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GEOLOGY OF THE TULLAH – MT BLOCK AREA

TASMANIA DEPARTMENT OF MINES

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MT READ VOLCANICS PROJECT GEOLOGICAL REPORT 2

Geology of the Tullah – Mt Block area

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INTRODUCTION

Scope of study

This report summarises the geology of the Tullah-Mt Block area, which constitutes the eastern portion of the 1:25 000 scale Rosebery-Mt Block map sheet (Mt Read Volcanics Project Map 2; Corbett and McNeill, 1986). A full report on this sheet will be published at a later date. A simplified geological map is given as Figure 1, but the report should preferably be read in conjunction with the original Map 2. A locality map for samples referred to in the text is given as Figure 2 (in pocket).

Geological mapping of the area was conducted by A.W. McNeill from January to May 1986, using 1:10 000 scale contoured base maps and colour air photos. Major aims of the study included examination of stratigraphic and structural relationships within the Central Volcanic Complex and between these rocks and the volcano-sedimentary sequence of the Que-Hellyer area, and the clarification of the nature and possible northern continuation of the Henty Fault Zone. The report has been prepared mainly from notes written by A.W. McNeill, with the addition of a new section on geochemistry by K.D. Corbett.

Access in the southern part of the area is good, being for the most part on roads and tracks associated with HEC construction near Tullah. Mt Block, however, is covered by thick horizontal scrub and associated rainforest, and has poor access mostly on cut lines and creeks. Exposure is generally poor, especially in the Farm Creek and Murchison-Mackintosh valleys, where Pleistocene glacial deposits (dominantly the Boco Till and Outwash of Augustinus and Colhoun, 1986), form a blanket of highly variable thickness.

Previous literature

Regional mapping (Barton et al., 1966; Collins, 1981), smaller scale projects (Brooks, 1962; McKibben, 1968; Anderson, 1972; Rivers, 1975; Polya, 1981), and HEC investigations (Patterson et al., 1979), have for the most part been centred on the Tullah area. Apart from reconnaissance mapping (Collins, 1981), little published data relates to the Mt Block area, however, unpublished exploration reports (Young, 1977; Hall, 1979; Shaw and Everett, 1985) yield some information. The literature on mineralisation in the Farrell Slates, worked since 1899, has been summarised by Collins et al. (1981) and Brooks (1962).

Nomenclature

Lithological nomenclature used in this report follows that of Corbett (1979) i.e. basalt (<53% SiO_2), andesite (53–63%), dacite (63–69%), rhyodacite (69–73%), rhyolite (>73%).

The term 'tuff' is used for pyroclastic rocks composed dominantly of fragments <4 mm in diameter, and 'agglomerate' for rocks with >30% of clasts over 4 mm in diameter. Ignimbrites are lithologies that have evidence of deposition from hot ash flows, whilst block-and-ash flows are rocks composed of non- to poorly-vesicular lithic fragments in an ash matrix (Busby-Spera, 1986).

CAMBRIAN ROCKS WEST OF THE HENTY FAULT

The Central Volcanic Complex

Central Volcanic Complex rocks form a virtually continuous belt from Mt Darwin, in the south, to the vicinity of Mt Charter. The paucity of shales and epiclastics, the abundance of ignimbrite-like flows, and the generally feldspar-phyric nature of this sequence, are characteristic (Corbett and Lees,

1986). Throughout the sequence, basaltic rocks are rare and occur mostly as dykes (Corbett 1981).

For the purpose of this report the Central Complex may be subdivided into the Tullah-Mt Block and Pieman Road areas, based on lithological association, mineralogy and alteration. The contact between these two areas occurs in the glacial covered valley of Farm Creek, but cleavage development and chlorite-sericite alteration on either side of the valley suggest the presence of a fault.

TULLAH–MT BLOCK SEQUENCE

Mt Block

The youngest units of the CVC, comprising ignimbritic tuff, vitric tuff and felsic lava, crop out on Bulgobac Hill, Mt Block and in the valley of Animal Creek.

The lavas are generally massive, except on Bulgobac Hill where flow banding is obvious on weathered surfaces. Sample A200 is typical of these lavas (A279, A276, A301, A402, A403). This pink-purple aphanitic rock is smooth weathering and leaches to a light tan colour. Pink feldspar crystals, irregular chlorite patches less than 2 mm in diameter, and scattered quartz phenocrysts, were noted in hand specimen. In thin section, a snowflake texture is well developed, and irregularly shaped quartz + chlorite filled vesicles are common. Plagioclase may be distinctly zoned, and occurs as single phenocrysts or glomerocrysts, with slight chlorite-sericite alteration. Myrmekitic intergrowth of plagioclase and quartz occurs in sample A403. Feldspar dominates the phenocryst assemblage, with lesser quartz (16% in A200 to 30% in A276 of phenocrysts), and very minor chloritised biotite(?). An alternation, on a scale of 10–15 mm, of pink and green, chlorite and feldspar rich, lava (A280) is found in restricted areas. Other green lavas (A199, A383, A268) would appear to differ in the degree and type of devitrification texture, but are chemically and mineralogically similar to A200. Chemical analyses (A200, A268, A280, A399) indicate that these lavas are rhyolites and dacites, with high potash (>5% K_2O) content.

East of the Murchison Highway and north of Animal Creek is a dark grey-green vitric tuff (A321A) containing some chloritic fiamme (?), lithics of vitric tuff, and disseminated pyrite. Angular to sub-rounded quartz crystals and heavily altered feldspar are set in a turbid brown glassy matrix with many partially welded glass shards showing axiolitic devitrification. Vitric tuff, with minor interbedded feldspar-quartz-phyric, partially welded, ignimbrite-like units (A217), crops out on the eastern slopes of Mt Block. The vitric tuff (A353, A261) is a conchoidally fractured, green-grey glassy rock containing broken feldspar and quartz crystals and devitrified shards.

Two major ignimbrite units crop out in Animal Creek and on the transmission line tracks to the north. At CP861889, a feldspar-phyric ignimbrite, containing felsic lithics up to 30 mm in diameter, grades south into a block-and-ash flow with angular pink dacite lava clasts up to 250 mm in diameter. To the north, lithics are uncommon in the feldspar and minor quartz-phyric welded ignimbrite (A285, A352) of this unit. A thin (<10 m), but laterally continuous dark green to grey vitric tuff overlies the ignimbrite to the west, and may be a co-ignimbrite ash fall. At CP867856, a block-and-ash flow, containing clasts of perlitically cracked feldspar-quartz-phyric lava, in a matrix of welded feldspar-phyric fragments (A266), is interbedded with devitrified feldspar-phyric ignimbrite (A274) and lithic-crystal tuff (A267). It is thought that this unit is continuous with a partially welded ignimbrite, containing feldspar-phyric lava clasts, on the eastern slopes of Mt Block (A259, A262).

The massive nature of the lavas described above, and the lack of interbedded sediments, suggest that this sequence was

SIMPLIFIED GEOLOGY OF THE TULLAH - MT BLOCK AREA

SCALE
0   1   2km

geological boundary
fault approximate
fault — inferred or concealed
bedding, facing known
bedding, facing unknown
fold axis with plunge

Henty Fault Zone

LEGEND

DEVONIAN—RECENT
Dominantly Pleistocene glacial deposits

CAMBRIAN—ORDOVICIAN
Owen Conglomerate

CAMBRIAN
Dundas Group
Dominantly sediments— greywacke, siltstone
Felsic tuff and basaltic — andesitic volcanics
Central Volcanic Complex
Farrell Slates
Murchison Volcanics

Intrusives
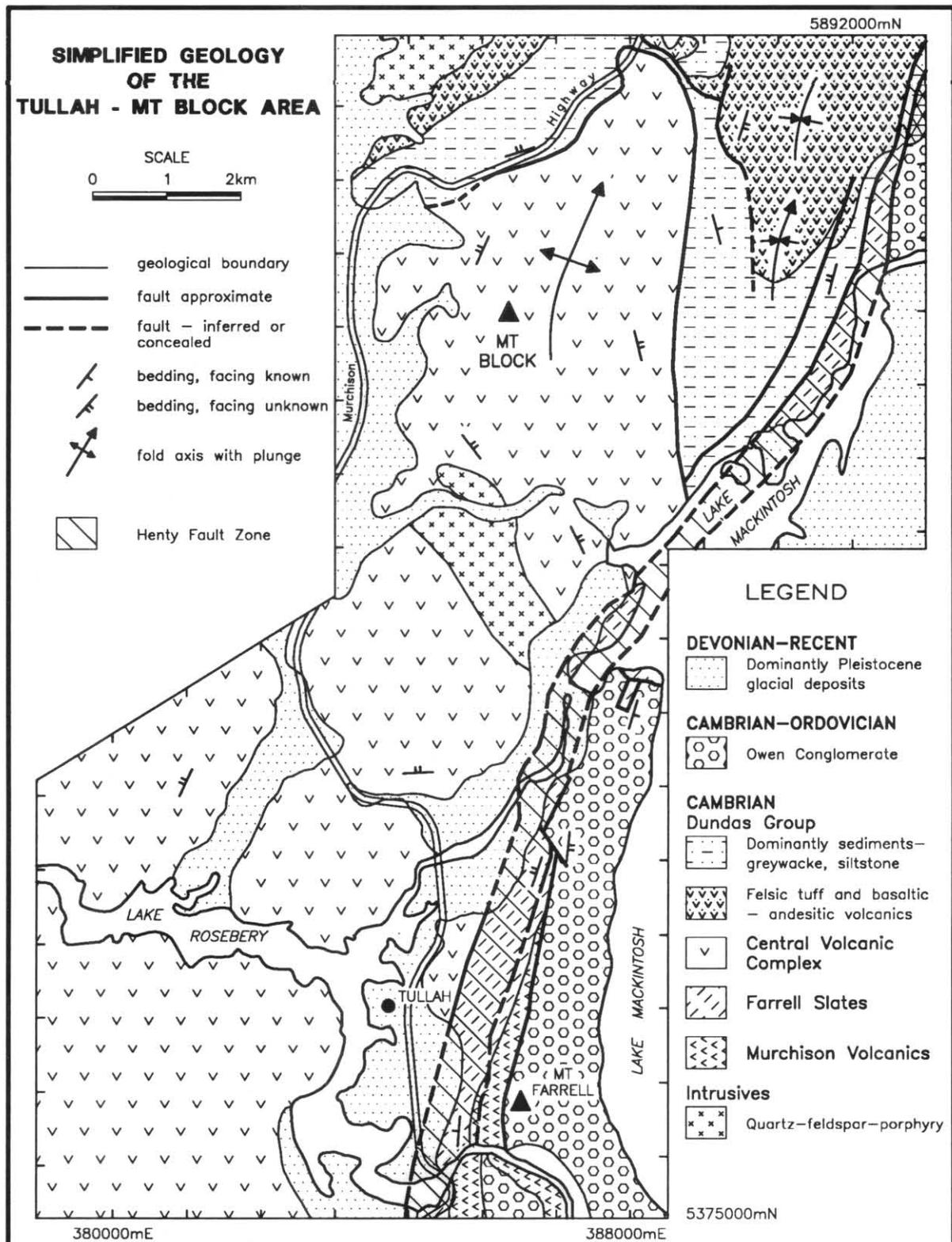Quartz—feldspar—porphyry

Figure 1. Simplified geological map of the Tullah–Mt Block area. (After Corbett and McNeill (1986) and Komyshan (1986a)

5 cm

erupted in a subaerial environment. Apparent abrupt termination of thick ignimbrite units near Animal Creek, and the flow-banded nature of lavas in this area, suggest that Bulgobac Hill may represent a rhyolite dome or cryptodome.

