QUEEN HILL GEOLOGICAL INTERPRETATION

C.H. YOUNG
DISTRICT MANAGER

March 31, 1980

Revised: September 1982

UNPUBLISHED   PDF ✓

TABLE OF CONTENTS

LIST OF PLATES

SUMMARY

This report summarises work completed on the Queen Hill Mineral Leases in the quarter ended February 11, 1980.

Detailed geological mapping of the Queen Hill grid area is nearing completion and J. Taylor (Geologist) has interpreted the outcrop pattern of the volcanics to describe a major F_2 antiformal structure and recognised numerous small scale isoclinal F_1 folds. Taylor confirms in principal the structure and stratigraphy proposed by Lutley (1975) but with repetition of stratigraphy by isoclinal folding without thrust faulting, for which there is little or no evidence.

Work continued on interpretation of the Queen Hill deposit and a revised interpretation is presented which demonstrates cassiterite-sulphide mineralisation to be structurally controlled, favouring reactive rocks such as dolomite and carbonate rich volcanics but with maximum development of mineralisation at the intersection of fault/fissure lodes.

Reassessment of pre-existing data for Severn was completed. Preliminary geological interpretation indicates the mineralisation intersected in G39 is fracture controlled and does not favour any particular lithology but may represent a steeply plunging fault/fissure controlled body of mineralisation.

The bedded pyrite horizons at Queen Hill are considered to be related to the volcanics.

INTRODUCTION

Queen Hill lies within the Zeehan Ag-Pb mining field in south-west

Tasmania and is situated immediately to the west of the Township of

Zeehan and 13 kms south-west of the Renison Bell Tin Mine.

At the turn of the century Queen Hill was the site of Ag-Pb mining from

Clarkes Lode. Reports show that the presence of Sn, particularly on

the Oonah lease, had been recognised (Waller, 1904; Twelvetrees and

Ward, 1910).

There is little information on small scale prospecting and mining in

the area after the closing of the main mines in about 1913. Henderson

reported the discovery of cassiterite on the north-west slope of Queen

Hill in 1937 and Hill & Blisset (1961) mention that in about 1938

the area was worked by the Zeehan Tin Development N.L. In 1960, this

area was being worked and prospected for cassiterite in an open-cut

and adits knows as the Stormsdown Mine (Blisset, 1961). Exploration

activities in the Zeehan field were renewed in the 1960's and several

lodes in the Queen Hill area known for their Ag-Pb-Zn content were found

to contain small amounts of Sn. Placer prospecting (1965) report assays

of ore, from Payne's and Poverty Point open-cuts, ranging from 0.16%

to 0.88% Sn. The Queen Hill cassiterite-sulphide mineralisation had

been cut by adits running into Clarkes Lode, but the extent of the

mineralisation and its cassiterite content were not recognised until

exploration by Gippsland Minerals N.L. which commenced in 1969 with

the acquisition of ML36M 62 (40 acres) owned by D. Dunkley and optioned

to Gippsland Minerals to July 31, 1972; option exercisable for $50,000.

In late 1970 and during 1971, Gippsland completed 10 diamond drill holes. At Queen Hill the first hole, G1, intersecting cassiterite in massive pyrite-pyrrhotite sulphides, as did G3 and G4; but other holes were not successful in expanding this major zone, although minor mineralisation was intersected. Aberfoyle (CEPL) recognised the apparent conformable nature of the mineralisation with the volcanic/shale contact and possible relation to the Cleveland Mine type mineralisation.

In late 1970 a Joint Venture Agreement was negoitated with Gippsland whereby CEPL (Aberfoyle) earnt an initial 40% equity by expenditure of $100,000 on exploration, payment of $25,000 half share exercise of the Dunkley option and by making a payment of $100,000 to Gippsland Minerals N.L. prior to 28 February, 1973, Aberfoyle's equity was then raised to 60% at the rate of 1% equity per $20,000 expended on exploration. The Joint Venture Agreement was finally signed on the 27th March 1972. An increase in equity to 70% was subsequently negotiated whereby Aberfoyle take the project to acceptable feasibility, as well, after mining operations commence, Gippsland will repay 3/4 of 30% of all joint venture expenses exceeding $155,000 incurred after January 7, 1977.

An Exploration Licence application, surrounding the Queen Hill area, was lodged early in November 1971 and granted as EL 47/71 on December 21, 1971.

Aberfoyle (CEPL) commenced drill hole G11 on August 24, 1971. This first drilling program was completed on October 7, 1971 with G14. Following this, exploration work became rather sporadic influenced by the realisation that the orebody had major metallurgical problems, essentially due to the very fine grain size of the cassiterite (average 20 microns). The influence of stannite mineralisation to total tin grades was also recognised.

The Matte Fuming process, currently being tested in a pilot plant operation at Kalgoorlie, is to a great extent the result of the difficult metallurgy at Queen Hill.

Parallel to the viability of matte fuming was the need to have confidence in the ore reserve at Queen Hill. In late 1977 Ken Palmer investigated the published ore reserve and found that there was not sufficient fact, drill hole density or assay reliability to validate the reserves.

During 1978 all drill core was re-logged and plotted on 1:500 sections. Surface geology fact plans were compiled at the same scale and based on the facts now available on cross-section and in particular the fault zones; a new interpretation was completed.

A new ore resereve assessment showed that only an inferred ore reserve could be quoted (865,000 tonnes at 1.31% SnT). This led to a Work Proposal for drilling, initially to establish an indicated ore reserve with provision for exploration drilling for ore potential. This was reconsidered and it was decided at this stage there was a greater requirement to establish gross ore reserves, by exploration drilling with some ore reserve holes to improve confidence in the current inferred reserve. Further drilling of the Severn zone was also proposed.

STRUCTURAL AND STRATIGRAPHIC INTERPRETATION

Structure

The outcrop pattern of the volcanics in the Oonah - Queen Hill - Montana area is recognised as the form surface of a major F_2 antiformal structure (Plate QH 154). Small scale isoclinal F_1 folds are also recognised and indicate a deformational history involving two phases of folding consistent in principle with the structure and stratigraphy proposed by Lutley (1975). Repetition of stratigraphy is considered however, to be by isoclinal folding without the thrust faulting suggested by Lutley (Plate QH 155).

Queen Hill lies in the broad hinge zone of the F_2 antiform which plunges moderately to the south-east. In the immediate prospect area the layering dips moderately to steeply south-east with a strike that swings gradually from ENE to NNW around the major fold hinge. A first generation cleavage parallel to bedding is axial plane to tight isoclinal folds and is folded around the major antiform, thus predating it. Evidence for large scale isoclinal folding (Plate QH 155), which repeats major stratigraphic units, is facing reversals within individual units from a variety of sedimentary structures and the form surface of some units (especially sedimentary inclusions within the largest volcanic body) suggesting fold interference patterns.

Structural and facing information is unfortunately severely limited because of the paucity of bedding/cleavage and fold vergence data, thus the location of large scale F_1 fold hinges is based only on stratigraphic correlation.

LEGEND

Tuffaceous greywackes and siltstones — CRIMSON CREEK FORMATION

Montana Volcanics

Slates and quartzites

Oonah & Queen Hill quartzites

500 m

NORTH WEST TASMANIA

QUEEN HILL

Geological Summary Plan showing axis of
Major F2 Antiform and repetition of Stratigraphy

Aberfoyle Exploration Pty Ltd

Drawn:	J.R.T.	Location code.	
Traced:	R.J.E.	Date:	April, 1980
Checked:		Scale:	1:10,000
Revised by:	Date:	Plate No	QH 154

ZEEHAN

MONTANA No.1

MONTANA No.2

MONTANA No.1

STORMSDOWN OPEN CUT

QUEEN HILL

SEVERN

OONAH

MN

361000E
3607000E
3606000E
3595000E
3592000E
3591000E
3562000E
3562000E

2550 N
2400 N
1900 N
1900 N
1500 N

QUEEN HILL

OONAH HILL

OONAH

F (?)

