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GEOLOGY AND MINERALISATION OF THE MT MURCHISON AREA
(MRVP Map 4)

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TASMANIA DEPARTMENT OF RESOURCES & ENERGY
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MT READ VOLCANICS PROJECT
GEOLOGICAL REPORT 3

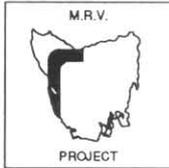# Geology and mineralisation of the Mt Murchison area (MRVP Map 4)

by A. W. MCNEILL, B.Sc. (Hons.) and K. D. CORBETT, B.Sc. (Hons), Ph.D.

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INTRODUCTION

Scope of Study

This report summarises the geology of the Mt Murchison area, as mapped on the 1:25 000 scale Map 4 of the Mount Read Volcanics Project (McNeill, 1987), and gives a brief account of mineralisation in the area, including the Henty gold prospect.

The main part of the sheet was mapped at a scale of 1:10 000 between December 1986 and May 1987, and includes some re-mapping of areas previously covered by MRVP Maps 2 and 3 (Corbett and McNeill, 1986; Corbett, 1986). The geology west of the Henty Fault Zone has mostly been compiled from these two sources, and will not be discussed in any detail in this report. The Precambrian rocks at the eastern margin of the sheet were mapped at reconnaissance level only.

A simplified geological map of the area is given in Figure 1, and a locality map showing sample locations is given as Figure 2 (in pocket). Whole-rock chemical analyses of twenty rocks are discussed in the geochemistry section. Rock samples and thin sections are held at the Division of Mines and Mineral Resources. The terminology adopted herein follows that of previous reports, particularly Pemberton *et al.* (1991).

Topography and Access

The area is dominated by the imposing bulk of Mt Murchison (1230 m a.s.l.), a N-S oriented massif of Owen Conglomerate bounded by precipitous slopes and cliffs to the west, north and east. The southern and south-eastern flanks are dissected by deep glacial valleys containing glacial lakes, and connect with a series of lower ridges which extend southwards to the Red Hills–Lake Selina area. To the NE of the mountain is the deep gorge of the Murchison River, now largely inundated by Hydro-Electric Commission lakes.

A major NNE-trending structural weakness, the Henty Fault Zone, passes west of Mt Murchison, and is marked by the valleys of the upper Henty, Stitt and Sterling Rivers. The divide between the Stitt and Sterling valleys is formed by a large Pleistocene glacial moraine deposited by a branch glacier of the Pieman ice system which pushed up the valley from the north. To the east of the mountain is a narrow belt of volcanic rocks and granite with relatively subdued topography, flanked further east by ridges of Precambrian quartzite and phyllite.

The higher parts of Mt Murchison, and the connecting ridges to the south, are generally open, with alpine to sub-alpine vegetation grading to buttongrass moorland. Outcrop in these areas is generally good, except for an irregular mantle of glacial deposits. The steep slopes of the mountain and the adjacent volcanic areas are mostly covered by dense rainforest, grading to dense sub-alpine rainforest (with deciduous beech and King Billy pine in some areas) on the higher slopes. Outcrop in these areas is poor and mainly confined to creeks and roads.

Access on the eastern side of Mt Murchison has been greatly improved by construction of the HEC Anthony Road, a major through-road from Tullah to Queenstown. Four-wheel-drive exploration tracks provide access to the Selina workings. The new HEC Howards Road provides access to the Henty dam area, and a 4-wheel-drive track leads northwards from there to the Red Hills area. Clearing and road development along a new HEC transmission line from the Henty dam area towards Moxon Saddle has occurred since the mapping was done, as has the development of the Henty portal and associated road works.

Previous Literature

Early regional mapping of a reconnaissance nature (Banks, 1952; Bradley, 1954; RTAE, 1957; Campana and King, 1963) delineated the gross lithological distribution and structure of the area, and has been supplemented by the more detailed mapping of Corbett (1975) in the Red Hills–Newton Creek area, and Polya (1981) in the Murchison Gorge area.

Reports dealing with old mining fields at Red Hills, Mt Selina and Sterling Valley are listed in the appropriate sections, as are publications dealing with the Henty gold prospect. Theses and reports dealing with the Tullah–Mt Farrell mining field, which overlaps the northern part of the present map sheet, have been listed in McNeill and Corbett (1989).

Acknowledgements

PRECAMBRIAN ROCKS

Reconnaissance mapping of the Precambrian rocks at the eastern margin of the map sheet indicates that the sequence consists of approximately equal proportions of quartzite and phyllite, with a general NNE lithological trend.

The quartzite is generally cream to white in colour and forms prominent ridges, with good exposure. In thin section (A540, A518), the quartzite is composed of strained quartz with serate grain boundaries, and sericite showing preferred dimensional orientation which defines a weak cleavage. Tourmaline is the major accessory. Sample A540 is brecciated, and shows angular fragments in a micaceous matrix which contains little quartz.

The phyllites (A609, A517, A518) are dark grey to black in colour and are composed dominantly of muscovite (with graphite inclusions), quartz, tourmaline and, in A517, poikiloblastic albite with quartz inclusions and iron oxide staining. Twinning is poorly developed in the albite, and the quartz inclusions have no obvious rotational pattern. Chlorite in A517 contains zircon inclusions with metamict haloes. These mineral assemblages are typical of low-grade greenschist facies metamorphic rocks from the Precambrian elsewhere in the Tyennan region (Collins *et al.*, 1981; Turner, 1989).

CAMBRIAN MT READ VOLCANICS — STRATIGRAPHY AND PETROLOGY

Introduction

The Mt Read Volcanics sequence in the mapped area may be considered in terms of six main units:

(1) the Central Volcanic Complex, comprising the dominantly feldspar-phyric rocks occurring in two areas:
(a) west of the Henty Fault Zone;
(b) east of the Henty Fault Zone in the Red Hills area;

(2) the Sticht Range Beds;

SIMPLIFIED GEOLOGY MT. MURCHISON AREA

—— / Fault boundary

—— Geological boundary

↙ Dip of bedding

CAMBRIAN—MT. READ VOLCANICS

| Q | Quaternary deposits |
| Late Cambrian—Early Ordovician Owen Conglomerate |

PRECAMBRIAN

〰 Phyllite and quartzite

+ + + Murchison Granite

> > Tyndall Group lavas & volcaniclastics

< < Eastern quartz-phyric sequence including Sticht Range Beds

/// Farrell Slates

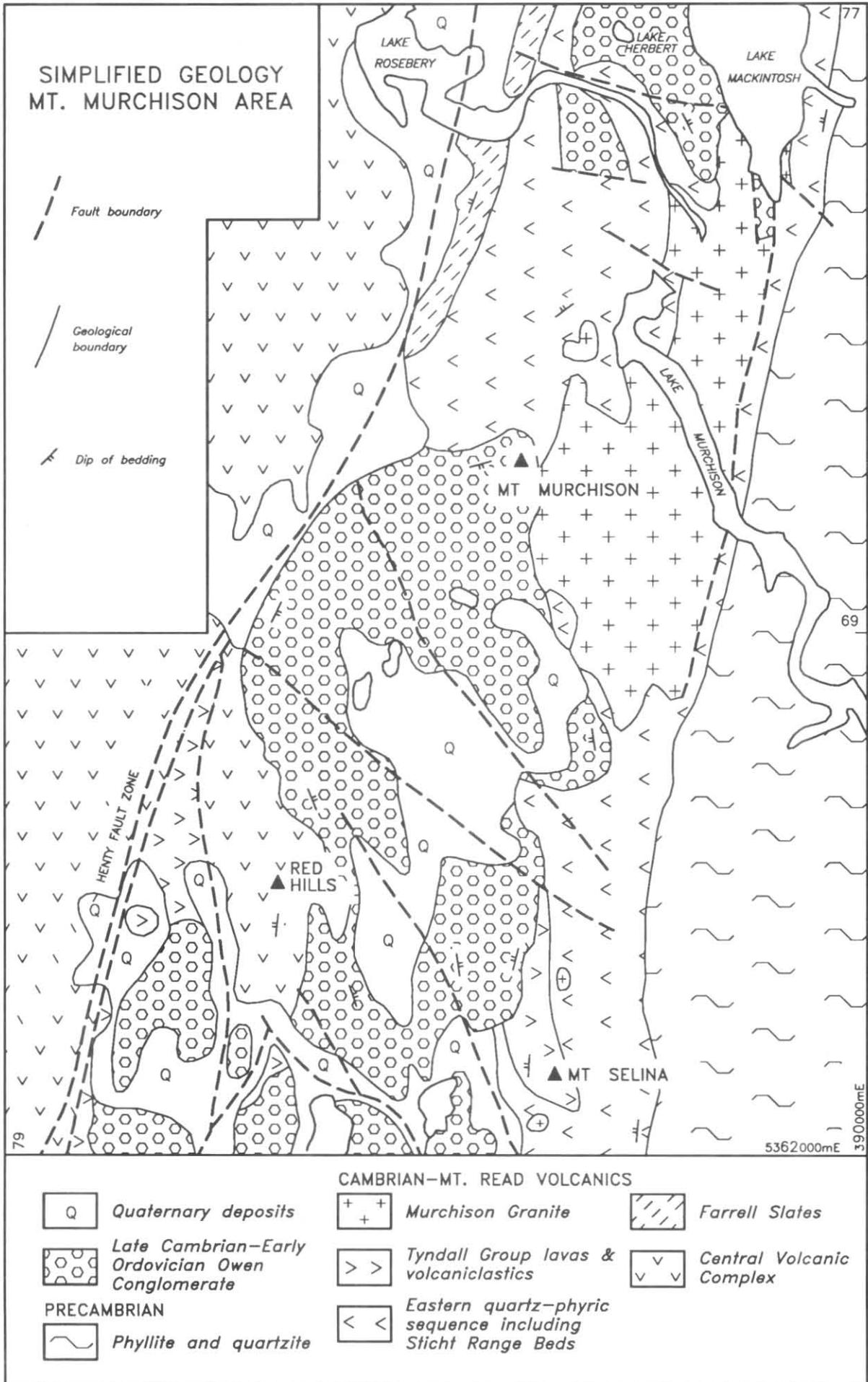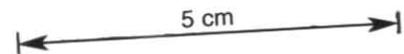v v Central Volcanic Complex

Figure 1. Simplified geological map of the Mt Murchison area

5 cm

(3) the Eastern Quartz-phyric Sequence, comprising the quartz-phyric volcanic, volcaniclastic and intrusive rocks in the Anthony River–Murchison Gorge area;

(4) the Farrell Slates belt;

(5) the Tyndall Group, comprising volcanic and volcaniclastic rocks in the Henty River–Gooseneck Hill area, and volcaniclastic conglomerate at Mt Selina and Lake Murchsion;

(6) the Murchison Granite.

The eastern belt of quartz-phyric rocks has been designated as belonging entirely to the Tyndall Group on Map 4 (following Corbett and Lees, 1987). Further mapping elsewhere, and other considerations, indicate that there are uncertainties associated with this correlation (Corbett, in press), and a separate designation as Eastern Quartz-phyric Sequence is considered preferable.

Central Volcanic Complex

West of the Henty Fault Zone

Volcanic rocks west of the Henty Fault Zone (HFZ) have been mapped and assigned to the Central Volcanic Complex on previous MRV Project maps (Corbett, 1986; Corbett and McNeill, 1986), and only those areas re-mapped for the present study will be described here.

In the upper Sterling Valley, a sequence of dominantly andesitic-basaltic lavas, with interbedded volcaniclastic rocks, is intruded by mafic dykes. The lavas (A728, A734) are dark green, chloritic rocks, autobrecciated in part, and commonly containing quartz-carbonate-chlorite veins. Glomerocrysts and phenocrysts of feldspar are common, but no ferromagnesian phenocrysts or vesicles were observed. The volcaniclastic rocks (A732, A735) are medium-grained sandstones composed dominantly of sub-rounded quartz and feldspar crystal fragments with scattered quartz-feldspar-phyric lava clasts in a chlorite-sericite-rich matrix. Both samples are well sorted and matrix supported, with no obvious metamorphic detritus.

Bedding is absent, and a weak cleavage, increasing in strength towards the HFZ, was noted. These sediments are similar to those on the shore of Lake Rosebery (Corbett and McNeill, 1986) and from DDH SS2 on the Sterling Saddle (Purvis, 1985). One mafic dyke was sampled (A729) and has a sub-ophitic texture with a felted mass of plagioclase and interstitial chlorite, epidote and minor quartz, similar to dykes from the Mt Block area (McNeill and Corbett, 1989).

To the south, in the Henty River area, the Central Volcanic Complex is dominated by altered, pink pumiceous tuff and lava, with minor shale and fine-grained tuff units. On the new HEC Howards Road, a sequence of pink feldspsar-quartz-phyric pumiceous tuff, with no obvious lithic clastic fragments, is intruded by dark green mafic dykes, from 0.4 m to 4 m thick, some of which have obvious altered feldspar and ferromagnesian phenocrysts, and chilled margins. Dykes form approximately 50% of the exposure here, and are apparently very common elsewhere in this area (Corbett, 1975).

East of the Henty Fault Zone in the Red Hills to Moxon Saddle area

Rocks assigned to the Central Volcanic Complex (CVC) occur in a narrow belt at Red Hills, faulted against Tyndall Group rocks to the west and overlain by Owen Conglomerate to the east. The belt is truncated by the Henty Fault Zone north of Moxon Saddle, but similar rocks occur in a few small creek exposures on the NW slopes of Mt Murchison, where there is an uncertain but possibly interfingering relationship with quartz-phyric rocks.

The rocks at Red Hills have been mapped and described in some detail by Corbett (1975), and the present mapping has confirmed the general distribution of lithologies. A prominent ridge of pink-weathering, feldspar-phyric rhyolitic to dacitic lavas (A750, A751, A758), with an associated unit of quartz-phyric rocks (A754), is flanked to the west by coarse to fine-grained volcaniclastic rocks and lavas with two distinct lenses of black to grey shale and siltstone.

The pink lavas are generally massive, closely-jointed, fine-grained rocks with rare flow banding. As described by Corbett (1975), they have an abundant microcrystalline groundmass of quartz, k-feldspar and sericite, with some chlorite in the greener-coloured varieties. Scattered phenocrysts of k-feldspar are present, usually deeply corroded, and rare small quartz phenocrysts. Also present are patches of coarse mosaic feldspar, commonly intergrown with magnetite, and fairly abundant crystals and irregular blebs of magnetite. Oxidation of the magnetite is partly responsible for the red colour of the outcrops.

East of the unit of quartz-phyric rocks are scattered outcrops of pale-coloured spherulitic lavas containing 40–80% spherulites (average 0.3 mm across), rare sericitised feldspar phenocrysts, rare small quartz phenocrysts, scattered chlorite blebs and iron oxide grains, in a microcrystalline quartz-feldspar-sericite groundmass.

The quartz-phyric rocks are grey-green to pinkish in colour, with about 20% quartz phenocrysts in a felsic groundmass. Feldspar phenocrysts are apparently lacking (Corbett, 1975). The sample collected during this study (A754) is actually a quartz-rich fragmental rock, with rock fragments up to 10 mm across of pink lava (feldspar-phyric, feldspar-quartz-phyric), and broken quartz crystals (10–20%), in a sericitic-chloritic matrix. The relationship between the quartz-phyric rocks and the surrounding feldspar-phyric lavas is difficult to determine because of poor outcrop, but Corbett (1975) described an apparently gradational and interfingering contact between the two on the NE flank of the Red Hills. This contact, and the presence of fragmental quartz-phyric rocks, suggests that the quartz-phyric sequence is interbedded with the feldspar-phyric rocks rather than representing a later intrusive complex.

The largest shale horizon occurs at the western foot of the Red Hills, and is 45–50 m thick. This horizon consists largely of grey to black shale or slate, with poorly-developed bedding dipping west at 80°. The horizon lenses out north of the main access road, but appears to be continuous southwards for about two kilometres to where it disappears under Owen Conglomerate cover. A second lens to the west is poorly exposed in bulldozed scrapes. No facings have been seen in the shales.

The western part of the Red Hills sequence comprises cleaved, grey-green feldspar-phyric volcanic rocks which appear to include pyroclastic rocks, autobrecciated lavas, and minor flow-banded lavas. Features of 14 thin sections examined by Corbett (1975) were: common to abundant plagioclase phenocrysts; rare quartz phenocrysts; and an abundant microcrystalline to micro-porphyritic felsic groundmass (quartz, feldspar, sericite, chlorite, calcite) in which the micaceous minerals usually outline a penetrative cleavage.

Access to the area north of Moxon Saddle has been improved by the cutting of an exploration grid. The CVC rocks in this area include feldspar-phyric (minor quartz-phyric) lava with pink alteration (A704) similar to that at Red Hills, with interbedded pyroclastic and epiclastic rocks. Sample A708 is

a pumiceous tuff with quartz and feldspar crystals set in a finely recrystallised flow-foliated matrix. Interbedded quartz-feldspar rich sandstone, and sericitic ash volcaniclastic (A710), form the northernmost exposures in this area. Similar lithologies occur to the north towards the Sterling Valley mine, as discussed in a later section.

Within the Henty Fault Zone itself are well-cleaved sericitic lithologies (A701, A705) in which rounded grains of feldspar and quartz are separated by films of sericite and minor quartz and chlorite veins. These samples may originally have been volcaniclastic rocks.

Sticht Range Beds

The Sticht Range Beds comprise that sequence of siliciclastic conglomerate, sandstone, and minor siltstone lying unconformably above Precambrian rocks and conformably beneath volcanic rocks in the Sticht Range–Lake Dora–Lake Spicer area (Corbett, 1982; Baillie, 1989).

The presence of Sticht Range Beds east of Mt Selina was recorded by McKibben (1972), and Polya (1981) recognised them east of the Murchison Dam. The present mapping shows the beds to be virtually continuous along the Precambrian margin, except for a possible break north of the Anthony River. The thickness of the sequence varies from less than ten metres to several hundred metres.

Throughout the area mapped the basal unit is a grey conglomerate with rounded clasts up to 300 mm in diameter (but generally 30–60 mm) of dominantly vein quartz and quartzite in a micaceous matrix that in some localities is phyllitic. The coarsest conglomerates are generally adjacent to the underlying Precambrian rocks. McKibben (1972) considered the basal unit to be a shale, underlying the conglomerate. However, in the Anthony River the style of deformation in the shale (F_1 is isoclinal) and its metamorphic mineralogy (in A609) suggests it is a Precambrian phyllite. The sequence overlying the conglomerate is variable and two sections will be described.

In the Anthony River, the conglomerate (<5 m thick) is overlain by green to grey sandstone interbedded with minor shale and fine-grained sandstone, pebble conglomerate, and a unit of quartz-feldspar-phyric volcaniclastic rocks. Parts of the sequence are folded by both polyclinal slump folds and probable tectonic folds. A gross fining-upwards was noted. The top of the unit (quartzite) is overlain by approximately 40 m of volcaniclastic rocks, with minor interbedded sandstone and shale, then 20 m of well-cleaved fine-grained sandstone and approximately 10 m of coarse volcaniclastic rock with quartzite clasts. A similar gradational contact with overlying volcanic rocks is exposed in the Anthony Power Station road [982695], where quartzite is overlain by sericitic quartz-feldspar-phyric volcaniclastic rocks, followed by interbedded tuff and shale, and finally lithic-rich quartz-feldspar-phyric volcaniclastic rocks.

East of Mt Selina, coarse grey-white pebble conglomerate is overlain by granule conglomerate, interbedded sandstone and shale, and coarse sandstone. This passes abruptly into a lens of pebble-cobble conglomerate, up to 125 m thick, containing clasts of sub-rounded vein quartz and quartzite and minor quartz-phyric volcanic material, set in a pink siliceous matrix. This conglomerate is similar in appearance to the Owen Conglomerate. The conglomerate fines westward into coarse pink, then grey, sandstone, which passes into volcaniclastic rocks, the boundary being obscured by cover.

Thin sections of sandstone (A604, A621, A542, A535, A505) and conglomerate (A502, A551) contain subrounded clasts of dominantly metamorphic provenance, i.e. micaceous quartzite and phyllite, with accessory tourmaline, while the volcanogenic content is minor, apparently less than Baillie (1989) recorded to the south. Much of the quartz content is recrystallised, and any primary volcanic features may have been destroyed. Input of at least some volcanic material is evidenced by the volcaniclastic unit in the Anthony River.

No detailed sedimentological studies were undertaken in the present study, but Baillie (1989) has suggested, for similar lithologies to the south, a transgressive sequence with basal conglomeratic fan deposits passing upwards into fluvial, and then marine, storm deposits. The lens of Owen-like conglomerate probably represents an alluvial fan in dominantly fluvial sediments.

Eastern Quartz-phyric Sequence

This sequence occurs in two parts, separated by the N-S orientated body of Murchison Granite.

Volcanic sequence south and east of the Murchison Granite

A belt of highly sheared, quartz-phyric volcanic, intrusive and volcaniclastic rocks overlies the Sticht Range Beds between Lake Mackintosh and Mt Selina, and is intruded by the Murchison Granite to the northwest.

In the Mt Selina area, several discrete bodies of intrusive/extrusive porphyries occur within a dominantly volcaniclastic and/or pyroclastic sequence. It should be noted that several small granitoid bodies have been found both in outcrop and drill holes (LS12), and these will be discussed with respect to the Murchison Granite.

Three bodies of pink quartz-feldspar-phyric porphyritic microgranite (€tpi) occur east of Mt Selina and are intrusive into volcaniclastic rocks. Highly strained quartz phenocrysts, chloritised biotite, sericitised plagioclase and relatively fresh k-feldspar, with zircon and apatite, are set in a cryptocrystalline groundmass with some patches of snowflake texture (A662). Quartz + k-feldspar + chlorite alteration and quartz-sericite-chlorite veining are common.

Two N to NW-striking intrusive/extrusive bodies (€tp) cross the access track south of the Anthony River. The easternmost of these bodies varies from brecciated pink quartz-plagioclase-biotite porphyry, which is sericitic and chlorite altered with some quartz k-feldspar veining (A687), to brown, brecciated quartz-phyric (phenocrysts <1 mm in diameter) ?lava with minor sericitised feldspar and a glassy groundmass (A625).

Southeast of Mt Selina is a large area of mixed intrusive and extrusive lithologies. Probable intrusive types, coarse grained with phenocrysts to 3 mm diameter, include quartz–plagioclase–k-feldspar–biotite porphyry (A677), containing some volcaniclastic xenoliths, plagioclase-quartz porphyry, with chloritised phenocrysts, quartz-plagioclase-muscovite (possibly after biotite) porphyry, and quartz-plagioclase-biotite porphyry (A669). These lithologies contain zircon as an accessory and are strained, with variable cleavage development, and in the case of (A745), brecciated.

Probable lavas (A679, A675) are fine-grained dark green-brown rocks with no obvious phenocrysts in hand specimen. In thin section, scarce sericitised feldspars predominate over quartz (<10% of phenocrysts) and are set in a snowflake-textured or spherulitic groundmass, with some irregular quartz-filled ?vesicles. A basaltic intrusive or lava occurs in HEC DDH 3150 [grid reference CP855637]. Phenocrysts of plagioclase and altered pyroxene are set in a trachytic groundmass (HEC sample 2567) in this lithology. No whole-rock geochemistry is available.

Volcaniclastic and/or pyroclastic rocks are abundant in the sequence but tend to be highly sheared, with the resultant obliteration of primary textures. This, combined with poor outcrop, makes determinations of mode of deposition difficult. Some units are clearly epiclastic and may contain metamorphic detritus (e.g. A686). Volcaniclastic sandstone occurs at 867627. Ferruginous clastic material is common in many units. Tuffaceous lithologies vary from highly sheared quartz-plagioclase-phyric crystal-rich tuffs (A681) to types containing dominantly angular quartz fragments and sericitised feldspar in a fine-grained felsic matrix (A686) with sub-rounded clasts of micaceous sandstone, micaceous quartzite and recrystallised fine-grained ?volcaniclastic. Clasts of micaceous sandstone and vitric tuff are common in A675, while vitric tuff and feldspar porphyry lithic clasts were described in A623.

