

Exploration History and Prospectivity of North Rosebery - EL 54/2004

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Summary

The principal exploration interest in Bass Metals' EL 54/2004 is in the potential northward continuation of the Rosebery Host Sequence beyond the Rosebery Mine lease and the possibility that it may contain a similar high grade volcanic hosted massive sulfide deposit. This concept has been carefully explored and tested to about 400 m below surface by several exploration companies directly connected with operators of the Rosebery Mine, but the results have been inconclusive and generally discouraging. Further pursuit of the concept along strike and at greater depth is problematic because of unresolved lithostratigraphic and structural complexity including the potential for the favourable zone to be truncated by the Rosebery Fault, lack of specific targets, extreme depths probably more than 800 m below surface, and the location of a hydro electric dam and power station over the laterally limited favourable zone. It has only low to moderate prospectivity, low findability, and high sovereign risk factors.

Several apparent boulders and clasts of locally zinc-rich pyritic massive sulfide in volcanoclastic breccia near Bastyan Dam are of uncertain metallogenic origin. They are possibly re-sedimented fragments of an eroded Cambrian volcanic hosted massive sulfide deposit but they have conflicting isotopic ratios and metal contents suggesting a Devonian source or at least Devonian hydrothermal overprint. This enigmatic occurrence has low prospectivity and exploration for the source of the clasts – if they are true VHMS clasts – has a low findability factor.

A partial leach extraction (Mobile Metal Ion) Cu, Ag, As, Bi, Cd, Mo, Tl soil geochemical anomaly located in the hangingwall of the Rosebery Fault north of Pieman Road remains untested. It is unsupported by existing geophysical data, and is partly coincident with spotty conventional soil geochemical anomalies that suggest the source is probably near surface. The likely source is minor vein-style or disseminated sulfide mineralized zones associated with the Rosebery Fault, or with hangingwall splays of the fault, or in stratabound zones in calcareous shale or limestone units in the volcanic succession similar to those previously intersected in drill holes near Bastyan Dam. The prospectivity of this MMI anomalous zone is low to moderate. However, it has a moderate findability factor and could be relatively simply tested by a few moderate depth diamond drill holes on line 5379200N.

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Introduction

Bass Metals Ltd. holds Exploration Licence 54/2004, which covers about 56 km² of Mount Read Volcanics (MRV) mainly extending from the Murchison Highway just east of Rosebery, northwards across Mt Black and Lake Rosebery, to the Farm Creek area a couple of kilometres south of Boco Siding¹. It adjoins the eastern and northern boundaries of the Rosebery Mine Lease 28M/1993, and includes a segment that extends westwards along Lake Rosebery to the Rosebery Fault marking the western edge of the MRV immediately south of Mt Kershaw and a few hundred kilometres west of Bastyan Dam.

This short segment of only about 2.4 kilometres strike length and 5 km² area adjacent to the Rosebery Fault has been the centre of Bass Metals' exploration interest in the licence because it is deemed to include a 'northern continuation of the Rosebery Mine Sequence'. This part of the exploration licence area also includes three 'Rosebery-Hellyer VHMS² style targets' generated by a GeoInformatics data collation and geologic modelling project carried out for Bass Metals in 2006 (Jones, 2006).

The most prospective zone, as recognized by Bass Metals and several previous exploration groups during the past 35 years, is just east of and above the Rosebery Fault because it potentially includes a northern continuation of the Rosebery Mine Sequence, with potential for undiscovered massive sulfide lenses in that favourable stratigraphic unit. There are three related, partly empirical and partly conceptual, approaches to exploring that zone:

- Exploratory 'stratigraphic' drilling to establish the litho-stratigraphic continuity and structure in the favourable zone, and hopefully to intersect new massive sulfide lenses in the favourable Rosebery host unit.
- Determining the significance and discovering the source of massive sulfide clasts observed in volcanoclastic breccias formerly exposed near Bastyan Dam.
- Geophysical and geochemical targeting, including novel techniques such as mobile metal ion geochemistry.

To date, Bass Metals has carried out only a modest and inconclusive soil geochemical exploration program, essentially limited to the far western segment of the EL in the Bastyan Dam to Mt Kershaw area. In the current cold economic climate, necessitating re-appraisal of all exploration projects, Bass Metals' exploration manager K.P. Denwer has requested me to evaluate the existing historic and recent data, evaluate the prospectivity, and outline future exploration possibilities.

Previous Exploration

Jones (2006) very briefly summarized exploration from EZ-Getty-Billiton programs on the Rosebery East portion of EL 1/62 between the early 1970s to mid 1980s, and subsequent Climax-Austmin programs in the late 1980s on EL 12/88, which covered essentially the same area as Bass' current EL 54/2004. He also mentioned Aberfoyle's exploration in the Marionoak area to the northwest, and Pasminco's exploration of the Burns Peak to Chester area, which are only obliquely relevant to EL 54/2004. Jones, unfortunately omitted, perhaps was unaware of, the detailed exploration of the western part of EL 12/88 by J.G. Purvis under a Pasminco-Austmin joint venture during 1990-1993. That program focussed on the VHMS potential of the interpreted northern strike extension of the Rosebery host rocks around Bastyan Dam. It benefited from management by experienced geologists familiar with the Rosebery deposit (e.g. J.G. Purvis and F.G. Fitzgerald) who understood the local and regional geology, developed credible stratigraphic and structural models, and drill-tested some essentially conceptual targets. The Pasminco work was *exactly* aligned with Bass Metals' proposed deep drilling program (Turnbull and Bates, 2007) and it produced results that *should* critically inform Bass' future exploration of the Rosebery northern extension concept.

Lachlan Resources NL subsequently held the area for a couple of years in 1996-97 as EL 12/96 – Lake Rosebery, with exploration managed by Plutonic Operations Ltd. Their interest stemmed from new regional seismic data along a Pieman Road traverse carried out by AGSO, which detected a major east-dipping reflector – possibly a thrust fault zone that suggested potential for structural repetition of the Rosebery host sequence east of Rosebery. Plutonic-Lachlan never carried out any fieldwork and (remarkably) did not submit any exploration reports to Mineral Resources Tasmania (MRT). However, they did commission me to comprehensively review previous exploration and evaluate prospectivity in 1996 and 1997 (Herrmann, 1996, 1997). These reports are included here as Appendices I and II³.

In 1998 Pasminco again acquired exploration title under EL 14/98- Mt Sale, covering 34 km² immediately adjacent to the eastern and northern boundaries of the Rosebery mine lease 28M/1993. That EL 14/98 area was identical to the southern part of Bass' current EL 54/2004; it extended to about 2 km north of Lake Rosebery to a northern boundary along (AGD66) 5382000N.

Pasminco initially again focused on the VHMS potential of the interpreted northern strike extension of the Rosebery host rocks, beyond the mine lease to Lake

¹ The boundaries of EL 54/2004 conform to graticules of the AGD 66 grid (Sally Bates, pers. comm.)

² VHMS: volcanic hosted massive sulfide deposits

³ These reports are not available from the MRT database, which probably means they were never submitted. Fortunately, I have unearthed the original text versions in digital form from an old floppy disk, and have reformatted them in Microsoft WORD for legibility and printability. I do not have copies of the 30 plans and figures included in the 1996 report, but many of them were copied or modified from earlier Billiton and Pasminco reports and could probably be partly recovered from those original sources.

Rosebery. They carried out a partial leach (MMI) soil geochemical survey with samples collected from 'B' Horizon (0.1-0.2m depth) 25 m apart on 200-m-spaced east-west lines, which were 'analysed for Cu, Pb, Zn, Ba, As, Au, Ag, Cd, Co, Bi, Mo, Ni, Y, Zr, La, Ce, Sm, Eu and Gd by method Deepleach 42 at Amdel' (McNeill and Simpson, 2000). This was designed to 'close off' two partial leach anomaly trends detected by an earlier orientation survey on the Rosebery lease area (Edwards et al., 1999, cited by; McNeill and Simpson, 2001). Pasmenco reported that: 'significant anomalies are obvious in the Pb, Cu, Bi, Au and Zn data. The most prominent feature is anomaly 1 of Edwards et al. (1999), which extends south⁴ onto the Rosebery Mine Lease.' In 2002 an infill sampling line confirmed its continuity into ML 28M/1993 and McNeill (2002) recommended a review of existing geophysical coverage prior to drilling Anomaly 1. However, in 2003 a review of previous drilling and interpretation of vectors to mineralisation in holes on the adjacent ML 28M/93, indicated that it is unlikely that the anomaly results from deeply buried mineralisation and consequently the proposed hole was not drilled (McNeill, 2003).

McNeill (2003) concluded that the most prospective areas were in the adjacent mining lease 28M/1993, and recommended relinquishment of EL 14/98.

Bass Metals Ltd. took on the exploration management of the current EL54/2004 on 10th August 2005 under a joint venture agreement with GeoInformatics, and subsequently in joint venture with Clancy Exploration Ltd.

Bass Metals' exploration program to date has focused on the ~5 km² mid-western segment in the Bastyan Dam to Mt Kershaw area. It has been a low-key program over the last three years involving only:

- Geological reconnaissance and rock chip sampling (Jones, 2006; Turnbull and Bates, 2007).
- Preparation of a longitudinal projection outlining results of recent drilling on the adjacent Rosebery lease (Turnbull and Bates, 2007)
- Planning of a deep drilling program to establish the stratigraphic continuity and to test IP anomalies in the VHMS-favourable Rosebery host unit immediately north of the ML 28M/1993 boundary (Turnbull and Bates, 2007). This conceptually targeted drilling program has not progressed beyond planning; presumably because of understandable uncertainties about the target location, extreme depth, and low findability factor.
- A conventional soil geochemical sampling program (acid digest analysis but sampling horizon not stated) across the Rosebery Fault between AGD66 5378600N and 5379400N carried out in late 2006 (115 samples at 50 m spacings on five east-west lines 200 m apart). This program detected only 'patchy Pb-Zn anomalism which lacks continuity across soil

lines' (Bates, 2009). However, the actual analytical data were not reported in the relevant Annual Reports, which merely referred to *planning* of the surveys (Turnbull and Bates, 2007; Bates, 2008).

- A B-horizon Mobile Metal Ion (MMI) soil geochemical survey over the prospective zone containing locally Zn-anomalous pyritic altered volcanics and IP anomalies adjacent to the Rosebery Fault north of Bastyan Dam. It comprised 339 samples on ~200 m spaced east west lines covering 1.4 km of strike, which were analysed by a partial leach method developed in conjunction with Pasmenco during the 1990s (Bates, 2008).

Exploring the lithostratigraphy and structure of the possible northward extension of the Rosebery host unit

J.G.Purvis carried out by far the most comprehensive interpretation and testing of this concept for the EZ-Getty-Billiton and Pasmenco-Austmin joint ventures in the mid 1980s to early 1990s. There has been no drilling, and little (published) progress in geologic interpretation of this zone since then. However, at the district scale, there is now common acceptance that the Mount Black Volcanics are more or less equivalent to (perhaps stratigraphically lower than?) the compositionally similar Rosebery footwall pumice breccia unit, and were thrust westwards over the Rosebery mine sequence and Hangingwall Volcaniclastics (e.g. Figure 1.6 of Gifkins et al., 2005) along the Mount Black Fault. That relationship was merely suspected in the early 1990s when Purvis was testing the North Rosebery concept.

Despite previous interpretations by Corbett & Lees (1987) the above-mentioned joint ventures pursued the Rosebery host unit northwards because of a well argued concept that it was not truncated by the easterly dipping Rosebery Fault but that it extended parallel to the fault in an anticlinal axis plunging at about 20° to the north (Randell et al., 1986) (Figure 13 & Figure 14).

Drill hole BY1 (562.5 m) was designed to test this anticlinal concept on section 5378000N, as well as the volcaniclastic unit hosting massive sulfide clasts near the southern shore of Lake Rosebery. It intersected an easterly dipping and facing succession comprised of volcaniclastics, rhyolite and black shale units in the upper half, and a mixed sequence of volcaniclastic sandstones, calcareous sandstones, siltstones and impure limestones beneath an east dipping subsidiary thrust, before passing through the Rosebery Fault at about 400 m below surface (Figure 15). This succession is probably equivalent to the Rosebery Hangingwall Volcaniclastics interlayered in the lower section with non-volcanogenic sedimentary rocks of Dundas Group affinity. The hole encountered traces of Zn and As in black shale and limestone bands (e.g. 0.5 m @ 2.1% Zn, 0.1% As and 13.5 m @ 0.5% Zn) but did not intersect an anticlinal axis, nor equivalents of the

⁴ We do not have access to Edwards et al. report but judging by McNeill & Simpson's subsequent comment about the high Cu response possibly being associated with andesite in the hanging wall of the Mt Black Fault, this 'anomaly 1' is probably the eastern one near Hawkesbury Mine.

Rosebery host unit (Purvis, 1991). A downhole EM survey failed to obtain any significant responses (Purvis, 1992).

BY2 (412.5 m) was subsequently drilled to test the same conceptual targets a little further west and about 600 m further north, immediately north of Bastyan Dam. It passed through Hangingwall type volcanics, with consistent sedimentary facings that confirmed the existence of a large anticline north of the Dam, and intersected the Rosebery Fault about 300 m below surface. It intersected only minor mineralized zones in the Hangingwall Volcanics (e.g. 1 m @ 0.12% Pb, 0.16% Zn). Downhole EM surveys were partly affected by 'noise' from the nearby power station but did not detect any significant off hole conductors. Surface geologic mapping around Bastyan Dam outlined many NNW and NNE trending faults (Figure 17) and did 'more to highlight the structural problems than solve them'. Purvis (1992) concluded that the only positive outcome of BY2 was confirmation of the anticlinal structure in Hangingwall Volcanics, which kept alive the possibility that the more prospective Rosebery Host Unit may exist at greater depth.

The point I wish to emphasise here is that Purvis' detailed and persistent work demonstrates that the lithostratigraphic and structural set up north of Rosebery is very complex. It is not simple 'tram track' geology. The Rosebery longitudinal projection (Figure 18) is illusory. The previous genuine exploratory efforts have shown that it is not a straightforward matter of stepping back and drilling deep holes to intersect the Rosebery host unit, let alone the disconnected massive sulfide lenses in it. At the extreme depths (~1000 m) contemplated, there are very likely to be geologic surprises to complicate interpretation and frustrate discovery. Bass Metals' sound exploration *concept* is fraught with *practical uncertainty*.

Accordingly, in the absence of defined targets, any program designed to test the conceptual northward extension of the Rosebery system needs to be forearmed with maximum available lithostratigraphic and structural knowledge to improve the probability, or even stand a slender chance, of success. That knowledge obviously resides with Rosebery Mine and Oz Minerals Ltd., if not in geological expertise at least in the wealth of information that could be gained from the cores of existing deep exploration holes around the northern part of the deposit.

Exploring for the source of Bastyan Dam massive sulfide clasts

During construction of the Pieman hydroelectric scheme in 1979, the Hydroelectric Commission 'uncovered an 8.5 x 1 m raft of basemetal massive sulfide within reworked volcanics while excavating the foundations of the Bastyan Dam' (Randell et al., 1986). The EZ-Getty JV exploration program on EL 1/62 in the early 1980s subsequently discovered additional 'large boulders of basemetal massive sulfide in a volcanic mass debris flow on the banks of the Pieman River' a little east of the dam (Figure 19).

Randell et al. (1986) assigned the clast-containing rocks to the Rosebery Hangingwall Volcanics, which at Bastyan Dam are poorly sorted and bedded, sub-aqueously deposited, volcanoclastic breccias containing deformed rafts of 'tuffaceous sediments' up to 'at least 20 m long and a cluster of at least five rafted lenses of pyritic and basemetal massive sulfides'. The original sulfide clast samples assayed up to 35.5% Zn, 0.8% Pb, 20 g/t Ag, 0.25 g/t Au 0.1% Sn and 0.07% As. Randell et al. hypothesized that the sulfide clasts had been transported southwards, originating from a massive sulfide deposit that formed at about the same time and stratigraphic level as Rosebery, but in a separate system further north.

Purvis (1991) referred to 'HEC photographs and descriptions' of the large sulfide rafts in the Bastyan Dam foundations that clearly showed that the rafts were 'only semi-lithified at the time of incorporation into the HW Epiclastics'. He described the eastern occurrence about 350 m east of the Dam as a 'group of massive sulfide boulders up to 2 m diameter, some of which are deformed' suggesting they also were only partly lithified at the time of emplacement. Purvis also noted that the high Zn/Pb ratio and Sn content of the samples (reported by Randell et al., 1986) were 'not representative of normal Cambrian volcanogenic mineralization in West Tasmania' (see data in Table 1).

The observation of coarse grain sizes in the Hangingwall Volcanics at Bastyan Dam, where they apparently include bouldery debris flows and rafts of shale and siltstone up to 50 m long, compared to much finer volcanics at Rosebery, supported an interpretation of southward transport. Also, that the sulfide boulders had probably travelled only a few hundred metres from their source. This propped up speculation that the source 'could perhaps' lie to the north, at depth along the 20° interpreted structural plunge. However, Purvis (1991) concluded that the structural complexity around the dam made it an extremely difficult target.

G.R.Green subsequently produced four sulfur isotope analyses from two samples of the eastern sulfide boulders (near 378285E 5378020N) with δS^{34} compositions between 7.3 and 10.5 ‰, which are at the lower extreme of the Rosebery sulfide δS^{34} values of 7.1 to 19.8 ‰, and also slightly lower than the 9.0 to 12.9 ‰ range in sulfides from the Pinnacles area (Green, 1992, Appendix 4 in

Purvis, 1992). He cryptically suggested that these data indicated that the source of the Bastyan sulfide clasts was 'yet to be established'!

In 2002, McNeill reported Pb-isotope analyses of two samples each from Cutty Sark and Langdon's prospects near the southern shore of Lake Rosebery, and a single sample of a 'small Py-Gn-rich clast, from near the Bastyan Dam spillway massive sulfide clasts'. All had Devonian signatures (Figure 1), which downgraded the prospectivity of those prospects (Denton et al., 2001; McNeill, 2002). The Pb-isotope data from Langdon's are consistent with the description and interpretation of it as a Devonian fissure fill deposit similar to Mount Farrell by Randell et al. (1986). The δS^{34} values of 9.3 to 12.6 ‰ at Langdon's are typical of Cambrian VHMS deposits, which led Green (1992) and Solomon et al. (1988) to speculate that the Devonian fluids may have derived most of their sulfur from Cambrian volcanic wall rocks.

In the following January, McNeill attempted to 'relocate the Zn-rich (35.5%) Bastyan Dam massive sulphide clasts, previously described by Purvis (1991). These clasts were not found (still probably underwater) but a 4m wide zone with abundant (1-10 modal%) massive pyrite clasts was located and sampled⁵. The massive pyrite clasts, up to 60cm x 20cm but generally <10 cm diameter, were hosted by a coarse quartz (to 5-8mm diameter)- feldspar-phyric mass flow unit with, in addition to the sulphide clasts, quartz phyric rhyolite and sericite-chlorite altered shard-rich siltstone clasts to 5 cm diameter' (McNeill, 2003).

He obtained multi element assay data of two samples of the host mass flow unit and four samples of the massive sulfide clasts, which indicated 'significant Zn grades' (2-8% Zn) with anomalous 310-1500 ppm Cu, 380-1800 ppm Pb, and precious metals (0.4-0.9 g/t Au and 11-106 g/t Ag). Additional Pb-isotope analyses on the two most Pb-rich of the clasts, together with the previous one taken in 2001 from the same area, indicate a heterogeneous population spanning the Cambrian to Devonian fields (Figure 2), which 'do not preclude' a Cambrian signature but is dominated by a Devonian overprint (Carr and Denton, 2003; McNeill, 2003).

The local metallogenic picture is further confused by a negative δS^{34} value of -2.9 ‰ from 'sooty pyrite' in deformed bands in volcanoclastics at the margin of a coherent quartz porphyritic rhyolite unit, outcropping in the same vicinity as sulfide clasts 180 m east of Bastyan Dam. Rock chip samples of this material apparently

contain highly anomalous As, Au, Ag (analyses 7950 and 12941-43 in Table 1). Green (1992) compared it to low (<5 ‰) sulfur isotope signatures of 'barren' pyritic systems such as Chester and Boco and interpreted it as being due to 'local low temperature hydrothermal processes associated with the intrusion' of the coherent rhyolite. This follows the concept originated by Solomon et al. (1988) that late-stage, relatively cool (<200°C), oxidized seawater of neutral pH convecting through felsic rocks, from which most of the reducing FeO had previously been exhausted, would not continue to inorganically reduce residual seawater sulfate, nor transport sufficient base metals to form a massive sulfide deposit, but would be capable of leaching primary magmatic sulfur from the volcanic country rocks, hence producing low δS^{34} values in pyrite. That model has been modified by recent advances in recognition of phyllosilicate assemblages in these 'barren' systems which suggest involvement of low pH magmatic derived fluids to account for the low sulfide δS^{34} values (e.g. Herrmann et al., 2004).

The wide range of Pb-isotope ratios, δS^{34} values, and unusual array of anomalous metals in the sulfide clasts and nearby vein style deposits are not easily categorized into a single metallogenic style. It seems that the sulfide clasts derived their sulfur from a Cambrian seawater source, or recycled sulfur from Cambrian VHMS type deposit (?) yet their lead appears to be mainly Devonian. And some of the clasts have anomalous metal compositions (Table 1) such as tin and bismuth, which also suggest a Devonian component. The nearby Langdon's deposit has classic Devonian vein-style features and Devonian Pb-isotope ratios. Likewise, the arsenopyrite vein sampled by Purvis (# 7950 in Table 1) has Devonian characteristics but it occurs in a felsic porphyry unit that has low δS^{34} Cambrian barren-type pyrite mineralized zones at its margin a few metres away (Figure 19). Perhaps the sulfide clasts represent fragments of a typical Cambrian VHMS deposit that were subsequently partly overprinted by a Devonian granitoid related metallogenic event to account for the anomalous Sn and Bi contents and nearby arsenopyrite and Langdon's veins. But in that case one would expect the sulfide clast lead to retain the original Cambrian isotopic ratios – unless the primary VHMS deposit was unusually lead poor and most of the lead was subsequently introduced in the Devonian event.

That makes an interesting academic conundrum but it makes little difference to the exploration challenge if we take the descriptions of re-sedimented sulfide clasts at their face value. In view of the confusing isotopic data we cannot easily dismiss the clasts as small epigenetic deposits of insignificant economic potential, and we should therefore honour the reported field relationships. If the sulfide clasts were transported and emplaced with a Cambrian volcanoclastic debris flow they must be at least Cambrian in age. Hence, it is likely that they originated within a few kilometres distance; from a VHMS deposit that was exposed for erosion at the time the volcanoclastic unit was emplaced, i.e. stratigraphically not far below the base of the volcanoclastic breccia unit that they exist in. A

⁵ The main 'boulders were still submerged' when the first of these small clasts was sampled in 2001, at which time the lake level was about 1.5 m below full (McNeill & Simpson, 2001). In January 2003, the lake was 'abnormally low' but the clasts described by Purvis in 1991 could still not be found, thought to be still underwater. Nevertheless, the GPS-derived location data for the samples obtained by McNeill in 2003 coincides with the approximate position of Purvis' eastern cluster as deduced from his sample location map, so it is probable that McNeill was sampling the same zone. At the date of this report (11/06/2009) Lake Rosebery was 0.8 m below full and steady. Updated lake levels are posted on Hydro Tasmania's website at <http://www.hydro.com.au/home/Tourism+and+Recreation/Lake+Levels.htm>

lateral extension of the Rosebery Host Unit would be a likely contender.