F (?)

Success Creek Phase

Oonah Quartzite Formation

500 metres

Slate - quartzite unit

Oonah and Queen Hill quartzites

Q

Crimson Creek Formation

Tuffaceous greywackes and siltstones

Montana Volcanics

Dolomite, siltstone unit

mineralisation

proj. onto plane of section

height in metres

600
500
400
300
200
100
S.L.
-100
-200
-300

Aberfoyle Exploration Pty Ltd

Drawn:	J.R.T.
Traced:	R.J.E.
Checked:	
Revised by:	Date:

NORTH WEST TASMANIA
Interpreted Geological Cross Section
through the Oonah and Queen Hills

Location code:	
Date:	April, 1980
Scale:	1 : 10, 000
Plate Nº	QH 155

Faulting

The interpretation of isoclinal folding as the mechanism for repetition of the main stratigraphic units, does not imply a lack of faulting in the Zeehan area and indeed deformation by faulting is well documented. There are two main fault and lode directions in the Oonah - Queen Hill - Montana area. One strikes in a north to north-easterly direction and dips moderately to steeply to the south-east and contains the majority of fissure lodes. The other fault direction is north-westerly trending, these are the north-east dipping slides described as occurring in the Oonah and Montana Mines.

Twelvetrees and Ward (1910) describe the slide at Oonah, as a fault plane with a zone of crushed rock up to 1 metre wide. In the Montana No. 1 Mine they also describe a slide with a strike length approaching 800 m, consisting of a zone of crushed and brecciated slate up to 50 m wide. More recently, detailed mapping on the bench at Queen Hill, shows unequivocally that Clarkes Lode truncates stratigraphy.

It is considered this faulting occurred contemporaneously with the second phase of deformation and is thus Tabberabberan (Middle Devonian). Twelvetrees and Ward (1910) describe lode mineralisation within the fault zones and show that fissure lode mineralisation post dates the faults. For example when the stannite lode at Oonah reaches the slide it bends and follows the slide before passing out into the country rock on the other side. Similarly in the Montana Mine, old workings follow lodes which cross the faults.

At Queen Hill, Clarkes Lode fissure mineralisation follows the path of a fault. This is discussed more fully in the section on the Queen Hill Lodes.

Post-mineralisation faulting is well documented, Blissett (1962) summarises a considerable body of evidence to show that the majority of faults in the area are post-Permian block faults.

Stratigraphy

Prior to Lutley's work and indeed more recently, the lithological sequence was considered to young unformly towards the east with the Oonah Quartzite at the base, progressing up through thin bedded slates and quartzites, minor dolomites and volcanics of the Success Creek Group to the lithic greywackes and shales of the Crimson Creek Formation.

The current interpretation (J. Taylor) correlates stratigraphic units by isoclinal folding. For example, the volcanics at Oonah and Queen Hill and the lavas and lithic greywackes of the Crimson Creek group are considered to represent the same stratigraphy.

Support for this correlation includes:-

1. West facing, shown by flame textures at the shale/volcanic contact on the bench at Queen Hill and east facing in the Crimson Creek Formation shown in drill core from the Severn area.

2. Fragments of vesicular lava, identical to the volcanics at Queen Hill, are reported by King and Blissett (1968) to be present in the Crimson Creek sediments east of Queen Hill.

3. The recognition that the thinly bedded slage-quartzite sequence reappears on the eastern side of the Queen Hill quartzite ridge (Severn drill core).

4. The complete lack of volcanic material in the slate-quartzite or quartzite units indicating these units pre-date the volcanics.

THE QUEEN HILL CASSITERITE-SULPHIDE LODES

Revised Interpretation

The following is a revision of the geological interpretation proposed in June 1979. Cassiterite-sulphide lode mineralisation is shown to be structurally controlled, related to fault/fissure lodes and best developed in a replacement mode where the lodes cut previously fractured reactive horizons, such as dolomite or carbonate-rich volcanics. The maximum development of mineralisation occurs where lodes intersect and a pipe like body with a plunge of 50° to the north-east is formed.

For some time, hydrothermal feeder structures have been recognised as one of the key features in the distribution of ore (June and December 1979 reports). In order to understand their role a thorough review of all data and an examination of recent drill core was completed with an emphasis on ore textures, paragenesis and zonation.

All cassiterite-sulphide and stannite bearing intersections are observed to include in part or wholly an interval of siliceous sulphide rich breccia and or veins, occasionally with chalcedonic agate - form textures indicative of open space filling. (Figures 1 to 4). These breccias and veins are considered to have been formed by pulses of ascending hydrothermal solutions (related to the emplacement of the Late Devonian Heemskirk Granite) localised in pre-existing fault planes.

When the position and attitude of Clarke's Lode, known from the old mine workings, is taken as a guide to the orientation of a possible sub-parallel fault set, the tin bearing breccias and veins in each intersection align remarkably well with a set of predictable planar

Figure 1   G45 194.4 m drill core section of siliceous
sulphide rich breccia showing veining and agate
textures indicative of open space filling.

Figure 2   G49 149.4 m drill core section of siliceous sulphide
rich breccia showing veining, sulphide breccia and
agate textures.

Figure 3   G45 240.5 m drill core section of siliceous
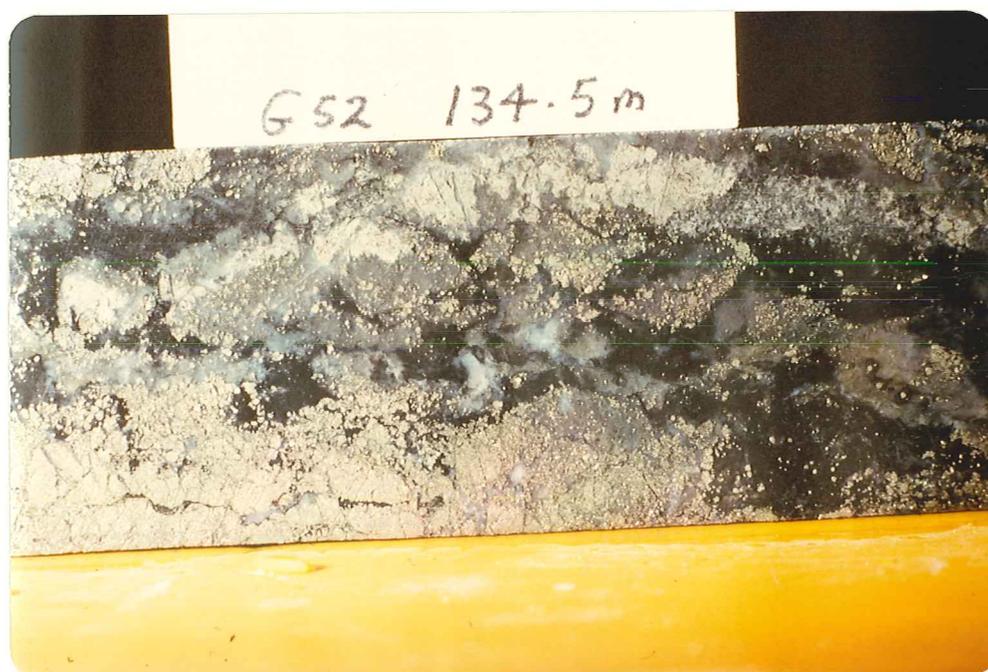   sulphide rich breccia.