West of Mt Selina, very fine-grained recrystallised cherty volcaniclastic rocks (A648, A649) crop out on the access track (€tva). These are dominantly hematite altered, containing appreciable amounts of pyrite with scattered quartz crystal fragments. Rare interbeds of lithic-rich material are generally <50 mm thick. To the south these pass into a dark-green, feldspar-rich rock (A657) containing minor quartz porphyry and grey vitric tuff lithic fragments, which is interbedded with minor vitric tuff on a scale of several metres.

In the area north of the Anthony River, the volcanic rocks along the eastern margin of the Murchison Granite are generally mylonitised and difficult to identify (e.g. A461, A547, A592), although some preserve original clastic textures (e.g. A531). As shearing decreases, clastic textures become more obvious, but features indicative of either pyroclastic or epiclastic origin are seldom seen. Most rocks have a crystal component dominated by broken angular quartz with variable amounts of plagioclase, k-feldspar and, in A472, biotite. A550 is notably crystal-rich. Lithic fragments are dominantly pink quartz-feldspar porphyry, often flow-banded (e.g. A467), while A468 contains reworked tuffaceous material. These clasts are supported by a turbid, sericite-rich felsitic matrix, probably recrystallised juvenile material. Sericitic alteration of feldspar, and sericite, chlorite and carbonate alteration of the matrix, is common.

A wider range of tuffaceous lithologies was recorded south of the Murchison Granite. On the Anthony Road [at 866669], Owen Conglomerate unconformably overlies a sequence of fine-grained, sheared, sericitic, lithic-bearing sediments, interbedded with 100–200 mm thick beds of vitric tuff [at 862664]. Sample A538 is crystal-rich, containing dominantly quartz up to one millimetre diameter, k-feldspar and minor plagioclase, in a fine-grained sericite-rich felsic matrix. Lithic fragments, up to 15 mm diameter, of hematitic ?vitric tuff are common, while pink quartz-porphyry was noted in hand specimen.

Further west on the Anthony Road, a small inlier of sediment has a partially faulted contact with enclosing porphyry. Sample A777 is a crystal-rich volcaniclastic rock dominated by sericitised feldspar with lesser quartz crystal fragments, virtually grain-supported, in an epidote, chlorite and opaque altered felsic matrix. Minor banded vitric tuff interbeds were noted.

Typical of tuffaceous sediments in Red Hills Creek is A600, containing sub-rounded clasts of at least two textural types of ?lava, both quartz-phyric, in a sericite, chlorite and opaque altered felsic matrix. To the north, samples A724 and A592 are both strongly sheared, with a weak SC fabric, and contain clasts of aphanitic lava, feldspar-quartz-porphyry and fine-grained tuffaceous material, with quartz and feldspar crystal fragments in fine-grained sericitic matrix. A clast of intergrown quartz and k-feldspar in A592 may be derived from a granitoid source.

In the Lake Mackintosh area, some fragmental lithologies appear to be brecciated lavas (A507, A465, A544), and consist of angular to sub-rounded clasts of flow-banded to massive quartz-phyric lava, with sparse feldspar and fractured and strained quartz crystals in an anastomosing net of turbid brown sericite-rich material. These contain abundant inclusions of opaque minerals, and are cut by rare quartz and quartz + k-feldspar veins. Cleavage is weak, while brecciation is considered to be hydrothermal. These brecciated lavas are intruded by an elongate body of quartz-feldspar-biotite porphyry which abuts the Sticht Range Beds on its eastern margin. The pink to tan-coloured porphyry contains quartz phenocrysts up to 5 mm in diameter, plagioclase and altered biotite phenocrysts in a brecciated spherulitic groundmass. Accessory phases are zircon and apatite, while granophyric intergrowth of K-feldspar and quartz was noted in some phenocrysts (A470). The rock resembles the Bonds Range porphyry of Pemberton et al. (1991), and possibly represents a southern extension of that body.

Intrusive porphyries crop out on the southern and western flanks of the Murchison Granite (A590, A593, A594, A571). These lithologies are generally dark green or pink, brecciated or strongly sheared, with mylonitic zones and a weak SC fabric (A590). Alteration is dominated by chlorite and epidote, while sericitisation of feldspar is pervasive. Sample A571 appears to be unsheared, with a glassy groundmass partially recrystallised to spherulitic or snowflake texture in parts, and phenocrysts of altered plagioclase and quartz.

A second body of porphyry (A598, A599, A617, A618, A774), centred on Red Hills Creek, is generally unsheared, the exception being A617 in which sericite-rich shear zones enclose 'clasts' of unstrained spherulitic material. Quartz phenocrysts, up to 6 mm in diameter, and feldspar up to 4 mm in diameter, are set in a snowflake-textured groundmass. Chlorite and opaque pseudomorphs after ?biotite, sericitisation of feldspar, and chlorite and epidote in the groundmass, are the main alteration types. Variations in this body include devitrification texture (e.g. A618 has a mosaic-textured granophyric groundmass) and the presence or absence of biotite. Connecting the two bodies described above is a belt of quartz–plagioclase–biotite–K-feldspar porphyry (A617, A724) which is generally fine grained, has phenocrysts <3 mm in diameter, and contains vesicle-like structures. It is not clear whether this body is intrusive or extrusive.

Volcanic sequence north and west of the Murchison Granite (Murchison Volcanics)

A complex sequence of mainly quartz-feldspar-phyric volcanic, volcaniclastic and intrusive rocks occurs west of the Murchison Granite, and grades into the Farrell Slates sequence adjacent to the Henty Fault. Subdivision of the volcanic sequence, which has been referred to as the Murchison Volcanics by Polya et al. (1986), is difficult because of the massive, altered nature of the rocks and the paucity of marker horizons or bedded units. The few recorded dips are to the west or northwest, but no facings were obtained. A generalised three-fold subdivision is possible into:

(i) an eastern volcaniclastic-volcanic unit with abundant intrusive bodies, occupying the eastern half of the sequence;

(ii) a lava-rich unit with volcaniclastic lenses, occurring west of Little Farrell and extending along the plateau margin east of the Sterling Valley;

(iii) a thin volcaniclastic unit along the contact with the Farrell Slates.

(i) EASTERN VOLCANICLASTIC-VOLCANIC-INTRUSIVE SEQUENCE

This sequence is exposed along the Murchison Gorge, on the shores of Lake Mackintosh, and along the Anthony Road east of where it reaches the plateau level south of Little Farrell. The sequence in the Murchison Gorge is considered to consist predominantly of rhyolitic lavas and intrusive rocks, with minor pyroclastics. Units D and E of Polya *et al.* (1986) could not be distinguished in the present mapping.

Samples from the Murchison Gorge road (A444, A445, A448, A449) are mostly pink-brown spherulitic quartz-feldspar-biotite porphyry, with variable chloritic alteration and veining. Shearing is common (A445), as is brecciation (A449), with porphyry 'clasts' in a mass of chlorite and sericite. Polya's (1981) description of Unit E pyroclastics is very similar to the brecciated porphyry described above. Little evidence has been found for extrusive origins of these porphyries, although Polya (1981) noted the presence of relict flow banding and suggested that the porphyry was partly extrusive.

On the upper slopes of Little Farrell, sheared quartz-plagioclase-biotite (in some cases altered to muscovite) porphyry is intimately mixed with coarse-grained granite. A similar relationship was noted at 868758, and Polya (1981) recorded mixed granite and porphyry in the Murchison River at 870756. Poor outcrop and access south of the Murchison River obscures the extent of the mixing, however similar spherulitic quartz-feldspar porphyry with opaque + chlorite-altered biotite (A436) crops out near Roderick Creek.

Quartz porphyry is present on the hill NW of Murchison Dam, where a typical sample (A744) shows quartz and sericitised feldspar phenocrysts in a silicified, brecciated groundmass. A crystal-lithic tuff (A487) is exposed at the western end of the Murchison Dam, and is quartz–plagioclase–k-feldspar–phyric, with clasts of spherulitic porphyry and vitric tuff in a weakly chlorite-epidote-altered matrix. Porphyry occurs again on the eastern end of the dam (A536), and shows phenocrysts of plagioclase, quartz and minor k-feldspar in a spherulitic groundmass, and minor quartz–chlorite and quartz–k-feldspar veins and disseminated pyrite. Similar porphyry on the shore of Lake Murchison at 869728 is intruded by a small body of pink quartz-feldspar-biotite porphyry.

A narrow, north-striking belt of volcaniclastic rocks occurs on the lake shore south of Murchison Dam. As exposed in an old quarry, the rock is weakly banded with a steep easterly dip. Clasts of pink porphyry (up to 10 mm diameter) and vitric tuff (<5 mm diameter), and pumice-like patches of chlorite, are contained in a quartz-feldspar-phyric matrix.

The sequence exposed along the Anthony Road is complex, and includes volcaniclastic rocks, intrusive quartz-feldspar porphyries, granite, and possible lavas. Poor outcrop away from the road has prevented the tracing of lithological boundaries.

Probable intrusive quartz-feldspar porphyry (A426, 429, 480, 566, 580, 581) is more common than feldspar-quartz porphyry (A428, 522, 583, 608). The quartz-feldspar porphyries generally contain highly altered (to chlorite and opaque minerals) biotite, embayed quartz, and feldspar (dominantly plagioclase) as phenocrysts and glomerocrysts, set in a fine to coarsely recrystallised felsic groundmass which may have a weak flow foliation (A480). In some samples shearing is strong, possibly with a weak SC fabric (e.g. A429), while alteration is dominantly sericite and chlorite + calcite with veins of calcite or quartz + epidote + chlorite.

The feldspar-quartz porphyry has a recrystallised felsic groundmass supporting glomerocrysts and single crystals of sericitised, often zoned, plagioclase, embayed quartz, minor k-feldspar and, in A532, biotite.

Hydrothermal brecciation of porphyry is common, often occurring in well-defined zones up to 200 mm wide which contain angular porphyry clasts in a chloritic matrix.

Sample A478, from an area mapped as lava, has a spherulitic pink-green groundmass which supports quartz and sericite-epidote–altered feldspar phenocrysts, up to 4 mm in diameter. The lack of vesicles, and other texture indicative of extrusive origins, suggests that this sample may be an intrusive porphyry. A probable lava is A652, a quartz-plagioclase-phyric lithology with phenocrysts up to 1.5 mm in diameter and extensive sericite + chlorite + calcite alteration of feldspar. Probable vesicles are sub-rounded and filled with quartz + chlorite + k-feldspar.

Volcaniclastic lithologies vary from probable tuff (A427) to epiclastic rocks (A606), but are predominantly of indeterminate origin (A432, A479, A482). Sample A427 is rich in quartz and feldspar crystal fragments which are set in a felsic matrix in which are patches of foliated material (foliation defined by iron-oxides) which may be collapsed pumice fragments. On the Anthony Road at 862731, a lithic-rich volcaniclastic rock, with clasts of lava vitric tuff and shale up to 50 mm long, set in a sand-grade feldspar-rich matrix, is interbedded with poorly cleaved, green-grey vitric tuff, and contains rare shale rafts up to one metre long. To the south, well-bedded vitric tuff and crystal-rich sandstone shows contorted bedding, and has been intruded by quartz-feldspar porphyry at 862729. Quartz-feldspar rich volcaniclastic rock (A482) is brecciated, with a few visible lithic clasts of volcanic material, although these may be breccia fragments. Sample A479 is a lithic-rich volcaniclastic rock with a crystal-rich, fine-grained recrystallised matrix. The lithic fragments (spherulitic quartz-porphyry and finer grained lava) are subrounded and 20–30 mm in diameter. Shearing has obliterated most primary features in A536, a quartz-feldspar crystal-rich lithology, but some pale cream vitric tuff and chloritic lithic fragments are visible in hand specimen.

A unit of sandstone and shale containing dominantly Precambrian metamorphic-derived detritus occurs in Roderick Creek near Little Farrell, and in the small creek one kilometre further south at 864733. The sandstone (A587) crops out over approximately 80 m in the creek bed and is massive and medium-grained, containing sub-angular clasts of graphitic phyllite, quartzite, tourmaline, muscovite and quartz phenocryst fragments in a turbid brown sericitic matrix. The shale is strongly folded and microfaulted, with intense quartz veining, and is composed dominantly of quartz, sericite and iron-oxide (A434).

The lavas and intrusive rocks of the Anthony Road are predominantly felsic (rhyolitic-dacitic). Two basic lavas or intrusive rocks (A768, A558) and one mafic volcaniclastic rock (A588) were sampled from the Anthony Road area SW of the Murchison Dam. Sample A768 is a fine-grained, dark grey lithology with some lighter patches (possible feldspar phenocrysts), which appears in thin section to have had an ophitic texture with laths of sericitised feldspar and interstitial chlorite, muscovite and remnant clinopyroxene. This specimen appears to be brecciated, with chlorite and sericite infilling. Sample A558 is also brecciated, with granular to fibrous actinolite comprising the host lithology, and epidote and orthoclase, minor chlorite and quartz forming veins around breccia fragments. Hornblende, altered to actinolite and tremolite, is dominant in A588, which has an apparently clastic texture in hand specimen. Clinopyroxene, epidote and

sericitised feldspar, with an appreciable content of sphene, comprise the remainder of the sample.

(ii) LAVA-RICH UNIT WEST AND SOUTH OF LITTLE FARRELL

This unit has an outcrop width of about 700 m, and is well exposed along the Anthony Road and in the cliffs and rugged slopes along the eastern side of the Sterling Valley. The lavas on the Anthony Road are typically pink to green, fine grained (A420, A437, A510), and commonly brecciated. Scattered phenocrysts of quartz and feldspar are present, and possibly biotite in A420. Snowflake texture is common, although patches of very fine-grained glassy material remain in A427. Sericite and chlorite form veins between breccia fragments, while disseminated pyrite and quartz-chlorite veins are obvious in hand specimen.

Brecciation is less apparent in the lavas (A684) on the eastern slopes of the Sterling Valley, where probable intrusive quartz-feldspar-biotite porphyry (A697) was also recorded. Sample A694 has quartz phenocrysts, up to 4 mm diameter, set in a weakly brecciated, recrystallised pink groundmass.

At least three lenses of volcaniclastic rocks occur within this lava sequence, while near the Murchison bridge, thin interbeds of weakly cleaved, fine-grained vitric tuff (A420), some with lava clasts, are common. On the upper slopes of Little Farrell, a sericitic, fine-grained, quartz-phyric volcaniclastic rock contains pink lava and chloritic clasts, and passes east into Jukes Conglomerate. On the Anthony Road, a lens of well-laminated cream-green to dark green recrystallised vitric tuff (A476), with no crystal or lithic fragments, is interbedded with quartz-feldspar-phyric volcaniclastic sandstone with scattered lava clasts. To the south, a large lens of volcaniclastic rocks is dominated, at its northern end, by recrystallised vitric tuff (A691, A692, A494), a green cherty rock with scattered quartz crystals and common chlorite + k-feldspar alteration. This passes south into quartz-feldspar-phyric sericitic volcaniclastic rocks, with clasts consisting dominantly of lava but including vitric tuff and micaceous phyllite. Sericitic crystal-rich volcaniclastic conglomerate and sandstone, lithologically similar to the Dora Conglomerate, occurs on the lower slopes of Mt Murchison (where it is interpreted to underlie the Jukes Conglomerate) and contains clasts of metamorphic detritus, vitric tuff, quartz sandstone and possible granite (A700) up to 15 mm in diameter.

Intruding the eastern contact of this volcaniclastic lens is a body of pink quartz-feldspar-biotite porphyry (A689). In thin sections, a snowflake-texture groundmass supports phenocrysts of strained embayed quartz, plagioclase (as single crystals or glomerocrysts), minor k-feldspar and chloritised biotite, with apatite as a major accessory.

In the southern part of the Sterling Valley, on the lower northern slopes of Mt Murchison, quartz-phyric volcanic rocks are apparently interbedded with feldspar-phyric rocks resembling those of the Central Volcanic Complex at Red Hills and north of Moxon Saddle. The actual relationship is uncertain because of the poor outcrop. The lithologies present include pink k-feldspar-plagioclase-phyric lava (A716), snowflake-textured plagioclase-minor quartz-phyric lava (A690), sheared and altered sericitic feldspar-phyric volcanic rocks (A739, A717), and feldspar-phyric volcaniclastic rock with probable sericitic fiamme (A761).

(iii) VOLCANICLASTIC UNIT ON EASTERN SIDE OF STERLING VALLEY

A volcaniclastic unit about 200 m wide lies between the lava unit to the east and the Farrell Slates to the west on the Anthony Road. The contact with the latter unit, which also consists largely of volcaniclastic rocks in the eastern part, is gradational and poorly defined. The volcaniclastic unit appears to wedge out to the south towards the Sterling Valley Mine, but is present on the western flanks of Mt Farrell and on the Murchison Gorge road (see descriptions in McNeill and Corbett, 1989).

The volcaniclastic unit is generally greenish in colour, and typically contains clasts of quartz-feldspar-phyric lava up to 300 mm across, and blocky to irregular or fiamme-like clasts of sericite-chlorite up to 100 mm long. The latter possibly represent altered pumice fragments. Some of the lava clasts preserve original flow-banding. The matrix is typically sericite-rich and may show strong cleavage development. The proportions of lava clasts and pumice clasts varies through the section, and a number of mass-flow type units may be present. Pumice-rich units have an ignimbritic appearance.

Two small dyke-like bodies, consisting of altered feldspar phenocrysts in a strongly altered chloritic groundmass, were noted within the unit.

Farrell Slates

The Farrell Slates sequence extends from north of Tullah to south of the Sterling Valley Mine, where it apparently wedges out against the Henty Fault. The sequence is about 700 m wide at the Murchison bridge, with steep westerly dips, but the presence of internal folding and faulting makes it impossible to give an accurate estimate of stratigraphic thickness. The western margin is formed by a major fault zone of crushed and quartz-veined rocks, dipping west at about 65°, marking the main trace of the Henty Fault. Altered andesitic rocks of the Central Volcanic Complex occur on the western side of the fault. Brittle-ductile strain effects associated with the faulting, in the form of intense cleavage development (giving the rocks a phyllitic appearance in many areas), kinking and crenulation of the cleavage, stretching lineations, small folds of tight to isoclinal form, small faults with striated and slickensided surfaces, and extension veins of various types and mineralogies, extend across most of the width of the Farrell Slates, and this broad zone is referred to as the Henty Fault Zone.

A general two-fold subdivision of the Farrell Slates is apparent south of the Murchison bridge (see Map 4), into an eastern unit of mainly volcaniclastic rocks with minor shales, and a western unit of mainly sedimentary rocks, including black slate, tuffaceous and micaceous sandstone, and fine-grained ashy siltstone. The eastern unit has a gradational, poorly defined contact with volcaniclastic rocks of the Murchison Volcanics. As exposed along the Murchison Highway near Thomas Blocks prospect, and on the adjacent Anthony Road, the eastern unit consists mainly of pale green to grey-green sericitic feldspar-quartz-phyric tuffaceous rock (MR418) with pumice-like clasts in places, intercalated with shaly ash, tuffaceous sandstone and minor black slate. Several small lodes of pyrite-sphalerite-galena (up to 250 mm across) are exposed in road cuttings near Thomas Blocks, and are aligned parallel to cleavage in a series of small, tight to isoclinal upright folds in fine-grained tuffaceous sandstone and ashy shale. Volcaniclastic rocks from further south in the valley include a relatively massive quartz-feldspar-biotite-phyric rock (MR386), and a pumiceous quartz-feldspar-phyric rock with some remnant pumice texture (MR387).

The western unit includes phyllitic black slates (commonly pyritic and graphitic, in units up to 100 m thick) exposed in several areas (including Sterling Valley Mine), fine-grained vitric ash or ashy shale, tuffaceous siltstone, fine-grained to coarse-grained tuffaceous sandstone (usually quartz-feldspar-phyric), and micaceous siliciclastic sandstone (MR417) containing abundant metamorphic detritus

(quartzite, schist). The latter is well developed in the Lakeside Prospect area. Also within this sequence are thick (to 20 m) units of massive to poorly bedded, coarse-grained, quartz-feldspar-phyric 'tuff' or tuffaceous sandstone, commonly containing clasts and rafts of shale and ash up to several metres long. Fiamme-like clasts of altered pumice may also be present. The matrix of these coarse, mass-flow like units contains abundant large volcanic quartz grains (up to 8 mm across) in some cases. Two such units are exposed in the Murchison Highway cutting 200 m north of the Murchison bridge.

Facing evidence is particularly difficult to obtain within the Farrell Slates, largely because the intense deformation effects, particularly cleavage development, have modified and obscured many of the primary textures and structures. One of the mass-flow units in the cutting north of the Murchison bridge has an apparently erosional contact on siltstones at its eastern margin, suggesting a west-facing. A possible example of graded bedding in this cutting also suggests westerly facing. Also present are several examples of cleavage refraction from coarse-grained to fine-grained beds which could be misinterpreted as truncated cross-bedding. No other facing evidence was seen. Randell (1989) reports that four examples of interpreted **easterly** facing are present in Farrell Slates intersections in DDH's SVD89-1 and 89-2, in the vicinity of Sterling Valley Mine (see fig. 9).

Two diamond-drill holes (SS1, SS2 on fig. 9) were drilled into the Henty Fault Zone some two kilometres south of the Sterling Valley Mine by Getty Oil Development Co. in 1985. The holes were collared in glacial deposits near the saddle at the head of the Sterling Valley, and must have been located almost directly above the surface trace of the fault (Purvis, 1985). DDH SS-1, angled 63° E, penetrated steeply east-dipping black and grey carbonaceous shales and tuffaceous siltstones for 146 m, interrupted by a silicified quartz-feldspar-phyric lava from 66 to 117 metres. The westwards-directed hole, SS-2, penetrated the fault zone (a zone of almost complete core loss) from 28 to 72 m, and thence into andesitic-basaltic volcanics and associated volcaniclastic rocks. The shales intersected in DDH SS-1 appear to be similar to the Farrell Slates, although they occur at least one kilometre south of where the main body of slates wedges out against the Henty Fault. The occurrence of another lens of similar black slates within the Henty Fault Zone four kilometres further south again (at the Red Hills track), and also in drill intersections at the Henty gold prospect, suggests that a continuous sedimentary sequence may originally have extended from the Farrell Slates through to the Henty Fault Wedge sequence. Alternatively, the shale occurrences may represent blocks caught up in the fault zone during transcurrent movement.

Tyndall Group

Henty River–Gooseneck Hill area

Tyndall Group rocks in this area have previously been described by Corbett (1975). A sequence comprising a lower quartz-feldspar-phyric lava unit and an upper pyroclastic-volcaniclastic unit (with minor lava lenses) was recognised in the Henty River–Mt Julia area, while the sequence between Gooseneck Hill and Moxon Saddle was considered to be predominantly lavas.

Outcrop in the Henty River area has been greatly improved by construction of the HEC Howards Road and other works associated with the Henty Dam [795624]. Outcrops on the new Howards Road south of the river show lenses and dyke-like bodies of lava (probably stratigraphically higher than the main lower lava unit) within a sequence of pyroclastic and volcaniclastic rocks. The lava is generally pink in colour,

and ranges from massive to flow-banded and brecciated. A thin section (A771) is brecciated and silicified, and shows phenocrysts of strained quartz, plagioclase and k-feldspar set in a fine-grained felsic matrix. No mafic minerals or vesicles were noted but graphic intergrowths of quartz and k-feldspar are common. The presence of these intergrowths, the lack of vesicles, and the dyke-like nature of some parts of the porphyry suggest that the body may be largely intrusive.

