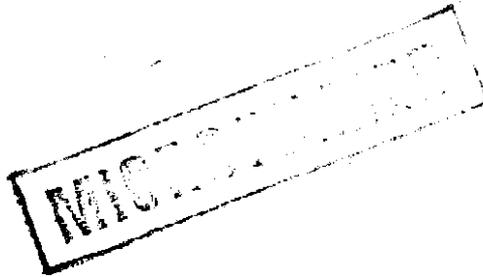


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ST.DIZIER AREA

PROGRESS REPORT TO JULY 1981

PRB

By: P. Roberts
Exploration Geologist

August 31st, 1981

Copies to: Renison (2)
Apollo International Minerals N.L. (1)
Mines Department (1)

S U M M A R Y

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Following the recommendations of the February 1980 Progress Report, a program of diamond drilling and detailed geological mapping was completed in December, 1980. Two holes, totalling 810m, were diamond drilled in the eastern part of the deposit; both intersected stanniferous mineralization.

Compilation of the new geological mapping and all diamond drillhole data has resulted in a changed geological interpretation: the granite-sediment contact is now thought to be trough-shaped beneath the skarn zone, with the trough axis plunging shallowly eastward. Following this re-assessment, the deposit's potential size is estimated to be 2.5 - 3 million tonnes of 0.5 to 0.7% Sn.

Preliminary metallurgical testwork has shown that, although the ore should be difficult to treat, production of a low grade concentrate, suitable as fuming plant feed, may be possible. Further testwork is in progress.

A 1000 to 1500m diamond drilling program is now underway. The first two holes are targeted at deep skarn mineralization in the eastern part of the leases. Further drilling proposals are dependant on the result of the Mining Lease application pending over an area adjacent to the eastern lease.

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1. INTRODUCTION

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The St. Dizier deposit is a stanniferous magnetite skarn which occurs within hornfelsed sediments on the northern margin of the Devonian Heemskirk Granite. It is located about 18 km W.N.W. of Zeehan, West Tasmania (Figure 1).

The property has been actively explored since the early 1960's primarily by four companies: Placer Prospecting, Minops, Cominco Exploration and the current Renison - Apollo Joint Venture. The first three companies carried out a series of geochemical and geophysical surveys, and completed twenty nine (29) diamond drillholes. To the end of July 1981, Renison has spent \$203,609 on exploration at St. Dizier (Appendix 1), mainly through the completion of seven (7) diamond drillholes for a total depth of 2197m. Under the terms of the Joint Venture Agreement Renison will have earned a 51% interest in the prospect when it has spent \$250,000. This figure should be reached at the end of September this year by expenditure on the drilling program now in progress.

This report describes the work carried out between March 1980 and July 1981 and includes an assessment of the deposit's potential size.

2. LAND TENURE

The property is covered by three mining leases, 13M/59, 16M/62 and 17M/62, each of 8.0 ha. Until recently these leases were held by Mr. Roy Laffer of Zeehan. Under the terms of an Option to Purchase Agreement between Mr. Laffer and Apollo (formerly Minops) the Option has been exercised and the leases are now held by Apollo. The ground surrounding the leases is part of Exploration Licence 47/71 held by Gippsland Minerals, and is currently subject to a Joint Venture Agreement between that company (30%) and Aberfoyle (70%).

3. WORK COMPLETED MARCH 1980 TO JULY 1981

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3.1 Geological Mapping

Detailed outcrop mapping has been carried out over most of the leases at 1: 1000 scale. Outcrop is generally scanty, particularly within the skarn zone, however a combination of outcrop and structural data from the footwall and hangingwall rocks limits the skarn's surface trace to within 20m along most of its length.

The attached interpretative geology map (Figure 2) was compiled by combining factual geology data and diamond drillhole information.

3.2 Diamond Drilling

Two diamond drillholes, designed to test the skarn zone at depth in the eastern part of the leases, were completed in October - December 1980, for a total of 810m.

As with the previous drilling program, it was decided to drill HQ or NQ triple tube to keep core losses at a minimum. As a result, core recovery in both holes exceeded 96% overall.

Both holes were surveyed by a down-hole single shot camera, and their collar positions and orientations determined by Renison surveyors while the drill was still in position. Examination of down-hole survey information from both these holes and those of the previous program reveals a tendency for holes to "deviate" west near the skarn before "returning" to their original bearing near the hole end. This tendency may result from the mineralized skarn (which is essentially a sheet of magnetite-bearing rock) affecting the compass in the down-hole survey instrument to a progressively larger degree with

proximity to the skarn.

Detailed drill logs, together with petrological descriptions are attached (Appendix 2). Cross sections are presented in Figure 3. Hole details are as follows:

3.2.1 D.D.H. SD14

This hole, 387.2m long, was designed to test the skarn zone approximately 175m below surface beneath Cominco drillhole SD6 (which contained approximately 2m true thickness of 0.78% Sn). In the event, the hole shallowed and apparently deviated west. It intersected approximately 50m (t.t.) of skarn of which 15m (t.t.) near the hangingwall contained magnetite mineralization. The latter included 3m (t.t.) of 0.74% Sn (0.62% acid soluble) and 4m (t.t.) of 0.10% Sn (0.09% acid soluble) and 1.41% Zn directly adjacent to one another, approximately 145m below surface.

Petrological work by Central Mineralogical Services (Appendices 2 and 3) identified pageite and ultrafine (<2µm) cassiterite as the tin-bearing phases but other acid soluble tin minerals may be present.

3.2.2 D.D.H. SD15

This hole, 422.8m long, was designed to test the skarn zone at depth close to the eastern limit of the mining leases. The true thickness of skarn intersected was again about 50m. Of this 28m (t.t.) contained magnetite mineralization, including 26m (t.t) of 0.47% Sn (0.19% acid soluble) and 0.06% WO₃.

The hole intersected 130m of granite enclosed by hangingwall sediments before intersecting the skarn zone, as well as stopping in granite on

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the footwall side of the skarn. The first granite intersection was quite unexpected and has changed the overall interpretation of the granite-sediment contact: it is now thought to be trough-shaped with the skarn occupying the deepest part of the trough throughout the deposit (Figures 3 and 4).

Petrological work by C.M.S. (Appendices 2 and 3) again identified pageite and fine cassiterite as the tin-bearing phases, however subsequent detailed microprobe studies by AMDEL on a crushed drillcore sample from 303.0 to 304.0m indicated a further tin mineral, schoenfliesite, which has a chemical formula of $MgSn(OH)_6$ and cubic crystallography (K. Henley, pers. comm.). AMDEL's work on this sample is still in progress.

3.3 Detailed Petrology - Tasmanian Mines Department

A detailed petrological investigation of the St. Dizier skarn by J. Everard of the Tasmanian Mines Department has now been in progress for about 18 months. The aim of this work is to understand the genesis of the skarn.

To date, one interim report has been received, together with a series of detailed petrological descriptions. Both are attached (Appendix 3). In addition one microprobe analysis of hulsite was reported (J. Everard, pers. comm.); this included approximately 2.5% Sn.

3.4 Metallurgical Testwork

A total of six samples of crushed drillcore rejects were subjected to mineral separation tests. At the same time a seventh sample (Sample A) was sent to AMDEL for detailed petrological examination (see 3.2.2 above). Sample details are tabulated overleaf:

SAMPLE	D.D.H.	INTERSECTION	%Sn	% ACID SOLUBLE Sn	% WO ₃	% Fe	SAMPLE WEIGHT (g)
A	SD 15	303-304m	2.96	2.30	0.04	N/A	521
B	SD 10	224-225m	0.76(?)	0.86(?)	0.18	16.3	975
C	SD 13	215-216m	1.45	0.56	0.08	26.3	405
D	SD 14	201-202m	0.99(?)	1.09(?)	0.05	20.5	557
E	SD 15	266-267m	1.03	0.45	0.11	36.1	578
F	SD 15	302-303m	0.91	0.68	0.01	46.3	710
G	SD 13	206-211m	0.57	0.31	N/A	18.6	2175

The above assays were all obtained from the samples tested to avoid any possibility of mix-ups.

Samples B to F were initially reduced to -300 μ m. They were then separated into three size fractions: -300/+106 μ m., -106/+38 μ m and -38 μ m. The coarser two fractions of each sample were then subjected to Davis Tube magnetic separation. Subsequently the -38 μ m fraction of Sample B was also magnetically separated, after the -6 μ m material had been removed by cyclosizing. Each product was assayed for % Sn, acid soluble Sn, Fe and, where there was sufficient sample, WO₃. Details of the results are attached (Appendix 4). This work indicated that:

- (1) the proportion of total tin in the non-magnetic products is higher in the finer size fractions than the coarser ones i.e. tin minerals in composite with magnetite are probably liberated by finer grinding.
- (2) the distribution of acid soluble tin in the products parallels that of total tin, suggesting that the cassiterite and acid soluble tin phases have similar grainsize and/or mineral association.
- (3) the sampler sizes were too small to assess the tin distribution on a wider range of magnetically separated size fractions.

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As a result of the third conclusion, sample G was obtained. It was separated into sixteen (16) size fractions ranging from -6 μ m to +1200 μ m. Each fraction (except - 6 μ m) was subjected to magnetic separation and each product was assayed for %Sn, acid soluble Sn and Fe. Details of the results are attached (Appendix 4).

X The metallurgical features of sample G are particularly interesting because the mineralization from which the sample was obtained contains "dizierite", a tin-manganese-iron oxide (Fander, 1980). The testwork indicated that, in Sample G:

- (1) in size fractions coarser than 600 μ m, the magnetic fraction contains 94% of the tin.
- (2) in size fractions finer than 53 μ m, the non-magnetic fraction contains 75% of the tin.

These results suggest that, for sample G at least, a coarse grind followed by magnetic separation, followed by a fine grind of magnetic concentrate and a second magnetic separation may concentrate around 70% of the tin into a non-magnetic product.

A bulked sample of the magnetic products from the +425 μ m size fractions in sample G has now been obtained and reduced to -75 μ m. It is currently being subjected magnetic separation and analysis of the resultant products.

Y Two magnetic products from the initial testwork, the +106/-300 μ m fractions of samples B and C were sent to AMDEL for microprobe identification of the tin minerals present. The AMDEL work indicated that tin is present as a tin-manganese-iron mineral (probably identical to the "dizierite" described by Fander) with a grainsize range of 2 to 50 μ m, and lesser cassiterite up to 20 μ m in grainsize (see Appendix 3).

4. GEOLOGY

4.1 Stratigraphy

The sequence at St. Dizier comprises hornfelsed siltstone and shales, skarn-carbonate rocks, quartzites and sandstones, all within Upper Proterozoic Oonah Formation. Cross-bedding in tourmalinized quartzites indicates that the succession youngs from south to north. The sequence has been subdivided into three units:

4.1.1 Footwall Slates

These are largely dark grey, chiastolite - bearing hornfelsed siltstones and shales. They are partly micaceous (muscovite) and graphitic and include interbeds of calc-silicate and carbonate particularly near their contact with the skarn zone. In the south-east corner of the lease area, these rocks merge into tourmalinized quartzites and sandstones - this probably reflects a transgressive facies change.

Minor stanniferous sulfide mineralization occurs within this unit in the western part of lease 16M/62. The occurrence has been tested by trenching and several drillholes, and is evidently impersistent and closely related to the granite contact.

4.1.2 Skarn-Carbonate

Where unmineralized, this unit comprises a serpentinous marble that probably originated as a dolomite which was converted to a forsterite-bearing marble by contact metamorphism.

Where it has been converted to skarn, the unit consists of various amounts of serpentine, magnetite, talc, diopside, tremolite, chlorite,

phlogopite, clinohumite, chondrodite and pyrrhotite. Tin occurs as cassiterite, hulsite, "dizierite" and schoenfliesite. These minerals are all associated with magnetite, however tin-barren magnetite skarn also exists.

This unit is interbedded in places with non-carbonate sediments, particularly around 345100E, where the skarn zone is split by thick lenses of hornfels and quartzite.

4.1.3 Hangingwall Quartzites

These are pale brown, pale grey and white quartzites and sandstones. Tourmalinization is common and has generally resulted in a banded rock with tourmaline (dravite)-rich and quartz-rich bands. Close to granite, this rock type is characteristically enriched in Ti-biotite and veined by microgranite. It includes interbeds of partly hornfelsed siltstones and calc-silicates.

It appears that very minor cassiterite mineralization occurs in quartz and tourmaline veins within this unit, particularly in the north-east portion of the leases. Assays of diamond drillcore and adit wall samples from this area indicate that no economically significant mineralization of this kind is present within the lease area, however.

4.2 Granite-Sediment Contact

Prior to the 1980 drilling program it was thought that this contact dipped northwards with a shallow to moderate dip (Newnham, 1980). As mentioned previously (section 3.2.2.), the first granite intersection in D.D.H. SD15 led to a revision of this interpretation. Contouring of granite-sediment R.L. positions from the diamond drillhole

logs reveals that the new interpretation - a trough-shaped contact with trough axis plunging shallowly east - fits all of the data convincingly (Figure 4). The interpretation is based on relatively few data points, however, and some other explanation may still be possible. If it is correct, it adds St. Dizier to the large list of skarns which have formed in granite embayments.

4.3 Structure

4.3.1 Folding

On a broad scale, the sequence dips vertically and strikes approximately E - W. Dips vary from steep N to steep S, and the strike swings from E.S.E. in the western end of the leases to E - W in the east. In some areas the hangingwall quartzites are intensely contorted but, in general bedding orientation is quite regular.

4.3.2 Faulting

Surface mapping suggests that the skarn is not offset significantly within the leases, however two faults are recognized:

- (1) a vertical fault striking NW is interpreted as offsetting the skarn within D.D.H. SD 13 because:
 - a) the true thickness of skarn intersected in SD 13 is unusually large,
 - b) there is a small topographic indentation in the northern strike ridge of Hangingwall Quartzites suggestive of a fault or fold movement on the skarn-hangingwall contact, and
 - c) there is a 1.0m cavity at 289.0 - 290.0m in SD 13 which could be a fault intersection.

(2) a fault striking N. to N.N.E. is interpreted at the eastern end of the leases. Horizontal movement appears to be limited but the fault's presence is indicated by a large breccia zone in D.D.H. SD6,^{and} a possible fault-thinning of the skarn in D.D.H. M2. The fault apparently strikes N.N.E. along a small gully in the hangingwall quartzites, and swings N-S through the skarn and footwall rocks.

5. ORE POTENTIAL ESTIMATE

An ore potential estimate was made to aid assessment of the economic value of this deposit. The tonnage figure was derived from drillhole data that is either widely spaced or considered somewhat unreliable because of a combination of poor core recoveries, inadequate drill logs, lack of down-hole surveys and (in the case of the Placer data) dubious assay techniques. This estimate is therefore a possible ore figure only, as defined by the Aus. I.M.M. Joint Committee on Ore Reserves Report (1972). It is not an ore reserve estimate and should not be quoted as such.

The estimate was made using a longitudinal projection of the deposit (Figures 5 and 6). In contrast with conventional longitudinals, which have a constant strike, this projection varies in strike so that, at any point, its strike is parallel to that of the skarn (see Figure 4). If this had not been done, it would have been necessary to adjust the tonnage figure to compensate for projecting a curved body on to a flat plane. The only mineralization considered was stanniferous magnetite skarn. The tin-bearing sulfide mineralization noted in the footwall rocks (see Section 4.1.1) appears to be minor and was therefore ignored, as were any concentrations of metals other than tin which are present in patches within the skarn (ie. tungsten, zinc, copper). The skarn is, of course, a low grade iron orebody

but the complete absence of iron assays in any drillholes prevents any assessment of its iron ore potential.

It can be easily demonstrated that a volume calculated by multiplying the horizontal thickness of a slab by its projected area on a longitudinal projection is the same as the true volume of the slab. Horizontal thicknesses of complete ore intersections were therefore calculated (Figure 5). Each intersection was projected at its mid-point on to the longitudinal projection.

Areas of influence for each drillhole were mostly assigned by a polygonal block method, in which polygon sides are constructed from perpendicular bisectors of lines between adjacent holes. Some geological bias was introduced, however, especially at the outer limits of mineralization. A cut-off grade of 0.4% Sn was assumed. Specific gravity was estimated at 3.4 on the assumption that stanniferous mineralization comprises 70% serpentine-carbonate-talc-chlorite (s.g. 2.8), 20% magnetite (s.g. 5.2) and 10% sulfide (s.g. 4.7); this is fairly conservative as magnetite content is probably higher, however the figure does not allow for porosity.

The following assumptions were made:

- (1) that mineralization occurs in three tabular bodies oriented near parallel to bedding: a small western body in a centre skarn to near footwall position, a central body also in a centre skarn to near footwall position and an eastern body in a near hangingwall position (Figures 5 (a) and (b)),
- (2) that earlier unsurveyed holes did not deviate sufficiently to materially affect the calculated tonnage,
- (3) that, notwithstanding core losses, the pre-Renison drillhole assay figures are representative of the true tin content of mineralized intersections.

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The calculated ore potential figure is 2.85 million tonnes of 0.62% Sn mineralization. Given the large uncertainties that exist at this stage it is more reasonable to say that the deposit has potential for 2.5 to 3.0 million tonnes of 0.5 to 0.7% Sn.

6. DISCUSSION AND CONCLUSIONS

The economic potential of the St. Dizier deposit depends primarily on three factors:

- (1) the metallurgical amenability of the ore,
- (2) the actual ore tonnage (as opposed to the deposit's potential), and
- (3) the metal content of the ore, not only as tin but also in other potentially recoverable and saleable minerals e.g. scheelite and magnetite.

It is clear that this mineralization is metallurgically difficult. The current approach is to mineralogically characterize the ore and develop a feasible metallurgical flowsheet. The aim is to produce a low-grade (5-10% Sn) concentrate with reasonable tin recovery (60% plus) with a view to feeding the concentrate to a tin fuming plant.

More drilling is necessary before any reserve estimate can be made. As a first step the hole spacing should be closed down to approximately 60 metres (Appendix 5, Figure 6). This should involve sixteen (16) diamond drillholes for a total of approximately 4000m.

None of the earlier drillcore was analysed for acid soluble tin, tungsten or iron. This means that, although we have some feel for the ore distribution within the deposit, we do not know much about either the variation in tin mineralogy or the distribution of potential by-products through the deposit.

7. CURRENT PROGRAM AND FUTURE WORK

7.1 At present a 1000 to 1500m diamond drilling program is underway at St.Dizier. A memorandum explaining the reasons for the first two drillholes is attached (Appendix 5). The work program additional to those drillholes will be affected by the result of the recent application for a fourth mining lease east of the current leases:

- (1) if the lease is not granted, one further hole should be diamond drilled. It should be collared in hangingwall quartzite and oriented to intersect the skarn at the "SD18" position shown on Figure 6. The target is the western limit of near hangingwall mineralization up-dip from an intersection of 3m (t.t.) of 0.44% Sn and 0.13% WO_3 in D.D.H. SD10 (Figure 7). The hole should also test the near-footwall position 60-80m down-dip from a thin, tin-barren, pyrrhotite-magnetite intersection in SD10 and east along strike from an intersection of 3m (t.t.) of 0.82% Sn in D.D.H. SD9. Estimated hole depth is 250m.
- (2) If the lease is granted:
 - (a) a rapid program of geological mapping, grid pegging, bedrock geochemistry and ground magnetics should be carried out. Lines should be pegged 100m apart and sampled at 25m intervals.
 - (b) three diamond drillholes should be completed on the new lease for a total depth of 830m. If the results of the reconnaissance program outlined in (a) above are available, they will influence any drilling proposals. If a reconnaissance program cannot be completed in time, the first of the three holes should be collared in footwall slates and oriented to intersect mineralized skarn 50m east along strike from the lease

boundary at 2025 RL. It is necessary to place the first hole quite close to the lease boundary because the skarn-granite contact appears to be "climbing" eastwards in this area. If it continues to do so further east, subsequent holes will have to be targeted at relatively shallow levels.

- 7.2 Detailed petrological and metallurgical studies should continue on this deposit. In future, only crushed rejects of mineralized drillcore will be submitted for petrological analysis. This should eliminate any problems caused by erratic tin distribution within the core. Given that the current AMDEL work will permit optical identification of all the tin phases, a quantitative comparison between tin assays and tin mineral content should be made for each sample submitted.
- 7.3 All mineralized intersections from the pre-Renison diamond drillcore should be quartered and assayed for % Sn, acid soluble Sn, As, Cu, Zn, Fe, S and WO_3 . Representative crushed reject samples should be submitted for petrological analysis as outlined in 7.2 (above). A series of bulked intersections should also be obtained for a complete trace element analysis.
- 7.4 The hole deviation problem mentioned in section 3.2 of this report should be resolved. Inquiries have been made concerning down-hole survey instruments unaffected by magnetic materials; these should be followed up.
- 7.5 A budget was prepared for the 1981-82 financial year (Appendix 1), assuming that a fourth lease would be granted, and, therefore, that the additional work outlined above would be carried out. Total planned expenditure is \$180,330. Should Apollo contribute to this program once Renison has spent an accumulated total of \$250,000, Apollo's share will be \$53,968.

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APPENDIX 1

EXPENDITURE BREAKDOWNS AND PROPOSED
BUDGET 1981-82

TOTAL EXPENDITURE TO END JULY, 1981

<u>ITEM</u>	<u>\$ EXPENDITURE</u>	<u>% OF TOTAL EXPENDITURE</u>
Salaries (including loading)	19393	10
Consumables	10804	5
Renison Services (Survey, Assay, Research, Vehicles)	17402	9
Travel and Accommodation	69	-
Diamond Drilling	144209	71
Site and Access Development	3871	2
Outside Services - Petrological	4371	2
Outside Services - Other (Drafting, Geophysical Equipment)	3418	2
Lease Payments	72	-
Rounding		-1
TOTAL:	<u>203609</u>	<u>100</u>

PROPOSED BUDGET 1981-82

<u>ITEM</u>	<u>\$ EXPENDITURE</u>	<u>% OF TOTAL EXPENDITURE</u>
Salaries (including loading)	34771	19
Consumables	4143	2
Renison Services (Survey, Assay, Research, Vehicles)	8409	5
Travel and Accommodation	851	-
Diamond Drilling	116534	65
Site and Access Development	2710	2
Outside Services - Petrological	11282	6
Outside Services - Other (Grid pegging, Soil Sampling, Drafting)	1630	1
TOTAL:	<u>180330</u>	<u>100</u>

APPENDIX 2

DIAMOND DRILL LOGS

DIAMOND DRILL RECORD

HOLE NUMBER : SD14

LOGGED BY : P.R.

INTERVAL (m)		RECOVERY		DESCRIPTION	FORM.	% Sn.										
FROM	TO	m	%			FROM	TO	TOTAL	ACID SOL.	% Cu.	% As.	% S.	% Pb.	% Zn.	% Bi.	g/t Ag
0.0	20.4	18.8	92	SANDSTONE White and pale grey, fine grained, bedded. Micaceous, quartz-rich bands alternate with lesser green-grey and brown bands consisting of massive chlorite (?) material containing occasional talc grains or rounded sandstone (?) grains in a replacive chloritic matrix. Intensely contorted with minor development of axial plane cleavage, feathery cleavage planes filled with chlorite or mica. Minor quartz veining. Frequent breaks along iron-stained or clay-coated joint surfaces. 11.7 - 14.9 Less contorted, BCA averages 15° to c.a. 14.9 - 20.4 More quartz veining cf. above, minor microfaulting. Includes soft clay veins at 17.4, 18.4m (VCA 40°). Olive green serpentine and grey talc spots 17.4-17.5m. Soft clayey and broken 19.6 - 19.8m. BCA averages 35°.												
20.4	22.2	1.8	100	The whole 54m. SANDSTONE Buff, fine grained, largely interbedded, friable. Grey talcy alteration along interbeds. Very badly broken along clay-covered joints.												
22.2	28.8	6.6	100	SANDSTONE AND QUARTZITE Pale grey-brown, laminated. Micaceous (muscovite) sandstone or quartzite interbedded with dark brown layers consisting largely of brown, finely acicular tourmaline. Quartz veined, vein thickness varies 0.5 - 10cm, occasionally with minor pyrite. Folded, BCA varies 0 - 40°.	25.0	26.0	0.01	0.01					0.001	<1	0.05	
								0.01	0.01				0.001	1	0.05	
								0.01	0.01				0.004	1	0.05	
28.8	31.0	2.2	100	SANDSTONE Pale grey-brown, fine grained, weakly laminated. BCA varies 20-45°. Broken along bedding planes.												
31.0	32.6	1.6	100	QUARTZITE Grey, bedded. BCA varies 20 - 35°. Partly altered to very soft, fine grained yellow material (weathered calc-silicate?).												
32.6	48.8	16.2	100	QUARTZITE AND SANDSTONE Quartzite- pale grey, comprising interbedded quartz-rich, and dravitic (?) tourmaline - rich bands, minor muscovite, minor pyrite in veinlets and/or on joint surfaces; quartzites change thin and wispy at top, both quartz-rich and tourmaline-rich bands downwards, tourmaline - rich bands become thicker towards bottom. Sandstones - lesser, pale brown, fine grained, massive, micaceous.	40.0	41.0	0.01	0.01					0.001	1	0.05	

020

020

DIAMOND DRILL RECORD

HOLE NUMBER : SD14

LOGGED BY : P.R.

020

INTERVAL (m)		RECOVERY		DESCRIPTION	FORM.	% Sn.										
FROM	TO	m	%			FROM	TO	TOTAL	ACID SOL.	% Cu.	% Al.	% S.	% Pb.	% Zn.	% Bi.	g/t Ag
				Rare quartz veins some with minor pyrite. BCA varies 35-60° averaging 45°. Broken along bedding and few joints.												
				47.1 - 48.8 Very badly broken with minor clay particularly 47.4 - 47.5m.												
				This section 36.9m.												
48.8	59.2	9.6	92	QUARTZITE AND MINOR SANDSTONE As above but sandstones contain small (0.5mm diameter) black dendrites, quartz veins more abundant (≤15mm thick) with minor pyrite. BCA averages 65°. Badly broken along iron-stained joints and bedding.												
59.2	70.2	8.0	73	SILTY CLAY Pale yellow brown and (lower 1.0m) mauve, featureless. Minor pyrite as disseminated small euhedra (≤0.5mm diameter) or in veinlets, rarely in larger, pod-like veins (≤1cm thick). Bottom 1.0m biotite-rich. 3.0m core loss.	58.0	59.0	<0.01	<0.01					0.003	1	0.05	
				64.2 - 64.3 concentration of disseminated pyrite.		60.0	<0.01	0.02					0.004	1	0.05	
				This section 61.5m.		61.0	<0.01	0.01					0.004	1	0.04	
70.2	76.4	6.2	100	QUARTZ SANDSTONE Pale mauve-brown, fine to medium grained, comprising quartz grains with varying amounts disseminated biotite. Various oriented veins (thickness ≤1mm to 1cm) of quartz-pyrite, pyrite and biotite. Largely unbedded except near silty interbed (?) at 73.8m where BCA (?) 25°. Broken along joints, mostly at 60-70° to c.a., with some breaks along pyrite or biotite veins at shallower angles.		62.0	<0.01	0.01					0.005	1	0.05	
				76.25 Thin vein of arsenopyrite, quartz and finely acicular tourmaline (?) VCA 65°.		63.0	<0.01	<0.01					0.005	1	0.04	
						64.0	<0.01	0.01					0.004	1	0.04	
						65.0	<0.01	<0.01					0.003	<1	0.04	
						66.0	<0.01	<0.01					0.003	1	0.04	
						67.0	<0.01	<0.01					0.005	<1	0.04	
						68.0	<0.01	<0.01					0.005	1	0.04	
						69.0	<0.01	<0.01					0.002	1	0.04	
						70.0	<0.01	<0.01					0.002	1	0.04	
						71.0	<0.01	<0.01					0.002	1	0.04	
						72.0	<0.01	<0.01					0.002	1	0.04	
						73.0	<0.01	<0.01					0.002	<1	0.04	
76.4	78.4	2.0	100	CALC-SILICATE OR ALTERED SILTSTONE (?) Pale yellow and mauve, soft, containing abundant disseminated biotite flakes (≤0.5mm) with very minor, disseminated, brown-black, equant grains of garnet (?) (≤1mm diameter). Minor irregular, pyrite veins, also very irregular, thin, green, micaceous and pyritic veins. Banded (possibly bedding), BCA (?) varying from 0° at 76.4m to 50 - 60° towards 78.4m.												
				76.6 - 77.0 Altered sandstone overlying a microgranite vein; with coarse dravitic tourmaline (VCA 80°) at 77.0m.												

60 027

DIAMOND DRILL RECORD

HOLE NUMBER : SD14

LOGGED BY : P.R.

INTERVAL (m)		RECOVERY		DESCRIPTION	FORM	% Sn												
FROM	TO	m	%			FROM	TO	TOTAL	ACID SOL	% Cu	% Ag	% Fe	% Pb	% Zn	% Bi	p/t Ag	% WO ₃	
78.4	88.4	10.0	100	BANDSTONE														
				Mauve, fine grained (almost d.g. siltstone). Abundant disseminated biotite, isolated, small, equant grains of garnet (?). Includes altered beds or veins in which rounded grains of cordierite (?) or greenish vesuvianite (?) are set in a biotite matrix. Numerous veins of topazized (?) pyritic microgranite (1-3cm thick), some containing coarse brown tourmaline, some halped by vesuvianite (?)/biotite alteration. Rare pyrite veinlets. Bedded, BCA 50-60°.		81.0	87.0	<0.01	<0.01						0.004	1	0.04	
							83.0	<0.01	<0.01						0.004	1	0.04	
							84.0	<0.01	<0.01						0.004	1	0.04	
							85.0	<0.01	<0.01						0.004	1	0.04	
							86.0	<0.01	<0.01						0.004	1	0.04	
							87.0	<0.01	0.01						0.004	1	0.04	
							88.0	<0.01	<0.01						0.004	1	0.04	
				85.4 - 88.4 Contains irregular quartz veins associated with relatively coarse grained biotite set in pale yellow and green, fine grained calc-silicate (?) lenses or veins 1cm thick.														
				This section fine.														
88.4	104.7	16.3	100	QUARTZ SANDSTONE														
				Grey to white, mauve-grey, medium grained, massive or faintly bedded. Variable amounts of biotite, disseminated and in veins. Minor pyrite in veinlets and/or coating joints, occasionally in flat rosettes. Minor veining of quartz and/or microgranite usually with black tourmaline. Rare brown-black tourmaline veinlets.														
				90.9 - 92.1 Siltstone and fine grained sandstone, mauve and pale yellow, including small lensoid veins of cream-coloured fine grained calc-silicate (?) with disseminated biotite.														
				92.6 - 94.4 Veined by yellow, fine grained calc-silicate (?) with disseminated biotite. Badly broken.														
				95.8 - 96.5 Partly altered to quartz and black tourmaline in dendritic patterns.														
				97.5 Isolated cassiterite (?) grains 0.5 - 1mm diameter on joint surface, JCA 35°.														
				99.5 - 99.7 Yellow, fine grained calc-silicate (?) alteration, veined by topazized (?) fine grained granite.		100.0	101.0	<0.01	<0.01						0.004	1	0.04	
							102.0	<0.01	<0.01						0.004	1	0.04	
				103.7 2cm vein or bed of yellow-green, fine grained calc-silicate (?) consisting of rounded olive green blebs (12 - 3mm diameter) in a softer yellow matrix. YCA 45°.			103.0	<0.01	<0.01						0.004	1	0.04	
							104.0	<0.01	<0.01						0.004	1	0.04	
							105.0	<0.01	<0.01						0.004	1	0.04	
				103.9-104.1 Greisenized granite, fine grained, consisting of quartz, tourmaline, muscovite and topaz (?) with minor fine														

027

60 028

DIAMOND DRILL RECORD

HOLE NUMBER : SD14

LOGGED BY : P.R.

