Tasmania Department Of Mines — Report 1992/06

Corinna 1:50 000 Geological Map

Field guide to selected rock exposures

Edited by N. J. TURNER

CONTENTS

[23 March 1992]

INTRODUCTION

This report has been prepared as the basis for a field symposium to be held in the area covered by the Corinna 1:50 000 geological map in the period 24 to 27 March 1992. The report draws primarily on field work by N. J. Turner in the western part of the area, and by A. V. Brown in the eastern part of the area. Much of Brown's work has been previously published in Geological Survey Bulletin 62 and as the pair of 1:25 000 scale maps titled *The Geology of the Dundas–Mt Lindsay–Mt Youngbuck area.*

Turner's work is previously unpublished, as is the supplementary laboratory work by A. J. Crawford, R. S. Bottrill and AMDEL which is included as appendices. All the previously unpublished work is presented here in summary form and does not substitute for the full accounts which will appear shortly.

Part 1 of the report draws on published work by R. H. Findlay and A. V. Brown near Tenth Legion in the Zeehan Quadrangle. Specifically Part 1 is concerned with the boundary of the Oonah Formation and the Success Creek Group/Crimson Creek Formation. This interesting boundary has been the subject of varying opinions in the past. Variation in current opinion will become apparent to participants as the boundary is crossed twice more in the Corinna Quadrangle.

Part 5 of the symposium will be led by representatives of Savage Resources Pty Ltd, whose participation in the field symposium is gratefully acknowledged.

PART 1
South Comstock Mine area and 10th Legion Thrust

from R. H. FINDLAY and A. V. BROWN (1992)

The 10th Legion Thrust is interpreted (Findlay and Brown, 1992) as a major structure separating overlying Precambrian Oonah Formation rocks from an underlying Cambrian volcano-sedimentary sequence containing boninitic lavas. The interpreted regional outcrop of the thrust is shown as Figure 1; Figure 2 shows the mapped outcrop of the thrust in the 10th Legion-South Comstock-Swansea Mine area; Figure 3 illustrates the geology of the sole of the thrust at the South Comstock Mine.

Field data at the South Comstock Mine indicate southward transport of Oonah Formation rocks with mesoscopic evidence indicating that the thrust is probably folded. These field data are summarised in the caption to Figure 3, and the reader is referred to Findlay and Brown (1992) for the full discussion.

The recognition that the southern outcrop trace of the Oonah Formation indicates thrusting of probably Early to Middle Devonian age has major implications for the interpretation of the Precambrian to Upper Palaeozoic geology of western Tasmania. These implications include the following:

1. If the Oonah Formation is a thin thrust sheet, does it over-ride Cambrian and Ordovician beds of economic importance? Note that:

   (a) acid volcanic rocks of probable Cambrian age and carbonate-bearing Ordovician units are known in the Dunkley Tram valley;

   (b) carbonate-bearing Ordovician units are known from the Zeehan area, where they appear to be overthrust by the Oonah Formation.

2. If the Oonah Formation is a thin thrust sheet, then the isolated outcrops of Precambrian rocks within the Cambrian volcano-sedimentary sequence of the Dundas trough, such as the Concert Schist (Turner, 1979), may be klippen derived from this thrust sheet.

3. Do the thrusted Precambrian rocks of the Sorell Peninsula region form part of this thrust system? If so there could well be a major sinistral strike-slip fault intervening between the Zeehan and Sorell Peninsula regions (Brown and Jenner, 1988; see also Findlay and Brown, 1992) and the thrust event has involved at least two sedimentologically distinct Precambrian units, such as are recognised in the Sorell Peninsula (McClenaghan and Findlay, 1989).

4. The internal structure of the Oonah Formation has not been resolved completely and nor has its sedimentology. Could this unit be formed of several thrust slices and could it incorporate units of the Rocky Cape Group (see above).

5. Burns (1964) described thrusting in Lower Palaeozoic rocks of northern Tasmania. This occurred during the earliest phase of the Tabberabberan Orogeny, and minor thrusts were also formed during the last phase of this event. If this early thrusting, the thrusting described herein, and that seen in the Sorell Peninsula are contemporaneous, then this thrust event must be regarded as a regional, early feature of the Tabberabberan Orogeny; this has important implications for minerals exploration programmes.

6. Extending the idea to its full limits, do our data confirm the geophysical interpretations of Richardson and Leaman (1987) that the Precambrian rocks forming both the Rocky Cape and Tyennan Regions are thin thrust sheets, but of a younger age than supposed by these workers?

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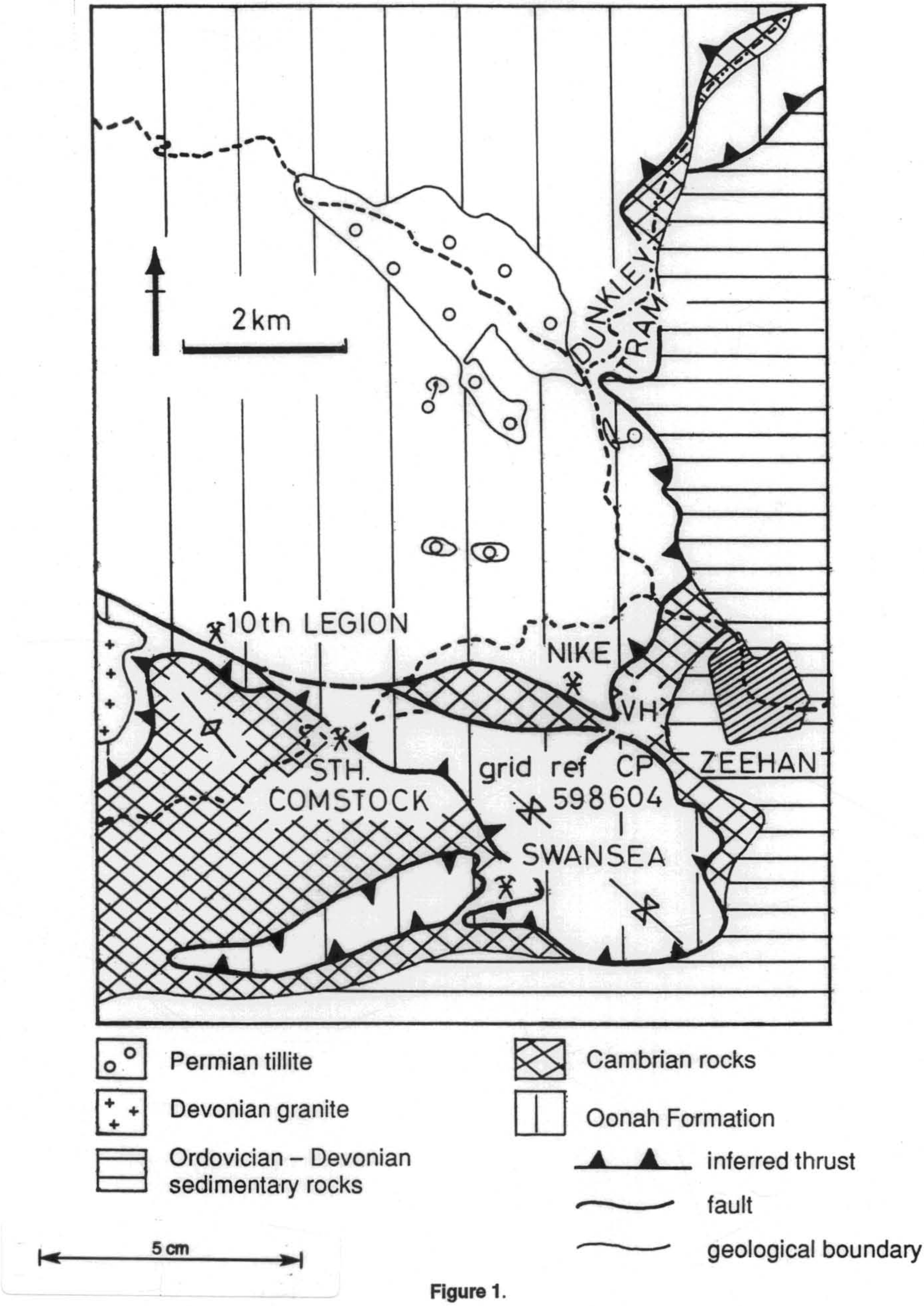


Figure 1.

Regional geological summary map showing mapped extent of 10th Legion Thrust.
VH = Vanoaness Hill

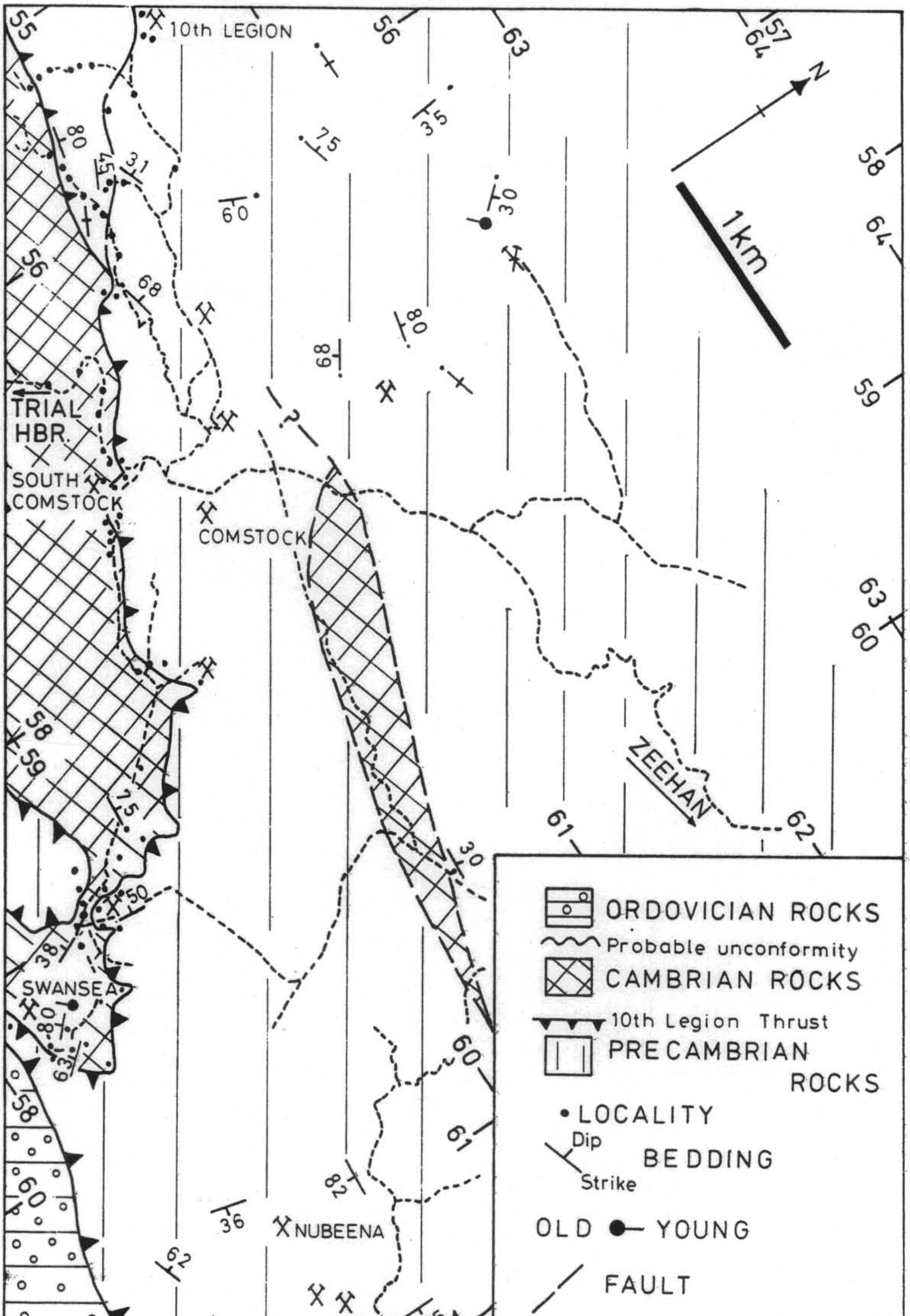
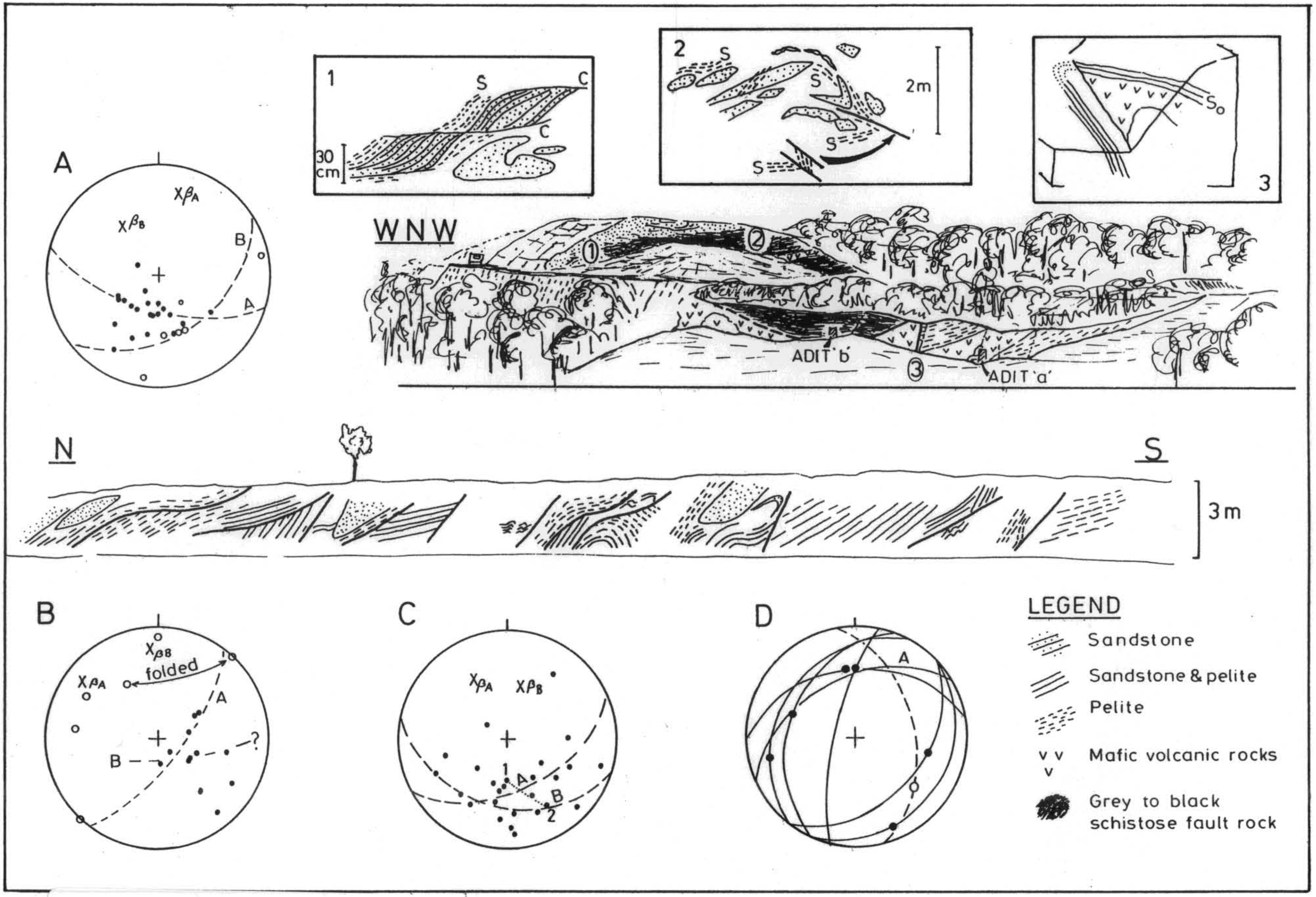


Figure 2.

Geological map summarising geological information along outcrop of 10th Legion Thrust between the 10th Legion Mine and Zeehan

5 cm



A
B
C
D
1
2
3
S
C
30 cm
2m
S_o
WNW
ADIT 'b'
ADIT 'a'
N
S
3 m
folded
LEGEND
Sandstone
Sandstone & pelite
Pelite
Mafic volcanic rocks
Grey to black schistose fault rock

5 cm

Figure 3.

Figure 3 (from Findlay and Brown, 1992)

Top sketch: Bird's-eye view of South Comstock Mine area (see legend for rock types).

Bottom sketch: Summary of structures exposed in road north of South Comstock Mine, showing faulting in upper plate immediately overlying the fault rock. Section 50 m long.

Inset 1: C–S structures in rocks of upper plate immediately overlying fault rock.

Inset 2: Transposed isoclinal fold at margin of upper plate and fault rock; the age of this structure relative to thrusting is uncertain; bedding is transposed along a penetrative fabric generally parallel to the S-fabric of the fault rock and the structure is folded by a northward-trending fold.

Inset 3: NW-trending fold in lower plate within layered chert-siltstone-mafic volcanic sequence.

Stereonet A: Poles to C-planes (solid circles) and bedding (open circles) of fold in inset 3. Likely statistical fold axes shown.

Stereonet B: Poles to schistosity (solid circles), commonly parallel to bedding, in the pelitic units in lower sketch section (upper plate rocks). Open circles are crenulation lineations possibly associated with folding on north and northwest trends; note one crenulation lineation is folded, as shown.

Stereonet C: Poles to all faults. Faults 1 and 2 (linked by dotted line) form a fault splay with an interfault angle of 36°.

Stereonet D: Solid great circles with solid circles are faults carrying quartz-fibre striations. The broken great circle represents a tension gash array thought related to slip on fault A, with open circle showing orientation of compression axis.

All stereonets are equal-area southern-hemisphere projections.

PART 2: Reece Dam area

by N. J. Turner

INTRODUCTION

Stops in the Reece Dam area will begin the introduction to the geology of the western part of the Corinna Quadrangle (fig. 4). In particular, rocks in the eastern part of the Timbs Group and in both the metamorphosed and relatively unmetamorphosed parts of the Oonah Formation will be inspected.

The geochemistry of mafic meta-igneous rocks in these and other units is discussed in Appendix 1, whilst data relating to their metamorphic grade are outlined in Appendix 2. Geochronological data in Appendix 3 indicate that hornblende in the Bowry Formation of the Timbs Group passed through the blocking temperature of the K-Ar system around 510 Ma. This may reflect the age of the retrograde greenschist metamorphism rather than the high pressure prograde metamorphism which affected the rocks. Possible regional relationships and palaeogeographic settings are depicted in Appendix 4.

Stop 1: CP408765 — Alpine Prospect

Sulphide mineralisation occurs as rubble and is exposed in shallow costeans on either side of the Heemskirk Road at the Alpine Prospect. The mineralisation comprises mainly fresh to deeply weathered, massive, fine-grained pyrite with subordinate magnetite. Banding in some mineralisation is emphasised by layers relatively rich in quartz. Coarse-grained euhedral pyrite occurs in cross-cutting fractures. A copper assay of 0.8% was returned from a sample of the massive pyritic mineralisation.

The Alpine mineralisation is in the Timbs Group near its boundary with the metamorphosed Oonah Formation, in rocks which are considered to be part of the Bowry Formation although they are poorer in mafic material than is usual. Much of the mafic material in the Bowry Formation lenses out near Reece Dam and it is present in substantial proportions only sporadically between Reece Dam and where the formation crosses the coast north of Duck Creek.

Around Alpine Prospect the Bowry Formation is deeply weathered and largely covered by basalt and gravel of Tertiary age. Rubble and scattered exposure provide limited information on the succession which hosts the mineralisation. Rock types include distinctive, green, richly-chloritic schist with albite porphyroblasts (?metavolcanic), albite-muscovite-quartz schist, grey mica phyllite and occasional quartzose schist. Amphibolite (?metabasalt) is known from drill core. Quartzose schist layers are more abundant in the lithological subdivision (Ꞓtsq) north of the prospect and in the metamorphosed Oonah Formation (Ꞓosm) to the south.

Work has been carried out on the Alpine Prospect by CRA Exploration Pty Ltd (e.g. Caithness, 1985) and by Outokumpu Australia Pty Ltd (e.g. Herrmann, 1991). They have demonstrated the presence of massive pyrite-magnetite mineralisation containing variable chalcopyrite (fig. 5), sphalerite, hematite and quartz as well as trace galena. The maximum prograde metamorphic assemblage found in the silicate rocks interbanded with the mineralisation is garnet-amphibole-plagioclase (metabasalt) and garnet-biotite-quartz (metasediment) but these upper to middle amphibolite facies assemblages are rare because of general retrogression to greenschist facies (Stolz, 1991).

The regional metamorphism, host-rock association and ore mineral assemblage at the Alpine Prospect are similar to those of the Besshi type of Cu-Zn mineralisation as summarised by Fox (1984). In particular, the Alpine Prospect occurs in a linear, high pressure metamorphic belt (Arthur Metamorphic Complex) similar to the larger Sanbagawa Belt (fig. 6) which contains the Besshi Mine and many similar deposits. The host rock association of epicontinental, rift-related basaltic volcanics (Appendix 1) with pelitic and psammitic metasediments is similar to the host association in the Sanbagawa Belt and elsewhere. Massive, Besshi-type ore consists of pyrite, chalcopyrite, minor sphalerite, magnetite and hematite, an assemblage similar to Alpine. The abundance of magnetite at Alpine appears to be unusual compared with the Sanbagawa deposits but not with respect to Blue Ridge (USA) deposits. Besshi-type deposits in the Norwegian Caledonian belt are associated with oxide and silicate facies iron formations.

