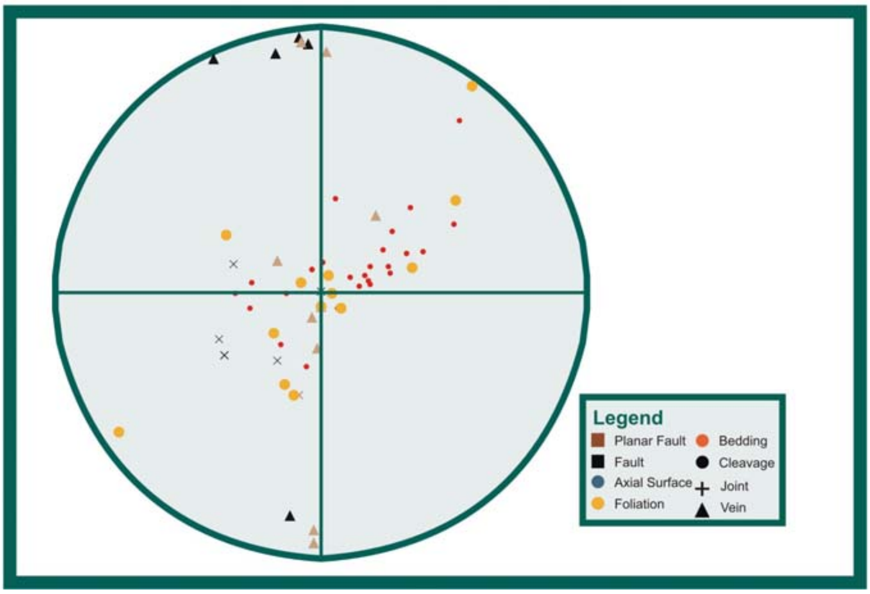
Lefroy Resources Limited

LEFROY PROJECT AREA

An Upgrade of the Structural Geology of the Lefroy Goldfield Based on a Review of Surface Mapping (May, 2006) and Historical Work



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Executive Summary

Recent work undertaken by Lefroy Resources (LEF) has led to an upgrading of the structural geology of the Lefroy Goldfield. This report follows on from previous studies by Reed (2001, 2002), Keele (2004a & b), Baxter and Keele (2004) and Baxter and Fulton (2006). It is based on further field mapping (including adits) and core logging by John Baxter and Russell Fulton.

To date detailed studies of the Pinafore, Chum and Native Youth mines have been completed. This work has been supported by previous workers that have highlighted the importance of shallow east-plunging ore shoots contained within the steeper dipping easterly striking faults within the field with 90 % of production (including Volunteer) attributed to them (Keele, 1996).

The study has concluded that the deformation model presented in Baxter and Fulton (2006) needs to be modified to match the regional North East Tasmanian descriptive work by including an early event, probably thrusting as D_1. This leads to a renaming of the remaining deformation events. Importantly the mineralising event previously ascribed to D_3 by Baxter Keele (2004) and Baxter and Fulton (2006) moves to D_4.

It is recommended that:

- Exposure, by costeaning or underground access, will be essential to determine the geometry of the mineralized shears. Clearly confidence would be higher if this could be conducted on Chum, Pinafore and Volunteer
- Sectional work, currently being done by Col Lloyd, be continued to create a sectional based structural model at Pinafore and Chum
- Once the model at Pinafore and Chum is complete the stratigraphic and structural model be extended across the field
- When oriented core is not available core axis angle analysis would be an advantage. Where possible stable fabrics such as S_2 or S_3 can be used to orient structures from core axis angle measurements.

Introduction

Further mapping by Lefroy Resources Ltd to an upgrade of the structural controls of mineralisation in the Lefroy Goldfield in northeastern Tasmania has been completed. This upgrade is based on surface and adit mapping and previous structural studies by Groves (1965), Reed (2001, 2002), Keele (2004a & b) and Baxter and Fulton (2006), together with aeromagnetic and radiometric data acquired by UTS Geophysics and prepared for interpretation by Andrew Boyd. This study includes surface and adit mapping with further core logging by John Baxter and Russell Fulton.

The Lefroy Goldfield was the centre of discontinuous gold mining between 1869 and 1911 during which time approximately 180,000ozs of gold was recorded as being produced. The records indicate that the average mined grade of the field was in excess of 30g/t Au, with most of the mining being restricted to a depth of approximately 30m however some mining occurred to depths of 200m. Testing of some of the reefs at depth, up to 380m, by both underground development and diamond drilling shows that the reef structures continue at depth and in places are mineralised at economic grades.

GEOLOGY

REGIONAL GEOLOGY

Reed (2001) summarises the tectonics of the Northeastern Tasmania as follows: "Recumbent folding in eastern Tasmania affected turbidites containing Lower to Middle Ordovician (Bendigonian Be1 to Darriwilian Da3) fossils, but not stratigraphically overlying turbidites containing Silurian (Ludlow) graptolites, and is of a timing consistent with Ordovician to Silurian Benambran orogenesis on the Australian mainland. Two subsequent phases of upright folding post-date deposition of turbidites containing Devonian plant fossils but pre-date intrusion of Middle Devonian granitoids, and are of Tabberabberan age. A closely spaced disjunctive cleavage (S_2), associated with the first phase of Tabberabberan folding, everywhere cuts a slaty cleavage (S_1) associated with the earlier formed recumbent folds. However, refolding associated with development of S_2 is not always clear in outcrop and it is proposed that coincident tectonic vergence between the two events has resulted in reactivation of recumbent D_1 structures during the D_2 event. The transition to rocks not affected by recumbent folding coincides with a marked change in sedimentology from shale to sand-dominated successions. This contact does not outcrop but coincides with the Pipers River and from seismic data, appears to dip moderately to the east, and can only be explained as an unconformity. The current grouping of all pre-Middle Devonian turbidites in eastern Tasmania into the one Mathinna Group is misleading in that the turbidite sequence can be subdivided into two distinct sedimentary packages separated by an orogenic event. It is proposed that the Mathinna Group be given supergroup status and existing formations placed into two new groups: an older Early to Middle Ordovician Tippogoree Group and a younger Silurian to Devonian Panama Group."