Figure 4   G52 134.5 m drill core section of siliceous-pyrite
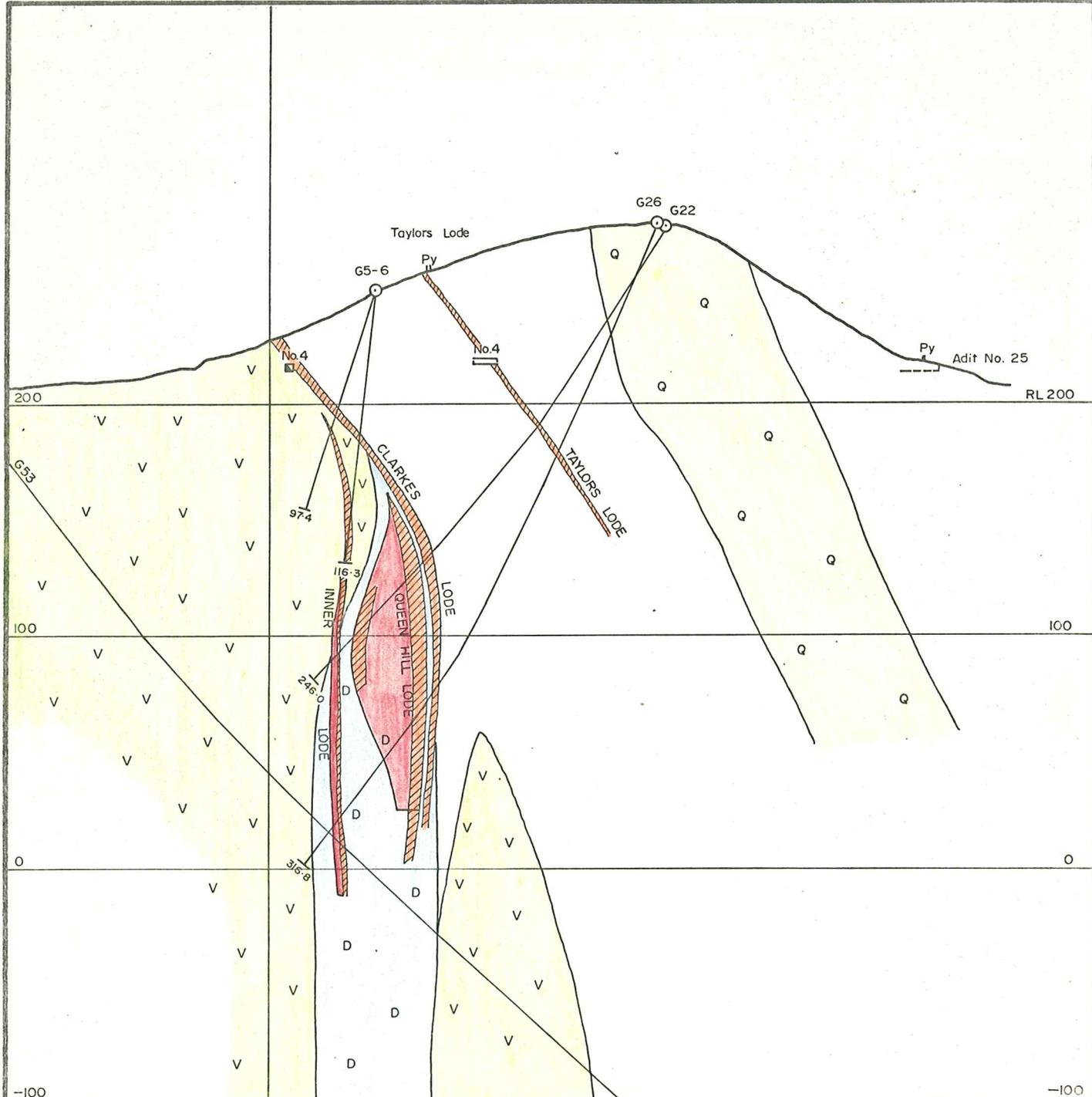   rich vein with local breccia textures.

structures, (Plates QH152 and QH153). For example, the lode associated with the main body of cassiterite-sulphide mineralisation, now termed the Queen Hill Lode, can be traced for over 150m on section and over 200m on plan and apart from a steepening of dip, this lode is a planar structure.

As indicated in the section on structure there are two well documented fault directions in the Oonah-Queen Hill-Montana area. One, striking in a north to north-easterly direction and dipping to the south-east, is the orientation of the majority of lodes at Queen Hill. These lodes are now identified as the Inner Lode, the Queen Hill Lode, Clarkes Lode and Taylors Lode.

The other fault direction, represented by the slides at the Oonah and Montana Mines, is north-westerly trending with dips to the north-east. At Queen Hill the fault/fissure lodes now termed Dunkleys Lode and Stormsdown Lode (Fig. 5) trend and dip in that direction.

Figure 5: View looking south-east. Skearing and silicification. Surface expression of the Stormsdown fault/fissure lode.
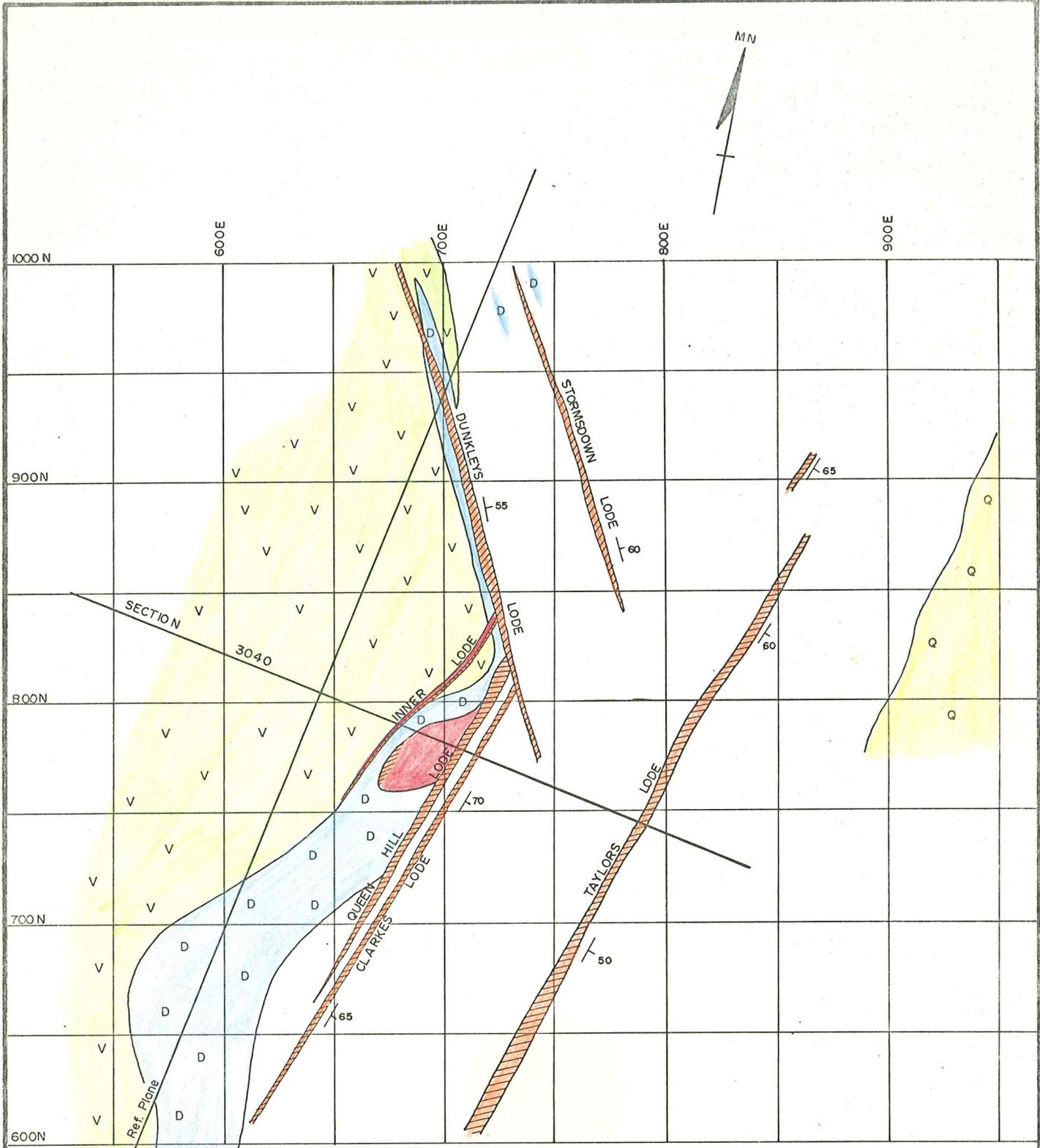
Taylors Lode

