A REPORT FOR ZINIFEX ROSEBERY MINE

REPORT ON GEOLOGICAL INVESTIGATIONS IN THE CASTRA - NIETTA - SHEFFIELD AREA, NORTHWEST TASMANIA

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November, 2006

CONTENTS

Page
EXECUTIVE SUMMARY 3
INTRODUCTION 4
PREVIOUS MAPPING AND REVIEWS 5
GENERAL FORM OF THE CAMBRIAN TROUGHS 6
THE ALLOCHTHONOUS ELEMENTS – BARRINGTON CHERT AND MOTTON SPILITE 7
MIDDLE CAMBRIAN SEQUENCES 8
- **Beulah – Mt Roland area** 8
- **Native Track Tier – Leven Gorge area** 10
- **Dial Range Trough area** 11
- **Central Fossey Mountains trough – the Nietta-Castra-Wilmot-Paloona area** 14
  - ***West Gawler River – Deep Gully Creek area*** 14
  - ***East Gawler River – McPhersons prospect – 13 Mile Road area*** 15
  - ***The Groove Creek belt*** 16
  - ***Spellmans Bridge – upper Wilmot River area*** 17
- **Synthesis and conclusions** 19

GEOLOGY AND PROSPECTS WITHIN THE EL'S 19
- **Castra EL 18/2005** 19
- **Nietta EL 17/2005** 20
  - ***Geology***
  - ***Prospects***
- **Sheffield EL 16/2005** 24
  - ***Geology***
  - ***Prospects***

DISCUSSION AND CONCLUSIONS 25
REFERENCES 26

APPENDIX 1: Petrographic report on 78 rock samples from Cambrian volcanic and volcano-sedimentary sequences in N and NW Tasmania. PM Ashley

TABLES — Follows page

Table 1. Chemical analyses Motton Spilite, Barrington Chert, Beulah 'granite'	7
Table 2. Chemical analyses andesites other than Leven Gorge	9
Table 3. Chemical analyses Leven Gorge andesites, dacites	11
Table 4. Chemical analyses felsic lavas Nietta area	15
Table 5. Chemical analyses sediments & volcaniclastics Castra–Sheffield area	17

FIGURES — Follows page

Figure 1. Regional geology of the Sheffield – Ulverstone area and location of Zinifex EL's	6
Figure 2. 1:50,000 scale geology of the Sheffield – Ulverstone area, with sample localities. Produced from 1:25,000 sheets by M.Vicary.	Pocket
Figure 3. Castra 1:25,000 geological map (Vicary, 2004) showing Castra and Nietta EL's	Pocket
Figure 4. Geology and exploration features of the Crosby Creek prospect	22
Figure 5. Geology and exploration features of the Castra Road prospect – Preston Silver Mine area	23

EXECUTIVE SUMMARY

- This report presents results from a study of the regional geology of the Castra-Nietta-Sheffield area, involving reconnaissance mapping, whole rock geochemical sampling (58 samples), petrological study (78 rock samples), and assessment of known prospects. Most of the study has concentrated on the Castra and Nietta areas.
- The Middle Cambrian sequence through the central part of the Fossey Mountains Trough, across much of the Castra and Nietta EL's, is volcano-sedimentary in nature, resembling the Western Volcano-Sedimentary Sequence.
- Sandstones, siltstones and mudstones predominate, with coarser, relatively proximal, facies present in only a few places, mainly outside the EL's. Otherwise the major volcanic units are either intrusive bodies (particularly andesitic-dioritic types) or discrete felsic lavas within sedimentary sequences.
- Correlates of the Tyndall Group are present at Native Track Tier, in the Dial Range Trough, and in the Sheffield – Mt Roland area, but have not been identified with any certainty in the central Nietta-Castra-Wilmot-Paloona area. Further mapping is required to clarify the stratigraphy in these areas.
- There are no recognizable equivalents of the Central Volcanic Complex or of the Rosebery Host Rock sequence in the Castra and Nietta EL's, and probably not on the Sheffield EL.
- No large areas of altered rocks, such as might indicate a Rosebery or Mt Lyell-type VHMS system, have been identified in the present study or any previous study. Prospects and signs of mineralisation are few and far between.
- Two main types of mineralisation appear to be present. The first is low-level Pb-Zn-minor Cu associated with the margins of some of the Cambrian andesitic intrusive bodies. This has been well documented at Crosby Creek prospect, at Nietta, by drilling and other techniques, and also seems to be the case at Loyetea South. A number of known prospects through the Dial Range Trough are also of this type.
- The second type involves scattered Pb-Ag-Ba-pyrite occurrences apparently related to Devonian structures, particularly major faults. The Castra Road and nearby Preston Silver Mine prospects appear to be of this type, although further mapping is required to establish the relationships. Remobilised Cambrian lead is suggested by Pb isotopes.
- The pyritic mineralisation at McPhersons prospect, on Castra EL, does not fit either model as presently known. It has sericitic alteration and disseminated pyrite over a zone at least 500 m long, and further investigation seems warranted.

INTRODUCTION

The author was contracted by Zinifex Rosebery Mine, through Dr Andrew McNeill, in November, 2005, to carry out reconnaissance mapping and geological assessment, with associated whole-rock geochemical sampling and petrological studies, over three newly-granted EL's in the Castra- Nietta – Sheffield area as part of the Year 1 program. It was suggested that some adjacent unallocated areas around the Wilmot River – Castra Plantation and Isandula be also examined to determine possible potential. The mapping was mainly aimed at achieving an understanding of the regional geology in terms of the better- known Mt Read Volcanic sequences in western Tasmania, locating zones or areas referable to the Rosebery footwall sequence and host rocks if they existed, and providing an assessment of exploration potential as a guide for further work in the area.

Mapping and sampling was carried out during the period late February to early May, 2006, with most of the work concentrated on the Castra and Nietta leases, the Sheffield area being better known through previous work by Pasminco, Aberfoyle, RGC and other companies. Much of the work was done using existing public and forestry roads, which provide generally good access to most areas except for the deeper gorges. Traverses were done into the Wilmot River gorge above and below Spellmans Bridge, and from the Alma Bridge and several access points in the Castra Plantation, using the recently constructed Dooleys walking trail along the river. Three traverses were made into the difficult Leven Gorge area, between Gunns Plains and Loongana, with walking access provided by the Penguin to Cradle 'Trail', a poorly constructed foot track which in many places is dangerously rough, steep and narrow. Several km of this 10km river section could not be visited or sampled.

Whole-rock analyses for the 58 rock samples collected across the area were supplied by Amdel Laboratories, with results for the following elements: SiO_2, TiO_2, Al_2O_3, MnO, MgO, CaO, Na_2O, K_2O, P_2O_5, Cr (all by ICP Fusion), Ag, As, Bi, Cu, Ni, Zn, Pb, Y, Nb, Sr, Sb, Tl, U, Rb (ICPMS Multi-Acid), La, Ce, Sm, Eu, Gd, Tb, Yb (Rare Earth ICPMS), Rb, Th, Ba, Zr (XRF), and Au (Fire Assay/AAS). These are given in Tables 1-5. Sample locations are shown on Figure 2 and are indicated by AMG grid references on the Tables.

Petrological descriptions based on thin sections of 78 rock samples, including those analysed for whole-rock geochemistry, were provided by Dr Paul Ashley, Armidale, NSW, giving information on compositional components, textures, alteration, and possible modes of origin. These descriptions are given in summary form in Appendix 1, and all sample locations are shown on Figure 2.

The author participated in a 5-day geological field visit to the area with geologists from Mineral Resources Tasmania from 16-20 October, as a review and familiarization exercise prior to MRT undertaking a major mapping program in the area over the coming field season. The field trip looked at rock types and correlations within the Cambrian sequences, particularly the question of Tyndall Group versus pre-Tyndall Group rocks, and the nature and relationships of the probable allochthonous units (Motton Spilte and Barrington Chert), as well as general structural, stratigraphic, sedimentological and alteration - mineralisation aspects of the area.

A special 1:50,000 scale compilation map of the geology of central NW Tasmania was prepared by M. Vicary for the above excursion, and has been used as a base map for this report (Figure 2). Also included is a copy of the Castra 1:25,000 sheet (Figure 3), which shows the geology of much of the Castra and Nietta EL's, and provides a legend which is also applicable to much of Figure 2.

PREVIOUS MAPPING AND REVIEWS

The area was initially covered by regional mapping at 1 inch to 1 mile scale (1:63,360) for the Sheffield Sheet (Jennings et al, 1959) and Devonport Sheet (Burns, 1963), and much of this 40-50 year old mapping has not been significantly updated, which has been a considerable impediment to modern exploration. CRAE undertook their own regional mapping of much of the North-West as part of their exploration program in the early 1970's, in an attempt to update knowledge and understanding (Porter, 1974, 1976). However, this good-quality work was done before it was realized that two of the major Cambrian units, the Barrington Chert and Motton Spilite, were actually allochthonous lithologies not related to the local stratigraphy.

Re-mapping of the Cethana, Wilmot, Gog and Sheffield **1:25,000** sheets, covering most of EL 16/2005, was done by the Geological Survey between 1997 and 2004 (McClenaghan, Green and others), but the central part of the Fossey trough, particularly Castra Sheet, remained unmapped.

A special project aimed at reviewing the mapping and providing correlations to western Tasmania was undertaken by the author in 2002-2003, as part of the Western Tasmanian Regional Minerals Program (WTRMP). This included some reconnaissance mapping, and resulted in a 1:100,000 scale geological map of the Que River to Sheffield area showing the Cambrian sequences correlated as far as was possible, with an associated report (Corbett and McClenaghan, 2003). A major problem recognized in this review was the difficulty in distinguishing Tyndall Group correlates, of late Middle Cambrian age, from Western Volcano-Sedimentary Sequence (WVSS) correlates, of middle Middle Cambrian age, in the extensive volcano-sedimentary sequences through the Castra-Wilmot area, where there was no fossil control.

Immediately following this, the series of 1:25,000 sheets surrounding the previously mapped area, including Castra, Loyetea, Riana, Kindred, Stowport, and Ulverstone, were compiled by M.J. Vicary, as an additional phase of the WTRMP project (Vicary, 2004). This involved compilation of previous work, including company mapping, and some additional mapping, necessarily of a reconnaissance nature. This extremely productive work program also produced a special report on the Cambrian rocks of the Castra – Kindred area (Vicary, 2006), covering most of EL's 17/2005 and 18/2005.

Vicary was able to show considerable detail to the rock sequences in several areas, including a series of andesitic to dacitic lavas and volcaniclastics around Groove Creek and Castra Road, where he distinguished Tyndall Group correlates from WVSS. Of great benefit was his recognition, based on mapping and the use of the radiometric images, that much of the cherty mudstone sequences mapped as **Barrington Chert** on the old Sheffield and Devonport sheets was actually volcaniclastic vitric mudstone related to the Mt Read Volcanics. This greatly reduced the area of Barrington Chert proper, now known to be an allochthonous lithology, and clarified the shapes of the allochthonous blocks in the Devils Gate area.

A program of more comprehensive mapping of the Dial Range – Castra – Wilmot area, including parts of the Zinifex EL's, is currently being undertaken by MRT geologists under a new project specially funded by the State Government.

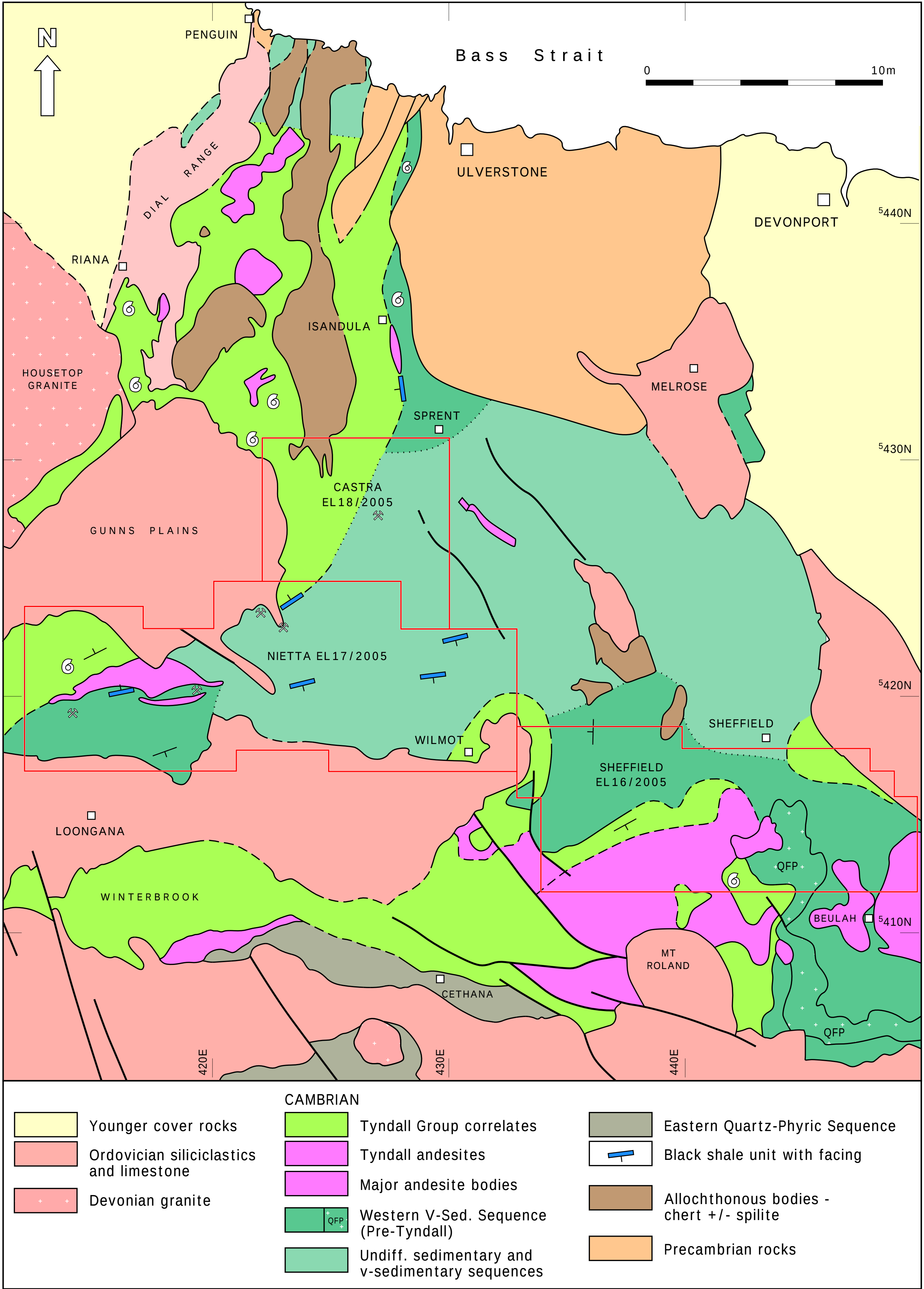
GENERAL FORM OF THE CAMBRIAN TROUGHS

Figure 1 shows a compilation of the regional geology of the Sheffield – Ulverstone area, partly based on the present study, and the location of the Zinifex EL's. The Tertiary basalt cover has been removed for clarity. Tyndall Group and pre-Tyndall Group rocks are shown where known, and those areas where there is still uncertainty are shown as undifferentiated.

The 'Fossey Mountains Trough' is the northerly continuation of the Dundas Trough and Mt Read Volcanics belt. It is limited to the south by the margin of the Precambrian Tyennan Region, and its northern limit is generally taken as the Precambrian quartzites and schists of the Forth 'Nucleus'– although the latter is probably a parautochthonous block involved in the early Middle Cambrian collision which produced the troughs. The western margin is against Burnie Formation rocks of the Rocky Cape Region, but is partly blocked out by the Devonian Housetop Granite body and is otherwise largely concealed beneath Tertiary basalt except near the north coast. To the east, the Cambrian rocks forming the continuation of the trough are buried under younger Ordovician, Permian and Tertiary rocks in the Railton – Devonport area.