WVPS

INTERVAL (m)		RECOVERY		DESCRIPTION	FORM	% Sn.											
FROM	TO	m	%			FROM	TO	TOTAL	ACID SOL.	% Cu.	% Al.	% S.	% Pb.	% Zn.	% Bi.	g/t Ag	% WO ₃
				grained pyrite. Top contact 70° to c.s., lower contact 80° to c.s.													
				104.2 3cm thick greisenized granite vein as above.													
				104.5 Irregular vein-style, fine grained, yellow calc-silicate/minor biotite alteration.													
				This section 102.7m.													
104.7	112.8	8.1	100	BANDSTONE AND QUARTZITE	105.0	106.0	<0.01	0.01						0.005	1	0.01	
				Mauve, fine grained, bedded. Disseminated biotite. Contains irregular greisenized granite veins, some halced by vesuvianite (?) /biotite alteration. Includes altered zones in which rounded grains of cordierite (?), 1-2mm diameter, set in biotite matrix. Trace pyrite in veinlets. BCA averages 65°.		107.0	<0.01	0.01							0.004	2	0.01
						108.0	<0.01	<0.01							0.004	1	0.01
						109.0	<0.01	<0.01							0.004	2	0.01
						110.0	<0.01	<0.01							0.005	2	0.01
						111.0	<0.01	0.01							0.005	2	0.01
						112.0	<0.01	0.01							0.005	1	0.01
				111.7 - 112.4 Contains disseminated subhedral or subhedral equant crystals of black spinel (?).		113.0	<0.01	<0.01							0.004	2	0.01
						114.0	<0.01	<0.01							0.003	1	0.01
				This section 112.3m.		115.0	<0.01	0.01							0.003	2	0.01
112.8	130.3	17.5	100	QUARTZITE AND CALC-SILICATE		116.0	<0.01	0.01						0.003	1	0.01	
				Quartzite, cream, pale pinkish brown, pale green, weakly bedded (BCA varies 40-55°), local minor disseminated biotite, minor sulphides - mainly disseminated and veinlet pyrite (some as flat rosettes), trace pyrrhotite and arsenopyrite, where coloured pinkish brown may contain very fine grained dravite. Cut by numerous soft, pyritic, black veinlets (serpentine or chlorite?). Calc-silicate, cream, consisting largely of massive, soft white tremolite (?) in rosettes, non-calcareous; partly parallel to bedding and partly cross-cutting. Core broken along bedding, less frequently along joints.		117.0	<0.01	<0.01							0.003	1	0.01
						118.0	<0.01	0.01							0.003	1	0.01
						119.0	<0.01	<0.01							0.002	<1	0.01
						120.0	0.03	<0.01							0.003	1	0.01
						121.0	<0.01	<0.01							0.003	<1	0.01
						122.0	<0.01	<0.01							0.003	1	0.01
						123.0	<0.01	<0.01							0.004	1	0.01
						124.0	<0.01	<0.01							0.003	1	<0.01
						125.0	<0.01	<0.01							0.002	<1	<0.01
				124.3 - 125.1 Pale blue-grey and brown calc-silicates (?) interbanded with olive green chlorite (?) and biotite, minor veinlet pyrite.		126.0	<0.01	<0.01							0.001	<1	<0.01
						127.0	<0.01	<0.01							0.002	<1	<0.01
						128.0	<0.01	<0.01							0.003	<1	<0.01
						129.0	<0.01	<0.01							0.002	<1	<0.01
				129.1 - 130.3 Olive green calc-silicate (?), chloritic (?), patches of brown garnet (?), relatively abundant vein pyrite.		130.0	<0.01	<0.01							0.003	<1	<0.01
						131.0	0.03	<0.01							0.002	1	<0.01
				This section 124.1m.													
130.3	151.3	21.0	100	QUARTZITE													
				Grey, mottled with yellow, weakly bedded; yellow patches soft - possibly weathered calc-silicates (?). Patchy disseminated muscovite. Minor quartz veins, 0.5 - 3.0cm thick, VCA generally 70°. Minor calc-silicate (?) veins. Trace pyrite in veinlets, rarely as veins up to 1cm. thick. Folded BCA varies 5-35°. Broken along joints, infrequently parallel bedding.													

020

6-0 020

029

DIAMOND DRILL RECORD

HOLE NUMBER : SD14

LOGGED BY : P.R.

HWPS

INTERVAL (m)	RECOVERY	DESCRIPTION	FORM	% Sn.													
				FROM	TO	TOTAL	ACID SOL.	% Cu.	% Al.	% S.	% Pb.	% Zn.	% Bi.	g/t Ag.	% WO ₃		
		138.2 - 140.1 Micaceous (Muscovite) quartzite with 10% of total being veins of quartz, biotite and pyrite, minor calc-silicates.		142.0	141.0	0.01	<0.01							0.002	1	<0.01	
						142.0	0.05	<0.01						0.002	1	<0.01	
						143.0	0.01	0.01						0.002	2	<0.01	
		140.8 - 141.4 Badly broken altered quartzite. Serpentine coating some fractures. One vein (1.5cm thick) of pyrite, quartz, biotite and clay at 140.8m.															
151.3	176.8	25.4	100	QUARTZITE													
				Grey, well bedded, comprising pale grey siliceous bands and dark grey-green chloritic (?) or brown tourmaline - rich (?) bands. Minor to trace pyrite in veinlets and disseminated. Few quartz and quartz-biotite veins 0.5-2.0cm thick, VCA generally 70-80° but occasionally parallel bedding. BCA averages 15° 151.3 - 157.3m, 30° 157.3 - 170.3m, 45° 170.3 - 176.8m. Broken along joints and bedding.	156.0	157.0	0.01	0.01							0.002	1	<0.01
						158.0	0.01	<0.01						0.002	1	<0.01	
				153.0 - 153.4 Yellow, soft clay alteration with thin veins rich in biotite, green micas and serpentine. Very badly broken.		159.0	0.05	0.01						0.002	1	<0.01	
						160.0	0.03	0.01						0.004	2	<0.01	
						161.0	0.02	0.01						0.003	1	<0.01	
				156.2 2cm thick breccia comprising quartzite fragments in clay matrix, crosses core at 35° to c.a.		162.0	0.02	<0.01						0.001	2	<0.01	
						163.0	0.02	<0.01						0.002	1	<0.01	
						164.0	0.02	<0.01						0.002	1	<0.01	
				156.7 - 157.0 Yellow, clayey alteration (after calc-silicates?) associated with several quartz veins.													
				159.0 5cm thick microgranite dyke, yellow and argillized, minor disseminated tourmaline. Crosses core at ~70° to c.a.													
				163.8 - 164.0 Muscovite-bearing quartzite. Includes small vein of quartz and small brown garnets (?), VCA 85°.													
176.8	178.2	1.2	86	Thin section 1512m. SILTSTONE AND QUARTZITE													
				Interbedded, grey. Minor fine grained biotite in veins, veinlets. Thin irregular veins of pyrite and quartz. BCA averages 40°.													
178.2	184.8	4.9	74	SHALE AND CALC-SILICATE	178.0	179.0	0.01	0.01	0.05	<0.1	2.3	<0.01	0.02	0.003	2	<0.01	
				Interbanded. Shale dark grey, laminated (BCA averages 40°), containing veinlets of pyrite, quartz and minor serpentine. Calc-silicate,		180.0	0.01	0.01	0.05	0.5	3.2	<0.01	0.01	0.005	1	<0.01	
				yellow, green-brown, very variable mineralogy, non calcareous, locally		181.0	<0.01	0.01	0.05	<0.1	1.9	<0.01	<0.01	0.001	1	<0.01	
				biotite-rich, minor, coarsely crystalline pyrite. Pink and garnet-		182.0	<0.01	0.01	0.03	<0.1	3.2	<0.01	0.12	0.004	1	<0.01	
				rich (?) 181.2 - 181.5 and 182.1 - 182.4m. Very badly broken,		183.0	<0.01	0.01	0.03	<0.1	1.0	<0.01	0.01	0.002	1	<0.01	
						184.0	<0.01	0.01	0.03	<0.1	2.5	<0.01	<0.01	0.002	2	<0.01	

60 030

DIAMOND DRILL RECORD

HOLE NUMBER : SD14

LOGGED BY : P.R.

HWPS

INTERVAL (m)	RECOVERY	DESCRIPTION	FORM	% Sn.											
				FROM	TO	TOTAL	ACID SOL	% Cu	% As	% S	% Pb	% Zn	% Bi	g/t Ag	% WO ₃
		1.7m core loss.		184.0	185.0	<0.01	0.01	0.04	<0.1	1.8	<0.01	<0.01	0.004	1	<0.01
184.8	187.6	2.8	100	SILICIFIED SHALES											
		Grey, hard, finely laminated. Includes veins or beds of black and green-black serpentine minor 184.8 - 186.6, ~30% of intersection		185.0	186.0	<0.01	0.01	0.04	<0.1	3.5	<0.01	0.01	0.002	1	<0.01
		186.6 - 187.6m. Minor sulphides, largely pyrrhotite in serpentine. BCA average 50°.		187.0	<0.01	0.01	0.02	<0.1	2.4	<0.01	0.01	0.003	1	<0.01	
187.6	193.7	6.1	100	MINERALIZED SERPENTINE											
		Colour varies black through to pale green. Approximately 10% sulphides. Mostly disseminated pyrrhotite, lesser pyrite largely in veinlets. Variably minor magnetite.		187.0	188.0	<0.01	0.01	0.02	<0.1	4.1	<0.01	0.02	0.003	1	<0.01
				189.0	<0.01	0.01	0.02	<0.1	4.1	<0.01	0.05	0.002	1	<0.01	
				190.0	<0.01	0.01	0.03	<0.1	3.2	<0.01	0.01	0.003	2	<0.01	
				191.0	<0.01	0.01	0.03	<0.1	3.3	<0.01	0.01	0.001	2	<0.01	
				192.0	0.05	0.03	0.03	<0.1	3.9	<0.01	0.01	0.004	2	<0.01	
193.7	194.2	0.5	100	SILICIFIED MICROGRANITE											
		Grey, feldspar phenocrysts (φ1.5mm diameter) set in a translucent grey, siliceous groundmass, minor biotite, trace sulphides. Enveloped by white quartz or chill zone (?) 10cm thick. Contacts irregular, ~50° to c.s.		193.0	0.01	0.02	0.04	<0.1	4.3	<0.01	0.21	0.003	2	<0.01	
				194.0	0.01	0.01	0.01	<0.1	0.6	<0.01	0.01	0.001	2	<0.01	
194.2	211.0	16.8	100	MAGNETITE SKARN											
		Black magnetite interspersed with apple green through to black serpentine. Magnetite coarsely crystalline down to 200m, finer grained below that point. Pyrrhotite disseminated and in veinlets cutting magnetite, pyrrhotite content decreasing downwards (1/2 of total). Minor pyrite in quartz veins (1/2 pyrrhotite) 1cm thick.		194.0	195.0	<0.01	0.01	0.05	<0.1	7.9	<0.01	0.02	0.002	2	<0.01
		Few cherty veins or alteration zones, white or pale green, 1/2 30cm thick, VCA varies widely. Numerous thin irregular calcite veins, especially 205.2 - 207.2m where core is cut by open joints lined with botryoidal calcite and small pyrite euhedra and filled with white and black clayey pug. Minor, fine grained, red-brown sphalerite(?) 205-211m.	0.32	196.0	<0.01	0.01	0.03	<0.1	2.0	<0.01	0.02	0.002	2	<0.01	
			0.35	197.0	0.03	0.02	0.02	<0.1	2.0	<0.01	0.03	0.004	2	0.04	
			0.37	198.0	0.02	0.02	0.03	<0.1	1.4	<0.01	0.08	0.004	2	0.01	
			0.42	199.0	0.02	0.02	0.04	<0.1	2.9	<0.01	0.03	0.001	2	<0.01	
			0.49	200.0	0.04	0.02	0.03	<0.1	0.9	<0.01	0.06	0.001	2	<0.01	
			0.45	201.0	0.86	0.80	0.40	0.3	4.1	<0.01	0.01	0.017	4	0.01	
			0.55	202.0	1.14	1.10	0.11	0.2	2.1	<0.01	0.01	0.014	2	0.03	
			0.42	203.0	0.51	0.40	0.10	0.2	1.6	<0.01	0.03	0.012	2	0.02	
			0.49	204.0	0.60	0.40	0.09	0.4	1.0	<0.01	0.10	0.014	3	<0.01	
			0.49	205.0	0.57	0.40	0.09	0.1	0.8	<0.01	0.16	0.007	2	<0.01	
			0.45	205.0	0.07	0.07	0.03	<0.1	1.1	<0.01	1.08	0.003	2	<0.01	
			0.71	207.0	0.14	0.10	0.02	<0.1	1.5	<0.01	0.44	0.005	2	<0.01	
		208.2 - 208.5 Core cut by collapse breccia vein 2cm thick, serpentine fragments in calcite matrix. VCA 10-15°.	0.46	208.0	0.04	0.04	0.02	<0.1	1.4	<0.01	1.09	0.001	2	<0.01	
			0.55	209.0	0.04	0.05	0.02	<0.1	1.4	<0.01	1.76	0.002	3	<0.01	
			0.44	210.0	0.11	0.11	0.02	<0.1	1.2	<0.01	1.56	0.004	3	<0.01	
		Gradational change to:	0.38	211.0	0.22	0.19	0.02	<0.1	2.1	<0.01	2.55	0.007	2	<0.01	
			0.23	212.0	0.04	0.05	0.03	<0.1	0.4	<0.01	0.04	0.005	2	<0.01	
211.0	240.0	29.0	100	SERPENTINOUS CARBONATE											
		Grey, green-grey, largely calcite, interspersed with minor apple green and green-black serpentinous carbonate in veins and irregular lenses. Core has granular appearance ("grain size" 0.5-1.0mm) crudely banded (Bedding?). Patchy minor black Mg-silicates (?) as spots, rarely more massive with pale grey cordierite (?) crystals.													

030

60 031

DIAMOND DRILL RECORD

HOLE NUMBER : SD14

LOGGED BY : P.R.

WVPS

INTERVAL (m)	RECOVERY		DESCRIPTION	FORM	% Sn													
	FROM	TO			m	%	FROM	TO	TOTAL	ACID SOL.	% Cu	% Al	% S	% Pb	% Zn	% Bi	g/t Ag	% WO ₃
307.3	311.2	3.9	100	SERPENTINE AND CALC-SILICATE (?) Thin (1-2mm average) "beds" of black and green-black serpentine intercalated with green-grey micaceous calc-silicate(?) and minor grey shale. Minor magnetite and veinlet calcite and clay. Minor disseminated pyrite 309.2 - 309.4m.														
				309.9 - 311.2 Serpentine and calc-silicate in massive patches (i.e. not thinly interbanded). Veined by pyrite with lesser pyrrhotite and sphalerite 310.1 - 310.3m. Soft and clayey 310.9 - 311.1m.	3210	3080	<0.01	<0.01	0.03	<0.1	<0.1	<0.01	0.07	0.001	1	0.01		
				This section 309.5m		3090	<0.01	0.01	0.03	<0.1	0.1	<0.01	0.14	0.004	2	0.01		
						3100	<0.01	0.03	0.04	<0.1	1.1	<0.01	0.61	0.004	3	0.01		
						3110	<0.01	<0.01	0.05	<0.1	1.7	<0.01	0.40	0.001	2	0.01		
311.2	313.4	2.0	91	HORNFELSED SHALE Grey, hard, laminated, finely micaceous. Abundant pyrite disseminated and in thin veins (<2mm thick). Few laths of dark brown mineral (average size 1 x 2mm). Minor, irregular quartz veining. One 1cm vein of pyrite and sphalerite at 312.3m. Upper contact marked by badly broken zone containing coarse pyrite crystals. BCA averages 35°.		3120	0.02	0.01	0.08	<0.1	2.6	<0.01	<0.01	0.004	1	0.01		
						3130	<0.01	0.01	0.07	<0.1	3.5	<0.01	0.03	0.003	1	0.01		
						3140	<0.01	<0.01	0.06	<0.1	2.1	<0.01	<0.01	0.002	2	0.01		
						3150	<0.01	<0.01	0.06	<0.1	1.5	<0.01	<0.01	0.002	3	0.01		
						3160	<0.01	<0.01	0.08	<0.1	1.4	<0.01	<0.01	0.004	2	0.01		
						3170	0.01	<0.01	0.06	<0.1	1.7	<0.01	0.01	0.003	4	0.01		
						3180	<0.01	<0.01	0.04	<0.1	1.3	<0.01	0.01	0.001	4	0.01		
						3190	<0.01	<0.01	0.06	<0.1	1.2	<0.01	0.01	0.001	4	0.01		
313.4	360.9			ALTERED QUARTZITE Pale grey-brown, hard, bedded. Consists of varying amounts of quartz, brown tourmaline in brown spots elongated parallel to bedding, laths of a dark grey-green mineral, muscovite, Disseminated sulphides throughout - mostly pyrite, trace pyrrhotite, sphalerite and chalcopyrite. Veined by quartz (vein thickness 1-5mm), some with biotite and less commonly, pyrite. BCA averages 45°. Broken along infrequent joints.		3200	<0.01	0.01	0.05	<0.1	1.3	0.01	0.02	0.001	4	0.01		
						3210	<0.01	0.01	0.06	<0.1	1.4	0.01	0.01	0.003	6	0.01		
						3220	0.01	<0.01	0.08	<0.1	1.5	0.01	0.01	0.001	6	0.01		
						3230	0.01	0.01	0.07	<0.1	1.8	0.01	0.04	0.002	4	0.01		
						3240	<0.01	<0.01	0.06	<0.1	1.7	<0.01	<0.01	0.002	2	0.01		
						3250	0.01	0.01	0.07	<0.1	1.2	<0.01	<0.01	0.004	2	0.01		
						3260	<0.01	0.01	0.04	<0.1	1.3	<0.01	<0.01	0.003	2	0.01		
						3270	<0.01	0.01	0.09	<0.1	1.3	<0.01	0.01	0.001	4	0.01		
						3280	<0.01	<0.01	0.05	<0.1	1.0	<0.01	<0.01	0.001	4	0.01		
				317.6 5mm pyrite - fluorite - quartz vein on slickensided surface, VCA 30°.		3290	<0.01	<0.01	0.09	<0.1	0.6	<0.01	<0.01	0.001	4	0.01		
						3300	<0.01	0.01	0.08	<0.1	0.9	<0.01	0.01	0.001	3	0.01		
						3310	<0.01	<0.01	0.04	<0.1	0.8	<0.01	<0.01	0.004	2	0.01		
				319.3 Pyrite vein, 1cm thick, VCA 80°.		3320	<0.01	0.03	0.04	<0.1	0.7	<0.01	<0.01	0.002	1	0.01		
						3330	<0.01	<0.01	0.05	<0.1	0.3	<0.01	<0.01	0.004	2	0.01		
				323.2 - 323.7 10cm of green serpentinous alteration followed by 40cm yellow calc-silicate apparently replacing and/or veining quartzite, consisting largely of felted yellow rosettes of tremolite(?), minor biotite and vein pyrite.		3340	<0.01	0.01	0.04	<0.1	0.3	<0.01	<0.01	0.003	2	0.01		
						3350	<0.01	0.02	0.05	<0.1	0.7	<0.01	<0.01	0.002	1	0.01		
						3360	<0.01	<0.01	0.06	<0.1	0.8	<0.01	<0.01	0.004	2	0.01		
						3370	<0.01	<0.01	0.04	<0.1	1.0	<0.01	<0.01	0.003	2	0.01		
						3380	<0.01	<0.01	0.06	<0.1	0.9	<0.01	<0.01	0.003	2	0.01		
						3390	<0.01	<0.01	0.04	<0.1	0.5	<0.01	<0.01	0.003	1	0.01		
				327.2- 327.4 Quartz-siderite(?) - pyrite - biotite vein.		3400	<0.01	0.01	0.05	<0.1	0.4	<0.01	<0.01	0.003	1	0.01		
						3410	<0.01	0.01	0.04	<0.1	0.8	<0.01	0.01	0.002	3	0.01		
				328.5 - 328.7 Pyrite vein, 3-4cm thick, VCA ~10°.		3420	<0.01	<0.01	0.04	<0.1	1.2	<0.01	0.03	0.002	2	0.01		
						3430	<0.01	<0.01	0.05	<0.1	0.4	<0.01	<0.01	0.003	1	0.01		

003

60 034

DIAMOND DRILL RECORD

HOLE NUMBER : SD14

LOGGED BY : P.R.

HWPE

INTERVAL (m)	RECOVERY	DESCRIPTION	FORM.	% Sn											
				FROM	TO	TOTAL	ACID SOL	% Cu	% As	% S	% Pb	% Zn	% Bi	g/t Ag	% WO ₃
		333.2 - 333.3 White mica-enriched.		342.0	344.0	<0.01	0.02	0.04	<0.1	<0.1	<0.01	<0.01	0.001	1	0.03
		This section 334m.			345.0	<0.01	0.01	0.04	<0.1	0.2	<0.01	<0.01	0.002	1	0.03
		Sharp contact 45° to c.a., no apparent chill zone.			346.0	<0.01	0.01	0.07	<0.1	0.4	<0.01	<0.01	0.001	1	0.02
					347.0	<0.01	<0.01	0.05	<0.1	0.8	<0.01	<0.01	0.002	1	0.02
360.9	366.8	GRANITE			348.0	<0.01	0.01	0.04	<0.1	0.7	<0.01	<0.01	0.001	1	0.02
		Pale grey, medium to coarse grained, consisting of equigranular			349.0	<0.01	<0.01	0.04	<0.1	2.3	<0.01	<0.01	0.014	3	0.03
		feldspars and quartz, with ~5% black biotite. Plagioclase generally			350.0	0.07	<0.01	0.07	<0.1	0.9	<0.01	<0.01	0.001	2	0.02
		yellow and pale green (argillized and sericitized). Biotite evenly			351.0	0.01	0.01	0.04	<0.1	1.5	<0.01	<0.01	0.002	3	0.02
		distributed in places, concentrated in patchy segregations elsewhere,			352.0	0.01	0.01	0.05	<0.1	0.8	<0.01	<0.01	0.002	2	0.02
		partly chloritized. Broken along few joints, some slickensided and			353.0	<0.01	0.01	0.07	<0.1	1.4	<0.01	<0.01	0.001	2	0.01
		clayey.			354.0	0.01	<0.01	0.07	<0.1	1.2	<0.01	<0.01	0.002	2	0.02
					355.0	<0.01	<0.01	0.08	<0.1	0.8	<0.01	0.01	0.001	2	0.02
		363.2 Micropegmatite vein (VCA 35°) followed by fine grained			356.0	<0.01	0.01	0.05	<0.1	1.2	<0.01	<0.01	0.001	1	0.02
		granite.			357.0	<0.01	0.02	0.06	<0.1	2.1	<0.01	<0.01	0.024	2	0.02
					358.0	<0.01	0.01	0.04	<0.1	1.4	<0.01	<0.01	0.004	1	0.02
		363.8 - 363.9 Greisenized granite - quartz, muscovite, minor pyrite			359.0	<0.01	<0.01	0.08	0.1	1.3	<0.01	<0.01	0.003	1	0.02
		- enclosing a central vein of quartz, pyrite and			360.0	<0.01	0.01	0.07	0.1	1.8	<0.01	<0.01	0.003	1	0.02
		fluorite, VCA 70°.			361.0	<0.01	<0.01	0.05	<0.1	0.7	<0.01	<0.01	0.003	<1	0.02
					362.0	<0.01	<0.01	0.04	<0.1	0.8	<0.01	<0.01	0.004	<1	0.02
		365.0 - 365.7 Fine grained granite, greisenized with minor pyrite			363.0	<0.01	<0.01	0.06	<0.1	0.1	<0.01	<0.01	0.002	<1	0.02
		365.5 - 365.6, feldspars weakly sericitized elsewhere.			364.0	<0.01	0.01	0.03	<0.1	<0.1	<0.01	<0.01	0.002	<1	0.02
		Gradational (?) upper contact, sharp lower one.			365.0	<0.01	<0.01	0.03	<0.1	<0.1	<0.01	<0.01	0.004	1	0.02
					366.0	<0.01	<0.01	0.04	<0.1	<0.1	<0.01	<0.01	0.002	<1	0.02
366.8	387.2	WEAKLY ALTERED GRANITE			367.0	<0.01	<0.01	0.04	<0.1	<0.1	<0.01	<0.01	0.002	<1	0.02
		Medium grained, original mineral composition similar to above but			368.0	0.01	<0.01	0.06	<0.1	0.7	<0.01	<0.01	0.002	1	0.02
		feldspars sericitized or argillized, biotite converted to chlorite.			369.0	<0.01	<0.01	0.04	<0.1	<0.1	<0.01	<0.01	0.002	<1	0.02
		Minor disseminated tourmaline. Broken along numerous, variously			370.0	<0.01	<0.01	0.04	<0.1	0.1	<0.01	<0.01	0.001	<1	0.02
		oriented joints, some slickensided and clayey.			371.0	<0.01	<0.01	0.05	<0.1	0.7	<0.01	<0.01	0.002	<1	0.02
					372.0	0.01	0.01	0.05	<0.1	0.2	<0.01	<0.01	0.002	<1	0.02
		366.8 - 376.2 Partly greisenized. Greisen comprising quartz,			373.0	<0.01	<0.01	0.04	<0.1	1.0	<0.01	<0.01	0.002	1	0.02
		muscovite, minor tourmaline and pyrite, enclosing			374.0	0.01	<0.01	0.04	<0.1	1.3	<0.01	<0.01	0.003	1	0.02
		central veins with VCA 70-80° and variously consisting			375.0	<0.01	<0.01	0.05	<0.1	0.2	<0.01	<0.01	0.001	<1	0.02
		of quartz, pyrite, arsenopyrite and tourmaline. Greisen			376.0	0.01	<0.01	0.07	<0.1	0.9	0.03	0.14	0.001	2	0.02
		is ~30% of total.			377.0	<0.01	<0.01	0.05	0.1	0.3	<0.01	0.01	0.001	<1	0.02
		376.2 - 387.2 Includes few, thin (4-15cm thick) greisen zones													
		similar to above but without central veins.													
		This section 384m.													
		END OF HOLE 387.2m.													

034

60 035

RENISON LIMITED
DIAMOND DRILL HOLE PLOT

SCALE:

HOLE No. 1

RENISON LIMITED

HOLE NO. SD14

M. BOLTON

MAGNETIC SUSCEPTIBILITY X 10⁻⁶ C.G.S. UNITS

DEPTH	NS	DEPTH	MS	DEPTH	MS	DEPTH	NS	DEPTH	MS	DEPTH	NS
0-114	4100*	-194	32000	-209	6400	-224	1000	-255	4100*	-336	4100*
-115	1900	-195	41000	-210	27000	-231	4100*	-256	300	-337	200
-116	400	-196	49000	-211	5000	-232	1000	-265	4100*	-338	4100
-117	400	-197	1800	-212	4400	-233	1900	-278	100*	-339	200
-123	4100*	-198	18000	-213	2900	-234	3200	-279	200	-340	500
-124	400	-199	40000	-214	1600	-235	300	-280	200	-341	4100
-185	4100*	-200	9000	-215	300	-236	1200	-281	300	-342	200
-186	300	-201	5800	-216	400	-237	1400	-282	4100*	-347	4100*
-187	400	-202	10000	-217	7200	-239	4100*	-283	200	-348	400
-188	1200	-203	12000	-218	1200	-242	100*	-308	4100*	-360	4100
-189	3200	-204	33000	-219	100	-245	4100*	-309	200	-361	800
-190	4000	-205	75000	-220	600	-246	300	-310	1600	-387	4100*
-191	6100	-206	45000	-221	500	-247	4100	-311	8300	* Same result for more than 1 metre.	
-192	12000	-207	18000	-222	500	-248	300	-330	4100*		
-193	1200	-208	13000	-223	100	-249	500	-331	400		

60 037

030

RENISON LIMITED
DIAMOND DRILL HOLE PLOT

SCALE:

HOLE No. 1 BD 14

PETROGRAPHIC DESCRIPTIONS

(C.M.S. REPORT B1/1/41)

SAMPLE NO.	CLASSIFICATION - COMPOSITION	FABRIC	ACCESSORIES	COMMENTS
5.4m (T.S. 35917)	<u>Quartz-Tourmaline Rock.</u> Quartz and olive-brown tourmaline (schorl) in varying proportions, subordinate to minor dravite, disseminated muscovite flakes.	Vague contorted to brecciated, relict pelitic banding. Fine-grained.	Thinly disseminated leucoxenic rutile. Sparse relict detrital zircon, rutile.	Tourmalinised, silicified pelitic sediment. Muscovite is porphyro-blastic in part ("tourmalinised mica hornfels").
36.9m	<u>Quartz-Tourmaline Rock.</u> Quartz and olive-brown schorl, subordinate dravite, subordinate, semi-sericitic muscovite. Patchy orange (titaniferous schorl).	Hornfelsic quartz, weakly poikiloblastic muscovite. Fine- to medium-grained.	Thinly disseminated leucoxenic secondary rutile. Sparse relict detrital zircon.	Marginally hornfelsed, extensively tourmalinised argillaceous quartzite with relatively altered shaly interbeds. Minor microfaulting.
61.5m	<u>Quartz-Kaolin Rock.</u> Fine subpolygonal quartz and leucoxene-stained kaolin in near-equant proportions. Disseminated 7marcasite (after pyrrhotite).	Contorted relict bedding. Semi-pervasive mica-derived structures in kaolin.	Rare pyrite subhedra. Thinly disseminated fine silt-sized, rounded zircons.	Degraded mica hornfels (\pm cordierite) developed in argillaceous quartzose fine sandy siltstone, silty shale intercalations. Affinities with 5.4m, 36.9m.
80.1m	<u>Spotted Hornfels.</u> Coarse retrogressed (muscovitised) cordierite poikiloblasts with interstitial quartz, titaniferous biotite. Disseminated colour-variable schorl, pyritised pyrrhotite.	Ovoid, millimetric blasts, weak preferred orientation discordant to relict bedding.	Patchy chlorite (after biotite), sparse sphene, rare cloudy andalusite.	Retrogressively altered cordierite-mica hornfels; mild tectonic over-print. Primarily a weakly bedded silty shale.
103.7m	<u>Spotted Hornfels.</u> Quartz and Ti-biotite, subordinate to minor albite, disseminated sericitised/kaolinised cordierite poikiloblasts, sparse kaolinised andalusite porphyroblasts.	Relict, sub- to millimetric-scale sedimentary banding. Medium-grained, hornfelsic.	Disseminated to conspicuous dravite; sparse pyritised pyrrhotite disseminations, films.	Affinities with 80.1m, but slightly higher grade in albite-epidote hornfels facies. Relatively conspicuous metasomatic dravite. Psammopelitic.
112.3m	<u>Spotted Hornfels.</u> Quartz and Ti-biotite with disseminated to semi-massive, extensively sericitised cordierite, subordinate 7andalusite. Disseminated schorl.	Medium-grained, hornfelsic, with faint relict sedimentary banding.	Patchy chlorite (after biotite), fresh cordierite, minor trace untwinned albite.	Porphyroblasts preferentially retrogressed. Close affinities with 80.1m, 103.7m. Primarily a weakly shale-parted quartzose psammite.
129.7m	<u>Tremolitic Hornfels.</u> Quartz and cordierite with patchy tremolite, subordinate to minor Ti-phlogopite, sporadic microfilms of pyrite (after pyrrhotite).	Fine- to medium-grained hornfelsic. Faint relict sub- to millimetric-scale relict bedding.	Disseminated dravite, schorl, extremely fine rutile. Traces cumming-tonite, sideritic carbonate.	Textural features indicate tremolitisation (+ traces pyrrhotite) pre-dated hornfelsing/minor cordierite-siderite veinlets/pyritisation of pyrrhotite.
153.2m	<u>Talc-Tremolite Rock.</u> Fine-grained tremolite as sparse relics in near-massive talc. Patchy quartz, minor cloudy, partly degraded siderite.	Semi-schistose with boudinaged quartz veinlets.	Degraded pale phlogopite (partly replaced by talc). Rare apatite.	Fabric consistent with a sheared/steatitised tremolite (=quartz-phlogopite) vein.
182.1m (T.S. 35925)	<u>Talc-Tremolite Rock.</u> Talc with patchy corroded relics of tremolite, irregular zones chloritised/steatitised phlogopite, minor quartz, disseminated apatite.	Crude relict banding disrupted by degraded phlogopitic veinlets (\pm quartz).	Traces cloudy sideritic carbonate. Minor traces ultrafine rutile.	Thoroughly steatitised, phlogopite-veined tremolite rock of altered carbonate facies character (devoid of clastic, altered ultramafic features).
194.7m (T.S., P.S. 35926)	<u>"Serpentinite".</u> Antigorite with conspicuous magnetite, extensively pyritised pyrrhotite.	Crudely banded. Opaque interstitial to "Olivine" - derived, mesh-textured antigorite.	Traces ankeritic carbonate.	No definite altered ultramafic features, although clearly a serpentinised olivine- or "humite" rock. No detectable Sn-phases.