Stop 2: CP423782 — Tertiary deposits

Well-bedded silty and carbonaceous mudstone occurs in the cutting on the eastern side of the Heemskirk Road at this locality. Beds range from 1–10 mm in thickness and there are scattered, particularly carbonaceous (lignitic) intervals up to about 200 mm thick. Spore and pollens from the beds are of upper Eocene to Oligocene age (upper *N. Asperus* — S. M. Forsyth, pers. comm.).

In the cutting on the opposite side of the road are older, bedded, granuly sands which have been strongly eroded and the resultant channel filled by the well-bedded mudstone.

Further north along the road are exposures of the siliceous sands and gravels which are the predominant Tertiary sedimentary deposits. Small clasts in the gravel tend to be angular but large pebbles and coarser clasts tend to be well rounded. These larger clasts comprise mainly vein quartz and various quartzites.

Basalt underlies the Tertiary sediments in the general vicinity of Stop 2 but several kilometres to the west there are sediments beneath the basalt as well as above it.

Around Stop 2, and to the north of the Pieman River, the Tertiary deposits cap hill tops of similar elevation and are

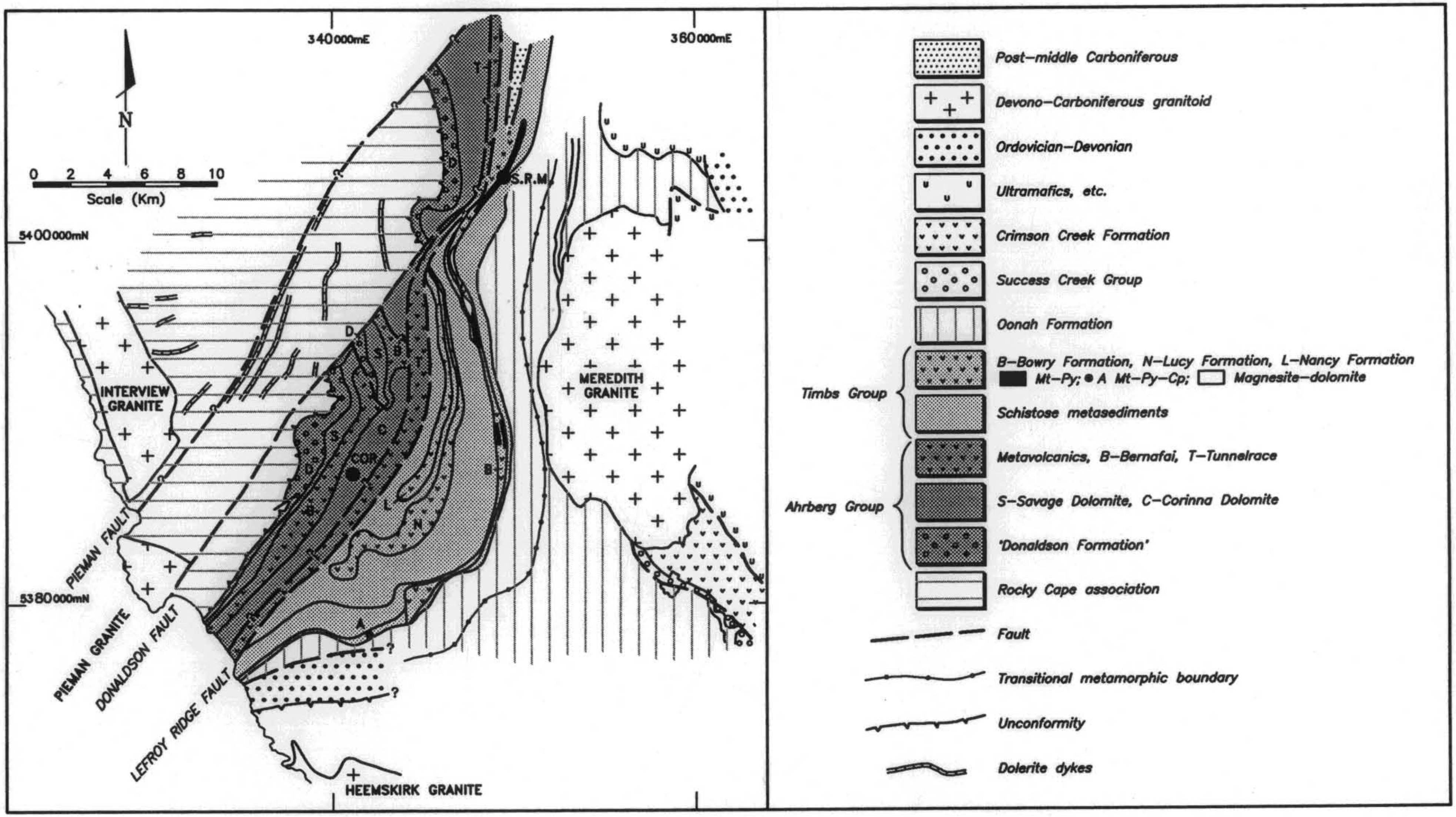


Figure 4.

Setting and stratigraphic nomenclature of the Palaeozoic and older units in the western part of the Corinna Quadrangle. Alpine locality indicated by solid dot and letter A.

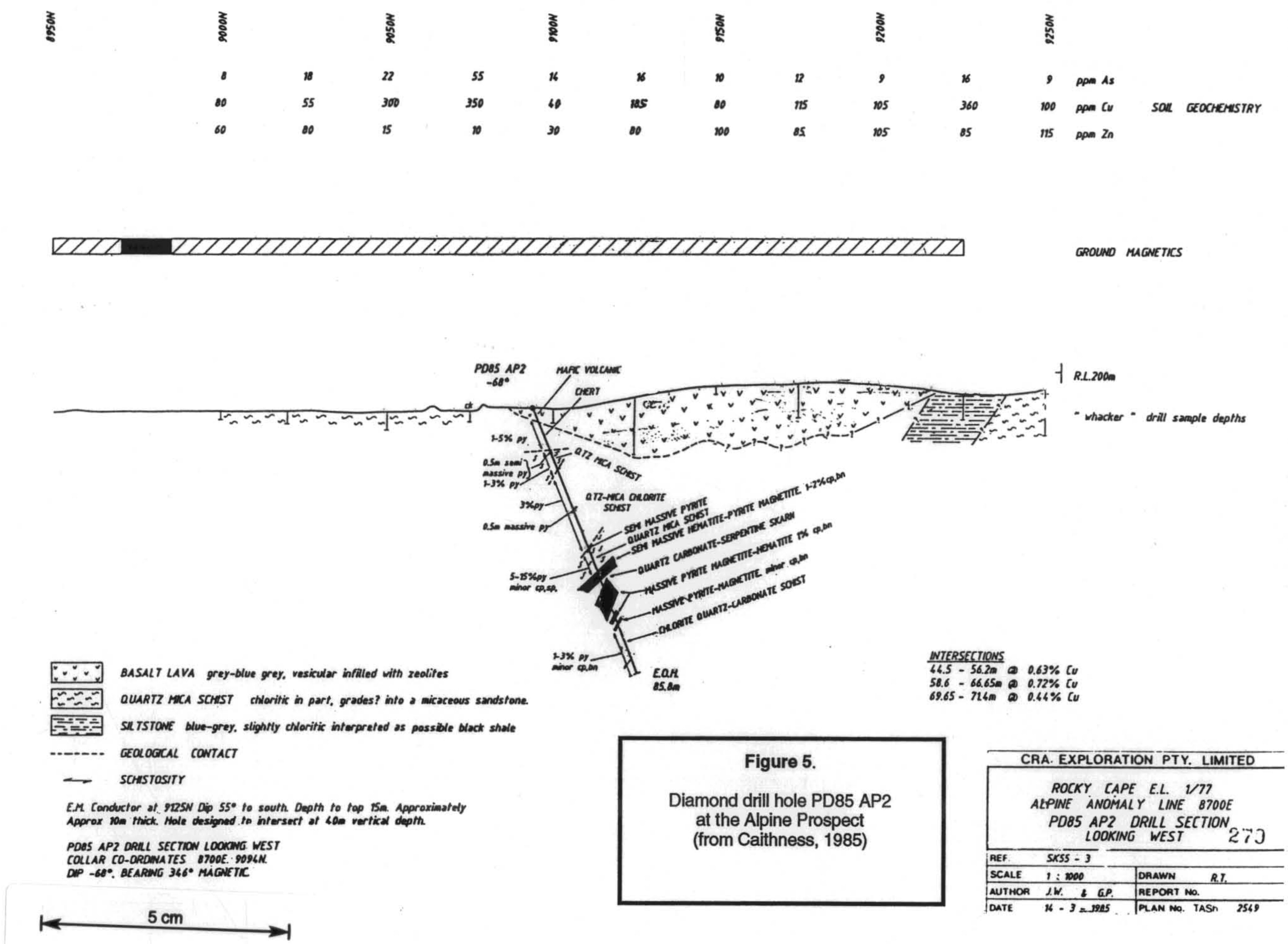
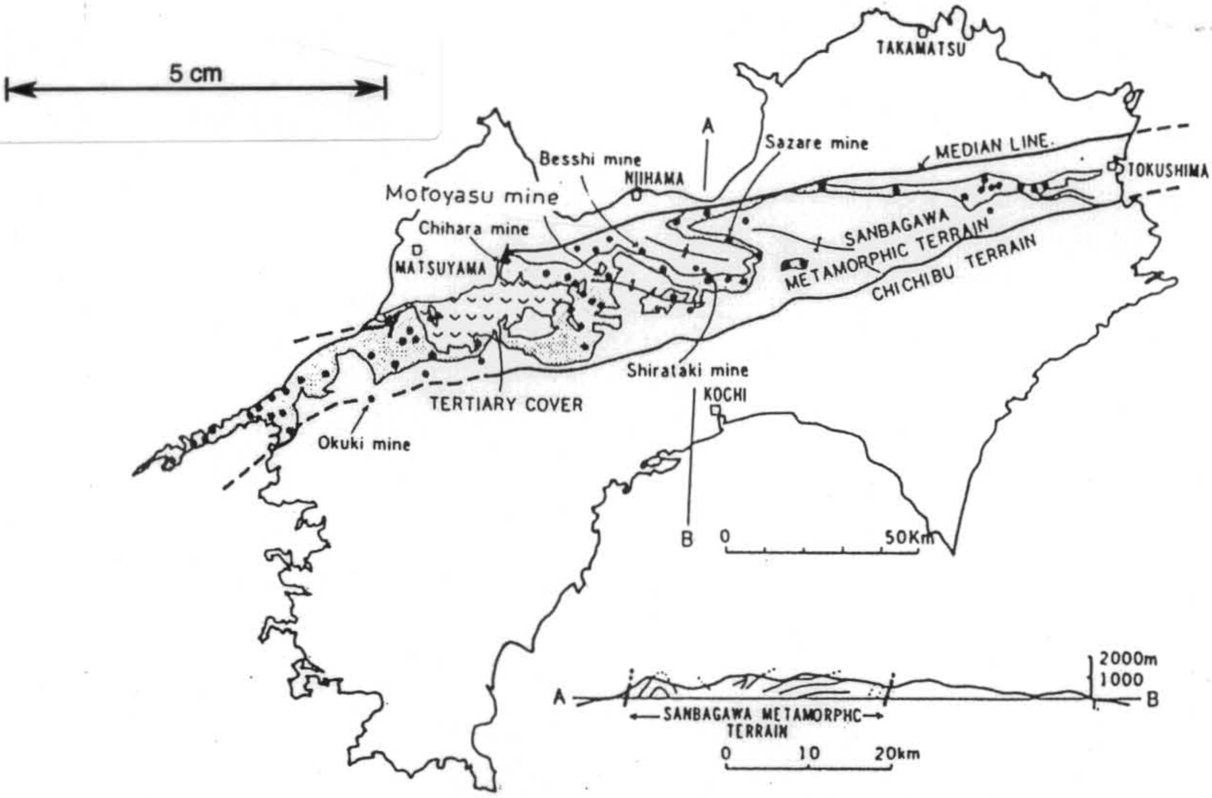


Figure 5.

Diamond drill hole PD85 AP2 at the Alpine Prospect (from Caithness, 1985)



Distribution of Besshi-type ore deposits (solid circles) and basic schist in the Sanbagawa terrain in Shikoku, Japan. Shaded areas indicate the distribution of the Middle member of the Minawa Formation in which basic schist predominates (figure 4 of Kanehira and Tatsumi, 1970; Motoyasu mine is added).

Figure 6. (from Yui, 1983)

therefore regarded as remnants of sediments formed on a now-dissected peneplain (Henty Peneplain). The deposits are interpreted as fluvial deposits formed in shallow channels (?braided) and backswamps on the peneplain.

Stop 3: CP438793–CP433796 — Glaucophane/crossite amphibolite and other Timbs Group lithologies

A track runs in a generally northwesterly direction from the Zeehan–Reece Dam road at CP438793 (fig. 7). Proceed to the bottom end of the track and traverse back towards the main road.

Around the dam at the end of the track are weathered to fairly fresh examples of fine-grained muscovite-quartz, albite-muscovite-quartz and albite-chlorite-quartz schists which are typical lithologies of the Timbs Group. On the branch track which leaves the top end of the dam there are some unusual rock types including dark grey, carbonaceous, pyritic siltstone of strongly cleaved rather than schistose appearance. In thin section, the siltstone has an early foliation which the dominant foliation, apparently S_2, crenulates. Associated with the siltstone is a band of pyritic, siliceous rock which appears to be a chemical rather than detrital deposit.

Just along the track is a body of fairly even-grained, medium-grained amphibolite which does not generally display schistosity. The amphibolite consists of glaucophane/crossite (NC493 in Appendix 2), albite, epidote, minor chlorite, magnetite and sphene. Together with the adjacent schistose rocks, the amphibolite indicates a level of metamorphism equivalent to the upper chlorite zone in the Sanbagawa Belt (Wallis and Banno, 1990; fig. 2 in Appendix 2). In comparison, the rare prograde garnetiferous assemblages at the Alpine Prospect suggest a rather higher level of metamorphism, as do the apparently prograde hornblende assemblages occurring in several parts of the Bowry Formation. The non-schistose nature of the glaucophane/crossite amphibolite suggests that blue schist facies conditions were pre-kinematic with respect to the event which produced S_2. Retrogression to greenschist facies (actinolitic) assemblages appears to have been synkinematic with this event and was apparently accompanied by mylonite formation.

Stop 4: CP450787 — Reece Dam Environs

This stop is on the eastern abutment of the Reece Dam spillway. Across the lake the orange to brown, deeply-weathered amphibolites and albitic, chloritic, dolomitic and micaceous schists of the Bowry Formation can be seen underlying the western dam abutment. The eastern boundary of the Bowry Formation runs beneath the centre of the dam, and the eastern dam abutment and western spillway abutment are underlain by very fine-grained muscovite-quartz schist and phyllite containing little mafic or feldspathic material. This unit has more affinity with the Oonah Formation than the Bowry Formation.

The eastern spillway abutment rests partly on the closure of an isoclinal fold in a strongly deformed gabbro which

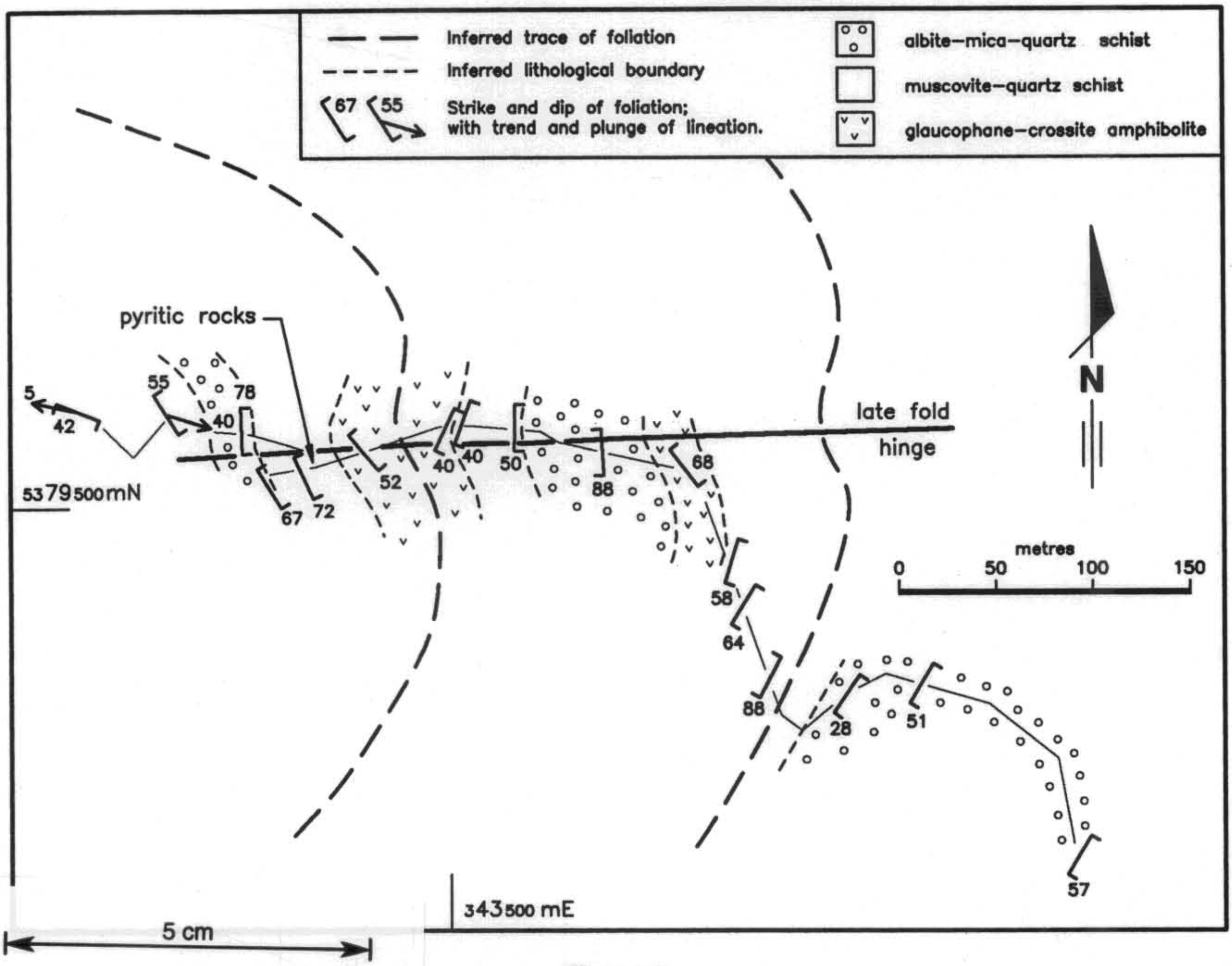


Figure 7.

Geology along a track trending NW from the Heemskirk Road near CP438793.

can be seen in the cliff on the southwest side of the engineering works and partly on metamorphosed Oonah Formation. The isoclinal closure in the gabbro is now obscured by the engineering works but similar closures can be seen in the Oonah Formation on the northwest side of the road about 30 m from the abutment. These folds are recumbent and the folded, graded meta-sandstone beds commonly show downward sedimentary facing, thus indicating that the folds are on the lower limb of a major recumbent fold. The cleavage associated with the folds is believed to be S_2.

The gabbro under the eastern spillway abutment extends SW for about one kilometre beneath the lake. Its fabric varies considerably along strike from strongly schistose to coarse-grained, equigranular igneous in the cores of larger boudins. These boudins have a 'skin' of the schistose material. Even where the schistosity is strongly developed the gabbro only exhibits very low grade metamorphism, with clinopyroxene showing little change and plagioclase showing strong, turbid alteration but no recrystallisation. The schistosity is cataclastic and the pyroxene grains are strongly fractured. Fibrous tremolite-actinolite has grown in the extension direction as these fractures have opened.

In contrast with the spillway gabbro there are totally recrystallised mafic rocks at the foot of the dam near the power station, only about 400 m away, which contain blue-green amphibole, albite, epidote, magnetite and sphene. The foliations in both the amphibolite and the gabbro appear to be the same fabric which is S_2 in the Bowry Formation and Oonah Formation metasediments.

Relict cores of lavender-coloured glaucophane/crossite occur in amphiboles in the Bowry Formation at Reece Dam (e.g. NC3 in Appendix 2), showing that the rocks have experienced higher metamorphic grade than their current, mostly retrogressed state indicates. Thus the metamorphic contrast between the amphibolites and the spillway gabbro is considerable, and may imply that a substantial fault is present along the eastern edge of the Bowry Formation.

Stop 5: CP505776 — Downward-facing folds

Recumbent and downward-facing folds appear to characterise the part of the Oonah Formation near the Timbs Group in the Reece Dam area. At Stop 5, in the northern road cutting, there is a longish limb in which locally preserved sole marks and grading demonstrate downward sedimentary facing. There is also a nicely exposed, small, synformal anticline.

