

**EL14/2006 “Dove River”**

**Annual Report 2009**



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**For Pluton Resources Ltd.**

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## Summary

This report is the third Annual Report for the Dove River exploration licence (EL14/2006) and is submitted in accordance with the Mineral Resources Development Act (1995) by Pluton Resources Limited (Australian Stock Exchange Code: PLV) on behalf of its subsidiary Dove River Pty Ltd.

The Dove River exploration licence contains a number of mineral occurrences, old mines and a goldfield (Five Mile Rise). Areas of hydrothermal alteration within the licence commonly yield anomalous metal values. The tenement has not been systematically explored for gold, more particularly no work has previously been conducted on the source of gold below the Ordovician rocks that host the Five Mile Rise goldfield. A review of previous literature confirmed the lack of activity exploring the Cambrian basement where exposed and concealed under cover.

The region shows similar characteristics to that of the copper-gold, high-sulphidation and porphyry districts in New South Wales, including the Cadia and Goonumbla deposits. These include the setting and chemistry of the host rocks, as well as the styles of mineralisation and related alteration.

Pluton's primary focus is to add value to the Dove River licence by demonstrating the potential for large-scale porphyry-style mineralisation in proximity to the Cambrian Dove Granite. Work to date has primarily focussed on three main areas of historic mineralisation within the tenement: the Devon Mine area, the Powerful Mine area and the Five Mile Rise Goldfield.

Work completed during the 12 months up until November 2009 has refocussed on the regional rock chip data set and associated petrological study which considered rock chip data collected from the regional samples in Pluton's adjacent tenements and drill core from all recent drill holes. The petrological work was accompanied by an expert report into the porphyry potential of Pluton's Tasmanian tenements.

The findings of the expert report by Greg Corbett into the prospectivity of the Tasmanian tenements identified the well focussed magnetic anomaly and associated alteration at Cethana (EL29/2006) north of the Dove River tenement to be the highest exploration priority. As a consequence planning for ground based geophysics has been scaled back until the results from drilling the Cethana chargeability zones (Feb-March 2010) are available. Funds have been allocated for this drilling and it is hoped that results will provide encouragement for further investment or joint venture partners to scale up exploration on the Dove River licence.

Variations in rock-type and alteration within the licence are subtle and work conducted on the whole rock and trace geochemistry has confirmed there are four main Cambrian rock units that have been affected by several different alteration types, a fine felsic unit, a volcanoclastic unit, a hornblende granodiorite (and porphyry), and the 'Powerful Granite'. New geological maps have not been compiled and conclusions about the setting and origins of Cambrian rocks are cursory. The stratigraphy remains contentious and due to the rugged terrain will probably remain so until some deeper bold exploration is done in the region. Tentatively the fine felsic unit underlies the volcanoclastics and the 'Powerful Granite' is older than the Hornblende Granodiorite (Dove Granite).

Location data referred to in this report are referenced to the AGD66 geodetic datum.

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## **Introduction**

Pluton Resources Limited is an Australian Stock Exchange listed mineral exploration company exploring for metallic minerals within EL14/2006 (Dove River) by way of its subsidiary company Dove River Pty Ltd. Pluton intends to assess the tenement primarily for porphyry style alteration systems and mineralisation with a primary objective of identifying potential for bulk tonnage copper-gold-silver mineralisation. The tenement is prospective for exploration due to similarities in aspects of the geology to porphyry-style copper-gold districts on mainland Australia and possible hybrid porphyry-VHMS systems (Henty and Mt Lyell) in Tasmania.

## **Tenure**

A tenement application (EL14/2006) for an area of about 36.5km<sup>2</sup> was made by Southern Ocean Science Pty. Ltd. in 2006. It was successfully partnered and transferred to Dove River Pty. Ltd., and Dove River Pty Ltd subsequently vested as a wholly owned subsidiary into Pluton Resources Ltd. in October 2006. Pluton Resources successfully listed on the ASX in December 2006

The exploration licence is located in the Mt Read Strategic Prospectivity Zone. This provides for security of exploration tenure by way of compensation of reasonable cost of work conducted (or resource defined) if a change in the tenement's land status results in the licence being revoked.

## **Location and land classification**

The licence is located about 35km south of the township of Sheffield (pop approximately 1000) and about 60km from port facilities at Devonport (figure 1). The licence land classification consists of State Forest, MDC informal reserves, the Dove River Forest Reserve, approximately 15% private land and sits adjacent to Lake Cethana (a Hydro-Electric lake) and the Lemonhyme power station.

## **Topography**

The topography of the licence is variable with a dissected plateau on the North of the licence and deeply incised creeks and (partially flooded) deep gorges of the Dove and Forth River valleys in the south (figure 2).

## **Vegetation and Soil**

Vegetation comprises wet and dry eucalypt forest typically dominated by *Eucalyptus Obliqua*, *Delegatensis*, and *Amygdalina* spp. On wetter south facing slopes and near river banks there are occasional patches of rainforest, dogwood scrub and *Acacia Dealbata* forest. Undergrowth is dependent on how dry the site is, but typically consists of spiky heath or ferns.

A variable soil profile is developed throughout the tenement with outcropping bedrock generally restricted to road cuttings, ridge tops, cliffs and creek/river beds.

## Access

Access to both the east and west of the tenement is via sealed road. Internal access and access to the south of the prospect is via formed forestry roads and four wheel drive tracks.

Access to the Five Mile Rise is via the Cradle Mountain Link Road (C132) than by way of a recently formed unsealed all weather forestry road from Daisy Dell. In part, this track parallels and crosses the Van Diemens Land Company (VDL Co.) track which was constructed by Fossey in 1827 between Mole Creek and Burnie.

Access to the Devon Mine is initially by way of the VDL Co. track, then a southerly fork with a dedicated track to the mine. The mine track descends about 600m elevation from the Five Mile Rise.

Access to the Powerful prospect is either from the south of the tenement by way of the Lemonthyme Road (C139) and then ungazetted track (locally known as River Road), or from the north via Lorinna.

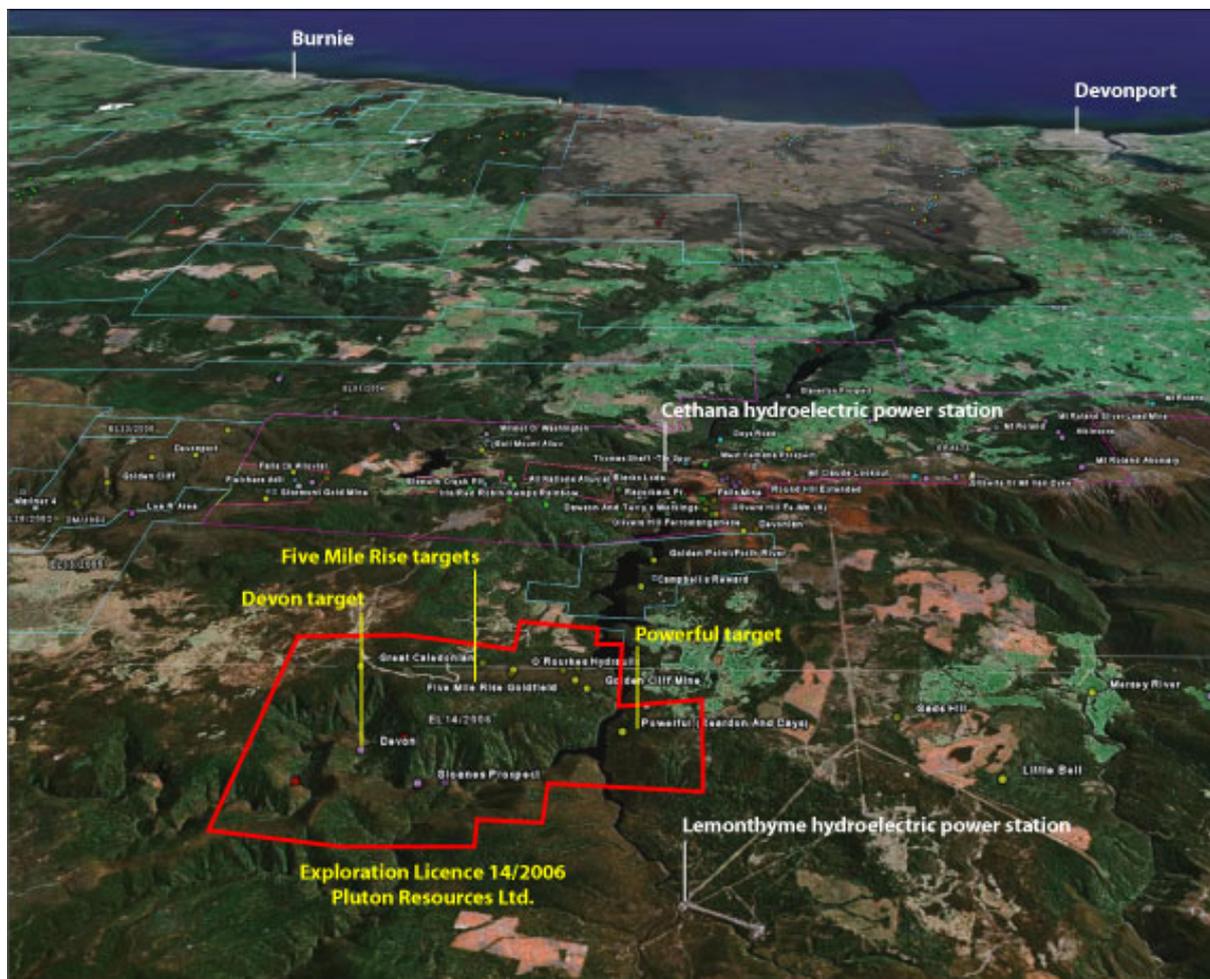


Figure 1 - Licence location and principal targets

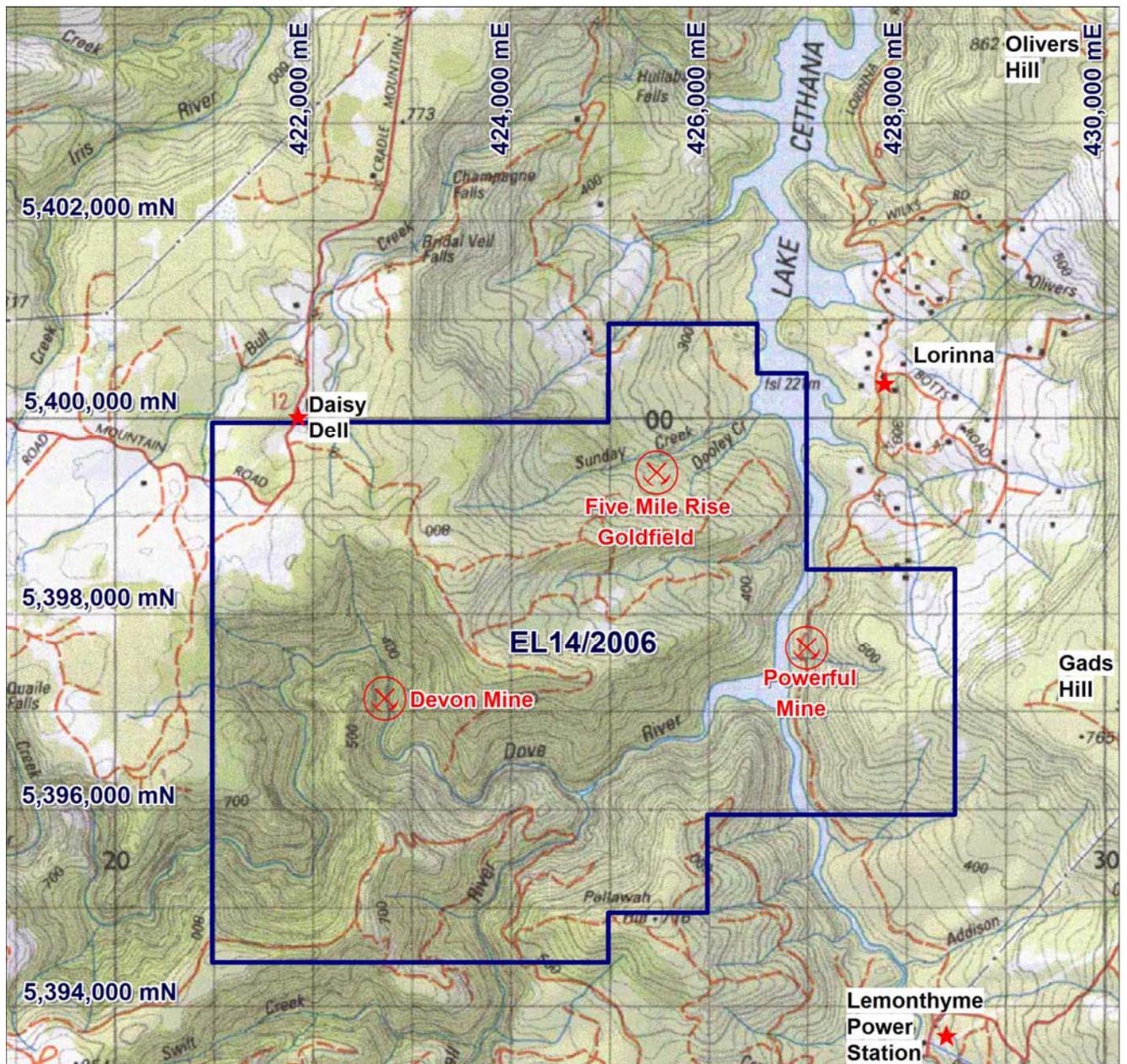


Figure 2 – Exploration Licence 14/2006 Dove River location and prospects on modified 1:100,000 Tasmanian government topographic base map.

### Geology

EL 14/2006 (Dove River) is contained within the northern portion of the c500Ma Cambrian Mt Read Volcanic belt (MRV). The MRV comprises mainly acid and lesser mafic volcanics and associated intrusive rocks. The MRV unconformably overlies Proterozoic metasedimentary rocks and, itself is unconformably overlain by Cambro-Ordovician siliciclastics and limestones. Rocks to the north of the Dove River Licence are intruded by the Devonian Dolcoath Granite.

Palaeozoic and Proterozoic rocks may be covered by outliers of Permian sedimentary rocks and there is a variable veneer of Tertiary basalt, sedimentary rocks and sediment.

The Mt Read Volcanic belt is highly mineralised. It contains numerous and some very large polymetallic VHMS-style deposits (e.g. Hellyer, Que River, Rosebery) and volcanogenic porphyry-VHMS hybrid copper-gold deposits (eg. Mt Lyell, Henty).

The Dove River area is dominated by Proterozoic schists in the south with younger Cambrian, Ordovician, and Tertiary rocks typically progressively exposed northwards. Very little detailed work has been undertaken in the current licence area. A description of the known lithologies and observed variations within the licence and potential correlations are summarised below.

### ***Precambrian schist***

The oldest rocks in the area are Proterozoic schists of the Tyennan block. The schists are typically light grey and strongly deformed. They are strongly foliated with a typically finely spaced crenulation cleavage evident as alternating mica rich and quartz rich lamellae. Bedding is rare but where observed in cut hand-specimen is isoclinally folded. Fold limbs are sheared parallel to the spaced cleavage. Kink banding is common. Bedding is rare in outcrop and then typically only visible on water-worn surfaces. Metamorphic grade is variable but not well defined. Very fine garnet of metamorphic origin is rare but indicates an amphibolite metamorphic grade. Reid (1967) describes these rocks as quartz-sericite schists and quartzites and indicates that there are areas of minor sulphide mineralisation and moderate alteration (typically hematitic).

Proterozoic schist borders the Powerful prospect and was intersected in the upper parts of the DR2 drill hole. The schists here are hematite and potassium feldspar altered; alteration clearly related to intrusion of the hornblende-biotite Dove granite and associated dykes. An intrusive contact between older Proterozoic schists and younger granitic and porphyritic intrusive rocks is exposed upstream and west of the Devon mine in the Dove River.

### ***Cambrian volcanics (updated)***

The Cambrian volcanics within the Dove River licence area have not been assigned a formal correlation within the Mt Read Volcanic stratigraphy. It has been inferred they should be grouped with the Eastern Quartz Phyric Sequence (Corbett, 2003) or the Tyndall Group (Herrmann, 1989 in Fleming and Castro, 1989). More recent work by Pluton suggests that correlation with any one part of the MRV is simplistic, the geochemistry supports a correlation with Suite 1 and 2 volcanics of Crawford et al (1992) Suite 1 comprises the Eastern Quartz Phyric Sequence, Central Volcanic Complex and the Tyndall group. The suite includes many of the Cambrian granitoids, quartz feldspar porphyries and the footwall andesites at Hellyer. They are transitional med-high K Calc-alkaline rocks (Crawford et al 1992). SiO<sub>2</sub> vs. K<sub>2</sub>O plots of volcanics from confirm this broad chemistry. This suite is from the basal to middle stratigraphy within the Mt Read volcanics

#### *Lower fine felsic volcanics (vitric tuff ?)*

The oldest Cambrian rocks in the Dove River area comprise fine-grained silica-rich massive bedded and cliff-forming sedimentary sequences. These rocks do not come into contact with the Proterozoic in the Dove River area, with the two packages separated by intermediate and felsic granitoids (Dove Granite). The lowermost part of this unit is exposed in cliff section west of the Devon Mine where more typical massive beds overlie a 20m thick unit of finely laminated siltstone.

Beds adjacent to quartz-porphyry exposed at the Devon Mine are fine grained and cream or grey coloured. Dark-grey diffuse round spots to 15mm indicate hornfelsing. Bedding is more clearly evident in contact-metamorphosed rocks with concentration of spots subtly indicating beds of up to about 75cm. The unit was originally mapped by Jennings (1963) as Precambrian schist. However, the unit lacks the foliation and folding evident in Precambrian schists to the south. A generally northerly dip is, however, consistent with that observed in nearby volcanoclastic rocks to the north. As such, the unit is almost certainly of Cambrian age. The unit was intersected in drilling DEVD1 and DEVD2 and field samples are consistently finer grained than the volcanoclastic units (eg: drill hole DR1). Petrography indicates the fine unit might represent an epiclastic variant of the volcanoclastic rocks, but is of similar bulk compositional type. The fields of both units typically overlap in bivariate plots.

Correlation of this unit with rocks elsewhere is uncertain. Based on gross lithological character of probable vitric material derived from a more volcanic origin, it is similar to vitric tuffs of the Back Peak Beds described by Herrmann (in Fleming and Castro, 1989).

#### *Mixed volcanic and volcanoclastic rocks*

A progressively coarsening quartz-rich volcano-sedimentary sequence gradationally overlies (?) the vitric tuff to the north. This unit was mapped as Lorinna Greywacke on regional maps by Jennings (1963). This sequence comprises angular clast rich poorly sorted sandstone, pumecious sandstone, and quartz rich volcanoclastic sandstones. Fine 'grain flow' greywackes and possible volcanics of near identical composition to the quartz rich volcanoclastics were observed in core from DR1. Based on reconnaissance mapping and drill core, there may be an increasing lithic component up stratigraphy. Beds may be laminated but are typically massive in outcrop. Differentiation between quartz-phyric volcanoclastics and quartz-porphry can be difficult, particularly in areas of hydrothermal alteration. The unit is thought at this stage to be largely derived from water-supported mass-flow, preserving finer and more delicate biotite alongside much larger quartz and sometimes angular lithics. The prevalence of rounded quartz and biotite indicates a proximal origin, with material possibly derived from an extrusive form of the quartz-phyric porphyry.