037

60 038

RENISON LIMITED
DIAMOND DRILL HOLE PLOT

SCALE:

HOLE No.: SD 14

PETROGRAPHIC DESCRIPTIONS
(E.M.S. REPORT 81/1/41)

SAMPLE NO.	CLASSIFICATION - COMPOSITION	FABRIC	ACCESSORIES	COMMENTS
196.8m (T.S., P.S. 35927)	"Serpentinite". Antigorite with corroded relic of humite, magnetite-stained serpentinous ankerite, pseudomorphs of pyroxene, conspicuous "primary" magnetite. Patchy late dolomite veining.	Similar to 194.7m, but with relic of coarse, lath-like humite.	Traces pyrite.	Close affinities with 194.7m. Primarily a humite-pyroxene (?diopside) rock. No detectable Sn-phases.
200.7m (T.S., P.S. 35928)	Scapolite-Chlorite-Magnetite Rock. Near -isotropic chlorite with disseminated to semi-massive scapolite (dipyre), patchy fluorite, serpentinite. Abundant magnetite, patchy sulphide.	Irregular to crudely banded, fine-grained. Serpentine-rich shears. Poikilitic scapolite.	Intersecting films of ankeritic carbonate. Locally conspicuous pyrrhotite, chalcopyrite, pagelite.	Late scapolitic alteration of relatively opaque-rich "serpentinite". No detectable cassiterite. Pagelite as ultrafine acicular bundles intimately intergrown with serpentine.
202.2m (T.S., P.S. 35929)	Steeatitised "Serpentinite". Serpentine and Mg-chlorite with conspicuous, closely intergrown magnetite, patchy talc, tremolite, corroded relic of clinohumite.	Granular relict humite with fine acicular opaques. Semi-schistose serpentine-talc-tremolite.	Minor corroded relic diopside, traces arsenopyrite. Minor traces pagelite, ?cassiterite.	Pagelite as rare, subradiating, ultra-fine acicular clots (sim. 200.7m). ?Cassiterite as sparse <2 u diameter needles in talc aggregates.
209.3m (T.S., P.S. 35930)	"Serpentinite". Antigorite with patchy, chloritised phlogopite, sporadic flakes brucite, disseminated spongy aggregates magnetite, semi-massive films of dark sphalerite.	Incipiently schistose with patchy, faint relict "olivine" and pyroxene textures.	Minor traces ankeritic carbonate, microscopic pyritised pyrrhotite films.	Originally a fine granular "olivine-pyroxene" rock (?humite-diopside), pervasively serpentinised. No detectable Sn-phases.
215.9m	Antigoritic Marble. Cloudy calcite with abundant clots antigorite, brucite, sparsely disseminated fine-grained magnetite.	Millimetric scale banded, medium-grained, granular, with olivine-derived structures in serpentine.	Rare late magnetite veinlets.	Mildly stressed. Serpentinised forsterite or humite marble.
237.3m (T.S., P.S. 35932)	Talc-Carbonate-Phlogopite Rock. Calcite with subordinate, closely intergrown talc, disseminated coarse flakes pale phlogopite, disseminated fibrous acicular magnetite.	Weakly banded. Similar to 215.9m, but coarser-grained.	Patchy corroded relic olivine, patchy antigorite (corroded, replaced by talc), ilvaite, hematite.	Affinities with 215.9m; "olivine" appears to be forsterite, but poorly resolved due sizing, habit. Ilvaite locally conspicuous, hematite after magnetite.
237.8m	Phlogopite-Carbonate Rock. Calcite with subordinate closely intergrown talc, disseminated coarse flakes pale phlogopite, disseminated fibrous acicular magnetite.	Coarse, random phlogopite interspersed with allicata semi-pseudomorphous carbonate.	Ultrafine secondary (?hydro) garnet, minor traces antigorite.	Vague textural affinities with 196.8m suggest carbonation of phlogopite-humite-diopside rock. Weakly stressed.
252.4m (T.S. 35934)	Graphitic Skarn. Cloudy diopside, phlogopite, subordinate grossular-andradite. Semi-pervasive late poikilitic epidote-clinozoisite; conspicuous fine graphite.	Relict, sub- to millimetric banding partly obliterated by epidotisation.	Patchy hornfelsic quartz, relict tremolite-actinolite (corroded by phlogopite).	Carbonaceous calc-pelite, skarnised to garnet-diopside-tremolite assemblage, subsequently epidotised/phlogopitised.
309.5m (T.S. 35935)	Altered Skarn. Diopside and thoroughly serpentinised ?humite, minor garnet. Patchy talc (?after tremolite). Disseminated pyritised pyrrhotite, minor sphalerite.	Medium-grained, granular with relict sub-to millimetric, microfolded banding.	Traces graphite.	Affinities with 252.4m, but with metasomatic assemblage analogous to 194.0 - 210.0m zone.
331.5m	Quartz-Mica Hornfels. Quartz and muscovite in varying proportions with conspicuous colour-variable schorl, minor dravite. Disseminated clots of ankeritic carbonate.	Medium-grained, hornfelsic with relict psammopelitic banding.	Minor traces pyrrhotite. Sparse relict detrital zircon, apatite.	Affinities with 5.4 - 112.3m zone. Hornfelsed, tourmalinised, shale-parted, quartzose, argillaceous siltstone/fine sandstone.
373.4m (T.S. 35937)	Muscovite Quartzite. Overgrown relict detrital quartz with abundant intergranular muscovite, minor sericite. Sparse pyritised pyrrhotite, chalcopyrite disseminations, arsenopyrite films. <i>Almost certainly wrong - could possibly be a greenschistic xenolith but this is unlikely given the general paucity of xenoliths.</i>	Relict medium sandy clastic fabric.	Minor schorl, dravite. Ankeritic carbonate. Sparse relict detrital zircon.	Greisenised orthoquartzite. Arsenopyrite introduced in veinlets with carbonate, quartz, minor schorl.

DIAMOND DRILL RECORD

HOLE NUMBER : SD15

LOGGED BY : P.R.

041

INTERVAL (m)		RECOVERY		DESCRIPTION	FORM	% Sn.											
FROM	TO	m	%			FROM	TO	TOTAL	ACID SOL.	% Cu	% Al	% S	% Pb	% Zn	% Bi	g/t Ag	% WO ₃
0.0	19.0	18.4	97	SANDSTONE White to pale grey-brown, fine grained. Alternates between thinly bedded, micaceous (muscovite) tourmalinized sandstone comprising tourmaline-rich and quartz-rich beds and buff to white, slightly coarser grained, massive sandstone with little mica. Minor bands of grey, green-grey chloritic material enclosing rounded sandstone grains(?) which sometimes elongated parallel to bedding. BCA averages 30°, local contortion - microfold spacing 1cm, locally with axial plane cleavage developed. Broken along joints, either smooth and coated with tourmaline, or coated with finely crystalline quartz, or coated with clay (badly broken).													
19.0	68.8	49.4	99	SANDSTONE AND QUARTZITE Similar to above but includes quartzite and is largely massive variety with thinly bedded, tourmalinized interbeds restricted to 19-43m. Minor brown tourmaline on joints and in vugs, particularly 40.5 - 41.6m, where vugs thinly rimmed by quartz (< 0.5mm thick) in pale pinkish brown dravitized(?) beds. Very minor pyrite in veinlets and with tourmaline on joints. Few quartz veinlets. BCA varies: 19-37m 40° average, 37-46m ~10° average (minor wispy axial plane cleavage filled with mica and chlorite? in microfolds), 46-51m 45-50°, 51-68.8m ~30° average. Broken along joints but more solid cf above. 52.5 - 59.3 Includes few veins of quartz + pyrite, 5-20cm thick, thicker veins enclosed in soft yellow-brown alteration. YCA 60-85°. 59.3 - 63.8 Very badly broken, veined by brown-black tourmaline, dark grey-green chlorite; and quartz-tourmaline veins near parallel to c.a. and with minor pyrite. 0.4m core loss in soft clayey zones. 63.8 - 68.8 Altered quartzite. Above 66.0m partly tourmalinized with numerous small quartz veins, below 66.0m includes patchy soft yellow-brown alteration which partially washed out during drilling(?) to give vuggy appearance. Minor veinlet and disseminated pyrite. Thin section 41.5m.													
68.8	70.4	1.6	100	SILTSTONE TO FINE GRAINED SANDSTONE Pinkish brown and pale grey, bedded, where pinkish dravitized(?).		68.8	70.4	<0.01	<0.01	0.01	<0.1	0.6	<0.01	<0.01	<0.001	<1	0.02

60 042

DIAMOND DRILL RECORD

HOLE NUMBER : SD15

LOGGED BY : P.R.

KWPS

INTERVAL (m)		RECOVERY		DESCRIPTION	FORM	% Sn.											
FROM	TO	m	%			FROM	TO	TOTAL	ACID SOL.	% Cu	% As.	% S.	% Pb.	% Zn.	% Bi.	g/t Ag	% WO ₃
				Minor veinlet quartz & tourmaline. Several veins of silicified microgranite(?) 1cm thick. Very minor pyrite on joint planes and in veinlets. BCA 35-40°. Breaks along bedding and joints.													
70.4	75.2	2.6	54	WEATHERED CALC-SILICATE(?) Pinkish brown and pale yellow-brown, very soft and clayey, bedded, brown colouration from fine grained biotite. Abundant veinlet and disseminated pyrite, latter generally as small (<0.5mm) euhedra. BCA 30-35°. Broken along pyritic or green clayey joints. 2.2m core loss.		70.4	71.0	<0.01	<0.01	0.03	<0.1	0.5	<0.01	<0.01	0.001	<1	0.02
							72.0	<0.01	0.01	0.04	<0.1	2.2	<0.01	<0.01	0.002	<1	0.01
							73.0	<0.01	<0.01	0.04	<0.1	2.5	<0.01	<0.01	0.002	<1	0.01
							74.0	<0.01	<0.01	0.04	<0.1	2.3	<0.01	<0.01	0.002	<1	0.01
							75.0	<0.01	<0.01	0.05	<0.1	2.8	<0.01	<0.01	0.002	<1	0.01
75.2	84.3	9.1	100	ALTERED HORNFELSED SILTSTONE Green-grey, pinkish brown, mauve, laminated, pinkish brown colour from very fine grained biotite. Coarser grained disseminated biotite in minor calc-silicate interbeds. Minor disseminated and veinlet pyrite throughout. Few quartz veinlets. BCA 30-40°. Broken along joints, rarely parallel bedding. 80.5 - 81.2 Calc-silicate comprising bands and swirls of massive biotite, white tremolite(?) and yellow clayey material. Pyritic 80.6 - 80.8m. Minor black serpentine veins. Non-calcareous. Thin section 78.2m.													
84.3	91.3	7.0	100	CALC-SILICATE MINOR ALTERED HORNFELSES Calc-silicate pale grey, yellow, brown, comprising abundant (locally massive) red-brown biotite, soft yellow clayey material, translucent white wollastonite(?), and rare patches dark green serpentine or chlorite. Minor disseminated sulphides - mostly pyrite, some pyrrhotite. Biotite and pyrite concentrations often in soft, clayey material. Soft and yellowish 84.3 - 86.9m. 89.6 - 91.1 Siliceous, consisting of mauve altered hornfels pervasively veined by quartz and calc-silicate minerals. Thin section 86.7m.		84.3	85.0	<0.01	0.01	0.03	<0.1	1.4	<0.01	<0.01	0.002	<1	0.01
							86.0	<0.01	<0.01	0.03	<0.1	1.4	<0.01	<0.01	0.004	1	0.02
							87.0	<0.01	<0.01	0.03	<0.1	1.5	<0.01	<0.01	0.005	1	0.01
							88.0	<0.01	0.01	0.05	<0.1	4.5	<0.01	<0.01	0.005	1	0.01
							89.0	<0.01	<0.01	0.03	<0.1	2.2	<0.01	<0.01	0.004	<1	0.01
							90.0	<0.01	<0.01	0.04	<0.1	4.7	<0.01	<0.01	0.004	<1	0.01
							91.0	<0.01	<0.01	0.02	<0.1	1.4	<0.01	<0.01	0.002	<1	0.01
91.3	93.5	2.2	100	QUARTZITE White, hard, faintly bedded. Minor disseminated biotite. Veined by pale greenish yellow calc-silicate minerals. Minor chlorite veinlets. BCA 25-30°, broken along joints. Thin section 92.4m.		91.3	92.0	<0.01	<0.01	0.02	<0.1	1.1	<0.01	<0.01	0.002	<1	0.01
							92.0	<0.01	<0.01	0.02	<0.1	0.9	<0.01	<0.01	0.002	1	0.01
							93.0	<0.01	<0.01	0.02	<0.1	0.1	<0.01	<0.01	0.002	<1	<0.01

042

50 043

DIAMOND DRILL RECORD

HOLE NUMBER : SD15

LOGGED BY : P.R.

WAFI

INTERVAL (m)		RECOVERY		DESCRIPTION	FORM	% Sn											
FROM	TO	m	%			FROM	TO	TOTAL	ACID SOL	% Cu	% As	% S	% Pb	% Zn	% Bi	g/t Ag	% WO ₃
93.5	98.8	5.3	100	ALTERED QUARTZITE Mauve, mauve-grey, crudely banded (bedding?). Colour derived from very fine grained biotite (locally coarser grained). Numerous irregular or lensoid quartz and/or silicified microgranite(?) veins ± brown tourmaline, 1mm to >1cm thick.. Minor pyrite in veinlets and with quartz, rarely disseminated. Rare dark green vesuvianite(?) in biotite-rich bands. BCA 40-50°.		94.0	95.0	48.01	<0.01	0.02	<0.1	0.4	<0.01	<0.01	0.002	1	0.01
						96.0	"	"	"	"	0.4	"	"	"	0.002	<1	0.01
						97.0	"	"	0.02	"	0.6	"	"	"	"	"	"
						98.0	"	"	0.02	"	0.4	"	"	0.004	"	"	"
						99.0	"	0.01	"	"	0.7	"	"	0.002	"	"	0.01
98.8	103.4	4.6	100	MASSIVE BIOTITE Brown, very soft, crudely banded (bedding?). Minor minerals : white and yellow clay (weathered calc-silicates?) and pyrite. Biotite grainsize <0.5mm, colour varies red-brown to black. Becoming harder, transitional to lithology below, with quartz veinlets, lower 1.9m. BCA averages 45°. Broken along joints coated with clay and serpentines. Thin section 101.2m.		99.0	100.0	<0.01	<0.01	0.02	<0.1	2.4	<0.01	<0.01	0.002	1	0.01
						100.0	"	"	"	"	1.8	"	"	"	1	0.02	
						102.0	"	"	0.07	"	5.2	"	"	"	1	"	
						103.0	"	0.01	0.02	"	1.6	"	"	0.004	<1	0.02	
103.4	108.4	5.0	100	HORNFELS Very pale grey-brown to white, hard, faintly laminated, bornfelsed siltstones. Minor alteration - dark green-grey and pyritic in mottled patches. Brown colouration 103.6 - 104.1m due to very fine grained biotite(?) BCA 0-20°. Broken along joints coated with fine grained brown tourmaline or dark green chlorite(?). 107.9 - 108.0 Siliceous, aphanitic granitic(?) vein with 1cm microgranite on upper contact. Contacts 50-65° to c.a. thinly coated with serpentines.		103.0	104.0	<0.01	<0.01	0.04	<0.1	0.2	<0.01	<0.01	0.002	<1	0.01
						105.0	"	"	0.02	"	0.2	"	"	0.002	"	"	
						106.0	"	"	0.02	"	0.1	"	"	"	"	"	
						107.0	"	"	0.05	"	1.3	"	"	0.001	"	"	
						108.0	"	0.01	0.02	"	0.2	"	"	0.002	"	0.02	
108.4	111.0	2.6	100	ALTERED SANDSTONE Pale yellow-brown, fine grained, soft, bedded. Comprising quartz and pale yellow tremolite(?). Very minor pyrite in mottled alteration zones. Very fine grained disseminated biotite lower 30cm, clayey bottom 10cm. BCA 5-30°, averaging 25°. Badly broken throughout but softer and more broken towards bottom.		108.0	109.0	<0.01	<0.01	0.02	<0.1	0.1	<0.01	<0.01	0.014	<1	0.01
						110.0	"	"	0.04	"	0.4	"	"	0.001	2	"	
						111.0	"	"	0.02	"	1.0	"	"	0.002	"	"	
111.0	172.4	61.4	100	BIOTITE GRANITE White, yellowish white, greyish white, fine to medium grained, comprising quartz, feldspar and 2-5% biotite (locally up to 15%). Plagioclase commonly pale yellow and weakly argillized. Biotite plates generally exposed on edge in core. Minor micropegmatite in irregular masses <20cm. long, consisting of coarse crystals of quartz and feldspar, minor tourmaline ± very minor fluorite, pyrite													

043

00 044

DIAMOND DRILL RECORD

HOLE NUMBER : SD15

LOGGED BY : P.R.

NWPS

INTERVAL (m)		RECOVERY		DESCRIPTION	FORM	% Sn.										
FROM	TO	m	%			FROM	TO	TOTAL	ACIDSDL	% Cu.	% As.	% S.	% Pb.	% Zn.	% Bi.	g/t Ag
				and muscovite; tabular feldspar crystals up to 2cm thick. Minor black tourmaline in clots or nodules of quartz-tourmaline >1cm diameter; one very large nodule(?) with minor pyrite 124.45-124.75m. Minor (7% of intersection) greisenized granite mostly in 10-20cm thick zones (up to 60cm), consisting of quartz, muscovite, minor sericite ± tourmaline and pyrite, rarely with fluorite and arsenopyrite, commonly enclosed in an argillized granite envelope, contact angles 40-60° to c.a. Argillized and very soft at 129.3m and 137.8 - 137.9m. Biotite enrichment lower 90cm. Broken along few joints.												
				170.5 - 170.8 Irregular, porphyritic aplite dyke, consisting of rounded quartz and feldspar phenocrysts in a very fine grained matrix, trace muscovite and pyrite. Partly sericitized.												
				Thin sections 115.1, 121.9m.												
				Gradational change to:												
172.4	174.4	2.0	100	PORPHYRITIC GRANITE Phenocrysts largely white and yellow (argillized) rounded feldspars, lesser quartz, set in a grey groundmass. Minor biotite. Some feldspars with yellow, argillized rims, possibly reflecting late plagioclase rimming K-feldspar(?). Thin section 174.4m. Sharp contact 10-15° to c.a. No chill zone.												
174.4	240.7	66.3	100	GRANITE Coarse to medium grained, comprising white or pale yellow (weakly argillized) feldspars, grey quartz, minor (~2%) black biotite. Minor (~10% of intersection) greisenized granite mostly in zones <15cm thick (thicker zones described below), consisting of quartz, muscovite ± sericite, tourmaline, pyrite, some with thin central veins of pyrite ± quartz ± tourmaline ± arsenopyrite and veinlet clay; vein and contact angles 30-50° to c.a. Below 185m, few thin tourmaline veins (mostly <1cm thick) in two sets (VCA's 65°, 40°, average) and rare tourmaline-quartz nodules. In places very many tiny white cracks through granite but core generally competent, only broken along infrequent joints.												

60 045

DIAMOND DRILL RECORD

HOLE NUMBER : SD15

LOGGED BY : P.R.

HWPS

INTERVAL (m)		RECOVERY		DESCRIPTION	FORM	% Sn.											
FROM	TO	m	%			FROM	TO	TOTAL	ACID SOL.	% Cu.	% As.	% S.	% Pb.	% Zn.	% Bi.	g/t Ag	% WO ₃
	177.1 - 178.8			Fine grained granite, weakly quartz-feldspar porphyritic, plagioclases partly altered to sericite-clay, very minor biotite. Few fine grained quartz-tourmaline nodules 1.5-2.5cm diameter. At 177.4 - 177.5m quartz-tourmaline vein (VCA 65°) within greisen selvage. Gradational contacts.													
	194.5 - 198.8			Fine grained granite, similar to above but feldspars pale yellow (weakly argillized). Few black tourmaline-quartz and siliceous greisen veinlets, and tourmaline-quartz nodules. Gradational contacts.													
	199.5 - 201.7			~60% of intersection is grey greisen comprising quartz muscovite, minor black tourmaline and sericite. One thin (3mm) vein of arsenopyrite - quartz - pyrite at 200.4m, VCA 45°.		199.5	200.5	0.01	0.01	0.03	0.01	0.1	0.01	0.01	0.001	0.01	
							201.7	0.03	"	0.06	0.2	1.0	"	"	0.016	"	
	213.5 - 213.7			Grey greisen with clay veinlets, trace arsenopyrite. VCA 50°.													
	215.7 - 215.9			Grey greisen with veinlets of clay, tourmaline - quartz and arsenopyrite - pyrite - quartz, VCA 40-45°.													
	216.5 - 220.9			Porphyritic granite - rounded quartz and feldspar phenocrysts in fine grained groundmass. Similar to 194.5 - 198.8m. Includes greisen vein 219.2 - 219.3m, VCA 50°. Gradational contacts.													
	222.1 - 225.7			~20% of intersection is grey greisen including few thin veins (2-8mm) of arsenopyrite - pyrite - quartz, VCA 45-50°.		222.5	229.5	0.01	0.01	0.04	0.1	1.1	0.01	0.01	0.013	0.1	
							230.5	"	"	0.07	0.1	1.3	"	"	0.004	"	
	228.7 - 240.7			~30% of intersection is green-grey greisen, including veins of quartz-tourmaline and, rarely, thin veins (2-5mm) of pyrite - quartz ± arsenopyrite ± chalcopyrite(?). Broken along slickensided clayey surfaces within 20cm of contact.		228.5		"	"	0.04	0.01	0.1	"	"	0.002	0.1	
							233.5	"	"	"	"	0.8	"	"	0.004	0.01	
							233.5	"	"	"	"	0.3	"	"	"	0.02	
							234.5	"	"	0.02	"	0.3	"	"	0.004	"	
							236.5	"	"	0.04	"	"	"	"	0.004	0.10	
							236.5	0.02	"	0.05	0.1	1.3	"	"	0.007	0.02	
	Thin sections 182.7, 200.4, 239.5m.						237.5	0.01	"	0.03	0.01	0.4	"	"	0.006	"	
							238.5	"	0.02	0.04	"	0.5	"	"	0.005	"	
	Very soft and clayey, 30cm. core loss at contact - Fault(?)						239.5	"	0.01	0.03	"	0.1	"	"	0.002	"	
							240.5	"	0.01	0.04	"	0.4	"	"	0.004	0.01	

040

60 040

DIAMOND DRILL RECORD

HOLE NUMBER : SD15

LOGGED BY : F.R.

INTERVAL (m)		RECOVERY		DESCRIPTION	FORM.	% Sn											
FROM	TO	m	%			FROM	TO	TOTAL	ACID SOL.	% Cu.	% As.	% S.	% Pb.	% Zn.	% Bi.	g/t Ag	% WO ₃
240.7	249.4	8.2	94	QUARTZITE LESSER HORNFELS		240.5	241.5	0.01	0.01	0.04	50.1	0.7	<0.01	<0.01	0.004	1	0.02
				Grey and brown, hard, finely laminated. Quartzite grey, finely micaceous (muscovite), derived from fine grained sandstone.			242.5	<0.01	<0.01	0.05	"	0.0	"	"	0.003	1	0.01
				Hornfels grey with brown interbeds (tourmaline-rich?), derived from siltstone. Minor red-brown biotite particularly associated with aplitic veins. Numerous silicified (or topazified?) aplitic veins			243.5	0.02	0.01	"	"	2.2	"	"	"	<1	"
				† tourmaline † biotite, rarely fluorite, pyrite, 5mm - 2cm thick, widely variable VCA's. Minor sulphides in thin (< 1cm) veins -			244.5	<0.01	"	0.04	"	0.5	"	"	0.004	1	"
				mostly pyrite with quartz, lesser pyrrhotite and arsenopyrite, rare sphalerite and chalcopyrite. One thicker quartz vein 247.7 - 247.9m.			246.5	"	<0.01	"	0.1	0.5	"	"	0.002	<1	"
				VCA 25°. Few fibrous brown tourmaline veinlets (< 0.5mm), VCA 40-50°. Increasing intensity of calc-silicate alteration and higher sulphide content in lower 1.1m - highly micaceous (muscovite and biotite), irregular talc-filled vugs 248.3 - 248.4m, minor			247.5	"	"	"	<0.1	0.6	"	"	"	1	"
				serpentine veining. BCA averages 35°. Broken along joints and infrequently parallel bedding. Rare small scheelite specks 249.0m, possible scheelite grains (2-3mm diameter) within brown tourmaline vein, yellow fluorescence under short wave only.			248.5	"	"	0.09	0.1	0.9	"	0.01	0.007	1	0.02
				Thin section 247.5m.						0.08	50.1	2.7	"	<0.01	0.006	1	0.01
249.4	255.6	5.6	90	MINERALIZED SERPENTINE MINOR CALC-SILICATE		249.0	250.0	<0.01	0.02	0.04	0.01	2.9	<0.01	0.02	0.004	2	0.01
				Serpentine varies from dark green through to black, talcose, generally bedded, very soft and clayey in short sections (< 10cm)			251.0	0.04	"	"	"	3.6	"	"	0.003	1	"
				- badly broken, minor core losses. Calc-silicate white, grey, pale green, bedded, partly biotite-rich. Mineralization - pyrrhotite and pyrite			252.0	0.05	"	0.07	"	4.2	"	"	0.006	1	0.02
				in veinlets and disseminated (< 5% sulphide overall, up to 25%), minor magnetite (content increasing downwards). BCA 40-50°.			253.0	0.62	0.12	0.03	"	1.3	"	"	0.006	1	0.09
							254.0	0.04	0.02	0.05	"	0.9	"	"	0.007	1	0.01
							255.0	"	0.05	0.02	"	1.2	"	0.06	0.072	2	0.02
							256.0	0.20	0.10	0.03	"	0.6	"	0.04	0.073	1	0.03
							257.0	0.25	0.12	0.01	"	0.2	"	0.02	0.005	2	0.05
				Thin section 251.2m.			258.0	0.44	0.10	0.03	"	0.5	"	"	0.008	2	0.06
							259.0	0.34	0.07	0.05	"	0.9	"	"	0.014	2	0.05
				Gradational transition to:			260.0	0.69	0.30	0.01	"	0.1	"	"	0.004	2	0.11
							261.0	0.46	0.13	0.05	"	0.9	"	"	0.150	2	0.05
255.6	307.4	50.2	97	MAGNETITE SKARN		262.0	0.99	0.40	0.02	"	0.1	"	"	0.004	2	0.11	
				Largely magnetite and serpentine, minor calc-silicates(?), partly bedded, non-calcareous. Magnetite black or dark grey. Black magnetite			263.0	0.10	0.03	0.08	"	4.1	"	"	0.016	2	0.01
				commonly finely acicular and associated with soft, white talcose			264.0	0.68	0.15	0.11	0.06	1.8	"	"	0.011	2	0.06
				tremolite(?); grey magnetite generally finer grained, either massive			265.0	0.21	0.14	0.01	0.01	0.3	"	0.03	0.004	2	0.01
				or in veinlet and disseminated from within serpentine. Serpentine			266.0	0.62	0.33	0.02	"	0.8	"	"	"	3	0.11
				varies apple green through to black. Sulphide content < 5% overall			267.0	1.09	0.35	<0.01	"	0.5	"	0.06	0.003	2	0.10
				but patchy - > 25% in places, largely pyrrhotite in veins and beds			268.0	0.77	0.09	"	"	0.7	"	0.01	"	2	0.06
				< 1cm thick (VCA 0-30°) and less commonly disseminated, minor			269.0	0.62	0.05	"	0.66	3.1	"	0.03	0.013	4	0.07
				arsenopyrite with pyrrhotite, very minor pyrite. Few veins of green			270.0	0.23	0.13	"	<0.01	0.3	"	0.01	0.011	2	0.02
							271.0	<0.01	0.02	"	"	1.4	"	"	0.007	1	0.01

040

50 047

DIAMOND DRILL RECORD

HOLE NUMBER : SD15

LOGGED BY : P.R.

WVPS

INTERVAL (m)	RECOVERY	DESCRIPTION	FORM	% Sn											
				FROM	TO	TOTAL	ACID SOL.	% Cu.	% As.	% S.	% Pb.	% Zn.	% Bi.	g/t Ag	% WO ₃
		mica, often associated with pyrrhotite veins as a selvage 1mm-3cm thick. Rare thin (1-4mm) chrysotile and talc veins (badly broken along latter), variable VCA's. Pale blue, fine grained vivianite(?) staining some joints. Rare quartz veinlets. BCA 30-50° (where visible), 40° average. Broken and, in places, badly broken on slickensided joints, scanning with UV showed scheelite 271.1 - 271.4m (few specks), 298.4m (small patches with pyrrhotite and sphalerite) mineral with short wave only, blue fluorescence weaker than scheelite at 300.1m.		271.0	272.0	0.51	0.11	0.16	0.01	0.01	0.7	0.01	0.013	2	0.07
					273.0	1.35	0.16	"	0.04	0.9	"	0.01	0.011	3	0.08
					274.0	0.47	0.08	"	0.01	1.1	"	0.015	2	0.06	
					275.0	0.28	0.04	0.26	0.1	0.9	"	0.11	0.005	2	0.10
					276.0	0.22	0.02	0.05	"	2.8	"	0.02	0.022	2	0.06
					277.0	0.81	0.03	0.08	0.1	2.8	"	0.009	3	0.06	
					278.0	0.18	"	0.37	0.1	2.9	"	0.06	0.016	3	0.04
					279.0	0.22	0.05	0.04	0.1	3.9	"	0.03	0.012	3	0.09
					280.0	0.08	0.04	0.05	"	1.4	"	0.62	0.007	3	0.05
					281.0	0.49	0.02	0.28	"	2.7	"	1.19	0.008	4	0.08
		283.7 - 283.8 Quartzite bed (?), serpentine veined.			282.0	1.00	0.03	0.32	0.3	2.4	"	0.02	0.017	3	0.06
					283.0	0.43	0.02	0.08	0.1	2.0	"	0.028	2	0.05	
		286.7 - 297.1 Pale green, badly broken serpentine. Black magnetite and soft white minerals (brucite or magnesite?, and talc) cross-cutting serpentine. Minor white cherty bands, unbedded, veined by green, black serpentine. Minor sections of more typical serpentine - magnetite - pyrrhotite. 1.3m core loss.			284.0	0.19	0.03	0.06	"	1.3	"	0.03	0.010	1	0.04
					285.0	0.27	0.16	0.05	0.4	0.8	"	0.03	0.007	2	0.07
					286.0	0.22	0.07	0.03	0.1	0.4	"	0.01	0.004	2	0.02
					287.0	0.28	0.22	0.04	"	0.5	"	0.02	0.004	3	0.04
					288.0	0.28	0.26	0.09	0.1	0.6	0.01	0.02	0.004	3	0.04
					289.0	1.11	0.29	0.09	0.2	3.3	"	0.02	0.010	3	0.08
					290.0	0.35	0.10	0.02	0.1	0.2	"	0.03	0.005	2	0.01
		Below 297.1m, core competent, few breaks.			291.0	0.31	0.25	0.03	0.3	0.4	"	0.02	0.004	2	0.02
					292.0	0.39	0.34	0.07	0.1	1.2	"	0.01	0.011	3	0.06
		302.5 - 304.4 Black magnetite interspersed with soft, white mineral (brucite or magnesite?), bedded (magnetite-rich and magnetite-poor bands). Magnetite grains (average diameter 1mm) either disseminated through white matrix or massive with minor pyrrhotite.			293.0	0.07	0.05	0.02	0.1	0.2	"	0.02	0.004	1	0.01
					294.0	0.10	0.07	0.03	0.1	0.2	"	0.01	0.004	2	0.01
					295.0	0.29	0.19	0.07	0.05	0.1	0.02	0.01	0.007	1	0.06
					296.0	0.09	0.04	0.05	0.1	0.5	0.01	0.02	0.004	2	0.02
					297.0	0.16	"	0.07	"	2.0	"	0.04	0.006	3	0.09
					298.0	0.02	0.02	0.11	"	4.4	"	0.03	0.027	3	0.14
		305.0 - 305.2 20-30% of intersection is red-brown, probably sphalerite.			299.0	0.04	0.02	0.05	"	2.0	"	0.02	0.010	2	0.06
					300.0	0.04	0.02	0.17	0.03	2.7	0.02	0.01	0.023	2	0.12
					301.0	0.61	0.05	0.19	0.59	5.6	"	0.01	0.015	3	0.09
		305.8 - 307.4 Magnetite interspersed with moderately soft white mineral as at 302.5 - 304.4m, minor serpentine and carbonate. Minor fold at 306.6m.			302.0	0.17	0.04	0.14	0.30	3.5	0.01	"	0.021	2	0.10
					303.0	0.96	0.70	0.08	0.01	0.7	0.02	0.01	0.008	1	0.14
					304.0	3.32	2.6	0.07	0.2	1.2	0.02	0.02	0.007	3	0.11
					305.0	0.85	0.40	0.36	0.86	2.2	0.02	0.12	0.015	3	0.18
		Thin sections 260.0, 265.4, 268.4, 274.9, 284.5, 289.4, 303.4, 305. m.			306.0	0.70	0.66	0.30	1.40	2.0	"	2.21	0.015	3	"
					307.0	0.08	0.05	0.05	0.01	0.1	0.01	0.01	0.004	1	0.07
307.4	317.0	9.4	98		308.0	0.04	0.01	0.08	"	0.2	"	0.15	0.004	3	0.06
		CARBONATE AND TALC-RICH ROCK			309.0	0.01	0.01	0.05	0.01	0.3	0.01	0.01	0.012	1	0.01
		Carbonate grey, crystalline, unbedded or crudely banded, largely calcite, minor magnetite (content decreasing downwards), includes small patches or green serpentinous carbonate, few stylolites.			310.0	"	0.01	0.02	"	0.4	"	0.01	0.014	"	"
					311.0	"	"	0.02	"	0.3	"	"	0.009	"	"
		Talc-rich rock, lesser, grey, unbedded or faintly laminated, minor green serpentine veins, grey micaceous patches. BCA 30-35°. Few breaks along joints.			312.0	"	"	"	"	0.6	"	"	0.012	"	"
					313.0	"	"	0.04	"	0.3	"	"	0.009	"	"
					314.0	"	"	0.03	"	0.1	"	"	0.008	"	"

047

60 048

DIAMOND DRILL RECORD

HOLE NUMBER : SD15

LOGGED BY : P.R.