Cleavage in sandstone is defined by anastomosing muscovite segregations about 0.5 mm thick and spaced 1–3 millimetres. In the more pelitic upper parts of the turbidite units and in the interbedded pelite this cleavage becomes very close spaced and slaty in appearance. It is transected by a late, fine (0.5–1 mm) crenulation cleavage which is only apparent in pelite.

Metamorphic grade in the Oonah Formation decreases from Reece Dam to Stop 5, with both sandstone and pelite at Stop 5 showing less pronounced recrystallisation. Relatively coarse muscovite flakes in sandstone at Stop 5 are thought to be of detrital origin and to be a distinguishing characteristic of this part of the Oonah Formation. Some 1.2 km further east along the road the sandstone in the Oonah Formation is more siliceous and contains only very fine-grained muscovite. Sandstone of this siliceous type persists past Stop 6 to about CP556808, where there is a return to micaceous sandstone which continues until the sequence grades to mostly mudstone near the Stanley River. In the same interval the folds change from downward facing to upward facing, thus the more siliceous sandstone appears to occupy the core of a large scale, recumbent fold.

Stop 6: CP537802 — Upward-facing folds

At this stop there is a moderately tight anticline with strong cleavage developed in the axial zone. The cleavage is defined by spaced, anastomosing mica seams but can be of slaty appearance in dark grey mudstone. The cleavage strikes north and is vertical. It is cross cut by a late, fine crenulation cleavage which is only developed in the muddy rocks. This late cleavage strikes 135° and dips 52°N.

The axial surface cleavage dies out quickly away from the axial zone. About two metres from the axial zone, on the western limb, it is weak but distinct in sandstone and transects another cleavage of similar morphology which is parallel to bedding. Some four metres further west there is more evidence of substantial deformation parallel to bedding provided by boudinage of a sandstone bed.

The bedding-parallel deformation at Stop 6 is thought to be equivalent to the dominant foliation at Reece Dam. Both are associated with boudinage. However although the dominant foliation at Reece Dam is S_2, it is not clear whether the bedding-parallel cleavage at Stop 6 is locally S_1 or S_2, that is, the earliest cleavage at Reece Dam may not extend this far east.

The youngest cleavage at Stop 6 trends southeast and is thought to be equivalent to the Devonian slaty cleavage developed in the Wurawina Supergroup around Duck Creek, on the coast northwest of the Heemskirk Granite (fig. 8). The anticline at Stop 6 is of uncertain, intermediate age.

Stop 7: CP576813 — West bank of Stanley River

Grey, carbonaceous, slaty mudstone is the predominant rock type in the Oonah Formation within 0.6 km of the Stanley River, although there are still scattered sandstone beds. These rocks may be equivalent to the rocks of the western edge of the mudstone interval (Ꝑom) in the Whyte and Heazlewood Rivers near the northern edge of Corinna map, although they underlie the locally occurring Ꝑom or 'upper' Oonah Formation as described by Brown (this volume).

In the cutting nearest the Stanley River there is a thin interval of pale green, altered ?igneous rock as well as thin micaceous sandstone in the dark grey mudstone. Berry, Elliott and Grey (1990) note that behind the tourist sign there are phacoidal textures which suggest faulting with a right lateral component of motion. They say that the fault post-dates S_1 and S_2 in the adjacent lithologies.

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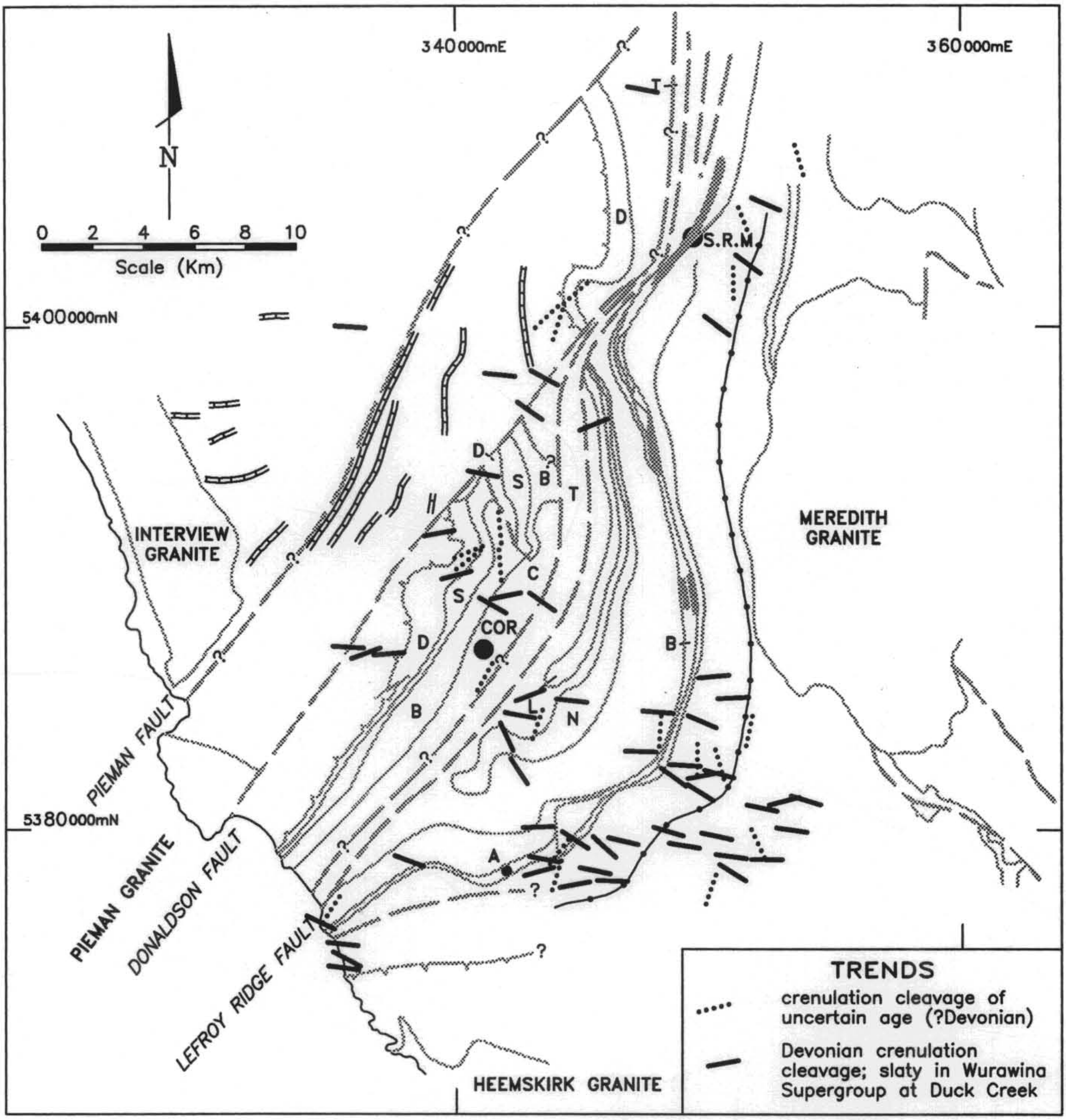

Figure 8.

Trends of late crenulation cleavages in the pre-Wurawina Supergroup rocks (pre-Ordovician in this area) compared with the trend of Devonian slaty cleavage in the Wurawina Supergroup at the coast NW of the Heemskirk Granite.

5 cm

PART 3:

Pieman Road Traverse — Corinna 1:50 000 geological map sheet: Stanley River to eastern side of map sheet.

by A. V. BROWN

BACKGROUND

A traverse along the Pieman Road, from just east of the the bridge over the Stanley River (LPD 20.1 km) to the eastern edge of the Corinna map sheet, gives access to sedimentary rock successions formed during Precambrian (Oonah Formation), and Late Precambrian (Vendian) times (Success Creek Group and Crimson Creek Formation), as well as during Cambrian (Huskisson River Group), Ordovician (Gordon Limestone) and Siluro-Devonian times (Eldon Group). Overlying most of the latter rock successions, especially around the nose of the Huskisson Syncline, are Recent, glacially-derived deposits of outwash conglomerate, gravel and sand. Tectonically emplaced ultramafic and associated gabbroic rocks crop out on both sides of the Huskisson syncline.

Oonah Formation

The Oonah Formation has never been strictly defined nor has the history of its deformation been clearly worked out. For the purpose of this guide, the Oonah Formation is taken as those rocks described at Oonah Hill by Hills and Carey (1958), and their physical continuation to the west Spry (1958), and north (Brown, 1986).

In the area covered by the Corinna map sheet, rocks of the Oonah Formation occupy a north–south area around the western and southern margins of the Meredith Granite. In the area to the south of Mount Livingstone and east of Whaleback Ridge the Oonah Formation can be divided into an 'upper' and 'lower' succession (Brown, 1986). The 'lower' succession (Eos)* consists of monotonously interbedded, indurated, muscovitic, quartz sandstone, quartz wacke and phyllitic mudstone. In the area from the bottom of the map sheet, north towards Mount Lindsay and east of the Stanley River to Misty Valley, this lower succession is typical of a distal turbidite sequence, being dominantly Bouma B and C units, with convolute laminations and minor graded sandstone units (Bouma A), at times with sole markings. The 'upper' succession (Eom) contains units of carbonate, sandstone, fine pebble conglomerate, volcaniclastic lithic wacke and minor, thin, tuff horizons within laminated siltstone and mudstone.

Up to five cleavages can be found in rocks of the Oonah Formation within the area under discussion, however the most measured in any specific outcrop was three. The first surface is a slaty penetrative cleavage associated with isoclinal folding; the second is a cross-cutting crenulation cleavage associated with refolding of the isoclinal folds; the third surface is found dominantly in the closure zone of regional-scale folds which produce the regional anticlinorial-synclinorial folding; the fourth and fifth surfaces are consistent with the north–south and NW–SE deformation events which have been ascribed to Devonian deformation. The latter three cleavages appear as penetrative, crenulation or transposition cleavages, depending on position (limb or fold closure), composition and grain size of the beds (Brown, 1986).

Contact between the Oonah Formation and the Success Creek Group

In the Pieman River at CP621744 the 'upper' succession of the Oonah Formation is overlain by the basal formation of the Success Creek Group (Taylor, 1954). The boundary is a landscape unconformity and represents a structural and low-grade metamorphic break (Brown, 1986).

The unconformable nature of the contact is apparent because of an angular discordance of bedding; a greater degree of deformation and metamorphism within the Oonah Formation compared to that within the Success Creek Group; and clasts of the underlying Oonah Formation occurring within the overlying basal conglomerate of the Success Creek Group.

The transgressive onlap nature of the contact becomes apparent as the succession is followed from the Pieman River north to the Misty Valley area. In this area [CP625790–CP635775] the Red Rock Member directly overlies rocks of the 'upper' Oonah Formation.

Success Creek Group

The Success Creek Group was defined by Taylor (1958) with the type section being along the Pieman River. Remapping of the type area, before it was flooded by Lake Pieman, showed the accuracy of Taylor's work. With the benefit of work in the Renison mine area (Gilfillan, 1965; Collins, 1972; Newnham, 1975; Patterson, 1979; Patterson *et al.*, 1981), Brown (1986) redefined the group into four mappable formations, each having a variable thickness along the extent of outcrop, between the Stanley River and the Renison mine area. In Taylor's type section the Success Creek Group has a measured minimum thickness of 950 metres.

The basal formation is a mixtite, consisting of poorly-sorted, immature, polymict conglomerate with sandstone lenses. The mixtite is gradationally followed by the second formation which is characterised by interbedded, clean, shallow-water, quartz sandstone with minor siltstone, pebbly sandstone and conglomerate, the Dalcoath Formation.

The Dalcoath Formation grades rapidly into the third formation (Ess), a succession of laminated mudstone and siltstone with minor sandstone and conglomerate units. This formation is characterised by pervasive intraformational soft-sediment deformation.

* Symbols in brackets refer to the Corinna map sheet reference column

The uppermost formation, the Renison Bell Formation, consists of two members. The lower member comprises a thinly-bedded, siliceous siltstone with mudstone partings and minor sandstone and carbonate units (Esr). The upper member is characterised by interbedded hematitic chert and mudstone with carbonate units, and minor lithic wacke and conglomerate (Esrr); this is the 'red rock' sequence of Conder (1918). In the Renison mine area the Red Rock Member is considered as a transition sequence separating the Success Creek Group and the Crimson Creek Formation (Newnham, 1975; Patterson *et al.*, 1981).

The northern extent of the Success Creek Group, as exposed along the Pieman Road to the east of the Stanley River, consists of a lower quartz sandstone succession followed by a siliceous siltstone with mudstone partings, and then the Red Rock Member. In this area, the Group as a whole is thinner than in the Pieman River and the Renison mine area, and carbonate units occur throughout both the Dalcoath and Renison Bell Formations correlates as well as in the Red Rock Member.

Crimson Creek Formation (Ecc)

The Crimson Creek Formation was defined by Taylor (1954) as gradationally following the Success Creek Group and consisting of a sedimentary rock succession dominated by basaltic-derived lithic wacke with turbidite characteristics, interbedded with siltstone, mudstone and minor basalt flows. Blissett (1962) considered that the succession was mainly a mudstone succession. Remapping of the type area (Brown, 1986) showed that this section consists dominantly of lithic wacke, derived from a basaltic source, with subordinate mudstone and siltstone units.

In the Salmon Creek–Mt Lindsay area, covered by the Corinna map sheet, numerous thin basaltic flows and thicker gabbroic intrusions occur within the sequence. The basaltic rocks are petrographically and chemically similar to basaltic rocks from the Smithton Basin, specifically those from higher up in the stratigraphic succession in the Smithton Basin.

Huskisson Group

The Huskisson Group was defined by Taylor as consisting of 19 un-named formations along the Huskisson River [between CP714751 and CP707771]. The formations were based on lithological variations, namely the incoming and outgoing of conglomeratic horizons within a laminated siltstone and mudstone succession. In the type section the group is bounded both at the base and at the top by faults and has a minimum thickness of 1250 metres. The conglomeratic units in the lower 1000 m of the sequence (Formations 1–14 of Taylor, 1954) were derived from a mixed metasedimentary and active acid to intermediate volcanic terrain, whereas those in the upper 200 m are from a dominantly metasedimentary source with reworked volcanic material (Brown, 1986). Separating the two conglomeratic sequences is approximately 50 m of laminated mudstone and siltstone. The latter sequence contains the early Late Cambrian *Glyptagnostus* fauna.

Although the Huskisson Group is a biostratigraphic correlate of the lower part of the Dundas Group, the dominance in most of the sequence of felsic volcanic detritus is an important difference between these two groups and, as such, the main reason that the Huskisson Group is considered a viable group in lithostratigraphic mapping (Brown, 1986).

EXCURSION GUIDE

As many as possible of the following locations (Stops 1–14) will be visited on Tuesday 24 March 1992. Because of time constraints some stops may have to be missed. The co-ordinates given for the stops are accurate to the nearest 100 m, with LPD distances accurate to within 50 metres.

Stop 1 — LPD 20.2–20.6 km [CP578814–CP582812]

Faulted contact between Precambrian Oonah Formation and Late Precambrian (Vendian) Success Creek Group — Stanley River area.

The last outcrops of Oonah Formation occur in road cuttings approximately 100 m east of the bridge over the Stanley River (LPD 20.2 km). These road cuts consist of interbedded sandstone and mudstone, and contain contorted and folded bedding. There are a number of different axial surface directions present, with plunges varying from relatively shallow to vertical. Late stage chevron folds and kink bands have shallowly-dipping axial surfaces.

The contact fault between the Oonah Formation and the Success Creek Group runs through the small gully approximately 200 m east of the Stanley River (LPD 20.3 km), with the first outcrops of the Success Creek Group being encountered in the road cuttings along the northern side of the road approximately 250 m east of the river (LPD 20.35 km).

In these cuttings, bedding is relatively uniform and dips steeply to the northeast. The dominant cleavage is north-south, with dips varying from steeply east to vertical. Sedimentary structures, especially multiple truncated cross bedding, can be observed in some beds, especially in the second set of cuttings between 400 and 450 m east of the Stanley River (LPD 20.5–20.55 km).

The rocks in this area have an overprint of thermal metamorphism associated with the nearby Meredith Granite. In places metamorphic spotting can be seen and sulphide staining is prevalent.

The valley to the north of the road section is underlain by a carbonate sequence. This is followed by the Red Rock Member and then rocks of the Crimson Creek Formation along the lower slopes of Mt Lindsay.

Stop 2 — LPD 21.1–21.2 km [CP586810]

Incoming of black siliceous siltstone, similar to the Renison Bell Formation, within the succession in this area.

Stop 3 — LPD 23.3–23.4 km [CP604802]

Incoming of carbonate units, then red mudstone and chert of the Red Rock Member.

Over 50 m of section the Red Rock Member grades from interbedded carbonate and grey-black siltstone, into red mudstone and chert with carbonate and siliceous granule to fine-pebble conglomerate units. One feature of this unit is the basin and dome bedding structure of the thicker, red chert-mudstone beds.

Stop 4 — LPD 24.05–24.15 km [CP610799]

Carbonate unit to the south of the road, then in the overgrown cutting to the south, oolitic chert with stromatolitic clasts interbedded with red and faun siltstone and mudstone.

Note: The cutting is heavily overgrown and only weathered, oolitic chert can now be seen. A large hand specimen, obtained from this locality, will be available for inspection. A photograph of this specimen occurs as Plate 2 in Brown (1986).

Stop 5 — LPD 24.6–24.85 km [CP615797–CP617798]

Transition from the Red Rock Member into the Crimson Creek Formation (Ecc).

The transition, which is gradational but sharp, is defined by the incoming of basalt-derived lithic wacke and the outgoing of quartz sandstone and red mudstone and chert units. In the Renison Mine sequence a third carbonate unit exists within the lower Crimson Creek Formation. In this area an equivalent carbonate horizon has not been found.

Starting with the corner exposure, on the right hand side of the road, the last of the black siltstone and mudstone of the Renison Bell Formation is observed. The stratigraphically highest quartz sandstone bed is now covered by the road.

Continuing east, granule to fine-pebble conglomerate units can be seen in the gutter of the cutting to the north of the road (LPD 24.7 km). The next cutting exposed well-bedded red mudstone, chert and buff-weathered pug after carbonate (LPD 24.75–24.85 km). At the eastern side of this cutting the first basalt-derived lithicwacke unit is encountered.

The next cutting to the east contains two gabbroic bodies associated with the volcanism within the Crimson Creek Formation. No basalt flows are observed in the Pieman Road cuttings, but 200 m to the south, exposed along the old Mt Lindsay Mine access track, three thin (0.5–1.5 m) basalt flows occur within the sequence, 50 m stratigraphically above the Red Rock Member.

Stop 6 — LPD 26.9 km [CP628812]

Greyish-black pug after carbonate.

If the regional strike of the Crimson Creek Formation is projected northward, these altered carbonate units become a continuation of the No. 2 skarn-carbonate in the Mt Lindsay Mine area. At the latter location mineralisation has been shown, by drilling, to be associated with alteration of carbonate units (Newnham and Schellekens, 1978).

Stop 7 — LPD 29.05 km [CP614815]

Outcrop of 'fresh' lithic wacke within laminated siltstone.

The only known fresh material within the Crimson Creek Formation cropping out along the Pieman Road section.

Stop 8 — LPD 29.45–29.5 km [CP645813]

Contact zone between the Crimson Creek Formation and ultramafic rocks

This zone begins, on the western side, with a zone of sheared black mudstone, of unknown affinity, and is followed by gabbro then carbonated and mineralised black mudstone.

Stop 9 — LPD 33.3 km [CP621792]

Serpentine Ridge Ultramafic Body (€sd)

Serpentine Ridge is composed of the dominant ultramafic rock type exposed on the Corinna map sheet, a succession of layered dunite, pyroxene-bearing dunite, and harzburgite with minor layers and late-stage dykes of orthopyroxenite. This succession, the LDH succession of Brown (1986), also comprises the Mt Stewart and Huskisson River ultramafic bodies. The southern part of the Serpentine Ridge area, around Rileys Knob just to the south of the map sheet, is composed of a succession dominated by orthopyroxenite with minor amounts of dunite and olivine orthopyroxenite, the LPD succession of Brown (1986) (€sp).

Layering in the LDH succession is crude in comparison to the other two ultramafic successions found in western Tasmania (Brown, 1986; 1989*a*, *b*) but it can easily be seen on the weathered surface of the serpentinised rocks by the presence of flattened orthopyroxene crystals and elongated chrome spinel grains. The light brown weathering colour is after serpentinised dunite and the pale to dark green elongate areas after serpentinised orthopyroxene. Samples from this area can have up to 85% primary mineral constituents still extant.

The LDH succession contains the Os-Ir-Ru mineralisation which is found throughout western Tasmania. The main alluvial fields associated with Serpentine Ridge occurred along the western margin in Aherne and Kershaw Creeks, and to the south in Rileys Creek. Minor deposits were also found in a number of other creeks in the area. A discussion of the PGE potential of the three different ultramafic successions in Tasmania can be found in Brown (1989*b*).

Boninitic lavas (€ba), which formed from the same parental magma as the LDH succession, crop out to the north of the Mt Stewart ultramafic body as well as in an area 6–9 km east of this location. Detailed petrographic and chemical descriptions of these lavas can be found in Brown and Jenner (1989).

