

A REPORT FOR ZINIFEX ROSEBERY MINE

**A REVIEW OF THE GEOLOGY AND EXPLORATION
FEATURES OF THE BROWNS TUNNEL –
BURNS PEAK AREA**

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for Corbettas Enterprises

June 2007

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SUMMARY:

1. This report presents a compilation and review of the geology and exploration features of the intensively explored area around Browns Tunnel, Thomas' Tunnel and Southern Trenches on the western flank of Burns Peak, and includes a set of five cross-sections at 100m spacing over the most closely drilled part.
2. The area has been subject to three major programs of diamond drilling since the 1940's, reflecting the occurrence of patches of high-grade mineralisation at surface and in some early drill holes. A small resource of 15,000t of high-grade lead-zinc was mined in 2000-2001 at Southern Trenches, and resource drilling at Browns Tunnel has indicated an inferred resource of 90,000t @ 7.4%Zn, 1.9%Pb, 49g/tAg, 0.9g/tAu, but this is not considered viable.
3. The regional geology is strongly influenced by two major structures, the Rosebery Fault, a shallowly east-dipping thrust which underlies and severely limits the mineralized zone in the Browns Tunnel area, and the NE-trending Burns Peak Shear Zone, a steeply dipping fault intersected in two drill holes but still poorly understood in terms of its displacement history, palaeogeographic significance, and relationship to the Rosebery Fault. It is suggested herein that all of the rocks to the west of the Burns Peak structure could be post-CVC in age.
4. The sedimentary host sequence at Browns Tunnel has been strongly tectonised, with the deformation evident as a network of small faults and shear zones, ranging from steep NE structures with associated zones of shearing to sharp planar structures on SE-NW trends which displace boundaries for 10m or more. Most rock unit boundaries are faults, and this unpredictable structural complexity would be a major factor in any potential mining operation.
5. Silica-sericite-pyrite alteration is widespread, producing augen schist textures in the many pumice breccia units, including those in the thick footwall sequence. More intense silicification produces grey cherty zones within the Browns Tunnel Host Sequence, some of which carry sulfide bodies. Some of the alteration seems to be sourced from quartz-feldspar porphyry bodies and a (related?) felsic lava body in the footwall. Hydrothermal energy may have been dissipated somewhat in the lower blanket of pumice breccias, with exhalative outlets being short-lived.
6. Mineralisation is concentrated in three zones: at Southern Trenches (where several elongate high-grade pods were mined), at Thomas' Tunnel, and at Browns Tunnel, which is located at the southern 'daylight' end of a gently north-plunging zone. A small stratiform band (5m x 1m) of high-grade massive sulfide at Browns Tunnel is probably exhalative, but drilling shows most of the high-grade material to be poddy and discontinuous, with considerable tectonic remobilization in the Devonian.
7. Consideration of the drilling data and cross-sections, and the degree of tectonic disruption, particularly the multiplicity of small faults, suggests that even the most recent conservative estimates of the resource at Browns Tunnel could be over-optimistic. The host unit appears to be limited at depth by the Rosebery Fault, and to the south by the facies change to pumice breccias, while to the north the waning mineralizing system has been effectively drilled out. However, further exploration opportunities may exist in the Hollway Rivulet area.

INTRODUCTION:

This report arises from a commissioning of the author by Dr A. McNeill in 2005 to produce a geological update and interpretation of the Burns Peak area, and a review involving cross-sections of the Browns Tunnel area, where a great deal of exploration and drilling had been done, mainly by Pasminco. An initial report on the general geology of the Burns Peak area, with revised maps, was presented in July, 2005, and incorporated in the 2006 annual report on EL 48/2004 Mt Kershaw (Skirka, 2007).

The second part of the project is reported herein, and consists mainly of a review of the geology and drilling at Browns Tunnel, with a set of five cross-sections. Three regional cross-sections across the Burns Peak Shear Zone are also included in an attempt to further clarify the relationships east and west of this structure. This has been done at the request of M. Skirka, who replaced A. McNeill as senior exploration geologist in late 2006.

Field work related to this report and the previous Burns Peak report involved 7 days mapping carried out during March-April, 2005, (following an earlier mapping program as part of the Mt Read Volcanics Project in 1986), and the logging over several weeks of some 55 drill holes located at the Zinifex Tullah core store and the MRT core store in Hobart. Numerous company reports have also been consulted.

EXPLORATION HISTORY:

The “Pinnacles’ area is one of the most intensively explored in Tasmania, with major drilling programs involving multiple diamond holes being undertaken by EZ Company in the 1940’s and 50’s, Comstaff in the 1960’s, 70’s and 80’s, and by Pasminco in the 1990’s (see the excellent summary by Skirka, 2007).

Surface mineralisation was discovered in the area in the 1890’s, and small-scale mining was carried out in the late 1890’s at Southern Trenches (estimated 55 t @ +10%Zn, +8%Pb, 39g/tAg, 8g/tAu), Browns Tunnel (estimated 300t @ 2%Zn, 44g/tAg, 2g/tAu), and Thomas’ Tunnel (estimated 50t @ 4%Zn, 7%Pb, 240g/tAg, 1g/tAu). The area was abandoned by 1918 (Reid, 1918).

A drilling program (PP31-59) was undertaken by EZ Co in 1947 (Hall, 1947; Cottle, 1949, 1950), followed by geochemical and geophysical work by Rio Tinto in the 1950’s (Muceniekas, 1959; Boniwell, 1959). Exploration by Comstaff in the 1960’s, on EL 5/63, included two diamond holes (CP1,2) (Anon, 1969, 1970; Everett, 1971; Orr and Smith, 1975), and 8 holes (CP1-10, 12-15) were drilled in the 1970s (Orr and Smith, 1975). Preussag entered a Joint Venture with Comstaff in 1976, and drilled two more holes (PIN1, 2) at Southern Trenches (Krummei, 1977).

Comstaff drilled 3 more holes (EAB1-3) in the Hollway area in 1983 (Shaw, 1983), followed by 15 holes (ESB1, EAF1-14) in 1984 in the Browns Tunnel area. The latter resulted in a resource calculation of 110,000t @ 18.8%Zn, 6.6%Pb, 1.3%Cu, 122g/tAg, 4.1g/tAu (Roberts, 1985; Shaw and Roberts, 1985). Two more holes (EAF15, 16) were drilled at Thomas’ Tunnel and two at Southern Trenches (Mroczek, 1985).

BHP entered the Joint Venture with Comstaff and Preussag in 1985, and carried out regional BLEG drainage sampling and a blanket UTEM survey (Anon, 1987, 1988).

Pasminco joined a JV with Noranda and Pioneer Mining (Plutonic) in the area in 1988, on EL 44/88, and commenced a program of deep drilling (BPD62-65) and detailed mapping (Rosenhain and Mathison, 1989). Pasminco became manager of the joint venture in 1990, and three further holes (BPD66, 69, 70) were drilled in the Browns Tunnel area, followed by two (BPD71, 72) in the area north of Leo’s Find (Lorrigan, 1990; Kirsner et al, 1991). Two holes were drilled at Summit prospect, east of Leo’s Find (BPD76, 77), in 1992-93, and two more (BPD78, 79) at Browns Tunnel (Kirsner, 1992; Poltock et al, 1993). During 1994, a follow-up hole was drilled at Summit prospect (BPD80), and three more (BPD81, 82, 85) at Browns Tunnel. Previous holes EAF2 and CP7 were extended, and hole BPD83 was drilled into the Hollway Pyrite Zone (Poltock and Saxon, 1994; Saxon, 1995).

Detailed resource drilling was undertaken at Browns Tunnel in 1996, with five shallow diamond holes (BT1-5). Previous holes were re-logged, and a re-interpretation was made of the geology. A provisional inferred resource for the near-surface ‘Lens 1’ was calculated at 190,000 @ 7.7%Zn, 2.8%Pb, 0.7%Cu, 48g/tAg, 0.98g/tAu (Quayle and Dibben, 1996; Weber et al, 1997). RC drilling and trenching were carried out at Southern Trenches.

Further resource drilling of the Browns Tunnel deposit was done in 1998, with 11 diamond holes (001B-008B, 011B-013B) on 40m-spaced lines. This led to a much lower inferred resource estimate for ‘Lens 1’ of 90,000t @ 7.4%Zn, 1.9%Pb, 49g/tAg, 0.9g/tAu. This was considered unviable after a preliminary mining feasibility study (Edwards et al, 1998). Another

four holes were drilled at Southern Trenches (009B, 010B, 014B, 015B), and an inferred resource of 10,00t @ 23.4%Zn, 18.3%Pb, 2.1%Cu, 96g/tAg, 12.1g/tAu was estimated. A Mining Lease (ML20M/2000) was taken out by Hercules Resources over the Southern Trenches – Browns Tunnel area in October 2000, and the pods of high-grade ore (~15,000t) were mined in a small open-pit operation in late 2000 – early 2001. The Mining Lease has since lapsed.

Some partial leach sampling carried out just south of Southern Trenches was followed up with a drill hole (STD1) in 2000 (Edwards and Denver, 2000), and further partial leach sampling in the Summit area was followed by relinquishment of EL 44/88 in 2001 (McNeill, 2001). The present EL 48/2004 Mt Kershaw was granted to Zinifex Australia Ltd in November 2005.

GENERAL GEOLOGY OF THE BURNS PEAK – BROWNS TUNNEL – HOLLWAY RIVULET AREA:

The area lies at a major regional bend in the western margin of the Mt Read Volcanics belt, where the generally N-S trending rock units of the Rosebery – Mt Kershaw area pass into the NE-trending units of the Boco Road – Sock Creek - Hellyer area. A large finger-like body of felsic lava, the Pinnacles Rhyolite, projects northwards from the bend, forming a north-plunging anticlinal ridge flanked by younger volcano-sedimentary rocks. An updated compilation of the geology is given in figure 1, and three cross-sections are shown in figures 2, 3 and 4.

The Rosebery Fault, a major east-dipping Devonian thrust structure forming the western margin of the volcanic belt from Rosebery to Southern Trenches, breaks up into several splays at about this point (fig1). The main footwall structure dips about 33° in this area, and veers on a NNW trend towards the Silver Falls area. The rocks beneath this fault are Late Cambrian Owen Group equivalents, including correlates of the Stitt Quartzite from Rosebery. The upper (hangingwall) splay fault has a slightly steeper dip (~ 40°?) and extends in a northerly direction, where it either joins with, or becomes, the faulted western margin of the Pinnacles Rhyolite body.

A second major fault structure, the Burns Peak Shear Zone, cuts NE across the central part of the area, and separates a major Devonian syncline to the east from a complex anticlinal structure developed in the Browns Tunnel host sequence and associated rocks, to the west. This fault is somewhat cryptic and poorly exposed, but is well established, at least in its central part, from several outcrops and drill intersections. The extremities of the fault have not been delineated from mapping, however. At its SW end, towards the Rosebery Fault, it appears to become diffused within a broad area of sheared felsic pumice breccias and lavas around and north of Cone Hill, and it remains unclear how or where it intersects the Rosebery Fault. To the NE, its intersection with the eastern margin of the Pinnacles Rhyolite is unclear and unmapped.

