ABERFOYLE TIN DEVELOPMENT PARTNERSHIP

REPORT ON THE SUMMER EXPLORATION PROGRAMME UNDERTAKEN AT MT LINDSAY TASMANIA, 1968-1969.

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SUMMARY

In the Mt. Lindsay area a sequence of geosynclinal Cambrian sediments consisting mainly of greywackes with minor volcanics and shales has been tightly folded. Repetition of a favourable host rock for mineralisation has occurred due to axial plane faulting on the N.E. limb of a large anticlinal structure.

These Cambrian rocks were subsequently intruded by the Devonian-Carboniferous Meredith Granite. This intrusion resulted in a wide contact metamorphic aureole and widespread mineralisation. The mineralisation consists mainly of high temperature metasomatic replacements of calcareous horizons, though minor mineralisation has occurred along faults and in basic igneous rocks. Later cross faulting is quite common.

Exploration in the area during the summer season of 1968-1969 consisted of a sequence of line cutting followed by geological mapping, geophysics, geochemistry, and finally diamond drilling. Four areas were examined in detail and one of these was drilled. This drilling established the existence of a wide lode formation strongly mineralised with magnetite actinolite and pyrrhotite, but carrying only very low tin values. As a result no additional contribtuion was made to the established reserves of tin bearing ore at Mt. Lindsay. Several other areas of interest, worthy of further investigation, have been indicated by geophysics and by geological mapping. The presence of scheelite, although in uneconomic quantities is considered promising.

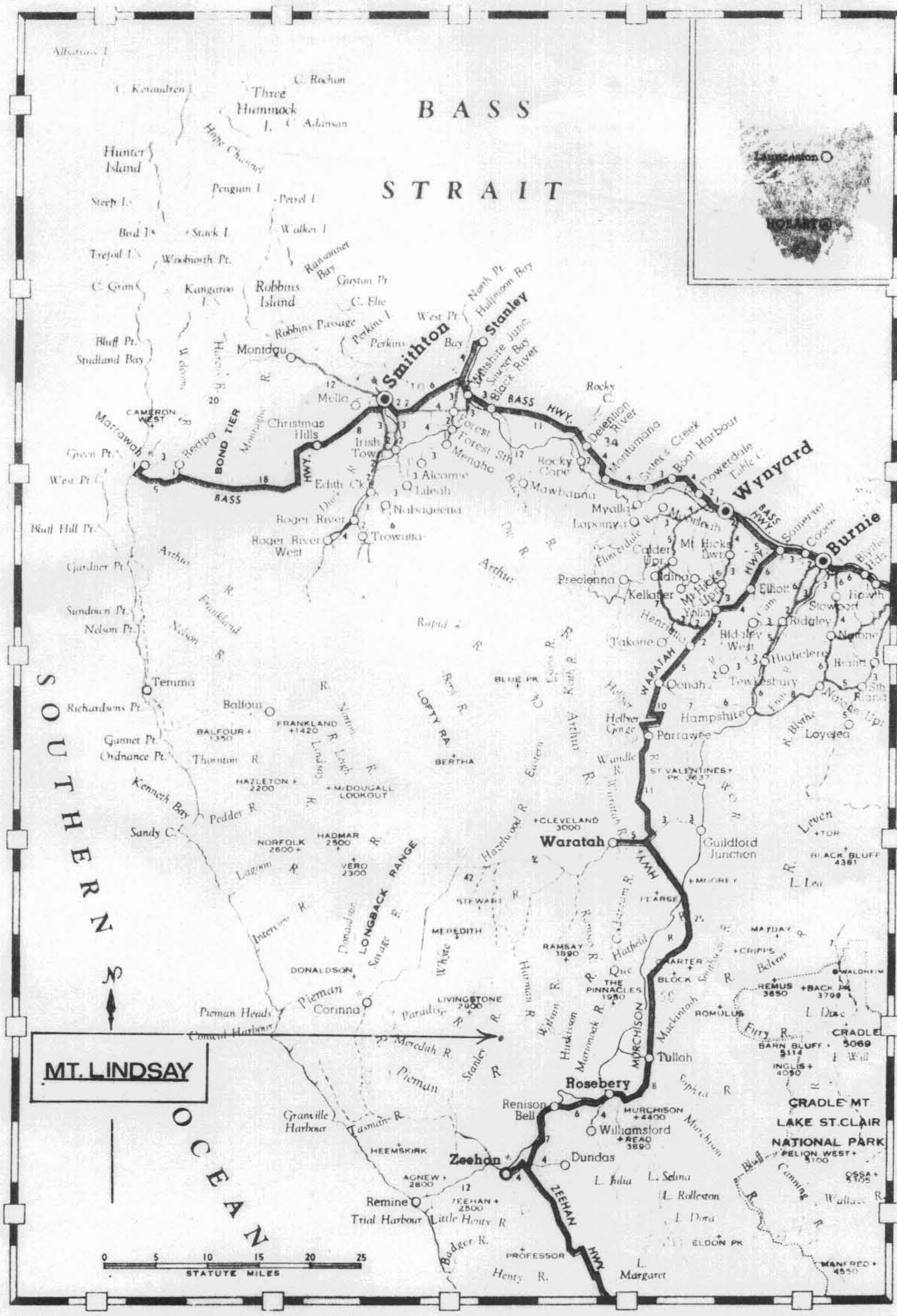

FIGURE 1

MOUNT LINDSAY TIN PROSPECT

LOCALITY PLAN

5 cm

GEOLOGY

1. INTRODUCTION

The economic geology of the Mt. Lindsay area was studied by the writer from October 1968 to March 1969. This work involved a logical exploration sequence of line cutting followed by geological mapping, geophysical surveys, geochemical soil surveys and finally diamond drilling. As a result of this work the structure and stratigraphy of the area has been re-interpreted, and a large mineralised zone of very low grade tin values has been outlined by diamond drilling.

(i) Location and Access

The Mt. Lindsay mine and associated deposits are situated approximately 15 miles N.W. of Renison Bell on the southern flanks of the Parsons Hood. (Fig 1). The terrain is rugged and the mine is at an elevation of approximately 1750 ft.

Access is either by helicopter or by a land rover track from Renison Bell to the Pieman River and then a walking track to Mount Lindsay. In both cases access is very difficult in winter months.

(ii) Summary of Previous Work

The Mt. Lindsay ore body was first worked by T. Macdonald in 1909. Production records are incomplete but the recorded production between 1916 and 1921 is listed as 2,156 bags of tin concentrate containing 68%-71% tin, coming largely from the oxidized portion of the main ore zone. Work on the deposit was discontinued in the 1920's.

The Aberfoyle Tin Development Partnership secured an option over 2 leases in 1962 covering most of the Mt. Lindsay workings. These leases were later incorporated in the exploration licence E.L. 2/63.

Following some geological mapping in January 1962 a programme of 4 drill holes for the summer of 1963 was proposed. These drill holes in the Main Ore Zone under the open cut encountered encouraging results and gave an indicated tonnage of 72,000 tons of 0.87% Sn.

A second drilling programme was undertaken from October 1963 to April 1964. Five holes were drilled in the Main Ore Zone and 5 holes were drilled in the Anomaly 1 Zone. Results were largely disappointing, but the indicated and inferred ore reserves in the main ore zone was raised to 362,000 tons of 0.85% Sn. The drilling on Anomaly 1 failed to intersect any mineralisation

A third drilling programme of 9 holes the following summer failed to disclose any mineralisation of significant grade.

In 1967-1968 detailed work by Eshuys and Etheridge resulted in a reinterpretation of the geological structure. They proposed a similar stratigraphy for Mt. Lindsay and Renison Bell and outlined a number of other magnetically anomalous areas (see L-69-2).

(iii) Outcrop, Climate and Vegetation

The area has a fairly high rainfall of approximately 70 inches per year and is largely covered by a thick myrtle rainforest. Although the terrain is rugged there is little erosion because of the dense cover of vegetation. Outcrop is generally poor except in creeks and the area is covered with 1 ft. to 10 ft. of yellow to orange podzolic soil and some grey hydromorphic soils.

Geology exerts some influence on vegetation. Most of the area is covered by typical myrtle rainforest consisting of myrtle, sassafrass, leatherwood, horizontal scrub and man ferns. But over any outcrop of granite the vegetation changes markedly with the development of pineapple palms and eucalypts, and the absence of myrtle, sassafras and man ferns. This change is easily recognisable on aerial photographs and enables the granite boundary to be marked out accurately.

Similarly there is a prominent vegetation change over the rocks of the Wilson River Ultramafic Belt. Here ti-tree scrub and baeura scrub are predominant. This change can also be recognised from aerial photographs.

2. STRATIGRAPHY

The rocks in the Mt. Lindsay area consist of a monotonous sequence of grey greywackes and shales with minor volcanics and some chocolate shales and greywackes. On the basis of lithology it has been possible to divide these rocks up into 7 formations or rock units having a total thickness of + 2,750 ft. (see table 1.) These 7 formations or rock units are largely conformable and are all of presumed Cambrian age although no fossils have been identified.

TABLE 1.

Formation or Rock Unit	Thickness	Lithology
Parsons Hood Beds	+ 200'	Fine to medium grained sub-labile grey greywackes some grey shale.
O'Briens Formation	20'-120'	Probably originally calcareous or dolomitic horizon.
Tulloch Formation	600'	Fine to very fine grained labile greywackes and grey shale.
Mt. Lindsay Formation	500'	Coarse grained quartzites and medium to coarse grained poorly sorted sub-labile greywackes. Some fine grained grey greywackes.
Alston Volcanics	150'	Mainly fine grained intermediate to basic volcanics.
Neagle Beds	500'	Sequence of grey fine grained greywackes and shale, blue-grey dolomitic shales and greywackes, some tuffs and red-brown shales.
Salmon Creek Beds	+ 700'	Red-brown shales and greywackes.

(i) Salmon Creek Beds

The Salmon Creek Beds are found outcropping in the southern part of the area mapped. The best exposures are seen in Salmon Creek and the lower part of Tulloch Creek. (L-69-2). They consist of fairly well bedded red-brown and chocolate coloured shales and greywackes. They also contain some interbedded grey shales and greywackes. The unit is at least 700' thick and possibly much thicker. The rocks are identical in appearance to the chocolate shales and greywackes in the Wilson River.

The shales are uniformly fine grained and are generally massive, although laminated and rare cross-bedded varieties occur. The greywackes which tend to be subordinate to the shales show well developed narrow graded units. They consist predominantly of lithic and feldspathic detritus with some quartz and minor mica in a purple or red matrix.

(ii) Neagle Beds

The Neagle Beds are a poorly outcropping sequence of rocks found in Tulloch Creek. The name is derived from Neagle Creek, a small tributary of Tulloch Creek.(L-69-2) These rocks have been referred to by Eshuys and Etheridge (3) as Khaki Shales and Turbidites because they include some khaki coloured members and also tend to weather to a khaki colour.

They include a variety of rock types characterised by their relative softness and poor outcrop. They range from grey to khaki shales and greywackes with some red-brown shales. The detritus is once again mostly lithic and feldspathic although mica rich greywackes are fairly common. These mica rich rocks are very similar in appearance to the mica sandstone at Cleveland.