Across the valley, to the east of this stop, is Merton Hill, around which alluvial tin has been worked. The hill consists of an overturned fault block of Eldon Group sedimentary rocks, which include a carbonate member (Sal) within the Amber Formation (Sa).

Stop 10 — LPD 33.6 km, track to east, 600–700 m [CP679793]

Felsic volcaniclastic succession — Huskisson Group (€h, €hs)

Cropping out in this cutting is an interbedded sequence of fossiliferous black siltstone/mudstone with felsic volcaniclastic sandstone and wacke, including an exceedingly feldspar-rich unit. The fossil fauna gives an age of Middle Cambrian and is the same age as the Que River Beds (Jago, *in* Brown, 1989*a*).

Stop 11 — LPD 34.35–34.45 km [CP681790]

Huskisson Group sedimentary rocks rich in felsic volcanic material.

These outcrops are a variation of Stop 10. Fossils have been found within this area in a cutting along the power pylon access track, approximately 100 m south of this locality [CP682788]. Two different faunas are present in that outcrop; one in a mudstone, which represents background sedimentation, the other in interbedded, sand grade, volcaniclastic units which contain characteristics of turbidite currents. Both faunas give a consistent late Middle Cambrian age (Jago, *in* Brown, 1989*a*, p. 79).

Stop 12 — LPD 34.65 km [CP684789]

Huskisson Group siliceous conglomerate units interbedded with laminated siltstone and mudstone.

The sandstone and conglomerate units are usually graded and the conglomerate beds are lensoidal along strike. Some sandstone beds contain ripple marks (Brown, 1986).

Stop 13 — LPD 41 km, track to south, 300 m [CP735788]

Serpentinised layered pyroxenite and dunite (€sp), part of the LPD succession of Brown (1986).

In this now revegetated quarry, sheared serpentinite with blocks of gabbro, amphibolite and serpentinised orthopyroxenite can be sampled. In comparison with the Serpentine Ridge material, the weathered surfaces are light green to greyish-buff with fresh surfaces being dark to light green. The bluish-black serpentinite usually contains bastite after orthopyroxenite.

Stop 14 — LPD 45 km [CP769786]

Siltstone and siliceous conglomerate similar to that encountered in both the Pieman River to the south, where they are included within the Rosebery Group (Green, 1983), and to the north, along the eastern edge of the Corinna map sheet in the area around Higgins Creek, where they are considered part of the Huskisson Group (€hs).

Recent fossil finds in a continuation of this sequence, approximately 350 m to the east of the Corinna map sheet boundary [CP756854–CP756865], contain Late Cambrian (Post-Idamean) faunas. The fauna consists of 18 trilobite taxa plus brachiopod elements. Much of the fauna has not been previously described in Australia and has affinities with fauna from other parts of the world, in particular, central China (Jell *et al.*, 1991).

OPTIONAL STOPS

Eldon Group Correlate — LPD 40.5–35.9 km

Between LPD 40.5 km and the Huskisson River (LPD 37.9 km), a highly fossiliferous succession of interbedded, laminated, siltstone and mudstone (Sa), calcareous mudstone (Sal), and friable siliceous sandstone (Sas) crops out. This succession yields a rich shelly fauna of probable Middle Silurian (Wenlock) age (Clarke, *in* Brown, 1986) and is therefor a correlate of the Amber Formation. In the Huskisson River, just to the south of the road section, this sequence stratigraphically overlies a fossiliferous correlate of the Crotty Quartzite (Sc). The road section cuts through a spur of Crotty Quartzite at LPD 38.9 km [CP695785].

- Outcrop of the Limestone Member (Sal), in Huskisson River [CP700785]
- Outcrop of the Sandstone Member (Sas), LPD 40.15–40.25 km [CP727790]
- Outcrop of the fossiliferous Amber Formation (Sa), LPD 40.45–40.50 km [CP729791]

Recent glacial outwash deposits — LPD 39.7–39.1 km

Numerous road cuttings occur within glacially-derived laminated clay, silt, sand and conglomerate units west from the Huskisson River, especially around CP722784].

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PART 4: Savage River–Corinna district

by N. J. Turner

INTRODUCTION

This section of the field symposium allows further examination of parts of the sequence from the Oonah Formation westwards into the Timbs Group. Time will be given to examining the aspects of magnesite, magnetite and residual ochre deposits in the Bowry Formation. In addition, the stratigraphy of the Ahrberg Group will be examined and the high grade silica flour deposits at Corinna visited.

More localities than can be examined in the time available are listed in the following notes. This is because of the necessity of having a fall-back position if the bridge across the Savage River is impassable.

We will not visit the Savage River Mine because interested people can make their own arrangements to do this. Instead we will concentrate on the less well known aspects of the district's geology.

Work done by the Geological Survey in the Savage River–Corinna area has benefited from the input of geologists involved in mineral exploration. These include Rod Henham (Aberfoyle), John Pemberton (Geopeko), Ian Mathison (EZ) and Henry Shannon (Savage Resources). The names Bowry Formation and Tunnelrace Volcanics were originated by Henry Shannon.

Stop 1: 5.8 km point in Figure 9 — Pom/Poq boundary

The boundary zone between Poq and the underlying Pom is poorly exposed in old, vegetated cuttings along the north side of the Waratah Road at Stop 1. There is a succession of lithologies from east to west in an interval of about 20 m but the nature of the lithological contacts is obscured. To the east there is coarsely muscovitic, poorly-sorted sandstone typical of Pom. A few metres west of this is an irregular band of siliceous, grey, fairly well-sorted, apparently exotic (?olistolith) sandstone which is bounded to the west by dark grey slaty mudstone. In places this mudstone contains scattered, irregularly shaped, small clasts of fine-grained sandstone and has the gross texture of a mixtite. The typical, poorly-sorted Poq sandstone also occurs in this part of the sequence. Cleaved mudstone typical of Pom is predominant to the west.

In the same stratigraphic position in the Heazlewood River, about 4 km south of Stop 1, there is a thin zone (?10 m) of open framework, clay-matrix breccia containing apparently exotic (?olistolith) blocks of stromatolitic dolomite and minor chert up to one metre across which are roughly aligned parallel to bedding. The interval appears to reflect instability and sliding on the depositional slope. Beds above and below the Pom/Poq contact zone in both the Heazlewood River and the Stop 1 locality appear to be east facing.

Stop 2: 9.8 km point in Figure 9 — unmetamorphosed Oonah Formation

Classic turbiditic, quartzose sandstone and interbedded grey-green silty pelite comprise the Oonah Formation in a cutting on the south side of the Waratah Road at Stop 2. On the sole of one nicely graded bed of about 200 mm thickness there are very well preserved flute casts. The micaceous sandstone that underlies Poq on the Lower Pieman Road is confined to a thin interval below Pom in the Heazlewood River, and has not been recognised on the Waratah Road.

Cleavage is well developed at Stop 2 and is steeply dipping and of apparently slaty character in the pelitic material. Unlike in the metamorphosed Oonah Formation which lies to the west, there are few quartz veins present and none parallel to cleavage.

Stop 3: CQ507412 — metamorphosed Oonah Formation

At this locality there is a track which leaves the Corinna Road in a westerly direction. The rocks of interest are exposed in cuttings along the opposite side of the Corinna Road from the track. They are deeply weathered and leached.

(a) About 10 m south of the track entrance there is a rare exposure of particularly well-preserved graded turbidite units in which the sedimentary facing is east. There is a strong, bedding-parallel foliation (?S_2) which, in the meta-sandstone, is defined by 0.25–0.5 mm thick, anastomosing muscovite laminae spaced at 1–3 mm. There is a late, fine crenulation cleavage (S_4) developed in the pelitic material which cuts bedding and its parallel foliation at a high angle.

(b) Opposite the track entrance S_0 is largely obscured but the probable S_2 foliation is very strongly developed. There are numerous, boudinaged quartz veins parallel to the foliation, some of which display isoclinal fold closures.

(c) About 30 m north of the track entrance, bedding and the metamorphically differentiated, parallel S_2 foliation are tightly folded about an axial surface striking 11° and dipping 62°E. Although a spaced axial surface cleavage (S_3) is developed in the core of the fold, it is not developed in the limbs. The late crenulation cleavage evident at (a) is again well developed in parts of this exposure. It strikes at 126° and dips 67°N.

The fold and cleavage relationships in this Stop 3 locality closely resemble those at Stop 6 on the Pieman Road. The early, metamorphically differentiated, bedding-parallel cleavage is thought to be the main cleavage in the metamorphic complex and to be S_2 on the basis of an earlier

21/45

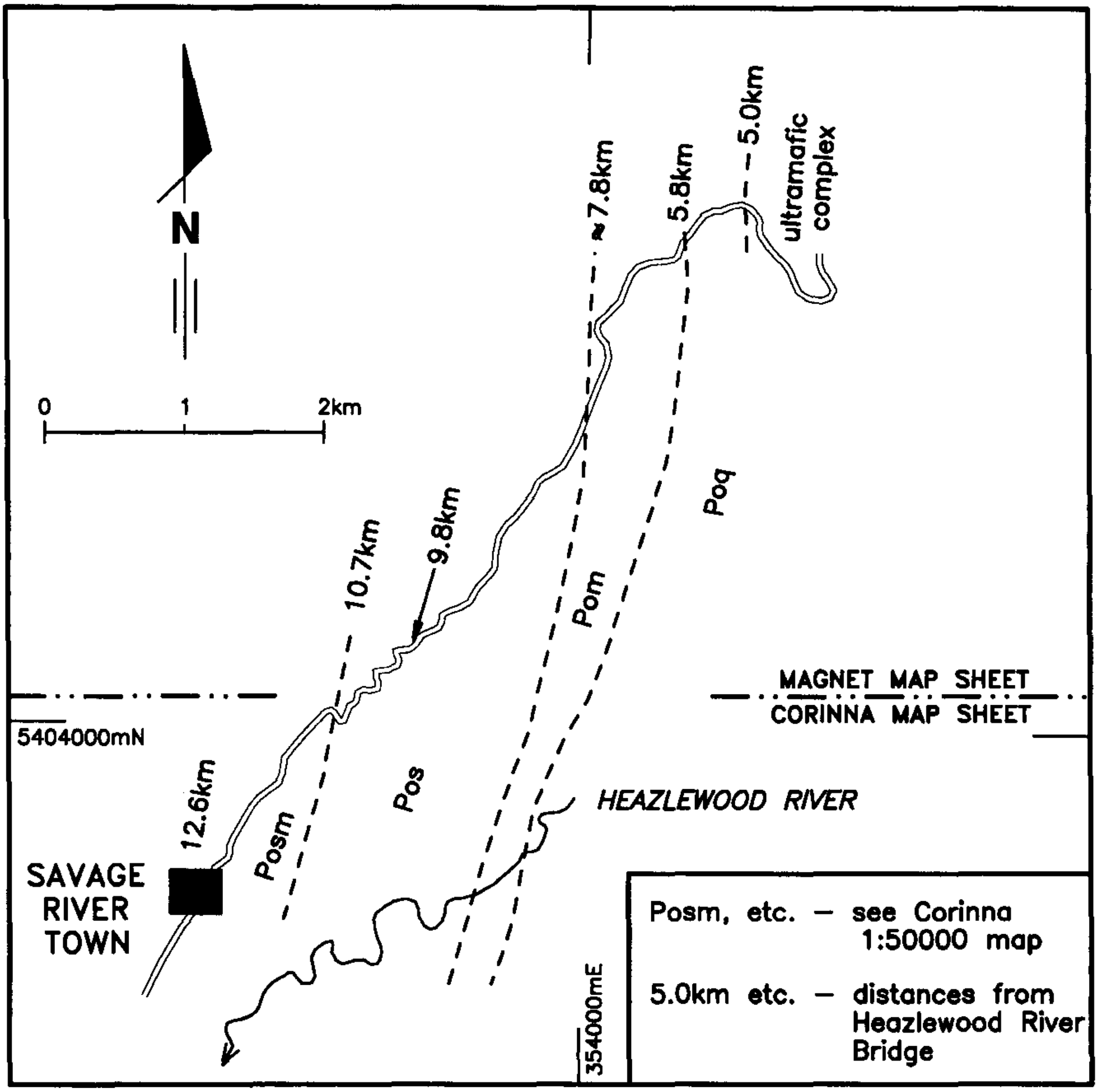


Figure 9.

Relationship of geological boundaries on the Waratah Road (Magnet Quadrangle) near Savage River to geological boundaries in the Corinna Quadrangle. Stops 1 and 2 in part 4 of the text correspond to the 5.8 km and 9.8 km points respectively

5 cm

fabric being observed in microtextures. The late, or S_4, cleavage is regarded as Devonian (see fig. 8) whilst the S_3 cleavage is of uncertain intermediate age.

Stop 4: CP484964 — Timbs Group/ Oonah Formation Boundary

Pale-coloured, weathered micaceous quartz schist and fine-grained mica schist of the Oonah Formation types are exposed at this stop. The main foliation is parallel to the compositional banding and more closely spaced (more intense) than at Stop 3.

About 100 m west, across an interval of no outcrop, there are weathered rocks (Pts) typical of the Timbs Group, that is, interbanded amphibolite and chloritic, feldspathic and micaceous schists. This sequence passes westward for about 200 m to the Long Plains South magnetite/pyrite lens.

The differences between the rocks in the two areas of outcrop is marked and clearly indicate that a geological boundary intervenes. However, there appear to be occasional mafic bands in the Oonah-type rocks in this vicinity and elsewhere near the boundary, hence these rocks have been designated separately (Ptsq) from the other Oonah-type rocks (Posm) and the typical Timbs Group rocks (Pts).

It is felt that the presence of the pale-coloured micaceous quartz schist is a more important criterion than the presence of mafic bands when determining stratigraphic affinity, and thus Ptsq is regarded as part of the Oonah Formation. None-the-less the mafic bands raise the problem of whether the passage from the Oonah Formation to the Timbs Group is transitional or faulted, as it appears to be at Reece Dam. The problem is further exacerbated by the lack of fresh samples of the mafic material in Ptsq.

Stop 5: CP468927 — Lucy Formation

The Lucy Formation is within the Timbs Group and consists of interbanded amphibolite and predominantly albitic, chloritic and muscovitic schist. Commonly, the amphibolite and chloritic schist contain disseminated, euhedral magnetite and thus the formation has a strong aeromagnetic signature. In contrast, the Nancy Formation, although it is characterised by amphibolite bands, contains little magnetite and does not have a distinct aeromagnetic signature.

Stop 5 is where a track crosses Timbs Creek. Relatively fresh examples of a variety of Lucy Formation (and Timbs Group generally) lithologies are present in the bed-load of the creek. Traversing upstream from the crossing gives access to small outcrops of the Lucy Formation, including fine to medium-grained amphibolite. In some amphibolite outcrops the fabric combines a planar component and a strong linear component which has a shallow northerly plunge. About 150 m above the crossing there is a change to a sequence dominated by muscovitic schists. This change is taken as the eastern boundary of the Lucy Formation.

Stop 6: CP470914 — Browns Plains alluvial gold prospect

This prospect is typical of many of the small alluvial gold shows in the Corinna district. It is located in a creek which, during Quaternary times, has cut down through Tertiary fluviatile gravels into the underlying deeply-weathered bedrock (Lucy Formation). The consequent reworking of the initially low concentration of gold in the Tertiary gravels led to locally enriched patches of alluvium in the creek, particularly in potholes.

Attempts to work the Tertiary gravels themselves were made around Corinna and south of the Whyte River at Lucy Spur and elsewhere. Despite expensive hydraulic sluicing techniques, none of the attempts was successful.

Stop 7: CP450915 — Ptsl

Along the western edge of the Timbs Group, partly adjacent to the bounding Lefroy Ridge Fault, is a formation (Ptsl) of mainly muscovitic schist which is characterised by the presence of intervals of boudinaged, thin beds of quartzite and scattered, small discoidal inclusions of quartzite. The quartzite is annealed to fine grainsize. It is pure and a single, very well-rounded grain of green tourmaline was found in one discoidal sample. The protolith is thought to have been quartz arenite.

Outcrop at Stop 7, which is about 300 m along a track north of the Corinna Road, is poor. However, there are several exposures of the typical schists of Ptsl and quartzite discoids, albeit broken, are common in the overlying regolith. The discoids resemble flattened pebbles.

Stop 8: CP436899 — Tertiary deposits

This stop is at a bend in the Corinna Road. A track leaves the road in a southerly direction from the apex of the bend.

About 30 m west of the track entrance there is an exposure of brown, lignitic clay which contains spores and pollens of Upper Eocene–Oligocene age. Despite the strong colouration, Savage Resources Pty Ltd has shown that similar clay at the eastern end of Browns Plains fires white and has potential as a raw material for pottery.

At the junction of the track and the Corinna Road there is lag of typical Tertiary gravel containing pebbles of mainly quartz and quartzite. There are also pebbles comprised of quartz-tourmaline which are very probably derived from the quartz-tourmaline nodules which are abundant in the Meredith Granite. Several mineral explorers, including Savage Resources and Cominex, have investigated the heavy mineral suite in the Tertiary gravels around Browns Plains and Corinna. The suite includes ruby tin, black tin and monazite, indicating provenance in the Meredith Granite; osmiridium and chromite, indicating provenance in the ultramafic complexes; gold of high purity which is far travelled; gold with relatively high silver which has probably undergone intermediate travel; 'crystalline' gold which has been traced to residual soils at the old Brookside Mine; also diamonds in very small number and of unknown provenance.

About 100 m from the Corinna Road along the branch track there is a cutting in which beds (150 mm thick) of granule sand in which there is large-scale cross-lamination are exposed. The cross laminae have a dip direction to the WSW, indicating that the current flowed in that direction.

Stop 9: CP435897 — Tunnelrace Volcanics

Proceed west along the Corinna Road from CP435897 through a deeply-weathered sequence of uniform, fine-grained, schistose metabasalt with occasional thin intervals of lustrous, grey slaty mudstone. Tiny white lenses in the metabasalt are probably flattened and altered porphyroblasts. Fresh outcrop of the metabasalt can be found at 0.5–1 km from the Corinna Road along the timber track to the south of Stop 9.

The geochemistry of the metabasalt is discussed in Appendix 1. It closely matches the geochemistry of the Bernafai Volcanics and the amphibolitic formations in the Timbs Group. A total rock K-Ar age from the Tunnelrace Volcanics is given in Appendix 3. The age is of the same order as hornblende ages from the Bowry Formation. However, total rock ages from very low grade rocks such as the Tunnelrace and Bernafai Volcanics are unreliable because their mineral assemblages do not have the necessary Ar retention characteristics.

The uninterpretable K-Ar ages obtained from the Bernafai Volcanics may reflect even lower metamorphic grade than the Tunnelrace Volcanics, that is, the Tunnelrace assemblage may contain some hornblende whereas the amphibole in the Bernafai is entirely actinolitic. Slightly higher metamorphism in the Tunnelrace may also be reflected by the relative abundance of magnetite, which gives the unit a strong aeromagnetic signature. In comparison, there is little magnetite in the Bernafai Volcanics and its relatively weak aeromagnetic signature is at least partly related to pyrrhotite.

Stop 10: CP417891 — Corinna Dolomite

Exposure of the Corinna Dolomite is very poor due to extensive cover by Tertiary gravels and by residual siliceous materials, including silica flour.

This small outcrop comprises cream, fine-grained dolomite which is massive though irregularly jointed. Silica mobility in the rock is indicated by numerous, small, elongate vugs lined with very fine-grained quartz.

Elsewhere [CP420785] the dolomite displays very distinctive botryoidal, banded, silicification textures resembling colloform texture. When this type of silicification is complete the altered dolomite resembles grey lacy agate. Most of the agate-textured material, as well as other, more massive silicification products, is known to disaggregate to form silica flour.

Stop 11: CP423913 — Northern silica flour pit

In this locality Tertiary gravels rest directly on silica flour. Drilling has shown that below the gravels there is some 65 m of silica flour and minor coherent siliceous material followed by more than 20 m of lustrous, slaty, chloritic mudstone similar to material (Ꞓbg) associated with the Bernafai Volcanics. Thus, in this locality, the entire thickness of dolomite above the mudstone has been altered to silica flour.

Agate-textured and relatively massive lumps of fairly easily disaggregated silica occur within the already disaggregated flour. Below a depth of some 18–20 m relative to the Tertiary gravel the silica flour is pervasively impregnated with brown organic matter deposited from groundwater. In contrast, at the southern silica flour pit, there is a distinct band of organic-rich silica flour with white silica flour below it.

The silica flour is thought to have formed by leaching of silicified dolomite after the Tertiary gravel had been deposited. The gravel then served as a protective capping over the silica flour. Timing of silicification is uncertain — part of it was almost certainly diagenetic and part(s) of it may have been later, perhaps even Tertiary.

Stop 12: CP401889 — Bernafai Volcanics

Cuttings along the track expose mostly weathered, fine-grained, schistose metabasalt and other fine-grained, basaltic rocks with fragmental texture which may be tuff.

In Appendix 2 the geochemistry of the Bernafai Volcanics is shown to be similar to the Tunnelrace Volcanics and the amphibolitic formations in the Timbs Group. There is also close geochemical similarity with the Smithton Volcanics, the basalts in the Crimson Creek Formation at middle Pieman River (see Appendix 4), and the Double Cove basalts at Macquarie Harbour.

K-Ar ages from the Bernafai Volcanics (Appendix 3) are regarded as unreliable because the albite-epidote-actinolite assemblage does not have the necessary Ar-retention qualities.