The Lefroy Goldfield is located in the Stony Head Sandstone within 2km of the contact with the Turquoise Bluff Slate. The Stony Head Sandstone is a thick bedded and typically unfossiliferous sandstone dominated succession (Reed, 2004). The Turquoise Bluff Slate, by contrast, is predominantly fine-grained rocks (shale, mudstone, chert and fine-grained sandstone) (Reed, 2004). The rheological contrast between these units is a likely focus of deformation, and mineralisation at Lefroy. Peak metamorphism does not correlate with stratigraphic position and does not change across most of the large faults, indicating that peak metamorphism occurred after east directed thrusting and as a result of crustal thickening. This indicated metamorphism is post- D_1. All of the mineralised host rock at Lefroy is within the Tippogoree Group of the Mathinna Supergroup and virtually all is within the Stony Head Sandstone.

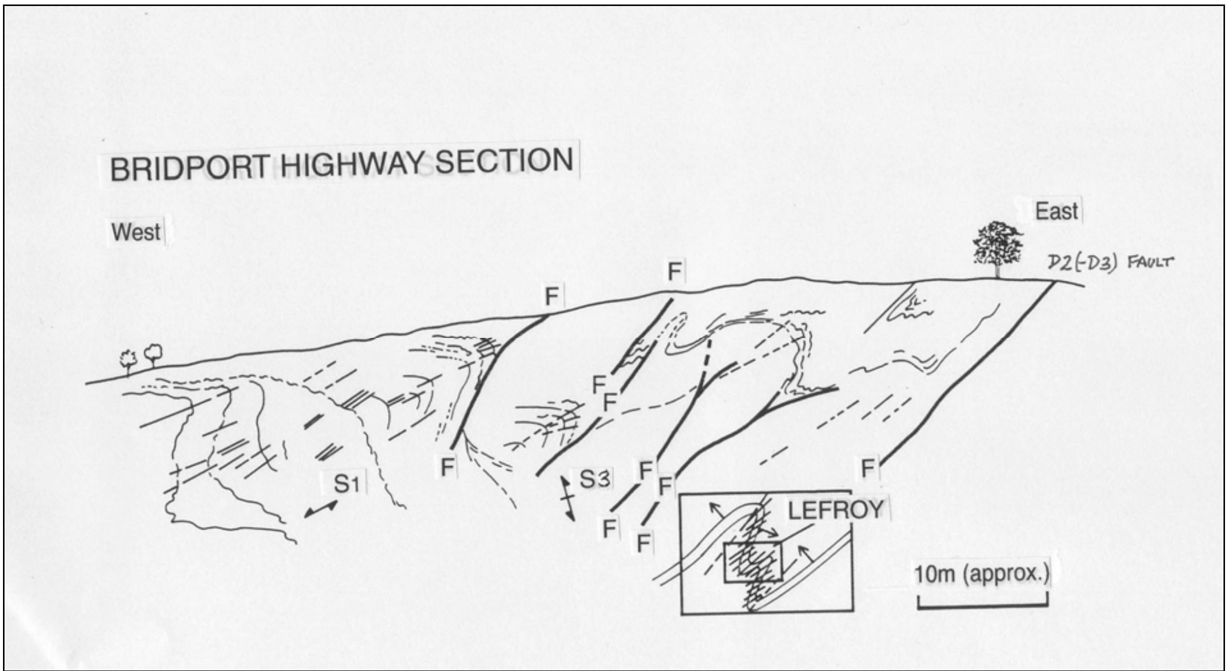

Figure 1. Sketch of the Richard Keele road cut at Volunteer: note the section has been made looking north from the south side of the road cut (499370E, 5448500N).

STRUCTURAL GEOLOGY

The earliest deformation fabric in the Lefroy district is recognised as an incipient flat lying cleavage (S_1). The fabric was identified by Rob Scott (2006). This cleavage is only identified in thin section, no exposure of F_1 folds occurs in the Lefroy district. D_1 is considered to be related to the development of the regional recumbent fold seen, as a regional southeast plunging fold, to the north of Lefroy. The sense of movement on this fold is west over east. The deformation appears to be the regional D_1 deformation identified by Reed (2004). The deformation does not appear to contribute to the geometry of mineralisation at Lefroy and may be a precursor to the more evident D_2 folding described below.

The second deformation is a sequence of thrusts and accompanying folds that have transport of the hangingwall to the northeast (500578E, 544713N, 148RL) similar to that seen in the Australasian Slate Quarry (504600E, 5456500N) by Reed (2004). The folds (Figure 2a) are associated with a flat dipping stripy cleavage (Figure 2b) best seen in the Stony Head Sandstone. The axial surface of the folds dip <15^{o} to the east and the folds plunge shallow to the north. Pyrite is seen smeared into the stripy cleavage. The F_2 are exposed in the Richard Keele road cutting (Figure 1). This deformation appears to be the regional D_2 deformation identified by Powell and Baillie (1992) and Reed (2004). It appears to control the distribution lithologies in the Lefroy Goldfield.

