

1987/08. Prospecting for heavy minerals in the Fingal Valley

V. M. Threader

Abstract

A proline auger survey and churn drilling programme was carried out in an area on the south-east slope of the Ben Lomond granite mass, near Avoca, to evaluate the detrital mineral content of alluvial sediments. A structural/geomorphological model was formulated from available information. There is insufficient evidence on which to base an assessment of the detrital mineral content of the sediments.

INTRODUCTION

The New Henbury tin mine is situated on the south-east slope of the Ben Lomond granite mass, adjacent to the 'Aberfoyle' homestead road which joins the Esk Main Road about 5 km north-east of Avoca in north-eastern Tasmania.

A proline auger survey was conducted over three kilometres along the pediment of the Ben Lomond granite, and onto adjacent terraces and the flood plain of the South Esk River, to evaluate the detrital mineral content before allowing aggregate mining by the local Municipal council.

A churn drilling programme was also carried out to test the deeper ground of the alluvial plain.

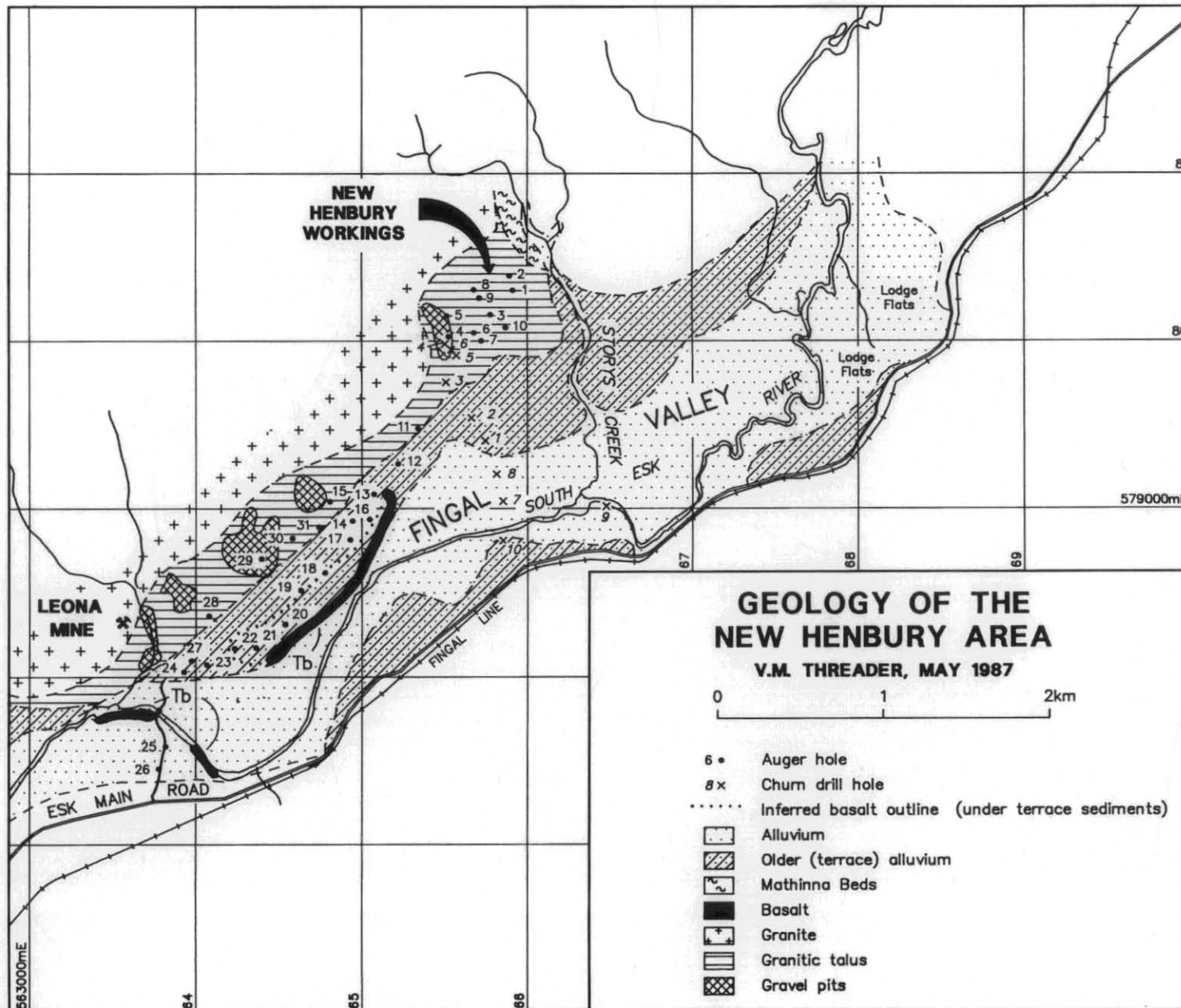
This report presents the results of this exploration and presents a conceptual structural model of the South Esk Valley upstream as far as Mathinna, in an attempt to identify future exploration targets.

GEOLOGY

The basement rocks of this area are the Mathinna Beds sequence of quartzwacke and phyllite, which are exposed in cuttings along the Esk Main Road. These rocks also crop out by Storys Creek and Aberfoyle Creek, where they are hornfelsed by contact with the Ben Lomond granite. Hornfelsed Mathinna Beds also underlie the alluvial sediments of the valley, and were intersected in several of the boreholes (section A-B, fig. 4). The Ben Lomond granite occupies the north-west margin of the terraces and alluvial plain of the South Esk River.

The detrital mineral content of the granitic colluvium and alluvial sediments are the subject of this investigation.

Minor basalt outcrops which occur in the valley probably constitute the furthest upstream tip of the basalt flows which occur extensively around Avoca. The possibility that the basalt occupies old channels containing alluvial cassiterite and/or gold should not be overlooked, and the presence of basaltic fragments in Bore Holes P17-22 indicates the lateral extent of the flow. Drilling at New Henbury has proven a thickness of 70 m of alluvium, and samples collected at 40 m in BH1 and 60 m in BH10 have been assigned to the Lower or Middle *Nothofagidites asperus* zone by S.M. Forsyth (pers. comm.), which is of middle to late Eocene age (Partridge, 1973; Stover and Partridge, 1973).



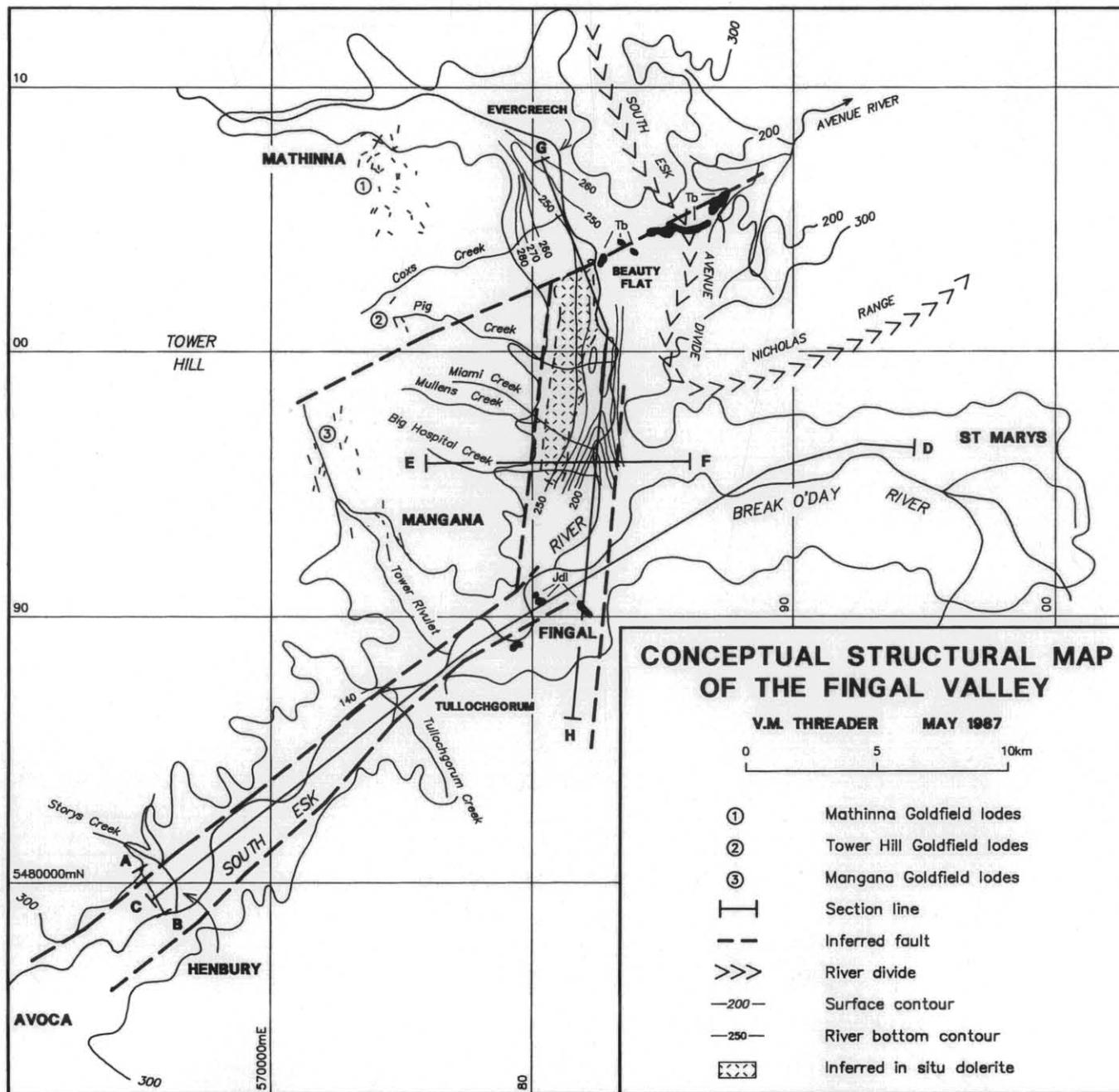


Figure 2

5 cm

HISTORY OF THE ALLUVIAL TIN FIELD

Alluvial mining dates back to the 1880s in Storys Creek and Rosier Creek (south-west corner of Figure 1), and is therefore as early as any mining activity on the Ben Lomond granite.

100 000 tonnes of alluvial tailings were reported to be dumped in Gilligan Creek from the Leona Mine and 20 000 tonnes in a creek which ran through the southernmost lease 108P/M on the New Henbury property, where 3.0-4.6 m of granitic detritus overlay 2.4 m of cemented gravel which rested on granite.

Reid and Henderson (1929) state that:

- (1) This mine produced 14 tonnes of cassiterite and the average grade was 0.445 kg/m³.
- (2) Four test pits were sunk over an area of 200 acres (80 ha) with the following results:

Test Pit no.	Soil depth (m)	Thickness of drift (m)	Value of Tin (kg/m ³)
1	2.4	2.1	1.056
2	2.4	3.05	0.558
3	1.2	6.1	0.546
4	1.2	6.1	0.587

The weighted mean of these values is 4.27 m of drift at 0.623 kg/m³.

- (3) A 16 m shaft was sunk in older gravel near the north end of the block. This intersected:

- 6.7 m shingle (boulders up to 0.3 m)
- 0.03 m limonite
- 3 m clay
- 0.9 m granitic drift

Test pits 2 and 3 above appear to have been sunk on older terraces on the alluvial plain, and not on the mineral leases. If this is so then it is inexplicable that such rich alluvial ground should have been left unmined.

In the Rosier Creek workings 2.1 m of granitic detritus overlay 2.4 m of coarse gravel with a granite bottom.

There has been no mining in this field for many years and there are no details of the localities of the high-grade alluvial ground reported by Reid and Henderson (1929).

PROLINE DRILLING

Twenty-nine auger holes were drilled along 3 km of the pediment between New Henbury and Leona, and two additional holes (25 and 26) were drilled on the flood plain.

Most of these holes were drilled into sandy clay of granitic origin, either as colluvium or weathered granite *in situ*. Several holes passed from material of granitic origin (Holes 1-16, 28, 29) to a mixture of quartz and hornfels, indicating admixture of alluvial material from Storys Creek and beyond (Holes 17, 21, 25, 26). Holes 18 to 22 were difficult to drill because of the prevalence of basaltic fragments, and this area is obviously underlain by the basalt which crops out on the nearby terrace edge.

The proline samples were all screened but no detrital mineral content was observed, and it is considered that cassiterite is only present in the alluvial fans of Rosier, Gilligan and New Henbury Creeks and not in the colluvium.

Only three holes contained useful aggregate:

- Hole 11 had 1.8 m of sand containing 9% of -75 μ m material
- Hole 13 had 4.5 m with 16% of -75 μ m material, and
- Hole 15 had 5.5 m with 13% of -13 μ m material.

Holes 13 and 15 would be worth resampling at smaller intervals.

The top 0.5 m of the colluvium is extensively mined for road making material by both the Department of Main Roads and the Fingal Municipality. This layer is clay leached and so is usable for this purpose but below this level the fines content is too high for use as road aggregate.

The shallow depth of usable aggregate has resulted in the stripping of large areas. There has been no attempt to rehabilitate the stripped areas and the stripping process is continuing.

The only other usable aggregate is derived from the Leona and New Henbury mine tailings, which are completely free of clay and are suitable as concrete aggregate. The supply of this material is limited.

CHURN DRILLING

A line of holes was drilled across the valley over a distance of 1400 m (Section A-B, fig. 4). This drilling was preceded by a seismic and gravity survey (Richardson, 1986) as an aid to selection of borehole sites.

A boulder bed was intersected in all but three holes at depths from 16 m to 40 m. It was not possible to drive the casing without splitting it on boulders, and the holes were abandoned. Holes 1, 3, 4 and 9 were deepened to bedrock by diamond drilling.

Clayey sediments predominate in the sequence and detrital minerals were either in sub-economic concentrations or absent altogether.