#### **Dove Granite**

The Dove Granite is regionally mapped as three occurrences, one in each of the Mersey, Forth and Dove valleys. Montgomery (1893) remarked on the similarity between granite east of the Dove River licence (at Gads Hill) with Devonian Dolcoath Granite located north of the Dove River licence. In contrast, on visiting the Five Mile Rise Goldfield, Twelvetrees (1913) concluded that the granite showed greater affinity with other Cambrian age granites of the West Coast. In producing the last geological map and explanatory notes of the area, Jennings (1963) described a relationship of granite intruding what he thought to be Ordovician rocks. He concluded that the Dove Granite was Devonian. Radiometric K-Ar and Rb-Sr ages determined by McDougall and Leggo, (1965) firmly suggested the Dove Granite is Cambrian, albeit with some outlying Ordovician ages that were attributed to argon loss. Unfortunately, Jennings interpretation persists in citation through much of the literature and company reports until the 1980's.

The reality is that few workers completed little if any work on the Dove Granite. Pluton is the first company to systematically sample the granite, mainly to determine if the Dove Granite is of the right composition to produce copper-gold porphyry deposits. Based on revisiting the field specimens in hand sample, there are two different granitic rocks that can be identified within the Intrusive Complex. These are tentatively subdivided into the Powerful Granite and the Dove Granodiorite.

#### *The Powerful Granite*

The Powerful granite is a quartz biotite granite that when potassically altered appears to be coarsely porphyritic. It was originally confused with the 'granite-porphyry' of Smyth (1981) in the vicinity of the Devon Mine where crops out as a potassically altered porphyritic rock in the Dove River downstream from the Devon Mine. Re-examination of drill core from the Devon Mine clearly shows a transition from weakly altered "Dove Granodiorite" to strongly altered porphyry with no discernable hornblende or plagioclase. The Powerful granite is a geochemically distinct unit. The first 90m of drill core from drill hole DR1 is the best record of the fresh rock type.

A common trait of this rock is the well-rounded quartz phenocrysts. The rounding is possibly due to silica solubility with shallow depth of intrusion, consistent with intrusion of the porphyritic rock at shallow levels within the Cambrian sequence.

### The Dove Granodiorite (Dove Granite)

The Dove Granodiorite is an equigranular hornblende granodiorite and has a porphyry variant. The porphyry unit adjacent to the Dove Granite at the Devon Mine is typical of porphyries mapped elsewhere in the tenement. The inference has been made by Herrmann 1989, M.Vicary (pers. Comm.) that the porphyry at the Devon Mine correlates with the quartz-feldspar porphyries that intrude the Sticht Range Beds, the Back Peak Beds and the Precambrian units near Back Peak (figure 3). Such an association would suggest Cambrian Granite at depth in this location if the porphyry at Devon is a marginal phase of the Dove Granite as suggested by Herrmann 1989 and Jennings 1963. This proved to be correct when the Devon Mine was drilled.

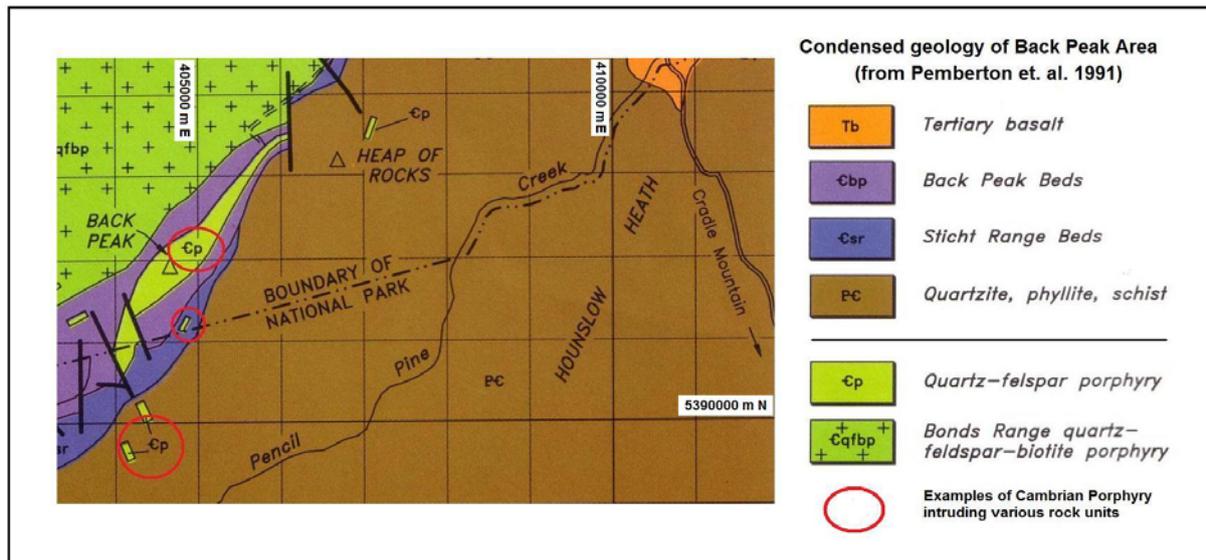


Figure 3 – Examples of Cambrian Porphyry intruding various units in the vicinity of Back Peak (modified from Pemberton et. al. 1991). \*Coordinates in AMG Zone 55, datum AGD66.

This unit was originally separated into two granitic rocks that were differentiated on the basis that one was dominated by biotite with lesser or little hornblende, whereas the other was dominated by hornblende as the mafic mineral. Potassic alteration of the rock has been found to account for most of the variation. The contacts with the quartz rich granite are commonly sharp and the granite is strongly altered indicating the granodiorite intrudes it.

The less altered biotite (-hornblende) granodiorite crops out on the access track to the Devon mine and in the river downstream of the Devon Mine. It comprises grey equigranular quartz-feldspar-biotite with rounded dark-grey biotite (+-hornblende) rich clots (possible xenoliths) to 20cm. Inclusions of laminated and altered rocks (Proterozoic xenoliths) are rare. Xenoliths were also recorded in drill cores from DEVD1 and 2.

The hornblende-rich rock crops out south of the Powerful Mine (but also possibly south of the Devon Mine) and in drill core from Powerful (DR3). The rock is medium grained, equigranular and visually similar to the biotite granite except for the prevalence of hornblende as the primary mafic component. The hornblende 'granodiorite' is commonly perceptibly magnetic in hand specimen which is consistent with classification as an I type magnetite series 'granite'.

There is also a perceptible concentration of sulphides within the more mafic clots in hand specimens of the biotite (-hornblende) granodiorite, possibly indicating an as yet unrecognised mineralised late magmatic phase within the granite suite. Several potassic dykelets cross cut the granodiorite in DR2 and 3 and may be the expression of such a magmatic phase.

### ***Owen Group***

Conglomerate and sandstone sequences are regionally unconformable on Middle Cambrian volcanic rocks, however no true conglomerates occur at the base of the Ordovician on the licence. At Five Mile Rise the basal unit was observed in drill core and is a bioturbated coarse to pebbly sandstone. Overlying this is pale yellow fissile siltstone interbedded with fine and pebbly sandstones and minor shale. The sequence has been identified by several previous workers as Moina Sandstone. The sandstone dips gently (15-20 degrees) to the north-northeast forming a veneer over the Cambrian stratigraphy.

Several kilometres northeast of the Dove River licence, the Moina Sandstone is underlain by thick sequences of Roland Conglomerate. The absence of the conglomerate units on the licence may indicate extension north of Five Mile Rise in the late Cambrian. The structures controlling this facies variation may be coincident with northwest-trending aeromagnetic linears north of the licence.

Gordon Limestone conformably and gradationally overlies the Moina Sandstone just north of the licence near Lorinna. Both this and the Moina Sandstone were faulted during the Devonian Tabberabberan Orogeny.

### ***Tertiary Basalt***

The Tertiary Basalt at the Powerful prospect was intersected by diamond drill hole DR2 in the previous drilling program. The basalt is a fine-medium grained vesicular dark rock with occasional zeolites and calcite veins. At Powerful, it is underlain by approximately 11 metres of probable Tertiary lake sediments. Herrmann in Fleming and Castro (1989) estimated Tertiary Basalt flows over much of the region to be only a few tens of metres thick.

### ***Quaternary Glacial and Fluvial Deposits***

Although not prominent in the main part of the licence there are surficial deposits of questionable fluvial origin on flatter parts of the Forth River valley that could be attributable to glacial action. These deposits are small and initial assessment suggests the sediments cover an area of minimal prospectivity.

## **Exploration History**

The Dove River licence area was prospected for gold and silver-lead until the mid 19<sup>th</sup> Century.

James 'Philosopher' Smith discovered alluvial gold in the Forth River in 1859 near Golden Point approximately three kilometres north of Lorinna (Jennings 1963). Malcolm and Alex Campbell opened the first hard rock mine, Campbell's Reward, in the early 1880's on the east side of the Forth River. It was not until 1887 that a discovery at Five Mile Rise (previously termed the Middlesex Goldfield) was made by J Aylett at the "Great Caledonian" Mine (Reid, 1919).

A number of leases at Five Mile Rise were pegged around the initial discovery in the following year. However, the alluvial prospects proved of little worth to the early miners. Montgomery (1893) described the alluvial workings as shallow, suggesting that no great depth to the auriferous wash probably accounted for the quick demise. Hard rock sources were soon located and developed by underground workings on the auriferous lodes. The lodes were gold rich in the oxide zones near the surface with gold not recoverable from the sulphide lodes at depth using techniques available at the time. By 1891 work had all but ceased on the gold field due to the rush at Bell Mount to the north (outside the licence area) and only three mines returned to production before work again ceased in 1901 (Jennings, 1963).

James Smith later discovered a galena lode SW of the site of the Devon Mine and Malcolm Campbell located the Devon Lode in 1897 (Reid, 1919). The Devon Silver-Lead Mining Company NL acquired the lease from Campbell later in 1897 (Jennings, 1963) in the form of four sections covering 40 acres. The Devon Mine and Five Mile Rise mines were operated at several times in the 19<sup>th</sup> Century with the most advanced activity at Devon, a detailed description of workings is given below.

## ***Description of Workings***

### ***Five Mile Rise Goldfield***

Six prospects on the Five Mile Rise mineral field constitute the main hard rock workings. These are the Great Caledonian, Glynn, Thistle, Golden Hill, Golden Cliff and Union Mines all of which were originally developed between 1887 and 1901. There are other workings mentioned in the area, although details of these prospects are uncertain. The only form of exploration on these prospects as individual targets has been by prospecting via adits and shafts. All but the Great Caledonian were accessed by adits, with the flat ground around the Great Caledonian only allowing access by a shaft.

All the lodes in the goldfield are said to occupy small faults that strike at approximately 140 degrees. The lodes outcropped as gold rich rubbly gossans and passed into mixed sulphide ores at depth containing silver-lead and pyrite with accessory chalcopyrite, arsenopyrite, gold, sphalerite and sometimes bismuthinite. The veins are irregular in width and extent and only enriched as gossan at surface. They occupy tension cracks which are sympathetic in width to, but do not generally cause replacement of, the variable lithology within the Moina Sandstone (Jennings, 1963).

Mineralisation is reported to extend below the Moina Sandstone host rock in several cases, for example Johnson's Reef is said to be approximately 300m south of the Great Caledonian workings and the host rock is described as being decomposed greenish "granite" and the main outcrop as "largely dense haematite". The description of the host rock in the deepest levels of the Great Caledonian is the same. At the Union Mine the lodes are said to pass into haematitic quartz lodes at depth. At Golden Cliff the bottom adit was driven into the sub-Ordovician country rock, however the lode was never met with.

Twelvetrees re-examined the Five Mile Rise Goldfield in 1913. The workings were abandoned, however by 1919 when Reid visited Five Mile Rise the Thistle mine was once again being worked for galena ore and alluvial gold was also being intermittently taken from O'Rourke's 'Hydraulic' lease.

| Deposit Name     | Size(tonnes)/ Production(oz)        | Deposit Form ; Strike and Dip  | Max. Width              | Commodities Recovered | Gangue Minerals  | Comments on development, history and sub-Ordovician mineralisation   |
|------------------|-------------------------------------|--|-------------------------|-----------------------|--|--|
| Great Caledonian | Small ~200t crushed/ ~100oz         | Several ferruginous veins of 'rubbly sandstone' / Unknown                | 30cm?                   | Gold                  | 'Cellular silica' (Twelvetrees, 1907), limonite and quartz | Accessed by shaft with a cross-cut and winze, possibly driven by O'Rourke from cliffs to the south, dewatering attempted once (1933 – Nye). Mineralisation reported in Ordovician host and Cambrian 'Granite' deeper in the workings (confirmed presence in mullock, Reid, 1919). Considered sub-greywacke of the 'Lorinna Formation' (Robinson pers. comm. in Jennings, 1963).  |
| Glynn            | Probably a little over 100t / 19oz+ | Vein; Strikes west of north and dips steeply west (Harcourt Smith, 1898) | 90cm                    | Gold                  | Silver   | An open cut near the head of Sunday Creek (tributors workings of Smith, 1898) and separate shaft later connected by a winze from the tributors workings. An adit 7.5m below the open cut intersects the lode at 15m. A five head battery was established 7.5m above big creek. The gold is argentiferous and there is no mention of connection to the Cambrian basement.   |
| Golden Cliff     | Small/ Unknown, probably <50oz      | One main vein, possibly others ; 330/-40W (Twelvetrees, 1913)            | 10cm                    | Gold                  | Arsenopyrite, manganese, quartz (MRT deposits database)    | Narrow vein with grades to 42 g/t Au as free gold in oxide and in pyrite at depth. One shaft adjacent to Winspears Rd sunk from an open cut 4 foot wide 30 foot long and deep. Two adits, the upper of which is 18m and extends 9m beyond the lode. The lower adit 30m below is 36.5m long and has a short drive and rise at the end but did not intersect the lode. The lower adit is in 'dark mica granite' (Twelvetrees, 1913).   |
| Golden Hill      | Smallish >60t/ >20 oz               | Three veins; Approx 140/80E  | 60cm and 90cm as gossan | Gold                  | Pyromorphite, quartz, pyrite and sphalerite (Smith, 1898)  | An open cut and adit were constructed in 1898. The adit intersects three thin quartz-sulphide veins which pinch and swell along fault zones within the Moira Sandstone, The No.3 vein carries grades to 23g/t Au (Waller, 1901). A 15 head stamper battery originally located at the Great Caledonian was located at the end of a tramway below the mine and was used for crushing. Sulphides possibly replacing bedding adjacent to lodes. Silver and Lead reportedly extracted from lower levels of the mine (Askins, 1980). |

|                      |   |  |                     |                         |   |  |
|----------------------|---|--|---------------------|-------------------------|---|--|
| Union                | Smallish  | One vein plus disseminated mineralisation<br>162/-75E  | 60cm                | Gold                    | Chlorite, quartz, galena, sphalerite (main lode)<br>Hematite and pyrite (porphyry hosted lodes) | Established pre-1893 by the Campbell Brothers, worked by E.C James again in 1917. 3 shafts and an 80m adit with the last 18m reported to be porphyritic Cambrian rocks with sparse hematite veins containing up to 0.1% Cu. The main lode occurs on the faulted Cambrian – Ordovician contact at depth.  |
| Thistle              | Smallish  | Three fracture filling veins /<br>No.1 NNW/-80W,<br>No.2 NNE/-85E,<br>No.3 (largest)<br>NNW/-65W | 30cm                | Gold, Silver,<br>Galena | Quartz, sphalerite, arsenopyrite, pyrite and minor chalcopyrite (Askins, 1980)                  | Discovered by the Campbell Brothers and originally worked for gold on the rich gossanous 'joints'. Later worked for small amounts of galena in the unoxidised portion of the lode (Reid, 1919). Galena was argentiferous and included trace gold and a peak of 14.5g/t in No.1 lode. Two adits (upper and lower - longer) and a number of shallow shafts and trenches (Askins, 1980). Lodes numbered 1-3 (E to W).   |
| O'Rourke's Hydraulic | Significant proportion of gold from the field (>100oz?) | An area of wash approximately 155 metres long, 3-3.75 metres deep and 40-60 metres wide.         | Alluvial (see form) | Gold                    | Quartz (sometimes attached to gold)   | Coarse angular talus worked over three creeks 'in the vicinity of the Union mine' (Jennings, 1963) and east of Glynn Mine (Harcourt Smith, 1898). A dam on 'Big Creek' and water race then piped water to site with less than hydraulicking pressure. Instead water was used to wash the gravel in a long sluice. The area had been worked to within twenty metres of the small dam feeding the 'pressure main' in an attempt to locate the source reef (Waller, 1901). The angular nature of the gold suggested short deposition distances, however no source had been located (Harcourt Smith, 1898) |

Table 1: Summary details of individual prospects in the Five Mile Rise Goldfield

### *Devon Mine*

The Devon Mine was mined for galena from clean 7 to 40cm veins producing high grade hand picked argentiferous lead. Consequently the Devon Mine has long been considered and reported as a lead-silver deposit, however appreciable gold and copper grades accompanied the lode material and the mixed sulfide portion of the lodes and any associated disseminated sulphide was never recovered. The mine was the only prospect in the district to pay it's way despite the restrictive location and associated transport costs of horse-packing it's clean galena ore to market.

Reid (1919b) reported that 172 tons of galena ore was produced from the Devon Mine to May 1899 and Twelvetrees indicated that 290 tons of silver-lead ore was produced since 1899 suggesting a total production of 462 tons to June 1907 including production of 25 tons since November 1906. Production at the mine continued sporadically until 1912 however dates overlap for the final production with 134 tons reported from March 1907 until December 1908, so  $134 - 25 = 111$  tons more, so 573 tons as a maximum total to Dec 1908. This disagrees with assessment of Nye who appears to have missed some of the production between September 1902 and June 1907 and suggests a 397 ton total. Neville McCoy held a mining lease over the Devon workings in 1980 and may have made more recent production.

Harcourt-Smith visited the Devon Mine in 1898 which was then operated by the Devon Silver Mining Company, development at the site was being hampered by poor access. An adit had been driven 26 metres in a westerly direction approximately 7.5 metres above the river, a second adit (approximately 36.5 metres north and approximately 5 to 5.5 metres below the first adit) had been driven 7.5 metres in 1898. Drives were established in the orientation of the intersected lodes (north-south orientation) in the first adit and the second adit was also noted by Waller (1901) and associated workings are described by Twelvetrees (1907).

The lodes reported in the first adit are at the entrance (7.5cm of galena dipping west), at 12 metres (a narrow gossanous vein) and at 15 metres (23cm of galena with a NNE strike and an 80 degrees easterly dip - the Devon lode or No.1 lode). Harcourt Smith reported that the tunnel had been continued for 10.5 metres past the drive on the Devon lode at 15 metres. There was no further development on this main adit in 1901 when Waller visited, however the main lode had been driven south for 25 metres and north for 47 metres (later confirmed by Reid 1919b) and stopped out above the drive. Twelvetrees reported that it had only been driven 7 metres to the north (probably back filled) and 31.5 metres to the south in 1907. A 12 metre rise was put in on the south drive (Twelvetrees, 1907) and this was driven some 55 metres back to the north and stopped in from the 'level 1' adit below.