Some soft blue-grey dolomitic shales and greywackes also outcrop in Tulloch Creek. These are similar to the dolomitic shales in the Wilson River described by Roetz, Cameron and Allen (10).

The Neagle Beds also contain some thin tuff horizons. These include a light pink-grey lithic tuff containing abundant fine disseminated pyrrhotite and a medium grained green cupriferous tuff composed mainly of fine volcanic fragments.

(iii) Alston Volcanics

The Alston Volcanics consist of grey-green mainly fine to very fine grained volcanics of intermediate to basic composition. They outcrop in a number of places to the south of Mt. Lindsay and can be well seen on the Pieman track just north of the Stanley River track turnoff.(L-69-2) They are named from the nearby Alston Creek, a tributary of Tulloch Creek.

The Alston Volcanics which are approximately 150 ft. thick are of probable andesite composition. They weather to a light grey colour and are often difficult to distinguish from greywackes of the Tulloch Formation. They can usually, however, be readily identified by the presence of small tabular plagioclase crystals, the absence of any bedding or layering, and the absence of quartz.

The volcanics are somewhat variable in composition, often containing phenocrysts of plagioclase up to $\frac{1}{4}$" as on the track to the Stanley River. Amphibole phenocrysts up to $\frac{3}{4}$" were found in fine grained volcanics on line 80E. Similarly grainsize tends to vary and though they are usually fine grained, medium to coarse grained varieties occur as on line 82E. These coarser grained rocks were previously considered to be diorite stocks. Pyrrhotite, actinolite and chalcopyrite are common minor constituents of the Alston volcanics occurring as small veins or patches.

The contact between the overlying Mt. Lindsay Formation and underlying Neagle Beds was not seen due to poor outcrop. Similarly no pillow structures were identified possibly also because of poor outcrop. The Alston Volcanics because of their fine grainsize probably represent flows or very shallow submarine intrusives. They are quite different in composition and texture from the dolerites and gabbros of the Harman River

(iv) Mt. Lindsay Formation

The Mt. Lindsay Formation consists of a distinctive sequence of medium to coarse grained poorly sorted quartz greywackes and coarse grained quartzites with minor fine grained grey greywackes and black and grey shales. The rocks of this formation outcrop in a number of places to the south of Mt. Lindsay, in Tulloch Creek, on the Pieman track, and on Mt. Lindsay. The formation is approximately 500 ft. thick.

The quartzites consist of quartz rich arenites and greywackes. The quartzitic appearance is probably due to some induration during contact metamorphism. Grainsize is variable but most of the rocks tend to be coarse grained with grains averaging $\frac{1}{10}$" in diameter. Sorting tends to be good.

The detritus in the quartzites consist predominantly of quartz and chert fragments with minor feldspar. The matrix is fine grained and mid-grey in colour. Pyrite and pyrrhotite are both fairly common minor constituents of the quartzites.

Medium to coarse grained poorly sorted greywackes make up a large part of the formation. They are composed of some large detrital grains of quartz and chert fragments set in an abundant fine to medium grained grey to dark grey matrix. These rocks are possibly tuffaceous in origin.

(v) Tulloch Formation

The Tulloch Formation consists of a monotonous sequence of fine grey greywackes with some grey shales. It occurs in the mine area and immediately to the south. The formation can be best seen in drill core as it usually weathers readily and forms poor outcrop. The name is derived from Tulloch Creek where it outcrops to some extent. The formati on is approximately 600 ft. thick.

The greywackes are characterised by an extremely labile composition and usually fine grainsize. The detritus consists almost solely of fine grained feldspar and rock fragments, with negligible quartz, in a dark grey matrix. Sorting is fairly good.

The shales vary from medium grey to siliceous dark grey varieties, and tend to occur in thin bands through the greywackes. The shales often carry some disseminated pyrite and pyrrhotite. The pyrite is possibly syngenetic.

The rocks of the formation tend to be massive and bedding is not very apparent. Graded bedding can be seen in drill core with the graded units in the order of one foot thick. Some minor slumping and current bedding can be seen in drill core and in occasional outcrop, and occasional load casts were also seen. Jointing is fairly well developed with thin films of chlorite and some calcite on joints. Less commonly pink ankerite and traces of pyrite are found on joint planes. Weathering on joints extends down to at least fifty feet.

As with the rest of the rocks mapped, no fossils were found in the Tulloch formation. However, right at the very top of the formation in D.D.H.'s 2/3 and 2/4 elliptical bodies ranging in size from $\frac{1}{10}$" to an inch were observed. These have been replaced by pyrrhotite with very minor chlorite and chalcopyrite. Similar structures occur at the Cleveland Mine and these are regarded by R. Cox (pers. com.) as replaced oolites.

(vi) O'Briens Formation

O'Briens Formation is the host for the mineralisation at Mt. Lindsay. It varies in thickness from 120 ft. in the vicinity of O'Briens Adit to approximately 20 ft. over parts of Anomaly 1.

Its original composition is unknown as it has suffered extensive allochemical metamorphism or metasomatism resulting in the development of skarn type rocks, and it has not been recognised in outcrop out of the mineralised zones.

The mineralisation shows a very prominent layering paralleling bedding and this layering is believed to represent original bedding. This would indicate that the rock was originally sedimentary. The presence of oolites immediately below the formation, and the nature of the mineralisation suggests that O'Briens formation was an originally calcareous or dolomitic horizon.

(vii) Parsons Hood Beds

The Parsons Hood Beds consist of at least 200 ft. of medium grained sub-labile greywackes and some grey shales. They can be well seen in D.D.H. 2/3 and 2/4. They outcrop sparsely but can be seen on the Mt. Lindsay heliport.

The greywackes are medium grained and show good graded bedding with graded units in the order of two feet. Detrital material consists of quartz, feldspar and rock fragments in a medium grey matrix. Intra-formational breccias composed of shale pieces up to ½" in diameter were seen at the base of graded beds on the Mt. Lindsay heliport and on the access track to D.D.H. 20.

3. STRUCTURE

(i) Folding

The Mt. Lindsay - Wilson River has been fairly tightly folded into large folds on a regional scale. The axial planes of these macroscopic folds are steeply dipping and strike approximately 310°. However, in the Mt. Lindsay area and along the southern contact of the Meredith Batholith they have a more westerly strike direction, commonly about 290°. The folds appear to have been formed about sub-horizontal axes as there are no prominent fold closures. The fold limbs are steeply dipping and are often overturned. Cleavage paralleling the axial plane is only very poorly developed in some shaley rocks.

The Mt. Lindsay orebody occurs within the steeply dipping NE limb of a large anticlinal structure. This limb is often variable in orientation, commonly overturned, and has been affected by some later deformation. Repetition of the upper part of the stratigraphy in the immediate Mt. Lindsay area is attributed to axial plane faulting of the anticlinal limb. This interpretation is similar to the structure proposed by Hopwood (4) for the Mt. Lindsay area.

Detailed mapping in the Wilson River area by Eshuys and Etheridge (3) and Overton and Jordan (7) has shown that there are both small and large scale swings of the general strike direction, and occasional mesoscopic folds. This is attributed primarily to the effect of a less prominent 2nd generation of folding, and to a lesser extent, to faulting.

Eshuys and Etheridge (3) have postulated that the more westerly strike direction of the rocks at Mt. Lindsay may be due to forcible intrusion of the Meredith Granite. Evidence for this is rather meagre.

(ii) Faulting

Faulting is quite intense in the Mt. Lindsay area. This can be well seen in underground workings and in drill cores. The faults can be divided into 2 prominent groups. The first of these is faulting parallel to the axial plane of the macroscopic folds in the area. These faults are steeply dipping with a strike direction parallel to bedding i.e. 290° - 300°. These faults probably formed during folding of the Mt. Lindsay rocks and would therefore be pre-mineralisation in age.

The second group of faults have a strike direction of approximately 055°. They generally dip to the S.E. and have a relative horizontal movement of N.W. block to the S.W. Slickensides observed in Adit No. 2 dipped 80° to the N.E. in a fault plane.

A fault with the same strike but opposite direction of movement has been postulated from magnetometer work just to the east of the open cut. It is not known in which direction this fault dips.

A number of these cross faults intersect the main ore zone and anomaly 2 can be seen in Adit No.2, the Western adit and in D.D.H. 2/2. These fault zones which are up to 10' wide profoundly affect the ore, altering it to a mixture of chlorite and clay with some magnetite and pyrite. For this reason they are believed to be post-mineralisation in age.

4. INTRUSIVES

(i) Meredith Granite

The Meredith Granite forms the second largest batholith in Tasmania covering an area of approximately 300 sq. miles. It is roughly oval in shape and the Mt. Lindsay deposits occur on its southern margin. Outcrop over the batholith as a whole is very good and in the Mt. Lindsay region fair. From the air very prominent joint directions can be seen to the north of Mt. Lindsay. These strike at approximately 50^{o} and 160^{o}.

Quite a number of phases of the Meredith Granite are found in the Mt. Lindsay area, especially in the contact zone. These can be well seen in D.D.H.'s 2/6 and 2/7 and News Creek. The bulk of the rock in the area is a coarse grained biotite adamellite to granodiorite in composition. This is composed of quartz plagioclase and orthoclase and considerable biotite. A little dark green hornblende is also present.

Towards the contact zone this adamellite tends to become finer grained and slightly porphyritic with some plagioclase phenocrysts. The contact zone contains considerable development of porphyritic micro-adamellite. This rock contains plagioclase orthoclase and quartz phenocrysts in a very fine grained groundmass. The feldspar phenocrysts are usually euhedral while the quartz tends to be anhedral. The groundmass consists of very fine grained quartz and feldspar with extremely abundant biotite. The rock often shows flow banding due to alignment of phenocrysts and also to layering in the groundmass. This layering is particularly evident with biotite distribution which is very erratic. Some biotite rich zones contain over 50% of biotite. The boundaries to these zones are usually diffuse and they probably represent partially digested xenolithic material.

In D.D.H. 2/7 two narrow syenite dykes were encountered in the contact zone. These were composed of coarse grained plagioclase with a very fine grained mafic mineral, probably biotite.

Strong development of quartz and tourmaline veins and patches were found in the contact zone and in the sediments close to the contact. These veins were composed of white to colourless quartz and black tourmaline. The grainsize ranges from fine to very coarse and the ratio of the two minerals is quite variable. The width of veins ranged from less than $\frac{1}{10}$" up to several feet, and large boulders of quartz and tourmaline are common in News Creek and the Stanley River. The veins occasionally contain feldspar and then appear very similar to the tourmaline pegmatite patches which are quite abundant in the contact zone.

Pyrite often occurs in the quartz-tourmaline veins, especially where tourmaline is the dominant mineral. Sometimes a little chalcopyrite and arsenopyrite are present and occasionally molybdenite and cassiterite.

The quartz-tourmaline veins are late stage, cutting all other rock types. They commonly show wallrock alteration effects in both adamellite and in the sediments. This effect is noticeable for up to two inches on either side of the vein. In the adamellites this alteration takes the form of development of sericite, muscovite, chlorite and clay at the expense of biotite and feldspars. In the sediments the wallrock alteration effects consist of a bleaching of the greywackes or shale.