A narrow northwards extension of the trough is sandwiched between the western margin of the Forth Nucleus and the Burnie Formation Precambrian rocks between Gunns Plains in the south and the Penguin – Ulverstone foreshore, this zone being known as the Dial Range Trough (Burns, 1964). This tectonically complex trough features a mountainous belt of Late Cambrian – Ordovician siliciclastic conglomerates and sandstones on the western side, forming the Dial Range itself, a series of elongate allochthonous blocks of Barrington Chert and Motton Spilite in the middle part, separated by zones of Middle Cambrian sedimentary and volcanic rocks, and an eastern zone of inter-faulted Burnie Formation and Forth Nucleus rocks with a strip of Middle Cambrian.

Ordovician siliciclastic rocks, comprising Moina Sandstone and a basal conglomeratic unit in places, lie across the Cambrian rocks of the Fossey Mountains Trough in large synclinal belts, typically with unconformities at the base. South of the irregular meridional belt of the Dial Range is the large circular basin-like syncline of the Gunns Plains area, with an arm projecting SW to the Loyetea Peak – Mt Everett area. This arm joins up with a major E-W belt extending through Loongana and the upper Wilmot gorge to the township of Wilmot, where it rounds off in a synclinal nose. Well to the east, a NNW-trending belt of siliciclastics extends through the Badger Range to Lower Barrington and Melrose, where it laps onto Precambrian rocks of the Forth 'Nucleus'. A small area of rugged siliciclastic hills extends NW along Lake Paloona from the chert allochthon at Devils Gate, and serves to emphasize the fact that these chert allochthons have been highland source areas of detritus throughout and beyond the Cambrian.



Regional geology of the Sheffield - Ulverstone area and location of Zinifex EL's

THE ALLOCHTHONOUS ELEMENTS – BARRINGTON CHERT AND MOTTON SPILITE

Structural blocks of these two rock types occur in two areas: (i) around the Devils Gate area at the northern end of Lake Barrington, where three separate bodies of chert are mapped, one of which extends into EL 16/2005; (ii) between North Motton and the coast, within the Dial Range Trough, where several large masses of mixed chert and spilite, and some smaller bodies less than 1km across, are intermixed with Middle Cambrian rocks. The southernmost end of this zone, with both basalt and chert, extends onto EL 19/2005 near Central Castra.

The Barrington Chert is typically pale to dark grey to black in colour, and varies from finely laminated to thinly bedded. Small folds and breccia zones are common. An excellent exposure in a large gravel quarry at Barren Knob, on the northern boundary of EL 18/2005, shows a shallowly dipping, highly brecciated sole thrust zone within the chert at its contact with underlying Motton Spilite. Large slugs and blebs of coarse pyrite are present within the brecciated chert in places.

Cherts from the Dial Range area have been shown to contain abundant sponge spicules and radiolaria, indicating a submarine ooze-type origin and a probable Early Cambrian age (Saito et al, 1988). A number of samples of conglomeratic rocks from the present study contained clasts of Barrington Chert in which radiolaria were preserved (petrological report).

A single sample of chert from the Stan Wing Lookout at Barren Knob was analysed (Table 1) in the present study (No 101) for comparison with the cherty ash material previously mapped as Barrington Chert (e.g. 168). The major differences in silica values (99.1% vs 73.7% SiO_2), Al_2O_3 (0.94 vs 12.9%), Fe_2O_3 (0.66 vs 1.65%) and K_2O (0.17 vs 6.16%, the latter reflecting the high sericite content) confirm the different origins for these two rocks. Values for all trace elements are much higher in the vitric ash except, surprisingly perhaps, for Cu, Pb, Zn.

The Motton Spilite consists of pillowed to massive submarine basalts, with intercalated cherty mudstone and volcaniclastic material in places, and is typically closely associated with Barrington Chert. Complex tectonic mixing and interleaving of the two lithologies is well exposed at Lodders Point on the coast, supporting the interpretation that both lithologies have come as allochthonous blocks from a deep-sea environment far to the east.

Petrological work done on the spilites by Hashimoto et al (1981) shows them to be weakly metamorphosed basalts with altered olivine, plagioclase and iron ore, but relatively fresh clinopyroxene (augite). Chemical analyses of the pyroxenes suggest the basalts are deep-sea tholeiites.

Two samples of Motton Spilite were analysed in the present study (Table 1), one from the West Gawler River (102) on EL 19/2005, and one from the Gunns Plains Road (114) to the NW. They show distinctively low SiO_2 values (47.3% and 47.4%) and high TiO_2 (1.8. 1.39%), with high MgO (5.85, 7.85%), high CaO (8.77, 8.87%), moderate Na_2O (3.59, 2.47%), low K_2O (0.33, 0.50%), high Cr (120, 130 ppm) and Ni (60, 68 ppm), and elevated Cu (150, 190 ppm), Zn (105, 84 ppm), and S values (800, 1300 ppm). The basalts are thus quite distinct from any of the Mt Read – related mafic rocks.

TABLE 1. CHEMICAL ANALYSES MOTTON SPILITE, BARRINGTON CHERT, BEULAH 'GRANITE'

Name	Motton Sp	Motton Sp	Barr Chert	Vitric ash	Beulah 'Gr'	Beulah 'Gr'
Number	102	114	101	168	180	177
Locality	West Gawler	Gunns Pl	Barren Knob	Gentle Annie	Beulah	Paradise
Easting	424464	423705	424755	434575	447475	443675
Northing	5429906	5432745	5432450	5429925	5410875	5414125
SiO2	47.3	47.4	99.1	73.7	59.2	58.4
TiO2	1.8	1.39	0.09	0.29	0.56	0.61
Al2O3	13	13.3	0.94	12.9	15.3	15.6
Fe2O3	15.5	14.1	0.66	1.65	8.3	9.28
MnO	0.26	0.19	<0.01	<0.01	0.12	0.09
MgO	5.85	7.85	0.1	0.34	2.77	3.01
CaO	8.77	8.87	0.14	0.05	3.43	3.44
Na2O	3.59	2.47	0.05	0.28	2.82	3.43
K2O	0.33	0.5	0.17	6.16	5.55	3.94
P2O5	0.17	0.12	<0.01	0.02	0.36	0.33
LOI	2.68	3.36	0.89	2.97	2.1	3.24
Ba	200	60	140	1450	1550	900
Rb	9.5	8.5	7	250	195	120
Sr	210	220	16	76	220	370
Y	35	26	4	28	27	31
Nb	10	6	<5	24	32	34
Zr	120	80	<20	160	190	180
Ni	60	68	5	3	18	17
Cr	120	130	190	<20	60	60
As	<3	4	4	10	6	4
Sb	<0.5	<0.5	<0.5	2	0.5	1
Th	0.91	1.75	0.99	23	26	19
U	0.2	0.53	0.54	4.7	6	4.3
La	6.5	13.5	4.5	54	52	52
Nd	12.5	8.5	3	36	47	48.5
Ce	17.5	12	8.5	100	105	94
Sm	3.8	2.7	0.52	5.5	8	8.5
Eu	1.55	1.15	0.18	1.35	2.4	2.3
Gd	5.5	1.75	0.55	5	6.5	7
Tb	0.89	0.63	0.09	0.73	0.86	0.93
Yb	4.3	2.9	0.45	3.1	2.5	3.2
Tl	<0.1	<0.1	<0.1	1	1.1	0.6
Cu	150	190	10	3	37	4
Pb	6	<5	48	42	<5	6
Zn	105	84	78	60	34	35
Au	0.003	0.001			0.005	0.003
S	800	1300	3	<100	<100	<100

MIDDLE CAMBRIAN SEQUENCES

The extensive sedimentary and volcano-sedimentary sequences of the Fossey Mountains and Dial Range Troughs contain few mappable marker horizons and only a few scattered fossil localities. Fine-grained vitric mudstones, pumiceous sandstones and micaceous greywacke sandstones are common rock types. The sequences have been disrupted by numerous major faults, particularly on NW and NNE trends, and affected by several major fold phases (mostly Devonian, but including at least one Cambrian phase). The major obduction/collision event related to the emplacement of the various allochthonous blocks and Precambrian blocks in the early Middle Cambrian, particularly evident in the Dial Range Trough, produced many large thrust faults and other faults in the ‘basement’ rocks to the Middle Cambrian sequences, and many of these have been reactivated during later tectonic events. In addition, the broad zones of Tertiary basalt on the drainage interfluves effectively divide the Cambrian rocks into sub-areas which are difficult to correlate between.

All of these factors make it difficult to subdivide the Cambrian sequences in many areas, or to correlate them with major units elsewhere, particularly the Tyndall Group and Western Volcano-Sedimentary Sequence (WVSS), although Vicary (2006) has made a bold attempt to do so.

In general terms, the sequences can be differentiated with reasonable confidence in the Sheffield– Beulah– Mt Roland area to the SE, in the Native Track Tier- Leven Gorge area in the west, and in the Dial Range Trough to the NW, where there is some fossil control and better lithological distinction. Differentiation becomes more difficult in the central parts (Nietta- Castra- Wilmot- Paloona), where there are no fossil localities and less obvious lithological differences.

Sheffield - Beulah – Mt Roland area (EL 16/2005)

The sequences are generally more volcanic-rich in this area, which corresponds to the main axial zone of the Mt Read belt. A zone of notably quartz-rich volcaniclastics, lavas and quartz-feldspar porphyry intrusives which wraps around the Tyennan margin in the Bonds Range- Cethana area is an excellent correlate of the Eastern Quartz-Phyric Sequence (EQPS) of the Mt Murchison area (Corbett and McClenaghan, 2003). This sequence hosts the 5 km-long Cethana Pyrite Zone SW of Gowrie Park.

North of this, a 5-7 km wide E-W belt of andesites, andesitic volcaniclastics, felsic lavas and coarse-grained volcaniclastics extending through Winterbrook- Staverton- Paradise area is correlated with the Tyndall Group, partly on fossil grounds (late Middle Cambrian trilobites at Paradise) and partly on lithological grounds (coarse andesitic volcaniclastics; Corbett and McClenaghan, 2003). This andesitic sequence in the Dasher River- Claude Road area appears to be broadly synclinal in character, and underlies about one third of EL 16/2005. Intrusive bodies of andesitic monzodiorite, with biotite, hornblende, pyroxene and feldspar phenocrysts, formerly referred to as Beulah ‘granite’, are associated with the andesites at Paradise and further east at Beulah. A large mass of andesites at Beulah has an enigmatic relationship with the adjacent sedimentary sequence of WVSS type, appearing to underlie it in one area and overlie it in another, and may be of Tyndall Group age or slightly older. The well-known ***Beulah Barite*** prospect is located on the southern margin of this body, 3 km south of the EL boundary.

Two samples of the Beulah ‘granites’ were analysed (Table 1), one from Paradise (177) and one from Beulah (180). They are andesitic, with 58.4 and 59.2% SiO_2, have low-moderate

TiO2 values (0.61, 0.56%), 3.01 and 2.77% MgO, moderate alkalis (3.43 and 2.82% Na2O; 3.94 and 5.55% K2O), and moderate P2O5 (0.36, 0.33%). Application of the Crawford et al (1992) discrimination diagrams suggests these are **Suite 2** rocks, like the hornblende andesites of Anthony Road and Crown Hill.

Two samples of andesites from Careys Road (175) and Lockwoods Road (176) in the broad zone just north of the Dasher River, are plagioclase-pyroxene-phyric rocks, with regional-style chlorite-pumpellyite-epidote alteration. They show (Table 2) low SiO2 levels (54.6, 49.4%), low-moderate TiO2 (0.73, 0.54%), moderate MgO (4.89, 4.36%), high CaO (7.34, 8.08%), and moderate alkalis (3.01, 4.24% Na2O; 1.02, 0.96% K2O). These rocks plot as **Suite 3**, like the Hellyer Basalt and Sock Creek basalts. A sample from Paradise Road (178) is also plagioclase-pyroxene-phyric, with 57.4% SiO2, 0.61% TiO2, 6.06% MgO, 6.11% CaO, 2.63% Na2O, 2.13% K2O, 0.16% P2O5, and may be transitional between Suites 1 and 2.

A sample from the Beulah andesite (181) is also plagioclase-pyroxene-phyric, with fairly strong chlorite-sericite-epidote alteration. It is slightly more felsic (61.3% SiO2, Table 2), with 0.79% TiO2, 2.67% MgO, 2,31% Na2O, 3.25% K2O, elevated Ba (1350ppm) and S (800ppm), and appears to be a **Suite 1** rock.

The range of geochemical suites apparently present in the andesitic rocks in the Sheffield area, from Suite 1 at Beulah to Suite 3 at Dasher River, suggests there may be an evolutionary sequence preserved which could be related to the footwall to hangingwall sequence at Hellyer.

Underlying the Tyndall Group correlates to the NW, in the Roland – Nowhere Else area, and to the E in the Beulah area, is an extensive, polymict sequence of sedimentary and volcano-sedimentary rocks, mainly sandstones and mudstones, correlated with the WVSS (originally the ‘Gog Range Greywacke’ of Jennings et al, 1959). These include a significant proportion of non-volcanic micaceous greywacke–type sandstones and siltstones, as well as crystal-rich, pumiceous and lithic-rich volcaniclastic sandstones and abundant vitric to cherty mudstones.

A large body of quartz-feldspar porphyry (the ‘Minnow Keratophyre’ of Jennings et al, 1959) lies along the contact of the WVSS and Tyndall Group correlates just east of Paradise. Abundant pumiceous deposits are associated with this porphyry body further south, near the Gog Range, suggesting it may be partly extrusive and partly intrusive, and thus essentially coeval with the WVSS sediments – and hence older than the Tyndall andesites and Beulah ‘granite’ which intrudes it.

The WVSS occupies much of the NW corner of EL 16/2005, where its contact with the underlying Tyndall Group correlates is marked by a mappable unit of siliceous pebble conglomerate with quartzite and chert clasts. This conglomerate outlines a broad SW-plunging faulted anticlinal structure with its crestal area transected by Lake Barrington. The Tyndall Group beds strike NNW across the lake (Fig. 3) and appear to wrap around a synclinal nose of Ordovician Moina Sandstone in the Wilmot area, where the basal conglomerate may be represented by an outcrop mapped as an outlier of ‘Roland Conglomerate’ just north of Wilmot township by Jennings et al, 1959 (Corbett and McClenaghan, 2003). However, recent updates of the map by Vicary (2004) lump all of the sequence in this area as Tyndall Group correlates (Fig. 3), and show the WVSS beds striking directly across the lake into Tyndall Group correlates on the north side, a situation which is not easily believable.