Assay results are shown in Figure 3 (see also Appendix 3), and in general would be about 10% of economically workable ground. The best values obtained were in BH1 at depths of 34 m to 40 m. Such depths would present considerable practical problems, even if the grades were attractive.

Samples collected from BH1 at 40 m and BH9 at 60 m have been dated as middle to late Eocene, and the valley has therefore had a long history of apparently relatively slow deposition. The sedimentary environment is obviously not one in which large concentrations of detrital materials can be expected, and this is borne out by the results which have been obtained.

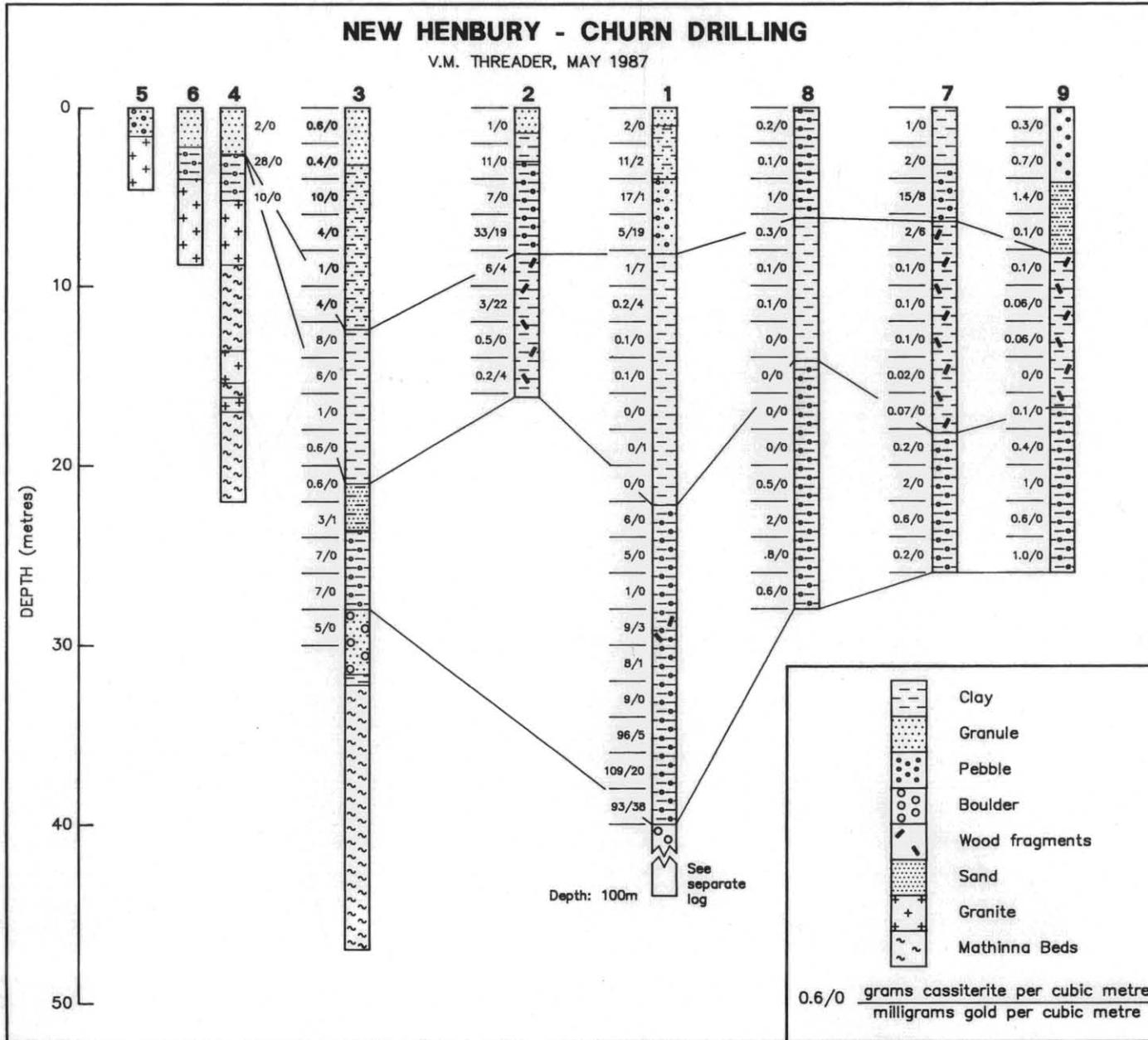
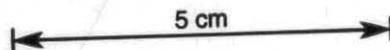


Figure 3



DRILLING OF THE ALLUVIAL SEDIMENTS, SOUTH ESK RIVER - NEW HENBURY PROJECT

V.M. THREADER, MAY 1987

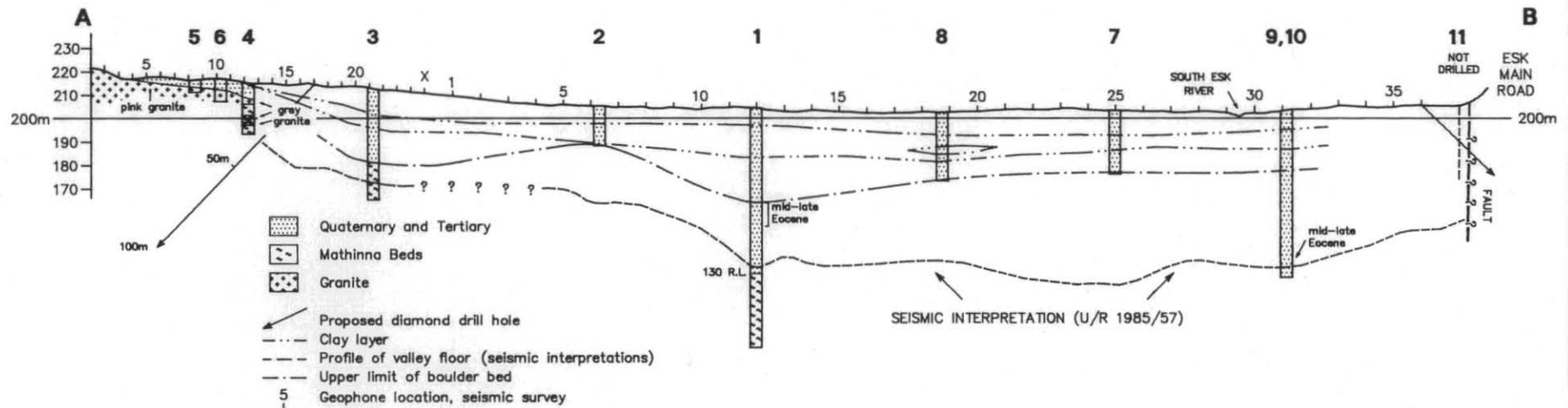
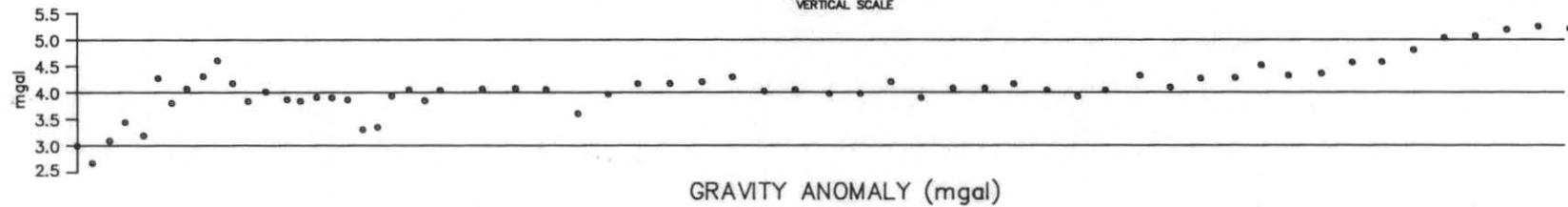
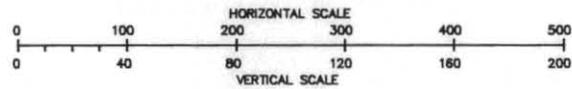
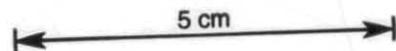


Figure 4



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PREVIOUS EXPLORATION

Krause (1883) conducted a drilling programme across the South Esk River at Tullochgorum (Appendix 4) in which nine holes totalling 436 m were drilled, the deepest being 71 m. Krause's report contained a drawn section (fig. 6) but no map and so the exact locations of the holes are not known. Krause was confident of finding rich alluvial ground from 'Black Boy' to 'Corners' (Mathinna to Conara). There were no assay values in the report and no alluvial mining ensued, and so it is apparent that his expectations were not realised.

Krause (1883) and Thureau (1885) (Appendix 4) considered the South Esk 'deep lead' to be of Miocene age and therefore to be highly prospective for alluvial gold, as are similar buried watercourses in other parts of Australia and America. Presumably this is related to changes of sea level on a global scale which would affect energy levels in drainage systems. Vail *et al.* (1977) state that the sea has dropped from a high point during Late Cretaceous times of 350 m above present level. Superimposed on this trend are cycles of the second and third order but the overall trend through Tertiary times was a global fall of around 300 m.

A middle to late Eocene age for these sediments, as determined by Forsyth (pers. comm.), indicates that the South Esk sediments were deposited during a period of high sea level, and therefore in a lower energy environment than the Miocene auriferous drifts which Krause and Thureau were expecting. The results of this exploration support this view but local geological structure must also have had an influence on the deposition.

Australian Anglo American Limited carried out an exploration programme in the South Esk valley between Mathinna and Fingal during 1981-82. They found that a moderately high energy environment existed in the valley north of Beauty Flat, where 6 m of sand and gravel with an average gold grade of 30 mg/m³ was deposited (Mellor, 1982).

To the south, there was a change to a thick sequence of clayey sediments containing authigenic sulphides and carbonaceous matter. Over a distance of 12 km these sediments thickened to 50 m just north of Fingal, with a conglomerate of quartz and dolerite at the base. Gold values in this sequence were much lower than in the northern part.

Separating these two areas was a basement high with dolerite outcrop on the west river bank, and a line of basalt outcrop on the east bank. It is suggested here that a fault with both vertical and strike slip displacement passes through this point.

DISCUSSION

As the thickness of alluvium is only a few metres in the Break O'Day valley and about 70 m in the Fingal Valley, there is clearly a buried escarpment at or near Fingal which would suggest a north-south fault with downthrow to the west (fig. 5, Section C-D).

There is an apparent continuity of sediment type and thickness extending from Beauty Flat through Fingal and Tullochgorum to the New Henbury area.

