BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD

RECORD 1985/24

MOUNT ISA FIELD EXCURSION GUIDE

14-22 AUGUST 1985

For Conference on Tectonics and Geochemistry of

Early to Middle Proterozoic Fold Belts

by

D.H. Blake, G.S. Lister, L.A.I. Wyborn (BMR) and
W.G. Perkins (Mount Isa Mines)

RECORD 1985/24

MOUNT ISA FIELD EXCURSION GUIDE

14-22 AUGUST 1985

For Conference on Tectonics and Geochemistry of

Early to Middle Proterozoic Fold Belts

by

D.H. Blake, G.S. Lister, L.A.I. Wyborn (BMR) and
W.G. Perkins (Mount Isa Mines)

MOUNT ISA EXCURSION, 14-22 AUGUST, 1985

The Mount Isa Inlier consists of Proterozoic sedimentary, volcanic, and intrusive rocks, most of which have been metamorphosed to greenschist and amphibolite facies. These rocks host economic deposits of Ag, Pb, Zn, Cu, Au, U, and Co, and there are several hundred mines and prospects within the Inlier, although only two, the Mount Isa Cu-Pb-Zn-Ag mine and the Mary Kathleen U mine, have been major producers.

The excursion will be restricted to the southern part of the Mount Isa Inlier (Fig. 1). Stops of stratigraphic, structural, metamorphic, and economic interest will be visited.

Geological investigations

A broad reconnaissance survey of the Mount Isa Inlier was carried out by geologists from the Bureau of Mineral Resources (BMR) and Geological Survey of Queensland in the 1950s (Carter & others, 1961). A more detailed survey between 1969 and 1980 by geologists from the same organisations has resulted in the Inlier being covered by 1:100 000 scale geological maps - see Fig. 2 and Table 1. Geochemical and geochronological studies were carried out concurrently with the fieldwork. The present geochronological framework for the Inlier is based on U-Pb data obtained by Page (1978, 1983a). Since 1983, BMR and University workers have been investigating structural, metamorphic, and geochemical aspects in greater detail in order to gain a better understanding of the tectonic setting, crustal evolution, and mineralisation of the Proterozoic rocks.

Synopsis of geology

The main tectonic units of the Mount Isa Inlier are the Lawn Hill Platform, Leichhardt River Fault Trough, Ewen Block, and Myally Shelf, which make up the Western Fold Belt, the central Kalkadoon-Leichhardt Belt, and the Mary Kathleen, Quamby-Malbon, and Cloncurry-Selwyn zones of the Eastern Fold Belt (mainly after Day & others, 1983); these are shown in Fig. 3.

Four major supercrustal sequences are present (Blake, in preparation): a basement sequence, which was deformed and metamorphosed before about 1875 Ma, and three cover sequences. Cover sequence 1 (1840-1875 Ma) consists predominantly of subaerial felsic volcanics. Cover sequence 2 (1760, or possibly 1720, to 1790 Ma) and cover sequence 3 (1670-1680 Ma) consist of shallow water clastic sedimentary rocks, carbonates, and bimodal volcanics. The cover sequences are more than 10 km thick. In terms of basin development, cover sequence 1 corresponds to a pre-rift phase, and both cover sequences 2 and 3 represent rift phases succeeded by more widespread sag phases. The general stratigrapahy is summarised in Table 2.

Granites intruding the cover sequences have been dated (mainly U-Pb zircon data) at 1840-1865 Ma (comagmatic with the felsic volcanics of cover sequence 1), 1820 Ma, 1800 Ma, 1720-1740 Ma, 1700 Ma, 1670 Ma, and around 1500 Ma. Six major batholiths are present: from west to east, the Sybella, Kalkadoon, Ewen, Wonga, Williams and Naraku Batholiths. Mafic intrusions, mainly dykes, are widespread and of various ages.

The cover sequences were first regionally deformed and metamorphosed between 1550 and 1620 Ma, with two deformation episodes, D_1 and D_2, being recognised. D_1 resulted in widespread thrust and fold nappes (for example, Bell, 1983; BMR, 1985), with movement directions apparently from the west, north, and east, towards the central southern part of the Inlier. During D_2, an east-west shortening event, major tight to isoclinal upright folds formed elongate basins and domes, and several major vertical shear zones with mainly north-south trends were developed. Regional metamorphism up to upper amphibolite facies accompanied the deformations. A series of northwest, northeast and north-trending faults and shears, some with lateral displacements of at least 20 km, were formed during subsequence deformation events.

Geochemistry

The geochemistry of the igneous rocks has been discussed by various workers (for example, Glikson & others, 1976; Derrick & others, 1977; Wilson 1978, 1983; Glikson & Derrick, 1978; Bultitude & Wyborn, 1982; Wyborn & Page, 1982; Ellis & Wyborn, 1984; and Wyborn, in Blake & others, 1984. More than 1200 igneous rocks have been chemically analysed for major and trace elements (Wyborn, in prep.). Most analysed samples are of regionally metamorphosed rocks, many of which are extensively recrystallised, but generally consistent trends for most elements on variation diagrams indicate that few of the samples have been extensively modified by metamorphism or metasomatism. The igneous rocks are markedly bimodal in terms of silica content.

Four widespread suites of felsic volcanics have been identified: the Leichhardt suite, represented by the Leichhardt Volcanics of cover sequence 1, the Bottletree and Argylla suites, represented by felsic volcanics in the Bottletree and Argylla Formations of cover sequence 2, and the Carters Bore suite, represented by the

Carters Bore Rhyolite and felsic Fiery Creek Volcanics of cover sequence 3. Each suite is thought to be derived from a chemically unique source (Wyborn, in Blake & others, 1984). The Leichhardt suite has higher Al and Sr and lower Zr, Nb, and Y contents than the Argylla suite. The Bottletree suite is generally similar to the Argylla suite, but has higher CaO, Sr, Zn, and Pb contents. High K values and relatively high Ti and Mg contents characterise the Carters Bore suite. The granites of the Kalkadoon and Ewen Batholiths (1840-1870 Ma), are geochemically as well as geochronologically similar to the felsic volcanics of the Leichhardt suite, and are considered to be cogenetic with this suite (for example, Wyborn & Page, 1983). Compared with these granites the younger granites, including those of the Sybella, Wonga, and Williams Batholiths, generally have lower Al and Sr contents, and higher levels of incompatible elements, especially Nb, Ti, Th, and U. The felsic volcanics of the Leichhardt suite and the cogenetic granites are classified as typical I-types, derived from first-stage melting of an igneous source in the lower crust, this source being formed during continent-wide differentiation from the mantle between about 1900 and 2100 Ma ago. The Bottletree and Argylla suites are considered to be A-types in the sense of Collins & others (1982), derived from a near-anhydrous source that remained in the lower crust after the formation of the earlier I-type felsic melt. Some of the younger granites may also be A-types. No major S-type felsic volcanics or granite plutons are known.

Most of the Proterozoic mafic volcanics and intrusions are of uniform chemical composition, and are classified as continental tholeiites, although they have lower contents of incompatible elements such as Ti, P, Zr, and Y than are typical for continental tholeiites. Most analyses plot in the subalkaline field on the conventional total alkalies-silica diagram, and show a trend of iron-enrichment on an AFM diagram (Ellis & Wyborn, 1984). Glikson & others (1976) and Glikson & Derrick (1978) recorded an eastward change in cover sequence 2 units, from basalts of continental tholeiite affinities with high values of Ti, P, K, Zr, and Y (Eastern Creek Volcanics) to basalts of ocean-floor tholeiite affinities, with low values for these elements (Soldiers Cap Group). However, as shown by Bultitude & Wyborn (1982), the chemical characteristics of the Eastern Creek Volcanics documented by Glikson & others and Glikson & Derrick apply only one part of this formation, and other basalts of the Eastern Creek Volcanics and probable correlatives in the southwest are not significantly different in composition from those of the Magna Lynn Metabasalt in the Kalkadoon-Leichhardt Belt and the Soldiers Cap Group in the Eastern Fold Belt.

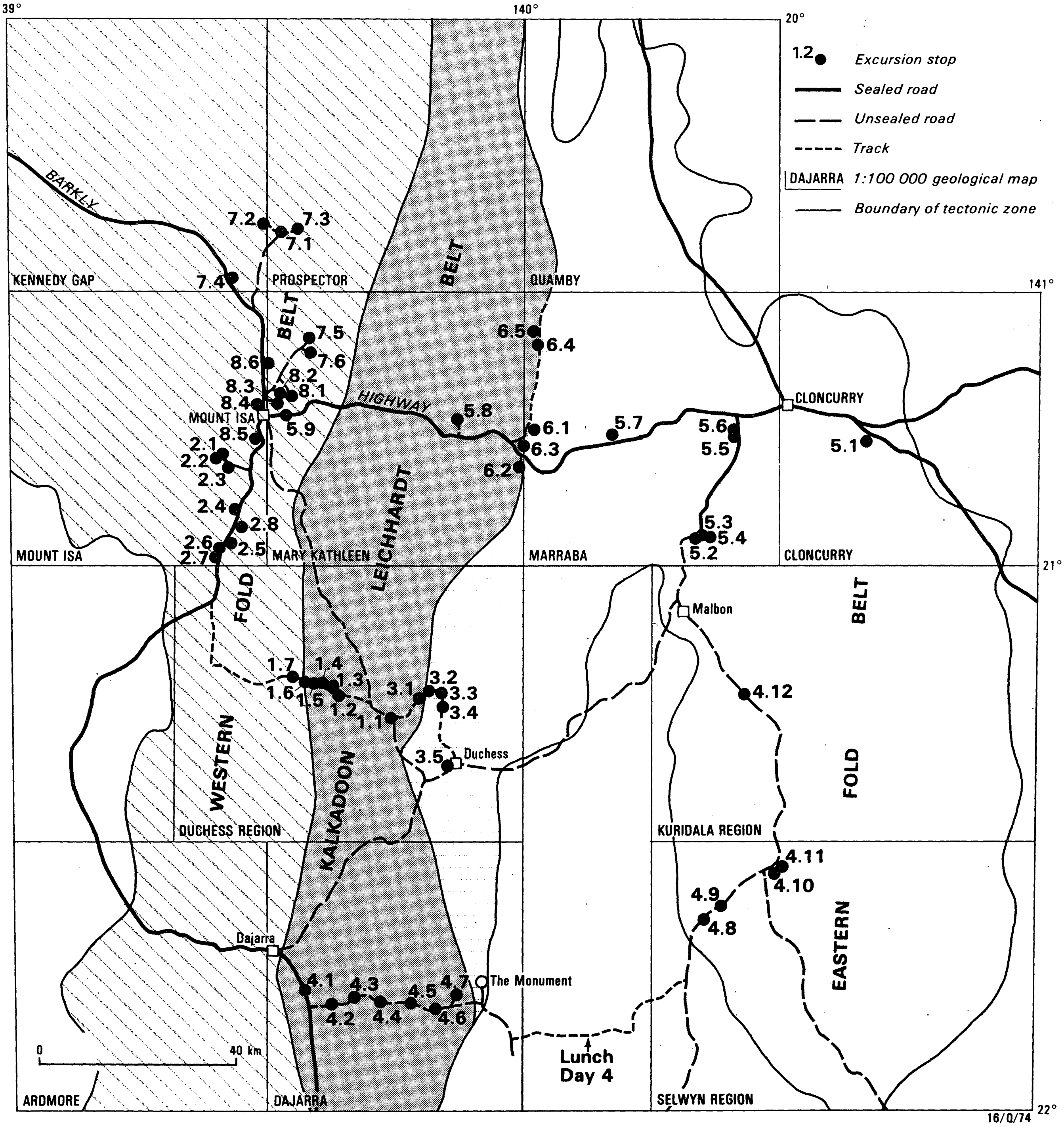


Fig 1 Excursion routes and stops.

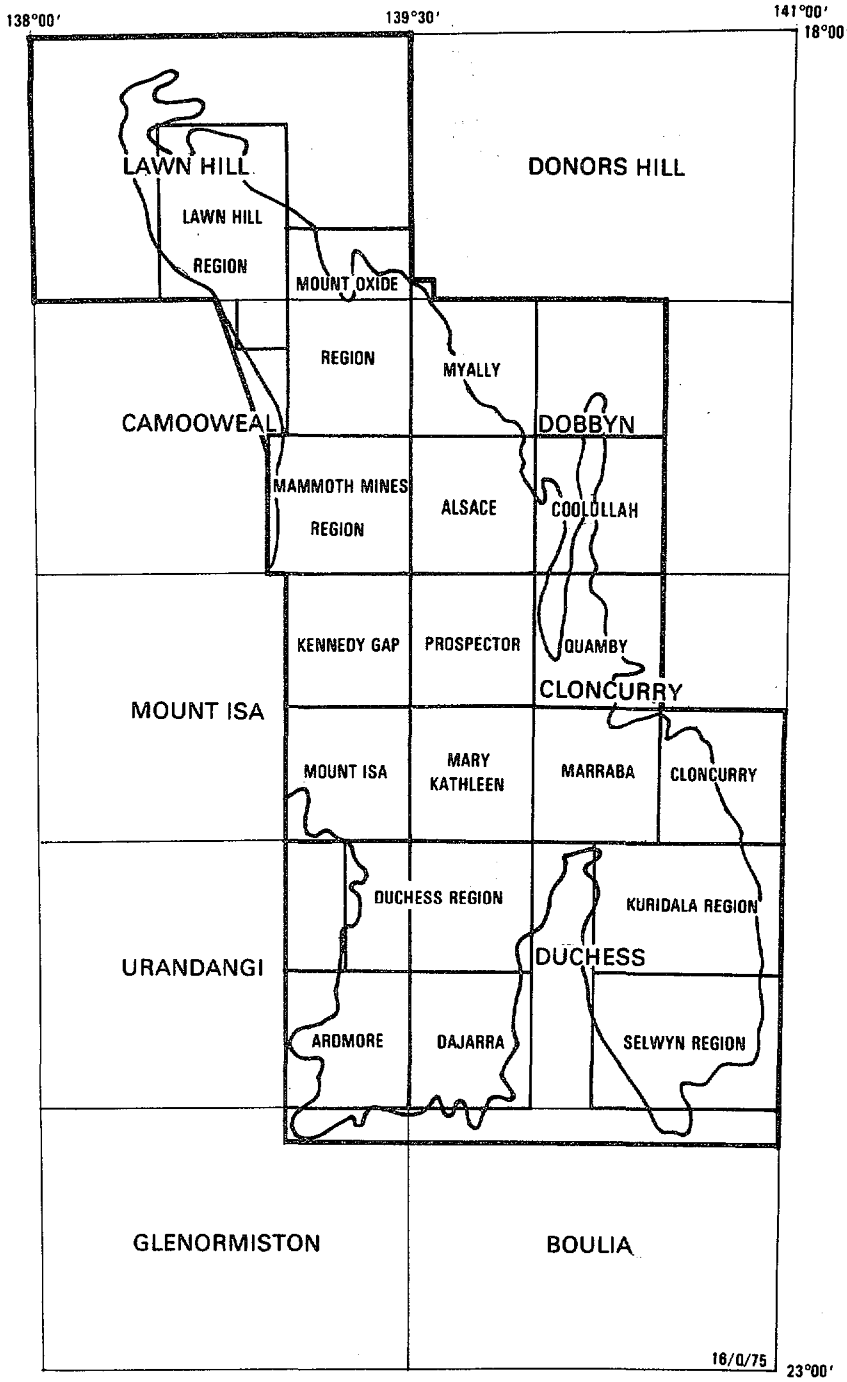


Fig 2 Index to 1:100 000 geological maps covering the Mount Isa Inlier.