Figure 2. Recumbent Folds a) hinge zone of fold b) stripy cleavage axial planar to folds.

The third phase of deformation can be seen clearly in a road cutting where steeply dipping spaced cleavage cuts the stripy cleavage (Figure 3). This fabric is similar to that described by Reed (2004). Stereographic nets created from mapping in the district (e.g. Figure 5) seem to suggest D_1 to D_3 are demonstrations of progressive deformation as the geometry of the three events appears to be the same. Folds (F_3) associated with D_3 are seen exposed in a road cutting at 512930E, 5452394N. The axial surface of these folds dips to the southwest at 50-70^{o}. Plunge of the folds is shallow to the south. This deformation appears to be the regional D_3 identified by Powell and Baillie (1992) and Reed (2004).

Figure 3. Spaced cleavage (D_2) cutting stripy cleavage (D_1) at 498527E, 5448271N

Reed reports that only folds that are upright in style (D_3) are present east of the Pipers River leading him to speculate that there is an unconformity separating these two structurally distinct domains, in which the Benambran-aged (or late Delamerian?) recumbent structures are present (D_2) and occur to the west.

The fourth deformation event (D_4) in the Lefroy district can be seen locally as brittle (Figure 4c) steep dipping faults and associated drag folds (Figure 4 a & b). The faults generally strike east-west and dip steeply to the north or south. The sense of movement is oblique right lateral with a significant normal component. Minor folds associated with the faults plunge shallowly to the southeast (Figure 4b). Quartz veins are deposited in the fault planes and these veins are associated with gold mineralisation. This deformation is not consistent with the regional D_3 described by Reed (2004) and Baxter and Keele (2004), as the orientation is markedly different and the style of faulting is normal rather than reverse (Reed, 2004). This deformation is associated with mineralisation at Lefroy. Mineralized shoots associated with these faults will plunge sub-horizontally, and consequently the deformation event is responsible for the sub-horizontal panels of mineralisation seen in the drilling. A corollary of this observation is that holes will not be planned to intersect a similar RL, rather different RL's will be tested to extend the resource. When drilling, the shoots will be followed at located RL's to establish resources.

(a) (b) (c)

Figure 4. Normal faulting and associated folding a) oblique drag folds on fault 498516E,5448267N; b) drag fold in costean 50004E, 5448414N; c) D_4 east-west veins cut by D_5 fault veins 499747E, 5448913N.

The last deformation identified in the district (D_5) is a right lateral brittle fault array that partitions the stratigraphy. The faults strike south-southeasterly and dip steeply to the east from surface mapping. Movement on the faults appears to be limited probably less than 10m in strike slip. The deformation event has the potential to produce high grade shoots that plunge sub-vertically in a similar manner to some stoping on historical longitudinal sections. It is likely the steep plunging shoots expected from this deformation event have a higher proportion of free gold with arsenic depletion (i.e. the second gold population identified in the geochemistry section). This deformation event was not identified by Reed (2004).

The crustal structure beneath the Lefroy deposits has been modelled by Keele et. al., (1994) and Reed (2004). The regional model is of a thrust terrain during D_1-D_2 that created the regional lithological architecture. It is worth noting that Reed (2004) expects an unconformity to develop between D_2 and D_3 separating rocks either side of the Pipers River. However, D_3 has a similar geometry to the preceding thrust environment. There is a rotation of the stress field that led to development of upright folds. During the D_4 event, northerly trending sinistral strike-slip faults accessed fluids from the base of the sequence and developed the easterly trending secondary shears that contain the lodes at Lefroy. The fluids were sourced from D_4 detachment faults that possibly daylight beyond the Beaconsfield gold mine on the western side of the Tamar Fracture Zone. The steeply dipping, easterly striking D_4

vein structures and accompanying faults short-circuited the gold-bearing fluids at depths of between 5 and 10km. Arsenopyrite geothermometry data suggests that Lefroy was closer to the fluid source than Beaconsfield: Lefroy fluids were hotter (460-470° C) than Beaconsfield (370-440°C, unpublished data). D_5 faults are late in the history and are well documented as slides in the historical studies. In some localities where D_5 structures are identified, high grade gold intercepts occur, suggesting there may be remobilisation of gold during D_5.

Structural Analysis of Drill Hole Data

Analysis of geological mapping and logging of core has established a well-defined deformation history in the Lefroy district:

The plunge of the intersection of faults and the axis of perturbations on fault planes, associated with D_4 and mineralisation, plunge shallowly to the east-southeast. This direction is correlated with the plunge of high-grade shoots in the historical workings.

Stereographic Net Analysis

Mapping of structures in the Lefroy district has been dominated by data obtained from road cuttings and isolated pits (Keele,1996; Reed,2004) and this is also the case with the basic data set reported herein. Orientation data from core is also reviewed however it is not as effective as might be, as there are very few observations from structures associated with mineralisation.

Surface mapping (Figure 5) and the core mapping (Figure 6) from LFD064 completed during this survey clearly identified structures associated with the D_1 event, consisting mainly of recumbent folds with well developed shallowly south plunging hinges and associated faults (thrusts). Lineations shown in Figure 5 are consistent with the shallow southerly plunge of recumbent folds mapped in the main road cutting by Richard Keele (Figure 1).

The folds contribute the architecture of the region, with partitioning between shallow west-southwest dipping thrusts. Asymmetric recumbent anticlines provide both upright and overturned limbs within the sequence (see Figure 18 of Reed, 2004). It appears that sandstone units are more coherent during D_2 deformation whereas shale units may have deformed in a more ductile manner.