G26 G22

G5-6 Py

Q

Q

Py Adit No. 25

No.4

No.4

RL 200

V

CLARKES

TAYLORS LODE

V

97.4

INNER

LODE

116.3

QUEEN HILL LODE

LODE

Q

246.0

D

D

316.8

D

Q

V

D

V

V

D

V

V

V

421.0

Reference Plane

G53

— LEGEND —

V	MONTANA VOLCANICS
D	DOLOMITE, SILTSTONE UNIT
	SLATE QUARTZITE UNIT
Q	QUEEN HILL QUARTZITE
	CASSITERITE - SULPHIDE ORE
	FAULT - FISSURE LODE

/A/ Aberfoyle Exploration Pty Ltd

Drawn:	C. H. Y.	
Traced:	R. J. E.	
Checked:		
Revised by:	Date:	

NORTH WEST TASMANIA

QUEEN HILL

CROSS SECTION 3040

Location code:
Date: April , 1980
Scale: 1 : 2,500
Plate Nº QH 152 / 3040

MN

1000 N
900 N
800 N
700 N
600 N

600E 700E 800E 900E

DUNKLEYS LODE
STORMSDOWN LODE
INNER LODE
QUEEN HILL LODE
CLARKES LODE
TAYLORS LODE
SECTION 3040
Ref. Plane

55 60 65 60 50 65 70 50

V D Q

Legend

V — MONTANA VOLCANICS
D — DOLOMITE, SILTSTONE UNIT
SLATE QUARTZITE UNIT
Q — QUEEN HILL QUARTZITE
CASSITERITE - SULPHIDE ORE
FAULT FISSURE LODE

Aberfoyle Exploration Pty Ltd

Drawn:	C.H.Y.
Traced:	R.J.E.
Checked:	
Revised by:	Date:

NORTH WEST TASMANIA
QUEEN HILL
R.L. 100 - LEVEL PLAN

Location code:
Date: April, 1980
Scale: 1 : 2,500
Plate Nº QH 153

The maximum development of cassiterite-sulphide mineralisation at Queen Hill occurs adjacent to and on the footwall side of the intersection of the two sets of fault/fissure lodes. Twelvetrees and Ward (1910) discuss the distribution of ore in the Montana No. 1 Mine as follows:-

"One is at once impressed with the manner in which the ore continually recurs at the intersections of the later fissures with the ruscheln (slide). The lode-fissures extend back for some distance from these points of intersection.......... But the shoots of ore are for the most part found to occur in the immediate proximity to the ruscheln, and on the footwall side of each of these main faults."

Twelvetrees and Ward also note that at the intersections of lode-fissures and ruscheln the actual bulk of the lode - matter is greatest. There is thus, in the same locality, well documented evidence for the type of ore distribution as observed at Queen Hill. The plunge of the intersection of the dipping fault/fissure lodes calculated stereographically is 50° toward 045°, which indeed is the orientation of the pipe-like main ore body at Queen Hill.

The steepening of dip of the Inner Lode, the Queen Hill Lode and Clarkes Lode is coincident with a thickening of the ore and may be the result of other fault/fissure lode intersections. As well there is some extension of mineralisation away from the area of the main fault/fissure lode intersection as shown by the ore intersection in G26. At this stage with only drill hole data, it is difficult to interpret a second fault/fissure lode set at depth, but this is a possibility.

The richest tin mineralisation is developed adjacent to where the fault/fissure lodes cut reactive horizons such as dolomite or carbonate rich volcanics. This is particularly so near the intersection of the

fault/fissure lodes, where the ground appears to be most fractured and thus more conducive to the passage of mineralising hydrothermal solutions. Numerous examples of replacement mineralisation, associated with a pyrite vein network healing fractures, have been observed in recent drill core. Figures 6 to 11 illustrate this type of mineralisation. At something like 50 m from fault/fissure lode intersections there is little development of replacement or vein network mineralisation even when fault/fissure lodes cut reactive rocks such as dolomite. This appears to be due to a decrease in the intensity of fracturing.

As noted in the December 1979 report, cassiterite mineralisation has been identified in a variety of rock types other than dolomite and carbonated volcanics. These other rock types are variously described as chloritic carbonaceous shale, cherty mudstone, quartz siderite rock and quartz sericite rock. The cassiterite-sulphide mineralisation in such rocks is considered partly replacement but occurs more generally as a pyrite vein network with individual pyrite veins from 1 to 5 mm wide healing a thoroughly fractured host. Some of the fine grained bedded pyrite exposed on the Queen Hill bench is mineralised in this fashion (part of the Queen Hill Lode). Only when a network of pyrite veins is present does the fine grained bedded pyrite have any direct association with tin mineralisation.

The effect of the mineralising hydrothermal solution on less reactive rocks is also illustrated by Clarkes and Taylors Lodes which are situated within the slate-quartzite sequence. Here more open fissures and different wall rock conditions prevail and there is a development of thick pyrite veins with stannite and argentiferous galena. Figure 12 illustrates the mode of mineralisation in Clarkes Lode.
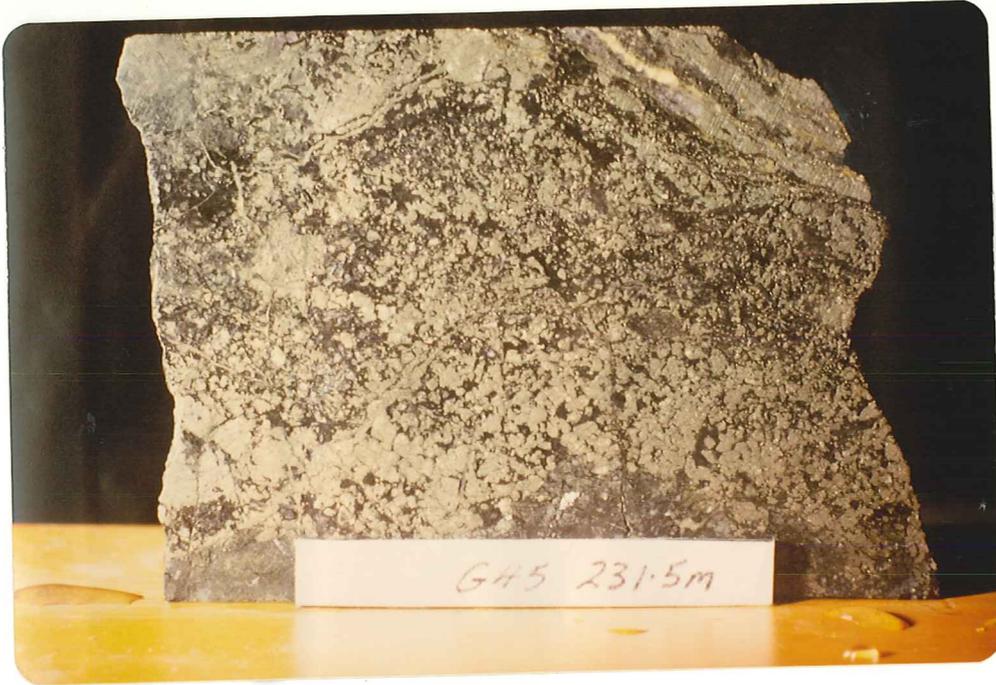
Figure 6: G45 231.5 m. Coarse grained replacement pyrite with a dolomitic matrix (Sn 0.9%).