South Mt Block.

Directly underlying the massive rhyolitic lava on the Mt Block access track is a feldspar-quartz-phyric ignimbrite showing extensive chlorite-epidote alteration. Fiamme, up to 60 mm long, are visible in hand specimen. Exposure below the track is extremely poor but, in the upper reaches of Farm Creek, a partially welded pumiceous rock (A245), containing a few altered feldspar phenocrysts in a highly recrystallised matrix, was collected. Similar lithologies have been sampled from the creek at CP857871, where the sequence is dominated by ignimbritic tuff with minor feldspar-phyric dacitic lava (A399). The tuff (A397) generally contains feldspar phenocrysts in a matrix of recrystallised pumice fragments that appear to be unwelded and uncompacted. Shard shapes were noted in the matrix, whilst primary quartz is absent.

The upper reaches of Farm Creek are also dominated by tuffaceous lithologies. A thick sequence of feldspar-phyric crystal-vitric tuff and massive vitric tuff underlies the ignimbrite (A245). Two shale lenses (<2 m thick) occur within the vitric tuff, and are separated by a feldspar- phyric ashy tuff (A244), containing rounded clasts of shale up to 30 mm in diameter. The tuff has irregular disrupted contacts with the shale and both lithologies are strongly pyritised, with up to 4–5% disseminated pyrite. The main vitric tuff sequence is underlain by a sequence of lithic-crystal tuff and agglomerate, with vitric tuff interbedded. The homogeneity of the feldspar-phyric, spherulitic lava clasts in specimen (A241), described in the field as an agglomerate, suggest it may be a lava breccia. Very minor primary quartz was noted in this succession, e.g. A239, and the majority of tuffs have a fine-grained vitriclastic matrix, often with wispy chloritic fiamme. The basal unit of this tuff sequence is a vitric tuff containing minor aphanitic felsic lava (A237B), however, the proportion of lava may be underestimated due to its fine-grained aphanitic nature.

Further down Farm Creek, and on several HEC investigation tracks, are outcrops of plagioclase-phyric vesicular (vesicles filled with quartz + chlorite ± epidote) lava with a spherulitic to snowflake-textured groundmass that may be strongly altered (A236, A177). A compacted, but apparently unwelded, feldspar-quartz- phyric ignimbrite underlies the lava and contains perlitically cracked lava clasts (A171).

On the cliffs above Tullabardine Creek [CP865855], feldspar-phyric, vesicular, snowflake textured lava (A191), is overlain by agglomerate containing clasts of andesitic to rhyodacitic lava in a felspar rich matrix with possible fiamme. The overlying massive dark grey vesicular basalt(?) contains feldspar phenocrysts and glomerocrysts in a recrystallised quartzo-feldspathic matrix with fine feldspar laths. This lithology (A193) is identical to a more extensive flow-like unit (A91), occurring further south which was mapped as a basalt, but is chemically a dacite.

Poor access in the area north of Tullabardine Dam has prevented the establishment of a succession, but feldspar-phyric lithic-vitric tuff [CP881868] grading to agglomerate [CP878854], vitric tuff [CP879848] and dacitic lava [CP880849], were recorded.

Vesicular, feldspar-phyric dacitic lavas (A354, A129), with a mottled pink-green groundmass, crop out at Tullabardine Dam and are overlain to the west by volcaniclastics. Feldspar-quartz-phyric ignimbrite (A181, A185) contains lithics of vitric tuff and lava in a pumice and shard rich matrix. This grades south into tuff and epiclastics (A136, A157) that contain rounded clasts of vitric tuff and quartz-feldspar-

porphyry. The overlying felsic 'lava' appears, at least in part, to be a welded ignimbrite (A133).

Tullah–Murchison Highway.

South of Tullah, on the shores of Lake Rosebery, pink-purple feldspar-phyric dacitic lava (A306, A305) is interbedded with minor volcanogenic sandstone (A308) containing both quartz and feldspar crystal fragments. Further north, tuffs predominate with only minor autobrecciated, feldspar-phyric dacitic lava. These crystal-lithic tuffs (e.g. A299) contain lava and vitric tuff clasts but no apparent pumice. Fiamme were noted in the cleaved, sericitic feldspar-phyric tuff near the Tullah hotel, east of which are feldspar-phyric dacitic lavas (A400) similar to those at the Tullabardine Dam.

The lavas at Tullah are separated from the 'Mackintosh crystal tuff' (of Collins, 1981), to the west, by a fault zone containing sheared shard-rich volcaniclastics (A110). The Mackintosh 'crystal tuff' is now considered to be dominantly feldspar-hornblende-phyric lava with minor feldspar-phyric lava and ignimbrite (A19). The lava (A55, A71, A68, A295, MCT1, MCT3, BA2) is crystal-rich, with a dark green to brown groundmass which is discoloured by albite and epidote alteration, and has been recrystallised and perlitically cracked. Vesicles, where present, are filled by quartz + chlorite + epidote. Chemical analyses indicate that this lithology is an andesite-dacite.

On the cliffs north of the Murchison Highway, and overlying the lava described above, is a sequence of feldspar-phyric ignimbrite (A143, A145), vitric tuff (A148), crystal-lithic tuff (A168), and minor shale. The dark grey shale forms a lens, 4–5 m thick, that has irregular contacts with the enclosing tuffs. Bedding is defined by concentrations of pyrite grains, elongated parallel to S_1.

This volcaniclastic sequence is overlain by mottled pink-green feldspar-phyric dacite and rhyodacite lavas (A102, A103, A109) which are normally massive but may be flow banded (e.g. A108, A80). Feldspar-quartz-phyric lavas are rare and in some cases (A187, A189) may be intrusives, as contact relationships are not known. Other minor lava types include vesicular feldspar-hornblende-phyric dacite (A161), feldspar phyric andesite (A121), and dark grey vesicular dacite (A91), with possible pillow structures, that was mapped as a basalt.

Agglomerate is the most common pyroclastic type along the eastern side of the Murchison Highway, south of Tramway Creek, and three separate units have been defined. Collins (1981) has described a distinctive agglomerate at [CP839820], in which pink lava clasts, up to 0.4 m in diameter, are set in a fine-grained, green, feldspar-rich matrix (BA3) that resembles the Mackintosh crystal tuff (sic.).

Angular clasts of feldspar-phyric andesitic lava, with quartz+chlorite filled vesicles, predominate in a second agglomerate unit to the east (A95). These clasts are set in a matrix of finer lava clasts and recrystallised ash. To the south, the clast type changes to dominantly pink ?dacitic lava in a matrix as described above.

West of the Mackintosh Dam an agglomerate contains sericitic fiamme, feldspar crystals, felsic lava and vitric tuff clasts up to 60 mm in diameter, in a mottled green matrix. Although this unit appears to lens out, it may correlate with a much more extensive agglomerate unit to the west, which in places (A89), is dominated by pumice fragments, and in other places (A97), contains mostly cream-grey felsic lava clasts. These lava clasts may reach 0.35 m in length and appear to be of two varieties; a vesicular type with snowflake texture, and a perlitically cracked, chlorite altered type.

Feldspar-quartz-phyric lithic-crystal-tuff (A117) and feldspar-phyric vitric tuff (A115) crop out on the Murchison

Highway north of Tramway Creek, while feldspar-phyric pumice and lithic bearing vitric tuff (A92) and partially compacted ignimbrite (A100) occur in the hills to the east.

PIEMAN ROAD SEQUENCE

West of Farm Creek vesicular feldspar-phyric dacite (A204, A206) and flow-banded feldspar-phyric rhyolite (A26, A27, A12), are interbedded with minor feldspar-phyric crystal-vitric-tuff (A155) and block-and-ash flows.

The rhyolite contains coarse (up to 7 mm in diameter) plagioclase phenocrysts and glomerocrysts in a spherulitic to glassy groundmass. Vesicles are rare and are filled by quartz + carbonate, whilst weak chlorite and sericite alteration of feldspar is common. These lithologies lack the pink alteration, and have lower K_2O contents, than the Mt Block rhyolites.

Block-and-ash flows are spectacularly exposed at [CP800802] and vary from lithic-rich, with blocks up to 0.4 m diameter, in an ash and pumice rich matrix (A366, A186, A157), to feldspar-phyric ignimbrite containing scattered blocks of lava (A153). Coarse graded bedding on a scale of 2–3 m, is apparent at CP800802 and indicates an east facing. These individually small lenses may have been formed by collapse of a lava dome, either by gravitation or explosive force, and subsequent movement by plug flow (Busby-Spera, 1986).

INTRUSIVE ROCKS IN THE CENTRAL VOLCANIC COMPLEX

Three types of intrusive were recorded in the Central Volcanic Complex:

Quartz-feldspar-biotite porphyry

Two bodies of this pale pink to dark grey spherulitic rock were mapped, the largest being north-west of the Mackintosh Dam (A165, A173, A183) and the other occurring on the Pieman Road (A151). Euhedral, often embayed, quartz phenocrysts, up to 7 mm in diameter, dominate the phenocryst assemblage (40-60% of phenocrysts), whilst chloritised biotite is a relatively minor component (10-15%). Feldspars are dominantly plagioclase, often as glomerocrysts, with only minor K-feldspar. Clasts of similar porphyry occur in volcaniclastic rocks near Tullabardine Dam, and suggest that intrusion was contemporaneous with part of the volcanism.

Mafic feldspar-phyric dykes

These dark green to brown dykes are generally <5 m thick, and occur apparently randomly throughout the sequence. A groundmass of fine interlocking feldspar laths contains interstitial chlorite, Fe-oxides and minor quartz. Remnant augite crystals were noted in (A271), whilst rare phenocrystic plagioclase, altered to sericite and chlorite, occurs in A265 and A271. Rounded quartz and Fe-oxide filled structures in A265 may be vesicles.

Quartz microdiorite dykes

These dykes occur on the Pieman Road (A31, A15) and west of Tullabardine Dam (A775). In hand specimen they are relatively fresh, hard, fine-grained blue-green rocks with weathering features typical of dolerite.

A775 has an ophitic texture with laths of sericitised plagioclase and clinopyroxene (partially mantled by amphibole), interstitial quartz (approximately 10% of the specimen) and K-feldspar, sometimes as granophyric intergrowth. Skeletal opaques, apatite and minor zircon are the major accessories, whilst chlorite and epidote are the major alteration products.

A31 and A15 have a similar mineralogy but with pleochroic brown hornblende partially replaced by chlorite.

These dykes are mineralogically and chemically distinct from the the other mafic dykes described above, and the lack of cleavage and alteration suggest a post-Cambrian age of emplacement.

STRUCTURE IN THE CENTRAL VOLCANIC COMPLEX

The generally massive nature and poor outcrop of the Central Volcanic Complex has hindered structural analysis. However, sparse bedding, flow banding and eutaxitic foliation indicate a broad, open, N-plunging anticline in the Mt Block area and a possible syncline on the Pieman Road (fig. 4b–c). These folds parallel those in the Dundas Group and swing from north to NNE-trend north of the mapped area (Komyshan, 1986). Folding is considered to have occurred in the earlier phase of Devonian deformation (Williams, 1978).