However, as discussed in the previous section, the position of the Rosebery Host Unit is unknown in EL54/2004, and the reported structural complexity may make it hard to locate and test. Furthermore, there are no reliable indications of the direction to the source VHMS deposit – along strike to north or south, down dip at great depth, or eroded away from above the present land surface. Overriding all those difficulties is the clear evidence, in the re-sedimented clasts themselves, that the source deposit was at least partly eroded soon after its formation. It may have been entirely eroded and distributed far and wide, as fragments in subaqueous volcanoclastic breccia deposits. Re-sedimented sulfide clasts are old chestnuts in the Mount Read Volcanics; they have been subjects of considerable exploration effort (e.g. near Newton Dam spillway and at Wart Hill) and so far have been only a bane to explorers.

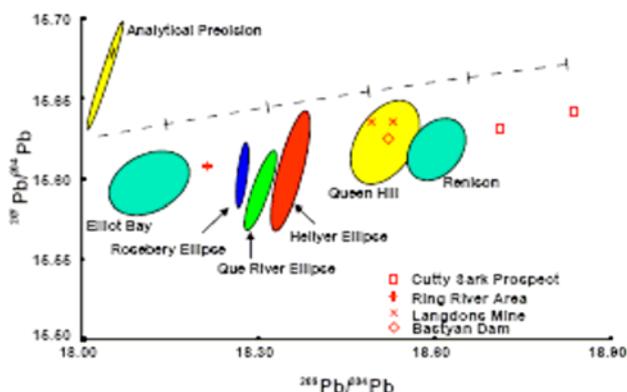


Figure 1 Pb-isotope ratio plot showing data from Cutty Sark, Langdon's and Bastyan Dam samples in relation to 95% confidence ellipses of data from Tasmanian Cambrian massive sulfide deposits and Devonian granitoid related deposits (from: Denton et al. 2001)

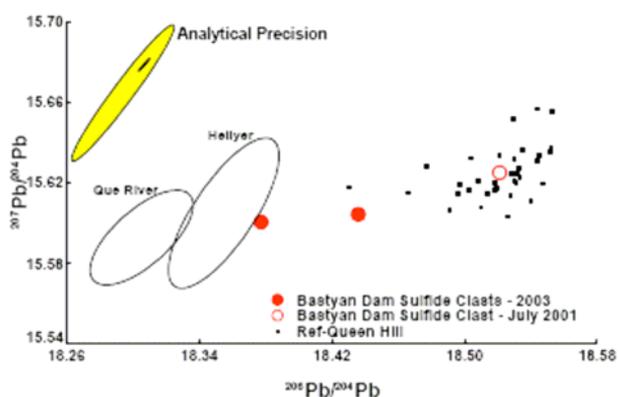


Figure 2 Pb-isotope ratio plot showing data from Pasmenco's Bastyan Dam sulfide clasts compared to Tasmanian Cambrian massive sulfide and Devonian granitoid mineralization types (from: Carr & Denton, 2003).

Exploration by geophysical and geochemical methods

Soil Geochemistry

Perhaps attracted by the historic large, high-intensity zinc anomalies coincident with the Rosebery Fault near Bobadil Plain (Figure 3) and Pasmenco's report of a significant MMI anomaly extending southwards into the Rosebery Mine lease, Bass Metals has carried out additional conventional and MMI soil geochemical surveys to fill a gap in the previous coverage between Bastyan Dam and Mount Kershaw (Bates, 2009).

The new conventional soil geochemical data (sampled at 50 m intervals on E-W lines spaced about 200 m apart) show spotty weak anomalies in Cu, Pb and Zn up to a few hundred parts per million, and low order anomalies in Au, Ag, As, Sb, Mo, Bi and Tl (Figure 6, Figure 8 and Figure 10). The most consistent anomalous zone is on line 5379200N where there are weak coincident anomalies in Zn, Au, Ag, As, Sb and Tl at about 377250E, and similarly weak coincident anomalies in Cu, Bi, Mo, Au, and Tl between 377400 and 377600E. Peak Pb and Ag values (of only 387 and 0.64 ppm, respectively) exist at a single point anomaly at 377650E on line 53778600N (Figure 6).

The MMI geochemical data (from samples 25 m apart on the same E-W lines spaced about 200 m apart) appear to have high intrinsic variability. That is highlighted by the poor repeatability of 17 duplicate paired samples (Figure 4). Table 2 shows that absolute percentage differences between duplicate analyses⁶ of important elements Cu, Pb, Zn, As and Ba average between 24% and 40%, and maximum differences range from 89% up to a few hundred percent. The precious metal data Ag and Au, are even less repeatable with average absolute differences of 96% and 1060%. The most repeatable common metal element in the data is Co, which averages only 19% absolute deviation, with a maximum difference of 57%.

Nevertheless, the MMI response ratios⁷ are broadly comparable to the conventional soil data in that the most coherent MMI anomalies in Cu, As, Mo and Tl are also centred on line 5379200N, between about 377350 and 377600E (Figure 7 & Figure 9). This anomalous zone has a crude north-northwest trend, which extends between about 5378800N and 5379900N (i.e. a strike length of almost one kilometre) and is best defined by Cu, Ag and Mo, but also evident in the Bi As and Cd MMI data (Figure 5, Figure 7, Figure 9, & Figure 11). It lies in a 100-200 metre wide corridor immediately east of and

⁶ These duplicates were presumably analyses of different packets soil taken from the same location at the same date – not repeat analyses of the same sample material.

⁷ Response ratios as calculated by Steve Richardson. The response ratio values for each partial leach element discussed in this report were derived from the analysed value (e.g. Cu ppb) divided by the 25th percentile value of the whole population data (356 analyses including duplicates) for that element (e.g. the 25th percentile value for Cu in this data set is 674.3 ppb).

parallel to the Rosebery Fault, which marks the western edge of the felsic volcanic group possibly including extensions of the Rosebery host unit. Thus the MMI anomaly is in the immediate hangingwall of the Rosebery Fault. Assuming the fault dips between 30 and 50° east, that implies a depth of 100-150 metres between surface and fault below the eastern edge of the MMI anomaly. If the source of the MMI anomaly is vertically below it, then the potential tonnage is depth-limited by the shallow proximity of the Rosebery Fault. On the other hand, if the MMI anomaly reflects a stratabound-mineralized zone then the probable east-dipping volcanic sequence would allow for greater down-dip continuity and tonnage, notwithstanding the slightly overturned anticline interpreted in BY2 near Bastyan Dam (Purvis, 1992).

There is an outlying As, Mo, Tl, Bi, Cd MMI anomaly near 537700E 5378800N, which is possibly a southeastern extension of the fault parallel zone mentioned above. It approximately coincides⁸ with western segment of a rock-chip traverse sampled by Bass Metals in October 2006, between sample locations NR016 and NR027. However, the geochemical data⁹ for those rock chip samples are unremarkable, except for a single sample (NR023) that assayed 0.38 g/t Au.

There is another MMI anomaly near the northeastern corner of the survey area, which has moderate to strong response ratios for As, Mo, Tl and Pb. This anomaly at the edge of the survey is 'open ended' to the north and south because of the EL boundary to the north, and the Chester Rivulet arm of Lake Rosebery to the south. BHP's 1987 UTEM surveys detected a number of weak shallow conductors in this zone but none were considered worthy of follow up.

The MMI anomalous responses are generally rather patchy, partly because of the broad ~200 metre line spacing, but the western one adjacent to the Rosebery Fault is more coherent and certainly more strike extensive than the very spotty mostly single point anomalies detected by the conventional soil geochemical survey. Even so, the approximate coincidence of anomalies in the two data sets supports suspicion that the MMI responses are related to a minor near surface mineralized zone – not necessarily to a deeper zone buried beyond the detection ability of conventional soil geochemistry.

The nature of that mineralized zone is largely speculative at present. Reasonable speculations are that it could be related to:

- Minor mineralized zones associated with a hanging wall fault splays akin to Purvis' (1991) 'Subsidiary Fault' (Figure 15). Saxon's (1995) report on exploration of EL 44/88 (which overlapped EL 54/2004 by one kilometre south of Mount Kershaw) contains an interpretative geologic plan (TCR 95-

3803, Fig. 23) that shows two east dipping faults on the west flank of Mt Kershaw that approximately align with Bass' MMI anomaly.

- Stratabound minor vein-style or disseminated Zn-Pb-Ag-As mineralization, similar to several short intervals hosted in calcareous black shale and limestone-pebble beds intersected by drill hole BY1; e.g. 2 m @ 0.7% Zn and 0.5 m @ 2.1% Zn, 0.1% Pb, 5 g/t Ag and 0.1% As (Purvis, 1991).

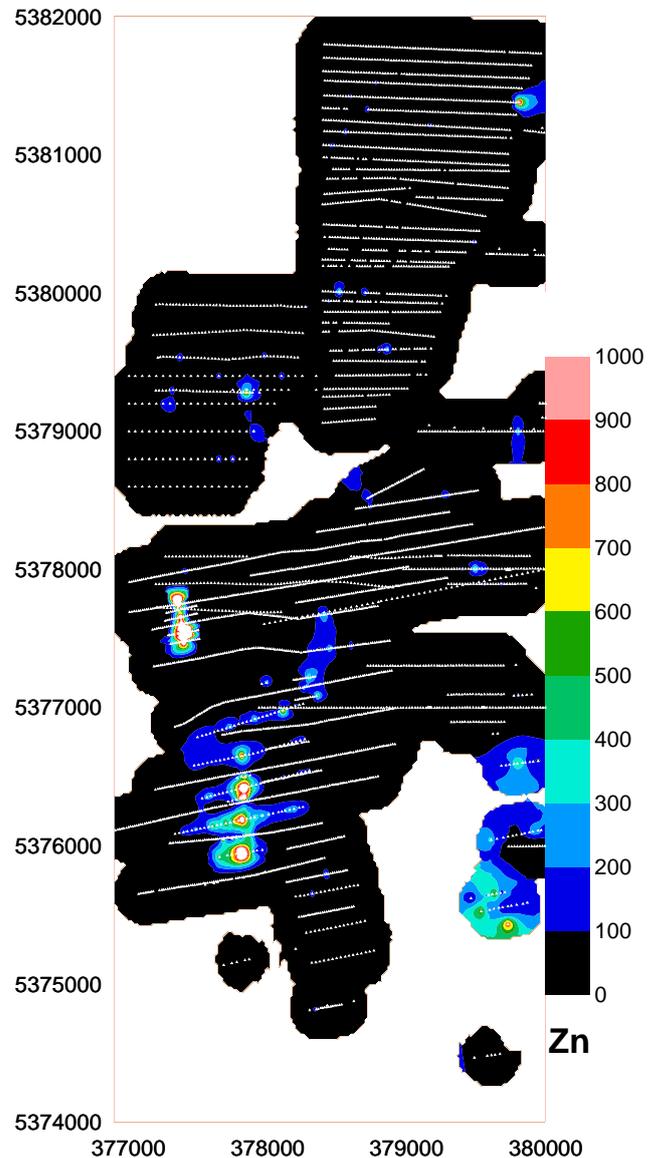


Figure 3 Contour plot of combined historic conventional Zn soil geochemical data from the area between Rosebery and Chester. The large Zn anomaly centred near 377500E 5377500N coincides with the Rosebery Fault a few hundred metres north east of Bobadil Plain. The gap filled by Bass Metals' soil surveys lies between 5378600 and 5379400N at the western edge of the plot.

⁸ Exact coordinate locations of most of these rock chip samples taken as 5-m composites along Pieman Road are unknown. A few of the locations are listed in spreadsheet 'NR Rock Chip Samples 10 Oct 2006.xls'; presumably the intermediate locations could be determined by interpolating between the known ones.

⁹ Data in spreadsheet 'NR_Reg_2.xls'.

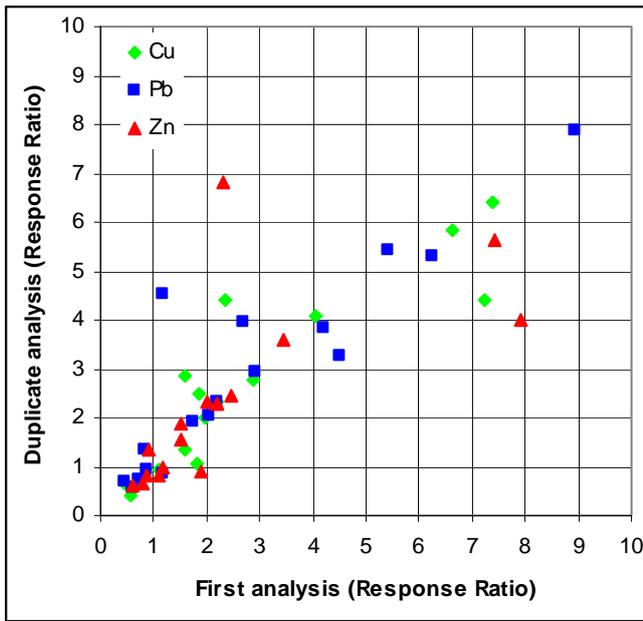


Figure 4 Plot showing variability of 17 duplicate sample partial leach analyses of Cu, Pb and Zn, expressed in 'response ratios'.

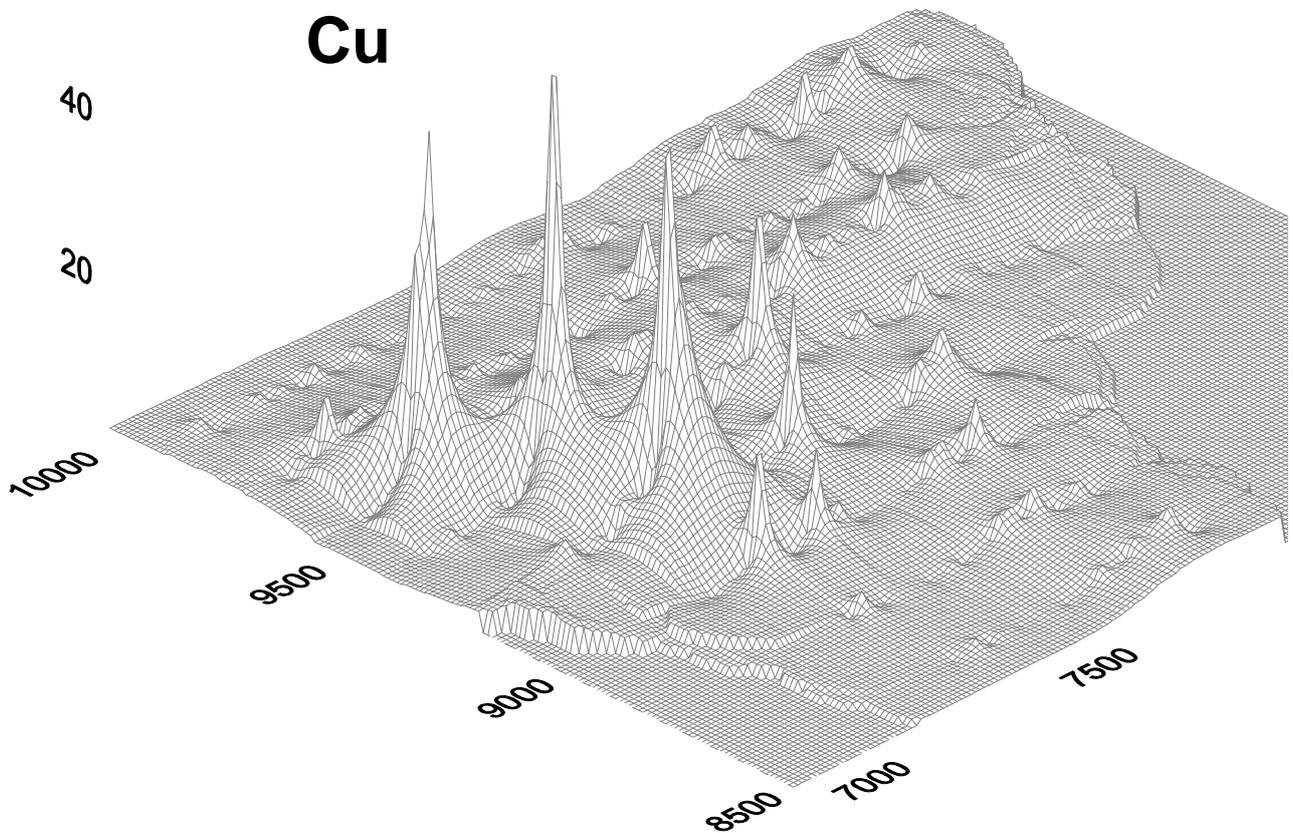


Figure 5 Northeast-looking view of a wireframe model of the MMI copper response ratio data, showing the NNW-trending anomaly semi-parallel to, and about 200 m east of, the Rosebery Fault.

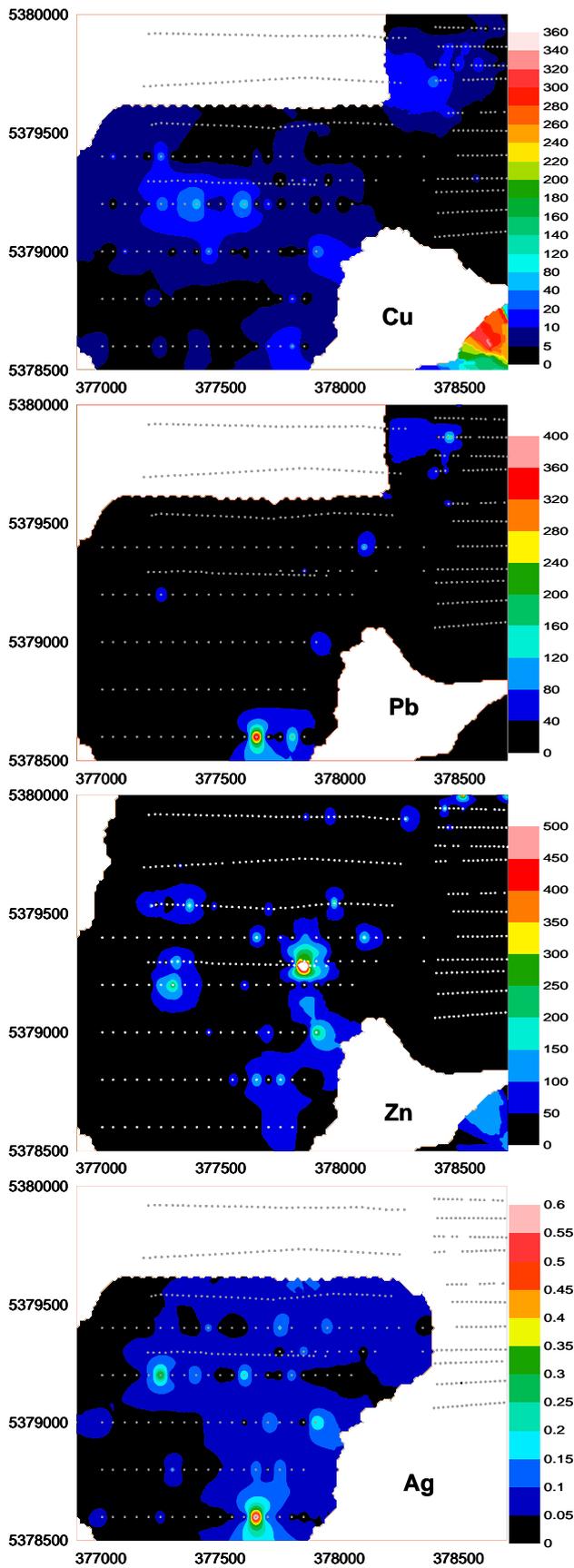


Figure 6 Contour plots of conventional soil geochemical Cu, Pb, Zn & Ag data (in ppm). The co-ordinates are relative to AGD66 datum.

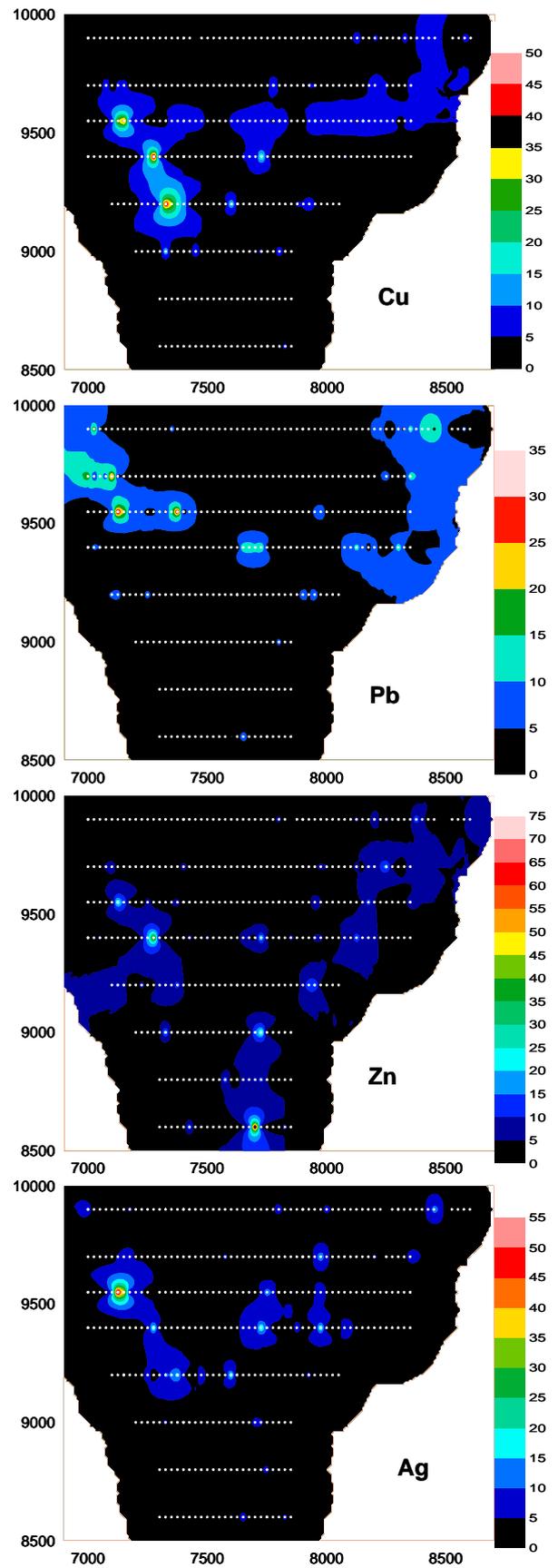


Figure 7 Contour plots of Bass Metals' MMI soil geochemical Cu, Pb, Zn & Ag data (expressed in 'response ratios' relative to 25th percentile values). The co-ordinates are relative to the AGD66 datum but the leading digits '37' in the easting and '537' in the northing are omitted.