SECTIONS THROUGH FINGAL VALLEY

V.M. THREADER, MAY 1987

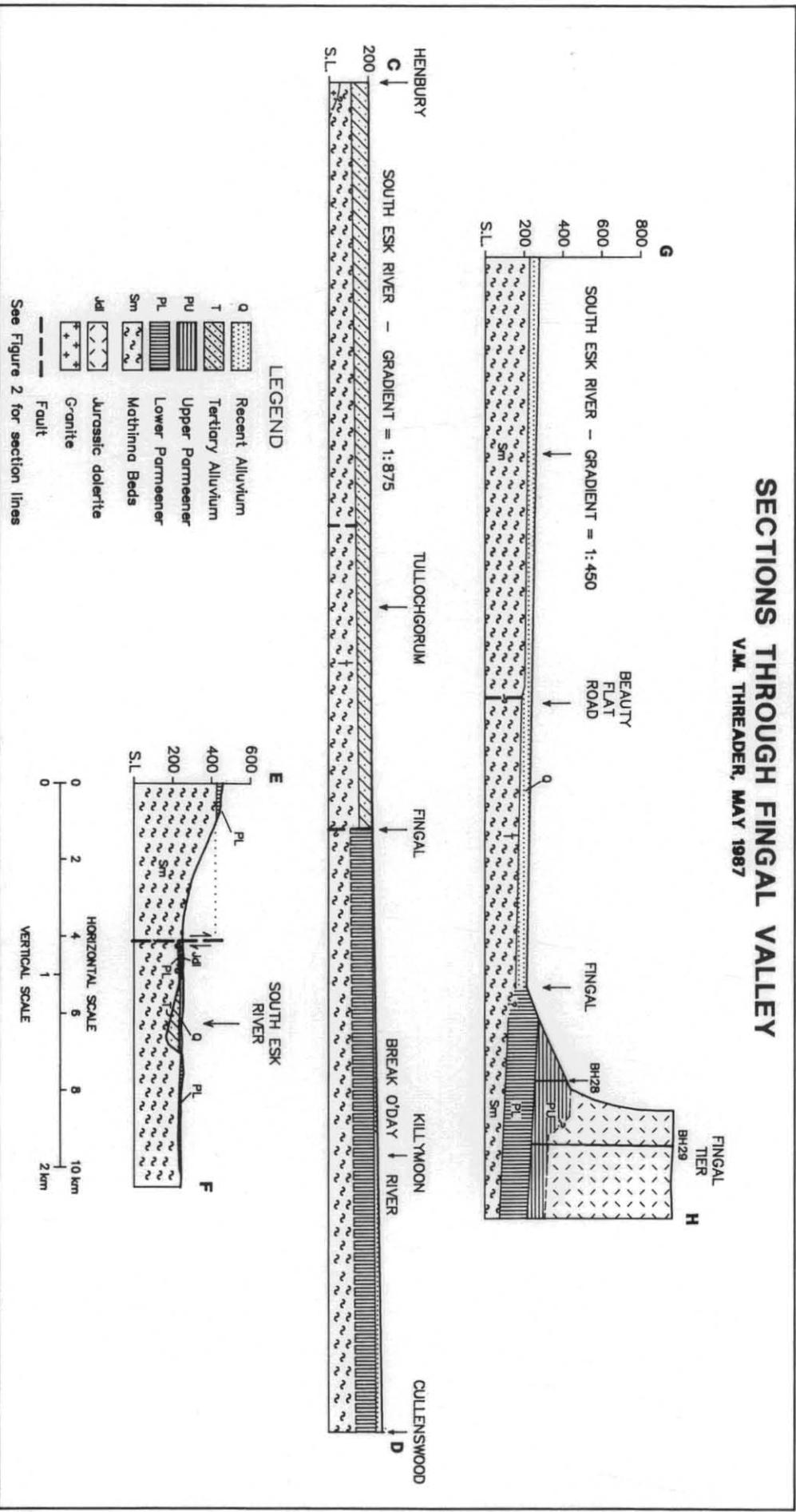


Figure 5

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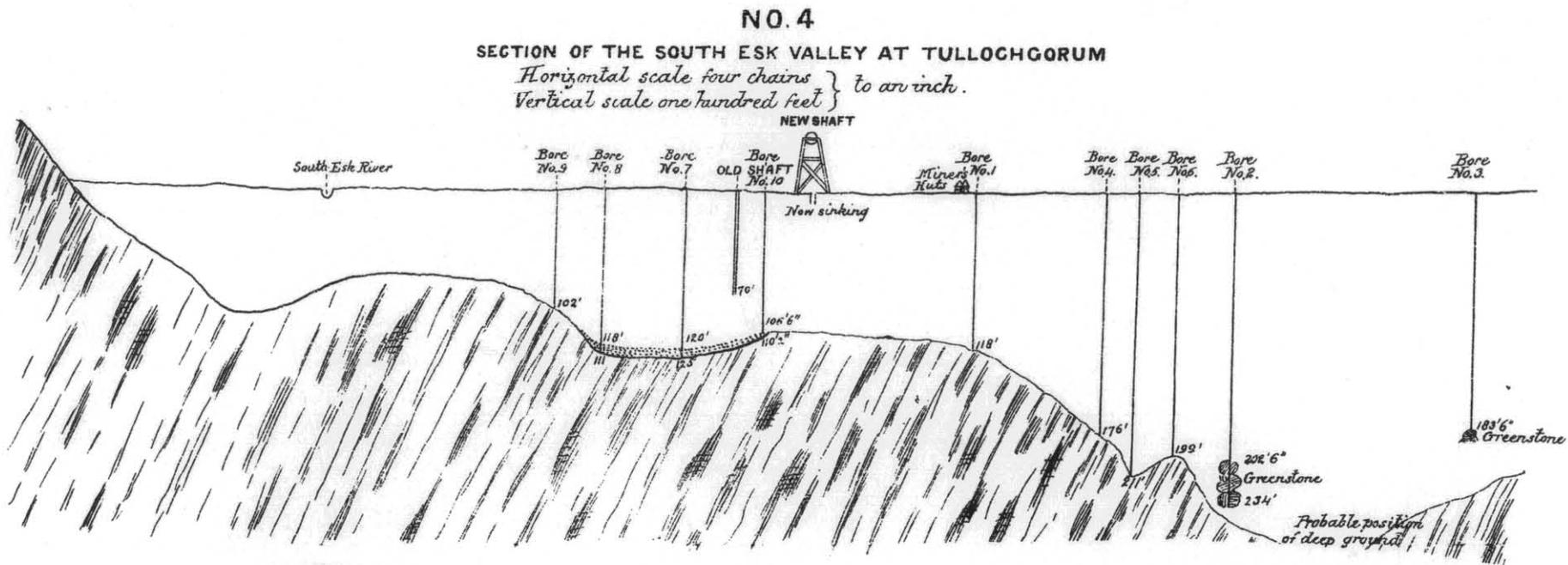
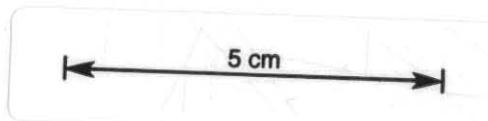


Figure 6. (From Krause, 1883)



This is consistent with the high Eocene sea level as already discussed but there is also evidence for contributory factors:

(1) Dolerite at Llewellyn, 13 km downstream from Avoca, could have acted as a barrier, causing a temporary damming of the South Esk River with a consequent build up of sediments upstream. As the subject area is only a few kilometres above Avoca, it would have been affected.

(2) Between Fingal and Avoca there is an alignment of truncated interfluvial spurs on the banks of the South Esk River which have the appearance of being fault controlled. The presence of boulder beds in the Tertiary sediments at Henbury (this exploration), Tullochgorum (Krause, 1883), and Fingal (Mellor, 1982) are suggestive of mass movement consequent on scarp retreat and thus support the view that this section of the river is bounded by faults and is in fact a graben.

(3) Masses of dolerite on the alluvial plain between Fingal and the Beauty Flat road could also have been derived by scarp retreat but their localised distribution is suggestive of being *in situ* sheets, which would indicate that they rest on or above the Mathinna Beds/Parmeener unconformity. The western boundary of this body of dolerite is then the likely location of a N-S fault, accounting for a 200 m displacement (downthrow to the east) between the Tower Hill and Nicholas Range blocks.

(4) The 6 km line of basalt outcrop north of Beauty Flat is either a valley infilling or a fissure eruption; in either case, this trend could be of structural significance and it is noted that it parallels the inferred graben faults of the Fingal Valley.

When this trend is continued westwards into the Tower Hill block, a 5 km sinistral strike slip movement can be inferred between the Mathinna and Mangana goldfields.

A point of interest here is that the inferred fault lies along a tributary of the Avenue River, which has an eastwards gradient of 1:75 to the east coast at Scamander whereas the South Esk River at this point has a gradient towards Fingal of 1:450 and from Fingal to Avoca of 1:850. With headward erosion of the Avenue River around ten times that of the South Esk River, it is apparent that capture of the South Esk above the Beauty Flat Road is imminent.

The 300 m contour is included on Figure 2 to illustrate the widening of the valley eastwards, which suggests drainage reversal and the possibility that the South Esk River originally flowed into the sea at either Falmouth or Chain of Lagoons. The cause of such reversal may have been the elevation of the Tower Hill block and the formation of the Fingal Valley graben. Such an event would account for the thinness of alluvium in the Break O'Day valley, as rejuvenation consequent on faulting would have caused flow reversal and stripped much of the alluvial cover, depositing it in the South Esk valley at or west of Fingal.

Prior to the uplifting of the Tower Hill block it is conceivable that the South Esk River flowed along a line continuous with the Dorset River/Dan Rivulet lineament through Mathinna and Mangana to the Tower Rivulet and the Fingal Valley.

Detrital gold which was shed from these goldfields and transported down Tower Rivulet is likely to have been deposited before the waters reached

the Fingal Valley because of retardation of stream velocity on entering a quieter regime. Consequently the coarser gold particles would have been deposited upstream and only the finest particles would have reached or entered the valley.

Redistribution of gold would occur during periods of flood but this basic pattern of gold occurrence should still exist.

Similarly, cassiterite placers could be expected in alluvium associated with Storys Creek before it enters the valley.

No records can be found of any exploration in these two areas, which must therefore be considered as prime targets for investigative geophysics and drilling.

EXPLORATION TARGETS

An interesting sulphidic rock intersected at 85 m in New Henbury BH1 and described by Bottrill (Appendix 2) merits further investigation. This hole was stopped at 100 m in hornfelsed Mathinna Beds. Deepening of this hole to intersect the granite contact could provide additional information on this mineralisation, on the nature of the contact and, as the bedding is nearly horizontal, would also be useful stratigraphically, considering that the sequence in the Mathinna Beds is so little known.

ALLUVIAL PROSPECTS

Seismic profiling of the Storys Creek and Tower Rivulet valleys upstream of the inferred graben fault is proposed as a means of testing the theory that a more favourable depositional environment for heavy minerals exists in these areas. This could be followed by drilling and sampling if justified by the seismic results.

The last hole (11) of the New Henbury programme (fig. 4) should be drilled to complete the section. The proposed site lies close to the edge of the valley, with a steep rise to the south. A buried channel is therefore likely to be found here.

In addition to these exploration targets, two angle holes are proposed as indicated on Section A-B (fig. 4). These holes would probably be no deeper than 50 m but would provide very useful data. The westerly hole is sited to determine the position of the granite boundary and the nature of the granite/Mathinna Beds contact. If, as suggested, this is a fault boundary, then the alluvium of Storys Creek and Tower Rivulet would be more prospective for detrital minerals. The easterly borehole is sited to examine the trough margin, which is also suggested as being fault-determined, as shown on this section.

CONCLUSION

There is as yet insufficient evidence on which to base an assessment of the detrital mineral content of the Fingal Valley.

The structural/geomorphological model has, as its objective, the identification of future exploration targets as outlined above. Much of the model has already been presented by the writer (Threader, 1968) and is supported in subsequent work by Legge (1968) and AAC (Mellor, 1982).

Current regional mapping programmes by Calver and Gulline in this area can be expected to clarify some of the points raised in this report.

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[13 October 1987]

APPENDIX 1

**Seismicity and gravity surveys in the New Henbury
area near Avoca**

by R.G. RICHARDSON

(UNPUBLISHED REPORT TASMANIA DEPARTMENT OF MINES 1985/57)

1985/57. Seismic and gravity surveys in the New Henbury area near Avoca

R.G. Richardson

Abstract

Three reversed seismic refraction spreads and a set of gravity readings along the seismic lines showed that the alluvial sediments vary in thickness from zero near the New Henbury tin mine to approximately 70 m near the South Esk River.

INTRODUCTION

At the request of V.M. Threader of the Economic Geology Section, the seismic refraction and gravity methods were used to determine the depth of the alluvial sediments in the New Henbury area of the South Esk River valley [EP660790]. Three reversed refraction spreads were recorded and interpreted using the reciprocal method (Hawkins, 1961). A 15 m geophone interval was used for Spread 1 and a 30 m geophone interval was used for Spreads 2 and 3. The northern end of Spread 1 (fig. 1) was located on granitic outcrop.

The gravity value was measured at each geophone position and corrected to a uniform height datum using a Bouguer density of 2.67. This corresponds to a correction of 0.197 mgal per metre. No terrain or latitude corrections were made.

RESULTS

Figure 2 shows the gravity anomaly, the ground surface and the base of the alluvial sediments as shown by the seismic refraction data.

The velocities and depths based on the critical distance formula are as follows for each spread:

Spread 1

15 m geophone spacing
End shots 15 m north of geophone 1 and 15 m south of geophone 24.

V₁ = 1650 m/sec
V₂ (northern end) = 7140 m/sec
V₂ (southern end) = 4080 m/sec
Depth from centre shot 11-16 m
Depth from south end shot 39 m

The differing V₂ velocities and a sudden reduction in arrival amplitudes near the centre of Spread 1 suggest that there is a fault near this point, with granite shallowing to the north on the northern side and a different rock type (probably Mathinna Beds) deepening to the south.

Spread 2

30 m geophone spacing
End shots 30 m north of geophone 1 and 30 m south of geophone 24.

V₁ = 1610 m/sec
V₂ = 5160 m/sec
Depth from centre shot 63 m
Depth from north end shot 40 m
Depth from south end shot 75 m

Spread 3

30 m geophone spacing

End shots 30 m north of geophone 1 and 30 m south of geophone 24

Long shots 230 m north of geophone 1 and 230 m south of geophone 24

Geophone 1 of Spread 2 is in the same position as geophone 12 of Spread 2.

$V_1 = 1580$ m/sec

$V_2 = 5000$ m/sec

Depth from centre shot 60-62 m

Depth from north end shot 72 m

Depth from south end shot 72 m

The position of the base of the alluvial sediments was then calculated from the data of all three spreads using the reciprocal method. The uncertainty in depth is no more than $\pm 10\%$.

The gravity traverse shows a steep increase in values to the north of the inferred fault, but then remains almost flat until the base of the alluvial sediments starts to shallow at the southern end of the line. The normal increase in gravity value with increasing latitude is counteracted by the deepening of the base of the alluvial sediments.