D_3 is well-defined in outcrop as an upright southerly plunging fold. The predominant structures identified during core logging (Figure 7) by Russell Fulton appear to be consistent with the development of upright folds identified as D_3 in a previous section. This fold phase has folds that plunge to the south at a gentle to moderate angle as observed in outcrop. The stereographic net in Figure 7 may require further verification as it is not consistent with the core readings (Figure 6). From the core measurements, the axial surface of the D_3 folds $70^{\circ}\rightarrow 070^{\circ}$ and is marked by a crenulation or spaced cleavage S_3 (Figure 3).

There are no folds identified with D_4 in the Lefroy area. There is however a number of faults and veins that cut the S_3 cleavage and that are known to contain mineralisation. The stereographic net data presented in Figure 8 shows the structures (only 22) that have been measured in mineralized rock and all of the faults measured in core from the district. It is clear this group of measurements come from a dip-slip array with an intersection lineation which plunges very shallowly to the east or west. Field observations suggest the fault array has an oblique normal sense of movement (Figure 4). This array is consistent with the lode orientation at Lefroy. The implication of this observation is that shoots of mineralisation will be sub-horizontal within the fault planes.

There is no stereographic net data that is confidently associated with D_5. There is a suggestion of a strike-slip array marked by the distribution of quartz veins on the stereographic net. This array has an intersection lineation plunging steeply to the southeast. From mapping D_5 faults have a south-easterly strike, dipping steeply to the east that would be consistent with this array and the veins would be consistent with a right lateral strike-slip array. Further work is required to define this array.

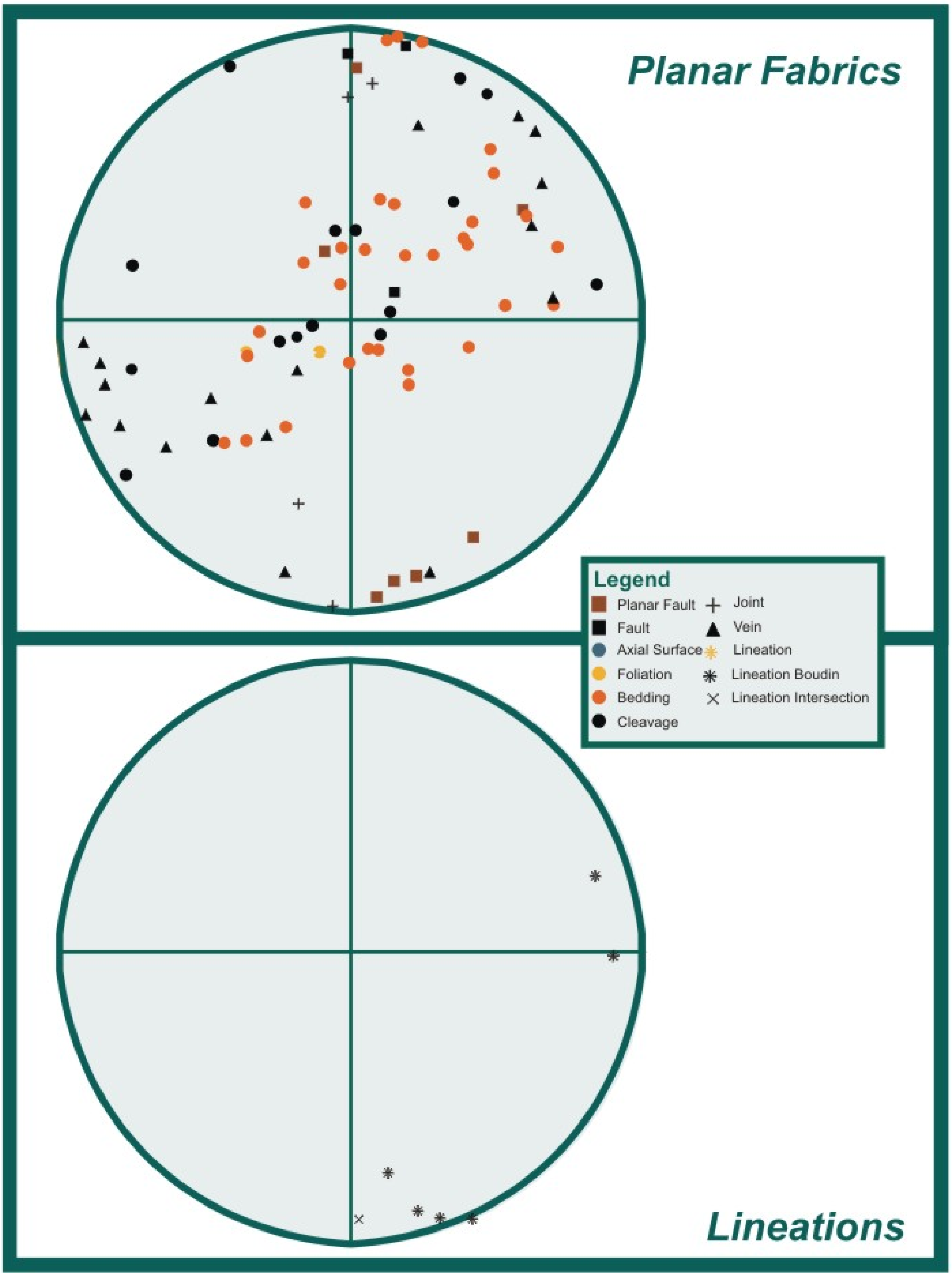

Figure 5. Stereonet from surface mapping, Lefroy District.