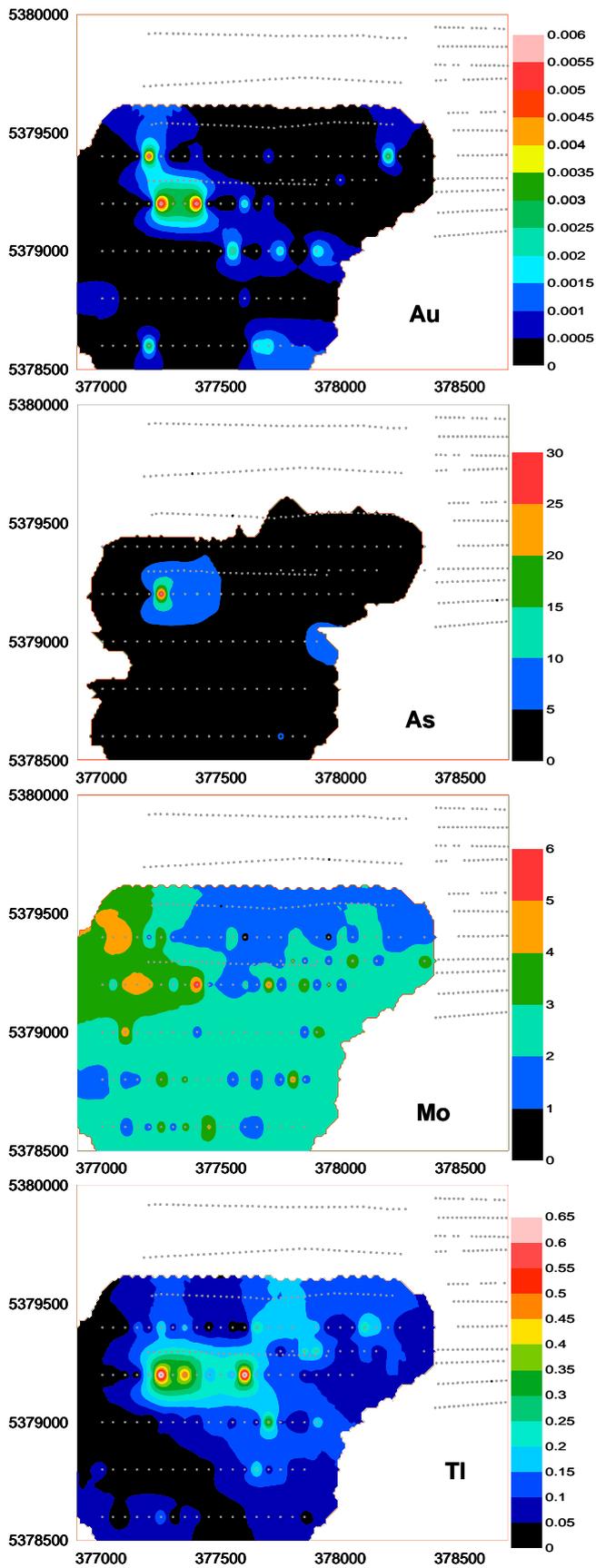


Figure 8 Contour plots of conventional soil geochemical Au, As, Mo & Tl data (in ppm).

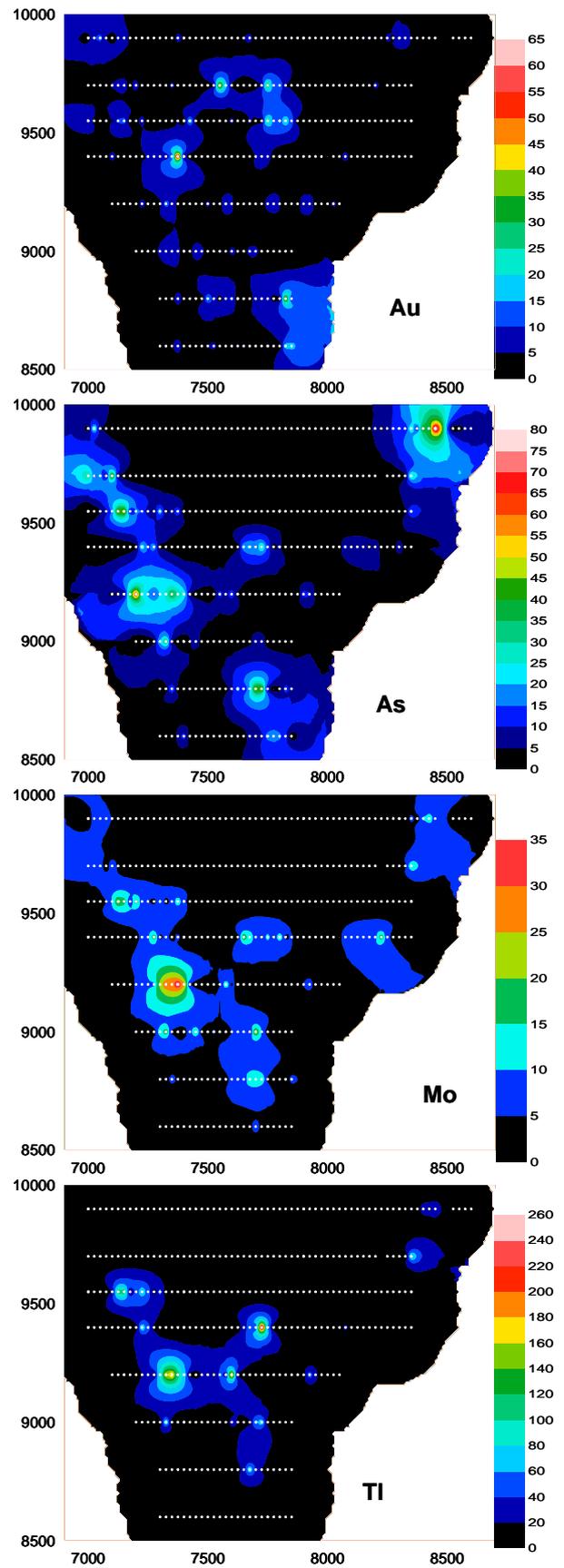


Figure 9 Contour plots of Bass Metals' MMI soil geochemical Au, As, Mo & Tl data (expressed in 'response ratios' relative to 25th percentile values).

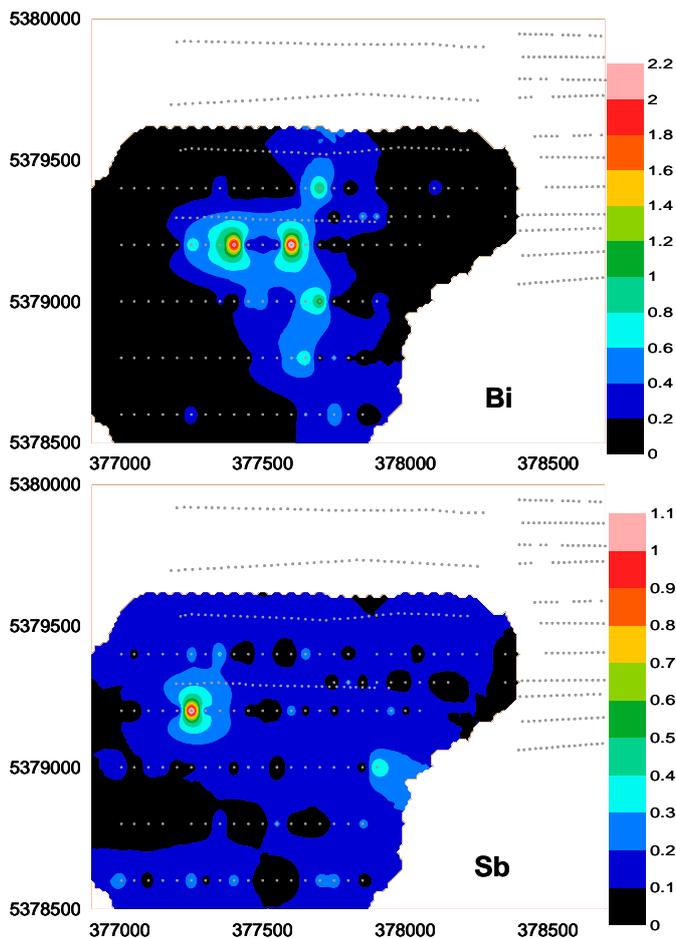


Figure 10 Contour plots of Bass Metals' conventional soil geochemical Bi and Sb data (in ppm).

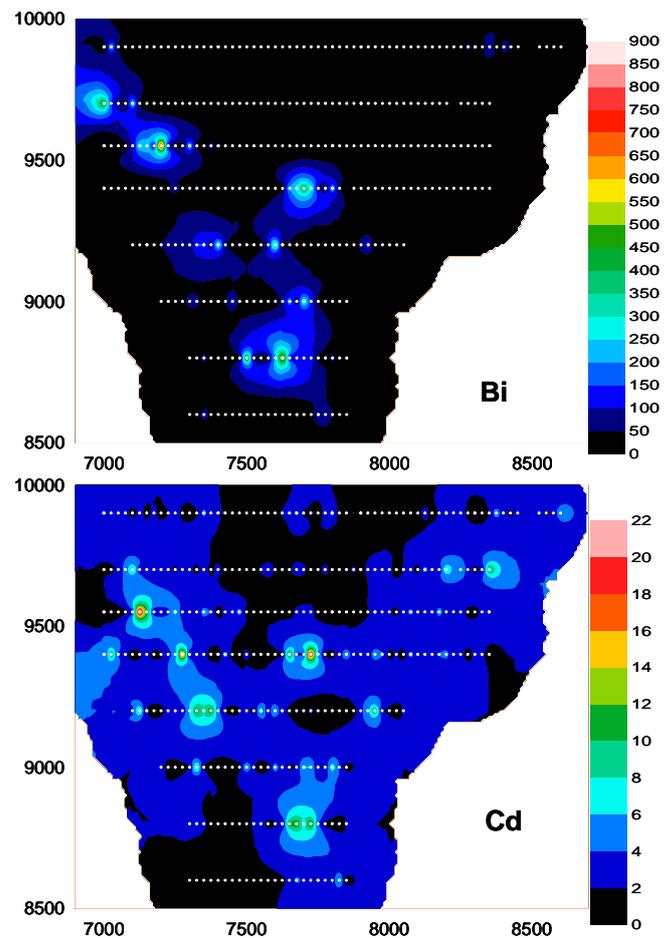


Figure 11 Contour plots of Bass Metals' MMI soil geochemical data of Bi and Cd.

EM and IP Geophysical Exploration

The western corner of EL 54/2004 northwest of Lake Rosebery and north of about (AGD66) 5379000N was covered by BHP's extensive blanket UTEM survey in 1984-87, and by Pasmenco's 50-m dipole-dipole IP-Resistivity survey in 1993 (Poltock et al., 1993). The 1-km² area around Bastyan Dam and power station has not been covered by modern surface electrical geophysical surveys, which one would in any case expect to be adversely affected by electrical 'noise'.

Three expert groups, BHP, Mitre Geophysics and Lamontagne, interpreted the UTEM data and all three concluded that there were no 'good' anomalies; only numerous weak responses presumably related to lithological contacts and resistivity differences, water or clay-filled shear zones, and variations in overburden thickness and conductivity (Poltock et al., 1993). However, it was (and still is) recognized that some zinc-rich sulfide deposits have poor conductance that could generate only weak anomalous responses or be undetected by TEM surveys.

In contrast, the South Kershaw IP survey conducted for Pasmenco in 1993 defined two significant anomalies:

- a strong, continuous linear chargeability-resistivity anomaly along the Rosebery Fault between 5378700N and 5380100N, and
- a distinct shallow IP chargeability anomaly with weak coincident low resistivity, in a northeast trending zone on lines 5379500N and 5379700N correlated with the southern extension of the Chester Pyrite Zone.

The latter anomaly was subsequently tested in 1995 by Pasmenco's drill hole BPD86 (Figure 12). The hole¹⁰ intersected a near surface, 15-metre-wide, zone of 'sericite-silica-augen schist' containing 1-10% pyrite and traces of galena, which is reportedly identical to but much thinner than the Chester Shear Zone that marks the western boundary of the Chester Altered Zone about a kilometre to the north (Saxon, 1995). The hole did not intersect significant base metal mineralized zones and no assays were reported, but it accounted adequately for the IP anomaly.

The greater than 1400-metre-long IP anomaly along the Rosebery Fault (Figure 12) parallels the dominant (Cu, Ag, Bi, As, Mo, Cd, Tl) MMI anomaly. Its striking chargeability contrast, from background levels of about 10

¹⁰ BPD86 was collared at (AGD66) 377754.6 E 5379517.6 N, inclined at 50° on azimuth 114° and drilled to 129.2 m depth.

mV/V east of the fault, to anomalous levels of 20 to 40 mV/V west of the fault, are very likely attributable to the different lithofacies: MRV felsic volcanics to the east and (assumed) carbonaceous shales and sandstones of the Dundas Group to the west. Thus, the axis of the chargeability anomaly lies about 200 metres west of the MMI anomaly, and just west of the surface trace of the fault. This main chargeable zone does not represent a favourable exploration target – precisely because it can be explained by chargeable-conductive lithofacies in the Dundas Group. The steep chargeability gradient marking the Rosebery Fault zone is exactly coincident with the MMI anomaly (Figure 12) and, as noted above, it imposes a depth limitation of 100-150 m to the potentially mineralized zone above the fault.

Altered zone mapping and Lithogeochemistry

J.G.Purvis put considerable effort into determining the origin and intensity of the altered rocks around Bastyan Dam, which at surface appeared ‘partly detextured, bleached, silicified, carbonatized and sericitized... and contain abundant generally flat lying wide veins of quartz-carbonate’ (Purvis, 1992). However, major and trace element analyses of over 40 rock samples from that area showed that only four were significantly altered – two from the very localized altered zone at Cutty Sark workings, and two from the North Bastyan altered zone adjacent to Pieman Road at about 5379000N. An oxygen isotope study of eight samples around Bastyan Dam showed no sign of O¹⁸ depletion and indicated they had undergone only low temperature regional diagenetic alteration (Green, 1992).

Pasminco subsequently focussed on the apparently more strongly altered North Bastyan Dam zone. Their mapping and sampling, carried out by Mark Saxon, extended northwards onto the adjacent EL 44/88 and was hampered by poor outcrop and featureless Mount Black Volcanics but I suspect that the quality of mapping was below the standard set by Purvis at Bastyan Dam. Nevertheless it outlined a 300 x 300 m zone, which is reportedly not continuous with the larger South Kershaw–Chester altered zone that lies to the north. One rock chip sample from North Bastyan showed significant sericite+pyrite alteration and two lines of 50 m dipole-dipole IP recorded a two-times-background chargeability anomaly associated with minor disseminated pyrite in the altered zone along Pieman Road (Fitzgerald, 1993).

Mapping at South Kershaw ‘located widespread intensely sericite-carbonate-pyrite altered felsic volcanics’ coincident with the IP anomaly (described above) but a few lines of soil sampling failed to indicate any significant geochemical anomalies (Poltock et al., 1993). That 1993 report mentioned (an undisclosed number of) rock chip assays and lithogeochemical data, which had ‘not been processed’. Unfortunately, those data were not subsequently presented in reports of the following years (Poltock and Saxon, 1994; Saxon, 1995).

My impressions of these previous exploration results from Bastyan Dam, North Bastyan and South Kershaw are that:

- The altered zones looked promising by visual inspection but turned out to be of low intensity when examined by lithogeochemical and isotopic methods.
- Conventional soil geochemical and rock chip sampling surveys (including Bass Metals’ 2006 traverse along Pieman Road through the North Bastyan zone) have not indicated significant metal anomalies associated with the altered zones.
- Some the altered zone/s contain a few percent disseminated pyrite, which generated IP chargeability anomalies. The most significant of those IP anomalies at South Kershaw was tested by BPD86, which intersected a pyritic sericite-quartz altered shear zone that appears to be the southern extension of a structure that partly controlled formation of the larger more intense Chester altered zone.
- The mineralogical and structural similarity and continuity between South Kershaw and Chester suggests the former is part of the ‘barren’ latter system. North Bastyan extends to within only a few hundred metres of South Kershaw and in view of the generally low geochemical response it to may also represent a peripheral part of the ‘barren’ Chester system¹¹, as interpreted by Corbett and McNeill (1986). If so, it would have lower empirical prospectivity, because of the entirely discouraging results of extensive exploration drilling in basemetal poor altered zones at Chester and Boco.

In any case, and as discussed in my earlier review (Herrmann, 1996), the North Bastyan to South Kershaw altered zones have dubious significance in relation to the supposed northward extension of the favourable Rosebery host unit, despite the lithostratigraphic and structural uncertainties. That is because they are either:

- higher in the sequence than Rosebery host unit, in the hanging wall part of a more or less continuous east dipping and facing volcanic succession, or
- from some laterally separate altered zone, if the host Mount Black Volcanics are equivalent to Rosebery footwall and emplaced at a higher structural level by low angle reverse faults.

In view of that doubt, and the probable relationship with the apparently barren Chester system, and the previous negative exploration results, the Bastyan to South Kershaw altered zones can be considered red herrings to the main game of exploring the conceptual Rosebery horizon target. I suspect that there’s not much more that can be done to explore them short of drilling many ‘stratigraphic’ holes to obtain lithogeochemical, isotopic, volcanic facies and structural data in the hope of elucidating the lithostratigraphic set up and identifying alteration based exploration vectors.

¹¹ Saxon (in Fitzgerald, 1993) interpreted that North Bastyan is separate from South Kershaw, but conceded that geologic exposure is poor; there is a small southeast draining creek between them, which possibly obscures outcrop.

Discussion of Prospectivity

The 'northern extension of Rosebery' concept has been well recognized and intermittently but persistently explored for at least the last twenty-five years by experienced companies and skilled geologists closely associated with the Rosebery Mine, who had the best available stratigraphic and structural knowledge to apply to the problem. However, there has been no drilling to test that concept within the area of EL 54/2004 since 1992. That is a sober reflection of the difficulty of drill targeting, in the absence of geophysical targets and reliable lithostratigraphic and structural information. It is well and truly in the 'very hard basket' - perhaps not too hard but certainly an unattractive proposition in times of tight exploration budgets.

Recent discoveries of additional deep lenses at the northern end of the Rosebery deposit, e.g. the Y-lens (Figure 18) tempt optimism that the mineralized zone is endless. However, the nearest known ore lens lies 1000 metres south of EL 54/2004, and 1000 metres below surface. Previous drilling to depths of 400 metres within EL 54/2004 did not intersect the favourable unit and showed that the stratigraphic and structural set up is complex. The nearest evidence of the northward extent of the favourable unit is in the barren hole 107R (Figure 18) fully 600 m below surface and 500 m outside the EL boundary. Furthermore, the moderate easterly dipping Rosebery Fault probably intersects the favourable unit such that the prospective zone lies at least 800 m below surface in EL 54/2004 (Figure 18). Even beyond that depth, potential flattening of the Rosebery Fault could truncate the favourable unit down dip, thus limiting the down dip tonnage potential of a stratiform sulfide deposit. In addition to those possible structural complications, the Rosebery long projection shows that the ore lenses are discontinuous with short strike and dip extents of up to only a few hundred metres, and some holes are barren within a few tens of metres of ore. Thus, blind exploration drilling has potential for many near misses, therefore demanding great persistence.

Overshadowing those problems is the fact that EL54/2004 encompasses only 2.4 km of favourable strike length. The Rosebery deposit currently has strike length of 3.3 km. The probability of finding another world-class deposit in a 2.4 km window only one kilometre north of Rosebery must surely be low. Finally, there is the unknown 'sovereign risk' associated with the existence of the Bastyan Dam and hydro-electric power station located virtually at the centre of the favourable zone in EL 54/2004 (Figure 21).

In view of those difficulties and the negative or inconclusive results to date, I subjectively rate the 'northern extension of Rosebery' concept in EL 54/2004 as having low to moderate prospectivity, low findability, and high sovereign risk factors. Any future exploration program in that zone should be undertaken in co-operation with operators of Rosebery Mine, if not with direct technical input at least with full access to update d geological information and drill cores obtained from

existing exploration holes in the northern half of the deposit.

I consider that the 'source of the Bastyan massive sulfide clasts' target is an even greater (and therefore even less attractive) exploration concept. The confusing isotopic and metal content data raise doubts about whether the observed sulfide pods are true clasts, and hence the style and potential economic significance of the source. If they are true clasts from a VHMS deposit the concept still has low prospectivity because the source deposit may have been entirely eroded and re-sedimented. It has low findability because of structural uncertainty and difficulty of determining volcanoclastic transport vectors. A future program to follow up the 'northern extension of Rosebery' concept may fortuitously yield some information to assist exploration for the source of sulfide clasts but I would not put much more effort into stand alone clast focused exploration.

That leaves the northwestern MMI soil geochemical anomaly as the only unexplored target. It is too coherent to be dismissed out of hand and will probably remain tantalizing until it is tested. It is unsupported by geophysical anomalies (the adjacent parallel IP chargeable zone is clearly lithologically related), it is coincident with spotty conventional soil geochemical anomalies that suggest a minor near-surface mineralized zone rather than a deep massive deposit, and the down-dip potential is limited by its apparent proximity to and location in the hanging wall of the Rosebery Fault. Steve Richardson (pers. comm., June 2009) has advised caution about the actual relationship between the plotted anomaly and the fault because the grid lines have not been surveyed and the western ends of the sample traverses may not be where they seem. Those locations, and the surface trace of the fault, obviously require field checking.

I have no prior experience with MMI soil geochemical exploration, I do not know of any convincing case studies where the technique has led to *discovery* of a buried blind deposit, and I am sceptical of its application in the high rainfall, rugged terrain, and complex structural geologic environment of western Tasmania. Nevertheless, I'll hazard a subjective guess that the MMI anomaly zone has low to moderate prospectivity. That is slightly enhanced by a moderate findability factor, based on its significant strike length and continuity, and its apparent localization in the hangingwall of the Rosebery Fault.

In the current absence of detailed lithofacies and structural information it is impossible to conclude whether the MMI anomaly relates to mineralization vertically below it, or whether it is laterally transposed from source. However, given the reasonably predictable orientation of the Rosebery Fault it should not be a difficult matter to design a few drill holes to test both the proximal sub-vertical and down-dip offset stratabound models of MMI-related mineralized zones, as hypothetically illustrated in Figure 20. The best location for such an initial test would be on line 5379200N (AGD66), which showed the strongest MMI responses in Cu, As, Mo, and Tl. The easting requires verification.

Table 1 Selected rock chip geochemical and location data for sulfide clasts and pyritic bands in the Bastyan Dam area (*adapted from Randell et al, 1986 and McNeill, 2003*)

Sample ID	East (AGD66)	North (AGD66)	Source	Description	Ag	As	Au	Ba	Bi	Cu	Fe	Hg	Mn	Mo	Pb	Sb	Sn	Tl	Zn
all data in ppm																			
167694	378279	5378022	McNeill, 2003	Massive pyrite clast 1; approx 60cm x 0.2m	106	1140	0.895	12		1475	304000		253	15	1770	48	69	26	20700
167695	378284	5378022	McNeill, 2003	Massive pyrite clast 2; minor host rock attached	12	465	0.465	76		311	244000		144	13	381	20	7	-5	42100
167696	378283	5378022	McNeill, 2003	Massive pyrite clast 3; approx. 12 cm dia.; minor host rock attached	20	502	0.36	28		322	267000		135	24	785	12	8	5	80300
167697	378282	5378022	McNeill, 2003	Massive pyrite clast 4; approx. 18 cm dia.	11	639	0.525	60		489	269000		81	21	610	22	8	-5	38200
167698	378282	5378022	McNeill, 2003	Host rock to Massive pyrite clasts; coarse Qtz-Feld crystal-rich volcanoclastic; minor lithics; this sample has scattered <1 cm dia. Pyrite clasts	-1	25	0.018	605		31	24500		161	-3	163	3	22	-5	185
167699	378284	5378022	McNeill, 2003	Host rock to Massive pyrite clasts; coarse Qtz-Feld crystal-rich volcanoclastic; minor lithics	-1	3	0.005	570		20	24500		242	-3	91	7	31	-5	93
7948	378285	5378010	Randell et al. 1986	o/c massive sphalerite>pyrite boulder in debris flow	20	320	0.12	75	14	410		22		32	8050	30	980		355000
7949	378293	5378007	Randell et al. 1986	o/c massive fi gr pyrite boulder in debris flow	10	700	0.25	80	70	200		0.73		20	2000	26	60		13500
7950	378092	5378051	Randell et al. 1986	o/c 15 mm AsPy vein in Qtz-Feld porphyry	8	96000	0.57	630	40	50				28	450	60	<4		810
12940	378150	5378037	Randell et al. 1986	o/c clasts of massive Py & trace Sp, Cp in silic volc	3	2100	<0.01	370		410					20				1100
12941	378118	5378046	Randell et al. 1986	o/c deformed massive Py band with trace Gn	4	280	0.12	1050		44					120				85
12942	378107	5378048	Randell et al. 1986	o/c deformed massive Py band 60 mm thick in Qtz porph.	46	2200	0.36	710		150					580				105
12943	378092	5378051	Randell et al. 1986	o/c Qtz porphyry with 1-2% Py & minor AsPy	3	2650	<0.01	650		26					185				24

Location data for 1986 samples are approximate; deduced from plotted position on plan.