Aplites are found at a number of localities such as in News Creek and in the small stock intruding Anomaly 2. They are fine grained and composed essentially of quartz and feldspar with muscovite and some biotite, and occasionally tourmaline. The aplite probably occur as dykes.

(ii) Contact Metamorphic Effects of the Meredith Granite

Contact metamorphic effects are not particularly evident around the adamellite margin mainly because of the composition of the country rocks. Fine grained grey greywackes and grey shales of the Tulloch Formation form by far the greatest amount of contact rocks. These rocks tend to be poor in aluminium and rich in potassium resulting in little development of andalusite or cordierite. However, these two minerals have been found in a few places such as D.D.H. 2/7 close to the adamellite contact. Within a few feet of the contact the greywackes and shales appear darker in colour and have a well developed sheen due to small mica flakes.

Spotting is the most prominent metamorphic effect in the Tulloch Formation and the Parsons Hood Beds. It occurs in patches and bands mainly in fine grained greywackes. This spotting is loosely related to the position of the adamellite, generally occuring within 500' of the contact or postulated contact. However this spotting does not increase in intensity closer to the adamellite.

Spots vary in size from $\frac{1}{10}$" to very fine barely visible spots. They are generally round or oval in shape though some are irregular. They are grey to black in colour and are probably composed of chlorite and or biotite. The constituents of the spots are very fine grained and not poikiloblastic. The spotting is closely related to jointing often following along prominent joints for an inch or so on either side. It is especially common in heavily fractured zones with abundant chlorite on fractures. The spotting is generally restricted to fine grained chloritic greywackes and is particularly common in shale or medium to coarse grained greywackes. Spotting due to development of cordierite or andalusite can be easily distinguished from chlorite-biotite spotting on form and colour.

Where rocks of different composition adjoin or are close to the granite margin more prominent contact metamorphism results. For example, basic volcanics on the track to the Harman River contain well developed euhedral garnets.

The original composition of O'Briens Formation is unknown but was probably dolomitic or calcareous. The Formation has suffered extensive allochemical metamorphism with the addition of iron silicon, minor copper, tin, arsenic, tungsten and fluorine. This has resulted in the development of a variety of rock types such as garnet-epidote marble, actinolite-magnetite-pyrrhotite rock, garnet-diopside rock; biotite-calcite-fluorite rock and other minor assemblages. Reid (9) has recorded the presence of wollastonite and vesuvianite from the main ore zone, indicating that the rocks belong to the pyroxene hornfels facies of contact metamorphism.

Elsewhere further north out of the area looked at this year, quite pronounced metamorphism of Silurian to Ordovician limestones to form skarns has occurred (Ransom and Wilson (8). Similarly there is development of cordierite-anthophyllite rocks and other high grade metamorphic rocks in the contact aureole of the Meredith Granite at the Harman River (Wilson (14).

(iii) Intrusive Basic and Ultrabasic Rocks

A number of basic and ultrabasic rocks are found in the area. The most prominent of these are the rocks of the north western extension of the Wilson River Ultramafic Belt. These outcrop in and around the Harman River and consist essentially of serpentinised dunites with minor pyroxenite. These ultrabasic rocks are associated with fairly extensive albite doleritesand gabbros which outcrop on the track to the Harman River. The gabbroic rocks are fairly variable in grainsize and composition but are very similar to rocks in the Ahearne's Creek area described by Jessup and Chenhall (6) and Overton and Jordan (7).

A small body of poorly outcropping gabbro was found approximately 1,000 ft. N.E. of the junction of Salmon Creek and Tulloch Creek. This gabbro which covered an area of roughly 50' x 50' is quite variable in grainsize and probably represents a small intrusive stock.

Another body of similar size was found on line 40E quite close to the granite contact. It gave a 3,000 magnetic anomaly and also outcropped poorly. It is coarse grained and composed essentially or pyroxene crystals up to $\frac{1}{2}$" in size. It either represents:

(a) A gabbro body similar to the Salmon Creek occurrence that has been contact metamorphosed.
or
(b) The metamorphosed equivalent of the Alston Volcanics which lie to the east roughly on strike.

Without thin section work it is difficult to elucidate the origin of this body.

Similar basic and ultrabasic rocks are fairly widespread in northern and western Tasmania and are attributed by Banks (1) as a Middle to Upper Cambrian age.

5. MINERALISATION

(i) Mineralisation in Anomaly 2 Area

A mineralised horizon of over 3,000 ft. strike length and averaging 100 ft. width has resulted in the geochemical, magnetic and self potential anomalies found in the Anomaly 2 area. This horizon is conformable with bedding. It outcrops poorly but fresh material has been found at a number of places as on line 1.1E and 2.2E and on the track to the Parsons Hood heliport. Lode has also been exposed in O'Briens Adit (now collapsed) and in 2 trenches. Five holes drilled this year gave good intersections of unweathered mineralisation.

Some small patches of clayey gossan also outcrop. Some of this gossan includes small euhedral crystals of magnetite. However, gossan is not as well developed ad it is in the main ore zone, and most of the mineralisation is covered by soil often with a reddish tinge.

The mineralisation shows three distinctive features. These are:

1. A varied and interesting mineralogy
2. A regular distribution of mineral assemblages
3. A prominent banding

The ore contains a considerable variety of minerals. The following have been identified in hand specimen: magnetite, pyrrhotite, pyrite, chalcopyrite, arsenopyrite, cassiterite, scheelite, sphalerite, actinolite, fluorite, calcite, biotite, garnet, diopside, tourmaline, epidote, chlorite and quartz. In addition acid soluble tin (stannite?), vesuvianite and wollastonite have been recorded from the main ore zone by Reid (9). The mineral assemblage is fairly typical for a high temperature metasomatic replacement of a calcareous horizon.

A number of prominent mineral assemblages are found in the ore. These have been briefly mentioned when discussing metamorphism. These include:

(a) actinolite, magnetite, pyrrhotite carbonate ± chalcopyrite, arsenopyrite etc.

(b) pyrrhotite, chalcopyrite ± magnetite

(c) calcite, biotite, fluorite

(d) diopside garnet ± pyrrhotite

(e) calcite, garnet, epidote

These different assemblages probably result from variations in the composition, texture and other physical properties of the original host rock. In the 5 drill holes that intersected mineralisation a thick zone containing actinolite and magnetite was first encountered. This was followed in D.D.H. 2/1 by largely a calcite-biotite-fluorite assemblage and in D.D.H.'s 2/1, 2/2 and 2/3 by assemblages containing garnet.

The distribution of tin in the mineralised horizon seems independent of the predominance of any one mineral. There is no apparent relationship between the tin assay and the amount of magnetite or sulphides. Generally though the actinolite-magnetite assemblages contain higher tin values.

Similarly distribution of scheelite tends to be quite erratic. It occurs as small individual grains and as thin veins throughout the ore.

There seems to be very little difference between mineralisation in Anomaly 2 and the main ore zone. The same minerals, textures and assemblages are found. On line 76E over Anomaly 3 some floaters of very fine grained magnetite-actinolite rock occur. This contains occasional larger patches ($\frac{1}{10}$" diameter) of actinolite and pyrrhotite.

Mineralisation over Anomaly 4 is not very apparent in outcrop but specimens containing magnetite, actinolite and sulphides were found. Near the Stanley River on the presumed strike extension of Anomaly 4 some fairly large lumps of galena, sphalerite and pyrite were found.

(ii) <u>Wallrock Alteration Effects</u>

Pronounced wallrock alteration effects are evident along Anomaly 2, the main ore zone, Anomaly 1 and in many other places. This commonly takes the form of extensive silicification of the country rock forming "cherts". These silicified rocks are a variety of colours ranging from light grey, to light green, to light pink. They usually contain abundant very fine disseminated pyrrhotite. Pyrrhotite and often a trace of chalcopyrite also occurs in blebs and in thin veins. These rocks are believed to be wallrock alteration effects and not an original sedimentary chert because:-

(a) Colour banding does not always follow bedding

(b) They show variations in grainsize similar to the greywackes of the Tulloch Formation and the Parsons Hood Beds.

(c) Similar features are evident along narrow actinolite-pyrrhotite-chalcopyrite veins cutting fine greywackes of the Tulloch Formation (see D.D.H. 2/3).

The wallrock alteration effects commonly extend for approximately 60 ft. either side of the mineralisation and involve firstly a weakly developed zone of chloritization. This is followed by a zone of bleaching forming brownish coloured greywackes and shales and finally a zone of silicification.

"Chert" outcrops at a number of locations which do not appear related to the main zones of mineralisation and are not at the same stratigraphic horizon. A small outcrop is visible just downhill from the coreshed and at other places between Anomaly 2 and the main ore zone. These "cherts" are probably related to premineralisation faults that have been slightly mineralised or acted as channelways for hydrothermal solutions.

6. REGIONAL CORRELATION

Regional correlation of the unfossilferous Mt. Lindsay rocks with published stratigraphic sequences of the West Coast is difficult as all correlations have to be based on lithology. Because of the presence of volcanics and presumed volcanic detritus in some of the sediments, and the absence of any significant regional metamorphism the rocks are presumed to be Cambrian in age.

The rocks of the Mt. Lindsay area have been variously correlated with the Dundas Group the Carbine Group, the Crimson Creek Argillites and the Huskisson Group. Taylor (12) placed these rocks within the Carbine Group or Success Creek Group of Upper Pre-Cambrian to Lower-Cambrian age. Campana and King included the rocks in the overlying Dundas Group on a regional map they compiled. Other workers have correlated the rocks with the Crimson Creek Argillites, which itself has been correlated with the lower part of the Dundas Group (Campana, King and McKenna (2)).

Spry (11) states that at Renison Bell sediments resembling Oonah Quartzite and Slate appear to underlie conformably either Crimson Creek or Dundas Group sediments. A similar contact can be observed near the junction of the Pieman and Wilson Rivers.

Banks (1) states that along the Huskisson River and along the Pieman River downstream from the Huskisson, the Success Creek Group of Pre-Cambrian or Lower-Cambrian age is followed concordantly by the Crimson Creek Argillites with minor greywackes and conglomerates, which is in turn overlain concordantly by the Huskisson Group. This last Group consists of over 6,000 ft. of shales, slates, greywackes, sandstone, conglomerate, chert, breccia and possibly pyroclastic rocks.

On lithological grounds the Salmon Creek Beds and possibly the Neagle Beds belong to the Crimson Creek Argillites while the other formations mapped are probably equivalent to part of the Huskisson Group. This would indicate that the rocks are Middle Cambrian in age.

EXPLORATION METHODS

1. EXPLORATION PROCEDURE

The exploration work this year consisted mainly of tracing zones of mineralisation or suspected mineralisation along strike. These zones constituted the known mineralised workings and magnetically anomalous areas found by Eshuys and Etheridge (3).

To obtain the maximum information lines were cut across these zones at 100 ft. intervals. These were then geologically mapped and surveyed by stadia method. Compass and tape surveying of lines, although much quicker than surveying by stadia method, tended to be unsatisfactory due to the large amount of magnetite in the area.