About 100 m to the east is the boundary between the Bernafai Volcanics and the adjacent unit (Ꞓbg). The rocks in Ꞓbg are glossy chloritic and muscovitic slates in which a late cross-cutting crenulation of inferred Devonian age (fig. 8) is present. There are also fragmental rocks comprising small, angular, basaltic pebbles.

Stop 13: CP406909 — Savage Dolomite near Guthrie Creek

In Guthrie Creek, west of the track, the Savage Dolomite consists of subordinate dark grey, thinly-bedded chert and dark grey, tough siltstone interbedded with fine-grained, cream dolomite. Exposure is more sporadic to the east of the bridge but appears to be mainly, or entirely, cream or light grey, fine-grained, massive dolomite. Along strike to the northwest, in Sabbath Creek, there are poorly-exposed stromatolitic structures in the dolomite whilst 7 km NNE, near The Longback, there are small stromatolites nicely preserved in growth position in a probable correlate of the Savage Dolomite. Oolitic textures are locally evident in the Savage Dolomite.

Along the track about 100 m north of Guthrie Creek there is good outcrop of dolomite on the east side of the track. The dolomite is cream, massive, fine grained and partially silicified. There are white seams of aggregated silica flour and there is the botryoidal form of silicification which, at its extreme stage, gives rise to material resembling grey, lacy agate.

Higher on the hill, overlying the partially silicified dolomite, is a layer of silica flour which is overlain by the Tertiary gravel which caps the hill. This 'stratigraphy' is also evident on slopes near Sabbath Creek and on slopes in the other belts of dolomite northeast of Sabbath Creek.

Stop 14: CP392913 — Quartz arenite in the 'Rocky Cape Association'

Much of the top of Mt Donaldson is underlain by silicified quartz arenite identical to the type which occurs in the Rocky Cape Group of North West Tasmania. The rock is a pure, well-sorted, medium to coarse-grained sandstone which forms well-bedded units in which the individual beds commonly display large-scale cross bedding. These features can be seen on the ridge at Stop 14.

The quartz arenite forms part of the basement on which the Ahrberg Group rests unconformably.

Stop 15: CP395917 — Base of the 'Donaldson Formation'

The lowest unit of the Ahrberg Group, the 'Donaldson Formation', rests on the older quartz arenite at Stop 15. The basal beds comprise well-sorted, siliceous, pebble and cobble conglomerate consisting of very well rounded clasts of silicified quartz arenite which is the same as material in the underlying unit. Such well-sorted conglomerate only occurs as sporadic, thin lenses resting on the basal unconformity.

Stop 16: CP395921 — Features in the lower 'Donaldson Formation' (Pdc)

Traverse along about 300 m of track walking slightly up-dip in an east-facing sequence.

Much of the sequence consists of dark grey, slaty mudstone and siltstone. There are numerous thin interbeds of pale grey coarse-grained siltstone and sandstone, grading being evident in the thicker beds. Features to be seen include:

(a) A 'dropped' block of quartz arenite about 200 mm across which breaks and bends the strata. The disturbance created by the impact of the block resulted in a thin mudstone breccia layer being deposited over the block before normal sedimentation resumed.

(b) A 100 mm thick intraformational mudstone breccia with planar top and bottom boundaries. Presumably the breccia reflects a disturbance that occurred some distance away laterally.

(c) Beds of pale quartzose sandstone ranging from 3–15 cm and graded. Turbiditic sandstone beds of this type, but commonly thicker, characterise the overlying part of the 'Donaldson Formation' which is designated Pds and closely resembles the Oonah Formation.

(d) Poorly-sorted conglomerate in a layer several metres thick and comprising very well-rounded pebbles and cobbles of quartz arenite in a muddy matrix. Other types of clast are common and comprise mainly fine-grained, muscovitic and quartzose sandstone and siltstone.

Cleavage appears strong but the quartz arenite clasts are not notably elongate although the more micaceous rocks tend to be. The dominant cleavage in the 'Donaldson Formation' is the same as the dominant cleavage in the underlying basement. It is designated S_1 although there is some local evidence of earlier folding if not cleavage formation. There is a late, fine crenulation cleavage evident in places which is thought to be the Devonian structure identified elsewhere in the western part of the Corinna Quadrangle (fig. 8).

PART 5:
Bowry Creek – Main Creek area

This segment of the field symposium will be led by representatives of Savage Resources Pty Ltd. It will focus on the magnesite, ochre and magnetite deposits around Bowry Creek near CP477973 and possibly around Main Creek near CP470985. The results of detailed mapping in this area by Savage Resources are shown in Figure 10.

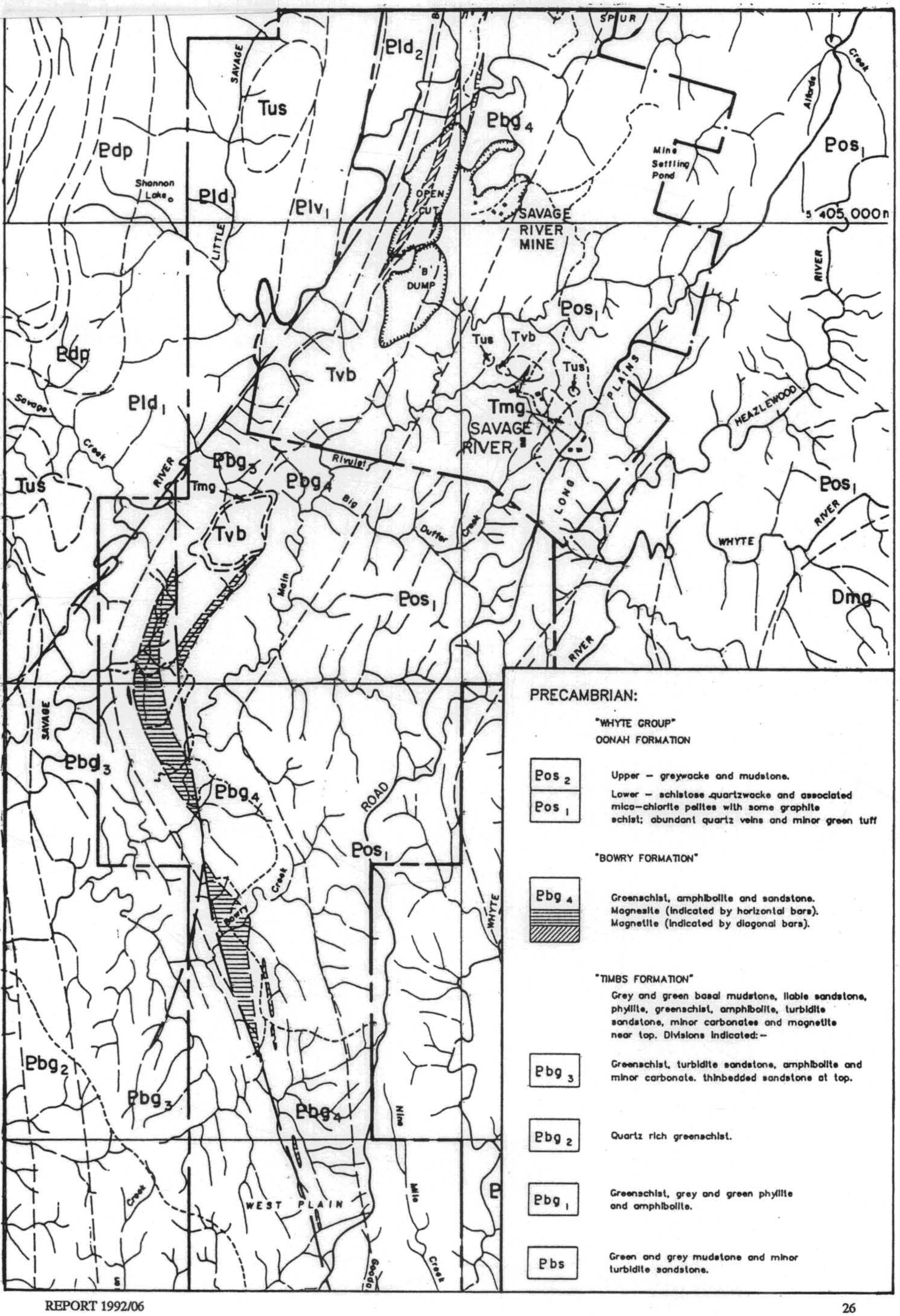
REFERENCE

ANNETT, R. W.; SHANNON, C. H. C.; VANZINO, L. 1986. *Report on investigations within Exploration Licence 4/61, West Coast, Tasmania.* Savage Resources Ltd. [TCR 86-2591]

Figure 10.

Portion of Figure 9.0 of Annett, Shannon and Vanzino (1986).

5 cm


SPUR
Ɛld 2
Tus
Ɛbg 4
Ɛdp
Shannon Lake
Ɛld
Ɛlv 1
OPEN CUT
SAVAGE RIVER MINE
'B' DUMP
LITTLE SAVAGE
Mine Settling Pond
Ɛos 1
5 405 000 m
Alforde Creek
RIVER
Ɛos 1
Tus
Tvb
Tmg
SAVAGE RIVER
PLAINS
HEAZLEWOOD
Ɛdp
Ɛld 1
Savage Creek
RIVER
Ɛbg 3
Ɛbg 4
Rivulet
Big Duffer Creek
Tus
Tmg
Tvb
LONG RIVER
WHYTE RIVER
Main
Ɛos 1
Dmg
SAVAGE
Ɛbg 3
Ɛbg 4
ROAD
Ɛos 1
Bowry Creek
WHYTE
Ɛbg 2
Ɛbg 3
Ɛbg 4
Nine Mile Creek
Creek
WEST PLAIN
PRECAMBRIAN:
"WHYTE GROUP"
OONAH FORMATION
Ɛos 2 Upper – greywacke and mudstone.
Ɛos 1 Lower – schistose quartzwacke and associated mica–chlorite pelites with some graphite schist; abundant quartz veins and minor green tuff
"BOWRY FORMATION"
Ɛbg 4 Greenschist, amphibolite and sandstone. Magnesite (indicated by horizontal bars). Magnetite (indicated by diagonal bars).
"TIMBS FORMATION"
Grey and green basal mudstone, liable sandstone, phyllite, greenschist, amphibolite, turbidite sandstone, minor carbonates and magnetite near top. Divisions indicated:–
Ɛbg 3 Greenschist, turbidite sandstone, amphibolite and minor carbonate. thinbedded sandstone at top.
Ɛbg 2 Quartz rich greenschist.
Ɛbg 1 Greenschist, grey and green phyllite and amphibolite.
Ɛbs Green and grey mudstone and minor turbidite sandstone.

APPENDIX 1

Geochemistry and implications of mafic metavolcanics in the Corinna–Savage River area

A summary of data prepared by A. J. Crawford for publication in Turner and Crawford (in prep.)

BACKGROUND

Ongoing studies (Brown, 1986; Varne and Foden, 1987; Crawford and Brown, in prep.; Crawford and Berry, in press) of the geochemistry and tectonic implications of the Eocambrian metabasic volcanics in western Tasmania have focused to date on the tholeiitic basalts of the Crimson Creek Formation and presumed correlates in the Smithton Trough, on Sorell Peninsula (e.g. Double Cove), and in the Dial Range Trough–Sheffield area ('Motton Spilite'). Taken together with information from regional geological mapping, these data suggest that the Crimson Creek Formation and correlates are best interpreted to be rift tholeiite assemblages. In modern settings, similar lava suites form during initial attenuation and splitting of continental crust in the earliest phases of ocean opening.

Attempted rifting of continental crust and eventual ocean opening is not always successful. For example, drilling for petroleum off the eastern coastline of Brazil has defined a basement architecture formed of thinned and stretched Precambrian crystalline crust cut by half grabens in which piles of rift tholeiites occur. The latter were generated during aborted attempts at ocean opening in the early Mesozoic opening history of the Atlantic. The Smithton Trough may be a local equivalent of such a feature.

The evolution of magmas during the complete sequence of initial stretching and rifting of continental crystalline crust, through opening of an ocean, to steady state ocean spreading at a stable spreading centre, is well documented. Initial magmas segregating at depth from the rising mantle diapirs (that supply the magmas that will eventually form oceanic crust) are transitional tholeiites trending to slightly alkaline basalt compositions. They are referred to as P (plume)-type for the more alkaline compositions, to E (enriched)-type for the more typically tholeiitic basalts erupted in rift settings. Usually, after several aborted attempts to invade and split the continental crust, a rift develops and eventually becomes a stable feature. Finally an ocean commences opening, with basalts erupted at spreading centre segments settling at what is referred to as N (normal)-type mid-ocean ridge basalts (MORB). Occasionally during the early rift stage, the supply of basaltic magma may jump to a new location. The 'beheaded' diapir(s) that were providing basalts to the upper crust of the former area may continue for some short time to provide basalts, but in less abundance. These late basalts from aborted rifts are often highly depleted compositions, called D (depleted)-type MORB, due to the 'basaltic' or 'fertile' component having been depleted by previous melt extraction events. They might be considered to be the last dregs of magma that can be squeezed from the dying diapir as it rises to higher levels in the mantle, and eventually freezes.

A serial geochemical variation parallels the change from P- through E- to N-type MORB, and further through to the less common D-type MORB. This trend is characterised by progressively decreasing contents of important and useful elements such as the high field strength elements (Ti, Zr, Y, Nb) and the light rare earth elements (LREE). All four types of (rift) tholeiitic basalt occur within the Crimson Creek Formation and its correlates in Western Tasmania, attesting to development of this area via one or more periods of rifting (aborted in some instances, such as the Smithton Trough) of the Rocky Cape passive margin in the latest Precambrian or Early Cambrian. Basalts transitional to P-MORB are represented among the Rocky Cape Dyke Swarm dolerites. However, the dominant basalt type is E-MORB, such as characterises most Phanerozoic incipient rifts. N-MORB are uncommon, and D-MORB are present only in the uppermost lava levels in the Double Cove basalt pile, and as late cross-cutting dykes and picritic plugs in the Smithton Trough.

Some representative compositional plots comparing the Smithton and Double Cove basalts are given in Figure 1. Both suites show pronounced enrichment of FeO* with increasing differentiation, clearly identifying them as having tholeiitic affinities. They show almost coincident compositional fields for plots of the immobile element TiO_2, and immobile element ratios Ti/Zr and Zr/Nb, versus fractionation index FeO*/MgO. On the Ti/Zr diagram, the primitive (i.e. low FeO*/MgO) and highly depleted uppermost basalts in the Double Cove pile stray from this close grouping; this simply reflects the fact that none of the Smithton Trough depleted lavas and picrites have been analysed to date.

THE CORINNA REGION METABASIC ROCKS

Introduction

For several years we have been collecting high-quality geochemical data for various suites of mafic metavolcanics and metadolerites from the Corinna region. These data are to be used to compliment regional mapping studies and to aid in determining the affinities and correlations of these poorly known rocks. The study will be published as Turner and Crawford (in prep.), probably in the *Australian Journal of Earth Sciences.*

One of the key aims of this study is to compare the Corinna metabasic rocks with the Smithton basalts and correlated Crimson Creek Formation mafic lavas. Despite their higher metamorphic grade, the metabasic schists and amphibolites of the Ahrberg Group occur in a stratigraphic association (with dolomites and silty mudstones) very reminiscent of the Smithton Trough sequence. As discussed by Nic Turner in this field guide, such a correlation poses very real problems for the interpretation of the timing and significance of the Penguin 'Orogeny'.

In the following, we present compositional variation plots for the various metabasic suites examined, and compare these with compositional fields on the same plots for the Smithton basalts. As shown above already, the pronounced compositional similarity between the Smithton and Double Cove basalt piles shows that the same exercise could equally well be carried out using the Double Cove basalts rather than the Smithton basalts.

CORINNA METABASIC SUITES

We have analysed samples from the following units/suites (see Nic's cross section and maps);

Precambrian Alkaline Suites

- Cooee Dolerite
- Deformed pillow basalts, Sulphur Creek foreshore
- Montana Melaphyre (Queen Hill Zeehan, for comparative purposes)

Rocky Cape Dyke Swarm

Dolerite dykes with mainly low greenschist facies assemblages that strike mainly NE across the Rocky Cape Region.

Ahrberg Group

- Bernafai Volcanics incl. (Western Amphibolite Band)
- Tunnelrace Volcanics

Timbs Group

- Lucy Formation
- Nancy Formation
- Bowry Formation

Gabbro at Stringer Creek

GEOCHEMICAL PLOTS AND THEIR INTERPRETATION

It is self evident that the only useful elements in exercises involving determination of affinities and correlations of meta-igneous suites are those that remain essentially immobile during metamorphic degradation of the original lavas/dolerites. Numerous studies have shown that for carefully selected samples, these elements include Fe, Mg, Ti, P, Zr, V, Nb, Y, Sc and the rare earth elements (REE). We concentrate, therefore, on this group of elements and present the data in a series of plots in which the compositions of the Smithton basalts are shown on the top diagram, and the various metabasic suites under investigation are plotted in the lower diagram together with an outline of the compositional field for the Smithton basalts. The following conclusions emerge:

1. On all variation plots (figs 1–6) and the REE diagram in Figure 7, the Precambrian alkaline dykes and lavas (Montana, Cooee and Sulphur Creek) define a distinct grouping far removed from the Smithton basalts or the remaining Corinna rocks. They are all assigned to a TiO_2-, P_2O_5- and high field strength element-rich alkaline intraplate basalt suite, with steeply light rare earth element (LREE)-enriched REE patterns. They are presumably correlated with each other. They are unrelated to the other suites studied, and will not be discussed further.

2. The TiO_2 – FeO*/MgO plot (fig. 2) shows that the Smithton basalts define a typically tholeiitic trend of increasing TiO_2 with increasing fractionation. The majority of the Corinna metabasics plot within the field defined by the Smithton basalts, with only the unusual alkaline deformed Precambrian lavas and dykes plotting well away from this field. The same applies for the Zr–FeO*/MgO relationships shown in Figure 3, Ti/V–FeO*/MgO in Figure 4, and the Ti/V–Ti/Zr plot in Figure 5. The implications of these data are clearly that **there are pronounced compositional similarities between the Smithton basalts and the Corinna metabasic suites. A correlation between these regional stratigraphic units is strongly supported by the available data.**

3. Only when very small-scale geochemical variations are taken into consideration do slight but useful distinctions appear among the suites studied. For example, Figure 6 shows that the Zr/Nb ratios (Zr/Nb reflects the primary magma value and is unaffected by fractionation or alteration) of the Corinna suites do vary somewhat away from the Smithton basalts field. The most significant variation away from the Smithton field is shown by the Bowry Formation amphibolites, that trend from values from 7–15 typical of Smithton and Double Cove tholeiitic basalts, to values in excess of 20. Note however from Figure 1 that similar high Zr/Nb values are known from the Double Cove basalts; unpublished work shows that the uppermost basalts in the Double Cove pile are those with the higher Zr/Nb (and Ti/Zr) values, indicating a temporal change from mainly E-MORB to late N-MORB, and even a few highly depleted D-MORB.

In modern tholeiitic basalts, this trend towards higher Zr/Nb follows the magma series variation from E-MORB (Zr/Nb = 10—25) towards N-MORB (Zr/Nb >30), and is accompanied by a progressive decrease in LREE-enrichment in the REE patterns. REE data plotted in Figure 8 and Figure 9 clearly show that this also holds true for the Corinna suites, as the Bowry Formation rocks have significantly less LREE-enrichment (i.e. flatter patterns) than the Smithton basalts.

4. From Figures 8 and 9, other features of the REE geochemistry of these rocks worth noting include:

   (a) Most Smithton (and Double Cove) basalts have somewhat LREE-enriched patterns with $(La/Yb)_N$ (i.e. chondrite-normalised La/Yb) values in the 2–4 range. However, the presence in the Smithton Trough (fig. 9) of basalts with unusual, broad U-shaped (saucer-shaped) patterns is notable; these basalts are formerly olivine-phyric lavas which occur near the base of the Smithton lava pile. Several basalts with similar patterns are known from Double Cove. These REE patterns may reflect crustal contamination of relatively unfractionated early-erupted basalts. This contamination might occur in magma conduits in passage to the surface, before continuous magma supply served to insulate the conduit walls and buffer against further contamination. However the petrogenesis of these basalts with U-shaped patterns is more complicated than can be modelled by a simple crustal contamination model, and further study is required. The important point is that such REE patterns are very unusual and that they occur in tholeiitic basalts and metabasic rocks from the Smithton Trough, Double Cove and the Western Amphibolite Band of the Bernafai Volcanics. Taken together with the foregoing geochemical considerations and regional mapping constraints, this very strongly supports the suggestion that **at least the Ahrberg Group is a more strongly metamorphosed correlate of the sequence in the Smithton Trough (and at Double Cove).** It may also be possible to use the U-shaped samples to define the base of the Bernafai Volcanics, and thus contribute positively in internal correlations of this belt.

(b) The Stringers Creek gabbro (fig. 8), and several of the Bowry Formation amphibolites (fig. 9), have LREE-depleted REE patterns typical of N-MORB to D-MORB. Basalts with strikingly similar REE (and other diagnostic trace element) geochemistry are present in the upper levels of the Double Cove basalt pile, and it could be confidently predicted that the Smithton Trough picritic plugs will have similarly depleted patterns. Therefore, **a preliminary but sound correlation can be made between the Bowry Formation and the youngest phase of Smithton Trough–Double Cove rift tholeiitic magmatism.** Furthermore, the presence of some LREE-depleted amphibolites in the Bernafai Volcanics suggests that it may be possible to refine the stratigraphy of this band, using the amphibolites with depleted REE patterns as markers of the top of the former metabasaltic pile.