TABLE 2. CHEMICAL ANALYSES ANDESITES OTHER THAN LEVEN GORGE

Name	Beulah And	Dasher And	Dasher And	Paradise	Lobster Ck Por	Isandula And	McPhersons And	Groove Ck And	Groove Ck And	Groove Ck And
Number	181	175	176	178	183	107	119	144	162	182
Locality	Beulah	Careys Rd	Lockwoods Rd	Paradise Hill	Allison Road	Isandula Rd	East Gawler R	Castra Plant'n	Wilmot R	Gentle Annie Hill
Easting	448425	438300	439800	443825	421825	427600	5426985	431350	432500	434225
Northing	5412450	5414000	5414375	5410875	5438375	5434720	5428875	5427600	5426950	5425675
SiO2	61.3	54.6	49.4	57.4	60.4	65	61.1	64.8	64.8	64.9
TiO2	0.79	0.73	0.54	0.61	0.75	0.65	0.63	0.63	0.63	0.75
Al2O3	15.1	15.8	19.8	14	16.5	14.6	14.5	14.6	14.7	16.1
Fe2O3	7.97	9.14	9.4	9.44	7.11	4.61	5.45	5.38	5.36	8.33
MnO	0.13	0.35	0.23	0.16	0.1	0.04	0.1	0.03	0.07	0.07
MgO	2.67	4.89	4.36	6.06	2.17	1.77	0.87	2.35	2.43	2.03
CaO	4.83	7.34	8.08	6.11	3.82	3.17	4.07	0.56	1.14	0.19
Na2O	2.31	3.01	4.24	2.63	4.61	3.86	3.75	4	3.99	2.23
K2O	3.25	1.02	0.96	2.13	2.05	3.38	2.15	3.71	3.57	2.3
P2O5	0.26	0.28	0.19	0.16	0.11	0.11	0.12	0.08	0.11	0.14
LOI	2.57	3.75	3.81	2.74	3.38	1.78	5.57	2.29	2.21	4.75
Ba	1350	330	230	900	430	800	490	900	750	16
Rb	84	36	33	58	48	90	66	84	78	66
Sr	330	250	460	310	250	280	155	130	135	40
Y	27	25	25	21	25	35	29	32	34	84
Nb	30	30	32	24	20	22	20	20	22	32
Zr	190	150	160	110	130	240	210	240	230	210
Ni	6	35	21	18	<2	4	6	12	3	14
Cr	60	100	30	130	30	<20	40	<20	20	30
As	4	4	4	<3	6	<3	6	6	6	<3
Sb	<0.5	<0.5	<0.5	<0.5	1	<0.5	2	<0.5	0.5	0.5
Th	10.5	8	11	7	7	16	13.5	16	14.5	13.5
U	2.5	2	3.2	1.7	1.15	3.8	3.2	3.4	4.1	2.9
La	34.5	25.5	22.5	20.5	18.5	33.5	28	22.5	31	40.5
Nd	33	21.5	22.5	19	24.5	30.5	26	25.5	30.5	45.5
Ce	70	50	49	41.5	36	74	62	56	68	62
Sm	5.5	3.9	4.1	3.5	4.9	6	5	5	6	9.5
Eu	1.8	1.15	1.15	1.1	1.4	1.5	1.25	1.4	1.45	2.4
Gd	5	3.8	3.8	3.5	4.5	6	5	5.5	6	11.5
Tb	0.75	0.6	0.59	0.52	0.67	0.9	0.73	0.85	0.91	1.9
Yb	3	2.7	2.8	2.4	2.9	4	3.3	4.2	4.1	8
Tl	0.5	0.2	0.3	0.8	0.1	0.2	0.2	0.3	0.3	0.2
Cu	10	20	7	25	3	7	33	4	6	<2
Pb	<5	12	34	<5	58	<5	<5	6	64	<5
Zn	54	280	260	72	50	30	17	54	180	80
Ag										
Au	0.006	0.005	0.004	0.003	0.003		<0.001	<0.001	<0.001	0.002
S	800	300	>100	<100	<100	100	200	400	<100	<100

Native Track Tier – Leven Gorge area (EL 17/2005)

Two fairly distinct sequences, separated by a poorly-defined NNE-trending boundary, are present in this large lens-shaped embayment almost surrounded by Ordovician siliciclastics. The northern sequence dips and faces north in large part, and contains late Middle Cambrian fossils indicating correlation with the upper part of the Tyndall Group (Corbett and McClenaghan, 2003). The sequence consists largely of crystal-rich volcaniclastic sandstones and pebble conglomerates with intercalated siltstone-mudstone units and fairly numerous intrusions and/or flows of dacitic lava. It has a moderate magnetic signature and is similar in many respects to the volcaniclastic-rich sequence at Winterbrook, 10 km to the south, also correlated with the Tyndall Group (Pemberton and Vicary, 1989).

Two samples of the pink dacitic lava (148,149) from the northern end of the Leven Gorge are plagioclase-biotite-pyroxene-phyric with K-feldspar-rich groundmass. Analyses (Table 3) show 69.1 and 61.3% SiO_2, 0.53 and 0.45% TiO_2, low MgO (0.44, 0.86%), highly variable alkalis (0.35 and 2.84% Na_2O; 9.45 and 4.42% K_2O), and elevated Ba (1600, 1300 ppm).

A volcaniclastic sandstone sample (150) from the gorge is quartz and feldspar-rich, with abundant volcanic clasts (felsic to intermediate) and some chert and siltstone clasts and mica flakes. There is abundant secondary carbonate and some hematite and minor chlorite.

A large E-W elongated intrusive body of strongly magnetic andesitic rock lies along the contact zone with the lower sequence, which appears to be a mixture of ashy to micaceous siltstones, volcaniclastic sandstones, andesitic to dacitic lavas and volcaniclastics, and a number of units siliciclastic pebble conglomerate (see Fig. 4). The sequence dips (and faces?) south in the southern part of the Leven Gorge, and around Crosby Creek to the east (Fig. 4), suggesting a broad anticlinal structure, and has been correlated with the WVSS (Corbett and McClenaghan, 2003). However, much of the sequence in the gorge remains unmapped and relatively unknown because of the difficult access. A distinctive N-facing unit of grey-black laminated siltstone/shale is present at the southern margin of the large andesitic body, and is also represented in the contact zones of the andesite body at Crosby Creek prospect. It is very reminiscent of the black shale unit apparently marking the base of the Tyndall Group correlates near Lake Isandula on the eastern side of the Dial Range Trough.

Two samples from the large andesite/diorite body (157, 158) in the gorge show sparse plagioclase phenocrysts, and a few microphenocrysts of ferromagnesian mineral and quartz, in a fine to medium grained crystalline groundmass with some chlorite-sericite-carbonate alteration. Analyses (Table 3) show a felsic andesite (monzodiorite) composition (61.0 and 63.0% SiO_2), with moderate TiO_2 (0.77, 0.79%), low MgO (1.69, 2.0%), strong alkalis (3.52, 3.84% Na_2O; 4.09, 4.63% K_2O), elevated Ba (1250, 1200ppm), and elevated Zn (600, 135ppm). The Crawford et al (1993) plots suggest this is a Suite 1 or Suite 2 rock. It appears to be responsible for the low-level Pb-Zn-Cu mineralisation and local sericitic alteration at the Crosby Creek prospect further east.

A smaller feldspar-phyric intrusive body a few hundred metres further south (159) is more mafic (54.5% SiO_2), but otherwise similar, with 0.77% TiO_2, 1.9% MgO, 6.01% Na_2O, 3.17% K_2O, 1200 ppm Ba, and 135 ppm Zn. Its mafic character gives this rock a Suite 3 classification.

A traverse of the southern 2 km of the sequence in the gorge showed a SSW-dipping mixture of sedimentary and volcanic rocks, with a unit at least 40m thick of white siliceous pebble conglomerate, rich in vein quartz clasts, located at 5418000mN. North of this is an andesitic lava/intrusive (174), with phenocrysts of plagioclase, minor quartz and ferromagnesian material. The rock has 59.4% SiO2, 0.55% TiO2, 2.84% MgO, %.23% Na2O, and 2.61% K2O (Table 3). It has a Suite 1 character, and appears to be similar to the large andesitic intrusive.

Slightly further north were buff to grey-black siltstones and shales, followed by a hard grey pumiceous rhyolitic sandstone (173) with 74.9% SiO2, 0.18% TiO2, 3.35 % Na2O, and 1.76% K2O (Table 5). To the south, above a zone of andesitic rocks, was a dacitic lava (187) with phenocrysts of plagioclase and altered ferromagnesian material in a fine groundmass with strong sericite-quartz-K-feldspar alteration. It has 64.0% SiO2, 0.83% TiO2, 0.80% MgO, 0.8% Na2O and 7.52% K2O (Table 5).

Dial Range Trough area

Although apparently highly disrupted, the Middle Cambrian sequences in the Dial Range Trough show a surprising degree of coherence, in part because good fossils were found at four major localities (Cateena Point, Isandula Road, Radfords Creek, Riana) by the early mappers (particularly Burns, 1964) and hence there is reasonably good age control.

The trough is divided longitudinally into a narrow eastern ‘basin’, about 3 km wide, and a broader western ‘basin’ about 7 km wide, by an elongate allochthonous block of chert and basalt extending 18 km from near Preston to the north coast (Fig. 1). Both basins become narrower northwards, until on the coastal section about 80% of the total width is occupied by allochthonous blocks and Precambrian fault blocks, and the Cambrian sedimentary sequences are reduced to 3 or 4 narrow zones of coarse breccia deposits.

There are many similarities in the sequences in the two basins, particularly in the occurrence of abundant felsic to andesitic volcaniclastic sandstones, Mt Read- type andesitic intrusives (locally referred to as Lobster Creek porphyries, and much more abundant in the western basin), and of conglomerates and breccias, such that considerable age overlap seems likely. The bulk of the sequence in the larger western basin appears to be of Tyndall Group age (fossil localities near Gunns Plains and at Riana), as does much of that in the eastern basin. However, the lower part of the sequence in the eastern basin, comprising mainly conglomerates and greywacke sandstones with interbedded mudstones, is pre-Tyndall in age (fossils at Isandula Road and Cateena Point).

The original stratigraphic arrangement proposed by Burns (1964), of Lobster Creek ‘Volcanics’, followed by Cateena Group, followed by Barrington Chert and Motton Spilite, followed by Radfords Creek Group, was developed before the allochthonous nature of the chert and spilite was recognized, and is now considered unworkable. A general subdivision into Tyndall Group equivalents and pre-Tyndall (WVSS) has been used on the revised map series by Vicary (2004), pending remapping in the current program.

The Lobster Creek ‘Volcanics’ appear to be mostly late-stage intrusive bodies of andesitic composition, intruding both Tyndall Group and older rocks. A zircon age of 500 +/-3.5 Ma has been obtained by Black et al (1997). A sample (183) from the large body on Allison Road west of North Motton is described as a medium grained porphyritic microgranodiorite, with phenocrysts of plagioclase, ferromagnesians (pyroxene, biotite?) intergrown with plagioclase, ferromagnesian material, FeTi oxide, and interstitial quartz and K-feldspar. There has been alteration to albite, epidote, chlorite,, actinolite and sericite. The rock has 60.4% SiO2 (Table 2), 0.75% TiO2, 2.17% MgO, 4.61% Na2O, 2.05% K2O, and has similarities to, and differences from, the Beulah ‘granites’.

TABLE 3. CHEMICAL ANALYSES LEVEN GORGE ANDESITES AND DACITES

Name	Diorite'	Diorite'	Diorite'	Andesite	Tyndall Dacite	Tyndall Dacite	Dacite
Number	157	158	159	174	148	149	187
Locality	Central gorge	Central gorge	Central gorge	Upper gorge	Lower gorge	Lower gorge	Upper gorge
Easting	416250	416150	416925	417750	415600	415750	418300
Northing	5421300	5420925	5420125	5418150	5423025	5422750	5417000
SiO2	61	63	54.5	59.4	69	61.3	64
TiO2	0.77	0.79	0.77	0.55	0.53	0.45	0.83
Al2O3	14	14.4	18.1	16	15.1	13	17.3
Fe2O3	7.48	7.37	6.7	7.35	3.9	2.46	7.11
MnO	0.12	0.19	0.15	0.14	0.01	0.1	0.01
MgO	1.69	2	1.9	2.84	0.44	0.86	0.8
CaO	2.82	1.07	3.15	2.14	0.12	1.99	0.32
Na2O	3.52	3.84	6.01	5.23	0.35	2.84	0.1
K2O	4.09	4.63	3.17	2.61	9.45	4.42	7.52
P2O5	0.32	0.35	0.2	0.18	0.09	0.07	0.24
LOI	3.7	2.52	3.92	4.39	1.72	3.26	3.31
Ba	1450	1250	1200	700	1600	1300	1800
Rb	96	110	68	64	270	160	200
Sr	175	105	220	58	52	130	26
Y	31	42	19	12	29	31	34
Nb	22	22	14	22	32	30	46
Zr	160	180	110	100	230	210	250
Ni	<2	<2	8	11	2	<2	3
Cr	<20	<20	<20	30	30	<20	20
As	4	8	<3	<3	8	4	6
Sb	<0.5	<0.5	<0.5	0.5	14	1	3
Th	11.5	12	5	6	19	18.5	16
U	2.6	3.2	1.25	1.35	2.8	4.3	3.5
La	40.5	47	13.5	20.5	42	42.5	26.5
Nd	35.5	38	14	16	36	34.5	27
Ce	82	78	24.5	37	90	88	54
Sm	6.5	7	2.7	2.7	6	6	4.7
Eu	2.1	2.3	0.83	0.98	1.75	1.7	1.4
Gd	6.5	8	3.1	2.4	5.5	5.5	4.7
Tb	0.91	1.1	0.48	0.33	0.75	0.8	0.79
Yb	3.7	4.2	2.4	1.7	3.4	3.5	4.5
Tl	0.3	0.3	0.4	0.4	2.9	0.9	1.4
Cu	11	7	27	<2	3	68	32
Pb	<5	310	48	<5	18	8	10
Zn	130	600	135	140	25	550	58
Ag							
Au	0.001	0.001		0.003	0.001	0.001	0.003
S	200	<100	200	<100	<100	300	<100

The age of the spectacular megabreccia units on the Penguin-Ulverstone foreshore remains uncertain in the absence of fossil control. They contain abundant chert and basalt detritus (including blocks up to tens of metres long) from the allochthons, and many blocks of carbonate of uncertain origin. Although felsic volcanic detritus of Mt Read type has not been reported, leading to suggestions of a pre-Mt Read age (e.g. Sproule, 1994; Crawford, 1993), brief observations by the author suggest some of the blocks may be of vitric ash (which resembles Barrington Chert, as noted previously), and that some volcanic quartz may be present in some of the sandstones. The breccias are intruded by andesitic to dacitic dykes which are probably related to the Lobster Creek andesitic porphyries. These intrusions are closely associated with minor Pb-Ag-Cu mineralisation at the old Penguin and Neptune mines near the coast (Burns, 1964).

The megabreccias have similarities to the pre-Tyndall 'Isandula Conglomerate', at the base of the Middle Cambrian sequence in the eastern basin, which contains abundant reddish chert/mudstone detritus and some basaltic detritus (petrology sample 109), and to the 'Sprent Conglomerates', which occur on either side of the chert-spilite allochthon in the Lake Isandula – Gunns Plains Road area. The latter conglomerates contain significant amounts of felsic to andesitic volcaniclastic detritus, or interbedded volcaniclastic units, as well as abundant chert and basaltic detritus (including clinopyroxene) derived from the allochthons, and appear to be at least partly of Tyndall age.

The Sprent –type conglomerates are prominent in the NW part of EL 18/2005, and were sampled on Closes Road (103), Lolbolly Road (104, 105), and near Lake Isandula (113). Sample 103 is a crystal-rich sandstone of Tyndall-type, with quartz and feldspar grains, pumice clasts, and clasts of glassy to porphyritic volcanics. The analysis (Table 5) shows 72.3% SiO2, 0.34% TiO2, 7.28% Na2O (reflecting secondary albite), 0.21% K2O, 50 ppm Cr, and 1400 ppm S. Samples 104 and 105 are of mixed provenance, dominated by chert and basaltic detritus but including some felsic volcanic detritus also. The chemical compositions reflect this, with overall dacitic values (66.4, 65.5% SiO2), moderate TiO2 (0.86, 0.78%), higher MgO (3.07, 3.05%), and elevated Cr (120, 110 ppm) and S (600 ppm each). Sample 113 appears to be mainly allochthon-derived, with clasts of argillite and chert (several with radiolaria), basalt and dolerite. It is more mafic (57.9% SiO2), with higher TiO2 (1.29%), high Fe2O3 (11.6%), high MgO (5.11%), high Cr and Ni (140, 86 ppm), and again elevated S (600ppm).