The Burns Peak Shear Zone is subvertical to steeply east-dipping, from two drill intersections (figs 2,3). The amount and direction of displacement are uncertain because of the lack of marker units, although a dextral and possibly west-side-up component to the latest movement is indicated by the folding on its eastern side. A complex history from Cambrian to Devonian times seems likely, and there is some suggestion that it might have been a growth fault in the Middle Cambrian, eg thickening of the Que River Shale on the eastern side; the pronounced differences in the sequences on either side. The fault is tentatively shown as merging with the Rosebery Fault at depth in the cross-sections (figs 3,4), although a westerly dip at depth is also possible.

A strong NNE to NE-trending cleavage is associated with intense minor faulting to the west of the shear zone, particularly in the Browns Tunnel host sequence.

The main stratigraphic units in the area are summarized below.

- (i) **Top. Owen Group equivalents:** These are present west of, and beneath, the main Rosebery Fault, and comprise a polymict sequence of sandstone, siltstone, mudstone and conglomerate, including thin-bedded quartzite and black shale. Late Cambrian fossils are known from several localities further west. Broad zones of strong deformation are typically associated with the fault.

- (ii) **Southwell Subgroup correlates:** This is a marine turbidite sequence of volcanoclastic sandstone, siltstone, mudstone and conglomerate occupying the core of the eastern syncline. It also occurs to the west of the Pinnacles ridge and in the wedge between the footwall and hangingwall Rosebery Faults, where it is intersected in several drill holes. Very crystal-rich and 'porphyry-like' sandstones with quartz and feldspar are typical, and bodies of quartz-feldspar porphyry are also present in the fault wedge, possibly suggesting proximity to some of the source eruptive centres. Trilobite fossils are present in a few places, and a Middle Cambrian age has been established elsewhere. The sequence is overlain by Tyndall Group correlates on the Silver Falls track.
- (iii) **Que River Shale correlate:** This unit of black/grey pyritic shale and siltstone, with minor sandstone, appears to thicken markedly in the core of the eastern syncline, from 30m on the eastern limb to a maximum of about 150m. However, it dies out immediately to the north, and is absent where the western limb is crossed by the Boco Road. It has not been recognized west of the Pinnacles ridge nor in the Browns Tunnel area. It has been a favoured host rock for the intrusion of a large tabular body of quartz-feldspar porphyry.
- (iv) **Quartz-feldspar porphyry bodies:** These bodies of grey-green to pink porphyry are mainly intrusive, and occur across the area. They contain prominent quartz phenocrysts 5-10mm across in most areas, but these are quite sparse in some varieties. The bodies are particularly abundant west of the Burns Peak Shear Zone, where they are found throughout the Browns Tunnel Host Sequence and within the underlying pumice breccias. They are also abundant here within the Southwell Subgroup rocks, particularly in the Rosebery Fault wedge. The impression gained is that this area has been a locus for intrusion of porphyries, and for extrusion of some, since many bodies seen in drill core show peperitic margins against mudstone. The large body on Burns Peak is partly surrounded by a 'carapace' of felsic lava lacking large phenocrysts. A silicified and pyritised zone is present at the lava contact in places, but it is not certain whether the porphyry is a later intrusive or has a genetic connection to the lava. A similar lava body to the SE of Burns Peak also has a close association with porphyries, in the form of a network of interconnected bodies on its western side, in an area showing considerable hydrothermal alteration and brecciation.
- (v) **Burns Peak Subgroup:** This term was first used in the author's earlier report (Corbett, 2005) for the variable sequence of sedimentary rocks and felsic to andesitic lavas located between the Que River Shale above and the Animal Creek Greywacke below (or the Central Volcanic Complex where the latter is absent). As such, it is equivalent to the Que-Hellyer Volcanics, the unit hosting the Que River and Hellyer orebodies. It includes, from east to west, the Boco Road dacite body (correlate of the Sock Creek dacites); the large Hollway Andesite body (a chemical and petrological correlate of the Hellyer Basalt – Coutts, 1993); and an overlying unit of volcanoclastic sandstone and siltstone which becomes increasingly rich in pumice breccias and wedges of felsic lava and lava breccia to the north and west around Boco Road. West of the Burns Peak Shear Zone it includes the large Pinnacles Rhyolite body; the Browns Tunnel host sedimentary sequence; several bodies of greenish lava/intrusive referred to as the 'Browns Tunnel andesite' but which appear to be mainly felsic

rocks (dacites) where seen fresh; and at least part of a thick unit of pumice breccias lying beneath the sedimentary rocks.

The felsic lava bodies at Burns Peak and along the ridge to the south, which are closely associated with the pumice breccias, have generally in the past been assigned to the Central Volcanic Complex (CVC), but it is suggested herein that they could be equivalent to the Burns Peak Subgroup dacites/rhyolites. This would mean that all the rocks west of the Burns Peak Shear Zone could be post-CVC.

The Hollway Andesite complex has an unusual recumbent Y-shape, with one of the arms extending some 1.5km SW of the main body down the Hollway Rivulet, and the shorter arm being cut off by the Burns Peak Shear Zone. The shape is interpreted to be due, at least partly, to a syncline-anticline fold set, with underlying CVC rocks present in the area between the arms (Coutts, 1990; Corbett, 1995). Numerous intercalations of felsic lava occur within the andesite in the SW area (eg intersected in BPD75 and 83), but it is uncertain whether these are related to the Boco Road dacites to the NE, or represent interfingering with CVC-type rocks.

- (vi) **Animal Creek Greywacke – Black Harry Beds correlate:** This thin sequence of micaceous – siliciclastic to volcanoclastic sandstones and siltstones and minor conglomerate lies along the upper contact of the CVC, and becomes much thicker to the NE, out of the area. Intercalations of andesitic and felsic volcanic rocks are present within the unit before it wedges out in the vicinity of BPD84. A thin wedge of similar sedimentary material in the Hollway Rivulet NE of BPD83 appears to be the last appearance.
- (vii) **Central Volcanic Complex (CVC):** This sequence is represented by felsic lavas, lava breccias and pumice breccias, intruded by numerous mafic dykes, along the Hollway Link Track in the SE part of the area. The area of felsic rocks between the two arms of the Hollway Andesite in the Cone Hill area has also been assigned to the CVC – partly on the basis of a single mafic dyke mapped by the author in 1986 – but there is some uncertainty associated with this.

GEOLOGY OF THE SOUTHERN TRENCHES – BROWNS TUNNEL AREA:

General Stratigraphy and Structure

The area lies on the western flank of a complex NE-trending anticlinal structure with a poorly defined axial zone (fig 5). Three main stratigraphic units, all considered to belong to the Burns Peak Subgroup, are present: (i) a lower sequence dominated by pumice breccias, well exposed along the Southern Trenches Road; (ii) the band of sedimentary rocks known as the Browns Tunnel Host Sequence (BTHS), which is best developed along the western flank of the anticline but is also present in rather attenuated form on the eastern flank high on Burns Peak. It is possibly represented by the series of poorly exposed sedimentary lenses on the ridge zone SW of Burns Peak, close to the BPSZ, in what could be the axial zone of a syncline (fig 4); and (iii) an upper mass of rhyolitic lavas and lava breccias, with intercalations of pumice breccia, sandstone and mudstone, known as the Pinnacles Rhyolite.

All three units sit above, and are truncated to the west by, the Rosebery Fault system. This system comprises a main lower (footwall) fault dipping east at $\sim 33^\circ$, and an upper (hangingwall) fault which appears to be slightly steeper at $\sim 40^\circ$. Owen Group equivalents, including correlates of the Stitt Quartzite, lie beneath the lower fault, and Southwell Subgroup rocks occupy the wedge between the faults.

The zone of sedimentary rocks and underlying pumice breccias is strongly affected by schistosity development and by multiple small faults, such that surface tracing of individual units is difficult or impossible. The schistosity is steeply dipping and NNE-trending, and is associated with a steep stretching lineation. In a detailed study of the Browns Tunnel area, Elliott (1990) noted that rock distribution was controlled by an anastomosing network of faults, ranging from 30m wide zones with intense schistosity to thin fracture planes. The early faults and schistosity and stretching lineation were considered to be indicative of a steepened west-directed thrust fault zone. A later fracture cleavage was associated with a shallowly-plunging lineation. Late brittle faults on a SE-NW trend caused significant displacement of rock units of up to 10m or more, and would be likely to have a major effect on the distribution of mineralized zones.

The intensity of faulting, and the difficulty of tracing individual faults or rock units for any distance, makes it virtually impossible to draw accurate sections (or plans for that matter) of the geology. The sections presented are therefore necessarily somewhat generalized.

Lower pumice breccia sequence

These massive felsic feldspar-phyric rocks show well-preserved pumice textures in places, and vary from coarse to fine-grained, grading into pumiceous sandstones. The rocks have been particularly prone to hydrothermal sericite-silica (-pyrite) alteration, which has modified or destroyed the primary textures in many places. Many outcrops show coarse blebby textures with siliceous nodules wrapped by foliated sericitic material, forming augen schist in its extreme form. Other varieties are pervasively altered to a fairly structureless sericite-quartz rock which may be difficult to distinguish from lava.

Bodies of quartz-feldspar porphyry are common within the pumice breccia zone, with an apparent concentration of anastomosing sills in the Southern Trenches area. A large lens-shaped body of felsic lava, with feldspar and small quartz phenocrysts and flow banding in places, underlies, or lies within, the pumice breccia sequence east of Southern Trenches. It is

possible that this body represents the core of a submarine eruptive centre which generated much of the pumice.

Browns Tunnel Host Sequence and associated ‘andesites’

The sedimentary rocks in this zone mostly dip steeply west and face west from numerous drill hole facings. There are also some overturned easterly dips, multiple minor faults, and evidence of folding in places, indicating considerable but mostly unresolved structural complexity. There has been considerable shearing and cleavage development along the zone.

The zone is about 100m wide at surface in most places, but widens to over twice this in the area of Thomas’ Tunnel, mainly due to the presence of a large body or bodies of the ‘andesite’ lava and some additional pumice breccia units in the sequence. The nature of the ‘andesite’ bodies in this area is problematical, partly because surface mapping is hampered by very poor outcrop. Five drill holes in the area (CP7,14; EAF15,16; BPD63) all show the ‘andesite’ near surface (fig 7), and this led some early authors to postulate a synclinal structure (eg Poltock et al, 1993). However, the intersection of several deep felsic lava units in this stratigraphic position in BPD85, just to the north on Section 5100N (fig 8), led Saxon (1995) to suggest that the ‘andesites’ at Thomas’ Tunnel were actually steeply-dipping (but somewhat altered) felsic lava units, an interpretation also adopted herein (fig 7).

To the south of Thomas’ Tunnel, the eastern part of the sedimentary zone extends as a more or less tabular body (with subvertical to easterly dip) to near the Southern Trenches, where it narrows rapidly and seems to wedge out rather rapidly within a thick sequence of pumice breccias. Drilling further south, at STD1, CP10 and CP15, shows only pumice breccias at this level. Although there are similar strongly altered pumice breccias on either side of the thin wedge of shales and sandstones, there is no evidence to suggest a fold axis. Rather, it seems that a ‘flood’ of pumice breccias has overwhelmed the other sedimentary rocks at this southern end of the small basin.