Magnetometer surveys were conducted over all these cut lines and in some cases S.P. Surveys were done. Soil samples were taken at 50 ft. intervals over these lines and were assayed for tin, copper and in some cases arsenic and zinc

2. GEOPHYSICS

(i) Magnetometer

Magnetometer traverses using Sharpe F1 magnetometers have been completed over the Main Ore Zone and Anomaly 1 from line 28E to line 30W. Traverses have also been done over the complete strike length of Anomaly 2 and over all the cut lines shown on the geological fact plans L69-13, L69-14 and L69-15 along the Stanley base line. In addition a magnetometer traverse has been completed to the Harman River from Mt. Lindsay. A reading interval of 25 ft. was used for all traverses and the total distance traversed was approximately 80,000 ft.

The two magnetometers used in this work had different base readings and the base reading of an individual magnetometer varied up to 800 due to diurnal variation and solar magnetic storms. These differences were measured by a number of readings at different times at the same station.

One of the magnetometers also showed jumps in the base reading of between 3,000 and 7,000 when accidentally bumped. This has led to some incongruous results and because of these variations is impractical to plot a contour map of the results.

In tracing anomalous zones it was necessary to have traverse lines every 100 ft. Anomaly 1 can be traced from line 30W to 28E while the main ore zone can be traced from line 30W to line 18E and may have been detected again at line 26E. Anomaly 2 was traced from line 13.8W to line 17.6E and a number of small magnetic peaks were also found between Anomaly 2 and the main ore zone.

Traverse lines are more irregularly spaced over Anomaly 3 and Anomaly 4 and this results in difficulty in interpretation. Anomaly 3 can be roughly traced from line 64E on the Stanley baseline to past line 20E on the main baseline. Anomaly 4 probably extends all the way from the Stanley River workings to Tulloch Creek.

Five other zones of high magnetic values were found on the track to the Harman River. These zones, which are related to outcropping "cherts" or mineralised gabbro, have not been traced. Their approximate position is marked on the plan L-69-2.

Assuming a near vertical direction of magnetisation and a large dip to the south then the magnetic profiles over a uniform hypothetical rectangular orebody of infinite length and depth will be almost symmetrical positive in the N-S direction. But in this area of variable magnetite content this simple one peaked curve would not be expected. However, on many traverses very steep gradients and negative troughs were found and these most likely owe their origin to faults destroying the uniformity of magnetisation.

At several places along Anomaly 1 and the main ore zone negative anomalies occur where no significant displacement of the zones is detectable. Examples are lines 14E, 5E and 4W on Anomaly 1, and lines 28W, 7W, 6W and 4W on the main ore zones. These may represent small scale faulting or faulting parallel to strike.

The most prominent faults outlined by the magnetometer are the fault shown truncating the Mt. Lindsay lode workings to the east and the fault which displaces the main ore zone at 19W, 10W and 11W. The latter fault displaces Anomaly 2 between lines 2.2W and 2.2E and also displaces Anomaly 1 by 200 ft. at lines 15W, 16W and 17W. This wide fault zone, visible in adit No.2 and in D.D.H. 2/2, changes the trend and magnetic nature of the three zones. The fairly wide fault zone to the east of the Lindsay workings intersects Anomaly 2 around line 6.8E where the magnetic anomaly goes from negative in the east to positive in the west. It intersects Anomaly 1 around line 1W. The magnitude of these two faults is quite large and they must continue on to cut Anomaly 3 which is only 1,000 ft. along their strike.

Other faults can be detected by bends in the trend of the magnetic zones. One of these faults occurs between lines 9.8W and 7.8W on Anomaly 2. At line 10E on the main ore zone and line 10E on Anomaly 1 another fault may strike N-S. This intersects Anomaly 2 at line 9.8E. Further to the east at line 23E another sudden change occurs in Anomaly 1, again presumably because of faulting.

East of line 12E, Anomaly 1 appears much broader with the development of two magnetic peaks to the south. In outcrop cherts and some mineralisation closely correspond to the northernmost peak. The two southerly peaks appear to be due to quite shallow mineralisation. They may be caused by a shallow fault along strike, which explains why D.D.H.'s 19, 20, 21 and 22 failed to intersect mineralisation corresponding to Anomaly 1.

(ii) <u>Self Potential Survey</u>

A self potential survey was run over Anomaly 2, the main ore zone and Anomaly 1. Another survey was conducted over Anomaly 3. Two instruments were used for this work, both Australex self-potential meters. One of these gave a positive reading over mineralisation, the other a negative reading. All the results in profiles and in plan L-69-26 have been corrected to give a negative reading. All readings on the main ore zone, Anomaly 1 and Anomaly 2 are relative to a value of 0 on line 6.8E 200S. All readings on Anomaly 3 are relative to a value of 0 on line 68E 0. Also a topographic correction factor of $\frac{1}{2}$ m.v. per vertical foot was used in all determinations where survey data was available.

The results are generally good and Anomaly 2 can be traced from line 13.8W to line 17.6E. The main ore zone and Anomaly 1 are also quite apparent. The self potential anomalies give a good correlation with magnetic anomalies, but provides little information that can't be gained from magnetometer work.

The self potential effect is believed due to the oxidation of sulphides forming a potential difference. However oxidizing sulphides do not always give this effect, and a potential difference can be caused by many other factors. Interpretation of self potential work is very difficult because of the number of factors that may influence it. These include:

(a) the amount and depth of oxidation

(b) the mineralogy of the ore

(c) a potential difference caused by the presence of waters of differing ionic concentration.

(d) depth of soil cover

(e) the height of the water table, which can profoundly affect results. It was found after a long dry spell it was impossible to duplicate results obtained earlier.

(f) the slope of a hill and corresponding slope of the water table. Falvey (pers. com.) after experimental work at Cleveland used an empirical factor of $\frac{1}{2}$ m.v. per vertical foot to give an approximate correction.

Self potential work gives very little more information than a magnetometer and in this terrain is a lot more difficult to carry and operate. It is not as fast and requires fairly tedious calculations and surveying to give a topographic correction, which itself is only empirical.

(iii) Ultra-Violet Survey

Because of the presence of quite abundant garnet, diopside, epidote and calcite in the ore it was decided to do an ultra violet survey to determine whether scheelite was present. All the core obtained in the recent drilling programme and all available mineralised core from previous drill holes was tested using an Oliphant ultra-violet lamp of wavelength 2537Å. The lamp was also tried in the old underground workings on the main ore zone, but mud and oxidation products on the walls inhibited the identification of fluorescent minerals.

A number of fluorescent minerals were found. These can be divided up on fluorescent colours into 5 groups.

(a) Bright blue-white fluorescing scheelite. This is the most abundant fluorescent mineral in the ore, and occurs as tiny white to colourless grains and in thin veins.

(b) Bright white fluorescing scheelite. This is not very common and it also occurs as small white to colourless grains.

(c) Bright gold gluorescing fluorite occurring as tiny colourless grains.

(d) Dull red and blue fluorescing fluorite. These two colours often occur together.

(e) Dull white fluorescing mineral, probably a carbonate. Fairly common in the ore.

Three specimen samples were consigned to AMDEL for identification. These appear in Table 2.

Table 2

Specimen No.	Description	Location
ML1	bright blue flourescing mineral	DDH 9 Depth unknown DDH 18 126'6"
ML2	bright white fluorescing mineral	DDH 16 114'4"
ML3	bright gold and dull blue fluoresing minerals.	DDH 2/1 136' DDH 14 150'6"

Scheelite was identified in M.L.1 and M.L.2. Fluorite in M.L.3. Identification was by examination under long and short ultra-violet radiation, by X-ray diffraction, and by chemical analysis.

Most of the fluorite and carbonates in the ore does not fluoresce.

(iv) Radiometric Survey

An airborne scintillometer survey was completed over selected areas of E.L. 2/63 and along the Meredith Granite contact northwards to Waratah. The survey was by helicopter using a wide band Scintrex BGS-1 Scintillation Counter.

The survey ran from the Stanley River along the granite contact, over Mt. Lindsay and followed the granite contact northwards. Runs were made along the fault contacts of the Wilson River Ultramafic Belt to the granite contact, and over the skarns developed in the Ordovician and Silurian rocks in the Huskisson syncline.

Whilst good correlation of results could be made with geology, no significant anomalous areas were found.

3. GEOCHEMISTRY

(i) Soil Sampling

A fairly extensive soil sampling survey was undertaken over the area, especially over magnetic zones. The purpose of this was firstly to attempt to estimate the potential of the magnetic zones; and secondly to obtain some idea of the distribution of tin in these zones, as drilling on the main ore zone had shown that tin distribution was erratic. This survey included all the cut lines across Anomaly 2, the Main Ore Zone and Anomaly 1. Eleven lines over the strongest part of Anomaly 3 were also sampled.

Mt. Lindsay is ideally suited to a geochemical soil survey as there is poor rock outcrop and the area is covered with 1' to 10' of soil. This is largely an orange coloured podzolic soil with a poorly developed A horizon. Locally both A_1 and A_2 horizons are absent and the soil profile has probably been truncated by erosion. Some grey hydromorphic soils also occur. All samples were taken in a presumed B horizon at approximately 1 ft. depth with a hand auger.

An orientation survey was undertaken over part of Anomaly 2 where there was no contamination from previous workings. In this area (lines 0 to line 17.6E) mineralisation similar to the Main Ore Zone outcrops in two places, and in a few places outcrops of gossan and chert also occur. The refief is fairly steep with a maximum variation of 500 ft. and the area forms a drainage divide between Tulloch Creek and the headwaters of South East Creek. The geology consists of a mineralised horizon striking approximately 295^{o}, bounded on either side by greywackes of the Tulloch Formation and the Parsons Hood Beds. The overburden is largely residual. Four elements were used in this survey. They were tin, copper, arsenic and zinc.

The normal background for tin over the Tulloch Formation and the Parsons Hood Beds is approximately 5 p.p.m. The threshhold value was estimated as 20 p.p.m. and peak values of 1,000 p.p.m. were obtained over suspected mineralisation. Tin was used as an indicator because cassiterite was the mineral primarily being sought and also because the mobility of tin is generally low, being limited by the high stability of primary cassiterite. Determinations were by colorimetric methods with an order of accuracy of 1 p.p.m.

Copper occurs in the ore as disseminated chalcopyrite, and tends to be concentrated in the more sulphide rich portions. A threshhold value of 70 p.p.m. was estimated for soil overlying Parsons Hood Beds and the Tulloch Formation, although a higher value of approximately 120 p.p.m. was taken as a threshhold value over the Mt. Lindsay Formation and the Alston Volcanics. A peak value of 6,732 p.p.m. was obtained. The mobility of copper is fairly low being limited by a high p.H. and to a lesser extent by co-precipitation with limonite and by absorption to organic matter and clay minerals. Determinations was by atomic absorption spectroscopy with an order of accuracy of 1 p.p.m.

Arsenic occurs as occasional crystals of arsenopyrite that tend to be concentrated with the magnetite-actinolite-pyrrhotite assemblage. A threshhold value of 30 p.p.m. was estimated for the area, and peak values up to 1,000 p.p.m. were obtained in the orientation survey. The mobility of arsenic is low and is severely limited by coprecipitation as $A_sO_3^{=}$ with limonite. Determination was by the Gutzeit method which gave an accuracy of 5 p.p.m.