7

TABLE 1

REFERENCES FOR 1:100 000 GEOLOGICAL MAPS AND MAP COMMENTARIES, MOUNT ISA INLIER

(See Fig. 2 for map coverage)

MAP NAME	REFERENCE
ALSACE	BMR, 1982 (no map commentary)
ARDMORE	Bultitude, 1982
CLONCURRY	Wilson & others, in prep.
COOLULLAH	Wilson & Grimes, in prep. b
DAJARRA	Blake & others, 1982
DUCHESS REGION	Bultitude & others, 1982
KENNEDY GAP	BMR, 1980 (no map commentary)
KURIDALA REGION	Donchak & others, 1983
LAWN HILL REGION	Sweet & others, 1982
MAMMOTH MINES REGION	Hutton & Wilson, in prep.
MARRABA	Derrick, 1980
MARY KATHLEEN	Derrick & others, 1977
MOUNT ISA	BMR, 1978 (no map commentary)
MOUNT OXIDE REGION	Hutton & Wilson, 1984
MYALLY	Wilson & Grimes, 1984
PROSPECTOR	BMR, 1979 (no map commentary)
QUAMBY	Wilson & Grimes, in prep. a
SELWYN REGION	Blake & others, 1983

8

TABLE 2
SUMMARY OF STRATIGRAPHY, MOUNT ISA INLIER

(Units underlined will be seen during excursion)

NAME OF UNIT (max.thickness in m)	MAIN ROCK TYPES	RELATIONSHIPS	REMARKS
COVER SEQUENCE 3:			
McNamara Group (8500)	Siltstone, dolomite, sandstone, shale,chert	Unconformable on older units	Correlated with Mount Isa Group
Mount Isa Group	Commonly dolomitic and pyritic siltstone, shale; sandstone at base	Unconformable and conformable? on Surprise Creek Formation; unconformable on older units	Includes Warrina Park Quartzite (at base) and Urquhart Shale (host for major Pb, Z, Ag, Cu ore deposits). Age 1670 Ma
Surprise Creek Formation (2000)	Sandstone, siltstone, shale	Unconformable on older rocks	
Fiery Creek Volcanics (250)	Bimodal volcanics	Conformable on Bigie Formation	Correlated with Carters Bore Rhyolite
Bigie Formation (800)	Sandstone, conglomerate	Unconformable on cover sequence 2	
Carters Bore Rhyolite (200)	Rhyolite, tuff	Unconformable on cover sequence 2	Age 1680 Ma
Mount Albert Group (3000+)	Sandstone, siltstone, shale, slate; calcareous in part	Unconformable? on and thrust over Mary Kathleen group (mainly Corella Formation) of cover sequence 2	The only unit assigned to cover sequence 3 in Eastern Fold Belt; includes Deighton Quartzite and White Blow Formation
COVER SEQUENCE 2:			
Mary Kathleen Group (4000+)	Banded and brecciated calc-silicate rocks, siltstone, sandstone, shale, slate, greywacke, marble, chert; commonly scapolitic	Conformable to unconformable on Malbon Group, Soldiers Cap Group, and Argylla Formation; intruded by granites dated at 1720-1740 Ma and by younger granites	Includes Corella Formation, Answer Slate, Staveley Formation, Kuridala Formation, Overhang Jaspilite, Chumvale Breccia. Correlated with Quilalar Formation
Malbon Group (4000)	Metabasalt (mainly in lower part), variably feldspathic sandstone, mainly in upper part	Conformable on Argylla Formation; intruded by granite	Comprises Marraba Volcanics and overlying Mitakoodi Quartzite
Soldiers Cap Group (6000+)	Sandstone, siltstone, greywacke, metabasalt; schist, gneiss	Base not exposed; intruded by granite	

9

NAME OF UNIT (max.thickness in m)	MAIN ROCK TYPES	RELATIONSHIPS	REMARKS
Stanbroke and Makbat Sandstones (300)	Sandstone	Unconformable on Argylla Formation, Leichhardt Volcanics	May be correlatives of Mary Kathleen Group and Quilalar Formation
Quilalar Formation (1500+)	Sandstone, siltstone; dolomitic and calcareous in upper part	Conformable on Myally Subgroup; unconformable on Leichhardt Volcanics and Kalkadoon Granite	Correlated with Mary Kathleen Group
Haslingden Group:			
Myally Subgroup (3000+)	Feldspathic sandstone, quartz sandstone	Conformable on Eastern Creek Volcanics	
Eastern Creek Volcanics (7200)	Metabasalt, interlayered sandstone	Conformabale on Mount Guide and Leander Quartzites; intruded by Sybella granite	
Mount Guide Quartzite (6200)	Greywacke and conglomerate in lower part, quartz sandstone in upper part	Unconformable on Kalkadoon Granite; probably conformable on Bottletree Formation; intruded by Sybella Granite	Correlated with Leander Quartzite
Leander Quartzite (5000)	Feldspathic sandstone, quartz sandstone, greywacke	Base not exposed	Correlated with Mount Guide Quartzite
Argylla Formation (2000+)	Rhyolitic to dacitic ignimbrite and lava	Conformable on and interfingers with Magna Lynn Metabasalt; intruded by granites of Wonga and Williams Batholiths	Age 1780 Ma
Magna Lynn Metabasalt (1500)	Metabasalt	Unconformable on Leichhardt Volcancis, intruded by granites of Wonga Batholith	Penecontemporaneous with Argylla Formation
Bottletree Formation (3000)	Greywacke, conglomerate, felsic and mafic volcanics	Unconformable on basement and Kalkadoon Granite	Age 1790 Ma
Jayah Creek and Oroopo Metabasalts (1000+)	Metabasalt, sandstone	Overlie probable basement rocks; intruded by Sybella Granite	Probably correlatives of Eastern Creek Volcanics
COVER SEQUENCE 1:			
Leichhardt Volcanics (1000+)	Rhyolitic to dacitic ignimbrite and lava	Unconformable on One Tree Granite; intruded by Kalkadoon Granite, Wills Creek Granite, Ewen Granite	Age 1850-1875 Ma
BASEMENT: (1000+)	Gneiss, schist, migmatite	Intruded by granites of Kalkadoon and Sybella Batholiths	Includes Plum Mountain Gneiss

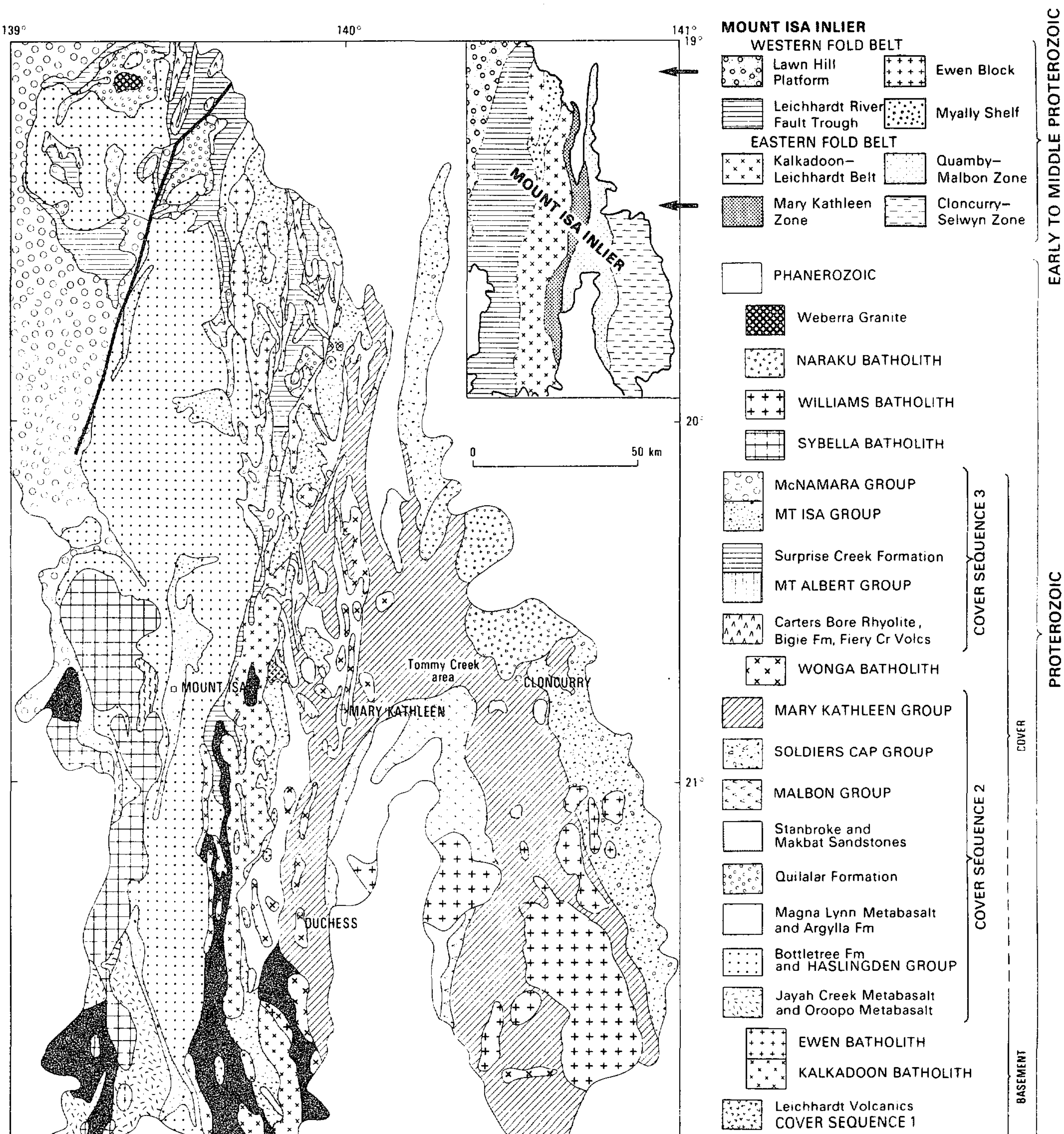


Fig 3 Generalised geology, Mount Isa Inlier.

11

SUMMARY OF ITINERARY

(see Fig. 1 for excursion routes and stops)

Wednesday 14 August 1985

Leave Darwin 1435 hrs TAA Flight 457;
arrive Mount Isa 1650 hrs.
Overnight: hotel in Mount Isa.

DAY 1, THURSDAY 15 AUGUST

Leave Mount Isa 0800; proceed south along Duchess Road to:

Stop 1.1, 74 km. Traverse 1.5 km across Leichhardt Volcanics/Magna Lynn Metabasalt/Argylla Formation sequence.
Arrive 1000; depart 1130.

Notes

12

Stop 1.2, 88 km. Migmatitic 'metadacite' of the basement intruded by leucogranite and amphibolite; geochronological (U-Pb zircon) sample site; lunch spot.
Arrive 1200; depart 1330

Notes

Stop 1.3, 90 km. Creek pavement exposure of basement migmatitic metasediments.
Arrive 1335; depart 1420.

Notes

Stop 1.4, 94 km. Felsic dykes related to volcanics of cover sequence 2 cutting basement migmatite.
Arrive 1430; depart 1445.

Notes

Stop 1.5, 95 km. Tors and boulders of granite, Kalkadoon Batholith.
Arrive 1450; depart 1500.

Notes

IV

Stop 1.6, 98 km. Traverse 1 km from unconformity at base of the Bottletree Formation west to ridge-forming Mount Guide Quartzite, cover sequence 2.
Arrive 1505; depart 1605.

Notes

Stop 1.7, 100 km. Basalt lava of the Eastern Creek Volcanics overlying Mount Guide Quartzite.
Arrive 1610; depart 1620.

Return to Mount Isa, 175 km, arrive 1800 hrs.
Overnight Mount Isa.

Notes

15

DAY 2, FRIDAY 16 AUGUST

Leave Mount Isa 0800, proceed west to:

Stop 2.1, 18 km. Lineated microgranite of the Sybella Batholith intruding cover sequence 2.
Arrive 0830; depart 0900.

Notes

Stop 2.2, 19 km. Foliated microgranite and pegmatite, Sybella Batholith.
Arrive 0900; depart 0930.

Notes

Stop 2.3, 22 km. Pegmatite segregations in Sybella Granite.
Arrive 0940; depart 0950.

Notes

Stop 2.4, 36 km. Th-rich phase of Sybella Granite.
Arrive 1020; depart 1040.

Notes

17

Stop 2.5, 44 km. Geochronological sample site (U-Pb zircon) in augen gneiss, Sybella Batholith.
Arrive 1050; depart 1110.

Notes

Stop 2.6, 46 km. Road cutting in screen of Eastern Creek Volcanics.
Arrive 1115; depart 1145.

Notes

18

Stop 2.7, 47 km. Very coarse augen gneiss, Sybella Batholith.
Arrive 1145; depart 1205.