The major rock types within the highly variable Browns Tunnel sedimentary sequence are: greenish-grey ashy siltstone and mudstone (vitric ash); volcanoclastic sandstone (typically with feldspar and quartz crystals and some pumiceous material); grey/black shale-siltstone; pumiceous sandstone; mega-graded mass-flow units of volcanoclastic sandstone and breccia-conglomerate, typically with blocks and rafts of ashy shale and grey/black shale up to several m long; conglomerate units, typically rich in rounded pebbles of felsic lava; pumice breccia units, commonly showing some degree of alteration; lenses of felsic lava and breccia; lenses or tabular bodies of greenish-grey chlorite-altered lava, commonly with peperitic margins, referred to as ‘andesite’ but probably mostly dacite; zones or layers of grey chert and cherty altered rocks, mostly representing intensely silicified pumiceous sediments but possibly including some primary exhalative cherts also; bodies of quartz-feldspar porphyry, some with peperitic margins.

The green rocks referred to as ‘andesites’ are seen in many drill holes between Thomas’ Tunnel and 5400N. Some examples have been described as amygdaloidal, with quartz-filled amygdaloids. The author examined a thin section (MR710) of one from CP14, near Thomas’ Tunnel, in 1986. It showed a good feldspar-phyric texture, with some scattered blebs of chlorite and opaques probably representing pseudomorphs after ferromagnesian, in a blebby felsic groundmass fairly rich in quartz. The rock was essentially felsic, probably dacitic. Geochemical discrimination studies done by Kirsner et al (1993) also showed the ‘andesites’ to be essentially dacitic, and probably related more to the Pinnacles Rhyolite than to the Hollway Andesite.

Pinnacles Rhyolite

This massive body of felsic lavas and breccias is exposed along the Boco Road and in many drill holes. The lavas are typically pale pink to cream or pale greenish in colour, with obvious feldspar phenocrysts and smaller quartz phenocrysts in some cases. The felsic groundmass commonly shows a spherulitic texture. Quartz-cored spherulites are so abundant in some types that the weathered rock resembles quartz-rich sandstone. Lava breccias, made up of close-packed angular lava clasts in a paler or darker lava 'matrix', are also common. In some cases, the clasts have a strong internal flow texture and a frothy pumice-like appearance, producing rocks which are gradational to pumice breccias.

Alteration and Mineralisation

Alteration is extensive in the general zone between Southern Trenches and Boco Road, and extends well outside the BTHS. Silica-sericite (-pyrite) alteration of pumice breccias extends for at least 150m below the sediment contact into the footwall sequences along most the 1200m of strike length, as shown by exposures along the Southern Trenches Road and adjacent areas. Typically, the alteration produces a nodular texture, with hard siliceous nodules (some with pyrite) wrapped around by schistose sericitic material. In its most advanced form, the rock type becomes an augen schist in which primary textures are obliterated.

Excellent exposures of the alteration are available around the EAB3 drill site. Here, the adjacent pumice breccias are augen textured, and the quartz-feldspar porphyry body is strongly silicified along its margin. Strong alteration also extends for some 150m into the adjacent felsic lava body in the form of intense net-veining, with a fine three-dimensional network of white quartz +/- sulfide veins permeating the rock. The veining and alteration strongly suggest that the hydrothermal fluids may have emanated from this body. Weathering of the intensely veined lava has produced a thick talus deposit of veined fragments which blankets the lower slopes.

At Southern Trenches, the intense augen schist style of alteration affects the pumice breccias on both footwall and hangingwall sides of the narrow mineralized zone. Loose fragments of sulfide mineralisation show remnant wispy pumice texture preserved within a blebby rock made up largely of galena and sphalerite.

Within the Browns Tunnel Host Sequence, alteration and mineralisation appear to be concentrated in three main areas: (i) at Southern Trenches, within and adjacent to the basal attenuated part of the sediment zone; (ii) around Thomas' Tunnel, particularly at the eastern margin of the 'andesite' bodies, in the central part of the sediment zone; and (iii) at surface around Browns Tunnel, near the upper part of the sedimentary belt, in a zone which plunges below surface to the north. Cherty alteration is characteristic of all three locations, but is best developed at the Browns Tunnel zone. Drilling to the north of Boco Road shows alteration and minor mineralisation persisting within the sediment zone to hole BPD69, and some galena-rich veins at this level in BPD 70.

The typical mineralisation consists of pods of high-grade zinc-lead ore within broader zones of low-grade mineralisation. At least some of the high-grade material is probably exhalative, as indicated by an exposure near Browns Tunnel, but many of the intersections appear to be remobilized material related to cleavage and/or fault zones.

Road building at Browns Tunnel in the 1980's by Comstaff exposed a band of massive sulfide near the collar of EAF5. The stratiform band is up to 1m thick (fig 6), and extends over 5m in length in a NE-SW direction, with a steep NW dip. It is hosted within cherty rocks carrying blebs and veinlets of sulfide, with faint bedding-type layering and unusual 'vermicular' bands of chert. The layering is folded into an upright N-plunging anticline/syncline couple, cut by a steep fault, and a second anticline cored by schistose volcanoclastic sandstone is present to the east. The sulfide consists of galena, sphalerite, chalcopyrite and pyrite, and an assay given by Quayle and Dibben (1996) has 35.2%Zn, 19.7%Pb, 0.59%Cu, 4.85g/tAu. The band appears localized and discrete, and there are others patches and blebs of similar sulfide in the vicinity, some associated with cleavage and small faults.

The nature of the alteration and mineralisation will be further discussed after consideration of drilling and cross-sections.

Drilling and cross-sections

Over 70 diamond drill holes have now been drilled in the general Browns Tunnel zone, ranging from short holes (<100m) collared within the sediment zone to a series of long (>500m) holes collared well to the west of the zone. Recent drilling for resource estimation has focused on the Browns Tunnel and Southern Trenches areas. The deeper holes give intersections of the sediment zone 200-400m below surface, at about which level the zone is truncated by the Rosebery Fault system.

The cross-sections have been compiled at 100m intervals along the original EAF grid, which has guided the drilling. Unfortunately, this grid is quite oblique to the strike of the rocks – by about 45° - and hence the sections cannot be overlapped to give an along-strike view. Each section needs to be moved ~100m to the east of its neighbour to the north to achieve this.

Cross-section 5000N – Thomas' Tunnel (Figure 7)

The four holes which the author has logged here include two (BPD63, CP14) which have penetrated both the hangingwall and footwall Rosebery Faults. Some points of interest from the section are listed.

- (i) The intersections of the footwall fault (plus its surface position) indicate a dip of 33° for this structure, while the hangingwall fault seems somewhat steeper (about 40°).
- (ii) The Southwell Subgroup sequence between the two faults is very rich in quartz-feldspar porphyry bodies (about 80% of the intersection lengths). The porphyry intersection between 211-280m in BPD63 includes a significant amount of aphyric to weakly porphyritic lava-like material, alternating in places with obviously quartz-phyric material, suggesting the porphyry bodies may have phases resembling normal felsic lava (reference the bodies on Burns Peak ridge).
- (iii) Two units of black shale within the Southwell Subgroup carry vein-style sphalerite mineralisation, typified by the 31m @ 1.0%Zn in CP14. It is uncertain how this deep-level mineralisation within the Rosebery Fault wedge might relate to similar vein-style occurrences in Browns Tunnel sedimentary units above the hangingwall fault in CP7 (30m @ 0.47%Zn), but there is a strong suggestion of a Devonian post-faulting mineralisation episode.
- (iv) A thin intersection of high-grade massive sulfide (0.6m @ 35.2%Zn, 0.73%Pb) is associated with cherty to schistose rocks in the upper part of BPD63, just above the Rosebery Fault and close to the western margin of the BTHS. There are also two intersections of moderate grade (8m @ 3.2%Zn; 5.5m @ 4.19%Zn) in EAF15,

corresponding to the Thomas' Tunnel mineralisation at the eastern margin of an 'andesite' body.

Cross-section 5100N (Figure 8)

Only two holes are available here.

- (i) BPD85 gives a complete section from Pinnacles Rhyolite through the BTHS to the footwall pumice breccias. Several felsic lava units within the BTHS are the probable 'andesite' equivalents, and there is a major upper unit of pumice breccia.
- (ii) EAF16 intersects the near-surface mineralized zone from Thomas' Tunnel and EAF15, with three zones associated with strong cherty alteration and cherty ash (best 5.4m @ 7.61%Zn). A small high-grade intersection (0.5m @ 17.8%Zn) at this stratigraphic level but some 200 m deeper in BPD85 may correlate with this zone.
- (iii) Several intersections of the deep-level low-grade mineralisation – around 1-2%Zn – are present in the lower part of the BTHS sediments.

Cross-section 5200N – Browns Tunnel (Figure 9)

This line passes just south of Browns Tunnel, and some of the geology and holes from there have been projected on to the section. Four of the six holes shown have been logged by the author (BPD81, EAF5, BT3, EAF2), and logs for EAF1 and PP31 have been taken from company reports.

- (i) EAF2 intersects the Rosebery Fault hangingwall about 150m east of its surface position, giving a dip of about 40°. A second fault intersected near the end of the hole is taken to be the footwall fault, 125m deeper. Typical low-grade mineralisation (28m @ 1.4%Zn) is again present in black shales in the Southwell Subgroup.
- (ii) BPD81 gives a complete intersection of the BTHS at depth. The felsic lava units of 5100N are no longer present, but may have passed laterally into pumice breccias. Several intersections of 1-2%Zn are present again, and the small intersection of 0.7m @ 19.4%Zn at 125m looks remarkably like the 0.5m @ 17.8%Zn seen on 5100N at about the same level.
- (iii) The surface mineralisation at Browns Tunnel includes the outcropping massive sulfide band mentioned previously, and a pod within the tunnel with 26.37%Zn, 2.39%Pb, 2.12%Cu, 13.3g/t Au (Quayle and Dibben, 1996). The adjacent drill holes mostly went beneath this zone, although BT3 intersected a second zone just to the west with 1m @ 4.05%Zn and 0.4m @ 3.6%Zn.
- (iv) A deeper zone of mineralisation and alteration further west, some 70-80m below surface, was intersected in both EAF2 (20m @ 1.3%Zn) and BT3 (3.8m @ 6.5%Zn, 3.3%Pb; 17.5m @ 1.02%Zn, 0.45%Pb). The extent of this particular mineralized zone, which is associated with strong cherty alteration, at shallower depths (ie west of EAF5) has not been tested.

Cross-section 5300N (Figure 10)

This is the most intensely drilled part of the BTHS, where two phases of recent resource drilling (Quayle and Dibben, 1996; Edwards et al, 1999) have been carried out, on 40m sections, in addition to six previous holes of the EAF series and two deep holes of the BPD series. A selection of 10 of these holes is shown.