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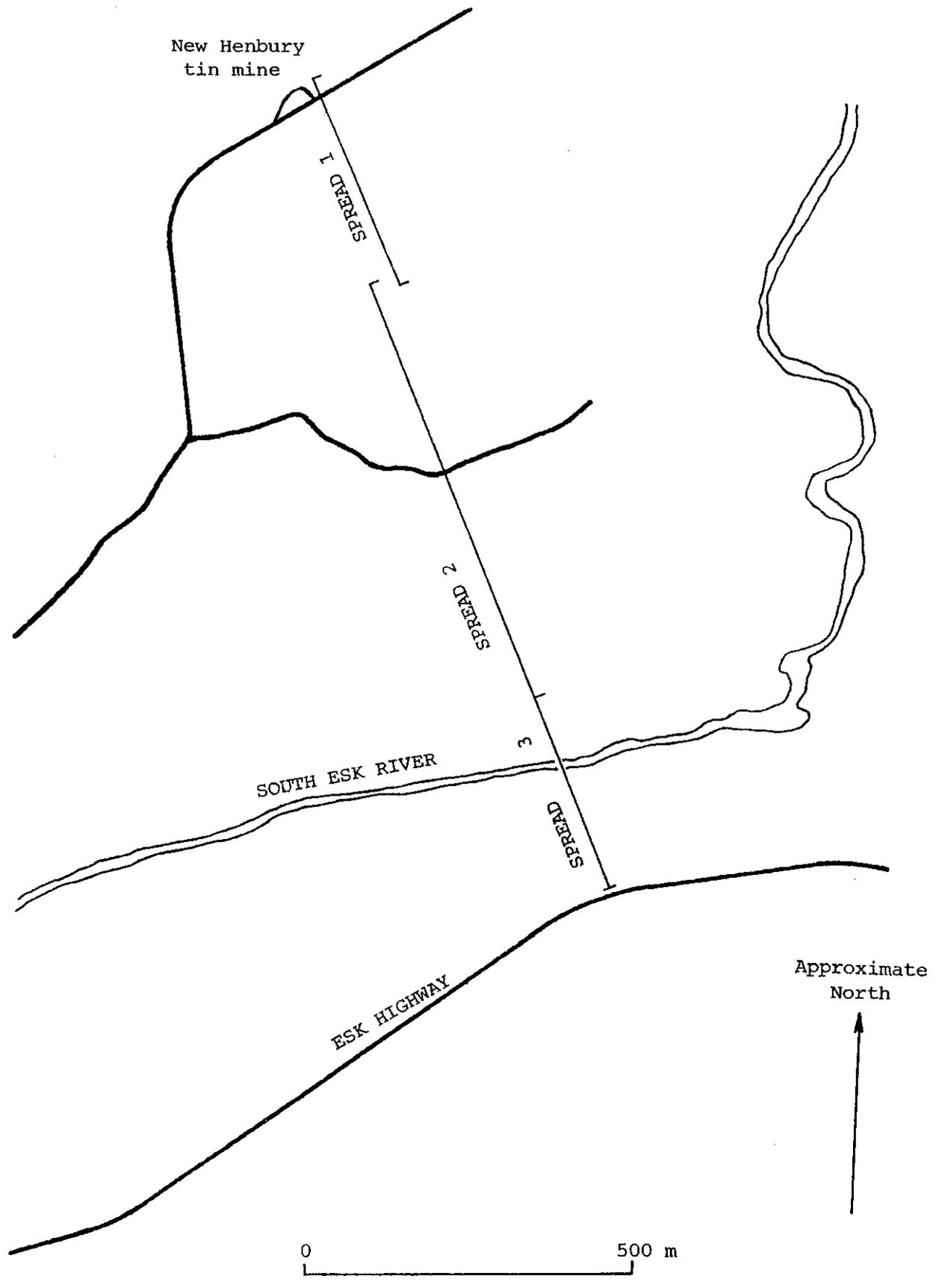
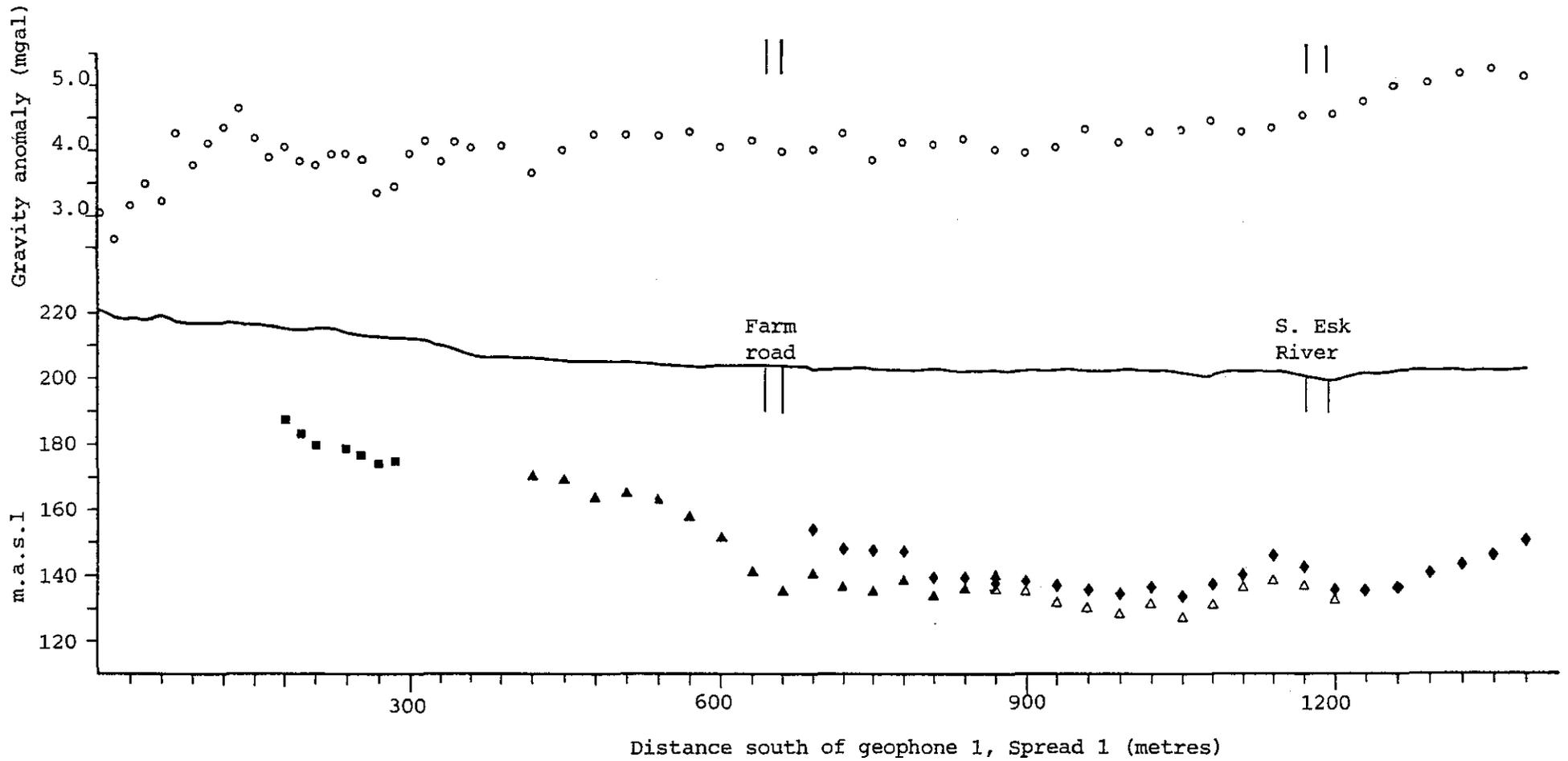


Figure 1. Location of seismic spreads

5 cm

81-18



Base of alluvial sediments from:

- Spread 1 end shots
- ▲ Spread 2 end shots
- △ Spread 3 end shots
- ◆ Spread 4 long shots

5 cm

Figure 2. Gravity and seismic profiles

APPENDIX 2a

**The petrology and mineragraphy of some New Henbury
samples**

by **R.S. BOTTRILL**

(UNPUBLISHED REPORT TASMANIA DEPARTMENT OF MINES 1986/75)

1986/75. The petrology and mineragraphy of some New Henbury samples.

R. S. Bottrill

Abstract

Samples described include panned concentrates, Devonian alkali granites, and Mathinna Beds sandstones. The concentrates contain cassiterite, gold, authigenic pyrite, and metallic lead. The sandstones are feldspathic quartzwackes with minor disseminated base metal sulphide mineralisation, and one is largely altered to epidote and montmorillonite.

INTRODUCTION

The following samples were collected by V. M. Threader at New Henbury, near Avoca, and submitted for petrography and mineragraphy. Sample locations are described by Threader (1987).

Sample No.	Borehole	Depth (m)	Description
C100040	BH2	0-6	1st Riffle
C100041	BH2	0-8	2nd Riffle
C100042	BH2	6-8	1st Riffle
C100043	BH2	0-8	3rd Riffle
C100044	BH1		Pb metal
C100045	BH1		Pan concentrate - Lab No. 85101
C100046	BH1		Pan concentrate - Lab No. 85106
C100047	BH1		Pan concentrate - Lab No. 85111
C100048	BH1		Pan concentrate - Lab No. 85116
C100066	BH1	85	?Mathinna Beds sandstone
C100067	-		Granite -1 (Storys Creek)
C100068	-		Granite -2 (outcrop near New Henbury mine)
C100069	BH4	13.6	Granite/Mathinna Beds contact
C100070	BH4	14.2	Granite
C100071	BH4	15.3	Mathinna Beds
C100072	BH5	4.51	Granite
C101401a	BH1	100	Mathinna Beds sandstone
C101401b	BH1	84	Mathinna Beds sandstone
C101416	BH9		Pyrite

PANNED CONCENTRATES: C100040-48

The mineralogical constitutions are summarised in Table 1, with the exception of C100044 which is described below. Quartz, pyroxene, siderite, pyrite and zircon are the major constituents of all but the latter sample. The first three of these minerals are relatively low in specific gravity and their presence is variable and largely dependent upon sample preparation.

Siderite occurs as small hollow spheres (commonly containing very fine pyrite) or crystalline aggregates and is probably of authigenic origin in

Tertiary sediments. Pyrite and marcasite occur mainly as aggregates (colloform, radiating and framboidal) and euhedral crystals, also indicating an authigenic origin. Some anhedral pyrite may, however, be detrital. Rock fragments and magnetite are commonly pyritised, and marcasite is commonly overgrown or replaced by pyrite.

Sphalerite is subangular to rounded and is presumably detrital, but the arsenopyrite is quite angular and may represent contamination. Cassiterite is relatively coarse and subangular, suggesting a nearby primary source.

Several gold grains were detected, most being in C100041. These are typically quite flaky, 0.1 - 1 mm in size, and some are attached to quartz and limonite. Probe analyses of one grain are listed in Table 2.

Zircon is bimodal (well rounded and euhedral), tourmaline is green, blue and brown, and ilmenite is variably altered to leucoxene and hematite.

Various metals, rust and other probable synthetic phases are very common and often abundant, but were omitted from Table 1.

PYRITE: C101416

This sample consists of quartz sand and colloform aggregates of pyrite. The pyrite exhibits three growth stages: framboids (not in the cores of all aggregates); fine-grained and rapidly tarnishing pyrite; and overgrowths of medium-grained pyrite, some exhibiting cubic morphology. Some are attached to quartz grains, and probably formed authigenically in sandy Tertiary sediments.

LEAD METAL: C100044

Sample C100044 contains lead metal grains, handpicked from the concentrates by L. Rhodes. These grains are up to 1.5 mm in size, and contain inclusions and attachments of quartz, pyrite and several unidentified phases. Some of the quartz and pyrite could conceivably have been 'pressed' into the very soft lead metal, but the unidentified phases require further study to help determine the origin of this material.

GRANITE: C100067-70, C100072

These samples are typical of the alkali granites in the area (McClenaghan and Williams, 1982), and only a summarised description is given below.

K-feldspar (perthite): (dominant)

Phenocrysts 4-12 mm (up to 25 mm in hand specimen), subhedral to anhedral, with abundant fine inclusions (including sericite and hematite). Some exhibit microcline twinning but most have only simple twins. Zones and patches of graphic quartz are common. Some grains appear to contain more plagioclase than orthoclase, probably due to late stage albitisation.

Quartz: (subdominant)

Bimodal in size (0.5-7 mm), some forming graphic intergrowths or euhedral inclusions in perthite. Patches of fine quartz near the contact (C100069) appear to derive from Mathinna Beds sediments. Coarser quartz is usually anhedral, with undulose extinction, and often occurs as rounded aggregates.

Plagioclase: (subdominant)

Albite (Ab₀₋₅) is euhedral, bimodal (0.2-5 mm, rarely as phenocrysts up to 12 mm in C100170), with cores especially rich in inclusions (principally sericite). The finer albite and inclusion-free zones probably relate to late stage albitisation.

Biotite: (accessory)

Anhedral to euhedral, 0.5-3 mm, variably altered to fine-grained hematite and/or chlorite and/or muscovite or tourmaline. Zircon, opaques, epidote, fluorite, anatase and unidentified fine inclusions giving pleochroic haloes, are usually associated, especially in C100068. Red-brown to green-brown, probably annite.

Tourmaline: (absent to accessory)

This is present in C100069 and 70 as anhedral grains, 0.1-1 mm, typically replacing biotite and interstitial to feldspar and quartz. It is mostly brown but varies from red-brown to blue-green. Some skeletal crystals appear to replace feldspar.

Muscovite: (trace)

This is present in most samples as sporadic coarse flakes (up to 1.5 mm) as well as the fine sericite in feldspar. Most coarse muscovite replaces biotite or, rarely, feldspar (C100072).

MATHINNA BEDS

C100069

This sample contains hornfelsed Mathinna Beds sediment in contact with granite. Quartz (up to 1 mm) and K-feldspar (up to 0.2 mm) are codominant, with subdominant biotite (to 0.1 mm) and plagioclase (to 0.2 mm), and trace muscovite, opaque minerals and zircon. Most muscovite is intergrown with feldspar and biotite, and may indicate both primary and retrograde formation.

C100071

This is a hornfels similar in composition to the above but shows sedimentary layering, represented by layers rich and poor in biotite, and coarser quartz in some layers. Quartz veins contain only trace feldspar and biotite, and are bordered by feldspar-rich zones.

C101401a (BH1, 100 m)

This is a moderately-sorted quartzwacke or feldspathic wacke consisting dominantly of stretched quartz grains about 0.2-0.5 mm in size. Plagioclase (albite), K-feldspar (orthoclase?), lithics and detrital muscovite are minor constituents. The matrix consists of granular quartz with variable amounts of white mica and chlorite. The texture is almost quartzitic, with sutured grain boundaries, and some sedimentary layering is evidenced by variations in quartz grain size and proportions of matrix phyllosilicates. Sulphides are widely dispersed in trace amounts, up to 150 µm in size. Pyrrhotite is the most abundant (0.5-1%), as aggregates and flakes, rarely with fine pyrite inclusions. Traces of chalcopyrite and

sphalerite are also present. Other trace constituents include zircon, carbonaceous material, rutile, tourmaline (subrounded to euhedral) and a carbonate (as veinlets and blebs).

C101401b (BH1, 84 m)

This is a somewhat similar wacke to the above, but is less well sorted, with quartz up to 1 mm in grain size, and carbonates are absent. Feldspars are still about 0.2-0.6 mm in size. Some altered biotite is present, and ilmenite is rarely present in rutile aggregates. Ilmenite shows late overgrowths. Sulphides (<1%) are relatively inhomogenously distributed as fine grains and aggregates to 0.25 mm, some forming apophyses into quartz. Pyrite is the most abundant and includes late stage veinlets, while galena, sphalerite, chalcopryrite and arsenopyrite are all present. Some chlorite veins occur, with minor epidote, pyrite and chalcopryrite. Quartz veins are minor and relatively barren. Apatite is widespread as a well-rounded trace constituent to about 0.1 mm.