The pyroclastic-volcaniclastic unit crops out east of the Henty Fault from Howards Road north to 805647, where it appears to terminate against quartz-feldspar porphyry of the Gooseneck Hill sequence. This coarsening-upward sequence dips steeply east, although some west dips were also recorded, and faces east, passing with apparent conformity into Newton Creek Sandstone at 800624 and Jukes Conglomerate in Julia Creek (Corbett, 1975). On the new Howards Road, faintly-banded pink and green volcaniclastic sandstone, with minor vitric siltstone, passes east into conglomerate containing quartzite and quartz-porphyry clasts, and thence into Newton Creek Sandstone. Further south, pebble conglomerate interbedded with minor sandstone and vitric tuff overlies coarse sandstone with bedding defined by concentrations of rutile, hematite and magnetite (A765), and green vitric sediments. The sandstones (e.g. A765) are well sorted and grain supported, with clasts of broken quartz and feldspar crystals, sub-rounded snowflake-textured porphyry and cherty material. This specimen, from lower in the sequence, contains no obvious metamorphic detritus. A typical volcaniclastic conglomerate (A764a) has a clast composition similar to the sandstone but is less well sorted, with clasts up to 20 mm, although in some specimens they may reach 200 mm in diameter.

A similar sequence was recorded in the costean at the Henty gold prospect [802639], with minor volcaniclastic sandstone and siltstone overlain by volcaniclastic pebble conglomerate, containing minor metamorphic detritus, which fines to the west. The overall appearance, presence of metamorphic detritus, and beds of heavy minerals suggest that this part of the sequence, probably overlying the Comstock Tuff correlate, is dominantly epiclastic.

Underlying the Owen Conglomerate on Gooseneck Hill, and extending northwards as a fault-bounded wedge to Moxon Saddle, is a sequence of pink to greenish-grey rhyolitic quartz-feldspar porphyries. Flow-banding and autobrecciation are common in the southern part, but the rocks become increasingly massive to the north. Varieties include quartz-phyric rocks with minor altered feldspar phenocrysts (A635), to quartz–plagioclase–k-feldspar–phyric types with a spherulitic or snowflake-textured groundmass (A635a). Minor pyroclastic rocks were noted by Corbett (1975), but lavas appear to constitute the bulk of the sequence.

An apparently abrupt change to volcaniclastic conglomerate occurs on the western flank of Gooseneck Hill some 900 m NNE of the Henty prospect, but the nature of this boundary is uncertain and it may correspond to a major fault (possibly a branch of the Great Lyell Fault — Corbett, 1975).

The contact between the lavas and overlying Owen Conglomerate at the northern end of Gooseneck Hill is abrupt and probably erosional, suggesting a disconformity. To the southwest of this, the siliceous Owen Formation is underlain conformably by some 20 m of volcaniclastic conglomerate correlated with the Jukes Formation, and the disconformity surface is probably below this.

Tyndall Group correlates crop out in several areas southeast of Gooseneck Hill towards Lake Westwood. Corbett (1975) observed outcrop and boulders of banded Comstock-type tuff, containing abundant quartz and feldspar grains, green chlorite splotches, and porphyry clasts up to 100 mm long, in a faulted

anticline core at Lukes Knob. Further north, a tributary valley of Julia Creek [around 823631] exposes an anticlinal sequence of volcaniclastic sandstone and grit, with intercalations of siliceous-micaceous sandstone, underlying Jukes Conglomerate. In one area, a 9–10 m thickness of Jukes Conglomerate is abruptly underlain by planar cross-bedded pink sandstone and cleaved, pink to green, quartz-feldspar-phyric volcaniclastic sandstone with scattered clasts of hematitic chert and pink porphyry up to 40 mm across. Lower in the sequence, a grey micaceous-siliceous sandstone showing slump structures and cross-bedding, identical to some facies of the Newton Creek Sandstone, is intercalated within cleaved, poorly-bedded volcaniclastic sandstone. Sample A572 is a typical well-sorted sandstone with sub-rounded to sub-angular clasts of volcanic quartz, k-feldspar, quartz-phyric porphyry, chert and micaceous quartzite up to 3 mm diameter, in a sericite-rich matrix.

The presence of Newton Creek Sandstone-type facies interbedded with volcaniclastic Tyndall Group sediments suggests correlation with the sequence at the Henty gold prospect.

Probable Tyndall Group conglomerates in the Mt Selina–Lake Murchison area

A sequence of volcaniclastic conglomerates, apparently overlying Eastern Sequence volcanic rocks, occurs on the crest and slopes of Mt Selina, extending northwards across the Anthony River. The sequence consists of brown-weathering conglomerate interbedded with coarser sandstone and grit, and appears to occupy the core of a NNW-plunging syncline.

The conglomerate is polymictic, with sub-rounded to sub-angular clasts up to 400 mm diameter (mostly 40 mm or less) having a bimodal size distribution. In A646, the coarser clasts consist dominantly of quartz-phyric porphyry. The finer fraction (<20 mm) is dominated by quartz crystals, cherty sericitic material, and grains of quartz porphry and granitic rocks. Metamorphic detritus is lacking in A646, but forms an appreciable component in some other areas. A typical sandstone (A647) contains some quartzite and tourmaline grains of Precambrian derivation, but is dominated by angular strained quartz crystal fragments, k-feldspar grains, and quartz porphry clasts. One grain of intergrown quartz and k-feldspar, probably of granitic origin, was noted.

The conglomerate at Mt Selina resembles the Dora Conglomerate of the Lake Dora area (Baillie, 1989), and appears to grade into Jukes Conglomerate (Meares et al., 1982) before being overlain by siliciclastic Owen Conglomerate.

A small area of similar volcaniclastic conglomerate occurs on the south shore of Lake Murchison at 871723. It contains clasts of fine-grained and corse-grained granite (up to 15 mm diameter), as well as clasts of quartz porphyry, quartz-phyric vitric tuff and volcanic quartz. The deposit lies at the margin of the Murchison Granite body, and the granitic clasts have probably been derived from that body.

Murchison Granite

This elongate granitoid body (approximately 9 × 2 km) extends from Lake Mackintosh to Murchison Creek, with small inliers indicating subsurface extension to Mt Selina and Lake Rolleston to the south (Corbett and Jackson, 1987). Other inliers occur on the northern slopes of Mt Murchison, and probably also in the lower part of the Murchison Gorge (Polya, 1981). The body has been dated at 524 ± 15 Ma (McDougall and Leggo, 1965; revised in Adams et al., 1985). The eastern margin of the granite is fault-bounded, and appears to have been a zone of high tectonic stress.

The granite, when fresh (A530, A773) is medium grained (2–6 mm) and composed of quartz (20–25%), k-feldspar (20–30%), plagioclase (25–30%), biotite, hornblende (20–25% combined), with minor apatite, zircon and rutile. The granitoid is therefore a granite to granodiorite. Common alteration phases in this 'fresh' granite are calcite in hornblende; chlorite after hornblende and biotite; sericite after plagioclase; and muscovite in biotite.

Granophyric intergrowths of quartz and k-feldspar are common in A530, while zoned plagioclase is ubiquitous. A marginal facies of the granite (A560) is composed of concentrically zoned laths of plagioclase, altered by webs of sericite, intergrown with quartz and plagioclase which fill the interstices between coarser laths. Rutile, sphene and zircon are abundant. The granite is intruded by many pink, fine-grained dykes up to 0.4 m wide which may also intrude the enclosing volcanic rocks (e.g. A498). This sample has a groundmass of granophyrically intergrown quartz and k-feldspar with some fine-grained (1.2 mm diameter) glomerocrysts of plagioclase and k-feldspar. Sample A528 is composed of intergrown quartz and k-feldspar with some coarser patches of granophyric intergrowth, and at least some microcline. Sub-rounded ?xenoliths of fine-grained feldspar and chlorite-dominated material, with less than 10% modal quartz and 5–10% opaque minerals, occur in A524 and may be cognate mafic xenoliths, as suggested by Polya (1981).

The majority of samples are highly altered (A521, A523, A524, A602, A605, A462). Complete chloritisation of hornblende and biotite, and sericitisation of plagioclase, are ubiquitous while minor epidote and carbonate alteration were recorded. Veining is widespread and includes sericite + quartz, chlorite, quartz + k-feldspar, and epidote. The alteration history of the granite has been studied by Polya et al. (1986) and involves, in approximate age order; intrusion of aplite dykes and alkali metasomatism; chloritisation of ferromagnesian minerals; calcite + epidote alteration; veining of variable style; and sericitisation of feldspar. Initial alteration is considered to be of magmatic origin, while the later alteration is probably Devonian in age.

Brecciation is a major feature of some samples (A523, A462), where angular to subrounded fragments of granite are supported by a sericite or sericite + quartz + chlorite matrix. Mylonitic zones, with strongly grainsize-reduced quartz in a sericite-chlorite matrix, were recorded in A561 and A521, while A626 shows virtually complete mylonitisation with fragments of coarsely intergrown strained quartz and k-feldspar in a sericitic matrix with extremely well-developed crystallographic preferred orientation. The quartz in A626 has well-developed sub-grain nucleation, as does that in A527, and strain lamellae.

The granite from the Mt Selina area (A688, A674) is brecciated and strained, with strong alteration of feldspar and ferromagnesian minerals, and chlorite veining.

OWEN CONGLOMERATE AND CORRELATES — LATE CAMBRIAN TO EARLY ORDOVICIAN

Introduction

The siliciclastic Owen Conglomerate caps most of the prominent peaks in the area, including Mt Murchison, Mt Farrell, Little Farrell and Gooseneck Hill. The coarser conglomerate units, in particular, tend to be massive, poorly jointed, hard rocks which break down only slowly to form large blocks (often house size). Such blocks are found as glacial erratics in many areas. The rocks form poor soils,

generally supporting buttongrass moorlands or alpine to sub-alpine scrub-forest vegetation.

Mapping by McNeill (1987) in the Mt Murchison area, and by Corbett and Jackson (1987) in the adjoining Tyndall Range area to the south, has established a stratigraphic sequence for the Owen Conglomerate, based on five major units as follows:

- Upper sandstone and granule-pebble conglomerate

- Middle Owen conglomerate (pebble to boulder grade, massive)

- Newton Creek Sandstone (grey micaceous sandstone and siltstone)

- Lower conglomerate (pebble to boulder grade)

- Jukes Conglomerate (volcaniclastic)

Jukes Conglomerate (€Oj)

The term 'Jukes Conglomerate' refers to a volcaniclastic conglomerate or breccia unit ('Jukes Breccia' of Hills, 1914) which is generally locally derived and locally developed at the base of the siliciclastic conglomerate and sandstone forming the bulk of the Owen Conglomerate. Scattered clasts of Precambrian-derived quartzite commonly occur within the formation, and may increase in abundance towards the top to produce a more or less gradational boundary with the siliciclastic rocks. The unit is characteristically purplish-brown in colour, due to a high hematite content, and is commonly poorly bedded and strongly cleaved.

The Jukes Conglomerate varies considerably in thickness in the mapped area, from approximately 200 m on the northwest flank of Mt Murchison to 0.6 m in HEC DDH 3156 at Murchison Creek [862683]. It is probably absent on much of the eastern flank of Mt Murchison. Lithologically (A576, A538) the Jukes Conglomerate is a sericite and hematite-rich coarse sandstone to pebble conglomerate, although in some units clasts reach 0.4 m in diameter. A tuffaceous matrix, with quartz and rare feldspar crystal fragments, supports sub-angular to sub-rounded clasts of both volcanogenic (dominantly quartz porphyry and fine-grained sericitic volcanic) and metamorphic (dominantly micaceous quartzite) material.

The Jukes Conglomerate generally rests disconformably on basement volcanic rocks and granite, but in Quinn Creek and the Anthony River, coarse sandstone and conglomerate (A771a, A597) containing volcanic and granitoid detritus has an apparently gradational contact with underlying volcaniclastic conglomerate, and differs mainly in its strongly hematitic nature. On the hill northwest of Lake Westwood the Jukes Conglomerate is also apparently transitional with underlying volcaniclastic sediments. Some 3–4 m of pebble-to boulder-grade volcaniclastic conglomerate is underlain by coarse sand-grade volcaniclastic rocks and interbedded coarse pink siliciclastic sandstone with well-developed crossbeds. The presence of this typical Owen Conglomerate-type sediment suggests that Owen-type sedimentation was commencing as the Jukes Conglomerate was being deposited. A similar relationship was recorded at 818634, where a window in an anticline of lower Owen Conglomerate reveals well cleaved, quartz-phyric, green-grey fine-grained volcaniclastic rocks interbedded with thin pink pebble conglomerate bands. The top of the Jukes Conglomerate may be sharp, with shallow channelling at the contact [e.g. at 844687], or gradational, most notably with the Lower Conglomerate unit at Moxon Peak.

Lower Conglomerate Unit (€Ool)

This unit conformably overlies the Jukes Conglomerate in the Lukes Knob area and on the NW slopes of Mt Murchison, where it reaches a thickness of 200–250 metres. The unit consists predominantly of siliceous grey to pink, pebble-cobble conglomerate, grading to cobble-boulder conglomerate towards the base. Lenses of cross-bedded, grey to pale pink sandstone, up to one metre thick, occur throughout the formation, and minor shale was recorded near Moxon Peak. Clasts of volcanic material occur in the basal part of the formation, which may have a partially volcaniclastic matrix.

At both Moxon Peak and southwest of Lukes Knob (on Map 5 – Corbett and Jackson, 1987), the unit passes conformably, but abruptly, into overlying grey micaceous sandstone of the Newton Creek Sandstone.

Newton Creek Sandstone (€Oon)

This unit of interbedded micaceous grey sandstone, siltstone and granule-pebble conglomerate crops out extensively in the Newton Creek–Mt Julia area, just south of Map 4, where it contains middle Late Cambrian fossils and has been described in detail by Corbett (1975). In the vicinity of Julia Creek [800627] the unit rests directly on Tyndall Group rocks without intervening Jukes Conglomerate or the lower conglomerate unit.

Outcrops near Moyle Rock [835797] are of interbedded grey micaceous sandstone and pebble conglomerate, and show deformation structures of both syn-depositional and tectonic origin. The sandstone (A577) contains dominantly Precambrian detritus (micaceous quartzite, quartz-mica phyllite), and some hematitic cherty material.

The unit occurs as a northwards-thickening wedge at Moxon Peak, where outcrops on the southern flank are more volcanic-rich than usual. Sample A640 is a well-laminated white micaceous sandstone with minor slump folds and convolute lamination. In thin section it is composed of sub-angular grains of quartz, tourmaline, phyllite, micaceous quartzite, k-feldspar, plagioclase and ?vitric ash. Sample A641 has a bimodal grainsize distribution, with scattered clasts (10–20 mm diameter) of pink lava in a well-sorted matrix of volcanic quartz, micaceous quartzite, strained quartz and tourmaline. North of Moxon Peak, the unit consists of interbedded grey pebble conglomerate, green-grey sericitic shale (in beds up to 1.5 m thick) and micaceous sandstone units (up to 15 m thick). Slump folds, ball and pillow structures, and various load-modified sole structures on sandstone beds, occur throughout the sequence.

Middle Owen Conglomerate (€Oom)

A unit of pale pink, thick-bedded to massive, pebble-cobble to cobble-boulder conglomerate, with lenses of coarse pink sandstone, conformably overlies the Newton Creek Sandstone on Mt Murchison and at Moyle Rock. The unit is continuous with the Middle Owen Conglomerate of the Tyndall Range, and also occurs on Mt Farrell and as outliers southeast of the Murchison Dam and on the eastern side of Lake Mackintosh [892754]. It has a maximum thickness of the order of 350 m near the summit of Mt Murchison but thins rapidly to the east of this and wedges out in the vicinity of Murchison Creek. It is of the order of 150 m thick in the Anthony River near Arnold Peak, but thins northwards to be absent or only a few metres thick in the vicinity of Red Hills Creek.

The Middle Owen Conglomerate rests directly on Jukes Conglomerate, or on volcanic rocks, in some areas, e.g. around the Red Hills and southeast of the Murchison Dam. Contacts with the Jukes Conglomerate are commonly abrupt

and sometimes channelled. Minor volcaniclastic material may occur in the basal part of the Middle Owen sequence, but the bulk of the unit comprises rounded clasts of quartzite, quartz-schist and vein quartz in a siliceous sand-grade matrix.

A mappable unit of cross-bedded sandstone and pebble conglomerate, 10–30 m thick, occurs in the central part of the Middle Owen sequence from south of the Red Hills to Moxon Peak. This unit may correlate with a sandstone-rich unit within the conglomerate on Little Farrell and Mt Farrell. Similar interbedded sandstone and conglomerate occurs at the base of the Middle Owen, forming a gradational contact with the Newton Creek Sandstone east of Lake Westwood.

A local hematitic facies of dark red-purple sandstone (A639) and minor pebble conglomerate occurs within the Middle Owen sequence north of Lake Westwood [831644].

Upper Sandstone Sequence (ЄOou)

This sequence of some 300 m+ of pink to purple and green sandstone, interbedded with granule-pebble conglomerate and minor siltstone and shale, overlies the Middle Owen Conglomerate and crops out extensively on Mt Murchison and Mt Farrell. The sequence rests directly on volcanic basement (including Murchison Granite) in many areas along the eastern side of the conglomerate belt, as a consequence of the wedging out of underlying units. The sequence is typically thin to medium-bedded and cross-bedded, and is characterised by the presence of abundant small chert clasts (in addition to the ubiquitous quartzite clasts) in a dark pink to chocolate-brown hematitic matrix. The base of the sequence is generally a sharp, sometimes erosional contact, on the underlying Middle Owen Conglomerate. The top of the sequence is presumably overlain by Gordon Group limestone, but has not been seen in the mapped area.

A discontinuous basal facies of grey to pale pink micaceous sandstone with minor siltstone and pebble conglomerate occurs just west of the summit of Mt Murchison and also on Mt Farrell near Lake Herbert (Plate 1). This facies is generally thin-bedded and characterised by abundant soft-sediment deformation structures.

A mappable unit of coarser pebble-cobble conglomerate occurs within the sequence near Lake Selina and also on the eastern flanks of Mt Farrell.

Bioturbation structures, including both horizontal and vertical burrows, occur in places throughout the sequence, and suggest a predominantly shallow marine environment of deposition. Well-developed mud cracks (Plate 2) were noted at one horizon on the eastern slopes of Return Ridge, indicating at least intermittent subaerial exposure, possibly in an inter-tidal setting. Dewatering structures have also been recorded near Tunnel End (Polya, 1981). Slump folds occur in places, and are particularly well exposed beside the Anthony Road at 844657. Some of the slumped horizons are truncated by the succeeding sandstone bed, indicating that the soft-sediment movement occurred on the sea floor prior to burial. Reduction spots up to 40 mm across were noted in sandstone beds SE of the Red Hills.

Sample A578, a typical sandstone from Moyle Rock, consists of angular to sub-rounded grains of chert, quartzite and quartz (including some grains with embayments suggesting a volcanic origin), up to 7 mm across, in a matrix of chert, quartz and dusty hematite. Zircon and rutile occur as accessories. A sample (A772) from the basal part of the sequence at Arnold Peak shows recrystallisation to mosaic quartz, with a film of sericite separating most grains. Scattered euhedral grains of tourmaline are also present.

Unassigned Owen sequence at Gooseneck Hill

A problematic sequence of sandstone and conglomerate overlies Tyndall Group porphyries and Jukes Conglomerate at Gooseneck Hill. A lower unit of interbedded grey sandstone and pebble conglomerate occurs in several areas, and is rich in volcanogenic material, including quartz porphyry clasts and volcanic quartz grains (sample A634). This passes upwards, fairly abruptly, into massive pink pebble-cobble conglomerate, with minor sandstone lenses. This unit coarsens upwards to boulder grade, and contains conspicuous clasts of quartz porphyry near the top.

On the southwestern ridge of Gooseneck Hill, the massive pink cobble-boulder conglomerate appears to be in faulted contact with grey-white sandy pebble-cobble conglomerate, the fault probably representing an arm of the Great Lyell Fault (Corbett, 1975). The grey conglomerates and sandstones have a significant volcanogenic component, suggesting correlation with the lower grey unit elsewhere on Gooseneck Hill. These units were correlated with similar grey, conglomerate-rich units within the Newton Creek Sandstone by Corbett (1975), but the overlying pink conglomerate is more akin to the lower conglomerate unit of this paper, or to the Middle Owen Conglomerate.

Summary of stratigraphic relationships within the Owen Sequence

The major stratigraphic relationships in the Owen Conglomerate in the mapped area are illustrated diagrammatically in Figure 3. The Newton Creek Sandstone and underlying lower conglomerate unit are developed in fault-bounded basins, in palaeogeographic lows in the volcanic basement, or in a combination of both settings. Many of the basin-forming faults have apparently been re-activated in the Devonian.

The relatively massive Middle Owen Conglomerate occurs across the whole area but thins considerably to the east, being absent in places at the eastern margin of the belt. This eastwards thinning probably reflects the graben-forming influence of the Henty Fault and Great Lyell Fault. A similar situation is even more evident on the Tyndall Range, where most units show pronounced thinning to the east away from the Great Lyell Fault (Corbett and Jackson, 1987).

The upper sandstone sequence appears to maintain its thickness, or possibly increase it slightly, to the east, and is regionally the most extensive unit.

Detailed sedimentological studies of the Owen sequence have not been attempted, but some tentative interpretations of depositional environments may be made. As discussed by Corbett (1975), the Newton Creek Sandstone is a marine sequence of proximal turbidite type, and probably represents a submarine fan complex. The overlying massive to thick-bedded Middle Owen Conglomerate, with its thin lenses of sandstone and apparent absence of trace fossils, appears more likely to be an alluvial fan deposit. The absence of fine-grained units of overbank type suggests a braid-plain environment rather than a meander-belt system. The upper sandstone sequence includes both pink and grey facies, suggesting variation in oxidation conditions, and shows bioturbation features and rare mud cracks. A variety of shallow marine and possibly intertidal to terrestrial environments seems likely.

Plate 1. Fold in conglomerate and sandstone, upper sandstone unit of Owen Conglomerate.
North-south phase of folding with overturned style. Near Lake Herbert [866761]

Plate 2. Mud cracks in upper sandstone unit of Owen Conglomerate.
Shore of Lake Mackintosh [881769]

Figure 3.

Idealised stratigraphic relationships in the Owen Conglomerate, Moxon Peak–Anthony River–Moyle Rock area (not to scale).
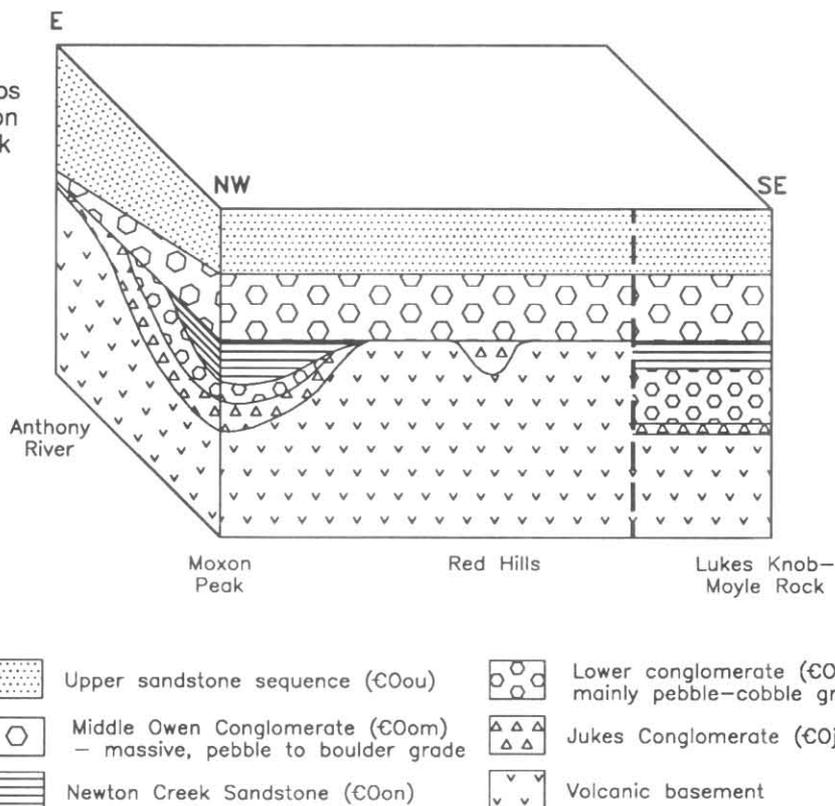
INTRUSIVE ROCKS WITHIN THE OWEN CONGLOMERATE

Probable intrusive bodies of two different types have been recorded from within the Owen Conglomerate.