043

INTERVAL (m)		RECOVERY		DESCRIPTION	FORM	% Sn.											
FROM	TO	m	%			FROM	TO	TOTAL	ACID SOL	% Cu.	% As	% S.	% Pb	% Zn	% Bi.	g/r Ag	% WO ₃
	307.4 - 308.1			Siliceous, minor magnetite,		314.0	315.0	<0.01	<0.01	0.02	<0.1	0.1	<0.01	<0.01	0.006	<1	<0.01
	313.0 - 313.1			White to pale green, siliceous, veined by green-black serpentine.		316.0	"	"	"	0.02	"	<0.1	"	"	0.004	"	"
	315.5 - 315.8			10cm recovery (20cm loss). Very pale green, soft vuggy carbonate. Green effervescence with acid, stains rock yellow.		317.0	"	0.01	0.02	"	"	"	"	"	0.005	"	"
	315.8 - 317.0			Grey, siliceous carbonate, veined by pale grey-green, pale brown serpentine and minor quartz. Serpentine predominates 316.4 - 317.0m. Partly brecciated textures developed by veining.													
				Thin section 310.4m.													
317.0	326.2	9.2	100	QUARTZ		317.0	318.0	<0.01	0.01	0.02	<0.1	<0.1	<0.01	<0.01	0.004	<1	<0.01
				White, pale grey, pale green, massive. Crossed by a fine network of chalcedony(?) and pale green serpentine veinlets. Broken along infrequent clay - or serpentine - coated joints (JCA 45-60°), some slickensided, or in thicker, soft clayey zones.		319.0	"	<0.01	0.01	"	"	"	"	"	0.004	"	"
						320.0	"	0.01	"	"	"	"	"	"	0.002	"	"
						321.0	"	<0.01	"	"	"	"	"	"	"	"	"
						322.0	0.04	"	0.05	"	2.0	"	0.01	"	"	"	0.01
						323.0	<0.01	"	0.02	"	<0.1	"	<0.01	0.002	"	<0.01	
	325.9 - 326.0			Very soft, cream-coloured, clayey material.		324.0	"	"	"	"	"	"	"	0.001	"	"	
						325.0	"	"	"	"	"	"	"	0.002	"	"	
				Thin section 310.4m.		326.0	"	"	"	"	"	"	"	0.002	"	"	
326.2	332.4	6.2	100	CARBONATE		326.0	327.0	<0.01	<0.01	0.04	<0.1	0.1	<0.01	<0.01	0.013	<1	<0.01
				Grey and white, crudely banded or faintly bedded in places, largely calcite. Minor veining by pale green serpentine, veinlet calcite and black Mg-silicates(?) - latter also in rare flecks. Very minor disseminated pyrrhotite 327.0 - 327.8m. Few veinlets of hard grey-green, botryoidal mineral 330.9 - 331.2. BCA 30-45°.		328.0	"	"	0.02	"	0.2	"	"	"	0.015	"	"
						329.0	"	"	0.05	"	0.1	"	"	0.010	"	"	
						330.0	"	0.01	0.02	"	<0.1	"	"	"	"	"	
						331.0	"	<0.01	0.02	"	"	"	"	"	"	"	
						332.0	"	0.02	"	"	0.4	"	"	0.04	"	"	
				Thin section 326.4m.													
332.4	334.2	1.8	100	SILICEOUS APLITE		332.0	333.0	<0.01	<0.01	0.02	<0.1	<0.1	<0.01	<0.01	0.007	<1	0.01
				Pale grey, hard. Mostly very fine grained but coarser, graphic texture at contacts in thin zones (5mm upper, 10mm lower). Numerous grey-green serpentine veinlets. Contacts slightly irregular 20-30° to c.a.		334.0	"	"	"	"	"	"	"	"	0.003	"	"
				Thin section 334.2m.													

00 049

DIAMOND DRILL RECORD

HOLE NUMBER : SD15

LOGGED BY : P.R.

HWPE

INTERVAL (m)		RECOVERY		DESCRIPTION	FORM.	% Sn.												
FROM	TO	m	%			FROM	TO	TOTAL	ACID SOL.	% Cu.	% As.	% S.	% Pb.	% Zn.	% Bi.	g/t Ag	% WO ₃	
				- mainly pyrite, with pyrrhotite and sphalerite lower 10cm. Lower contact parallel bedding, BCA 30°.														
347.8	383.7	33.4	93	HORNFELSED SHALE		347.0	349.0	<0.01	<0.01	0.04	<0.1	2.3	<0.01	0.12	0.003	<1	<0.01	
				Dark grey, faintly bedded, becoming harder downwards. Pyritic throughout; pyrite as blebs (often elongated parallel bedding) 0.5 - 5mm diameter, as veinlets and in thin (mostly <2mm thick) veins of quartz, pyrite ± biotite. Partly graphitic. Includes few calcareous zones rich in pale grey cordierite (larger crystals have hexagonal outlines), with possible andalusite. Weakly calcareous down to 350.2m and non-calcareous - apart from the cordierite zones - below that point. BCA 30-45° (35° average). Broken along infrequent joints which are mostly rough and pyritic, rarely graphitic slickensided and smooth. Badly broken 360.3 - 360.9m (20cm loss), 365.1 - 365.7m (40cm loss), 380.0 - 381.0 (-80cm loss), 381.5 - 382.4m (-70cm loss) and 382.7 - 383.3m (40cm loss).			350.0	"	"	"	"	2.3	"	0.02	"	"	"	0.01
						351.0	"	"	0.05	"	2.3	"	0.05	"	"	"	"	
						352.0	"	"	0.04	"	1.4	"	0.02	0.004	"	"	"	
						353.0	"	"	0.03	"	1.8	"	<0.01	0.003	"	"	"	
						354.0	"	"	0.04	"	2.1	"	0.02	0.009	"	"	"	
						355.0	"	"	"	"	2.1	"	0.05	0.002	"	"	"	
						356.0	"	"	"	"	2.1	"	0.05	"	"	"	"	
						357.0	"	"	0.05	"	2.8	"	0.02	0.004	1	"	"	
						358.0	"	"	0.04	"	2.3	"	0.04	"	1	"	"	
						359.0	"	0.01	"	"	2.4	"	0.01	"	1	"	"	
						360.0	"	<0.01	0.05	"	2.5	"	0.02	"	<1	<0.01	"	
						361.0	"	"	"	"	2.0	"	0.02	0.003	1	"	"	
						362.0	"	0.01	0.04	"	2.3	"	0.06	0.004	1	"	"	
				347.8 - 348.0 With abundant (~5%) red-brown sphalerite in irregular blebs 41cm diameter.		363.0	"	<0.01	0.06	"	2.7	"	<0.01	0.003	1	0.01	"	
						364.0	"	"	0.04	"	2.0	"	0.10	0.004	1	<0.01	"	
						365.0	"	"	0.05	"	2.8	"	0.12	0.002	<1	"	"	
				349.2 - 350.2 Cut by veinlets of fine bladed calcite crystals. 10cm zone micaceous calc-silicate 350.0 - 350.1m.		366.0	"	"	"	"	2.4	"	0.09	0.004	1	0.01	"	
						367.0	"	"	"	"	2.1	"	0.01	0.002	1	"	"	
						368.0	"	0.01	"	"	2.1	"	<0.01	"	<1	"	"	
				353.0 - 353.1 Silicified granitic(?) vein, including angular transported hornfels fragments (fragment size up to core width). VCA 20-25°.		369.0	"	<0.01	0.05	"	1.9	"	"	"	"	<0.01	"	
						370.0	"	"	0.06	"	2.0	"	"	"	"	"	"	
						371.0	0.01	"	"	"	1.0	"	0.17	0.002	3	"	"	
						372.0	0.02	0.01	0.06	"	1.3	"	0.04	0.006	<1	"	"	
				359.7 - 359.8 With minor disseminated sphalerite.		373.0	0.02	<0.01	0.03	"	1.4	"	0.07	0.003	1	"	"	
						374.0	<0.01	"	"	"	2.1	"	<0.01	0.005	<1	"	"	
				370.2 - 371.6 Calc-silicate, pale green-grey with pink patches, hard bedded, weakly calcareous.		375.0	"	"	0.03	"	2.2	"	0.02	0.004	"	"	"	
						376.0	"	"	0.04	"	2.2	"	"	"	1	"	"	
						377.0	"	"	"	"	1.6	"	0.01	0.003	<1	"	"	
383.7	389.9	6.2	100	CALC-SILICATE AND CARBONATE		378.0	"	"	0.02	"	<0.1	"	<0.01	0.001	"	"	"	
				Calc-silicate, pale grey-green, pale yellow, mottled, partly bedded, calcareous except for top 80cm. Numerous dark grey-green veinlets of chlorite(?) near - parallel bedding. Minor irregular veins calcite and veinlet pyrite. Few zones (interbeds?) dark grey, cordierite-bearing hornfels with minor pyrite. Minor sphalerite abundant at 287.8 - 287.9m and 289.5 - 289.9m. with lesser pyrite, pyrrhotite and arsenopyrite. BCA 20 - 30°. Solid core.		379.0	"	0.01	0.05	"	1.6	"	"	0.006	"	0.01	"	
						380.0	"	<0.01	0.04	"	2.0	"	"	0.006	1	"	"	
						381.0	"	"	0.02	"	2.0	"	"	0.006	<1	<0.01	"	
						382.0	"	"	"	"	2.5	"	"	"	"	0.01	"	
						383.0	0.01	0.02	"	"	3.3	"	"	0.004	"	"	"	
						384.0	0.13	0.02	0.04	"	0.7	"	0.01	0.011	"	"	"	
						385.0	0.31	0.20	0.05	"	1.0	"	"	0.019	"	"	"	
						386.0	0.07	0.04	0.03	"	<0.1	"	<0.01	0.04	"	<0.01	"	
				This section 384.4m.		387.0	0.02	<0.01	0.05	"	0.5	"	0.20	0.009	1	0.01	"	
						388.0	0.04	"	0.02	"	"	"	0.04	0.008	1	<0.01	"	

050

051

DIAMOND DRILL RECORD

HOLE NUMBER : SD15

LOGGED BY : P.R.

NDPS

INTERVAL (m)	RECOVERY		DESCRIPTION	FORM	% Sn.												
	FROM	TO			m	%	FROM	TO	TOTAL	ACID SOL.	% Cu	% As	% S	% Pb	% Zn	% Bi	g/t Ag
389.9	394.2	4.3	100	HORNFEELS-QUARTZITE	389.0	389.0	0.02	<0.01	0.07	<0.1	0.7	<0.01	0.11	0.005	1	<0.01	
				Pale grey or grey-green, bedded, hard and siliceous. Minor, very fine grained disseminated pyrite and rare coarser grained pyrrhotite in blebs 2-3mm wide. BCA 30-35°. Broken along rare flat joints.	390.0	390.0	0.02	"	0.05	"	1.0	0.02	0.02	0.150	4	0.01	
					391.0	391.0	<0.01	"	0.02	"	<0.1	<0.01	0.02	0.000	4.1	"	
					392.0	392.0	"	"	"	"	0.2	"	0.02	"	"	"	
					393.0	393.0	"	"	0.05	"	1.1	"	0.01	0.002	"	<0.01	
					394.0	394.0	"	"	0.02	"	1.2	"	<0.01	0.000	"	"	
				390.6 - 390.9 Altered granitic(?) vein - white quartz phenocrysts(?) set in a grey-green groundmass. Contacts irregular, top ~10° to c.a., bottom ~30° to c.a.													
				392.3 - 393.8 Hornfelsed shale, dark grey, faintly bedded, calcareous, cordierite(?) - rich (pale grey crystals <3mm diameter), minor pyrite in blebs or veinlets.													
394.2	397.4	3.0	94	GRANITE	394.0	395.0	<0.01	<0.01	0.02	<0.1	<0.1	<0.01	<0.01	0.002	1	<0.01	
				Pale grey fine grained, consisting of grey quartz, white or pale green (weakly sericitized) feldspars, minor dark brown biotite, rare tourmaline. Partly silicified. Upper contact 30° to c.a., lower contact not visible. Broken along joints, badly broken (20cm core loss) 396.4 - 397.4m.	396.0	396.0	"	"	0.02	"	"	"	"	0.001	1	0.01	
					397.0	397.0	"	"	0.04	"	"	"	"	0.002	1	"	
					398.0	398.0	<0.01	<0.01	0.04	<0.1	1.1	<0.01	<0.01	0.002	1	0.01	
					399.0	399.0	"	"	"	"	1.0	"	"	"	<1	"	
					400.0	400.0	"	"	"	"	0.3	"	"	"	1	"	
397.4	400.0	2.4	92	BIOTITE-RICH QUARTZITE	401.0	401.0	"	"	0.03	"	<0.1	"	"	"	1	<0.01	
				Grey, hard, laminated, comprising quartz, fine grained, red-brown biotite in thin discontinuous beds, abundant pyrite disseminated and in veinlets. Thin (2mm - 1cm) veins of massive biotite at contacts, BCA 30° average. Badly broken on numerous pyritic joints (20cm core loss).	402.0	402.0	"	"	"	"	"	"	"	0.002	<1	"	
					403.0	403.0	"	"	0.02	"	"	"	"	"	1	"	
					404.0	404.0	"	"	0.03	"	"	"	"	0.001	<1	"	
					405.0	405.0	"	"	0.02	"	"	"	"	"	"	0.01	
					406.0	406.0	"	"	0.02	"	0.1	"	0.04	0.002	"	"	
					407.0	407.0	"	"	"	"	<0.1	"	<0.01	0.001	"	"	
					408.0	408.0	"	"	0.02	"	"	"	"	"	1	"	
					409.0	409.0	"	"	0.02	"	"	"	0.02	<0.001	1	<0.01	
					410.0	410.0	"	"	"	"	"	"	<0.01	0.001	1	0.01	
					411.0	411.0	"	"	"	"	<0.1	"	"	"	1	0.02	
					412.0	412.0	"	"	0.04	"	0.4	0.01	0.01	0.002	1	0.01	
					413.0	413.0	"	"	0.03	"	0.2	0.02	0.02	0.001	1	0.02	
					414.0	414.0	"	"	"	"	0.4	<0.01	0.73	"	1	0.01	
					415.0	415.0	"	"	"	"	<0.1	"	0.01	"	1	0.02	
					416.0	416.0	"	"	"	"	"	"	<0.01	0.002	1	"	
					417.0	417.0	"	"	0.04	"	"	"	"	"	1	0.01	
					418.0	418.0	"	"	"	"	0.3	0.5	0.02	0.01	0.004	5	0.02
					419.0	419.0	"	"	0.05	<0.1	0.6	<0.01	"	0.002	1	"	
					420.0	420.0	"	"	0.02	"	<0.1	"	<0.01	0.002	4.1	0.01	
					421.0	421.0	"	"	0.04	"	"	"	"	0.002	"	"	
					422.0	422.0	"	"	0.02	"	"	"	"	"	"	0.02	
					423.0	423.0	"	"	"	"	0.1	"	"	"	"	"	
				400.0 - 400.5 Enriched in biotite and feldspar, depleted in quartz.													

051

052

DIAMOND DRILL RECORD

HOLE NUMBER : SD15

LOGGED BY : P.B.

HWPE

INTERVAL (m)		RECOVERY		DESCRIPTION	FORM.	% Sn.										
FROM	TO	m	%			FROM	TO	TOTAL	ACID SOL	% Cu	% As	% S	% Pb	% Zn	% Bi	g/t Ag
				400.9 - 401.2 Fine grained, gradational contacts. Upper contact marked by reduction in biotite content downwards, contact angle ~30° to c.a.												
				411.6 - 412.0 Greisen, greenish grey, comprising quartz, muscovite, sericite, minor pyrite, tourmaline. Includes 10cm argillized granite and a 1-2mm vein of tourmaline - arsenopyrite at 411.7m (VCA 70°).												
				412.2 Quartz and coarse brown-black sphalerite vein, 1cm thick, VCA 20°.												
				412.9 Quartz-sphalerite vein as above but 5-8mm thick, VCA 35°.												
				416.2 - 416.4 Quartz-muscovite greisen, central tourmaline vein, 1mm thick.												
				417.1 - 417.6 Quartz-muscovite-sericite-minor pyrite greisen. Includes 10cm argillized granite and several thin arsenopyrite veins ~8mm thick at 417.3m, VCA 70°.												
				418.3 - 418.8 Quartz-muscovite-sericite-minor tourmaline greisen. Includes 1cm quartz vein at 418.7m with central seam of arsenopyrite and chalcopyrite, VCA ~70°. Granite argillized around above greisen zone including intense argillization (very soft) 417.8 - 418.1 and 418.8 - 418.9m.												
				420.9 - 421.7 Green-black chloritic(?) and argillic alteration zone crossing core at 15° to c.a. Broken along smooth slickensided fracture surfaces.												
				422.6 - 422.7 Quartz-muscovite-sericite greisen.												
				Thin sections 401.9, 418.6m.												
				END OF HOLE 422.8m.												

052

00 052

RENISON LIMITED
DIAMOND DRILL HOLE PLOT

SCALE :

HOLE No. :

RENISON LIMITED

HOLE NO. SD15

M. BOLTON

MAGNETIC SUSCEPTIBILITY ($\times 10^{-6}$ C.G.S. units)

DEPTH	MS	DEPTH	MS	DEPTH	MS	DEPTH	MS	DEPTH	MS	DEPTH	MS
0-111	≤100*	-264	65000	-279	54000	-294	100	-309	1600	-333	≤100
111-230	no readings (granite)	-265	9100	-280	38000	-295	11000	-310	5200	-334	500
		-266	52000	-281	41000	-296	43000	-311	3200	-374	≤100*
-252	≤100*	-267	4000	-282	38000	-297	41000	-312	2300	-375	300
-253	10000	-268	91000	-283	100	-298	18000	-313	1100	-376	200
-254	6000	-269	56000	-284	200	-299	64000	-314	1800	-377	300
-255	30000	-270	1400	-285	44000	-300	28000	-315	2400	-378	200
-256	14000	-271	2000	-286	1200	-301	32000	-316	3500	-379	100
-257	26000	-272	52000	-287	18000	-302	76000	-326	≤100*	-380	400
-258	61000	-273	27000	-288	36000	-303	78000	-327	500	-384	≤100*
-259	50000	-274	29000	-289	35000	-304	60000	-328	≤100	-385	300
-260	56000	-275	41000	-290	400	-305	57000	-329	200	-386	≤100
-261	26000	-276	27000	-291	30000	-306	9400	-330	100	-387	500
-262	2300	-277	2700	-292	27000	-307	1600	-331	200	-422	≤100*
-263	33000	-278	2400	-293	3400	-308	10000	-332	600	* Same result for more than 1 metre	

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RENISON LIMITED
DIAMOND DRILL HOLE PLOT

SCALE:

HOLE No.: 5D 15

PETROGRAPHIC DESCRIPTIONS

(C.M.S. REPORT 81/1/41)

SAMPLE NO.	CLASSIFICATION - COMPOSITION	FABRIC	ACCESSORIES	COMMENTS
41.5m (T.S. 35938)	<u>Quartz-Dravite Hornfels.</u> Quartz and dravite in varying proportions with subordinate to minor muscovite.	Fine-grained, hornfelsic, with relict pelitic bending.	Sparse, cloudy fine rutile. Sparse relict detrital zircon, rutile.	Close affinities with SD 14/5.4m, 36.9m, but more distinctly hornfelsed.
78.2m	<u>Tremolite Quartz-Mica Hornfels.</u> Quartz and pale titaniferous phlogopite, subordinate closely intergrown cordierite, disseminated poikiloblastic tremolite, fine pyritised pyrrhotite.	Fine-grained hornfelsic with relict millimetric-scale bedding.	Minor traces ankeritic carbonate, poikilitic dravite.	Hornfelsed siltstone. Tremolite is metasomatic, probably after diagenetic carbonate impregnations. Bedded (recrystallized, syngenetic) sulphide.
86.7m	<u>Retrogressed Hornfels.</u> Sericitised pyrrhotite, kaolinised ?cordierite, subordinate quartz, patchy, pale cummingtonite, pale phlogopite, pyritised pyrrhotite, ankeritic carbonate.	Fine-grained, hornfelsic, with poikilitic amphibole, phlogopite. Minor quartz veining.	Conspicuous, extremely fine, cloudy rutile.	Relict pelitic bedding. Close affinities with 78.2m. Cummingtonite late metasomatic, introduced partly with vein-quartz (-carbonate-pyrite).
92.4m	<u>Metaquartzite.</u> Anhedral/weakly interlocking quartz with relatively minor included intergranular kaolinitic alkali feldspar. Patchy tremolite aggregates and chloritised phlogopite.	Quartzitic, medium-grained, faint relict deformed banding.	Traces sideritic carbonate, sphene, dravite. Sparse relict detrital zircon, rutile.	Thoroughly silicified, hornfelsed feldspathic psammite with patchy metasomatic tremolite, phlogopite, sim. 78.2m, 86.7m.
101.2m (T.S. 35942)	<u>Phlogopite-Tremolite Rock.</u> Pale green phlogopite with patchy, corroded aggregates of tremolite. Patchy talc, sparse, partly degraded albite, thinly disseminated pyritised pyrrhotite.	Medium-grained, faintly directed. Patchy, vague coarse semi-pseudomorphs (talc after ?pyroxene).	Traces dravite, minor ankeritic carbonate.	Affinities with 153.2, 182.1m facies in SD 14. Steatitised ?talc-tremolite-dioptide rock.
115.1m (T.S. 35943)	<u>Mica Adamellite.</u> Quartz, moderately sericite-stained oligoclase, incipiently kaolin-stained orthoclase-microparhite in near-equal proportions, sparse Ti-biotite, rare muscovite flakes.	Uneven-grained, granitic to locally subgraphic ("granophytic").	Minor chlorite (after biotite). Traces partly metamict monazite. Rare pyrite, ?chalcopyrite.	Typical characteristice of N.W. Tasmanian "tin granites". Mildly greisened. Sulphide is ultrafine, associated with chloritised biotite.
121.9m	<u>Greisen.</u> Quartz and muscovite with conspicuous fluorite, disseminated topaz, schorl, dravite, muscovitised biotite. Orthoclase-microparhite, quartz, variably muscovitised oligoclase.	Medium- to coarse-grained, weakly banded greisen. Granitic-textured selvage.	Traces pyrite, chalcopyrite, cloudy (secondary) rutile. Rare apatite.	Greisened adamellite (sim. 115.1m) with accessory tourmaline in contact with greisen vein or segregation. Contact is transitional, mica-rich.
174.4m	<u>Biotite Adamellite.</u> Quartz and orthoclase-microparhite, slightly subordinate, weakly muscovitised oligoclase, disseminated Ti-biotite, sparse topaz, schorl, minor phlogopite.	Uneven-grained, granitic. Incipiently stressed.	Traces fluorite, monazite, pyrite, dravite, chlorite.	Close affinities with 115.1m. Mildly greisened with muscovite after plagioclase, phlogopite after biotite, topaz. Topaz is late-, tourmaline early post-magmatic.
182.7m	<u>Biotite Granite.</u> Quartz and orthoclase-microparhite with relatively minor, moderately sericitised oligoclase, disseminated, weakly chloritised Ti-biotite, extensively kaolinised topaz.	Weakly directed, weakly orthoclase-porphyrific, granitic. Incipiently stressed.	Metamict monazite, zircon inclusions in biotite.	Close affinities with 115.1m and particularly 174.4m. Relatively potassic (granitic, verging on alkali granitic), mildly greisened. Primary topaz.
200.4m	<u>Greisened "Granite"</u> Quartz and feldspar-semi-pseudomorphous muscovite-quartz aggregates, subordinate, muscovitised biotite. Disseminated clots, films schorl, dravite, arsenopyrite, pyrite.	Relict, even-grained, granitic.	Traces zircon, monazite, secondary rutile. Minor sideritic carbonate. Rare chalcopyrite.	Thoroughly greisened (muscovitised/silicified), relatively coarse-grained biotitic granitoid, with sparse veins quartz, arsenopyrite, (pyritised) pyrrhotite.
239.5m	<u>Quartz-Tourmaline Rock.</u> Quartz, with subordinate colour-variable schorl, closely intergrown dravite, sparse muscovite.	Medium- to coarse-grained, granular quartz, weakly poikilitic tourmaline.	Traces fluorite, apatite, minor traces zircon.	Greisen-type vein or segregation with affinities to 121.9m.

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RENISON LIMITED
DIAMOND DRILL HOLE PLOT

HOLE No.: 5D 15 contd.

SCALE:

PETROGRAPHIC DESCRIPTIONS

(C.M.S. REPORT 81/1/41)

SAMPLE NO.	CLASSIFICATION - COMPOSITION	FABRIC	ACCESSORIES	COMMENTS
247.5m	<u>Grainaged Pelite.</u> Fine to semi-sericitic muscovite, subordinate to minor, closely intergrown quartz, pale phlogopite. Locally conspicuous fine-grained schorl. Quartz-ankerite veins.	Locally brecciated, sub- to millimetric, laminated relict pelitic. Weakly hornfelsic.	Traces fluorite, apatite, fine cloudy rutile, dark sphalerite, talc.	Muscovitised/tourmalinised pelite. Sphalerite introduced with discordant quartz-ankerite (-phlogopite-talc) veins.
251.2m (T.S., P.S. 35950)	<u>Altered Skarn.</u> Diopside with minor, closely intergrown, extensively steatitised clinohumite interspersed with semi-massive talc-minnesotaite. Patchy tremolite, spongy pyritised pyrrhotite.	Weakly schistose, crudely banded.	Minor carbonate, serpentine.	Steatitised/tremolitised, mildly sheared talc-diopside-clinohumite "skarn". No detectable Sn-phases.
260.0m (T.S., P.S. 35951)	<u>Steatitised "Serpentinite"</u> Antigorite aggregates with rosettes of phlogopite, conspicuous magnetite, interspersed spongy to semi-massive replacive fine-grained talc.	Crudely banded (magnetite). Vague pyroxene-derived mesh-textures.	Rare, semi-opaque cassiterite.	Serpentinised/partly steatitised ?diopside-magnetite skarn. Cassiterite semi-opaque grains to 1.5 x 2mm in antigorite. No detectable "soluble" Sn-phases.
265.4m (T.S., P.S. 35952)	<u>Steatitic "Serpentinite".</u> Serpophitic and fine antigorite serpentinite with abundant spongy to semi-fibrous magnetite, subordinate chloritised phlogopite, disseminated talc flakes.	Crudely banded, semi-schistose, faint ?olivine-derived mesh-textures.	Rare clots microscopic cassiterite (<20 u) in serpentine.	Mildly sheared/partly chloritised steatitised antigoritic serpentinite. Cassiterite typically <5 u ?exsolved from ferromags. No detectable soluble Sn phases.
268.4m (T.S., P.S. 35953)	<u>Phlogopitic "Serpentinite".</u> Antigorite and fine mesh-textured opaques. Sporadic crosscutting foliae of talc. Semi-pervasive green phlogopite magnetite aggregates. Minor late brucite veinlets.	Relict "olivine" and pyroxene-derived mesh-textures.	Patchy pyrrhotite, rare chalcopyrite, talnakhite, arsenopyrite. Traces ultrafine cassiterite, pegsite.	Complex alteration pattern with serpentinisation/steatitisation/phlogopitisation. Cassiterite <5 u wide films in serpentine. Pegsite sim. 5D 14/200.7m.
274.9m (T.S., P.S. 35954)	<u>Chloritic "Serpentinite".</u> Antigorite with sparse magnetite, interspersed with Mg-chlorite aggregates with abundant opaques (magnetite, pyrrhotite), minor talc, brucite.	Similar to 268.4m, but with poorly preserved mesh-textures. Weakly sheared.	Traces ultra-fine ?cassiterite.	Analogous to 268.4m, but with late chloritisation phlogopite. ?Cassiterite as 5 u particles, clots, microfilms in serpentine, similar to 265.4m.
284.5m (T.S., P.S. 35955)	<u>"Serpentinite"</u> Serpophitic and subradiating antigorite, conspicuous spongy, granular and fibrous magnetite, disseminated arsenopyrite, patchy brucite, chrysotile, skutterudite, talc.	Crudely banded. Locally faintly "olivine" mesh-textured. Incipiently sheared.	Minor late fibrous, subradiating dolomitic carbonate. Rare ultrafine ?cassiterite.	?Cassiterite as <5 u semi-amorphous particles, microscopic films in serpentine. No detectable soluble Sn-phase.
289.4m (T.S., P.S. 35956)	<u>Steatitised "Serpentinite".</u> Talc with patchy relic of antigorite, disseminated spongy, granular and extremely fine fibrous "magnetite". Patchy, late porcellanous carbonate.	Mildly sheared/flattened mesh-textures. Crudely banded opaques.	Disseminated clots, minor films semi-amorphous ultrafine ?cassiterite.	Some textural affinities with 5D 14/215.9m, possibly a steatitised olivine or humit marble. ?Cassiterite identical with 284.5m.
303.4m (T.S., P.S. 35957)	<u>Steatitised "Serpentinite"</u> Talc with patchy relic of antigorite, tremolite, abundant magnetite.	Relict, magnetite-rich mesh-textures. Crumulated phyllitic overprint.	Sporadic clots of amorphous ?cassiterite.	Complexly altered (serpentinised/tremolitised/steatitised) and relatively deformed. ?Cassiterite analogous to that in 284.5, 289.4m. No detectable soluble Sn phase.
305.1m (T.S., P.S. 35958)	<u>Tremolitised, Steatitised Serpentinite.</u> Very fine talc with interspersed patches antigorite, conspicuous dark sphalerite, arsenopyrite subheda, sparse magnetite, relict tremolite.	Talc pseudomorphous after fine, felted tremolite. Antigorite pseudomorphs "olivine" (?humite).	Traces ultrafine, semi-amorphous ?cassiterite. Minor traces pyrrhotite, biemuth.	Alteration analogous to 303.4m, but with introduction of sphalerite, arsenopyrite. Tremolitised/steatitised ?diopside-humite rock. Cassiterite sim. 284.5m. No detectable soluble Sn-phase.

RENISON LIMITED
DIAMOND DRILL HOLE PLOT

SCALE:

HOLE No.: SD 15 contd.