The spread of data, in Figure 4, may be attributed to the rotation of eutaxitic foliation into cleavage and irregularities in flow banding which, although generally parallel to lithological trends may be highly contorted, e.g. at Bulgobac Hill. Complications in the Tullah area are probably related to the HFZ.

A single N-trending, W-dipping cleavage (fig. 4d) occurs throughout the Central Volcanic Complex. Adjacent to the HFZ this cleavage trends more NNE, parallel to the fault, but further to the west it has a northerly trend, related to Devonian folding.

No major faults were detected apart from the HFZ, but faults with large displacements may occur in the valleys of Farm Creek and Tullabardine Creek. Detailed structural analysis (Berry, 1989) on the Pieman Road, indicates several generations of minor faulting related to the HFZ.

Dundas Group correlates

STRATIGRAPHY AND PETROLOGY

Correlates of the Dundas Group (the western volcano-sedimentary sequence of Collins, 1981) have been mapped in a small area on the Murchison Highway (near Animal Creek), and in a large fault-bounded wedge north-east of Mt Block. The Animal Creek greywacke, as described by Collins (1981), forms part of the mixed volcanogenic and terrigenous clastic sequence, and is conformably overlain by felsic and basaltic volcanics forming the lower part of the Que-Hellyer Volcanics (Corbett and Komyshan, 1989).

In the eastern area, the sequence consists of four units, viz. lower greywacke, vitric tuff, upper micaceous greywacke and upper felsic tuff with minor lavas. The lower E-dipping sequence of greywacke, shale and vitric tuff occurs in a creek north of Tullabardine Creek, and similar lithologies are found north to [CP887878], where greywacke and shale are conformably overlain by a thick vitric tuff unit. These greywackes show a continuous variation from those composed of dominantly Precambrian detritus to those containing dominantly volcanogenic material (e.g. A338). Mixed provenance rocks (e.g. A212) predominate and are composed of quartz and feldspar crystals, up to 4 mm in diameter, with irregular chloritic and lithic clasts, in a dark blue-grey matrix of micaceous fine sand grade material. In thin section, lithics of schistose quartzite and quartz-rich pelite, with minor tourmaline, comprise the metamorphic detritus, while embayed quartz, altered plagioclase and feldspar-phyric chloritic 'fiamme' constitute the volcano-genic component. These clasts are contained within a partially recrystallised turbid brown ash matrix. Rafts of micaceous greywacke and shale, up to 100 mm long, occur in the volcanogenic greywacke.

The overlying massive green-grey vitric tuff (A356) is partially recrystallised and contains minor quartz and feldspar crystals, up to 0.08 mm in diameter. To the east, a tuff (A218) in the same stratigraphic position has been recrystallised to form rounded quartz and calcite ovoids. Quartz and feldspar crystals are coarser and more common in this sample.

Micaceous greywacke and shale, with minor tuffaceous greywacke, conformably overlie the vitric tuff, with little lateral variation between the HFZ and Murchison Highway, where they form part of the Animal Creek greywacke. These turbidites (A220, A232, A745) are composed almost exclusively of Precambrian metamorphic detritus, and have been described by Collins (1981). Quartz and sericite with minor tourmaline, opaques and chlorite are the major constituents of the interbedded siltstones and shales (A331, A344). In the Murchison Highway area these sediments are underlain, through a gradational boundary, by a dark grey vitric tuff (A325), a lateral equivalent of the thick vitric tuff unit to the east. This well-bedded tuff contains scattered quartz and feldspar crystals and is interbedded with massive, poorly sorted, matrix-supported, dark grey tuffaceous greywacke (A235). Quartz and feldspar crystals predominate in this latter lithology, whilst metamorphic quartz, muscovite and pumice fragments are common. These are set in a sericite-chlorite-altered ash matrix that contains some cuspate shards and disseminated sulphides. A similar lithology (A335) is found near the base of the micaceous greywacke in the eastern area at CP893881. The presence of sample A235, interpreted to be a mass flow deposit, and of slump structures in the vitric tuff (Collins 1981), suggest that the unit was deposited in a sub-aqueous environment.

The upper sequence of felsic tuff and minor lava crops out south-east of Mt Charter and extends to the north edge of the map sheet. This unit forms the lower part of the Que-Hellyer Volcanics as defined by Corbett and Komyshan (1989). The tuffs are generally plagioclase-rich (A314), with a partially recrystallised glassy matrix that contains some shards. Angular fragments of quartz and lithic clasts are minor components. Saussuritisation of feldspar, and chlorite alteration, are widespread. Interbedded with these tuffs are massive flows of light-pink to tan aphanitic lava, similar in appearance to Central Volcanic Complex lavas on Mt Block. In thin section these vary from spherulitic with minor sericitised feldspar phenocrysts (A312), to a vesicular feldspar-phyric type with partially recrystallised groundmass (A311).

Also occurring within the tuff is a unit of vesicular green to dark grey, plagioclase-clinopyroxene-phyric basalt lavas, some of which (A317, A318, A328) are auto- brecciated with a light grey cherty infilling. Vesicles form a well developed flow foliation in some flows (e.g. A317), and are filled with quartz, calcite and epidote. Basaltic crystal-lithic tuff and vitric tuff (A346) are interbedded with the flows, and indicate that the basalts dip to the west. Vesicles, autobrecciation and interbedded sediments are less common to the south, where lithologies have textures more in common with intrusive rocks. Sample (A334) contains clinopyroxene phenocrysts in a heavily altered ophitic feldspar-augite groundmass, and has previously been described as a dolerite (Young, 1977). This change from extrusive rock to probable intrusive to the south is consistent with mapping, which indicates that the basalt is transgressive from felsic tuff to the underlying greywacke.

The Dundas Group appears to overlie the CVC near Mt Block (fig. 3), as is the case elsewhere in the Mount Read Volcanics (Corbett, 1981). In a creek north of Tullabardine Creek, at CP888861, a cleaved vitric tuff marks a faulted contact with the CVC that may be traced to the north, roughly following linear terrain features. The CVC-Dundas Group contact is not exposed in the Murchison Highway area, but it would appear to be discordant. Komyshan (1986) has interpreted it to be a W-dipping fault, near Mt Charter. Faulting is considered to have occurred on an original unconformity surface. The Dundas Group correlate has a discordant contact with the HFZ, west of Lake Mackintosh, and this boundary is marked by weak cleavage development in greywackes.

STRUCTURE IN THE DUNDAS GROUP

A broad structural fold has been defined by the mapping, and bedding data (fig. 4a) indicates folding on a shallowly north plunging axis, with minor complications from faulting. Folding is considered to have occurred in the earlier phase of Devonian deformation. Cleavage development is generally
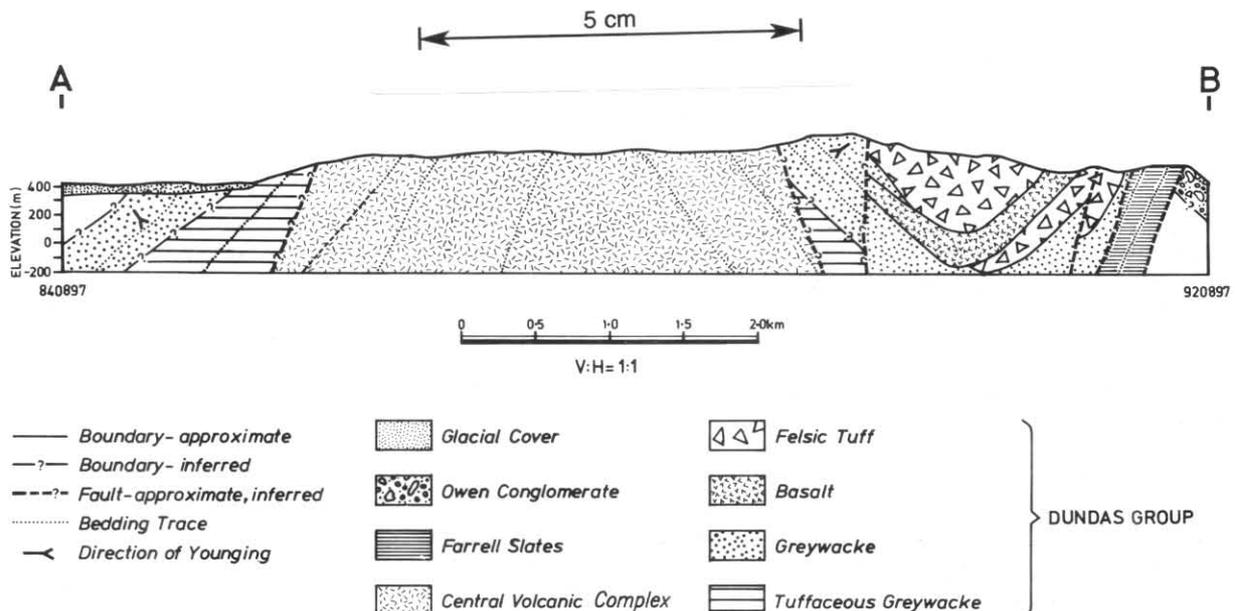
Figure 3. Geological cross-section north of Mt Block. (see fig. 2 for location)

5 cm
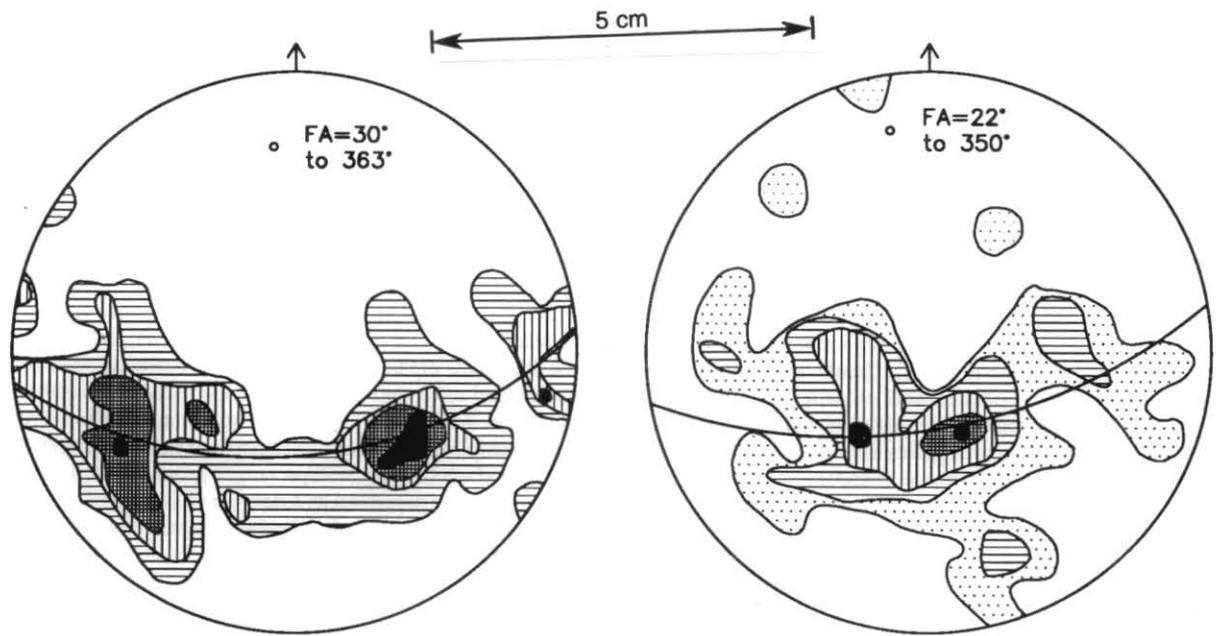
(a) Dundas Group bedding, 72 points