Quartz porphyry

A small outcrop of cleaved felsic igneous rock occurs within the upper sandstone sequence near the southern end of Return Ridge, off Mt Farrell. The occurrence was mapped by Brooks (1962) as Jukes Conglomerate, but the present mapping and petrological examination suggests the body is more likely to be an igneous porphyry.

The sample (A483) shows a weak cleavage in hand specimen. In thin section the sample has a pink-brown, cryptocrystalline glassy groundmass showing abundant perlitic cracking and incipient brecciation marked by brown chloritic seams. There are scattered, small, embayed quartz phenocrysts up to 1 mm across; fairly numerous opaque grains; numerous chlorite blocks and patches, some of which are subhedral and may be pseudomorphs after a ferromagnesian mineral; and blebs and flecks of very fine-grained sericite, some of which are probably after feldspar phenocrysts. Minor pumpellyite is present. There are also some internal wispy shapes reminiscent of tube pumice texture.

The glassy perlitic nature of the groundmass suggests either a shallow intrusive or extrusive origin. The presence of a NW-trending cleavage in the outcrop suggests emplacement prior to the second phase of Devonian deformation.

Quartz porphyry intrusions in the Owen Conglomerate have been recorded at Newton Creek canal by Corbett and Jackson (1987), and at Pumicestone Ridge near Deloraine by Pike (1973).

Dolerite

A four metre thick dolerite dyke was recorded by Roberts and Cartwright (1984) from drill hole RH-17 within the Owen Conglomerate two kilometres south of Red Hills [825631]. Examination of the core suggests that two dykes (or a composite dyke), separated by 0.8 m of quartz-veined conglomerate, are present. The dykes are dark green, medium-grained rocks with chilled and altered margins.

A thin section (A776) shows a sub-ophitic texture, with weakly-sericitised laths and some coarse phenocrysts of plagioclase enclosing pink clinopyroxene and skeletal to euhedral opaque minerals. Minor chloritised biotite was noted, but may be an alteration product. Chlorite and sericite alteration is weak but pervasive. A single sub-rounded patch of chlorite and calcite may be a vesicle.

QUATERNARY DEPOSITS

Pleistocene glacial deposits

The Mt Murchison area was extensively glaciated during the Pleistocene, producing widespread deposits of bouldery till. At least two glacial episodes occurred. The most recent, referred to as the Margaret Glaciation (Colhoun, 1985), was restricted mainly to high-level cirques and short valley glaciers, and was responsible for the obvious morainal ridges and associated deposits in the southeasterly-directed valleys emanating from Mt Murchison. Lakes Sandra and Gaye, and Shaded Lake, lie in the heads of these valleys. The peak of this glaciation occurred 18,000–20,000 years BP. The ice had withdrawn from its limits before 11,000 years BP, and had disappeared from the highest levels before 9000 years BP (Colhoun, 1985). The deposits, as exposed along the Anthony Road in the vicinity of Quinn Creek, are of poorly-sorted bouldery material with clasts up to several metres across in a matrix of clayey gritty sand. Clasts are predominantly of

siliceous conglomerate and sandstone derived from the Owen Conglomerate, with a smaller component of volcanic and rare granitic clasts. The deposits typically support a dense implicate rainforest except in burnt areas, where buttongrass and scrub vegetation types predominate.

At least two earlier phases of Pleistocene glaciation have been recognised in western Tasmania, and were clearly much more extensive than the younger Margaret phase (Colhoun, 1985). A major ice system flowed around the northern side of Mt Murchison and Mt Farrell, and spread westwards and northwestwards into the Pieman River system and its tributary valleys. The most obvious expression of this phase in the mapped area is the large east-trending end moraine forming the divide between the Sterling River to the north and the Stitt River to the south. This feature, which butts against the northwestern slopes of Mt Murchison, was apparently formed by ice pushing up the Sterling Valley from the north. This ice appears to have over-topped the broad divide west of the Sterling Valley, and flowed into the Rosebery area, such that the prominent moraine ridge has a finger-like extension connecting with morainal deposits at Dalmeny.

Till deposits in the Sterling Valley and on the south Sterling end moraine are typically bouldery, poorly-sorted deposits rich in clasts of siliceous conglomerate and sandstone derived from the Owen Conglomerate, as well as volcanic clasts from the Mt Read Volcanics. Also present, however, are clasts up to large boulder size of granite, generally pink in colour, and presumably derived from either the Cambrian Murchison Granite or from the Devonian Granite Tor Granite further east. One of these granite clasts, exposed in a costean on the western side of the valley at 841734, was five metres long, and had previously been considered to be granite bedrock by some exploration geologists.

Rounded boulders of fresh, equigranular dolerite, resembling the Jurassic dolerite, were noted within morainal deposits south of Red Hills [821635] and east of Red Hills [841645]. The source of these boulders is uncertain, as the nearest known dolerite outcrops are on Mt Sedgwick and Mt Dundas.

Extensive outwash gravels of Pleistocene age occur on the plains around Lake Rosebery and Tullah. These gravels have been quarried for some time as back-fill for the Que River Mine.

Alluvial deposits

Areas of stratified pebbly to sandy alluvium of probable Holocene age, associated with peaty swamp deposits, occur in the valley of the upper Anthony River, at Lake Selina, in the valley of Julia Creek, and in several small areas around Red Hills.

GEOCHEMISTRY

Introduction

Chemical analyses of 20 rocks from the mapped area are given in Table 1. The major element values have been recalculated volatile-free. Original analyses, and locality details, are given in Appendix 1.

The analysed rocks comprise five from the Central Volcanic Complex in the Red Hills area, nine from the Eastern Quartz-phyric Sequence, two from the Murchison Granite, two from the Tyndall Group in the Gooseneck Hill area, and one from the dolerite dyke intruding Owen Conglomerate in DDH RH-17 at Red Hills.

Three of the analyses (84/1, 84/1A, 84/6) were done in 1975 following the mapping project by Corbett (1975). The remaining analyses were of samples collected by A. McNeill during the present programme. All analyses were carried out by the Department of Mines Launceston Laboratories. Sample localities are shown on Figure 2.

General geochemical features

As is the case with the Mt Read Volcanics generally, the rocks in the mapped area are mildly to strongly altered, such that most major element values have probably been modified to some extent. For this reason, classification of the rocks is better achieved using the relatively immobile trace elements, and Figure 4 shows the standard discrimination plot using Zr/TiO_2 vs Nb/Y (Winchester and Floyd, 1977). The majority of the analysed rocks plot in the sub-alkaline (or calc-alkaline) fields on this diagram, and are predominantly rhyodacites-dacites or andesites. The three 1975 samples are not plotted as Nb was not determined.

The general calc-alkaline nature of the rocks is confirmed on the Ti vs Zr plot (fig. 5), where all the samples but one plot in the lower part of the diagram on a flat trend typical of calc-alkaline rocks (Pearce and Cann, 1973) and of the Mt Read Volcanics generally (Corbett, 1989). The exception is the doleritic dyke from the Owen Conglomerate (A776), which plots in the general area of tholeiitic rocks.

A plot of SiO_2 vs TiO_2 for the analysed rocks is shown in Figure 6. All of the felsic rocks fall roughly on a straight line, suggesting the possibility that the Central Volcanic Complex lavas, the Eastern Sequence porphyries, and the Tyndall Group lavas could be essentially co-magmatic. The Murchison Granite appears to lie on this same straight-line trend.

Central Volcanic Complex

Four of the analysed rocks from the CVC are pink feldspar-phyric lavas from the large dome-like body at Red Hills. Sample A754 is a clastic quartz-phyric rock from just east of the crest of Red Hills, and 84/1A is a grey-green feldspar-phyric lava from about 600 m west of Red Hills.

The four pink lavas have recalculated SiO_2 values in the 69–74% range (rhyodacite-rhyolite) and the three plotted samples lie in the rhyodacite-dacite field on Figure 4. The lavas fall within the fairly well-defined field of southern CVC dacites and rhyolites on the Ti vs Zr plot (fig. 5, data from Corbett, 1989). A significant feature of the major element chemistry of these rocks is the very high potash levels (6.6–9.2% K_2O) associated with low levels of Na_2O (0.15–0.25%) and CaO (0.01–0.05%). The high potash content is attributed mainly to the presence of k-feldspar in the groundmass and as rare phenocrysts, and may in part be an alteration feature associated with local sulphide mineralisation (Eastoe et al., 1987). Similar pink, potash-rich rocks occur within the southern CVC at Mt Darwin, Whip Spur and Mt Sedgwick (Corbett, 1979; Solomon, 1964).

The quartz-phyric rock from Red Hills (A754) does not show the same potash enrichment (1.84% K_2O), and has relatively 'normal' values of Na_2O and CaO.

The grey-green lava from west of Red Hills (84/1A) has high silica and low MgO, moderately high K_2O (5.45%), and moderate Na_2O (2.32%). Its Zr content of 63 ppm appears to be anomalously low (fig. 5), and a laboratory error is suspected.

Table 1

RE-CALCULATED CHEMICAL ANALYSES FOR 20 ROCKS FROM THE MT MURCHISON AREA

	CENTRAL VOLCANIC COMPLEX						EASTERN QUARTZ-PHYRIC SEQUENCE									MURCHISON GRANITE		TYNDALL GROUP		DYKE IN OWEN
	A751	A758	A750	84/1	A754	84/1A	A679	A478	A694	A687	A470	A671	A689	A668	A545	A773	A530	A635	84/6	A776
SiO₂	69.77	71.22	72.63	74.21	71.91	78.47	61.99	70.22	70.90	69.62	70.49	75.51	72.02	73.20	78.07	60.85	61.90	76.26	77.20	48.83
TiO₂	0.46	0.36	0.30	0.24	0.39	0.20	0.62	0.52	0.48	0.48	0.47	0.30	0.37	0.46	0.18	0.79	0.77	0.23	0.19	1.66
Al₂O₃	14.35	12.66	12.18	11.67	13.48	11.02	16.01	13.69	13.41	14.36	13.28	12.90	13.72	13.86	12.85	15.26	15.69	12.16	11.56	17.74
FeO	2.76	3.05	4.57	3.48	3.14	1.21	10.05	3.92	3.52	3.95	4.98	1.23	1.72	2.07	0.74	2.63	4.30	1.34	0.49	2.28
Fe₂O₃	2.42	3.14	2.33	1.64	1.79	1.01	4.50	0.82	1.61	2.98	2.24	1.18	1.55	0.13	0.78	4.71	2.58	1.18	1.43	9.88
MnO	0.03	0.05	0.05	0.07	0.07	0.04	0.21	0.08	0.06	0.26	0.36	0.06	0.04	0.05	0.02	0.28	0.28	0.02	0.08	0.28
MgO	0.72	1.25	1.02	0.76	1.08	0.12	3.22	2.20	1.49	0.94	2.28	0.59	0.86	1.29	0.34	3.52	3.09	0.54	0.32	6.77
CaO	0.01	0.02	0.02	0.05	2.45	0.12	0.03	1.64	0.06	0.03	0.04	0.13	0.10	2.34	0.55	4.83	4.26	0.03	1.23	9.47
Na₂O	0.21	0.25	0.18	0.15	3.81	2.32	0.07	3.37	0.74	0.18	0.08	2.42	1.52	3.52	4.96	2.76	2.39	3.49	3.68	2.19
K₂O	9.22	7.98	6.67	7.68	1.84	5.45	3.27	3.50	7.71	7.13	5.75	5.64	8.06	3.03	1.50	4.17	4.61	4.74	3.79	0.66
P₂O₅	0.05	0.02	0.05	0.05	0.04	0.04	0.03	0.04	0.02	0.07	0.03	0.04	0.04	0.05	0.01	0.20	0.13	0.01	0.03	0.24
	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

Trace elements in ppm

	A751	A758	A750	84/1	A754	84/1A	A679	A478	A694	A687	A470	A671	A689	A668	A545	A773	A530	A635	84/6	A776
Ba	3300	6100	2900	5300	490	2540	990	840	2600	2100	1700	1250	1850	700	290	1250	1300	1450	1750	220
Rb	180	165	135	163	83	131	120	160	!75	190	180	220	250	140	71	160	200	94	83	23
Sr	96	53	79	101	195	84	13	125	73	53	75	100	88	155	160	390	340	30	100	280
Y	28	31	59	27	44	42	29	30	30	28	21	32	18	41	18	26	29	20	41	30
Nb	10	10	9	-	15	-	5	11	14	14	14	15	13	14	13	12	12	19	-	7
Zr	250	270	260	246	210	63	130	240	240	240	195	190	160	240	135	190	185	195	186	155
Co	<4	5	24	12	<4	<6	24	<4	<4	7	30	<4	<4	<4	<4	18	17	4	<6	42
Ni	4	4	5	<4	17	7	15	23	8	5	27	4	4	10	3	11	10	5	9	48
Cr	61	49	62	46	125	56	51	165	73	57	145	100	64	100	50	105	89	100	50	110
V	59	26	20	<13	42	<13	220	69	56	50	73	24	39	49	12	170	160	9	<13	230
Sc	10	<10	<10	-	<10	-	24	10	<10	10	<10	<10	<10	11	<10	20	21	<10	-	31
Cu	73	36	170	8	20	<5	50	13	64	20	17	20	15	15	16	36	34	140	<5	34
Pb	4	5	6	12	10	<6	10	18	22	170	175	62	10	38	7	83	92	5	7	<4
Zn	72	89	70	71	61	30	200	94	88	330	195	66	82	120	35	240	430	50	120	63
As	12	<10	14		<10		11	11	<10	16	16	<10	<10	<10	<10	-	26	10		
Ag	<5	<5	<5		<5		<5	<5	<5	<5	<5	<5	<5	<5	<5	-	<5	<5		

Samples 84/1, 84/1A, 84/6 submitted by K. Corbett, 1975. All others submitted by A. McNeill, 1987. All analyses by Department of Mines Launceston Laboratories. Analysed by XRF. Note: sample locations are shown on Figure 2, AMG references are given in Appendix 1.

  -   not analysed   <5   below detection limit

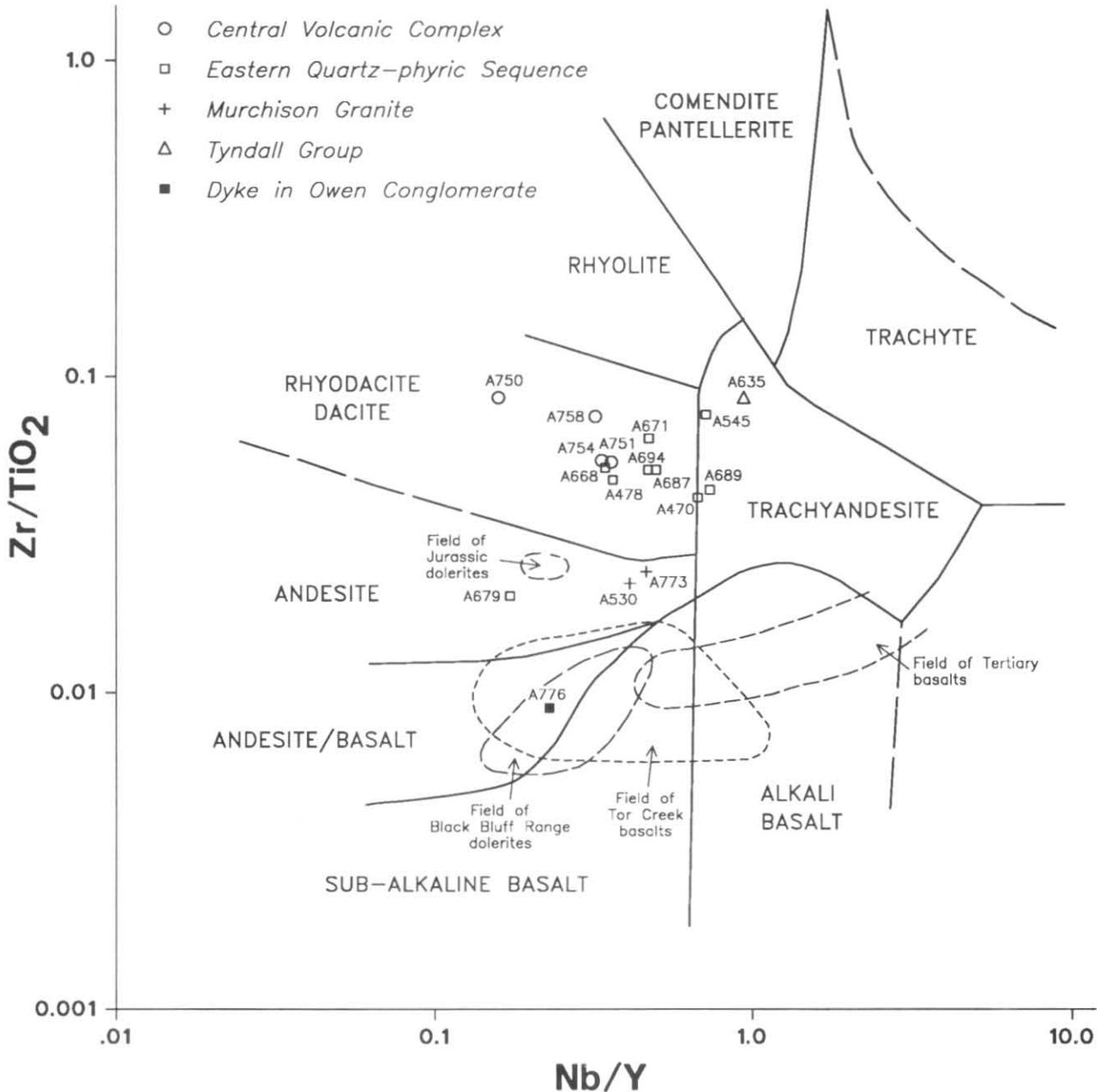|		
A751	Feldspar-phyric lava	Crest of Red Hills
A758	Feldspar-phyric lava	1 km north of Red Hills
A750	Feldspar-phyric lava	Crest of Red Hills
84/1	Feldspar-phyric lava	Crest of Red Hills
A754	Quartz-feldspar-phyric volcaniclastic	East side of Red Hills
84/1A	Grey feldspar-phyric lava	1 km west of Red Hills
A679	Quartz-feldspar-phyric lava	Near Selina Pyrite workings
A478	Feldspar-quartz-phyric lava	Anthony Road north of Mt Murchison
A694	Quartz-feldspar porphyry	Ridge east of Sterling Valley
A687	Quartz-feldspar-biotite porphyry	Near Anthony River
A470	Quartz-feldspar-biotite porphyry	East shore Lake Mackintosh
A671	Quartz-feldspar-biotite porphyry	Near Selina Pyrite workings
A689	Quartz-feldspar porphyry	North of Mt Murchison
A668	Quartz-feldspar porphyry	Anthony Road NE of Mt Murchison
A545	Quartz-feldspar porphyry	Anthony Road south of Mt Murchison
A773	Murchison Granite	Ridge SE of Mt Murchison
A530	Murchison Granite	Anthony Power Station Rd
A635	Quartz-feldspar-phyric lava	Gooseneck Hill
84/6	Quartz-feldspar-phyric lava	North of Gooseneck Hill
A776	Basaltic dyke in DDH RH17	2 km south of Red Hills

Figure 4. Plot of Zr/TiO_2 vs Nb/Y for analysed rocks. Fields for Black Bluff Range dolerite and Tor Creek basalts are from Pemberton *et al.* (1991) and unpublished data of Pemberton and Vicary (1989). Field of Tertiary basalts from data of Everard *in* Seymour (1989).

Eastern Quartz-phyric Sequence

The nine analysed rocks from the Eastern Sequence comprise four from the Anthony River–Mt Selina area (A545, A671, A679, A687), four from the Murchison Gorge area west of the Murchison Granite body (A478, A668, A689, A694), and one from a porphyry body east of the Murchison Granite at Lake Mackintosh (A470). Four of the samples (A545, A470, A668, A689) are from definite or probable intrusive bodies (mostly quartz-feldspar-biotite porphyries), three are probably lavas (A679, A478, A694), and two may be either intrusive or extrusive.

Silica values for all except one of the rocks range from 70–78%, indicating rhyodacite to rhyolitic compositions. The trace element plot (fig. 4) suggests the rocks are rhyodacites and dacites rather than rhyolites. Sample A679, a lava from near the Selina workings, has 62% SiO_2 and is apparently an andesite (fig. 4). It plots within the field of Que-Hellyer

andesites on both the Ti-Zr plot (fig. 5) and the SiO_2-TiO_2 plot (fig. 6).

The rhyodacites show high to very high potash levels (5–8% K_2O) in many cases, combined with variable but generally low Na_2O and CaO levels. The high potash levels resemble those of the feldspar-phyric CVC lavas from Red Hills, and there seems little to distinguish the two groups geochemically. The groups overlap extensively on both the Ti-Zr plot and the SiO_2-TiO_2 plot (figs 5, 6).