Sphalerite is an uncommon constituent of the ore and this coupled with a moderately high distribution of zinc led to only a small variation between peak value (125 p.p.m.) and threshhold value (90 p.p.m.). For this reason zinc was not used as an indication for any further surveys.

Spurious anomalies can be caused by a number of factors which include :-

(a) contamination from old workings
(b) changes in soil type or sampling horizon
(c) different types of mineralisation such as thin tourmaline veins.
(d) source rocks of relatively high background values

No contamination from previous workings was expected over Anomalies 2, 1 and 3 except downhill from the mullock heap of O'Briens Adit. However, no sampling was undertaken on the main ore zone around the old open cut because of probable contamination. Similarly care was taken in sampling near old workings along the main ore zone.

Spot high values of copper or tin occur in quite a few places especially around Anomaly 2. These may be due to sampling near quartz-tourmaline or actinolite-pyrrhotite-chalcopyrite veins which are fairly common in that area. These isolated spot highs have been disregarded in evaluation. Similarly some of the grey hydromorphic soils have anomalously high values for copper. These soils are probably formed in seepage areas and a constant flow of copper rich water has resulted in considerable absorption of copper on clay minerals.

Most of the rocks in the area give similar threshhold values. Not enough samples were taken over adamellite to determine whether this would give a relatively high background, and therefore a geochemical anomaly.

Anomaly 2 gave prominent peak values of 6,732 p.p.m. copper, 2,500 p.p.m. arsenic and 1,000 p.p.m. tin. A very good correlation was obtained with the three elements. There were generally three areas of high geochemical values. These were centred on O'Briens Adit, line 2.2E and line 10.1E, and formed the basis for drilling targets. All geochemical values dropped off to the east of line 15.5E. These three anomalies were separated by areas of low values which also corresponded to either cross fault zones or the intrusion of an adamellite boss. As mentioned previously spot high values especially for copper were quite common. (see L-69-21).

Because of the considerable expense of the Gutzeit method, arsenic was not used as an indicator over the main ore zone and Anomaly 1. Copper values on the main ore zone are generally lower than on Anomaly 2 and all values were less than 500 p.p.m. At the time of writing most of the tin determinations for the main ore zone and Anomaly 1 have not been received. There are two areas of high copper values on the main ore zone. These are on lines 11W and 4W, and closely correspond to magnetic anomalies. To the east of the open cut copper values are very low and it is impossible to distinguish the main ore zone. (refer L-69-21)

Copper values over Anomaly 1 are generally low. The highest values are on lines 2W and 18E. Values are increasing around line 18E. This corresponds to an increase in magnetic and self potential values to the east. (see L-69-22)

Values for copper tin and arsenic are all low over Anomaly 3 and show little correlation except on line 72E where small tin and arsenic anomalies coincide. (see L-69-24)

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DISCUSSION

1. ANOMALY 2

Diamond drilling during the 1968-1969 programme was concentrated on the No. 2 Anomaly Zone where prominent magnetic, self potential and geochemical anomalies indicated the possibilities of substantial mineralisation. Seven holes were completed totalling 2896 ft. of drilling. A summary of this drilling is given in Table 3 and a summary core log appears in the appendix.

TABLE 3

Hole No.	Section	Lode Intersection	Estimated True Width	Grade Tin Sn%	Grade Cu. Cu%	Final Depth
2/1	2.2E	190'3" - 321'3"	120'			350'
		including				
		190'3" - 232'3"		0.20	0.04	
		232'3" - 244'3"		0.14	0.04	
		244'3" - 231'3"		Tr.	Tr.	
2/2	2/2E	308'7" - 350'7"	40' (lode width affected by faulting).			479'
		including				
		308'7" - 320'7"		0.08	0.03	
		320'7" - 338'7"		0.16	0.03	
		338'7" - 350'7"		Tr.	Tr.	
2/3	10.1E	156'4" - 273'0"	90'			400'
		including				
		156'4" - 174'4"		Tr.	0.02	
		174'4" - 204'4"		0.15	0.01	
		204'4" - 273'0"		Tr.	0.08	
2/4	10.1E	330' - 390'6"	50'	Tr.+	Tr.+	550
2/5	10.1E	515' - 590'	40'+ (Full width not exposed)			590
		including				
		518'5" - 575'5"		0.11	0.06	
		575'5" - 589'4"		0.06	0.05	
2/6	10.8W	No lode intersected	(Hole entered adamellite)			242
2/7	9.4W	" " "	" "		"	300

Distribution of tin in the main ore zone, which is similar to Anomaly 2 in form and mineralogy, is erratic. Therefore these seven holes were drilled on four sections corresponding to prominent geochemical anomalies (see map L-69-4). Five of these holes intersected strong mineralisation of widths up to 120 ft. This mineralisation consisted essentially of actinolite, magnetite and pyrrhotite, with garnet, diopside and other minor minerals. However, it contained very low tin values and only traces of copper and tungsten.

The other two drill holes on the western extension of Anomaly 2 intersected fine grained porphyritic and coarse grained adamellites at a shallow depth. Porphyritic adamellites outcrop approximately 150 ft. to the west of the drill collars and therefore the adamellite - sediment contact must dip at approximately 25° to the east. It is probable that the adamallite forms a shallow ridge underlying the mineralisation, and this ridge joint up with the boss outcropping on line 2.2E. If this is the case then the whole of the area from line 0 to line 13.8W represents only a thin veneer of mineralisation overlying adamellite.

Magnetic, geochemical and self potential values tend to diminish to the east around line 18.6E. This gives a strike length of over 3,000 ft. for Anomaly 2. However outcrops of "chert" have been found up to 2,500 ft. further east indicating that some mineralisation does continue in this direction.

As drilling was undertaken under geochemical anomalies for tin and copper, and only values of 0.15% to 0.2% tin were obtained, it is concluded that the chances of finding medium to large tonnages of mineable grade ore in Anomaly 2 are poor.

The presence of scheelite in diamond drill core from Anomaly 2 and the main ore zone is considered interesting because it is occurring in association with a skarn type assemblage, i.e. containing garnet, calcite, diopside and epidote. Contact metamorphism of limestones to the north of the Mt. Lindsay area has resulted in the formation of similar mineral assemblages, and the possibility that these contain scheelite cannot be overlooked.

2. MAIN ORE ZONE

The main ore zone can be traced by magnetometer for nearly 5,000 ft. It is exposed in a number of trenches, pits, and underground workings. It has been intersected in 18 drill holes and has an average width of 80 ft. The mineralogy of the main ore zone appears similar to that encountered in the drill intersections of Anomaly 2.

Drilling has extended along the main ore zone from line 15W to line 5E. A total of 362,000 tons of probable and inferred ore of grade 0.85% Sn. has been outlined. This ore mainly underlies the open cut area, and tin values in it tend to be erratic. The depth and lateral extensions of this ore have been adequately tested. Tin values decrease at depth and along strike.

To the east of the open cut geochemical values are poor (see L-69-21) and there is only a weak magnetic anomaly. Near line 5E, D.D.H. 33 intersected strong mineralisation but this contained very low tin values. It is unlikely that there is any significant development of ore in this area.

Between lines 20W and 30W near the western end of the main ore zone there are extensive workings in gossan along News Creek. However the contact of the Meredith Batholith runs roughly parallel to and less than two hundred feet to the north of this mineralisation. Adamellite probably underlies the main ore zone in this area at a shallow depth and therefore limits any potential tonnage of ore.

It is not known what controls distribution of tin in the main ore zone. The distribution does not appear related to the predominance of any particular mineral or mineral assemblage, or to any obvious structural feature. However the chances of significantly increasing ore reserves in the main ore zone do not appear good.

3. ANOMALY 1

Anomally 1 is a zone of magnetic, self potential and geochemical anomalies with a strike length of over 6,000 ft. Mineralisation has not been exposed in any workings, although chert outcrops in a number of places. Five drill holes in the eastern end of the anomaly failed to intersect mineralisation, which in this area has been extensively faulted.

Generally the magnetic, self potential and geochemical values tend to be smaller over Anomaly 1 than over the main ore zone or Anomaly 2 (see L-69-21). Similarly the zone appears narrower than the main ore zone. Because of these facts Anomaly 1 does not appear a particularly interesting exploration target.

However, geochemical, self-potential and magnetic values increase to the east around line 18E (see L-69-22) this extension has not been adequately investigated and further lines need to be cut in this area.

4. ANOMALY 3

Anomaly 3 was examined in detail between lines 68E and line 88E (see L-69-13). The strike extensions are unknown, but it is likely that to the west the Meredith Batholith truncates it near line 40E.

Anomaly 3 is a rather broad weak magnetic anomaly that differs considerably from the magnetic anomalies associated with the main ore zone, Anomaly 2 and Anomaly 1. It is at a different stratigraphic horizon occurring over the Alston Volcanics and the Mt. Lindsay Formation. Geochemical values over the magnetic anomaly are very poor and there is no relation between copper and tin values. (see L-69-22 and L-69-24). Small tin and arsenic anomalies coincide on line 72E and floaters containing magnetite and actinolite have been found on line 76E and line 78E. Generally there is an absence of chert coinciding with the magnetic anomaly.

The magnetic anomaly seems to be largely due to the Alston Volcanics. Although these volcanics do contain some thin veins of actinolite pyrrhotite and chalcopyrite, there is no apparent significant mineralisation. The floaters of magnetite and actinolite found over the Mt. Lindsay Formation are probably derived from minor mineralised faults.

5. OTHER MAGNETIC ANOMALIES

Anomaly 4 (see L-69-2) appears to be a mineralised horizon similar to the main ore zone and Anomaly 2. Traverse lines have only been cut across this magnetic anomaly in a few places, and the strike extensions of it are unknown. It probably extends in a westerly direction to the Stanley River workings and should therefore be looked at in much more detail.

Five magnetic anomalies were found on the track to the Harman River. These are marked on the geological fact plans L-69-9, L-69-10 and L-69-11 "Chert" either outcrops or occurs as floaters associated with the first four of these anomalies. The fifth anomaly appears to be related to a gabbro carrying some pyrrhotite. Because of the association of a prominent magnetic anomaly with outcrops of "chert", these areas warrant further investigation.

CONCLUSIONS

1. A structure and stratigraphy has been interpreted for the Mt. Lindsay area. The mineralisation at Mt. Lindsay is stratigraphically controlled by replacement of a favourable host rock (O'Briens Formation). Repetition of this host rock is due to axial plane faulting on the N.E. limb of a large anticline.

2. Mineralisation is widespread in the Mt. Lindsay area and only some of this has been examined in detail. The area offers good exploration targets for tin, tungsten and copper mineralisation.

3. Seven diamond drill holes completed in the Anomaly 2 area have failed to increase the previously known ore reserves. The chances of finding significant tonnages of mineable grade mineralisation in the Anomaly 2 area are considered poor.

4. The main ore zone has been adequately tested and the chances of increasing the known ore reserves are not good.

5. From magnetometer and geochemical survey results, a large part of Anomaly 1 area does not attract as a target for further exploration. However further work is required on the eastern extension of Anomaly 1, where there is an increase in magnetic, geochemical and self potential values.