PETROGRAPHIC DESCRIPTIONS

(C.M.S. REPORT 81/1/41)

SAMPLE NO.	CLASSIFICATION - COMPOSITION	FABRIC	ACCESSORIES	COMMENTS
310.4m	<u>Talc-Brucite Magnesite Rock</u> . Talc, brucite, magnesite in varying proportions with disseminated fine to ultrafine magnetite.	Phyllitic with vague relict fine granular mesh-texture.	Minor traces fibrous magnetite, hematite in relatively sheared zones.	Steatitised/carbonated magnesian serpentinite. Primarily a fine- to medium-grained granular "olivine" (Thumite) rock.
321.4m (T.S. 35960)	<u>Diopside Rock</u> . Virtually massive diopside.	Coarse-grained, granular. Weakly microfaulted.	Minor traces talc, chlorite, quartz.	Probably a vein. Devoid of metasomatic features and (primary) accessories. Talc, quartz, heal late subparallel fractures.
326.4m (T.S. 35961)	<u>Antigoritic Marble</u> . Calcite aggregates partly replaced, veined by dolomite-ankerite. Sparse antigorite aggregates. Sparse, partly martitised magnetite.	Incipiently banded, medium-grained marble. Antigorite pseudomorphs "olivine" grains.	Minor traces talc, brucite, pyritised pyrrhotite.	Mildly stressed. Relatively pure marble, but with close affinities to SD 14/215.9m.
334.2m	<u>Serpentinised Skarn</u> . Variably talc-magnesite-stained antigorite aggregates with patchy relicts of granular diopside, localised zones of microgranular andraditic garnet.	Relict fine to micro-granular calc silicates. Fine mesh-textured to sheared serpentinite.	Sporadic chrysotile veins.	Primarily a banded garnet-diopside-olivine (Thumite) skarn. Extensively serpentinised (after olivine, diopside with late stress, partial steatitisation.
334.8m	<u>Graphitic Skarn</u> . Fine-grained diopside, quartz with frequent porphyroblasts of grossular-andradite, semi-pervasive, late poikiloblastic prehnite; conspicuous graphite.	Relict, sub- to millimetric-scale banding. Hornfelsic quartz, diopside.	Sparsely disseminated pyritised pyrrhotite.	Skarnised carbonaceous calc-pelite with late introduction of prehnite. Close affinities with SD 14/252.4m.
340.2m	<u>Antigorite Marble</u> . Cloudy, semi-porcellanous magnesite, relatively clear dolomite, patchy corroded relicts calcite. Frequent extensively leached, opaque-stained antigorite aggregates.	Medium-grained marble-like with evenly disseminated antigorite clots.	Traces corroded relict ?chondrodite. Minor traces pyritised pyrrhotite.	Mildly stressed. Altered chondrodite marble with close affinities to SD 14/215.9m. SD 15/26.4m (7289.4m).
384.4m	<u>Garnet-Diopside-Vesuvianite Skarn</u> . Granular to poikilitic grossular-andradite, closely intergrown diopside, subordinate, near-isotropic vesuvianite, patchy ankerite.	Medium-grained, weak compositional banding (metasomatised, relict) weakly microfractured.	Traces quartz, epidote-clinozoisite, minor traces pyritised pyrrhotite.	Metasomatised ?"limestone". Devoid of definite relict clastic features and relatively weakly banded in comparison with e.g. 334.8m.
401.9m	<u>Biotite "Granite"</u> . Orthoclase-microperthite and quartz, subordinate, weakly sericitised/muscovitised oligoclase, disseminated, partly chloritised Ti-biotite.	Coarse, weakly orthoclase-porphyrific, slightly myrmekitic, granitic.	Rare (primary) dravite, minor traces monazite, zircon, fluorite.	Mildly greisenised. Strictly adamellite, but verging on granitic. Close affinities with 115.1m, 174.4m.
418.6m (T.S. 35968)	<u>Greisenised Granite</u> . Quartz and quartz-muscovite semi-pseudomorphed feldspar, minor muscovitised biotite. Disseminated dravite, schorl, arsenopyrite, sparse pyritised pyrrhotite.	Quartz-tourmaline-arsenopyrite-veined, vague, relict coarse-granitic (sim. 401.9m).	Traces ankeritic carbonate. Rare fluorite, chalcopyrite.	Thoroughly greisenised (muscovitised, silicified) coarse granitoid. Near-identical with SD 15/200.4m.

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APPENDIX 3

PETROLOGY REPORTS

REPORT CMS 81/1/41

Twenty-one drill core specimens from SD 14 and thirty-one from SD 15 were examined in thin-section with selected polished sections to examine the nature of tin mineralogy. Individual specimens are briefly described in the accompanying tables.

Petrology

Intersected sequences in both drill holes are essentially quite similar and can be generalised as low-grade hornfelsed and variably metasomatised (tourmalinised) psammopelites, overlying serpentinitised, magnetite-rich skarns and a basal hornfelsed psammopelite sequence similar to the upper zone. Skarn zones may be flanked by marginal tremolitised or skarnised sediments and olivine marbles (serpentinitised). The main contrast between SD 14 and SD 15 sequences, as sampled, lies in two intersections (SD 15) of biotite adamellite intrusives and related greisens.

Magnetic skarns are typically thoroughly altered to serpentinitic assemblages, characteristically antigoritic, with variably preserved olivine- and pyroxene-derived mesh-textures. These rocks are texturally closely analogous to orthodox (altered ultramafic) serpentinites and have, in part, been previously interpreted as such. A few, however, exhibit textural features (e.g. elongate lath-like, pseudomorphed "olivine") atypical of ultramafic rocks. Some include corroded relics of colourless, orthorhombic and monoclinic silicates (humite, clinohumite, chondrodite). Chromite (and Cr-spinels) are conspicuously absent. These features confirm these facies as primarily humite-diopside skarns.

Tin Mineralogy

Optically identifiable tin mineralogy comprises cassiterite and pageite, representing essentially insoluble and acid soluble components respectively. Within the limits of sampling and microscopic data, it cannot be stated positively that pageite is the only acid soluble phase present. This mineral is of relatively restricted occurrence in materials examined (SD 14/200.7 m, 202.2 m; SD 15/268.4 m). A more detailed analysis would be dependent on electron-probe microanalyses. Conceivable additional soluble Sn-phases are micas and spinels.

Cassiterite exhibits two distinct modes of occurrence which may be categorised as "primary" and "secondary".

Primary cassiterite is represented by extremely rare, relatively coarse grains, apparently relict (on textural grounds) from the original skarn assemblage and, in the sections examined, entirely restricted to SD 15/260.0 m.

Secondary cassiterite forms two textural types, is extremely fine-grained and, on microtextural grounds, appears to have developed essentially by "exsolution" during alteration of the skarn silicate assemblage. The inference that the original Mg(Ca-Fe) silicates were, in part at least, stanniferous requires verification by electron-probe analysis of (relatively unaltered stanniferous skarn (if such can be located), but, as notes, is consistent with observed microtextures.

Secondary cassiterite occurs partly as $< 20 \mu$ and typically $< 5 \mu$ diameter equant to micro-acicular particles embedded in antigorite, chlorite and/or talc (SD 14/202.2 m; SD 15/265.4 m 274.9 m). The second mode comprises microscopic clusters, films and stainings similarly restricted to "serpentinites". This material is optically leucoxene-like, whitish and semi-opaque. Identification of this material, relatively conspicuous in SD 15/284.5m, 289.4 m, 303.4 m and 305.1 m, as cassiterite is based on previously reported probe analyses of optically identical material in SD 9 (refer CMS 79/7/24).

D. Cowan, B. Sc.

Sample No.	Classification - Composition	Fabric	Accessories	Central Mineralogical Services Comments
50.14 5.4 m (T.S. 35917)	Quartz-Tourmaline Rock. Quartz and olive-brown tourmaline (schorl) in varying proportions, subordinate to minor dravite, disseminated muscovite flakes.	Vague contorted to brecciated, relict pelitic banding. Fine-Grained.	Thinly disseminated leucoxenic rutile. Sparse relict detrital zircon, rutile.	Tourmalinised, silicified pelitic sediment. Muscovite is porphyroblastic in part ("tourmalinised mica hornfels").
36.9 m	Quartz-Tourmaline Rock. Quartz and olive-brown schorl, subordinate dravite, subordinate, semi-sericitic muscovite. Patchy orange (titaniferous) schorl.	Hornfelsic quartz, weakly poikiloblastic muscovite. Fine- to medium-grained.	Thinly disseminated leucoxenic secondary rutile. Sparse relict detrital zircon.	Marginally hornfelsed, extensively tourmalinised argillaceous quartzite with relatively altered shaly interbeds. Minor microfaulting.
61.5 m	Quartz-Kaolin Rock. Fine subpolygonal quartz and leucoxene-stained kaolin in near-equant proportions. Disseminated marcasite (after pyrrhotite).	Contorted relict bedding. Semi-pervasive mica-derived structures in kaolin.	Rare pyrite subhedra. Thinly disseminated fine silt-sized, rounded zircons.	Degraded mica hornfels (+ cordierite) developed in argillaceous quartzose fine sandy siltstone, silty shale intercalations. Affinities with 5.4 m, 36.9 m.
80.1 m	Spotted Hornfels. Coarse retrogressed (muscovite-ised) cordierite poikiloblasts with interstitial quartz, titaniferous biotite. Disseminated colour-variable schorl, pyritised pyrrhotite.	Ovoid, millimetric blasts, weak preferred orientation discordant to relict bedding.	Patchy chlorite (after biotite), sparse sphene, rare cloudy andalusite.	Retrogressively altered cordierite-mica hornfels; mild tectonic overprint. Primarily a weakly bedded silty shale.
103.7 m	Spotted Hornfels. Quartz and Ti-biotite, subordinate to minor albite, disseminated sericitised/kaolinised cordierite poikiloblasts, sparse kaolinised andalusite porphyroblasts.	Relict, sub- to millimetric-scale sedimentary banding. Medium-grained, hornfelsic.	Disseminated to conspicuous dravite; sparse pyritised pyrrhotite disseminations, fine	Affinities with 80.1 m, but slightly higher grade in albite-epidote hornfels facies. Relatively conspicuous metasomatic dravite. Psammopelitic.
112.3 m	Spotted Hornfels. Quartz and Ti-biotite with disseminated to semi-massive, extensively sericitised cordierite, subordinate andalusite. Disseminated schorl.	Medium-grained, hornfelsic, with faint relict sedimentary banding.	Patchy chlorite (after biotite), fresh cordierite, minor trace untwinned albite.	Porphyroblasts preferentially retrogressed. Close affinities with 80.1 m, 103.7 m. Primarily a weakly shale-parted quartzose psammite.
129.7 m	Tremolitic Hornfels. Quartz and cordierite with patchy tremolite, subordinate to minor Ti-phlogopite, sporadic microfilms of pyrite (after pyrrhotite).	Fine- to medium-grained hornfelsic. Faint relict sub- to millimetric-scale relict bedding.	Disseminated dravite, schorl, extremely fine rutile. Traces cumingtonite, sideritic carbonate.	Textural features indicate tremolitisation (+ traces pyrrhotite) predated hornfelsing/minor cordierite-siderite veinlets/pyritisation of pyrrhotite.
153.2 m	Talc-Tremolite Rock. Fine-grained tremolite as sparse relics in near-massive talc. Patchy quartz, minor cloudy, partly degraded siderite.	Semi-schistose with boudinaged quartz veinlets.	Degraded pale phlogopite (partly replaced by talc). Rare apatite.	Fabric consistent with sheared, steatitised tremolite(-quartz-phlogopite) vein.
182.1 m (T.S. 35925)	Talc-Tremolite Rock. Talc with patchy corroded relics of tremolite, irregular zones chloritised/steatitised phlogopite, minor quartz, disseminated apatite	Crude relict banding/disrupted by degraded phlogopitic veinlets (+ quartz).	Traces cloudy sideritic carbonate. Minor traces ultrafine rutile.	Thoroughly steatitised, phlogopite-veined tremolite rock of altered carbonate facies character (devoid of clastic, altered ultramafic features).

Sample No.	Classification - Composition	Fabric	Accessories	Comments
SD 14 cont. 194.7 m (T.S., P.S. 35926)	"Serpentinite". Antigorite with conspicuous magnetite, extensively pyritised pyrrhotite.	Crudely banded. Opaques interstitial to "olivine"-derived, mesh-textured antigorite.	Traces ankeritic carbonate.	No definite altered ultramafic features, although clearly a serpentinised olivine- or "humite" rock. No detectable Sn-phases.
196.8 m (T.S., P.S. 35927)	"Serpentinite". Antigorite with corroded relics of humite, magnetite-stained serpentinous ankerite, pseudomorphs of pyroxene, conspicuous "primary" magnetite. Patchy late dolomite veining.	Similar to 194.7 m, but with relics of coarse, lath-like humite.	Traces pyrite.	Close affinities with 194.7 m. Primarily a humite-pyroxene (?diopside) rock. No detectable Sn-phases.
200.7 m (T.S., P.S. 35928)	Scapolite-Chlorite-magnetite Rock. Near-isotropic chlorite with disseminated to semi-massive scapolite (dipyre), patchy fluorite, serpentinite. Abundant magnetite, patchy sulphide.	Irregular to crudely banded, fine-grained. Serpentine-rich shears. Poikilitic	Intersecting films of ankeritic carbonate. Locally conspicuous pyrrhotite, chalcopyrite.	Latescapolitic alteration of relatively opaque-rich "serpentinite". No detectable cassiterite. Pageite as ultrafine acicular bundles intimately intergrown
202.2 m (T.S., P.S. 35929)	Steatitised "Serpentinite". Serpentine and Mg-chlorite with conspicuous, closely intergrown magnetite, patchy talc, tremolite, corroded relics of clinohumite.	Granular relict humite with fine acicular opaques. Semi-schistose serpentine-talc-tremolite.	Minor corroded diopside, traces arsenopyrite. Minor traces pageite, ?cassiterite.	Pageite as rare, subradiating, ultra-fine acicular clots (sim. 200.7 m) ?cassiterite as sparse < 2 μ diameter needles in talc aggregates.
209.3 m (T.S., P.S. 35930)	"Serpentinite". Antigorite with patchy, chloritised phlogopite, sporadic flakes brucite, disseminated spongy aggregates magnetite, semi-massive films of dark sphalerite.	Incipiently schistose with patchy, faint relict "olivine" and pyroxene textures.	Minor traces ankeritic carbonate, microscopic pyritised pyrrhotite films.	Originally a fine granular "olivine-pyroxene" rock (?humite-diopside), pervasively serpentinised. No detectable Sn-phases.
215.9 m	Antigoritic Marble. Cloudy calcite with abundant clots antigorite, brucite, sparsely disseminated fine-grained magnetite.	Millimetric scale banded, medium-grained, granular with olivine-derived structures in serpentine.	Rare late magnetite veinlets.	Mildly stressed. Serpentinised forsterite or humite marble.
237.3 m (T.S., P.S. 35932)	Talc-Carbonate-Phlogopite Rock. Calcite with subordinate, closely intergrown talc, disseminated coarse flakes pale phlogopite, disseminated fibrous acicular magnetite.	Weakly banded. Similar to 215.9 m, but coarser-grained.	Patchy corroded relics olivine, patchy antigorite (corroded, replaced by talc), ilvaite,	Affinities with 215.9 m; "olivine" appears to be forsterite, but poorly resolved due sizing, habit. Ilvaite locally conspicuous, Hematite after magnetite.
237.8 m	Phlogopite-Carbonate Rock. Pale, weakly titaniferous phlogopite and talc-stained, cloudy ankeritic carbonate in varying proportions.	Coarse, random phlogopite interspersed with silicate semi-pseudomorphous carbonate.	Ultrafine secondary (?hydro) garnet, minor traces antigorite.	Vague textural affinities with 196.8 m suggest carbonation of phlogopite-humite-diopside rock. Weakly stressed.
252.4 m (T.S. 35934)	Graphitic Skarn. Cloudy diopside, phlogopite, subordinate grossular-andradite. Semi-pervasive late poikilitic epidote-clinzoisite; conspicuous fine graphite.	Relict, sub- to millimetric banding partly obliterated by epidotisation.	Patchy hornfelsic quartz, relict tremolite-actinolite (corroded by phlogopite).	Carbonaceous calc-pelite; skarnised to garnet-diopside-tremolite assemblage, subsequently epidotised/phlogopitised.

Sample No.	Classification - Composition	Fabric	Accessories	Comments
SD 14 cont. 309.5 m (T.S. 35935)	Altered Skarn. Diopside and thorough serpentinitised thornite, minor garnet. Patchy talc (after tremolite). Disseminated pyritised pyrrhotite, minor sphalerite.	Medium-grained, granular with relict sub- to millimetric, micro-folded banding.	Traces sphelite.	Affinities with 252.4 m, but with metasomatic assemblage analogous to 194.0 - 210.0 m zone.
331.5 m	Quartz-Mica Hornfels. Quartz and muscovite in varying proportions with conspicuous colour-variable schorl, minor dravite. Disseminated clots of ankeritic carbonate.	Medium-grained, hornfelsic with relict psammopelitic banding.	Minor traces pyrrhotite. Sparse relict detrital zircon, apatite.	Affinities with 5.4 - 112.3 m zone. Hornfelsed, tourmalinised, shale-parted, quartzose, argillaceous siltstone/fine sandstone.
373.4 m (T.S. 35937)	Muscovite quartzite. Overgrown relict detrital quartz with abundant intergranular muscovite, minor sericite. Sparse pyritised pyrrhotite, chalcopyrite disseminations, arsenopyrite films.	Relict medium sandy clastic fabric.	Minor schorl, dravite, ankeritic carbonate. Sparse relict detrital zircon.	Greisenized orthoquartzite. Arsenopyrite introduced in veinlets with carbonate, quartz, minor schorl.
	doubtful; maybe a greisenized xenolith.			
SD 15 41.5 m (T.S. 35938)	Quartz-Dravite Hornfels. Quartz and dravite in varying proportions with subordinate to minor muscovite.	Fine-grained, hornfelsic, with relict pelitic banding.	Sparse, cloudy fine rutile. Sparse relict detrital zircon, rutile.	Close affinities with SD 14/5.4 m, 26.9 m, but more distinctly hornfelsed.
78.2 m	Tremolitic Quartz-Mica Hornfels. Quartz and pale titaniferous phlogopite, subordinate closely intergrown cordierite, disseminated poikiloblastic tremolite, fine pyritised pyrrhotite.	Fine-grained hornfelsic with relict millimetric-scale bedding.	Minor traces ankeritic carbonate, poikilitic dravite.	Hornfelsed siltstone. Tremolite is metasomatic, probably after diagenetic carbonate impregnations. Bedded (recrystallized, syngenetic) sulphide.
86.7 m	Retrogressed Hornfels. Sericitised, kaolinised cordierite, subordinate quartz, patchy, pale cumingtonite, pale phlogopite, pyritised pyrrhotite, ankeritic carbonate.	Fine-grained, hornfelsic with poikilitic amphibole, phlogopite. Minor quartz veining.	Conspicuous, extremely fine, cloudy rutile.	Relict pelitic bedding. Close affinities with 78.2 m. Cumingtonite late metasomatic, introduced partly with vein-quartz(-carbonate-pyrite).
92.4 m	Metaquartzite. Anhedral/weakly interlocking quartz with relatively minor included intergranular kaolinitic alkali feldspar. Patchy tremolite aggregates and chloritised phlogopite.	Quartzitic, medium-grained. Faint relict deformed banding.	Traces sideritic carbonate, sphene, dravite. Sparse relict detrital zircon, rutile.	Thoroughly silicified, hornfelsed feldspathic psammite with patchy metasomatic tremolite, phlogopite, sim. 78.2 m, 86.7 m.
101.2 m (T.S. 35942)	Phlogopite-tremolite rock. Pale green phlogopite with patchy, corroded aggregates of tremolite. Patchy talc, sparse, partly degraded albite, thinly disseminated pyritised pyrrhotite.	Medium-grained, faintly directed. Patchy, vague coarse semi-pseudomorphs (talc after pyroxene).	Traces dravite, minor ankeritic carbonate.	Affinities with 153.2, 182.1 m facies in SD 14. Steatitised talc-tremolite-diopside rock.

				Central Mineralogical Services
Sample No.	Classification - Composition	Fabric	Accessories	Comments
SD 15 cont. 115.1 m (T.S. 35943)	Mica Adamellite. Quartz, moderately sericitic-stained oligoclase, incipiently kaolin-stained orthoclase-microperthite in near-equant proportions, sparse Ti-biotite, rare muscovite flakes.	Uneven-grained, granitic to locally subgraphic ("granophytic").	Minor chlorite (after biotite). Traces partly metamict monazite. Rare pyrite, ?chalcopyrite.	Typical characteristics of N.W. Tasmanian "tin granites". Mildly greisened. Sulphide is ultrafine, associated with chloritised biotite.
121.9 m	Greisen. Quartz and muscovite with conspicuous fluorite, disseminated topaz, schorl, dravite, muscovitised biotite. Orthoclase-microperthite, quartz, variably muscovitised oligoclase.	Medium- to coarse-grained, weakly banded greisen. Granitic-textured selvage.	Traces pyrite, chalcopyrite, cloudy (secondary) rutile. Rare apatite.	Greisened adamellite (slm. 115.1 m) with accessory tourmaline in contact with greisen vein or segregation. Contact is transitional, mica-rich.
174.4 m	Biotite Adamellite. Quartz and orthoclase-microperthite, slightly subordinate, weakly muscovitised oligoclase, disseminated Ti-biotite, sparse topaz, schorl, minor phlogopite.	Uneven-grained, granitic. Incipiently stressed.	Traces fluorite, monazite, pyrite, dravite, chlorite.	Close affinities with 115.1 m. Mildly greisened with muscovite after plagioclase, phlogopite after biotite, topaz. Topaz is late, tourmaline ^{early post-magmatic.}
182.7 m	Biotite Granite. Quartz and orthoclase-microperthite with relatively minor, moderately sericitised oligoclase, disseminated, weakly chloritised Ti-biotite, extensively kaolinised	Weakly directed, weakly orthoclase-porphyritic, granitic. Incipiently stressed.	Metamict monazite, zircon inclusions in biotite.	Close affinities with 115.1 m and particularly 174.4 m. Relatively potassic (granitic, verging on alkali granitic), mildly greisened. Primary
200.4 m	Greisened "Granite". Quartz and feldspar- ^{topaz.} semi-pseudomorphous muscovite-quartz aggregates, subordinate, muscovitised biotite. Disseminated clots, films schorl, dravite, arsenopyrite, ^{pyrite.}	Relict, even-grained, granitic.	Traces zircon, monazite, secondary rutile. Minor sideritic carbonate. Rare chalcopyrite.	Thoroughly greisened (muscovitised ^{topaz,} silicified), relatively coarse-grained biotitic granitoid, with sparse veins quartz, arsenopyrite, (pyritised) ^{pyrrhotitic.}
239.5 m	Quartz-Tourmaline Rock. Quartz, with subordinate colour-variable schorl, closely intergrown dravite, sparse muscovite.	Medium- to coarse-grained, granular quartz, weakly poikilitic tourmaline.	Traces fluorite, apatite, minor traces zircon.	Greisen-type vein or segregation with affinities to 121.9 m.
247.5 m	Greisened Pelite. Fine to semi-sericitic muscovite, subordinate to minor, closely intergrown quartz, pale phlogopite. Locally conspicuous fine-grained schorl. Quartz-ankerite ^{veins.}	Locally brecciated, sub-to millimetric, laminated relict pelitic. Weakly hornfelsic.	Traces fluorite, apatite, fine cloudy rutile, dark sphalerite, talc.	Muscovitised/tourmalinised pelite. Sphalerite introduced with discordant quartz-ankerite(-phlogopite-talc) veins.
251.2 m (T.S., P.S. 35950)	Altered Skarn. Diopside with minor, closely intergrown, extensively steatitised clinohumite. Interspersed with semi-massive talc-minnesotaite. Patchy tremolite, spongy pyritised pyrrhotite.	Weakly schistose, crudely banded.	Minor carbonate, serpentine.	Steatitised/tremolitised, mildly sheared talc-diopside-clinohumite "skarn". No detectable Sn-phases.
260.0 m (T.S., P.S. 35951)	Steatitised "Serpentinite". Antigorite aggregate with rosettes of phlogopite, conspicuous magnetite, interspersed spongy to semi-massive replacive fine-grained talc.	Crudely banded (magnetite). Vague pyroxene-derived mesh-textures.	Rare, semi-opaque cassiterite.	Serpentinised/partly steatitised ?diopside-magnetite skarn. Cassiterite semi-opaque grains to 1.5x2 mm in antigorite. No detectable "soluble" ^{Sn-phases.}

Sample No.	Classification - Composition	Fabric	Accessories	Comments
0.15 cont. 65.4 m T.S., P.S. 35952)	Steatitic "Serpentine". Serpophitic and antigorite serpentinite with abundant spongy to semi-fibrous magnetite, subordinate chloritised phlogopite, disseminated talc flakes.	Crudely banded, semi-schistose, faint ?olivine-derived mesh-textures.	Rare clots microscopic cassiterite (< 20 μ) in serpentine.	Mildly sheared/partly chloritised steatitised antigoritic serpentinite. Cassiterite typically < 5 μ ?exsolved from ferromags. No detectable soluble Sn-phases.
68.4 m T.S., P.S. 35953)	Phlogopitic "Serpentine". Antigorite and fine mesh-textured opaques. Sporadic crosscutting foliae of talc. Semi-pervasive green phlogopite magnetite aggregates. Minor late brucite veinlets.	Relict "olivine" and pyroxene-derived mesh-textures.	Patchy pyrrhotite, rare chalcopyrite, talnakhite, arsenopyrite. Traces ultrafine cassiterite.	Complex alteration pattern with serpentinitisation/steatitisation/phlogopitisation. Cassiterite < 5 μ wide films in serpentine. Pageite sim. SD 14/
74.9 m T.S., P.S. 35954)	Chloritic "Serpentine". Antigorite with sparse magnetite, interspersed with Mg-chlorite aggregates with abundant opaques (magnetite, pyrrhotite), minor talc, brucite.	Similar to 268.4 m, but with poorly preserved mesh-textures. Weakly sheared.	Traces ultrafine ?cassiterite.	Analogous to 268.4 m, but with late chloritisation phlogopite. ?Cassiterite as < 5 μ particles, clots, microfilms in serpentine, similar to 265.4 m.
84.5 m T.S., P.S. 35955)	"Serpentine". Serpophitic and subradiating antigorite, conspicuous spongy, granular and fibrous magnetite, disseminated arsenopyrite, patchy brucite, chrysotile, skutterudite, talc.	Crudely banded. Locally faintly "olivine" mesh-textured. Incipiently sheared.	Minor late fibrous, subradiating dolomitic carbonate. Rare ultrafine ?cassiterite.	?Cassiterite as < 5 μ semi-amorphous particles, microscopic films in serpentine. No detectable soluble Sn-phase.
89.4 m T.S., P.S. 35956)	Steatitised "Serpentine". Talc with patchy relics of antigorite, disseminated spongy, granular and extremely fine fibrous "magnetite". Patchy, late porcellanous carbonate.	Mildly sheared/flattened mesh-textures. Crudely banded opaques.	Disseminated clots, minor films semi-amorphous ultrafine ?cassiterite.	Some textural affinities with SD 14/215.9 m, possibly a steatitised olivine or humit marble. ?Cassiterite identical with 284.5 m.
03.4 m T.S., P.S. 35957)	Steatitised "Serpentine". Talc with patchy relics of antigorite, tremolite, abundant magnetite.	Relict, magnetite-rich mesh-textures. Crenulated phyllitic overprint.	Sporadic clots of amorphous ?cassiterite.	Complexly altered (serpentinised/tremolitised/steatitised) and relatively deformed. ?Cassiterite analogous to that in 284.5, 289.4 m. No detectable soluble Sn-phase.
05.1 m T.S., P.S. 35958)	Tremolitised, Steatitised Serpentine. Very fine talc with interspersed patches antigorite, conspicuous dark sphalerite, arsenopyrite euhedra, sparse magnetite, relict tremolite.	Talc pseudomorphouse after fine, felted tremolite. Antigorite pseudomorphs "olivine"	Traces ultrafine, semi-amorphous ?cassiterite. Minor traces pyrrhotite, bismuth.	Alteration analogous to 303.4 m, but with introduction of sphalerite, arsenopyrite. Tremolitised/steatitised ?diopside-humite rock. Cassiterite sim.
10.4 m	Talc-Brucite Magnesite Rock. Talc, brucite, magnesite in varying proportions with disseminated fine to ultrafine magnetite.	Phyllitic (humite) with vague relict fine granular mesh-textures.	Minor traces fibrous magnetite, hematite in relatively sheared zones.	284.5m. No detectable soluble Sn-phase. Steatitised/ carbonated magnesite serpentinite. Primarily a fine- to medium-grained granular "olivine" (humite) rock.
21.4 m T.S. 35960)	Diopside Rock. Virtually massive diopside.	Coarse-grained, granular. Weakly microfractured.	Minor traces talc, chlorite, quartz.	Probably a vein. Devoid of metasomatic features and (primary) accessories. Talc, quartz, heal late subparallel fractures.

Sample No.	Classification - Composition	Fabric	Accessories	General Mineralogical Services Comments
SD 15 cont. 326.4 m (T.S. 35961)	Antigoritic Marble. Calcite aggregates partly replaced, veined by dolomite-ankerite. Sparse antigorite aggregates. Sparse, partly martitised magnetite.	Incipiently banded, medium-grained marble. Antigorite pseudomorphs "olivine" grains.	Minor traces talc, brucite, pyritised pyrrhotite.	Mildly stressed. Relatively pure marble, but with close affinities to SD 14/215.9 m.
334.2 m	Serpentinised Skarn. Variably talc-magnesite-stained antigorite aggregates with patchy relics of granular diopside, localised zones of microgranular andraditic garnet.	Relict fine to microgranular calc silicates. Fine mesh-textured to sheared serpentinite.	Sporadic chrysotile veins.	Primarily a banded garnet-diopside-olivine (?humite) skarn. Extensively serpentinised (after olivine, diopside with late stress, partial steatitisation).
334.8 m	Graphitic Skarn. Fine-grained diopside, quartz with frequent porphyroblasts of grossular-andradite, semi-pervasive, late poikiloblastic prehnite; conspicuous graphite.	Relict, sub- to millimetric-scale banding. Hornfelsic quartz, diopside.	Sparsely disseminated pyritised pyrrhotite.	Skarnised carbonaceous calc-pelite with late introduction of prehnite. Close affinities with SD 14/252.4 m.
340.2 m	Antigoritic Marble. Cloudy, semi-porcellanous magnesite, relatively clear dolomite, patchy corroded relics calcite. Frequent extensively leached, opaque-stained antigorite aggregates.	Medium-grained marble-like with evenly disseminated antigorite clots.	Traces corroded relict chondrodite. Minor traces pyritised pyrrhotite.	Mildly stressed. Altered chondrodite marble with close affinities to SD 14/215.9 m, SD 15/26.4 m (2289.4 m).
384.4 m	Garnet-Diopside-Vesuvianite Skarn. Granular to poikilitic grossular-andradite, closely intergrown diopside, subordinate, near-isotropic vesuvianite, patchy ankerite.	Medium-grained, weak compositional banding (metasomatised, relict) weakly microfractured.	traces quartz, epidote-clinozoisite, minor traces pyritised pyrrhotite.	Metasomatised ?"limestone". Devoid of definite relict clastic features and relatively weakly banded in comparison with e.g. 334.8 m.
398.5 m	Hornfelsed Arkose. Orthoclase with subordinate to minor quartz, Ti-biotite, albite, disseminated pyrite (partly after pyrrhotite). Minor cordierite.	Fine- to medium-grained hornfelsic, with sub- to fine millimetric relict bedding laminations.	Minor traces fluorite. Sparsely disseminated fine silt-sized relict detrital zircon.	Affinities with SD 14/331.5 m, 373.4 m, but distinctly meta-arkosic, biotitic (mildly metasomatised). Cordierite-orthoclase indicates pyroxene hornfels facies.
401.9 m	Biotite "Granite". Orthoclase-microperthite and quartz, subordinate, weakly sericitised/muscovitised oligoclase, disseminated, partly chloritised Ti-biotite.	Coarse, weakly orthoclase-porphyrific, slightly myrmekitic, granitic.	Rare (primary) dravite, minor traces monazite, zircon, fluorite.	Mildly greisenized. Strictly adamellite, but verging on granitic. Close affinities with 115.1 m, 174.4 m.
418.6 m (T.S. 35968)	Greisenized Granite. Quartz and quartz-muscovite semi-pseudomorphed feldspar, minor muscovitised biotite. Disseminated dravite, schorl, arsenopyrite, sparse pyritised pyrrhotite.	Quartz-tourmaline-arsenopyrite-veined, vague, relict coarse-granitic (sim. 401.9 m).	Traces ankeritic carbonate. Rare fluorite, chalcopyrite.	Thoroughly greisenized (muscovitised, silicified) coarse granitoid. Near-identical with SD 15/200.4 m.