Notes

Stop 2.8, 53 km. Lunch, followed by traverse 3 km east from the Sybella Batholith, crossing upper amphibolite to lower greenschist facies rocks of cover sequences 2 and 3.
Arrive 1230; depart on traverse 1300; pick up by 4-wheel drive vehicle 1700.

Return to Mount Isa, 80 km, 1800.
Overnight Mount Isa.

Notes

DAY 3, SATURDAY 17 AUGUST

Leave Mount Isa 0800, proceed south to:

Stop 3.1, 82 km. Cover sequence 2 units (Magna Lynn Metabasalt, Argylla Formation, Corella Formation) and Bushy Park Gneiss (Wonga Batholith) in the Duchess belt. Arrive 1000; depart 1200.

Notes

Stop 3.2, 85 km. Attenuated (highly compressed) folds in calc-silicate rocks of the Corella Formation. Arrive 1205; depart 1215.

Notes

20

Stop 3.3, 88 km. Tight but less compressed folds in the Corella Formation; Lunch spot.
Arrive 1225; depart 1320.

Notes

Stop 3.4, 91 km. Traverse 2 km across the Corella Formation to the Revenue Granite (Wonga Batholith).
Arrive 1330; depart 1600.

Notes

Stop 3.5, 105 km. Mount Erle Igneous Complex (Wonga Batholith) exposed in railway cutting at Duchess.
Arrive 1630; depart 1700.

Continue on to Dajarra, 160 km; arrive 1800.
Overnight Dajarra Hotel, Dajarra.

Notes

DAY 4, SUNDAY 18 AUGUST

Leave Dajarra 0800; proceed south to:

Stop 4.1, 10 km. Felsic gneisses possibly belonging to cover sequence 2.
Arrive 0810; 0820

Notes

92

Stop 4.2, 17 km. Low-grade felsic ignimbrite of the Leichhardt Volcanics (cover sequence 1).
Arrive 0830; depart 0840.

Notes

Stop 4.3, 25 km. Traverse for 1 km across high-grade metamorphics (basement?) and granite of the Kalkadoon Batholith.
Arrive 0850; depart 0950.

Notes

Stop 4.4, 31 km. Low-grade felsic porphyry, Leichhardt Volcanics.
Arrive 1000; depart 1010.

Notes

Stop 4.5, 39 km. Schistose porphyry, Leichhardt Volcanics.
Arrive 1020; depart 1030.

Notes

24

Stop 4.6, 44 km. One Tree Granite phase of the Kalkadoon Batholith.
Arrive 1045; depart 1055.

Notes

Stop 4.7, 50 km. Plum Mountain Gneiss, part of the basement.
Arrive 1105; depart 1120. Lunch spot: Bourke River crossing, 90 km, 1220-1250.

Notes

25

Stop 4.8, 137 km. Answer Slate in the Eastern Fold Belt showing two phases of deformation.
Arrive 1350; depart 1405

Notes

Stop 4.9, 136 km. Folds in calc-silicate rocks of the Staveley Formation.
Arrive 1415; depart 1430.

Notes

26

Stop 4.10, 155 km. Kuridala Formation : schist and ironstone ('Selwyn Hematite').
Arrive 1455; depart 1525.

Notes

Stop 4.11 160 km. Mount Elliott mine (abandoned): Cu-Au orebody in folded black slate of the Kuridala Formation.
Arrive 1535; depart 1610.

Notes

27

Stop 4.12, 201 km. Geochronological sample site (U-Pb zircon) in post-tectonic Wimberu Granite of the Williams Batholith.
Arrive 1710; depart 1730.

Continue on to Cloncurry, 280 km, arrive 1930.
Overnight Clonclurry.

Notes

DAY 5, MONDAY 19 AUGUST

Leave Cloncurry 0800; proceed east to:

Stop 5.1, 21 km. Calc-silicate breccia of the Corella Formation and metasediments of the Soldiers Cap Group.
Arrive 0830; depart 0915.

Notes

28

Stop 5.2, 61 km. Mitakoodi Quartzite exposure in creek bed.
Arrive 1010; depart 1020.

Notes

Stop 5.3, 63 km. Overhang Jaspilite.
Arrive 1025; depart 1035.

Notes

Stop 5.4, 64 km. Chumvale Breccia.
Arrive 1040; depart 1050.

Notes

Stop 5.5, 87 km. Traverse 1.5 km across Mitakoodi Quartzite, Overhang Jaspilite and Chumvale Breccia.
Arrive 1120; depart 1220.

Notes

Stop 5.6, 88 km. Calc-silicate breccia of the Corella Formation.
Arrive 1220; depart 1230.

Notes

Stop 5.7, 130 km. Lunch spot. Geochronological sample site (U-Pb zircon) in quartzofeldspathic mylonite or rhyolite mapped as Corella Formation.
Arrive 1300; depart 1400.

Notes

Stop 5.8, 133 km. Traverse for 2 km across the Corella Formation to base of the Deighton klippe.
Arrive 1430; depart 1700.

Notes

Stop 5.9, 174 km. Metabasalt of the Eastern Creek Volcanics in road cutting.
Arrive 1730; depart 1750.

Continue on to Mount Isa, 180 km, arrive 1800.
Overnight Mount Isa.

Notes

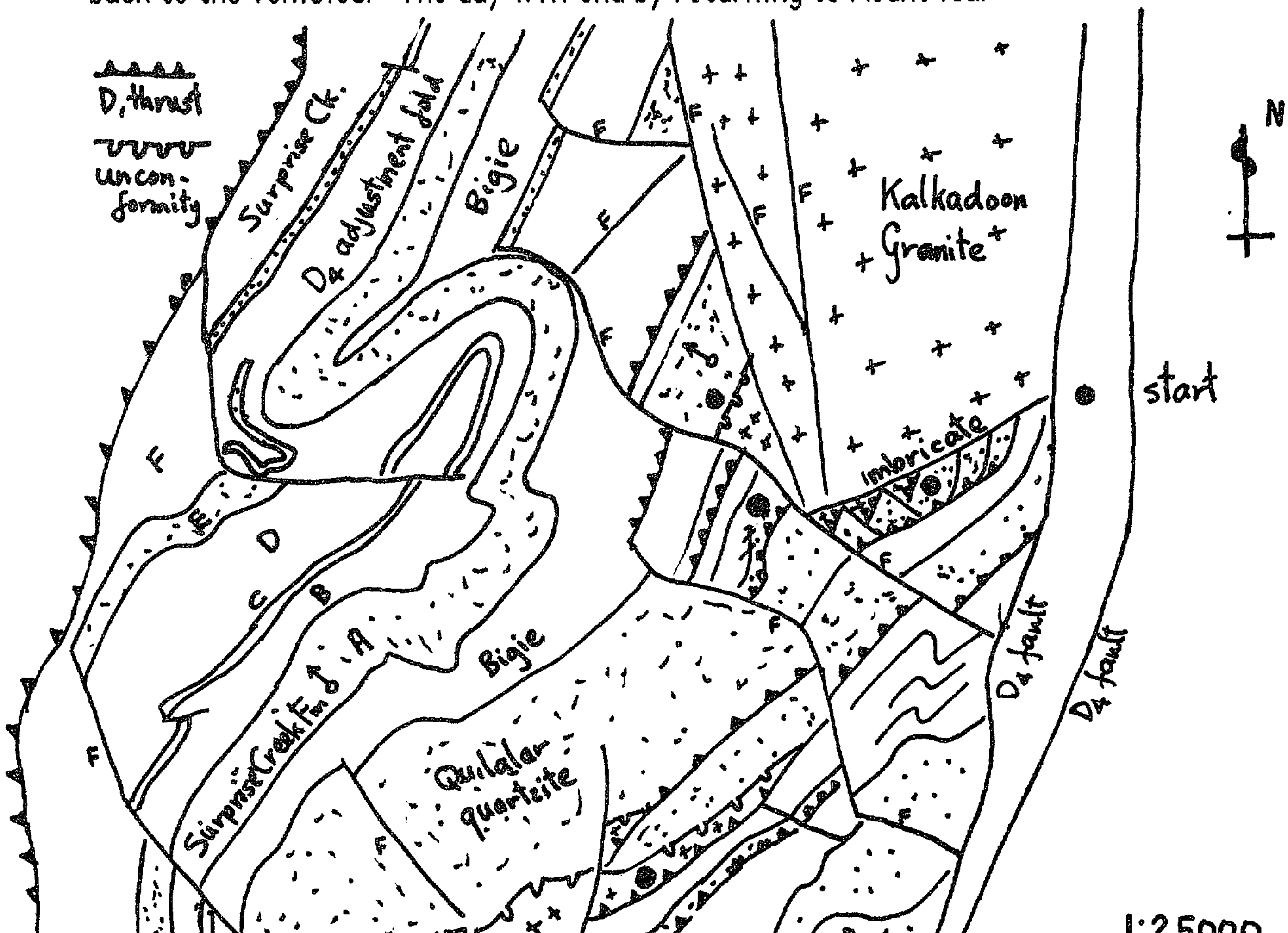
32

Alternative $^1/_2$ day for Mount Isa excursion

Drive 55 km north on road to Lake Julius dam. Walk 1.5 km westward along low range of hills, south of a plain defined by low outcrops of deformed Kalkadoon Granite. This is believed to be a thrust imbricate. Initially repeats of Quilalar quartzite and Surprise Creek siltstones will be encountered, and finally deformed porphyritic granite overlying these metasediments. In the final stage of the traverse, repeats of a sedimentary sequence involving Bigie "red-beds" through to Surprise Creek siltstones is encountered.

Then, walking a few meters north across an adjustment fault associated with the Mount Remarkable right-lateral strike slip fault system, we encounter the basal conglomerate of the Quilalar quartzite, where it unconformably overlies Kalkadoon granite. The sedimentological nature of the contact is of particular interest.

Those faint-hearted amongst us can then make their way back to the vehicles. The remaining party would walk 1.5 km south to an even more spectacular thrust repetition, and then make its way through the sequence back to the vehicles. The day will end by returning to Mount Isa.



DAY 6, TUESDAY 20 AUGUST

Leave Mount Isa 0800; proceed east to:

Stop 6.1, 57 km. Open cut at the Mary Kathleen uranium mine.
Arrive 0900; depart 1000.

Notes

Stop 6.2, 70 km. Highly deformed granite and associated rocks of the Wonga Belt exposed in creek pavements.
Arrive 1030; depart 1200.

Notes

Stop 6.3, 77 km. Foliated and crenulated fine-grained granite of the Wonga Batholith. Lunch spot nearby. Arrive 1220; depart 1300.

Notes

Stop 6.4, 100 km. Structures in sillimanite-grade schist of the Corella Formation. Arrive 1345; depart 1445.

Notes

35

Stop 6.5, 102 km. Traverse 1.5 km across part of the Wonga Belt.
Arrive 1450; depart 1650.

Return to Mount Isa, 176 km, arrive 1800.
Overnight Mount Isa.

Notes

DAY 7, WEDNESDAY 21 AUGUST

Leave Mount Isa 0800; proceed north to:

Stop 7.1, 37 km. Traverse across an early (D_1) east/west syncline and associated major thrust.
Arrive 0845; depart 0945.

Notes

36

Stop 7.2, 40 km. Anticlinal structure with cover sequence 2 (Eastern Creek Volcanics) overlying cover sequence 3 (Mount Isa Group).
Arrive 1000; depart 1100.

Notes

Stop 7.3, 49 km. Thrust or fault contact between the Eastern Creek Volcanics and Mount Isa Group.
Arrive 1115; depart 1215. Lunch 1230-1300.

Notes

Stop 7.4, 83 km. Possible site of thrust for major thrust duplex.
Arrive 1400; depart 1420.

Notes

Stop 7.5, 123 km. Spillway Fault - a growth fault, spoon fault, or thrust.
Arrive 1500; depart 1630.

Notes

Stop 7.6, 126 km. Early fold (D_1) in the Mount Isa Group.
Arrive 1645; depart 1745.

Return to Mount Isa, 146 km; arrive 1800.
Overnight Mount Isa.

Notes

DAY 8, THURSDAY 22 AUGUST

Leave Mount Isa 0800; proceed east to:

Stop 8.1, 13 km. Traverse across basal sediments of the Mount Isa Group.
Arrive 0820; depart 1030.

Notes

Stop 8.2, 21 km. Rapid facies changes in the basal part of the Mount Isa Group near the Moondarra Fault.
Arrive 1100; depart 1130.

Notes

Stop 8.3, 31 km. Unconformable contact between Eastern Creek Volcanics and overlying Mount Isa Group.
Arrive 1200; depart 1300. Lunch spot.

Notes

Stop 8.4, 37 km. Urquhart Shale of the Mount Isa Group exposed in road cutting.
Arrive 1330; depart 1400.

Notes

Stop 8.5, 42 km. Features indicative of shallow water deposition in the upper part of the Mount Isa Group.
Arrive 1430; depart 1600.

Notes

41

<u>Stop 8.6</u>, 57 km. Transmitter Fault - a growth fault or later structure?
Arrive 1700; depart 1730.

Return to Mount Isa, 68 km; arrive 1800.

<u>Notes</u>

DAY 1, THURSDAY 15 AUGUST

Objective: To examine rock types, relationships, and structural features of the basement, Leichhardt Volcanics of cover sequence 1, Kalkadoon Granite, and the Magna Lynn Metabasalt and Argylla Formation of cover sequence 2 in the Kalkadoon-Leichhardt Belt, and the lower part of cover sequence 2 (Bottletree Formation, Mount Guide Quartzite, and Eastern Creek Volcanics) in the Western Fold Belt, in DUCHESS REGION (DU) 1:100 000 Sheet area (Fig. 4).

Leader: David Blake.

Stop 1.1 (Grid reference = GR DU690470)

Traverse southeast for about 1.5 km across grey felsic ignimbritic rocks of the Leichhardt Volcanics (Pel), mafic lavas and interlayered sediments and felsic tuff of the Magna Lynn Metabasalt (Pem), and pinkish felsic volcanics of the Argylla Formation (Pea), all of which have been regionally metamorphosed to amphibolite facies. The Leichhardt Volcanics are inferred to be overlain unconformably by the Magna Lynn Metabasalt, but the contact between the two units is concealed here. Interbanding of felsic and mafic volcanics in the contact zone between the Magna Lynn Metabasalt and Argylla Formation indicates that these two units are not significantly different in age. U-Pb zircon data show that the Leichhardt Volcanics are between about 1875 and 1850 Ma old and the Argylla Formation is about 1780 Ma old (Page, 1983a). The felsic volcanics of the Argylla Formation differ from those of the Leichhardt Volcanics in being generally magnetic, and richer in Zr, Nb, and Y; they are classified as A-type whereas the Leichhardt Volcanics are normal I-types (Wyborn, in Blake & others, 1984).