The Devon (No.1) lode is described as being 60 to 90 centimetres wide, typically with 38 centimetres of clean galena in the centre of the lode. Twelvetrees (1907) had noted the width varied from around 10 centimetres to 90 centimetres in outcrop and that very little galena (<2.5 centimetres) showed in the southern drive, however in the top of the rise from this drive the lode was carrying 10 to 13 centimetres of galena to the south and 7.5 to 10 centimetres going north, he also noted the outcropping lode took a more northerly strike at the northern end and has been proven to extend over 122 metres. Twelvetrees also believed that if the main adit was continued another 10m that it may intersect another parallel lode which takes the form of a gossan approximately 60 metres above the river level, bearing 9 degrees east of north and being sub vertical.

Apparently this development did occur because a second lode is described at 27.5 metres in Reid's account (1919b). This lode (No.2) is driven 9 metres south and 25 metres north where it branches, one vein of 5 to 7.5 centimetres of mixed sulphide ore being followed on 350 degrees for 23 metres and the other vein of 5 to 15 centimetres of good grade galena being followed on 025 degrees for 23 metres. A sample from the face of the north-easterly branch assayed 62.2% lead and 2884 g/t silver.

No stoping had occurred on this vein in 1919. The south drive on this lode exposed a little galena and chalcopyrite in porphyry.

A third poor quality lode is described at 38 metres and is driven on north and south for 6 metres, the gossan of this lode at surface assaying only 12g/t silver. The final length of the main adit was stated to be 52 metres (Reid, 1919b).

Lodes in the northern adit were encountered at 1.5 metres (this is a 7.5cm west dipping vein according to Twelvetrees and it probably equates to the west dipping vein in the entrance of the first adit) and at 7.5m where development was still occurring at the time of Harcourt-Smith's visit (1898). The development had found the lode barren for 3.5 metres to the south, however ore was being encountered again at 6.5 metres from the cross cut with up to 46 centimetres of galena with lesser chalcopyrite, in one place, however the lode pinched out to a "thread" in the drive floor. The lode is described as splitting in two at the end of the south directed drive with each vein only carrying around 10 centimetres of clean galena. The whole drive contains a little disseminated pyrite and stringers of galena in the wall rock (Harcourt Smith, 1898).

Twelvetrees indicated the main lode was cut at 21 metres in the northern adit (which is contradictory, so is either incorrect or is a further lode) and was driven 21 metres north and 44 metres south and that the lode was pyritic (which agreed with Harcourt Smith's description of the lode encountered at 7.5 metres). Reid later (1919) describes the No.1 lode as being intersected at 15 metres with drives north over 30.5 metres and south over 61 metres. The lode was also reported as being stoped out above and below the drive to the south for 30.5 metres before the lode pinches out.

In the northern drive on the No.1 lode a winze was sunk 5 metres from the 'flat sheet' and 5 metres down, the lode showing 18 centimetres of galena to the north, unfortunately water was encountered here. By the end of the northern drive the lode is almost barren of galena with bands of quartz and 'gossan' only (Twelvetrees, 1907).

Reid (1919b) reported that from the end of the second adit a main shaft 2.5x1.25 metres has been sunk 30.5 metres deep on the No.1 lode to open up a third level and a ladder-way shaft 10.5 metres northward has been sunk to 23 metres, drives were reportedly developed north and south at the 18 metre and 30.5 metre levels (Reid 1919b) and a winze joins these levels (Nye, 1928). 7.5 to 18 centimetres of high grade ore was reported from these workings, however these were underwater when visited by Reid (1919b). This main shaft was being operated by means of a pumping and winding plant, the 4 inch pump controlled the inflowing water and was powered by way of flow from the creeks on the opposite bank of the river, however continuous operation was not possible in summer.

The third level is also accessed by a shaft (according to Nye, 1928) which has been sunk some 21 metres deep from surface approximately 33.5 metres (Twelvetrees, 1907; 46 metres according to Reid 1919b) north of the winze. A drive has been directed south from the end of the shaft in an attempt to intersect the lode 12 metres below the bottom of the winze. Water was within 9 metres of the top when Twelvetrees visited (1907), however the lode had been encountered in this drive and apparently widened from 7.5 to 18 centimetres of galena.

Three other adits occur above the No.1 and No.2, two of which had been driven in recent years for prospecting purposes (Nye, 1928).

Despite the intensive work completed to extract lead and silver in the form of galena ore, historic assays for gold from the Devon lodes were very encouraging (Table 2) and made for an interesting target.

| Sampler (date)                         | Sample type  | Gold Values  |
|--|--|--|
| Harcourt Smith (1898)                  | Selected lode material   | Up to 4 pennyweights and 4 grains of gold per ton (~6 g/t) |
| Waller (1901)                          | Average gold grades from the 172 tons of hand-picked ore to 1901 | 5 pennyweights, 4 grains of gold per ton (~7g/t).          |
| Reid (1919b)                           | Gossanous grab sample  | Up to 20g/t Au   |
| Hermann (1989), see modern exploration | Two lode samples (from mullock heap?)                            | 3.6 and 6.3 g/t Au respectively                            |

Table 2 – Assays for gold from various samples from the Devon Mine

The ore bodies are composed of mainly galena, abundant sphalerite and chalcopyrite and subordinate pyrite with a quartz-siderite gangue. The gold appears to increase proportional to the amount of chalcopyrite (Reid 1919b) and the lode in the northern shaft is banded suggesting open fissures with progressive precipitation. Oxidation of the ore down to river level has seen the development of cerussite, azurite and malachite. Gossanous samples may also have enriched gold values similar to the occurrences at Five Mile Rise.

At the time of Harcourt Smith's visit a small open cut on the original discovery some 18 metres above the workings had been developed, he indicated that this too had a bunched appearance with lodes occupying a fault surface with variable dilation. One other lode potentially occurs 61 metres south-west of the mine where Harcourt-Smith reported a manganese gossan which strikes NNW and dips to the east (similar to the Devon lode).

Another lode termed the diagonal lode is present in the northern end of the surface development and apparently runs into the footwall where it may join with the No.2 lode. Further up the hill approximately 15 to 25 metres west of the Devon lode there is a surface outcrop described as the 'big lode'. This may correlate with the No.3 lode in Adit No.1. An adit was also driven in 36.5 metres west during 1922-23 at a point some 15 metres above the No.1 adit. The Devon lode was not cut but a "wall" was passed through at 12 metres and a lode formation at 18 metres (possibly the diagonal lode). The adit must have terminated a short distance from the No.3 lode.

Sporadic production at the Devon Mine continued until 1912 with production ceased in 1913 when Twelvetimes reported on the mine for a second time. In 1916 the lease was abandoned despite the lodes being encountered in both adits and apparently in the northern shaft, this suggests that strike extent of the narrow clean galena shoots was limited. In 1919 Mr G.M.Day was extracting the remaining unstopped sulphidic ore and hoped to remove any gossanous material of commercial value (Reid, 1919b), he was also hoping to de-water the shafts if enough water was available for power generation during the winter.

In 1923 the Mt Farrell Mining Company picked up the lease over the Devon, however no production was recorded to 1924 when the lease was dropped. The workings were abandoned in 1928 (Nye, 1928). A small parcel of ore was then exported in 1937 (Jennings, 1963) and a mining lease at Devon was held by Neville McCoy in 1980, it is believed the area was made accessible by bulldozer track at this time.

#### *Other mines*

The Sirdar Prospecting Association's section was approximately 5.5 miles upstream of the Devon Mine on the Dove River (Waller 1901) and ~1 ½ miles SW of Devon in a straight line (possibly near the licence boundary), one small galena vein reportedly in the Precambrian schists has been driven

on for approximately 12 feet and 60lbs of galena extracted. A 'gossan' apparently outcrops on the north side of the river on this section.

A copper prospect in the schists upstream from the Devon Mine was also reported, these workings were known as the Welcome Home prospect and are located approximately 6 miles south west of the Devon Mine (outside the licence boundary).

The Silver Dove is also located in the licence downstream of the Devon Mine and is described as a 7.5cm pyromorphite vein in the Precambrian schist, this was driven for approximately 46 metres with no further encouragement (Reid 1919b).

The Powerful Mine is first referred to in Bulletin 14 (Twelvetrees, 1913) as Reardon and Days Mine. The mine is located approximately three kilometres south of Lorinna. The lode is in granite opposite the Dove River where it now enters Lake Cethana. The lode is comprised of quartz, specular haematite and pyrite. Two samples produced assays of 1.5 g/t gold and silver and no trace of gold and 6 g/t of silver. A bulk sample produced a trace of gold and 7.5 g/t silver.

Twelvetrees believed the lode was some 40-50 feet wide and strikes NW-SE with a 30 degree dip to the SW, however Reid (1919) considered the lodes to be proven 8-14 feet wide in the cuts. Four cuts or adits were driven on the lodes with 'granite porphyry' described between cuts three and four. The first three cuts are described as being 11, 18 and 25 feet, all of which are probably too short to describe the adit that leaves the Lorinna Road (originally the Pelion Road) south of the township. Pyrite is also said to be more plentiful where quartz is more abundant in the Powerful workings.

D. Davies' show is described as being a haematite lode in the Precambrian schist and is sketched on Twelvetrees' map to the south-east of Powerful. The lode is said to strike northwest and samples from a small pit revealed neither a trace of gold nor silver (Twelvetrees, 1913).

A further prospect probably in the northern half of Lorinna occurs '200m west of G.Sloanes house'. A 30 foot tunnel was driven on a specular haematite formation in quartz porphyry, the specularite attached to quartz said to be gold bearing. The vein is 6-8 inches wide with 2-3 inches of specularite. Granite sub-crop or float appears proximal to the prospect (Reid, 1919).

### ***Modern Exploration History***

Modern exploration began in 1965 when the area was examined by the Mt Lyell Mining and Railway Company Ltd, they were followed by Freeport 1973, Comalco and Shell 1974-1984 (with CRA managing from 1985-1987), RGC 1989-1990 and Rio Tinto Exploration 1995. Activities are summarised below.

Exploration in the Dove River licence area has largely focussed on locating tin, tungsten or fluorine mineralisation associated with the younger Devonian (Dolcoath) granite to the north. With little or no tin or tungsten mineralisation identified, the area has been largely ignored. Some effort went into locating gold mineralisation at Five Mile Rise in the Ordovician rocks, however the Cambrian rocks have not been systematically explored for gold.

Exploration for base metals finished before the discovery of the Cadia and Goonumbla deposits in the 1990's, and the understanding these deposits brought to porphyry exploration in eastern Australia.

#### ***MT LYELL (1965-1971)***

Modern exploration began in 1966-67 when the area was examined by the Mt Lyell Mining and Railway Company Ltd as part of exploration for base metal or tin Mineralisation within EL8/1965.

The Mt Lyell Co. undertook an aeromagnetic survey and a regional -80# stream sediment survey for tin, copper and zinc. A close association between zinc and copper was noted regionally however

individual results were considered doubtful with known anomalous areas not all registering on the survey. Reid (1967) concluded that there could be real interest in the copper and zinc anomalies if it could be confirmed (by resampling) that the tenor of mineralisation at known localities such as Round Mount were not being identified.

Several areas were recommended for follow up stream sediments including the possibly anomalous copper in stream sediments (34ppm Cu) draining from the magnetic anomaly 12 (later aeromagnetic anomaly C) above the Powerful mine.

Particular anomalies were followed up by more detailed exploration consisting of soil geochemistry and geological mapping on grids and reconnaissance geophysical surveys with VHEM equipment and a magnetometer (Foster 1969).

Anomaly C (Powerful) was gridded, with a B-Horizon soil survey and a ground magnetics survey completed. A few high values (probably anomalous) of cobalt and zinc were located on the margins of the magnetic anomaly but were attributed to the breakdown of ferromagnesian minerals in the basalt. The magnetic anomaly was found to correspond well to the outcrop of Tertiary Basalt. The diffuse and variable signature associated with the anomaly was potentially explained by magnetite in quartz-haematite-gold veins, however the restriction to the outcropping basalt was not explainable.

Reid (1967) identified two locations where disseminated chalcopyrite and pyrrhotite occurred in 'granite associated porphyry' upstream from the Devon mine. Reid also located minor disseminated chalcopyrite in the Lorinna Greywacke on the southeast slopes of the Five Mile Rise.

Reid (1967) recognised that there were two ages of granite and therefore a possibility of two phases of mineralisation, the possibility of Cambrian mineralisation being remobilised in the Devonian was not precluded. Reid (1967) also mapped a possible fourth body of Dove Granite in the Dove River west of the current licence.

The part of EL8/1965 containing the current EL was relinquished in 1971. Later in the 1970's they concluded the probability of locating an economically viable deposit of their target type was low and relinquished the whole licence.

#### *FREEPORT (1973)*

Freeport's main target was porphyry copper mineralisation, but considered the chances of finding gold, tin and tungsten or stratabound lead-zinc-copper. They employed consultants Cundill, Meyers and Associates whose activities consisted of mapping, collecting rock chips and stream sediment sampling using -40# and -80#. Freeport's Licence was approximately the same area as the current licence.

Exploration was focused on the flanks and cusps of the granite due to identifying chloritic and kaolinitic alteration in the granite at the Powerful prospect associated with minor disseminated pyrite-chalcopyrite (Walsham, 1973).

Freeport erroneously thought the Dove Granite to be younger (Devonian) in age (Austin and Serim referred to Jennings, 1963) even though the previous tenement holder (Reid, 1967) had indicated a Cambrian age. Austin and Serim (1973) also prefaced their investigation with the assertion that the Five Mile Rise gold-sulphide deposits were related to granite intrusion, another assumption made by Jennings.

Freeport located significant copper anomalism in stream sediments and -80 mesh stream sediment sampling was found to be a reliable method for identifying areas of known anomalism and it was recommended that -40# was not to be used again. Rock chips assayed to 0.16% copper in fractures in the Dove River near the Devon Mine and several regional 600ppm copper samples were collected

from fractured granite and quartzite. One sample in quartzite from the east near the Powerful prospect assayed molybdenum to 160ppm, but despite these anomalous samples no follow up work was done.

Despite not following up the anomalous samples, several other prospective features for porphyry style deposits were identified by Freeport in the brief assessment of their licence. These features include quartz veining in the Precambrian quartz-mica schists that was observed to increase near the granite contact, occasional disseminated pyrite within biotite granite and biotite-hornblende granite and quartz porphyry (Lorinna Greywacke) with considerable chloritic alteration.

Freeport also identified hematite alteration in the "Lorinna Greywacke" and concluded that this was caused by the late stages of the Dove Granite with chlorite veins containing minor gold and base metals (Walsham, 1973). It was also noted that "there are signs at Mt Lyell that haematite gossans preface the existence of acid volcanic ore bodies" (Walsham, 1973) and that the considerable hematite alteration noted in the licence may indicate a similar setting.

The discovery of Eastern Australian porphyry copper-gold deposits came much later than the exploration by Freeport (who in 1973 recently opened and operated the Ertzberg porphyry copper-gold mine in Indonesia) and the features they identified may not have had a context suitable to keep their interest in the project. Based on their understanding at the time, they concluded it was unlikely that a Cu-porphyry ore body of a size that would be suitable for Freeport existed in the licence area. The EL was relinquished in 1973.

#### *COMALCO (1974-1979)*

The main aim of Comalco exploring the Moina area was to locate a fluorite body (magnetite-fluorite skarn) for their aluminium smelting needs, however investigations included the search for Sn, W, Au and Pb-Zn. Askins (1980) focussed on the broader area (488km<sup>2</sup> later reduced to 405km<sup>2</sup>) including 18 km<sup>2</sup> released in 1976 by the Mines Department. This large exploration licence covered the whole of EL14/2006.

Comalco's activities included a literature search, stream sediment sampling, rock chip sampling, colour air photo collection, a reassessment of airborne magnetics, geological mapping and selected prospects were gridded and soil sampled. Follow up work on grids included rock chip collection, ground magnetics and induced polarisation surveys.

Comalco suggested that gold and lead at FMR may be remobilised from volcanogenic base metal deposits and recommended an EM survey, however this was not done. Comalco also mapped the Dove Granite adjoining the Moina Sandstone at the Golden Cliff as previous workers had done. The level of alteration within rocks at this locality had even led Freeport (1973) and Jennings (1963) to conclude that the Dove Granite intruded the Moina Sandstone in this area. This strong alteration highlights the prospectivity of the Cambrian units in this area.

Future work identified by Comalco included follow up of copper and zinc anomalies in Olivia Creek, the Dove River, a tributary below magnetic anomaly 14 (Zarzatjian, 1966) and copper from streams draining magnetic anomaly 12 (Zarzatjian, 1966) above the Powerful Mine.

Significant results include four samples of Dove Granite (rock chips) that contained anomalous Cu, Pb and Zn. Eight other anomalous samples were taken from the Lorinna Greywacke, maximum values for all rock chips in these units were 175ppm Cu, 245ppm Pb, 245ppm Zn and 1500ppm F. Two -20# stream sediment anomalies of 65ppm Cu (60ppm considered anomalous using this mesh size) and one F anomaly of 950ppm were also found to drain the granite at the Powerful prospect. Like Freeport had experienced it was again recommended that a finer mesh size would be a more appropriate technique. Follow up work on select anomalies was then undertaken using -80#.

Stream sediment copper anomalism was defined in the Campbell River (to 375ppm Cu) using -80#, possibly attributable to weathered dykes intruding the schists that contain up to 340ppm in rock chip, this area was later relinquished by Shell in 1983.

#### *SHELL (1980-1984)*

EL7/1974 was joint ventured with Shell in 1980. The licence was still a large 405km<sup>2</sup> holding when Shell became JV manager.

Shell's focus was on cassiterite rich magnetite or pyrrhotite rich skarns. Mineralisation models for targets were wriggilite skarn like Shepherd and Murphy and Renison style skarn. They had ancillary targets of coarse scheelite and stockwork greisens tin-tungsten deposits and sphalerite skarns adjacent to the Shepherd and Murphy Mine. Shell undertook a 250m line spaced helicopter-borne magnetics survey with 100m terrain clearance to explore for their primary target.

Shell also undertook -20# stream sediments (despite the evidence from two previous surveys that a finer mesh is more appropriate) and a more localised survey using -80#. Pb anomalies (65 to 245ppm) in stream sediments south of Five Mile Rise were believed to be sourced from veins or related to 'Devonian' Dove Granite emplacement rather than volcanogenic deposits and were not considered a priority target. Three -20# Pb anomalies were also identified in a tributary of Bull Creek near Daisy Dell in an area mapped as Tertiary basalt (Smyth, 1981).

Shell identified the "Lorinna East" bullseye anomaly adjacent to the Powerful mine as 'possibly a plug with a south dip'. They drilled one 200m long percussion hole into the bullseye anomaly. The lithologies intersected were Tertiary basalt to 58m, Tertiary clays to 80m, Pre-Cambrian schist with minor granitic veining to 200m. Susceptibilities in the basalt were considered too low to explain the aeromagnetic anomaly (Smyth, 1981). Remanent magnetism studies were meant to be done on these basalts. The conclusion was that remnant magnetism caused the anomalies even though the aeromagnetic signal 'could not be formational' according to the report and no evidence was tendered that remnant magnetism studies were done. The drill hole contained elevated Ba, Cu, Zn, however was not assayed for gold, despite being located adjacent to the Powerful gold mine.

The exploration licence area was reduced in 1984 but no work was completed on the prospects within the current Dove River licence area retained in the 7/74 licence.