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amdel

4 August 1981

GS 3/89/0

Renison Limited,
PO Box 20,
ZEEHAN, Tas. 7469.

Attention: Chief Geologist

REPORT GS 6129/81

YOUR REFERENCE: PAR/cvb/3450
MATERIAL: 2 magnetic concentrates
IDENTIFICATION: EPB, EPC
DATE RECEIVED: 23 June 1981
WORK REQUIRED: Determination of Sn-bearing minerals by
electron microprobe

Investigation and Report by: Dr Michael Farrand
Electron Microprobe Analysis by: Peter Schultz

Manager, Geological Services Division: Dr Keith J. Henley

Keith Henley

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DETERMINATION OF TIN-BEARING MINERALS

1. INTRODUCTION

Two products of metallurgical test work on a tin-bearing ore were received from the Chief Geologist of Renison Limited. The products were the +106-300 μ m magnetic fraction from samples B and C. The request was for probe work to determine the tin minerals present.

2. PROCEDURE

Epoxy mounts of each sample were polished and scanned using an electron microprobe. Details of sample numbers are:

<u>Sample</u>	<u>Polished Section</u>
EPB	29782
EPC	29783

3. DETERMINATION OF TIN-BEARING MINERALS

Sample: PS29782

Tin is present as inclusions in spongy magnetite. The inclusions vary from a few microns to 40 microns. The tin content of the inclusions approximates 50% and there are manganese and iron also present.

Sample: PS29783

Tin is present as inclusions in magnetite of cassiterite up to 20 μ m in size but is mainly present as the tin-manganese-iron mineral, also included in magnetite, which is up to about 50 μ m in size but is usually smaller.

4. CONCLUSION

The main location of the tin in both samples is in an iron-manganese-tin oxide mineral included in magnetite. A minor part of the tin is in small cassiterite inclusions.

Interim Report - St Dizier Stanniferous Skarn

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Aim

The aim of this investigation is to arrive at an understanding of the nature of, and factors controlling, tin mineralization at St Dizier, a mineralogically unusual contact metasomatic deposit in Western Tasmania. It is hopeful that this will be relevant not only to the possible development of this particular prospect, but will contribute to the understanding of such deposits and hence assist in the search for and exploration and development of them in Western Tasmania and elsewhere.

Tenure

At present, the prospect is covered by three Mining Leases of 8.0 ha each, held by Mr R. Laffer of Zechan, and is being explored by Renison Limited, whose co-operation is gratefully acknowledged. The surrounding exploration licence (E.L. 47/71) is held by Gippsland Minerals N.L.

Outline of Geology

At St Dizier, Devonian adamellite of the Heemskirk Granite has intruded a steeply northerly dipping Eocambrian sequence of shale (footwall), dolomite, and quartzite (hanging wall). The first two formations have been contact metamorphosed to andalusite slate and skarn respectively. The skarn, now extensively serpentinized, evidently provided a chemically favourable environment for magnetite and tin mineralization.

Method of Approach

Since outcrop is poor, the source of most information is from the thirty-four holes drilled at various times in recent years by four different companies. However, core and in some cases logs of the earlier holes is not available or has been lost. A further difficulty is that many of the remaining holes are very shallow and, largely because of the

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deep weathering, recoveries were poor. Thus core from only about 100
of the holes is worthy of detailed study.

Because of the nature of the deposit and the resources available to the Department, this investigation is confined mainly to mineralogical, petrological and geochemical aspects. For example, some of the geologically more important problems to be considered are:

- (a) the spatial relationship of the various skarn assemblages and the mineralization to the granitic intrusive and to the host sediments;
- (b) the sequence of formation of the silicate, magnetite, tin and sulphide mineralization;
- (c) pressure and temperatures under which the various assemblages formed and tin mineralization occurred;
- (d) the source and composition (e.g. X_{CO_2}) of the fluid phase or phases during metamorphism, its influence on and how it was influenced by various reactions that took place and the physical state (e.g. permeability) of the sediments;
- (e) the degree and nature of metasomatic introduction of material from the intrusive;
- (f) the source of the iron deposits as magnetite;
- (g) the mode of occurrence of tin, as cassiterite, as other discrete tin minerals and in the lattice of rock forming minerals;
- (h) the nature of the ore-forming solutions, and the physical and chemical aspects of the environment that induced ore deposition;
- (i) the nature of the post metamorphic alteration, including its effect, if any, on the distribution of the tin.

- (a) Available company data, mainly derived from drill core, has been reviewed. Logs have been drawn in diagrammatic form, and structural information available from them (e.g. surface geology, form of granite contact, dip and strike of the skarn footwall and hanging wall) has been plotted in plan on base maps. Zones of high assays for tin or other elements have been noted. Previous petrographic data, mainly compiled by consultants, has been summarised.
- (b) The core of SD9, 10, 12 and 13 has been inspected and sampled with particular regard to economically or mineralogically interesting zones. Twenty-seven polished thin sections have been prepared and petrographic work has been completed on the first batch (twelve).
- (c) Approximately seven hours of electron probe microanalysis time has been spent, chiefly in characterising the metamorphic silicate phases in the skarn.
- (d) A literature study of metamorphic phase relations relevant to this deposit has been commenced. At present, a nearly complete qualitative understanding of the system most relevant to St Dizier, $\text{CaO-MgO-SiO}_2\text{-H}_2\text{O-CO}_2$, has been reached, and plotted in the form of ternary phase diagrams and isobaric $T\text{-X}_{\text{CO}_2}$ diagrams derived from various sources. Data are available to partially quantify this, which will assist in determining the physical conditions and processes of metamorphism and ore deposition. The effects of the addition of iron, alumina and alkalis are relevant and are being considered, although at this stage the system becomes too complex for a comprehensive treatment, and experimental data on many minerals appear to be scanty.

- (e) References to similar magnetite-rich contact metasedimentary ore deposits are being studied, with particular regard to ideas and evidence on their genesis which may be applicable to St Dizier.
- (f) Partly in connection with this project, information on the mineralogy of tin is being gathered. A list of some fifty minerals containing essential tin has been compiled (see appendix), and although most are very rare, some are known to occur at St Dizier or in similar deposits. Information on their physical and chemical characteristics may be relevant not only to their genesis but to their likely distribution within the skarn and the metallurgical characteristics of the ore. Some information and ideas on the substitution of low to trace amounts of tin in rock-forming silicates has also been found.

Present Status of Project

At this stage it is not intended to comprehensively describe the geology of St Dizier, nor is it possible to present a complete model for its genesis. However, the directions along which ideas are developing are outlined.

Previous workers have interpreted the "serpentinite" at St Dizier variously as an altered ultramafic (e.g. logs of early drilling) or as an altered skarn dominated by the chondrodite-humite group minerals (e.g. H.W. Fander). The current work has shown that, although the skarn interpretation is correct, the dominant silicate phases are stoichiometric diopside and forsterite ($\text{Fo}_{97}\text{Fs}_3$). During post-metamorphic alteration, the latter mineral has been largely serpentinized, whilst the diopside alters more slowly, first to a poorly crystalline hydrated phase. Other silicate minerals identified are tremolite, clinocllore and other magnesian

chlorites, phlogopite and biotite, the calcium mica clintonite/xanthophyllite and possibly talc.

A striking feature of the silicates is their very low iron and manganese contents, despite the abundance of magnetite in the deposit. This is in striking contrast to many other skarns (e.g. Kara, Grassy, Ban Ban). Hydrous and alkali-bearing minerals are generally restricted to veins and veinlets in the main skarn. For instance, a common sequence, passing outward from the axis of a vein, is cryptocrystalline, colloidal magnesite/phlogopite/chlorite/tremolite/diopside-fosterite rock.

It is thought that the initial process following intrusion of the granite was essentially isochemical metamorphism of the impure, siliceous dolomite. As large volumes of CO₂ would be released, this took place in an almost anhydrous pure CO₂ phase, and little or no hydrous phases were formed. At a slightly later stage acidic, aqueous fluid phases bearing Fe, Na, K, Sn, B and I and Cl were released from the solidifying granite, penetrating the diopside-fosterite skarn along fractures and other zones of weakness, and forming minerals such as tremolite, chlorite and micas as it interacted with the skarn. In the axes of these veinlets, pyrrhotite was often deposited, but as the granitic fluids mingled with the CO₂ rich metamorphic fluid, pH rose and possibly pO₂ fell, causing large quantities of magnetite to be precipitated. Most workers on similar magnetite skarn deposits consider the magnetite to be of hydrothermal rather than magmatic or metamorphic origin, and in some instances this conclusion has been supported by trace element data.

At this stage it is not possible to estimate the physical conditions of metamorphism with any certainty, particularly as independent temperature or pressure data are not available. However, the coexistence of forsterite and diopside in equilibrium with an essentially pure CO₂ fluid, and reacting to produce tremolite with the introduction of water, will impose a minimum temperature at a given pressure, probably about

540° at 1 kb or 580° at 2 kb, for the formation of the silicate assemblage.

At present, minor cassiterite is the only tin-bearing mineral identified, although work on samples reported to contain the tin borate, hulsite, is in progress. The tin content of the silicate phases, and on the limited data available, the magnetite, is below the normal electron microprobe detection limit (a few hundred ppm). The model outlined above suggests that tin mineralization will be patchy, and confined mainly to veins of hydrous skarn minerals, as cassiterite and hulsite. Probably tin deposition took place fairly late in the skarn genesis, after metamorphism and magnetite deposition. This is in marked contrast to Mt Lindsay (Badington and Kinealy), where metasomatism took place early and tin is highest in the prograde assemblages.

Proposed Future Work

- (a) Further petrography, including both transmitted and reflected light work and electron probe microanalysis where warranted, on the thin sections already prepared. No further sampling is planned for some time. The less altered (not serpentized samples) containing primary assemblages will be the most genetically significant.
- (b) Quantification of relevant metamorphic reactions, from data in the literature. Combined with the independent application of geothermometry (e.g. the calcite-dolomite solvus, or oxygen isotope data) this should enable a more certain determination of the physical conditions of metamorphism.
- (c) Much more work is needed on the mode of occurrence of tin at St Dizier. Largely because of its patchy distribution, few of the thin sections already prepared, even those from zones with high tin assays, contain tin mineralization. Apart from

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microscopic work, X-ray diffraction (for identification of possible non-cassiterite phases) and electron microprobe analysis should be useful techniques.

- (d) Analysis of magnetite for trace elements, including Sn, Ti, Cr, V, Ni and Co, could be significant from both genetic and economic viewpoints.
- (e) If obtainable, a chemical analysis of the original, unaltered carbonate would be useful in interpreting metamorphic phase relations.

The Mineralogy of Tin

Although only cassiterite and stannite are well known, at least forty-eight essentially tin-bearing minerals exist. The majority are very rare and are known only from a few localities, whilst some, such as malayaite, are increasingly being recognised and may be much more common than previously thought.

Each class of minerals tends to be restricted to a particular geological environment. Thus the tin sulphides and sulphosalts are mostly found in hydrothermal cassiterite-sulphide vein deposits such as in Bolivia and Japan; natural tin alloys in magmatic platinum and nickel-copper deposits; niobo-tantalates in granite pegmatites, and silicates and oxides variously in both skarns and pegmatites. However, in most environments in which tin may be concentrated, cassiterite is the stable tin mineral.

In certain circumstances, particularly in skarns, appreciable tin may substitute in the lattice of certain oxides and silicates. The available, scanty data can be rationalised by simple crystal structure principles.

The following list is for the most part simply a summary of the data in the literature. The more important references are given, and from them further references can be obtained. In addition, some more general sources of information are:

Palache, C.; Berman, H. & Frondel, C., 1951, "Dana's System of Mineralogy", 7th Ed., Vols. I & II, Wiley, New York.

Roberts, W.L.; Rapp, G.H. & Weber, J., 1974, "Encyclopaedia of Minerals", Van Nostrand Reinhold Co., New York.

Vlasov, K.A. (ed.), 1964, "Geochemistry and Mineralogy of rare elements and genetic types of their deposits. II. Mineralogy of Rare Elements", Trans. Israel Prog. for Scientific Translation, Jerusalem, 1966.

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Native Tin

Sn

Tetragonal I4₁/amd (β or white tin, SG = 7.28), changes to cubic Fd3m (α or grey tin, SG = 5.77) below 13°C. Opaque, white, metallic. H2. Ductile and malleable, hackly fracture, no distinct cleavage. As minute embedded or rounded grains.

Occurs in calcite, associated with pitchblende and base metal sulphides at Nesbitt La Bine uranium mines, Saskatchewan. Also reported from Oban, N.S.W. and from volcanic gases on Volcano and Stromboli.

Natural AlloysStistaite

SnSb

Light grey, opaque, metallic, malleable cubic crystals, 0.02 - 0.15 mm in size, lacking cleavage.

Occurs in placers near the Elkiaidan R., Uzbekistan, U.S.S.R.

Reference: Nikolaeva et al. (1971), Am.Min. 56, p. 358.

Unnamed mineralCu₆Sn₅

Pseudo-hexagonal. Soft, sectile, highly reflectant (62%) white rounded grains (1 mm), surrounded by malachite.

Occurs in oxidized ores of the wolframite-cassiterite mine at Panasqueira, Portugal. Also reported from placers in Borneo and Uzbekistan.

References: Clark (1973), Am.Min. 58, p. 347; Stumpf & Clark (1965), Trans.Inst.Mining Met. 74, pp. 933-46.

Niggliite

PtSn

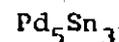
Hexagonal P6₃/mmc. Minute silver-white opaque metallic grains. SG = 13.44, H3, brittle, no cleavage.

Associated with cubanite, galena, chalcopyrite and parkerite at Waterfall Gorge, Insizwa, S. Africa, and with stannopalladinite, hessite,

platinum and tellurides at Monchegorsk, U.S.S.R.

Reference: Groenoveld Meijer (1955), *Am.Min.* 40, pp. 693-6.

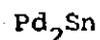
Stannopalladinite



Cubic. Occurs as opaque, brown-rose, elongated and rounded crystals, SG = 10.2, intergrown with niggliite in association with hessite and platinum-palladium tellurides at Monchegorsk, U.S.S.R.

References: Maslenitzky et al. (1949), *Min.Abs.* 10, p. 453; (1971) *Am.Min.* 56, pp. 360-1.

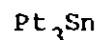
Paalovite



Orthorhombic Pbnm. A lilac-rose, strongly birefractant (41.8% - 61.8%) mineral occurring as polysynthetically twinned grains intergrown with native silver, sperrylite and other platinum minerals, in the Cu-Ni sulphide ores of the Oktyabr deposit, Norilsk, U.S.S.R.

Reference: Genkin et al. (1974), *Am.Min.* 59, p. 1331.

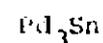
Rustenburchite



Cubic Fm3m; ordered and disordered forms. Small (100 μ), light cream, highly reflectant (c. 58%) grains. Solid solution to atokite. In Cu-Ni sulphide ore from Norilsk, U.S.S.R.; in platinum concentrates from the Merensky Reef, S. Africa; also reported from China.

References: Mihalik et al. (1975); *Am.Min.* 13, pp. 146-50; Razin & Bykov (1971), *Am.Min.* 57, p. 595; Joo & Huang (1975), *Am.Min.* 60, pp. 733-9.

Atokite



Cubic Fm3m; ordered and disordered forms. Solid solution to rustenburgite; physical properties very similar. Localities and references also as for rustenburgite.

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Sulphides and SulphosaltsHerzenbergite

SnS

Orthorhombic Pbnm. Opaque, metallic, black, SG = 5.20. Massive and fine grained. Associated with cassiterite and pyrite in the Maria-Teresa mine, Huari, Bolivia. Solid solution to teallite.

Reference: Nekrasov et al. (1974), Am.Min. 60, p.163.

OttensmarniteSn₂S₃

Orthorhombic Pnam. Opaque. In reflected light, grey, strongly anisotropic with orange-brown internal reflections. Occurs as small twinned lathes replacing stannite and replaced by cassiterite in secondarily enriched tin sulphide ore at Cerro de Potosi, Bolivia.

Reference: M^h & Berndt (1965), Am.Min. 50, p. 2107.

BerndtiteSnS₂

Trigonal P $\bar{3}$ m1. Minute grey, translucent tabular crystals. Very soft. Streak and internal reflections golden yellow. Occurs as very fine inclusions in pyrite which has replaced stannite in secondarily enriched cassiterite-sulphide ore, Cerro de Potosi, Bolivia. A hexagonal polymorph is reported from a cassiterite-wolframite mine at Panasqueira, Portugal.

References: M^h & Berndt (1965), Am.Min. 50, p. 2107; Clark (1972), Am.Min. 58, p. 347.

TeallitePbSnS₂

Orthorhombic Pbnm. Opaque, metallic grey, sometimes tarnished iridescent. H1 $\frac{1}{2}$, SG6.4. One perfect cleavage, flexible, inelastic, somewhat malleable. Usually as massive aggregates of square, thin, striated lamellae. Solid solution to herzenbergite.

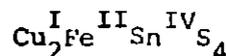
Occurs in cassiterite-sulphide veins from numerous localities in Bolivia; also reported from Freiberg, Germany.

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References: Nekrasov et al. (1974), Am.Min. 60, p. 163;

Chang & Brice (1971), Mineral.Mag. 38, p. 186.

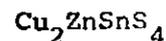
Stannite



Tetragonal $I\bar{4}2m$. Opaque, metallic grey to grey-black, often tarnished blue. H4, SG4.44, cleavage indistinct, fracture uneven, brittle. Usually massive and granular, sometimes as twinned crystals.

Widespread in hydrothermal cassiterite-sulphide vein deposits; rare in pegmatites. Strongly covalent, similar to chalcopyrite.

Kesterite, Kősterite

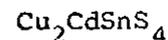


Tetragonal $I\bar{4}2m$, pseudocubic. Opaque, greenish black. H4½, SG4.54-4.59. No cleavage, massive. Solid solution to stannite.

Occurs in quartz-sulphide veins in the Kester deposit, Yanochansk, U.S.S.R. and the Snowflake Mine, Revelstoke, British Columbia. Reported in complex pegmatites at Bernic Lake, Manitoba and Keystone, S. Dakota.

References: Ivanov & Pyatenko (1959), Am.Min. 44, p. 1329; Kissin & Owens (1975), Can.Min. 13, p. 309; Springer (1972), Can.Min. 11, pp. 535-41.

Cernyite



Tetragonal $I\bar{4}2m$. Steel grey, metallic, H4, SG4.6-4.8, no cleavage observed. Physically similar to, and isostructural with kesterite.

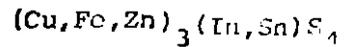
Occurs as small (200 μ) grains intergrown with kesterite and associated with various other sulphides at the Tanco Mine, Bernic Lake, Manitoba and the Hugo Mine, Keystone, S. Dakota.

References: Kissin et al. (1978), Can.Min. 16, pp. 139-46; Am.Min. 64, p. 653.

Hocartite

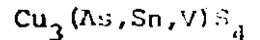
Tetragonal, probably isostructural with stannite. Occurs as small (< 1 mm), brownish grey inclusions in sphalerite, wurtzite and stannite in tin mines in Bolivia and at Fournial, France.

Reference: Caye et al. (1969), Am.Min. 54, p. 573.

Sakuraiite

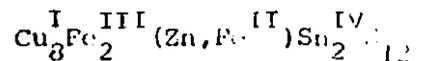
Tetragonal, probably isostructural with stannite. Opaque, greenish to steel grey, streak lead grey with olive tint. H4, SG4.45. Forms an exsolution texture (up to 500 μ x 30 μ) with stannite, associated with cassiterite, sulphides, calcite and quartz in a vein in the Ikuro mine, Japan.

Reference: Kato (1968), Am.Min. 53, p. 1421.

Colusite

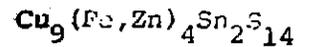
Cubic $F\bar{4}3m$. Opaque, metallic, bronze; streak black. H3-4, SG4.50. Usually massive, sometimes as tetrahedral crystals. Associated with enargite and other copper sulphides and sulphosalts at Butte, Montana, and Red Mountain, Colorado, U.S.A., and at Chelopech, Bulgaria.

References: Murdoch (1953), Am.Min. 38, pp. 794-801; Dangel & Wuensch (1970), Am.Min. 55, pp. 1767-91; Terziev (1971), Am.Min. 56, pp. 1847-54.

Stannoidite

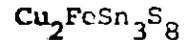
Orthorhombic. Brass brown, metallic, streak dark brown grey. H4, SG4.29. No cleavage, fracture uneven to subconchoidal, commonly massive. Occurs with chalcopyrite, stannite and other sulphides in xenothermal cassiterite-sulphide vein deposits of Japan, and at the Chelopech copper deposit, Bulgaria.

References: Kato (1969), Am.Min. 54, pp. 1495-6; Yamanaka & Kato (1976), Am.Min. 61, pp. 260-5; Terziev (1971), Am.Min. 56, pp. 1847-54.

Hexastannite

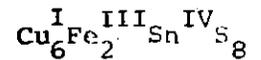
Uncertain validity - reported from the subvolcanic hydrothermal veins of the Ashio copper mine, Japan, associated with chalcopyrite, ferberite, cassiterite and other Cu-Fe-Sn minerals.

Reference: Nakamura, in Tatsumi (ed.) (1970), "Vulcanism and Ore Genesis", Univ. of Tokyo Press, p. 242.

Rhodostannite

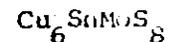
Hexagonal. Reddish, opaque, metallic. Massive. An alteration product of stannite at Vila Apacheta, Bolivia.

Reference: Springer (1968), Mineral.Mag. 36, pp. 1045-51.

Mawsonite

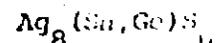
Cubic or pseudocubic, I lattice. Opaque, brownish orange, massive, cleavage poor. $H3\frac{1}{2}$ -4. Occurs as inclusions in bornite, associated with sulphides and sulphosalts at Mt Lyell, Tasmania; associated with and probably formed by the replacement of cassiterite by bornite at the Ashio Mine, Japan. Also reported from Tingha, N.S.W.; Mt Pleasant, New Brunswick, Canada, and the U.S.S.R.

References: Markham & Lawrence (1965), Am.Min. 50, pp. 900-8; Petruk (1973), Can.Min. 12, pp. 46-54; Yamanaka & Kato (1976), Am.Min. 61, pp. 260-5.

Hemusite

Cubic. Opaque, grey, metallic, H4. As small (50 μ) rounded grains and aggregates associated with cotunnite, stannoidite, chalcopyrite and other copper minerals at Chalcopch, Bulgaria.

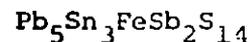
Reference: Terziyev (1971), Am.Min. 50, pp. 1847-54.

Canfieldite

Cubic 1 m3m. Opaque, metallic, steel grey with a reddish tinge, rapidly tarnishing to purple-black. Streak greyish - black. $H 2\frac{1}{2}$, SG 6.3

Fracture conchoidal to uneven, brittle. Crystals octahedral, spinel-type twinning common. Solid solution to argyrodite. Occurs in sulphide vein deposits, often associated with argentite, other silver minerals and cassiterite; e.g. in Bolivia, Freiberg, Germany and Renison Bell, Tasmania.

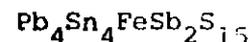
Franckeite



Triclinic $\bar{P}1$. Opaque, metallic, greyish black. $\mu 2\frac{1}{2}$ -3, SG 5.9. One perfect cleavage. Crystals thin and tabular, flexible, inelastic, somewhat malleable. Twinning complex. Often in spherical, vertically striated aggregates; also massive, foliated or radial.

Abundant in hydrothermal cassiterite-sulphide veins in Bolivia, occurs with meneghinite and stannite in a skarn at Santa Cruz, California; at Renison Bell, Tasmania; and elsewhere.

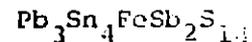
Incaite



Triclinic; alternating pseudotetragonal and pseudo-hexagonal layers in structure. Greyish white, strongly anisotropic, one excellent cleavage, reflectance 28%-34%. Occurs with stannite, as very fine lamellae replacing cylindrite at Pogo, Bolivia.

Reference: Makovicky (1974), Am.Min. 60, p. 486.

Cylindrite



Orthorhombic. Opaque, metallic, blackish lead-grey. $\mu 2\frac{1}{2}$, SG 2.46. Massive, in cylindrical forms or as spherically grouped aggregates. Somewhat malleable; cleavage good parallel to elongation. Associated with franckeite, sphalerite and pyrite in hydrothermal tin-bearing veins in Bolivia.

Reference: Makovicky (1974), Am.Min. 60, p. 486.

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Oxides (including niobo-tantalates)Cassiterite

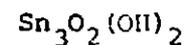
Tetragonal $P4_2/mnm$. Colour and opacity variable, usually dark. H6-7, SG 6.99. Cleavage {100} imperfect, {110} indistinct, {111}{011} parting. Fracture subconchoidal to uneven, brittle. Lustre submetallic adamantine to vitreous. Crystals short prismatic, bipyramidal or slender prismatic (needle-tin), twinning common. Also granular, or botryoidal and reniform (wood-tin).

Widespread and locally abundant in veins, skarns, greisens, pegmatites, placers and less commonly in rhyolites. Varieties include ainalite, varlamoffite and hydrocassiterite (qv.).

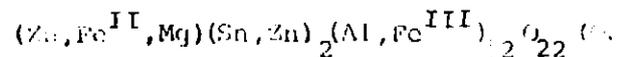
Romarchite

Tetragonal $P4/mnm$. Black. Tin pannikins lost in the Winnipeg R., Ontario, early last century were recovered and found to be encrusted with this substance. Accepted as a mineral by the I.M.A.

Reference: Organ & Mandarino (1971), Can.Min. 10, p. 916.

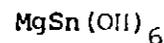
Hydromarchite

Triclinic. White. Mode of occurrence and reference as for romarchite.

Nigerite

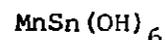
Trigonal $P\bar{3}m$ or $P31m$. Nearly opaque, weakly magnetic, brittle, lustrous brown hexagonal plates up to 5 mm or more across. H8½, SG 4-61. Occurs in association with cassiterite, columbite, gahnite, chrysoberyl, andalusite, sillimanite and quartz in pegmatites in the Egba district, central Nigeria; and with colloform magnetite, fluorite, biotite, gahnite, corundum and cassiterite in a skarn at Mt Garnet, N. Queensland.

References: Bannister et al. (1974), Mineral Mag. 28, pp. 129-36; Peacor (1967), Am.Min. 52, pp. 864-6; Grey & Gatehouse (1979), Am.Min. 64,

Schoenfliesite

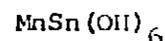
Cubic Pn3. Occurs massive, as extremely fine ($\approx 0.05 \mu$) particles, as an alteration of hustite and associated with magnetite, fluorite, ludwigite-vonsenite, calcite, skarn silicates and sulphides, in a contact metasomatized dolomite adjacent to a granite at Brooks Mountain, Alaska.

Reference: Faust & Schaller (1971), Zeit. für Krist. 134, pp. 116-41 (in English); (1972), Am.Min. 57, p. 1557.

Wickmanite

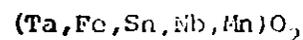
Cubic Pn3m. Brownish yellow octahedral crystals in a manganiferous skarn at Långban, Sweden.

Reference: Moore & Smith (1967), Am.Min. 53, p. 1063.

Tetrawickmanite

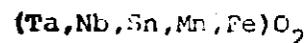
Tetragonal $P4_2/n$. Transparent to translucent, honey yellow to brownish orange vitreous crystals and rounded globules. No cleavage. SG 3.65. A dimorph of wickmanite occurring very sparsely in a spodumene mine, Kings Mountain, N. Carolina. Associated with bavenite, siderite, rhodochrosite, eakerite (qtz.), quartz and albite in a pegmatite.

Reference: White & Nelen (1973), Min.Rec. 4, pp.24-9.

Ixiolite

Orthorhombic, Pcam. Opaque, metallic, blackish to steel grey. $HG-6\frac{1}{2}$, SG 7.03-7.23. Fracture uneven to subconchoidal, brittle; crystals prismatic, rectangular, rarely twinned. A disordered structure of vague composition, closely related to wolganite, columbite/tantalite and wolframite. Found in pegmatites at Skogholm, Finland; at Londonderry and Tappa Tappa, W. Australia, and in the U.S.S.R.

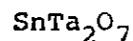
References: Nickel et al. (1963), Am.Min. 48, pp. 961-79; Pryce (1970), J.Roy.Soc. W.A. 53, pp. 65-8; Graham & Thornber (1974), Am.Min. 59, pp. 102-30; Hogarth (1977), Am Min. 62, pp. 403-10

Wodginite

Monoclinic PC2/c or Cc . Reddish brown to almost black, submetallic spheroidal, tabular or irregular grains, sometimes forming partially radiating groups. H_6 , SG 7.19-7.81. Contains 12-17 mol % SnO_2 .

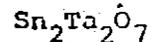
An ordered, but slightly distorted structure. Occurs in pegmatites at Wodgina, Western Australia, Bernic Lake, Manitoba and Sukula, Finland; also found in alluvium at Marble Bar and Tabba Tabba, Western Australia.

References: Nickel et al. (1963), *Can.Min.* 7, pp. 390-402;
Pryce (1970) *J.Roy.Soc. W.A.* 53, pp. 65-68; Verma & Siivola (1968),
Am.Min. 53, pp. 2103-4; Turnock (1966), *Can.Min.* 8, pp. 461-70;
Graham & Thornber (1974), *Am.Min.* 59, pp. 1026-39.

Thoreaulite

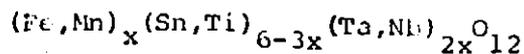
Monoclinic C2/c . Opaque, translucent in thin fragments. Brown to yellowish, adamantine to resinous lustre. $H_{5\frac{1}{2}}-6$, SG 7.5-7.9. Cleavage $\{100\}$ perfect, $\{011\}$ imperfect. Occurs in granite pegmatites, associated with cassiterite and lithium and niobium-tantalum minerals at Monono and Punia, Zaire; at Seheia, Rwanda; and in the U.S.S.R.

Reference: Murme (1970), *Am.Min.* 55, pp. 367-77.

Sukulaite

Cubic $\text{Fd}3m$. Occurs as minute, hard, yellow brown translucent inclusions in cassiterite which is replacing wodginite, in pegmatite at Sukula, Tammela, south west Finland. Isostructural with microlite; Hogarth (1977, *Am.Min.* 62, pp. 405-10) suggests it be renamed stannomicrolite.

Reference: Verma et al. (1968), *Am.Min.* 53, pp. 2103-4.

Staringite

Tetragonal $P4/mmm$. Massive, compact, black. $H6-6\frac{1}{2}$, SG 7.2, no cleavage. Lower symmetry than cassiterite, rutile or tapiolite. Typically $x = 0.5$. Occurs as small (20-50 μ) exsolution bodies in tapiolite from pegmatites at Seridozenko and Pedra Lavreda, Paraiba State, Brazil.

Reference: Burke *et al.* (1969), *Mineral.Mag.* 37, pp. 447-52.

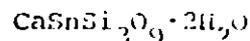
SilicatesMalayaite

Monoclinic $P2_1/a$. Massive, translucent pale yellow to colourless with a white streak and characteristic yellow-green fluorescence.

$H 3\frac{1}{2}-4$, SG 4.3. Occurs as irregular grains. Isostructural with the low temperature form of splene; the solvus crests at about 615° at about $\text{Ti}_{0.75}\text{Sn}_{0.25}$, above which complete solid solution exists.

Found as a late stage mineral in stanniferous skarns in Malaysia, Japan, Thailand and Cornwall, typically associated with wollastonite and other calc-silicates. Also an apparent hydrothermal alteration product of cassiterite in Malaya and at Arandis, Namibia. Probably forms in iron-poor skarns due to the incompatibility of cassiterite and wollastonite.

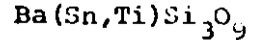
References: Ingham & Bradford (1961), *Am.Min.* 46, pp. 768-9; Burt (1978), *Econ.Geol.* 73, pp. 269-82.