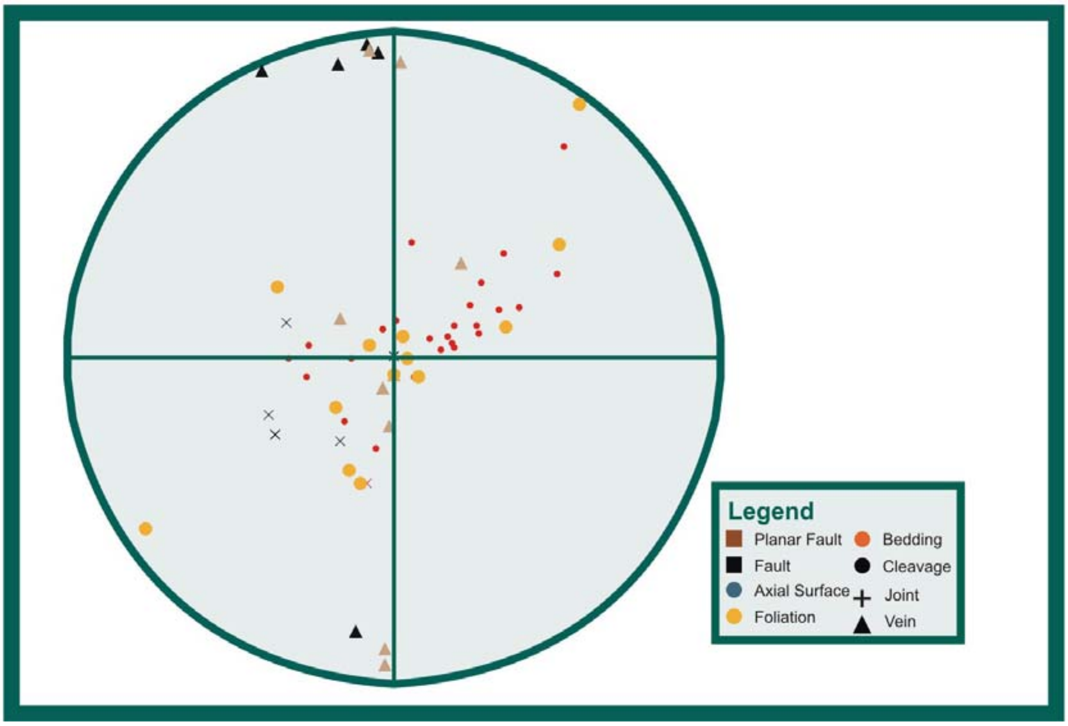

Figure 6. Core structural Mapping by Russell Fulton on LFD064.