Table 2 Percentage differences between duplicate analyses, expressed as absolute and actual proportions.

Absolute percentage differences between duplicate analyses (absolute %)

	Cu	Pb	Zn	Ba	As	Ag	Au	Bi	Cd	Co	Mo	Tl
Mean	26	34	29	24	40	96	1060	259	26	19	109	41
Std Dev	26	69	46	53	84	107	3929	890	36	15	225	55
Max	89	293	196	229	359	445	16300	3700	150	57	840	180
Min	0.73	0.00	0.00	1.14	0.00	0.00	0.00	0.00	0.00	0.00	4.35	0.00

Actual percentage differences between duplicate analyses (relative to first analysis of duplicate pair, expressed in %)

	Cu	Pb	Zn	Ba	As	Ag	Au	Bi	Cd	Co	Mo	Tl
Mean	-4	-22	-6	-11	-19	-60	-1001	-237	-18	0	-68	-22
Std Dev	37	74	55	57	91	133	3946	897	41	25	241	65
Max +ve	41	28	52	18	56	72	100	64	18	57	95	64
Max -ve	-89	-293	-196	-229	-359	-445	-16300	-3700	-150	-50	-840	-180

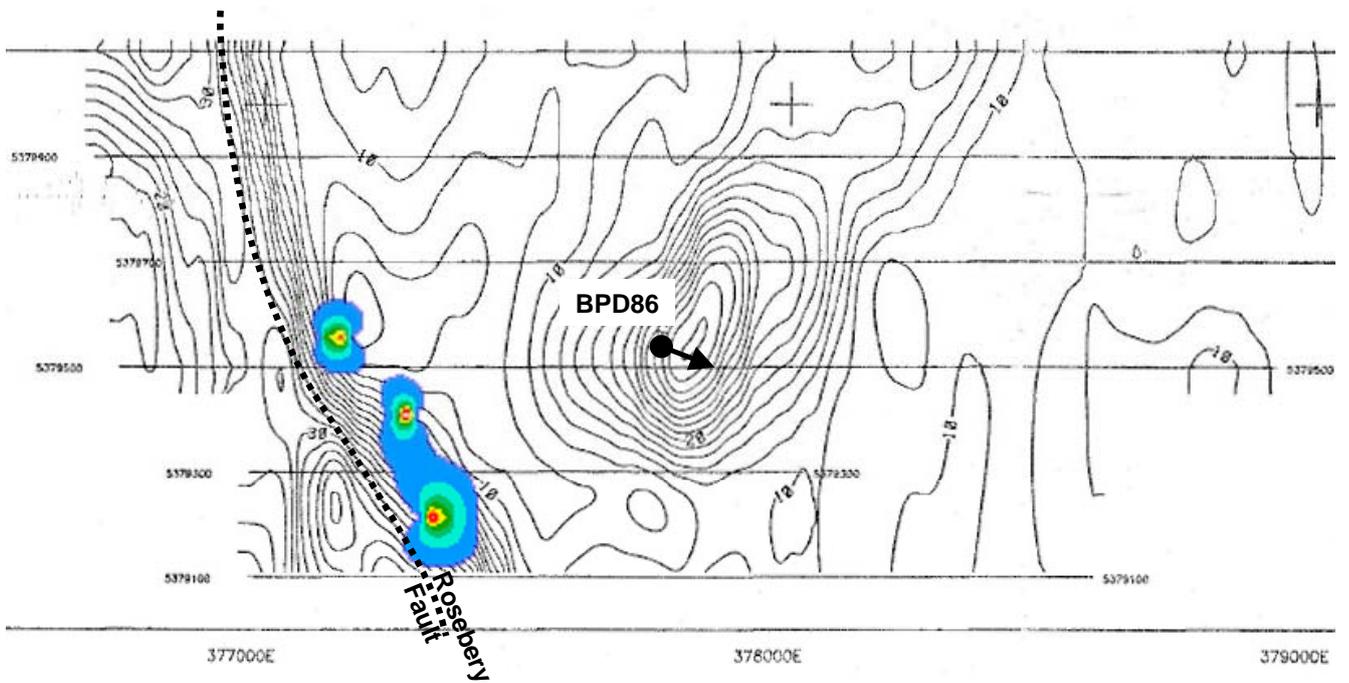


Figure 12 Fraser-Filtered Chargeability map of South Kershaw IP data (adapted from Poltock et al., 1993) with MMI Cu response ratio >10 anomaly zone and the trace of Rosebery Fault (as interpreted by Corbett and McNeill, 1986) superimposed.

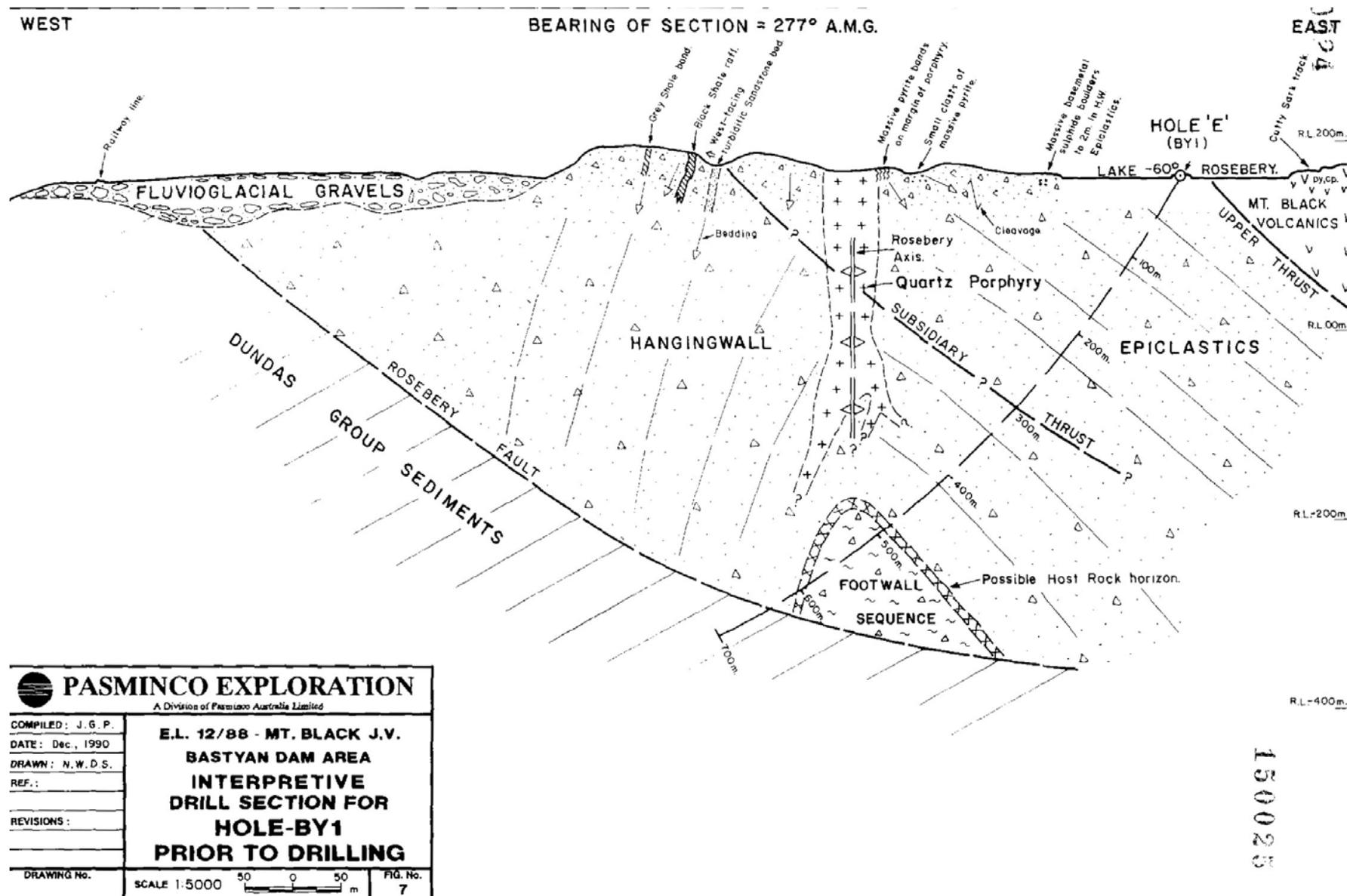


Figure 14 J.G.Purvis' interpretative geologic cross section of the Bastyan Dam area showing the locations of massive sulfide clasts at surface and the inferred anticlinal Rosebery host unit at depth. Hole BY1 was designed to test both these targets. (Adapted from Purvis, 1991).

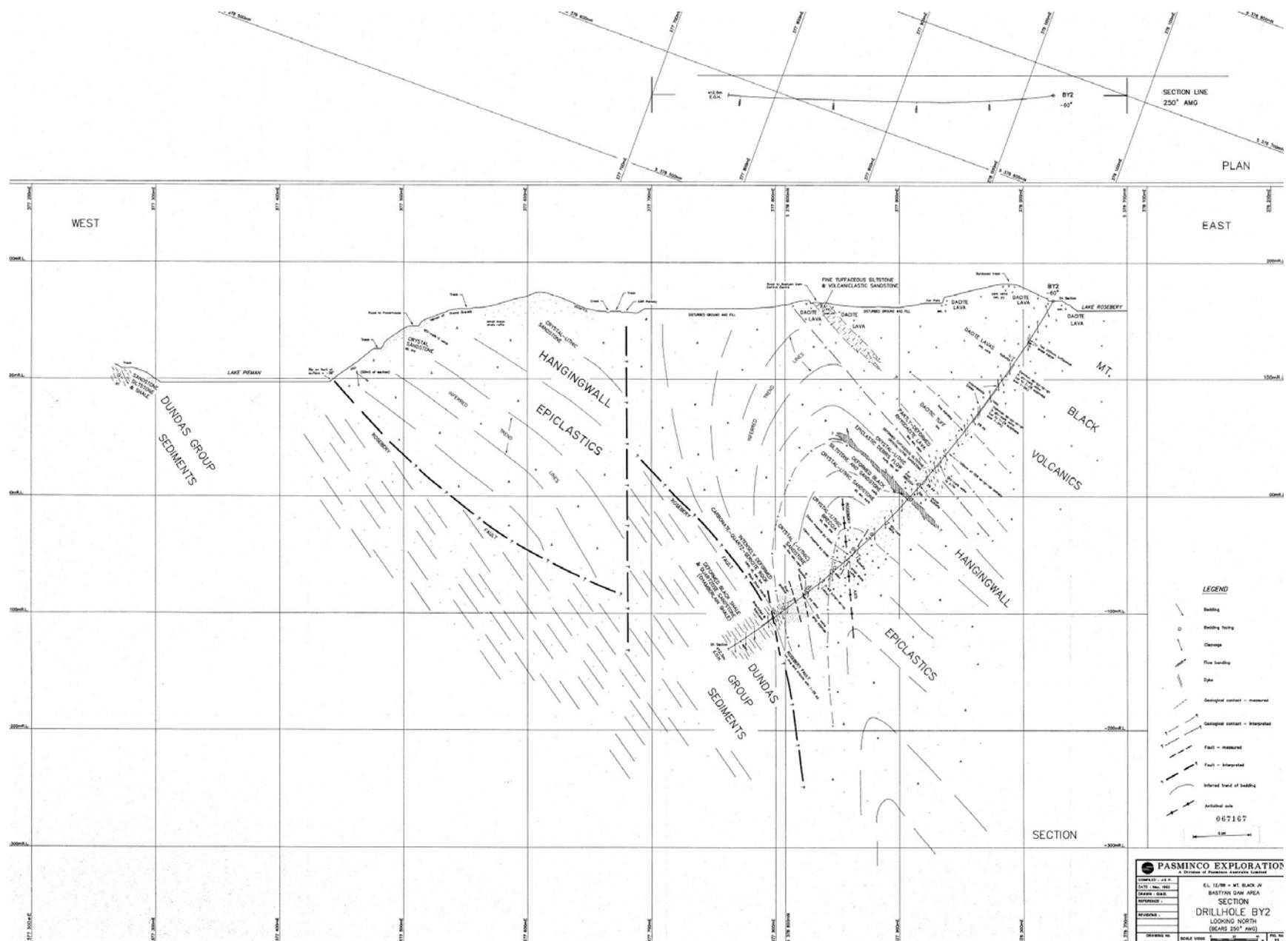


Figure 16 Geologic cross section on approximately (AGD66) 5378600N showing results of hole BY2, (adapted from Purvis, 1992).

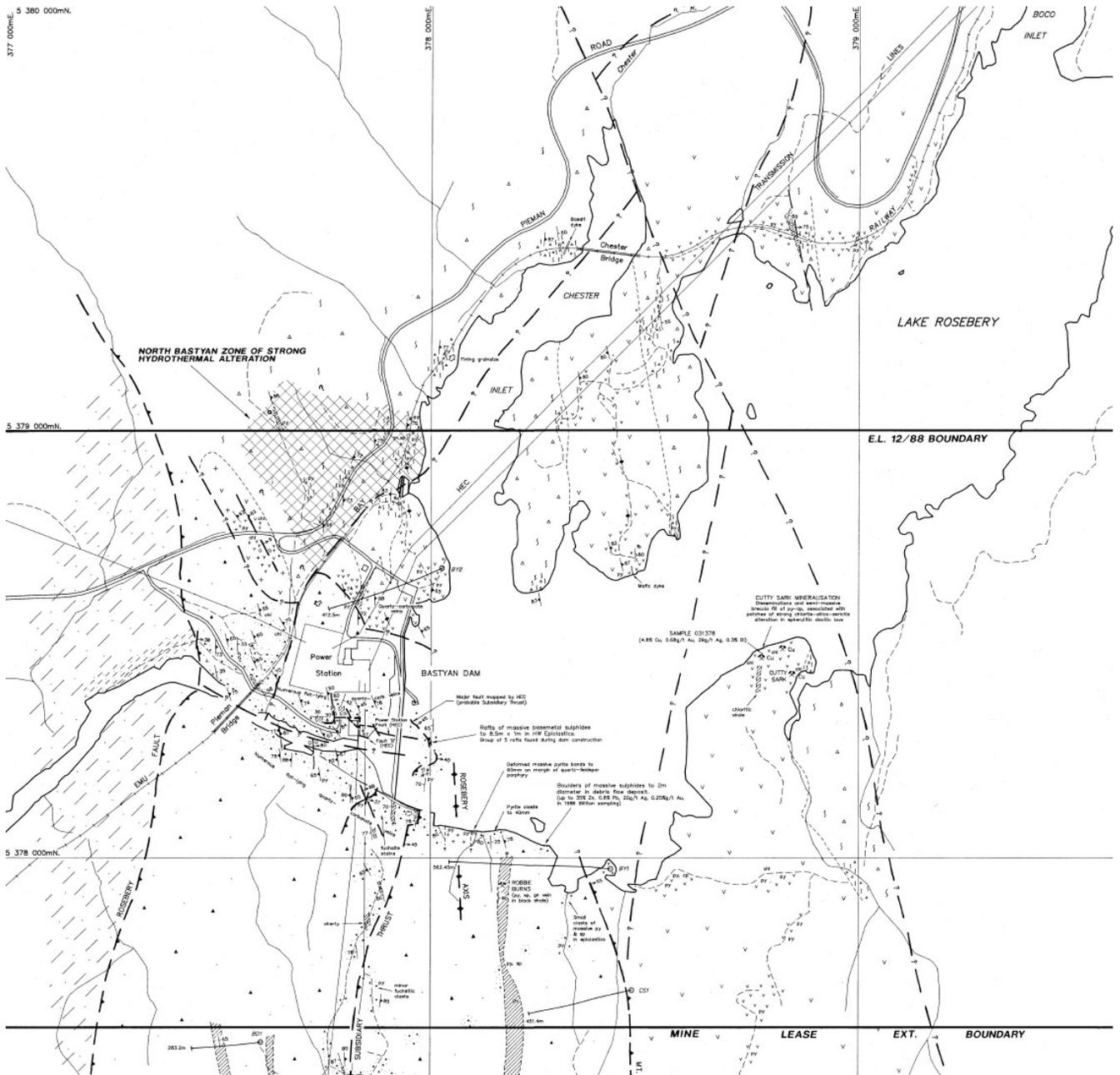


Figure 17 Geology of the Bastyan Dam area, (adapted from Figure 10 of Purvis, 1992)

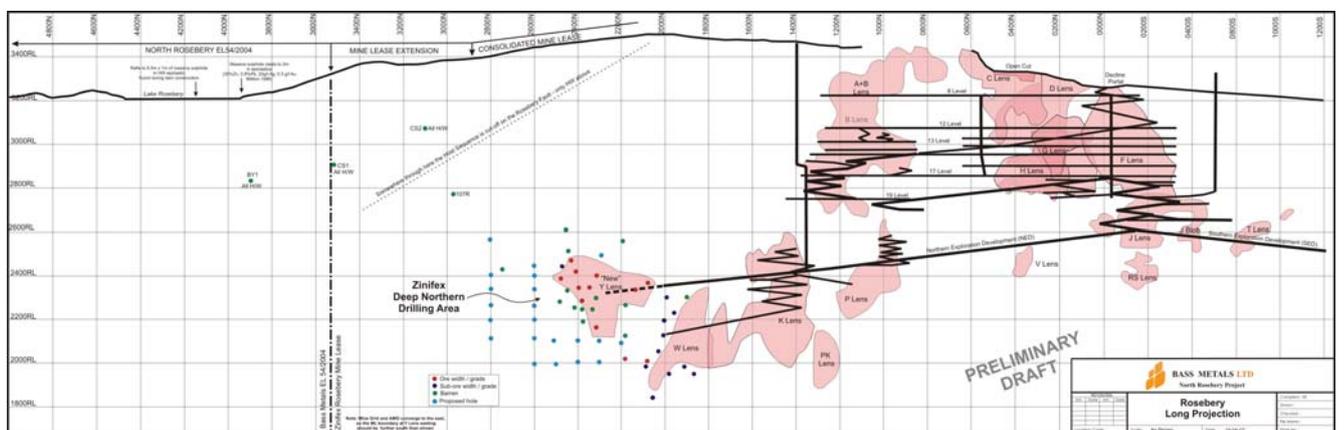


Figure 18 Longitudinal projection of Rosebery ore lenses.

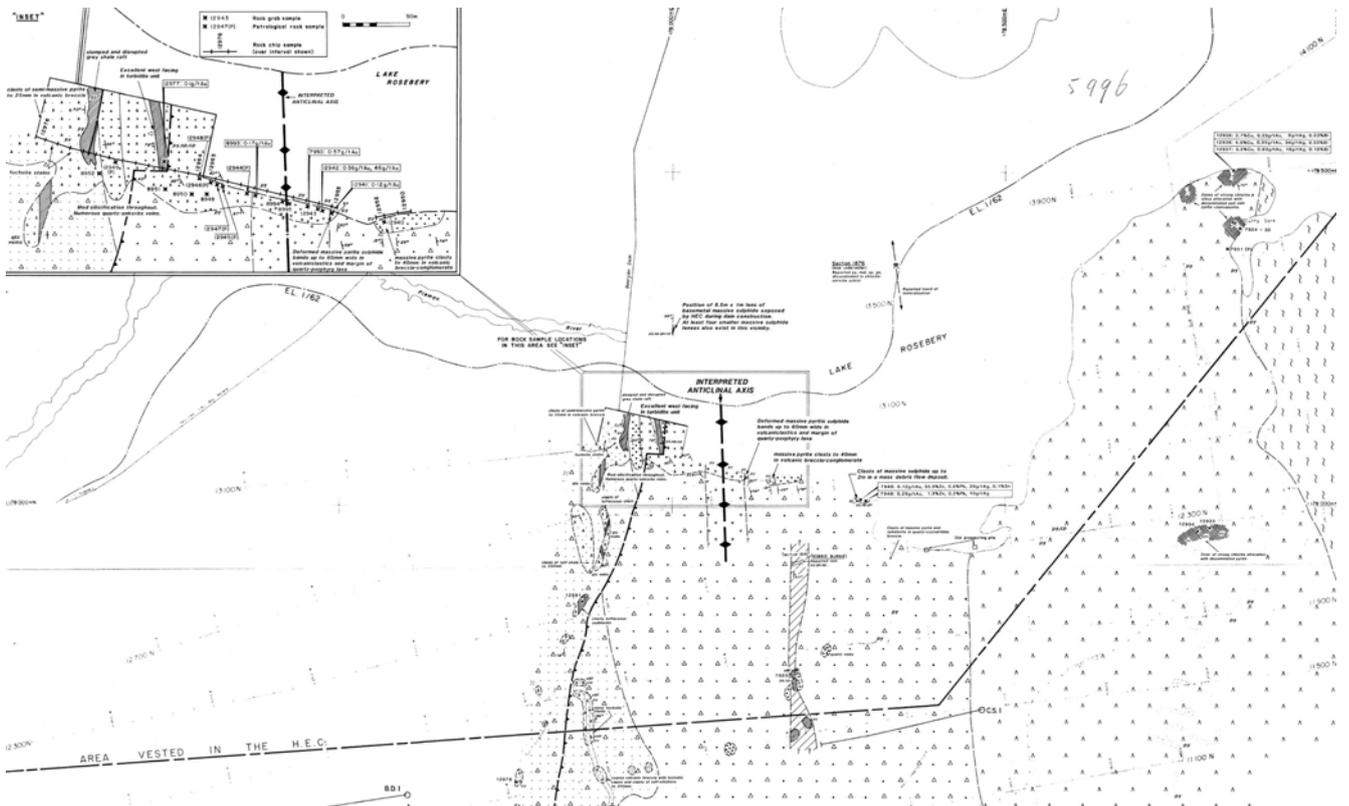


Figure 19 Northern segment of Billiton's interpreted geology map of the Cutty Sark area showing locations of massive sulfide clasts near Bastyan Dam (adapted from Figure 21 of Randell et al. 1986).