(c) The Rocky Cape Dyke Swarm includes dolerites with trace element and REE signatures overlapping with the Smithton basalts, but also a number of samples with more strongly LREE-enriched (fig. 8) REE patterns, and lower Ti/Zr and Zr/Nb (fig. 7) and higher Ti/V (fig. 6) values than the Smithton basalts. These compositions are transitional to P-MORB and alkaline basalts. Following the generalised temporal sequence of decreasing enrichment (alkalinity in a very broad sense) with time, it is suggested that many of the Rocky Cape dykes are an early manifestation of the extended period of crustal attenuation and rift development that led to aborted rift development in the Smithton Trough, and eventuated in ocean opening at some location further east than the present Rocky Cape Region.

SUGGESTED TIME SEQUENCE OF META-IGNEOUS SUITES, CORINNA REGION

OLDEST

Pre-rifting, intraplate setting:

Alkaline basalts from Sulphur Creek, Montana Melaphyre and Cooee Dolerite.

Early rift

Rocky Cape Dyke Swarm and some basal Smithton Trough–Double Cove lavas

Middle Rift

Most Smithton Trough, Double Cove basalts, Bernafai Volcanics, Lucy Formation, Nancy Formation

Later Rift (including stage at which rift probably aborted and jumped eastward)

Upper Double Cove basalts, Smithton Trough plugs, Bowry Formation amphibolites, some Bernafai Volcanics

CONCLUSIONS

There can be little doubt that the sequences of metabasic lavas and dolerites in the Corinna–Savage River area are rift tholeiites belonging to a period of stretching and rifting of the Rocky Cape continental crust. They show a range of compositions that are closely matched and, likely directly correlated, with basaltic piles in the Smithton Trough and at Double Cove, and are interpreted to reflect evolving magma generation in a continental margin rift setting. Future ion probe dating of selected samples could test and refine this model.

REFERENCES

BROWN, A. V. 1986. Geology of the Dundas–Mt Lindsay–Mt Youngbuck region. *Bull. geol. Surv. Tasm.* 62.

VARNE, R.; FODEN, J. D. 1987. Tectonic setting of Cambrian rifting, volcanism and ophiolite formation in western Tasmania. *Tectonophysics* 140:1–9.

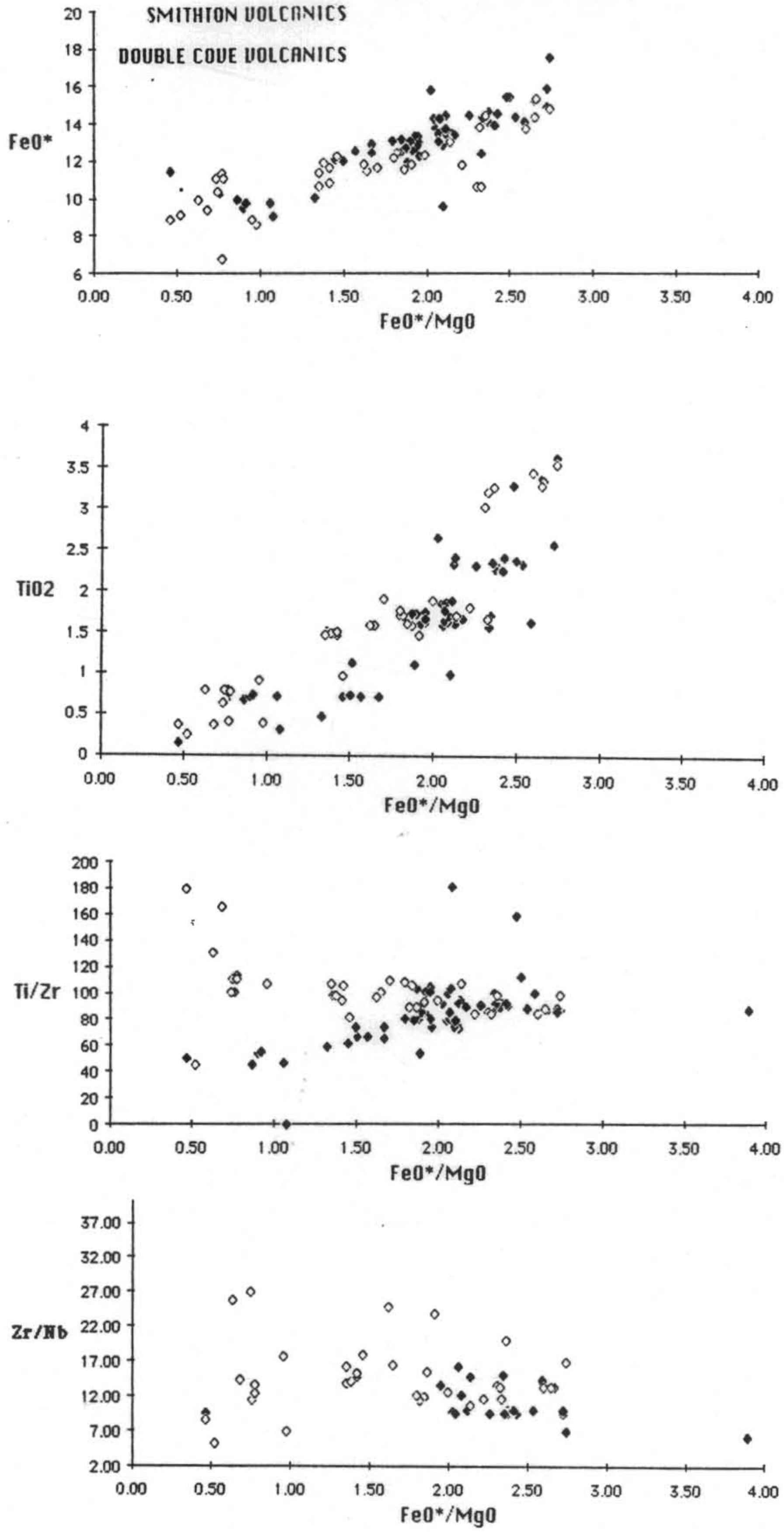


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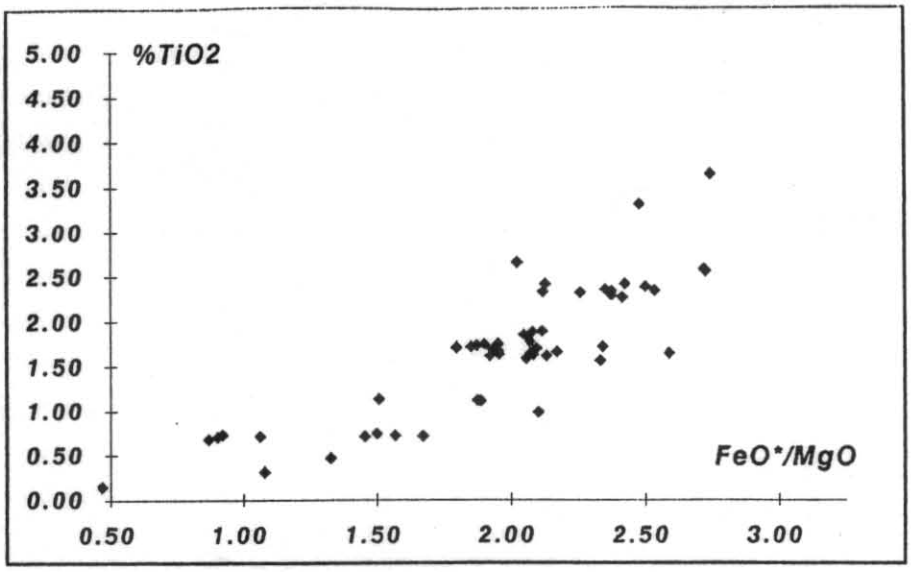
FIGURE 1:

Chemical variation diagrams showing the pronounced compositional similarities for basalts from the Smithton Trough (filled symbols) and Double Cove on Macquarie Harbour (open symbols).



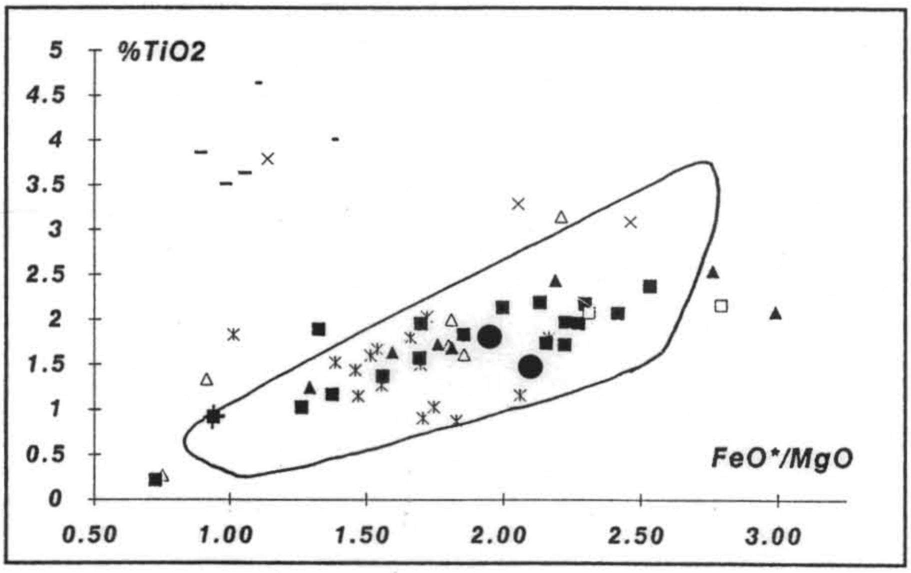


FIGURE 2:

TiO_2(%) contents versus fractionation index FeO*/MgO (where FeO* = total Fe as FeO, or 0.9times Fe_2O_3 + FeO) for Smithton basalts and Precambrian deformed intraplate alkaline rocks (top) and Corinna metabasics (bottom). The field defined by Smithton basalts is superimposed on the lower diagram.

5 cm

SYMBOLS FOR CORINNA METABASIC ROCKS

- COOEE DOL.
- × MONTANA MEL.
- SULPHUR CK
- ✱ ROCKY CAPE DYKE SWARM DOLERITES
- △ BERNAFAI VOLCANICS
- ▲ TUNNELRACE VOLCANICS
- ● NANCY FORMATION (TIMBS GROUP)
- □ LUCY FORMATION (TIMBS GROUP)
- ■ BOWRY FORMATION (TIMBS GROUP)
- STRINGERS CK GABBRO

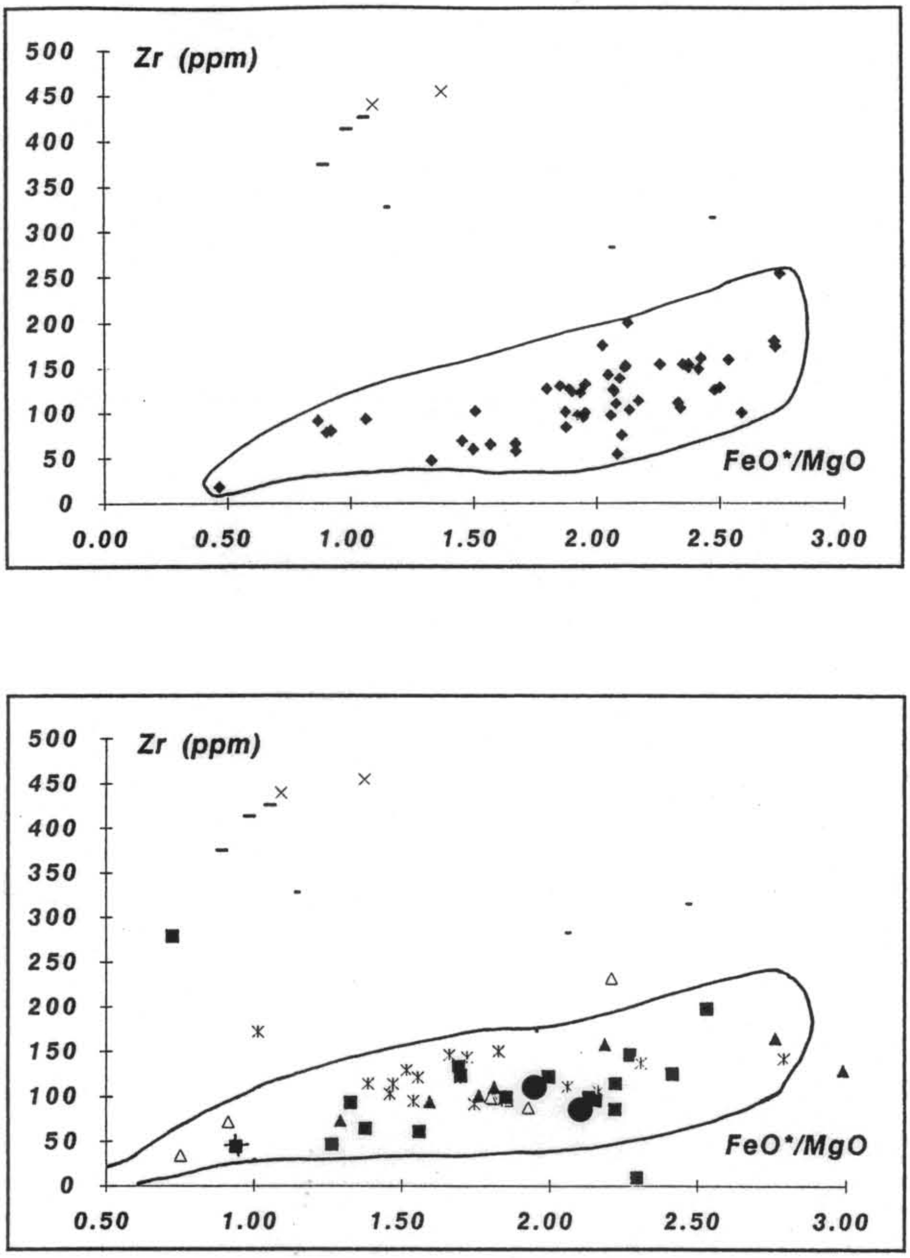
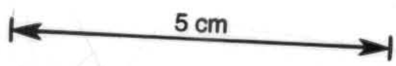
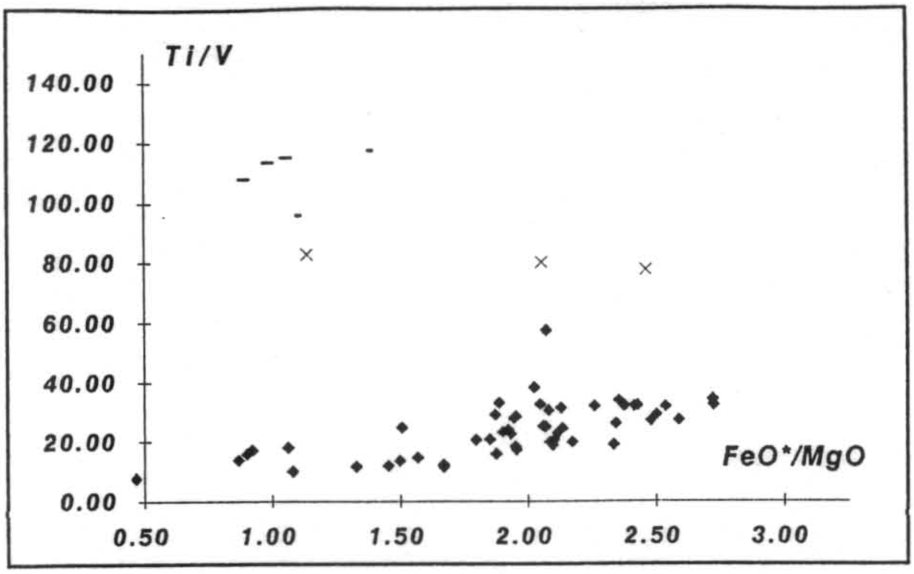


FIGURE 3:

Zr (ppm) contents versus fractionation index FeO*/MgO (where FeO* = total Fe as FeO, or 0.9times Fe2O3 + FeO) for Smithton basalts and Precambrian deformed intraplate alkaline rocks (top) and Corinna metabasics (bottom). The field defined by Smithton basalts is superimposed on the lower diagram.

- COOEE DOL. × MONTANA MEL. ▬ SULPHUR CK
* ROCKY CAPE DYKE SWARM DOLERITES
△ BERNAFAI VOLCANICS
▲ TUNNELRACE VOLCANICS
● NANCY FORMATION (TIMBS GROUP)
□ LUCY FORMATION (TIMBS GROUP)
■ BOWRY FORMATION (TIMBS GROUP)
✚ STRINGERS CK GABBRO





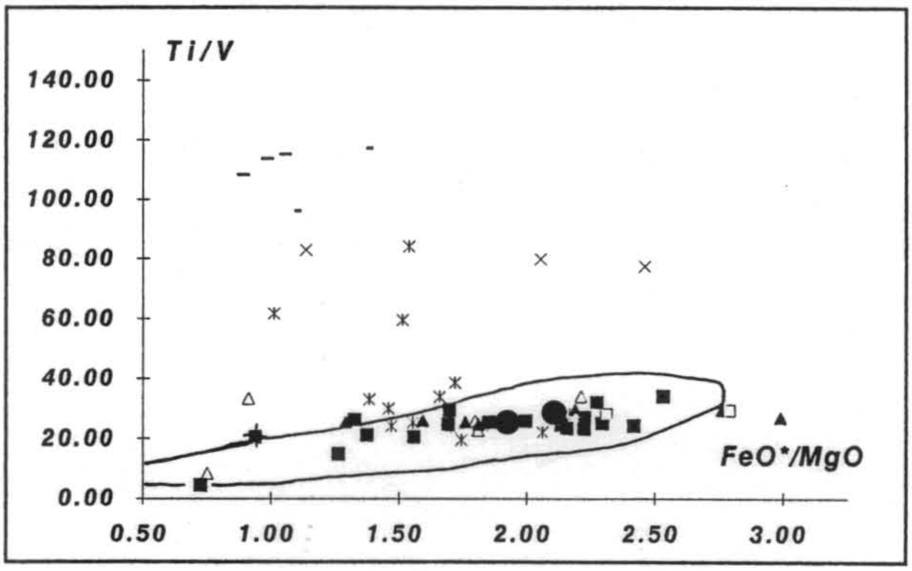


FIGURE 4:

Ti/V value versus fractionation index FeO*/MgO (where FeO* = total Fe as FeO, or 0.9times Fe2O3 + FeO) for Smithton basalts and Precambrian deformed intraplate alkaline rocks (top) and Corinna metabasics (bottom). The field defined by Smithton basalts is superimposed on the lower diagram.

SYMBOLS FOR CORINNA METABASIC ROCKS

- COOEE DOL.
- × MONTANA MEL.
- SULPHUR CK
- ✱ ROCKY CAPE DYKE SWARM DOLERITES
- △ BERNAFAI VOLCANICS
- ▲ TUNNELRACE VOLCANICS
- ● NANCY FORMATION (TIMBS GROUP)
- □ LUCY FORMATION (TIMBS GROUP)
- ■ BOWRY FORMATION (TIMBS GROUP)
- STRINGERS CK GABBRO

5 cm

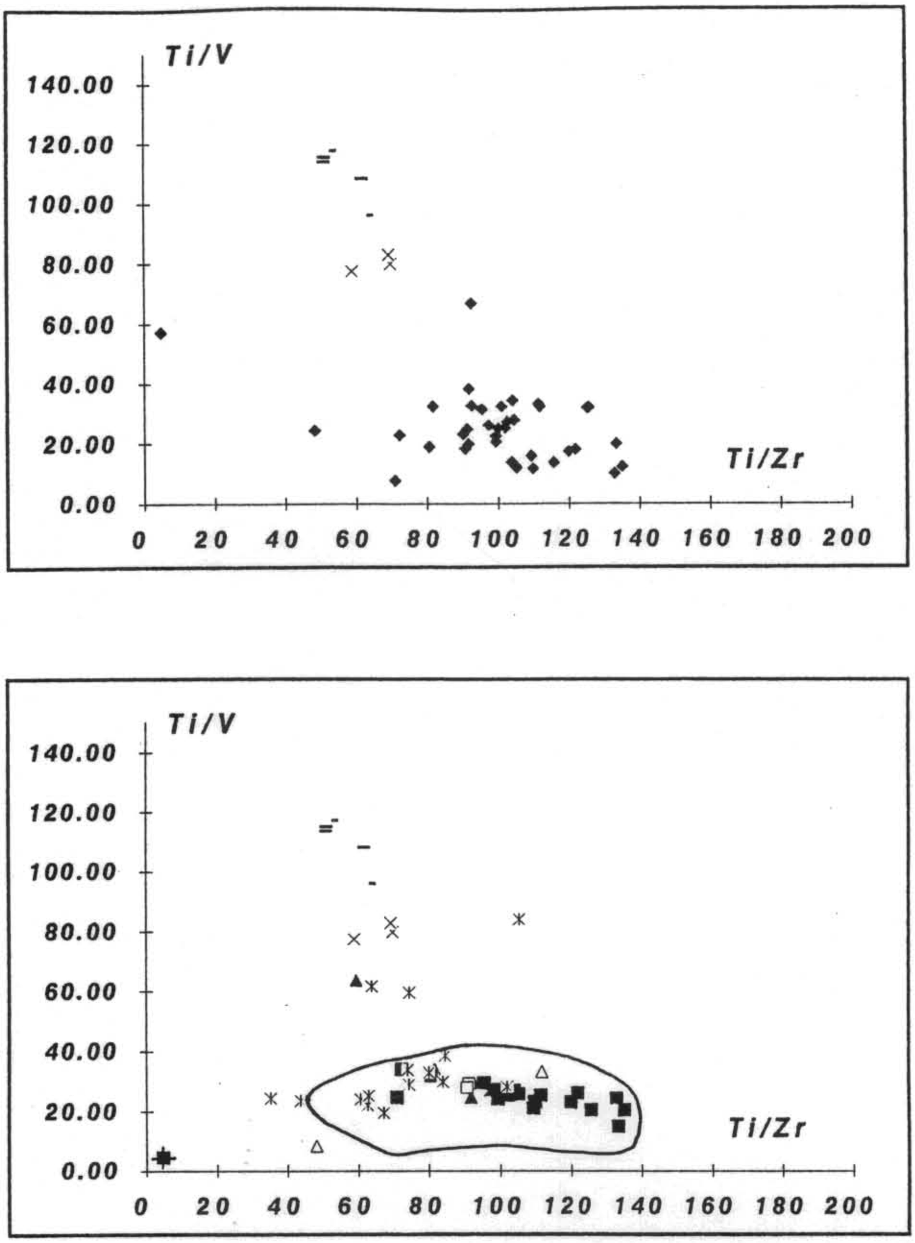


FIGURE 5:
Ti/V versus Ti/Zr for Smithton basalts and Precambrian deformed intraplate alkaline rocks (top) and Corinna metabasics (bottom). The field defined by Smithton basalts is superimposed on the lower diagram.