Stokesite

Orthorhombic $Pnma$. Colourless pyramidal crystals. $H6$, SG 3.2. Cleavage $\{110\}$ perfect, $\{010\}$ poor. Reported in association with axinite at two localities in Cornwall, and from pegmatites in Czechoslovakia, California and Brazil. Experimental work suggests that it is formed at around $300^\circ-400^\circ$.

References: Couper & Clark (1977), Mineral.Mag. 41, pp. 411-11;
Burt (1978), Econ.Gool. 73, pp. 269-82; Nekrasov (1973), Acad.Sci.
SSSR Doklady, Earth Sci.Sect. 212, pp. 126-30.

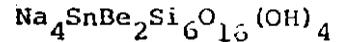
Pabstite



Hexagonal $P\bar{6}c2$. Colourless to pinkish-white; bluish-white
fluorescence. H6, SG 4.03. Occurs as small (< 2 mm) scattered or
clustered anhedra, rarely showing crystal form, in a calcic skarn at
Santa Cruz, California, associated with cassiterite and stannite.

Reference: Gross et al. (1965), Am.Min. 50, pp. 1164-9.

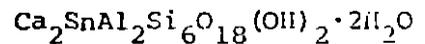
Sorensenite



Monoclinic $C2/c$ or Cc . Fine silky colourless to pinkish white
acicular to elongate tabular crystals. H5.5, SG 2.9. Brittle with
two distinct cleavages at 63° . Occurs in hydrothermal veins and in
coarse rock in the Ilimaussaq undersaturated alkalic intrusive, Greenland.
Associated with nepheline, microcline, aegirine, arfvedsonite, analcime,
sodalite, neptunite, apatite and rare beryllium minerals.

Reference: Semenov et al. (1966), Am.Min. 51, pp. 1547-8.

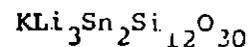
Eakerite



Monoclinic $P2_1/a$. Colourless to milky white, transparent, vitreous.
H5½, SG 2.93. No cleavage, conchoidal fracture. Prismatic crystals
up to 5 mm long, striated parallel to the elongation. Occurs in seams
with quartz, albite, baryte, apatite, spodumene and tetrawickhamite (qv.)
in pegmatite at Kings Mountain, N. Carolina.

Reference: Leavens et al. (1970), Min.Rec. 1, pp. 92-6;

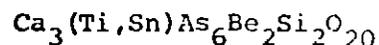
Kossiakoff & Leavens (1970), Am.Min. 61, pp. 956-62.

Brannockite

Hexagonal P6/mcc. Colourless with blue-white fluorescence, transparent, vitreous, SG 2.98. No cleavage. Brittle, very thin plates. Isostructural with osumilite. Occurs in minute amounts in vugs and on fracture surfaces in leached pegmatite, associated with quartz, albite, bavenite, apatite, spodumene and tetrawickmanite at Kings Mountain, N. Carolina.

References: White et al. (1973), Min.Rec. 4, pp. 73-6.

Am.Min. 58, p. 1111.

Asbecasite

Hexagonal P3c. Lemon-yellow, transparent, vitreous rhombohedral crystals up to 5 mm. H6-7, SG 3.70. Occurs in cleft faces in orthogneisses of the Monte Leone nappe, Switzerland.

References: St Grasser (1967), Am.Min. 52, pp. 1583-4;

Cannillo et al. (1970), Am.Min. 55, p. 1818.

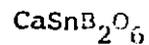
BoratesHulsite

Monoclinic P2/m. Black, submetallic to vitreous. H3, SG 4.5-4.6. Cleavage {110} good. As small rectangular crystals with uneven faces, or as tabular masses. A 3A fibre-axis wallpaper structure, quite distinct from ludwigite-vonsenite. Occurs in a contact metamorphosed limestone at Brooks Mountain, Seward Peninsula, Alaska, associated with idocrase, garnet, calcite, phlogopite and magnetite.

References: Knopf & Schaller (1908), U.S. Geol.Surv.Bull. 358,

pp. 41-4; Clark (1965), Am.Min. 50, pp. 249-54; Konert et al. (1976),

Am.Min. 61, pp. 116-22.

Nordenskiöldine

Trigonal R $\bar{3}$. Colourless to yellow, transparent and vitreous. H5 $\frac{1}{2}$ -6, SG 4.2 Cleavage {0001} perfect, {10 $\bar{1}$ 1} indistinct; fracture conchoidal, brittle. Tabular or thick lensoid crystals and as parallel growths with cassiterite and carbonates. Probably incompatible with quartz. Occurs in both calcic and magnesian skarns: in the Seward Peninsula, Alaska; in Yakutia and E. Kirghizia, U.S.S.R., and at Arandis, Namibia. Often partly replaced by cassiterite and calcite. Also recorded in a nepheline syenite pegmatite at Åro Island, Norway.

References: Burt (1973), Econ.Geol. 73, pp. 269-82; Aleksandrov (1974, 75), Geochemistry 11, pp. 132-539; 12, pp. 139-50.

Invalid or Dubious SpeciesAinalite

A variety of cassiterite containing up to 9% (Ta, Nb)₂O₅; greater quantities appear to lower the symmetry: see starringite.

Arandisite

Sometimes given as Sn₃Si₄O₈(OH)₈. A greenish, microscopically fibrous or fibrous, resinous substance from a skarn at Arandis, Namibia. According to Dana it is probably a mixture of colloidal and crystalline phases.

Hjelmite, Hielmite

Described from a granite pegmatite near Falun, Sweden. Crook (1979, Am.Min. 64, pp. 890-2) re-examined material, from the type locality, dense greenish black masses and octahedral crystals. It contains 18.42% R₂O₃, 4.53% U₃O₈ and 3.81% SnO₂, and may be regarded as yttromicrolite with some sukulaite (qv.) in solid solution. For a discussion of the nomenclature of the pyrochlore-microlite group, see Hogarth (1977), Am.Min. 62, pp. 403-10.

Hydrocassiterite

A vague term roughly synonymous with varlamoffite (qv.).

Isostannite

Kissin & Owens (1975, Can.Min. 13, p. 309) conclude that isostannite is identical with kesterite.

Limaite

A stanniferous variety of the zinc spinel, gahnite, $ZnAl_2O_4$.

Montesite

A name given to material from Bolivia, approximately $PbSn_4S_5$. An intermediate of the herzenbergite-teallite solid solution; thus not a distinct species.

Souxite

A name given to varlamoffite from Bolivia.

Varlamoffite

Tetragonal $P4_2/mnm$. A waxy or earthy, massive yellow substance, SG = 2.5-2.60, described from Cornwall, Zaire, Bolivia, France, S. Dakota and North Queensland. Apparently usually an alteration product of stannite but perhaps sometimes also of cassiterite or malayaite. Usually considered a distinct species, but a review of the literature, particularly X-ray and thermal data, suggests that it is a poorly crystalline, impure and hydrated form of cassiterite, containing up to 10% $Fe(OH)_3$ and minor amounts of other impurities. These substitute in the cassiterite structure, distorting but not destroying it.

References: Alexander & Flinter (1965), Mineral.Mag. 35, pp. 622-7; Russell & Vincent (1951), Mineral.Mag. 29, pp. 817-26; Taylor et al. (1970). Mineral.Mag. 37, pp. 624-7.

Wood-tin

A colloform, yellow to red or dark brown variety of cassiterite containing up to 8% Fe_2O_3 , occurring as veinlets and fracture fillings in rhyolite.

Reference: Lufkin (1977), *Am. Min.* 62, pp. 100-6.

Substitution of tin into rock-forming minerals

The average crustal abundance of tin is only 2-3 ppm, at which level quantitative analysis is difficult. Some idea of the degree to which tin substitutes into rock-forming minerals is obtainable from mineral analyses from stanniferous environments. As these are scattered throughout the literature, no attempt has been made to compile them. Rather, the table below is largely a summary of compilations by previous authors.

Anorthite	0.1, 0.4 ppm	Epidote	≤ 2.0%
Plagioclase	2.1, 5.2	Idocrase	43, 57, 64, 72, 85, 87
Albite	3-5.0	Axinite	218, 780, 1270, 1350
K-Feldspar	2-12	Garnet (andradite)	≤ 5.8% reported
Muscovite	3500, 1240 (max.)	Sphene	1.8%, 1.4% reported; see malayaite
Paragonite	42, 53	Magnetite	≤ 1.1%, usually much lower
Phlogopite	176, 213 (max.)	Spinel	13.5% reported in gahnite
Biotite	1300 reported, often < 360	Ilmenite	46, 200 ppm
Lepidolite	4-700	Rutile	1.2%, 2.7%, 3.0%
Zinnwaldite	300, 400, 3500	Ludwigite-vonsenite	0.26-0.73%
Hornblende	≤ 4260 reported in skarns, commonly much lower	Sphalerite	170, 230 ppm
Pargasite	15-39	Pyrrhotite	18-28
		Chalcopyrite	13

References: Desborough & Sainsbury (1970), *Econ. Geol.* 65, pp. 1004-7

: Mulligan (1968), *Can. Min.*

: Nekrasov (1971), *Int. Geol. Rev.* 13, pp. 1532-42.

: Taylor, R.G. (1978), "Tin Deposits - Geology and Exploration,

: Wedepohl, K.H. (1974), "Handbook of Geochemistry",
Springer, Berlin.

Eadington & Kincaid (1980), in a restricted circulation CSIRO
report, interpreted this and their own data as follows:

- (a) Many minerals able to accommodate tin are titaniferous or
have titaniferous varieties: rutile, sphene, andradite
(melanite), and hornblende (kaersutite). This is expected
because of the similar ionic radii, Pauling electronegativity
and oxidation state of Ti^{IV} and Sn^{IV} , and their preference
for octahedral co-ordination.
- (b) Others contain essential Fe^{III} : magnetite, epidote,
ludwigite, and again andradite, or may contain significant
 Fe^{III} : biotite, axinite, amphibole. This is explained in
terms of a coupled substitution:



Again, ionic radii are similar, minimizing structural
distortion. It should be noted in this context that
Amthauer (1979, Phys.Chem.Minerals 4, pp. 235-44) demonstrated
by Mossbauer spectroscopy that in andradite with 6 wt % SnO_2 ,
 Sn^{IV} indeed directly replaces Fe^{III} in the octahedral sites.

- (c) $Mg-Fe^{II}$ silicates, containing little or no Fe^{III} , such as
pyroxene and idocrase have very low tin contents.
- (d) tectosilicates such as the feldspars, and no doubt quartz,
have the lowest tin contents of all.

Electron Probe Microanalyses

Analyses were carried out on the University of Tasmania's Jeol 50A electron microprobe. Elements sought and reported as the oxide were Si, Ti, Al, Cr, Fe, Mn, Mg, Ca, Na and K, except where otherwise indicated. Detection limits for each oxide are about 0.2%. All iron is reported as FeO, and analyses are recalculated to near 100% on an anhydrous and CO₂-free basis. The area scanned was usually a few μm^2 ("spot mode") with a beam penetration of several μm .

Forsterite

<u>Sample</u>	SD 13/2074A			
	<u>1A</u> (broad area)	<u>1B</u> (broad area)	<u>1C</u>	<u>6B</u>
SiO ₂	43.64	43.54	42.02	40.23
FeO	2.76	2.75	2.85	9.43
MnO	0.32	0.32	0.31	1.09
MgO	52.78	52.90	53.42	48.57
CaO	0.26	0.26	0.24	0.24
K ₂ O	0.22	0.22	-	0.27
	99.98	99.99	99.84	99.83
Si	1.034	1.032	1.000	0.994
Fe	0.055	0.055	0.057	0.195
Mn	0.006	0.006	0.006	0.023
Mg	0.864	1.869	1.931	1.788
Ca	0.007	0.007	0.006	0.006

Analyses are recalculated on basis of (O) = 4, excluding K₂O. High iron content in 6B could be due to fine magnetite impurities.

096

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Diopside

	<u>SD 10/224.9</u>		<u>SD 13/207.4A</u>		
	<u>2</u>	<u>2A</u>	<u>2B</u>	<u>3B</u>	<u>4C</u>
SiO ₂	48.29	55.40	55.17	55.08	55.08
TiO ₂	1.49	-	-	-	-
Al ₂ O ₃	5.58	-	-	-	0.32
FeO	1.99	-	-	-	-
MgO	15.10	17.87	17.77	18.05	18.08
CaO	26.03	26.64	26.81	26.68	26.32
Na ₂ O	0.76	-	-	-	-
K ₂ O	0.63	-	-	-	-
	99.87	99.91	99.75	99.81	99.80
Si	1.790	2.003	1.999	1.995	1.992
Al ^{iv}	0.210	-	-	-	0.008
Al ^{vi}	0.034	-	-	-	0.006
Fe	0.062	-	-	-	-
Mg	0.834	0.963	0.960	0.975	0.975
Ca	1.034	1.032	1.041	1.035	1.020
Na	0.055	-	-	-	-
K	0.030	-	-	-	-

Analyses are recalculated on the basis of (O) = 6.

SD 10/224.9/2 also contains a trace of chlorine and appears to be partly altered or impure, or to contain small components of jadeite and aegirine.

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TremoliteSD 13/207.4B

	<u>13A</u>	<u>11A</u>	<u>10</u>	<u>9A</u>
SiO ₂	59.24	59.04	58.94	58.72
Al ₂ O ₃	-	-	-	0.27
FeO	2.60	2.61	2.50	2.72
MgO	24.09	26.86	26.45	25.80
CaO	13.80	11.03	11.80	12.16
K ₂ O	-	0.22	-	-
	<hr/> 99.73	<hr/> 99.76	<hr/> 99.69	<hr/> 99.67
Si	7.951	7.883	7.883	7.874
Al ^{iv}	-	-	-	0.043
Fe	0.292	0.291	0.280	0.305
Mg	4.820	5.346	5.274	5.157
Ca	1.985	1.578	1.691	1.747
K	-	0.038	-	-

Analyses are recalculated on the basis of (O) = 23 (anhydrous).

All appear to be slightly altered, with calcium depleted.

Biotites and phlogopites

	<u>SD 10/226.7</u>		<u>SD 13/206.0</u>		<u>SD 13/207.48</u>				
	<u>4A</u>	<u>4B</u>	<u>3A</u>	<u>3B</u>	<u>4</u>	<u>5</u>	<u>8</u>	<u>11B</u>	<u>12B</u>
SiO ₂	43.48	44.77	40.38	40.98	38.98	40.77	45.60	44.79	45.98
Al ₂ O ₃	11.51	12.72	12.22	15.22	17.16	17.07	9.57	11.10	7.44
FeO	5.34	4.02	21.38	20.69	13.81	19.36	5.16	6.68	4.55
MnO	-	-	0.46	-	-	-	-	-	-
MgO	29.11	27.65	16.59	12.37	22.82	11.83	33.04	29.30	36.71
CaO	0.61	0.80	0.58	0.64	0.34	0.78	0.34	0.39	0.25
Na ₂ O	-	-	-	-	-	0.27	-	-	-
K ₂ O	9.95	10.04	8.39	9.93	6.81	9.82	6.25	7.54	4.93
	100.00	100.00	100.00	99.83	99.92	99.90	99.96	99.80	99.86
Si	2.949	3.005	2.935	2.973	2.704	2.933	3.021	2.704	3.028
Al ^{iv}	0.920	0.995	1.047	1.027	1.296	1.067	0.747	1.296	0.577
Al ^{vi}	-	0.011	-	0.274	0.107	0.380	-	0.107	-
Fe	0.303	0.226	1.300	1.255	0.801	1.165	0.286	0.801	0.250
Mn	-	-	0.028	-	-	-	-	-	-
Mg	2.944	2.767	1.798	1.338	2.360	1.269	3.263	2.360	3.603
Cu	0.044	0.058	0.045	0.050	0.025	0.060	0.024	0.025	0.018
Na	-	-	-	-	-	0.038	-	-	-
K	0.861	0.860	0.778	0.919	0.603	0.901	0.528	0.603	0.414

Analyses are recalculated on the basis of (O) = 23 (anhydrous)

099

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Clintonite /Xanthophyllites

	<u>SD 10/224.9</u>		<u>SD 10/227.2</u>	
	<u>7</u>	<u>2B</u>	<u>2C</u>	<u>5B</u>
SiO ₂	19.67	18.54	19.57	21.69
Al ₂ O ₃	42.82	41.90	41.82	40.94
FeO	1.61	1.87	3.44	1.43
MgO	22.65	22.53	22.51	23.05
CaO	12.66	14.97	12.65	12.38
Na ₂ O	-	-	-	0.40
K ₂ O	0.27	-	-	-
	99.88	99.81	99.99	99.89
Si	1.327	1.256	1.320	1.446
Al ^{iv}	2.673	2.744	2.680	2.554
Al ^{vi}	0.731	0.602	0.645	0.663
Fe	0.091	0.106	0.194	0.080
Mg	2.278	2.276	2.264	2.291
Cu	0.915	1.087	0.914	0.885
Na	-	-	-	0.052
K	0.023	-	-	-

Analyses are recalculated on the basis of (O) = 11 (anhydrous)

Chlorites

<u>Spec.No.</u>	<u>SD 10/224.9</u>		<u>SD 10/227.2</u>		<u>SD 13/207.4A</u>		<u>SD 13.207.4B</u>
	<u>3</u>	<u>6</u>	<u>2A</u>	<u>3A</u>	<u>4B</u>	<u>3</u>	
SiO ₂	45.46	22.80	46.33	45.12	34.35	28.53	
TiO ₂	2.28	-	0.70	-	-	-	
Al ₂ O ₃	1.89	38.94	2.68	10.59	24.11	22.37	
FeO	3.95	5.70	4.05	3.02	3.61	31.05	
MnO	1.80	0.35	0.87	-	-	1.41	
MgO	44.63	30.48	45.05	40.90	37.38	16.30	
CaO	-	1.17	-	-	-	-	
Na ₂ O	-	-	-	-	-	0.24	
K ₂ O	-	0.22	-	-	-	-	
Si	3.883	1.919	3.868	3.726	2.828	2.693	
Al ^{iv}	0.117	2.081	0.132	0.274	1.173	1.307	
Al ^{vi}	0.073	1.782	0.130	0.756	1.166	1.182	
Fe	0.136	0.401	0.237	0.205	0.248	2.452	
Mn	0.130	0.025	0.061	-	-	0.113	
Mg	5.683	3.824	5.571	4.950	4.587	2.294	
Ca	-	0.106	-	-	-	-	
Na	-	-	-	-	-	0.044	
K	-	0.024	-	-	-	-	

Analyses recalculated on the basis of (O) = 14.

According to the nomenclature of Hey, the varieties are ³talc-chlorite, ⁶corundophilite, ^{2A}talc-chlorite, ^{3A}talc-chlorite, ^{4B}clinochlore, and ³ripidolite respectively.

Serpentines

	<u>SD 10/227.2</u>	<u>SD 13/204.2</u>	<u>SD13/206.0</u>			<u>SD 13/207.4A</u>		
	<u>1</u>	<u>1</u>	<u>4</u>	<u>5</u>	<u>2C</u>	<u>4A</u>	<u>5</u>	<u>7B</u>
SiO ₂	44.69	49.91	49.82	48.18	50.18	47.53	49.53	49.44
Al ₂ O ₃	1.50	-	-	-	-	-	-	-
FeO	3.78	1.59	1.56	2.71	2.18	2.45	2.02	1.98
MnO	0.69	-	-	-	0.76	0.73	0.28	0.42
MgO	49.06	48.50	48.52	48.85	46.71	48.48	48.11	47.69
CaO	-	-	-	-	-	0.50	-	-
K ₂ O	-	-	-	-	-	0.26	-	0.28
	99.72	100.00	99.90	99.74	99.83	99.95	99.94	99.81
Mg/Si	1.637	1.449	1.452	1.512	1.388	1.521	1.448	1.438

	<u>SD 13.207.4B</u>		<u>SD 13/226.0</u>	
	<u>7</u>	<u>13B</u>	<u>3A</u>	<u>3B</u>
SiO ₂	49.06	47.55	49.31	49.58
Al ₂ O ₃	-	-	-	-
FeO	1.81	3.57	1.32	1.27
MnO	0.54	0.52	-	-
MgO	48.59	48.35	49.24	49.09
CaO	-	-	-	-
K ₂ O	-	-	-	-
	100.00	99.99	99.87	99.94
Mg/Si	1.476	1.516	1.489	1.476

Carbonates

	<u>SD 13/207.4B</u>			<u>SD 13/226.0</u>			
	<u>1</u>	<u>2A</u>	<u>2b</u>	<u>1</u>	<u>2A</u>	<u>2B</u>	<u>2C</u> (broad area)
SiO ₂	-	-	-	5.94	2.08	-	2.86
Al ₂ O ₃	-	-	-	2.00	0.40	-	-
FeO	-	0.49	-	2.91	3.07	-	0.90
MnO	0.71	0.26	-	-	0.23	-	-
MgO	39.38	41.53	40.15	88.77	93.51	-	45.70
CaO	59.91	57.72	59.91	-	0.62	99.99	50.49
	99.68	100.00	99.64	99.62	99.91	99.99	99.95

Although SD 13/207.4B consists of dolomite, probably with admixed calcite, and SD 13/226.0 consists of calcite and magnesite (see petrography) the analyses are difficult to interpret due to the presence in most instances of impurities.

103

Clinohumite(?)

60 104

SD 13/207.4B6

SiO ₂	36.12
TiO ₂	0.22
FeO	11.27
MnO	1.13
MgO	51.26
	<hr/>
	100.00

Mg + Mn = 2.148

This phase occurs as a microcrystalline to almost cryptocrystalline, high birefringence pale yellow mineral at the margin of a phlogopite-rich vein (see petrography). The analysis is not conclusive, although the high Mg + Mn/Si ratio suggests clinohumite (iron is omitted as magnetite is admixed). Naturally occurring clinohumites always contain appreciable fluorine as well as hydroxyl ion, neither of which can be detected with the probe.

Apatite

SD 10/2267

3

SiO ₂	2.54	Probably some magnesium and iron are substituting for Ca, and minor impurities are present.
Al ₂ O ₃	1.18	
FeO	1.80	
MgO	1.33	
CaO	51.95	
P ₂ O ₅	<u>41.07</u>	
	<u>99.87</u>	
Ca/P -	1.601	

RENISON LIMITED
DIAMOND DRILL HOLE PLOT

HOLE No.: SD9

206.0

The rock is a predazzite marble with a modal analysis ($n = 400$) of calcite (62%), brucite (36%) which pseudomorphs after periclase, and minor opaques (3%). The hand specimen is a chalky grey white massive rock containing fine grained black pyrite as disseminations and narrow, contorted, almost graphic intergranular streaks. The core grades into a coarser grained ophicalcite rock containing colourless to apple green serpentine and more abundant pyrite.

In thin section, the periclase pseudomorphs are typically equidimensional and 100-200 μ across, crudely idioblastic to subidioblastic against the calcite matrix, and oblong to square or crudely octagonal with very well rounded corners. They are composed of tightly packed scales of colourless to off-white brucite (birefringence up to low order yellow brown, straight extinction, length fast) which often display a bent to highly contorted texture and undulose extinction, within each pseudomorph. In many pseudomorphs there are also patches of very fine grained, disordered and almost cryptocrystalline brucite. No periclase remains, even in the cores of the largest pseudomorphs.

The matrix consists of irregular but roughly equidimensional xenoblasts of calcite, usually a few hundred μ to 1mm or so across. Grain boundaries are difficult to delineate because of the cloudiness of the grains, but range from nearly straight to irregular. Minor local brecciation and slight curving of the rhombohedral cleavage suggests minor deformation.

Minor opaques are scattered throughout the section as small equidimensional rounded blebs and irregular aggregates from a few μ to 50 μ across. Although opaque inclusions are found both in calcite and brucite, it tends to be concentrated along grain boundaries, and in particular sometimes forms rims partially surrounding the periclase pseudomorphs.

The modal analysis suggests that the rock was originally a dolomite with only a slight excess of calcium carbonate as calcite ($Ca/Ca + Mg \approx 0.53$).

Thermal metamorphism subsequently converted the rock into a calcite-periclase marble, resulting in a decrease in volume of solids of 25% assuming isochemical metamorphism. This reaction requires temperatures of 800-850 $^{\circ}$, assuming lithostatic pressures of 1-2 kb and a predominately metamorphogenic fluid phase dominated by CO₂. Granite occurs in drill core 34m below the sample locality, and the contact is probably directly only about 25m away.

The hydration of periclase to brucite was probably a late - or even post-metamorphic event at lower temperatures in the presence of an essentially aqueous fluid phase either of magmatic or connate origin. Again assuming isochemical replacement, brucite expands to more than twice the volume of the original periclase, and in fact predazzite marble occupies only about 4% less volume than original dolomite. The stained calcite xenoblasts and the minor brecciation were probably caused by the large increase in volume at this stage, especially as the rounded form of the periclase pseudomorphs suggest expansion.

Assay - (SD9/205-206, 206-207) : Sn 0.01%; WO₃ = 0.01%; S = 0.88%, 0.53%; As < 0.10%; Bi 40, 60ppm; Cu < 500 ppm; Pb 40 ppm; Zn 30, 20 ppm; Ag 3 ppm.

Probe - Nil

UV light - Weak to moderate fluorescence of carbonate.

Further work - Probe opaques?

207.4

A predazzite/ophicalcite marble with a mode ($n = 400$) of calcite (69%), brucite (27%) pseudomorphing after periclase, opaques (3%) and serpentine (1%).

The hand specimen, more varied in mineralogy than the thin section, is a striking, off-white to grey, fine-grained marble. Disseminations of magnetite and serpentine and stringers (1mm x several cm) of magnetite define a well developed wavy banding. Ovoid pods (typically 2cm x 4cm) consisting of pale yellow-green to pinkish serpentine and almost massive magnetite lie aligned to the banding which wrap around them. A few irregular discordant patches of magnetite are associated with the pods, particularly occurring adjacent ones.

In thin section, the rock is very similar to SD9/206.0, in consisting mainly of periclase pseudomorphs of brucite in a calcite matrix. Small irregular patches of serpentine, a few hundred μ long occur adjacent to both calcite and brucite, and almost certainly are replacements of forsterite, with the original crystal outlines obliterated by subsequent stresses. A few tiny (20-50 μ) well rounded crystals of diopside (?) (high relief and birefringence) are found within calcite grains, and may represent a locally more siliceous assemblage - perhaps a quartz grain surrounded by dolomite.

The genetic considerations outlined for SD9/206.0 also apply to this rock. Originally the rock was a slightly siliceous dolomite which was contact metamorphosed at high temperatures to produce a calcite - periclase - forsterite marble with isolated development of diopside, although not in an equilibrium assemblage with periclase, nor probably forsterite.

RENISON LIMITED
DIAMOND DRILL HOLE PLOT

PETROLOGICAL DESCRIPTION BY J. EVERARD
TASMANIAN MINES DEPARTMENT

HOLE No. : SD9

207.4 cont'd.

The more siliceous bands or beds in the dolomite developed forsterite as well as calcite and periclase, but metasomatic diffusion caused them to develop into elongate pods and produced banding. The fluid phase present must have contained significant water as well as CO₂, as metasomatism or the deposition of magnetite from introduced iron could not have otherwise taken place.

Assay - SD9/207.0 - 208.0 : Sn <0.01%, WO₃ = 0.02%, S = 0.88%, As <0.10%, Bi = 60 ppm, Cu = 500 ppm, Pb = 40 ppm, Zn = 20 ppm, Ag = 3 ppm.

Probe - Nil.

UV light - Weak to moderate fluorescence of carbonate.

Further work - Probe opaques, diopside?

100

60 100

RENISON LIMITED
DIAMOND DRILL HOLE PLOT

PETROLOGICAL DESCRIPTION BY J. EVERARD
TASMANIAN MINES DEPARTMENT

224.2

SCALE:

HOLE No.: SD10

This rock is an altered aluminous skarn, comparable to, but less altered than, SD10/227.2. Relict minerals include forsterite, fassaite (aluminous diopside), and clintonite/xanthophyllite. These minerals have been altered and serpentinized to varying degrees, obscuring the original texture.

Forsterite occurs as aggregates of cracked, rounded anhedral. Alteration occurs more readily than in the other minerals, but is patchy, and almost unaltered forsterite is present. Serpentinization commences in the grain boundaries, and rapidly spreads, often leaving splinters of slightly higher birefringence, hydrated forsterite within coarsely fibrous or cross-hatched serpentine.

Fassaite which often occurs with brittle mica, is difficult sometimes to distinguish from forsterite when octagonal outlines are not visible. It alters to a poorly crystalline, fuzzy, fine grained grey material. This probably involves formation of clay minerals on grain surfaces and in cleavages, as the cores of high birefringence diopside are often visible under strong illumination.

Clintonite/Xanthophyllite occurs as high relief, moderate birefringence, length slow laths with straight extinction. They alter only slowly to cryptocrystalline grey clay minerals, often retaining their original form.

Irregular patches of disseminated to granular magnetite are abundant throughout the slide, and in places also appear to be altering to impart a red-brown coloration to the altered skarn minerals.

Assay - (1m interval, 224.0 - 225.0)

Sn 0.84% (0.80 acid sol.), Cu <0.05%, As <0.10%, S 1.4%, Pb 0.003%, Zn 0.18%, Bi 0.006%, Ag 2 ppm, WO₃ 0.09%

100

60 107

RENISON LIMITED
DIAMOND DRILL HOLE PLOT

PETROLOGICAL DESCRIPTION BY J. J. EVERARD
TASMANIAN MINES DEPARTMENT

226.7

SCALE:

HOLE No.: SD10

The rock is a partly serpentinized forsterite (-diopside?) skarn bearing abundant, fibrous magnetite and cut by a 2cm wide vein of phlogopite and subordinate apatite.

Forsterite occurs as cracked, broken anheda and rarely subhedra. Serpentinization has commenced along cracks and grain boundaries, and larger irregular patches occur. However, the texture is difficult to observe because of the poor quality of the slide. Some diopside may be present. There is no sharp boundary between the serpentinized skarn and the phlogopite-rich vein. Fragments of phlogopite appear in the skarn and become more numerous towards the vein. Phlogopite occurs as short broken laths and equidimensional, interlocking anheda, typically 500 μ . Extinction angles are less than 10° and the mineral is almost uniaxial and negative. It is colourless, and electron microprobe analysis shows it to contain less than 10 mol.% iron in the octahedral sites.

Irregular patches of fine grained almost isotropic apatite occur within the phlogopite, discordantly cutting across the cleavage. Thus the apatite is clearly a late stage introduction, into the already crystallized phlogopite vein. Similarly, irregular clusters of subhedral to euhedral opaques have intruded phlogopite.

Fibrous magnetite is most abundant towards the margins of the vein and in the skarn. Frequently it is surrounded by a fibrous low birefringence phyllosilicate, perhaps a highly magnesian chlorite, with cleavage parallel to the magnetite fibres. This suggests that fibrous magnetite has formed by the expulsion of iron from the phlogopite as it crystallised from mineralizing fluids of granitic origin, in disequilibrium with the carbonate (non-skarn) environment.

Assay - (1m interval, 226.0 - 227.0)

Sn 0.4% (0.37 acid sol.), Cu <0.05, As <0.10, S 5.2, Pb 0.003, Zn 0.018, Bi 0.011, Ag 2 ppm, WO_3 0.19%.

227.2

This rock is a thoroughly altered aluminous skarn, consisting of altered laths of clintonite/xanthophyllite and highly irregular patches of magnetite in a disordered, chaotic matrix of serpentine, talc, lesser tremolite and disseminated magnetite.

Clintonite/xanthophyllite occurs as oblong to slightly fanning laths up to 1mm along, but typically around 500 μ x 100 μ . Many laths are completely altered to cryptocrystalline clay minerals, whilst others retain cores of relict brittle mica, and a few show only incipient alteration. The mineral is colourless with a fairly high relief and has one good cleavage parallel to the elongation to which extinction is straight. It is length slow with moderate birefringence to yellow-green of second order, although the section may be rather thick. 2V is small and the mineral is optically negative. (See also analyses). The mineral, before alteration probably represented 5-10% of the rock. Magnetite occurs as highly irregular aggregates of anheda up to 1mm across, which grade down in size to a fine dissemination in the matrix.

The matrix is a chaotic mixture of rather coarse to finely fibrous, colourless to tawny brown serpentine which frequently bears numerous tiny ($\approx 10 \mu$) anhedral to elongate inclusions of a high birefringence length-slow fibrous phase, probably talc. There are irregular, longer patches of finely fibrous, high birefringence colourless tremolite and pale green - pale yellow pleochroic tremolite/actinolite, which appear to be altering to serpentine. Fine grained magnetite is disseminated throughout the matrix. Overall, the rock has a very altered, mottled, dirty texture.