C100066 (BH1, 85 m) - HAND SPECIMEN

This is a well indurated rock with blebs of pyrite (up to 5 mm) and finer sphalerite (up to 1 mm). A weak foliation is defined by elongation of sand-sized quartz grains, supported in a matrix of epidote/clinozoisite and montmorillonite (XRD identifications). Scattered cavities indicate leaching of clay and/or other minerals.

C100066 (BH1, 85 m) - POLISHED THIN SECTION

Non-sulphides

Quartz comprises about 50-60% of the sample, as slightly elongate grains 0.02-1 mm in size with undulose extinction and inclusion trails, or rarely polycrystalline and sutured. Inclusions of sulphides are uncommon (some are apophyses) and both quartz overgrowths and partial replacement by epidote/clinozoisite are common.

Epidote/clinozoisite comprises most of the matrix to the quartz grains, about 30-40% of the sample. It varies from about 10 to 250 µm in size, is commonly poikiloblastic with quartz, sphalerite and chalcopryrite inclusions, partly replaces quartz, and is variably replaced by montmorillonite. It is very pale green and most is optically negative and epidote (with about 10% Fe₂O₃), but some is optically positive and this is clinozoisite.

Montmorillonite (or another mineral of the smectite group) constitutes about 10% of the sample, generally with a grain size of a few micrometres but up to about 50 µm. It largely appears to be replacing epidote/clinozoisite but poorly preserved (plucked) aggregates up to 2.5 mm in size, enclosing some quartz inclusions, probably represent replacement of an earlier phase. It is pale brown in colour.

Other constituents include an unidentified carbonate which occurs in a few patches intergrown with epidote/clinozoisite and/or sphalerite. Sphene is a trace constituent, is poorly crystalline with fine rutile inclusions, and probably represents alteration or original detrital ilmenite or rutile. Carbon occurs in rare patches of very fine-grained aggregates of (?)protographite (weakly bireflectant). Zircon is a subangular to subrounded trace constituent, probably an original detrital phase.

Sulphides

Sphalerite is the most abundant sulphide, approaching 1% in abundance and up to one millimetre in size. It is widely dispersed throughout the rock, typically intergrown with epidote and montmorillonite (frequently as inclusions). In places it appears to bisect epidote grains, while epidote commonly bisects sphalerite, and they were undoubtedly re-crystallised together. It rarely occurs as inclusions in quartz, up to about 60 µm in size. Chalcopyrite is common as inclusions, usually very fine, while pyrrhotite is rare, pyrite uncommon, and epidote common as inclusions. It is red-brown in transmitted light and probably relatively iron-rich (supported by the pyrrhotite inclusions).

Pyrite occurs in larger aggregates than sphalerite (up to 5 mm in size), with crystals up to one millimetre, and constitutes nearly 1% of the rock. The aggregates often form a network of veins and crystals surrounding and including quartz grains, and many of these appear to have been partly replaced. Some fine crystals are included in epidote, but the relations are not quite clear (cogenetic?).

Chalcopyrite occurs in trace amounts as fine inclusions in sphalerite (up to 30 µm), quartz (up to 120 µm) and epidote (up to 30µm). Rare aggregates up to 0.3 mm occur interstitial to quartz and epidote, often intergrown with pyrite and/or sphalerite. Sphalerite may occur as inclusions.

Pyrrhotite is very rare and only found as inclusions in sphalerite.

Galena is noticeable by its absence.

C100066 - TEXTURES

The rock has a metasomatic texture, with original detrital quartz in a matrix of epidote, montmorillonite and sulphides. Sphalerite occurs as disseminated grains and less commonly as vague stringers parallel to the foliation (?bedded sphalerite). Most pyrite occurs as larger crystals, aggregates and fine anastomising veinlets (flattened parallel to the foliation), and could be diagenetic and slightly remobilised during metasomatism. Some epidote veinlets, approximately perpendicular to the foliation, occur and contain traces of fine sphalerite and chalcopyrite. They may, however, cut sphalerite stringers and grains and thus post-date most mineralisation. The cavities are probably due to disintegration of the montmorillonite aggregates. The bedding and tectonic foliations are suggested to be approximately parallel, but both are poorly defined.

CONCLUSIONS

The concentrates indicate minor mineralisation in the Cainozoic sediments. The iron sulphides and siderite are predominantly authigenic, while the cassiterite and wolframite are detrital, probably deposited close to their source. The sphalerite is rounded and may be detrital, but the arsenopyrite is angular and of unknown origin. The origin of the lead metal is very conjectural at present, and the possibility of contamination cannot be ruled out, although an authigenic origin in organic-rich sediments should be considered.

The granitic rocks are fairly similar to the alkali granites described by McClenaghan and Williams (1982), although the biotites are more chloritised.

The Mathinna Beds rocks appear to have all originated as quartzwackes with a small content of iron and base metal sulphides. Pyrrhotite seems to replace pyrite with depth in bore hole BH1, perhaps because of desulphurisation driven by contact metamorphism with a conjectural underlying igneous intrusion. The carbonate, chlorite and epidote veining and metasomatism may also be related to this, but the base metal sulphides do not appear to be significantly remobilised. The Scamander-type mineralisation appears unrelated but, while no gold was detected in these rocks, it is interesting to note that Reid (1926) considered much of the gold in the Lisle-Golconda area to derive from Mathinna Beds sandstones rather than veins.

The epidote-rich rock (C100066) could have derived from metamorphism of a marly sandstone, but such rocks are unknown from the Mathinna Beds. Turbiditic quartzwackes are common in the Mathinna Beds and include samples C101401a and b; these were probably epidotised and later partly replaced by montmorillonite. The chlorite-epidote veins in C101401b are possibly related. The metasomatism was basically a replacement of alkalis by calcium, but some silica was probably lost, and alumina added to the rock. Quartz-feldspar-biotite hornfels are produced by contact metamorphism adjacent to the contact with granites in boreholes BH4 and BH5.

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[31 October 1986]

Table 1. MINERALOGY OF PANNED CONCENTRATES

	Quartz	Lithics	Pyroxene	Siderite	Zircon	Ilmenite	Magnetite	Cassiterite	Rutile	Pyrite	Marcasite	Tourmaline	Sphalerite	Others
C100040	D	A	SD	A	A	A	TR	A	TR	A	ND	TR	ND	Garnet, gold
C100041	D	A	A	A	A	A	A	TR	TR	A	TR	ND	ND	Gold, leucoxene
C100042	D	A	A	SD	A	A	TR	A	TR	A	TR	TR	TR	
C100043	SD	A	A	A	D	A	A	TR	TR	TR	TR	TR	ND	Leucoxene
C100045	SD	A	A	D	A	TR	TR	TR	TR	A	TR	TR	ND	Garnet, leucoxene
C100046	TR	TR	ND	D	A	A	TR	TR	TR	A	A	TR	TR	Wolframite
C100047	A	TR	TR	A	A	A	A	TR	A	D	TR	TR	TR	Leucoxene
C100048	A	TR	TR	D	TR	TR	TR	TR	TR	SD	TR	TR	TR	Arsenopyrite

D: Dominant; CD: Co-dominant; SD: Subdominant (>20%);
 A: Accessory (5-20%); TR: Trace (<5%); MD: Not detected.

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Table 2. ELECTRON MICROPROBE ANALYSES OF NEW HENBURY GOLD

<i>Analysis</i>	<i>Au</i>	<i>Ag</i>	<i>Total (wt %)</i>
1	100.26	BLD	100.26
2	99.33	1.09	100.42
3	99.11	1.49	100.6
4	98.68	1.23	99.91
5	99.09	1.37	100.46
Average	99.294	1.036	100.33

BLD = Below limit of detection

APPENDIX 2b

Analysis of clay sample

A sample of clay from New Henbury BH9 at a depth of 10-12 m was selected as being typical of clay sediments intersected in the series of churn drill holes.

Department of Mines Laboratory serial No. 861427

Tests performed were:

- 1. Chemical analysis: (%)

SiO ²	54.88
TiO ²	0.68
Al ² O ³	15.93
Fe ² O ³	2.58
FeO	8.95
MnO	0.20
MgO	0.75
CaO	0.55
Na ² O	0.08
K ² O	1.38
P ² O ⁵	0.05
Totals	0.44
CO ²	6.60
+H ² O	7.43

- 2. Sedimentation test: 67% of minus 20 μm

- 3. Fusion point:

- 4. Probable normative analysis (RSB):

Siderite	15%
Illite	28)
Montmorillonite	7) 61%
Kaolinite	26)
Quartz	25

This material has an unusual mineralogical composition but the presence of carbonates may preclude its usability, as a ceramic clay and a firing test is required to further evaluate it.

The clay is continuous over much of the area, as it was intersected in seven boreholes at depths of 2.5 m to 10 m, and averaging 12 m in thickness. The volume would therefore be of the order of tens of millions of cubic metres.

APPENDIX 3

Assay results and grade calculations

Reg. No.	Depth (m)	Mass (g)			Assay of PC (% Sn)
		+2 mm	PT	PC	
<i>Hole 4</i>					
860987	0- 2	5.1	25.3	14.7	0.38
* 988	2- 4	14.3	14.7	19.4	4.08
989	4- 6	5.6	10.6	12.9	2.32
* This result is outside the range where Sn determinations by XRF are accurate.					
<i>Hole 7</i>					
860990	0- 2	1.6	16.7	14.1	0.20
991	2- 4	9.4	33.5	20.7	0.27
992	4- 6	11.4	2.5	20.8	2.01
993	6- 8	9.0	22.7	22.4	0.21
994	8-10	3.2	28.9	21.3	0.02
995	10-12	0.8	-	7.1	0.04
996	12-14	0.5	-	4.7	0.04
997	14-16	0.7	-	4.9	0.01
998	16-18	8.9	19.5	19.7	0.01
999	18-20	29.4	81.3	29.1	0.02
861000	20-22	29.2	28.4	20.7	0.24
001	22-24	13.9	23.5	15.0	0.12
002	24-26	4.1	44.8	16.4	0.03
<i>Hole 8</i>					
861003	0- 2	0.8	36.0	11.3	0.06
004	2- 4	10.8	11.4	12.8	0.03
005	4- 6	32.3	20.5	18.8	0.20
006	6- 8	12.8	11.3	12.3	0.06
007	8-10	2.6	62.9	19.0	0.02
008	10-12	2.7	5.6	12.5	0.02
009	12-14	0.8	-	6.9	<0.01
010	14-16	16.7	47.5	20.2	<0.01
011	16-18	18.4	54.5	21.9	<0.01
012	18-20	7.2	-	24.0	<0.01
013	20-22	23.2	10.6	30.0	0.05
014	22-24	44.9	46.8	32.2	0.17
015	24-26	30.3	24.0	27.2	0.08
016	26-28	4.3	46.9	19.3	0.09

Reg. No.	Depth (m)	Mass (g)			Assay of PC (% Sn)
		+2 mm	PT	PC	
<i>Hole 9</i>					
861017	0- 2	2.2	47.9	18.4	0.04
018	2- 4	10.6	33.2	10.2	0.20
019	4- 6	13.2	13.2	18.7	0.21
020	6- 8	8.7	65.1	18.3	0.02
021	8-10	2.4	18.4	13.1	0.03
022	10-12	0.8	28.2	16.9	0.01
023	12-14	0.8	16.6	18.2	0.01
024	14-16	1.3	9.4	14.7	<0.01
025	16-18	21.7	30.3	32.7	0.01
026	18-20A	45.2	20.3	39.3	0.03
027	18-20B	21.4	39.4	40.9	0.07
029	22-24	27.9	41.6	34.0	0.05
030	24-26	22.6	62.0	21.2	0.14

Samples 860995, 860996, 860997, 861008, 861009, 861012, 861021, 861022, 861023, and 861024 were all very clayey. They did not appear to be cradle concentrate, but rather a grab sample of clay.

No gold was detected in heavy mineral concentrates from holes 4, 7, 8 and 9. Gold occurred in only two samples as follows:-

Hole	Reg. No.	Depth (m)	Mass of gold (mg)	
7	860992	4 - 6	0.19	2 pieces +200 µm
7	860993	6 - 8	0.14	1 piece +200 µm

Zircon and lead appeared in practically all the samples. Rutile was noticed occasionally, but may be present in all samples. Sulphides were noticed in Holes 7, 8, and 9, and were very abundant towards the bottom of Hole 9.

Analyses by M. Frith and L. Rhodes, Department of Mines, Launceston

GRADE CALCULATION

Assay results were received from the laboratory as % Sn and milligrams of gold per two metre sample. These were converted to mg/m³ of ore (cassiterite and gold). BH1 was drilled with 150 mm casing and the remainder with 125 mm casing.

The basis of the conversion was:

Two metres of 150 mm (6 inch) diameter hole contains -

$$\pi(3/12 \times .3048)^2 \times 2 = 0.036 \text{ m}^3$$

and for a 125 mm (5 inch) diameter hole contains -

$$\pi(2.5/12 \times .3048)^2 \times 2 = 0.025 \text{ m}^3$$

$$\%Sn \times 1.27 = \% \text{ cassiterite}$$

$$\% \text{ cassiterite} \times \text{mass PC}/100 = \text{mass cassiterite for sample}$$

$$\text{therefore } \%Sn \times 1.27 \times \text{mass PC}/100 \times 1/0.036$$

$$(\text{or } \times 1/0.025 \text{ for a 125 mm hole})$$

$$\text{i.e. } \%Sn \times \text{mass PC (grams)} \times 0.35 \text{ (or } 0.51 \text{ for a 125 mm hole)}$$

$$= \text{gross cassiterite}/\text{m}^3$$

The calculation for gold grade is:

$$\text{mg gold} \times 0.35 \text{ (or } 0.51 \text{ for a 125 mm hole)} = \text{mg gold}/\text{m}^3$$

For comparative purposes, what was once called pound ground (i.e. one pound cassiterite per cubic yard) becomes, on metric conversion, about 600 g/m³ which is nearly six times the highest grade found in this investigation (109 g/t at 36-38 m in BH1).