- (i) BPD82 actually drilled beneath the Rosebery Fault hangingwall, which surfaces just east of its collar. The hole penetrated Southwell Subgroup rocks (interbedded volcanoclastic sandstone, siltstone, shale, conglomerate, minor nodular limestone) for its entire 620m length. Secondary faults were intersected at 75m and 170m. Two zones of the typical low-grade mineralisation (20m @ 0.8%Zn; 18m @ 1.2%Zn) were

- intersected. A conglomerate unit at 431m contained at least one fossiliferous clast with probable trilobite fragments. The lack of any intersection of the footwall fault suggests the two faults have diverged significantly at this northing.
- (ii) BPD78 gives a complete intersection of the BTHS at depth, where it has a thickness of about 140m, including an upper pumice breccia unit about 40m thick.
 - (iii) Although there is general correlation between holes along strike, there are many instances where units do not match up across intervals of 40m, supporting the impression from surface geology that there are many small to medium fault offsets. One example of this is the felsic lava unit and associated pumice breccia in the upper levels of EAF7 and EAF14 not seen in EAF9.
 - (iv) A major zone of cherty alteration is now present in the stratigraphically upper part of the BTHS, within which two main zones or 'lenses' of sulfide mineralisation are developed. The cherty zone seems to be largely replacing the upper pumice breccia unit, which is still seen at depth in EAF9 and in altered form (augen schist) in BPD78. Closer to surface, this position seems to be mainly occupied by ashy to cherty sediments (and possibly a felsic lava unit included in the Pinnacles Rhyolite).
 - (v) The 'Lens 1' mineralisation (from Quayle and Dibben, 1996) is probably the same as that on surface at Browns Tunnel, and has a gentle northerly plunge to be about 25m below surface at this northing. The best intersection of 15m @ 9.8%Zn, 5.9%Pb in BT2 has been drilled partly down-dip. That in 012B (4.6m @ 12.1%Zn, 1.6%Pb) may be more like true width. Only a small intersection (1m @ 4.3%Zn, 2.9%Pb) of what is probably a separate small sub-lens was obtained in 001B (concealed beneath BT2 at 38-39m on section), only 25m beneath 012B. Similarly, EAF3 intersected a separate sub-lens (2.8m @ 13.5%Zn, 8.5%Pb) to the east, but showed no down-dip continuity of the main lens beneath the BT2 intersection (see also the more detailed sections of Edwards et al, 1999).
 - (vi) A second 'lens' of patchy high-grade mineralisation was intersected by EAF9 (11m @ 18.9%Zn, 8.0%Pb) just over 100m below surface. The broad interval of patchy sulfides in EAF13 (65.2m @ 1.08%Zn, 0.01%Pb in Roberts, 1985) probably corresponds to this. This high-grade material was not seen in EAF14 or EAF7. This 'Lens 2' may correspond to the deeper western 'lens' on 5200N.
 - (vii) A deeper mineralized zone associated with strongly altered pumice breccia and augen schist extends from 150m below surface in EAF14 to 250m in BPD78. Intersections are only around 1-2%Zn, except for the 4m @ 3.1%Zn, 0.2%Pb at 355m in BPD78.

Cross-section 5400N (Figure 11)

This section is anchored by two deep holes (BPD62, BPD79) on either side, which correlate reasonably well with depth. It also has two moderate depth holes (EAF11, EAF12) 40m apart along strike, which also correlate well.

- (i) BPD62, drilling partly down-dip from the east, intersected large intervals of pumice breccia, much of it moderately to strongly altered (to augen schist in places), a long interval of quartz-feldspar porphyry, and some volcaniclastic sandstones and shales, before bottoming in a massive felsic rock considered to be altered pumice breccia rather than lava as reported at the time. From the other direction, BPD79 penetrated a long interval of Pinnacles Rhyolite lavas underlain by a distinctive grey 'andesite' lava unit with irregular ribbons of bluish mudstone through it giving a strong suggestion of pillow lava structure. This amygdaloidal lava is also present in both EAF11 and 12 at shallower levels, but its apparent absence above this is an unresolved puzzle.

- (ii) The 'Lens 1' mineralisation is present here – 70m below surface, with cherty rocks hosting sulfides giving four intersections in EAF10 of 1.4m @ 26.3%Zn; 11m @ 3.11%Zn; 4m @ 10.5%Zn; and 5m @ 6.02%Zn, and in 008B of 1.4m @ 10.7%Zn. Other holes in the vicinity, such as EAF8, ESB1, 007B and 013B (not shown) drilled above this lens and did not record any significant intersections.
- (iii) The small intersection of 2m @ 5.94%Zn, 6.55%Pb at 200m depth in EAF11 may be a remnant of the 'Lens 2' from 5300N, but the position at this northing seems to have been largely replaced by the 'andesite' lava.
- (iv) Scattered patches of the deeper level mineralisation are present in BPD 79 (eg 7.3m @ 2.1%Zn) but are not concentrated as on 5300N.

Further comments on mineralisation from the cross-sections

1. The patchy discontinuous nature of the high-grade mineralisation is evident from the sections, and assumptions about continuity between sections – even over the 40m strike length used in the 1999 resource drilling exercise – would appear to be dangerous.
2. Edwards et al (1999) concluded that the economic grade mineralisation occurred as 'localised steeply dipping high grade, *cleavage controlled* veins or lodes within a much larger halo of low grade mineralisation'. The exposed band of stratiform massive sulfide at Browns Tunnel demonstrates that at least some of the high-grade mineralisation is of this type, but there is a strong suggestion that such examples may be rare remnants of a more primary, possibly exhalative style, while the bulk of the sulfides have been remobilized along cleavage zones and faults during the Devonian deformation. The evidence suggests that the original stratiform bodies may have been limited in size, and that they have been further disaggregated and dispersed during tectonism.
3. Some petrographic studies on sulfides from EAF9 and BT2 reported by Quayle and Dibben (1996) showed a lack of deformation or annealing textures in the sphalerite, which they interpreted to mean that the mineralisation was 'post-deformation and post-metamorphic'. The significance of this is uncertain.
4. In terms of remaining potential in the Browns Tunnel area, only one 'gap' is apparent from the sections. This is the extension of the 'Lens 2' sulfides on 5200N, both above and below the area sampled by BT3 and EAF2. An east-angled hole located about 130m west of EAF5 would probably achieve this, but is difficult to justify considering the lowish grades (max. 6.5%Zn, 3.3%Pb). Further extensions of the host sequence seem to be effectively limited by the Rosebery Fault at depth, and drilling confirms the domination by pumice breccias to the south.

Speculative History of the Browns Tunnel Basin

The basin containing the Browns Tunnel Host Sequence and associated rocks appears to have been small and complex compared to others containing VHMS deposits in the Mt Read belt, such as Rosebery and Que-Hellyer. Some features of its development are suggested below.

- (i) The early history was dominated by pumice breccias, at least some of them probably sourced from nearby felsic lava domes such as the one SW of Burns Peak.
- (ii) There appears to have been no equivalent of the large Hollway andesite complex developed in this basin, and the flows and eruptions from the large Hollway

- volcano must have been fairly effectively blocked – perhaps by some structure or edifice.
- (iii) Deposition of the Browns Tunnel sedimentary sequence was probably fairly rapid, with many mass-flows bringing much of the sediment into deep water. Erosion of seafloor sediments (and sulfides in some cases) and re-deposition is indicated by the occurrence of rafts and blocks of sediment, and rare clasts of sulfide, in some of the mass-flow units.
 - (iv) The quartz-feldspar porphyry intrusive activity may have started at this time or possibly earlier. The close association of some of these porphyry bodies with silicification and pyritisation, and with lava bodies showing intense hydrothermal-type brecciation, suggests that they could have been responsible for introducing at least some of the hydrothermal fluids to the system. Such fluids emanating from magma bodies in the footwall appear to have spread out through the lower pumice breccia sequence to produce extensive altered rocks, and much of the hydrothermal ‘energy’ could have been dissipated in this way. Some fluids may have been focused along or beneath lava flows within the overlying sediments to produce exhalative outlets at surface, but the longevity and effectiveness of these was probably limited by interruptions due to depositional events or fluid flow changes, such that only relatively small sulfide lenses were formed. Some of these were subsequently eroded by mass-flows.
 - (v) The basin was eventually blanketed by more pumice breccias and a mass of felsic lavas from the Pinnacles Rhyolite volcano to the north and west, which built up a large edifice to the north which remained emergent for a considerable time as sedimentation went on around it.
 - (vi) The tectonic history is still to be clarified, but some Cambrian deformation was followed by major E-W compression in the Devonian, resulting in westward thrusting of the folded basin rocks over the Owen Group sequence, with much deformation focused on the altered and mineralized rocks. The role of the Burns Peak Shear Zone in this deformation is still unclear.
 - (vii) Considerable remobilization of sulfides occurred in the Devonian, including disruption and disaggregation of sulfide bands into cleavage and fault zones, and emplacement of widespread vein-style sphalerite-galena in the Southwell Subgroup rocks within the Rosebery Fault wedge and in the deeper levels of the BTHS beneath the shallower massive sulfide pods. Some of this veining may be related to original feeder zones to the massive sulfide lenses.

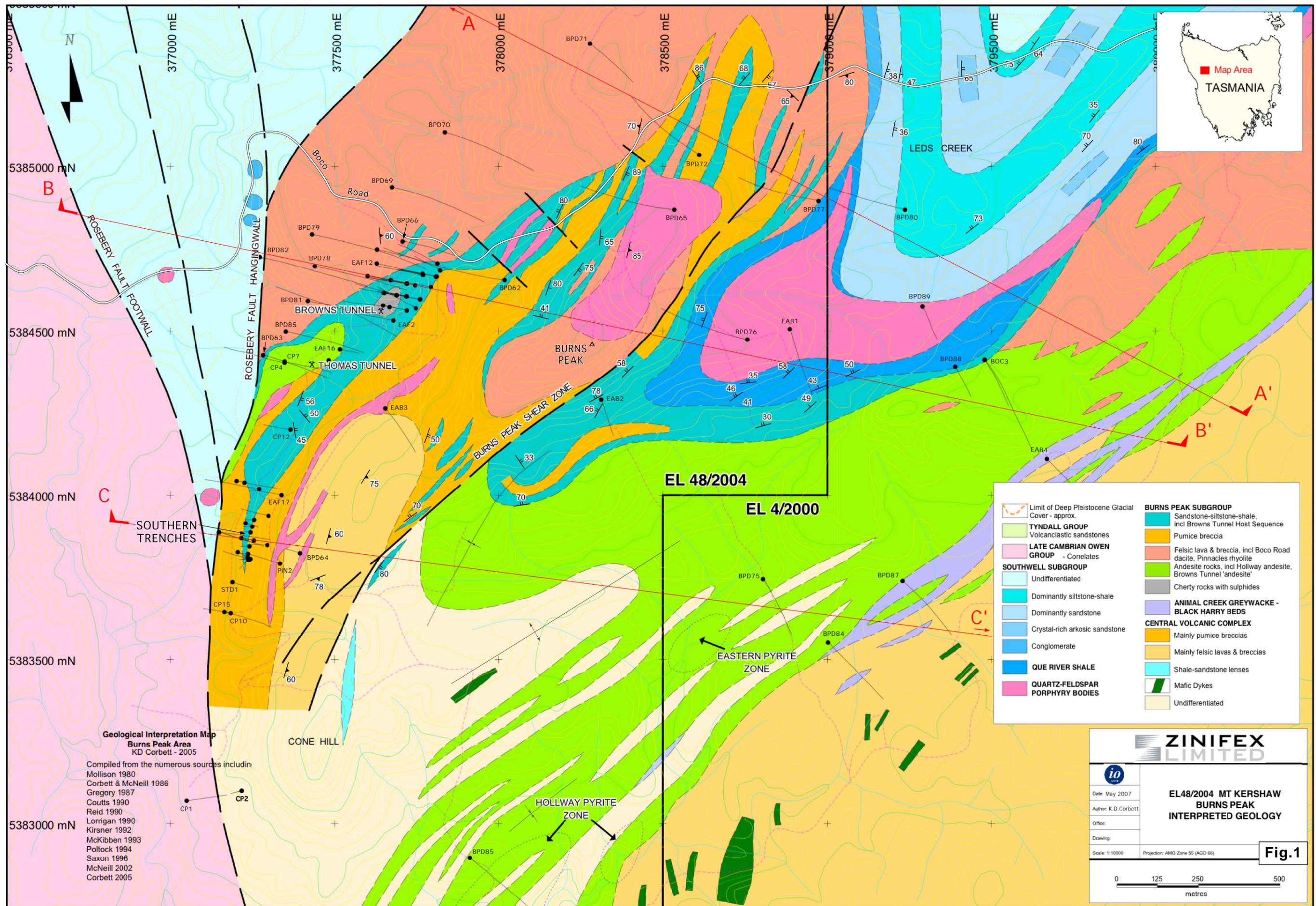
CONCLUSIONS AND RECOMMENDATIONS:

1. The intensive drilling carried out in the Browns Tunnel area appears to have sufficiently delineated the economic sulfide mineralisation to indicate that it is highly unlikely to constitute a viable resource. Consideration of the structural characteristics of the area, particularly the multiplicity of small faults and shear zones, suggests that even the conservative previous estimates of Edwards et al (1999), based on 40m spaced drill holes, may have been optimistic.
2. Extensions of the host sedimentary sequence appear to be limited at depth by the Rosebery Fault, and to the south by the facies change to pumice breccias. Drilling has indicated the northern limits of the waning system.
3. The unique features of the Browns Tunnel basin include the small size of the depositional area, the abundance of pumice breccias, and the apparent importance of quartz-feldspar porphyry intrusives as likely generators of hydrothermal activity. The large Hollway andesite complex just to the east, with its associated hydrothermal activity, does not seem to have been an influence here.
4. A feature of the geology which remains unclear is the nature and extent of the Burns Peak Shear Zone. This structure forms a major dividing line, with many significant changes and breaks across it, e.g. the disappearance of the Hollway andesite and Que River Shale, the increase in abundance of pumice breccias and porphyry intrusives to the west, yet we are still uncertain about the direction and amount of displacement, its structural history, and what happens at either end of its mapped length. Detailed structural studies of the few exposures of the fault would be beneficial, as would a structural study of the overall area.
5. The nature and age of the felsic rocks intercalated with the Hollway Andesite on its SW arm, and of the felsic rocks in the Cone Hill area - are they Boco Road dacite equivalents or CVC? - and the nature of the andesite-CVC contact (which has clear indications of hydrothermal activity just to the NE) in the Hollway Rivulet further to the SW, are other questions which remain unanswered (as noted also by Skirka, 2007), but which would repay further work.

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	Limit of Deep Pleistocene Glacial Cover - approx.		BURNS PEAK SUBGROUP Sandstone-siltstone-shale, incl Browns Tunnel Host Sequence
	TYNDALL GROUP Volcanoclastic sandstones		Pumice breccia
	LATE CAMBRIAN OWEN GROUP - Correlates		Felsic lava & breccia, incl Boco Road dacite, Pinnacles rhyolite
	SOWELL SUBGROUP		Andesite rocks, incl Hollway andesite, Browns Tunnel 'andesite'
	Undifferentiated		Cherty rocks with sulphides
	Dominantly siltstone-shale		ANIMAL CREEK GREYWACKE - BLACK HARRY BEDS
	Dominantly sandstone		Mainly pumice breccias
	Crystal-rich arkosic sandstone		Mainly felsic lavas & breccias
	Conglomerate		Shale-sandstone lenses
	QUE RIVER SHALE		Mafic Dykes
	QUARTZ-FELDSPAR PORPHYRY BODIES		Undifferentiated

Geological Interpretation Map
Burns Peak Area
KD Corbett - 2005

Compiled from the numerous sources including:

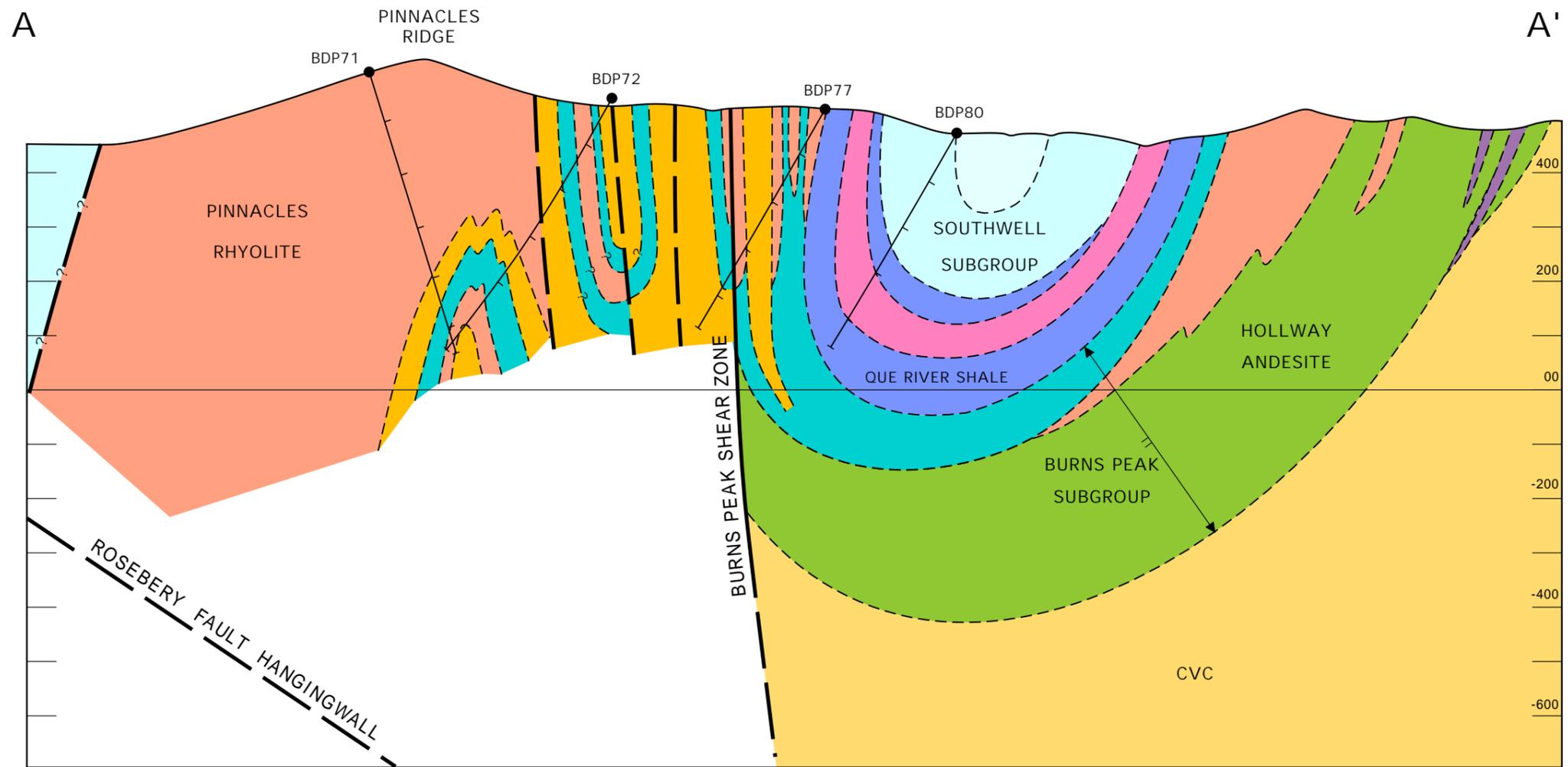
- Mollison 1980
- Corbett & McNeill 1986
- Gregory 1987
- Coutts 1990
- Reid 1990
- Lorrigan 1990
- Kirsner 1992
- McKibben 1993
- Poltock 1994
- Saxon 1996
- McNeill 2002
- Corbett 2005

ZINIFEX LIMITED

Date: May 2007
 Author: K.D. Corbett
 Office:
 Drawing:
 Scale: 1:10000
 Projection: AMG Zone 55 (AGD 66)

EL48/2004 MT KERSHAW BURNS PEAK INTERPRETED GEOLOGY

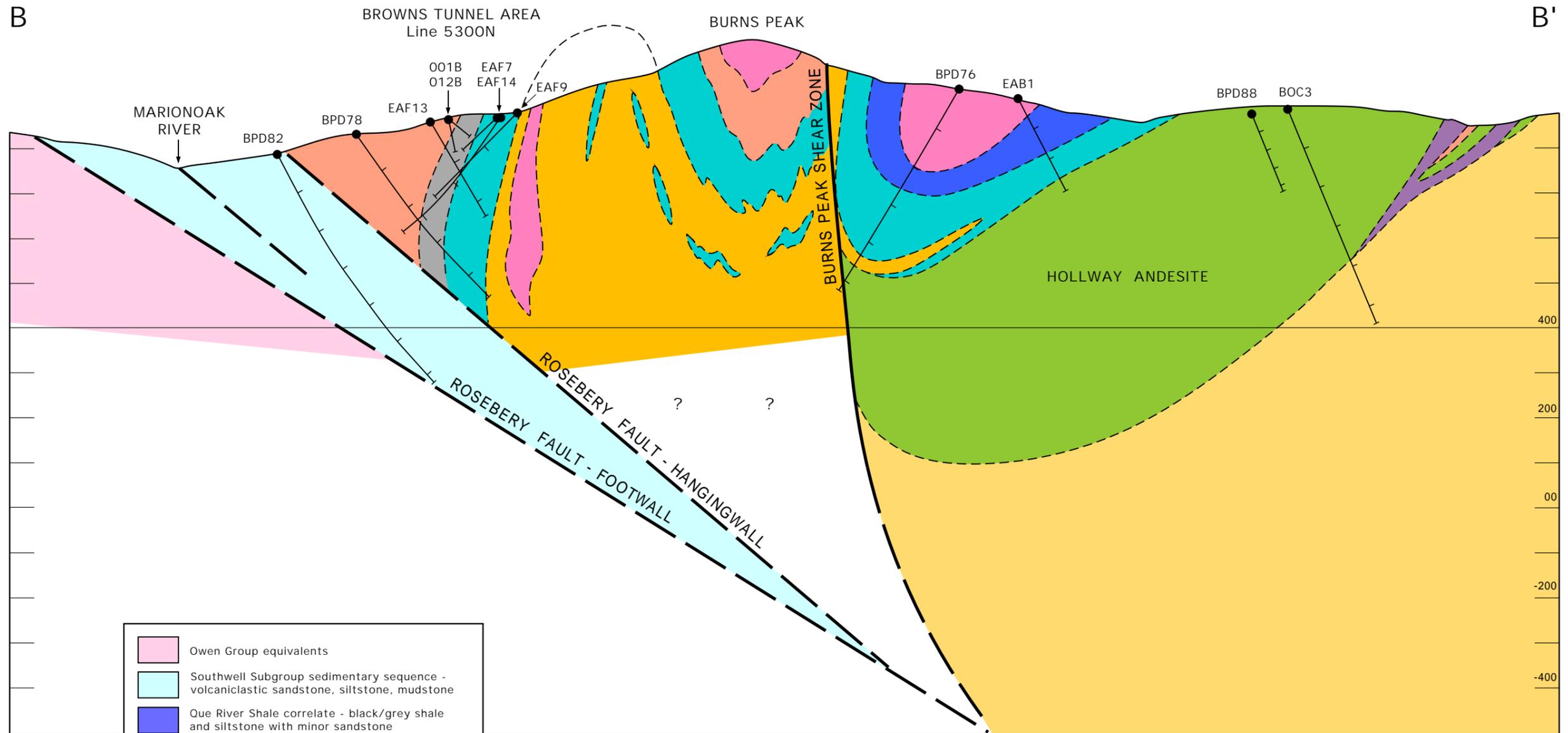
Fig.1



CROSS-SECTION A - A'
from Pinnacles Ridge
to Holloway Andesite

0 500m
 Scale 1:10,000 (at A3)