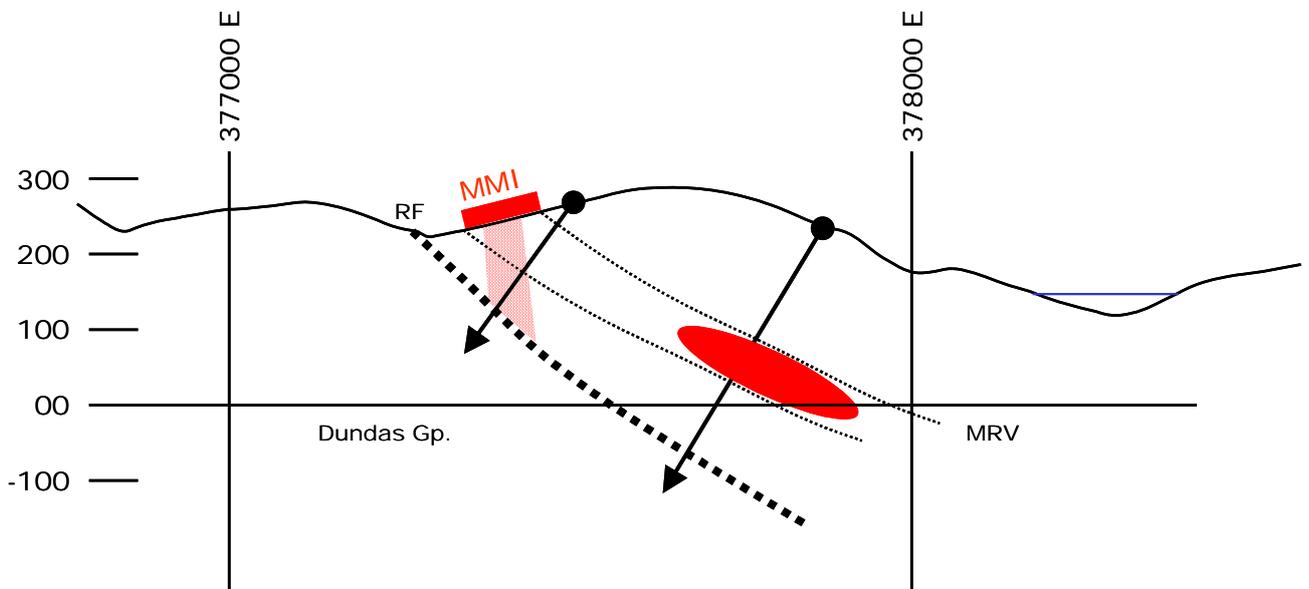


Figure 20 Cross-section 5379200N (AGD66) illustrating potential drill holes to test the North Rosebery MMI anomaly. The ~250 m deep western hole would test a potential sub-vertical mineralized zone directly beneath the MMI anomaly and intersect the Roseberry Fault about 150 m below surface. Depending on the outcome of the former, another ~400 m deep a few hundred metres further east could test for a hypothetical stratabound deposit offset down dip of the MMI anomaly.

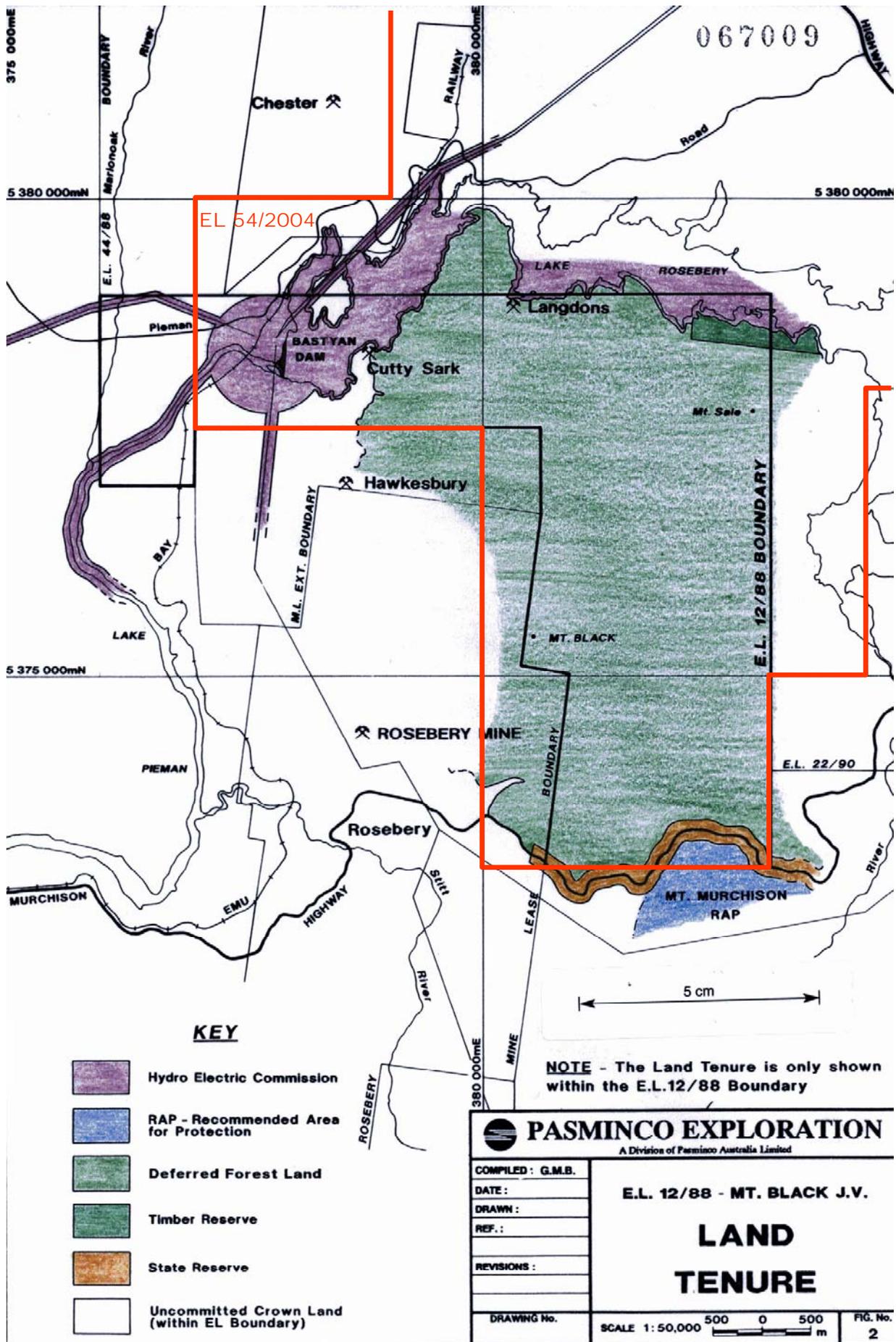


Figure 21 Location of EL 54/2004 in relation to land vested in the Hydro Electric Commission (adapted from Purvis, 1992).

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Appendices

Appendix I **EL 12/96 – Lake Rosebery, Tasmania, Report on Exploration History and Potential**

Appendix II **Lake Rosebery EL 12/96; Update on geological interpretation**

Appendix I

PLUTONIC OPERATIONS LIMITED

EL 12/96 - Lake Rosebery, Tasmania

(pending)

Report on Exploration History & Potential

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Date: June 11, 1996

To: R.J. Close
District Geologist-Base Metals, Sydney

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1 SUMMARY

The EL 12/96 - Lake Rosebery area has been semi continuously, and relatively thoroughly, explored for VHMS deposits since the early 1960s. Early exploration techniques included stream sediment geochemical surveys, reconnaissance IP and soil geochemical surveys and airborne EM surveys, and culminated in virtual blanket coverage of the area by fixed loop TEM surveys during the mid 1980s.

The results of these programmes have been unexceptional; only four targets (three UTEM and one alteration zone) within the EL 12/96 area had been drilled up to 1990 and the results were discouraging.

Since 1991, exploration has been focussed on testing of a conceptual model, which indicates that the Rosebery VHMS favourable horizon may extend in a sub surface anticlinal position north of the mine. Two holes have been drilled within the EL 12/96 area near Bastyan Dam to test this concept; the first hole was inconclusive and the second supported the existence of the anticlinal fold but did not intersect the favourable horizon. Moderate potential remains for the favourable horizon to exist at >350m below surface near Bastyan Dam, but the prospectivity is lessened by the evident structural complexity, short strike length covered by EL 12/96 and the location beneath a hydroelectric dam and power station.

Relatively good coverage by high resolution aeromagnetic and regional gravity surveys, and a recent seismic traverse, has enabled broad scale structural interpretations which suggest (but do not precisely define) several east dipping fault zones sub parallel to the Rosebery Fault. These structures indicate potential for near surface repetition of the Rosebery favourable horizon east of the exposed mine sequence and may also be associated with structurally controlled epigenetic mineralisation.

The detailed structure, volcanic facies and stratigraphic succession of the greater part of the area remain insufficiently known to permit confident assessment of the structural-conceptual prospectivity. A considerable geological effort, perhaps best applied as medium term academic research, will be required to improve this situation.

Previous exploration has implied that low grade copper+gold mineralisation at the old Hawkesbury and Cutty Sark workings is associated with chlorite+magnetite+pyrite alteration localised above the east dipping Mt Black Fault, which marks the contact between the Rosebery Mine Sequence and the Mt Black Volcanics to the east. Aeromagnetic data suggest that the alteration zone may have considerable down dip and lateral extent, which remains relatively untested. The style of mineralisation is uncertain, the grade appears to be low, it has restricted strike length within EL 12/96 (1km) and there are no currently economic analogous deposits in Tasmania. These factors combine to suggest an empirically low prospectivity. However, the association with magnetite would permit relatively simple targeting and testing of this style of mineralisation.

2 INTRODUCTION

EL 12/96 - Lake Rosebery was applied for by Lachlan Resources NL on February 27, 1996 and is currently pending approval from the Director of Mines (Appendix 1).

The area lies entirely within the Central Volcanic Complex of the Mt Read Volcanics and comprises an amalgamation of territories formerly held under EL 12/88 and part of EL 44/88 which were progressively relinquished in 1993 and 1995.

Lachlan's interest stems from the recent recognition in new seismic data, of a major east dipping fault zone which suggests potential for structural repetition of the Rosebery (VHMS) favourable horizon or structurally controlled epigenetic? mineralisation.

Plutonic Operations Limited provides geological expertise and exploration management for Lachlan Resources NL.

This report presents the first stage of exploration of EL 12/96, consisting essentially of a comprehensive review and discussion of previous geological information and current exploration potential. No new exploration data have been generated.

3 EXPLORATION HISTORY

The area of Lake Rosebery - EL 12/96 has been semi continuously explored for Rosebery type VHMS deposits for about the last 30 years.

Most of the southern two thirds, known as Mt Black and roughly encompassing the area south of Lake Rosebery, was formerly covered by part of EL 1/62 (EZ Co.-Getty-Billiton JV) and more recently by EL 12/88 (Austmin-Climax-Pasminco JV), (Figures 1 & 8).

The northern part between Boco Creek and Farm Creek was explored under EL 5/63 by Comstaff & BHP and the northern boundary just overlaps EZ Co's old Boco Grid on their former EL12/72. This northern part, which I refer to as Farm Creek, was taken up by a Pasminco-Noranda-Pioneer (now Plutonic) JV as part of EL 44/88 and explored for VHMS deposits with Pasminco as operator.

The previous exploration over these southern and northern portions are summarised separately, below, in order to maintain chronological and exploration philosophical continuity.

3.1 Previous Exploration - Mt Black Area

Pre 1983 EZ Co. carried out stream sediment sampling over the area between Hercules and the Pieman River followed by extensive wide spaced reconnaissance gridding, mapping, soil geochem, gradient IP, TURAIR and TURAM, particularly south of Rosebery but eventually extending to Mt Black, Cutty Sark, Langdon's and Farm Creek. No drilling targets were defined.

During the early 1980's EZ Co's exploration priority seemed to switch to Renison type tin deposits and little work was done in the area north of the Murchison Highway apart from testing of some Sn-Au mineralisation associated with the Henty Fault at the Murchison River prospect south of Tullah.

1983-85 Getty Oil development Co. (GODC) joint ventured in to EL 1/62 and revived VHMS exploration with a Dighem III survey which indicated a broad conductive zone at Mt Black in the vicinity of some previous EZ Co. Cu-Pb soil geochem and gradient IP anomalies. GODC carried out more soil geochem, mapping and a VLF-EM survey and identified a 400m x 100m "feeder"? zone of chlorite+magnetite+/- (hematite+pyrite+quartz) alteration in otherwise unaltered andesitic (?) volcanics but the absence of associated soil geochem or bedrock conductors led to the prospect being down graded.

GODC also re-gridded the area between the Rosebery Fault and the Hawkesbury - Cutty Sark prospects (mostly now within the extended Rosebery Mine leases) where EZ Co. had done some soil geochem, magnetics and IP and near some massive sulfide clasts discovered in Hydroelectric Commission (HEC) excavations during construction of the Bastyan Dam in 1976

GODC carried out a UTEM survey which showed only a weak formational conductor over andesites? in the eastern part of the grid.

Two diamond drill holes, CS1 & CS2, were cored to test low order (200ppm Pb, 800ppm Zn) soil anomalies over ~900m of strike outlined by previous EZ Co. work in the western part. Both holes intersected a sequence of quartz phyric volcanoclastics with interlayered black shale hosting a westward diminishing, weakly sphalerite mineralised, stockwork of quartz+chlorite+carbonate veinlets.

Best assays were:

CS1:	5m	@ 0.14% Pb	0.32% Zn
CS1:	12m	@	0.24% Zn
CS2:	6m	@	0.25% Zn

An additional hole, BD1, drilled ~600m further west to test a strong soil geochem anomaly, intersected a similar volcanoclastic-shale sequence with similar vein type mineralisation and went on through the Rosebery Fault into deformed Dundas Group sediments.

The best mineralisation was:

BD1: 20m @ 0.32% Zn including 4m @ 0.92% Zn (but with insignificant Cu, Pb, Ag, Au)

GODC examined core from EZ Co's BD269 (a few hundred metres to the south) and several HEC geotechnical holes at the dam site but found no further mineralisation or a source for the massive sulfide clasts.

1985-87 Billiton took over the management of exploration on EL 1/62 under the new Rosebery East JV between Shell Co., EZ Co. and Little River Resources P/L.

A major TEM survey involving ~150 line kilometres of UTEM (and minor SIROTEM) and 25 transmitting loops was completed, to cover virtually all of that part of EL 1/62 which is now in EL 12/96, on east-west grid lines at 250m intervals (Figure 2). The survey identified several anomalies but only two (8A, ~2km NE of Mt Black and 20A, called Robbie's Creek ~1km SE of Cutty Sark) were interpreted to be favourable deep bedrock conductors and followed up by additional TEM surveys. Several other UTEM responses in the Mt Black - Mt Sale area (6A, 6B, 6C, 7A, 7B, 8A, 8B, 9A, 10A, 10B) were interpreted to be due to weak shallow conductors and were checked out by geochemical sampling; (results summarised below).

Drainage geochemistry: The regional coverage also included a stream sediment geochemical survey of samples from 46 selected sites. Bulk samples were analysed by BCL (bulk cyanide leach) for Au and -20#, -40#, -80# and -120# size fractions were analysed for Cu, Pb, Zn, As, Ba, Sn, W, Ag & Au. Ten sample sites were found to be anomalous in gold and/or other metals but follow up sampling failed to duplicate the anomalies. It was proposed that variable stream flows had caused the discrepancies and further sampling in the following summer was planned but never subsequently reported.

Anomaly 8A - Mt Black

This UTEM anomaly was a late time response, interpreted as possibly due to noise, located ~ 1.5km NE of GODC's chlorite+magnetite+etc. alteration zone which had not itself shown a UTEM response. Mapping in the area indicated an ESE dipping and facing sequence of sub aerial? dacitic lavas west of Mt Black, transitional through a 1500m thick zone of lavas and thin intercalated cherty siltstones, to possibly sub aqueous andesitic lavas to the east. A detailed follow up SIROTEM survey confirmed that the UTEM "anomaly" was due to noise. Rock chip and C-horizon geochemical sampling over 8A and nearby anomalies 6B, 7A, 9A & 10B found no significant anomalies and the area was downgraded although it was considered geologically "interesting".

Anomaly 20A - Robbie's Creek

This UTEM anomaly SE of Cutty Sark was coincident with a possibly vertical CSAMT conductor that had been detected on a single traverse, between Bobadil and Mt Black, (which Billiton surveyed after successfully testing the method over the northern extension of Rosebery where mineralisation was known to be 200-300m below surface). Three follow up UTEM Tx loops were used to detail the anomaly and arrive at an interpretation which indicated that it was due to a conductor with the conductivity expected of a Zn-Pb VHMS deposit, a depth to top of ~300m, 45° E dip, strike extent of >700m and down dip extent of 200m. Detailed ground magnetics indicated an easterly dipping magnetic source with depth to top of 150-200m located about 300m west of the UTEM conductor.

Diamond drill hole RED 87-1 (607m) was drilled westwards to test the UTEM target. It intersected a steeply east dipping sequence of rhyolitic-dacitic-andesitic lavas and ended in fine sediments and volcanoclastics. A zone of strong "annealed deformation" associated with chlorite alteration and irregular veinlets and disseminations of magnetite and pyrite, near the upper contact of the volcanoclastics, was found to be weakly anomalous (maxima: 1600ppm Cu, 630ppm Pb, 3300ppm Zn, 175ppm W) and conductive, and adequately explained the geophysical anomalies.

Anomalies 6A, 6C & 7B - Mt Sale

Reconnaissance geochemical sampling over these weak superficial UTEM responses did not indicate any significant values apart from a rock chip sample of andesite with disseminated magnetite+pyrite from near Anomaly 6C which contained 6.6g/t Au and 5450ppm As. Subsequent detailed follow up sampling could not duplicate the anomaly and it was dismissed as due to very localised, late stage amygdale fillings of no economic significance.

Cutty Sark

Randell et al. (1986) convincingly argued that the Rosebery favourable horizon is not cut off by the east dipping Rosebery Fault 3km north of the mine, as previously interpreted (eg: Corbett & Lees, 1987a) but instead continues north to Bastyan Dam where it is tightly folded about a shallow north plunging anticline; (cf: Figs. 3, 4 & 5).

This interpretation indicated that GODC's drill holes CS1 & CS2 had drilled the Hangingwall Epiclastics on the eastern limb of the fold but had not gone deep enough to test the favourable horizon. Billiton did a DHEM survey of CS1 (CS2 was blocked) to test the possibility that mineralisation existed below these holes but no off hole conductors were evident. The possibility of deepening CS1 by 200m was considered but rejected due to the expense of reaming out PVC casing in the hole. A one line CSAMT survey was conducted across the CS2 section but it indicated only weak conductors due to faults, alteration or shaley lenses, unlike the responses over the Rosebery deposit.

Randell et al. (1986) theorised that the southward thinning of a quartz crystal rich volcanoclastic unit in the hangingwall sequence indicated the provenance of the volcanoclastic materials, and sulfide clasts, was to the north and that a VHMS deposit could exist down plunge beneath Lake Rosebery in the vicinity of Bastyan Dam. Drilling of this conceptual target within EL 1/62 was precluded by the proximity of the dam and hydroelectric power station.

Langdon's

Billiton undertook mapping and rock chip sampling in the vicinity of Langdon's workings which consist of a short adit and surface stopes in quartz-chlorite altered brecciated andesite about 2km east of Cutty Sark, on the southern shore of Lake Rosebery. The breccia matrix consists of quartz+carbonate + (galena+pyrite+ arsenopyrite) which Randell et al. (1986) interpreted to be similar to Mt Farrell type Devonian fissure fill mineralisation. Dump samples indicated erratic, localised values upto ~20% Pb, 2% Zn and 4.8g/t Au. Two steeply west dipping but east facing cherty sandstone units, east of (stratigraphically above) Langdon's, were considered to represent a potentially favourable horizon (possibly equivalent to cherty siltstone units east of Mt Black) despite the lack of geochemical encouragement or UTEM response. A programme of deep bedrock geochemical sampling was recommended but apparently never pursued.

EL 1/62 expired and was put up for exploration tender in early 1988, although the Billiton - EZ - Little River Resources JV continued to explore for Henty Fault associated gold mineralisation at Murchison River and South Stitt prospects under a one year extension.

1989-90 EL 12/88 over the Mt Black - Mt Sale - Cutty Sark area was acquired under the ETA system by a Climax Mining - Austmin Gold JV, with the objective of drill testing a number of unexplained UTEM anomalies identified by Billiton's extensive survey, (Hine & Scott, 1989).

Climax (as JV operators) carried out limited shallow hand auger geochemical sampling in an attempt to confirm a previous GODC Pb anomaly (250ppm) ~600m east of the summit of Mt Black but found "results were of a considerably lower tenor than those reported by Getty".

Four diamond drill holes (MBDs 1-4; total of 869m) were cored to test three of Billiton's UTEM anomalies (6B, 10B & 10A) and the GODC chlorite+magnetite alteration zone near Mt Black (Figures 7 & 8). All of the holes intersected massive feldspar phyric dacite with variable, mostly weak, chlorite, sericite and pink feldspar alteration overprinted by ubiquitous quartz+carbonate veinlets. No significant mineralisation was intersected and maximum assays were 250ppm Cu, 40ppm Pb, 160ppm Zn & 0.017g/t Au! The three UTEM targets were attributed to contrasts in rock type imposed by shearing, fracturing and, in one case, extensive weathering. The holes were cased for DHEM but not surveyed due to equipment failures.

Following these negative results, Climax withdrew from the joint venture and Austmin turned their exploration interest to the northward extensions of the Rosebery mine stratigraphy and signed up with Pasminco as new JV partners to manage exploration.

1991 PASMINGO (Purvis, 1991) focussed on potential for subsurface extensions of the Rosebery host rocks under equivalents of the Hangingwall Epiclastic unit in the Bastyan Dam area (the Billiton anticline model) by coring one diamond drill hole, BY1, on the southern shore of Lake Rosebery. This work was brought into a semi-regional structural interpretation by completion of high-resolution helicopter aeromagnetic & radiometric surveys and a gravity survey over the Mt Black area, supervised and interpreted by D.Leman.

The geological interpretation suggested that most of EL 12/88 occupies the eastern limb of a major anticline, known as the Rosebery axis, which was interpreted to extend for 20km between Hercules and Pinnacles, just east of and parallel to the Rosebery Fault. Between Rosebery and Bastyan Dam the anticlinal axis has been observed to plunge at ~20° to the north; with the dominantly volcanoclastic, quartz crystal rich, Hangingwall Epiclastics of the Rosebery Mine sequence exposed at surface. On the eastern limb of the fold, the Hangingwall Epiclastics and the overlying dominantly massive dacitic-andesitic lavas of the Mt Black Volcanics, were interpreted to face and dip moderately to the east for at least 700m stratigraphically up into the Mt Black Volcanics. Facing of the Mt Black Volcanics further east was unknown, but inferred from geophysics to be consistently east facing.

Purvis' (1991) detailed geological interpretation indicated structural complexity south of Lake Rosebery where the Mine Sequence appears to be disrupted by two additional east dipping thrusts, thought to be listric splays off the lower

Rosebery Fault, termed the Subsidiary Thrust (within the Hangingwall Epiclastics) and the Upper Thrust (separating the Hangingwall Epiclastics from the overlying Mt Black Volcanics).

This is further complicated at Bastyan Dam by an inferred E-W structure which appears to displace the equivalents of the Mt Black Volcanics westward against the Rosebery Fault so that the Hangingwall Epiclastics, exposed in the anticlinal hinge on the southern shore of the lake, are not present along strike on the northern side (Figures 8, 9 & 10). This structural offset is associated with strong detexturing quartz-sericite-carbonate alteration and shallow dipping quartz+ankerite veins.

The Bastyan Dam E-W offset, Cutty Sark and Langdon's workings all lie along a sub E-W linear or structural corridor, inferred from aeromagnetic and gravity data. The Hawkesbury workings and alteration associated with the Upper Thrust coincide with a NNW geophysical trend (Figure 11). The intersection of these trends near Bastyan Dam was considered to have major exploration significance in light of the intersection of exactly parallel sub E-W and NNW trends at the Rosebery Mine, which D. Leaman had previously interpreted (particularly the sub E-W trend) as fundamental controls on Cambrian mineralisation. Purvis (op cit.) did, however, recognise that the anomalous tin in sulfide clasts at Bastyan Dam, high bismuth at Cutty Sark and Farrell type Pb > Zn mineralisation at Langdon's, whilst confirming the existence of Leaman's sub E-W lineament, suggested some other than Cambrian - possibly Devonian granitoid related - hydrothermal circulation.

The intersection of geophysically interpreted structural trends exactly analogous to that at Rosebery Mine, the extension of Rosebery host rocks and the existence of massive sulfide clasts in the Hangingwall Epiclastics, were considered to indicate high exploration potential in the Bastyan Dam area.