Murchison Granite

The two analysed granite samples are from near the southern end of the main body, and show very similar chemistry. Silica values (61–62%) are in the upper part of the andesite range, and the samples plot in the andesite field on the Zr/TiO_2 vs Nb/Y diagram (fig. 4). Samples listed by Polya *et al.* (1986) show considerably more chemical variation, and plot mainly
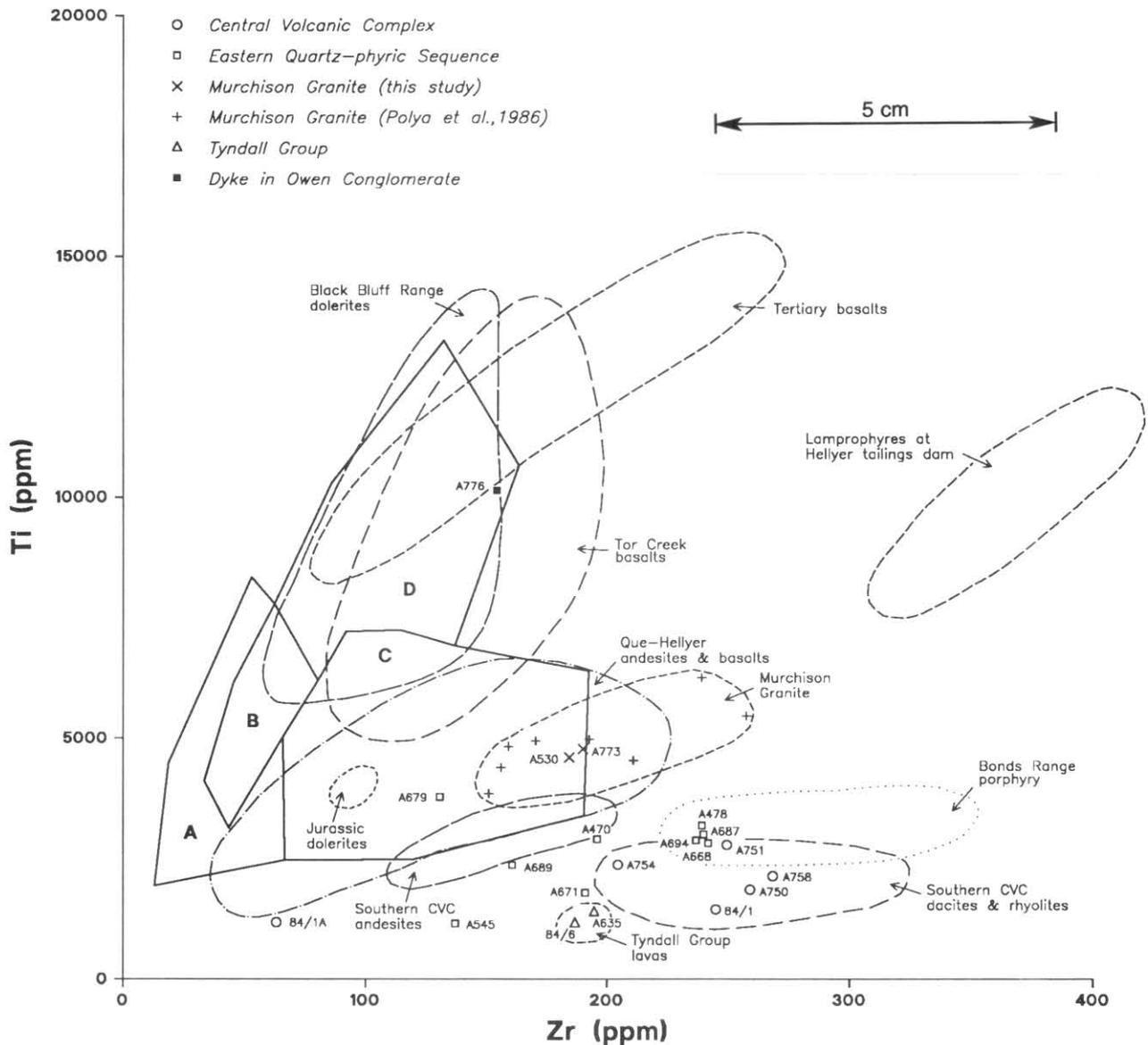
Figure 5. Plot of Ti vs Zr for analysed rocks (after Pearce and Cann, 1973). Data for fields of rock units shown are from the following: Tertiary basalts – Everard *in* Seymour (1989); Tor Creek basalts – Pemberton *et al.* (1991) and unpublished data; lamprophyres – Pemberton *et al.* (1991); Que–Hellyer andesites and basalts – Corbett and Komyshan (1989); Murchison Granite – this study and Polya *et al.* (1986); Southern CVC andesites – Corbett (1989); Southern CVC dacites and rhyolites – Corbett (1989); Bonds Range porphyry – Pemberton *et al.* (1991); Jurassic dolerites – Hergt *et al.* (1989).

in the rhyodacite-dacite field. On the Ti-Zr plot (fig. 5) the two samples plot within the field of calc-alkaline andesites generally, and the field defined by these plus the samples of Polya *et al.* (op. cit.) lies mainly within the field of Que-Hellyer andesites and basalts.

On a plot of SiO_2 vs TiO_2 (fig. 6), the granite samples (including those of Polya *et al.*, 1986) appear to lie on the same straight line as the Eastern Sequence samples, a feature interpreted by Polya *et al.* (op. cit.) to indicate a probable co-magmatic origin for the granite and volcanic rocks.

Tyndall Group lavas

The quartz-feldspar-phyric Tyndall Group lavas from Gooseneck Hill have high silica values (76–77%) and are therefore likely to be rhyolites. The plot for sample A635 on the Zr/TiO_2 vs Nb/Y diagram (Nb was not determined for 84/6) falls in the trachyandesite field (fig. 4) as a consequence of its relatively high Nb value (19 ppm) but the significance of this is uncertain. The lavas have moderate potash

(3.8–4.7%) and soda (3.5–3.7%) levels, in contrast to the highly potassic lavas to the east. Other aspects of the chemistry are generally similar to those of the other felsic rocks in the mapped area, and the SiO_2 vs TiO_2 plot (fig. 6) suggests they could be co-magmatic with the dacites and rhyolites of the Eastern Sequence and other parts of the CVC.

Dyke in Owen Conglomerate

The dolerite dyke has a basaltic composition (49% SiO_2), with relatively high TiO_2 (1.66%). The high CaO (9.5%) value suggests carbonate alteration, and possibly some carbonate-filled vesicles. Tholeiitic affinities are evident in the Ti-Zr plot (fig. 5), where the sample plots close to the field of Tertiary basalts from the St Valentines Peak area (Everard *in* Seymour, 1989). The sample also falls within the field of Tertiary basalts on the SiO_2 vs TiO_2 diagram (fig. 6). However a genetic relationship to the Tertiary magmas seems less likely from the Zr/TiO_2 vs Nb/Y plot (fig. 4), where the dyke plots well within the sub-alkali field compared to the Tertiary rocks, which are predominantly alkaline.
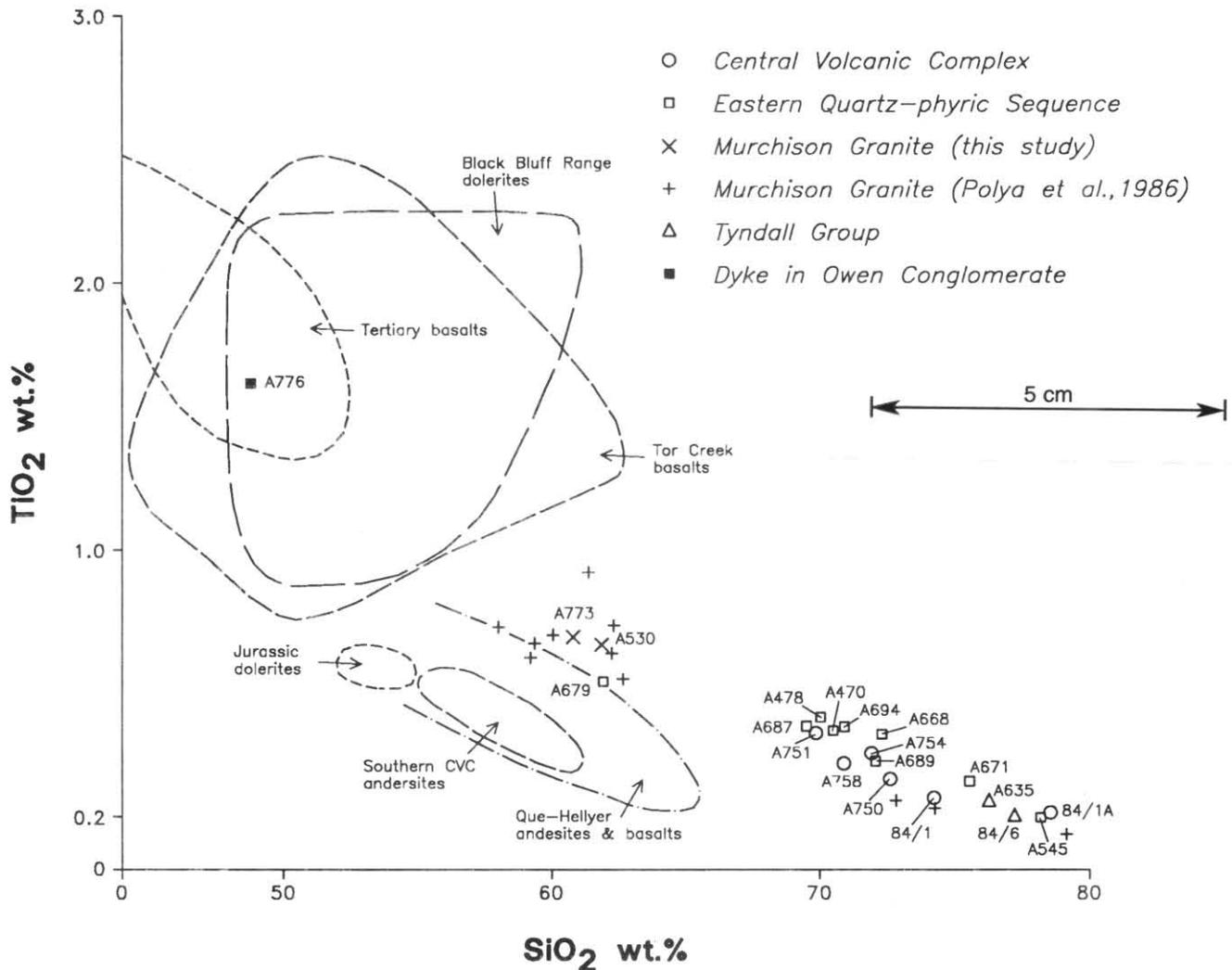
Figure 6. Plot of TiO_2 vs SiO_2 for analysed rocks. See Figure 5 for data sources.

No relationship is evident between the dyke and the Tasmanian Jurassic dolerites (figs 4, 5, 6), nor with the lamprophyric dykes (fig. 5) which intrude the Cambrian rocks at the Hellyer tailings dam (Pemberton *et al.*, 1991).

A series of dolerite dykes intrude the Owen Conglomerate in the Black Bluff Range area, and have been mapped on MRV Map 7 (Vicary and Pemberton, 1988) and MRV Map 9 (Pemberton and Vicary, 1989). Also occurring within the Owen Conglomerate in this area are altered basaltic lava flows referred to as the Tor Creek basalts (MRV Maps 8, 9 — Pemberton and Vicary, 1988, 1989). Descriptions of these rocks, and some geochemical data, are given in Pemberton *et al.* (1991), and further geochemical data has been obtained from the Map 9 area. Fields for the Black Bluff Range dolerites and Tor Creek basalts have been plotted on the three discrimination diagrams (figs 4, 5, 6) to indicate any possible relationship with the Red Hills dyke. Although the fields are dispersed and rather poorly defined because of the altered nature of the rocks, sample A776 falls within the two overlapping fields in all three cases. Its position within the central part of the Black Bluff Range dolerite field on the Zr/TiO_2 vs Nb/Y diagram (fig. 4) is perhaps most significant.

It is tentatively concluded that the Red Hills dolerite dyke is related to the Black Bluff Range dolerites. These have given

a minimum K-Ar age of 329 ± 4 Ma (Carboniferous), but the presence of alteration and strain effects, and the fact that the bodies appear to have been folded with the enclosing rocks in the Devonian, suggest a pre-Devonian, possibly Ordovician, age (Pemberton *et al.*, 1991).

STRUCTURAL GEOLOGY

Precambrian rocks

Two main folding events are evident in the Precambrian rocks. The D_1 event produced steeply inclined, tight to isoclinal, angular folds which have both north and south plunges. Axial planar to this is an anastomosing lepidoblastic foliation (S_1) in phyllite, and a spaced cleavage in quartzite which is sub-parallel to compositional layering. Associated with this deformation is the boudinage of quartzite layers. A stereoplot of poles to S_0 and S_1 is shown in Figure 7a.

D_2 folds are moderately tight, moderately east-plunging structures which produce a weak, spaced fracture cleavage in quartzite, a crenulation cleavage in phyllite, and a spaced, 2–4 mm crenulation cleavage in interbedded phyllite and quartzite. A crenulation lineation on S_1 in the Anthony River may be related to this deformation.
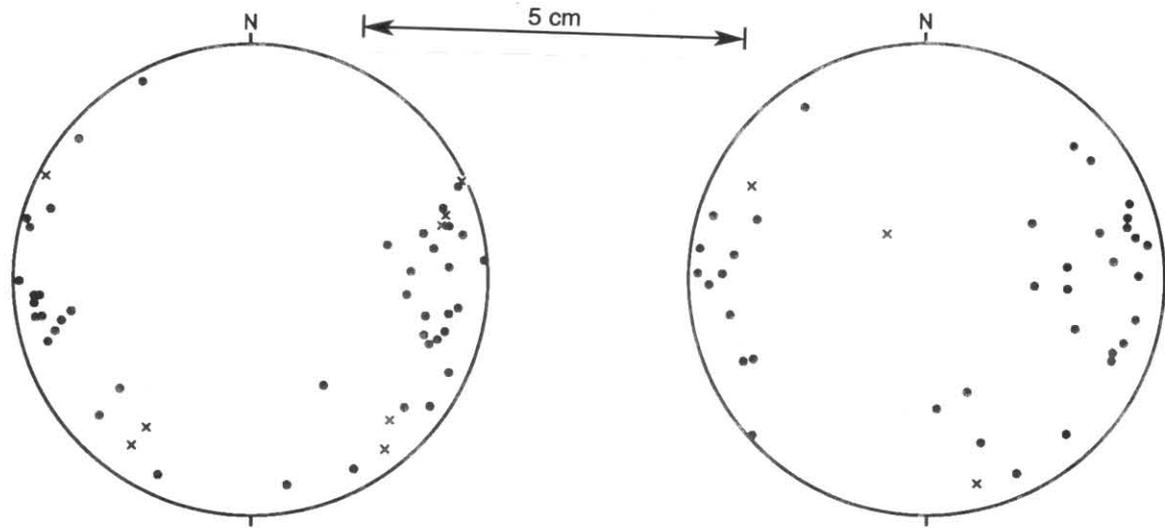
(a) Poles to S₀–S₁ in Precambrian rocks (•);
poles to S₂ (x).

(b) Poles to bedding, Sticht Range Beds.
x are fold axes of minor folds.
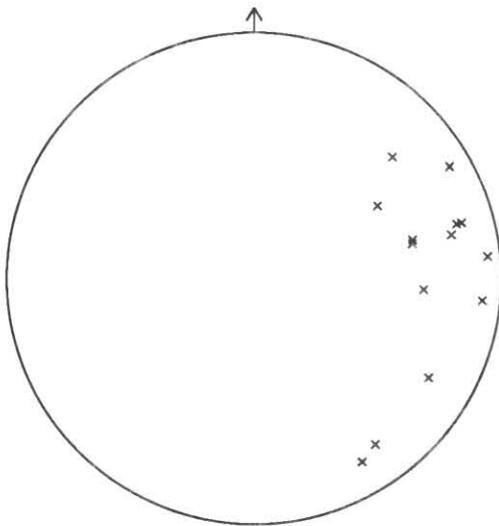
(c) Poles to bedding, Eastern Sequence,
Murchison Gorge–Anthony Road area
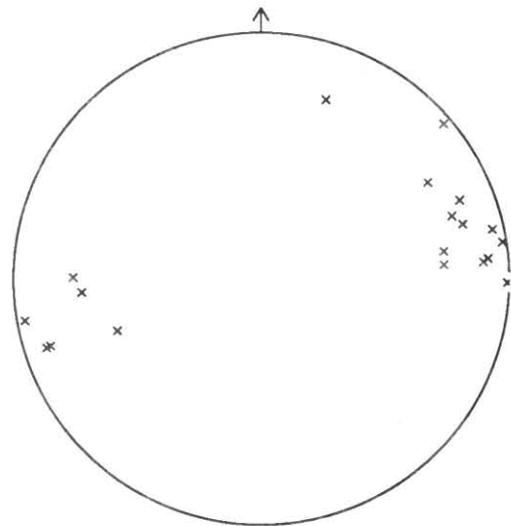
(d) Poles to bedding, Eastern Sequence,
Mt Selina area
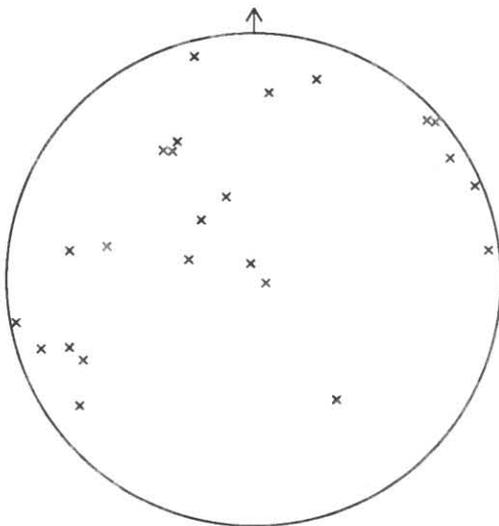
(e) Poles to bedding, Tyndall Group,
Gooseneck Hill area
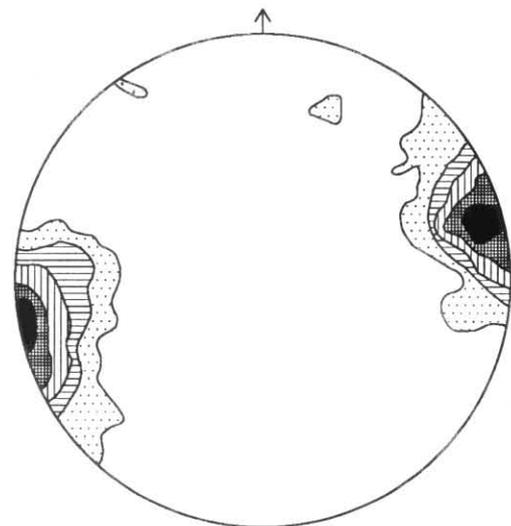
(f) Poles to cleavage, all Eastern Sequence, Sticht
Range Beds and Tyndall Group volcanics.
Contoured at 1–3.8–7.6–12.4–17.1%. 105 points

Figure 7. Stereoplots of poles to bedding and cleavage in Precambrian and Cambrian sequences
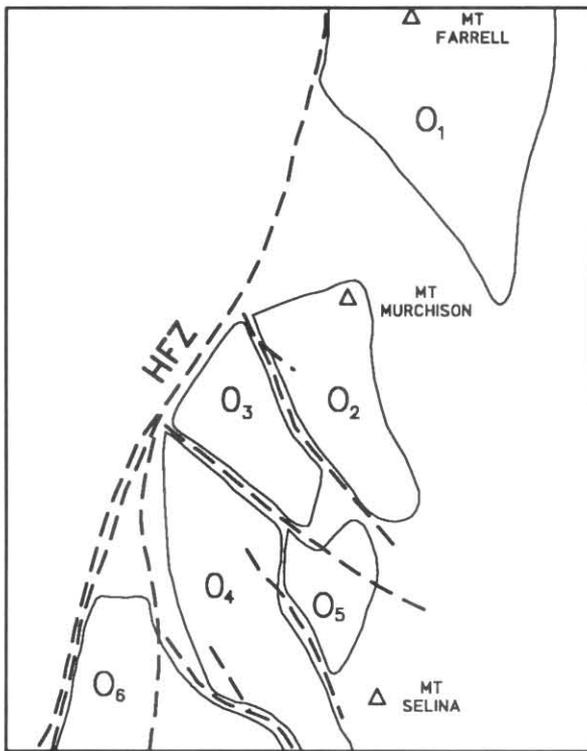
(a) Structural domains.
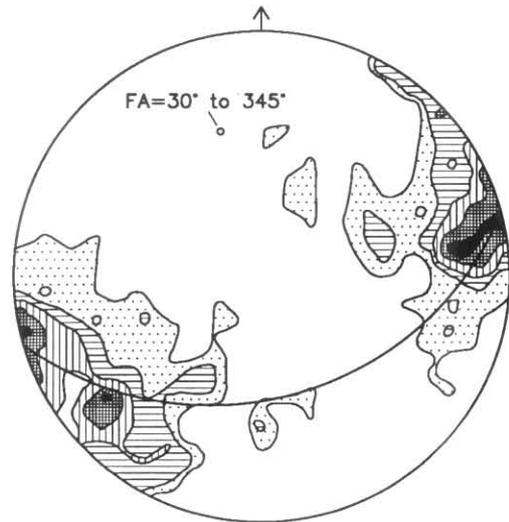
(b) Domain O_1 bedding. Contours at 1.1–2.1–4.2–6.3–8.4%. 95 points.
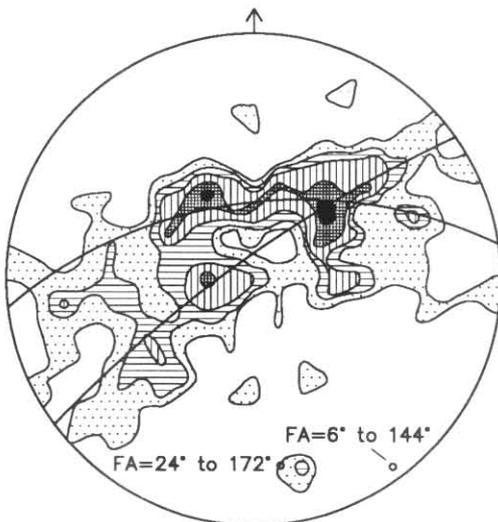
(c) Domain O_2 bedding. Contours at 1.1–2.1–3.2–5.3–7.4%. 94 points.
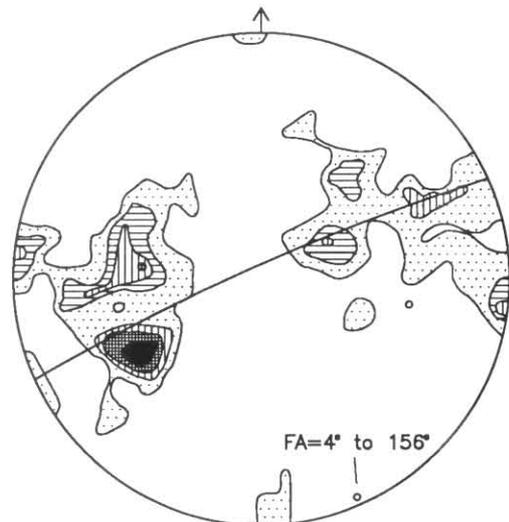
(d) Domain O_3 bedding. Contours at 2.2–4.3–6.5–8.7%. 46 points.
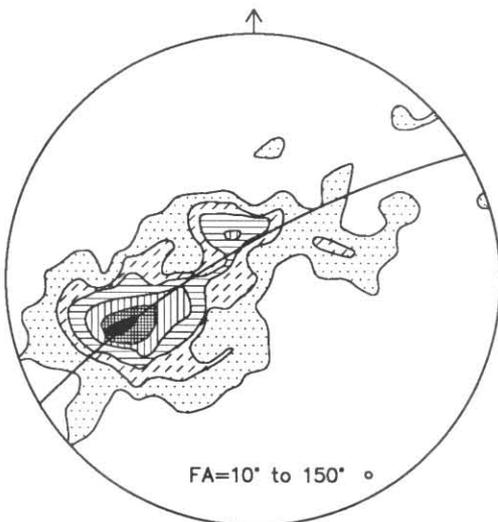
(e) Domain O_4 bedding. Contours at 1.0–2.9–4.9–8.7–12.6–16.5%. 103 points.

(f) Domain O_5 bedding. Contours at 1.3–2.6–3.9–5.3–7.9%. 76 points.

(g) Domain O$_6$ bedding. Contours at 1.6–3.2–4.8–6.3–9.5%. 63 points.

(h) Cleavage, all domains. Contours at 2.8–8.3–11.1–13.9%. 36 points.

Figure 8. Stereo plots of poles to bedding and cleavage, Owen Conglomerate

Both S$_1$ and S$_2$ have a wide range of orientations which may be related to later deformation. S$_1$ has been refolded by rounded to angular chevron-style folds, while kink bands were recorded at 889702.

This style of deformation is similar to that in the Cradle Mountain area (Collins *et al.*, 1981) but there is an apparent swing in lithological strike from the ENE trends in the Cradle Mountain area, to the NNE orientation recorded here.