K.D.C. May 2007 **Fig.2**

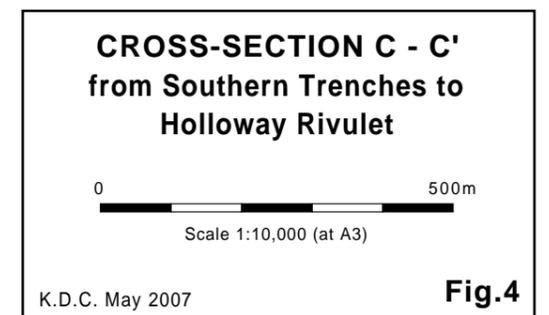
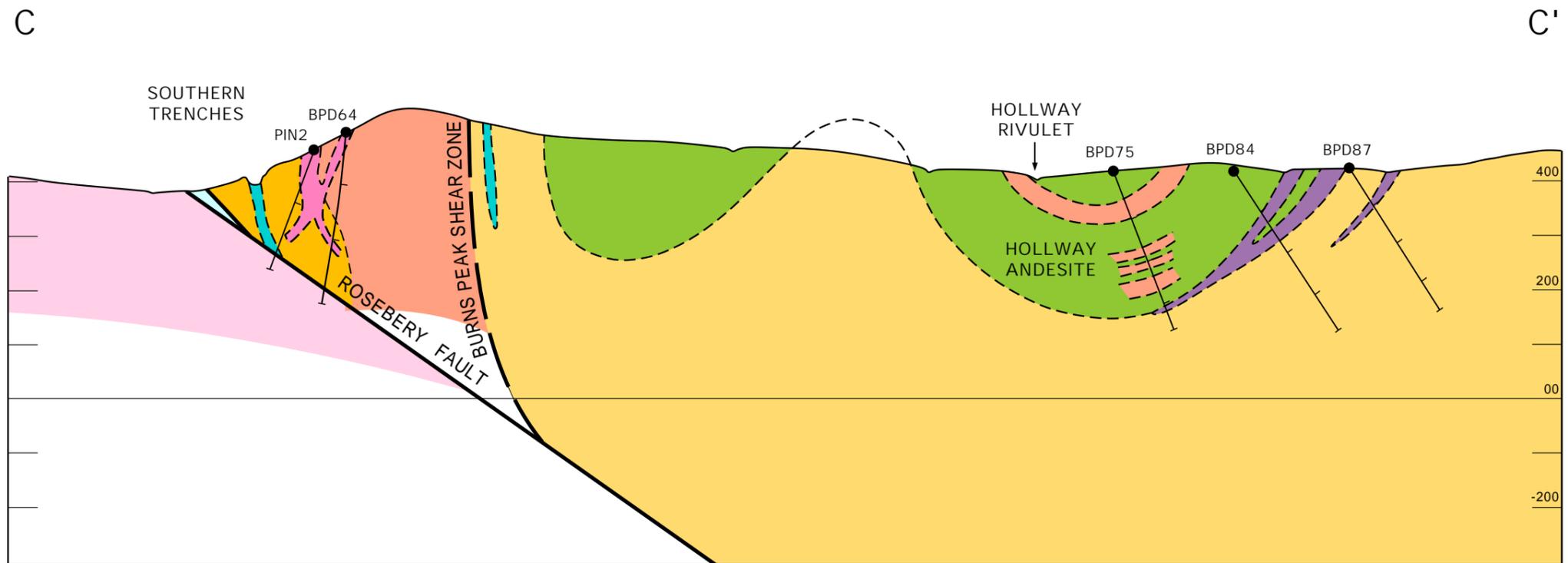


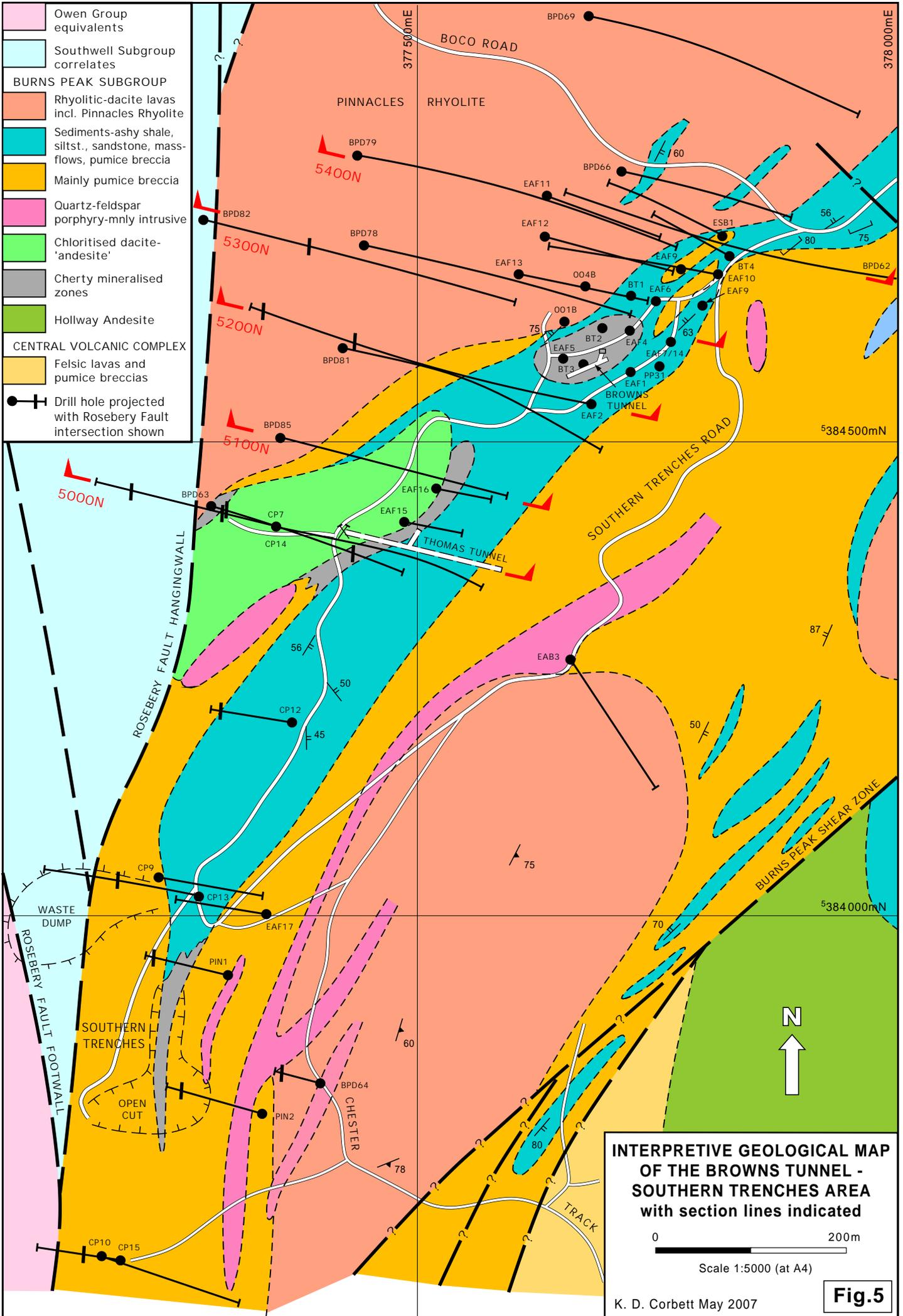
- Owen Group equivalents
- Southwell Subgroup sedimentary sequence - volcaniclastic sandstone, siltstone, mudstone
- Que River Shale correlate - black/grey shale and siltstone with minor sandstone
- Quartz-feldspar porphyry - mainly intrusive but partly extrusive
- BURNS PEAK SUBGROUP**
- Rhyolitic-dacite lavas and breccias, including Pinnacles Rhyolite
- Mainly pumice breccia
- Sedimentary units - sandstone, siltstone, ashy shale, mass-flow breccia, minor conglomerate. Includes lenses of pumice breccia and lava in places
- Andesitic lava and breccia (Hollway Andesite). Numerous dacite lenses in places
- Cherty alteration zone
- ANIMAL CREEK GREYWACKE**
- Micaceous to volcaniclastic sandstone, siltstone, shale
- CENTRAL VOLCANIC COMPLEX**
- Felsic lavas and pumice breccias with mafic dykes

CROSS-SECTION B - B'
from Browns Tunnel to DH BOC3

0 500m
 Scale 1:10,000 (at A3)