(b) Central Volcanic Complex bedding – Tullah-Mt Block, 68 points
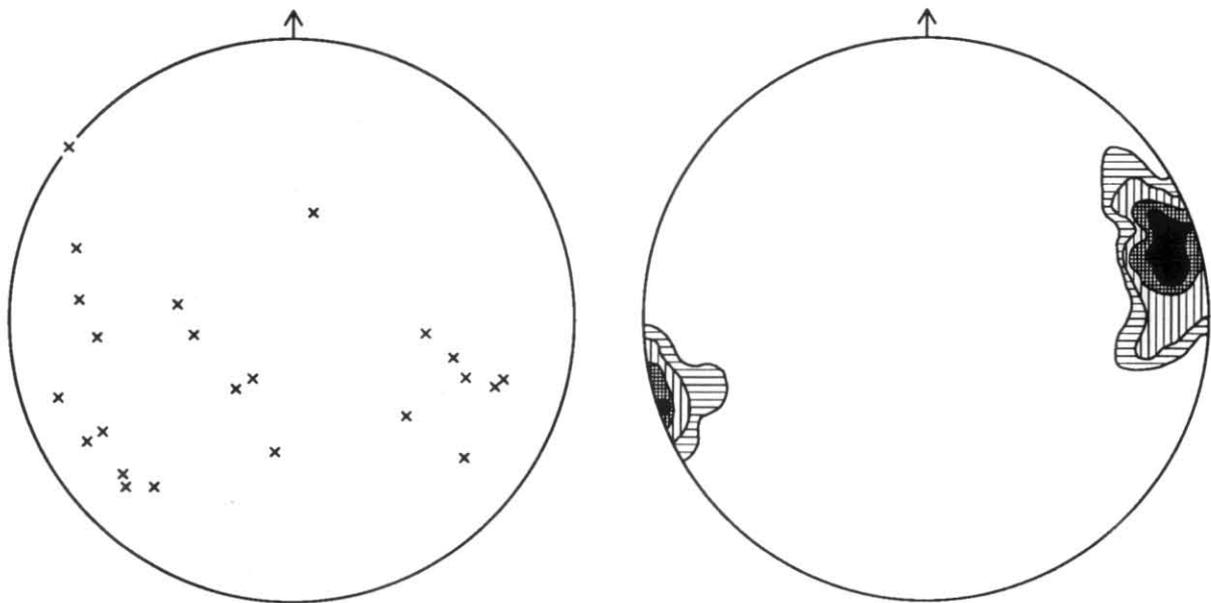
(c) Central Volcanic Complex bedding – Pieman Road, 23 points

(d) Central Volcanic Complex cleavage, 36 points

Figure 4. Stereographic plots of structural data

weak and normally associated with faulting. A ?W-dipping reverse fault, marked by strong cleavage development and disruption of bedding, parallels, and is probably related to, the HFZ.

CAMBRIAN ROCKS EAST OF THE HENTY FAULT

Farrell Slates

The Farrell Slates of Hills (1915), form a NNE-trending belt from south of the Sterling Valley mine to the northern end of Lake Mackintosh, where they abut Dundas Group sediments, the nature of this contact being unknown due to poor exposure. This sequence of shale, greywacke, tuff and minor lava, reaches a maximum thickness of about 850 m near Tullah, thinning both to the north and south.

Rivers (1975) compiled stratigraphic sections for the Farrell Slates from the Murchison and Mackintosh Rivers, and attempted, with some success, to correlate the two. However, these sections have been submerged by HEC impoundments and it was considered that exposure was insufficient and units too lensoidal to establish a detailed stratigraphic section. The Farrell Slates will therefore be described by lithological type.

Micaceous dark grey to brown greywacke, with a weak spaced cleavage, ranges from volcanic to dominantly metamorphic in provenance. Sample FC1 is dominated by sub-angular clasts of recrystallised fine-grained ?vitric tuff (>1 mm in diameter), with angular quartz crystal fragments and minor micaceous quartzite, graphitic phyllite and tourmaline grains set in a sericitic matrix. Angular clasts of phyllite, muscovite and quartzite, and lesser quartz-crystals, in a sericite and calcite rich matrix, with minor carbonate veining, characterise A379. The shales (A223, A360) are well bedded, ranging from coarse- to fine-grained siltstone, and in
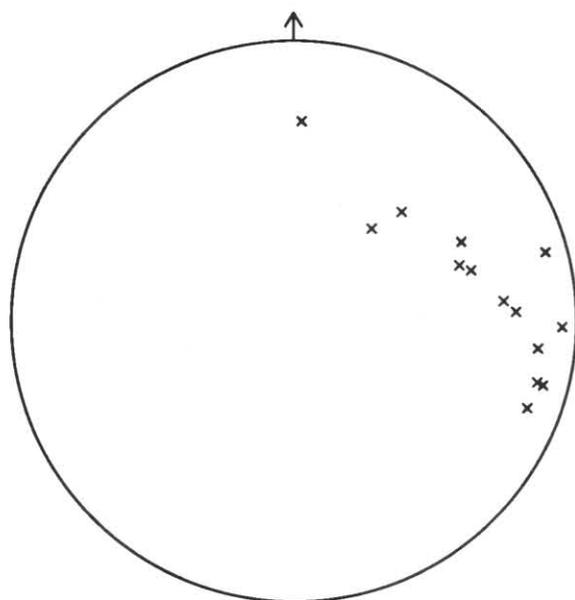
(e) Bedding in Farrell Slates, 14 points
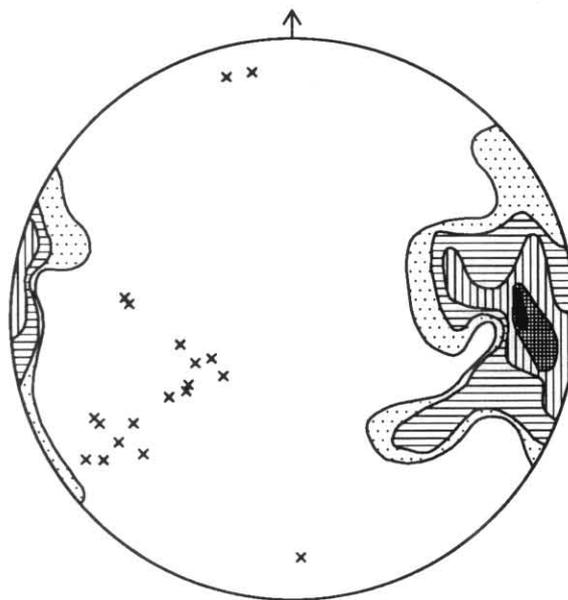
(f) Cleavage in Farrell Slates, 50 points. Extension lineation (x), 18 points.
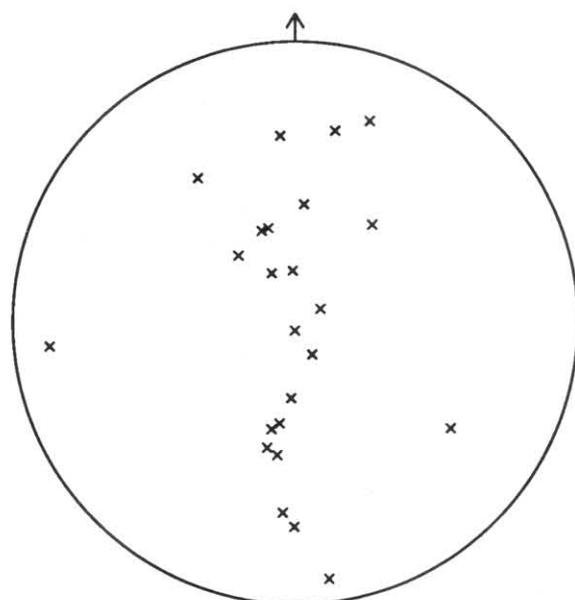
(g) Fold axes of kink style folds in Farrell Slates, 24 points
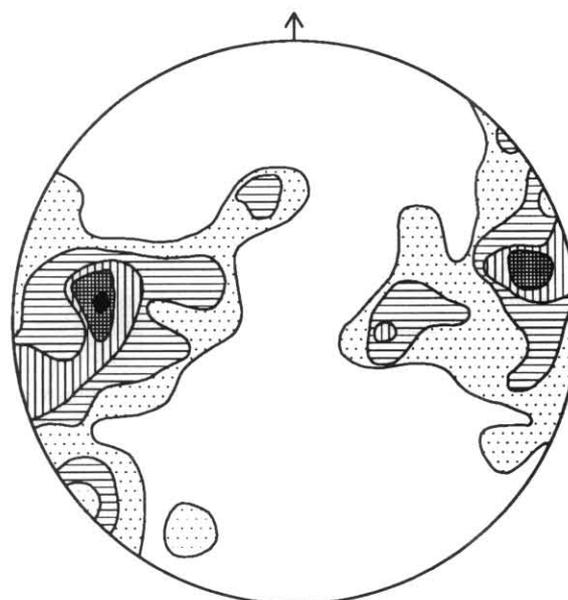
(h) Bedding in Owen Conglomerate, 89 points

Figure 4. Stereographic plots of structural data (continued)

5 cm
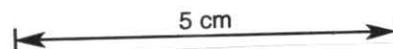
(A360) with a possible S-C fabric, cutting S_1 at 30°. They are composed dominantly of quartz, sericite, chlorite and opaque oxides, concentrations of which define bedding.

Volcaniclastic rocks are well exposed on the spillway of the Mackintosh Dam and in the creek to the south, where light pink to brown vitric tuff, containing shale rafts and chloritic 'fiamme', are interbedded with sand to conglomerate grade volcaniclastics and shale, on a scale of 0.5–0.8 m, and often have interfingering relationships. On the spillway itself, pale green-grey fine-grained vitric tuff and crystal-rich sandstone are dominant. Sample A393 is a vitric tuff with cuspate shards in a partially spherulitic matrix that supports quartz crystal fragments and recrystallised volcanic material. However, the majority of fine-grained volcaniclastic rocks are recrystallised and cleaved (A380, FC2, A784) but may contain clasts of sericitised feldspar and quartz-feldspar-phyric lava (A384A). Mylonites on the shore of Lake

Mackintosh (A254, A224) have been designated as volcaniclastic due to their high quartz crystal content and the presence of possible volcanogenic lithics.

Coarse volcaniclastics include quartz-feldspar-phyric lithic-crystal tuff, with clasts of perlitically cracked lava and quartz-feldspar-phyric volcanics in an opaque-studded fine-grained felsic matrix (A385), while A401 is crystal-rich, containing quartz, plagioclase and minor K-feldspar, with some intergrowth of quartz and plagioclase, in a finely recrystallised matrix.