#### *CRAE (1985)*

In 1985, CRAE became managers in EL7/74 in a three-way joint venture with the Commonwealth Aluminium Corporation (Comalco) and Shell. CRAE embarked on another very widely spaced reconnaissance stream sediment survey north of the current licence and reprocessed and reinterpreted Shell's aeromagnetic data. Exploration licence 7/74 was reduced in 1987 with the Dove River area dropped, with the joint venture maintaining tenure over the Moina fluorite deposit via Retention Licence.

#### *RGC (1989-1990)*

RGC originally picked up the EL8/1988 to look for economically viable gold or Renison-style tin mineralisation in the Moina Sandstone and Gordon Limestone associated with the Dolcoath Granite. During 1989-1990 RGC conducted exploration on the Five Mile Rise area as part of a program that compiled and assessed previous geophysical data and integrated it with new sampling, mapping and ground geophysics. EL8/1988's southern limit was approximately the northing of the Devon Mine.

A 20.5km grid was established at Five Mile Rise with an east-west base line and 15 north-south lines spaced every 200m easting. Mapping was completed from scarce outcrop and C-horizon soil samples taken every 25m in a north-south direction. Soil sampling was aided by a well developed soil profile

allowing representative samples to be taken. The grid was largely located over the Ordovician Moina Sandstone. Results were not reported until 1990.

A program of stream sediment and rock chip sampling was undertaken by consultant W.Herrmann for RGC in 1989. The stream sediment survey of approximately 160 sample sites was a regional program covering three other licences and EL8/1988 which overlaps with the current tenement. Fifty gram panned concentrate (from <0.5mm and >200 mesh fraction) and -200 mesh wet sieved fractions were collected at 20 locations within the current licence and assayed by Neutron Activation Analysis. Very high gold values were obtained from the sediments in the Five Mile Rise Goldfield. Moderate anomalism was obtained from the Powerful prospect area and moderate-high anomalism was recorded in a south draining creek, north of the Devon Mine. This anomalous sample was not repeated in the creek immediately to the east suggesting a local source (figure 1). The Dove River was excluded from the survey due to high water levels.

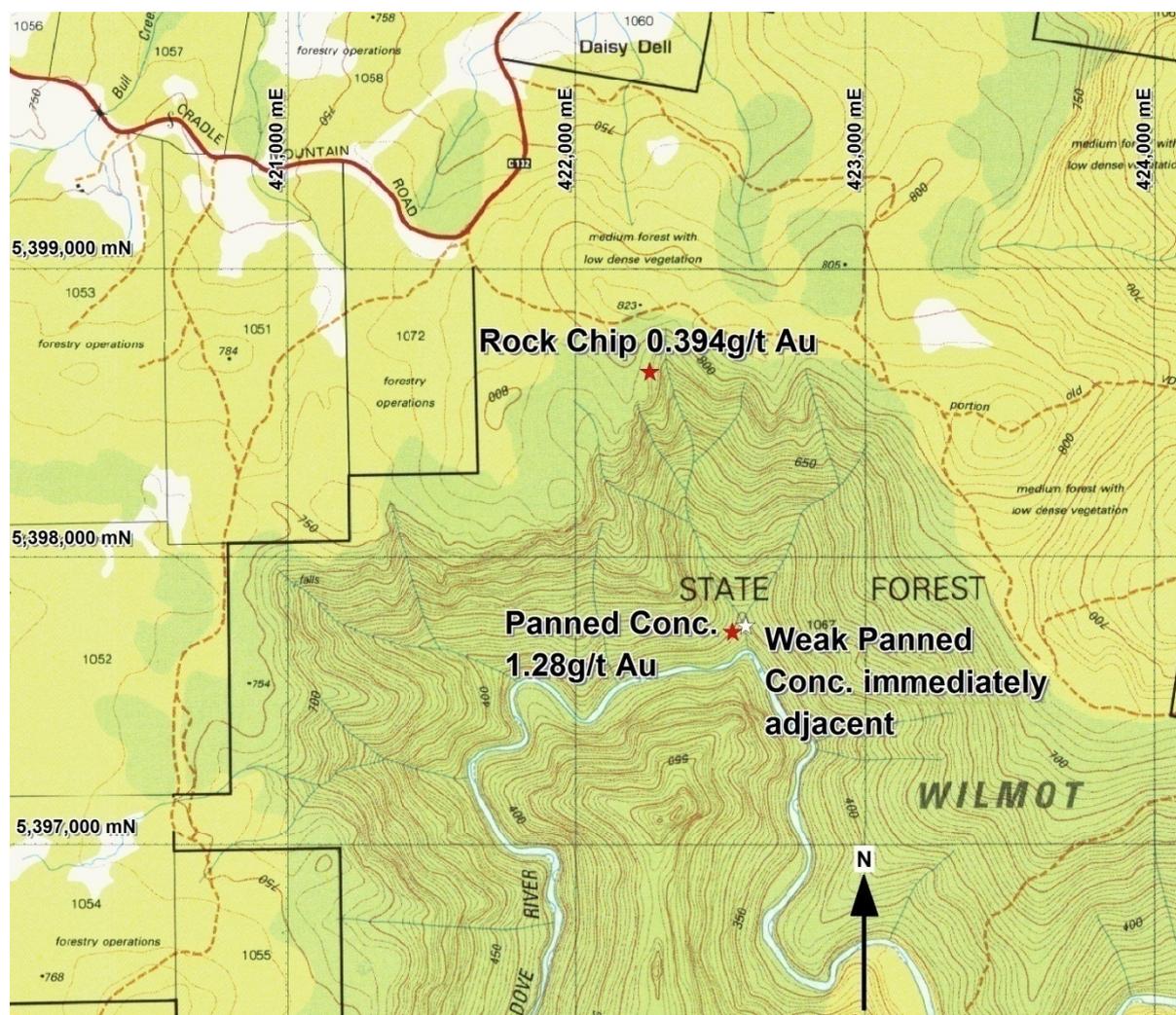


Figure 4 - Gold anomalous samples collected by Herrmann (1989) north of the Devon Mine

Herrmann (1989) also located two high grade gold, silver and base metal rock chip samples from the Devon Mine (3.6g/t Au, 428g/t Ag, 6.7% Pb, 1.95% Cu and 6.3g/t Au, 433g/t Ag, 7.8% Pb and 0.5% Cu) and a highly anomalous grade gold sample adjacent to the south draining creek north of the Devon Mine. This anomalous sample was from a NNW trending milky quartz vein with minor haematite. Despite this coincident stream sediment and rock chip anomalism the area was not further scrutinised (Figure 4), neither was the prospectivity of the Devon Mine. Two further rock chips from

the edge of Lake Cethana yielded low metal values, however one in the creek below Golden Cliff had gold to 0.093ppm.

Further rock samples (M prefix) were also collected but not assayed, these samples are believed to have been destroyed when Placer took over RGC (M.Vicary pers. comm.). 39 of these were taken inside in the current tenement, many of which have been duplicated by rock chip sampling this reporting year.

Results from the C-Horizon soil survey at Five Mile Rise (1989) highlighted geochemical anomalism coincident with IP (chargeability and resistivity) anomalies south of Five Mile Rise. The RGC geophysicist also noted that chargeability highs in part may coincide with Dove Granite at depths of only 100-150m. Drilling was recommended. However because RGC mistakenly thought all mineralisation (including that in the Cambrian rocks) was Devonian, the targets were never followed up. 41 rock chip samples were collected on the FMR grid over the Ordovician sandstones. Wacker bedrock sampling was recommended to follow up soil anomalies in the Ordovician rocks.

Castro and Fleming (1990) indicated that exploration re-focussed on geophysical methods rather than mapping and sampling as this data was previously completed in 1989. Ground magnetics and a gradient IP survey were conducted over the Five Mile Rise grid. Only reconnaissance mapping and sampling was conducted where soil geochemistry had indicated 'slight anomalism'.

A sub-regional magnetic gradient was defined on the Five Mile Rise grid. R.Deakin (in Castro and Fleming, 1990) interpreted the magnetic gradient in the north of the grid to be a slab of weakly magnetic rock with an equivalent intensity to the Dove Granite at approximately 100m depth and approximately 1km thick with superimposed individual 100-200 nT anomalies possibly reflecting basement highs. The ground IP survey did not define anomalous conductors, however several chargeability anomalies were defined at around 100-200m depth. Within Castro and Fleming's report (1990), R.Deakin reported on the survey and identified five chargeability anomalies and 6 drill targets which were never tested. Deakin also made the mistake of referring to the Dove Granite as Devonian.

After the geophysical surveys and final sampling were completed RGC decided that no further work was warranted in the Five Mile Rise area. This is probably due to their stated primary aim of locating economically viable gold mineralisation related to the Dolcoath Granite in the second year of exploration. The data collected was considered to be 'largely sufficient' for the assessment of the licence and the area within the current exploration licence (14/2006) was relinquished.

#### *RIO TINTO EXPLORATION (1996-1997)*

Rio Tinto acquired a new Exploration Licence - EL30/1996 covering 242 km<sup>2</sup> which is approximately eight times larger than the current EL but it included the whole current EL. The target style was sediment hosted fine grained sulphide poor Carlin or Sepon style gold. They were focused on the Ordovician Gordon Limestone and the Moina Sandstone where they are intruded by Devonian Granite

Rio Tinto took 12 -80# stream sediment samples and 12 panned concentrate samples. They found the Five Mile Rise area to be anomalous for gold and lead. Rio Tinto then reviewed RGC's soil and ground geophysical data for Five Mile Rise and decided that existing small workings were not a viable target of this type. The main reason for their withdrawal was the lack of conductors in the RGC survey. The licence was surrendered November 1997.

## **Work Completed**

Work has focussed on petrological examination, geochemistry and prospectivity analysis on a range of samples collected from drill core and from previous rock chip sampling. Further work targeting areas of historic geophysical anomalism will be completed once a drilling program confirms the target mineralisation style at the adjacent Cethana (EL29/2006) tenement.

## **Geochemistry**

Field samples were grouped into four major units based on gross petrology; hornblende granodiorite – visually crystalline igneous rock with abundant hornblende, fine felsic – quartz rich with lack of plagioclase, volcaniclastics – shown to have shard like textures, porphyry – large quartz and feldspars within a fine grained often altered groundmass. Other rock types were identified and not included within the detailed dataset including faulted and heavily veined rocks. Where the rock types had been significantly altered the boundaries between granodiorite with porphyry and porphyry with volcaniclastic containing primary crystals is not easy to distinguish.

The aim was to discriminate between the intrusive rocks found within the drill core and rock chip database and to identify any rocks that show positive correlations to known copper gold porphyry systems. Using a sweep of research papers; distinct chemical signatures should help to provide information on the prospective Tasmanian porphyry systems. Also several plots were made to see if the visually different volcanic units could be separated geochemically and how they correlated regionally or tectonically.

### *Whole Rock Data*

The colour index was invented by Karimpour (1983) and is defined by the equation:

$$\text{Colour Index} = \frac{\text{SiO}_2 + \text{K}_2\text{O} + \text{Na}_2\text{O}}{\text{Fe}_2\text{O}_3 + \text{MgO} + \text{CaO}}$$

The colour index has indicated that some hornblende granodiorites are within the boundaries of a potential host rock (see figure 5). Samples 129559 (pale green chlorite-epidote alteration), 129573, 129472 and 129476 (all hornblende granodiorite samples) are the only rocks to have colour indexes of <8 which is the arbitrary cut-off used for suitable Copper-Gold porphyry source rocks. Notably the Powerful granite samples sit well outside the prospective field (see 0-90m in figure 6).

Other alteration indexes were trialled on granodiorite within the DR2 drill core, however both the CCPI and Ishikawa alteration indexes were found to be inappropriate for potassic and strong propylitic alteration with indexes consistently approaching 100.

By choosing a pyritic sample (129579) from the Devon Track and checking it's colour index, it was found that this 'pre-identified' prospective source rock had a marginal value of 11 on the colour index plotting just outside the copper-gold field and tending marginally towards the molybdenum field. It is not known how widely this index is used as no further reference has appeared in the literature search.

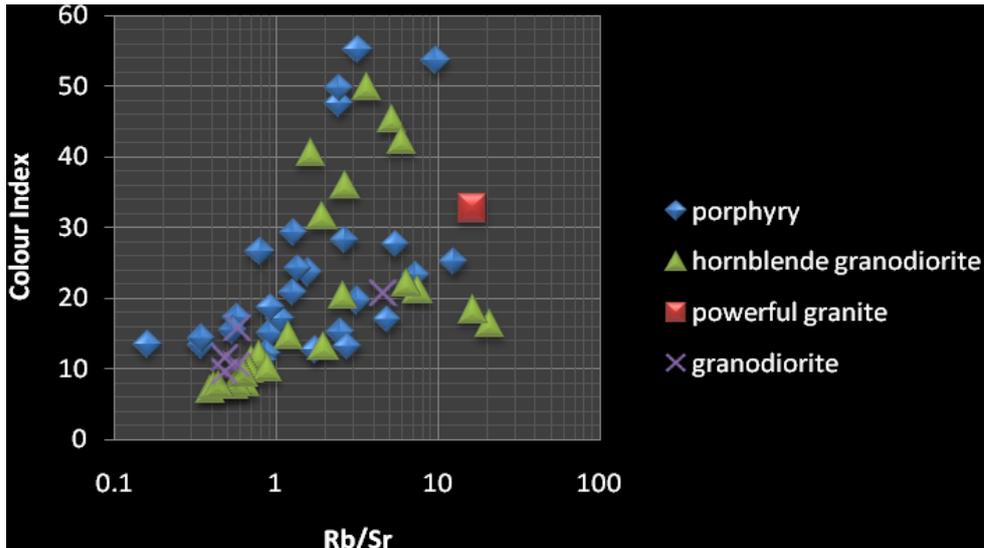


Figure 5 – Colour index vs. Rb/Sr plots of various intrusive rocks from the Dove River tenement

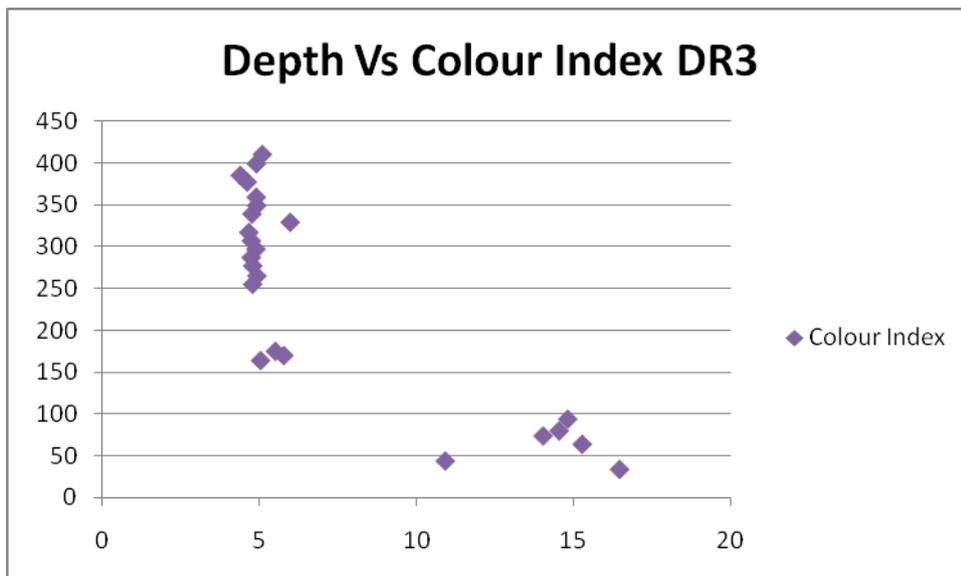


Figure 6 – Colour index v's depth showing the distinction between the Powerful Granite (high index) and the Hornblende Granodiorite (index <8)

The samples classified as the fine felsic unit was also found to have very low  $\text{TiO}_2$  and high silica suggesting a reworked epiclastic origin, this was consistent with observations made during petrography.

Within the intrusive rocks, potassic rocks with medium K to shoshonitic affinities are considered more prospective for porphyry style mineralisation, this is often plotted as a  $\text{SiO}_2$  vs.  $\text{K}_2\text{O}$  diagram (see below). The "Dove Granodiorite" from drill hole DR3 has a high K signature and is considered the most prospective source rock seen so far.

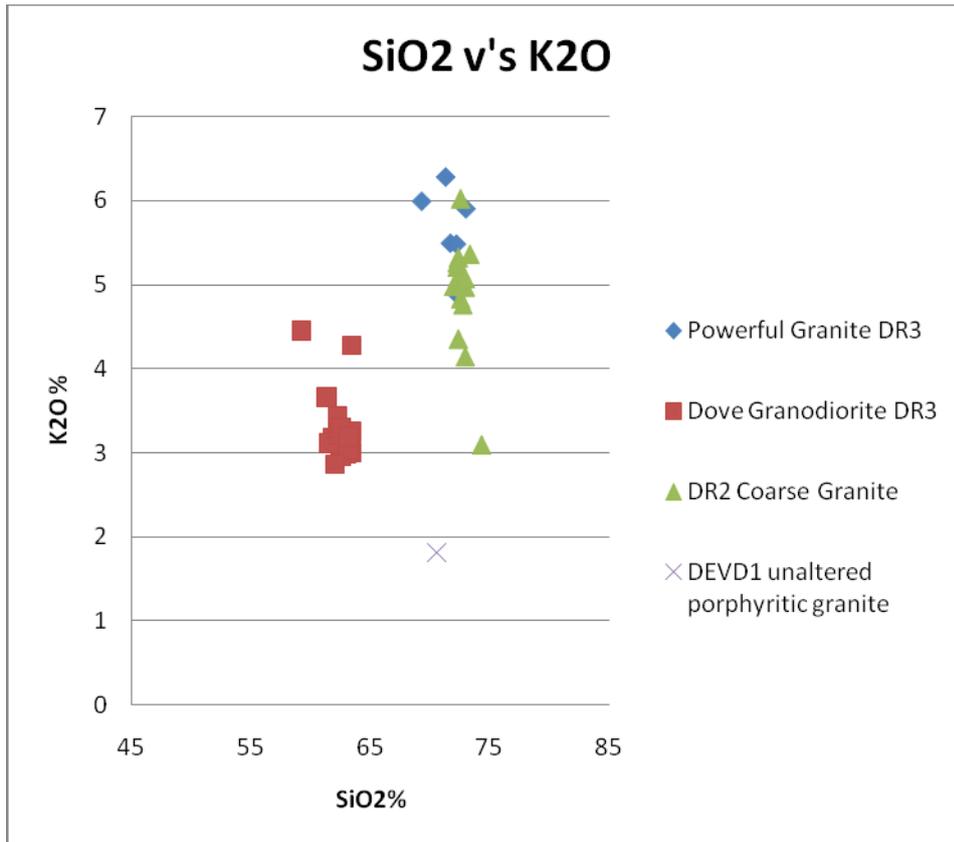


Figure 7 – Silica-Potassium plot of intrusive rocks from Dove River, note the alteration trend of increasing K<sub>2</sub>O in the Powerful Granite from high to very high K which is intruded by the high-K granodiorite.