A close inspection was made of the volcanic- sedimentary sequence in the eastern basin as exposed at Lake Isandula and along the Gawler River downstream of this, to provide a reference section for mapping on the adjacent EL 18/2005. The west-facing sequence is well exposed, and shows the volcanic-rich Tyndall Group correlates passing down via a laminated black shale unit into underlying greywacke-mudstone and basal conglomerate. The thick greywacke unit contains pre-Tyndall fossils further north, and was sampled in two places (106, 108). It is slightly micaceous but typically weathers to a red-brown colour, suggesting a somewhat mafic composition. The analyses (Table 5) confirm this, with 54.1 and 58.8% SiO2, and high TiO2 (1.92, 2.03%), 12.2 and 13.0% Fe2O3, 190 and 380 ppm Cr, 155 and 98 ppm Ni. The lithic components are mainly shale, siltstone, chert, and quartzite, plus weathered basaltic material, with some feldspar, quartz, and minor chromite, indicating derivation largely from the allochthons and Precambrian sources.

The greywacke is overlain by a siltstone sequence exposed along the pipeline road on the east bank of the Gawler below the Fork of the Gawlers. The siltstones become grey-black and pyritic near the junction, in impressive cliff exposures. A coarse-grained crystal-rich volcaniclastic sandstone has an extraordinary intrusive-like contact against the black siltstone, and produces a spectacular breccia made up of blocks of black shale up to 3m long in a feldspar-quartz crystal-rich matrix. This breccia is exposed over a width of about 30m in the river bed at the junction of the East and West Gawlers, and is the host rock for the old Fork of the Gawlers prospect (Vivian, 1984).

A sample of the sandstone from the breccia (111) shows a mixed but dominantly volcanic provenance, with volcanic feldspar and lesser quartz, pumiceous, andesitic and mafic volcanic clasts, abundant fine-grained shale/siltstone clasts (some with carbonaceous material), plus minor chert, quartzite and muscovite. The analysis (Table 5) shows an andesitic composition (57.8% SiO2), with 0.63% TiO2, 17.1% Al2O3, high Ba (1550 ppm), 50 ppm Cr, and 1400 ppm S (reflecting some disseminated pyrite).

It is tempting to suggest that this large and highly erosive volcanic-derived mass-flow unit, with its abrupt contact on a pyritic- carbonaceous black shale/siltstone unit, could mark the base of the Tyndall Group (and of the MRV volcanic facies generally?) in this area. It is noteworthy that a similar black shale/siltstone unit is present at the possible base of the Tyndall Group correlates in the Native Track Tier – Leven Gorge area, as mentioned, and also in the Castra Road prospect area. A remarkably similar shale-sandstone arrangement was noted in the Wilmot River some 750m north of Spellmans Bridge, where a coarse crystal-rich sandstone has an erosive contact on a south-facing black shale/siltstone unit, producing a shale-clast breccia. However, there are problems in accepting that the rocks in this area are Tyndall Group, as discussed later.

An andesitic intrusive body lies just along strike to the north of the shale unit at the Fork of the Gawlers. The old **Duncan and McClaren prospect**, comprising shallow excavations on the east bank of the river, is located on the pyritic eastern contact of this body against shale, 250m from the junction. (Vivian, 1984) records minor Ag and As values from the pyrite. The andesite body (Burns' 'Kerrison Volcanics') was sampled further north (107), and is a chlorite-epidote-altered feldspar-pyroxene-phyric rock with quartz and K-feldspar in the groundmass. The analysis (Table 2) shows a felsic andesite (65.0% SiO2), with 0.65% TiO2, 1.77% MgO, 3.86% Na2O, 3.38% K2O, 0.11% P2O5, <20 ppm Cr, with a Suite 1 character.

The volcaniclastic mass-flow unit is overlain to the west by a sequence of interbedded ashy siltstones and volcaniclastic, commonly pumiceous, sandstones, with one unit of slightly micaceous greywacke and siltstone. A sample (112) of volcaniclastic sandstone contains abundant feldspar and quartz grains, pumiceous and feldspar-phyric volcanic clasts, lesser clasts of shale, chert and quartzite, and minor K-feldspar and muscovite. The chemical composition (Table 5) is andesitic (57.4% SiO2), with moderate TiO2 (0.98%), high Cr (120ppm), and 900 ppm S. A second sample from the spillway of Isandula Dam (110) is more pumice-rich, with much K-feldspar, and has a rhyolitic composition with 75.6% SiO2.

The upper part of the Isandula sequence consists mostly of interbedded buff-coloured ashy siltstones and sandstones, and has a poorly exposed contact (possibly faulted) against Sprent-type conglomerates (previously described) to the west.

The sequences in the western basin were not examined in detail, but include abundant siltstones (some of which are fossiliferous), volcaniclastic sandstones, and andesitic intrusives. A sample of one of the Lobster Creek porphyry bodies at Allison Road (183) is plagioclase-pyroxene-biotite(?)-phyric with a crystalline groundmass showing chlorite-sericite-epidote-actinolite alteration. It has 60.4% SiO2, 0.75% TiO2, 4.61% Na2O, 2.05% K2O, 0.11% P2O5 (Table 2), and appears to be a Suite 1 rock similar to the Isandula body.

Central Fossey Mountains Trough – the Nietta- Castra- Wilmot- Paloona area
The extensive Middle Cambrian sedimentary and volcano-sedimentary sequences across the central part of the trough (mainly on the Castra 1:25,000 sheet) have been mapped at a reconnaissance level in recent times by Vicary (2004), following earlier mapping by Porter (1974, 1976), Burns (1957) and Jennings et al (1959). Vicary has designated the sequences as either Tyndall Group correlates or pre-Tyndall WVSS correlates in most areas, largely on the basis of lithological characteristics, since there are no fossil localities. The author agrees with some of the designations, but finds that some appear to be based on too little evidence and are difficult to accept. Further mapping will hopefully resolve some of the questions.

West Gawler River – Deep Gully Creek area
In the NW part of the area, around Preston and Central Castra, the belt of west-dipping Sprent-type conglomerates and associated volcaniclastic rocks flanking the Barren Knob allochthon extends southwards along the West Gawler River to the Mt Minnie area. Here they are apparently underlain by a black shale/siltstone unit, also west-facing, exposed on the Castra Road adjacent to the Castra Road prospect (Fig. 5). This is almost certainly the same shale unit as that which hosts the Preston Silver Mine a little to the west. It is tempting to correlate this black slate with the one at Isandula forming the apparent base of the Tyndall Group correlates, as Vicary has done on the Castra sheet (Fig. 3). The shale appears to be faulted out just south of the Preston Silver Mine, and has not been recognized in the South Preston area. It is possibly equivalent to the NNW-facing unit described in the Leven Gorge, some 6km to the SW.

The sequence underlying the black shale unit, and exposed in the Deep Gully Creek – Nietta Creek – Ghost Hole Road area, consists mainly of pumiceous to ashy volcaniclastic sandstones and mudstones with intercalated large bodies of mainly dacitic lava and intrusive. The arcuate strikes of these units seem to define a broad SW-plunging anticlinal fold, and the presence of a SSE-facing unit of black shale mapped by the author on the southern flank of the structure in Castra Rivulet (Fig's 1,2) seems to confirm this. One of the major bodies of lava/intrusive, well exposed on Flints Road, was designated as a Lobster Creek- type intrusive (usually andesitic) by Vicary, but three samples collected by the author (126, 127, 129) clearly show (Table 4) rhyolitic to rhyodacitic compositions (70.8, 74.3, 71.8% SiO2) for this feldspar- ferromag- phyric rock with K-feldspar-rich holocrystalline groundmass. Other features are low TiO2 (0.42, 0.36, 0.42%), low MgO (0.40, 0.43, 0.52%), and mostly high alkalis (4.23, 0.06, 4.62% Na2O; 4.40, 4.29, 4.24% K2O).

A parallel lava body (125, 154) with amygdaloidal and spherulitic textures in places, and exposed, in Nietta Creek, has a similar rhyolitic composition (74.8, 74.0% SiO2; 0.37, 0.35% TiO2; 0.33, 0.31% MgO), as does another (130) exposed on Filluels Road, and another (133) near White Rock Road (Table 4). There do not appear to be any true andesitic rocks in this sequence.

A typical sandstone within the sequence (153) from Castra Falls (on Nietta Creek) contains feldspar and quartz grains and abundant pumiceous clasts, as well as a minor component of quartzite grains and muscovite flakes. There is strong K-feldspar alteration, with subordinate chlorite, carbonate and quartz.

A distinctively banded volcaniclastic ashy sandstone which outcrops over a limited area beside Flints Road has a startling resemblance to outcrops of banded pink and green 'Comstock Tuff' considered typical of the Tyndall Group in western Tasmania. A sample

(128) gives an andesitic composition (60.5% SiO_2), with 0.65% TiO_2, high Al_2O_3 (16.3%), high Na_2O (5.7%, reflecting the abundance of fine secondary albite), and 3.57% K_2O (Table 5). The rock contains abundant plagioclase grains and lesser quartz and altered ferromag grains, abundant pumice clasts, and some porphyritic and aphanitic volcanic clasts. There is strong albite and K-feldspar alteration, with minor chlorite, carbonate, quartz and sericite, and a trace of pyrite.

A generally similar sequence of pumiceous to ashy volcaniclastic sandstones and mudstones with intercalated felsic lavas/intrusions is present on the north side of the ESE-trending Deep Gully Fault in the Ghost Hole Road area. Strikes are mainly NW-SE along the road, so that the broad anticlinal structure is not obvious. Two of the feldspar-phyric amygdaloidal lava units were sampled (185, 186; Table 4). They are rhyodacitic to rhyolitic (74.3, 71.0% SiO_2), with low TiO_2 (0.32, 0.37%), low MgO (0.23, 0.69), moderate Na_2O (2.33, 2.89%), high K_2O (5.34, 4.39%), and high Ba (1550, 1150ppm). Potassic alteration in the form of fine-grained K-feldspar is prominent, with albite and minor chlorite, sericite, carbonate and a little pumpellyite.

East Gawler River – McPhersons Prospect – 13 Mile Road area

In the central part of the Castra lease, along the East Gawler River around McPhersons Prospect, is a belt of ashy mudstones and volcaniclastic, commonly pumiceous, sandstones generally similar to those elsewhere. One andesite body has been mapped in the northern part. Strikes appear to vary from NE to NW, with dips to both E and W. Vicary has designated these rocks as WVSS, but there are no distinguishing characteristics. A pumiceous sandstone near the Castra Road (115; Table 5) is rhyolitic (74.4% SiO_2), with very low Na_2O (0.07%) and high K_2O (4.35%). The thin section shows quartz and feldspar grains, pumiceous and felsic lava clasts, in a sericite-quartz-altered matrix. Closer to McPhersons Prospect, an originally pumiceous sandstone (116) shows strong and pervasive alteration to sericite and quartz, with lesser carbonate, hematite and minor pyrite. The rock has a surprisingly mafic composition, with 55.1% SiO_2, 1.02% TiO_2, 6.1% Fe_2O_3, 1.1% MgO, 2.74% CaO, low Na_2O (0.23%), but high K_2O (5.06%) reflecting the abundant sericite present.

A unit of thick-bedded, medium to coarse-grained quartz-rich polymict sandstones exposed in the river about 700m north of McPhersons Prospect area (118) contains a mixture of felsic volcanic detritus (quartz and feldspar grains), allochthon -derived detritus (chert, argillite, chromite and minor fuchsite), and minor metamorphic detritus (muscovite, quartzite, tourmaline). There is some carbonate alteration of the matrix, but only minor sericite alteration compared to samples closer to the prospect. The rock (Table 5) has an overall andesitic/dacitic composition (63.7% SiO_2), with moderate TiO_2 (0.93%), moderate alkalis (1.42% Na_2O; 1.90% K_2O), and high Cr (240ppm). The rock has similarities to some of the sandy units within the Sprent-type conglomerates.

The andesite body (119) exposed in the East Gawler north of McPhersons is a feldspar-pyroxene-quartz-phyric amygdaloidal lava showing moderate sericite-chlorite-carbonate-quartz alteration. It has 61.1% SiO_2, 0.63% TiO_2, low MgO (0.87%), moderate alkalis (3.75% Na_2O; 2.15% K_2O), 0.12% P_2O_5, 40 ppm Cr (Table 2). It has Suite1- Suite2 characters.

South-east of the McPhersons area, a wide unit of buff-coloured micaceous to siliceous greywacke sandstone and siltstone appears to strike uniformly NE and dip SE in the vicinity of Pettits Road and 13 Mile Road. It is overlain to the east by a sequence of mainly

TABLE 4. CHEMICAL ANALYSES FELSIC LAVAS NIETTA AREA

Name	Dacite	Dacite	Dacite	Dacite	Dacite	Rhyolite	Qtz-fsp por	Dacite	Rhyolite	Rhyolite	Qtz-fsp por	Dacite	Dacite	Dacite
Number	125	154	126	127	129	130	121	133	135	136	131	132	185	186
Locality	Flints Rd	Nietta Ck	Flints Rd	Flints Rd	Flints Rd	Filluels Rd	White Rock Rd	White Rock Rd	Off White Rock	Off White Rock	Castra Rd	Castra Rd	Ghost Hole Rd	Ghost Hole Rd
Easting	422650	423640	423050	423120	424120	422125	422220	421690	421550	421550	422800	422870	425500	424925
Northing	5422330	5421250	5422240	5422250	5421770	5422160	5423480	5423625	5423850	5423850	5423045	5423115	5422350	5422450
SiO2	74.8	74	70.8	74.3	71.8	77.6	78.5	71.6	76.4	77.5	73.8	67.9	74.3	71
TiO2	0.37	0.35	0.42	0.36	0.42	0.37	0.32	0.4	0.31	0.36	0.29	0.44	0.32	0.37
Al2O3	13.4	12.6	13.8	13.2	13.8	13.7	12.7	13	11.8	13.5	12.1	13.4	11.8	12.7
Fe2O3	1.28	2.51	2.86	4.22	3.4	1.28	1.76	3.69	3.34	1.66	4.26	3.71	2.38	3.68
MnO	<0.01	0.07	0.01	<0.01	0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.1	0.08	0.47
MgO	0.33	0.31	0.4	0.43	0.52	0.41	0.31	0.38	0.21	0.34	0.48	0.89	0.23	0.69
CaO	0.03	0.15	0.12	0.03	0.19	0.04	0.04	0.05	0.02	0.02	0.02	1.02	0.2	0.57
Na2O	1.62	3.28	4.23	0.06	4.62	0.06	0.08	1.05	0.08	0.07	0.09	2.3	2.33	2.89
K2O	4.2	4.45	4.4	4.29	4.24	2.96	3.97	4.95	3.44	4.27	4.26	4.85	5.34	4.39
P2O5	0.01	0.04	0.08	0.02	0.08	0.02	0.03	0.01	0.02	0.05	<0.01	0.04	0.03	0.08
LOI	2.75	1.29	1.31	3.45	1.17	3.9	2.68	2.73	3.88	2.9	3.77	3.42	1.23	2.45
Ba	600	1200	1000	250	1000	170	220	1350	180	390	380	1250	1550	1150
Rb	140	120	125	150	125	115	125	115	100	140	165	125	130	140
Sr	20	60	78	8	105	12	15	12	11	15	8	36	115	125
Y	30	33	31	25	30	30	22	33	27	31	14	37	38	40
Nb	24	22	20	22	22	26	24	26	22	24	22	22	32	34
Zr	220	200	220	210	230	220	210	160	200	210	170	210	180	210
Ni	<2	2	<2	3	<2	<2	<2	<2	3	3	3	<2	<2	<2
Cr	20	<20	<20	<20	30	<20	30	30	<20	<20	20	<20	50	<20
As	<3	12	<3	<3	<3	6	4	8	8	8	18	6	4	6
Sb	1	1	<0.5	5	<0.5	1	1.5	1	2	1.5	3.5	1	0.5	1
Th	21	20	19.5	19.5	19	19.5	19.5	19.5	17.5	22	19.5	18.5	18.5	19
U	4.8	4.7	4.3	4.2	4.6	2.8	2.1	2.8	3.3	3.1	2.7	4	3.3	4.8
La	39.5	35.5	42.5	36.5	24	52	28	52	70	44	37	36	45.5	49.5
Nd	35	33	38.5	33	23.5	46.5	27	33.5	62	37.5	35	33.5	43	47.5
Ce	86	80	92	82	56	115	62	115	150	92	86	80	90	100
Sm	6.5	6	7	6	4.5	7	4.3	7	10.5	7	5.5	6.5	7.5	8.5
Eu	1.55	1.3	1.85	1.35	1.3	1.35	0.88	1.35	1.65	1.6	0.74	1.85	1.85	2
Gd	0.78	5.5	6.5	5	4.4	5	3.9	6.5	7	6	3.6	6.5	6.5	7.5
Tb	3.8	0.83	0.83	0.7	0.68	0.79	0.6	0.89	0.9	0.8	0.41	1	0.94	0.99
Yb	0.5	4.1	3.8	3.1	3.8	4	3.1	3.6	3.3	3.3	2.1	4.5	4.2	4.2
Tl	0.3	1.2	0.4	0.4	0.4	0.3	0.3	0.3	0.4	0.4	0.5	0.4	0.4	0.6
Cu	<2	5	<2	<2	<2	<2	3	<2	17	3	66	4	<2	4
Pb	6	<5	6	<5	<5	6	<5	<5	100	6	6	<5	<5	6
Zn	9	22	13	16	15	10	27	8	9	15	9	17	17	62
Ag														
Au	<0.001	<0.001	<0.001	<0.001	>0.001	<0.001	<0.001	<0.001	0.001	0.001	<0.001	<0.001	0.004	0.003
S	<100	800	<100	<100	300	300	<100	<100	200	200	2.50%	400	<100	300

volcaniclastic sandstones and mudstones, including a variety (120) with feldspar and quartz grains and clasts of felsic to intermediate volcanics. The rock (Table 5) has rhyodacitic composition (69.2% SiO_2), with 0.64% TiO_2, 4.53% Na_2O, 2.46% K_2O. General exposure in the 13 Mile Road area is poor, and it is uncertain how the sequence in this area, designated as WVSS by Vicary, relates to the broad NW-trending zone of andesite-rich Tyndall Group correlates in the Groove Creek area to the NE, or to the south-facing sequence in the Wilmot River to the SE.