SYMBOLS FOR CORINNA METABASIC ROCKS

- ▬ COOEE DOL. × MONTANA MEL. ▬ SULPHUR CK
- * ROCKY CAPE DYKE SWARM DOLERITES
- △ BERNAFAI VOLCANICS
- ▲ TUNNELRACE VOLCANICS
- ● NANCY FORMATION (TIMBS GROUP)
- □ LUCY FORMATION (TIMBS GROUP)
- ■ BOWRY FORMATION (TIMBS GROUP)
- ✚ STRINGERS CK GABBRO

5 cm

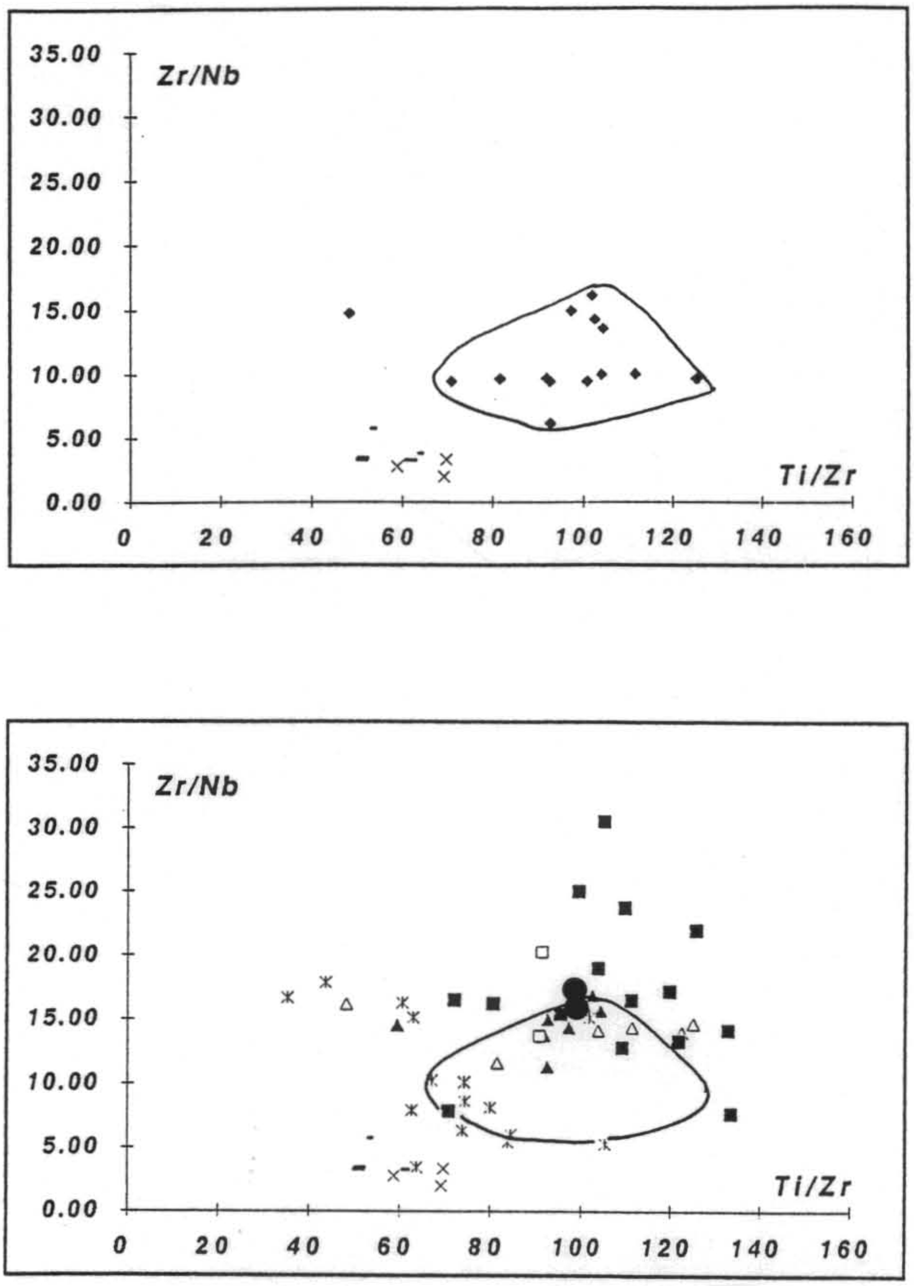


FIGURE 6:

Zr/Nb versus Ti/Zr for Smithton basalts and Precambrian deformed intraplate alkaline rocks (top) and Corinna metabasics (bottom). The field defined by Smithton basalts is superimposed on the lower diagram.

SYMBOLS FOR CORINNA METABASIC ROCKS

- ▬ COOEE DOL.
- × MONTANA MEL.
- ▬ SULPHUR CK
- ✱ ROCKY CAPE DYKE SWARM DOLERITES
- △ BERNAFAI VOLCANICS
- ▲ TUNNELRACE VOLCANICS
- ● NANCY FORMATION (TIMBS GROUP)
- □ LUCY FORMATION (TIMBS GROUP)
- ■ BOWRY FORMATION (TIMBS GROUP)
- ✚ STRINGERS CK GABBRO

5 cm

5 cm

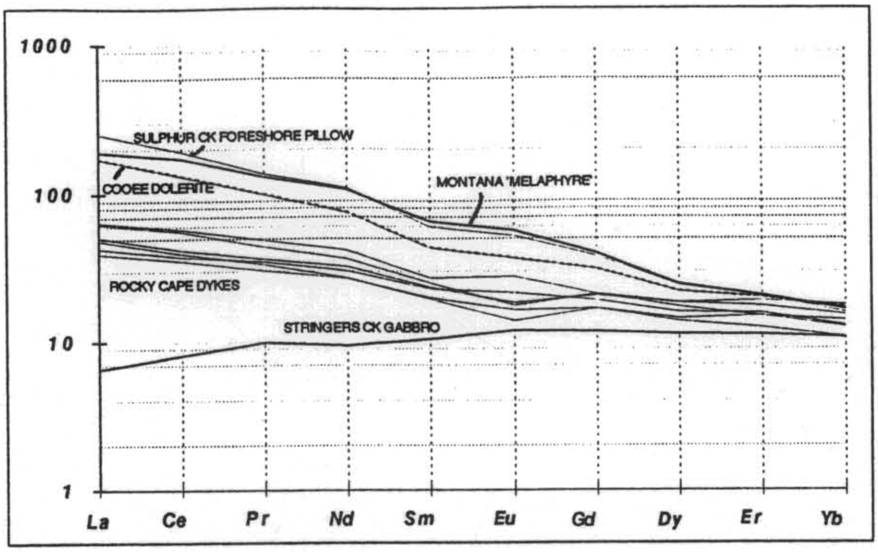


FIGURE 7:
Rare earth element patterns for Stringers Creek gabbro, Precambrian deformed intraplate alkaline rocks, and the Rocky Cape Dyke Swarm dolerites. Note the very strong LREE-enrichment of the three alkaline samples.

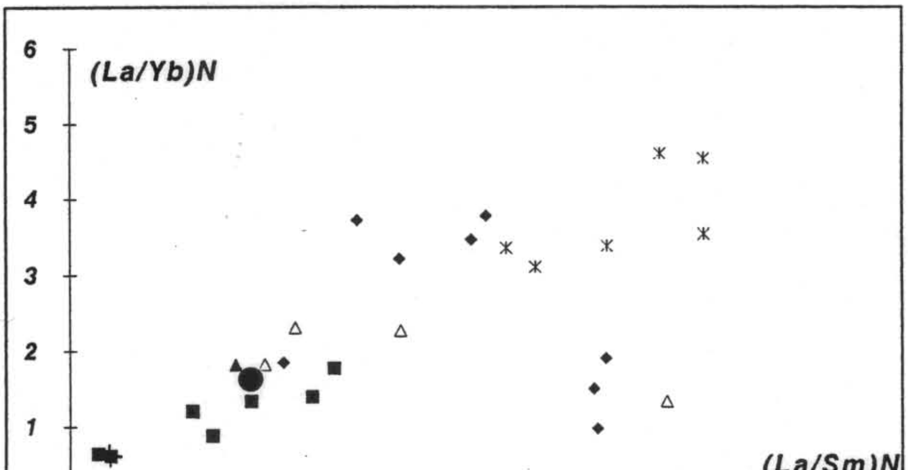


FIGURE 8:
$(La/Yb)_N$ vs $(La/Sm)_N$ plot for Smithton basalts (filled diamonds) Corinna metabasic rocks (symbols as for Figs. 2-7). Note the progressive decrease in LREE-enrichment from the Rocky Cape dykes to the Bowry Formation amphibolites.

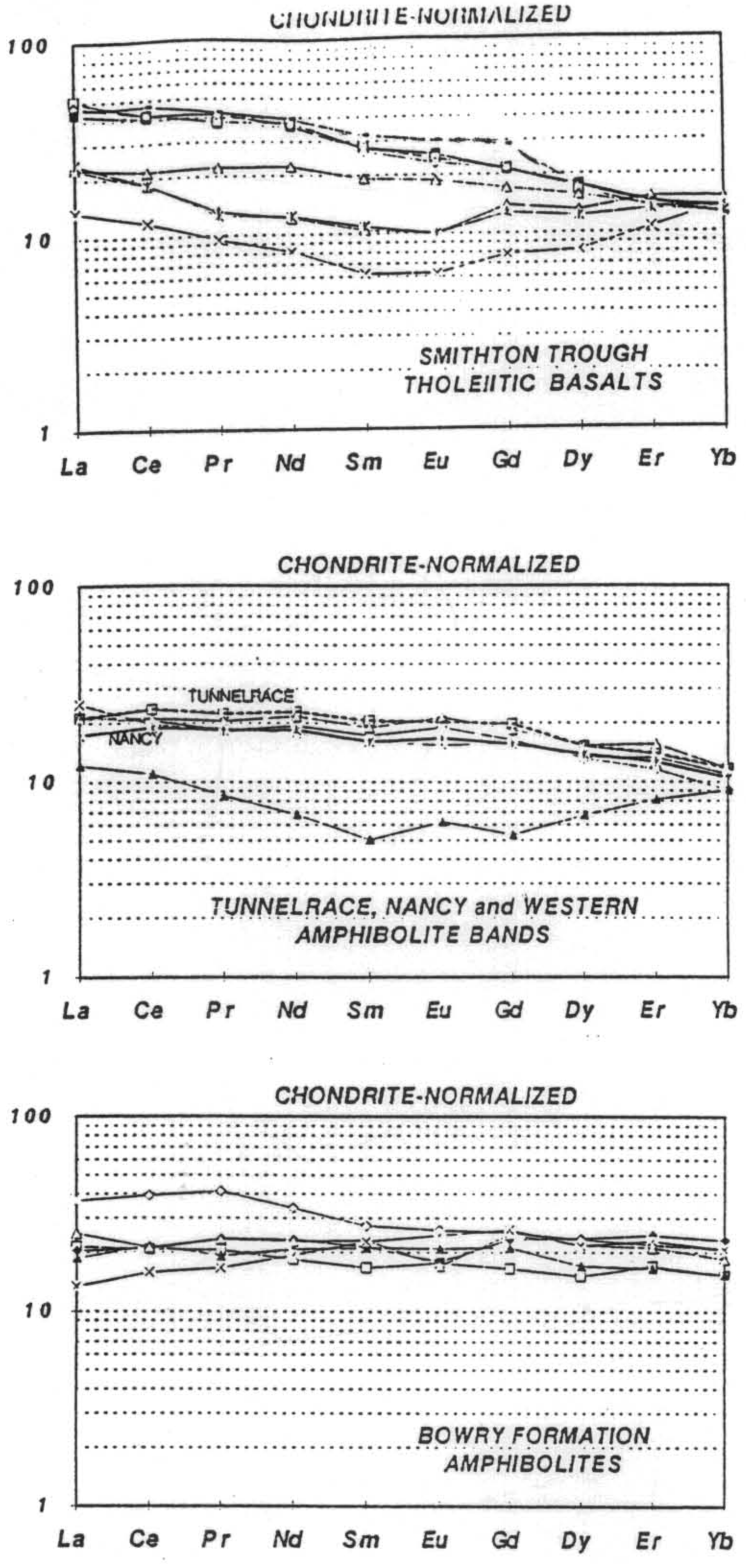


FIGURE 9:

(Top) REE patterns for Smithton Trough basalts, showing basal olivine-phyric lavas with unusual saucer-shaped patterns, and more typical smoothly LREE-enriched patterns.

(Middle) REE patterns for amphibolites from Western Amphibolite Band of the Ahrberg Group, and Nancy Member and Tunnelrace Member of the Timbs Group. Note the presence in the Western Amphibolite Band of one sample with the saucer-shaped pattern of the basal Smithton Trough lavas.

(Bottom) REE patterns of amphibolites from the Bowry Formation. Note the generally flatter patterns of these rocks compared with the more typical patterns above.

5 cm

APPENDIX 2
Sodic and sodic-calcic amphiboles from Corinna

A summary of data prepared by R. S. Bottrill for publication in Turner and Bottrill (in prep.)

ANALYSIS PROCEDURES AND FORMULAE CALCULATION

The amphiboles and associated minerals were analysed with a Cameca SX-50 electron microprobe, using WDS spectrometers at 15 kV, at the University of Tasmania.

The amphibole formulae were determined from the wt.% oxides using the procedures of Robinson *et al.* (1982). The amphibole nomenclature is that of Leake (1978). To determine the actual mineral species the cation distributions must be calculated in accord with the standard amphibole formula: $A(M4)_2(M1{-}3)_5T_8O_{22}(OH,O,Cl,F)_2$ (Leake, 1978). The FeO/Fe_2O_3 ratios were not determined separately but were calculated by crystal chemical considerations (Robinson *et al.*, 1982). Of the several methods suggested for these calculations, the 13eCNK method is probably the most suitable for these particular amphiboles (Robinson *et al.*, 1982). This method distributes Fe between FeO and Fe_2O_3 to arrive at a cation sum of 13, excluding Ca, Na and K. The 15eK method should also give a close result, but in the case of these amphiboles, a substantial grunerite component (Fe in M4 sites) results. This is unlikely in these assemblages, where epidote, albite and chlorite are usually present (Robinson *et al.*, 1982). Under the likely high pressure metamorphic conditions, the following reactions are probable:

Epidote + Grunerite → Hornblende + Chlorite

and

Albite + Grunerite → Ferroglaucophane + Fe-talc (in chlorite)

Both methods neglect the possibility of cation site vacancies, but they should provide a reasonable approximation in most cases.

The analyses of several almost pure albites in these samples indicate a deficiency in sodium of approximately 8%. This is taken to represent an analytical problem (probably excess volatilisation of sodium), and the sodium contents in the amphibole analyses are recalculated upwards accordingly. There is still a common cation deficiency in these amphibole analyses (even assuming some grunerite component), which may indicate either:

- contamination with chlorite (unlikely due to the analytical consistency and lack of correlation with the Mg/Fe ratio) site vacancies (possible),
- volatilisation of calcium (probably very minor),
- or proportionally higher sodium loss from volatilisation in amphiboles than in albite (most likely).

Assuming no grunerite component in the amphiboles, this should have no effect on the calculated glaucophane component or Al^{iv} calculated. The Na_{M4} contents are, however, less certain, although probably within about 10%, and this would probably represent an uncertainty in geobarometry (see below) of less than 0.5 kbars.

INTERPRETATION OF RESULTS

The amphibole analyses were plotted on the Na_{M4}–Al^{iv} diagram of Brown (1977) (fig. 1). The analyses indicate that the range of amphiboles present includes glaucophane, crossite, barroisite, ferri-winchite, actinolitic hornblende and actinolite, as defined by Leake (1978). This diagram also suggests that the most Na-rich compositions determined in this study may have formed at pressures of about 7 kb. Allowing for analytical problems with Na, the minimum pressure from most of these amphiboles, using Brown's (1977) interpretation, is about 6.5 kb. The mineral assemblages present with the sodic amphiboles (usually epidote, chlorite, albite and iron oxides) are indicative of metamorphic equilibration at this pressure, supporting the use of this geobarometer for the reaction (from Brown, 1977):

crossite + epidote + H_2O → chlorite + albite + iron oxide

The sodic amphiboles were also plotted on a Mg/(Mg+Fe) vs. $Fe^{III}/(Fe^{III}+Al)$ diagram, showing the amphibole fields defined by Leake (1978). Note that only true sodic or alkali amphiboles, with $Na_{M4} > 1.34$, are plotted on this diagram, and only one of the analyses of Green and Spiller (1977) applies to this field.

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GREEN, T. H.; SPILLER, A. R. 1977. Blue amphibole from Precambrian metabasalts, Savage River, Tasmania. *Amer. Mineral.* 62:164–166.