6. The area of Anomaly 3 examined in detail can be disregarded in any future exploration programme. However the eastern extension of Anomaly 3 has not been adequately tested.

7. Anomaly 4 and the fine magnetic anomalies on the track to the Harman River have not been examined in sufficient detail and warrant further investigation.

8. Magnetometer surveys, geochemistry, and to a lesser extent geological mapping are the best exploration tools for this area.

9. The occurrence of scheelite is considered significant. Scheelite has not been recognised in this area before. Furthermore scheelite commonly occurs in association with contact metamorphosed limestones (skarns), and these rocks are developed at many points near the contact of the Meredith Batholith.

RECOMMENDATIONS

1. Continue exploration by line cutting, geological mapping, magnetometer surveys and geochemical sampling in the following areas:

   (a) Each of the five magnetic anomalies on the track to the Harman River.

   (b) The eastern extension of Anomaly 1. Some lines in this area are to be extended to cover Anomaly 3.

   (c) Anomaly 4 and specifically the western end around the old Stanley River workings.

2. An examination is to be made of all drill core at Mt. Lindsay, and the scheelite content estimated by use of an ultra-violet lamp.

3. The potential of the tungsten occurrence in the Mt. Lindsay area to be investigated by geochemical soil sampling and stream sediment sampling.

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APPENDIX

SUMMARY OF DRILL CORE LOGS FOR THE SEVEN HOLES DRILLED IN THE ANOMALY 2 AREA 1968 - 1969 (SEE FILE 6-3 FOR DETAILED LOGS.

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SUMMARY OF D.D.H. 2/1

D.D.H. No. 2/1

Location: No. 2 Anomaly Zone - Section 2.2E

R.L.: 1852'

Co-ords of collar: 2466.1N 3134.5E

Bearing: 019° (Grid)

Angle: -35°

Depth: 350'

00 - 151'4"	Fine grained grey greywackes with minor grey shale. Weathered and brecciated in places. Chlorite and carbonate on joints, some spotting. Porphyritic microadamellite dykes with some tourmaline from 120'5" to 123' and from 134'10" to 135'5".
151'4" - 178'8"	Brownish greywackes and shales. Light green, grey and pink "chert". Fairly well bedded. Some fine disseminated pyrrhotite and thin veins of pyrrhotite and chalcopyrite.
178'8" - 250'7"	Coarse grained actinolite with minor carbonates, chlorite and fluorite. Some pyrrhotite and magnetite, sparse chalcopyrite, arsenopyrite and scheelite. Some thin green chert bands.
250'7" - 324'	Largely biotite carbonate and fluorite. Some magnetite. Bands of green and grey chert. Some bands of actinolite.
324' - 350'	Fault with 7" cavity at 324'. Fine grained brown and grey greywackes. Chlorite on fractures. Abundant thin veins of quartz and tourmaline.

ASSAYS

From	To	Core Length	Assay % Sn.	Assay % Cu.
181'3"	190'3"	9'0"	0.09	0.05
190'3"	232'3"	42'0"	0.20	0.04
232'3"	244'3"	12'0"	0.14	0.04
244'3"	324'	79'9"	Tr.	Tr.

SUMMARY OF D.D.H. 2/2

D.D.H. No. 2/2

Location: No. 2 Anomaly Zone - Section 2.2E

R.L.: 1840'

Co-ords of Collar: 2380.2N 3104.7E

Bearing: 019° (Grid)

Angle: -45°

Depth: 479'2"

00 - 244'9"		Fine grained grey greywackes with minor grey shales. Weathered and brecciated in places. Chlorite and some carbonate on joints, some spotting. Porphyritic microadamellite dyke from 200'11" to 210'6". Some thin irregular quartz and chlorite veins. Veins and patches of aplite.
244'9" - 308'7"		Brownish greywackes and shales. Light green, grey and pink "chert". Fairly well bedded. Some fine disseminated pyrrhotite and thin veins of pyrrhotite and some chalcopyrite.
308'7" - 330'		Coarse grained actinolite with magnetite, pyrrhotite and minor carbonates, chlorite and fluorite. Sparse chalcopyrite and arsenopyrite.
330' - 354'		Chlorite, magnetite, and minor pyrite passing into clay gouge. Major fault around 350'.
354' - 471'8"		Grey medium grained greywackes. Fairly bedded with graded units. Abundant tourmaline and quartz veins.
471'8" - 479'2"		Aplite passing into quartz-tourmaline then medium grained porphyritic adamellite finally coarse grained biotite adamellite.

ASSAYS

From	To	Core Length	Assay % Sn.	Assay % Cu.
308'7"	314'7"	6'0"	0.15	0.02
314'7"	320'7"	6'0"	Tr.	0.05
320'7"	338'7"	18'0"	0.16	0.03
338'7"	350'7"	12'0"	Tr.	0.01

SUMMARY OF D.D.H. 2/3

D.D.H. No. 2/3

Location: No. 2 Anomaly Zone - Section 10.1E

R.L.: 1902'

Co-ords of collar: 2170.95N 3874.21E

Bearing: 019° (Grid)

Angle: 35°

Depth: 385'6"

00 - 171'1"	Largely fine grained grey greywackes and minor shale. Weathered and brecciated in places. Chlorite and carbonate on joints, some spotting. Some quartz and chlorite veining with a little pyrrhotite.
117'1" - 162'5"	Brownish greywackes and shales. Light green, grey and pink "chert" containing disseminated pyrrhotite, and some thin veins of chalcopyrite and pyrrhotite.
162'5" - 173'	Banded garnet marble with some epidote. Some bands of actinolite and bands of "chert".
173' - 208'7"	Magnetite actinolite with minor pyrrhotite and sparse chalcopyrite. Some "chert" bands.
208'7" - 217'8"	Pyrrhotite and magnetite with minor "chert" actinolite, biotite, carbonate and garnet.
217'8" - 271'6"	Garnet, diopside and epidote with "chert" bands.
271'6" - 320'6"	Brownish greywackes and shales with some "chert". Contains fine disseminated pyrrhotite.
320'6" - 385'6"	Fine and medium grey fairly well bedded greywackes. Graded bedding prominent.

ASSAYS

From	To	Core Length	Assays % Sn.	%Cu.
162'4½"	- 177'7½"	15'3"	Tr.	0.02
177'7½"	- 192'4"	14'8½"	0.14	0.02
192'4"	- 207'4½"	15'0½"	Tr.	0.03
207'4½"	- 216'4½"	9'0"	Tr.	0.20
216'4½"	- 242'4½"	26'0"	Tr.	0.06
242'4½"	- 258'0"	15'7½"	No assays available	
258'0"	- 273'0"	15'0"	Tr.	0.05

SUMMARY OF D.D.H. 2/4

D.D.H. No. 2/4

Location: No. 2 Anomaly Zone - Section 10.1E

R.L. 1891

Co-ords of Collar: 2076N 3853E

Bearing: 019° (Grid)

Angle: -45°

Depth: 550'4"

00 - 265'	Fine grained grey greywackes with minor grey shale. Weathered and brecciated in places. Chlorite, calcite and ankerite on joints. Prominent zone of faulting 20' and 64'3" $1\frac{1}{4}$" aplite dyke at 205'3". Abundant thin irregular quartz-chlorite-actinolite veins.
265' - 331'6"	Brownish greywackes and shale. Light green, grey and pink "chert" containing disseminated pyrrhotite. Some thin actinolite veins and veinlets of pyrrhotite and chalcopyrite.
331'6"- 405'2"	Garnet diopside epidote with some "chert" bands. Some magnetite actinolite and pyrrhotite.
405'2"- 463'	Brown and green altered greywackes and shales. Some chert bands and some disseminated pyrrhotite. Occasional bands of magnetite and actinolite.
463' - 550'4"	Largely medium grained greywackes. Fairly well bedded with graded units.

ASSAYS

From	To	Core Length	Assay %Sn.	Assay %Cu.
330'6"	408'6"	78'0"	0.05	0.4

SUMMARY OF D.D.H. 2/5

D.D.H. No. 2/5

Location: No. 2 Anomaly Zone - Section 10.1E

R.L. 1887

Co-ords of collar 2076N 3853E

Bearing 019° (Grid)

Angle -65°

Depth 589'4"

00	- 403'2"	Generally greywacke with subordinate grey shale. Weathered and brecciated in places with occasional very sparse sulphide mineralisation and occasional to swarms of very narrow quartz-actinolite and quartz-chlorite veins or stringers. Chlorite and carbonates on joints. Slumped bedding in evidence between 371' - 386'.
403'2"	- 518'5"	Generally grey-green f.g., greywacke with shale and cherty bands. Occasional disseminated pyrrhotite. In places bedding parallel with core or overturned.
518'5"	- 589'4"	Lode formation variably mineralised with magnetite, actinolite, tourmaline, pyrrhotite and sparse arsenopyrite and chalcopyrite - interspersed with chert bands and carbonate and chlorite veinlets and garnet epidote diopside near end of hole.

NOTE: Hole 2/5 was suspended at 589'4" to allow drill to be shifted to hole 2/6 at O'Briens Adit area whilst helicopter was available.

ASSAYS

From	To	Core Length	Assay % Sn.	Assay % Cu.
518'5"	- 575'5"	57'0"	0.11	0.05
575'5"	- 589'4"	13'11"	0.06	0.04

SUMMARY OF D.D.H. No. 2/6

D.D.H. No. 2/6

Location:	No. 2 Anomaly Zone - Section 10.8W
R.L.:	2055'
Co-ords of Collar	2932.9N 1877.35E
Bearing:	019° (Grid)
Angle:	-45°
Depth:	242'

00 - 105'4"	Largely grey shales and fine grained grey greywackes. Prominent fault zone between 31'4" and 41'5". Some alteration and microfaulting around 100 ft. Development of some andalusite and cordierite.
105'4" - 242'	Aplite followed by layered prophyritic microadamellite becoming coarser at depth. Minor syenite dykes and xenoliths. Tourmaline - quartz - pyrite veins fairly common.