Stop 1.2 (GR DU585510)

At this locality migmatitic metadacite with thin wispy leucosomes, assigned to the basement (Pl), is cut by leucogranite, pegmatite and granodiorite/tonalite of the Kalkadoon Granite (Pgk) and by mafic dykes. The migmatite was formed during amphibolite facies metamorphism and was deformed before being intruded by granite. It contains zircons of apparently igneous origin dated at about 1865 Ma (Page, 1983a). This age is statistically indistinguishable from the established ages of the Leichhardt Volcanics and Kalkadoon Granite, but the migmatite is considered by Blake (1980 and in prep.) to be appreciably older than these two units. To the southwest the metadacite merges with migmatitic metasediments.

43

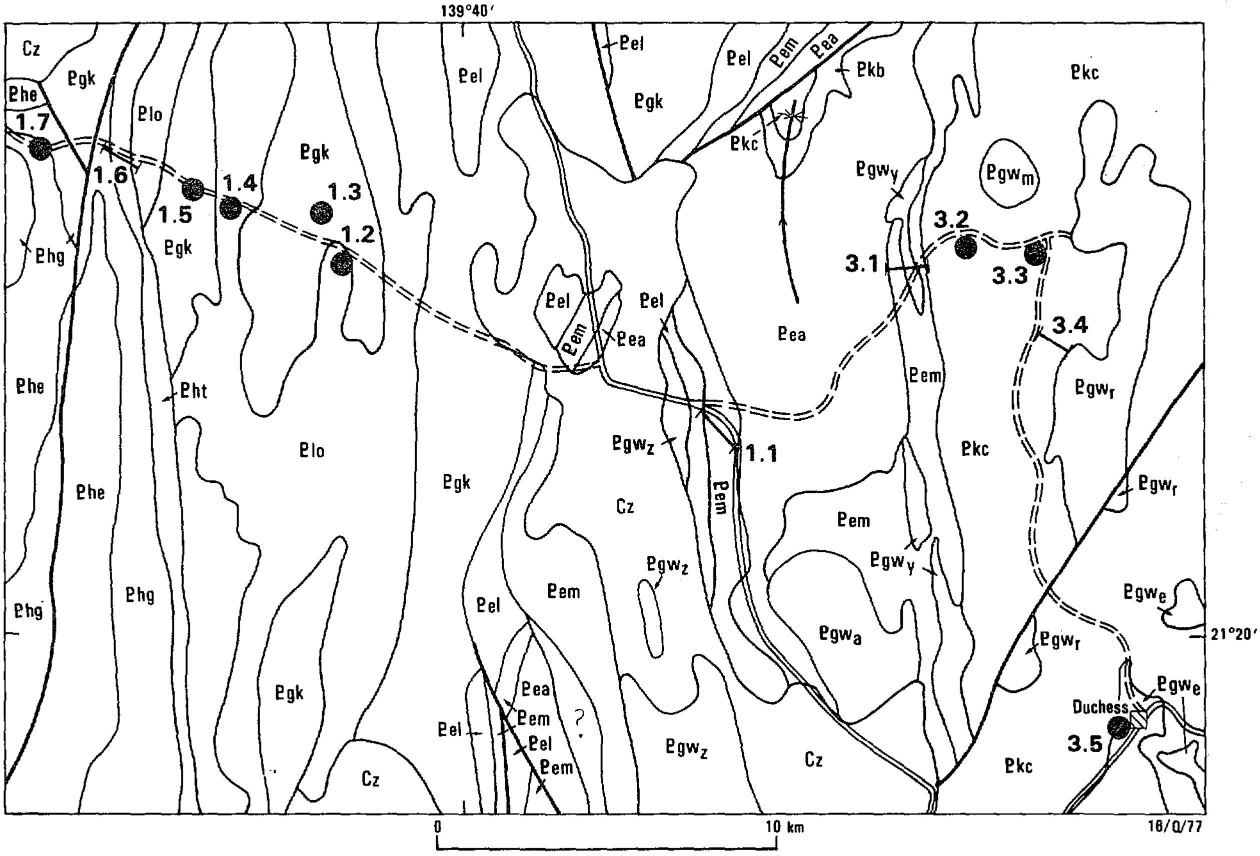


Fig 4 The Bushy Park area, showing excursion stops for Day 1. For key to letter symbols see Table 3.

Table 3 Key to letter symbols used in Figures 4-11

UNIT	SYMBOL
CAINOZOIC	Cz
MESOZOIC	M
CAMBRIAN	Ꞓ
PROTEROZOIC	Ᵽ
Metadolerite	dl
Cover sequence 3:	
Mount Isa Group	Ᵽi
Warrina Park Quartzite	Ᵽiw
Surprise Creek Formation	Ᵽr
Mount Albert Group:	
White Blow Formation	Ᵽpw
Deighton Quartzite	Ᵽpd
Roxmere Quartzite	Ᵽpr
Cover sequence 2:	
Mary Kathleen Group:	
Corella Formation	Ᵽkc
Marino Slate	Ᵽkm
Agate Downs Siltstone	Ᵽkg
Staveley Formation	Ᵽks
Kuridala Formation	Ᵽkr
Answer Slate	Ᵽka
Ballara Quartzite	Ᵽkb
Overhang Jaspilite	Ᵽkj
Chumvale Breccia	Ᵽkv
Soldiers Cap Group	Ᵽo
Stanbroke Sandstone	Ᵽxs
Makbat Sandstone	Ᵽxm
Malbon Group:	
Mitakoodi Quartzite	Ᵽnm
Marraba Volcanics	Ᵽna
Argylla Formation	Ᵽea
Magna Lynn Metabasalt	Ᵽem

UNIT	SYMBOL
PROTEROZOIC	
Cover sequence 2:	
Haslingden Group:	
Myally Subgroup	Ᵽhm
Eastern Creek Volcanics	Ᵽhe
Mount Guide Quartzite	Ᵽhg
Leander Quartzite	Ᵽhq
Bottletree Formation	Ᵽlo
Cover sequence 1:	
Leichhardt Volcanics	Ᵽel, Ᵽel$_{s}$
Basement	Ᵽl
Plum Mountain Gneiss	Ᵽlp
Undivided basement and Cover sequences 1 & 2	Ᵽe
Williams Batholith:	
Wimberu Granite	Ᵽgi$_{m}$
Mount Dare Granite	Ᵽgi$_{d}$
Gin Creek Granite	Ᵽgi$_{g}$
Sybella Granite	Ᵽgs
Wonga Batholith:	
Wonga Granite	Ᵽgw
Birds Well Granite	Ᵽgw$_{z}$
Bushy Park Gneiss	Ᵽgw$_{y}$
Hardway Granite	Ᵽgw$_{h}$
Burstall Granite	Ᵽgw$_{b}$
Revenue Granite	Ᵽgw$_{r}$
Mairinda Creek Granite	Ᵽgw$_{a}$
Myubee Igneous Complex	Ᵽgw$_{m}$
Mount Erle Igneous Complex	Ᵽgw$_{e}$
Lunch Creek Gabbro	Ᵽdl
Kalkadoon Batholith:	
Kalkadoon Granite	Ᵽgk
One Tree Granite	Ᵽgk$_{v}$
Wills Creek Granite	Ᵽgk$_{w}$

Stop 1.3 (GR DU575525)

Migmatitic metasediments of the basement are well exposed in a creek pavement. They are irregularly folded and cut by medium to fine-grained tonalite, amphibolite, and at least two generations of aplitic to pegmatitic leucogranite. Veins of leucogranite cutting the tonalite may be rheomorphic, formed by partial melting of pre-existing quartzofeldspathic rocks during intrusion of the tonalite.

Stop 1.4 (GR DU550530)

Grey migmatitic metasediments and possible mafic metavolcanics of the basement are intruded by dykes of foliated fine-grained tonalite, grey felsic metaporphyry, and schistose amphibolite. The metaporphyry is identical in chemistry to felsic volcanics of the Bottletree Formation, which has been isotopically dated (U-Pb zircon) at about 1790 Ma (Page, 1983a). Although deformed and metamorphosed, the dykes cleary post-date a major deformation event which affected the migmatitic rocks.

Stop 1.5 (GR DU535525)

Tors and boulders of Kalkadoon Granite. A typical phase of the 1860 Ma-old Kalkadoon Batholith (Wyborn & Page, 1983), the rock exposed is a grey porphyritic granodiorite which is foliated and recrystallised. It contains dark fine-grained xenoliths (less numerous than usual) and is cut by veins of leucogranite. The Kalkadoon granite is similar in age and chemistry to the Leichhardt Volcanics, and belongs to the same cogenetic I-type suite.

Stop 1.6 (GR DU519541-510545)

Traverse for 1 km across the lower part of cover sequence 2 westwards from a major unconformity separating this sequence from granitic rocks of the Kalkadoon Batholith and basement migmatitic rocks to the east. The basal unit of cover sequence 2, the 1790 Ma-old Bottletree Formation (Pht), consists of epidotic metabasalt lavas and minor interlayered quartzite overlain by grey, possibly ignimbritic, felsic metavolcanics with some interlayered mafic rocks (extrusive metabasalt or intrusive metadolerite) and schistose metasediments, including conglomerate. It is succeeded conformably by metaconglomerate and metagreywacke which make up the lower part of the Mount Guide Quartzite (Phg). The conglomerates contain deformed pebbles, cobbles, and boulders of quartzite, granite, felsic volcanics, and other rock types, and show cross-bedding. Overlying upper Mount Guide

Quartzite consists of ridge-forming cross-bedded medium to coarse-grained white quartzite.

The felsic volcanics of the Bottletree Formation are generally similar in chemistry to those of the 1780 Ma-old Argylla Formation, but have higher Sr, Pb, Zn, and Ba values.

Stop 1.7 (GR DU495545)

Amygdaloidal metabasalt lavas of the Eastern Creek Volcanics (Phe) are exposed by the side of the track, overlying Mount Guide Quartzite to the east. The two formations are inferred to be conformable, but contacts between them are almost invariably concealed, as is the case here.

DAY 2, FRIDAY 16 AUGUST

Objective: To examine the Sybella Granite, cover sequence 2 (Eastern Creek Volcanics, Myally Subgroup), and cover sequence 3 (Mount Isa Group), all of which were deformed and regionally metamorphosed between 1620 Ma and 1550 Ma, in the eastern part of the MOUNT ISA (MI) 1:100 000 Sheet area, Western Fold Belt (Fig. 5).

The Sybella Granite forms a composite batholith 160 km from south to north and up to 31 km wide. It consists largely of granite, granodiorite, microgranite, and pegmatite, but also includes several gabbro-dolerite intrusions and associated net-veined complexes (for example, Blake, 1981). Most or all of the batholith was emplaced at around 1670 Ma, before the main metamorphism and deformation, and the granites range from lower greenschist facies in the northwest, with near pristine igenous mineralogy and textures, to upper amphibolite facies and metamorphic textures west and southwest of Mount Isa. At the excursion stops the Sybella Granite is metamorphosed to upper amphibolite facies.

Leaders: Lesley Wyborn and Gordon Lister.

Stop 2.1 (GR MI355985)

Deformed xenolithic microgranite of the Sybella Batholith (Pgs). Most of the xenoliths appear to be derived from the adjacent country rocks, which are exposed a few metres to the east. They are elongated parallel to a prominent lineation in the microgranite, which is an L-tectonite. The country rocks are strongly foliated amphibolites which may be correlated with the Eastern Creek Volcanics (Phe), but alternatively could belong to the basement. Tourmaline-bearing pegmatite cuts both the microgranite and country rocks.

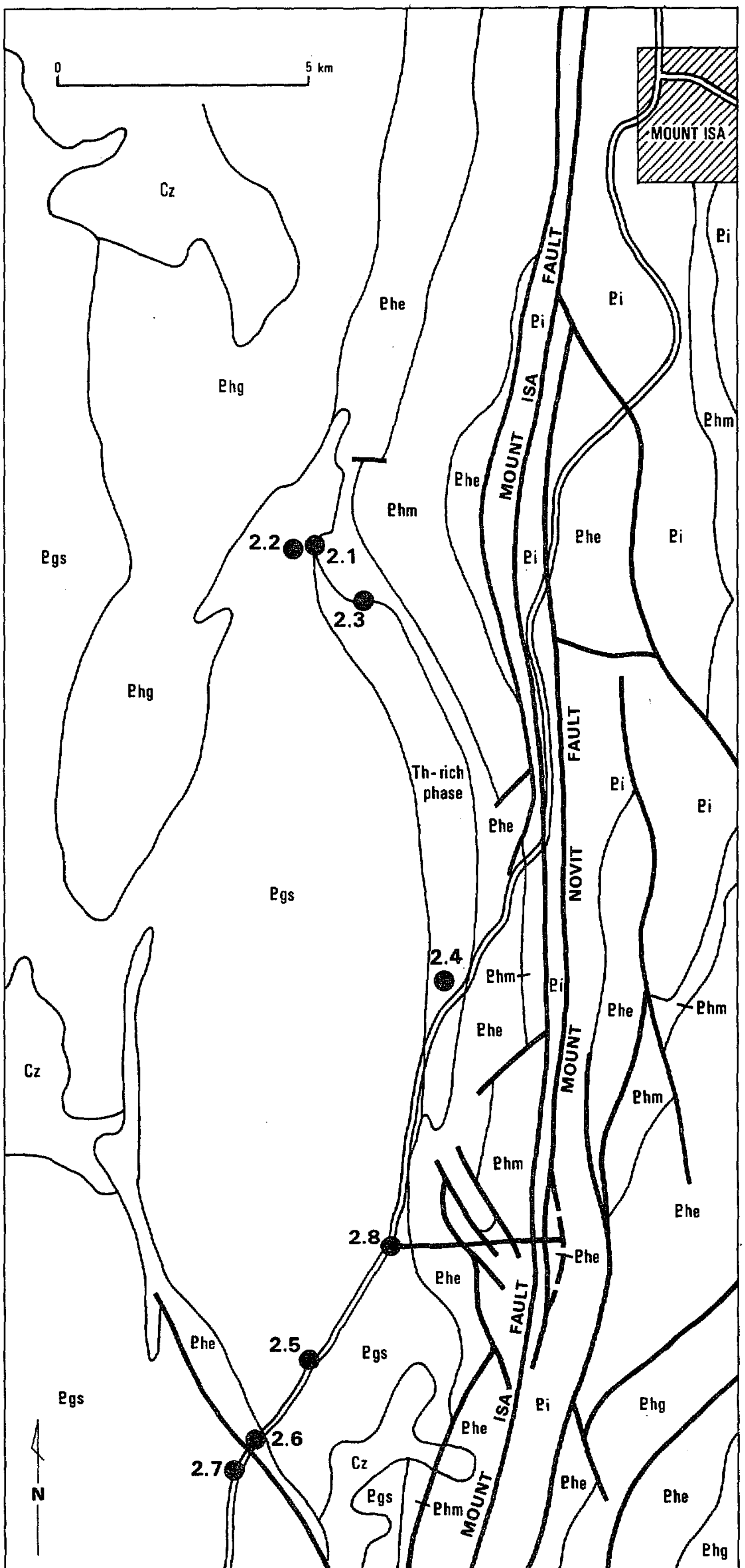


Fig 5 The Queen Elizabeth pluton, showing excursion stops for Day 2.
For key to letter symbols see Table 3.