The Groove Creek belt

Corbett and McClenaghan (2003) distinguished a poorly-defined lens of possible Tyndall Group correlates in the Groove Creek area, between the Wilmot River and Claytons Rivulet, on the basis of Burns' (1957) description of some coarse-grained andesitic (?) volcaniclastics thereabouts. Vicary has greatly expanded this zone to a belt 4 km wide and over 12 km long, spanning the Wilmot River from Lake Barrington in the SE to Sprent in the NW, where there is connection beneath Tertiary basalt to the Tyndall Group correlates at Isandula Dam. Part of the belt lies within EL18/2005. The belt is shown as being bounded by NW-trending major faults, with a sequence of mainly vitric mudstones (formerly mapped as Barrington Chert) to the NE assumed to be mainly older WVSS correlates.

There are no fossil localities known within the Groove Creek belt, and hence the Tyndall Group correlation remains open to doubt. Most of the area has been developed as plantations ('Castra Plantation') and is managed by Forestry Tasmania.

The sequence within the belt includes abundant pumiceous volcaniclastic sandstones and ashy mudstones, and some micaceous greywacke units, but also features a number of coarse-grained andesitic volcaniclastic units which resemble parts of the Tyndall Group in the Sheffield- Paradise area. A large NW-trending linear body of feldspar-pyroxene-phyric andesite lava/intrusive occurs in the central part, and a number of smaller bodies of similar lava are scattered about. Strike trends through the main part of the belt are NW-SE, but this appears to change dramatically to NE-SW strikes on the eastern side of the Wilmot River.

A number of samples were taken through the sequence because of indications of proximal andesitic volcanism reminiscent of the mineralized andesite sequences at Beulah and Hellyer. Two samples of the main andesite body from the plantation area (144) and near the Wilmot River (162) are plagioclase-pyroxene+/-hornblende-phyric, with groundmass rich in K-feldspar and quartz, and show some (regional-type?) chlorite-sericite alteration. The chemical analyses (Table 2) are remarkably similar, with identical SiO_2 (64.8%) and TiO_2 (0.63%) values, and similar alkalis (4.0, 3.99 Na_2O; 3.71, 3.57% K_2O). It appears to be a Suite 1 rock. A second andesitic lava from a different unit on Gentle Annie Hill at Lower Wilmot (182) is also plagioclase-pyroxene-phyric, gives a fairly similar analysis (64.9% SiO_2; 0.75% TiO_2; 2.23% Na_2O; 2.3% K_2O), and also has Suite 1 characters.

Similar felsic andesite lavas were sampled (for petrology only) in the Wilmot River north of Ellis Flats (160, 161), and from north of the basalt-capped hill in the plantation area (142, 143). All show plagioclase phenocrysts and less common altered pyroxene +/- hornblende phenocrysts in a chlorite-sericite-altered K-feldspar – plagioclase-quartz-rich groundmass.

Three units of andesitic volcaniclastic sandstone were also sampled for petrology (141, 146, 147), one of which (147) was analysed (Table 5). They typically contain abundant plagioclase grains and volcanic lithics, with some ferromagnesian grains and quartz, and show albite-feldspar-chlorite alteration, with a little carbonate, epidote and sericite. The analysed sample has 57.9% SiO2, 0.89% TiO2, 3.41% Na2O, 2.11% K2O.

A pumice-rich sandstone with prominent green pumice wisps aligned parallel to bedding was sampled in a large quarry (145). It contains feldspar and quartz grains and lithic clasts of pumice and other glassy to porphyritic felsic volcanics, and is described as having strong sericite-chlorite alteration, with ~50% sericite. The analysis (Table 5) is rhyodacitic, with 71.2% SiO2, 0.47% TiO2, 5.17% K2O (reflecting the high sericite component), and 0.07% Na2O.

Spellmans Bridge – upper Wilmot River area

A very thick sequence of south-dipping and south-facing polymict sandstones and mudstones is exposed along the Wilmot River in the vicinity of Spellmans Bridge and in the southern part of the Castra Plantation area. The northern (older?) part of the sequence has been designated WVSS by Vicary, but the rocks appear to be identical to the felsic pumiceous-vitric units in the supposed Tyndall Group correlates of the Groove Creek area.

A coarse-grained pink-green volcaniclastic sandstone (151) was sampled from '13 Mile 2" Road. It contains abundant plagioclase grains and pumiceous volcanic clasts as well as minor ferromagnesian material, in a recrystallised ashy matrix. The analysis (Table 5) shows a rhyodacite composition (71.8% SiO2), with 0.35% TiO2, 4.39% Na2O and 3.34% K2O.

Vicary's Castra Sheet (Fig. 3) shows a passage into Tyndall Group correlates some 2km north of Spellmans Bridge, marked by a coarse volcaniclastic sandstone/breccia unit mapped as being andesitic. Thin sections of this unit on the road (152) and its possible equivalent in the river (140), show abundant felsic volcanic clasts – mostly either pumiceous or porphyritic – with feldspar grains, some quartz and minor ferromagnesians, in an ashy matrix showing alteration to K-feldspar, chlorite, carbonate, sericite and quartz. The rock appears to be of felsic composition, and is not convincing as a basal Tyndall Group unit.

A sequence of well-bedded vitric and cherty mudstones overlies the volcaniclastic breccia, and has within it (at 429975E, 5423625N) a thin unit of grey-black laminated shale (5-10 m thick) similar to that at Castra Road prospect etc. This seems to be just a local lens-like development of the black shale facies, and suggests there is potential danger in placing too much emphasis on such facies as stratigraphic markers.

Above the cherty mudstone sequence is a distinctive unit of micaceous/siliceous greywacke sandstone and grey-black siltstone, typically brown-weathering, which outcrops at the southern end of '13 Mile 2'Road and in the river to the east. This sandstone-shale sequence resembles the 'Stitt Quartzite' of the Rosebery area. A zone of intense brecciation and carbonate veining is exposed on the east bank and in the river bed around 431050E, 5422975N. Shallow scratchings around here probably correspond to the 'Lower Wilmot River Barite' prospect, although no barite or sulfide was noted in the traverse. Some of the carbonate veins are up to 25 cm thick, with a rough trend of 150E50. The brecciation and veining appear to be related to folding and fracturing of the siltstones, suggesting a probable Devonian age. The prospect is just inside the boundary of EL 17/2005.

The micaceous greywacke unit is followed by a unit of thick-bedded volcaniclastic sandstones (139), with quartz and feldspar grains, pumiceous volcanic clasts, shale and minor quartzite clasts. This is followed by a distinctive unit of laminated grey-black siltstone and fine sandstone, with graded beds, striking ENE parallel to a long straight stretch of the river

TABLE 5. CHEMICAL ANALYSES SEDIMENTS AND VOLCANICLASTICS CASTRA - SHEFFIELD AREA

Name	Sprent Con	Sprent Con	Sprent Con	Isandula Gw	Isandula Gw	Vcl breccia	Vcl sandst	Vcl sandst	Sprent Con	Pumic. Ss	Pumic. Ss	Crystal ss	Vcl sandst	Vcl sandst	Vcl sandst	Pumic. Ss	Pumic. Ss	Kerrison Volc'	Vcl sandst
Number	103	104	105	106	108	111	112	110	113	115	116	118	120	151	128	145	147	184	173
Locality	Lolbolly Rd	Lolbolly Rd	Lolbolly Rd	Isandula Rd	Gawler R	Fork of Gawlers	Below Isand Dam	Isandula Dam	Isandula Rd	McPhersons	McPhersons	McPhersons	13 Mile Rd	Castra Plant'n	Flints Rd	Castra Plant'n	Castra Plant'n	North Motton	Leven Gorge
Easting	425245	425480	425350	427720	428075	427950	427750	427380	326900	427500	427140	427155	428800	430825	423650	431125	430225	427200	417750
Northing	5429795	5430335	5430555	5436600	5434250	5433245	5433190	5432970	5433600	5427850	5428250	5428825	5425750	5424150	5422200	5427175	5426700	5439125	5418300
SiO2	72.3	66.4	65.5	54.1	58.8	57.8	57.4	75.6	57.9	74.4	55.1	63.7	69.2	71.8	60.5	71.2	57.9	58.8	74.9
TiO2	0.34	0.86	0.78	1.92	2.03	0.63	0.98	0.2	1.29	0.65	1.02	0.93	0.64	0.35	0.65	0.47	0.89	0.83	0.18
Al2O3	13.9	8.9	9.07	16.5	11	17.1	13.8	11.7	14.4	13.6	18.2	10.7	13.8	14.4	16.3	14.1	16.4	16.7	12.4
Fe2O3	3.51	7.5	6.75	12.2	13	5.28	6.72	1.87	11.6	1.72	6.1	7.18	4.76	3.45	5.13	2.84	6.78	7.25	3.16
MnO	0.07	0.12	0.12	0.05	0.27	0.07	0.11	0.02	0.14	<0.01	0.23	0.13	0.07	0.05	0.1	<0.01	0.1	0.16	0.04
MgO	0.84	3.07	3.05	2.34	4.04	3.42	2.42	0.67	5.11	0.68	1.1	1.96	1.78	0.82	1.79	1.49	2.73	3.22	1.1
CaO	0.36	4.89	4.77	0.07	0.9	4.22	4.98	0.14	0.2	0.13	2.74	2.7	0.24	0.55	1.46	0.04	6.79	3.02	0.84
Na2O	7.28	2.9	2.72	0.14	2.64	3.56	3.14	3.3	2.42	0.07	0.23	1.42	4.53	4.39	5.7	0.07	3.41	5.1	3.35
K2O	0.21	0.68	0.97	2.1	0.81	1.6	2.08	3.15	0.51	4.35	5.06	1.9	2.46	3.34	3.57	5.17	2.11	2.6	1.76
P2O5	0.06	0.16	0.13	0.18	0.2	0.1	0.14	0.04	0.05	0.02	0.16	0.16	0.1	0.09	0.17	<0.01	0.16	0.16	0.01
LOI	1.42	4.06	4.3	8.5	4.3	5.61	6.98	1.63	6.17	3.11	8.4	7.04	2.18	1.47	2.55	3.69	3.16	2.42	2.6
Ba	100	160	210	180	210	1550	300	550	240	600	600	270	650	600	950	200	300	850	420
Rb	1	17	29	70	32	50	78	94	8.5	190	200	76	62	120	105	210	58	80	72
Sr	58	92	110	8	64	330	200	78	70	12	19	82	135	135	140	5	350	350	36
Y	15	20	37	45	37	22	26	18	10	19	21	24	64	36	21	25	26	32	29
Nb	14	8	8	40	10	14	18	20	<5	18	18	20	26	24	18	24	16	28	30
Zr	150	60	60	250	250	150	210	100	70	230	160	230	220	210	200	350	170	200	140
Ni	4	46	62	155	98	15	32	7	86	8	6	64	32	<2	5	8	5	8	6
Cr	50	120	110	190	380	50	120	20	140	60	40	240	90	30	30	40	30	30	30
As	12	4	6	<3	<3	6	<3	8	4	4	<3	4	6	4	12	4	4	4	<3
Sb	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	1.5	0.5	0.5	1	1.5	1	<0.5	1	1	1.5	<0.5	1.5	<0.5
Th	5.5	3.8	3.8	10	8	9.5	9	28.5	1.75	12.5	8.5	9.5	15.5	16	12	19.5	8	9.5	24.5
U	0.93	0.84	0.86	2.1	1.75	2.2	1.9	3.8	0.53	2.4	1.85	1.8	3.8	4.1	2.4	4.3	2	2.4	5.5
La	14	9.5	10.5	42	26	21.5	22	52	13.5	22.5	14.5	27	56	33.5	32	39	23	30.5	47.5
Nd	13	10.5	11.5	50	27	20.5	21	32.5	9	23	17.5	25.5	52	52	31	17	52	30	27
Ce	24.5	21	22	58	56	46.5	48	100	18.5	52	36	58	105	74	62	94	49.5	60	94
Sm	2.5	2.5	3	10	6	3.7	4.3	5	1.6	4.3	3.7	5	7.5	6	5.5	7.5	4.7	5.5	5
Eu	0.64	0.87	1	2.8	1.8	1.55	1.25	1.05	0.56	1.1	1.2	1.35	2.1	1.5	1.75	1.45	1.5	1.9	0.93
Gd	2.5	3.2	4.6	11	6.5	4.4	4.4	4	1.75	3.7	4	4.8	9.5	5.5	5.5	6	4.8	5.5	4.1
Tb	0.36	0.49	0.72	1.45	0.96	0.66	0.64	0.53	1.28	0.48	0.59	0.71	1.35	0.82	0.72	0.82	0.71	0.85	0.62
Yb	2.2	2.2	3.2	4.4	3.4	2.8	2.6	2.7	1.55	2.4	2.6	2.8	4.9	3.7	2.6	3.7	2.9	3.8	3.9
Tl	<0.1	<0.1	0.2	0.5	0.2	0.3	0.3	0.3	<0.1	0.7	0.9	0.4	0.3	0.5	0.5	0.8	0.2	0.4	0.4
Cu	14	72	88	115	21	26	19	15	42	5	7	31	21	4	18	8	19	9	6
Pb	30	14	14	16	6	<5	6	8	<5	<5	<5	<5	12	6	<5	<5	6	130	<5
Zn	160	76	90	290	98	39	45	15	100	14	27	58	52	52	42	17	52	480	27
Au	0.001	0.003	0.003	0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.003	0.006
S	1400	600	600	300	300	1400	900	200	600	100	400	400	<100	300	700	400	400	200	<100

around 430160E, 5422530N, and facing south. A thin section of a sandstone (138) shows detrital plagioclase, K-feldspar, quartz and fine-grained lithics, in a chloritic matrix with patchy carbonate. The shale laminae have a little carbonaceous matter and pyrite.