Purvis (1991) provided a good summary of the styles of mineralisation and alteration known in the EL 12/88 area, and drew particular attention to patchy magnetite+pyrite+chalcopyrite associated with chlorite alteration within Mt Black Volcanics, parallel to and just above the Upper Thrust, extending ~2km north of Rosebery mine to the Hawkesbury workings and possibly a further 2km to the aeromagnetic anomaly at Cutty Sark. It was postulated that this alteration (possibly of similar style to GODC's "feeder", tested by Climax-Austmin's hole MBD4, near the summit of Mt Black?) was associated with early movement of the Upper Thrust. To date, only low grade Cu-Au mineralisation has been found in this zone; best assays are 1.2% Cu & 0.2g/t Au from selected dump samples at Hawkesbury.

A small zone of disseminated pyrite in Mt Black Volcanics, on the Murchison Highway 2km east of Rosebery, was attributed to a sub surface spine of Devonian granite, inferred from gravity data. Minor disseminated pyrite in Mt Black Volcanics on the Pieman Road north of Bastyan Dam was considered to be part of a zone of sericite+pyrite alteration extending north to Chester.

Gravity modelling (rather unconvincingly) suggested the Mt Black Volcanics overlie a shallow PreCambrian continental basement of which the western margin is approximately beneath the Rosebery deposit and the north trending Upper Thrust, with the inference that this margin was a control on mineralisation.

The Mt Black Volcanics were geophysically interpreted to be limited to about 3000m thick, lithologically variable, generally moderately east dipping and floored by the eastward flattening Rosebery Fault or associated thrusts. No evidence of hydrothermal alteration zones was recognised in the geophysical data.

BY1 (562.5m) was collared in Mt Black Volcanics about 500m east of Bastyan Dam and drilled to the west (Figure 12). It intersected the Upper Thrust at ~60m and passed into Hangingwall Epiclastics including a unit of coherent qtz-fs phyric spherulitic rhyolite and several intercalated units of calcareous black shale; one of the shale units contains minor (0.5%) Zn mineralisation but no sulfide clasts were intersected. At 282m the hole intersected the Subsidiary Thrust and went down through a *mixed sequence* of crystal-lithic volcanoclastic sandstones interbedded with calcareous sandstones, siltstones and impure limestones (rather like the Dundas Group sediments); some limestone pebble bands contained minor disseminated pyrite+sphalerite+arsenopyrite mineralisation with several zones upto 2m @ 0.7% Zn. The hole finally passed through the Rosebery Fault at 507m and ended in deformed interbedded graphitic shale and fine quartzite of the Dundas Group.

No equivalents of the Rosebery host rocks were intersected. Two "detextured" sericite carbonate altered feldspar crystal rich volcanoclastic sandstone units in the lower part of the mixed sequence are megascopically similar to Rosebery footwall rocks but Ti/Zr data were interpreted to indicate a similarity to the Hangingwall Epiclastics.

The *mixed sequence* and Hangingwall Epiclastics above the Rosebery Fault dip and face eastward, the relationship of the *mixed sequence* with the west facing Hangingwall Epiclastics on the western limb of the anticline at surface is unknown.

Several samples of core with extensive sericite-carbonate "detexturing" alteration (similar to that at surface near Bastyan Dam) were found to contain normal CaO & Na₂O levels giving low Alteration Indices, which were interpreted to indicate that this style of alteration is unlike proximal VHMS footwall type. A (dubious) empirical comparison of Rb/K ratios with rocks from the Rosebery area suggested that the alteration was not related to a Devonian granitoid associated hydrothermal system either, (there is no geophysical evidence for granite in the near sub-surface north of Rosebery).

Further structural mapping, litho-geochemical sampling and improvement of the structural and geophysical interpretation, particularly around Bastyan Dam, was recommended as a to lead up to additional drilling at Bastyan.

1992 Pasmenco's exploration reported by Purvis (1992) included:

- further mapping with litho-geochemical, petrographic and isotopic studies in the Bastyan Dam area
- drilling of hole BY2 (412.5m) on the north side of Bastyan Dam
- DHEM survey of BY1
- Examination of Cutty Sark and Langdon's workings and the aeromagnetic anomaly at Cutty Sark
- Gravity traverses east of Mt Black
- Re-logging and sampling of Austmin's drill holes MBDs 1-4

BY2 was collared in dacitic Mt Black Volcanics at the northern end of Bastyan Dam, drilled westward and intersected the Hangingwall Epiclastics at 179m; there was no indication of the Mt Black Fault (formerly called the Upper Thrust) at the contact (Figures 13 & 14). The Rosebery Fault was intersected at 366m, higher in the hole than expected but (paradoxically) oriented core measurements suggested a steep NE dip on the structure. The 190m intercept of Hangingwall Epiclastics included consistent sedimentary facings indicating the existence of a large anticline in HWE (the Rosebery Axis) north of the dam. No significant mineralisation or alteration was intersected.

A two loop DHEM survey of BY1 (drilled in the previous year) did not produce any significant responses.

Mapping and drilling around Bastyan Dam did "more to highlight the [structural] problems than to solve them and the detailed structural geology at Bastyan [was] still not well understood".

Litho-geochemical studies of an additional 41 samples from BY2, Austmin's MBDs 1-4 and outcrops around Bastyan Dam suggested two distinct groupings, with Ti/Zr ratios in the ranges 5.1 to 8.3 and 11.6 to 17.7, represented in both the Hangingwall Epiclastics and the Mt Black Volcanics. This led to a (rather muddled) conclusion that both sequences had inputs from separate volcanic centres and that the low Ti/Zr groups had some "genetic connection" with the Rosebery Footwall Sequence.

Normal Na₂O levels and low Alteration Indices in most samples, even in the apparently strongly altered rocks around Bastyan Dam, indicated a generally low level of VHMS footwall type alteration. Only four samples, all from the Mt Black volcanics (2 from the North Bastyan alteration zone and 2 from Cutty Sark workings) were found to be strongly altered (<0.2% Na₂O and AI ~95). The North Bastyan alteration zone was interpreted to have significant extent (300m x 400m) and further sampling and mapping was recommended to define it.

Assessment of Rb/K ratios suggested Devonian granitoid related alteration had been minimal.

An oxygen isotope study of 8 outcrop samples from around the Bastyan Dam area showed no signs of zonal δO¹⁸ depletion and suggested only low temperature, regional diagenetic alteration.

Sulphur isotopes in four samples from Bastyan, Cutty Sark and Langdon's indicated that:

- Pyrite at the margin of the quartz+feldspar porphyry intrusive in hangingwall epiclastics near Bastyan Dam had a low δS³⁴ value (-2.9 ‰) and was probably related to low temperature hydrothermal processes associated with the intrusion,
- Massive sulfide clasts in the Hangingwall Epiclastics near Bastyan Dam have δS³⁴ values in the range 7.3 to 10.5 ‰ which is at the lower end of the ranges for Rosebery (7.1 to 19.8 ‰) and Pinnacles (9 to 12.9 ‰) suggesting that the source of the clasts was "yet to be established", although the Pinnacles was not precluded.

It was concluded that the results of BY2 were not entirely discouraging because the recognition of the anticlinal (Rosebery Axis) fold in Hangingwall Epiclastics re-opened the possibility that Rosebery host rocks could exist at depth, not truncated by the Rosebery Fault, which appears to have a steeper dip on the north side of the lake. G.Purvis seems to have been very encouraged by the recognition of strong feldspar destructive alteration north of the dam and discussed the possibility of testing the surface alteration and the deep Rosebery host rock targets with a single deep (~800m) drill hole.

Detailed Gravity infill traverses on the east side of Mt Black were interpreted to indicate a uniform slab of possibly east dipping normal volcanics with no gravity features of immediate exploration significance.

Modelling of the Cutty Sark magnetic anomaly led D.Leaman to conclude that the major part of the response was due to a buried easterly dipping slab of ultramafics with a depth to top ~600m and dip ~45°E, coincident with the position of Mt Black Fault. Purvis (1992) appears to have had doubts about this, and leaned towards an interpretation involving chlorite-magnetite alteration along the fault, but in any case concluded that the alteration style and the deeper magnetic anomaly did not appear to have economic potential.

1993 Exploration during 1993 was fairly low key compared to previous years and consisted of a DHEM survey of BY2 mapping, limited litho-geochemical sampling, and two lines of IP over the North Bastyan alteration zone (Fitzgerald, 1993).

BY2 was the subject of DHEM surveys using two transmitter loops with a UTEM probe (which could only penetrate to 170m due to a constriction in the PVC casing) and subsequently a CRONE PEM probe to the bottom of the hole. There were some EM noise problems related to the nearby power station but no significant off hole conductors were indicated.

Mapping of the North Bastyan alteration zone was hampered by poor outcrop and featureless massive volcanics but it indicated that the zone, although poorly defined, had an extent of ~300m x 300m and was not continuous with the larger South Kershaw - Chester alteration zone to the north. Only two rock chip samples were analysed; one of these (from a site virtually across the road from one of Purvis', 1992, strongly altered samples) showed significant sericite+pyrite alteration and Ca, Na depletion but the other (from ~110m further east) was relatively unaltered.

Two lines of 50m pole-dipole IP across the North Bastyan alteration zone recorded strong (4x background) chargeability over black shales west of the Rosebery Fault and a broad subtle increase in chargeability (not associated with low resistivity) over the alteration zone. This was attributed to a slight increase in pyrite content associated with alteration. A coincident chargeability high - resistivity low, recorded over the Chester Inlet arm of Lake Rosebery, was interpreted to be continuous with similar responses marking a NE trending shear zone further north.

It was concluded that 30 years of relatively intensive exploration over the Mt Black - Bastyan area indicated that it was unlikely that economic sulfide deposits exist within a few hundred metres of surface but that there could be mineralised favourable horizons at greater than 500m depths.

A 10sqkm area in the eastern part of the EL was recommended for relinquishment and no active exploration for the remainder was planned.

1994-95 No exploration work was carried out during 1994-95 and expenditure was effectively limited to logistic support for PhD student Catherine Gifkins.

Saxon (1995) concluded that current geological interpretations indicated that the Rosebery host sequence extended into EL 12/88 near Bastyan Dam and under Mt Black at depths "well beyond economic interest". No other significant targets remained untested and the licence was recommended for relinquishment.

3.2 Previous Exploration - Farm Creek Area

Pre 1985 Comstaff carried out detailed -80# and panned concentrate drainage geochemical sampling in the early 1970's and flew an airborne INPUT - magnetic survey in 1975 but did not find sufficient encouragement for gridding or drilling.

1986-88 During the period 1986-88 EL 5/63, north of the Pieman River, was explored by BHP (as operators of a joint venture with Comstaff and Preussag). It was considered that previous exploration was unlikely to have missed major near surface VHMS deposits and so extensive fixed loop TEM surveys were utilised to explore virtually the entire licence "to at least the 200m depth level" before the impending licence expiry in mid 1988. Petrophysical testing of mineralised rocks from the EAF area (Pinnacles?) indicated that the high-grade sulfide samples had moderate to high conductivities, which would be detectable by TEM.

Most of the Boco Creek to Farm Creek area (now in EL 12/96) was covered by a UTEM survey involving 3 loops and approximately 44 line km on 200m line spacings (Figure 6). No significant conductors were located and no further work was carried out.

1988-93 Exploration carried out in the Farm Creek area by Pasmenco, under the Burns Peak JV, was mostly of a regional - reconnaissance - remote sensing nature, (Fitzgerald, 1993b).

Sporadic geological mapping has generally confirmed the interpretation of Corbett & McNeill (1986) that the rocks in the area are mostly massive rhyolitic to dacitic lavas, sub volcanic intrusives and pumiceous volcanoclastics of the Central Volcanic Complex (CVC) similar to the weakly altered and non-mineralised Mt Black Volcanics, which overlie the Rosebery Mine Sequence south of Lake Rosebery.

The area has been covered by parts of three high-resolution helicopter borne aeromagnetic and radiometric surveys, which have been merged to produce a 120m terrain clearance drape of residual magnetic intensity. Interpretation of the magnetics (by D.Leaman) indicated that:

- Obvious NE-SW features are related to lithological variations in the volcanics.
- Other NW-SE and sub E-W trends probably represent transverse or conjugate fractures and some appear to be associated with mineralisation, eg: Chester.
- Strongest anomalies are attributable to Cambrian ultra-mafic rocks, possibly in sub surface fault bounded slices.
- There is no evidence of hydrothermal alteration signatures (within the area of current EL 12/96).

Infill surveys to improve the regional Gravity data to ~500m or ~250m station spacings allowed D.Leaman to interpret that:

- The volcanics comprise several large slices with basal detachments dipping to the southeast.
- This thrust stack is folded with amplitudes exceeding 2km and is displaced westward across the original basement - trough margin by at least 3km.
- Thrusting and folding has produced very variable thicknesses of the volcanics which are interpreted to be < 1km in parts of the area.
- Devonian granitoids affect the gravity field in the southeastern part but are not related to any major structures.

A Structural Synthesis suggested that major NE trending faults, such as the Boco Creek Shear Zone (BCSZ), could be syn-volcanic growth faults. The BCSZ marks the boundary between less magnetic rocks to the SE and more magnetic rocks to the NW and lies close to a major NW-SE change in the gravity gradient. Sub-vertical faults east of and sub-parallel to the BCSZ are associated with sericite-pyrite alteration and have west side up dip slip displacements. The large Boco Siding quartz-sericite-pyrite alteration zone (north of the current EL) sits astride the BCSZ.

Several sub E-W structures (called "enigmatic cross structures" (ECS) because they are prominent in Landsat TM, aeromagnetics and gravity data but inconspicuous in surface exposures) were interpreted as possible syn-volcanic growth faults and regarded as possible controls on mineralisation where they intersected (lithologically) strike parallel "basin margin" faults; [presumably by empirical analogy to the Rosebery structural setting; cf: Ch. 3.1, 1991, above].

Fitzgerald (1993b) concluded that the lack of encouragement from previous exploration (UTEM) and absence of mineral shows or alteration indicated a low prospectivity for VHMS deposits within a few hundred metres of the surface.

The 30sqkm block in the Farm Creek area contributed to a 50% required reduction of EL 44/88 in December 1993.

4 INTERPRETATION OF WHOLE ROCK GEOCHEMICAL DATA

Table 1 lists 48 major and immobile trace element "wholerock" analyses from drill core and outcrop samples collected (mostly by G.Purvis and a couple by M.Saxon) in the Mt Black and Bastyan Dam areas. The (assumed) immobile components TiO_2 and Zr are plotted in Figure 16.

All of the following discussion and interpretation of immobile element data is rendered doubtful by my not having logged the core and seen the samples but some are reasonable assumptions consistent with the reported lithologies. The interpretations and mass change estimates are based on litho-geochemical methods presented by MacLean & Barrett (1993).

It is immediately apparent (as recognised by Purvis, 1992) that the samples split into two distinct groups, with Ti/Zr ratios in the ranges 5.1 to 8.3 and 11.6 to 17.7, which (for simplicity in discussion) are here termed "rhyolitic" and "dacitic", respectively. Both groups include members of the HWE and MBV. Purvis (op cit.) noted that samples from the Rosebery Footwall Sequence have low Ti/Zr ratios (5.6 - 9.3) similar to the rhyolitic group (but he did not give actual analyses).

Close consideration of Table 1 and Figure 16 shows that the samples from the Austmin drill holes near Mt Black, which core loggers and petrographers have indicated are very lithologically uniform, actually fall in to three distinct sub groups. The samples from MBD2 and MBD3 (furthest south holes) have the highest Ti/Zr (all >15.5) and those from the (centrally located) chlorite+magnetite alteration zone (Ti/Zr = 12.8 - 13.8) cluster with the majority of other "dacitic" samples. All samples from MBD1 (the northern most hole) fall in the rhyolitic group.

There is little doubt that the Austmin holes have, despite their apparent similarity, intersected parts of three compositionally distinct eruptive units. The south to north decrease in Ti/Zr is consistent with a magmatic differentiation trend and (drawing a very long interpretative bow) could support the concept that the MBV hereabouts young to the north, or northwest, or perhaps (at a pinch) northeast.

The displacement of the MBD4 samples to slightly lower absolute immobile element concentrations (Ti, Al, Zr) from the hypothetical differentiation trend suggests minor mass gains (probably dominantly Si) associated with alteration.

Of the MBD2 sub group, 32765 (148m) plots out at 300ppm Zr, almost on a perfect radial line (through the origin) from 32764 & 32766 suggesting component mass changes due to alteration; Purvis' (1992) core log notes strong chlorite alteration in the interval 147-164m. Mass change calculations using the average composition of 32764 & 32766 as the least altered precursor (Table 1, p.2) indicate this chloritisation involved loss of significant Si and a slight gain of Na, suggesting albitisation of primary K-feldspar, for a total nett loss of $\sim 17\text{g}/100\text{g}$.

The Cutty Sark altered "rhyolitic" MBV also have low Zr values suggesting mass gains. Using the mean composition of 32779 & 34055 (the spatially nearest analyses of possible less altered precursors from the upper parts of BY1 and BY2) as a least altered precursor, the mass changes associated with alteration at Cutty Sark appear to be major gains of SiO_2 ($\sim 40\text{-}50\text{g}/100\text{g}$), Fe_2O_3 and (suspiciously) Al_2O_3 with significant losses of CaO and Na_2O for nett gains of $>50\text{g}/100\text{g}$; MgO and SO_3 are unchanged. The high Si, Fe and Al gains suggest quartz + Fe chlorite (+ magnetite?) veining. Al_2O_3 usually is immobile in VHMS related sea water dominated hydrothermal systems and these assumed mass changes suggest some other alteration/mineralisation style may be responsible.

The HWE volcanoclastics in both rhyolitic and dacitic groups have quite a broad spread of immobile element concentrations which could be partly due to varying crystal/matrix ratios and primary compositional differences but the more or less radial alignments on the TiO_2 -Zr plot suggest that some of the spread is due to alteration mass changes. This is particularly so for the dacitic HWE sub group (Ti/Zr range 11.6 - 14.4) which are highly correlated ($r = 0.946$) to a linear regression which runs almost exactly through the origin (Figure 16). Picking least altered precursors from this sub group is problematic but it appears fairly certain that the "detextured" altered HWE volcanoclastic sandstones from the lower part of the sequence in BY1 (31346 & 31348) have suffered significant mass losses due to alteration. Calculations based on the mean composition of surface samples 31367 & 31381 suggest that the detexturing alteration in 31346 & 31348 involved the loss of moderate amounts of SiO_2 but other components were not significantly changed.

The most strongly sericitised samples of the entire set appear to be 31373, 32775 & 34848 from the North Bastyan alteration zone within apparent MBV "rhyolitic" volcanoclastics. If they are volcanoclastics then there may have been primary compositional inhomogeneities, which makes picking a least altered precursor even more uncertain than usual. However, weakly altered samples 31372 & 34848 are within 100m radius of the strongly altered 32775 & 34845 and

have been used by default, for comparative mass change estimates (Table 1). The indications are that the North Bastyan alteration was associated with moderate Si and total Na mass losses. Sample 31373 from 200m to the NW is a ring-in; it has slightly higher Ti/Zr (making the choice of precursor less valid) and appears to have gained Si and lost all Na.

As a general conclusion, it appears that there are several types of alteration with the following component mass change characteristics:

- A: not plagioclase destructive, moderate Si loss (eg: Bastyan Dam "detexturing" in HWE)
- B: not plagioclase destructive, moderate Si loss & Na gain (eg: MBD2 type chl+ab?)
- C: not plagioclase destructive, slight Si, Fe? gains (eg: MBD4 type chl+Mt+Q? in MBV)
- D: very plagioclase destructive, moderate Si loss & major Na loss (eg: North Bastyan sericite+Py alteration)
- E: very plagioclase destructive, major Si, Fe (& Al?) gains & major Ca & Na losses (eg: Cutty Sark)

Only types D & E have slight similarities to the strong feldspar destructive alteration associated with mass gains of Si, Fe, Mg? & S typical of VHMS footwall systems but neither are direct analogues and both appear to have limited extent, possibly related to brittle structures.

5 DISCUSSION

There is no doubt that the area of EL 12/96, particularly the Mt Black part south of Lake Rosebery, has been thoroughly explored for VHMS deposits with a good mix of systematic grid based exploration, semi-regional remote sensing - structural - stratigraphic interpretation and development and testing of conceptual targets.

For most of the last 30 years exploration has been either managed by, or conducted in joint venture with, the operators of the nearby Rosebery Mine and it is safe to assume that progressive exploration models based on ideas of Rosebery ore genesis were applied. Furthermore, in the last 12 years, there was an almost continuous thread of senior geological expertise in the persons of G.Purvis (who worked on the Getty, Billiton and Pasminco programmes) and F.Fitzgerald (who was involved in the Getty and Pasminco programmes) interrupted only by the Climax-Austmin JV in 1989-90.

The coverage and detail of the systematic grid based surveys appears to be adequate, particularly the Billiton TEM survey which was monumental by Tasmanian standards. The results were generally unimpressive with most of the few desperation drill holes intersecting only weak veiny - disseminated mineralisation (eg: CS1 & CS2) or being inconclusive in defining the source of weak geophysical anomalies (eg: MBDs 1 - 3).

Billiton's RED 87-1 to test a CSAMT-UTEM-magnetic target at Robbie's Creek was probably the most successful of the "anomaly testers" in that it did intersect a discrete conductive and magnetic zone associated with shearing near a contact between lavas and volcanoclastics, even though the style of mineralisation and alteration was not considered encouraging.

There can always be doubts about EM coupling and TEM cannot reliably be used to "sterilise" ground for VHMS deposits, especially poorly conductive sphalerite rich deposits. However, I believe that the systematic geophysical-geochemical surveys were mostly effective, and sufficiently followed up, to indicate a low probability of economically important (large and high grade) VHMS deposits remaining undiscovered within, say, 100m of the surface.

This shifts the exploration focus to the deeper, more conceptual, mineral potential which is enhanced by the nearby Rosebery favourable horizon and apparent, but unresolved, structural complexities.

The conceptual exploration models are basically threefold; listed and discussed below, in order of decreasing exploration difficulty:

1. VHMS potential on possible down dip, or structurally repeated, extensions to the Rosebery favourable horizon under the greater Mt Black-Farm Creek area.
2. VHMS potential on northward strike extensions to the Rosebery favourable horizon, down plunge in an anticlinal setting in the Bastyan Dam area.
3. Potential for structurally controlled mineralisation.

5.1 VHMS potential of extensions to the Rosebery horizon under the Mt Black-Farm Ck area.

The greatest deficiency in the systematic grid based surveys, bearing also on the regional picture, is geological - the greater part of the Mt Black Volcanics remain undifferentiated - and this is mainly attributable to poor outcrop, poor access and relatively uninterpretable massive volcanic facies. The problem is least in the Bastyan Dam area where the lithological contrast between Mt Black Volcanics (MBV) and Rosebery Hangingwall Epiclastics (HWE) and several deep drill holes permit reasonable interpretation (which, nevertheless, seems to be complicated by each new drill hole). Also at the eastern margin of the EL where C.Gifkins (pers. comm., 1996) apparently is mapping out sensible stratigraphy in andesitic units.

C.Gifkins interprets that these andesites face west and underlie the MBV, but so far she has not been able to differentiate the MBV, except into broad groupings of uncertain correlation, and it appears that they are dominantly of dome like intrusive facies. An in depth academic study is probably a good way of unravelling these complexities and could be improved by lots of whole rock geochem, some radiometric dating and especially some strategically placed drill holes. Her PhD project also includes an examination of alteration styles; the results of this will not be available to Plutonic because it is part of the current AMIRA sponsored Mount Read & Mt Windsor Volcanics regional alteration study by CODES ¹².