48

Stop 2.2 (GR MI350980)

The same microgranite as at stop 2.1 is here foliated rather than lineated, and is an S-tectonite. Pegmatite nearby contains rutile, apatite, columbite, beryl, and ubiquitous tourmaline. The view to the south is of the Queen Elizabeth pluton of the Sybella Batholith. The eastern margin of this pluton is a chemically distinct phase enriched in Th and Sn, as reported by Towsey & Patterson (1980), who also reported that it coincides with a botanical anomaly characterised by *Eucalyptus pruinosa* (western silver box), in contrast to *Acacia chisholmii* (turpentine), *Eucalyptus brevifolia* (snappy gum), and *E. argillacea* (Grey box), the main trees growing on other phases of Sybella Granite.

Stop 2.3 (GR MI365873)

Pegmatite segregations in Sybellas Granite. As first suggested by Blanchard & Hall (1942), the pegmatites are considered to be of metamorphic origin, probably being formed during the D_2 deformation. Sn and Th-bearing pegmatites occur adjacent to the *E. pruinosa* phase of Sybella Granite, whereas beryl-bearing pegmatites are mainly associated with coarse-grained granite. The beryl pegmatites are restricted to the upper amphibolite facies.

Stop 2.4 (GR MI375875)

E. pruinosa phase of the Queen Elizabeth pluton, Sybella Batholith. This petrographically and chemically distinctive phase is generally strongly foliated and white to pale grey where fresh. It has gradational contacts with other parts of the Queen Elizabeth pluton, and may have been chemically reduced from interaction with pelitic metasediments during regional metamorphism.

Stop 2.5

Geochronological sample site in coarsely porphyritic Sybella Granite which has been deformed and metamorphosed to augen gneiss. Zircon from this site has been dated at 1610 Ma, although chemically similar granite elsewhere in the batholith has been dated at 1670 Ma. The younger age may indicate that the granite here is younger than other phases of Sybella Granite, or it may be the age of metamorphism rather than granite emplacement.

Stop 2.6 (GR MI345805)

Road cutting through a screen of metabasalt and metasediments, assigned to the Eastern Creek Volcanics, between the Queen Elizabeth pluton and another pluton of the Sybella Batholith. To the north this screen forms a tight syncline.

Stop 2.7 (GR MI340798)

Spectacular exposure of extremely coarse augen gneiss of the Sybella Granite.

Stop 2.8 (GR MI370845)

Traverse eastwards for about 3 km from Little Galah Creek, where Sybella Granite is exposed. The traverse first crosses lineated amphibolites (upper amphibolite facies) of the Eastern Creek Volcanics. To the east are exposures of mica schist, some containing rosettes of sillimanite, and quartzite of the 'Judenan beds' - a probable correlative of the Myally Subgroup (Phm). A strong foliation and lineation associated with the D_1 event in these rocks have been refolded and intensely crenulated by D_2; yet the quartzites still show cross-bedding. Continuing eastwards the rocks become increasingly strained until a quartz mylonite is encountered. This mylonite, which shows well-developed stretching lineations plunging steeply southwards, represents part of a major ductile D_2 shear zone formed when a block to the west, comprising the Queen Elizabeth pluton (which may represent a gneiss nappe or mantle gneiss dome) was uplifted relative to a block to the east. The Mount Novit Fault in this part of the traverse is probably a late-stage brittle manifestation of the D_2 shear zone. Further east the metamorphic grade progressively decreases to lower greenschist facies.

The final part of the traverse is through low hills of slate, formed during D_2, belonging to the Mount Isa Group (Pi). A synclinorium can be demonstrated here, corresponding to an anticlinorium present on the west side of the ductile D_2 shear zone. A brief stop will be made on the return journey to observe lower greenschist facies rocks of the Eastern Creek Volcanics underlying the Mount Isa Group.

50

DAY 3, SATURDAY 17 AUGUST

Objective: To examine features in the highly deformed Duchess belt and adjacent parts of the Kalkadoon-Leichhardt Belt and Eastern Fold Belt in the DUCHESS REGION (DU) 1:100 000 geological sheet area (Fig. 4). Porphyritic felsic metavolcanics of the Argylla Formation (Pea) in the west overlie and interfinger eastwards with the Magna Lynn Metabasalt (Pem), which is intruded in the most intensely deformed part of the Duchess belt by the Bushy Park Gneiss (Pgw_y), a unit of crenulated pink augen gneiss and aplite cut by tightly folded quartz veins. To the east a band of Argylla-type felsic metavolcanics separates the Magna Lynn Metabasalt from the Corella Formation (Pkc), which consists of tightly folded calc-silicate rocks that are variably scapolitic, amphibolitic, diopsidic, and feldspathic, and also includes some mafic metavolcanics. The Corella Formation is intruded by granite and gabbro of the Myubee and Mount Erle Igneous Complexes (Pgw_m, Pgw_e) and by the Revenue Granite (Pgw_r) which, like the Bushy Park Gneiss, make up part of the Wonga Batholith. The granites were probably emplaced between 1720 Ma and 1740 Ma (Blake & others, 1984). The Magna Lynn Metabasalt, Argylla Formation, and Corella Formation are assigned to cover sequence 2, although part of the Corella Formation may predate cover sequence 1 (Blake, 1982).

Mylonites with subhorizontal stretching lineations trending north-south, were formed during the earliest deformation recognised in the central part of the belt, and open folds with northwest-trending horizontal plunges were formed to the west and east. This deformation was followed by emplacement of the Myubee Igneous Complex and probably the Revenue Granite. Subsequent intense east-west shortening caused rotation and tightening of the earlier folds, which now have north-south trends, and resulted in the formation of vertical lineations in all units and steep mylonitic shape fabrics in the granitic rocks.

Leaders: Cees Passchier and David Blake.

Stop 3.1 (GR DU750510)

Traverse across the most deformed part of the Duchess belt. Relatively little deformed felsic metavolcanics of the Argylla Formation in the west overlie amphibolitic lavas and some interlayered metasediments (including conglomerate) and felsic tuff of the Magna Lynn Metabasalt. Deformation increases eastwards, and is particularly intense where the Magna Lynn Metabasalt is intruded by Bushy Park Gneiss. Tightly folded calc-silicate rocks of the Corella Formation further east are separated from amphibolites of the Magna Lynn Metabasalt by a band of mylonitic Argylla-type felsic metavolcanics.

Stop 3.2 (GR DU765520)

Attenuated (highly compressed) folds in calc-silicate rocks of the Corella Formation close to the zone of maximum deformation within the Duchess belt.

Stop 3.3 (GR DU790520)

Tight but less compressed folds in calc-silicate rocks of the Corella Formation in a less deformed part of the Duchess Belt.

Stop 3.4 (GR DU800490)

Traverse eastwards across the Corella Formation to the intrusive contact of the Revenue Granite. In addition to calc-silicate metasediments, the Corella Formation is taken to include amphibolite which may represent either a basaltic volcanic pile or intrusive dolerite. Mylonitic rocks are developed at the granite contact.

Stop 3.5 (GR DU820380)

An undeformed to locally strongly foliated net-veined complex, part of the Mount Erle Igneous Complex of the Wonga Batholith, is exposed in a railway cutting at Duchess. The net-veined complex consists of metadolerite pillows and pillow-fragments enclosed in and veined by leucogranite, and results from the intrusion of mafic magma into either felsic magma or melted felsic rock (for example, Blake, 1981). Similar net-veined complexes occur elsewhere in the Wonga Batholith and also in other batholiths within the Mount Isa Inlier; they are a typical feature of high-level bimodal plutonism.

DAY 4, SUNDAY 18 AUGUST

Objective: To examine alternating fault-bounded bands of amphibolite and greenschist facies rocks in the south of the Kalkadoon-Leichhardt Belt (Fig. 6), in DAJARRA (DA) 1:100 000 sheet area (morning) and lithological and structural features in the south of the Eastern Fold Belt (Fig. 7), in SELWYN REGION (SE) and KURIDALA REGION (KU) 1:100 000 geological sheet areas (afternoon).

Leader: David Blake.

Stop 4.1 (GR DA520920)

Amphibolite facies felsic gneisses (Pe) representing metamorphosed granitic and possibly also volcanic and sedimentary rocks are exposed on the side of the road. Similar grade rocks in this band further south include Kalkadoon Granite dated at 1856 Ma (Wyborn & Page, 1983) and gneissic felsic metavolcanics similar in chemistry

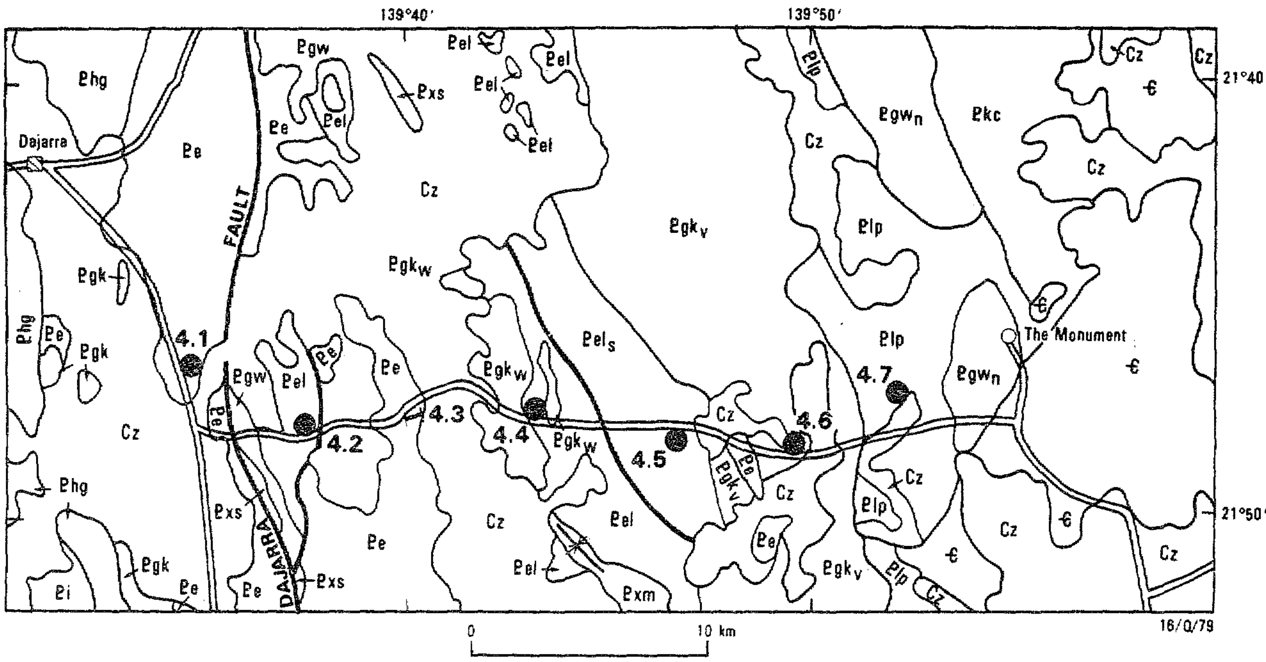


Fig 6 The area between Dajarra and The Monument, showing excursion stops 4.1 – 4.7.
For key to letter symbols see Table 3.

and age to the Argylla Formation volcanics of cover sequence 2.

Stop 4.2 (GR DA580885)

Low-grade band on the east side of the Dajarra Fault. Grey felsic ignimbrite of the Leichhardt Volcanics (Pel, cover sequence 1) is exposed here. It contains small quartz and feldspar phenocrysts and well preserved fiamme (clearly visible on weathered surfaces), and has been dated at about 1875 Ma (Page, 1983a). Metadolerite intrusions indicate regional metamorphism to lower or middle greenschist facies.

Stop 4.3 (GR DA620895)

Traverse across part of the high-grade band to the east (Pe). At this locality foliated granite, granodiorite, aplite and pegmatite of the Kalkadoon Batholith and amphibolitic mafic dykes intrude gneissic and schistose felsic metavolcanics and metasediments which may be part of either the basement (pre-1875 Ma) or cover sequence 1.

Stop 4.4 (GR DA673890)

Low-grade band east of Wills Creek. Undeformed felsic porphyry of the Leichhardt Volcanics is exposed here. Nearby it is intruded by the high-level Wills Creek Granite (Pgk_w), part of the Kalkadoon Batholith. Both units are essentially undeformed, and cross-cutting metadolerite dykes indicate regional metamorphism to only the lower or middle greenschist facies.

Stop 4.5 (GR DA740888)

Across another fault, into a band of schistose felsic porphyries and bedded tuffs mapped as Leichhardt Volcanics (Pel_s).

Stop 4.6 (GR DA790875)

Exposures of somewhat weathered One Tree Granite (Pgk_y, part of the Kalkadoon Batholith), which consists mainly of pink foliated medium-grained porphyritic granite. It is overlain unconformably to the north by the Leichhardt Volcanics, hence was probably emplaced before 1860 Ma.