The grey-black siltstone unit is of the order of 100-200 m thick, and has an upper contact marked by the erosional base of a coarse mass-flow volcaniclastic sandstone-breccia unit. The breccia contains clasts and rafts of black shale, as well as rare quartz pebbles to 2 cm, in a quartz-feldspar-rich matrix. A thin section (137) shows pumiceous and porphyritic volcanic clasts, and some schist and quartzite clasts, plus quartz and feldspar grains, in a fine ashy matrix, with some alteration to albite, quartz, K-feldspar, sericite and chlorite. As noted previously, there are clear similarities between this shale – mass-flow arrangement and that seen at the base of the probable Tyndall Group equivalents near Isandula Dam. This may, however, be purely coincidence.

The sequence between the black shale and Spellmans Bridge consists mostly of ashy-cherty siltstones and volcaniclastic, commonly pumiceous, sandstones, with one probable felsic lava (M. Vicary, pers. comm.). A similar polymict sequence is present south of the bridge. A massive grey volcaniclastic sandstone (163) has abundant plagioclase grains, lesser quartz, abundant volcanic clasts, and very rare chromite grains, in a fine-grained ashy matrix. Partial derivation from allochthonous sources seems indicated.

A second sandstone (164) is more obviously polymict and Precambrian-derived, with abundant quartz and quartzite grains, lesser volcanic grains and feldspar, some shale-mudstone clasts, mica flakes, plus minor detrital carbonate, zircon, tourmaline, biotite and chromite. There is some chlorite-carbonate-pyrite alteration. Further upstream is a massive quartz-rich sandstone (165) consisting mainly of quartz, quartzite and quartz-mica schist grains, with muscovite flakes and a little altered biotite, K-feldspar and carbonate, and traces of tourmaline, rutile and chromite. Again, derivation from metamorphic and allochthonous sources is indicated.

The micaceous-siliciclastic sandstone is followed by a unit of massive grey volcaniclastic sandstone (167) with abundant plagioclase and lesser quartz grains, and abundant pumiceous volcanic clasts, in a fine ashy matrix showing the ususal albite-K-feldspar – sericite alteration.

The last unit visited on this traverse was a thin-bedded to laminated sequence of buff-yellow ashy mudstones passing up into grey-black micaceous siltstone-shale. The latter dips and faces south, and resembles the black shale unit north of Spellmans Bridge, raising the possibility that there is a cyclical repetition of the facies sequence from volcaniclastic mudstone to micaceous sandstone to volcaniclastic sandstone to black shale seen north of the bridge.

The very thick sequence of mainly south-dipping volcano-sedimentary and sedimentary rocks extends south along the Wilmot River, with some E-W folds mapped in places, to the contact with Ordovician rocks near Narrawa (all on EL 17/2005), as shown on Figure 2. The whole sequence has been correlated with the Tyndall Group by Vicary (Castra Sheet) except for a small section around the mouth of Castra Rivulet, which is designated WVSS.

However, in the absence of fossils or of any distinctive marker units, even of any andesitic volcanics, it is difficult to be confident about such a correlation. Indeed, the polymict nature of the sequence, and the lack of major andesitic units or of coarse volcaniclastics, is more suggestive of the pre-Tyndall sequences.

Synthesis and conclusions

- Most of the sequence in the central part of the Fossey Mountains Trough is generally similar to the Western Volcano-Sedimentary Sequence of western Tasmania, being dominated by sandstones and mudstones with relatively few proximal volcanic facies. Correlates of the Tyndall Group are identified at Native Track Tier, in the Dial Range Trough, and in the Sheffield- Mt Roland area, but are difficult to distinguish in the central area because of the lack of fossil localities and coarse-grained facies. Further mapping will be required to delineate Tyndall Group from older rocks in this area.
- There are no recognizable equivalents of the Central Volcanic Complex or of the Rosebery Host Rock sequence in the Castra and Nietta EL's, and probably not in the Sheffield EL.

GEOLOGY AND PROSPECTS WITHIN THE EXPLORATION LICENCES

Castra EL 18/2005

A central zone of Tertiary basalt cover through Central Castra (Fig's 2,3) divides this EL into a western zone, along the West Gawler River, of Sprent-type conglomerates and associated sedimentary rocks, and an eastern zone of non-diagnostic sedimentary and volcano-sedimentary rocks along the East Gawler River and in the 13 Mile Road – Claytons Rivulet area. Part of Vicary's 'Groove Creek belt' of volcaniclastic and andesitic rocks comes into the NE corner of the EL around Sprent and the Castra Plantation area.

The only known prospect in the area is McPhersons (Copper), located somewhere along the gorge of the East Gawler between Central Castra and Sprent, in an area of State Forest. Although the deposit seems well known, and appears on many maps, no reference to any early work at the site has been quoted or found, and no-one appears to have been able to locate it exactly. Vivian (1984) gives a comprehensive account of all the known prospects in the general area, noting that McPhersons was not located despite several traverses. He describes 'weathered, intensely sericitised pumice tuff, formerly rich in disseminated sulfides' as outcropping extensively between the river and the nearby Upper Castra Road, and notes that two samples of this gave no significant results.

Virgoe (1990) reports that two rock samples from McPhersons with anomalous Pb were submitted to CSIRO for Pb isotopes analysis, and both gave a Cambrian Pb signature, similar to that of Rosebery- Hercules.

The author did a single traverse along the river in the area. Although the prospect was not found, outcropping semi-massive pyrite mineralisation, associated with coarse vuggy quartz veining, was noted in the river bed at about 427080E, 5428600N. A rock chip sample from here was submitted for assay, but was lost in the system after problems with the lab. Strong sericite-quartz-pyrite alteration (sample 116), of hydrothermal type, was first noted in the pumiceous host rock some 350 m to the south of this, and disseminated pyrite was still present some 150 m to the north, suggesting there could be an alteration zone at least 500 m long. Sample 116 also showed some hematite and carbonate. A weak foliation is evident in the sericitic alteration, suggesting the sericitisation could be pre-Devonian and possibly associated with a Cambrian VHMS-type alteration system.

There is a need for careful detailed mapping of the area to locate the prospect and to clarify the extent and nature of the associated alteration and mineralisation.

<u>Nietta EL 17/2005</u>

Geology

The western part of this EL covers much of the Native Track Tier – Leven Gorge embayment, with a N-dipping Tyndall Group volcaniclastic-rich sequence (with felsic lavas) in the north, a large E-W oriented andesitic to dioritic intrusive body and several smaller bodies in the middle part, and a polymict volcaniclastic– sedimentary sequence, partly S-dipping, in the south. This zone is separated from the Deep Gully zone to the east by several major NW faults and a strip of Ordovician siliciclastics at Watts Lookout (Fig. 3).

The Deep Gully – Castra Rivulet area contains a series of dacitic-rhyolitic lavas and intrusives in a 'matrix' of mainly pumiceous volcaniclastic sandstones and mudstones. Part of the zone, SW of a major NW fault along Deep Gully Creek, has arcuate strikes indicative of an early-phase (Cambrian) SW-plunging anticlinal fold. A north-facing black shale unit, possibly marking the base of Tyndall Group correlates, is present on the northern side, and a similar south-facing shale on the south side.

The eastern and southern parts of the EL are occupied by an extensive polymict sequence of mainly sandstones and mudstones ranging from volcaniclastic (mainly felsic) to micaceous/siliciclastic of metamorphic derivation. Several units of south-facing black siltstone/shale have been mapped. No major primary volcanic units have been mapped within this sequence.

Prospects

Four major prospects are present within this EL. Two of these in the Native Track Tier – Leven Gorge area (*Loyetea South* and *Crosby Creek*) have a similar geological setting, with a close association to andesitic/dioritic intrusive bodies. The Castra Road prospect consists of a zone of pyrite and sericite probably associated with a major NW fault, and the nearby Preston Silver Mine comprises small workings with minor galena and sphalerite in a black shale host close to the same fault system.

The **Loyetea South prospect** is located 3 km west of the Leven River, in rugged forested country on the south side of Tulip Tree Creek. Access to the area is now very difficult since logging roads have become overgrown. It was first located by anomalous Pb and Zn geochemistry in stream sediments sampled by CRAE in the 1970's. This was followed up by gridding, soil geochemistry, gradient array IP, and finally drilling of two diamond holes in 1976 (Porter, 1976). The holes intersected 'shales, tuffaceous shales, tuffs, dacitic lavas and a locally altered rhyodacitic intrusive'. Rocks within 50 m of the intrusive showed some intense sericitic alteration, but no significant mineralisation was observed, and the geophysical-geochemical anomalies were not really explained.

Geopeko (in joint venture with Pasminco) carried out some further soil and rock chip sampling in the general prospect area, but obtained only slight anomalism in 3 out of 30 samples (1800, 245 and 220 ppm Pb). A number of anomalous Zn values (to 650 ppm) were obtained, but Cu values were low (Virgoe, 1990). Pb isotope determinations on 5 samples from the Tulip Tree grid gave Cambrian signatures. Petrological descriptions of a number of rocks from the area by Crawford suggested a complex of related intermediate to felsic eruptives and magma chambers. Fitzgerald (1991) summarized the work and results, suggesting that the sericitic alteration was shear-related rather than hydrothermal in origin, and that true hydrothermal alteration appeared to be absent. The area was relinquished soon after.

Some further exploration was done by RGC Exploration in 1994-95, consisting mainly of geological mapping and some further rock chip sampling, but there was no further follow-up (Vicary, 1994, 1995).

The author did not visit the area for the present study, because of the difficult access, and it is difficult to see what further work might fruitfully be done on the prospect.

The **Crosby Creek prospect**, located east of the Leven River between Crosby Creek and Cullens Road (Fig. 4), was also located by the 1970's CRAE stream sediment sampling and follow- up soil geochemistry. This outlined an anomalous zone with 1.5 km strike length and 20-100 m width, defined by 400+ ppm Pb, 200+ Zn, 100+ Cu. Three diamond holes (75CC1 to 293m, 75CC2 to 200m, 75CC3 to 149m) were drilled on the northern margin of a large 'microdiorite' body intruding shales and tuffs. All intersected low-grade disseminated Pb-Zn-Cu mineralisation in shales and tuffaceous shales close to the intrusive contact (Porter, 1976). Downhole IP, dip-dip IP, gradient array IP, ground magnetics, airborne EM and SP surveys were also done, but no good geophysical anomalies or targets were defined. However, some coincident IP and soil geochem anomalies to the south were recommended as possible drilling targets, but were not followed up (Porter, 1976).

Geopeko (in joint venture with Pasminco) re-logged the drill core and checked mapping in the area in 1989-90. They concluded that the drilled mineralisation was confined to within a few metres of the northern diorite contact, and that no extensive zones of hydrothermal alteration had been intersected. Gold values from the mineralized zones and weakly altered zones were low. The unexplored southern part of the area around Crosby Creek itself was of more interest, and a 400 m spaced grid was established over a strike width of 2.5 km (Fig. 4). Soil sampling showed a zone of overlapping Pb and Zn anomalism (300_+ ppm Pb, 300+ ppm Zn) centred on Line 184E, in mainly tuffaceous sedimentary rocks and black shales, at the southern margin of a large intrusive body. A halo of sub-anomalous values extended along strike from this for some 800 m. Copper values were mostly very low (<50 ppm), but two weakly anomalous zones (>150 ppm) were defined in the eastern part of the grid.

Mapping revealed several more intrusive bodies, ranging from dacite to basaltic andesite, which seemed the likely source of the minor mineralisation, and no drilling was done (Virgoe and Mathison, 1989; Virgoe, 1990). Pb isotopes from the CRA drill hole samples gave a Cambrian signature. The lack of significant surface hydrothermal alteration, and the presence of multiple dioritic intrusions, suggested a VHMS deposit was unlikely, and the area was relinquished the following year (Fitzgerald, 1991).

RGC undertook some re-logging of the three CRAE holes, and some further mapping in the area (Vicary, 1995), and the similarities to the geology in the Tulip Tree Creek area were again noted. Vicary suggested there was probable continuity of the larger intrusive bodies between these areas.

A map of the geology and exploration features of the area, compiled from work by Geopeko (Virgoe and Mathison, 1989; Virgoe, 1990) and RGC (Vicary, 1994), and with some additional data from the author's mapping in the Leven River, is given in Figure 4. The large intrusive diorite/andesite body lies more or less along strike on the contact between Tyndall Group correlates (volcaniclastic conglomerates and sandstones with some dacitic lavas) and an older, more polymict sequence. The grey-black siltstone/shale unit at the contact in the river is probably equivalent to similar black shales reported on the contacts in the prospect area. Bedding readings suggest an anticlinal fold close to the position of the smaller intrusive body.

The strong association of the soil anomalies, particularly Pb and Zn, with the contacts of the major dioritic intrusive are obvious (some small Cu anomalies on the northern margin near the CRA drill holes have been left off for clarity). There is a strong suggestion that the larger Cu anomalies are more closely associated with the smaller, more mafic (basaltic andesite) intrusive, although the southernmost anomaly does not appear to have an associated intrusive.

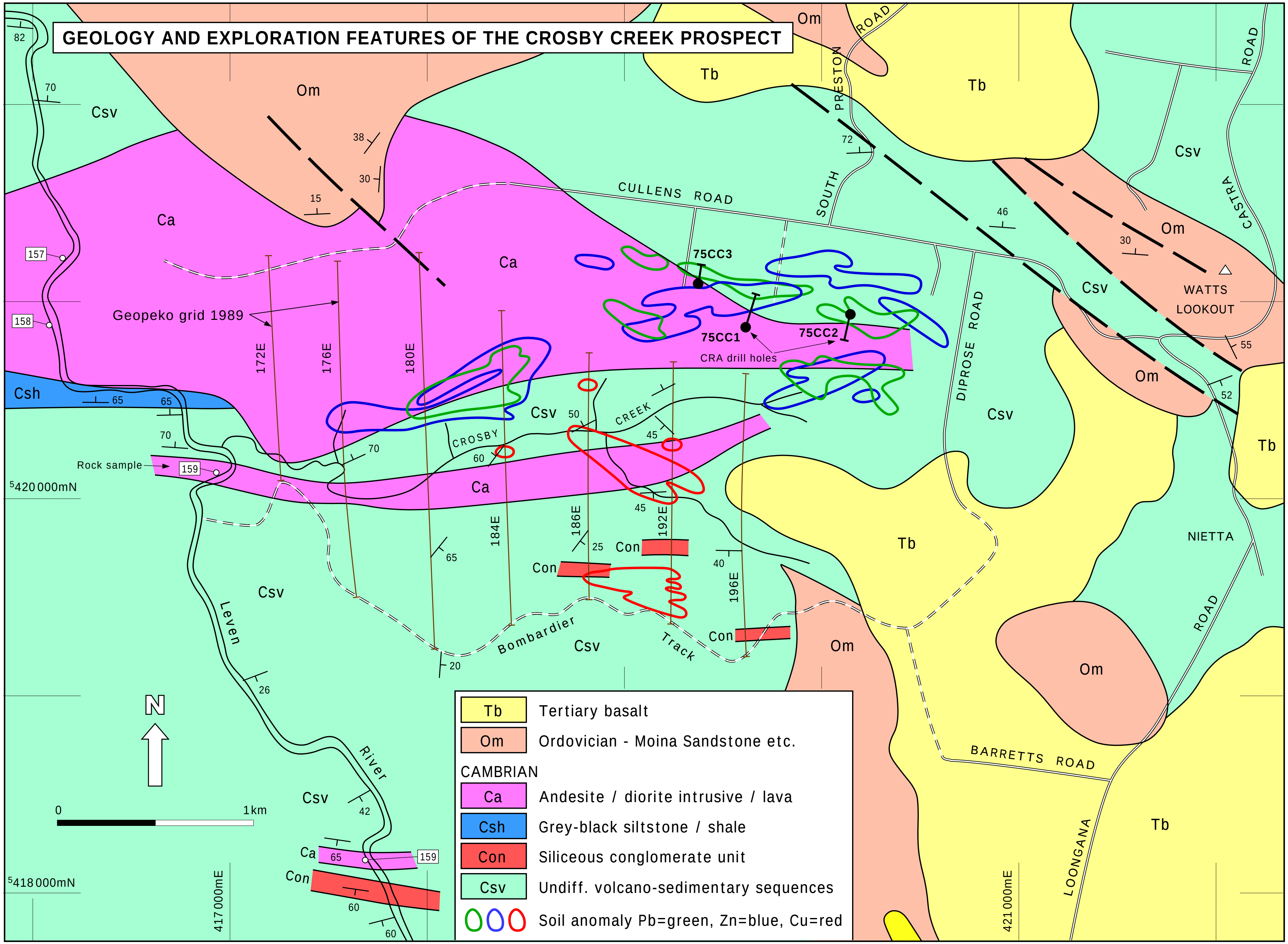
The Crosby Creek prospect area is an excellent example of this kind of intrusive-related low-level mineralisation, and should serve as a guide for assessing other such occurrences.