The current understanding of the lithostratigraphic-structural setting of the MBV is more uncertain than controversial. The MBV have more or less traditionally been regarded as the stratigraphically uppermost unit of a conformable Central Volcanic Complex (CVC) sequence in the Rosebery area.

Lees et al. (1990) subdivided the stratigraphy as follows:

TOP	Mt Black Volcanics (dacitic-andesitic lavas)	>1000m	(MBV)
	Hangingwall Pyroclastics (of epiclastic origin)	50-200m	(HWE)
	Rosebery Mine Seq {Black Slate	0-30m }	(RMS)
	Tuffaceous shale (ore host rock)	35m }	
BOTTOM	Footwall Pyroclastics	>300m	(RFP)

The base of the sequence is cut off by the Rosebery Fault, an east dipping thrust, sub-parallel to stratigraphy, which emplaced the east-facing and -dipping CVC onto slightly younger (?) Dundas Group sediments to the west.

Purvis (1991) recognised that the basal 700m of the MBV (at least) consistently face and dip to the east and retained the MBV at the top of the stratigraphic sequence, but also recognised that the contact between the HWE and MBV is another east dipping thrust (termed the Upper Thrust and, later, the Mt Black Fault - MBF).

These interpretations of MBV at the top are (I suppose) consistent with radiometric dates from an MBV dacite sample (~0.5km west of the summit of Mt Black) indicating an emplacement age of 494.9 +/- 4.3 Ma, similar to the Tyndall Group (Perkins & Walshe, 1993).

More recently, the lithological similarity of the Rosebery Footwall Pyroclastics (RFP) and the MBV, and the presence of the reverse fault (zone?) at the western contact of the MBV, has prompted the interpretation that they are parts of the same volcano-stratigraphic unit repeated by thrust faulting, (Corbett, 1992; Allen, 1994). Allen (op cit., in discussion) was adamant that pumiceous mass flow units of the RFP and MBV are indistinguishable, and considered it unlikely such similar lithologies and facies would exist in stratigraphic repetition.

This interpretation that the pumiceous mass flows of MBV and RFP are equivalent, is not necessarily in conflict with the young radiometric age of the MBV dacite; Gifkins' (pers comm.) opinion that the MBV coherent dacites may have been largely intrusive domes leaves open the possibility that the coherent dacites were intruded into the pumiceous sequence after the main Mt Read Volcanic eruption and mineralising event (set radiometrically) at ~502.6 +/- 3.5 Ma. However, there are some inconsistencies in the radiometric ages which cast doubt on the use of radiometric dating for fine scale lithostratigraphic correlation; (eg: an 8 Ma discrepancy in stratigraphically equivalent Tyndall Group rocks from Anthony Road - dismissed by Perkins (1994, in discussion) as due to volcanoclastically recycled older zircons).

¹² I suggest that if Plutonic is interested in exploring the deep conceptual potential of this and other well explored areas, we can hardly afford not to be involved in the AMIRA & CODES research programmes which are currently spearheading advances in regional lithostratigraphic correlations and interpretation of alteration patterns.

Lachlan Resources NL's interest in the area stems from the TASGO Pieman Road seismic traverse interpretation that there is a major east-dipping fault, which may be a sub-parallel splay off the Rosebery Fault, surfacing just east of the Boco Creek inlet on Lake Rosebery (Drummond et al., 1995). (This fault was unfortunately named the "Mt Black Fault" causing confusion with the possibly different fault of the same name at the MBV-HWE contact between Lake Rosebery and Rosebery Mine; I will here refer to the former as the Tasgo Fault.)

The strike and sense of displacement of the Tasgo Fault are not known but it is seen as having potential for structural repetition (or elevation to near surface) of the east dipping Rosebery favourable horizon, which would enhance the VHMS prospectivity of the area under Mt Black, and/or potential for structurally controlled gold mineralisation.

Two critical factors affecting this structural concept from the VHMS exploration perspective are:

- the trace and displacement of the fault
- the stratigraphy and volcanic facies of the Rosebery Mine Sequence and enclosing rocks.

Preliminary interpretation of the seismic data by AGSO personnel (Figures 17, 18 & 19) shows the Tasgo fault dipping at about 65° E, steeper than the Rosebery Fault, (I am uncertain if this interpretation is on "migrated" data which would affect the dip) and soling in to the Rosebery Fault below ~38 000E, just west of Farm Creek. The east side down offset of shallow, sub horizontal reflectors in the seismic profile paradoxically suggest a normal fault displacement. There has been no further work on this (since the AGC in February) but I understand that a meeting of geological experts in Canberra is imminent (J.Pemberton, pers. comm.) and we may expect some advances in interpretation over the next few months.

It's important because, if the MBV do stratigraphically overlie the Rosebery Mine Sequence (RMS) and the Tasgo Fault had normal displacement, then it is likely to place the favourable horizon at greater depths (exploration negative). If it is a reverse fault then the reverse movements of the Mt Black Fault and the Tasgo Fault (and perhaps others in the package) could combine to bring the favourable horizon nearer, or up to, the surface (exploration positive). Alternatively, if Allen's model of MBV being equivalent to RFP is correct, then combined reverse movements on the Mt Black and Tasgo faults may have emplaced the favourable horizon far above surface (exploration negative) or normal displacement of the Tasgo Fault could cancel out some of the reverse movement of the Mt Black Fault and preserve the favourable horizon east of Rosebery (exploration positive).

The strike of the Tasgo Fault remains speculative; it could be the strike extension of, or an imbricate splay off, the Mt Black Fault (MBF) with a swing in strike from north to NNE across Lake Rosebery and eventually linking with the Boco Shear Zone along the upper part of Boco Creek.

Purvis (1991) interpreted the MBF to swing NW across Lake Rosebery and link with the Rosebery Fault just north of the Pieman Road. He later found the MBV-HWE contact in BY2 was not faulted¹³ and modified the interpretation to suggest that the main structure trends north, cutting through MBV between Chester and Boco inlets on the north shore (Purvis, 1992). This position is about 1km west of the seismic interpretation of the Tasgo Fault. Pasmenco's aeromagnetic pseudo-colour image (Figure 22) suggests that a structure in this position curves north eastward to link with the Boco Shear Zone at ~380500E, 5382400N.

Another potential trace for the Tasgo Fault south of the lake, is through RED 87-1 which intersected an "annealed shear zone" ~450m below surface at ~379200E, 5376950N, (Randell, et al., 1987). This hole has been volcano-stratigraphically under interpreted and it is not clear (to me) if the "annealed shear zone" represents the Mt Black Fault, considerably flattened from its ~60° dip at surface and underlain by HWE, or some other structure entirely within MBV, (Figure 20). Purvis (1992) considered that the MBF (generally) remains essentially conformable with the enclosing sequence and does not appear to flatten at depth.

East of RED 87-1 the MBV geology is insufficiently known to constrain the position of possible fault structures. Leaman (1990) suggested "many [low angle, reverse] detachments are implied [from magnetic and gravity interpretation] around the face of Mt Black, along the axis between Farrell and Boco Sidings and near Farm Creek".

North of Pieman Road, the Tasgo Fault may run in to the Boco Creek Shear Zone (BCSZ). Leaman (op. cit.) implied that the BCSZ is a low angle, east dipping reverse fault.

Fitzgerald's (1993b) structural synthesis suggested that structures like the BCSZ could have been synvolcanic growth faults, re activated and inverted during compression and noted that "volcaniclastic units in the CVC to the east ... are cut

¹³ This is inconsistent with Allen's (1994) MBV=RFP model which requires that the contact between HWE and MBV is reverse faulted. There are three possibilities: either the contact in BY2 is faulted, but not obviously so; the dacites and rhyodacite above HWE in BY2 are some other stratigraphically higher feldspar phyric units not equivalent to the RFP=MBV; or the MBV are semi-conformable over HWE and younger than RFP.

by sub-vertical shear zones, sub parallel to the BCSZ, that show west side up dip slip displacement. Sericitic and pyritic alteration is associated with these shears." However, the west up movement does not seem consistent with deformation in the hangingwall of an east-dipping, west transporting thrust.

In early 1987, I looked at the Boco prospect for Pancontinental (Herrmann, 1987) and developed an interpretation that the large Boco sericite alteration zone sits astride, and was dislocated by, a north east trending and steeply east dipping fault (= BCSZ?) with a dextral wrench component of ~600m which transformed the originally cylindrical alteration pipe into a figure-eight or dumbbell shape in plan ¹⁴. This plan shape is, with a little imagination, apparent in the Pasmenco aeromagnetic pseudo-colour image (Figure 22).

There is clearly no consensus, and currently probably insufficient factual data to form a conviction, on the location, orientation and displacement of potentially complex faults in the Mt Black-Farm Creek area. I am not optimistic that further interpretation of existing gravity, aeromagnetic, and Landsat TM data can do much to refine the structural interpretation. Existing interpretation plans by Leaman (1990) and in Fitzgerald (1993b) portray such a great density and variety of structural "linears" that virtually anything seems possible. The only aspect that seems reasonably constrained by gravity and magnetics, is that the volcanics between the Rosebery Fault and the Henty Fault are depth limited to a few thousand metres at most, and occupy an eastward thickening wedge floored by the Rosebery Fault.

It may be possible to reasonably pinpoint the surface position of the Tasgo Fault on Pieman Road from seismic interpretation and carry out detailed structural mapping of faults and movement sense indicators in the cuttings there, to get a better idea of the orientation and displacement of this structure. It needs, however, good volcanic facies mapping to confirm the gross structural picture (movement sense indicators on faults are notorious for recording minor youngest movements) and also to piece together the volcano-stratigraphic sequence to enable recognition of favourable horizon(s) or infer their sub surface locations.

However, the internal structure and stratigraphy of the volcanics, east of the Rosebery Mine Sequence under Mt Black and in the Farm Creek to Boco area, remains very poorly understood.

Previous explorers, particularly GODC and Billiton, made serious attempts to identify VHMS favourable horizons within the "lava" dominated MBV (which they considered to be stratigraphically higher than the Rosebery horizon) and were interested in volcanic hiatuses represented by fine volcanoclastic units at Robbies Creek (in RED 87-1), Langdon's and east of Mt Black, but in the absence of geochemical and geophysical encouragement could not justify deeper exploration of these horizons. It seems unlikely that any exposed analogues or extensions of the RMS would have been overlooked.

Sainty (1986), from the results of deep drill holes collared east of the Rosebery Mine (south end) postulated that the RMS is folded about a synclinal axis and would come to "near surface about 1km east of the drill sites". I estimate the drill sites to be near 379500E, 5374500N and therefore the RMS should surface about the easting of Mt Black according to Sainty's model. If it is exposed, one would expect that the RMS would have been recognised in the road cuttings along the Murchison Highway east of the mine. I have not seen this concept discussed elsewhere and am uncertain whether it has been discounted or simply never followed up. Sainty interpreted that the MBV conformably overlies the HWE, at least at the north end of the mine, and did not mention any fault at this contact.

In view of the volcano-stratigraphic and structural uncertainties of the Mt Black - Farm Creek area, I conclude that there are no currently evident conceptual drilling targets.

It seems to call for a longish term and detailed (but not necessarily expensive) approach by "boot and hammer" mapping and, if possible, relogging and interpretation of drill core from holes through MBV, to develop a volcanic facies and structural model and conceptual exploration targets for testing.

Since the prime favourable horizon is represented by possible extensions of the Rosebery Mine Sequence it would be extremely advantageous to have access to, or first hand knowledge of, the Rosebery environment and the several drill holes on the mine lease which have been drilled through MBV in attempts to intersect the Rosebery Sequence at depth. The outcrop in the Mt Black area is reportedly poor and given the abundance of compositionally similar, possibly

¹⁴ The summary page of Herrmann (1987) (which is all I have available at the time of writing) refers to a north trending fault and N-S oriented elongate dumbbell shaped alteration zone. I'm pretty sure that this refers to grid north on the old EZ Co. Boco grid, which was equivalent to AMG northeast (Figure 1). The Boco alteration zone sits right along strike of the BCSZ and the incised valley of Boco Creek and, as far as I recall, it was my impression that it is the same fault that dislocated the alteration zone. The presence within volcanoclastic breccias, of very pyritic clasts and assemblages of slightly and intensely altered volcanic clasts led me to conclude that the alteration was synvolcanic, that parts of the alteration zone had been reworked in proximal breccias and that the fault dislocation was essentially post alteration. It could be argued that the alteration zone was focussed on a synvolcanic fault and dislocated by subsequent minor dextral movement or (more radically) that the variable alteration of clasts in breccias was due to differences in susceptibility to alteration and that the alteration was entirely post volcanic and structurally controlled.

largely intrusive, coherent volcanic facies, it will be difficult enough to construct better than a skeletal geological interpretation. Familiarity with the Rosebery set up will be essential to ensure that subtle clues are not overlooked. As suggested above, this may be best achieved by (Gifkins'?) academic studies or, alternatively, in JV with Pasminco to obtain access to Rosebery data and core.

It is noteworthy that Pasminco are apparently not currently exploring the RMS deeper than ~1500m below surface in the immediate vicinity of the mine, (Berry, 1996) and that Pasminco voluntarily relinquished EL 12/88 on the understanding that possible extensions to the RMS existed at depths "well beyond economic interest", (Saxon, 1995).

5.2 VHMS potential of northward strike extensions in the Bastyan Dam area.

The north plunging anticline model developed by Billiton has been persistently pursued by Pasminco in the drilling and DHEM of two holes totalling 975m at Bastyan Dam.

The first hole, BY1 (on the southern shore of the lake) drilled into a consistently east facing sequence of HWE (apparently >450m thick but possibly thickened by repetition above the Subsidiary Thrust and possible interdigitation of Dundas Group units in the lower part) without apparently intersecting equivalents of the Rosebery host rocks or RFP. It did nothing to support the interpretation of the anticlinal "Rosebery Axis" or host rocks extending to that northing, and there was no encouragement in the DHEM to suggest a near miss.

BY2, 600m further north, made an ~190m intercept of HWE with consistent facings indicating it passed through a major anticlinal axis near about the middle of the HWE intercept; i.e. it apparently intersected approximately the upper 100m of the HWE sequence. Likewise, no Rosebery host rock equivalents were intersected or DHEM anomalies detected. This result, however, was more positive than the former in that it does support the existence of the "Rosebery Axis" at that northing and keeps open the prospect that the Rosebery host rock equivalents exist further down sequence. The apparent local steepening of the Rosebery Fault reduces (but does not eliminate) the possibility that the host rocks are truncated by it.

BY2 passed through the interpreted "Rosebery Axis" at ~220m below surface after penetrating ~100m of HWE. If the maximum thickness of HWE is 200m (as per the estimate of Lees et al., 1990, at Rosebery) then the host rock equivalent in the hinge should be <170m below BY2; i.e. at <380m below surface, with allowance for thickening in the hinge as inferred in Figure 14. However, if the indication from BY1 that the HWE at Bastyan is >450m thick is correct, then the host rock equivalent may lie in the inferred hinge >550m below BY2, or >750m below surface. In the latter case, the Rosebery Fault would have to have an east apparent dip of >60° to avoid truncation of the host rock/hinge position.

The shallower possibility remains a mildly tantalising exploration target which could be tested in a fairly straightforward way by drilling another hole of ~520m, collared at -80° to -85° to the west, from the site of BY2. Major negative factors influencing this target are:

- The evident structural complexity around Bastyan Dam, which could produce an inconclusive result from a limited programme restricted to one additional hole.
- The very limited strike extent, of 1400m (1000m within EL 12/96 and 400m open ground immediately to the south) and the potential mining complications due to the hydroelectric dam and power station sitting directly above it. The potential for the target zone plunging north into EL 44/88 is less problematic on account of the existing Pasminco-Plutonic JV.
- The nearest reported drill hole to intersect the northward extension of the Rosebery host rock and footwall pyroclastics is 71R, some 1700m south of Lake Rosebery and within the mine lease, only 750m north of the orebody. The host rock in this hole was not significantly mineralised (Randell et al., 1986) and we have no information on the degree of footwall alteration¹⁵. The HWE in 71R appears to have a stratigraphic thickness of ~250m which includes a ~50m thick black shale unit near the top. Purvis' (1991) longitudinal projection (Figure 30) shows an additional hole, 107R, midway between 71R and Lake Rosebery, which evidently intersected the host rock unit but (since it is within the mine lease) is not discussed in available reports.

¹⁵ Randell et al. (1986) included a core log of hole 71R as Appendix IX; I don't have a copy but it may provide some information on the RFP alteration style. Their cross section of 71R (reproduced here as Figure 29) indicates three petrographic samples from the RFP and notes it is "strongly schistose, moderate-strong sericite [altered]".

There is no (publicly available) documented evidence to show that the Rosebery host rocks do extend to Lake Rosebery or, if so, alteration/mineralisation vectors to suggest that it is mineralised in that area. Previous explorers have interpreted the sulfide clasts in the HWE near Bastyan Dam, particularly the group of large "rafts" upto 8.5 x 1m size, to indicate a fairly proximal source, and were somewhat encouraged by the extent of hydrothermal alteration in the Bastyan area. Purvis (1992) showed that the alteration is not as strong as it seemed and it is unlike VHMS footwall alteration (which is not, in itself, a damning result since it is in the hanging wall sequence above the inferred favourable horizon). He subsequently became more interested in the newly recognised North Bastyan alteration zone on account of strong sodium depletion in a few samples, and the long held view that the HWE in the Rosebery area was deposited from mass flows originating to the north and therefore alteration to the north of the sulfide clasts might indicate the VHMS source in that vicinity. Since the North Bastyan alteration zone was interpreted to exist in Mt Black Volcanics, then regarded as younger than the Rosebery sequence, it is not clear what syn-volcanic hydrothermal alteration relationship was envisaged between it and the favourable horizon but presumably the structural complexity at Bastyan could account for it. Purvis (op cit.) speculated on the possibility of testing both targets - the North Bastyan alteration zone and the inferred host rocks in the anticlinal hinge - with a single drill hole.

Saxon (1993) subsequently downgraded the importance of the North Bastyan alteration zone and I also, on the basis of a brief inspection of some roadside outcrops there and the suggestion of nett mass losses (Ch.4), am so far unimpressed with it. Given the current alternative interpretations (that North Bastyan alteration is in MBV which either overlies the favourable horizon or are lateral equivalents of the footwall thrust over it from some distance to the east) the spatial association between alteration at the surface and potential mineralisation in an upright favourable horizon at some depth does not provide a clear exploration vector. Of greater importance, is the alteration zonation and intensity in the immediate stratigraphic footwall of the favourable horizon, and this can only be determined by drilling. Accordingly, I would not be too distracted by weak alteration and weak IP responses at surface if the deep structural target, notwithstanding the negative factors, is considered prospective.

I do have some doubts about the validity of extending the favourable horizon concept over 20km of strike between Hercules and Pinnacles (Purvis, 1991), through probable lateral volcanic facies changes, and still being certain of recognising the equivalent of the Rosebery host rocks. From about 1986 on, G.Purvis seems to have been fairly sure that the RFP-RMS-HWE layered sequence was recognisable north of the mine. However, after drilling BY1 & BY2, he suggested that the HWE may have been partly contemporaneous and interbedded with the (less volcanic) sediments of the Dundas Group and, on recognition of some low Ti/Zr rhyolitic volcanics in the RFP, HWE and MBV, inferred some common magmatic source.

From reported descriptions, it seems that the Rosebery host rocks are not very distinctive volcanoclastic (tuffaceous) siltstones and I am surprised that it has been unequivocally stated that holes such as CS1, CS2, BY1 & BY2 did not intersect the host horizon. Obviously, any hole in the Rosebery vicinity that went down through a sequence of quartz+feldspar crystal rich volcanoclastic sandstones, tuffaceous siltstones and into altered massive feldspar phyric pumice breccia, could be safely interpreted to have gone through the host rock position. However, given the possibility of lateral facies changes and interdigitating mass flow volcanoclastic units from separate provenances, it may not be simple in every case to pick the host rock position. For example: if the RFP was laterally transitional into quartz+feldspar phyric volcanoclastics, it could be difficult to distinguish the host rock tuffaceous siltstone from other volcanoclastic siltstone and shale units, which exist within the HWE.

In this regard, the interpretation of any future "exploratory-stratigraphic" drilling for the sub surface extensions of the Rosebery host horizon in the Bastyan Dam area, would be substantially improved if geological access to core from previous holes drilled through the RMS were available.

5.3 Potential for structurally controlled mineralisation.

Over the past ten years there has been considerable exploration in western Tasmania for structurally controlled gold mineralisation analogous to the Henty deposit, especially along the Henty and Rosebery fault zones. Genetic models for Henty are not yet widely published but current opinion seems to be swinging to favour a structurally modified? "essentially stratigraphic Cambrian VMS character... in the lower part of the Tyndall Group volcanic sequence and the underlying Central Volcanic Complex rocks, (Corbett & Green, 1995).

EL 12/96 lies just west of the Henty Fault Zone (where EZ Co., GODC & Billiton discovered sub economic Au-Sn mineralisation at the Murchison River) but given the uncertainty of regional volcano-stratigraphic correlations and the indications of other major faults in the Mt Black - Farm Creek area which could connect with the Henty and/or Rosebery Faults at depth, there may be potential for more of this style of "fault associated" mineralisation.

A deeply buried Henty analogue, associated with strong quartz-sericite-pyrite alteration, would be difficult to detect by surface geophysics but the Mt Black Volcanics host another style of possibly fault related mineralisation, associated with chlorite+magnetite alteration, which represents a relatively simple geophysical target.

Purvis (1991, p.12) discussed a zone of patchy magnetite+pyrite+chalcopyrite mineralisation within chlorite altered MBV just above the Mt Black Fault (which was at that time called the Upper Thrust) extending for at least 2km north of Rosebery Mine. This reportedly is best developed at ~5377000N at "the old Hawkesbury workings" where dump samples were found to contain up to 1.2% Cu and 0.2g/t Au.

Billiton's drill hole RED 87-1, drilled beneath the workings to test a UTEM anomaly, intersected a zone of strong "annealed deformation" associated with patchy chlorite alteration and irregular veinlets and disseminations of magnetite and pyrite containing up to 1600ppm Cu, 630ppm Pb, 3300ppm Zn and 175ppm W, (Randell et al., 1987). Purvis (1991) reported the best assay in RED 87-1 as 0.4m @ 0.13% Cu and 0.12g/t Au. This style of mineralisation is possibly responsible for the large aeromagnetic anomaly extending for over ~5km of strike from east of Rosebery through Cutty Sark to the north of Lake Rosebery.

Purvis (1992) also considered that the pyrite+chalcopyrite mineralisation associated with chlorite alteration in massive lavas at the Cutty Sark workings is a related style of mineralisation, even though there is no magnetite there. A picked dump sample from Cutty Sark contained upto 4.8% Cu, 0.13% Pb, 0.05% Zn, 29g/t Ag, 0.7g/t Au and 0.3% Bi. Pyrite from this sample has a δS^{34} value of 18.1 ‰ which is at the high end of the Rosebery range, similar to barite ore (and may suggest an original sulfur source substantially from Cambrian seawater sulphate ?).

Modelling of a single (meandering, non linear) ground magnetic traverse across the aeromagnetic anomaly at Cutty Sark led D.Leaman (App.8 in: Purvis, 1992) to interpret that the bulk of the magnetic response was due to a deep, east dipping sheet of ultramafic rocks. However, Purvis (op cit.) clearly preferred an interpretation involving the chlorite+magnetite alteration, which happens to occupy the same position and dip as Leaman's ultramafic slab. Leaman's model was based on his observation that none of the rock magnetic susceptibilities measured in the MBV are anywhere near high enough to account for the broad aeromagnetic anomaly. He noted that an altered volcanic model (as in his Fig. 5, App. 8 in: Purvis 1992; which actually provides one of the best "fits" of his various options) would require "a key portion to bulk at > 0.001 cgs" and argued that "peak values are typically half to one third the bulk minimum required by the model and a tenth of the peak required."