Stop 4.7 (GR DA830900)

Weathered felsic and minor relatively mafic augen gneiss of the Plum Mountain Gneiss (Plp). The gneisses have a vertical northerly-trending foliation and a southerly-plunging mineral lineation, show tight minor folds and crenulations, and are cut by aplitic to pegmatitic veins. The Plum Mountain Gneiss is inferred to be intruded by the One Tree Granite, and is considered to be part of the basement.

Stop 4.8 (GR SE327065)

Answer Slate (Pka) of the Mary Kathleen Group, part of cover sequence 2 in the Eastern Fold Belt, is exposed here. It consists of crenulated grey slate and thin beds of fine-grained sandstone/siltstone. Two phases of folding are evident.

Stop 4.9 (GR SE365097)

Exposures of calcareous and minor micaceous metasediments of the Staveley Formation (Pks), Mary Kathleen Group. Two phases of folding are apparent, as also is a solution cleavage in the calcareous rocks.

Stop 4.10 (GR SE460170)

Kuridala Formation (Pkr) Mary Kathleen Group. Grey phyllite and fine-grained mica schist possibly representing turbiditic metasediments are intruded to the east by amphibolitic metadolerite. Further east there is a ridge of 'Selwyn hematite' (SH) - thinly banded quartz - hematite ± magnetite rock which in places contains economic concentrations of Au and minor Cu. The origin of these banded ironstones is a matter of debate - a syngenetic sedimentary origin is favoured by some whereas an epigenetic metasomatic or structural origin is favoured by others (for example, Blake & others, 1984).

Stop 4.11 (GR SE480180)

Mount Elliott mine, which produced 24862 t Cu and 1054698 g Au from 268201 t of ore before being abandoned in 1920. The ore occurs in black slates and minor greywacke of the Kuridala Formation. These show two phases of folding: an early phase of small-scale isoclinal folds and a later phase of more open folds.

Stop 4.12 (GR KU402522)

Geochronological sample site in Wimberu Granite (Pgi_w) Williams Batholith. This nonfoliated granite, like other 1500 Ma post-tectonic granites in the Eastern Fold Belt, commonly contains primary pale green clinopyroxene, blue-green hornblende, magnetite, and red-brown sphene, and is richer in Na_2O and poorer in K_2O than older granites in the Mount Isa Inlier. The Wimberu Granite shows evidence of fractionation, and hosts some small deposits of Cu, Au, and Ag.

55

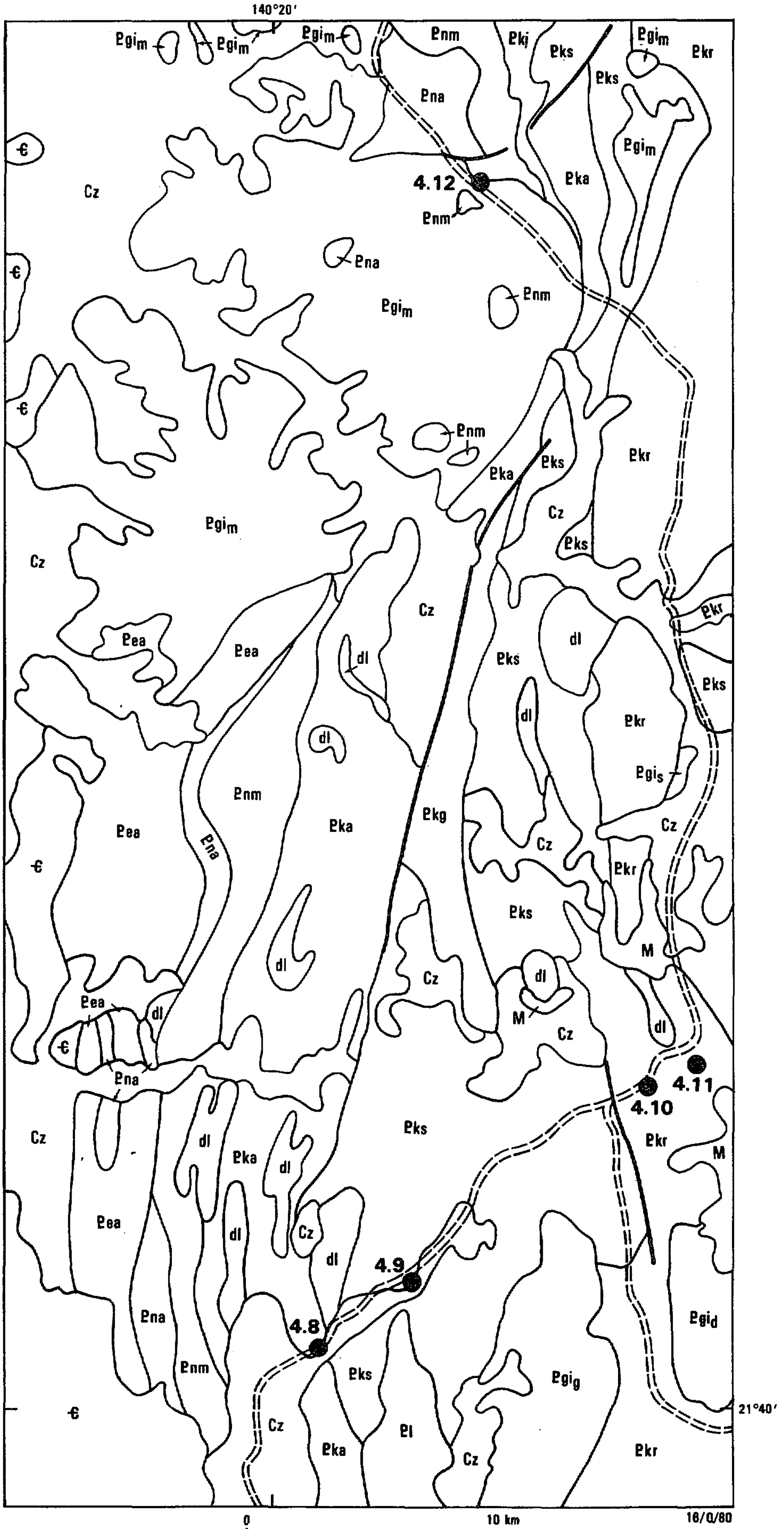


Fig 7 Part of the Eastern Fold Belt, showing excursion stops 4.8–4.12.
For key to letter symbols see Table 3.

56

DAY 5, MONDAY 19 AUGUST

Objective: To examine breccias and associated formations of cover sequence 2 in the Eastern Fold Belt, CLONCURRY (CL) and MARRABA (MA) 1:100 000 sheet areas (Fig. 8) and the Deighton klippe in the Kalkadoon-Leichhardt Belt, MARY KATHLEEN (MK) 1:100 000 sheet area (Fig. 9).

Leaders: David Blake, Gordon Lister, Ramon Loosveld.

Stop 5.1 (GR CL620020)

Calc-silicate breccia at this locality, although mapped as part of the Corella Formation (PKc), probably postdates the main regional deformation and metamorphism, as it does not appear to be deformed. Adjacent pelitic metasediments of the Soldiers Cap Group (Po) are strongly deformed and metamorphosed to the garnet-andalusite grade of the amphibolite facies. The breccia consists mainly of angular fragments of calc-silicate rocks in a calcareous matrix, but in places it also contains fragments of Soldiers Cap Group rocks and microgranite. Its origin may be related to granite emplacement, as it is intruded by albitised granite. A sharp subvertical contact between the breccia and the Soldiers Cap Group is exposed at the western edge of the outcrop area.

Stop 5.2 (GR MA305840)

Cross-bedded, variably feldspathic sandstone of the Mitakoodi Quartzite (Pnm, upper part of the Malbon Group) is well exposed in a creek bed. The Mitakoodi Quartzite lies conformably between the Marraba Volcanics (Pna, lower part of the Malbon Group) and the Overhang Jaspilite (Pkj, a basal formation of the Mary Kathleen Group), and includes some basaltic lavas and also felsic volcanics of Argylla type.

Stop 5.3 (GR MA320845)

The Overhang Jaspilite exposed here consists mainly of thinly bedded siltstone and variably ferruginous chert which may represent silicified carbonates. Tight minor folding is a characteristic feature of the chert. Silicified breccia with chert fragments is invariably present at the top of the formation.

Stop 5.4 (GR MA325645)

Chumvale Breccia (Pkv), at the top of the Overhang Jaspilite. This silicified breccia shows a steeply-dipping crude layering parallel to bedding in the Overhang Jaspilite. It has been interpreted as a regolith marking an unconformity between the Overhang Jaspilite and overlying sediments of the Mary Kathleen Group, as a structural breccia related to folding,

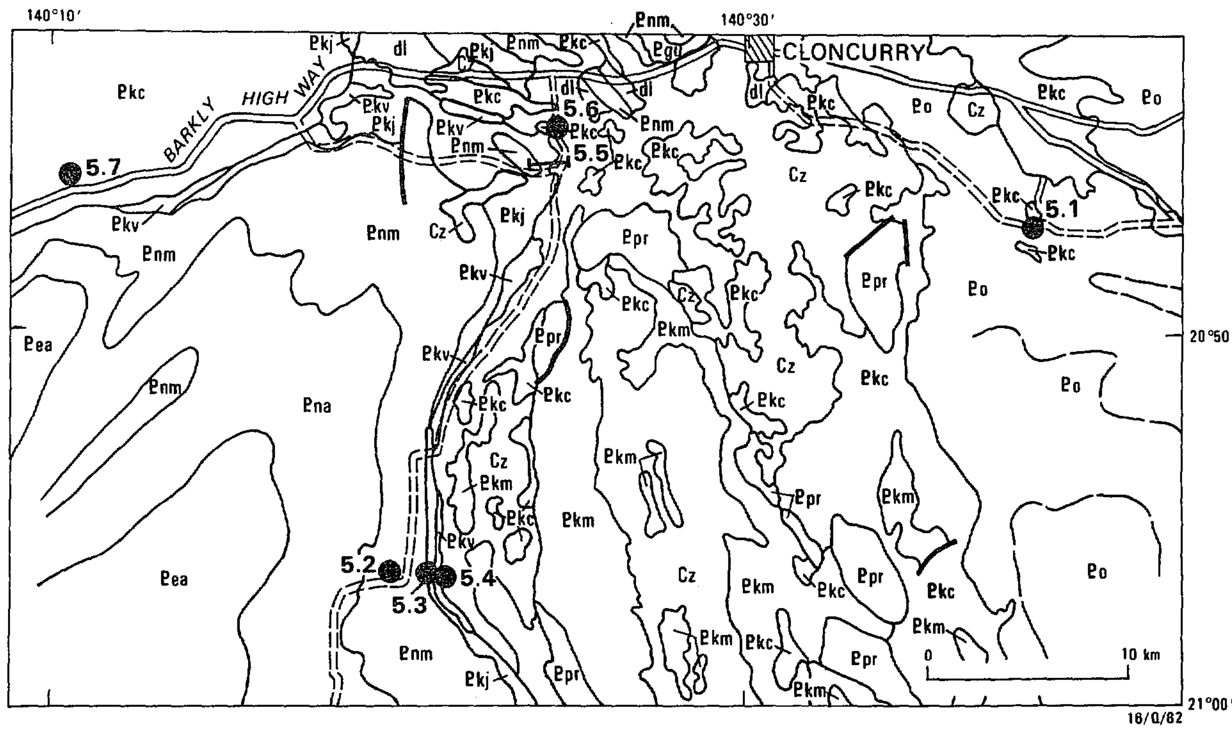


Fig 8 Part of the Eastern Fold Belt, showing excursion stops 5.1–5.7. For key to letter symbols see Table 3.

58

faulting, and/or thrusting, and as a breccia formed during Phanerozoic weathering.

Stop 5.5 (GR MA372004)

Traverse eastwards across a gradational contact between Mitakoodi Quartzite and overlying Overhang Jaspilite and onto Chumvale Breccia.

Thinly bedded calcareous and micaceous sandstone and siltstone, with some limestone, assigned to the upper part of the Mitakoodi Quartzite, pass upwards into siltstone and chert of the Overhang Jaspilite, which is intruded by metadolerite. Several bands of quartz-hematite breccia mark small faults in the sequence. A large mass of Chumvale Breccia forms irregular ridges to the east.

Stop 5.6 (GR MA382062)

1 km to the north of the Chumvale Breccia, a lower ridge of Corella Formation (which is inferred to overlie the Chumvale Breccia) shows all gradations from bedded to chaotically brecciated calc-silicate rocks.

Stop 5.7 (GR MA140040)

Geochronological sample site in a fine-grained, strongly foliated, quartzofeldspathic rock assigned to the Corella Formation. When sampled, the rock was considered to be either a metamorphosed rhyolite lava or a microgranite, and it has since also been regarded as a mylonite. The U-Pb zircon age obtained from this site, 1600 Ma (Page, 1983a), is anomalous in that it is much younger than that of any dated rocks of cover sequences 2 and 3 elsewhere in the Mount Isa inlier, and is about the same age as the D_1 deformation.

Stop 5.8 (GR MK818062-828072)

Traverse across rocks of the Corella Formation to the base of the Deighton klippe (Fig. 9), Kalkadoon-Leichhardt Belt. As described by Loosveld & Schreurs (1985), the Deighton klippe is made up of the Deighton Quartzite (Ppq) and White Blow Formation (Ppw) of the Mount Albert Group. It structurally overlies the lithologically similar Ballara Quartzite (Pkb) and Corella Formation of the Mary Kathleen Group, which may be allochthonous equivalents. The klippe is a D_1 structure which has the form of an elongate basin as a result of D_2 folding. Most of the small folds around the margins of the klippe are D_2 structures.