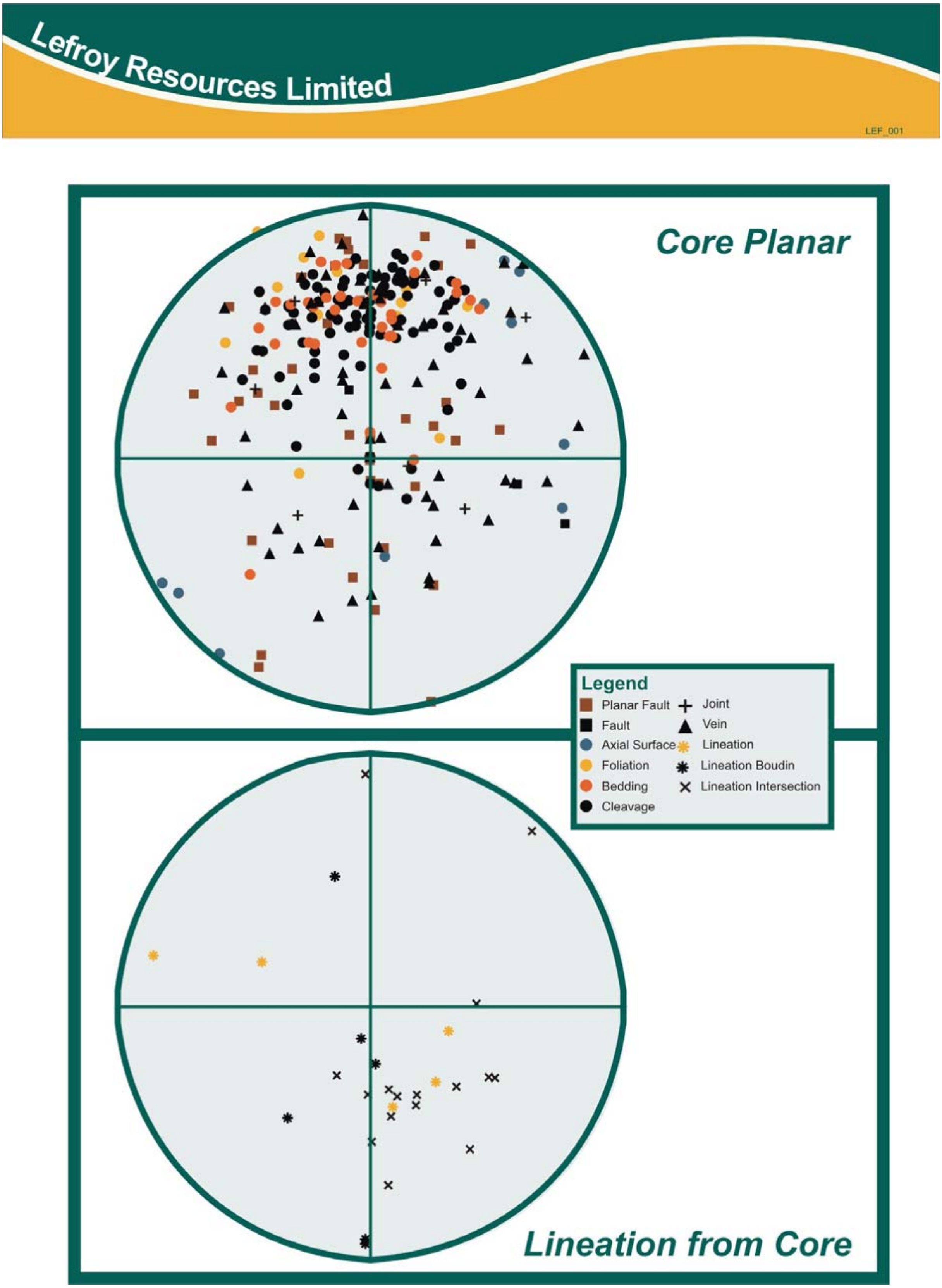

Figure 7. All core data collected by Russel Fulton.

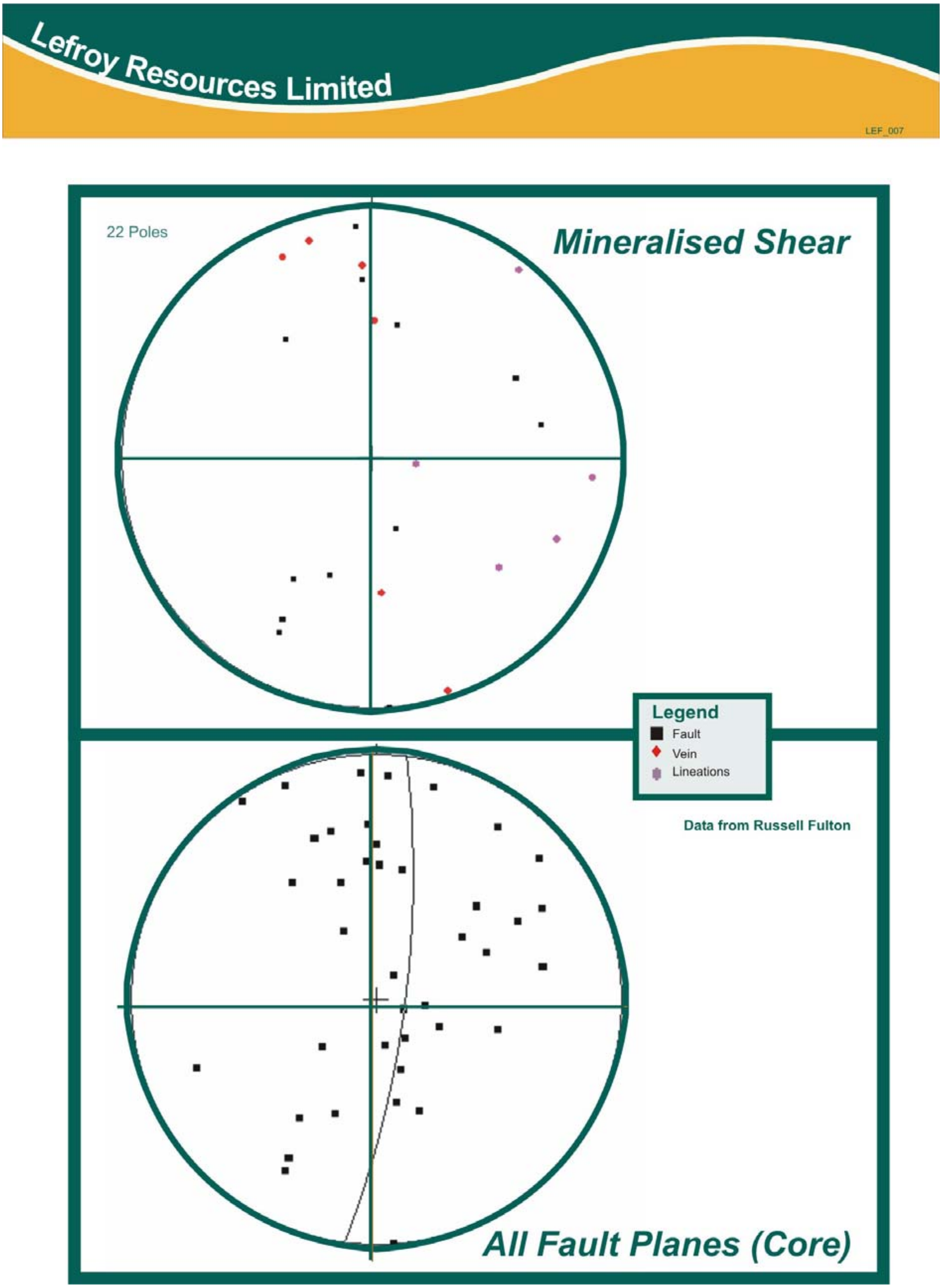

Figure 8. Core measurements in mineralized rock and fault planes.

Modelling Structures at Lefroy

The fact that the axes of folding is nearly at right angles to the mineralized structures in the Lefroy Goldfield make it challenging to picture the relationship between stratigraphy, faulting and mineralization. In an attempt to resolve this visualization problem two attempts were made to represent the structure as currently interpreted.