K.D.C. May 2007 **Fig.3**





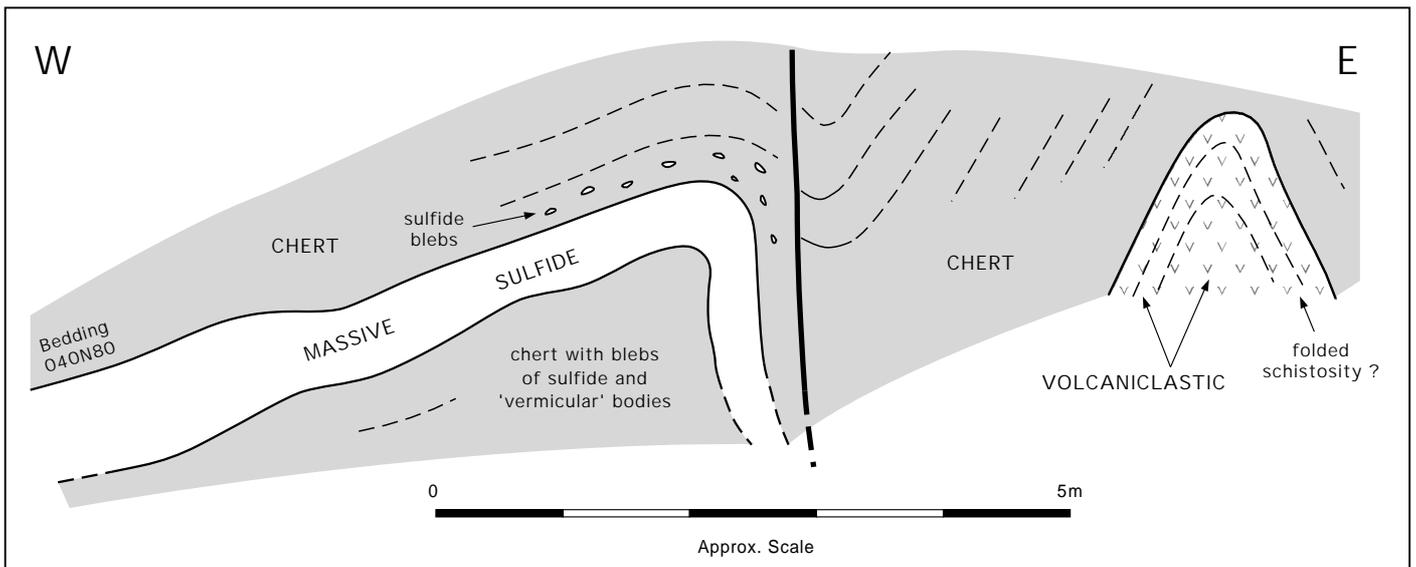
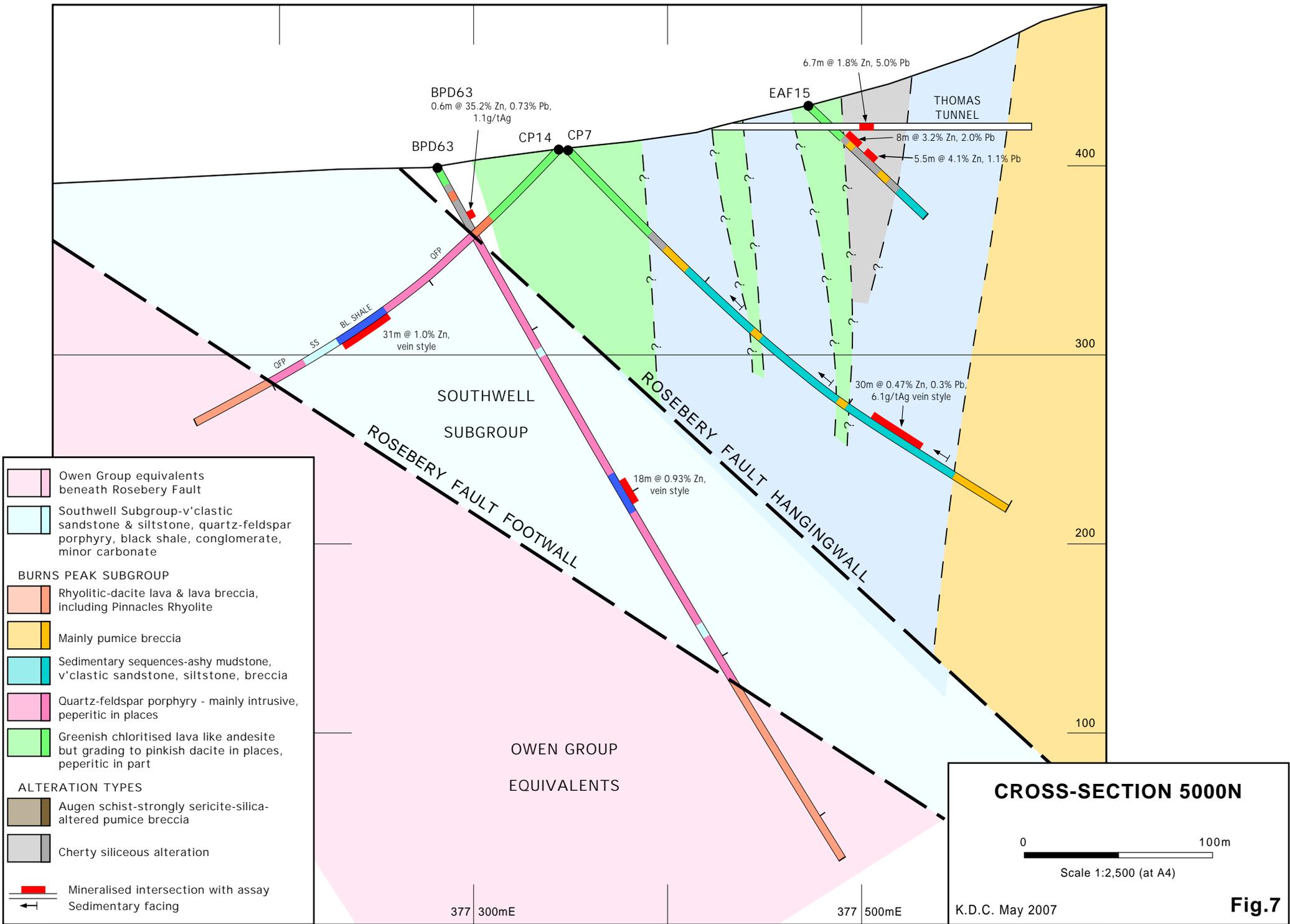
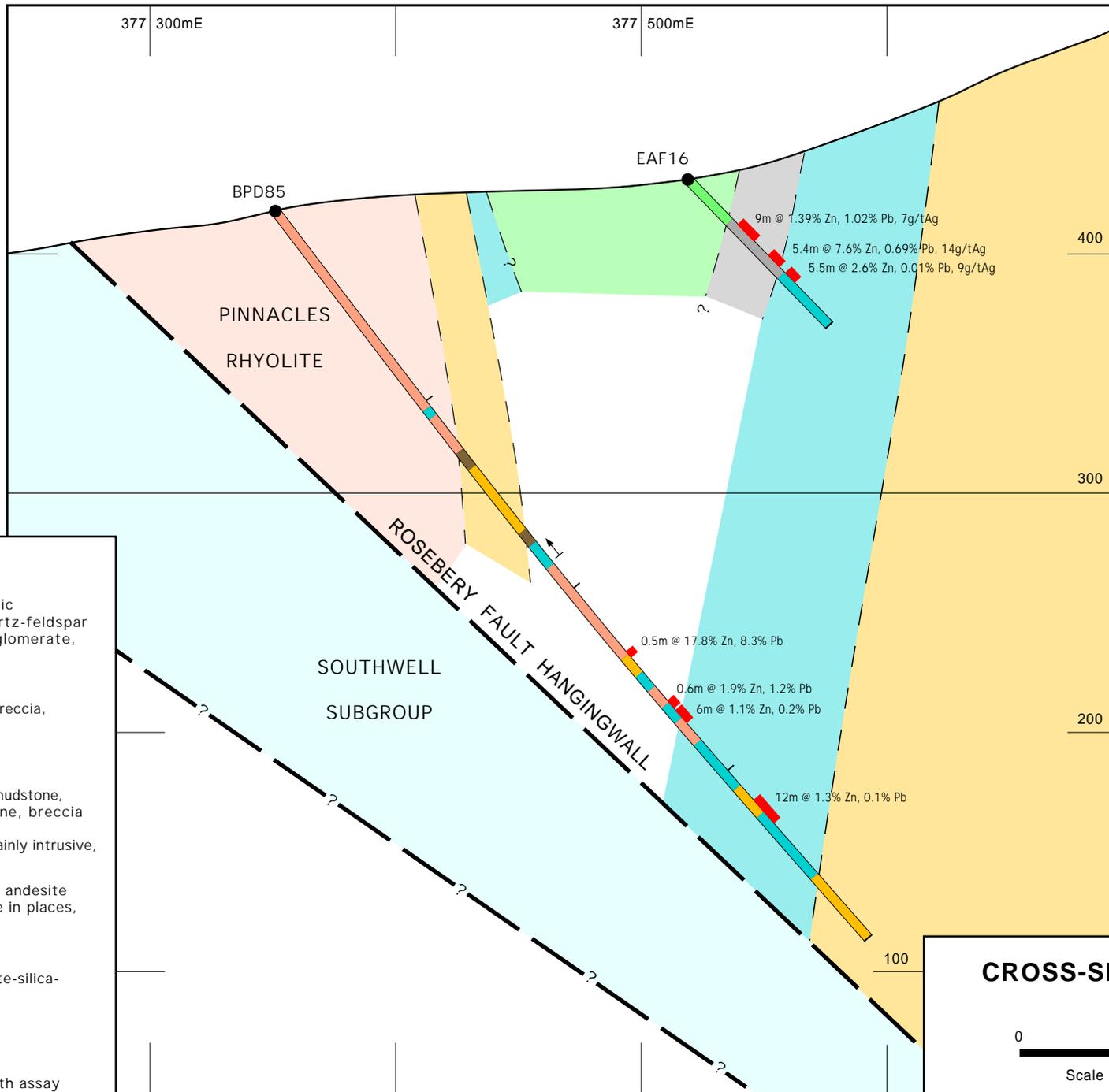


Fig.6 Sketch of massive sulfide outcrop near Browns Tunnel





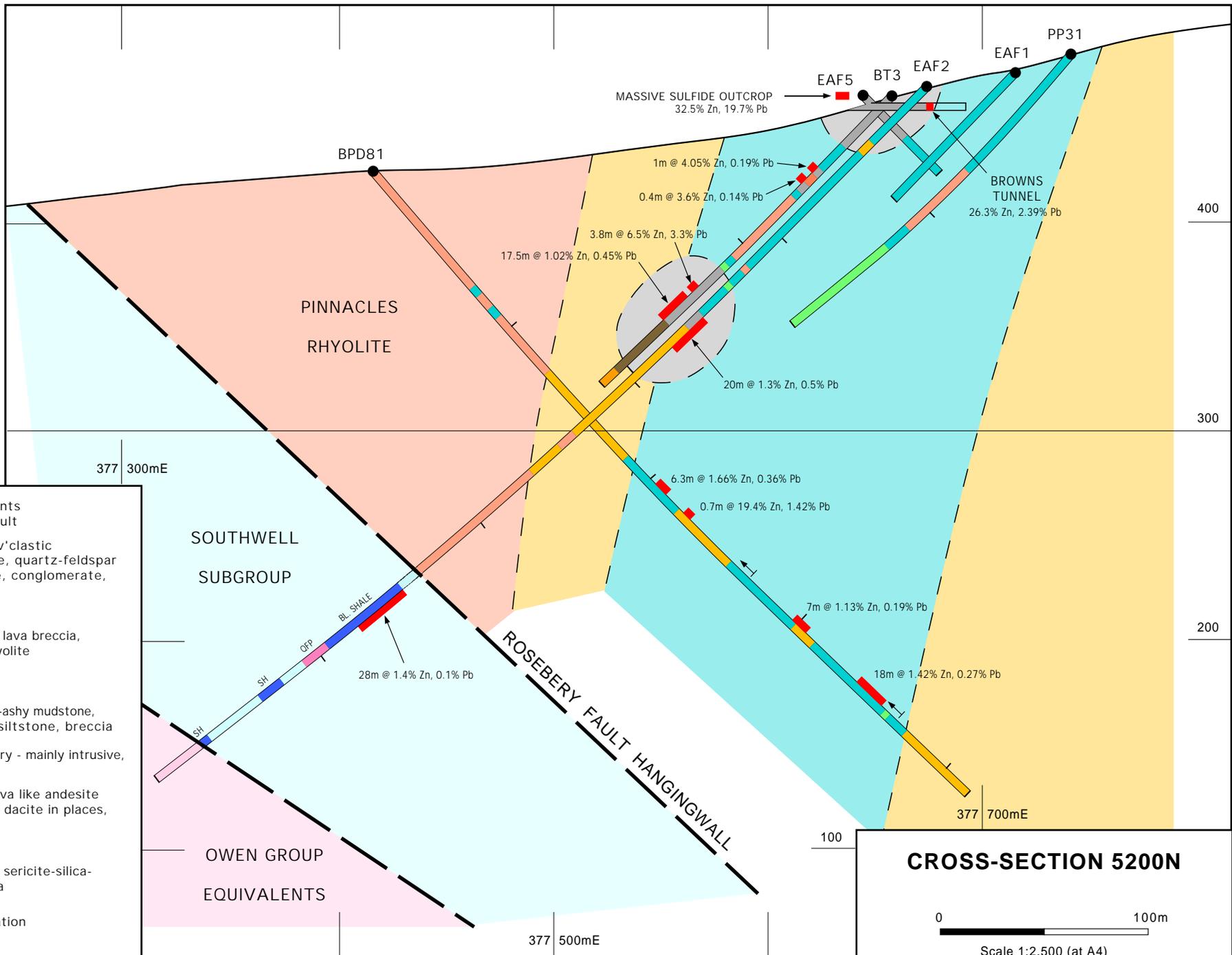
- Owen Group equivalents beneath Rosebery Fault
- Southwell Subgroup-v'clastic sandstone & siltstone, quartz-feldspar porphyry, black shale, conglomerate, minor carbonate
- BURNS PEAK SUBGROUP**
- Rhyolitic-dacite lava & lava breccia, including Pinnacles Rhyolite
- Mainly pumice breccia
- Sedimentary sequences-ashy mudstone, v'clastic sandstone, siltstone, breccia
- Quartz-feldspar porphyry - mainly intrusive, peperitic in places
- Greenish chloritised lava like andesite but grading to pinkish dacite in places, peperitic in part
- ALTERATION TYPES**
- Augen schist-strongly sericite-silica-altered pumice breccia
- Cherty siliceous alteration
- Mineralised intersection with assay
- Sedimentary facing