Structures in Mt Read Volcanics

The Sticht Range Beds are well bedded, and have an overall westerly dip and westerly facing (fig. 7b). Some macroscopic folding on northerly trends is also present, as well as minor folds with wavelengths less than 300 mm. Overturned bedding, folding and strong cleavage development occur at the boundary with the Precambrian rocks in some areas, and suggest some relative motion. In places (e.g. near the Anthony power station site at 883698) there is apparent intermixing of Precambrian metamorphic rocks and Sticht Range Beds, and at the Sophia River [896760] the strong deformation makes it difficult to distinguish between the two.

Bedding is generally difficult to determine in the volcanic sequences because of their massive nature and the widespread shearing.

Sparse bedding data from the volcanic sequence in the Murchison Gorge–Anthony Road area is all westerly dipping (fig. 7c), and weak grading at 862731 suggests a west-facing. This would be consistent with a gradat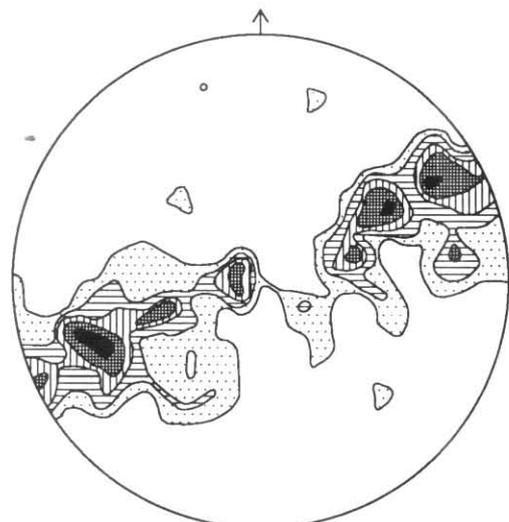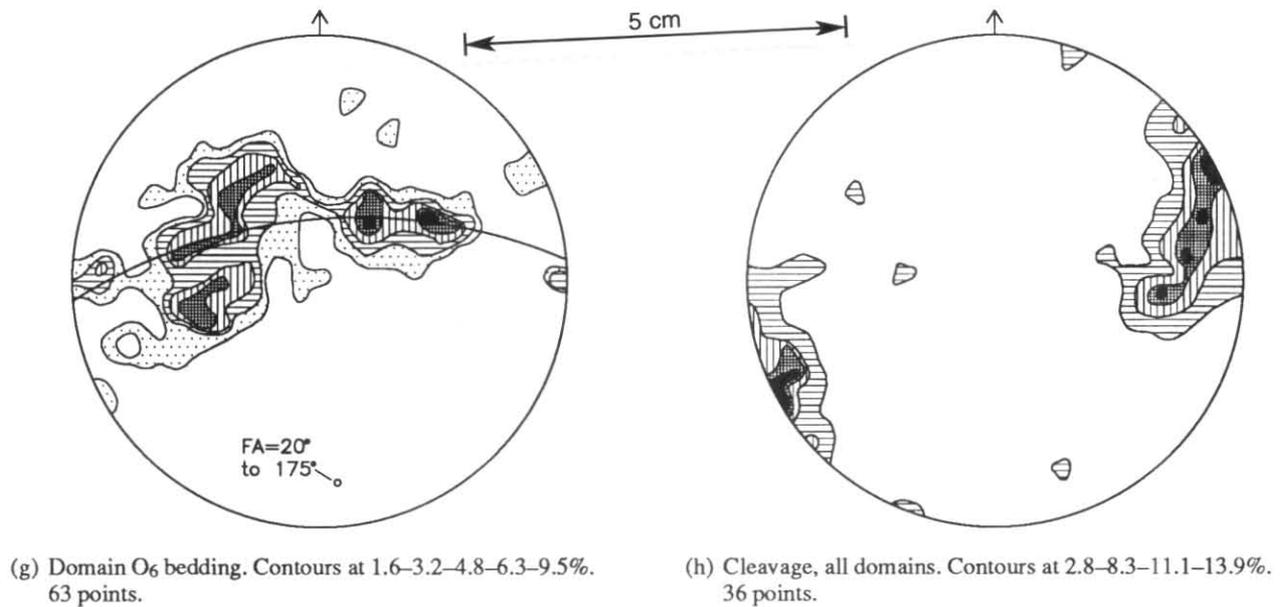ional contact with the overlying west-dipping, and apparently west-facing, Farrell Slates. However the overlying Owen Conglomerate on Mt Murchison and Mt Farrell has been folded into major regional structures which should be reflected in the underlying volcanic rocks. It has been suggested that the volcanic rocks have deformed by shearing rather than folding (Polya, 1981), and this may be the case as mylonitic fabrics are well developed in many localities. This problem remains unresolved.

At Mt Selina (fig. 7d), folding has apparently affected the volcaniclastic conglomerate sequence which forms the younger part of the volcanic succession, and a major NNW-plunging synclinal structure appears to be present.

Folding related to the Devonian deformation is evident in the Tyndall Group volcaniclastic rocks and lavas around Gooseneck Hill (fig. 7e). An anticline plunging SW is evident in bedded volcaniclastic rocks 800 m north of Lukes Knob, and this same fold affects the adjacent Owen Conglomerate. Flow-banding in lavas around Gooseneck Hill appears to reflect the major synclinal structure in the adjacent Owen Conglomerate. Steeply dipping, east-facing bedding in the Henty Dam area is similar to bedding in the overlying Owen Conglomerate sequence.

Cleavage is well developed in the volcanic rocks in most areas, and is generally steeply dipping with a well-defined NNW trend (fig. 7f). This is similar to the dominant cleavage in the Owen Conglomerate (fig. 8h), and is therefore likely to be mainly of Devonian origin.

Structures in the Owen Conglomerate

The area occupied by the Owen Conglomerate has been subdivided into six domains, reflecting both structural and stratigraphic features, for the purposes of structural assessment (fig. 8a). Stereoplots of poles to bedding in each of the domains are shown in Figures 8b–8g. The data indicate a range of fold trends from slightly east of north to slightly west of NNW, with two major trends at approximately north-south and NNW. All folds have relatively shallow plunges. Both major fold sets are represented by large-scale (wavelength greater than 500 m) and small-scale (wavelength less than 100 m) structures. There are also folds on NE-SW and E-W trends, with folds of the latter type (mainly open, east-plunging structures) being described by Brooks (1962) from the Mt Farrell area. The E-W structures probably represent the latest phase of folding.

The north-south trending folds (20–30° to 160–170°) have wavelengths of 15–20 m on the ridge southeast of Mt Murchison, where they are associated with a weak, steeply west-dipping cleavage (020W66°). The folds are rounded, open synclines with a steeply-dipping east limb, and angular, crestless anticlines. On the ridge west of Mt Murchison, folds of this orientation are open and rounded, with some development of parasitic folds. Plate 1 shows an anticlinal fold of this phase developed within grey sandstone and conglomerate just west of Lake Herbert on Mt Farrell. The fold has a rounded hinge and an overturned eastern limb.

Large-scale N-S folds occur on the Farrell Range, which forms the partially overturned western limb of a north-plunging syncline; on Gooseneck Hill, which forms a large south-plunging syncline; and at Arnold Peak, where a large north-plunging syncline is present. The bedding data for the Arnold Peak area (fig. 8f) do not clearly indicate the major N-plunging fold as mapped, but suggest either horizontal folds or folds plunging to both the SSE and NNW.

The NNW-trending folds (10° to 140–160°) have wavelengths of 200–700 m in the conglomerate of Mt Murchison, but 100–150 m in the thinly-bedded Newton Creek Sandstone on Mt Julia. The folds appear to be mainly rounded, open to moderately-tight structures. Minor folds on this trend occur in the Newton Creek Sandstone beside Howards Road at 800626. They are angular, moderately-tight folds with wavelengths less than 400 mm. Corbett (1975) also reports intense 'kink'-like folding in a zone of thinly-bedded sandstone on the NW slope of Mt Julia [around 805621]. These folds trend 140–160°, with steep to sub-vertical plunges to both the north and south. The folds may be related to the adjacent Great Lyell Fault.

Cleavage in the Owen Conglomerate sequence tends to be weakly developed except in the thinly-bedded sandstone and siltstone (e.g. Newton Creek Sandstone), where it may be prominent. It is predominantly steeply dipping and of NNW trend (fig. 8h), indicating a genetic relationship to the NNW folds.

Faulting

Henty Fault and associated structures

The largest fault structure in the area is the NNE-trending Henty Fault, which is evident as a zone of highly cleaved, folded, lineated and crushed rocks varying from several tens of metres to several hundred metres in width. This fault juxtaposes Central Volcanic Complex against Tyndall Group rocks in the southwestern part of the area, and against Farrell Slates in the northern part. A description of the fault zone in the Farrell Slates has been given in a previous report (McNeill and Corbett, 1989). Near the southern margin of the map sheet, the Henty Fault divides into two structures (North and South Henty Faults) which enclose a wedge of sedimentary rocks (greywacke sandstone, siltstone, shale). A cross-section of the fault zone near where these two faults coalesce is exposed on the HEC Howards Road just west of the bridge over the Henty River [799627]. From west to east, the section shows fractured and sheared pink feldspar-phyric lavas and highly chloritised mafic dykes of the CVC, passing through a mylonitic crush zone with a strong 'kinked' cleavage into sheared purple and green siltstone. These pass through another steep shear zone into highly sheared volcaniclastic mass-flow material of the Tyndall Group.

The fault zone has been intersected in numerous drill holes in the vicinity of the Henty gold prospect, where it dips west at 65° and is associated with various subsidiary structures. A description is given in a subsequent section. Lenses of shale which occur within the fault zone in the Henty prospect area, and further north at the Red Hills track [807662], probably represent sheared remnants of the Henty Fault Wedge sequence which crops out to the south. Regional overturning of the east-facing Tyndall Group sequence occurs along the fault, implying considerable west-side-up movement on the fault. Work by Berry (1989) in the Tullah–Mt Farrell area has defined a complex movement history for the fault, involving five phases ranging in age from Early Palaeozoic to Tertiary.

The Henty Fault is joined in the vicinity of Gooseneck Hill by the interpreted northern extension of the Great Lyell Fault. The latter is apparent on the western flank of Mt Julia as a major fault which splits into two faults to the north, one trending NW towards the Henty prospect (where it is concealed under glacial deposits), and the other passing through the conglomerate sequence on the western flank of Gooseneck Hill (Corbett, 1975). A second major N-S fault is present on the eastern side of Gooseneck Hill and Mt Julia, and joins the Henty Fault in the vicinity of Moxon Peak. This fault is associated with a fan-like series of splay faults in the headwaters of Julia Creek, and probably reconnects with the main Great Lyell Fault to the south of the mapped area (Corbett and Jackson, 1987). It possibly represents a major splay structure off the Great Lyell Fault, similar to the Margaret and Whitham Faults of the Tyndall Range area (Corbett and Jackson, op. cit.).

Other Faults

Faults and shear zones are common in the belt of volcanic rocks and Owen Conglomerate east of the Henty Fault. Shearing and mylonitisation are widespread in the volcanic rocks, but are often difficult to relate to discrete faults. Many faults which affect the Owen Conglomerate are difficult to trace into the volcanics.

A major N-S fault at the eastern boundary of the Murchison Granite is associated with a steeply east-dipping cleavage, but the dip of this fault is not known. Porphyroclastic rotation textures in A461, A531 and A592 suggest west-side-up movement, using the criteria of Simpson and Schmid (1983).

Other faults in the area are predominantly of either east-west or NW-SE trend. The east-west faults generally have small (<100 m) offsets, with both dextral and sinistral displacements being apparent. The NW-SE faults are larger structures, and coincide in some cases with major stratigraphic changes in the Owen Conglomerate, suggesting they are reactivated basin-forming features. One of these faults on Mt Murchison [840696] is associated with an extensional lineation and low-angle kink bands, features indicative of ductile shear zones. The NW-plunging fold in this area [838701] may also be related to this fault.

Cross-cutting relationships between these two fault systems have not been observed, and Brooks (1962) considered that they formed a conjugate system.

MINERALISATION IN THE
MT MURCHISON AREA

Introduction

Mineralisation is widespread within the Mt Read Volcanics in the Mt Murchison area, and includes both Cambrian VMS type and Devonian granite-related types. Apart from the Rosebery field, which will be considered elsewhere, there are four main fields in the vicinity of Mt Murchison:

(i)   Sterling Valley–Farrell field

(ii) The Red Hills area

(iii) Selina area

(iv) Henty prospect area

Sterling Valley – Farrell field

A series of vein and fissure-style galena-sphalerite lodes occurs within the Farrell Slates and adjacent volcanic rocks in a belt spatially associated with the Henty Fault extending from the Sterling Valley Mine to north of Tullah. The lodes were discovered in 1897, and mining commenced in 1902. Descriptions have been given in a previous report (McNeill and Corbett, 1989), and in earlier works by Groves and Noldart (1965), Collins et al. (1981), Brooks (1962), Rivers (1975) and Ward (1908). The Sterling Valley Mine is of this general type, with arsenopyrite and minor gold also present in the mineral assemblage. This mine operated during the early part of this century, and a description is given in Reid (1918).

The genesis of the Farrell lodes — whether Devonian or Cambrian — has been a source of some controversy, but it is now accepted that they are essentially Devonian and granite-related, with possibly some input of Cambrian sulphur (Solomon et al., 1969; Gulson and Porritt, 1987; Polya et al., 1986).

Several small vein-type deposits which occur in the Murchison Gorge and on the northern slopes of Mt Murchison are probably genetically related to the Farrell lodes. The deposits have variable mineralogy, from barite + galena to chalcopyrite-covellite-malachite with minor galena, pyrite and sphalerite, and have been described by Ward (1908) and Brooks (1962).

Recent exploration in the Sterling Valley area has been concentrated on the Lakeside prospect, on the shore of Lake Rosebery (fig. 9), and on the zone between the Sterling Valley tin prospect [842744] and the Sterling Valley Mine.

Sterling Valley tin area

Early exploration for base metals in the Sterling Valley included diamond drilling by the EZ Company around the Sterling Valley Mine from 1947 to 1960. Farrell-type mineralisation was intersected, with best grades of 9 feet at 0.3% Cu, 13% Pb, 8.2% Zn, 7 oz/ton Ag and 0.7 dwt/ton Au (Barker, 1974). An RTAE EM survey located a long linear anomaly, the southern part of which was tested by DDH's STP101 and 105 (fig. 9) with poor results. Trenching and stream sediment sampling over the northern part of this anomaly by Asarco failed to locate significant anomalous base metals. Anomalous tin values (3 m at 0.65% Sn) were recorded in a trench, and this led to a re-direction of exploration aimed at locating replacement-style tin deposits (Barker, 1974).

Abminco drilled three holes in the Farrell Slates in the mid-1970's, one of which (SV3) intersected 0.85 m of 0.2% Sn in pyrite-pyrrhotite-arsenopyrite-sphalerite-chalcopyrite veins (Simpson, 1977, 1978). The Electrolytic Zinc Company undertook further drilling to the north, targeted on magnetic, IP and EM anomalies. This drilling intersected vein-style pyrite-pyrrhotite-chalcopyrite-cassiterite-arsenopyrite ± stannite mineralisation in quartz-fluorite gangue, hosted in both the Central Volcanic Complex (Mt Black Volcanics) and Farrell Slates. The best intersection of one metre at 0.49% Sn (in STP217) provided encouragement for a further five drill holes in this area, known as the 'Sterling Valley tin' prospect (Mollison, 1980; McDonald, 1981a, 1984). Further low-grade tin mineralisation was intersected, mainly in the Mt Black Volcanics.

This tin mineralisation was considered to be too low grade and too narrow for exploitation, but high arsenic values associated with the tin — e.g. 0.5 m at 9.8% As, 0.5% Sn and 5.5 g/t Ag in STP231 — were considered encouraging. An informal ore reserve estimate of 480 000 t at 5.02% As was calculated, based on four zones in holes STP217, 221, 231, and 234 (McDonald, 1984).

The gold potential of this area was also assessed, and maximum results of 26.6 and 8 g/t Au from grab samples of a quartz-sulphide vein in Costean 3260N (at 384075E, 537370N) provided encouragement for further drilling. Hole STP283, drilled beneath the veins, intersected weak gold mineralisation in both high sulphide (2 m at 0.38 g/t Au, 6.22% As, 0.77% Cu, 28 g/t Ag) and low sulphide (0.45 m at 2 g/t Au) styles of mineralisation (McDonald, 1986). A further two holes were drilled with poor results (SVD87-1, 87-2) before exploration for base metals recommenced near the Sterling Valley mine (Randell, 1989).

Lakeside prospect

Recent exploration in the Lakeside area was initially designed to locate the northern extension of the 'Sterling Valley tin' mineralisation. DDH's MRP212 and 219 (fig. 9) both intersected low-grade pyrite-pyrrhotite-arsenopyrite-cassiterite mineralisation in the Farrell Slates (maximum two metres at 0.55% Sn in MRP212), while two holes drilled approximately one kilometre to the north and targeted on magnetic anomalies similar to those at 'Sterling Valley tin', failed to intersect significant mineralisation (McDonald, 1981b). A further hole (MRP233), drilled south of MRP212, intersected 2.1 m at 0.3% Sn, 11% As within a zone of vein and minor disseminated pyrite-arsenopyrite dominated mineralisation in the Henty Fault and Farrell Slates.

A programme of re-assaying drill core, prompted largely by the discovery of the Henty gold prospect and results from the Sterling Valley area, located significant gold mineralisation, including four metres at 3.3 g/t Au in MRP233. This led to the drilling of a further seven drill holes in 1987. These holes intersected gold-bearing sulphides within silica-chlorite altered sandstone and shale of the Farrell Slates, with the best grades in RED87-3 (4.65 m at 5.9 g/t Au, 7% As, 34 g/t Ag; Hall et al., 1987). Three more holes were drilled during 1988, with a best intersection of one metre at 4.9 g/t Au, 7 g/t Ag, 3.7% As in RED88-2. A resource of 0.75 million tonnes at 2.1 g/t Au was defined, and considered to be sub-economic (Hall et al., 1988).

The mineralogy and genesis of the Lakeside prospect have been studied in detail by Taheri and Green (1990a, 1990b) as part of the Mt Read Volcanics Project. These authors have concluded that the mineralisation is essentially Devonian, and formed above a high point (less than one kilometre depth) on the buried ridge of Devonian granite which extends between Renison to the west and Granite Tor to the east. The more
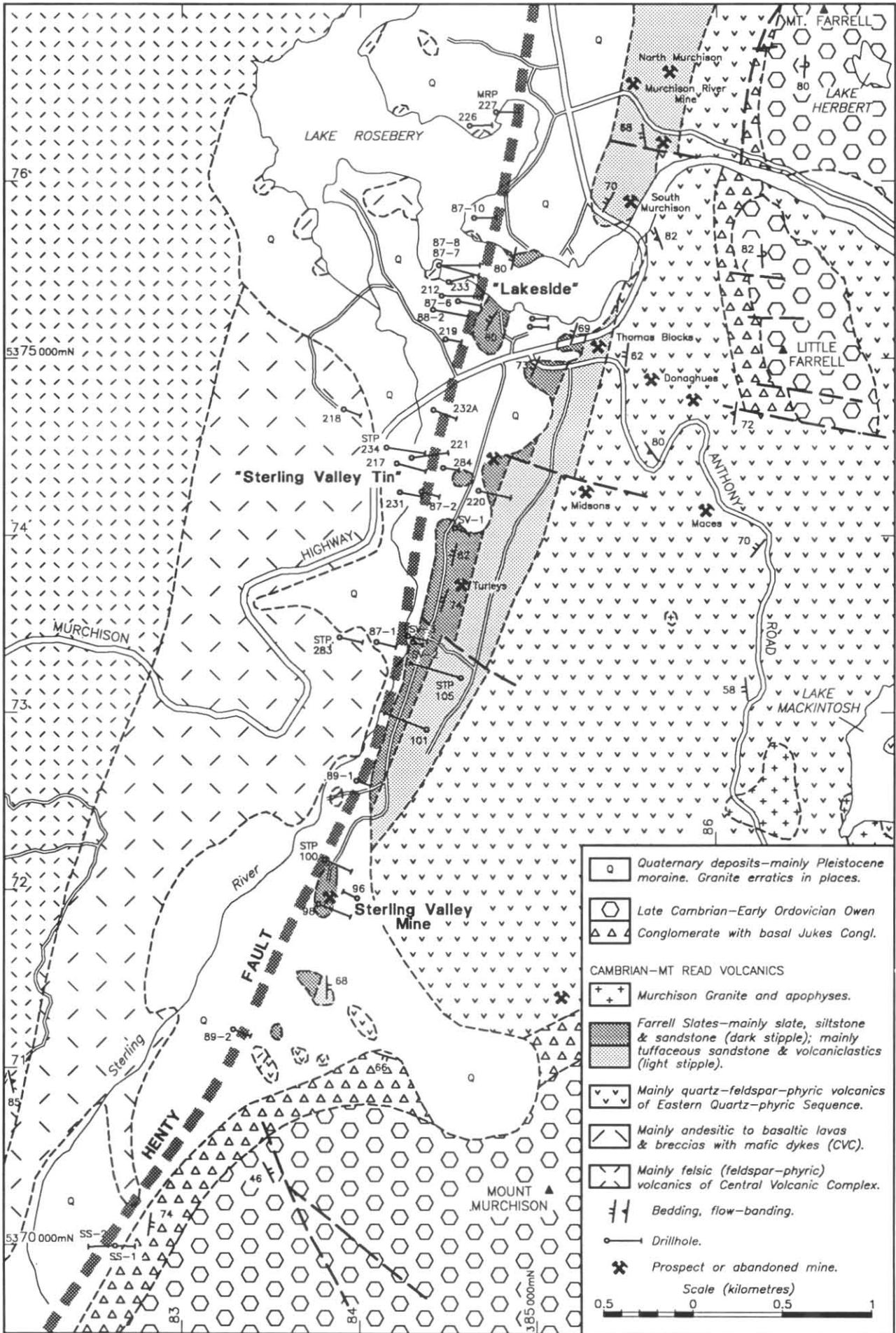
Figure 9. Geology and exploration features in the Sterling Valley area

|←——————— 5 cm ———————→|

extensive Farrell-type lead-zinc-silver lodes are considered to have formed off the main granite axis at heights of 2–4 km or more above the granite surface. The apparent close relationship in mineralogy and genesis between the Lakeside and Sterling Valley tin prospects is explained by Taheri and Green (1990a) as being due to post-mineralisation sinistral (and west-side-up) displacement on the Henty Fault, causing separation of originally juxtaposed deposits.

The Red Hills area

The Red Hills area has had a long history of mineral exploration. Prospecting for copper late last century is evidenced by numerous small workings (Smith, 1898). Some of these workings in the magnetite-pyrite-chalcopyrite stockwork at the northern end of the Red Hills rhyolite dome were extended and sampled by the Mt Lyell Mining and Railway Company in 1907.

Modern exploration commenced in 1957, and in the four years to 1961 Rio Tinto Exploration and the EZ company completed extensive geophysical surveys over the area, leading to the drilling of four holes. DDH's GN-1, GN-2, and RHP-95 intersected black shale and volcaniclastic rocks hosting pyrite and pyrrhotite (fig. 10). DDH RHP-94 tested the Red Hills lava dome with negative results (McKenna, 1959).

After 1966, the Mt Lyell Company again focussed attention on the copper potential of the pyrite-magnetite-chalcopyrite stockwork, drilling 23 percussion and 4 diamond-drill holes (RH1–RH4). No significant mineralisation was intersected, and attention moved to the base-metal potential of the shale horizon. A small body (2.8 m wide) of banded massive sulphide was intersected in DDH RH-5 (fig. 10) in 1977, assaying 34.5% Zn, 11.4% Pb, 0.3% Cu, 250 g/t Ag and 6.5 g/t Au. Sulphur isotopes (Eastoe et al., 1987) and lead isotopes from this body (Gulson and Porritt, 1987) indicate a Cambrian age and affinities. The body was hosted within a fine-grained tuffaceous sediment between the shale and the Red Hills lava.