The traverse starts at an exposure of Corella Formation structurally close to, but beneath, the main thrust at the base of the Deighton klippe. Here minor folds in thinly bedded calcareous siltstones are related to the D_1 thrusting. The more competent thicker beds have

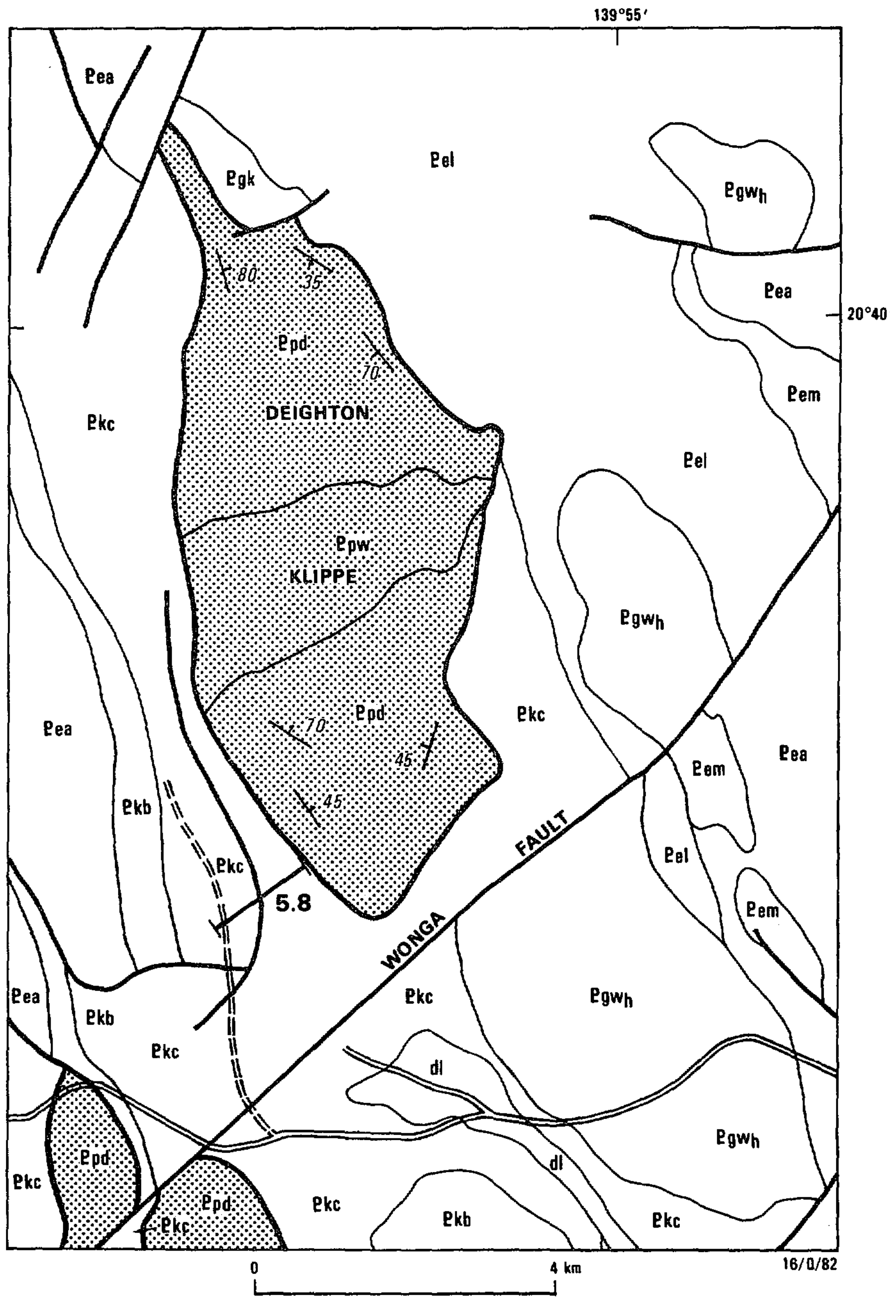


Fig 9 The Deighton Klippe, stop 5.8. For key to letter symbols see Table 3.

60

relatively open folds with steeply-dipping axial planes. Shear strains have been localised in the less competent layers, where tight to isoclinal folds have been developed. The axial planes of these folds have been rotated to become subhorizontal, and their fold axes have been deflected by up to 60°. This enables inferences to be drawn about the direction of thrusting, since it can be assumed that initially the axes of all the minor folds were parallel and at a high angle to the a-vector. During thrusting the fold axes and axial planes of the minor folds were rotated towards parallelism with the shear direction and bulk shear plane, respectively. The evidence here suggests that thrusting was from east to west.

The traverse continues eastwards to the base of the Deighton klippe, which is marked by a band of phyllonite 1-2 m thick. (The phyllonite does not crop out well, so please refrain from damaging the exposure.) In some phyllonite layers a mineral elongation is developed subparallel to the inferred movement direction of the klippe.

Stop 5.9(GR MK480078)

Metabasalts of the Eastern Creek Volcanics (Phe) exposed in a road cutting (Fig. 10). The metabasalts consist largely of chlorite, albite, and epidote, and range from massive to strongly cleaved. In massive metabasalt the chlorite is usually a mauve to brown Fe-rich variety, and sulphides (pyrite, pyrrhotite, chalcopyrite) are commonly present in veins and amygdales. In cleaved metabasalt the chlorite is typically a pale green Mg-rich variety, and sulplhides are rare or absent.

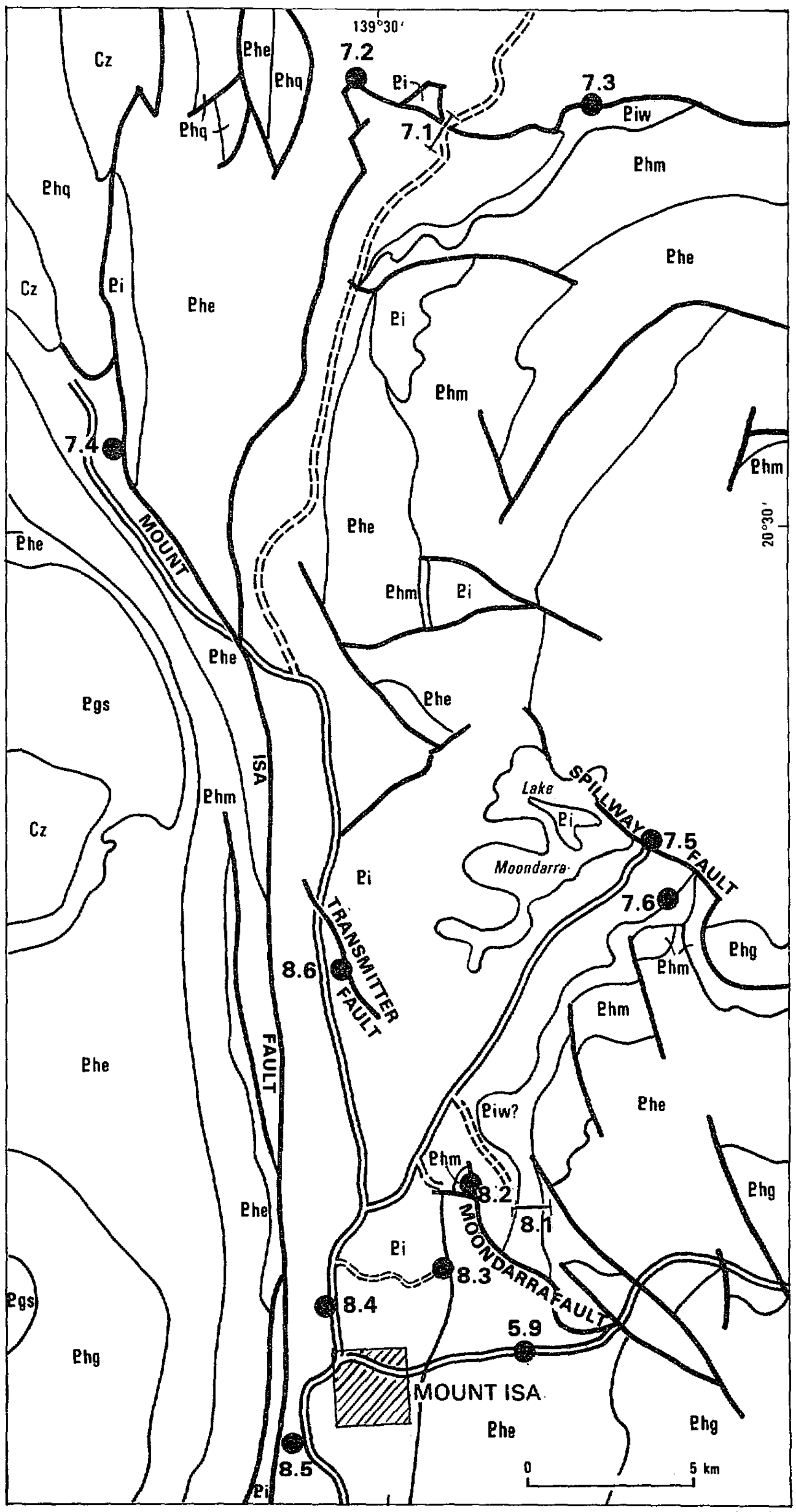
DAY 6, TUESDAY 20 AUGUST

Objective: To visit the open cut at the Mary Kathleen uranium mine (worked out), where the country rocks are assigned to the Corella Formation (Mary Kathleen Group) of the Eastern Fold belt, and to examine features of the highly deformed Wonga belt (the northern continuation of the Duchess belt examined on Day 3), in the MARRABA (MA) and MARY KATHLEEN (MK) 1:100 000 sheet areas (Fig. 11).

Leader: David Blake.

Stop 6.1 (GR MA970050)

Mary Kathleen uranium mine. Metasomatised breccia, conglomerate, and 'microdiorite' are well exposed on the sides of the open cut. There appear to have been two main periods of breccia formation and at least two of metasomatism (for example, Derrick, 1977; Page, 1983b). The first phase of brecciation and metasomatism was a high-temperature event, as indicated by the assemblage garnet ± pyroxene in skarns, and has



16/0/83

Fig 10 Part of the Western Fold Belt, showing excursion stops 5.9, 7.1–7.6 and 8.1–8.6. For key to letter symbols see Table 3.

62

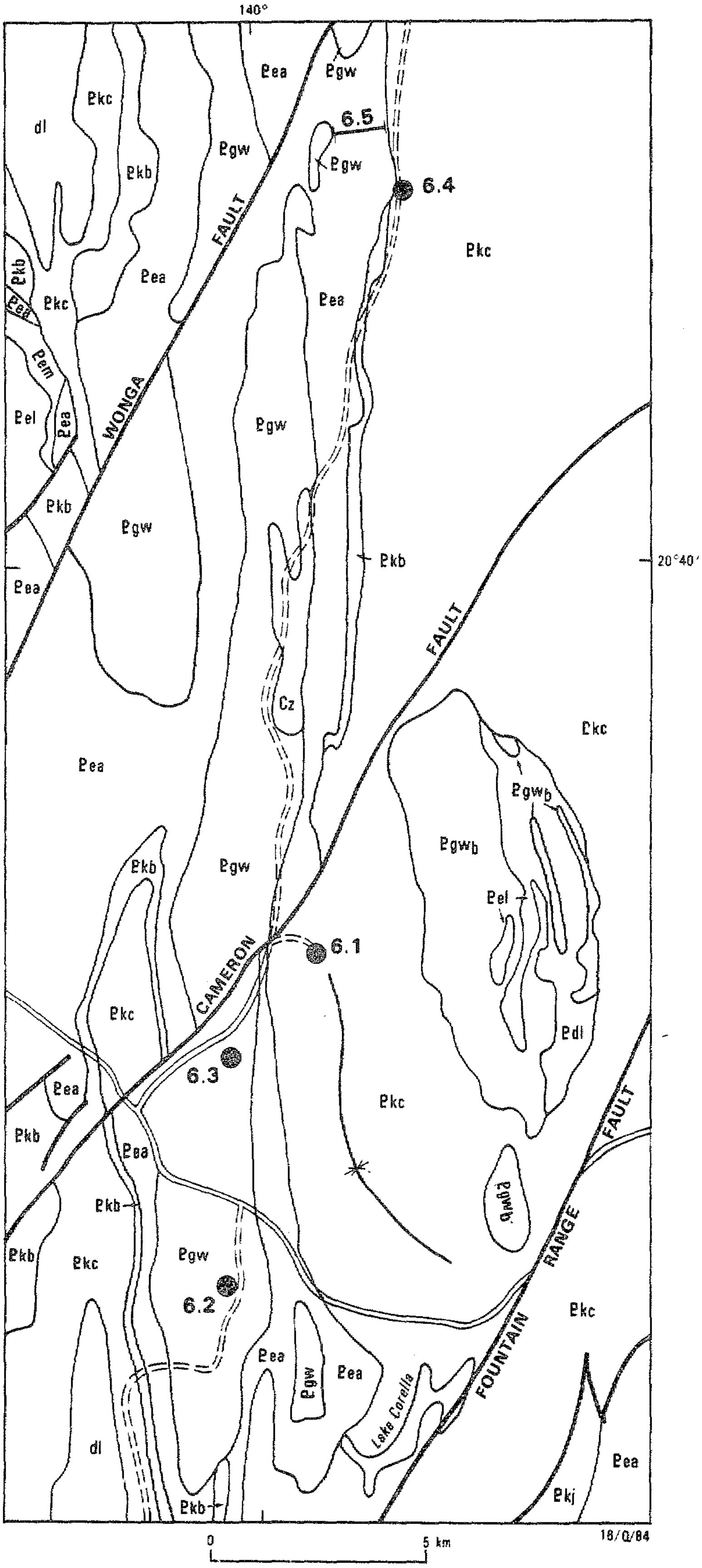


Fig 11 Part of the Wonga Belt, showing excursion stops for Day 6.
For key to letter symbols see Table 3.

63

been related to emplacement of nearby Burstall Granite (Pgw_b) rhyolite dykes, and Lunch Creek Gabbro (Pdl) of the Wonga Batholith at 1720-1740 Ma. The second phase was a lower temperature event, and resulted in the formation of uraniferous allanite-amphibole-apatite skarns; it was related to regional metamorphism at about 1550 Ma, and was the main uranium mineralisation event. There are also some cross-cutting and therefore younger veins of calcite + garnet skarn. In an alternative interpretation, Scott & Scott (1985) have suggested that the uranium mineralisation is syngenetic and related to basaltic volcanism accompanying deposition of the Corella Formation, therefore being much older than 1550 Ma.