Figure 7: G53 259 m fractured and locally replaced pyritic dolomite adjacent to a siliceous pyritic vein. Irregular black coloured lines may be stylolites with carbonaceous filling. (Sn 2.35%).
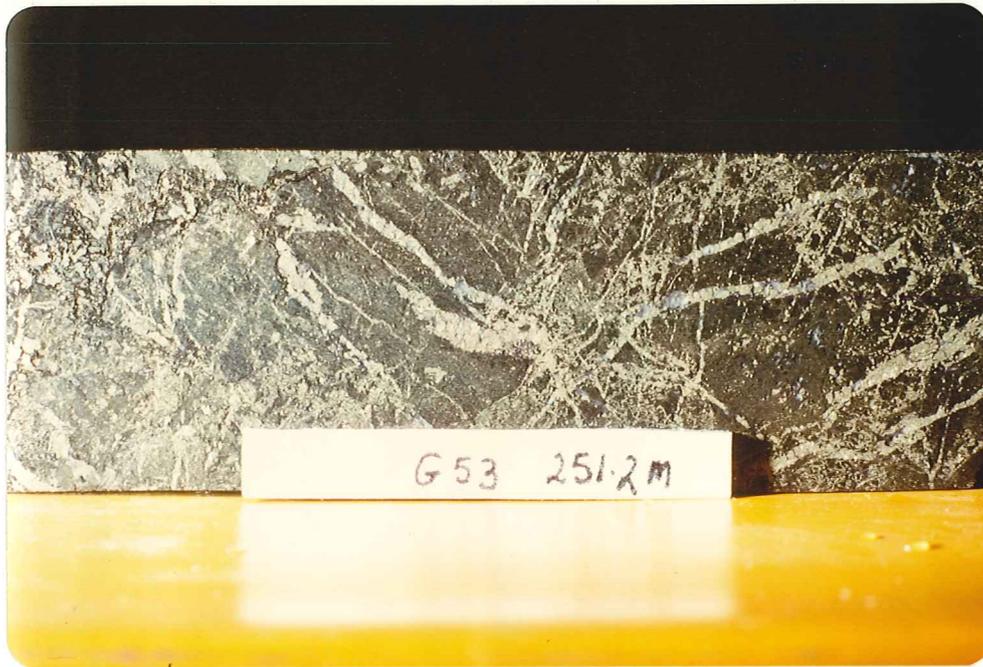
Figure 8 G53 251.2 m Fractured and partly replaced pyritic
dolomite. Pyrite vein textures indicate more than
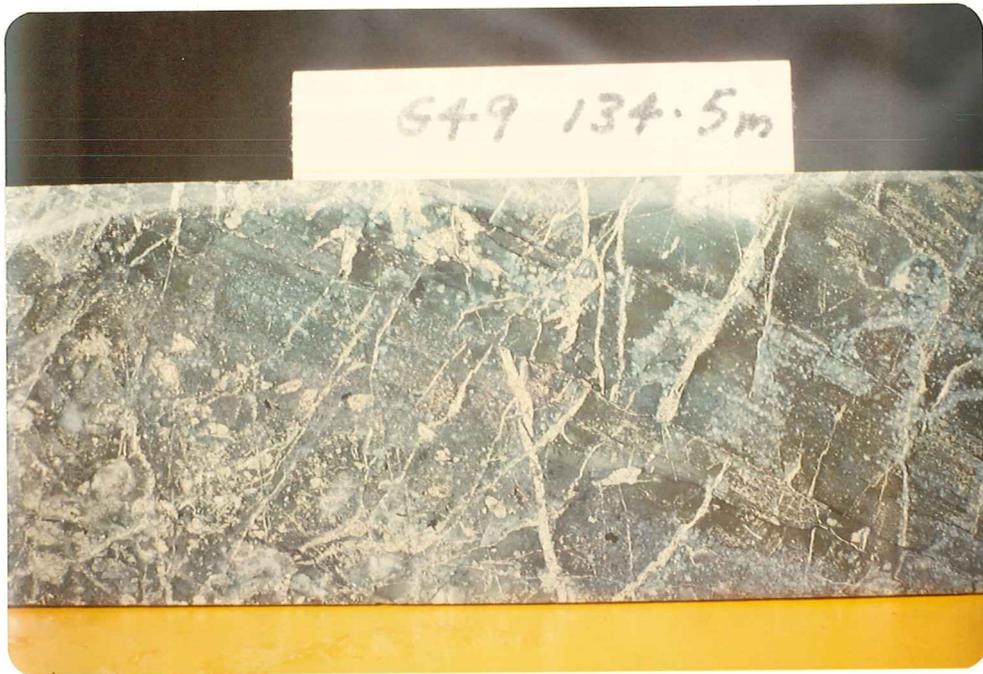one phase of mineralisation. (Sn 1.45%).

Figure 9 G49 134.5 m Fractured bedded pyritic dolomite showing
partial replacement and pyrite vein nettwork. Note blue
colouration due to positive carbonate test reaction.
(Sn 2.1%).

Figure 10   G51 236.4 m Volcanic rock, note preferential
            replacement of pumiceous? fragments by pyrite.
            (Sn 0.1%).
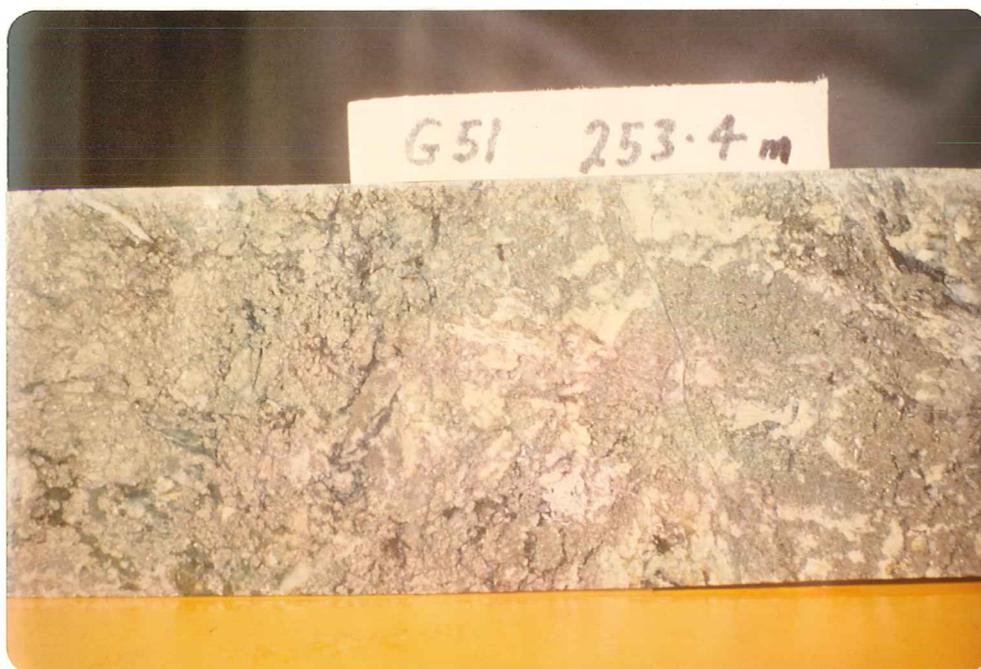