South of the Mackintosh power station, on the western side of Lake Rosebery, is a sequence of well cleaved, feldspar-phyric pumiceous tuff (A394) with obvious chloritic and sericitic 'fiamme' in a felsic matrix, with angular perlitically cracked lava clasts. It is underlain by a low angle, brittle fault then a sub-ophitic, calcite-chlorite-quartz altered dyke (A395) and vitric tuff, typical of the Farrell Slates. It is

possible that the ignimbritic lithology is part of the CVC and the Henty Fault passes through the position occupied by the dykes. At CP870827, the Henty Fault may also be intruded by a mafic dyke, which separates vitric tuff, to the north-east, from pink dactic lava, typical of the CVC near Tullabardine dam.

Lava in the Farrell Slates is rare and only two occurrences are known. At CP865805 in DDH TP135, andesitic lava was recorded (J. G. Purvis, pers. comm.), while in the Spillway Creek at CP871827, a weakly sheared pink felspar-phyric, vesicular dacitic lava, with a snowflake textured groundmass and minor sericite and chlorite alteration (A383A), occurs in the dominantly volcaniclastic succession. It is fairly similar chemically to CVC lavas from near Tullabardine Dam, and it is unclear whether it is faulted into, or forms part of, the Farrell Slates.

Correlation of the Farrell Slates has been problematical. Some workers have correlated them with the Que River Shales (e.g. Young, 1977). They are lithologically similar to the basal part of the Dundas Group near Mt Block, but no definite correlation can be made.

Structure in the Farrell Slates and the Henty Fault Zone

Bedding in the Farrell Slates is generally sub-parallel to cleavage (fig. 4e–f) and has been folded into angular, tight to isoclinal, reclined folds and kink bands, with low-angle fold axes (fig. 4g). The wide range of fold axis orientation, and the style of folding, are common in ductile shear zones (Ramsay, 1980). These folds are concentrated near the Henty Fault, but may occur up to one kilometre east of the fault. One of the major features of the Farrell Slates is a penetrative, steeply W-dipping cleavage that may have an associated down-dip extensional lineation (fig. 4f) that produces a characteristic L-S fabric. Where folding is not obvious, a W-facing has been determined. However, interference of tectonic and sedimentary features may lead to confusing facing evidence (Brooks, 1962; Groves and Noldart, 1964).

The western boundary of the HFZ is not exposed; however, on the shore of Lake Rosebery a brecciated and silicified lava of the Central Complex (A305) lies within a few tens of metres of the Farrell Slates. Drill holes MRP227, MRP229, MP70 and MP70 (E.Z. Company) all intersect the fault. The intersections indicate that the fault is a W-dipping structure and is associated with brecciation, silicification, sericitisation, albitisation and carbonate alteration of the Central Complex volcanics up to 30 m from the fault. Quartz-carbonate and sulphide veining, with associated crenulation, occur in the Farrell Slates adjacent to the fault. The contact with Dundas Group sediments west of the northern part of Lake Mackintosh is marked by a sudden decrease in cleavage intensity and disappearance of kink-stype folds and mylonitic textures.

The apparent eastern boundary of the HFZ, where Farrell Slates are faulted against Owen Conglomerate, is exposed north-east of Tullah at CP870813 in a large rock face. Pebble conglomerate (?Middle Owen) is underlain by possible Jukes Conglomerate correlate in this area, and both lithologies are strongly quartz-veined. The moderately W-dipping face of the outcrop appears to be the fault plane, with patches of Farrell Slates on its irregular surface. The slate, shale and sandstone are strongly cleaved, with well-developed LS fabric, and brecciated in part.

Microtextures in sample (A224), from the western shore of Lake Mackintosh, indicate reverse motion for the Henty Fault, using the criteria of Simpson and Schmidt (1983), while shear fibre veins at CP870813 indicate oblique to dip-slip reverse motion. Striae in the Murchison Gorge suggest later oblique normal motion.

Studies of brittle deformation (Berry, 1986, 1989) have indicated a five-phase history for the Henty Fault Zone: two early phases of reverse movement (one pre-Devonian folding and the other Devonian) followed by sinistral wrench faulting and further wrench faulting in the ?Triassic and normal faulting in the Tertiary. The early reverse phase is considered to involve a 'ramp' through the Owen Conglomerate followed by juxtaposition of Farrell Slates and Central Complex by the second phase. This model is an attractive solution for the structural complication on the Farrell Range, i.e. the Owen Conglomerate at Buttress Hill and the fault slice of Farrell Slates at Hanging Rock. However, it requires a fault separating Murchison Volcanics and Farrell Slates, a structure not obvious in the field. It also implies the presence of Owen Conglomerate west of the present Henty Fault, none of which is preserved.

The Murchison Volcanics

A sequence of quartz-feldspar-phyric lava and tuff, structurally underlying the Farrell Slates in the Murchison Gorge, was informally termed the Murchison Volcanics by Rivers (1975). Polya (1981) applied this name to all the volcanics between the Farrell Slates and the siliciclastic Sticht Range Beds, to the east.

Only those parts of the sequence exposed on the Murchison Dam road, west of the outcrop of Owen Conglomerate, and on the western slopes of Mt Farrell, have been studied, while descriptions of the remainder of the sequence have been summarised from Polya (1981).

Directly underlying the Farrell Slates at CP847762 is a well cleaved, pale grey quartz-feldspar-phyric volcaniclastic (A361) containing minor recrystallised volcanogenic lithics and shale clasts up to 30 mm in diameter. Sheared aphanitic green and purple sericitic tuff (A362), quartz-feldspar-phyric sericitic tuff (A363), and ignimbritic rock (A364), crop out to the east. The ignimbritic rock contains feldspar-phyric chloritic fiamme, quartz and feldspar crystals, and lithic fragments, in a fine-grained sericitic matrix. These rocks are underlain by dark pink-purple aphanitic lava containing scattered quartz phenocrysts (A367). The lava ranges from massive to autobrecciated, and it has been suggested that across-strike variation of autobreccia textures may indicate a sequence of flows (Polya, 1981). Interbedded with the lava is sheared quartz-phyric sericitic tuff and quartz-, sparsely feldspar-, phyric ignimbrite having a matrix similar in colour to that of the lava. Similar lithologies are exposed on the western flank of Mt Farrell where brecciated quartz-feldspar (sericitised and chloritised)-phyric spherulitic lava (A374) is interbedded with sheared quartz-phyric sericitic tuff (A381). Chemical analyses (Polya, 1981) indicate that the lavas are rhyodacitic and rhyolitic.

East of the lava on the Murchison Dam road, a unit of fine-grained sericitic tuff is faulted against a correlate of the Jukes Conglomerate. The Owen Conglomerate is underlain to the east by quartz-feldspar-phyric lava, pyroclastics and minor basaltic lava (Polya, 1981). The basal sequence of pyroclastics, slates and tuffaceous sandstone overlies the Sticht Range beds of Corbett (1981), which in turn unconformably overlies Precambrian basement.

The eastern part of the Murchison volcanics has been intruded by the Murchison granite, a sill like body dated at 524 ± 15Ma (Adams, et al. 1984).

The facing of the Murchison Volcanics and overlying Farrell Slates has been in doubt (Brooks, 1962, Groves and Noldart, 1964), due in part to a lack of bedding in the volcanics. A west facing in the Sticht Range beds was obtained by Polya (1981), and coupled with facings in the Farrell Slates (e.g. at CP846764), suggest the sequence is right way up and facing west.

Sericitic tuffs have developed a strong cleavage while the lavas have acted as competent bodies and have little cleavage development. Shearing of varying intensity is apparent throughout the sequence, with an increase in intensity to the west, accompanied by development of L-S fabric and low angle kink bands. The orientation and ductile nature, as evidenced by rotational textures around porphyroclasts, of this deformation indicate it was related to the HFZ.

Polya (1981) has suggested correlation of the Murchison Volcanics with Central Volcanic Complex rhyolites at Red Hills. However, the dominantly quartz-phyric nature of the volcanics and their relationship to the Sticht Range Beds, indicate that they may be Tyndall Group correlates.

GEOCHEMISTRY OF THE MT READ VOLCANICS

Introduction

Chemical analyses of major and trace elements of 22 rocks from the area are given in Table 1. The analyses have been re-calculated volatile-free to 100% for the purposes of comparison. Original major element analyses and locality notes are given in Appendix A. Sample localities are shown on Figure 2. A TiO_2/Zr vs Nb/Y discrimination diagram for the samples is shown as Figure 5.

Only a brief discussion of the chemical features of the Tullah–Mt Block samples is given here, pending a more complete review of geochemistry of the Mt Read Volcanics and associated intrusive rocks over the whole area of MRV Maps 2 and 3 (Corbett, in prep.).

The samples analysed comprise 14 lavas and three tuffs from the Central Volcanic Complex, a felsic lava from the Farrell Slates belt, a 'basalt' lava from the Que–Hellyer Volcanics, two 'diorite' intrusives and a quartz-feldspar porphyry intrusive from the Central Complex.

Lavas from the Central Volcanic Complex

The data in Table 1 and the discrimination plot (fig. 5) indicate that the 14 lavas from the CVC comprise nine dacites and five rhyolites. Two of the dacites (A161, A91) were mapped as basaltic or andesitic rocks in the field, but are clearly dacites in chemical terms. The two types plot as separate groups on the discrimination diagram, and are distinct in a number of chemical parameters. Note that both types occur in the Pieman Road area and in the Mt Block area, and chemical differences are not apparent between these two areas.

The dacites have silica values in the 66–69% range (average 67.6% SiO_2), while the rhyolites range between 74 and 76% (average 75.5%). $TiO2$ values for the dacites are in the 0.4-0.7% range (average 0.56%), while the rhyolites are consistent at around 0.24%. The dacites have consistently higher values than the rhyolites for Al_2O_3 (average 15.1% vs 12.8%), Fe_2O_3 (2.2 vs 0.7%), FeO (2.8 vs 1.4%), MgO (1.3 vs 0.4%), CaO (2.5 vs 0.8%), Na_2O (4.1 vs 2.4%) and P_2O_5 (0.14 vs 0.05%), but slightly lower potash values (average 3.6 vs 5.6% K_2O). Note that the two feldspar-hornblende-phyric lavas from the Mackintosh bridge area (MCT3, BA2) are similar to the other dacites except for slightly higher Fe_2O_3 and lower K_2O values. The rhyolites from the Mt Block area (A268, A280, A200) are notably potash rich, with 5.7–8.25% K_2O.

Within the trace elements, the dacites are notably higher than the rhyolites in strontium (176 vs 104 ppm average), cobalt (10 vs 6 ppm), vanadium (85 vs 11 ppm) and scandium (14 vs 11 ppm), but lower in rubidium (128 vs 180 ppm) and chromium (104 vs 140 ppm).

A clear difference is apparent in Ti/Zr ratios, the dacites ranging between 10 and 26 (average 16), and the rhyolites being consistently around 6.

Sample A161, a feldspar-hornblende-phyric lava from near the Murchison Highway, was originally mapped as an andesite but is chemically similar to the other dacites except for relatively low Sr and Zr values. It is the low Zr value (135 ppm vs 240 ppm average for dacites) which causes this sample to plot in the andesite field (fig. 5).