Stop 6.2 (GR MK950975)

By the side of the track a south-plunging lineation is evident in strongly foliated, pink xenolithic and porphyritic granite, a typical phase of the Wonga Granite (Pgw) in the Wonga belt. 300 m to the west a variety of highly deformed rocks are well exposed in creek pavements. Here xenolithic granite, now an augen gneiss with mylonite streaks, and cross-cutting veins of foliated aplitic microgranite intrude finely banded quartzofeldspathic rocks which may represent felsic ignimbritic metavolcanics, arkosic metasediments, and flow-banded rhyolite of the Argylla Formation (Pea), and mylonitic granite. Several small amphibolite bodies, probably representing metadolerite dykes, have also been caught up in the deformation. Augen gneiss similar to that exposed at this locality has been dated at 1740 Ma. All the rocks show a strong subvertical north-trending foliation. At similar exposures of the Wonga belt to the north Holcombe & Fraser (1979) have measured finite ductile strains indicating 65-80% maximum shortening.

Stop 6.3 (GR MK950030)

Fine-grained phase of Wonga Granite which has been dated (U-Pb zircon) at 1670 Ma (Page, 1978). This granite has a prominent foliation, which is crenulated and cut by aplite and quartz veins showing tight minor folds.

Stop 6.4 (GR MA990230)

Several folding phases can be identified here in sillimanite-muscovite schist of the Corella Formation (Pkc) within the Wonga belt. The dominant foliation trends north and is subvertical. Doubly-plunging lineations are well displayed.

Stop 6.5 (GR MA990240-975240)

Traverse across part of the Wonga belt to examine relationships between and structures within gneissic granites and other felsic rocks. At the western end of the traverse foliated fine-grained leucogranite is seen to contain disoriented xenoliths of more strongly foliated porphyritic granite (augen gneiss) and it also cuts an older gneissic foliation, mylonitic shears, and quartz veins. At least two ages of granite intrusion are indicated, separated by a major deformation.

DAY 7, WEDNESDAY 21 AUGUST

Objective: To examine evidence in the Western Fold Belt north of Mount Isa for growth faults (Smith, 1969; Derrick, 1982), thrusts (Bell, 1983), and late normal faults displacing rocks of cover sequences 2 and 3; PROSPECTOR (PR), KENNEDY GAP (KG), and MARY KATHLEEN 1:100 000 sheet areas (Fig. 10).

Leader: Bill Perkins.

Stop 7.1 (GR PR455445)

Traverse across an east-west trending D_1 syncline in the Mount Isa Group (Pi, cover sequence 3) and a major thrust or normal fault northwards to the Eastern Creek Volcanics (Phe, cover sequence 2).

Stop 7.2 (GR KG430460)

Here the Eastern Creek Volcanics appear to overlie the Mount Isa Group in an anticlinal structure. Evidence for thrusting will be sought at both north-south and east-west trending contacts.

7.3 (GR PR500450)

Warrina Park Quartzite (Piw) the basal formation of the Mount Isa Group, is exposed alongside sandstone of the Eastern Creek Volcanics in a gorge. The contact may be a D_1 thrust or a younger fault.

Stop 7.4 (GR KG350350)

A roof thrust has been interpreted at this locality (Bell, 1983). Sandstone of the Eastern Creek Volcanics is in contact with either another (or the same) sandstone of the Eastern Creek Volcanics or a sliver of Mount Isa Group (Warrina Park Quartzite?).

Stop 7.5 (GR MK520230)

The Spillway Fault exposed here has been interpreted as a growth fault (Smith, 1969), a spoon fault (Dunnet, 1976), and a thrust ramp (Bell, 1983).

Stop 7.6 (GR MK520230)

D_1 fold in the Warrina Park Quartzite of the Mount Isa Group.

65

DAY 8, THURSDAY 22 AUGUST

Objective: To examine outcrops near Mount Isa (Fig. 10) showing sedimentological and structural features of the Mount Isa Group which have been considered indicative of growth faulting (Smith, 1969), rift sedimentation (Derrick, 1980), and post-depositional thrusting (Bell, 1983); MOUNT ISA (MI) and MARY KATHLEEN (MK) 1:100 000 sheet areas.

Leader: Bill Perkins

Stop 8.1 (GR MK480120)

At this locality there appears to be an unbroken sedimentary sequence from an unconformity at the base of the Surprise Creek Formation (Pr) up into the basal part (Warrina Park Quartzite) of the Mount Isa Group. These units belong to cover sequence 3 of the Western Fold Belt. An angular unconformity has been reported in places between the Surprise Creek Formation and Mount Isa Group (Derrick & others, 1980).

Stop 8.2 (GR MA460130)

Sediments which may belong to either the Surprise Creek Formation or Mount Isa Group show marked facies changes towards the Moondarra Fault, indicating that this fault may have been active during sedimentation.

Stop 8.3 (GR MK450100)

The Mount Isa Group here lies unconformably on the Lena Quartzite Member of the Eastern Creek Volcanics (cover sequence 2). The erosional contact may be attributed to the effects of growth faults or to the development of the Mount Gordon Arch of Derrick (1982).

Stop 8.4 (GR MI420090)

The lower part of the Urquhart Shale, Mount Isa Group, is exposed in a road cutting. Siltstones show parallel laminations, and interbedded fine-grained sandstone is cross-bedded. An S_2 cleavage is folded about a D_3 fold. The Urquhart Shale, which is the ore-bearing formation at the Mount Isa Ag-Pb-Zn mine, has been interpreted as both a deep water and a shallow water deposit.

Stop 8.5 (GR MI410050)

Upper part of the Mount Isa Group showing evidence of shallow water deposition. Stromatolites, trough cross-bedding, halite casts, and flat-pebble conglomerates are present.

Stop 8.6 (GR MI425190)

Exposure of the Transmitter Fault. This fault has been interpreted as a fault which was active during Mount Isa Group sedimentation and also as a post-D_2 fault.

REFERENCES

BELL, T.H., 1983 - Thrusting and duplex formation at Mount Isa, Queensland, Australia. Nature, 304, 493-497.

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., 1981 - Intrusive felsic-mafic net-veined complexes in north Queensland. BMR Journal of Australian Geology & Geophysics, 6, 95-99.

BLAKE, D.H., 1982 - A review of the Corella Formation, Mount Isa Inlier, Queensland. BMR Journal of Australian Geology & Geophysics, 7, 113-118.

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

BLAKE, D.H., BULTITUDE, R.J., & DONCHAK, P.J.T., 1982 - Dajarra Queensland. Bureau of Mineral Resources, Australia, 1:100 00 Geological Map Commentary.

BLAKE, D.H., JAQUES, A.L., & DONCHAK, P.J.T., 1983 - Selwyn region, Queensland. Bureau of Mineral Resources, Australia, 1:100 000 Geological Map Commentary.

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.

BLANCHARD, R., & HALL, G., 1942 - Rock deformation and mineralization at Mount Isa. Proceedings of the Australasian Institute of Mining and Metallurgy, 125, 1-60.

BMR, 1978 - Mount Isa, Queensland - 1:100 000 Geological Series, Sheet 6756. Bureau of Mineral Resources, Australia.

BMR, 1979 - Prospector, Queensland - 1:100 000 Geological Series, Sheet 6857. Bureau of Mineral Resources, Australia.

BMR, 1980 - Kennedy Gap, Queensland - 1:100 000 Geological Series, Sheet 6757. Bureau of Mineral Resources, Australia.

BMR, 1982 - Alsace, Queensland - 1:100 000 Geological Series, Sheet 6858. Bureau of Mineral Resources, Australia.

BMR, 1985 - Nappe tectonics in the Mount Isa Inlier. Bureau of Mineral Resources Research Newsletter, 2, 11.

BULTITUDE, R.J., 1982 - Ardmore, Queensland. Bureau of Mineral Resources, Australia, 1:100 000 Map Commentary.

BULTITUDE, R.J., & WYBORN, L.A.I., 1982 - Distribution and geochemistry of volcanic rocks in the Duchess-Urandangi region. BMR Journal of Australian Geology & Geophysics, 7, 99-112.

BULTITUDE, R.J., BLAKE, D.H., MOCK, C.M., & DONCHAK, P.J.T., 1982 - Duchess region, Queensland. Bureau of Mineral Resources, Australia, 1:100 000 Geological Map Commentary.

CARTER, E.K., BROOKS, J.H., & WALKER, K.R., 1961 - The Precambrian mineral belt of north-western Queensland. Bureau of Mineral Resources, Australia, Bulletin, 61.

COLLINS, W.J., BEAMS, S.D., WHITE, A.J., & CHAPPELL, B.W., 1982 - Nature and origin of A-type granites with particular reference to southeastern Australia. Contributions to Mineralogy and Petrology, 80, 189-200.

DAY, R.W., WHITAKER, W.G., MURRAY, C.G., WILSON, I.H., & GRIMES, K.G., 1983 - Queensland geology. A companion volume to the 1:2 500 000 scale geological map (1975). Geological Survey of Queensland, Publication, 383.

DERRICK, G.M., 1977 - Metasomatic history and origin of uranium mineralization at Mary Kathleen, northwest Queensland. BMR Journal of Australian Geology and Geophysics, 2, 123-130.

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

DERRICK, G.M., 1982 - A Proterozoic rift zone at Mount Isa, Queensland, and implications for mineralisation. BMR Journal of Australian Geology & Geophysics, 7, 81-92.

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.

DERRICK, G.M., WILSON, I.H., & SWEET, I.P., 1980 - The Quilalar and Surprise Creek Formations - New Proterozoic units from the Mount Isa Inlier: their regional sedimentology and application to regional correlation. BMR Journal of Australian Geology & Geophysics, 5, 215-223.

DONCHAK, P.J.T., BLAKE, D.H., JAQUES, A.L., & NOON, T.A., 1983 - Kuridala region, Queensland. Bureau of Mineral Resources, Australia, 1:100 000 Geological Map Commentary.

DUNNET, D., 1976 - Some aspects of the Panantarctic cratonic margin in Australia. Philosophical Transactions of the Royal Society of London, A 280, 641-654.

ELLIS, D.J., & WYBORN, L.A.I., 1984 - Petrology and geochemistry of Proterozoic dolerites from the Mount Isa Inlier. MBR Journal of Australian Geology & Geophysics, 9, 19-32.

GLIKSON, A.Y., & DERRICK, G.M., 1978 - Geology and geochemistry of Middle Proterozoic basic volcanic belts, Mount Isa/Cloncurry, northwestern Queensland. Bureau of Mineral Resources, Australia, Record, 1978/48.

GLIKSON, A.Y., DERRICK, G.M., WILSON, I.H., & HILL, R.M., 1976 - Tectonic evolution and crustal setting of the middle Proterozoic Leichhardt River fault trough, Mount Isa region, northwestern Queensland. BMR Journal of Australian Geology & Geophysics, 1, 115-129.

HOLCOMBE, R.J., & FRASER, S.J., 1979 - Structural and stratigraphic problems of the Argylla Formation near Mary Kathleen, Queensland. Journal of the Geological Society of Australia, 26, 419-434.

HUTTON, L.J., & WILSON, I.H., 1984 - Mount Oxide region, Queensland. Bureau of Mineral Resources, Australia, 1:100 000 Geological Map Commentary.

HUTTON, L.J., & WILSON, I.H., in preparation - Mammoth Mines region, Queensland. Bureau of Mineral Resources, Australia, 1:100 000 Geological Map Commentary.

LOOSVELD, R., & SCHREUES, G., 1985 - Structural reconnaissance of the northeastern part of the Mary Kathleen 1:100 000 Sheet, Mount Isa Inlier, Queensland. Bureau of Mineral Resources, Australia, Record.

PAGE, R.W., 1978 - Response of U-Pb zircon and Rb-Sr total rock and mineral systems to low-grade regional metamorphism in Proterozoic igneous rocks, Mount Isa, Australia. Journal of the Geological Society of Australia, 25, 141-164.

PAGE, R.W., 1983a - Timing of superposed volcanism in the Proterozoic Mount Isa Inlier, Australia. Precambrian Research, 21, 223-245.

PAGE, R.W., 1983b - Chronology of magmatism, skarn formation and uranium mineralization, Mary Kathleen, Queensland, Australia. Economic Geology, 78, 838-853.

70

SCOTT, A.K., & SCOTT, A.G., 1985 - Geology and genesis of uranium-rare earth deposits at Mary Kathleen, northwest Queensland. Bulletin and Proceedings of the Australasian Institute of Mining and Metallurgy, 290, 78-89

SMITH, W.D., 1969 - Penecontemporaneous faulting and its likely significance in relation to Mount Isa ore deposition. Geological Society of Australia - Special Publication, 2, 225-235.

SWEET, I.P., & HUTTON, L.J., 1982 - Lawn Hill region, Queensland. Bureau of Mineral Resources, Australia, 1:100 000 Geological Map Commentary.

TOWSEY, C.A.J., & PATTERSON, D.F., 1984 - Tin exploration at Mount Isa - a case history. Journal of Geochemical Exploration, 22, 71-82.

WILSON, I.H., 1978 - Volcanism on a Proterozoic continental margin in northwestern Queensland. Precambrian Research, 7, 205-235.

WILSON, I.H., 1983 - Geochemical discrimination of acid volcanic units in the Mount Isa region, Queensland. BMR Journal of Australian Geology & Geophysics, 8, 109-117.

WILSON, I.H., & GRIMES, K.G., 1984 - Myally, Queensland. Bureau of Mineral Resources, Australia, 1:100 000 Geological Map Commentary.

WILSON, I.H., & GRIMES, K.G., in preparation (a)- Quamby, Queensland. Bureau of Mineral Resources, Australia, 1:100 000 Geological Map Commentary.

WILSON, I.H., & GRIMES, K.G., in preparation (b) - Coolullah, Queensland. Bureau of Mineral Resources, Australia, 1:100 000 Geological Map Commentary.

WILSON, I.H., GRIMES, K.G., & RYBURN, R.J., in preparation - Cloncurry, Queensland. Bureau of Mineral Resources, Australia, 1:100 000 Geological Map Commentary.

WYBORN, L.A.I., in preparation - Compilation of BMR geochemical anlayses of rocks from the Mount Isa Inlier. Bureau of Mineral Resources, Australia, Report.

WYBORN, L.A.I., & PAGE, R.W., 1983 - The Proterozoic Kalkadoon and Ewen Batholiths, Mount Isa Inlier, Queensland: source, chemistry, age, and metamorphism. BMR Journal of Australian Geology & Geophysics, 8, 51-69.

72