The sectional study being completed by Col Lloyd will provide a basis for development of a regional distribution of sandstone dominated and shale dominated sections that will assist in targeting mineralisation at Lefroy.

Structural Observations and Mineralization

There are no direct observations that can be identified to define the relationship between deformation and gold mineralisation. It is clear that pyrite mineralisation is deposited during D_1-D_4 events. Pyrite is smeared out parallel to the S_2 cleavage and folded by crenulation cleavage formed during D_3. Most pyrite associated with D_4 structures is euhedral, or brecciated. Arsenopyrite is not seen deformed in the deposits, indicating late-stage deposition. Carbonate and quartz veining appear to be associated with all deformation events and veins do not appear to attract gold mineralization, although arrays (particularly D_5) appear to attract arsenopyrite.

Gold mineralization clearly post-dates D_1, D_2 and D_3 cutting all fabrics associated with the deformation events.

A review of mineralization on the stereographic net is not very helpful. There is a weak association of gold with the interpreted D_4 array, arsenic appears to be associated with fabrics from both D_2 and D_5 and silver has no particular association (Figure 9).

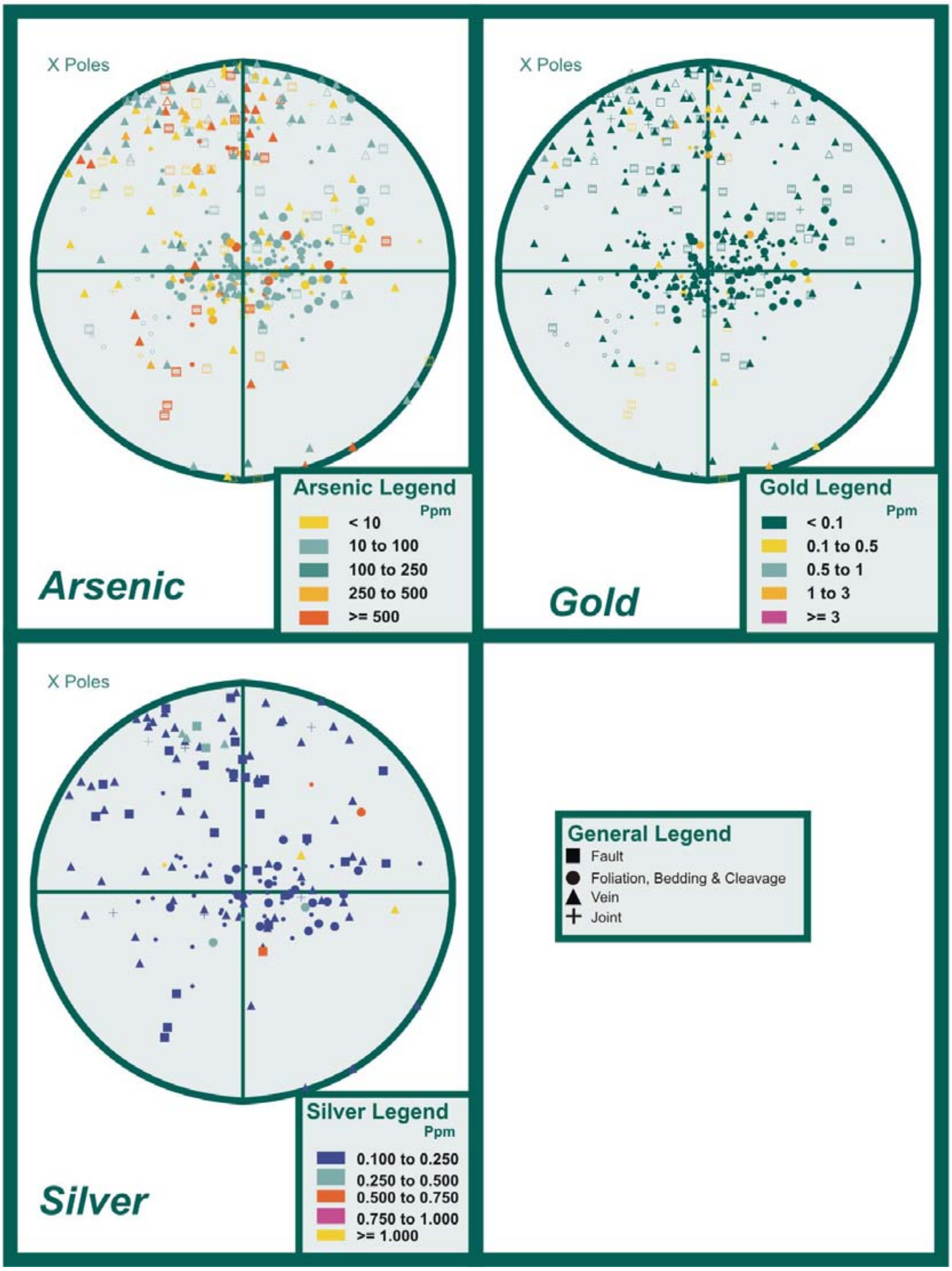

Figure 9. Distribution of Gold, Arsenic and Silver related to structures.

Conclusions and Recommendations

This upgrade of the structural study by Baxter and Fulton (2006) and Baxter and Keele (2004) added adit mapping to the previous data from the Lefroy Goldfield. It is an attempt to connect the observations with the regional deformation of Northeastern Tasmania as developed by Reed (2004).

The Lefroy Goldfield has no folds associated with D_1; however insipient fabrics related to the deformation event have been identified in thin section. This has led to the inclusion of a deformation event earlier than reported in Baxter and Fulton (2006).