The strike extension of the shale and 'host horizon' was tested by a further eleven drill holes (RH6–16) which failed to

Figure 10. Geology and exploration features in the Red Hills area.

intersect economic mineralisation. Re-assaying of core has delineated a zone of significant gold mineralisation straddling the contact between the 'host horizon' and underlying volcanics to the east (best grades of 1.5 m at 8.1 g/t Au in RH8), while disseminated sphalerite and galena (up to 0.7% Pb + Zn over 50 m, with narrower intervals up to 7% Pb + Zn) were intersected in the eastern part of 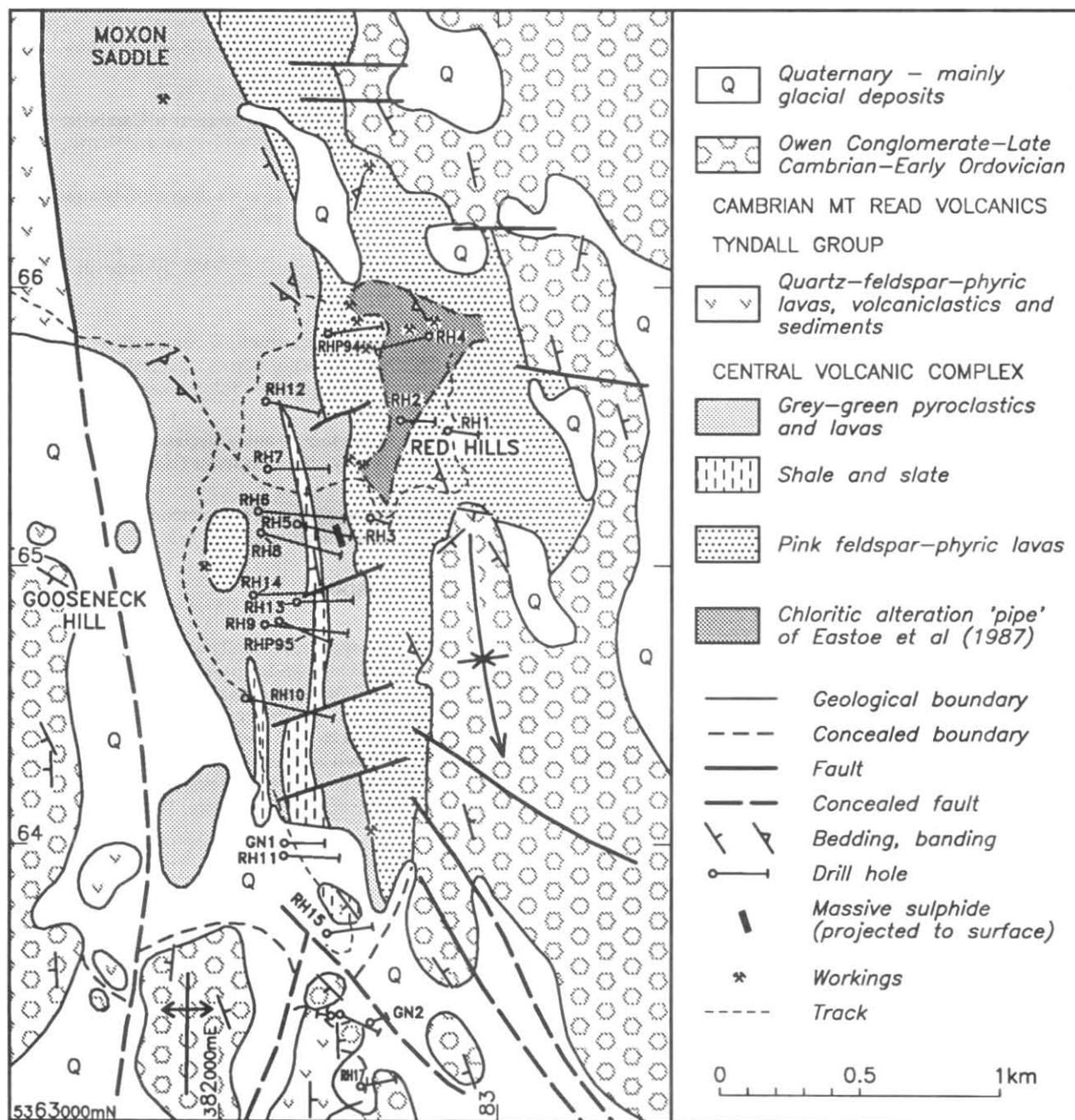the black shale. Lead isotope data from this mineralisation yields a different signature to the BMS lens, suggesting a separate source (Gulson and Porritt, 1987).

Detailed summaries of various aspects of the exploration completed in this area have been given by Reid and Meares (1981), Bishop (1982), Purvis *et al.* (1983), and Fitzgerald (1987).

Mapping of alteration types at the Red Hills by Eastoe (*in* Eastoe *et al.*, 1987) has delineated an irregular zone of intense chlorite alteration in the pink lavas, interpreted as a feeder pipe for the massive sulphide mineralisation (fig. 10). The pyrite-chalcopyrite-magnetite stockwork style mineralisation occurs in the core of this alteration. Zones of silicification occur to the west of the 'host horizon', and appear to be at least in part conformable. Several alteration zones, broadly conformable with stratigraphy, were mapped, from east to west:

(i)   quartz–k-feldspar–chlorite (corresponding to the Red Hills lavas);

(ii)   quartz–sericite–chlorite (containing the massive sulphide body and shale horizon); and

(iii) quartz–albite–chlorite ± carbonate (a typical low-grade regional metamorphic assemblage).

Selina area

Alteration and mineralisation in this area forms two major N-trending zones referred to as the Eastern and Western Pyrite Zones (fig. 11; Purvis *et al.*, 1983). Several adits and trenches, known as the 'Lake Selina workings', were driven into the pyrite-magnetite ± chalcopyrite mineralisation of the Western Pyrite Zone (WPZ) around the turn of the century. This zone parallels the faulted contact of the volcanic rocks and Owen Conglomerate, and extends south onto MR VP Map 5 (Corbett and Jackson, 1987).

The Eastern Pyrite Zone (EPZ) was located on the eastern side of Mt Selina in 1979–80 by Dighem, IP and mapping. It is interpreted to extend north to Red Hills Creek on the basis of coincident IP and magnetic anomalies, and mapped alteration and minor chalcopyrite–pyrite–magnetite mineralisation (McKibben, 1972).

Exploration in the Selina area has been intensive (see Purvis *et al.*, 1983; Roberts and Cartwright, 1984; Fitzgerald, 1987, for detailed summaries). Nine diamond holes (2273 m total) have been drilled in the WPZ (fig. 11) and have intersected zones of disseminated base metal–poor magnetite–pyrite-dominated mineralisation hosted by k-feldspar–chlorite–quartz-altered volcanics. The best intersection, in LS-5, was 4.5 m at 0.65% Zn, 24 g/t Ag.

The EPZ was tested by three drill holes (1080 m total) which intersected bands of massive pyrite, up to 0.2 m thick, apparently associated with altered pyritic ash. Hole LS-10 was terminated in a highly siliceous altered volcaniclastic rock containing 15% pyrite-magnetite, with a best intersection of six metres at 0.4% Cu, 0.2% Zn, 3.5 g/t Ag.

An area of anomalous soil geochemistry (up to 0.4% Pb, 0.1% Zn, 8 g/t Ag) and rock chip geochemistry (up to 1.3% Zn, 24 g/t Ag) was defined southeast of the summit of Mt Selina and south of the EPZ. This zone, and an interpreted UTEM conductor, were tested by DDH LS-13 (503 m), which intersected weak disseminated mineralisation and associated thin galena–sphalerite veins (best intersection one metre at 4.8% Zn, 0.3% Pb, 66 g/t Ag; Fitzgerald and Cartwright, 1986).

Purvis *et al.* (1983) suggested that the Selina mineralisation and alteration formed part of the footwall stockwork zone beneath a VMS deposit, while Hunns (1987) and Eastoe *et al.* (1987) have suggested that the Selina area lies within the proximal part of a Cambrian hydrothermal system driven by the cooling of the adjacent Murchison Granite. Major factors relevant to the question of genesis are:

(i)   The presence of altered and sheared Cambrian granite both in outcrop (fig. 11) and in drill intersections, e.g. LS-12;

(ii)   Lower zinc numbers for the mineralisation than in typical western Tasmanian VMS deposits (Huston and Large, 1987);

(iii) Lead isotope values which suggest a Cambrian rather than Devonian age for the lead (Gulson and Porritt, 1987);

(iv)   the presence of magnetite and minor molybdenite in the mineralisation (Hunns, 1987);

(v)   Low gold values atypical of VMS systems in western Tasmania (Hunns, 1987);

(vi)   Sulphur isotope values which are consistent with a model of a Cambrian seawater-derived hydrothermal system driven by a cooling granite (Solomon *et al.*, 1988);

(vii) The apparent zonation of alteration broadly similar to that found in porphyry-copper systems (Hunns, 1987).

All of these factors suggest a strong genetic link between the granite and the mineralisation-alteration at Selina.

Henty gold prospect

The Henty gold prospect is presently at an advanced stage of exploration involving underground development and intensive diamond drilling. Details of the geology and mineralisation in the following account are taken from Roberts (1990), Roberts and Fleming (1990), and from the Development Proposal and Environmental Management Plan prepared for RGC and Little River Resources Pty Ltd by NSR Environmental Consultants (November, 1990).

Exploration history

Active exploration by the Mt Lyell company commenced in the Henty Fault Zone area in 1968–69, when a broad-spaced grid was established and soil sampling, mapping, EM and ground magnetics surveys were carried out. An old shaft was located just north of the Red Hills track, and a costean and two drill holes in this area (1972–73) showed patchy, weak base-metal mineralisation. An IP survey produced some 17 strong anomalies along the zone, and in 1973–74 further IP, soil sampling and costeaning were done and a programme of diamond drilling commenced to test the IP anomalies. Soil sampling generally gave poor results, a factor attributed to the widespread cover of glacial deposits.
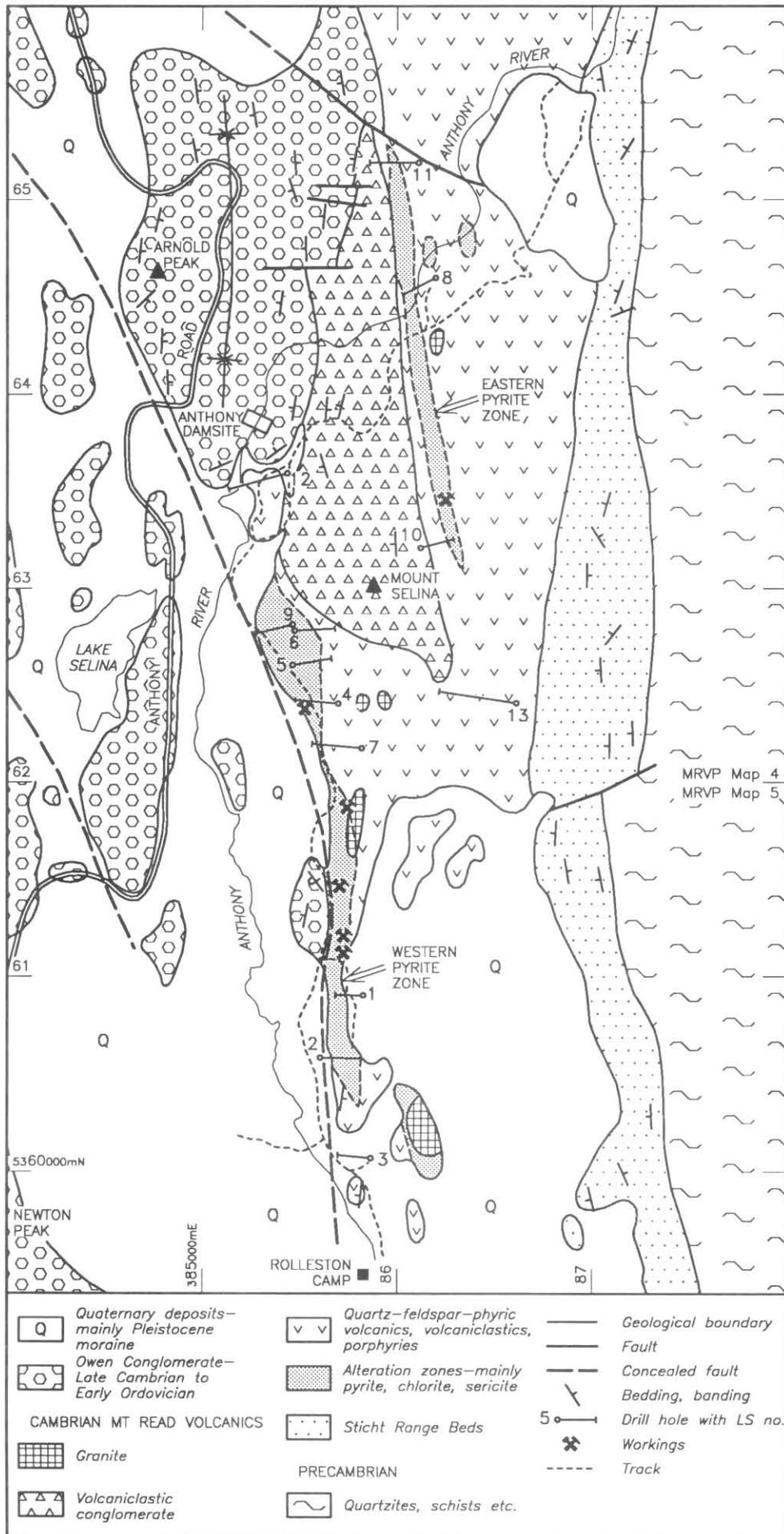
Figure 11. Geology and exploration features in the Mt Selina area

|←   5 cm   →|

A costean over one of the IP anomalies, just east of the Henty Fault (fig. 12), exposed a small body (1.5 m thick) of banded massive sulphide (pyrite-chalcopyrite-galena-sphalerite) assaying 1.67% Cu, 1.68% Pb, 0.2% Zn, 95 g/t Ag, and 1.6 g/t Au. Eight holes were drilled from 1972 to 1975. HFZ5, drilled beneath the massive sulphide body, was barren, but HFZ6, drilled 125 m further south, intersected 0.5 m of massive sulphide assaying 1.1% Cu, 4% Pb, 7% Zn, 85 g/t Ag, and 2 g/t Au. The sulphide body was assumed to be cut out against the Henty Fault at depth, and as the other holes intersected only weak mineralisation, interest in the area waned.

In a review of the Exploration Licence in 1982, Purvis *et al.* (1983) suggested there was room for a significant massive sulphide body, and three further holes were drilled. Of these, HFZ 11, drilled 80 m north of the massive sulphide, was barren, and HFZ 9 intersected 0.7 m of massive sulphide. HFZ 10, drilled 200 m south of the massive sulphide, intersected 0.6 m of sulphide and also a 1.1 m interval of sulphidic chert, 28 m stratigraphically higher (i.e. further east), which assayed 5.1 g/t gold.

The review team concluded that there was possibly a single massive sulphide body at least 300 m long, 100 m wide and 0.5–1.5 m thick, open at depth and to the south. The Henty Fault Zone was thought to be localised within the footwall alteration zone to this mineralisation. It was recommended that the second zone of cherty gold-bearing mineralisation above the massive sulphide be tested by drilling.

A further hole, HFZ 11 (figs 12, 14) was drilled to test the extension of the mineralisation to the south, but intersected only a very thin massive sulphide occurrence with very low gold grades.

Results from the area were reviewed again in 1984, and a decision was made to re-assay the drill holes for gold. A zone in HFZ 5 (fig. 14) gave four metres at 10 g/t gold, and this stimulated a major search for gold.

A major drilling programme between 1984 and 1988 outlined a continuous broad zone of mineralisation (down to 350+ m below surface) within which high grade intersections (to >50 g/t) were very erratic. The unpredictable nature of the gold occurrence prompted the decision in February 1988 to drive a decline into the upper part of the deposit. This was commenced in November 1988, with the portal located at the site of the 1973 VMS discovery (fig. 12). The 850 m of decline and 212 m of sill development along the ore zone (figs 13, 14) were completed in October 1989.

A main zone containing high-grade gold mineralisation could be traced the full length of the sill, but was offset by numerous small faults with displacements of 1–2 metres.

Continued surface drilling during this period discovered another major zone of mineralisation (HP 96 zone) about 400 m below surface (figs 13, 14), within which a best intersection of 7.5 m horizontal width grading 107 g/t Au was obtained. Further exploration will be concentrated on this zone, including probable underground development via a vertical shaft.

To June 1990, 119 holes plus 12 wedges had been drilled (a total of 30 km of drilling), with a total expenditure (including underground development) of approximately $8.5 million.

Geology of the Henty deposit

The Henty prospect lies in a broad, forested, glaciated valley at the head of the Henty River, with most of the bedrock being covered by bouldery glacial deposits. The presence of this superficial cover (1–5 m thick) probably explains why the deposit was not discovered by early prospectors.

The mineralisation lies on the structural footwall of the Henty Fault (fig. 12), a major zone of shearing, brecciation and pug development dipping west at 65°. The fault separates Central Volcanic Complex rocks to the west from overturned, west-dipping Tyndall Group volcaniclastic rocks to the east. The fault divides southwards into two faults which enclose a narrow wedge of shale, mudstone and sandstone. Disrupted lenses of similar shale occur within the fault zone in the prospect area, where the zone is up to 100 m wide.

The CVC rocks comprise mainly felsic lavas and minor pyroclastics (mainly feldspar-phyric) intruded by altered mafic dykes of tholeiitic basalt and dolerite. The dykes appear to increase in abundance close to the Henty Fault, and occur as sheared and chloritised bodies within the fault zone. A gradational contact is present in the hangingwall of the fault as the CVC rocks become progressively more sheared (fig. 13).

The footwall of the fault is typically marked by a major crush zone, up to 15 m wide, of pug and milled fragments. The footwall contact with the Tyndall Group is generally sharp, although the footwall volcanic rocks and associated mineralisation are often broken up into the crush zone.

The Tyndall Group rocks are predominantly volcaniclastics from the upper part of the east-facing Tyndall Group sequence, the lavas from the lower part being cut out against the fault in the vicinity of Lake Henty (fig. 12). The volcaniclastic rocks are mainly epiclastic rather than pyroclastic in origin, and range from conglomeratic to fine ash grade. Volcanic quartz is an abundant component, and many of the clasts are of quartz-feldspar porphyry.

A 20 m wedge of interbedded siliciclastic pebble conglomerate, sandstone and shale, similar to the Newton Creek Sandstone member of the Owen Conglomerate, occurs within the Tyndall Group sequence in the upper part of the decline (fig. 13). This unit has apparently gradational contacts on either side, and it is uncertain whether it represents a continuation of the main belt of Newton Creek Sandstone from the south (fig. 12) or a local lens of this lithology interbedded within the Tyndall Group volcanic sequence. Such a lens occurs within the upper part of the Tyndall Group near Lake Westwood at 825632.

A number of faults at various orientations affect the Tyndall Group in the decline area (fig. 13), and one of these to the east of the decline appears to juxtapose the volcaniclastic rocks against Tyndall Group lavas further east. Structural relationships in the area, and particularly the nature and age of the many faults present, are not yet fully understood.

The alteration zone containing the mineralisation is of the order of 20 m wide, being bounded by the footwall of the Henty Fault to the west and a gradational contact with relatively unaltered volcaniclastic rocks to the east. The alteration varies from silica-sericite with lenses of massive pyrite, to strong silica-sericite-pyrite with zones of quartz–base metal mineralisation. The highest gold grades occur in massive quartz shoots, which in the sill area are up to 50 m in strike length and 1.5 m in width. The VMS body discovered in 1973 represents one of the scattered pods of massive sulphide (mostly pyrite), but there is no continuous sulphide body.