A payable gold grade is about 200 mg/m³, depending on the price of gold and mineability of the ground. The highest gold grade found in this investigation was 38 mg/m³ which, is about 20% of minimum economic grade.

SAMPLING PROCEDURE

Drilling was carried out by churn drill and drilled material was removed by bailer and passed over a prospectors cradle to produce a heavy metal concentrate for laboratory processing. The cradle overflow was collected in a one cubic foot container and this tailings volume was estimated and reported by the driller.

Some of the clay content of the drilled material may collect in this container but most of it remains in suspension and is washed away. It is not possible therefore to calculate the volume of ground drilled and an accurate grade determination cannot be made.

The above procedure is normally used by the Department of Mines in evaluating alluvial fields and is reasonably reliable in sand and gravel which are the sediments in which accumulations of detrital minerals can be expected, but is quite unsatisfactory in clayey sequences. For this reason, the volume of ground was calculated from hole size in this investigation.

A more reliable method is to collect all the drillings in a settling tank. The volume is then measured, a bulking factor applied, and the true volume of ground calculated. This is the more usual technique applied by exploration companies and one that is recommended by the Department in any future evaluation of alluvial fields.

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Reg. no.	Depth (m)	Mass (g)			Assay of P C		Mass of Au (mg)	No of pieces of Au at Size (μm)			
		+ 2 mm	PT	PC	% Sn	%WO ₃		+500	+200	+100	-100
BH 1											
851797	0 - 2			61.1	0.09	0.10	Nil	-	-	-	-
851798	2 - 4	58.3	95.2	25.4	1.25	0.05	0.09	-	2	3	3
851799	4 - 6	24.7	66.6	13.1	3.64	0.06	0.04*	-	-	4	7
851800	6 - 8	14.6	61.6	13.2	1.15	0.03	0.70	-	3	-	4
851801	8 - 10	0.9	40.9	13.6	0.23	0.01	0.25	-	1	-	1
851802	10 - 12	2.7	9.8	7.5	0.06	<0.01	0.13	-	-	1	1
851803	12 - 14	6.8	20.6	12.8	0.03	<0.01	Nil	-	-	-	-
851804	14 - 16	11.0	20.0	13.8	0.02	<0.01	Nil	-	-	-	-
851805	16 - 18	2.2	8.1	7.8	<0.01	0.01	Nil	-	-	-	-
851806	18 - 20	5.4	35.7	20.0	<0.01	<0.01	0.04	-	-	1	2
851807	20 - 22	6.3	75.1	29.2	<0.01	<0.01	Nil	-	-	-	-
851808	22 - 24	76.9	163.4	100.7	0.18	<0.01	Nil	-	-	-	-
851809	24 - 26	32.1	55.3	68.3	0.20	<0.01	Nil	-	-	-	-
851810	26 - 28	8.5	29.4	22.4	0.16	<0.01	Nil	-	-	-	-
851811	28 - 30	148.4	115.5	32.6	0.78	<0.01	0.07	-	-	-	1
851812	30 - 32	150.1	156.6	51.8	0.42	<0.01	0.05	-	1	2	1
851813	32 - 34	49.1	63.6	53.3	0.49	<0.01	0.00	-	-	1	1
851814	34 - 36	7.0	20.6	24.0	11.5	0.07	0.20	-	5	4	-
851815	36 - 38	27.0	45.6	30.3	10.3	0.06	0.71	1	3	5	1
851816	38 - 40	29.5	45.3	36.0	7.4	0.04	1.35	3	9	4	1

(*) Some of the reported gold was lost - mass is estimated

Analyses by M. Frith, Department of Mines, Launceston

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Reg. no.	Depth (m)	Mass (g)			Assay of P C	Mass of Au	No of pieces of Au at Size (µm)		
		+ 2 mm	PT	PC	% Sn	(mg)	+200	+100	-100
BH 2									
860632	0 - 2	4.2	10.0	11.3	0.19	Nil	-	-	-
860633	2 - 4	2.5	17.8	18.5	1.7	Nil	-	-	-
860634	4 - 6	0.8	16.0	21.1	0.97	Nil	-	-	-
860635*	6 - 8	3.8	21.6	20.3	4.6	0.48	2	-	-
860636	8 - 10	10.3	17.8	18.4	0.95	0.10	1	1	-
860637	10 - 12	6.2	7.0	20.2	0.45	0.54	4	1	1
860638	12 - 14	3.7	2.8	26.8	0.06	Nil	-	-	-
860639	14 - 16	6.3	23.2	26.2	0.02	0.09	-	1	-
BH 3									
860640	0 - 2	8.7	7.3	18.7	0.09	Nil	-	-	-
860641	2 - 4	4.4	6.8	11.9	0.10	Nil	-	-	-
860642	4 - 6	6.4	27.4	18.9	1.5	Nil	-	-	-
860643	6 - 8	0.8	-	5.0	2.3	Nil	-	-	-
860644	8 - 10	2.8	-	9.4	0.43	Nil	-	-	-
860645	10 - 12	14.3	7.3	16.5	0.73	Nil	-	-	-
860646	12 - 14	7.1	23.7	18.5	1.2	Nil	-	-	-
860647	14 - 16	7.4	44.2	27.1	0.62	Nil	-	-	-
860648	16 - 18	10.8	61.4	15.9	0.26	0.00	-	1	-
860649	18 - 20	4.8	32.8	16.9	0.10	Nil	-	-	-
860650	20 - 22	28.3	81.6	24.7	0.07	Nil	-	-	-
860651	22 - 24	22.3	12.4	21.9	0.41	0.03	-	1	-
860652	24 - 26	19.9	61.6	36.8	0.55	Nil	-	-	-
860653	26 - 28	19.1	64.5	22.1	0.89	Nil	-	-	-
860654	28 - 29	16.1	44.7	26.2	0.58	Nil	-	-	-

Samples 860643 and 860644 were very clayey. They did not appear to be cradle concentrate, but rather a grab sample of clay.

* This result is outside the range where Sn determination by XRF is accurate.

Analyses by M. Frith, Department of Mines, Launceston.

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APPENDIX 4

Extract from Krause (1883)

Middle Pliocene (deep-lead) Drifts - Deposits of alluvial gold have been traced from shallow levels, in the neighbourhood of auriferous lodes, trending towards the deep ground under the Esk Flat in many places, notably at the Mangana Creek, the Black Boy diggings, and several gullies near Hazlemere, all falling in on the west side of the valley. The doubtful point in connection with deep-lead mining in this locality, therefore, is, not whether gold will be found in the deep drifts, but in what manner it has been distributed. For instance, as, in addition to the main channel, there is assuredly a system of tributary leads, it must be left to actual mine-work to ascertain whether these branches may not be, in parts, richer than the main trunk.

The site of the prospecting operations at Tullochgorum appears to be well chosen, as it commands the main lead as well as the Mangana lead, and probably other subsidiary channels. The subjoined section (No. 4) across the Esk valley at Tullochgorum is constructed from the following particulars:- The Silurian rocks (sandstone predominating) crop out on the edge of the alluvial flat, about 200 yards (180 m) north of the river. Taking this outcrop as a starting point, and going in a south-easterly direction across the main valley, we come, at a distance of 330 yards (300 m), to No. 9 bore, which bottomed at 102 feet (31.1 m); at 363 yards (332 m) No. 8 bore struck wash at 106 feet (32.3 m), bottoming at 111 feet (33.9 m); at 418 yards (382 m) No. 7 bore reached the bed-rock at 125 feet (38.1 m), after going through 5 feet (1.5 m) of wash; at 450 yards (411 m) a prospecting shaft was (1874) sunk to a depth of 70 feet (21.4 m), not bottomed, but meeting with a heavy influx of water; at 470 yards (429.6 m) No. 10 bore bottomed at 110.5 feet (33.7 m), having encountered five feet (1.5 m) of wash; at 506 yards (462.5 m) the new engine shaft is now being sunk; at 616 yards (563 m) No. 1 bore bottomed at 118 feet (36 m); at 704 yards (634.5 m) No. 4 bore bottomed at 176 feet (53.7 m); at 726 yards (663.6 m) No. 5 bore bottomed at 211 feet (64.4 m); at 755 yards (690 m) No. 6 bore bottomed at 199 feet (60.7 m), - the last three bores terminating on bare sandstone; at 792 [yards] (724 m) No. 2 bore struck greenstone at 202 feet 6 inches (61.8 m), - it was continued, at my suggestion, to a depth of 23 feet (7 m), still working in greenstone; at 957 yards (874.7 m) No. 3 bore struck greenstone at 180 feet 6 inches (55.05 m). At a total distance of 1480 yards (1352.7 m) we arrive at the opposite side of the valley, where the bank is made up of well-worn detritus of diabase, limestone, upper palaeozoic sandstone, and a little quartz.

From the extensive water-shed drained by the deep lead, it is only reasonable to expect a much greater depth of wash than has been proved to exist in any of the bores, and it is, therefore, all but certain that none of these bores (the correctness of the data given by the workmen being admitted) have, as yet, struck the deepest ground, even if the results obtained by No. 5 bore, bottomed at 211 feet (64.4 m), and No. 2 bore, sunk to 236 feet (72 m), did not argue in the same direction. With regard to Nos. 2 and 3 bores, discontinued while working greenstone, I have already expressed an opinion that the diabase rocks in this position are, probably, derivative deposits, i.e., loose shingle and boulders overlying other and deeper-seated drifts. The possibility, nay, the probability, therefore, exists that deep ground will be found between bores Nos. 2 and 3, or even further to the south. It is, also, not improbable that a smaller run of

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deep ground lies between bore No. 9 and the western bank of the valley, in proximity to the river.

The shaft now being sunk is intended to test the character of the drift between Nos. 10 and 8 bores. Although the deepest ground will, probably, not be found in this position, it is, as already observed, a doubtful point of importance to ascertain if gold is most plentifully distributed in the side valleys and shallower tributaries or in the deeper main channels.

Apart from the company's individual concern, the progress of the trial workings now carried on at Tullochgorum is fraught with the greatest possible public interest; for the disclosure of the existence of a payable auriferous gutter in this position is merely the precursor of deep-lead mining that will probably extend from the Black Boy to Corners, - a distance of upwards of 60 miles (96 km).

Extract from Thureau, 1885

A few remarks on the Tullochgorum prospecting area are added to this Report for the purpose of drawing attention to matters connected with gold-mining operations in that locality; should a "deep lead" exist there it will be of very considerable importance to this Colony; also with a view of drawing comparisons from a geological point of view between the lower gold drifts - older Pliocene - so extensively worked with such splendid results in Australia and America (California) and those alleged to occur in the South Esk valley. If the deep gravels now brought to light in the cores of the diamond drill are also of that age, then the opinions of well known and prominent geologists who have carefully examined this matter, in reference to their great established commercial value of those older or lower gold drifts of the Pliocene era, and the unproductiveness or non-payable character of the still older Micoene, must be considerably modified.

About a mile (1.6 km) below the junction of the Mangana Creek with the South Esk River a very considerable amount of work has been effected in order to prove the existence of a deep lead which is said to exist thereabouts. A number of boreholes were put down by manual labour, and afterwards a main shaft was sunk, equipped with steam-winding and pumping gear, through the gravel to the bedrock; finally the Government No. 2 diamond drill was also engaged for still further testing this ground for gold. Gold has been reported to have been found in the former, but it has also been stated that the drives from the shaft failed to disclose same, and but very little gravel on the bedrock. By means of the diamond drill one bore was sunk to a depth of 253 feet (77.2 m), bottoming on sandstone, interspersed with veins of calcite as underlaying the higher gravel; and preparations were just about completed for the commencement of No. 2 borehole.

The distance of this prospecting area is about five miles (8 km) from the Mangana and 22 miles (35 km) from the Black Boy quartz reefs, and, as these constitute presumably the sources of the supposed deep gold deposits here, it should, for instance, be remembered that at Ballarat their deep "gutters" or "leads" become so impoverished from their former so well-known *unparalleled richness* in gold within less than three miles (5 km) from their auriferous matrices as to have rendered all efforts to obtain profitable or even payable results futile.

At the goldfields mentioned in the foot-note quartz forms the principal and characteristic constituent of their deep gravel deposits or lower

gold-drifts, in which it occurs as the base and in the form of "drifts," "pebbles", and small to large boulders, which are frequently cemented together thoroughly by ferruginous matter, i.e., decomposed iron pyrites, at the higher levels or beds, but which, at the deeper bottoms of these gutters or leads, remain in their original state as sulphurets.

The lithological character of the lower Tullochgorum wash or deep gravel deposits, on the other hand as shown by the cores of the diamond drill, differs very materially from those just now described, as they exhibit in a gritty and, at the bottom, calcareous base rounded pebbles only of hard metamorphic schists, some of quartzite and greenstone only.

This latter mode of occurrence differs consequently altogether from the true Pliocene gravels in the gold-producing countries mentioned, and from those also which have been found here in Tasmania beneath two distinct flows of basalt at Lefroy and the Black Creek, as described in my Reports Nos. 45 and 118 of 1882, and afterwards recorded by the Foreman of the No. 1 diamond drill.

Under these circumstances it would be interesting and probably instructive to wait further developments by means of the diamond drill, as the one core examined would not give sufficient data to form a decisive opinion upon, but at the same time it is quite probable that Mr A. R. C. Selwyn's - formerly Director of the Geological Survey of Victoria, and now Director-General of the Geological Survey of the Dominion of Canada - opinion on the Miocene - older than the Pliocene of lower gold drifts - of the Golden River and Moorabool deposits also applies to this deep ground. If I have been correctly informed, there exists here a false bottom near the Tullochgorum shaft, which to the east and south-east overlies the still deeper ground, held to be of the Miocene era, overlying also at much less a depth a "gutter", the value of which has not been, on the same authority, sufficiently ascertained, nor have the tests of boreholes or workings been of a character to settle this important question definitely.