The principal conclusions are that:

- Five phases of deformation are identified:
  - D_1 and D_2 are associated with regional thrusts and are essentially architecture building within the Lefroy District, the axial surfaces strike northerly and fold hinges plunge southerly. Although pyrite is deposited during D_2 there is no indication of any gold mineralization associated with either event. The main contribution D_2 has in the area is that depending on whether a section is in the hinge, or on the limb of a D_2 fold, the thickness of sandstone units will be greater or lesser respectively.
  - D_3 is a simple upright fold dominated deformation that has affected the geometry of the D_1 and D_2 structures and likewise has no mineralisation associated. It should be noted that this is the dominant event seen east of the Pipers River Disruptive Zone and there is expectation that it will be the dominant architectural deformation in deposits such as Denison.
  - D_4 is a brittle fracture event that has pyrite, arsenopyrite and gold mineralization associated. D_4 faults focus the mineralization at Lefroy. Most of the mineralization appears to be in the cataclased wall rock of the faults. High grade shoots will plunge sub-horizontal with a tendency to plunge shallowly to the east. The westerly plunge seen in some longitudinal sections of the goldfield are likely to be because of

the intersection of D_4 faults with south-westerly dipping beds associated with D_2 thrusts.

  - D_5 is a late brittle fault system, it partitions the stratigraphy and mineralization developed along D_4 faults and has some arsenopyrite associated with the fault and vein development. Remobilisation of gold may occur during this event and it may be that intersections of D_4 easterly shears and D_5 northerly shears may focus zones where high grade "nuggetty" gold occurs.
- Mineralisation is associated with D_4. Although there has been no direct observation to confirm these conclusions, the following can be interpreted:
  - D_4 faults are oblique normal faults
  - High grade shoots will plunge in a sub-horizontal manner, probably with some preference to plunging shallowly east

It is recommended that:

- Exposure, by costeaning or underground access will be essential to determine the geometry of the mineralized shears. Clearly confidence would be higher if this could be conducted on Chum, Pinafore and Volunteer
- Sectional work, currently being done by Col Lloyd, be continued to create a sectional based structural model at Pinafore and Chum
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- When oriented core is not available, core axis angle analysis would be an advantage. Where possible stable fabrics such as S_2 or S_3 can be used to orient structures from core axis angle measurements.

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References

Anon, 1998	Australasian Code For Reporting of Identified Mineral Resources and Ore Reserves. *Report of the Joint Committee of the Australasian Institute of Mining and Metallurgy and Australian Mining Industry Council.*
Baxter, J.L. and Fulton, R., 2006	Northeast Tasmania; Review of Exploration Potential of Lefroy Resources Ltd. Tenement in Northeast Tasmania, *Lefroy Resources Ltd.*
Baxter, J.L. and Keele, R, 2004	Structural Control ofr Mineralisation based on geological reports and aeromagnetics covering the Lefroy Goldfield, Tasmania: Continental Resource Management Report WA04/038
Bottrill, R.S., Huston, D.L., Taheri, J. and Khin Zaw, 1992	Gold in Tasmania. Geological Survey Bulletin 70, Tasmanian Department of Mines.
Bottrill, R.S., Taheri, J. and Keele, R.A., 1994	A Field Guide to Deposits in northeastern Tasmania, MRT Report 1994/19.
Broadbent, G., 1982	Pipers River EL53/80 Geological Report, MRT Report 83_1955.
Coroneos, C., 1993	A poor man's diggings; An archaeological survey of the Lisle-Denison Goldfield.
Cromer, W.C.,1986	EL32/85, Lisle-Golconda area North East Tasmania. Annual Report, year 1 (to 10/12/86). Argyle Minerals NL (TCR87-2629).
Cromer, W.C., 1987a,b	EL32/85, Lisle Golconda area North East Tasmania. Annual Report, year 1, Argyle Minerals NL (TCR87-2629 and TCR87-2737).
d'Auvergne, P., 1992	Drill Core Recoveries. Relationship with Assay Grade, Geological Structure and Drill Hole Diameter. *North Broken Hill-Peko/Ballarat Goldfields NL unpublished joint venture report.*
Purvis, J., 1998	Annual Report – Lefroy EL 1/95, Lefroy Joint Venture.
Purvis, J., 1999	Annual Report – Lefroy EL 1/95, Allstate Explorations NL.
Randell, J.P., 1991	EL6/90 – Lisle. Final Exploration Report. Billiton Australia. (TCR91-3296).
Reed, A., 2002a	Formation of Lode-style gold mineralisation during Tabberabberan wrench faulting at Lefroy, eastern Tasmania, *Aust. J. of Earth Sciences.*
Reed, A., 2002b	Targeting Hard-Rock Gold Mineralisation at Lefroy, Northeastern, Tasmania, *Australia. Sapphire Trading In-House Confidential GIS.*
Reed, A.R., 2004	Gold mineralisation and the regional Palaeozoic structure of the Mathinna Supergroup, eastern Tasmania: *Mineral Resources Tasmania, Tasmanian Geological Survey Record 2004/01*
Reid, A.M., 1926	The Golconda Mining District, MRT Report GSB37 (Geological Survey Bulletin).
Russell, D.W. and van Moort, J. C., 1992	Mineralogy and stable isotope geochemistry of the Beaconsfield, Salisbury and Lefroy Goldfields, Geological Survey Bulletin.
Russell, D.W. and van	Lefroy and Beaconsfield Gold Mines, Tamar region,

Moort, J. C., 2003 Tasmania; CRC LME.