QUATERNARY

	Mostly Pleistocene moraine–boundaries very generalised
Q	

LATE CAMBRIAN-EARLY ORDOVICIAN

OWEN CONGLOMERATE

Ou	Undifferentiated
Onc	Newton Creek Sandstone

CAMBRIAN-MT READ VOLCANICS

TYNDALL GROUP

Tv	Mainly volcaniclastics
Tl	Mainly quartz–feldspar–phyric lavas

CENTRAL VOLCANIC COMPLEX

CVC	Mainly felsic lavas with associated basaltic intrusives

HENTY FAULT WEDGE SEQUENCE

HFs	Shale, sandstone, mudstone

Geological boundary

Fault

Bedding, banding

Drill hole
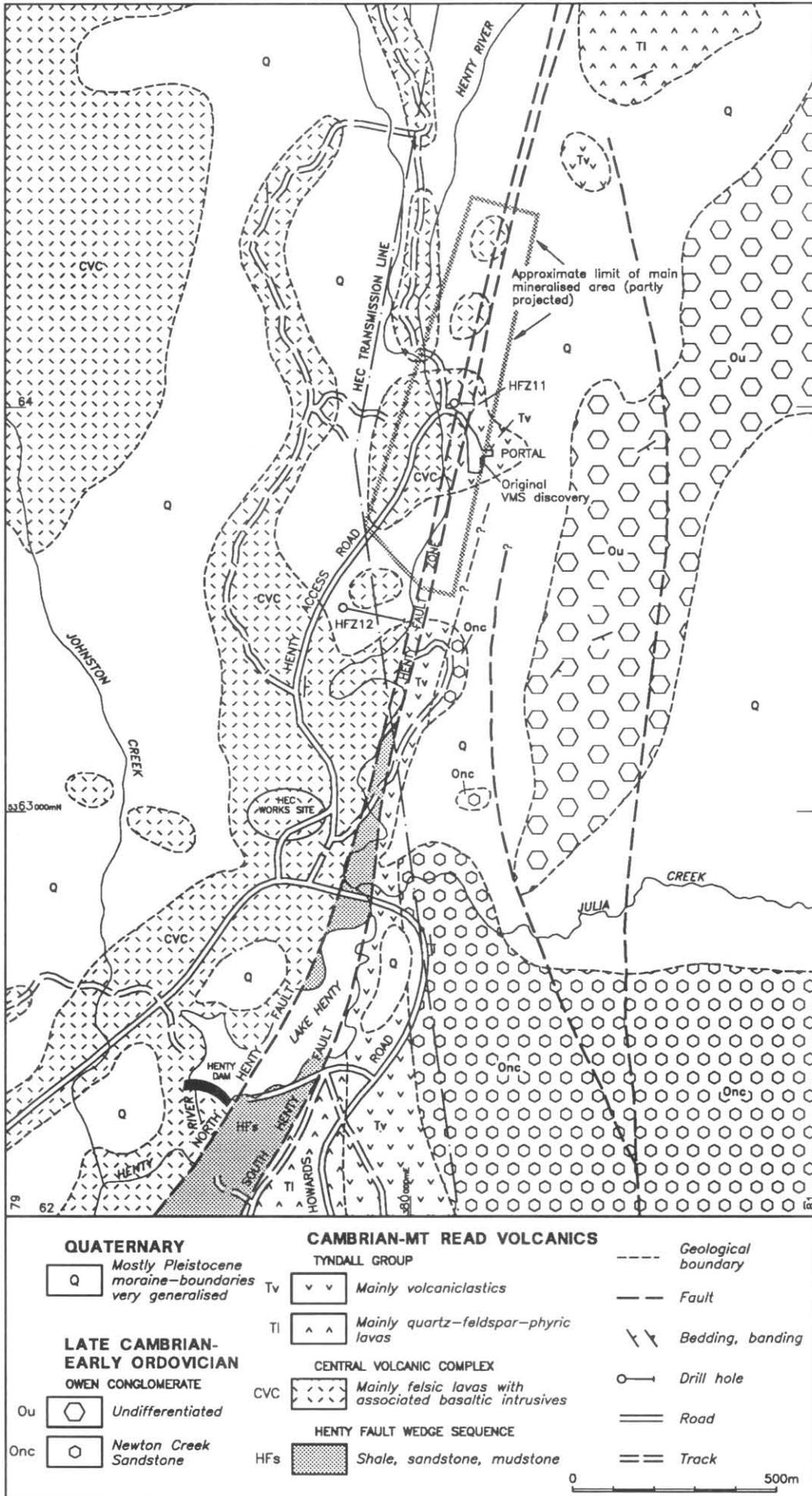
Road

Track

0   500m

Figure 12. Geology of the Henty Prospect area

5 cm
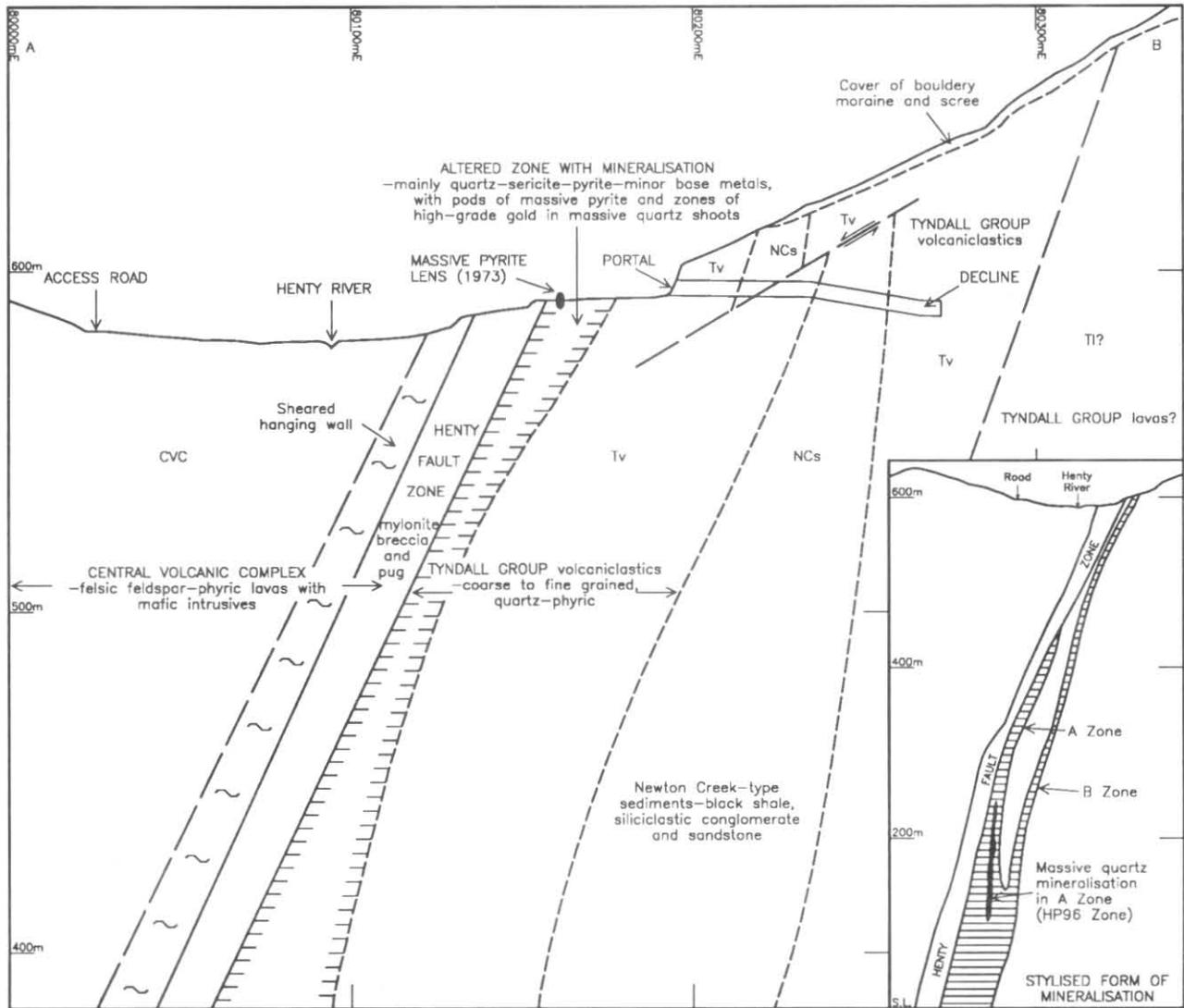
Figure 13. Cross-section of the Henty Prospect (from Roberts, 1990). Inset is deeper cross-section showing stylised forms of mineralisation with A and B Zones and massive quartz mineralisation in the HP96 area (from Environmental Management Plan)

|← 5 cm →|

Two main zones of siliceous mineralisation have been identified, with the bulk of the gold contained within massive quartz shoots (such as the sill area and HP 96 zone) in the A Zone (figs 13, 14). Gold grades are commonly above 30 g/t in this zone, which contains only minor sulphide mineralisation.

The A Zone appears to be partly truncated by the Henty Fault, with its hangingwall intersection in the fault plunging southwards at about 40° (fig. 14). B Zone is apparently restricted to the upper part of the deposit, and is yet to be evaluated. The two zones appear to amalgamate at depth below the HP 96 area (fig. 13 inset).

Resource

The following resource estimates are as quoted in the Development Proposal and Environmental Management Plan (November, 1990). The values represent the *in situ* geological resource of the massive quartz (MQ) mineralisation in A Zone (not all of which will be mineable) using all the data available to the beginning of December 1989. All assay values are as reported, and no cutting of high-grade values has been applied. A zero g/t gold cut-off was employed, as the significant gold mineralisation is geologically restricted to the MQ unit in A Zone.

An *in situ* resource estimate by the manual isoline method has been conducted over:

(a) the sill area, which has been tested by pattern drilling and underground development, and

(b) other areas delineated by surface drilling.

Massive Quartz Unit (MQ)

(a) Sill Area:

  – Indicated resource 19 000 t at 29 g/t Au

(b) Other Areas:

  – Inferred resource 216 000 t at 70 g/t Au (including Zone 96 containing 160 000 t at 91.2 g/t Au).

MQ Diluted to 1.5 m horizontal width

(a) Sill Area:

  – Indicated resource 45 000 t at 13 g/t Au
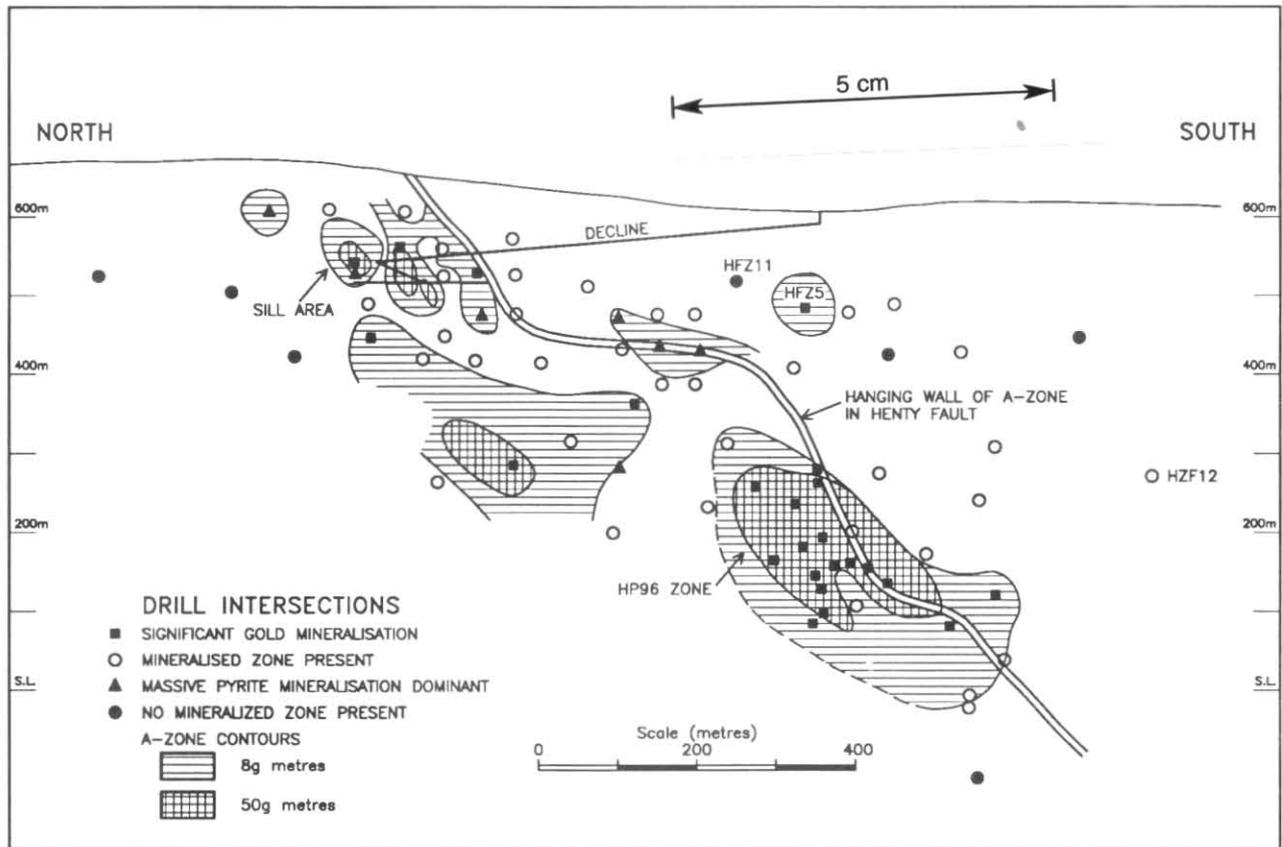
Figure 14. Longitudinal projection of Henty Prospect showing decline and sill development, drill hole intersections, and gold contours on A Zone (from Environmental Management Plan)

(b) Other Areas:

  – Inferred resource 259 000 t at 59 g/t Au (including Zone 96 containing 186 000 t at 78.4 g/t Au).

Total in-ground resource by the latter method is approximately 15.866 tonnes of gold, or 510,000 ounces.

Genesis of the deposit

The Henty gold-sulphide mineralisation is unlike any of the other known deposits in the MRV belt, and studies are presently being undertaken to clarify its genesis. There has been considerable speculation as to whether the mineralisation represents a structurally controlled, Devonian granite-related deposit, such as Lakeside and the Farrell lodes further north on the Henty Fault, or an unusual Cambrian VMS-type deposit, or some combination of both. Its position on the footwall of the Henty Fault suggests some degree of structural control, but this orientation is also parallel or sub-parallel to the overturned stratigraphy (fig. 13) and hence does not preclude a largely syngenetic origin. The presence of pods of massive sulphide, some of which are banded (although the banding could be tectonic rather than primary), associated with a large sericitic-pyritic alteration zone, is suggestive of a volcanic-exhalative origin. However the presence of abundant quartz, and particularly of the massive quartz shoots which host the main gold mineralisation, is more suggestive of epigenetic-epithermal deposits.

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APPENDIX 1

## Original major element analyses of 20 rocks from the Mt Murchison area, with descriptive notes

	CENTRAL VOLCANIC COMPLEX						EASTERN QUARTZ-PHYRIC SEQUENCE									MURCHISON GRANITE		TYNDALL GROUP		DYKE IN OWEN
	A751	A758	A750	84/1	A754	84/1A	A679	A478	A694	A687	A470	A671	A689	A668	A545	A773	A530	A635	84/6	A776
SiO_2	68.27	69.35	70.38	72.5	70.29	77.7	58.48	68.75	68.57	67.72	67.76	74.42	70.62	71.78	77.22	59.08	59.92	75.65	75.4	45.64
TiO_2	0.45	0.35	0.29	0.23	0.38	0.20	0.59	0.51	0.46	0.46	0.45	0.30	0.36	0.45	0.18	0.77	0.75	0.22	0.19	1.55
Al_2O_3	14.04	12.33	11.80	11.4	13.18	10.9	15.10	13.42	12.97	13.97	12.75	12.72	13.47	13.59	12.71	14.82	15.19	12.05	11.3	16.58
FeO	2.70	2.97	4.43	3.4	3.07	1.2	9.48	3.84	3.41	3.84	4.79	1.21	1.69	2.03	0.73	2.54	4.17	1.33	1.4	2.13
Fe_2O_3	2.37	3.06	2.26	1.6	1.75	1.0	4.25	0.79	1.56	2.90	2.13	1.16	1.52	0.13	0.78	4.57	2.51	1.17	0.48	9.23
MnO	0.03	0.05	0.05	0.07	0.07	0.04	0.20	0.08	0.06	0.25	0.33	0.06	0.04	0.05	0.02	0.27	0.27	0.02	0.08	0.26
MgO	0.71	1.22	0.99	0.74	1.06	0.12	3.04	2.16	1.44	0.92	2.19	0.58	0.85	1.27	0.34	3.42	3.00	0.53	0.31	6.33
CaO	0.01	0.02	0.02	0.05	2.41	0.12	0.03	1.61	0.06	0.03	0.04	0.13	0.10	2.30	0.55	4.69	4.13	0.03	1.2	8.85
Na_2O	0.21	0.24	0.18	0.15	3.73	2.3	0.07	3.30	0.72	0.17	0.08	2.38	1.49	3.47	4.91	2.68	2.31	3.47	3.6	2.05
K_2O	9.02	7.76	6.46	7.5	1.80	5.4	3.09	3.43	7.46	6.93	5.53	5.55	7.91	2.97	1.49	4.05	4.46	4.69	3.7	0.61
P_2O_5	0.04	0.02	0.05	0.05	0.04	0.04	0.03	0.04	0.02	0.07	0.03	0.04	0.04	0.05	0.01	0.19	0.13	0.01	0.03	0.22
H_2O^+	1.51	1.46	2.21	1.4	1.51	0.61	4.49	1.96	1.94	2.37	3.16	1.08	1.15	1.25	1.46	2.08	2.35	0.82	1.5	4.53
CO_2	0.17	0.18	0.17	0.22	0.50	0.37	0.13	0.32	0.10	0.21	0.09	0.14	0.19	0.62	0.09	0.58	0.33	0.18	1.2	1.05
Total S	<0.05	<0.05	<0.05		<0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.10	<0.05		<0.05
Total	99.58	99.06	99.34	100.32	99.84	100.00	99.03	100.26	98.82	99.89	99.38	99.82	99.48	100.01	100.54	99.79	99.62	100.22	100.39	99.08

Samples 84/1, 84/1A, 84/6 submitted by K. Corbett, 1975. All others submitted by A. McNeill, 1987.

All analyses by Department of Mines Launceston Laboratories.

Note: sample locations are shown on Figure 2.

A751	Feldspar-phyric lava	Crest of Red Hills	CP828653
A758	Feldspar-phyric lava	1 km north of Red Hills	CP822664
A750	Feldspar-phyric lava	Crest of Red Hills	CP826652
84/1	Feldspar-phyric lava	Crest of Red Hills	CP825652
A754	Quartz-feldspar-phyric volcaniclastic	East side of Red Hills	CP831656
84/1A	Grey feldspar-phyric lava	1 km west of Red Hills	CP819656
A679	Quartz-feldspar-phyric lava	Near Selina Pyrite workings	CP854626
A478	Feldspar-quartz-phyric lava	Anthony Road north of Mt Murchison	CP859743
A694	Quartz-feldspar porphyry	Ridge east of Sterling Valley	CP849732
A687	Quartz-feldspar-biotite porphyry	Near Anthony River	CP863646
A470	Quartz-feldspar-biotite porphyry	East shore Lake Mackintosh	CP894759
A671	Quartz-feldspar-biotite porphyry	Near Selina Pyrite workings	CP857623
A689	Quartz-feldspar porphyry	North of Mt Murchison	CP851728
A668	Quartz-feldspar porphyry	Anthony Road NE of Mt Murchison	CP863732
A545	Quartz-feldspar porphyry	Anthony Road south of Mt Murchison	CP855669
A773	Murchison Granite	Ridge SE of Mt Murchison	CP869685
A530	Murchison Granite	Anthony Power Station Road	CP867696
A635	Quartz-feldspar-phyric lava	Gooseneck Hill	CP812652
84/6	Quartz-feldspar-phyric lava	North of Gooseneck Hill	CP812660
A776	Basaltic dyke in DDH RH17	2 km south of Red Hills	CP825631
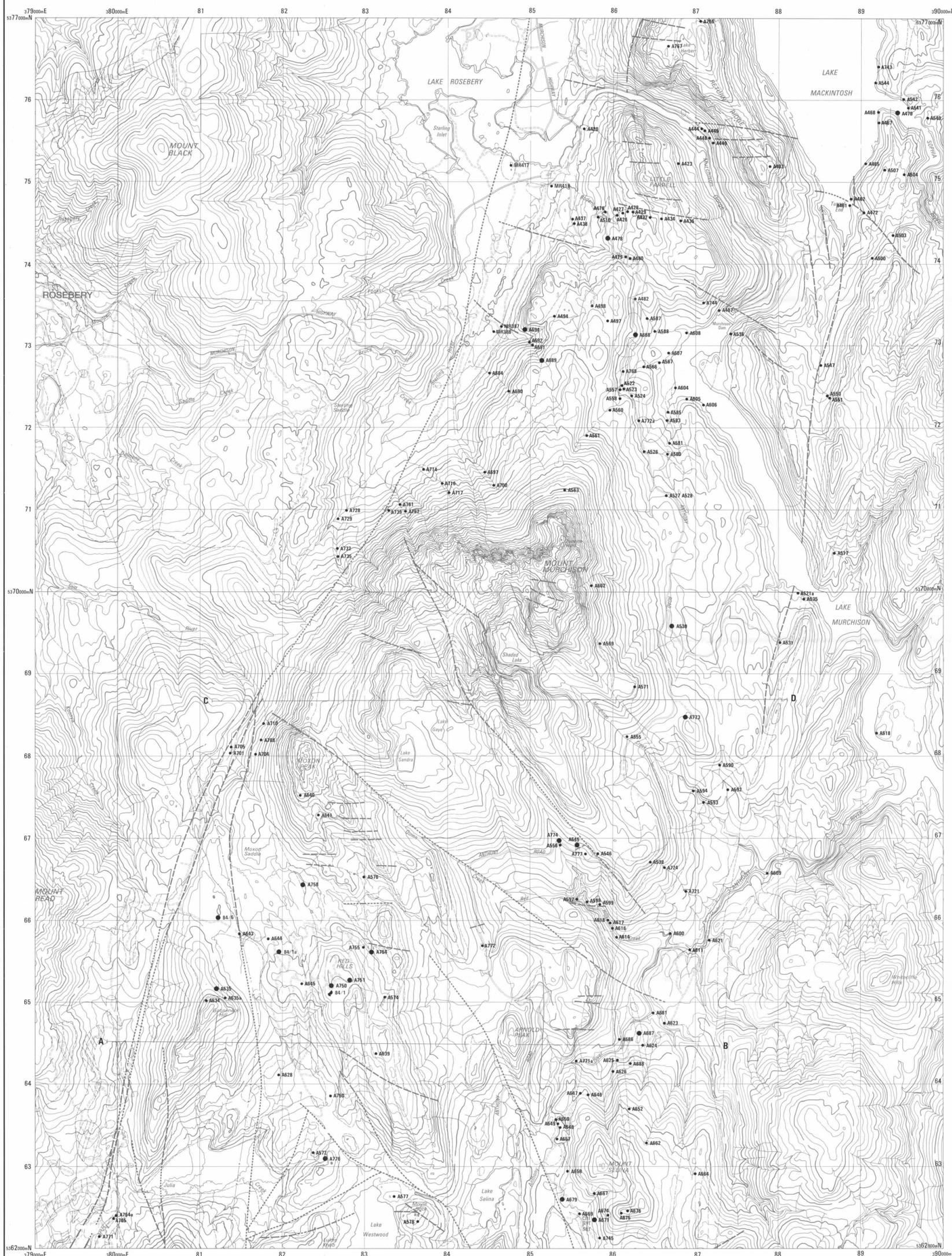
MAP 4. GEOLOGY OF THE MT. MURCHISON AREA — SAMPLE LOCALITIES.
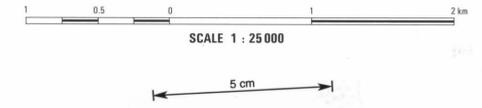
SCALE 1 : 25 000

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.
A420	C100990	A531	C102336	A607	C102378	A690	C102525
A423	C100991	A535	C102337	A608	C102379	A691	C102530
A426	C100992	A536	C102338	A609	C102380	A692	C102526
A427	C100993	A538	C102339	A611	C102381	A694	C102527
A428	C100994	A540	C102340	A614	C102382	A697	C102528
A429	C100995	A541	C102341	A616	C102383	A700	C102529
A432	C100996	A542	C102342	A617	C102384	A701	C102534
A434	C100997	A544	C102343	A618	C102385	A704	C102535
A436	C100998	A545	C102344	A621	C102386	A705	C102536
A437	C100999	A546	C102345	A623	C102387	A708	C102537
A438	C101000	A547	C102346	A624	C102388	A710	C102538
A444	C102301	A550	C102347	A625	C102389	A714	C102539
A445	C102302	A551	C102348	A626	C102390	A716	C102540
A448	C102303	A555	C102349	A628	C102392	A717	C102541
A449	C102304	A556	C102350	A634	C102393	A721	C102542
A461	C102305	A557	C102351	A635	C102394	A724	C102543
A462	C102306	A558	C102352	A635a	C102395	A728	C102544
A465	C102307	A560	C102353	A639	C102396	A729	C102545
A467	C102308	A561	C102354	A640	C102397	A732	C102546
A468	C102309	A563	C102355	A641	C102398	A735	C102547
A470	C102310	A566	C102356	A643	C102399	A739	C102548
A472	C102311	A567	C102357	A644	C102400	A743	C102549
A476	C102312	A569	C102358	A645	C102501	A744	C102550
A478	C102313	A571	C102359	A646	C102502	A745	C102551
A479	C102314	A572	C102360	A647	C102586	A750	C102552
A480	C102315	A574	C102561	A649	C102504	A751	C102553
A482	C102316	A576	C102361	A650	C102505	A754	C102554
A483	C102317	A577	C102362	A652	C102506	A755	C102555
A487	C102318	A578	C102363	A657	C102507	A758	C102556
A494	C102319	A580	C102364	A658	C102508	A760	C102557
A497	C102320	A581	C102365	A662	C102509	A761	C102558
A498	C102321	A583	C102366	A664	C102510	A762	C102559
A500	C102322	A585	C102367	A667	C102511	A764a	C102562
A503	C102323	A587	C102368	A668	C102513	A765	C102563
A504	C102324	A588	C102512	A669	C102514	A766	C102564
A507	C102325	A590	C102369	A671	C102515	A767	C102565
A510	C102326	A592	C102370	A674	C102516	A768	C102566
A517	C102560	A593	C102532	A675	C102517	A771	C102567
A518	C102327	A594	C102371	A676	C102518	A771a	C102571
A521a	C102328	A597	C102572	A679	C102519	A772	C102568
A522	C102329	A598	C102373	A681	C102520	A772a	C102572
A523	C102330	A599	C102533	A684	C102531	A773	C102573
A524	C102331	A600	C102374	A686	C102521	A774	C102574
A526	C102332	A602	C102375	A687	C102522	A776	C102576
A527	C102333	A604	C102376	A688	C102523	A777	C102577
A528	C102334	A605	C102377	A689	C102524		
A530	C102335	A606	C102391				

LEGEND

• Thin section.

● Thin section and chemical analysis.

Figure 2.   Geol. Rep. Mt Read Volc. Proj. Tasm. 3.