Figure 11   G51 253.4 m Volcanic rock showing more thorough
            replacement. Tuffaceous fragments can still be seen.
            Patches of pale buff-coloured cassiterite are common.
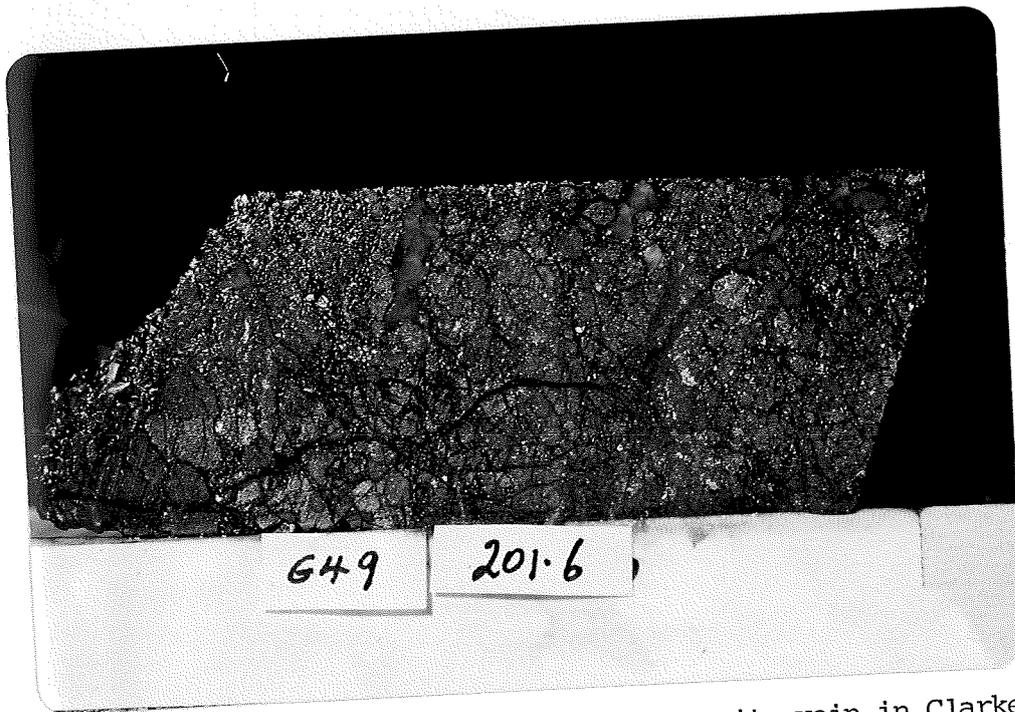   (Sn 2.6%).

Figure 12: G49 201.6 m Coarse grained pyrite vein in Clarkes fault/fissure lode.

Six lodes are recognised in the Queen Hill area and are described below. At least three, Clarkes, Dunkleys and Stormsdown are related to pre-existing faults.

1. Inner Lode

The Inner Lode is associated with a predictable zone of fissure mineralisation which cuts bedded pyrite, carbonaceous shale, siltstone and dolomite at depth and then moves into the volcanics when closer to the surface (Plate QH152). In the July 1979 interpretation, part of the recently named Inner Lode was correlated with the bedded pyrite, siltstone, chert and dolomite exposed in the Queen Hill bench area, and termed the Queen Hill Lens. The current interpretation changes this and the Inner Lode is not considered to be connected with the mineralisation exposed on the bench.

The fissure has no obvious surface expression, strikes 030° and dips very steeply south-east. At 100 RL the fissure has a strike length of approximately 125 m and has a width of 3-5 metres.

The mineralisation associated with the Inner Lode is essentially cassiterite-pyrite in the form of replacement mineralisation and a sulphide vein network, best developed in fractured dolomite adjacent to the fissure vein (Figures 5 and 6). Within the volcanics the mineralisation takes the form of veins and minor replacement. A significant Inner Lode intersection in G11W of 5 m of 0.72% Sn, within volcanics, was recently delineated by the assay of previously unsampled core.

2.   <u>Queen Hill Lode</u>

This is the main cassiterite-sulphide orebody at Queen Hill. In the previous interpretation it was called the Stormsdown Lens because of the inferred connection with an interpreted vertical fault zone called the Stormsdown Fault.

The Queen Hill fissure has a strike length greater than 200 m, strikes at 025° and dips very steeply to the east. However, it is only when in proximity to the intersection with Dunkleys Lode and in the area of the steepening of dip (Plates QH 152 and 153), that a significant orebody is formed. This orebody, developed adjacent to and as part of the fissure lode, consists of replacement and vein network cassiterite-sulphide mineralisation, essentially in dolomites but also in cherts, dolomitic siltstones and in volcanics. On the Queen Hill bench, part of the bedded pyrite, siltstone, chert and dolomite sequence is cut by a dense

network of pyrite veins and is now correlated with the Queen
Hill Lode. The shallower drill intersections of the orebody
(G1 and G3) consist wholly of siliceous sulphide rich breccia
and pyrrhotite is the major sulphide. Elsewhere pyrite is the
dominant sulphide.

The strike length of the orebody is short, varying from 30 to
70 metres and the width varies from 3 to 25 metres. The orebody
plunges 50° toward 045° following the intersection with
Dunkleys Lode for a distance of at least 350 m. The similarity
of strike length to width and the down plunge extension combine
to give the body a pipe like shape.

3.   Clarkes Lode

Clarkes Ag/Pb Lode was initially worked from the Queen No. 4 shaft
for a strike length of at least 100 metres and later from a
crosscut adit. The greatest depth reached by the early workings
was in the Queen No. 2 level, approximately 100 m below surface.
Twelvetrees and Ward (1910) describe the early workings and
Lutley (1975) describes the mineralogy.

The fault/fissure lode strikes approximately 020° and dips 60°
south-east. The strike length is currently interpreted at
approximately 200 m and the average width is 5 m. Drill hole
intersections suggest a steepening of dip with depth (Plate QH152).

Recent detailed mapping at 1:250 scale associated
with the collection of 2 metre spaced channel samples on the
bench at Queen Hill, shows Clarkes Lode to truncate bedded pyrite,

siltstone, chert and dolomite and is thus a fault. As no features indicative of tectonic deformation are observed in Clarkes Lode, the hydrothermal activity associated with the formation of the fissure mineralisation is considered to post date the fault.

Previous interpretation shows the strike of Clarkes Lode to swing to the north-west. There is no evidence for a change in strike, but drill intersections provide strong evidence for a linear structure with a similar dip. This structure was named Dunkleys Lode and appears to truncate Clarkes Lode.

4.   Dunkleys Lode

This is the north-westerly trending fault/fissure Ag/Pb lode which truncates the Inner, Queen Hill and Clarkes Lodes, forming the plunging lode intersection that is the major control for the distribution of cassiterite-sulphide ore.

Dunkleys Lode is linear, with a dip of 55° to 60° to the north-east and a strike length of approximately 200 metres. Mineralisation in Dunkleys Lode is similar to Clarkes but thinner, average width is 2-4 metres.

Dunkleys Lode is thought to be a similar structure to the slides at the Oonah and the Montana No. 1 Mines. Due to lack of exposure it has not been possible to map any displacement associated with Dunkleys Lode but this is inferred because of the apparent truncation of the previously mentioned lodes and the planar relationship of Dunkleys Lode with the volcanics. The upper part of drill hole G52 through which Dunkleys Lode projects was severly broken and there was core loss over a 40 metre interval, this supports the presence of a fault zone.