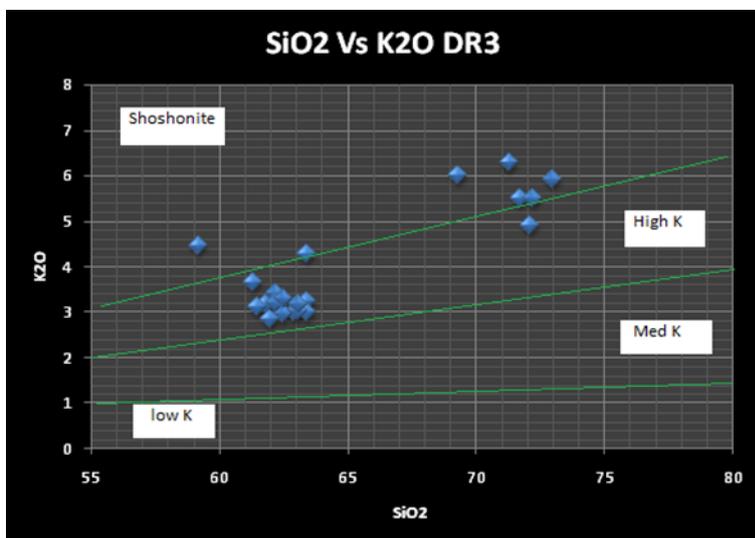


Figure 8 – K<sub>2</sub>O vs. SiO<sub>2</sub> with defined abundance fields (from Xiaoming 2007)

The granodiorite cluster (left) clearly in the high K field. The Powerful Granite cluster (right) shows higher K<sub>2</sub>O levels and SiO<sub>2</sub> levels, this is attributed to the alteration of the granites by the intruding granodiorite.

### Trace element diagrams

Distinguishing the Tectonic Setting has been attempted using various plotting techniques from Pearce (1984) and Schandl and Gorton (2002). The hornblende granodiorite dominantly shows a trend towards the Volcanic Arc origin.

The Rb and (Y+Nb) ranges for some typical post collision granites have similar signatures to the Hornblende granodiorite plotted below. The grouping within the volcanic arc granites suggests a syn collisional to post collisional (late) volcanic arc origin is probable.

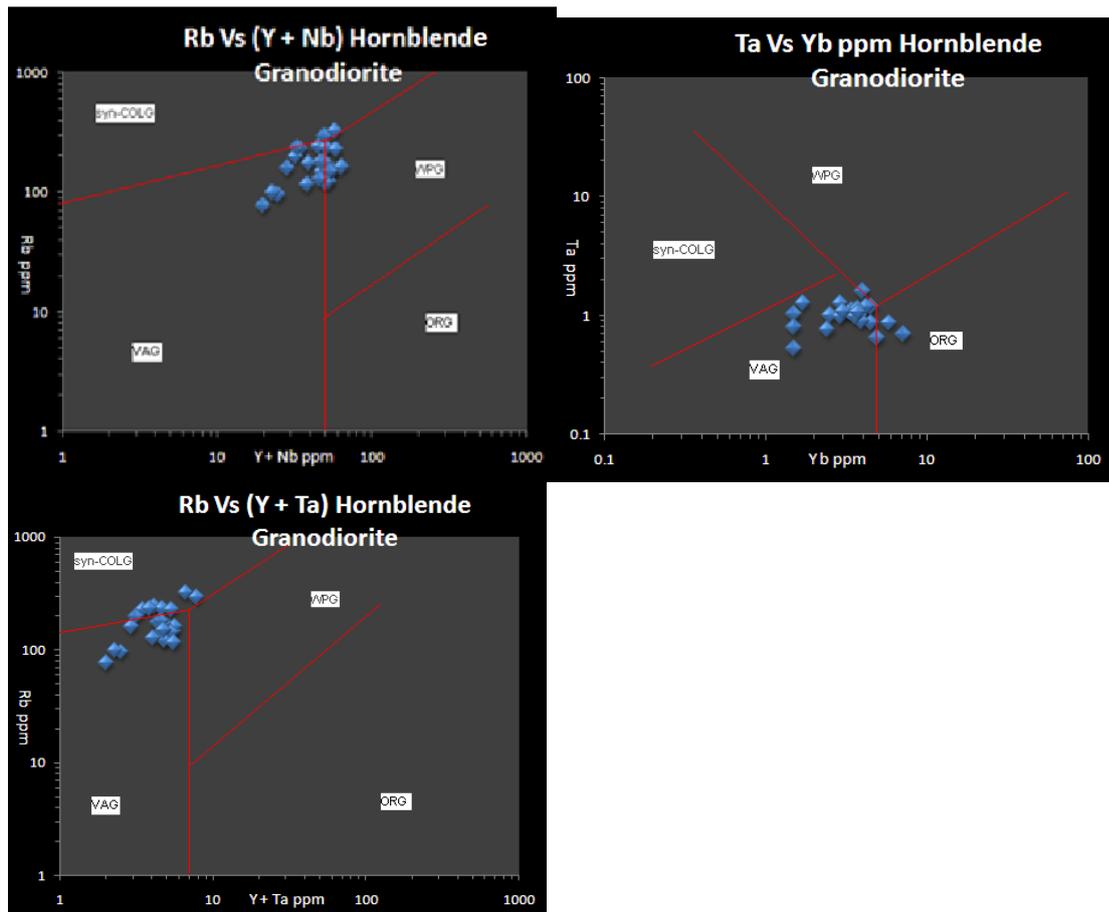


Figure 9 - Trace element plots of Hornblende Granodiorites from Dove River within tectonic fields defined by Pearce (1984).

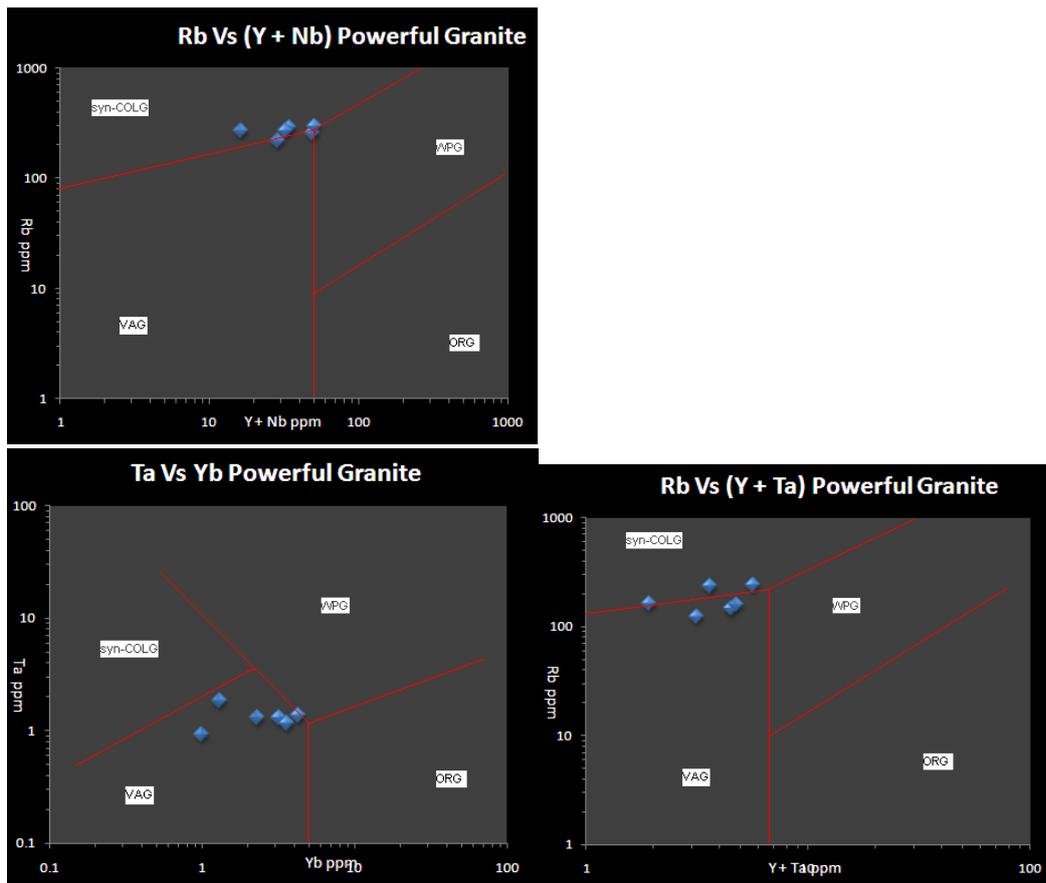


Figure 10 - Trace element plots of Powerful Granite samples from Dove River within tectonic fields defined by Pearce (1984).

Within the Powerful Granite samples the geochemical signature is very similar to syn- collisional granites where variable mixtures of the mantle and crust derived magmas are required to explain the observed variation. There is some overlap with the field for post collisional Volcanic Arc Granites. This chemistry is consistent with the interpretation that the Powerful Granite is the earliest granite.

The Y + Nb geochemical signatures show the Powerful Granite being closely related to a syn collisional granite. The hornblende granodiorite shows a trend towards the Volcanic Arc section, potentially indicating the evolution of the source magma.

La/Yb ratios are also used to determine the tectonic regime with values of <18 typically indicating compression and values of 15-35 indicating extension. The powerful granite has a value of ~ 18 although when normalised this figure falls into the extensional field. The hornblende granodiorite has a distinctly lower (extensional) ratio, possibly more evidence of relaxation of the compressive regime during emplacement.

A Zr/Ti vs. Nb/Y plot was done on the two main volcanic units (see figure 11) and despite the apparent epiclastic nature of the fine felsic unit, the immobile elements have a strikingly similar signature. This observation confirms observations from petrography which indicate a very similar clast composition despite the disparate grain size. Both units plot in the rhyodacite to trachy-andesite field (not shown).

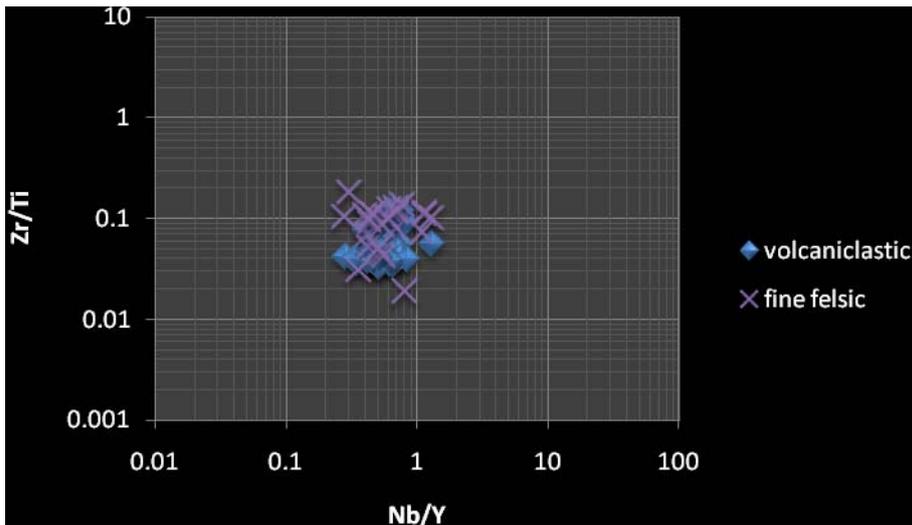


Figure 11 – Immobility element ratio plot of Winchester and Floyd indicating a strong overlap in trace element patterns for the fine felsic and coarse volcaniclastic units.

The difference between the volcaniclastic field samples and the fine felsic samples have been attempted to be discriminated by Schandl and Gorton models. These have been used previously to the discrimination of geotectonic environment of felsic volcanic rocks, proposed by Schandl & Gorton (2002). It is based on combination of four presumably little immobile trace elements (Ta, Yb, Th, Hf). The volcanic units were found to show little variability (see figure 12 below)

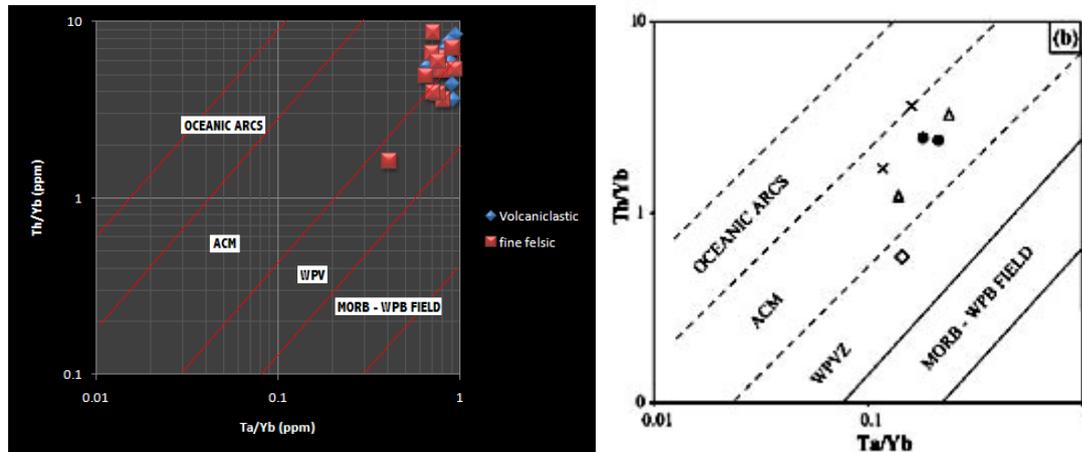


Figure 12 - Schandl and Gorton geochemical discrimination diagram shows that the volcaniclastic and fine felsic units lie within the Active continental margin and within plate volcanic zones (WPVZ).

### REE plots

All samples have a negative Eu anomaly and flat HREE patterns much like the CVC and Murchison Granite (Wyman, 2001).

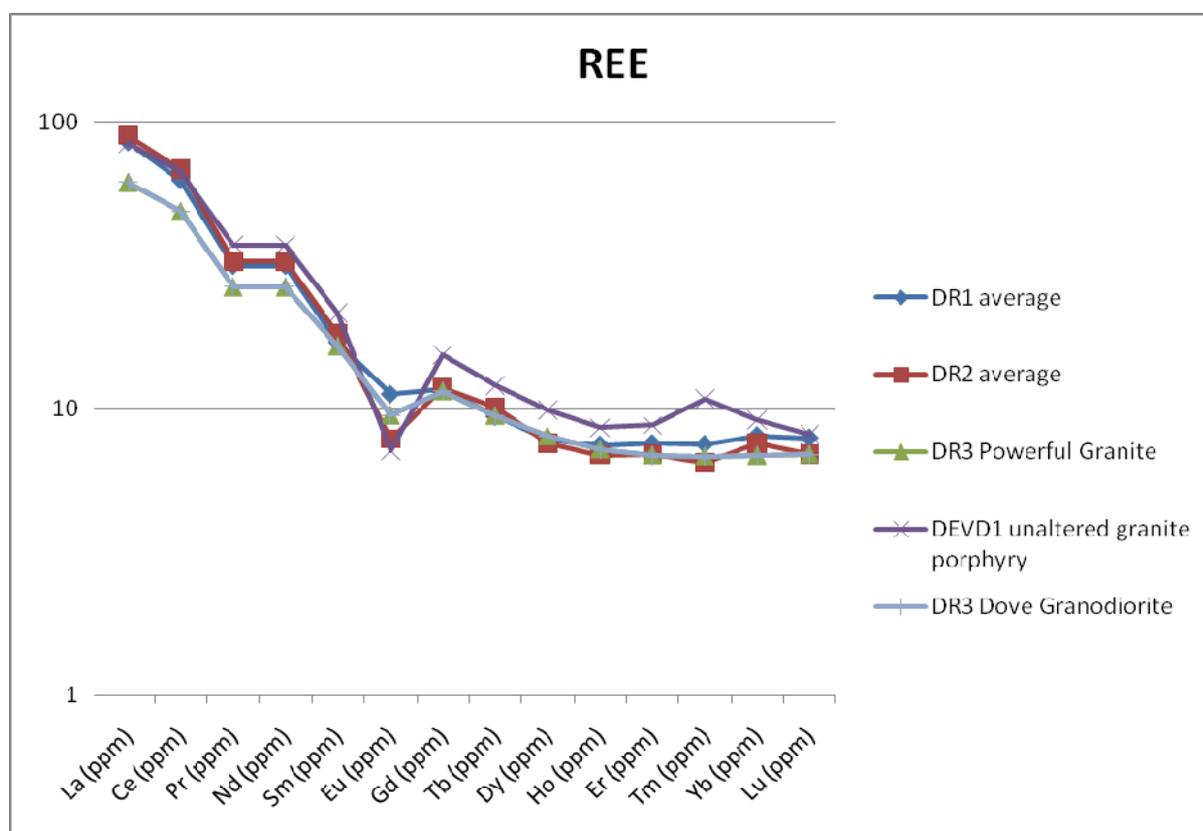


Figure 13 - REE plot for all intrusive rock types in drill core and the volcanics from DR1

Notably the volcanic rocks from DR1 have a very similar REE plot to the intrusive rocks within the Dove Granite intrusive complex, suggesting a similar source or indeed the volcanics could be directly evolved from the Dove Granite magma chamber. It is also noted that granitic intrusions forming coeval with volcanics is a common attribute of porphyry systems.

### **Prospectivity Study (Dr Greg Corbett, Consultant Economic Geologist)**

The Powerful mine and Campbell's Reward are interpreted to have extracted surficial supergene enriched Au from quartz-sulphide style Au near-porphyry veins, the latter related to the speculated Cethana intrusion. The Devon Ag-Pb mine is also interpreted to have exploited veins derived from the Cambrian Dove granite batholith, here of a low sulphidation epithermal carbonate-base metal Au character. None of these occurrences are considered viable targets for continued exploration. The Five Mile Rise goldfield warrants continued exploration at a moderate priority for buried porphyry Cu-Au mineralisation, possibly after continued work at Cethana has helped to resolve the distinction between Cambrian and Devonian vein mineralisation.

## *POWERFUL MINE AREA*

The Powerful mine lies within intrusive rocks characterised by an equigranular granite and xenolith-bearing hornblende granodiorite, each with textures typical of batholithic intrusions. These intrusions are interpreted to occur as part of the Dove River batholith. One intrusive contact is apparent in drill core (DR3, 104m) between these two intrusions. A chilled contact on the granodiorite provides the same interpretation as field exposures that the hornblende granodiorite is younger. Bleached dykes crop out in road cuttings at the mine level and also occur in drill core, while thin pink (K-feldspar-rich) dykes are recognised in drill core and at the Gads Hill ridge top. Both pervasive and epigenetic K-feldspar alteration are recognised, the latter with minor porphyry style quartz veins, while green retrograde sericite overprints pervasive K-feldspar and occurs marginal to K-feldspar veins, as typical of many porphyry systems. Breccias examined, 2 km east of the road exposure and at a much higher elevation at Gads Hill are typical of magmatic hydrothermal breccias and may be derived from the same source as pink dykes recognised there in outcrop and drill core. These breccias display a silica-K-feldspar altered matrix and contain milled quartz vein clasts while also being cut by later open crystalline quartz veins. No sulphides indicative of Cu-Au mineralisation occur in the breccias or quartz veins.

The position of mineralisation identified in one drill hole (DDH DR3, 132-134m) corresponds to the expected position of the vein exploited in the Powerful Mine. A fault zone contains a bleached dyke, quartz-magnetite-haematite vein/breccia, specularite-haematite fluidised breccias and chlorite-pyrite fluidised breccia, all typical of D vein or low sulphidation deep epithermal quartz-sulphide Au ± Cu veins which might be expected to develop marginal to buried porphyry intrusions. The low Cu-Au anomalism in drill core (0.05% Cu, 0.2 g/t Au) is consistent with expected primary sulphide Au grades for this material. These veins are notorious for the development of anomalous Au by near surficial supergene Au enrichment, which may have been exploited by former miners.