The **Castra Road prospect** comprises road cuttings of altered and pyritised quartz-feldspar porphyry on the Castra Road near White Rock Road, at 422800E, 5423050N (Fig. 5). A large cutting on the inside of a sharp bend shows strongly sericite-silica-altered yellowish porphyry carrying abundant fresh pyrite, some of it in steeply oriented crush zones. A major NW-oriented fault, the Deep Gully Fault, is presumed to be nearby, and Vicary's map (Castra sheet, Fig. 3) shows two diverging arms of this fault, one on either side of the outcrop. There are no known prospector's workings in the area.

The area was investigated by CRAE in the 1970's, on the basis of the exposed alteration rather than any stream sediment anomaly. Reconnaissance soil sampling on a 400 m-spaced grid (Fig. 5) gave some patchy anomalous Pb and Zn values but no continuous anomaly (Porter, 1976). Detailed sampling of the road section was carried out by Purvis (1978), who reported 'fist-sized clots and stringers of barite' in one part of the outcrop (an observation not repeated by any other workers). The sampling showed base metal values to be uniformly low, leading Purvis to suggest that this in itself might represent an anomaly reflecting hydrothermal leaching, with the inference that the base metals had been deposited somewhere else in the area.

Geopeko also carried out mapping and rock chip sampling of the road section (Virgoe and Mathison, 1989), again finding that Pb and Zn values were very low. Only one sample was weakly anomalous in gold (0.079 ppm), and two samples for Cu (110, 340 ppm).

The road section was examined by the author, and several samples taken for petrology and analysis. The altered porphyry has abundant large quartz phenocrysts (1-3 mm), and a yellow sulfur 'bloom' from the abundant pyrite. The pyrite occurs in stringers, blebs, veins and disseminations, and appears to be related to sub-vertical shearing and fracturing trending ~140°. Pyrite and dark material (tourmaline?) are concentrated in fracture zones up to 70 cm wide. There is no indication of any other sulfides present. A sample of the porphyry (131) shows scattered large quartz phenocrysts and less common altered feldspar and ferromagnesian phenocrysts in a fine-grained quartzofeldspathic groundmass. Strong alteration has replaced the groundmass, feldspar and ferromag minerals with quartz and sericite, with minor leucoxene/rutile and tourmaline. Cross-cutting veins contain quartz, pyrite and tourmaline. The analysis (131, Table 4) shows 73.8% SiO_2, 12.1% Al_2O_3, 0.09% Na_2O, 4.26% K_2O, low Cu, Pb, Zn (66, 6, 9 ppm), and 2.5% S.



GEOLOGY AND EXPLORATION FEATURES OF THE CROSBY CREEK PROSPECT
Om
Tb
Csv
Ca
Csh
Con
CULLENS ROAD
SOUTH PRESTON ROAD
CASTRA ROAD
DIPROSE ROAD
WATTS LOOKOUT
NIETTA
75CC3
75CC1
75CC2
CRA drill holes
Geopeko grid 1989
172E
176E
180E
184E
186E
192E
196E
CROSBY CREEK
Rock sample
157
158
159
5420 000mN
5418 000mN
417 000mE
421 000mE
Leven River
Bombardier Track
BARRETTS ROAD
LOONGANA ROAD
N
0
1km
Tb Tertiary basalt
Om Ordovician - Moina Sandstone etc.
CAMBRIAN
Ca Andesite / diorite intrusive / lava
Csh Grey-black siltstone / shale
Con Siliceous conglomerate unit
Csv Undiff. volcano-sedimentary sequences
Soil anomaly Pb=green, Zn=blue, Cu=red

The occurrence of significant amounts of **tourmaline** (3%+ in the thin section) in this rock does not seem to have been previously noted.

Along the road to the south, the porphyry has a fused (i.e. non-faulted) contact with massive pumiceous to ashy sandstone, showing disseminated pyrite and some carbonate veining. To the north, the porphyry has an unexposed (faulted?) contact with an altered feldspar-phyric rock (132) which appears to be an amygdaloidal dacitic lava similar to other dacites in the area (Table 4). The rock shows strong sericite-chlorite-quartz-carbonate alteration, but doesn't appear to be pyritic. Beyond this, across a faulted contact, is the unit of west-dipping grey-black siltstone and shale, which here contains abundant pyrite, some of it in solid veins up to 1 cm + wide.

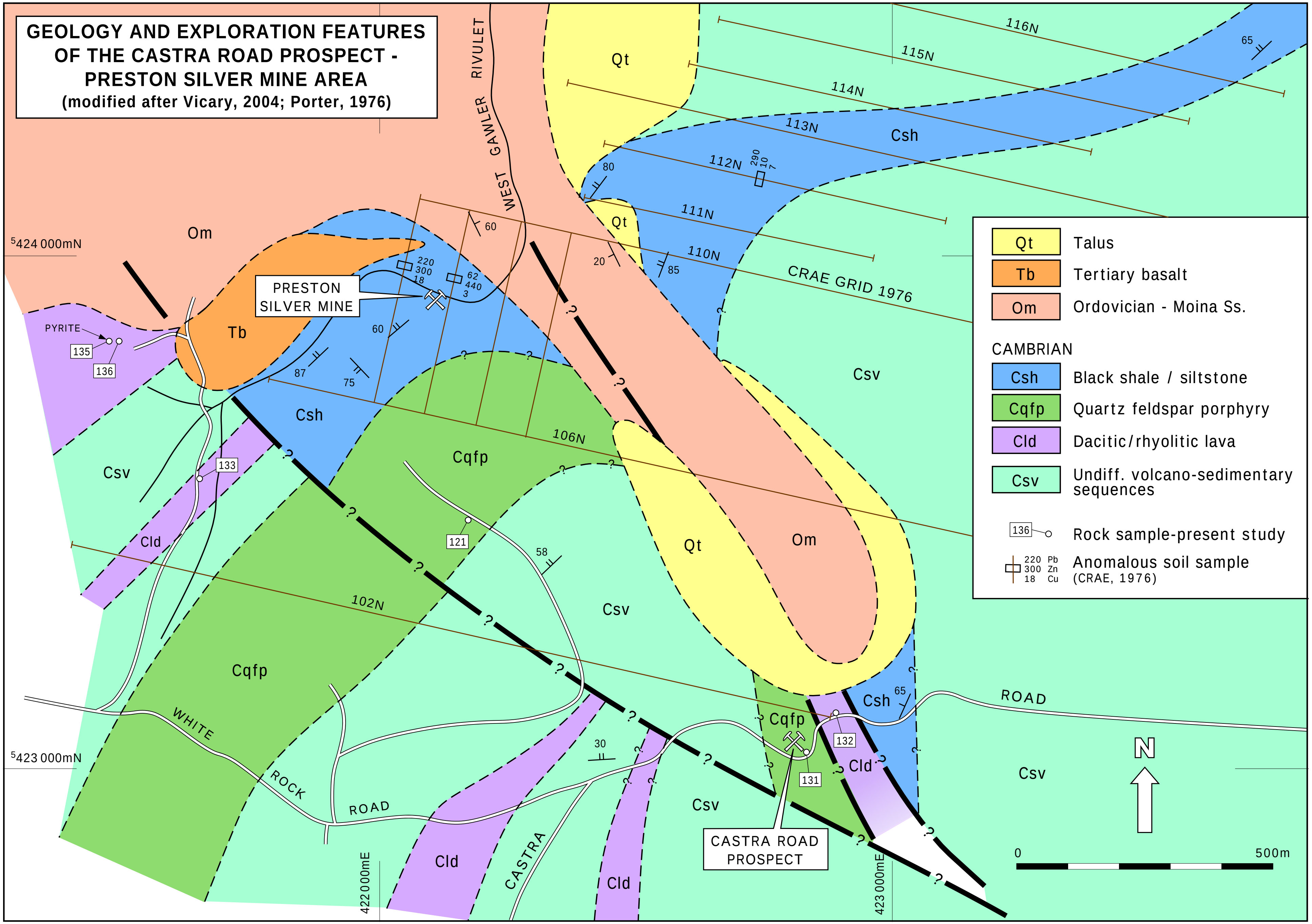
The **Preston Silver Mine** comprises small workings located on the south bank of the West Gawler Rivulet just over 1 km NW of Castra Road prospect (Fig. 5). Descriptions have been given by Twelvetrees (1909) and Virgoe and Mathison (1989). Two small trenches are evident in the rising bank, and a small mullock pile from a collapsed shaft (5 m?). The mineralisation is said to consist of minor galena and sphalerite along joints and cleavage planes within the host grey-black siltstones and slates. CRAE investigated the area with a 100m-spaced grid and soil sampling as part of a wider coverage of the general area (Fig. 5). Results were low except for two samples with 220 ppm Pb, 300 ppm Zn, 18 ppm Cu, and 62 ppm Pb, 440 ppm Zn, 3 ppm Cu, near the river (Porter, 1976). No further follow-up was done.

Geopeko submitted two rock samples with anomalous Pb from the area for Pb isotope analysis, both of which plotted in the Cambrian vein-style field (Virgoe, 1990). A petrological sample of the shale host rock was described by Crawford (in Virgoe, 1990). The shale layers consist of detrital quartz (metamorphic derivation) and muscovite set in carbonaceous material. The sandier layers have considerable secondary carbonate. There is finely disseminated pyrite and magnetite, and a single narrow quartz-calcite vein with a small amount of galena and chalcopyrite.

The author traversed the area and located the workings on the south bank. No obvious mineralisation was seen. The contact with Ordovician siliciclastics (pebble conglomerate and sandstone) crosses the river just downstream (not where shown on the current Castra map), and appears to be a normal depositional contact rather than a fault. A dyke of Tertiary basalt was located on the south bank. There was insufficient time to determine the attitude of the host rocks or the nature of the mineralisation, and further detailed mapping is recommended.

In addition to the known prospects, the author discovered a **pyritic zone within strongly quartz- sericite-altered felsic lava** some 600 m west of the Preston Silver Mine. The locality is at a quarry and waterhole in massive pinkish feldspar-phyric lava, with a zone on the NW side where the rock is distinctly yellowish and pyritic. The pyrite occurs as veins and segregations through the rock, with no other obvious sulfides present. Two rock samples (135, 136) show scattered feldspar phenocrysts and minor ferromagnesians in a fine-grained quartzofeldspathic groundmass showing strong hydrothermal-type quartz-sericite alteration. Geochemically (Table 4), the rocks are rhyolitic (76.4, 77.5% SiO_2), with low Na_2O (0.08. 0.07%) but high K2) (3.44. 4.27%) reflecting the sericite content. Sample 135 has 2.2% S, reflecting the pyrite content, but Cu-Pb-Zn values are low (17, 100, 9; 3,6,15 ppm).

The pyrite zone has much in common with that at the Castra Road prospect, and it seems likely that the three mineralized sites in the area (including Preston Silver) are associated in



GEOLOGY AND EXPLORATION FEATURES OF THE CASTRA ROAD PROSPECT - PRESTON SILVER MINE AREA
(modified after Vicary, 2004; Porter, 1976)
RIVULET
GAWLER
WEST
PRESTON SILVER MINE
CASTRA ROAD PROSPECT
WHITE ROCK ROAD
CASTRA ROAD
CRAE GRID 1976
116N
115N
114N
113N
112N
111N
110N
106N
102N
5424 000mN
5423 000mN
422 000mE
423 000mE
PYRITE
135
136
133
121
132
131
Qt
Tb
Om
Csh
Cqfp
Cld
Csv
Qt Talus
Tb Tertiary basalt
Om Ordovician - Moina Ss.
CAMBRIAN
Csh Black shale / siltstone
Cqfp Quartz feldspar porphyry
Cld Dacitic/rhyolitic lava
Csv Undiff. volcano-sedimentary sequences
136 Rock sample-present study
220 Pb 300 Zn 18 Cu Anomalous soil sample (CRAE, 1976)
N
0
500m

some way with the major zone of NW faulting, with a Devonian flavour. However, the Cambrian Pb isotope values, and the amount of alteration present in places, raises the possibility of a Cambrian progenitor somewhere, and further mapping is recommended to clarify the geology and to determine if there is potential for more economic styles of mineralisation.

Sheffield EL 16/2005

Geology

The geology of this EL is dominated by a central zone of Tyndall Group andesitic lavas and coarse volcaniclastics, stretching west from Paradise along the Dasher River (Fig. 2). Much of the valley area and the northern slopes of nearby Mt Roland are covered by extensive bouldery scree-like deposits of siliciclastic conglomerate detritus. The Tyndall andesites are flanked to the NW and east by an older WVSS-type volcano-sedimentary sequence, comprising a mixture of Precambrian-derived and volcanic-derived sediments, formerly referred to as ‘Gog Range Greywacke’. The northern part of the Beulah andesite sequence is present at the eastern margin, and several bodies of Beulah ‘granite’ also. Much of the northern part is covered by Tertiary basalt and associated sediments, with part of an inlier of Barrington Chert west of Sheffield

Prospects

The only prospect known in the area is **Stonebridge**, located on the southern boundary near the Paradise fossil locality. According to Rand and Noonan (1989), it consists of minor barite veins and some gossan development in andesitic and felsic volcanics. Despite several companies holding the ground, there has been very little follow-up or interest in this prospect.

The author has not done any detailed work on this EL, apart from the collection of a number of rock samples for comparative geochemistry and petrology, for the present program.

DISCUSSION AND CONCLUSIONS

Examination of the rock sequences through the Castra- Nietta area has not shown any large areas of altered rocks which might indicate a VHMS system similar to Rosebery or Mt Lyell. As noted by most previous explorers, the general nature of the rocks is blocky, uncleaved or weakly cleaved, with regional style alteration features only. Prospects and signs of mineralisation are few and far between, despite the intense efforts of generations of prospectors. The general geochemical character of the rocks is also not comparable to notable host rock sequences such as Rosebery, as described in studies by Beeson (2005a,b).

The dominant volcanic facies present are of relatively distal volcano-sedimentary type, dominated by sandstones, siltstones and mudstones. Relatively proximal coarser-grained facies are present in only a few places, such as the Groove Creek (Castra Plantation) area, mostly outside EL 18/2005. Otherwise, the major volcanic units are either intrusive bodies (particularly andesitic- dioritic types) or discrete felsic lavas within sedimentary sequences.

The mineralisation occurrences appear to be of two main types:

(i) low-level Pb-Zn-minor Cu associated with the contacts of some of the Cambrian andesitic intrusive bodies. This is well documented at the Crosby Creek prospect by three drill holes and extensive soil sampling and geophysical surveys, and also seems to be the case at the Loyetea South prospect. A major exploration program by Pasminco in the Dial Range area in the early 1990's also concluded that this was the main type of mineralisation at many of the major prospects in that area (e.g. Keddies, Dial Mine, Penguin Mine; Fitzgerald, 1993);

(ii) scattered Pb-Ag-Ba-pyrite-(Cu) occurrences apparently related to Devonian structures, particularly faults. This seems to be the case at Castra Road and Preston Silver Mine, although the relationships in this area have not been fully demonstrated. The mineralisation may have been remobilized by Devonian granite intrusion, or may simply be related to the tectonic event, but at least some of the sulfide is of Cambrian age, as indicated by Pb isotopes.