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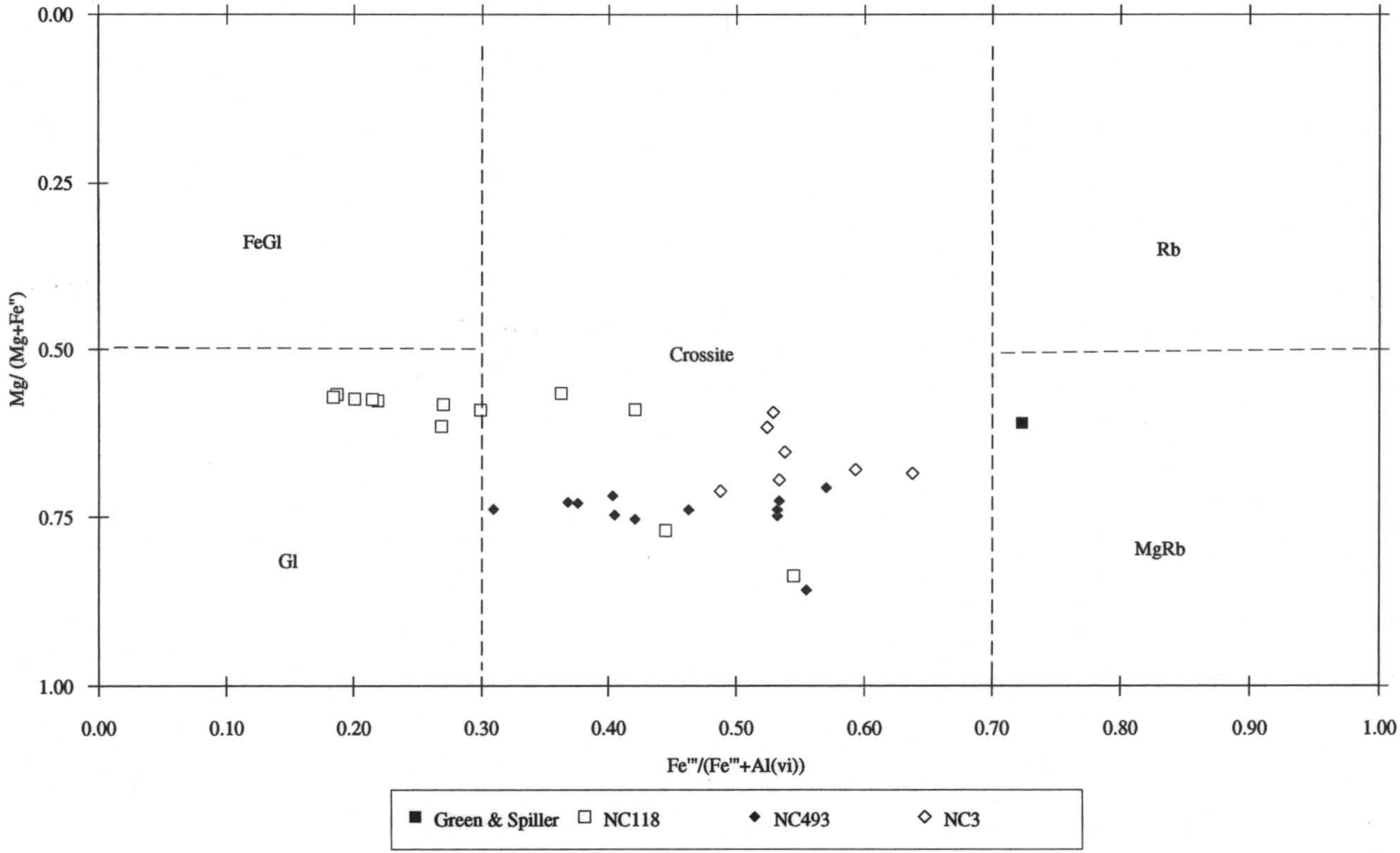
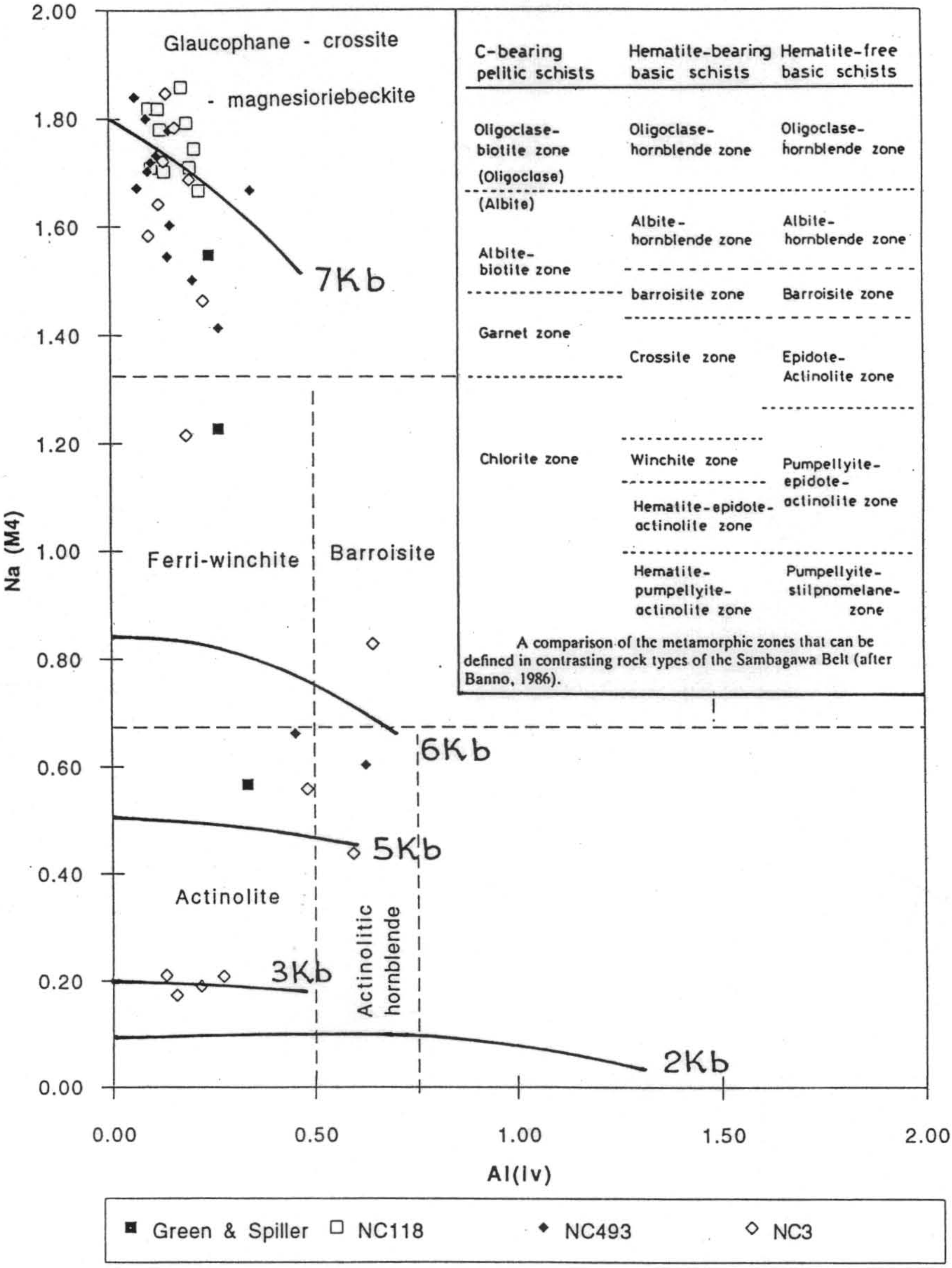
ROBINSON, P.; SPEAR, F. S.; SCHUMACHERS, J. C.; LAIRD, J.; KLEIN, C.; EVANS, B. W.; DOOLAN, B. L. 1982. Phase relations of metamorphic amphiboles: natural occurrence, *in:* VEBLEN, D. R.; RIBBE, P. H. (eds). Amphiboles: petrology and phase relations. *Miner. Soc. Amer. Reviews in Mineralogy.* 9B:3–8.



5 cm

Figure 1. Sodic amphibolites, Pieman River

39|45



C-bearing pelitic schists	Hematite-bearing basic schists	Hematite-free basic schists
Oligoclase-biotite zone (Oligoclase)	Oligoclase-hornblende zone	Oligoclase-hornblende zone
(Albite) Albite-biotite zone	Albite-hornblende zone	Albite-hornblende zone
	barroisite zone	Barroisite zone
Garnet zone	Crossite zone	Epidote-Actinolite zone
Chlorite zone	Winchite zone	Pumpellyite-epidote-actinolite zone
	Hematite-epidote-actinolite zone	
	Hematite-pumpellyite-actinolite zone	Pumpellyite-stilpnomelane-zone

A comparison of the metamorphic zones that can be defined in contrasting rock types of the Sambagawa Belt (after Banno, 1986).

Figure 2.

Amphiboles, Corinna

5 cm

APPENDIX 3

K-Ar geochronology — Corinna

A summary of determinations carried out by A. Webb, AMDEL, to be published in Turner and Crawford (in prep.)

BOWRY FORMATION AMPHIBOLITE

Sample	%K	^{40}Ar* (× 10^{-10}moles/g)	^{40}Ar*/ ^{40}Ar $_{Total}$	Age†
NC77 Hornblende	0.1214 0.1215	1.2411	0.876	510 ±4
NC80 Hornblende	0.0922 0.0930	0.92232	0.813	499 ±10
NC478 Hornblende	0.1996 0.2001	1.9698	0.871	494 ±5

TUNNELRACE METABASALT (NC384)
BERNAFAI METABASALTS (NC506, 508)

Sample	%K	^{40}Ar* (× 10^{-10}moles/g)	^{40}Ar*/ ^{40}Ar $_{Total}$	Age†
NC384 Total rock	0.2853 0.2852	2.5301	0.980	450 ±7
NC506 Total rock	0.1440 0.1446	0.8908	0.945	325 ±4
NC508 Total rock	0.0571 0.0567	0.2604	0.788	246 ±9

* Denotes radiogenic ^{40}Ar

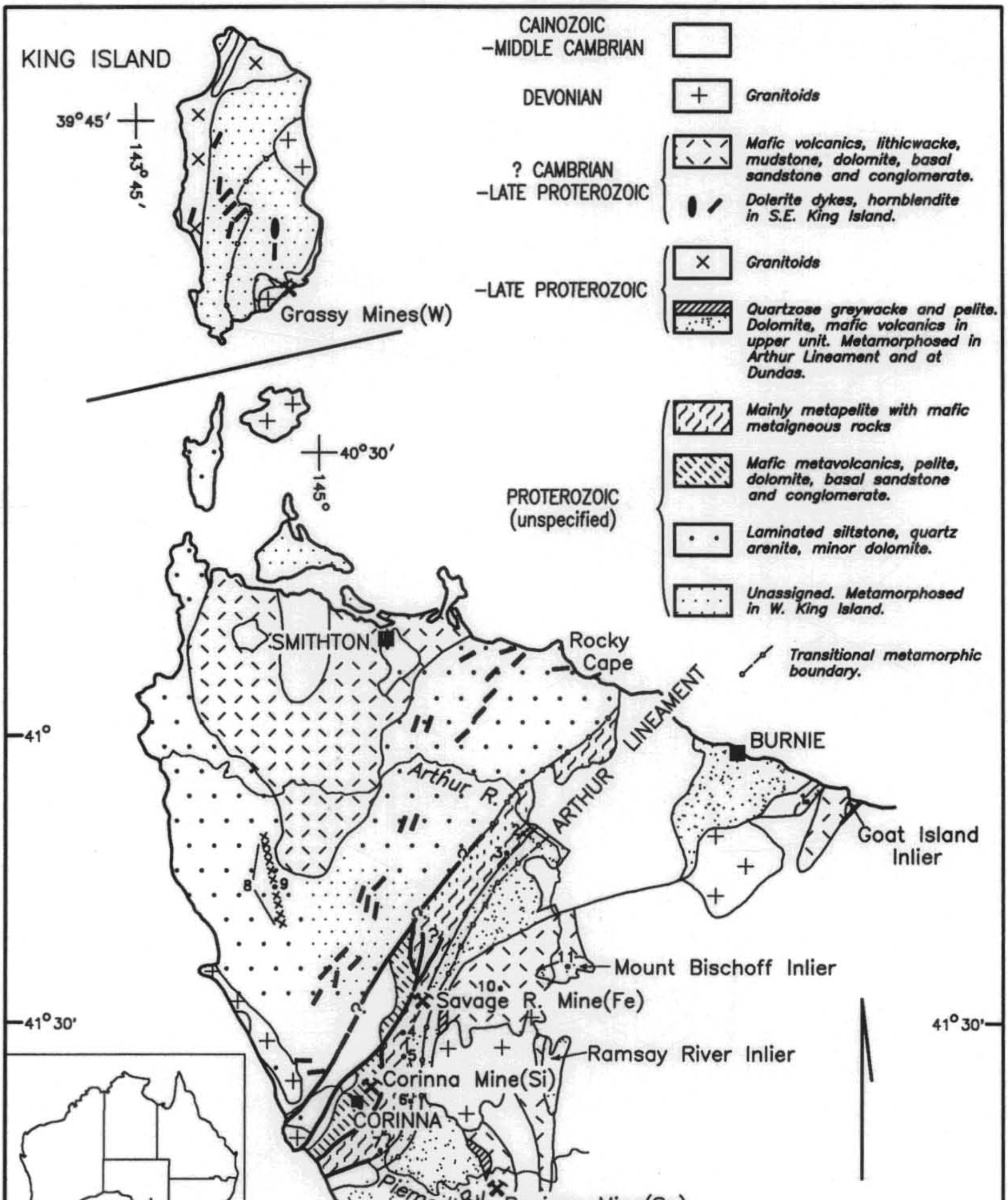
† Age in Ma with error limits given for the analytical uncertainty at one standard deviation.

Constants: $^{40}K = 0.01167$ atom%
$\lambda\beta = 4.962 \times 10^{-10} y^{-1}$
$\lambda\varepsilon = 0.581 \times 10^{-10} y^{-1}$

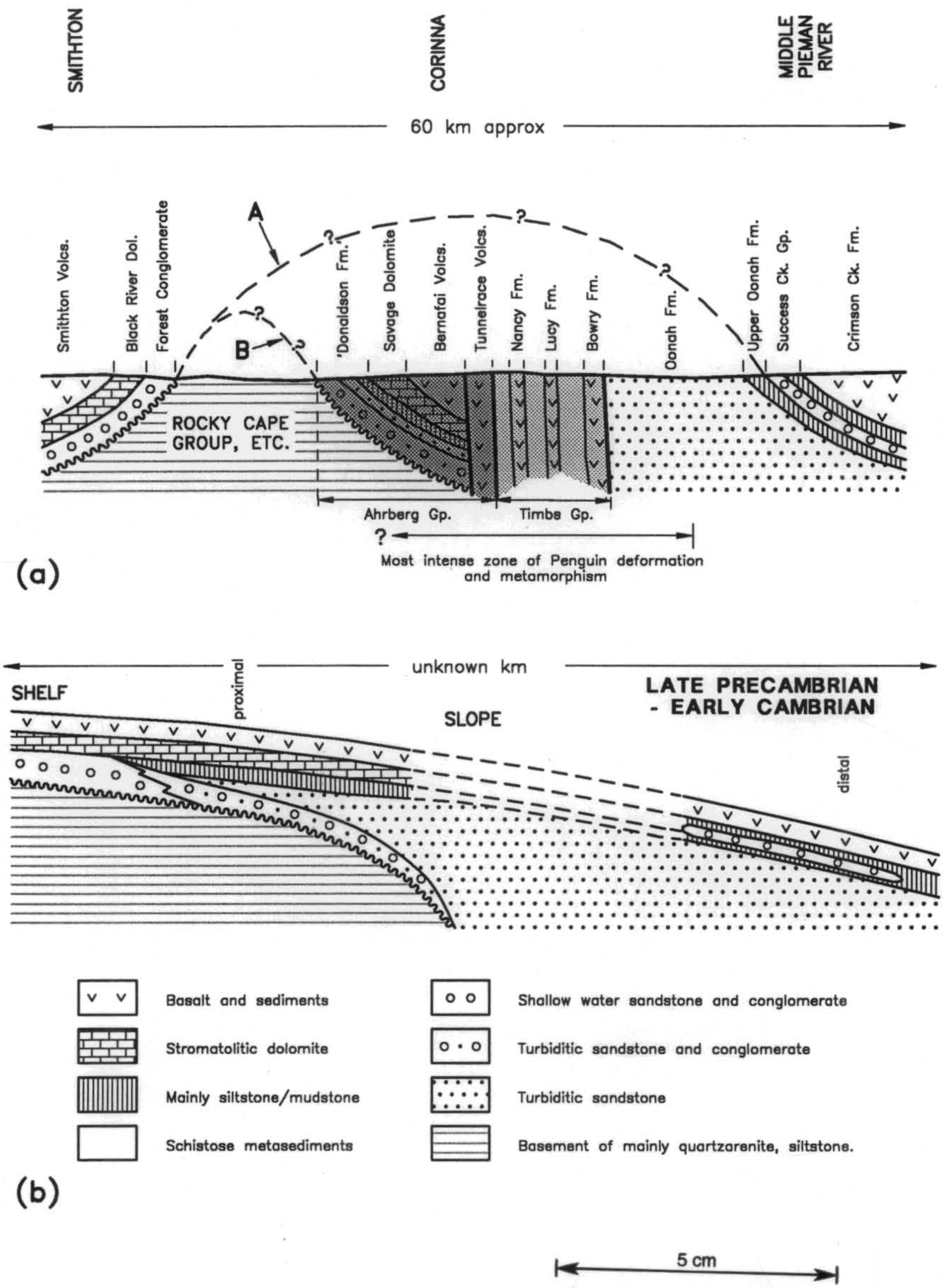
APPENDIX 4

Regional setting of the Corinna rocks and possible tectonic implications.

A summary of material prepared by N. J. Turner for publication in Turner and Crawford (in prep.) and Turner and Bottrill (in prep.).



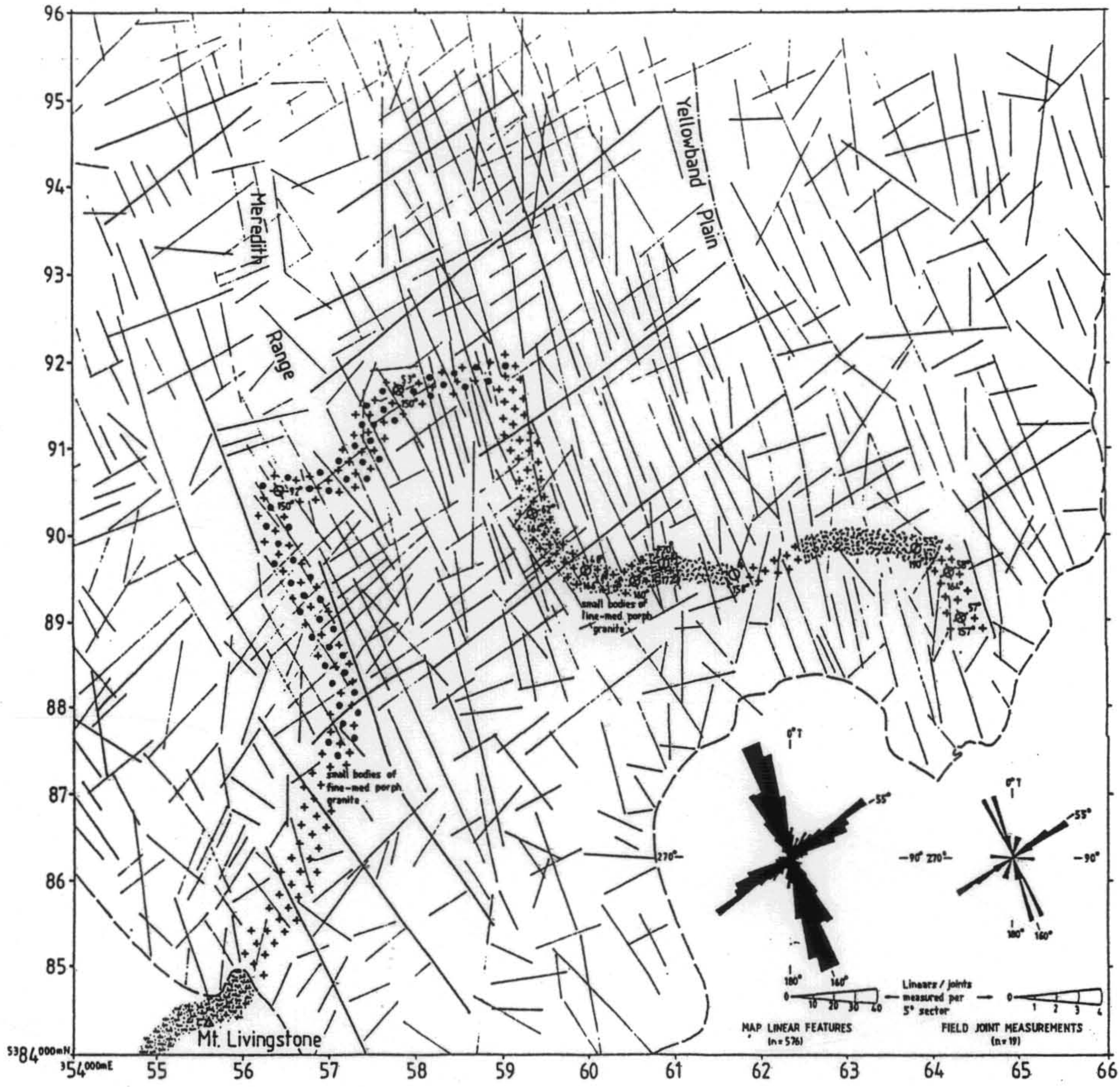
from TURNER, N. J. 1990. Late Proterozoic of Northwest Tasmania — Regional geology and mineral deposits, *in:* HUGHES, F. E. Geology of the mineral deposits of Australia and Papua New Guinea. *Monogr. Ser. australas. Inst. Min. Metall.* 14:1169–1174.


SMITHTON
CORINNA
MIDDLE PIEMAN RIVER
60 km approx
A
B
Smithton Volcs.
Black River Dol.
Forest Conglomerate
'Donaldson Fm.'
Savage Dolomite
Bernafai Volcs.
Tunnelrace Volcs.
Nancy Fm.
Lucy Fm.
Bowry Fm.
Oonah Fm.
Upper Oonah Fm.
Success Ck. Gp.
Crimson Ck. Fm.
ROCKY CAPE GROUP, ETC.
Ahrberg Gp.
Timbs Gp.
Most intense zone of Penguin deformation and metamorphism
(a)
unknown km
SHELF
proximal
SLOPE
LATE PRECAMBRIAN - EARLY CAMBRIAN
distal
Basalt and sediments
Stromatolitic dolomite
Mainly siltstone/mudstone
Schistose metasediments
Shallow water sandstone and conglomerate
Turbiditic sandstone and conglomerate
Turbiditic sandstone
Basement of mainly quartzarenite, siltstone.
(b)
5 cm

APPENDIX 5
Subdivisions in the southern part of the Meredith Granite

From SHARPLES, C. (in press), *in: A study of the Heritage values of North-West Tasmania : A report prepared by the Tasmanian Conservation Trust for the Australian Heritage Commission.*

The report was carried out with assistance of funds made available by the Commonwealth of Australia under the National Estates Program.



KEY:

Devonian / Carboniferous

- Grey-white medium-coarse grained equigranular
- Pink medium-coarse grained equigranular
- Grey fine-medium grained variably quartz/feldspar porphyritic
- Quartz-tourmaline nodules present

} Meredith Batholith granitoid types

Precambrian

- Meta-sedimentary rocks (predominantly quartzite outcrop) - Oonah Formation