It is interpreted the Powerful Mine exploited supergene enriched structurally controlled vein Au mineralisation of the style commonly present marginal to intrusions. An equigranular granite is cut by hornblende granodiorite which is in turn cut by two styles of dykes, bleached sericite-chlorite and pink K-feldspar altered, the latter with magmatic hydrothermal breccia and quartz veins but no sulphide mineralisation. Although part of the overall porphyry intrusion-related geological model, this vein mineralisation is not considered a target for continued exploration.

## *DEVON MINE*

Pluton has carried out detailed geological mapping and sampling of the accessible Devon mine workings which have also been tested with two drill holes (DEVD1 & 2). While most mining probably took place in the 1920's, some activity may have occurred as recently as the 1980's. The mine workings exploited N-S fault hosted Ag-rich galena ore, although inspection of dump material, supported by Cu carbonate stain within the mine, indicates veins locally contain: early comb quartz overprinted by pyrite, chalcopyrite, galena and dark Fe-rich (high temperature) sphalerite and possible Ag sulphosalts (tennantite-tetrahedrite [apparent from limited petrology]), with later stage carbonate. This mineral assemblage is typical of polymetallic veins formed marginal to intrusions, such as D veins in the Gustafson and Hunt (1975) classification or intrusion-related low sulphidation deep epithermal carbonate-base metal Au veins in Corbett and Leach (1998). Veins intersected in DDH DEVD2 display the paragenetic sequence of early comb quartz with chlorite progressively overprinted by pyrite-chalcopyrite, galena-sphalerite and then carbonate. Silica-tourmaline is also apparent in the vicinity of the Devon Fault overprinted by magnetite-haematite (including specularite)-pyrite and later

carbonate. No paragenetic relationships could be identified between the tourmaline and base metal veins.

The adits follow the fault-hosted veins within hornfels close to the contact between volcanic and granitic rocks, a position where there is expected to be greatest host rock competency. While the fault corridor, which varies up to several metres wide, hosts many possibly discontinuous veins and possible splays, the Ag-rich galena mined appears to have been derived from veins only a few cm wide. One 10 cm vein is apparent ready for extraction. Ore would have been hand picked prior to shipment. Projection of the veins up or down plunge away from the most competent host rocks should be treated with caution. The NS fault trend no doubt continues for some distance, as Pluton reports W. Herrmann identified Au-mineralised float in a drainage several km north of the Devon mine, interpreted to have been derived from a continuation of that structure.

The intrusion exposed is interpreted as part of the Dove Granite suite and varies from a relatively equigranular biotite-hornblende granodiorite away from the contact, to display a more porphyritic texture with prominent quartz eyes and pervasive K-feldspar alteration close to the contact with hornfelsed volcanic rocks. This intrusion is currently interpreted as the source for the base metal vein mineralisation, as well as the tourmaline and magnetite-haematite breccias, although the latter two interpretations remain tentative.

It is interpreted the Devon Mine veins are typical of those which might be expected to form marginal to intrusions and have been mined from a setting where competent hornfels would contribute towards quality vein formation. Tourmaline-magnetite-specularite breccias are similar to other occurrences in the region. Although it cannot be established whether vein Ag-galena mineralisation was derived from Cambrian or Devonian granitic sources, the former Cambrian Dove River batholith source is preferred. The Devon veins are not expected to represent a quality target for an economic mining operation and no evidence of porphyry mineralisation was recognised in the likely setting close to the intrusion margin. While an important element in the geological model for intrusion-related mineralisation, the Devon Mine area is not regarded as an ongoing exploration target.

#### *FIVE MILE RISE GOLDFIELD*

Five Mile Rise was one of the earliest goldfields in Tasmania. Here, a 20-30 m cap of Ordovician Moina Sandstone overlies Cambrian volcanic rocks which display strong propylitic alteration, typical of that which might be expected in the vicinity of a porphyry intrusion, intersected at depth. Porphyry style sheeted quartz-magnetite chlorite veins intersected in drill core (DDH DR1) cutting granitic rocks are typical of veins recognised elsewhere in the region. Volcanic rocks are described as vitric lithic tuffs in which local flattened pumice clasts locally display differential darker chlorite alteration from the general pale chlorite. Iron oxide stain supports the possibility that disseminated pyrite has been present in what appears as propylitic alteration.

Soil geochemical anomalies obtained by RGC support the current thinking that early mineralisation and alteration in the Cambrian volcanic rocks derived from emplacement of Dove River style intrusions has been overprinted by later vein mineralisation associated with the emplacement of unseen Dolcoath-style Devonian granites. Pluton (J. McDougall, pers. commun.) suggest lower metal grade Cambrian Au mineralisation has been remobilised by the Devonian event. Well developed pervasive Cu in soil anomalies within Cambrian volcanic rocks terminate at the contact with the Ordovician sandstones which might then be considered as post-mineral cover. Specular haematite veins within the volcanic rocks are similarly not recognised in the sandstones, interpreted as later. However, the Five Mile Rise mine workings exploited veins, no doubt with near surficial supergene enrichment, developed within the Ordovician sandstone, and are reported as continuing at depth into the underlying Cambrian volcanic rocks.

Drill hole DR1, which bores from the Ordovician sandstone into altered Cambrian volcanic and intrusive rocks, was examined in this review. While incomplete overprinting relationships prevent construction of a reliable paragenetic sequence, the current SPECULATED time relationships are:

- Silica-pyrite breccia with cross cutting chalcopyrite fracture/veins which is similar to breccias locally identified at Cethana.
- Silica-tourmaline breccias cut the silica-pyrite.
- Specularite-haematite overprints the silica-tourmaline alteration.
- Sheeted quartz-magnetite veins occur within early K-feldspar flooding which passes to a sericite overprint and locally cut the tourmaline and haematite alteration.
- Pyrite magnetite veins and quartz-pyrite-chalcopyrite-galena Au-Ag mineralised lodes are interpreted as equivalents of D veins formed marginal to porphyry intrusions and host low grade Au mineralisation. These veins typically display near surficial supergene Au enrichment which is expected to have been exploited by former miners above the oxide zone. These may include the speculated Devonian veins exploited within the Ordovician sandstone by early miners.

It is currently interpreted unseen Devonian intrusion activity accounts for veins mined from within Ordovician sandstone which caps more diffuse Cu-Au mineralisation within Cambrian volcanic and intrusive rocks. Many features are typical of intrusion environments such as the granite hosted sheeted quartz veins, Au-Ag base metal sulphide veins are likened to D veins formed marginal to intrusions and silica-tourmaline evolving to haematite veins, although no definitive paragenetic relationships are apparent between these features. D veins commonly display near surficial supergene Au enrichment, and if these were mined by the early miners, then these veins would be expected to be of a Devonian origin, as they cut the Ordovician sandstone. In such a model the early silica-pyrite-chalcopyrite breccias overprinted by tourmaline-specularite and sheeted quartz-chlorite veins are all likely to have been related to Cambrian magmatism and account for more dispersed Cu in soil anomalism, although the silica-pyrite-chalcopyrite breccias remain enigmatic.

Continued exploration at Five Mile Rise should proceed at a moderate priority with an aim of identification of a possible mineralised intrusion source for the near-porphyry style veins recognised to date. Additional data may aid in the resolution of the categorisation of the Cambrian/Devonian alteration and mineralisation events.

#### *PROSPECTIVITY CONCLUSIONS*

Exposures of the Dove River Granite and environs near the Devon and Powerful Mines as well as Five Mile Rise display geological relationships typical of those which might be expected close to batholithic intrusions.

Most mineralisation mined to date can be classed as D vein or low sulphidation deep epithermal quartz-sulphide Au  $\pm$  Cu varying to carbonate-base metal Au vein style and typical of veins formed marginal to porphyry intrusions. The early quartz-sulphide Au  $\pm$  Cu element of these veins is notorious for near surficial supergene Au enrichment and so represents the source of material exploited by early miners. Lower precious metal grades are expected from sulphide material intersected in drill holes. Although an important element of the geological model, these veins are not expected to represent an economic target. Continued exploration, at a high priority, should seek to test for prograde porphyry style Cu-Au mineralisation targeted within an apophysis to a magmatic source for the Cethana magnetic feature at depth.

#### *Previous work by Pluton*

During the 2006-2007 field season Dove River Pty Ltd drilled three diamond drill holes, collected regional rock chips and systematically assayed the Devon Mine Workings, (see McDougall and Reed 2007). In the following year two diamond drill holes were targeted under the historical Devon Mine workings. The results were ambiguous in terms of the scale and style of the alteration system, given

that strong potassic alteration over a large area had been identified associated with the workings. The best drilling results are summarised below, confirming an unconvincing scale of metal anomalism (Table 3).

| Hole_ID   | From | To  | Interval   |
|-----------|------|-----|--|
| DR1       | 232  | 242 | 10m @ 0.1% Cu  |
| incl      | 232  | 233 | 1m @ 0.34% Cu  |
| DR1       | 299  | 300 | 1m @ 0.52 g/t Au   |
| DR1       | 315  | 316 | 1m @ 1.13g/t Au, 63.3g/t Ag and 3.03% Pb                                   |
| DR1       | 336  | 337 | 1m @ 1.37g/t Au  |
| DR2       | 90   | 98  | 8m @ 0.06% Cu, 0.27g/t Au, 149ppm Co, 0.59g/t Ag                           |
| including | 90   | 91  | 1m @ 1.96 g/t Au, 0.09% Cu, 1.45g/t Ag and 145ppm Co                       |
| DR2       | 128  | 134 | 6m @ 55ppm Mo  |
| DR2       | 138  | 152 | 14m @ 0.02% Cu   |
| DR2       | 256  | 260 | 4m @ 0.04% Cu  |
| DR3       | 31   | 32  | 1m @ 1.39 g/t Au   |
| DR3       | 102  | 103 | 1m @ 170ppm Mo   |
| DR3       | 132  | 133 | 1m @ 0.2 g/t Au, 0.05% Cu, 2g/t Ag   |
| DR3       | 194  | 195 | 1m @ 0.12% Co, 2.15g/t Ag, Te, Se association                              |
| DR3       | 239  | 240 | 1m @ 93.4ppm Mo  |
| DR3       | 366  | 367 | 1m @ 0.56% Zn, 0.11% Pb  |
| DEVD1     | 80   | 81  | 1m @ 0.07% Cu, 1.1 g/t Ag  |
| DEVD1     | 103  | 110 | 7m @ 0.08g/t Au, 0.7g/t Ag, 83ppm Co                                       |
| DEVD1     | 168  | 169 | 1m @ 0.07g/t Au, 1.5g/t Ag   |
| DEVD1     | 170  | 171 | 1m @ 84ppm Co  |
| DEVD1     | 177  | 178 | 1m @ 0.08g/t Au, 0.07% Pb  |
| DEVD1     | 202  | 203 | 1m @ 0.21g/t Au, 5.7g/t Ag, 0.25% Pb                                       |
| DEVD1     | 211  | 212 | 1m @ 0.8g/t Ag, 0.07% Pb, 0.09% Zn   |
| DEVD1     | 217  | 218 | 1m @ 0.04g/t Au, 0.9g/t Ag, 0.1%Pb   |
| DEVD2     | 31   | 32  | 1m @ 63.4 g/t Silver   |
| DEVD2     | 73   | 76  | 3m @ 190ppm Cobalt and 40ppm Molybdenum                                    |
| DEVD2     | 79   | 81  | 2m @ 177ppm Cobalt   |
| DEVD2     | 83   | 84  | 1m @ 0.23% Copper  |
| DEVD2     | 100  | 112 | 12m @ 0.12 g/t Gold, 6.3 g/t Silver and 165ppm Cobalt                      |
| including | 101  | 104 | 3m @ 0.33 g/t Gold and 19.6 g/t Silver                                     |
| and       | 101  | 102 | 1m @ 0.43 g/t Gold, 17.2 g/t Ag and 208ppm Cobalt                          |
| and       | 103  | 104 | 1m @ 0.39 g/t Gold, 41 g/t Silver, 0.69% Copper, 0.51% Lead and 0.77% Zinc |
| DEVD2     | 119  | 120 | 1m @ 103 g/t Silver  |

Table 3 – Significant intersections from previous Pluton Drilling

### ***Updated drill logs***

Minor amendments have been made to the drill logs for all drill holes, based on the examination by Greg Corbett (experienced porphyry geologist) and Paul Ashley (Petrologist). The amended drill logs are appended.

### **Discussion**

The following is a discussion of the assumptions made in previous exploration regarding the age of source rocks and mineralisation ages. The mineralisation model provides a summary of regional prospectivity indicators and other relevant features within the licence that highlight bulk tonnage copper-gold prospectivity.

#### ***Age of the Dove Granite***

The Dove Granite was interpreted by Jennings (1963) to be a Devonian Granite. Subsequent potassium-argon dating undertaken by McDougall and Leggo (1965) gave a Cambrian (Ordovician or older) age. The misconception that the intrusive bodies were Devonian was adopted by many subsequent workers including Austin and Serim (Freeport, 1973) and Smyth (Shell, 1981).

#### ***Age of mineralisation***

Mineralisation at Dove River spans two geological events (Cambrian and Devonian). The mineralisation of Ordovician rocks in the Five Mile Rise goldfield has long been considered Devonian due to the obvious emplacement of lodes in typical Devonian trending structures. These lodes were generally considered by explorers to be genetically related to the Dolcoath Granite. The Dolcoath Granite is modelled to be at significant depth (based on sparse gravity stations) and anomalous gold is more typically associated with tin and tungsten anomalism near this granite. Indeed, gold and base metal mineralisation may rather be a product of orogenic remobilisation of metals from the underlying mineralised Cambrian basement rocks. This latter conclusion is consistent with DR1 intersecting copper and weak gold mineralisation associated with Cambrian porphyry-style potassic alteration in Cambrian rocks underlying the Five Mile Rise Goldfield.

#### ***Mineralisation Model***

The style of mineralisation targeted in the Dove River exploration licence is a bulk tonnage copper-gold system related to the Cambrian Dove Granite. The granite intrudes and alters (possibly coeval?) Cambrian volcanics and older Precambrian schists and phyllites. The licence includes two of three known granite 'stocks' and porphyritic intrusives have been identified at the margins of both of these granite bodies. This has provided sufficient encouragement to investigate the potential of locating bulk tonnage copper-gold mineralisation of either an Eastern Australian porphyry style (eg: Cadia) or a disseminated style similar to the Mt Lyell deposits in Tasmania.

Mineralisation of porphyry style is usually associated with oxidised magnetite series sub-volcanic intrusions (Wilson et. al. 2002). Pluton has been encouraged by the presence of magnetite series hornblende granodiorite on the licence. The Eastern Australian porphyries are typically moderate grade alkalic systems however mineralisation may also manifest as higher grade smaller tonnage systems. A high-K calc-alkalic porphyry system developed in the apparently more calc-alkalic and shoshonitic Mt Read Volcanics would be a likely scenario given the inferred arc-continent collision setting. A higher grade deposit of this style would be conducive to being developed by block cave mining techniques.

Tasmania has numerous volcanic hosted copper deposits within the Mt Lyell mineral field. Examples of these vary from disseminated pyrite-chalcopyrite VHMS systems to more characteristic high sulfidation style deposits which are commonly associated with large scale faults. More recently, mineralisation at Mt Lyell has been identified as an example of the transitional nature of deposit styles and a hybrid mineralised body should not be overlooked as a possibility.

Within the Mt Read Volcanics there is a recognised break between copper-gold rich deposits to the south and east of the Henty Fault with lead and zinc rich deposits located to the north and west. Located east of the Henty fault, the Dove River exploration licence is in a location recognised as prospective for copper-gold mineralisation.

Potential deep crustal structures have been identified in airborne magnetic data to the north of the licence and are associated with variations in thickness within the basal Ordovician stratigraphy. These deep structures are important conduits that may concentrate fluids or focus the intrusion of stocks. Thickness variations across structures in the vicinity of the Devon Mine indicate activation during sedimentation and these structures are ideal foci for fluid movement during granite intrusion or could focus porphyry intrusion. Other potential major structures include a strong magnetic gradient transecting the Five Mile Rise from northeast to southwest.

Regional geochemical anomalism suggests that a buried porphyry system is a real possibility, with some encouraging anomalism in the region. Stream sediment surveys include several sites of anomalous copper, fluorine and one molybdenum anomaly draining from the Powerful prospect. Fluorine anomalism is typical of porphyry deposits and fluorine enrichment is also known from magmatic fluid input in high sulphidation systems. Copper and molybdenum anomalism may be a direct indication of porphyry mineralisation.

Porphyry copper deposits are almost always associated with a high concentration of iron oxides, typically magnetite and hematite. This is due to I type magmas being high in iron, which is consistent with preliminary indications of the geochemistry of the Dove Granite. Magnetite has been identified in close association with Au bearing sulphide veins (for example in DR1) and hematite alteration and veining is prominent at the Powerful prospect (eg: 1m @ 1.39 g/t Au in DR3) and in volcanics immediately south of Five Mile Rise. Regionally, gold mineralisation is also located marginal to hematite alteration and porphyritic rocks at the Ten Mile Creek prospect (Funnell and von Strokirch, 1987) to the west of the tenement. The presence of these oxide minerals is important because it indicates a high oxidation state of parent magmas that allows greater sulphur solubility in the melt.

Phyllic alteration is a characteristic of the high-K calc-alkalic porphyries and is recognised by abundant quartz-sericite-pyrite. Mapping alteration may identify phyllic and peripheral propylitic alteration adjacent to or above mineralised potassic zones. The phyllic alteration haloes around mineralised porphyries can also be recognised by Induced Polarisation surveys as highly chargeable zones. This peripheral disseminated pyrite mineralisation can be a good indicator for proximity to mineralisation. Narrow zones of disseminated sulphide have already been located in DR1 which targeted a chargeability anomaly.

Anomalous potassium radiometric signatures are present in the WTRMP data both in this and the surrounding Pallawah Hill tenement. Potassic alteration typical of porphyry alteration systems has been identified in the field at Powerful prospect, Devon and elsewhere around the Dove Granite. It is believed the multiple occurrences of this alteration style upgrades the chance of locating a viable porphyry deposit.

## Expenditure

The expenditure requirement set by Mineral Resources Tasmania on the exploration licence was \$20,000 over the current reporting period, although this has been significantly exceeded and the proposed expenditure for the next 12 month period is would be a similar amount (\$35,000), Pluton is hoping to complete geophysics and and follow up drilling of generated targets if success occurs on the adjacent Cethana tenement and the company can secure further funds or an appropriate Joint Venture partner. The expenditure detailed below is for the 12 month period September 2008 to September 2009 and the total is expenditure to September 30<sup>th</sup> 2009.

|                        |                                  |
|------------------------|----------------------------------|
| Geology                | \$ 35,942                        |
| Geochemistry           | NIL (included in geology figure) |
| Drilling               | NIL                              |
| Track Clearing & Rehab | NIL (see other)                  |
| Administration         | \$ 1,105                         |
| Other                  | \$ 1,411                         |
|                        | <hr/>                            |
| Sub-Total              | <b><u>\$ 38,458</u></b>          |
| Previous Expenditure   | <u>\$846,953</u>                 |
| Total to date          | <b><u>\$ 885,411</u></b>         |

## **Conclusions**

The Dove River exploration licence has considerable untested potential to host bulk tonnage copper-gold deposits. The alteration styles (potassic and propylitic alteration) and the mineralisation style (disseminated copper in DR1 and gold-sulphide veins DR1, DEVD1 and DEVD2) intersected in drilling provide confirmation that the region is capable of producing mineralisation of interest for porphyry exploration. The challenge is to find geochemical, alteration and geophysical vectors to target such mineralisation.