This does not seem to be strictly so: magnetic susceptibilities measured in Austmin's drill hole MBD4 (which tested part of the chlorite+magnetite alteration zone discovered by GODC northeast of Mt Black) range upto 22.9×10^{-3} SI (= 0.0018 cgs) (App. 2 in: Purvis, 1992). This order of magnitude would satisfy Leaman's requirement and it is not difficult to envisage a large mass of magnetite rich material down dip on the Mt Black Fault as an equally plausible source for the magnetic anomaly. It is rather surprising that Leaman did not attempt to bring the gravity data into the modelling exercise - this is usually one of his mainstays: that combined magnetic & gravity modelling can produce near unique solutions.

I share Purvis' (1992) apparent doubts about the ultramafic interpretation of the Cutty Sark magnetic anomaly and accordingly consider that the modelling needs to be revisited, preferably with additional magnetic susceptibility and specific gravity measurements from chlorite+magnetite type mineralisation from RED 87-1 and the Hawkesbury workings, to check whether a large body of this material can definitely be excluded as a magnetic source rock.

The point is that, if the magnetic source is related to alteration near the fault, then the greatest development of it may not yet have been sampled at surface or in the few drill holes, and (optimistically) there may be down dip or lateral zones which are more significantly mineralised. Billiton, and later Pasminco, were discouraged by the indications of low grade mineralisation and the style of alteration but it can certainly not be regarded as having been exhaustively tested.

The important questions, which I can only speculatively address, are:

- what is the style and origin of mineralisation and alteration?
- what is its economic significance?

The anomalous tungsten in RED 87-1 and bismuth at Cutty Sark suggest that (Devonian?) granitoid associated hydrothermal systems have been involved. Alternatively, the Cu-Au in a chlorite+magnetite+pyrite+chalcopyrite assemblage seems similar to that of the Red Hills, Lake Selina and Jukes Proprietary copper-gold prospects, which Large et al. (1994) interpreted to occur in medial shells of chlorite+pyrite+magnetite alteration surrounding Cambrian granitoids.

Large et al. (op cit.) presented a genetic model relating deep intrusive granites with shells of Jukes-Selina type Cu-Au (Mt>>Py) forming at ~4km below sea floor, to mid-level Mt Lyell type disseminated Cu-Au (Py>>Mt) and Rosebery type massive sulfides (Py, no Mt) forming at/near the sea floor, and suggested that the Cu and Au were sourced from the granites. It is interesting that their model also suggests heaviest sulfur isotopic ratios for the deepest (Jukes-Selina type) mineralisation, of $\delta S^{34} \sim 10-17\%$, which approach that of the single Cutty Sark sample. Oxygen isotopes of magnetites from mineralisation in the granite haloes and the Mt Lyell deposit are reportedly consistent with a magmatic source.

C.Gifkins (pers. comm.) was not at liberty to discuss her Mt Black alteration studies because of AMIRA sponsorship but it is fairly likely that she is, or should be, looking at this possibly fault associated or Cambrian granite associated style of chlorite+magnetite alteration. This is another reason to regret the lack of Plutonic involvement in Tasmanian CODES-AMIRA research.

As far as I am aware, the Jukes-Selina type Cu-Au mineralisation is currently sub-economic and there are no economically important analogous deposits in Tasmania, except perhaps Mt Lyell, which the model of Large et al. (1994) places midway between the Jukes-Selina type deep granite halo and the Rosebery type sea floor mineralisation.

Therefore, it must be empirically regarded as a second order exploration target. However, the magnetite association makes it fairly easy to define and test. A major drawback is that EL 12/96 will cover only 1km of strike of the aeromagnetic anomaly, and almost half of that is under Lake Rosebery.

If this type of target is of interest to Plutonic, then I would envisage an exploration programme along the following lines:

- Revised modelling of aeromagnetic and gravity data.
- Study of style of alteration and mineralization, preferably in conjunction with current academic research and virtually dependent on access to core from RED 87-1 and the Hawkesbury workings, in the Rosebery Mine lease.
- Grid refurbishment, ground magnetics and geophysical modelling to refine targets, if justified.
- Diamond drilling, DHEM and down hole magnetics to test targets.

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Appendix II

MEMORANDUM

To Bob Close, District Geologist - Base Metals, Lachlan Resources N.L., North Sydney

From Wally Herrmann

Date 27 February, 1997

Subject Lake Rosebery EL 12/96; Update on geological interpretation

Dear Bob,

As requested, I have brushed up on the Lake Rosebery geological data in an attempt to outline some direction for the next phase of exploration.

Given the extent of previous systematic exploration programmes, it seems to me that the overall VHMS prospectivity x findability factor is lowish and that the three 'conceptual' exploration models discussed in my June 1996 report still apply. These are further discussed below, in order of decreasing economic potential and decreasing exploration difficulty:

1. VHMS potential on possible down dip, or structurally repeated, extensions to the Rosebery favourable horizon under the greater Mt Black-Farm Creek area.

An informal conversation with Cathryn Gifkins last week suggests that she has not made any major breakthroughs in establishing a stratigraphic sequence or regional correlation for the Mt Black Volcanics (MBV). We still do not know if they are younger than the Rosebery Mine Sequence (RMS) or (alternatively) equivalent to the Rosebery footwall pumice breccias (RFP) repeated by reverse movement on the inferred 'Mt Black Fault' to the east of the RMS. She is struggling to find some funding for additional radiometric dating to help resolve the issue but is not convinced that it would be successful in view of her interpretation that most of the MBV represent intrusive sill/dome facies. She was reasonably forthcoming in discussion and does not expect that Pasminco will require confidentiality of the regional geological aspects of her work but, regrettably, the work doesn't seem to have come up with concrete interpretations of significance to conceptual exploration. Cathryn is currently flat out logging core (to maximise the last opportunity for laying out and stacking assistance from Pasminco's core store staff who apparently will be retrenched in a few weeks) and is unable to formally consult to Lachlan Resources for about the next month but indicated that she'd be happy to co-operate, if Pasminco is agreeable, after about mid March.

The major stimulus for Lachlan's EL application over this area was the TASGO seismic interpretation of an east dipping fault near Boco Inlet which 'may have been the locus of hydrothermal mineralisation or be responsible for repetition of the favourable Rosebery Mine Sequence', (Randell, 1996). My enquiries at Mineral Resources Tasmania (David Seymour, pers. comm. 18/2/97) indicated that MRT and AGSO experts had convened last November to interpret the TASGO data but had mainly worked on offshore interpretation problems; the Pieman Road Traverse data had been tabled but no advance in interpretation had been proposed.

I had a further discussion about the inferred fault with AGSO's Barry Drummond (pers. comm. 27/2/97). He says that the seismic reflections are pretty clearly indicating a fault or shear zone of some sort but he has no idea of the sense of movement. The TASGO name for it (Mt Black Fault) apparently derived from a suggestion from an MRT geologist (possibly Geoff Green) that it might link up with the known? fault of that name at the eastern boundary of the Rosebery Mine Sequence some 1.5km further west. Apparently the entire Pieman Road traverse is seismically very complex and B.Drummond suspects 'a fearful amount of out of plane movement' and considerable late stage strike slip movement on

faults in general. He is unable to distinguish the base of Mt Read Volcanics from the underlying Proterozoic? basement. He mentioned, that following discussion with Prof.R.Large, the TASGO seismic interpretation data is to be sent to CODES for comparison with mega structural concepts and that Dr.R.Berry may be able to provide comment on the Pieman structural set up.

One of the problems with the TASGO Boco Inlet Fault is that the original seismic interpretation implies a normal displacement, east side down, on an east dipping structure. It's an important problem because, if the MBV do stratigraphically overlie the Rosebery Mine Sequence (RMS) and the TASGO Boco Inlet Fault had normal displacement, then it is likely to place the favourable horizon at greater depths (i.e. negative factor for exploration). If it is a reverse fault then the reverse movements of the Mt Black Fault and the TASGO Fault (and perhaps others in the package) could combine to bring the favourable horizon nearer, or up to, the surface (i.e. positive for exploration). Alternatively, if Rod Allen's model of MBV being equivalent to RFP is correct¹⁶, then combined reverse movements on the Mt Black and TASGO faults may have emplaced the favourable horizon far above surface i.e. negative factor for exploration) or normal displacement of the Tasgo Fault could cancel out some of the reverse movement of the Mt Black Fault and preserve the favourable horizon east of Rosebery (i.e. positive for exploration).

In short, the sense of movement, displacement and trace of this postulated fault (if it exists), together with the stratigraphic correlation of the MBV, are fundamentally critical factors influencing the Lachlan exploration concept. But at this stage there is virtually no documented work to narrow down the ramifications.

I have searched for the TASGO Boco Inlet Fault in the field and found no sign of a major fault in the rather good exposures in cuttings along the Pieman Road although there are certainly enough sections of no outcrop or glacial boulder till to obscure it. Outcrops in cuttings for about 1km west of Boco Creek are dominated by feldspar (+/- minor quartz) phyric rhyolite-dacite coherent facies with minor possibly pumiceous felsic volcanoclastics whilst those east of Boco Creek are mainly siliceous feldspar phyric +/- lithic pumice breccias and lesser sparsely feldspar phyric coherent spherulitic rhyolite-dacite. However, the megascopically discernible differences are very slight and I am by no means convinced that they represent different sequences.

I have collected a suite of 19 fresh samples from this area which would be suitable for major and immobile trace element analyses and petrographic examination (at a cost of around \$2,000) but in the absence of a well defined stratigraphy of the MBV, the results of such a study may not be conclusive and probably the best we could anticipate is either an indication of, or absence of, a compositional change near Boco Creek, neither of which would confirm or deny the presence of a fault. I am reserving a decision on whether to go ahead with such analytical and petrographic studies until either some improved structural interpretation comes out or Lachlan indicates high priority for exploring this concept.

At this stage there is no firm evidence of the fault, apart from some subtle alignments of wiggly lines on a seismic reflection section, to support the structural/stratigraphic repetition exploration concept. Other than deep stratigraphic drilling, there does not seem that much can be done to advance it in the short term.

2. VHMS potential on northward strike extensions to the Rosebery favourable horizon, down plunge in an anticlinal setting in the Bastyan Dam area.

This target was vigorously tested by Pasminco's two drill holes BY1 and BY2, near Bastyan Dam, respectively on the south and north banks of the lake. I had a look at the core from these holes (at Tullah, last week) to check the evidence for an anticlinal fold at this latitude.

¹⁶ G.Purvis (pers. comm. 26/2/97) disagrees with the correlation of Rosebery footwall pyroclastics with the MBV on the grounds that volcanoclastic units in the MBV have a prominent quartz crystal component whereas the Rosebery footwall pumice breccias are entirely feldspar phyric - in logging many metres of RFP he has rarely seen a quartz crystal.

In BY1 there are a number of units of turbiditic sandstone-siltstone and thick graded mass flow volcanics which provide reliable (grainsize grading) facing indicators and I agree with G.Purvis' interpretation that the sequences both above and below the Subsidiary Fault young UP the hole; ie: to the east (see Figure 12 in Herrmann, 1996).

In contrast, the lithologies in BY2 are dominantly very thick units of massive lithic felsic volcanoclastic sandstone and breccia without grainsize stratification or clearly graded zones and I think the evidence for eastward facing in the upper part and westward facing in the lower part of the hole, is slender indeed. If I had been logging the hole unaware of the previous interpretation of an anticlinal fold, I would not have noted opposing facings. The zone of crystal-lithic felsic volcanoclastics between ~210 to 330m in BY2 does appear to have a greater proportion of lithics in the middle part, with more coarse sandy-pumiceous material above and below, which would be consistent with fold symmetry. However, there are quite unsystematic local variations in clast frequency and furthermore the pervasive alteration tends to obscure clast outlines so that some apparent gradations in clast content may be spurious. The only reasonably reliable facing I could infer in BY2 (~50% confidence) was in the Hanging Wall 'Epiclastic (HWE) type lithic fs-qtz crystal rich volcanoclastic sandstone unit between ~177 to 206m which has a higher clast frequency in the lower part and appears to indicate facing to the east. In short: the only reliable facing indicators in BY1 and BY2 core suggest that the sequence faces east. In the middle to lower parts of BY2 the facing is indeterminate, and there is no strong evidence of an anticlinal closure in the drill core.

Becoming sceptical, I also spent a morning examining outcrop along the south shore near Bastyan Dam and in the spillway; the lake level being temporarily about 2.5m below normal levels. Between the upper weir of the spillway and the point opposite the small island about 300m to the east, the exposure is dominated by massive quartz+feldspar crystal rich lithic/pumiceous? coarse volcanoclastic sandstones and a central zone of uniform, coherent quartz+feldspar porphyry.

The quartz phenocrysts in the porphyry have a distinctive rounded partly resorbed form, crowded with small white globular melt? inclusions, and are identical in appearance to the quartz crystals in the HWE volcanoclastics hereabouts. The volcanoclastics contain an average ~2% of 5-100mm sized clasts of cherty siltstone, aphyric rhyolite and some fine QFphyric lava (and in a small patch at the low water line on the point opposite the island, also some lenticular pods and patches of massive pyrite +/- minor quartz & sphalerite). There are local variations in clast frequency but I could not discern any grainsize or compositional layering (let alone facing) in these very massive looking volcanoclastics. The only example of grainsize layering was in a 2-3m long deformed thin lens or raft of fine grained cherty siltstone amongst massive lithic volcanoclastic sandstone between the porphyry and the top of the spillway. I am very doubtful of the validity of the bedding and facing measurements shown on Pasmenco's 1:5000 plan (reproduced as Figure 13 in Herrmann, 1996).

The massive lithic sandstones persist for about 40m down the spillway where they terminate against the 45° east dipping Subsidiary Fault (which is grouted right across the floor and wall of the spillway). Immediately below the fault is a ~5m thick unit of massive medium to fine grained pink feldspathic sandstone grading west (downstream) into fine cherty sandstone/siltstone and ultimately to a ~3m thick bed of black cherty siltstone. The latter has a very sharp contact, trending 355°/dip77°W, on its western side, with a coarse grained (5mm) quartz-feldspar crystal rich volcanoclastic sandstone containing abundant irregular black siltstone intraclasts within about 1m of the contact. The coarse sandstone also fines up westward over a few metres and then passes into a ~50m thick sequence of massive to diffuse bedded pink sandstone with some diffuse units of coarse crystal-lithic rich sandstones gradually diminishing westward to culminate in a 5m wide zone of thinly bedded, partly transposed, sandstone, siltstone and minor black cherty siltstone. This is succeeded downstream by a very massive blurry 'detextured' apparently feldspar phyric (with rare small quartz crystals according to petrographic reports) vaguely pumiceous looking volcanoclastic (but possibly an altered coherent dacite) which continues westward ad nauseum beyond the base of the spillway to the EBR Pieman River bridge. The consistent grading in sandy units and the sharp siltstone-sandstone contact with intraclasts presents unequivocal evidence for westerly facing and steep westerly dips for about 60m below the Subsidiary Thrust, but the dip and facing above (east of) the thrust is indeterminate.

The simplified lithological and structural set up is illustrated in Figure 1a (attached).

The sequence is lithologically very similar to that intersected in BY1. That is: the westward progression at surface, from quartz phyric-lithic volcanoclastics through coherent quartz+feldspar phyric rhyolite (intrusive and/or lava) into a layered sequence of felsic volcanoclastic sandstone/siltstone and black siltstone followed by massive 'detextured' sericite-carbonate altered feldspar phyric volcanoclastics, is repeated downhole and westward in BY1.

Furthermore, this arrangement is similar to the reported sequence at Rosebery and I am tempted to speculate that the layered sandstone-black siltstone assemblage could be equivalent to the Rosebery host rocks immediately underlying the quartz phyric HWE. In this, I feel seriously handicapped by not having first hand knowledge, or access to good lithological descriptions, of the Rosebery set up. A.J.Crawford (in petrographic descriptions) suggested that the

'detextured' sericite-carbonate altered feldspar phyric volcanoclastics in the interval 408-507m in BY1, were 'similar to the Rosebery footwall rocks' but Purvis (1991, p18-19) discounted this on the basis of Ti/Zr ratios (12.5 compared to 6-8 for the Rosebery footwall pumice breccias) which he regarded as 'clearly indicating that [the detextured samples] are from the Hangingwall Epiclastics and not the Footwall'.

However, could it be possible that the 'footwall pyroclastics' may have local variations in composition, magmatic provenance and volcanic facies? ¹⁷ The problem with this interpretation is the opposing facings in the layered sequence between BY1 (where it faces east consistent with the sequence at Rosebery) and the surface (where it faces west towards the 'detextured' sericite-carbonate altered feldspar phyric volcanoclastics and would imply unrecognised structural complexities or fault breaks if the overall stratigraphic sequence youngs east). To pursue this line of interpretation, a possible structural set up is illustrated in Figure 1b (attached); this involves an un-recognised normal fault displacement through the western limb of an antiform below the Subsidiary Thrust, to bring the stratigraphically lowest 'footwall pyroclastics' to surface at the lower end of the spillway.

If this correlation between lithologies at Bastyan Dam and Rosebery is valid (and I must state that I'm extremely doubtful about it) then BY1 has passed through the favourable horizon without intersecting significant mineralisation and penetrated into footwall rocks which are not Na₂O depleted, have low pyrite contents, low Alteration Indices, low δO^{18} determined alteration temperature and generally do not have the alteration characteristics which would be expected in the proximal footwall zone of a VHMS deposit.

Alternatively, if G.Purvis' interpretation is correct (correlating the 'detextured' sericite-carbonate altered feldspar phyric volcanoclastics with parts of the HWE) then the potential for finding the Rosebery favourable horizon further down sequence is seriously reduced, under the southern shore of the lake, by the eastwards flattening dip of the Rosebery Fault which probably has truncated the sequence there.

BY2, on the north shore of the lake (about 600m north of BY1) intersected a rather different sequence from the one described above in that the layered sandstone/siltstone/black siltstone group was not encountered. From ~180m to 335m the hole is in massive quartz-feldspar crystal/lithic HWE type sandstones and breccias similar to those in BY1 between 106-220m; ie: the upper part of the HWE as interpreted by G.Purvis (1992). As discussed in my previous report, (Herrmann, 1996) the possibility that the Rosebery favourable horizon exists in an anticlinal hinge at some depth below BY2 (~380m to >750m below surface) represents a mildly tantalising target. However, a major negative factor is the better than even chance that the Rosebery Fault flattens eastward (unlike Purvis' optimistic interpretation that it steepens: see Fig 14 in Herrmann, 1996) and, given that the anticline is inferred to plunge north, would truncate the hinge stratigraphically above the favourable horizon position. The upper part of the hole (above ~180m) is in massive coherent, pink-buff coloured feldspar phyric dacite. Curiously, one of the four wholerock analyses from this interval has a distinctly rhyolitic Ti/Zr ratio (Herrmann, 1996; Table 1) but the core is virtually (megascopically) indistinguishable from the dacites above and below.

The lack of confidence in precise correlation of the Bastyan Dam rocks and the Rosebery Mine Sequence, and the evident structural complexity, makes it difficult to advance a neat conceptual target for this area. The short available strike length, position under the lake-dam-power station, and the discouraging indications from alteration studies and DHEM, do not help much. I would be reluctant to propose even a 'stratigraphic-exploratory' drill hole to Lachlan Resources without further information on the favourable horizon and the enclosing sequence at Rosebery; i.e. one needs to be familiar with the analogous model in order, firstly, to design the best drill target and, secondly, to interpret the results.

I can envisage three ways of obtaining this information:

- i) Subject to Pasminco's agreement, re-log lots of drill core and undertake a study of the Rosebery mine environment.
- ii) Seek the consulting service of Gerald Purvis who, over the past 10-15 years, has logged lots of core and is familiar with the Rosebery mine environment.
- iii) Seek a joint venture with Pasminco and geological input from their staff; this could also offer a chance to overcome the short strike length problem if they would consider JV exploration in the northern part of the mine lease.

A combination of the last two would provide good geological resources for further exploration of the area.

¹⁷ This could be analogous to the situation in Climax's MBD 1-4 drill holes on Mt Black which were all logged as uniform dacites but subsequent immobile element geochemistry showed a range from rhyolite to dacite compositions, (Herrmann, 1996, p15). It seems reasonable to speculate along the lines that if coherent rhyolites and dacites in the MBV are indistinguishable then their explosive eruptive equivalents (pumice breccias) might also be indistinguishable, and, if Rod Allen's interpretation that the MBV are upthrust correlates of the Rosebery footwall pyroclastics is correct, this may lend slender support to the concept (outlined above) that the 'detextured' sericite-carbonate altered feldspar phyric volcanoclastics (west of the layered sandstone shale sequence in the spillway and BY1) could be dacitic variants of the Rosebery footwall pyroclastics?

3. Potential for structurally controlled mineralisation.

There has been no advance on this concept since my report of June 1996.

There is a fair chance that the large Cutty Sark magnetic anomaly is related to chlorite+magnetite+/- pyrite+/- chalcopyrite alteration and mineralisation in the hanging wall of the Mt Black Fault, (see discussion in Herrmann, 1996, p23).

Although the indications, from Billiton's drill hole (RED 87-1) and shallow workings, are that copper grades are low and there are no known analogous economic deposits in Tasmania, the concept has not been exhaustively tested. It presents a fairly straightforward target, albeit limited by a short strike length mostly under the lake, and could be explored by a programme involving:

- * Revised modelling of aeromagnetic and gravity data.
- * Study of style of alteration and mineralisation, preferably in conjunction with current academic research and virtually dependent on access to core from RED 87-1 and the Hawkesbury workings, within the Rosebery Mine lease.
- * Grid refurbishment, ground magnetics and geophysical modelling to refine targets, if justified.
- * Diamond drilling, DHEM and down hole magnetics to test targets.

Discussion

The principal difficulties in recommending a course for further exploration in the Lake Rosebery EL are that :

- * The targets are mainly conceptual and will probably require 'stratigraphic-exploratory' drilling - perhaps the type of projects that Plutonic and Lachlan have not traditionally been into.
- * The regional geology is not well known, partly because much of the relevant work has been carried out on Rosebery mine lease and the results are not publicly available.

I believe that a useful means of addressing these difficulties might be to hold a one day 'brain storming' meeting involving:

W. Herrmann to present a summary of previous data and outline exploration concepts,
C.Gifkins to provide expertise on MBV geology,
G. Purvis (& R.Sainty ?) to provide expertise of the Rosebery model and MBV exploration,
R.Close & W.Bucknell to assess project merit and feed back company priorities.

The idea would be to thoroughly thresh all the relevant regional geological and local exploration concepts, chuck out the rejects and attempt to develop the stayers to well defined exploration programmes, ready for consideration by exploration management.

I contacted Gerald Purvis yesterday to sound him on the idea and he has expressed interest in principal but will need check with Pasminco in regard to confidentiality (although he is not currently consulting to them). Gerald expects to have time available from about mid March. Cathryn Gifkins is also fairly busy till mid March but I have the impression she would be happy to co-operate provided there is no objection from Pasminco.

Contact numbers:

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C.Gifkins Tel: 03 6220 2376 (CODES) Tel: 03 6473 1092 (Pasminco Exploration, Rosebery)

Gerald mentioned that, if Lachlan is looking for conceptual targets, the Bastyan Dam one is a long shot compared to another he helped to develop in Que-Hellyer Volcanics at the 'High Point' prospect, west of Hellyer Mine. In this case the Que-Hellyer favourable horizon is 'known' to be present, but at considerable depth (~900m) which Pasminco balked at testing. His understanding is that Pasminco would look favourably on a joint venture offer.

Best regards,

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