CROSS-SECTION 5100N

0 100m

Scale 1:2,500 (at A4)

K.D.C. May 2007 **Fig.8**



- Owen Group equivalents beneath Rosebery Fault
- Southwell Subgroup-v'clastic sandstone & siltstone, quartz-feldspar porphyry, black shale, conglomerate, minor carbonate
- BURNS PEAK SUBGROUP**
- Rhyolitic-dacite lava & lava breccia, including Pinnacles Rhyolite
- Mainly pumice breccia
- Sedimentary sequences-ashy mudstone, v'clastic sandstone, siltstone, breccia
- Quartz-feldspar porphyry - mainly intrusive, peperitic in places
- Greenish chloritised lava like andesite but grading to pinkish dacite in places, peperitic in part
- ALTERATION TYPES**
- Augen schist-strongly sericite-silica-altered pumice breccia
- Cherty siliceous alteration
- Mineralised intersection with assay
- Sedimentary facing

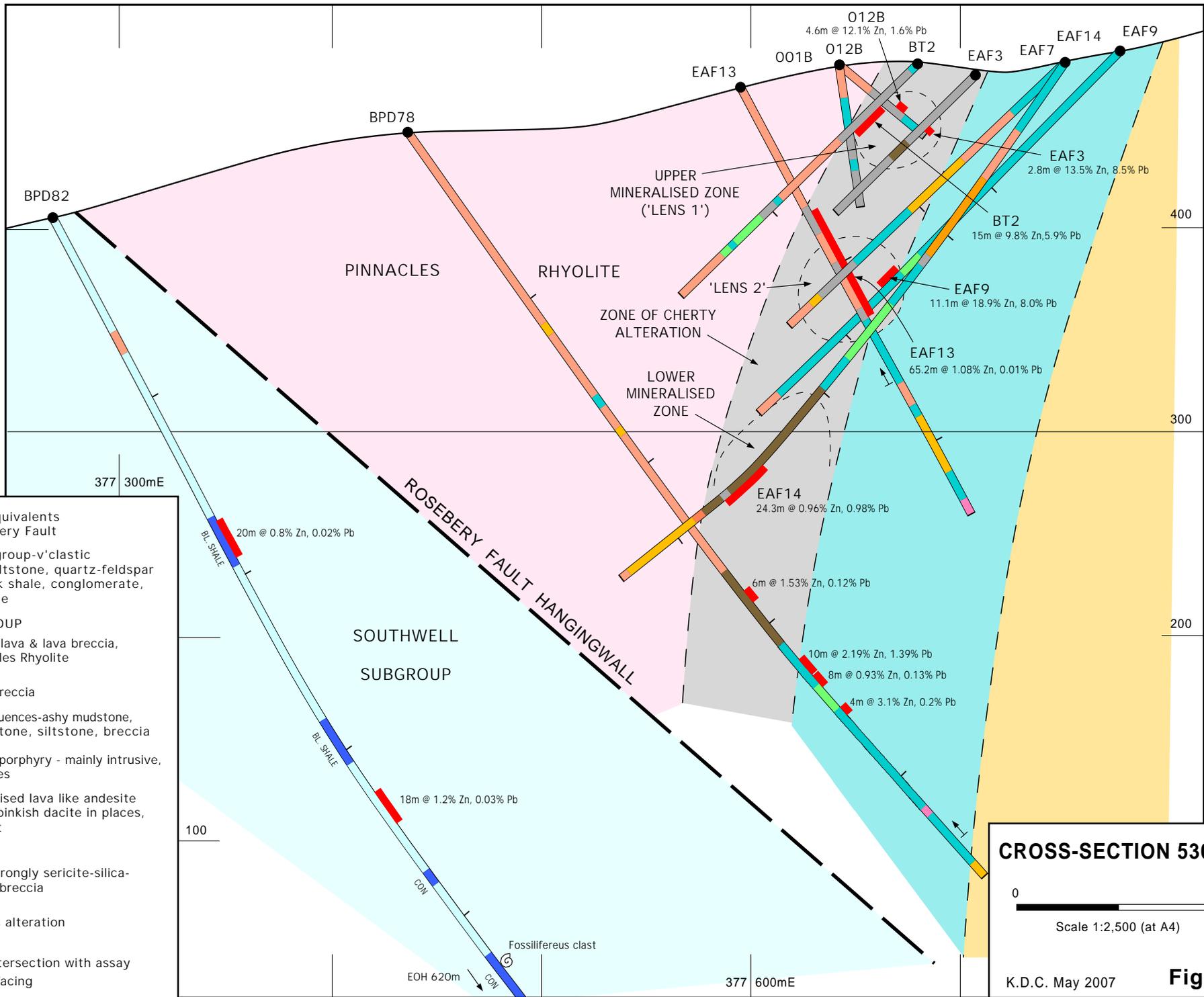
CROSS-SECTION 5200N

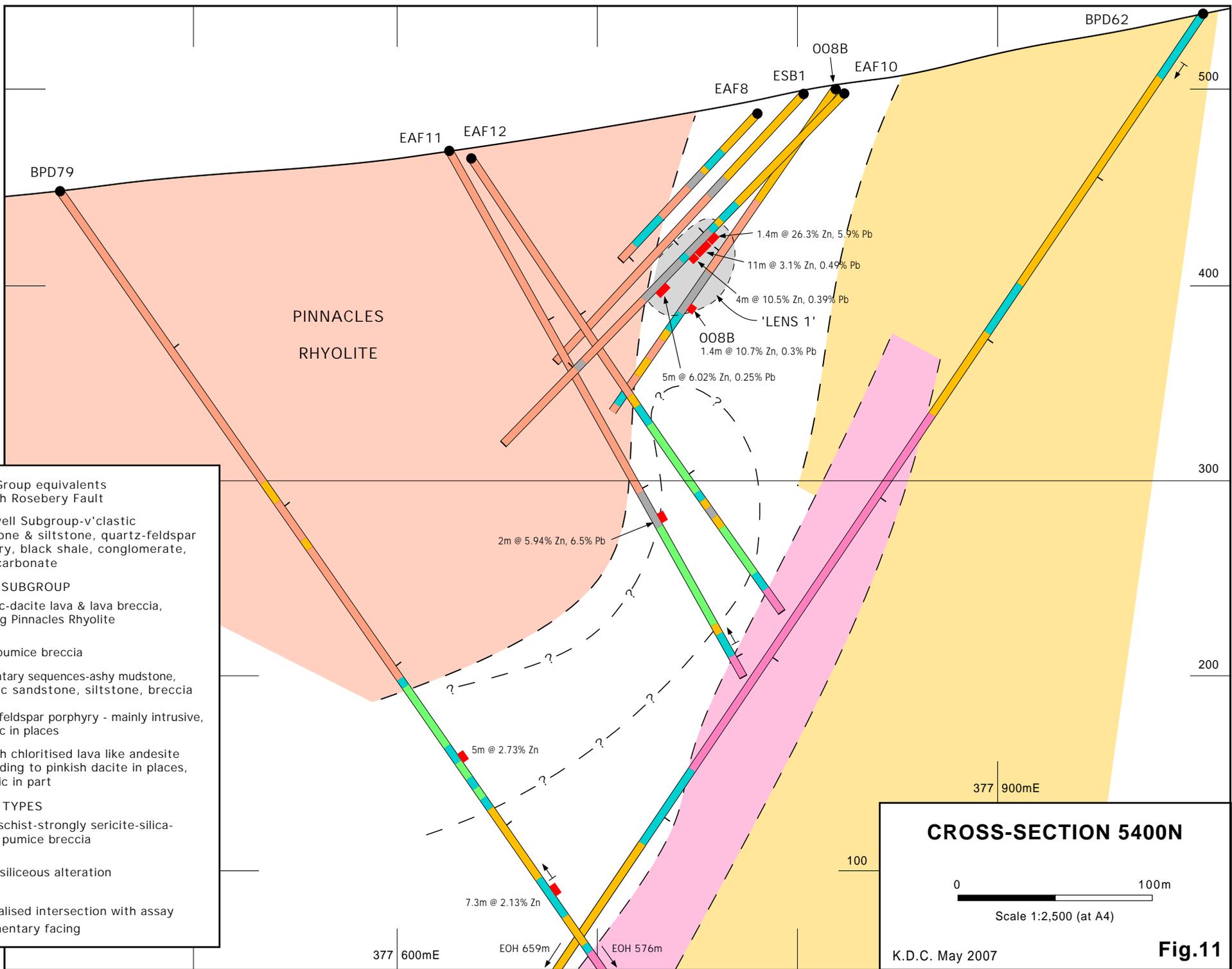
Scale 1:2,500 (at A4)

0 100m

K.D.C. May 2007

Fig.9





Owen Group equivalents beneath Rosebery Fault

Southwell Subgroup-v'clastic sandstone & siltstone, quartz-feldspar porphyry, black shale, conglomerate, minor carbonate

BURNS PEAK SUBGROUP

- Rhyolitic-dacite lava & lava breccia, including Pinnacles Rhyolite
- Mainly pumice breccia
- Sedimentary sequences-ashy mudstone, v'clastic sandstone, siltstone, breccia
- Quartz-feldspar porphyry - mainly intrusive, peperitic in places
- Greenish chloritised lava like andesite but grading to pinkish dacite in places, peperitic in part

ALTERATION TYPES

- Augen schist-strongly sericite-silica-altered pumice breccia
- Cherty siliceous alteration

Mineralised intersection with assay

Sedimentary facing

CROSS-SECTION 5400N

0 100m

Scale 1:2,500 (at A4)

K.D.C. May 2007

Fig.11