Since full analysis and revisiting the original 3 drill holes, an internationally recognised expert with >20years experience in porphyry and epithermal terrains reviewed the drill core, the Devon Mine workings and key field locations of Dove Granite. The conclusion for the Devon Mine was that the alteration style was near porphyry base metal-sulphide vein style and probably a trickier lower tonnage target than the company's preferred bulk tonnage style. Metal values at the site remain impressive and highlight the prospectivity of the Dove Granite as a source rock.

The focus of ongoing work will be to weigh up the comparable prospectivity for bulk tonnage deposits and smaller higher grade vein or traditional VHMS systems. With this in mind, the potential for bulk tonnage at Five Mile Rise has not been discounted and may yet prove to be a viable bulk tonnage target.

The Powerful system has been identified as likely too deep and "batholithic", however strong magnetite veining with associated with elevated molybdenum values is a curious and largely unexplained feature which may have a proximal source that is richer in copper and gold. The likelihood is that targeting such mineralisation would be confounded by the interference by the magnetic flow bases of Tertiary basalts at very similar depths to known magnetite veining in the Cambrian units. It is also likely that if a more sulphide rich zone within the anomaly exists that EM methods would also suffer interference by the basalts as seen with Mincor's VTEM surveys conducted on the Round Hill licence to the north

Pluton will continue to focus on adding value to the Dove River licence by demonstrating the potential for large-scale porphyry-style mineralisation in proximity to the Cambrian Dove Granite.

The variation of lithologies within the Dove Granite and associated porphyry indicates there are a range of compositions within the intrusive Cambrian rocks. The intermediate 'hornblende granodiorite' phase of the Dove Granite intersected in the lower part of drill hole DR3 and porphyries intersected at the Devon Mine may be a more suitable source rocks than the more granitic phase. A geophysical assessment of known anomalies or follow up drilling at Five Mile Rise will be considered after a program of 1-2 drill holes at the nearby Cethana Magnetic anomaly which should provide 'proof of concept' for the porphyry exploration model.

## **Future Work**

Five Mile Rise will be re-assessed to see if magnetic phases within the Dove Granite are a possible source rock for mineralisation and the broad copper anomaly in soils mirroring the mapped outcropping Cambrian volcanics south-east of Five Mile Rise. This area may be targeted by a dipole-dipole IP survey, possibly a gravity survey and if warranted follow up diamond drilling.

Ongoing mapping and collection of rock chips suitable for whole rock analysis will also hopefully identify any differences in lithology and structural setting between the Cethana area to the North and the setting of the Dove River tenement. EM methods will be considered for the Great Caledonian and Thistle prospects within the Five Mile Rise goldfield.

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Appendix 1 – List of digital files

EL142006\_200911\_01\_Report.pdf

EL142006\_200911\_02\_DrillLogs.pdf

\*note all previous geochemistry data used in this report is available with the previous annual reports

Appendix 2 – Drill logs and codes (see separate .pdf)

## **Appendix 3 – Petrographic Thin Section Descriptions**

**PETROGRAPHIC REPORT ON TEN DRILL CORE SAMPLES AND  
EIGHTEEN OUTCROP ROCK SAMPLES FROM NORTH-CENTRAL  
TASMANIA**

For

Pluton Resources Limited

Reference: Email from John McDougall 12-12-08 and subsequent emails. Sample  
receipt 15-12-08

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March, 2009

## **Report #548**

## SUMMARY

A suite of ten drill core samples and eighteen outcrop rock samples from north-central Tasmania was submitted for petrographic preparation, description and interpretation. Drill core samples were from drill holes DR3 (2 samples) and CETD1 (8 samples). Outcrop samples were labelled in series between 129458-129586 and 152802-152812 (with gaps in sequence). The samples included rocks from the Bull Creek Volcanics, Lorinna Greywacke and the intrusive Dove Granite. Petrographic sections were prepared by Petrographic International Pty Ltd in Brisbane. Three polished thin sections (PTS) were prepared of sulphide- and oxide-bearing rocks, with the remainder having standard thin sections (TS) prepared. One sample (CETD1 215.3 m) had a PTS and a TS prepared. PTS were examined microscopically in transmitted and reflected light, with the TS examined in transmitted and oblique reflected light. Twenty of the section offcuts were treated with hydrofluoric acid and sodium cobaltinitrite in order to check for the presence of K-feldspar. All sample offcuts were measured for magnetic susceptibility.

Summary descriptions of each sample are listed following:

**DR3    56.7 m            TS**

**Summary:** Coarse grained monzogranite, with moderate propylitic alteration. The rock originally contained abundant interlocking, inequigranular grains of quartz, plagioclase and K-feldspar, with small volumes of micrographic quartz-K-feldspar intergrowths and minor amounts of ferromagnesian material (possibly mostly biotite). Alteration has largely affected the ferromagnesian material and plagioclase, with replacement phases including chlorite, sericite and carbonate, with trace leucoxene/rutile.

**DR3    339.2 m            TS**

**Summary:** Medium to coarse grained hornblende-biotite granodiorite, with moderate pervasive propylitic alteration. The rock contains abundant plagioclase, quartz and K-feldspar, intergrown in an inequigranular texture with subordinate hornblende and biotite, and accessory FeTi oxide, apatite and zircon. Much biotite has been altered, largely to chlorite, and plagioclase is extensively replaced, mainly by sericite, plus a little epidote.

**CETD1            93.5 m            TS**  
**REMOVED**

**CETD1            113.85 m            TS**  
**REMOVED**

**CETD1            190.5 m            TS**  
**REMOVED**

CETD1      213.7 m      PTS  
REMOVED

CETD1      214.6 m      TS  
REMOVED

CETD1      215.3 m      PTS and TS  
REMOVED

CETD1      216.25 m      PTS  
REMOVED

CETD1      233.2 m      TS  
REMOVED

**152802 TS**

Summary: Medium to coarse grained, inequigranular biotite-hornblende granodiorite, with moderate alteration effects. The rock contained abundant plagioclase, with less common hornblende and biotite, enclosed by abundant interstitial quartz and minor K-feldspar. Accessory apatite and FeTi oxide grains are locally present. There may have been initial localised potassic alteration, manifest by patchy replacement of igneous ferromagnesian grains by finer grained secondary biotite, and by the occurrence of a couple of thin veins of K-feldspar-magnetite-pyrite-biotite. Later alteration is of propylitic type, with development of sericite, chlorite, epidote and trace pyrite, mainly from ferromagnesian minerals and plagioclase.

**152804 TS**

Summary: Medium to coarse grained biotite syenite or monzonite, with strong albitisation and development of muscovite/sericite, plus minor chlorite, epidote and leucoxene/rutile. The original rock was feldspar-rich, with plagioclase apparently enclosed by alkali feldspar, with minor biotite and only a little quartz. Feldspars were albitised and also locally strongly flecked by muscovite/sericite, with local epidote patches. Most biotite was replaced by chlorite and minor epidote.

**152805 TS**

Summary: Medium to coarse grained inequigranular biotite-hornblende granodiorite. The rock contains abundant plagioclase and interstitial quartz, with less abundant interstitial K-feldspar and scattered grains of biotite and green hornblende. Mild low grade alteration has occurred, with development of minor sericite, epidote and chlorite, mainly from plagioclase and biotite. The rock

also contains a trace of pyrite, mostly associated with alteration of biotite. There is considerable similarity between this sample and 152802.

#### **152807 TS**

**Summary:** Unusual leucocratic, quartz-poor granitoid, originally with abundant medium to coarse grained plagioclase, plus minor interstitial quartz, alkali feldspar, titanite and biotite. The rock could represent a plagioclase-rich quartz diorite or granodiorite in which rather coarse poikilitic titanite appears to be of late magmatic crystallisation. The rock has subsequently undergone strong alteration with considerable albitisation of feldspars. Plagioclase is also flecked by fine grained sericite, with formation of traces of epidote and prehnite, with former biotite being altered to chlorite ± prehnite. Alteration could be viewed as of sodic type, maybe a variant of propylitic type.

#### **152808 TS**

**Summary:** Strongly altered, medium to coarse grained volcanoclastic rock, derived from felsic volcanic material, perhaps representing an epiclastic sandstone or a lithic-crystal felsic tuff. There are abundant altered lithic fragments (some were porphyritic felsic volcanic material), plus quartz, altered feldspar and ferromagnesian grains in a fine to medium grained altered matrix. There has been widespread replacement of the rock by fine to medium grained quartz, epidote and lesser amounts of magnetite and pyrite, plus a little chlorite. Supergene oxidation has led to pyrite being replaced by goethite.

#### **152810 TS**

**Summary:** Rather coarse grained, inequigranular texture biotite-hornblende monzogranite. The rock contains abundant plagioclase, biotite and hornblende enclosed in anhedral interstitial quartz and K-feldspar. A small enclave dominated by medium grained hornblende and biotite is present. Only localised mild alteration has occurred, with minor development of sericite and epidote at plagioclase sites and actinolite and carbonate in hornblende (but where former pyroxene cores might have existed). The rock is clearly of I-type affinity and is similar to samples 152802 and 152805.

#### **152812 TS**

**Summary:** Medium to coarse grained inequigranular K-feldspar-rich rock, possibly representing a felsic igneous rock (e.g. syenite), or another variant of granitic rock that has undergone strong replacement by K-feldspar. Interstitial to K-feldspar are small amounts of sodic plagioclase and alteration aggregates after former ferromagnesian material. The latter have been replaced by fine to medium grained aggregates of chlorite, rutile and local magnetite. The rock is locally fractured and veined, with K-feldspar slightly replaced by sericite and chlorite, and local veining by chlorite, magnetite and a little sericite and quartz.

#### **129458 TS**

**Summary:** Strongly altered, medium to coarse grained hornblende-biotite granodiorite. The rock originally contained abundant plagioclase and quartz, with subordinate amounts of hornblende, biotite and interstitial K-feldspar. It underwent pervasive strong propylitic alteration, with

replacement of plagioclase by albite and epidote, and ferromagnesian by epidote, actinolite and chlorite. There was also replacement by irregular to veinlike epidote masses. A few grains of pyrite would have formed as part of the alteration assemblage but were later replaced by goethite due to supergene oxidation.

#### **129556 TS**

**Summary:** Medium to coarse grained hornblende-biotite granodiorite, with moderate propylitic alteration. The rock contains abundant plagioclase and quartz, with interstitial K-feldspar and scattered grains of hornblende and biotite. Minor accessory FeTi oxide and apatite are present with the former being mostly associated with the ferromagnesian phases. Alteration has led to partial replacement of plagioclase by sericite, epidote and albite, biotite by chlorite and epidote, and FeTi oxide by chlorite.

#### **129559 TS**

**Summary:** Medium to coarse grained hornblende-biotite granodiorite, with moderate propylitic alteration. The rock contains abundant plagioclase and quartz, with interstitial K-feldspar and scattered grains of hornblende and biotite. There are a few mafic micro-enclaves composed of hornblende, with smaller amounts of biotite, plagioclase and FeTi oxide. Plagioclase is partly altered to sericite, epidote and albite, with biotite and FeTi oxide being partly replaced by chlorite. The rock contains a couple of grains of pyrite as an alteration product.

#### **129560 TS**

**Summary:** Strongly altered medium to coarse grained granitic rock, possibly of original granodiorite composition. It is interpreted that the rock was composed of abundant quartz and plagioclase, with less abundant K-feldspar and minor ferromagnesian material and FeTi oxide. There was partial replacement of abundant plagioclase by K-feldspar, with subsequent strong sericitisation of feldspars. Ferromagnesian material was replaced by sericite and rutile/leucoxene, and FeTi oxide by rutile/leucoxene ± hematite. A couple of pyrite grains were formed during alteration but were later replaced by goethite/hematite aggregates due to supergene oxidation.

#### **129564 TS**

**Summary:** Very strongly altered coarse grained granitic rock, perhaps originally a biotite monzogranite. It was composed of abundant quartz and feldspar, with scattered coarse biotite grains. Phyllic hydrothermal alteration was imposed, leading to replacement of all feldspar and biotite by fine grained sericite. At altered biotite sites, there has also been patchy development of fine grained hematite and a little leucoxene.

#### **129565 TS**

**Summary:** Very strongly altered porphyritic felsic igneous rock (originally quartz-feldspar-biotite porphyry, perhaps of dacitic or rhyodacitic character). The rock would have contained abundant phenocrysts of quartz and feldspar, with less common ferromagnesian phenocrysts (mostly biotite) in a fine grained quartzofeldspathic groundmass. Alteration is of phyllic type, with replacement of

groundmass by finely granular quartz and interstitial sericite, feldspar by sericite, biotite by sericite, hematite and leucoxene, and FeTi oxide by hematite or leucoxene + sericite.

**129567 TS**

**Summary:** Strongly altered porphyritic biotite granodiorite, with replacement by a phyllic assemblage plus hematite. The original rock contained a few large quartz phenocrysts, set in a medium to coarse aggregate of plagioclase, quartz, ferromagnesian material (probably mostly biotite) and interstitial K-feldspar. There was strong alteration of plagioclase and ferromagnesian material to fine grained sericite, with considerable fine hematite occurring at former ferromagnesian sites and replacing former FeTi oxide grains.

**129569 TS**

**Summary:** Coarse grained lithic-crystal clastic rock, probably representing a type of felsic volcanic-dominated epiclastic. It contains abundant lithic grains including quartz-feldspar-biotite porphyry, a more even grained granitic rock of similar composition and massive to weakly banded feldspathic quartzite. Interstitial to the large grains is a medium to coarse grained matrix with smaller lithic grains, quartz, altered feldspar and altered ferromagnesian material (originally mostly biotite). Pervasive alteration has led to strong replacement by sericite (mostly of former plagioclase) and chlorite (mostly of former ferromagnesian), with minor hematite. Slight weathering effects have caused intergranular goethite staining.

**129573 TS**

**Summary:** Porphyritic hornblende-biotite granodiorite with scattered phenocrysts of plagioclase and less common phenocrysts of quartz, biotite and hornblende in a medium grained inequigranular groundmass of quartz, K-feldspar, plagioclase, biotite and hornblende, with accessory FeTi oxide. The rock contains a few small mafic micro-enclaves with assemblages including hornblende and plagioclase ± biotite ± FeTi oxide. Moderate propylitic alteration has been imposed, with development of actinolite from hornblende, chlorite and epidote from biotite and sericite, epidote and trace carbonate from plagioclase. The rock contains a few aggregates of pyrite that formed as a result of alteration.

**129582 TS**

**Summary:** Medium grained, inequigranular K-feldspar-rich rock, with scattered hematite-rich aggregates and a little interstitial quartz. A minor amount of sericite has developed by alteration of K-feldspar and there are a few aggregates of fine grained leucoxene associated with hematite. It is possible that the rock represents a former granitic rock that has undergone intense replacement by a K (-Fe) alteration assemblage. Some of the hematite aggregates might represent former ferromagnesian mineral sites.

**129586 TS**

**Summary:** Strongly hydrothermally altered quartz-feldspar-biotite porphyry, probably of rhyodacitic composition. The rock originally contained scattered phenocrysts of plagioclase, biotite and quartz, in

a fine grained granular quartzofeldspathic groundmass that included considerable K-feldspar. Alteration was of propylitic type, with replacement of most plagioclase by sericite, and most biotite by chlorite. A little hematite has also formed at altered biotite sites and there are a couple of veins of K-feldspar, hematite and quartz. A trace of pyrite occurred in the veins but was later replaced by goethite due to supergene oxidation.

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## **Interpretation and comment**

Samples in the suite fall into four main lithological categories, mostly of felsic igneous derivation.

- (1) Many samples represent felsic volcanoclastic rocks (including lithic-crystal (-vitric) tuffs, epiclastics and possible ignimbrites). These include samples 152808 and 129569.
- (2) Many samples represent medium to coarse grained, locally porphyritic, I-type granitic rocks (Dove Granite and relatives), mostly ranging from granodiorite to monzogranite. These include the two samples from drill hole DR3, plus samples 152802, 152805, 152810, 129458, 129556, 129559, 129560, 129564, 129567 and 129573.
- (3) Two samples are classified as quartz-feldspar-biotite porphyry, probably of rhyodacite composition (129565, 129586). These could represent volcanic lavas or sub-volcanic intrusives.
- (4) Four samples represent strongly feldspathic altered granitoids, including sodic types (152804, 152807) and potassic types (152812, 129582).

The volcanic-derived rocks generally have moderately to well preserved relict textures (although some of the more altered and deformed examples have less well defined primary texture). Most samples are medium to coarse grained, lithic-crystal or lithic-crystal-vitric tuffs and others retaining possible pumiceous textures. Lithic fragments are commonly composed of porphyritic felsic volcanic material. Individual mineral grains (the crystal component) would have included quartz and feldspars (mostly plagioclase) and in places ferromagnesian grains, FeTi oxide (e.g. titanomagnetite), apatite and trace zircon. Samples 152808 and 129569 might represent epiclastic variants of the volcanoclastic rocks, but are of similar bulk compositional type.

The granitic rocks have moderately to well preserved relict textures, with many samples being only mildly altered and consequently having considerable retention of primary igneous minerals. On the other hand, a few samples have rather intense alteration and most primary minerals (except quartz) are altered (e.g. 129458, 129560, 129564, 129567). Preserved primary mineralogy, or inferences on primary mineralogy, indicate that the granitic rocks range from monzogranite to granodiorite, with a few being somewhat more leucocratic, but

most being mesocratic and having 10-25 volume % of ferromagnesian minerals. Textures range from porphyritic to more even-grained and inequigranular, with grain size being medium to coarse grained. Primary igneous minerals include abundant plagioclase and commonly subhedral grains of biotite and hornblende, with abundant interstitial quartz and minor to moderate amounts of K-feldspar. FeTi oxide (titanomagnetite), apatite and zircon are characteristic accessory minerals, commonly being in association with the ferromagnesian phases, but with larger apatite grains being isolated in feldspars. It is possible that a little pyroxene might have originally been present, enclosed in hornblende, but if so, all pyroxene was subsequently altered. Micro-enclaves of more mafic composition than the host occur locally (e.g. in 152810, 129559, 129573) comprised of hornblende ± plagioclase, biotite, FeTi oxide, apatite. The less altered granitic rocks are all moderately magnetic, and what with the presence of hornblende in most, indicate that they are of I-type character.

The two volcanic porphyry samples (129565, 129586) are interpreted to have compositional and genetic affiliations with the above-mentioned granitic rocks, rather than with the volcanoclastic rocks. Possibly, they represent sub-volcanic equivalents (e.g. shallow plugs, dykes) or a chilled marginal phase of the intrusives. The porphyries are of rhyodacitic bulk composition, with phenocrysts of quartz, plagioclase and biotite, with a fine grained granular quartzofeldspathic groundmass containing significant K-feldspar.

The four samples dominated by either sodic or potassic feldspars (152804, 152807, 152812, 129582) could superficially be viewed as feldspar-rich igneous rocks (e.g. syenitic). However, the fact that their textures differ from "normal" igneous rocks and that they have a suite of other (minor) alteration minerals, implies that they are products of strong replacement of originally granitic protoliths. There is a possibility that the protoliths were of similar character to the Dove Granite, but that there has been strong mineralogical and textural transformation.