Felsic tuffs from the Central Volcanic Complex

One of the tuff samples (A180) is from a unit mapped as a feldspar-quartz-phyric ignimbrite near Tullabardine Creek. It is very similar in both major and trace element chemistry to the dacite lavas, and differs only in having higher strontium and lower vanadium values. Its Ti/Zr ratio is 15.

A vitric tuff or possible ignimbrite from south of Mt Block (A92) is virtually identical to the rhyolite lavas in its chemistry, including its trace element values and Ti/Zr ratio of 6.

By coincidence the third sample (A321B), from a thick unit of vitric tuff north-west of Mt Block, is almost exactly intermediate in its chemistry between the dacites and rhyolites, and has a Ti/Zr ratio of 11. It is apparently enriched in Sr, Nb and Ni compared to either group.

Farrell Slates lava

The felsic lava from the Spillway Creek at Mackintosh Dam (A383A) is rhyodacitic, with 72% SiO_2. It is intermediate in character between the dacites and rhyolites of the CVC (Ti/Zr ratio of 11), although generally closer to the dacites in its $TiO2$, Al_2O_3, Fe_2O_3, MgO, P_2O_5, Cr, V and Sc levels. It is strongly depleted in strontium compared to either group.

Basalt from Que-Hellyer Volcanics

The pyroxene-bearing 'basaltic' lava (A317) from the lower part of the Que–Hellyer Volcanics is andesitic in its silica content (62.8% SiO_2) and MgO level (2.3%). It is generally comparable with other andesites and basalts from the lower part of the Que–Hellyer Volcanics (Corbett and Komyshan, 1989) except for higher $TiO2$ (1.05% vs 0.55% average), lower MgO, lower Ni (5 ppm vs 73 ppm average), and very low Cr (90 ppm vs 370 ppm average). Its Ti/Zr ratio (43) is higher than those for most of the Que-Hellyer rocks (average values between 20 and 30).

Diorite intrusives

The two samples of pyroxene-bearing, ophitic-textured mafic dykes from the CVC (A775, A31) have silica values in the andesite range (58 and 59% SiO_2) and relatively low MgO contents (2.3, 3.3%). They are rich in $TiO2$ (1.2, 1.5%), FeO (8.7%), CaO (6.7, 5.1%) and P_2O_5 (0.25, 0.43%). Trace element levels are fairly similar to those of the Que–Hellyer andesite (A317) except for notably higher Zr levels, and consequently lower Ti/Zr ratios (28 and 26 vs 43).

A preliminary comparison with the more abundant tholeiitic mafic dykes which occur in the CVC (e.g. in Table 4.1 of Corbett and Solomon, 1989), particularly numbers 17 and 19 from the Chester and Boco areas) indicates that the 'diorites' have higher $SiO2$ values, higher $TiO2$, lower Al_2O_3, lower Sr, higher Nb and much higher Zr levels. Ti/Zr ratios for the tholeiitic dykes are greater than 50. These differences, and the fact that the 'diorites' plot well away from the general field of the tholeiitic dykes on the discrimination diagram (fig. 5), indicates that they belong to a different and probably unrelated suite. They may be related to several other examples of non-cleaved and relatively unaltered dykes in the

Table 1.
RE-CALCULATED CHEMICAL ANALYSES OF 22 ROCKS FROM THE TULLAH–MT BLOCK AREA

	CVC DACITES										CVC RHYOLITES						CVC TUFFS			FARRELL SLATES LAVA	QUE-HELLYER VOLCANICS	'DIORITE' INTRUSIVES		Q-F-PORPHYRY INTRUSIVE
	A161	A191	A305	MCT3	BA2	A400	A384	A206	A399	Av. values	A26	A27	A268	A280	A200	Av. values	A180	A92	A321B	A383A	A317	A775	A31	A165
SiO$_2$	66.31	67.52	66.00	66.07	67.45	67.53	68.89	69.10	69.64	67.61	74.69	75.03	75.82	75.59	76.19	75.46	69.26	77.70	71.77	72.16	62.77	58.04	59.06	76.76
TiO$_2$	0.59	0.70	0.59	0.57	0.54	0.64	0.50	0.42	0.46	0.56	0.25	0.23	0.23	0.25	0.25	0.24	0.61	0.22	0.47	0.43	1.05	1.22	1.52	0.28
Al$_2$O$_3$	15.11	15.24	15.38	15.50	15.25	15.66	14.80	14.29	14.81	15.12	13.71	13.23	12.09	12.54	12.56	12.83	14.78	12.05	13.66	14.95	15.84	15.29	14.90	12.90
Fe$_2$O$_3$	1.96	1.29	2.54	3.21	3.42	2.19	2.01	1.65	1.68	2.22	0.45	0.30	1.48	0.68	0.57	0.70	0.65	0.65	0.56	2.11	1.00	1.55	2.36	1.35
FeO	3.21	3.10	3.00	2.18	1.95	2.95	2.84	2.90	2.81	2.77	2.12	1.66	1.08	1.16	1.01	1.41	3.73	1.63	2.78	1.20	7.12	8.76	8.69	0.77
MnO	0.07	0.08	0.09	0.06	0.07	0.08	0.09	0.10	0.24	0.10	0.13	0.06	0.11	0.05	0.01	0.07	0.09	0.06	0.05	0.03	0.18	0.20	0.22	0.02
MgO	1.37	0.93	1.72	1.42	1.66	1.61	1.06	1.20	0.92	1.32	0.61	0.62	0.38	0.09	0.13	0.37	1.66	0.55	1.72	1.03	2.26	3.33	2.58	0.59
CaO	3.38	2.33	4.21	3.13	1.71	2.13	2.38	2.57	0.57	2.49	0.52	1.97	0.94	0.49	0.07	0.80	2.29	0.80	1.57	0.25	5.45	6.75	5.12	0.14
Na$_2$O	4.73	4.19	3.72	4.75	5.36	3.38	3.23	3.87	3.78	4.08	3.35	3.37	2.13	2.41	0.90	2.43	3.24	2.58	3.51	2.91	2.61	3.32	3.26	1.82
K$_2$O	3.14	4.44	2.60	2.95	2.45	3.71	4.06	3.77	4.98	3.57	4.13	3.46	5.69	6.69	8.25	5.64	3.52	3.70	3.79	4.81	1.47	1.81	1.86	5.34
P$_2$O$_5$	0.13	0.18	0.15	0.16	0.14	0.12	0.14	0.13	0.11	0.14	0.04	0.07	0.05	0.05	0.04	0.05	0.17	0.06	0.12	0.12	0.25	0.25	0.43	0.03
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	-	100.00	100.00	100.00	100.00	100.00	-	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
LOI	1.21	1.99	1.70	1.58	1.79	3.18	1.53	2.38	1.55	-	1.38	2.45	0.85	0.80	0.47	-	2.28	1.13	1.45	1.95	3.17	2.75	2.37	1.84
ppm																								
Ba	1650	1690	710	750	730	790	960	950	1150	1042	1010	920	1750	1300	1180	1230	1000	860	1050	1050	910	590	860	1450
Rb	140	110	86	105	87	185	155	130	150	128	155	125	165	210	240	180	175	185	210	175	56	57	77	160
Sr	42	125	270	220	195	125	260	190	160	176	90	93	175	86	77	104	370	120	230	17	320	450	390	73
Y	28	39	32	30	31	47	26	23	25	31	40	38	36	31	40	37	30	41	26	20	29	30	36	25
Nb	7	13	8	11	9	12	9	9	9	10	13	14	12	11	11	12	12	13	15	12	10	8	10	16
Zr	135	430	220	230	220	220	210	190	210	230	250	250	240	240	230	240	240	220	250	210	145	260	350	165
Co	11	<4	13	10	11	14	9	8	15	10	<4	5	8	8	5	6	4	5	12	4	17	27	15	<4
Ni	1	5	4	6	3	11	5	<3	10	6	5	4	3	8	5	5	7	4	25	5	5	6	4	6
Cr	110	85	87	120	88	83	120	115	125	104	115	93	155	180	155	140	110	88	145	98	90	86	74	65
V	66	<3	130	105	94	125	84	82	80	85	<3	<3	24	26	<3	11	42	<3	72	69	210	195	100	26
Sc	17	13	15	16	12	17	12	10	11	14	<10	<10	<10	<10	<10	<10	10	<10	11	13	28	27	27	<10
Cu	83	13	21	12	16	9	12	16	8	21	13	8	8	9	13	10	13	12	25	9	49	19	22	36
Pb	5	<4	13	28	15	6	6	5	5	11	<4	<4	6	6	<4	3	8	7	12	59	8	7	30	4
Zn	37	46	52	73	75	36	31	50	50	50	21	29	52	27	14	29	56	29	42	93	110	84	160	22
Ti/Zr	26	10	16	16	15	17	14	12	15	16	6	6	6	6	7	6	15	6	11	12	43	28	26	10
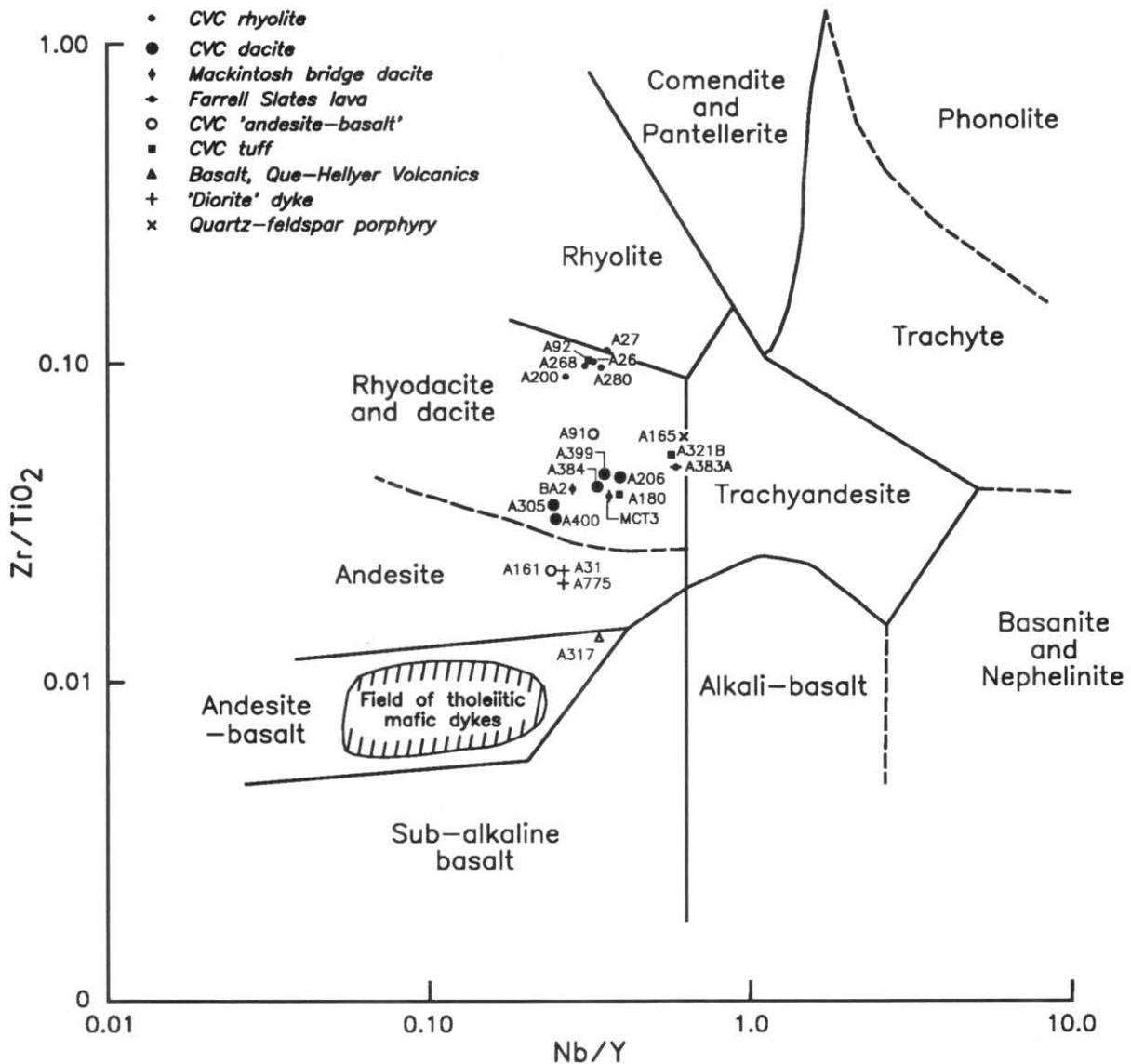
Figure 5. Discrimination diagram using Ti, Zr, Nb, Y; from Winchester and Floyd (1977).