The pyritic mineralisation at McPhersons prospect, on Castra EL, does not fit either of these models as presently known, i.e. there is no known large intrusive body nearby, nor any major Devonian structure. Sericitic alteration and disseminated pyrite mineralisation extends over at least 500 m at this site, and further investigation seems warranted.

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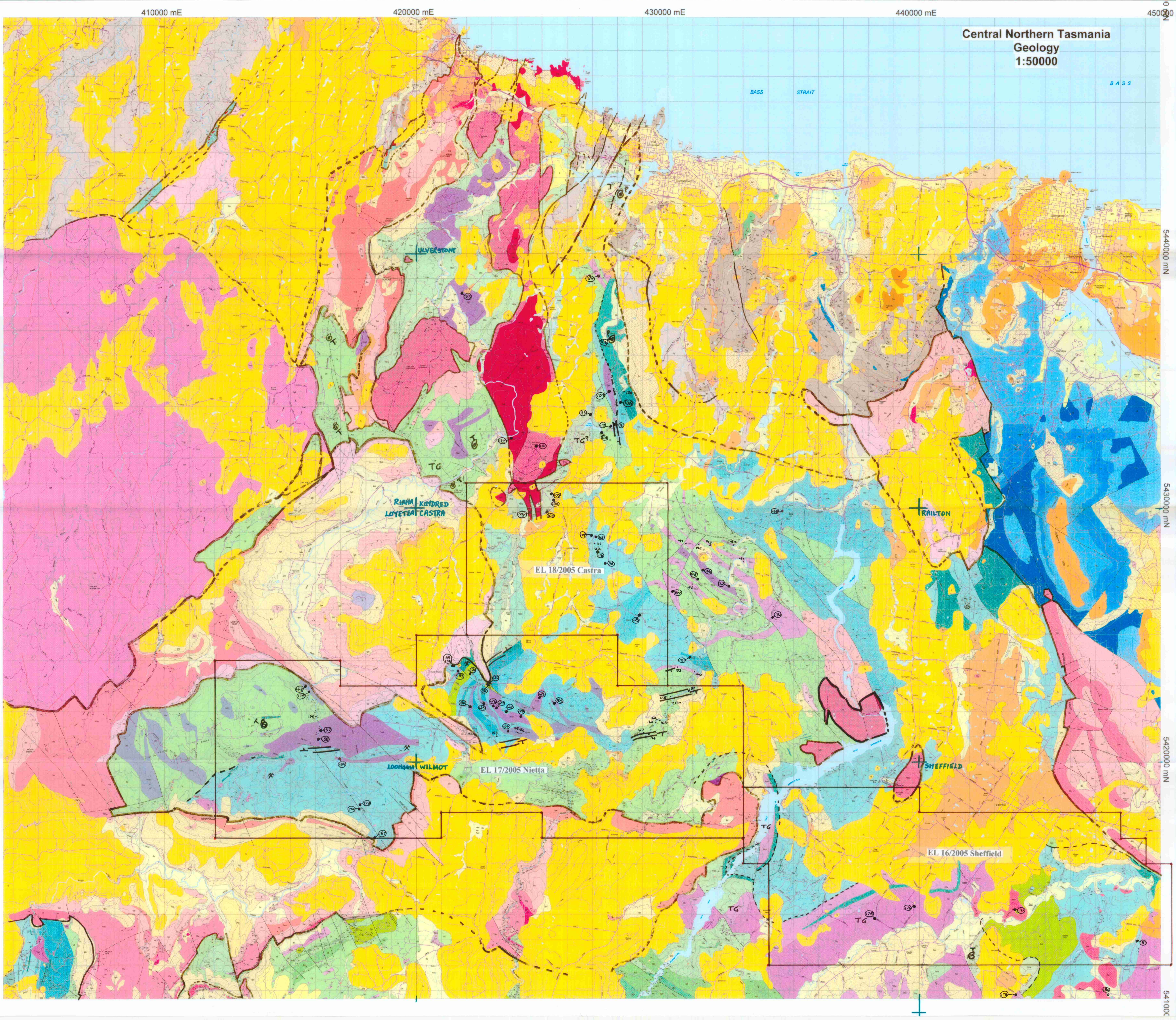
Central Northern Tasmania
Geology
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STRAIT
BASS
ULVERSTONE
RAILTON
SHEFFIELD
WILMOT
KINDRED
CASTRA
EL 18/2005 Castra
EL 17/2005 Nietta
EL 16/2005 Sheffield
5440000 mN
5430000 mN
5420000 mN

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DIGITAL GEOLOGICAL ATLAS 1:25 000 SERIES
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CASTRA

Scale: 1:25 000

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Tasmania
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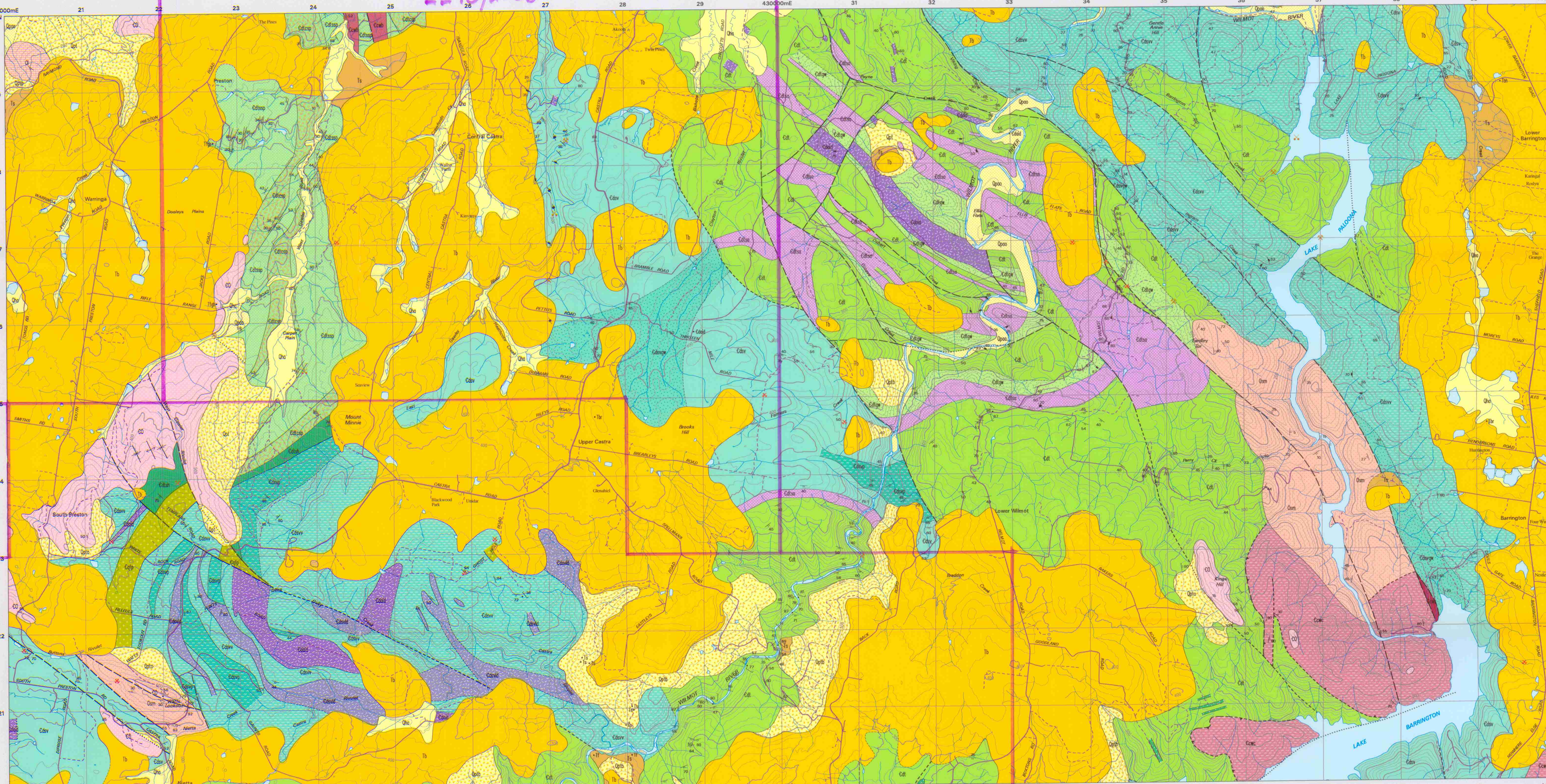
EL 18/2005



EL 17/2005

CAINOZOIC	QUATERNARY	HOLOCENE	Qha	Stream alluvium, swamp and marsh deposits (Qha).	
		PLEISTOCENE	Qpt / Qptb	Basalt talus (Qptb).	
			Qpt / Qpto	Quartz sandstone and conglomerate talus derived from Owen Group correlates (Qpto).	
			Qpao	Older alluvium (Qpao).	
	TERTIARY		Tb	Basalt (Tb) including local occurrence of hawaiite (Tbh), and transitional olivine tholeiite (Tbr).	
			Tfgb	Greybilly and silcrete (Tfgb).	
			Tf	Ferricrete (Tf).	
			Ts	Terrestrial sand, gravel and minor lacustrine deposits (Ts).	
PALAEOZOIC	ORDOVICIAN		Ol	Limestone (correlate of Gordon Limestone) (Ol).	GORDON GROUP; WURAWINA SUPERGROUP
	EARLY ORDOVICIAN - LATE CAMBRIAN		Osm	Grey poorly sorted fine-grained sandstone, commonly bioturbated (correlate of Moina Sandstone) (Osm).	OWEN GROUP; WURAWINA SUPERGROUP
			€O	Pebble-cobble siliciclastic conglomerate and coarse-grained sandstone with abundant quartzite and chert clasts (€O).	OWEN GROUP; WURAWINA SUPERGROUP

PALAEOZOIC	MIDDLE - LATE CAMBRIAN	€dt	Predominantly crystal +- lithic rich volcaniclastic sediments with minor siltstone and minor acid to intermediate volcanics. (Correlate of Tyndall Group and Radfords Creek Group) (€dt).	TYNDALL GROUP; MOUNT READ VOLCANICS AND CORRELATES
		€dtcs	Siliciclastic conglomerate, typically pebble-cobble grade, with quartzite and chert clasts, some interbedded coarse sandstone and lithicwacke (€dtcs).	
		€dtgw	Predominantly micaceous greywacke and siltstone (€dtgw).	
		€dtsa	Predominantly andesitic-dacitic volcaniclastic sandstone. Commonly pumiceous (€dtsa).	
		€dtssp	Predominantly fine grained ashy siltstone with interbedded lithicwacke, greywacke and shale (€dtssp).	
		€dtcsp	Coarse-grained polymict conglomerate with clasts of basalt, chert, siltstone and limestone (Sprent Formation) (€dtcsp).	
		€dtsh	Black laminated shale and volcaniclastic siltstone (€dtsh).	
	MIDDLE CAMBRIAN	€dsv	Mixed volcano-sedimentary sequences of massive to bedded ashy-pumiceous volcaniclastic sediments with interbedded greywacke, siltstone, conglomerate and lava(€dsv).	WESTERN VOLCANO-SEDIMENTARY SEQUENCE; MOUNT READ VOLCANICS AND CORRELATES
		€dsvv	Predominantly ashy siltstone (€dsvv).	
		€dsvp	Pumice bearing volcaniclastic sandstone and breccia (€dsvp).	
		€dsvld	Dacitic to rhyolitic lava intrusive (€dsvld).	
		€dsvgw	Predominantly micaceous greywacke and siltstone (€dsvgw).	

PALAEOZOIC	?EARLY CAMBRIAN	€cwb	Pillowed to massive fine-to medium-grained augite bearing tholeiitic basalt with intercalated volcaniclastic sandstone and conglomerate, mudstone and chert bearing breccia (Motton Spilite) (€cwb).	CLEVELAND-WARATAH ASSOCIATION
		€cwc	Pale to dark grey, faintly bedded to massive or brecciated chert (Barrington Chert) (€cwc).	
		€cws	Hematitic siltstone (€cws).	

INTRUSIVE ROCKS

PALAEOZOIC	MIDDLE CAMBRIAN	€daid	Massive plagioclase – hornblende phyric dioritic, andesitic and dacitic intrusives (Lobster Creek Intrusives) (€daid).	MOUNT READ VOLCANICS
		€qfp	Quartz feldspar porphyry (€qfp).	
	?EARLY CAMBRIAN	€cwb	Pillowed to massive fine-to medium-grained augite bearing tholeiitic basalt and intrusives (Motton Spilite) (€cwb).	CLEVELAND-WARATAH ASSOCIATION

Geological boundary – position accurate or approximate.
Geological boundary – inferred.
Geological boundary – inferred from airborne magnetic data.
Fault – position accurate or approximate.
Fault – inferred.
Fault – concealed.
Thrust fault (teeth on upper plate) – position accurate or approx.
Thrust fault (teeth on upper plate) – inferred.
Axial surface trace of major antiform.
Axial surface trace of major synform.
(White line) Limit of mapping of sub-unit within undifferentiated rock unit.

Strike and dip of bedding, right way up.
Strike and dip of bedding, facing unknown.
Strike of vertical bedding, facing unknown.
Strike and dip of cleavage, type and relative age unspecified – dipping; vertical..
Strike and dip of dominant joint set.
Strike of dominant joint set, vertical.
Notable small outcrop with rock unit indicated
Mineral deposit location – hardrock
Mineral deposit location – alluvial
(Data derived from Mineral Resources Tasmania DEPOSITS data base. Data point position has not been verified in every case.)
Construction materials location – Data derived from Mineral Resources Tasmania DEPOSITS data base. Data point position has not been verified in every case.

Compiled by M.J. Vicary, 2004 as part of the Western Tasmanian Regional Minerals Program from the following sources (see Responsibility Diagram):

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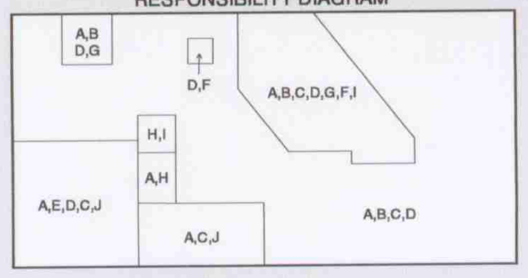
H POLTOCK, R. 2002. Ground truthing aeromagnetic and radiometric features, Northern Tasmania. Tasmanian Geological Survey Record 2002/20 Mineral Resources Tasmania.

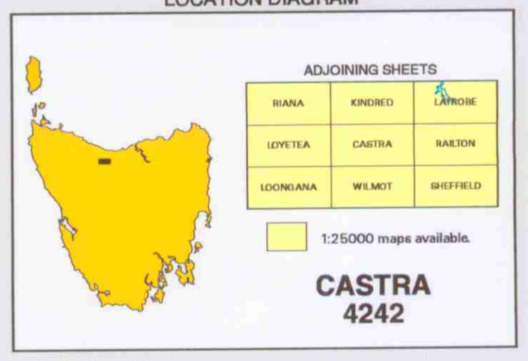
I Air photograph and WTRMP geophysical data interpretation by M. Vicary.

J PORTER, T.M. 1976. E.L. 19/72 Dial Range, North West Tasmania. Progress Report No 3. CRA Exploration Pty Ltd. TCR76-1157.

RESPONSIBILITY DIAGRAM



LOCATION DIAGRAM



Base data from the LIST, Copyright State of Tasmania.

Map produced by the Data Management Branch of Mineral Resources Tasmania using G.I.S. software.

AGD66 - AMG Zone 55. Contour Interval: 20 metres.

Plotfile for this map generated from digital data as at: 23-MAY-2006

WARNING: INKS ARE LIGHT SENSITIVE