All samples in the suite show the effects of alteration. Much could be the result of imposed hydrothermal fluids, although some could be a product of metamorphism (e.g. by nearby intrusive rocks). Alteration effects range from mild (e.g. only slight replacement of igneous minerals in a few of the granodiorites/monzogranites) to intense. In addition, several of the volcanoclastic rocks underwent weak to moderate deformation effects during or after hydrothermal alteration, with the development of a foliation. Such effects are not observed in the granitic rocks or porphyries implying that penetrative deformation pre-dated emplacement of these felsic igneous rocks.

Several of the volcanoclastic rocks, many of the granitic rocks and porphyry sample 129586 display propylitic alteration, ranging from mild to strong. There has been replacement of primary igneous minerals, including feldspars (mainly plagioclase), ferromagnesian phases and FeTi oxide. Development of albite, sericite and epidote from plagioclase is typical, although in stronger altered examples, albite is totally replaced. Other minerals developed include chlorite, uncommon carbonate and small amounts of leucoxene/rutile, hematite and

pyrite. Actinolite has developed locally from replacement of hornblende (and possible pyroxene) in some of the granitic rocks.

Phyllic alteration is demonstrated in a few of the granitic rocks (129560, 129564, 129567) and porphyry sample 129565. Replacement assemblages tend to be dominated by sericite (-muscovite), with associated quartz and a little hematite and leucoxene.

Feldspathic alteration of various types is mainly restricted to the above-mentioned granitoids (152804, 152807, 152812, 129582), although vestiges of potassic alteration, manifest by local replacement of igneous minerals by K-feldspar and (hydrothermal) biotite could have occurred in granitic rock 152802 and replacement by K-feldspar in 129560 (in both cases, prior to retrograde alterations of propylitic and phyllic types, respectively). In samples 152804 and 152807, it is interpreted that albitic feldspar replaced initial igneous feldspars (and possibly quartz), with associated or later replacement by minor sericite/muscovite, epidote, chlorite, prehnite and tourmaline. Sample 152807 is unusual in that it contains several volume % of rather coarse titanite, texturally in late magmatic habit. In samples 152812 and 129582, replacement of igneous feldspars ± quartz by K-feldspar (hematite-pigmented) has occurred, with accompanying or later replacement by one or more of sericite, chlorite, hematite, magnetite and rutile. Volcaniclastic rock sample 152808 displays unusual alteration (for the suite) in having replacement by quartz-epidote-magnetite (-pyrite-chlorite). In many of the above alteration assemblages, there is evidence of local Fe-enrichment during alteration, manifest in replacements (and local veining) by Fe-rich minerals including magnetite, hematite, Fe-bearing sulphides, epidote and Fe-bearing carbonate.

Possible early veining occurs in 152802, where thin veins of K-feldspar-magnetite-pyrite-biotite were emplaced. Minor veining by K-feldspar-hematite-quartz-pyrite occurred in 129586, chlorite-magnetite (-quartz-sericite) in 152812 and sericite/muscovite in 152804.

**Appendix 4 – Petrographic Descriptions of Thin Sections (Batch 2)**

## SUMMARY

A suite of twenty drill core samples from north-central Tasmania was submitted for petrographic preparation, description and interpretation. The samples were mostly porphyritic felsic igneous (volcanic and intrusive) and volcanoclastic rocks and were from drill holes DEVD1, DEVD2, CETD1, CETD2 and DR1, and included rocks from the Bull Creek Volcanics, Lorinna Greywacke and the intrusive Dove Granite. Petrographic sections were prepared by Petrographic International Pty Ltd in Brisbane. Four polished thin sections (PTS) were prepared of sulphide-bearing rocks, with the remainder having standard thin sections (TS) prepared. PTS were examined microscopically in transmitted and reflected light, with the TS examined in transmitted and oblique reflected light. Eleven of the section offcuts were treated with hydrofluoric acid and sodium cobaltinitrite in order to check for the presence of K-feldspar. All sample offcuts were measured for magnetic susceptibility.

Summary descriptions of each sample are listed following:

### DEVD1            70 m    TS

Summary: Mildly altered porphyritic microgranodiorite (granodiorite porphyry), with phenocrysts of quartz, plagioclase and biotite, a few phenocrysts of K-feldspar and amphibole and possible pseudomorphic aggregates after former clinopyroxene grains. The phenocrystal phases occur in a finely inequigranular groundmass that is dominated by K-feldspar, quartz and plagioclase. Apart from the replacement of possible igneous clinopyroxene by amphibole and biotite, other alteration is relatively weak and of low grade type. It is manifest by the development of sericite, chlorite and trace carbonate.

### DEVD2            75.6 m   TS

Summary: Porphyritic microgranodiorite or dacite, originally containing phenocrysts of quartz, feldspar (probably plagioclase), biotite and another ferromagnesian phase in a fine grained quartzofeldspathic groundmass. There was initial K-feldspar alteration, replacing igneous feldspar phenocrysts as well as the groundmass. This was followed by strong propylitic alteration, with replacement of ferromagnesian phases and partial replacement of K-feldspar by carbonate, chlorite and sericite. Patches of carbonate and quartz have replaced the groundmass. The rock contains minor network veining by chlorite and sericite as well as possibly later carbonate veining. Disseminated pyrite occurs in a zone where carbonate and sericite vein development is strong.

### DEVD2            108.8 m    PTS

Summary: Possible quartz phyric, porphyritic felsic igneous rock (e.g dacite) with a few fractures and partly recrystallised quartz phenocrysts. The rock has been fractured and locally brecciated, with initial strong hydrothermal replacement by fine to medium grained quartz and tourmaline with disseminated to locally semi-massive medium grained pyrite. There is a gradation of alteration into an assemblage of fine to medium grained carbonate, hematite and chlorite, with hematite and carbonate also acting as breccia matrix, along with quartz. The rock has also been cut by several irregular aggregates and veins that range from medium to coarse grained carbonate to fine to

medium grained specular hematite. Traces of magnetite occur irregularly in carbonate, in association with pyrite.

**DEVD2      157.6 m      TS**

**Summary:** Strongly recrystallised fine grained quartzofeldspathic rock, with development of scattered medium grained quartz-rich aggregates and subsequently imposed strong sericite/muscovite alteration. The nature of the original rock remains obscure although it could be speculated that it represents a former fine grains clastic sedimentary rock, or perhaps an epiclastic of felsic volcanic derivation. Initially, the rock recrystallised to an assemblage of dominant K-feldspar and quartz, but subsequently, much K-feldspar was replaced by sericite/muscovite, with minor carbonate and chlorite. The rock also contains a few disseminations and small aggregates of pyrite, titanite and rutile.

**CETD1      REMOVED**

**CETD2      REMOVED**

**CETD2      REMOVED**

**CETD2      REMOVED**

**CETD2      REMOVED**

**CETD2      REMOVED**

**DR1    138.4 m      TS**

**Summary:** Strongly altered crystal-lithic-vitric felsic tuff. The original rock contained scattered phenocrystal grains of quartz and feldspar, with a few smaller grains of ferromagnesian material and FeTi oxide, with porphyritic felsic volcanic lithic fragments and a matrix that probably contained vitric tuffaceous material. A weak foliation in the matrix suggests that the rock could have been emplaced as an ignimbrite. There was initial alteration of feldspar grains and lithic and matrix material by K-feldspar, with associated quartz and minor disseminated magnetite. Subsequently, a retrograde phyllic overprint occurred, with strong development of sericite from K-feldspar and replacement of magnetite by hematite.

**DR1    143.9 m      TS**

**Summary:** Medium grained quartzofeldspathic sandstone (greywacke), with strong hydrothermal alteration. The original rock contained abundant detrital quartz and less common feldspar and lithic grains, with a generally matrix-supported texture. Imposed alteration has caused complete replacement of feldspar, lithics and matrix components, with development of an assemblage of quartz, tourmaline, sericite and minor hematite. A few veins and aggregates of hematite ± tourmaline are present, along with a couple of thin quartz veins.

**DR1    144.5 m      TS**

**Summary:** Possible sedimentary breccia showing angular fragments of altered porphyritic felsic volcanic rock hosted in an altered medium grained, matrix-supported sandstone host. The volcanic fragments contained quartz and altered feldspar phenocrysts in a fine grained groundmass. The sandstone contained angular to sub-rounded detrital quartz grains in a finer grained matrix. Alteration has been of greisen type, resulting in a quartz-dominant assemblage in the volcanic fragments, with minor sericite and a little tourmaline, and a tourmaline-quartz assemblage replacing

the sandstone matrix. A little disseminated hematite occurs as part of the alteration assemblage, and both altered rock types have been cut by a few sub-planar, medium grained quartz veins.

**DR1 151.75 m PTS**

**Summary:** Strongly hydrothermally altered, rather coarse grained lithic-crystal felsic tuff. The original rock contained scattered phenocrystal grains of quartz, with a few possible feldspar and ferromagnesian grains, along with abundant lithic fragments (mostly porphyritic felsic volcanic and possible pelite). The rock has been strongly replaced by fine grained sericite and quartz, with patchy disseminations and aggregates of medium grained pyrite, fine to medium grained tourmaline and a little specular hematite. Pyrite and hematite are locally intergrown. Slight supergene oxidation effects have led to minor replacement of pyrite by goethite.

**DR1 219.5 m TS**

**Summary:** Porphyritic and possibly fragmental felsic volcanic rock (e.g. crystal-lithic tuff, possibly welded), with strong hydrothermal alteration. The rock contained scattered quartz phenocrysts, with less common phenocrysts of K-feldspar and ferromagnesian material in a fine grained quartzofeldspathic groundmass. Possible fragments are composed of porphyritic volcanic similar to the host. The rock has experienced initial potassic alteration, with replacement of the groundmass (and possible plagioclase phenocrysts) by K-feldspar, with development of minor quartz and magnetite. Subsequently, there was a propylitic alteration overprint, with partial replacement of K-feldspar by fine grained sericite, development of chlorite (mainly at ferromagnesian sites) and traces of leucoxene, allanite, hematite, chalcopyrite and pyrite.

**DR1 236.3 m PTS**

**Summary:** Tourmaline-rich metasomatic rock, perhaps of greisen character. Fine to medium grained tourmaline is intergrown with rather abundant interstitial and veinlike masses of specular hematite, minor quartz and a few aggregates of pyrite. Hematite veins locally contain minor quartz, carbonate and pyrite. The rock displays a few large coarse grained quartz masses; these could be metasomatic or possibly represent relict phenocrysts from a porphyritic felsic igneous rock.

**DR1 243.7 m TS**

**Summary:** Coarse grained felsic volcanoclastic rock, with abundant volcanic lithic fragments (some porphyritic), with scattered relict quartz phenocrystal grains. There is only a minor finer grained tuffaceous matrix component. The rock has undergone strong phyllic alteration, with replacement of lithic and matrix material by fine grained sericite, granular quartz, disseminations, aggregates and network veins of fine to medium grained specular hematite, plus disseminated pyrite.

**DR1 249.35 m TS**

**Summary:** Felsic volcanoclastic rock, with rather coarse grained porphyritic volcanic lithic fragments and scattered phenocrystal grains of quartz and K-feldspar, in a finer grained tuffaceous material. The rock has been cataclastically deformed, with subsequent imposition of K-feldspar-quartz development in the groundmass/matrix components and subsequent development of patchy sericite, network veining, aggregates and disseminations of fine grained hematite, and a little chlorite.

**DR1 249.7 m TS**

**Summary:** Porphyritic felsic igneous rock with rather intricate contact with a medium grained volcanoclastic rock (e.g. epiclastic sandstone). Both rock types are compositionally similar, with the igneous rock containing scattered quartz and K-feldspar phenocrysts in a fine grained quartzofeldspathic groundmass. There are a few fragments of this rock type in the volcanoclastic. The latter rock is dominated by clastic grains of quartz and K-feldspar, with a few altered biotite and lithic grains. Both rock types have probably undergone initial potassic alteration, with replacement of groundmass/matrix components by fine grained K-feldspar and minor quartz. There was a subsequent propylitic alteration overprint and fracturing, with replacement by chlorite and sericite, minor tourmaline and hematite, and a trace of allanite. Chlorite is more abundant in the volcanoclastic component and hematite in the felsic igneous rock, where there are several chlorite- and hematite-filled fractures.

**DR1 319.8 m TS**

**Summary:** Porphyritic felsic volcanic rock, of rhyolite/rhyodacite composition and showing moderate propylitic alteration. The rock contains relict phenocrysts of quartz and K-feldspar and has a few pseudomorphs after former phenocrysts of plagioclase and biotite, all set in a fine grained K-feldspar-rich groundmass. Weak fluidal texture is apparent in the groundmass and in places it is apparent that the rock is fragmented. Alteration has led to patchy development of sericite and chlorite, with a little hematite and leucoxene, and the complete replacement of biotite and plagioclase.

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**Interpretation and comment**

Samples in the suite include probable felsic intrusives, felsic volcanic and volcanoclastic rocks and rather coarse grained clastic sedimentary (possibly epiclastic) rocks. A range of hydrothermal alteration types has been imposed, along with local veining, and there is some evidence in a few samples for a thermal metamorphic episode to have been imposed on earlier alteration. Similarly, several samples show greisen styles of alteration that could be related to adjacent intrusive rocks and evolution of magmatic hydrothermal fluids.

Sample DEVD1 70 m is identified as a porphyritic microgranodiorite. It contains phenocrysts of quartz, plagioclase and biotite, with less common K-feldspar and amphibole, and it could have originally contained clinopyroxene. This rock type represents an intrusive and it has undergone only weak alteration. Possible early alteration (e.g. post-magmatic replacement of clinopyroxene by amphibole and biotite) was followed by propylitic alteration, with minor replacement by sericite, chlorite and trace carbonate. DEVD2 75.6 m and DEVD2 108.8 m represent quartz-feldspar porphyries (e.g. porphyritic dacite, microgranodiorite). They might be compositionally similar to DEVD1 70 m, and if there is a

relationship, then they might represent a chilled marginal phase of the intrusion. These two samples display much stronger alteration than DEVD1 70 m, with DEVD2 75.6 m having initial replacement by K-feldspar (potassic alteration) followed by later strong propylitic alteration (carbonate-chlorite-sericite-pyrite) and DEVD2 108.8 m having initial greisen-type quartz-tourmaline-pyrite alteration, followed by brecciation and infill by carbonate, hematite (specular), chlorite and trace magnetite.

The majority of the other samples (e.g. from DR1) are composed of felsic volcanics, mostly pyroclastics (e.g. crystal-lithic tuff and crystal-lithic-vitric tuff), but possibly also including lava of rhyolitic/rhyodacitic type (e.g. DR1 319.8 m). One of the pyroclastic rocks (DR1 219.5 m) might have been welded, i.e. ignimbritic character). In the volcanic rocks, relict textures are generally moderately to well preserved, except for one or two (e.g. DR1 236.3 m) in which the intensity of alteration has largely obliterated relict features. Characteristics of the volcanic rocks include the presence (or former presence) of phenocrystal grains of quartz, feldspars (maybe plagioclase as well as K-feldspar), ferromagnesian phases (probably mostly biotite) and traces of FeTi oxide, apatite and zircon. Groundmass materials are fine grained and quartzofeldspathic composition. Many samples contain lithic fragments, most of which are porphyritic felsic volcanics (similar to the host material), but there are rare fragments of pelitic and quartzitic metasediments. A minority of the samples in the suite represent sedimentary clastic rocks (probably epiclastics), generally of medium to coarse grained character and with lithic (felsic volcanic), quartz and feldspar grains and variable amounts of finer quartzofeldspathic matrix. These rocks could be classified as volcanic-derived greywacke (e.g. DEVD2 157.6 m, DR1 143.9 m, DR1 249.7 m), although DR1 144.5 m is a type of sedimentary breccia with a rather quartz-rich sandstone hosting fragments of porphyritic felsic volcanic rock. In DR1 249.7 m, there is a rather intricate contact between greywacke and felsic volcanic. The greywacke also contains fragments of the latter, implying a strong genetic relationship. In fact, the greywacke bulk composition is probably similar to the felsic volcanic rocks.

As mentioned above, alteration is varied, both in type and intensity. There may have been early (syn- to post-volcanic) alteration of the volcanic rocks, with later intrusive-related alteration and metamorphic effects imposed on some of the volcanic and clastic rocks. Early alteration could be represented by phyllic (i.e. sericite  $\pm$  quartz  $\pm$  pyrite) and propylitic (chlorite, sericite, carbonate, albite, pyrite) types, some of which are weakly foliated (eg DR1 243.7 m). Other alteration of potassic type might also be early and volcanic-related, but it could also be intrusive-related; this type is manifest mainly by groundmass replacement by fine grained K-feldspar ( $\pm$  quartz  $\pm$  magnetite) and possible replacement of former plagioclase phenocrysts by K-feldspar. It is interpreted that several samples have been strongly affected by intrusive-related, greisen-type alteration and that there is also a later stage of retrograde, oxidising alteration. Greisen-type alteration is mostly manifest in the development of a tourmaline + quartz assemblage, in places accompanied by sericite, pyrite

and hematite. Samples in which tourmaline is prominent include DEVD2 108.8 m, DR1 143.9 m, DR1 144.5 m and DR1 236.3 m. In sample DR1 151.75 m, the alteration assemblage contains less tourmaline, but with dominant quartz-sericite-pyrite and in DEVD2 157.6 m, a sericite/muscovite (carbonate-chlorite-pyrite) assemblage, interpreted to be greisen-like, overprints early potassic alteration. In the tourmaline-bearing assemblages, tourmaline is relatively early, with hematite and pyrite being paragenetically later. The oxidised retrograde alteration assemblages might follow the formation of K-feldspar-rich and tourmaline-rich assemblages, occurring as overprints, veins and local breccia fillings. These assemblages are characterised by the presence of fine to medium grained, commonly specular hematite, in places with chlorite, sericite and carbonate (e.g. in DEVD2 108.8 m, DR1 138.4 m, DR1 143.9 m, DR1 236.3, DR1 243.7 m, DR1 249.35 m). In some of the later stage assemblages, there is a trace of allanite, e.g. associated with chlorite (e.g. DR1 219.5 m, DR1 249.7 m).

In several samples, it is interpreted that there could have been a metamorphic overprint on already-altered rocks, e.g. caused by a later intrusion into altered rocks such as some of the felsic volcanics and greywacke. Metamorphic mineral growth is random in orientation and manifest by the growth of fine grained biotite, in places with quartz, magnetite and chlorite, and with granular recrystallisation of pre-existing quartz and feldspar.

Pyrite is widespread and can be part of early (e.g. volcanic-related) phyllic and propylitic alteration, as well as occurring in some of the tourmaline-rich assemblages (e.g. DEVD2 108.8 m, DR1 151.75 m). Hematite is common in the interpreted retrograde assemblages, with chlorite and sericite; in places it appears to have crystallised in equilibrium with pyrite (e.g. in DR1 236.3 m).

Sulphide mineralisation occurs in many samples, but (a) is dominated by pyrite (commonly as the only sulphide) and (b) base metal sulphides, where they are observed, are only in trace amounts. Pyrite concentrations attain 10-15 volume % in a few samples with strong tourmaline and/or sericite development (e.g. DEVD2 108.8 m, DR1 151.75 m), where it is in association with magnetite and/or hematite (possibly in equilibrium). Pyrite occurs as disseminations and local vein fillings in several other samples, but mostly <1-2 volume %. Traces of chalcopyrite have been observed in DR1 219.5 m. The rather abundant pyrite associated with some of the strong tourmaline development is assumed to have formed by the intrusive-related greisen type alteration,