SUMMARY OF D.D.H. 2/7

D.D.H. No. 2/7

Location: No. 2 Anomaly Zone and Section 9.4W

R.L. 2053

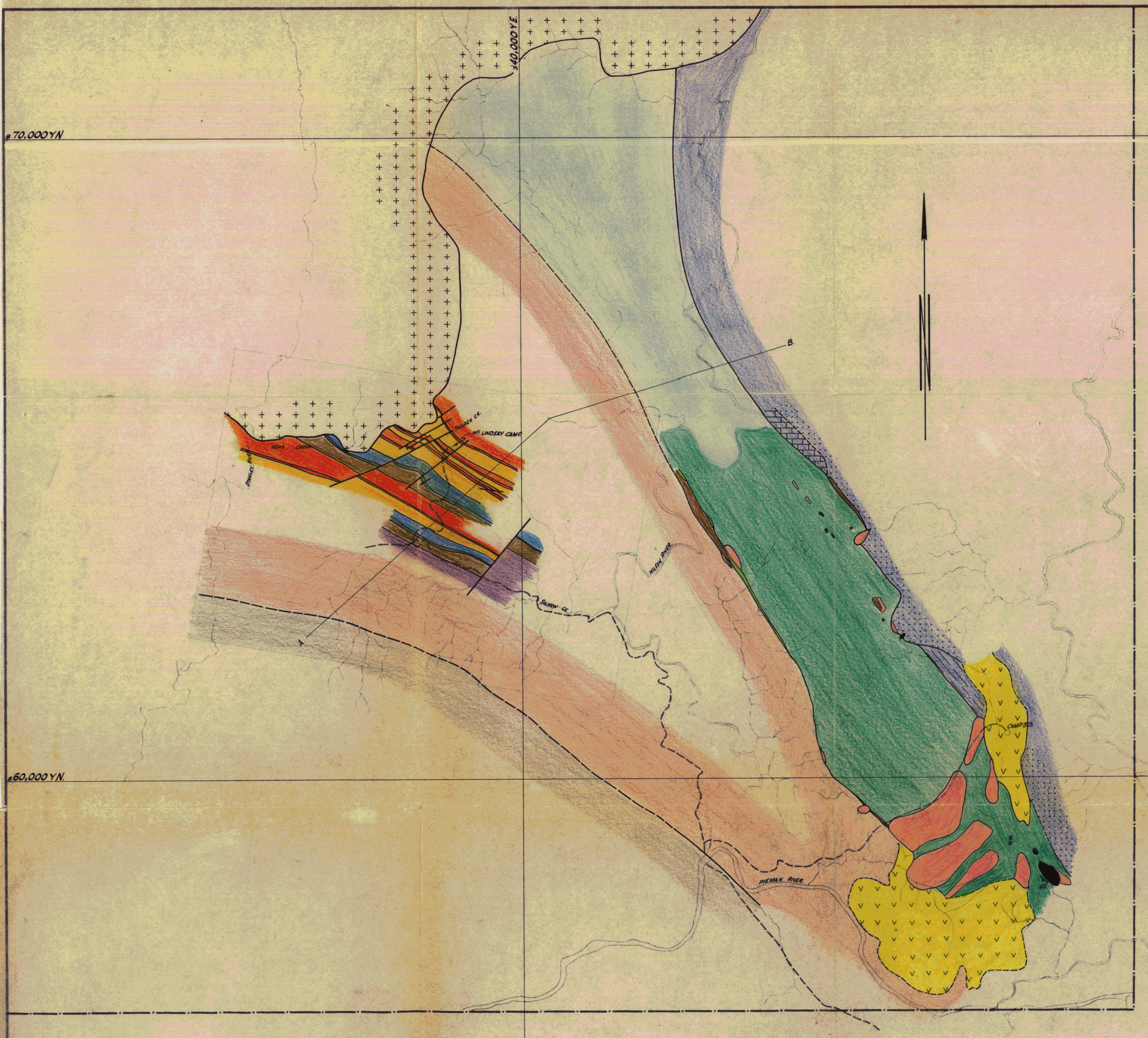
Co-ords of collar: 2928N 1885E

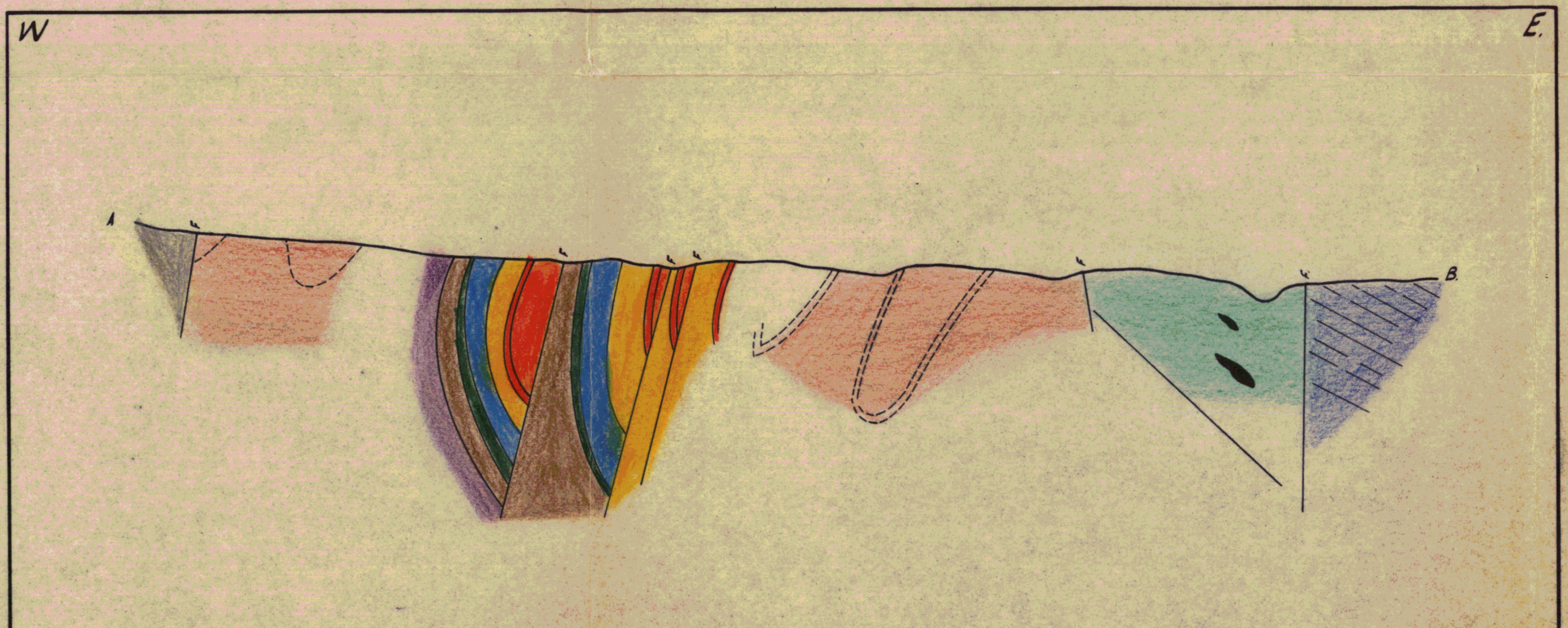
Bearing: 073° (Grid

Angle: -38°

Depth: 300'

00 - 173'3"	Fine grained grey greywackes and grey shales 6" fault zone at 32'4". Some alteration at depth and development of cordierite and andalusite in a few places. Some aplite dykes and quartz-tourmaline veins.
173'3" - 300'	Fine grained slightly porphyritic biotite adamellite with some coarse grained biotite adamellite and granite. Abundant quartz and tourmaline patches and veins.





IDEALIZED CROSS SECTION

LEGEND

PLEISTOCENE	V	GLACIAL MORAINE
MIOCENE		LATERITE
DEVONIAN		FLORENCE SANDSTONE
SILURIAN		LIMESTONE AMBER SLATE
		GREY SHALE
		UNDIFFERENTIATED SILURIAN & DEVONIAN SEDIMENTS
CAMBRIAN MT. LINDSAY AREA		PARSONS HOOD BEDS
		O'BIENS FORMATION
		TULLOCH FORMATION
		MT. LINDSAY FORMATION
		ALSTON VOLCANICS
		NEAGLE BEDS
		SALMON CREEK BEDS
		UNDIFFERENTIATED (?) CAMBRIAN SEDIMENTS
PRE-CAMBRIAN		OONAH QUARTZITE
IGNEOUS ROCKS		
DEVONIAN-CARBONIFEROUS	+	MEREDITH GRANITE
CAMBRIAN		SERPENTINITE
		PYROXENITE
		AMPHIBOLITE
		BASIC IGNEOUS ROCKS
		UNDIFFERENTIATED BASIC & ULTRABASIC ROCKS.

SCALE OF FEET

5 cm

69-600

ABERFOYLE TIN DEVELOPMENT PARTNERSHIP

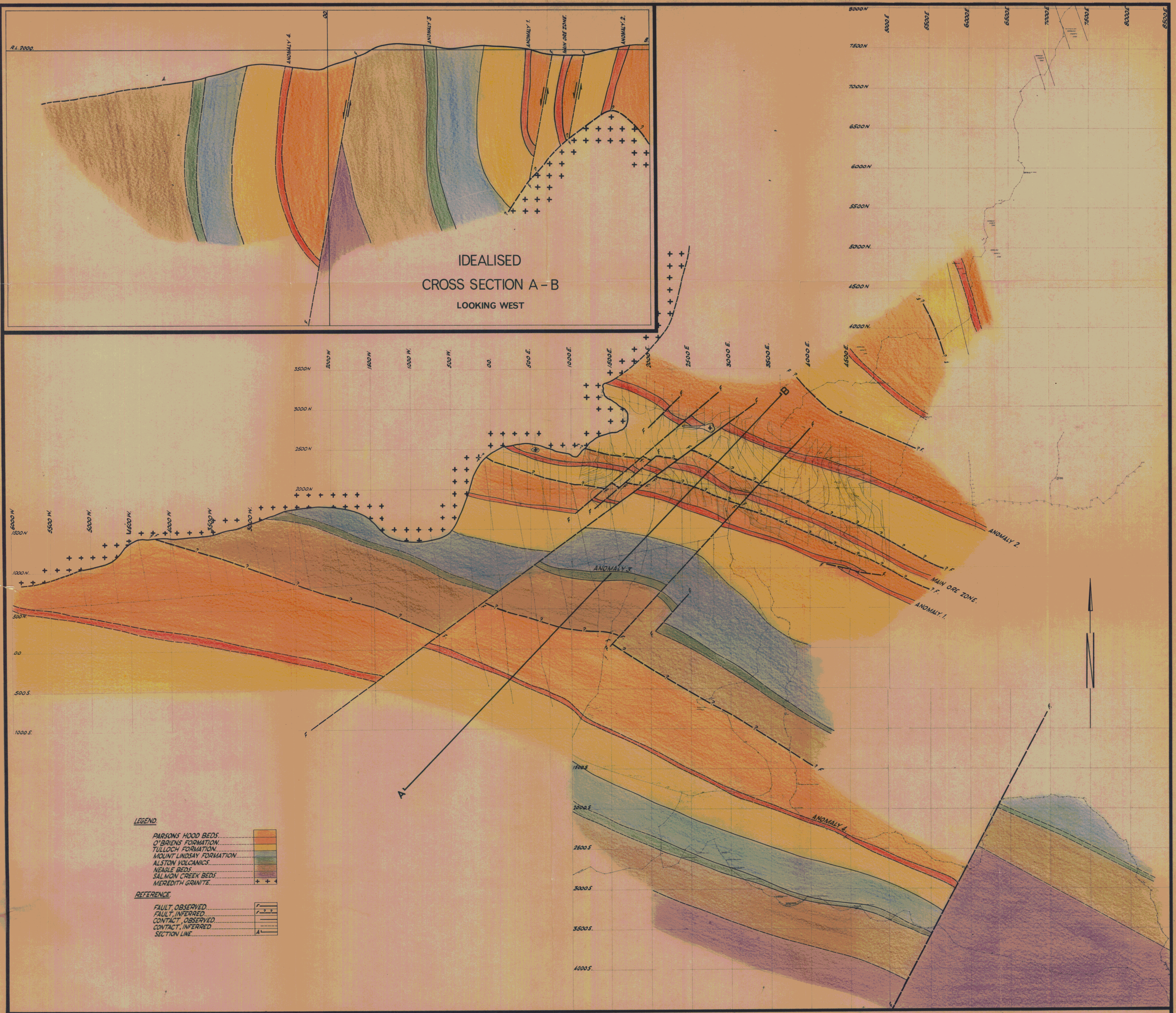
INTERPRETIVE GEOLOGICAL MAP AND SECTION
MT. LINDSAY-WILSON RIVER AREA
TASMANIA

040018

SURVEY – – / /
GEOLOGY – A.JESSUP. ET.AL. – / /68-69.
ENGINEERING – – / /
DRAWN – C.B/AJ. – 1 / 5 / 69
TRACED – CB/NW. – 1 / 5 / 69.
REFERENCE –
PRINT No. –