5 cm
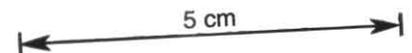
Rosebery–Bastyan Dam area (unpublished data of K.D.C).

Quartz-feldspar porphyry intrusive

The sample from the large porphyry body west of Tullabardine Dam (A165) is rhyolitic in composition (76.8% SiO_2), and fairly similar chemically to the CVC rhyolites. It differs in having lower Zr (165 vs 240) and Cr levels (65 vs 140), slightly lower Sr and Y, higher Nb (16 vs 12), and higher Ti/Zr ratio (10 vs 6 average). There is a close similarity with felsic porphyries from the Hellyer-Mt Charter area, particularly the large quartz-feldspar porphyry body in the Sock Creek area (Corbett and Komyshan, 1989).

DENISON GROUP OR OWEN CONGLOMERATE

Jukes Conglomerate correlate

Correlates of the volcaniclastic Jukes Conglomerate crop out in the Murchison Gorge (Brooks, 1962; Polya, 1981) and at the northern end of Lake Mackintosh. A lens of 'Jukes Breccia' mapped on the north-west flank of the Farrell Range by Brooks (1962) and Rivers (1975) is probably part of the Farrell Slates sequence.

In the bed of the Murchison Gorge, at CP863761, a quartz-phyric, fine-grained sericitic lithology with a purple matrix supporting sub-rounded clasts of volcanics, quartzite and hematitic sandstone, has been strongly sheared and is bounded to the west by a steeply dipping reverse fault. Reverse faults also disrupt the E-dipping boundary with the Owen Conglomerate. This contact is sharp and probably depositional. Shearing has destroyed bedding, but there appears to be at least two fining east sequences, on a scale of 5-6 m, implying an east facing, comparABLE with that in the Owen Conglomerate.

At CP915890, near the north end of Lake Mackintosh, a thin wedge of Jukes correlate is bounded by the HFZ to the west and conformably underlies Owen Conglomerate to the east. This dark red to purple sandstone (A251) contains volcanogenic detritus in a finely recrystallised, opaque-rich,

quartz-sericite-feldspar matrix. Extensive shearing, with shear fibre veins indicating both dip slip (reverse) and strike slip motion, has obliterated primary depositional features.

Siliciclastic Owen Conglomerate

The Owen Conglomerate occurs east of the HFZ, most notably on the Farrell Range and Little Farrell, with scattered outcrops east of the Murchison Dam. However, only the section from Hanging Rock to Lake Herbert on the Farrell Range was mapped in detail.

Massive, poorly bedded, siliciclastic boulder-pebble conglomerate forms the base of the sequence on the western side of the Farrell Range, and also crops out north of Lake Mackintosh [CP918895], where it is overlain by Gordon Limestone. Rounded clasts of quartzite, vein quartz, and minor volcanogenic material, are set in a pink, siliceous sand-grade matrix. Bedding is generally defined by lenses of coarse pink sandstone. A 15–25 m wide unit of sandstone, intensely folded in part, occurs within the massive conglomerate west of the summit of Mt Farrell and may be the southern extension of a similar sandstone which occurs to the north at Buttress Hill.

Conformably and abruptly overlying the lower conglomerate near the summit of Mt Farrell is a sequence of well-bedded grey micaceous sandstone and siltstone with minor pink-grey pebble-cobble conglomerate. The lowermost unit is a pink-purple hematitic shale resting abruptly, and possibly erosionally, on the massive coarse conglomerate. Graded bedding, cross-bedding, slump structures and channelling are common within the grey sandstone-siltstone sequence, which is overlain by a thick upper sequence of dark pink coarse sandstone and granule-pebble conglomerate occupying the eastern part of the range. The grey sandstone unit lenses out to the north, where the upper pink sandstone sequence rests directly on the lower coarse conglomerate. Small angular clasts of chert are common in the upper sequence, which also includes a unit of pink pebble-cobble conglomerate.

Structural data (fig. 4h) indicate that the Farrell Range forms the steeply dipping, overturned in parts, western limb of a major north plunging syncline. Minor folds are rare and occur predominantly in the sandstones and shales west of Lake Herbert, where overturned, moderately tight folds, with a wavelength of 0.15–4 m, produce a steeply W-dipping cleavage (average = 018/66 W). These folds have both N- and S-plunging axes, probably the result of E-W crossfolds as described by Brooks (1962). Longer wavelength N-S trending folds occur near Lake Herbert and are probably parasitic to the major synclinal structure. Steeply dipping E-W faults are common but are not traceable into adjacent Cambrian lithologies, except near Buttress Hill where the contact with the Farrell Slates is offset. A horst of Farrell Slates near Hanging Rock is bounded by N-S trending faults, but the significance of this structure is not well understood. Complications in the vicinity of Buttress Hill occur where steeply dipping massive conglomerate overlies shallowly dipping sandstone and conglomerate. Berry (1986) has suggested this is related to a shallowly E-dipping normal fault, and although the fault is not exposed, a zone of intense quartz veining at the base of the massive conglomerate suggests its presence.

The western boundary of the Owen Conglomerate is considered to be a fault since:

(1) at CP870813 the Farrell Slates are faulted onto massive conglomerate.

(2) the base of the Jukes Conglomerate is a fault in the Murchison Gorge.

(3) there is a discordant relationship with the Murchison Volcanics.

MINERALISATION

Detailed descriptions of mineralisation from the Farrell mining field, and in the adjacent Murchison Volcanics, have been presented by previous workers (Brooks, 1962; Groves and Noldart, 1964; McKibben, 1968), and only the salient features summarised from Rivers (1975) and Collins et al. (1981) are given here.

Brooks (1962) catalogued approximately eighty mines and prospects in the vicinity of Tullah and noted that the most important mineralisation occurred in two NNE-trending, W-dipping lodes.

Farrell Lode

This lode, close to the western margin of the Farrell Slates, consists of up to three closely spaced shear zones and includes the deposits from Dutton's workings north to the Metropolitan and possibly the now-submerged Tullabardine mine. Three styles of mineralisation have been recorded:

LEAD-ZINC-COPPER-SILVER

This group includes the North Mt Farrell, operational from 1899 to 1933, and the New North Mt Farrell, operational from 1934 to 1973, the two major ore producers in the field. Mineralisation occurs as lenses and disseminations that may transgress bedding in slate and minor tuffaceous sandstone. The intersection of cross faults with the main lode has led to intensification of mineralisation, particularly in tuffaceous horizons (Collins et al., 1981).

COPPER

The Tullabardine mine [CP890852], Farrell Blocks and Mackintosh copper-silver mine (un-named on map sheet at CP861800), contain ore assayed at approximately 10% Cu (Rivers, 1975). Disseminated chalcopyrite at the contact between tuff and shale units, and chalcopyrite-malachite-azurite in quartz veins, are the styles of mineralisation.

BARITE

Massive barite has been found in altered tuff west of the Mackintosh copper-silver mine and in an un-named dump near this mine (Rivers, 1975).

Murchison Lode.

To the east of the Farrell Lode, the Murchison Lode extends from the Central Farrell mine to the South Murchison Mine, and possibly into the Sterling Valley. Vein style mineralisation, associated with closely spaced shear zones, is dominantly Pb-Cu-Ag. High silver values (~407 g/t) have been recorded from the Central Farrell mine (Collins et al., 1981).

Genesis of the mineralisation

The mineralisation of the Farrell Lode was originally suggested to be related to intrusion of Devonian granitoids (Solomon, 1965), but this idea has been reviewed in the light of isotopic data (Polya, 1981; Solomon et al., 1969) which indicate a Cambrian seawater source, with possible minor magmatic input, for the sulphur in this lode. These data coupled with a lack of an obvious granitic source, the common deformation of galena, and lack of wall rock alteration, led Collins et al. (1981) to suggest that the mineralisation is probably remobilised volcanogenic massive sulfide. However, the mineralogy of these deposits is similar to Pb-Zn deposits associated with Devonian granites (Polya, et al., 1986), and the lead isotope data of Gulson and Porritt (1987) indicate that the lead is post-Cambrian.

to Pb-Zn deposits associated with Devonian granites (Polya, et al., 1986), and the lead isotope data of Gulson and Porritt (1987) indicate that the lead is post-Cambrian.

The Murchison Lode has sulphur isotope values indicating significant Devonian sulphur content (Polya, et al., 1986), and this, coupled with Post-Cambrian lead isotope ratios (Gulson and Porritt, 1987), suggest formation as Devonian vein style mineralisation.