5.   <u>Stormsdown Lode</u>

The Stormsdown Lode is parallel to Dunkleys Lode, has a similar

dip and is considered to have originated by faulting of the same

style as Dunkleys. The strike length of the lode is approximately

150 metres and the width, including replacement and vein network

mineralisation adjacent to the fault/fissure lode, averages

5 metres.

Lutley describes the mineralisation in the Stormsdown Open Cut

as massive pyritic bands several metres thick and notes that

adjacent to the mineralisation in the Open Cut there is a

mineralised fault zone striking 330°. This fault zone (Figure 5)

is considered to have truncated and fractured a minor sequence of

folded siltstone, quartzite and bedded pyrite and then acted as

the pathway for mineralising hydrothermal solutions to preferentially

replace the most reactive and pre-fractured rocks and thus develop

pods of cassiterite-sulphide mineralisation.

6.   <u>Taylors Lode</u>

This Ag/Pb lode has a similar strike and dip to Clarkes Lode and

similar mineralogy. Drill hole data suggests mineralisation is

not well developed and this is confirmed by the paucity of old

mine workings.

The strike length is close to 300 m and the lode does not appear

to be truncated by Dunkleys or Stormsdown Lodes. This suggests

faulting in Taylors either post dates Dunkley and Stormsdown or

that Taylors is a simple fissure lode formed during the phase of

hydrothermal mineralisation which post dated the faulting.

General Paragenetic Sequence of Mineralisation

Textures observed in both thin and polished section taken from recent drill core suggest the formation of cassiterite pre-dates other minerals, for instance, cassiterite may be observed enclosed by fluorite, pyrite, pyrrhotite, siderite, quartz and sericite. As well, clusters of fine grained cassiterite are cut by quartz, fluorite and pyrite veins.

Rutile, topaz, arsenopyrite, pyrite, tourmaline, apatite and chlorite are observed together with cassiterite indicating early formation. Veins of pyrite, pyrrhotite, stannite, cassiterite, chalcopyrite, sphalerite, siderite and galena indicate a later stage of crystallisation (Figure 13) and veins of quartz, sericite, chlorite and siderite cut all earlier formed veins.

Figure 13:   G49 137 m Late stage sphalerite-galena mineralisation.
               Galena vein with sphalerite selvage cuts cassiterite
               sulphide mineralisation.

The habit of the cassiterite as cloudy, very fine grained crystals suggests formation under low energy, low temperature hydrothermal conditions. This is supported by the presence of anisotropic pyrite with inclusions of arsenopyrite. The association of arsenopyrite with cassiterite suggests arsenopyrite is one of the earliest formed sulphides.

Lutley (1975) considers textural relationships between cassiterite and pyrite indicate much pyrite was probably crystallized before cassiterite but infers there is some overlap. The new data, noted above, supports this inference and Lutleys contention that mineralisation may well have continued over a considerable time interval, i.e. initially cassiterite and then younger stannite-cassiterite mineralisation.

The two phase zonal concept of Waller (1904), Twelvetrees and Ward (1910) and Both and Williams (1968) is not supported by Lutley (1975) nor the recent data. In particular it is difficult to reconcile two phase zonation with the observation that the formation of cassiterite may sometimes pre-date all other minerals.

The two phase zonation described by Williams (1974) is explained by the development of a "cupola", interpreted as a second intrusive phase, emplaced some time after a broad regional zoning had been established around an earlier phase represented by the Heemskirk Granite. This resulted in super-imposition of a second mineralisation (cassiterite-pyrite) on an initially zoned hydrothermal vein system (sphalerite-siderite-galena) and accounted for the presence of cassiterite, wolframite and bismuthinite in the Queen Hill area and for the intermingling of sideritic and pyritic veins. The presence of abundant stannite is also explained, by the reaction of tin bearing fluids and pre-existing sphalerite, in the presence of adequate copper.

Lutley presents convincing textural evidence contrary to the above and considers intermixture of cassiterite-pyrite and sphalerite, siderite and galena veins can be explained equally well by one phase of hydrothermal vein mineralisation in the following way:-

1.   Mineralisation over a considerable time interval.

2.   Local fluctuations in sulphur fugacity.

3.   Variations in the environment of deposition.

4.   Variations in the composition of the introduced hydrothermal
        fluids.

Textures indicating the early formation of cassiterite, observed in the recent drill core, support Lutleys concept of penecontemporaneous formation of the cassiterite-sulphide and silver-lead fissure ores.

Zonation

The spatial distribution of the lodes at Queen Hill is illustrated in Plates QH152 and 153. From the Inner Lode across to Clarkes Lode there is an apparent gross horizontal zonation from cassiterite (G53, 240 m) to stannite and silver-lead (G45, 188 m). Similarly in the vertical sense cassiterite-pyrite mineralisation at depth (G47, 401 m) gives way to mixed cassiterite-pyrite and silver-lead at shallower depths (G49, 136 m). This crude zonation is attributed to variations in the composition of the hydrothermal fluids, the long period of deposition and in particular, changes in the environment of deposition.

On the basis of the broad regional zonation about the Heemskirk Granite, the presence of cassiterite-sulphide mineralisation in the Queen Hill area is markedly anomalous. This zonal anomaly is best explained by the emanation of mineralising hydrothermal fluids from a localised heat source, i.e. a "cupola" situated in the general area beneath Queen Hill.

SEVERN DATA RE-ASSESSMENT

Re-logging of the Severn drill core was completed. Tin mineralisation is related to a pyrite-pyrrhotite vein network in zones of fractured ground and does not appear to favour any particular lithology.

Lithologies noted include quartzite and siltstone of the Queen Hill Quartzite Ridge, thinly bedded slates and quartzites of the Slate-Quartzite sequence and a mixed sequence of tuffaceous greywacke and shale which includes dolomitic siltstone, dolomite, andesitic lavas and tuff, of the lower Crimson Creek Formation.

Preliminary geological interpretation indicates the mineralisation intersected in G39 is fracture controlled and may represent a steeply plunging fault/fissure controlled body.

THE BEDDED PYRITE HORIZONS

Within the Dolomitic Siltstone sequence adjacent to the volcanics, bedded pyrite horizons are commonly developed, ranging from thin bands 5-10 cm, up to well defined horizons 4-5 metres thick, with an average pyrite content of 30-50% but occasionally >70%.

Thin and polished section studies and XRF geochemical data (December 1979 report) demonstrate conclusively that the bedded pyrite is not genetically related to the Queen Hill cassiterite-sulphide mineralisation. In general the pyrite shows a complete lack of tin mineralisation.

The bedded pyrite is commonly very fine grained and framboidal, occasionally with a cherty matrix and can be associated with chert bands up to 15 cm wide, but more often with a silty matrix and associated with siltstone. The other rock types associated with the bedded pyrite horizons are carbonaceous shales, dolomitic siltstones and dolomite. The dolomites have been described as primary chemical sediments (Fander 1979).

It is well known that transitions from volcanic sequences to sediments are typically sulphur rich and it is common for the deposition of pyrite in volcanic environments to be localised within a fault bounded basin, giving rise to an abundance of soft sediment deformation features.

29

The bedded pyrite at Queen Hill exhibits a wide variety of soft
sediment deformation features and these are illustrated below:-

Figure 14: G45 194.7 m. Fine grained bedded pyrite with very
thin chert bands cut by a cassiterite bearing
siliceous pyritic breccia.