DRAWING No. – L-69-1 3437

DRAWER



SCALE OF FEET

5 cm

ABERFOYLE TIN DEVELOPMENT PARTNERSHIP

MOUNT LINDSAY TIN PROSPECT

GEOLOGICAL INTERPRETATION

SURVEY – – / /
GEOLOGY – A. JESSUP. – 10 / 5 / 69.
ENGINEERING – – / /
DRAWN – C. BOYD. – 14 / 5 / 69
TRACED – – / /
REFERENCE – 3438
PRINT No. –

DRAWING No.- L - 69 - 2

040049

DRILLING SCHEDULE 1968 - 1969

HOLE No.	CO-ORDS		R.L. COLLAR	BEARING (GRID)	ANGLE	TARGET ZONE	FINAL DEPTH
	N	E					
2/1	2466·11	3134·52	1852·00	19°	-35°	60'-230'	350'
2/2	2380·22	3104·71	1840·00	19°	-45°	170'-340'	479'
2/3	2172·72	3875·19	1902·80	19°	-35°	40'-300'	385·5'
2/4	2076·00	3853·00	1887·00	19°	-45°	130'-420'	550'
2/5	2076·00	3853·00	1887·00	19°	-65°	450'-550'	590'
2/6	2933·00	1877·00	2055·00	19°	-45°	230'-370'	242'
2/7	2928·00	1885·00	2053·00	73°	-38°	± 300'	300'

100 75 50 25 0 100 200 300

SCALE OF FEET

5 cm

LEGEND

- TREND OF SELF-POTENTIAL ANOMALY
- MAGNETIC ANOMALY >15000 γ
- TIN ANOMALY 201–300 p.p.m.
- TIN ANOMALY 301–500 p.p.m.
- TIN ANOMALY >500 p.p.m

ABERFOYLE TIN DEVELOPMENT PARTNERSHIP

MT. LINDSAY TIN PROSPECT

N°2 ANOMALY ZONE
PLAN OF DRILLING LAYOUT

LEGEND

- COPPER ANOMALY 251–350 p.p.m
- COPPER ANOMALY 351–500 p.p.m
- COPPER ANOMALY >500 p.p.m.
- ADAMELLITE OUTCROP
- INFERRED ADAMELLITE OUTCROP

040050

SURVEY	— A. FRASER / H.S. FRASER	— / /
GEOLOGY	—	— / /
ENGINEERING	—	— / /
DRAWN	— GEODRAFTING SERVICES PTY. LTD.	— / /
TRACED	—	— / /
REFERENCE	—	
PRINT No.	—	

3439

DRAWING No. – L – 69 – 4

DRAWER:

100' 0 100 200'
SCALE OF FEET

5 cm

- TREND OF SELF-POTENTIAL ANOMALY
- MAGNETIC ANOMALY 71500 γ
- TIN ANOMALY 201-300 p.p.m.
- TIN ANOMALY 301-500 p.p.m.
- TIN ANOMALY >500 p.p.m.

MOUNT LINDSAY
No 2 ANOMALY ZONE
DRILL SECTIONS.

- COPPER ANOMALY 251-350 p.p.m.
- COPPER ANOMALY 351-500 p.p.m.
- COPPER ANOMALY >500 p.p.m.
- ADAMELLITE OUTCROP
- INFERRED ADAMELLITE OUTCROP.
- ARSENIC ANOMALY.

040051

SURVEY — FRASER AND JESSUP — / /
GEOLOGY — A. JESSUP — / /
ENGINEERING — — / /
DRAWN — C L BOYD — 2 / 4 / 69
TRACED — — / /
REFERENCE —
PRINT No. —

DRAWING No.-L-69-5 3440

DRAWER:

ABERFOYLE TIN DEVELOPMENT PARTNERSHIP

MT. LINDSAY TIN PROSPECT

COPPER GEOCHEMICAL CONTOUR PLAN

SHEET ON-OE

LEGEND.

0	0 - 70 p.p.m.
1	71 - 100 p.p.m.
2	101 - 150 p.p.m.
3	151 - 200 p.p.m.
4	201 - 250 p.p.m.
5	251 - 350 p.p.m.
6	351 - 500 p.p.m.
7	>500 p.p.m.

69-600

SURVEY —	A. FRASER H. S. FRASER	— / 4 /68.
GEOLOGY —	A. JESSUP.	— / 4 /69.
ENGINEERING —		— / /
DRAWN —	GEODRAFTING SERVICES PTY. LTD.	— 13 / 4 /69.
TRACED —	N.W./C.B.	— 30 / 4 /69.
REFERENCE —		3441
PRINT No. —		

DRAWING No. – L – 69 – 21

DRAWER :

040052

100 0 100 200
SCALE OF FEET

5 cm

LEGEND
0 ------ 0 - 70 p.p.m.
1 ------ 71 - 100 p.p.m.
2 ------ 101 - 150 p.p.m.
3 ------ 151 - 200 p.p.m.
4 ------ 201 - 250 p.p.m.
5 ------ 251 - 350 p.p.m.
6 ------ 351 - 500 p.p.m.
7 ------ > 500 p.p.m.

ABERFOYLE TIN DEVELOPMENT PARTNERSHIP

MOUNT LINDSAY TIN PROSPECT

COPPER GEOCHEMICAL CONTOUR PLAN

SHEET 1S-OE

040053

SURVEY — E. ESHUYS/A. JESSUP — /4/68
GEOLOGY — A. JESSUP — /2/69
ENGINEERING — — / /
DRAWN — A.J./C.B — 28/4/69
TRACED — N.W. — 28/4/69.
REFERENCE —
PRINT No. —

DRAWING No. — L-69-22 3442

DRAWER:

100 75 50 25 0 100 200 300
SCALE OF FEET

5 cm

ABERFOYLE TIN DEVELOPMENT PARTNERSHIP

MT. LINDSAY TIN PROSPECT

TIN GEOCHEMICAL CONTOUR PLAN

SHEET ON-OE

LEGEND.

0 ------ 0 - 20 p.p.m.
1 ------ 21 - 40 p.p.m.
2 ------ 41 - 60 p.p.m.
3 ------ 61 - 100 p.p.m.
4 ------ 101 - 200 p.p.m.
5 ------ 201 - 300 p.p.m.
6 ------ 301 - 500 p.p.m.
7 ------ 7 500 p.p.m.

040054

69-600

SURVEY	–	A. FRASER H.S. FRASER	– / 4 / 68
GEOLOGY	–	A. JESSUP.	– / 4 / 69.
ENGINEERING	–		– / /
DRAWN	–	GEODRAFTING SERVICES PTY. LTD.	– 13 / 4 / 69.
TRACED	–	C.B.	– 10 / 5 / 69.
REFERENCE	–		3443
PRINT No.	–		

DRAWING No. – L – 69 – 23

DRAWER :

100 0 100 200
SCALE OF FEET

5 cm

LEGEND.
TIN
0 ------ 0 - 20 p.p.m.
1 ------ 21 - 40 p.p.m.
2 ------ 41 - 60 p.p.m.
3 ------ 61 - 100 p.p.m.
4 ------ 101 - 200 p.p.m.
5 ------ 201 - 300 p.p.m.
6 ------ 301 - 500 p.p.m.
7 ------ > 500 p.p.m.
TIN CONTOUR SHOWN THUS:- 3

ABERFOYLE TIN DEVELOPMENT PARTNERSHIP

MOUNT LINDSAY TIN PROSPECT

ARSENIC AND TIN GEOCHEMICAL CONTOUR PLAN

SHEET 1S-OE

LEGEND.
ARSENIC
0 ------ 0 - 30 p.p.m.
1 ------ 31 - 60 p.p.m.
2 ------ 61 - 100 p.p.m.
3 ------ 101 - 150 p.p.m.
4 ------ 151 - 250 p.p.m.
5 ------ 251 - 350 p.p.m.
6 ------ 351 - 500 p.p.m.
7 ------ > 500 p.p.m.
ARSENIC CONTOUR SHOWN THUS:- 3

SURVEY	—	E. ESHUYS/A. JESSUP	— 1 / 4 / 64
GEOLOGY	—	A. JESSUP	— 1 / 2 / 69
ENGINEERING	—		— / /
DRAWN	—	A.J./C.B.	— 28 / 4 / 69
TRACED	—	N.W.	— 28 / 4 / 69.
REFERENCE	—		
PRINT No.	—		

DRAWING No. – L·69·24 3444

040055

DRAWER:

100 75 50 25 0 100 200 300
SCALE OF FEET

5 cm

ABERFOYLE TIN DEVELOPMENT PARTNERSHIP

MT. LINDSAY TIN PROSPECT

ARSENIC GEOCHEMICAL CONTOUR PLAN

SHEET ON-OE

LEGEND.

0 — 0 - 30 p.p.m.
1 — 31 - 60 p.p.m.
2 — 61 - 100 p.p.m.
3 — 101 - 150 p.p.m.
4 — 151 - 250 p.p.m.
5 — 251 - 350 p.p.m.
6 — 351 - 500 p.p.m.
7 — 7 500 p.p.m.

040056

SURVEY —	A FRASER H.S. FRASER	— / 4 /68
GEOLOGY —	A.J.	— 13/ 4 /69.
ENGINEERING —		— / /
DRAWN —	GEODRAFTING SERVICES PTY LTD.	— 10/ 4 /69.
TRACED —	C.B./N.W.	— 29/ 4 /69.
REFERENCE —		
PRINT No. —		

3445

69-600

DRAWING No. – L – 69 – 25

DRAWER :

100 FT. 50 25 0 100 200 300
SCALE OF FEET

ABERFOYLE TIN DEVELOPMENT PARTNERSHIP

MT. LINDSAY TIN PROSPECT

SELF POTENTIAL PLAN

SHEET ON-OE

Note:- ALL VALUES RELATIVE TO A VALUE OF O ON LINE 6·8E 200S.
A TOPOGRAPHIC CORRECTION FACTOR OF 0·5 M.V. PER VERTICAL FOOT HAS BEEN APPLIED TO ALL READINGS.
CONTOUR INTERVAL IS 25 MILLIVOLTS.

040057

SURVEY — A. FRASER, H. S. FRASER — / /
GEOLOGY — A. JESSUP. — / /
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DRAWN — GEODRAFTING SERVICES PTY LTD. — / /
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REFERENCE —
PRINT No. —

DRAWING No. — L — 69 — 26 3446

DRAWER :