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APPENDIX A

Original major element chemical analyses

Sample	A161	A91	A305	MCT3	BA2	A400	A384	A206	A399	A26	A27
Major elements (mass %)											
SiO_2	65.40	65.49	64.81	64.90	66.48	65.22	67.57	67.22	68.27	73.01	72.93
TiO_2	0.58	0.68	0.58	0.56	0.53	0.62	0.49	0.41	0.45	0.24	0.22
Al_2O_3	14.90	14.78	15.10	15.22	15.03	15.33	14.52	13.90	14.52	13.39	12.87
Fe_2O_3	1.93	1.25	2.49	3.15	3.37	2.12	1.97	1.61	1.65	0.44	0.29
FeO	3.17	3.01	2.95	2.14	1.92	2.85	2.79	2.82	2.75	2.07	1.62
MnO	0.07	0.08	0.09	0.06	0.07	0.08	0.09	0.10	0.24	0.13	0.06
MgO	1.35	0.90	1.69	1.39	1.64	1.55	1.04	1.17	0.90	0.59	0.60
CaO	3.33	2.26	4.13	3.08	1.69	2.05	2.33	2.50	0.56	0.51	1.91
Na_2O	4.67	4.06	3.65	4.67	5.28	3.26	3.17	3.76	3.70	3.28	3.28
K_2O	3.10	4.31	2.56	2.89	2.41	3.58	3.98	3.67	4.88	4.04	3.37
P_2O_5	0.13	0.18	0.15	0.16	0.14	0.12	0.14	0.13	0.11	0.04	0.07
H_2O^+	0.94	1.11	1.65	1.47	1.67	1.95	1.37	1.24	1.10	0.87	1.09
CO_2	0.27	0.86	0.05	0.11	0.13	1.23	0.15	1.13	0.44	0.50	1.35
Total S	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Total	99.87	99.00	99.93	99.85	100.41	99.79	99.64	99.69	99.60	99.14	99.69

Sample descriptions

A161   CVC feldspar-hornblende-phyric 'andesite', near Murchison Highway [CP843813]

A91   CVC vesicular feldspar-phyric 'basalt', south Mt Block [CP849821]

A305   CVC dacitic lava, south of Tullah [CP844772]

MCT3   CVC dacitic lava, 'Mackintosh Bridge unit', Pieman Road [CP838814]

BA2   CVC dacitic lava, 'Mackintosh Bridge unit', near Tullah [CP853790]

A400   CVC dacitic lava, near Tullah [CP853787]

A384   CVC dacitic lava, Tullarbardine Dam [CP879843]

A206   CVC dacitic lava, west of Murchison Highway [CP825832]

A399   CVC feldspar-phyric dacitic lava, west of Mt Block [CP854871]

A26   CVC feldspar-phyric rhyolite lava, near Pieman Road [CP818800]

A27   CVC feldspar-phyric rhyolite lava, near Pieman Road [CP819800]

Sample	A268	A280	A200	A180	A92	A321B	A383A	A317	A775	A31	A165
Major elements (mass %)											
SiO_2	75.07	74.82	75.74	67.35	75.98	70.23	71.12	60.89	56.0	57.46	75.23
TiO_2	0.23	0.24	0.25	0.59	0.21	0.46	0.42	1.02	1.18	1.48	0.27
Al_2O_3	11.97	12.40	12.48	14.37	11.78	13.37	14.73	15.38	14.75	14.50	12.65
Fe_2O_3	1.47	0.66	0.57	0.63	0.64	0.55	2.08	0.97	1.50	2.30	1.32
FeO	1.07	1.14	1.00	3.63	1.59	2.72	1.18	6.94	8.45	8.45	0.75
MnO	0.10	0.05	<0.01	0.09	0.06	0.05	0.03	0.17	0.19	0.21	0.02
MgO	0.37	0.09	0.13	1.61	0.54	1.67	1.02	2.19	3.21	2.51	0.58
CaO	0.93	0.48	0.07	2.23	0.78	1.54	0.25	5.29	6.51	4.98	0.14
Na_2O	2.11	2.37	0.90	3.15	2.52	3.44	2.87	2.53	3.20	3.17	1.78
K_2O	5.63	6.60	8.20	3.42	3.62	3.71	4.74	1.43	1.75	1.81	5.24
P_2O_5	0.05	0.05	0.04	0.17	0.06	0.12	0.12	0.24	0.24	0.42	0.03
H_2O^+	0.57	0.50	0.41	2.09	0.90	1.13	0.94	2.51	2.42	2.30	1.56
CO_2	0.15	0.30	0.06	0.17	0.23	0.24	1.02	0.68	0.32	0.06	0.27

Sample Descriptions

A268   CVC rhyolitic lava, transmission line, north of Mt Block [CP866891]

A280   CVC feldspar-quartz-phyric rhyolite lava, north of Mt Block [CP868894]

A200   CVC feldspar-quartz-phyric rhyolite lava, Mt Block [CP871872]

A180   CVC ignimbritic tuff, Tullarbardine Valley [CP871853]

A92   CVC crystal rich ignimbritic tuff, south Mt Block [CP847822]

A321B CVC vitric tuff, north-west of Mt Block [CP855895]

A383A Felsic lava in Farell Slates, Spillway Creek, Mackintosh Dam [CP871827]

A317   Basaltic lava, Dundas Group, north-east of Mt Block [CP904892]

A775   Diorite dyke near Tullabardine Dam [CP871843]

A31   Diorite dyke, Pieman Road [CP823806]

A165   Quartz-feldspar porphyry, north-west of Tullarbardine Dam [CP864835]

Sample locations are shown in Figure 2.

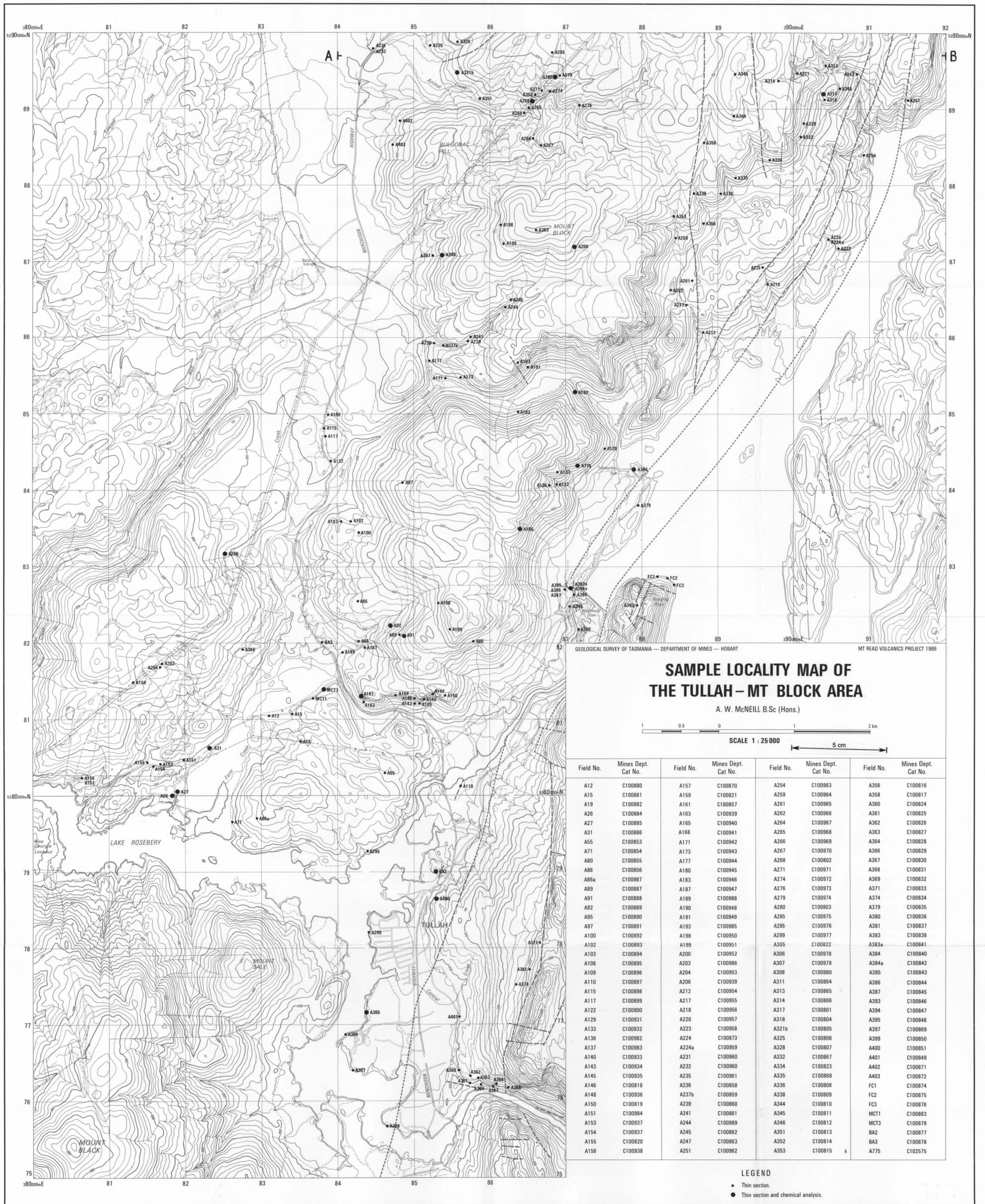All analyses by Department of Mines Launceston Laboratories.

GEOLOGICAL SURVEY OF TASMANIA — DEPARTMENT OF MINES — HOBART   MT READ VOLCANICS PROJECT 1986

SAMPLE LOCALITY MAP OF
THE TULLAH — MT BLOCK AREA

A. W. McNEILL B.Sc (Hons.)

SCALE 1 : 25 000

5 cm

Field No.	Mines Dept. Cat No.	Field No.	Mines Dept. Cat No.	Field No.	Mines Dept. Cat No.	Field No.	Mines Dept. Cat No.
A12	C100880	A157	C100870	A254	C100963	A356	C100816
A15	C100881	A159	C100821	A259	C100964	A358	C100817
A19	C100882	A161	C100857	A261	C100965	A360	C100824
A26	C100884	A163	C100939	A262	C100966	A361	C100825
A27	C100885	A165	C100940	A264	C100967	A362	C100826
A31	C100886	A168	C100941	A265	C100968	A363	C100827
A55	C100853	A171	C100942	A266	C100969	A364	C100828
A71	C100854	A173	C100943	A267	C100970	A366	C100829
A80	C100855	A177	C100944	A268	C100802	A367	C100830
A86	C100856	A180	C100945	A271	C100971	A368	C100831
A86a	C100987	A183	C100946	A274	C100972	A369	C100832
A89	C100887	A187	C100947	A276	C100973	A371	C100833
A91	C100888	A189	C100988	A279	C100974	A374	C100834
A92	C100889	A190	C100948	A280	C100803	A379	C100835
A95	C100890	A191	C100949	A285	C100975	A380	C100836
A97	C100891	A193	C100985	A295	C100976	A381	C100837
A100	C100892	A198	C100950	A299	C100977	A383	C100838
A102	C100893	A199	C100951	A305	C100822	A383a	C100841
A103	C100894	A200	C100952	A306	C100978	A384	C100840
A108	C100895	A203	C100986	A307	C100979	A384a	C100842
A109	C100896	A204	C100953	A308	C100980	A385	C100843
A110	C100897	A206	C100939	A311	C100864	A386	C100844
A115	C100898	A212	C100954	A313	C100865	A387	C100845
A117	C100899	A217	C100955	A314	C100866	A393	C100846
A122	C100900	A218	C100956	A317	C100801	A394	C100847
A129	C100931	A220	C100957	A318	C100804	A395	C100848
A133	C100932	A223	C100958	A321b	C100805	A397	C100869
A136	C100982	A224	C100873	A325	C100806	A399	C100850
A137	C100983	A224a	C100959	A328	C100807	A400	C100851
A140	C100933	A231	C100960	A332	C100867	A401	C100849
A143	C100934	A232	C100961	A334	C100823	A402	C100871
A145	C100935	A235	C100961	A335	C100868	A403	C100872
A146	C100818	A236	C100858	A336	C100808	FC1	C100874
A148	C100936	A237b	C100859	A338	C100809	FC2	C100875
A150	C100819	A239	C100860	A344	C100810	FC3	C100876
A151	C100984	A241	C100861	A345	C100811	MCT1	C100883
A153	C100937	A244	C100989	A346	C100812	MCT3	C100879
A154	C100937	A245	C100862	A351	C100813	BA2	C100877
A155	C100820	A247	C100863	A352	C100814	BA3	C100878
A156	C100938	A251	C100962	A353	C100815	A775	C102575

LEGEND

• Thin section.

● Thin section and chemical analysis.

Figure 2.