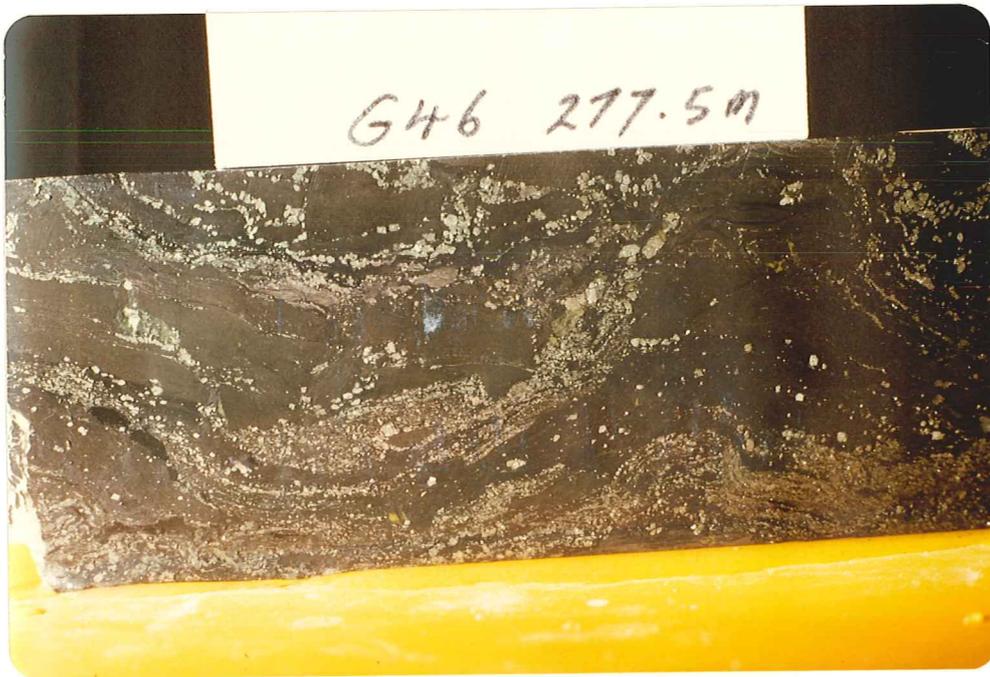Figure 15   G45 196.1 m   Bedded pyrite with a silty matrix.

Figure 16   G46 227.5 m   Bedded pyrite, locally re-crystallised,
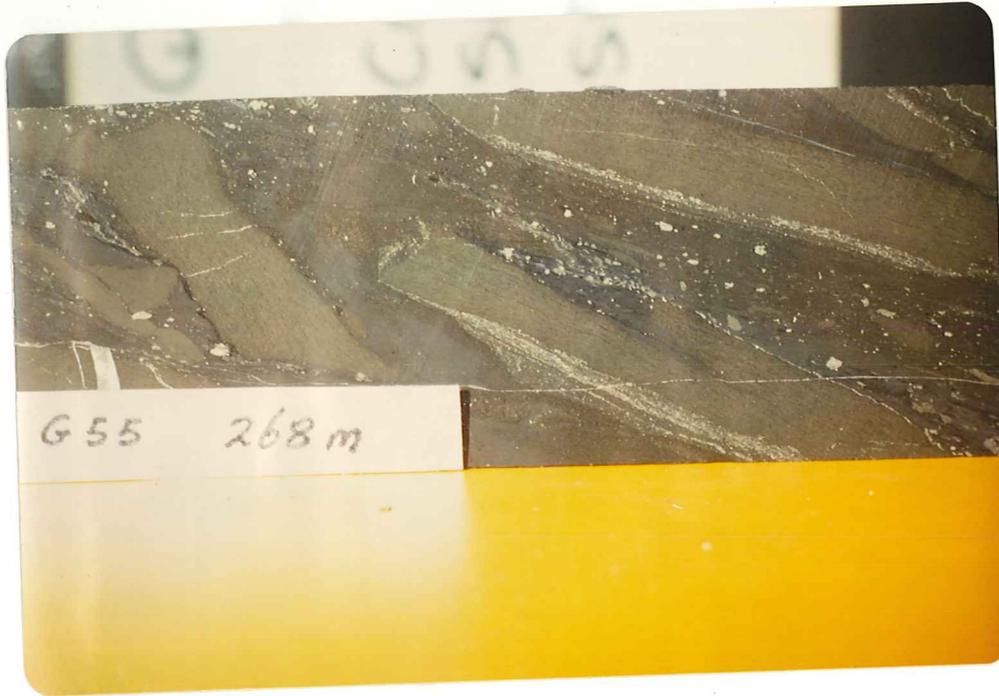showing soft sediment slump features.

Figure 17:   G55 268 m Bedded pyrite showing soft sediment
             rafting and brecciation features.

Figure 18:   G45 236.4 m Bedded pyrite fragments as a major
             component of a sedimentary breccia.

At Queen Hill the following evidence suggests the dolomitic siltstone (bedded pyrite) sequence is related to the volcanics:-

1.   Close association of the sequence to the volcanics. The sequence occurs stratigraphically above volcanics and includes some volcanic fragments.

2.   The development of bedded pyrite with a chert matrix, typical of fumerolic deposition.

3.   Pyrite fragments in the volcanics (G46, 244 m) suggest contemporaneous deposition of pyrite.

4.   Although lacking tin mineralisation the bedded pyrite contains anomalous base metal values. (Lutley 1975) describes sphalerite as very small scattered grains within the bedded pyrite.

CONCLUSIONS

The revised interpretation shows that at Queen Hill ascending mineralising hydrothermal solutions, possibly related to a nearby "cupola", have formed fissure lode mineralisation, including cassiterite-sulphide mineralisation, localised in pre-existing faults. The maximum development of cassiterite-sulphide ore occurs where north to north-east and north-westerly trending faults intersect, and the intersection coincides with reactive rocks such as dolomite or carbonated volcanics. The resulting orebody follows the fault/fissure lode intersection and has a steep plunge and a pipe like shape.

At Severn immediate exploration potential is thus recognised. The intersections in G39 (5.65 m of 1.95% Sn) and G20 (6.1 m of 1.57% Sn), the association of known fissure-lode mineralisation and reactive rocks indicate the potential for steeply plunging orebodies similar to those at Queen Hill.

Signed by: _____

C.H. YOUNG
DISTRICT MANAGER

REFERENCES

Blissett, A.H.   (1962)   Geology of the Zeehan Sheet.
                                        Explanatory Rep. Geol. Surv. Tasm.

Both, R.A., and   (1968)   Mineralogical zoning in the lead-zinc
Williams, K.L.   ores of the Zeehan field, Tasmania.
                                        Part 1. Introduction and Review, Part 11.
                                        Paragenetic and zonal relationships.
                                        J. Geol. Soc. Aust.

King, D.   (1961)   A statistical and geological review of
                                        the Zeehan silver-lead mines, West
                                        Tasmania.

Lutley, W.M.   (1975)   Cassiterite-Sulphide Mineralisation at
                                        Queen Hill, Zeehan, Western Tasmania.
                                        M.Sc. Thesis Department of Economic
                                        Geology, University of Adelaide.

Twelvetrees, W.H. and   (1910)   The Orebodies of the Zeehan Field.
Ward, L.K.   Bull. Geol. Surv. Tasm.

Waller, G.A.   (1904)   Report on the Zeehan Silver-Lead Mining
                                        Field. Rep. Dep. Mines Tasm.

Williams, K.L.   (1974)   Compositions of Sphalerites from the
                                        Zoned Hydrothermal Lead-Zinc Deposits
                                        at Zeehan Tasmania. Econ. Geol.
                                        69, 657-672.

Young, C.H.   (1979)   Progress Report Queen Hill Joint Venture
                                        E.L. 47/71 Tasmania.
                                        Quarter to September 30, 1979.

_____   (1979)   Progress Report Queen Hill Joint Venture
                                        E.L. 47/71 Tasmania.
                                        Quarter to December 31, 1979.