldspar-rich dolerite	159-164	8	2.75-3.22	2.98	2.83	0.15
Gabbro, amphibolite, pyroxenite	165-232	68	2.68-3.44	2.99	3.01	0.15

Table 10. Details of drillholes in the Cloncurry 1:250 000 Sheet area

No.	1:100K Sheet area	Latitude	Longitude	Orientation	Units intersected
3	Marraba	20°45'50"S	140°24'40"E	vertical	metadolerite, amphibolite (do)
4	Marraba	20°51'40"S	140°22'05"E	vertical	Marimo Slate (Bkm2)
5	Mary Kathleen	20°46'45"S	139°52'50"E	vertical	Corella Formation (Bkc3s)
6	Marraba	20°45'20"S	140°21'05"E	inclined at 50° towards 250°	Overhang Jaspilite (Bkj), Mitakoodi Quartzite (Bnm3)
7	Marraba	20°43'50"S	140°05'50"E	inclined at 50° towards 095°	Corella Formation (Bkc1)
8	Mary Kathleen	20°46'20"S	139°52'25"E	inclined at 60° towards 260°	Corella Formation (Bkc3)

Table 11. Summary of susceptibility logs

Unit	Lithology	Drill-hole	Depth range* (m)	N	Susceptibility (μSI) range	median	mean
metadolerite (do)	metadolerite, chlorite and amphibole schist, sheared amphibolite	3	12.2-23.2	7	3300-79760	20590	31840
Marimo Slate (Bkm2)	weathered siltstone and shale	4	15.2-64.3	13	130-480	200	20
Corella Formation (Bkc3s)	black carbonaceous shale with evaporitic minerals and sulphides	5	8.5-40.0	34	70-17670	1370	2610
(Bkc3)	limestone, quartzite, shale	8	20.1-183.6	168	0-8010	310	1220
(Bkc1)	calc-silicates, metasilt-stone, meta-arenite	7	1.1-70.8	683	110-63520	2720	4400
Overhang Jaspilite (Bkj)	calcareous shale and jaspilite	6	2.9-131.9	172	100-327940	900	19570
Mitakoodi Quartzite (Bnm3)	siltstone, shale	6	142.2-167.4	38	300-59580	33090	30450

* The depths recorded here for BMR Cloncurry Nos. 6, 7, and 8, which were inclined holes, have been converted to vertical depths.

REFERENCES

BLAKE, D.H., 1980 - The early geological history of the Proterozoic Mount Isa Inlier, northwestern Queensland: an alternative interpretation. BMR Journal of Australian Geology & Geophysics, 5, 243-256.

BLAKE, D.H., in press - Geology of the Mount Isa Inlier and environs, Queensland and Northern Territory. Bureau of Mineral Resources, Australia, Bulletin 225.

BLAKE, D.H., BULTITUDE, R.J., DONCHAK, P.J.T., WYBORN, L.A.I., & HONE, I.G., 1984 - Geology of the Duchess-Urandangi region, Mount Isa Inlier, Queensland. Bureau of Mineral Resources, Australia, Bulletin 219.

CARTER, E.K., BROOKS, J.H., & WALKER, K.R., 1961 - The Precambrian mineral belt of north-western Queensland. Bureau of Mineral Resources, Australia, Bulletin 51.

DERRICK, G.M., 1980 - Marraba, Queensland - 1:100 000 Geological Map Commentary. Bureau of Mineral Resources, Australia.

DERRICK, G.M., WILSON, I.H., HILL, R.M., GLIKSON, A.Y., & MITCHELL, J.E., 1977 - Geology of the Mary Kathleen 1:100 000 Sheet area, northwest Queensland. Bureau of Mineral Resources, Australia, Bulletin 193.

GARDENER, J.E.F., 1964 - Dobbyn area geophysical survey, Queensland, 1963. Bureau of Mineral Resources, Australia, Record 1964/187.

GIBB, R.A., 1967 - Western Queensland reconnaissance gravity surveys, 1957-1961. Bureau of Mineral Resources, Australia, Report 129.

HILL, R.M., & DUFF, B.A., 1975 - Metalliferous diamond drilling, Mount Isa area, 1971. Bureau of Mineral Resources, Australia, Record 1975/84.

HONE, I.G., & SPIES, B.R., 1974 - Transient electromagnetic field tests, Northern Territory and Queensland, 1973. Bureau of Mineral Resources, Australia, Record 1974/191.

LAMBOURN, S.S., & SHELLEY, E.P., 1972 - Cloncurry detailed airborne magnetic and radiometric survey, Queensland, 1970. Bureau of Mineral Resources, Australia, Record 1972/110.

MUTTON, A.J., & ALMOND, R.A., 1979 - Geophysical mapping of buried Precambrian rocks in the Cloncurry area, northwest Queensland. Bureau of Mineral Resources, Australia, Report 210; BMR Microform MF95.

NEUMANN, F.J.G., 1959 - Preliminary report on a reconnaissance gravity survey in the Georgina Basin area, Queensland. Bureau of Mineral Resources, Australia, Record 1959/8.

PLUMB, K.A., & DERRICK, G.M., 1975 - Geology of the Proterozoic rocks of the Kimberley to Mount Isa region. In KNIGHT, C.L., (Editor) - ECONOMIC GEOLOGY OF AUSTRALIA AND PAPUA NEW GUINEA. 1: METALS. Australasian Institute of Mining and Metallurgy, Monograph Series, 5, 217-252.

PLUMB, K.A., DERRICK, G.M., & WILSON, I.H., 1980 - Precambrian geology of the McArthur River-Mount Isa region, northern Australia. In HENDERSON, R.A., & STEPHENSON, P.J., (Editors) - THE GEOLOGY AND GEOPHYSICS OF NORTHEASTERN AUSTRALIA. Geological Society of Australia, Queensland Division, Brisbane, 71-88.

SAMPATH, N., & OGILVY, R.D., 1974 - Cloncurry area geophysical survey, Queensland, 1972. Bureau of Mineral Resources, Australia, Record 1974/135.

SMITH, R.J., 1966a - Dobbyn gravity reconnaissance survey, Queensland, 1963-4. Bureau of Mineral Resources, Australia, Record 1966/41.

SMITH, R.J., 1966b - Mount Isa gravity test survey, Queensland, 1963-1964. Bureau of Mineral Resources, Australia, Record 1966/50.

SMITH, R.J., 1968 - Dobbyn-Kamileroi geophysical survey, Queensland, 1967. Bureau of Mineral Resources, Australia, Record 1968/78.

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