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APPENDIX 5

Drill Summary

LOCATIONS AND DEPTHS OF HOLES DRILLED

BH No.	Easting (m)	Northing (m)	Height (m)	Depth (m)	Drill method (m)
1	565748	5379381	203.8	0-40 40-100	Churn (152 mm) Diamond (45 mm)
2	565667	5379542	205.3	0-16	Churn (127 mm)
3	565648	5379772	210.6	0-29 29-46.50	Churn (127 mm) Diamond 46.5 mm
4	565548	5379930	216.7	0-15.50	Diamond 46.5 mm
5	565531	5379972	216.9	0-4.50	Diamond 46.5 mm
6	565545	5379954	217.6	0-8.50	Diamond 46.5 mm
7	565879	5379027	202.0	0-26.00	Churn (127 mm)
8	565801	5379212	202.7	0-28.00	Churn (127 mm)
9	566504	5379002	201.0	0-26.00	Churn (127 mm)
10	565990	5378850	202.3	0-29 29-49 49-64	Rotary (114 mm) Diamond (61 mm) Diamond (45 mm)

Auger Drilling

P1	565900	5380300	230	1.4
P2	565900	5380400	232	3.6
P3	565800	5380100	230	1.0
P4	565500	5380000	220	1.4
P5	565500	5380200	235	5.9
P6	565700	5380010	220	3.6
P7	563700	5378000	220	1.0
P8	565700	5380300	235	1.5
P9	565700	5380200	235	2.1
P10	565900	5380100	225	1.4
P11	565300	5379500	209	2.7
P12	565200	5380300	209	1.8
P13	565000	5380100	209	4.5
P14	565000	5378900	211	1.8
P15	564800	5379000	213	5.4
P16	565100	5378900	208	3.2
P17	565000	5378800	205	5.4
P18	564800	5378600	205	1.5
P19	564700	5378400	205	1.5
P20	564600	5378300	208	1.0
P21	564400	5378200	205	2.0
P22	564300	5378200	205	0.3
P23	564100	5378100	205	2.5
P24	563900	5378000	208	3.0
P25	563800	5377600	205	2.0
P26	563800	5377500	208	6.0
P27	564000	5378190	208	3.0
P28	564100	5378400	210	5.5
P29	564400	5378700	210	5.5
P30	564600	5378800	211	7.0
P31	564800	5378900	211	4.5

PROLINE AUGER SURVEY

Proline BH No.	Depth (m)	Lab Ser. no.	+2 mm	-2 mm +68 µm	-68 µm	% +9 mm
1	0-1.4	850752	24	50	26	
2	0-2.7	850753	17	61	22	
3	0-0.9	850754	22	38	40	
4	0-1.4	850755	34	42	24	5
5	0-0.9	850756	15	35	50	
	0.9-4.5	850757	29	39	32	
	4.5-8.7	850758	34	32	34	6
6	0-0.9	850759	15	37	48	
	0.9-6.4	850760	20	45	35	2
7	0-0.9	850761	26	38	36	5
8	0-0.9	850762	16	27	57	
	0.9-1.2	850763	6	40	54	
9	0-2.1	850764	15	50	35	
10	0-1.4	850765	21	45	34	
11	0-1.8	850766	43	48	9	3
	Suitable road-making aggregate					
12	0-1.8	850767	17	57	26	
13	0-4.5	850768	28	56	16	2
	Potential aggregate, smaller interval sampling required					
14	0-0.9	850769	17	40	43	
	0.9-1.8	850770	20	47	33	
15	0-5.5	850771	26	61	13	
	Potential aggregate, smaller interval sampling required					
16	0-0.9	850772	6	24	70	
	0.9-3.2	850773	21	43	36	8
Holes 1-16 in granitic colluvium						
17	0-0.9	851043	9	27	63	
	0.9-1.8	851044	19	46	35	
	1.8-2.7	851045	7	51	42	
	2.7-3.6	851046	3	42	55	
	3.6-4.5	851047	23	42	35	13
	4.5-5.2	851048	12	46	42	1
	0-3.6 m granitic colluvium, 3.6-4.5 m hornfelsed Mathinna Beds alluvium. Hole stopped in basalt.					
18	0-1.5	851049	12	34	54	5
19	0-0.9	851050	0	15	85	
	0.9-1.8	851051	39	36	25	12
20	0-0.9	851052	19	34	47	5
21	0-0.9	851053	13	42	45	1
	0.9-1.6	851054	17	39	44	4
	Hole stopped in basalt					
22	Unable to penetrate due to basalt boulders					
Boreholes 18-22 were difficult to penetrate due to presence of basaltic fragments. <i>In situ</i> basalt may be present at lower levels						
23	0-0.9	851055	2	34	46	
	0.9-1.8	851056	37	35	28	18
	1.8-2.4	851057	24	54	22	9

PROLINE AUGER SURVEY (continued)

Proline BH No.	Depth (m)	Lab Ser. no.	+2 mm	-2 mm +68 µm	-68 µm	% +9 mm
24	0-0.9	851058	10	54	36	
	0.9-1.8	851059	25	37	38	2
	1.8-2.7	851060	24	49	27	9
Holes 23-24 gravel, probably derived from Gilligan Creek						
25	0-0.9	851061	4	43	53	2
	0.9-1.8	851062	24	41	35	3
Granitic colluvium						
26	0-0.9	851063	8	37	55	2
	0.9-1.8	851064	1	72	27	
	1.8-2.7	851065	4	17	79	
	2.7-3.6	851066	1	53	47	
	3.6-4.5	851067	0	30	70	
	4.5-5.4	851068	46	19	35	21
	5.4-6.1	851069	33	39	28	11
4.5-6.1 m hornfelsed Mathinna Beds pebbles						
27	0-0.9	851070	9	28	63	1
	0.9-1.8	851071	20	43	37	4
	1.8-2.7	851072	31	41	28	16
Gravel probably derived from Gilligan Creek						
28	0-0.9	851073	22	49	29	
	0.9-1.8	851074	25	47	28	
	1.8-2.7	851075	2	29	69	
	2.7-3.6	851076	0	44	56	
	3.6-4.5	851077	0	30	70	
	4.5-5.4	851078	0	45	55	
29	0-0.9	851079	26	44	30	
	0.9-1.8	851080	22	44	34	
	1.8-2.7	851081	21	49	30	
	2.7-3.6	851082	16	38	46	
	3.6-4.5	851083	0	31	69	
30	4.5-5.4	851084	0	37	63	
	0-0.9	851085	21	48	31	
	0.9-1.8	851086	17	48	35	
	1.8-2.7	851087	16	44	40	
	2.7-3.6	851088	14	45	41	
	3.6-4.5	851089	14	54	32	
	4.5-5.4	851090	14	55	31	
31	5.4-6.3	851091	10	41	49	
	6.3-7.2	851092	10	40	50	
	0-0.9	851093	21	37	42	
	0.9-1.8	851094	13	41	46	
	1.8-2.7	851095	8	49	43	
2.7-3.6	851096	9	43	48		
3.6-4.5	851097	6	46	48		

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DRILLERS LOGS OF CHURN DRILL HOLES

BH No.	Depth (m)	Description
2	0 - 0.30	Surface soil
	0.30- 1.25	Gravel
	1.25- 2.80	Brown clay
	2.80- 7.70	Gravel, wash, clay
	7.70-16.00	Grey clay and rotten wood
7	0 - 3.00	Surface soil, silt and clay
	3.00- 6.10	Gravelly clay and wash
	6.10-19.80	Brown clay and rotten wood
	19.80-22.20	Green gravelly clay and rotten wood
	22.20-24.30	Clay and fine sand
	24.30-26.00	Green clay and gravel
8	0 - 3.50	Surface soil, silt and clay
	3.50- 6.80	Clay, gravel and wash
	6.80-13.50	Brown clay
	13.50-19.00	Grey clay and gravel
	19.00-28.00	Gravel, wash and clay
9	0 - 2.10	Fine sand and clay
	2.10- 5.50	Gravel and wash
	5.50- 8.00	Brown clay and rotten wood
	8.00-16.70	Grey clay and rotten wood
	16.70-18.50	Sand and grey clay
	18.50-26.00	Gravel and wash

Gravel denotes granule grain size, typical of weathered granite (colluvium) and wash denotes pebbles and boulders (alluvium).

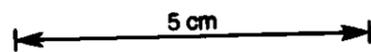
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TASMANIA DEPARTMENT OF MINES
GEOLOGICAL SURVEY BRANCH

DIAMOND DRILL CORE GEOLOGICAL RECORD

HOLE No. NEW HENBURY NO. 1
REF. No. SHEET No. 2 of 4

INTERVAL		REC. (%)	Core lift	Core loss	Depth (m)	Graphic Log	Min	DESCRIPTION	SPECIMEN		
From (m)	To (m)								Number	Depth	Prep'n
0	0.60				0			Soil and clay			
0.60	2.00							Granule sand and pebbles			
2.00	4.00							Granule sand and grey clay			
4.00	8.00				10			Granule sand and pebbles			
8.00	22.10							Blue and grey clay			
22.10	26.00				20			Clay, granule sand and pebbles			
26.00	28.40							Clay, granule sand, fine sand			
28.40	31.50				30			Granule sand, pebbles and wood fragments			
31.50	40.00							Clay and pebbles			
					40			<u>Churn Drilling</u>			
40.00	43.00	2						Pebbles and boulders of Mathinna Beds and light grey sandstone ^{Diamond Drilling} in clay matrix (Palynological dating: mid - late Eocene)			
43.00	49.20	100						Fine grained light grey sandstone, in part carbonaceous			
49.20	51.20	44						Medium-coarse grained lithic sandstone in part pebbly containing fine carbonaceous matter			
51.20	55.05	13			50			As above with fragments of indurated Mathinna Beds			
55.05	62.50							Crumbly green sandstone containing grits (1 mm) and pebbles to cobbles 100 mm			
								Soft white veinlets at 59.00 m and hard white veinlets at 60.60 m (Quartz) - Probably fragments			
					60			of boulders of Mathinna Beds			
62.50	64.00	100						Interbedded lithic and fine grained pale grey sandstone, bedding 45° to core length (boulders?)			
64.00	65.50	73						Soft lithic sandstone containing grits and pebbles (quartz and indurated Mathinna Beds)			
65.50	67.20	100						Contorted or slumped bedding (in boulders of Mathinna Beds?)			
67.20	68.50	67						Lithic sandstone			
68.50	70.00							Quartz and Mathinna Beds pebbles - no matrix (probably dissipated in drilling water)			
70.00	70.20	100						Green lithic sandstone			
70.20	70.80	25			80			Pebbles (cf. 68.50-70.00)			
70.80	74.97							Interbedded green and grey sandstone with anastomosing black partings (cleavage recognisable in thin section)			
74.97	84.30							Some sections are soft and friable; others indurated. A quartz/sandstone breccia at base (64.00 - 76.00: very broken core)			
					90			Interbedded sandstone, mudstone and laminite with occasional			
								Slumped sections, all indurated. Pyrite on joint surfaces at 81.50 and 82.00			
84.30	84.90	100			100			Sulphidic epidote clinzoisite rock - probably hydrothermally altered Mathinna Beds			
								ref: Bottrill UPR 1986/75			
84.90	100.00	100						Indurated Mathinna Beds, pyritised on joint surfaces, part slumped.			
								Where not slumped bedding in horizontal or low angle.			



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TASMANIA DEPARTMENT OF MINES
GEOLOGICAL SURVEY BRANCH

DIAMOND DRILL HOLE PLOT

HOLE No. NEW HENBURY No. 1

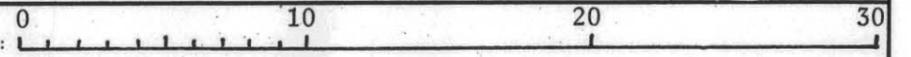
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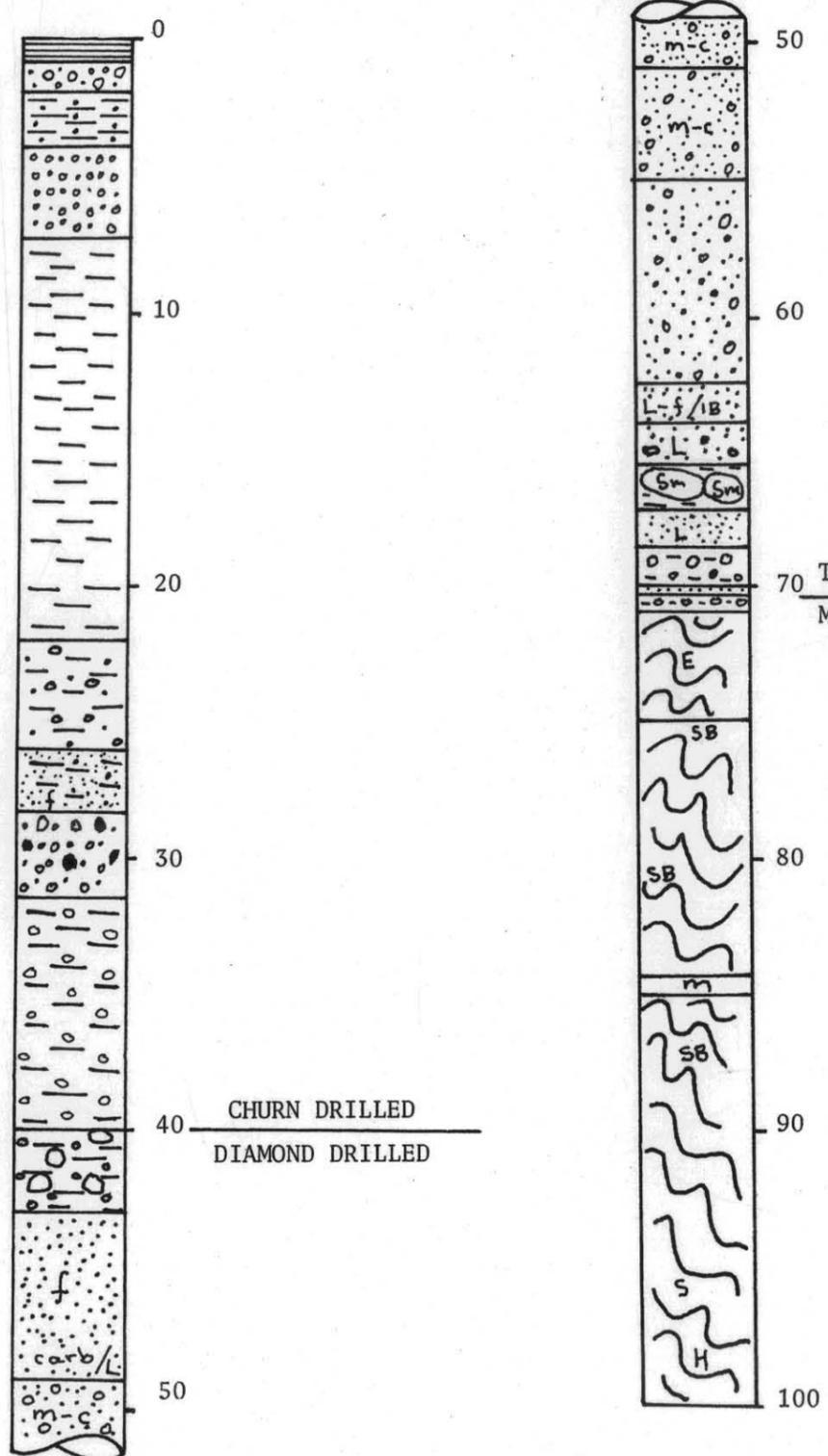
SHEET No. 4 of 4

A.M.G. CO-ORDS: 565 748 mE
5 379 381 mN

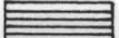
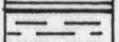
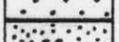
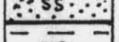
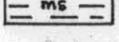
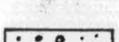
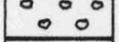
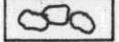
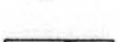
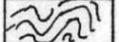
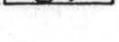
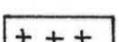
COLLAR R.L.: 203.8 m
TOTAL DEPTH: 100 m

COLLAR DIP: VERTICAL
AZIMUTH: -

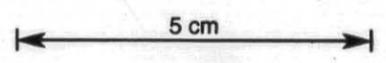
SCALE 1:  30
(Bar scale must be shown)



LEGEND

- Soil 
- Clay 
- Tertiary Sand (c)coarse, (m)medium, (f)fine 
- Sandstone (L) Lithic 
- Mudstone (sls) slickensided, (carb) carbonaceous particles 
- (lig) lignitic partings, (IB) interbedded sequence 
- Granule 
- Pebble 
- Cobble/Boulder (J) dolerite, (P) Permian limestone, 
- (Sm) Mathinna Beds 
- (W) wood fragments 
- L. Palaeozoic Mathinna Beds (E) eroded surface 
- (H) horizontal bedding 
- (SB) slumped bedding 
- (M) mineralisation 
- Granite (D) decomposed 
- Cassiterite/Gold (g/m³) (mg/m³) 

2/0

5 cm 

8-44

47/54

TASMANIA DEPARTMENT OF MINES
GEOLOGICAL SURVEY BRANCH

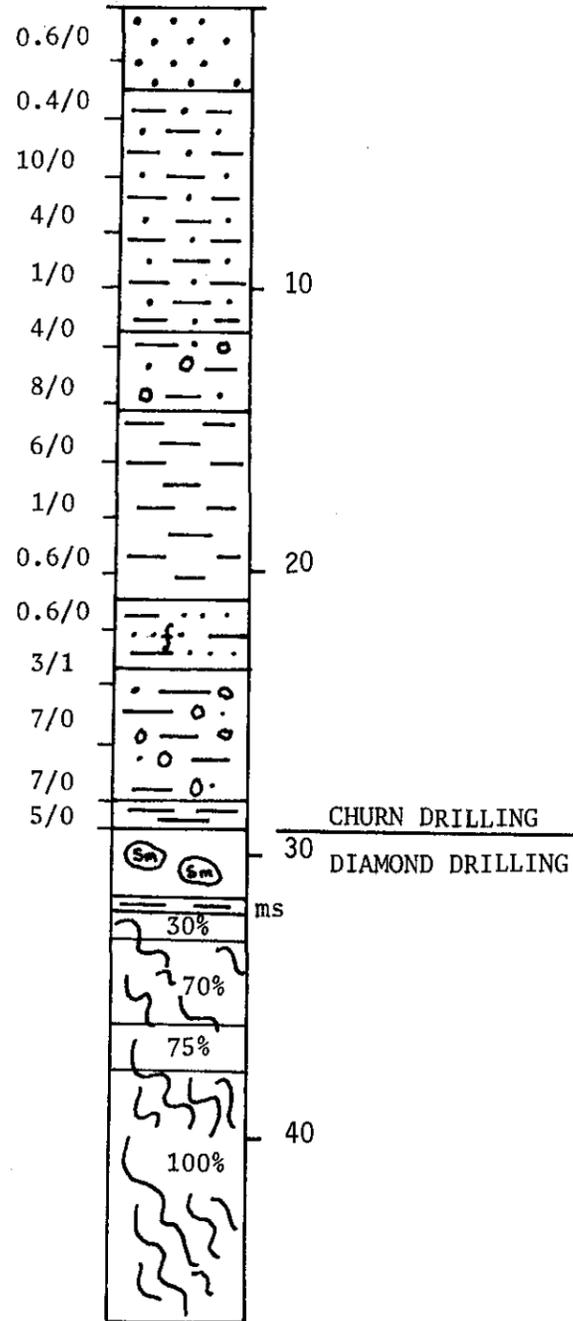
DIAMOND DRILL HOLE PLOT

HOLE No. NEW HENBURY No. 3
REF. No. SHEET No. 3 of 3

A.M.G. CO-ORDS: 565648 mE
5 379 772 mN

COLLAR R.L.: 210.6 m COLLAR DIP: VERTICAL
TOTAL DEPTH: 46.5 m AZIMUTH: -

SCALE 1 : 0 10 20 30
(Bar scale must be shown)



LEGEND

	Soil	
Tertiary	Clay	
	Sand (c)coarse, (m)medium, (f)fine	
	Sandstone (L) Lithic	
	Mudstone (sls) slickensided, (carb) carbonaceous particles (lig) lignitic partings, (IB) interbedded sequence	
	Granule	
	Pebble	
L. Palaeozoic	Cobble/Boulder (J)dolerite, (P)Permian limestone, (Sm) Mathinna Beds (W) wood fragments	
	Mathinna Beds (E)eroded surface	
	(H)horizontal bedding	
	(SB)slumped bedding	
	(M)mineralisation	
	Granite (D)decomposed	
Cassiterite/Gold (g/m ³) (mg/m ³)		
		2/0

8-47

5 cm

49/57

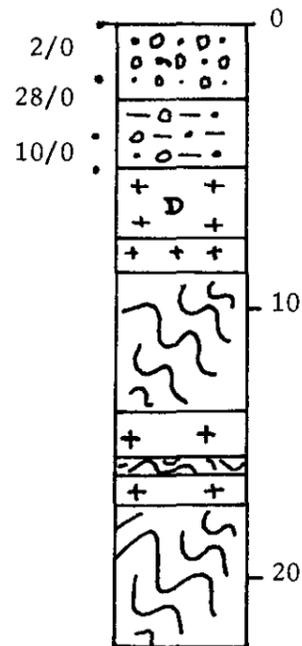
TASMANIA DEPARTMENT OF MINES
GEOLOGICAL SURVEY BRANCH

DIAMOND DRILL HOLE PLOT

HOLE No. NEW HENBURY No. 4
REF. No. SHEET No. 2 of 2

A.M.G. CO-ORDS: 565 548 mE COLLAR R.L.: 216.7 m COLLAR DIP: VERTICAL
5 379 930 mN TOTAL DEPTH: 22.00 m AZIMUTH: -

SCALE 1: 0 10 20 30
(Bar scale must be shown)



LEGEND

	Soil	
	Clay	
Tertiary	Sand (c)coarse, (m)medium, (f)fine	
	Sandstone (L) Lithic	
	Mudstone (sls) slickensided, (carb) carbonaceous particles (lig) lignitic partings, (IB) interbedded sequence	
	Granule	
	Pebble	
	Cobble/Boulder (J)dolerite, (P)Permian limestone, (Sm) Mathinna Beds (W) wood fragments	
L. Palaeozoic	Mathinna Beds (E)eroded surface (H)horizontal bedding (SB)slumped bedding (M)mineralisation	
	Granite (D)decomposed	
	Cassiterite/Gold (g/m ³) (mg/m ³)	

5 cm

54/54

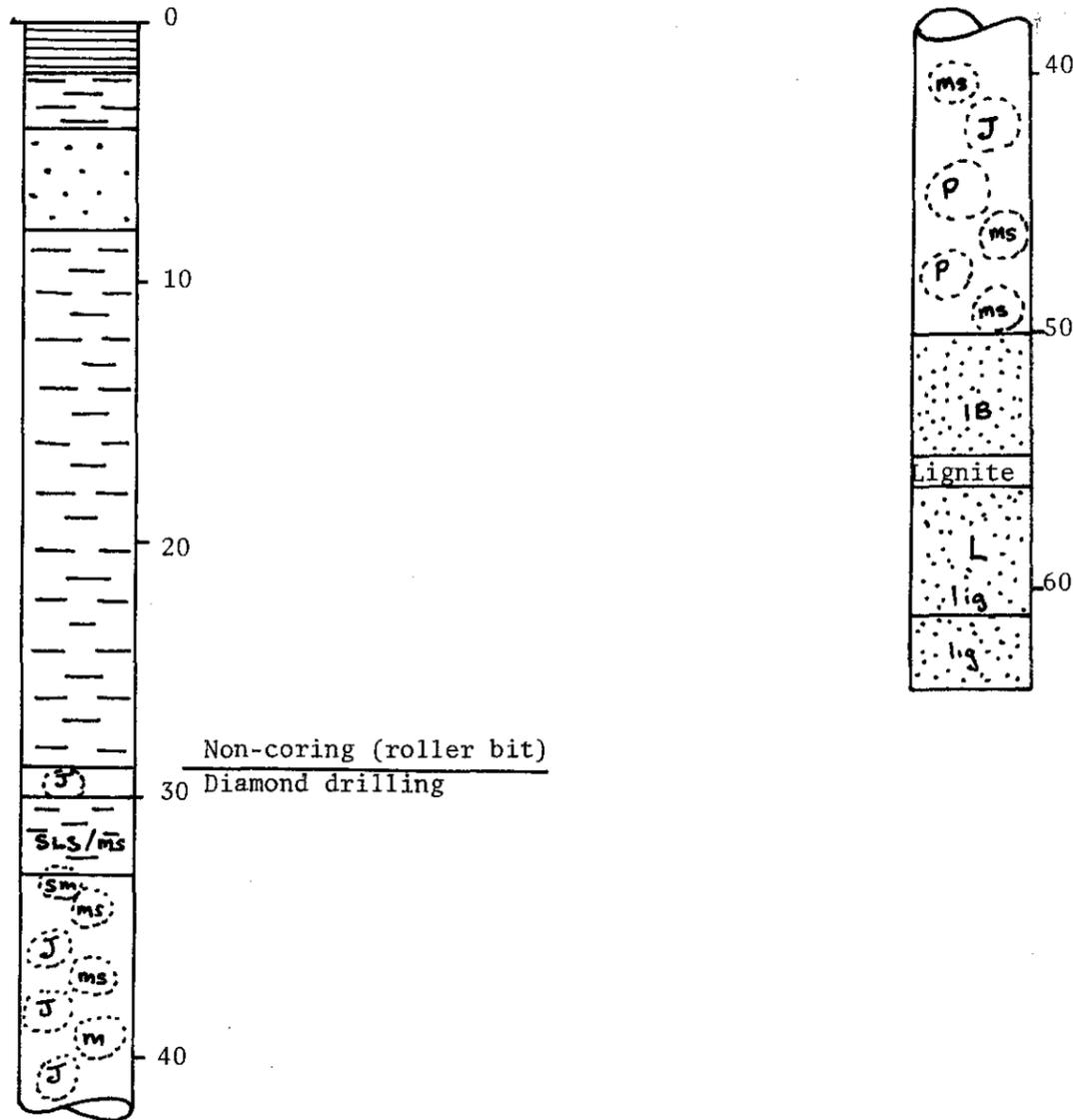
TASMANIA DEPARTMENT OF MINES
GEOLOGICAL SURVEY BRANCH

DIAMOND DRILL HOLE PLOT

HOLE No. NEW HENBURY No. 10
REF. No. SHEET No. 3 of 3

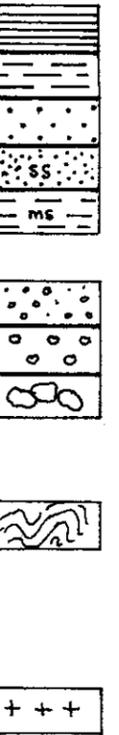
A.M.G. CO-ORDS: 565 990 mE COLLAR R.L.: 202.3 m COLLAR DIP: VERTICAL
5 378 850 mN TOTAL DEPTH: 64.00 m AZIMUTH: —

SCALE 1 : 0 10 20 30
(Bar scale must be shown)



LEGEND

- Soil
- Clay
- Sand (c)coarse, (m)medium, (f)fine
- Sandstone (L) Lithic
- Mudstone (sls) slickensided, (carb) carbonaceous particles
- (lig) lignitic partings, (IB) interbedded sequence
- Granule
- Pebble
- Cobble/Boulder (J) dolerite, (P) Permian limestone, (Sm) Mathinna Beds, (W) wood fragments
- Mathinna Beds (E) eroded surface, (H) horizontal bedding, (SB) slumped bedding, (M) mineralisation
- Granite (D) decomposed
- Cassiterite/Gold (g/m³) (mg/m³)



8-54