Assay - (227.0 - 228.0)

Sn 0.54% (0.33 acid sol.), Cu <0.05, As <0.10, S 0.52, Pb 0.003, Zn 0.032, Bi 0.005, Ag 3 ppm, WO_3 0.16%.

229.2

The rock is a fine grained mass of disseminated to almost massive granular magnetite (60%) and interstitial relict forsterite and serpentine (40%). Magnetite occurs as opaque, jagged anheda ranging from a few μ to a few hundred μ across, often forming almost massive granular aggregates. In serpentine patches, it may be finely ($<1\mu$) and shortly acicular, sometimes randomly oriented, but often, especially when somewhat coarser, oriented to form radiating or fanning "suns".

The remainder of the rock is forsterite, with possibly minor diopside, in varying degrees of serpentinization. There are occasional fragments of unaltered relict forsterite, mostly as jagged anheda interstitial to almost massive magnetite, which has apparently protected it from serpentinizing solutions. There appears to be a continuous gradation from this, through to recrystallized, partially hydrated forsterite with a birefringence of yellow and oranges of first order, to a low birefringence (grey) finely fibrous to cryptocrystalline serpentine.

307.0 - The rock is medium-coarse grained muscovite-biotite adamellite. Principal minerals are quartz, partially saussuritised K-felspar/perthite, plagioclase, biotite (with pleochroic haloes around zircons) and muscovite, both of secondary (alteration of biotite) and apparently primary origin.

107

60100

RENISON LIMITED
DIAMOND DRILL HOLE PLOT

UNPUBLISHED DESCRIPTION BY J. EVERARD
TASMANIAN MINES DEPARTMENT

123.4

SCALE:

HOLE No.: SD12

108

A dark-brown to grey, non-magnetic micaceous skarn with a well defined fine, linear banding. Mineralogically it consists of tremolitic hornblende (4%), biotite (5%), plagioclase (5%) and pyrite (18%), with minor patches of chloritic alteration.

In thin section the banding is seen to be defined by variations in mineralogy and grain size, particularly of tremolite. Semi-continuous bands, typically only a few hundred μ wide (not much more than the average grain size) are characterized by a phlogopite-plagioclase assemblage, or particularly abundant phlogopite, pyrite or tremolite, or coarser or finer tremolite. Laterally the bands are ill defined and merge into one another without any sudden change in mineralogy.

Tremolite (Act. with minor alumina) occurs both as colourless, very ragged laths (up to $300 \mu \times 150 \mu$) and anheda, grading down to very finely crystalline, fibrous material. The latter shows incipient to partial alteration to an almost cryptocrystalline green-brown fibrous chloritic substance. This is most apparent near pyrite-rich bands.

Phlogopite grains are squat oblongs and broken laths and basal sections, typically about $50 \mu \times 20 \mu$. Extinction is at low angles to the cleavage, which is often slightly bent or curved. Birefringence is high but is largely masked by the strong pleochroism (orange-brown to prismatic // colourless). Basal sections give an apparently uniaxial negative figure.

Plagioclase grains are small (40μ) equidimensional anheda, occurring in bands with phlogopite and minor pyrite. Multiple twinning is absent and single twinning rare. However, they are distinguished by their low relief and birefringence (to greys and pale yellows) and differ from quartz or scapolite by their biaxial figure with large $2V$ and uncertain sign. Probe analysis shows that they are andesine (An 30-40).

Pyrite is disseminated throughout the rock as angular subhedra and anheda, ranging from a few μ to 200μ . It tends to be concentrated in pyritic bands. No other opaque minerals are present. Traces of a colourless high relief mineral, as tiny colourless blebs or elongate fragments most abundant in association with plagioclase, are probably diopside. Despite the banding any pair of the minerals pyrite, tremolite, phlogopite and plagioclase, can be found in contact, and thus the four probably constitute an equilibrium assemblage.

Within the thin section the banding is interrupted by a narrow (1-4mm) discordant structure consisting of coarse grained tremolite, phlogopite and pyrite and subordinate calcite. This structure is probably caused by the late stage escape of CO_2 -rich fluids generated during metamorphism. Similar discordant structures disrupting the banding can be seen in hand specimen.

Assay - (SD12/123.0 - 124.0): Sn <0.01%, WO_3 0.02%, S 3.7%, As <0.10%, Bi 20 ppm, Cu <500 ppm, Pb 20 ppm, Zn 60 ppm, Ag 2 ppm.

Probe - Tremolite, plagioclase, phlogopite.

UV light - No fluorescence

Further work - Probe carbonate, further plagioclase, phlogopite analyses. Possible scapolite (XRD).

125.5

Probe required? Section too thick?

125.9

A dark grey to brownish and greenish, well banded non-magnetic skarn texturally similar to SD9/123.4. Principal constituents are biotite (42%), diopside (25%) and pyrite (5%), which are idiomorphic with respect to a matrix of plagioclase (32%). Minor tremolite and sporadic chloritic alteration, and several narrow discordant veinlets of serpentine are also present.

The well developed, fine, linear banding is, as in SD9/123.4, defined by laterally vague variations in mineralogy. Parallel bands or discontinuous stringers of biotite, 150 - 250 μ apart and individually traceable for only a few millimetres, are separated by zones predominantly of plagioclase. There is also a tendency for diopside to be more abundant in the biotite rich bands. In contrast, pyrite is evenly and sparingly disseminated throughout the rock as small (50-100 μ), angular, irregular grains, and does not form bands.

001 00

RENISON LIMITED
DIAMOND DRILL HOLE PLOT

123.4

SCALE:

HOLE No.: SD12

A dark-brown to grey, non-magnetic micaceous skarn with a well defined fine, linear banding. Mineralogically it consists of tremolitic hornblende (43%), biotite (34%), plagioclase (5%) and pyrite (18%), with minor patches of chloritic alteration.

In thin section the banding is seen to be defined by variations in mineralogy and grain size, particularly of tremolite. Semi-continuous bands, typically only a few hundred μ wide (not much more than the average grain size) are characterized by a phlogopite-plagioclase assemblage, or particularly abundant phlogopite, pyrite or tremolite, or coarser or finer tremolite. Laterally the bands are ill defined and merge into one another without any sudden change in mineralogy.

Tremolite (Act... with minor alumina) occurs both as colourless, very ragged laths (up to 300 μ x 150 μ) and anhedral, grading down to very finely crystalline, fibrous material. The latter shows incipient to partial alteration to an almost cryptocrystalline green-brown fibrous chloritic substance. This is most apparent near pyrite-rich bands.

Phlogopite grains are squat oblongs and broken laths and basal sections, typically about 50 μ x 20 μ . Extinction is at low angles to the cleavage, which is often slightly bent or curved. Birefringence is high but is largely masked by the strong pleochroism (orange-brown to primrose // colourless). Basal sections give an apparently uniaxial negative figure.

Plagioclase grains are small (40 μ) equidimensional anhedral, occurring in bands with phlogopite and minor pyrite. Multiple twinning is absent and single twinning rare. However, they are distinguished by their low relief and birefringence (to greys and pale yellows) and differ from quartz or scapolite by their biaxial figure with large 2V and uncertain sign. Probe analysis shows that they are andesine (An 30-40).

Pyrite is disseminated throughout the rock as angular subhedra and anhedral, ranging from a few μ to 200 μ . It tends to be concentrated in pyritic bands. No other opaque minerals are present. Traces of a colourless high relief mineral, as tiny colourless blebs or elongate fragments most abundant in association with plagioclase, are probably diopside. Despite the banding any pair of the minerals pyrite, tremolite, phlogopite and plagioclase, can be found in contact, and thus the four probably constitute an equilibrium assemblage.

Within the thin section the banding is interrupted by a narrow (1-4mm) discordant structure consisting of coarse grained tremolite, phlogopite and pyrite and subordinate calcite. This structure is probably caused by the late stage escape of CO₂-rich fluids generated during metamorphism. Similar discordant structures disrupting the banding can be seen in hand specimen.

Assay - (SD12/123.0 - 124.0) : Sn <0.01%, WO₃ 0.02%, S 3.7%, As <0.10%, Bi 20 ppm, Cu <500 ppm, Pb 20 ppm, Zn 60 ppm, Ag 2 ppm.

Probe - Tremolite, plagioclase, phlogopite.

UV light - No fluorescence

Further work - Probe carbonate, further plagioclase, phlogopite analyses. Possible scapolite (XRD).

125.5

Probe required? Section too thick?

125.9

A dark grey to brownish and greenish, well banded non-magnetic skarn texturally similar to SD9/123.4. Principal constituents are biotite (42%), diopside (23%) and pyrite (3%), which are idiomorphic with respect to a matrix of plagioclase (32%). Minor tremolite and sporadic chloritic alteration, and several narrow discordant veinlets of serpentine are also present.

The well developed, fine, linear banding is, as in SD9/123.4, defined by laterally vague variations in mineralogy. Parallel bands or discontinuous stringers of biotite, 150 - 250 μ apart and individually traceable for only a few millimetres, are separated by zones predominantly of plagioclase. There is also a tendency for diopside to be more abundant in the biotite rich bands. In contrast, pyrite is evenly and sparingly disseminated throughout the rock as small (50-100 μ), angular, irregular grains, and does not form bands.

RENISON LIMITED
DIAMOND DRILL HOLE PLOT

PETROLOGICAL DESCRIPTION BY J. EVERARD
TASMANIAN MINES DEPARTMENT

125.9 cont'd.

SCALE:

HOLE No.: SD12

Diopside occurs as small (typically 30-70 μ) equidimensional to shortly elongate subhedra and euhedra, usually with rounded corners. Cleavage is not well developed and is best seen in larger grains or under high power. The mineral, colourless with a high birefringence, is distinguished from tremolite by its higher relief, larger extinction angle and different form.

Biotite (Am₄₋₁₅), as ragged laths or subhedral basal sections, is typically 50-200 μ but also as fragments of only a few μ , is similar to that in SD9/123.4, but paler in colour. Probe analyses suggest that this is due to a slightly lower iron content. Colourless, ragged laths, a few hundred μ long, or tremolite are fairly rare in the slide. The mineral is biaxial negative with a large 2V and slightly oblique extinction. Birefringence is high, but relief is lower than that of diopside.

The matrix consists of large (up to 500 μ or more), interlocking anhedral of plagioclase (about An₃₈), often bearing numerous tiny inclusions of biotite and sometimes diopside or pyrite. Multiple twinning is present but only sporadic. Unlike most of the St. Dizier skarns, the rock is relatively unaltered. However, in places a poorly crystalline yellow-brown chloritic alteration occurs around or has replaced diopside.

A few narrow (200-300 μ) inconspicuous crooked veinlets of colourless very low birefringence serpentine traverse the slide. These are clearly a late stage or post-metamorphic feature as they bear no relation to the mineralogy or banding, and contain fragments of unaltered biotite that have apparently been in their path. The corner of the slide is cut by part of a veinlet, a few millimetres wide, of particularly coarse (600 μ) phlogopite with only minor diopside and chloritic alteration.

Assay - (ED12/125.0 - 126.0) Sn <0.01%, WO₃ <0.01%, S 2.1%, As <0.10%, Bi 30ppm, Cu <500ppm, Pb 10ppm, Zn 70ppm, Ag 1ppm.

Probe - Diopside, phlogopite, plagioclase.

UV light - Traces of fluorescence.

Further work - Probe - confirm tremolite, pyrite, serpentine.

128.4

A strongly magnetic, well banded micaceous grey skarn with abundant opaques. The rock consists dominantly of coarse to very fine grained phlogopite, with subordinate patches of tremolite and green to brown chlorite, and abundant opaques. These include pyrite, magnetite and hulsite and possibly minor chalcopyrite.

Phlogopite occurs both as ragged narrow laths to broken irregular fragments several hundred μ long, and as a yellow-grey, almost cryptocrystalline ground mass. There is a continuous gradation between these extremes. The larger fragments are colourless, or very pale aqua-green in basal sections or in longitudinal sections aligned with the vibration direction. There is no alignment or orientation of the phlogopite.

Several very irregular patches contain phlogopite, tremolite, opaques (pyrite?) and a grass green to brown-green to orange-brown chlorite. The latter mineral occurs as large, anhedral to raggedly subhedral irregular patches, into which phlogopite and tremolite are inserted to poikiloblastic. The chlorite probably has a low birefringence, and an internal uneven chatly fibrous structure can be seen under crossed nicols.

Within these patches, which may be several millimetres across, tremolite, as well as phlogopite occurs. The former is very similar in form, occurring as short laths, but is distinguished by its oblique extinction, and, where visible in cross section, two 60° cleavages. One mineral is probably the metasomatic alteration product of the other. Brown chlorite also occurs in narrow veinlets.

The hulsite is typically opaque under transmitted light, although in very thin slivers under strong illumination it is translucent, with a characteristic pleochroism: dark brandy brown // deep sea-green \perp . Extinction is difficult to determine but is oblique at moderate angles. The mineral in form ranges from angular, irregular crystals or aggregates to narrow laths and short, very narrow needles. Under reflected light, hulsite is grey and has a moderate to low reflectivity, somewhat less than that of magnetite. A very strong bireflectance from dark orange-brown to very dark blue-grey is distinctive. However, pleochroism is absent. One good cleavage is present, often it is curved or crenulated, similar to molybdenite or graphite. Also present are pale grey magnetite (distinguished by its lack of bireflectance) and yellow-white pyrite (with no bireflectance and a much higher reflectivity). At least pyrite-magnetite and pyrite-hulsite may be in contact.

RENISON LIMITED
DIAMOND DRILL HOLE PLOT

PETROLOGICAL DESCRIPTION BY J. EVNHARD
TASMANIAN MINES DEPARTMENT

134.7

SCALE:

HOLE No.: SD12

A strongly magnetic dark skarn with a diffuse, ill defined banding not noticeable in thin section. Opaques, which comprise 55-60% of the rock, are irregular, anhedral aggregates 500 μ - 1mm across, ranging to almost massive, or narrow needles 200 - 400 μ x 10-30 μ . Most of this material is an iron-rich borate, either vonsenite or huleite, X with up to 10% MgO and 2% SnO₂ on a boron-free basis; however, magnetite and possibly pyrite are also present. Under reflected light, the borate is distinguished from magnetite by its slightly lower reflectivity and, under crossed nicols, its strong anisotropism to dark red-grey. Weak red-brown internal reflections may be present.

The gangue consists mainly of incipiently altered, massive olivine (Fa ₃₆₋₄₃) Individual crystals, recognized under crossed nicols by their optical continuity, vary from less than a hundred to several hundred μ across. Typically they are cracked irregular anhedral, with sometimes one or more faces being discernible.

The principal subordinate gangue mineral is colourless to pleochroic (aqua green // , colourless \perp) phlogopite, as short ragged laths (50-100 μ). Cleavage is often slightly wavy. Like in the other samples, the phlogopite is practically uniaxial, and negative. Minor tremolite is also present.

Assay : SnO₂ 0.20% (acid sol 0.20); WO₃ 0.01% S 4.5%, As <0.10%, Bi 80ppm, Cu 700ppm, Pb 30ppm, Zn 110ppm, Ag 2ppm.

60-419

RENISON LIMITED
DIAMOND DRILL HOLE PLOT

204.2

SCALE:

HOLE No.: SD13

A very strongly magnetic, moderately well banded and visually striking black-and-white rock, consisting of rather fine grained magnetite (40%), disseminated to locally almost massive in a cream-white to light grey matrix of Szaibelyte (53%), minor serpentine (6%) and colloided (?) magnesite (1%). The banding is defined by a weak tendency for the magnetite grains to occur in ill defined bands or lenses, a few millimetres wide and a few centimetres long, with gradational borders.

Magnetite occurs mostly in the form of very irregular, jagged masses or aggregates, typically roughly equidimensional and 200 μ - 400 μ across, but which often adjoin to form a disseminated network or a crude banding. Magnetite also occurs as tiny (2-10 μ) rounded blebs, or more commonly as slender needles (20-100 μ by 2-5 μ) sparingly disseminated and often locally aligned within the matrix.

Szaibelyte, a magnesium borate of uncertain composition, occurs as a microcrystalline mat of shortly fibrous wisps and needles mostly 50 μ long and not more than a few tens of μ wide. The fibres, which have a ragged, splintery appearance, are only locally aligned, and produce a chaotic, haystack-like texture. The mineral is colourless to very pale grey with straight or nearly straight extinction and length fast orientation (hence probably optically negative). Birefringence ranges up to yellow-green of mid second order. Relief is low to moderate.

Adjacent and interstitial to the magnetite patches are sometimes small quantities of fine grained, finely fibrous to equidimensional granular, low birefringence (to pale grey) colourless serpentine. Occasional isolated grains or irregular patches occur within the hydroxyl-szaibelyte matrix, usually associated with very fine grained magnetite. The generally sharp borders of these serpentine patches and their irregular to subhedral outline suggests that they are a secondary alteration, pseudomorphing after olivine, rather than a primary metamorphic phase.

A very small amount of fuzzy, cryptocrystalline grey-brown material, probably with high birefringence is found in association with magnetite and serpentine. This is probably magnesite, formed by the late stage alteration of serpentine by CO₂-rich post metamorphic fluids. Minor carbonate is detectable along the joints and crevices in hand specimen. Intergrown with the magnetite and in occasional isolated equidimensional grains, is a dull yellow, possibly isotropic opaque mineral, with low reflectance, and quickly susceptible to tarnishing. It is probably a sulphide, possibly a copper sulphide (check with probe).

Assay - (SD13/204.0-205.0). Sn 0.41% (0.37% acid sol.). W₂ 0.03%, S < 0.1%, As 0.10%, ⁸¹30 ppm, Cu 100 ppm, Pb < 100 ppm, Zn 100 ppm, Ag 2 ppm.

Probe: Serpentine present, essentially Mg-rich phase free of other common elements present.

UV light - No fluorescence

Further work - a) Probe unidentified opaque

b) Run powder photo of hydroxyl/szaibelyte.

Obtain an analysis of it.

Determine extent in core of it.

206.0

A visually striking apple-green serpentinite bearing abundant magnetite and with two generations of serpentine. The rock is cut by a 1.5cm wide vein of phlogopite colloidal magnesite and sulphides. The major and finer portion of the serpentinite is a fine-grained, poorly ordered mass with an average crystallite size of 30-40 μ . In thin section this serpentine is colourless with birefringence up to pale greys. It is cut by inconspicuous very narrow (5-10 μ), anastomosing crooked veinlets of fibrous colourless chrysotile. There is also a second, earlier generation of pale yellow-green chrysotile. This is distinguished by its higher birefringence (to reds and sometimes blues of lower second order) and occurs in crooked, slightly broader and mutually subparallel veinlets crossing the later generation at an oblique angle. It appears to be a more iron-rich variety, and the veinlets are related to the second generation of serpentine described below.

The second coarser generation of serpentine has invaded the first to form both small veins 1-2mm wide and larger irregular patches several millimetres across. It is a coarsely fibrous (up to 1mm), chaotic, colourless to pale yellow green mineral with birefringence again up to lower second order although more commonly pale yellows and greys. With it is contained abundant magnetite as irregular anhedral 1mm or more across, grading to very fine dust. The narrow veins within the finer serpentine are fringed by a very fine grained to colloidal mixture of magnetite dust, serpentine and high birefringence phase, possibly fine grained phlogopite.

Probably the portion that is now the finer grained serpentine was the first to crystallize as a forsterite skarn, mainly under thermal metamorphic influences. Later it was invaded by serpentinizing fluids at least partly of granitic origin, depositing magnetite. The remaining forsterite skarn altered slowly later to a finer, essential magnetite free serpentine. Unless metasomatism is invoked, the original carbonate sediment must have been highly magnesian as no calcium-bearing phases are now present.

RENISON LIMITED
DIAMOND DRILL HOLE PLOT

206.0 cont'd.

SCALE:

HOLE No.: SD13

Apparently later still the rock was invaded by a second fluid phase, again containing elements of granitic origin but also rich in presumably metamorphism-generated CO₂, to form a sulphide-bearing vein about 1.5cm wide. The outer zones of this vein, about 3mm wide, consists of minor opaques and radiating sheaves of coarse (up to 1mm), yellow-green biotite fanning out towards the axis of the vein. Optical characteristics of the biotite are a sea green (H), to straw yellow (L) pleochroism, straight extinction, optically negative, a small but noticeable 2V and a high birefringence masked by the colour, and sometimes ink-blue anomalous. Colloform, very fine grained opaques within the biotite zone are particularly abundant towards the outer margins.

The discontinuous lenticular inner zone of the vein is composed of very fine, crypto-crystalline tawny-brown magnesite, admixed with microcrystalline to cryptocrystalline, magnetically aligned fibrous to granular, opaque black magnetite. This zone displays a well developed colloidal texture, with concentric botryoidal structures being best seen near its margins. Several wavy, sub-parallel veinlets, typically 50 μ wide, of particular fine (less translucent) magnesite traverse the earlier deposited magnesite, including the black magnetite-rich patches. Dendritic structures within these black patches suggest fluids drained into these veinlets, suggesting that they are diagenetic, possibly resulting from compaction which forced fluids out of the carbonate. Tiny patches of corroded serpentine, embayed by carbonate and altering to it, occur within this inner zone of the vein and may be unassimilated fragments or "microxenoliths" of the host serpentine. Irregular grains of pyrite, mostly 1-3mm across, are disseminated throughout the phlogopite-magnetite outer zone of the vein. Another, pale copper-brown sulphide is also present.

Assay - (SD13/206.0-207.0) Sn 0.50% (0.32% acid sol.), WO₃ 0.02%, S 0.8%, As 0.60%, Bi 110ppm, Cu 200ppm, Pb <100ppm, Zn 200ppm, Ag 1ppm.

Probe - Biotite, serpentine, magnesite.

UV light - No fluorescence.

Furtherwork - a) Probe (?) phlogopite near margins of coarse serpentine

b) Confirm pyrite.

c) Identify other sulphide.

207.4 (A & B)

An unbanded, non magnetic fine grained forsterite-diopside skarn which has been partially serpentized to produce irregular grass green streaks and blotches within it. It has been cut by a vein several centimetres wide produced by fluids of granitic origin, leaving an axially zoned phlogopite-chlorite-tremolite mineralogy, together with abundant magnetite.

The host, partially serpentized, skarn consists of diopside and forsterite which, although difficult to distinguish in individual grains, are probably of similar abundance. They form an interlocking mass of anhedral and subhedral of widely ranging sizes, from large cracked grains of 1mm across to densely packed grains with rounded boundaries, 20 μ or less across.

Much of this finer material is probably diopside, as it is known to nucleate less readily. However, some of the larger grains also show parts of octagonal outlines. A small quantity of irregular, ragged to crudely fibrous (opaque material) is disseminated throughout the skarn.

Serpentinization appears to have commenced by the formation of narrow intergranular veinlets of pale yellow, fibrous chrysotile a few μ wide, by the alteration of forsterite. In more altered parts these veinlets are numerous and anastomose to form a braided pattern. There is a continuous gradation from this, through serpentine with abundant, aligned forsterite relics, to massive and less fibrous chrysotile, with progressive serpentization.

Diopside alters, probably less readily, to a poorly microcrystalline to cryptocrystalline, fuzzy grey brown material, which is most abundant within or fringing patches of serpentine. Probe analysis suggests that the serpentizing fluids remove calcium, to produce a finely crystalline mixture of serpentine and diopside, which finally alters to a more crystalline serpentine. This host skarn has been cut by a vein, formed by fluids of at least partly magmatic origin. The mineralogical zonation is as follows.

- a) A broad patch of serpentinite, several millimetres wide, lies between the partly serpentized diopside-forsterite skarn and the vein.
- b) The outermost zone of the vein is 5-15mm wide and consists predominantly of tremolite with minor biotite, subordinate, irregular but equidimensional patches of finely crystalline material, probably also altered diopside, and minor irregular, jagged, mostly equidimensional magnetite grains, 500 μ to a few μ in size. The tremolite occurs as narrow laths and fibres, rarely more than 500 μ long and often bent or curved, which are randomly oriented to form a haystack texture. The mineral is colourless to rarely very pale yellow. The small quantity of fine grained phlogopite associated with it is distinguished by its sea-green to yellow colour and nearly isotropic basal sections.
- c) This is followed by a narrow (1-3 μ) semi-continuous zone of talc-chlorite, as coarsely fibrous, fanning sheaves up to 1mm long. Optically, although with very low (dark grey) birefringence, it is length fast and well crystallized. The margins of the zone are very irregular and it is often mixed with the neighbouring tremolite, phlogopite or altered diopside. Clearly it has formed by the alteration or leaching of tremolite as it has a similar habit, and sometimes talc-chlorite (low birefringence) and tremolite (high

RENISON LIMITED
DIAMOND DRILL HOLE PLOT

207.4 (A & B) cont'd

SCALE:

HOLE No.: BD13

birefringence) are crystallographically continuous between opposite ends of the same lath. This zone passes fairly abruptly into:

- d) a nearly monomineralic zone about 3mm wide of biotite, with only a small amount of opaques. The biotite occurs as straight to sometimes slightly bent, curved or fanning laths up to 1.5mm long, forming a coarse disoriented decussate texture. The mineral is pleochroic from pale green (*g*) to colourless or very pale yellow (*h*), and the basal sections, which may show parts of a pseudo-hexagonal outlines, give an almost uniaxial figure. This zone passes into:
- e) a zone also of biotite, but with a deep ink-blue anomalous interference colour. Here the mineral is colourless and non-pleochroic, but the habit is similar, and sometimes normal and anomalous biotite are optically continuous, suggesting that the latter is an alteration product. Irregular, jagged magnetite grains, serpentine and poorly crystalline dolomite are present, and this zone gradually gives way to:
- f) the inner zone of poorly crystalline dolomite, fine grained serpentine, abundant irregular magnetite and grains of pyrite up to 5mm across. A narrow (400 μ), sinuous late stage veinlet of fine grained dolomite cuts across zones (d), (e) and (f), cutting across patches of opaques and weaving its way between the phlogopite veins. Fine grained magnetite(?) has been deposited along its axis.

Assay - (SD13/207.0-206.0) Sn 0.34% (0.30% acid sol.), WO₃ 0.09%, S 0.5%, As 1.40%, Bi 60ppm, Cu 500ppm, Pb < 100ppm, Zn 200ppm, Ag 2ppm.

Probe - Forsterite, diopside, serpentine, clinocllore, ripidolite, dolomite, tremolite, biotite, pyrite.

UV light - No fluorescence.

Further work - Probe opaques.

209.0

A very strongly magnetic, thoroughly altered and crudely banded rock consisting of disseminated to almost massive magnetite, in a very patchy matrix of pale green to off-white serpentine.

Magnetite grains occur over a wide size range, from equidimensional, crudely rounded to irregular anhedral blebs up to 1.5mm across, to densely disseminated black dust particles only a few μ across. These locally have nucleated to granular aggregates similar to the larger grains. Thus there is a range not only of grain size but in density of packing.

The matrix is so thoroughly altered that few clues remain to the original mineralogy and texture. It consists of irregular, ill defined patches of almost cryptocrystalline to somewhat coarser (100 μ), low birefringence granular serpentine and grey to dull-brown, translucent cryptocrystalline mass of fibrous to acicular material. The less altered needles and ragged fibrous laths are up to several hundred μ long, and are in places transparent, with birefringence up to pale orange yellows, length slow orientation and straight extinction. The material is probably thoroughly altered biotite or tremolite. Originally the rock may have been a forsterite-diopside? - phlogopite or tremolite - magnetite skarn.

Assay - (SD13/209.0 - 210.0) : Sn 1.21% (0.80% acid sol.), WO₃ 0.06%, S 0.4%, As 0.10%, Bi 100ppm, Cu 300 ppm, Pb < 100ppm, Zn 200ppm, Ag 2ppm.

Probe - nil.

UV light - No fluorescence.

Further work - Probe. Only reconnaissance necessary.

218.5

A moderately well banded, strongly magnetic dense black rock consisting mainly of coarse, massive to disseminated magnetite (62%) and fine grained, disordered, colourless serpentine (38%) which is off-white in hand-specimen. The bulk of the magnetite occurs as irregular, angular anhedral, (200 - 500 μ diameter) when isolated, but usually clustered into interlocking aggregates, grading to massive. A small amount of finer grained material, grading down to dust of few μ and to finely fibrous grains, is sparingly disseminated throughout the serpentine. The coarse banding is defined by crude variations, over the scale of a centimetre or so, in the abundance of magnetite, from disseminated to massive.

The serpentine is mainly a disordered mat or crude meshwork of microcrystalline, low birefringence (greys) crystallites 10 - 100 μ . Where disseminated within massive magnetite, the serpentine patches pseudomorph crudely subhedral forsterite, and traces of high birefringence material, probably the original olivine, are preserved very occasionally enclosed in or in the interstices of magnetite grains.

Irregular wisps of cryptocrystalline, almost opaque material occur sporadically throughout the serpentine, and are especially abundant adjacent to magnetite grains. They are cloudy but translucent under strong illumination and dull tawny brown in colour. They may consist of secondary, impure crystalline magnesite. Among and intergrown with the magnesite are small grains of an opaque mineral which has a higher reflectivity than the surrounding magnetite.

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RENISON LIMITED
DIAMOND DRILL HOLE PLOT

PETROLOGICAL DESCRIPTION BY J. EVERARD
TASMANIAN MINES DEPARTMENT

218.5 cont'd.

SCALE:

HOLE No.: SD13

Sheet
No. 5

Originally, this rock was probably a forsterite - (?diopside) - magnetite skarn which has subsequently been altered to a serpentine-magnetite assemblage.

Assay - (SD13/218.0-219.0): Sn 0.54% (0.12% acid soluble), WO_3 0.03%, S 0.7%, As 0.10%, Bi 50ppm, Cu 400ppm, Pb <100ppm, Zn 100ppm, Ag 4ppm.

Probe - Serpentine present.

UV light - No fluorescence.

Further work - a) Probe cryptocrystalline tawny substance = best seen in 13/2090)

b) Probe unknown opaque (could be well polished magnetite).

226.0

This rock is a weakly banded, non-magnetic ophicalcite-predazzite marble, consisting mainly of calcite and brucite, with irregular elongate patches of serpentine and very-fine grained pyrite as disseminations and granular pods. The original sediment was a slightly siliceous dolomite which has been subjected to high grade thermal metamorphism, but without significant metasomatism, to produce a calcite-periclase-minor forsterite assemblage. Low grade alteration has hydrated this to a brucite-serpentine marble.

Brucite occurs as wispy, curly aggregates of very fine colourless flakes or scales, barely discernible under the microscope, which pseudomorph the original periclase grains, the original globular to crudely square or octagonal outlines of which are idiomorphic against the calcite. Distinctive optical characteristics of the brucite are its length-fast character, and moderate birefringence to low second order.

The calcite is generally fairly coarse (50 - 500 μ) and xenomorphic. Slight to moderate bending of the rhombic cleavage and possibly some fracturing indicates some syn- or post-metamorphic deformation. Brucite and calcite are about equally abundant, suggesting the original rock was close to dolomite in bulk composition. Patches of rather coarse but disordered, pale green (pale yellow in thin section) serpentine are up to several centimetres long and tend to be elongated so that, together with the pyrite, they define a crude banding. Smaller (9mm) patches of serpentine in the thin section sometimes show a crude octagonal to oblong outline, presumably pseudomorphing after forsterite, but are more commonly quite irregular.

Fine grained, colloidal opaque black pyrite is sprinkled or forms fuzzy rounded globules (mostly <100 μ) throughout the rock, but is most abundant in broad, elongate pods, typically 1.5cm x 5mm. In these, colloidal black pyrite is almost massive, or almost obscures to largely obscures associated calcite or brucite grains. Minor filaments of chlorite, 50-100 μ long, are associated with these veins. The mineral has straight extinction, length fast orientation and a birefringence up to reds of upper first order. The pyrite was probably deposited from low temperature fluids of magmatic origin that permeated the rock in the latter stages of metamorphism.

Assay - (SD9/225.0-227.0) Sn <0.10%, WO_3 0.01%, S 0.3%, As <0.10%, Bi 70 ppm, Cu 100ppm, Pb <100ppm, Zn 100ppm, Ag 5ppm.

Probe - Brucite, calcite, serpentine.

UV light - No fluorescence.

Further work - a) Probe chlorite.

b) Check identification of pyrite.

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APPENDIX 4

RESULTS OF METALLURGICAL TESTWORK

EPB		IN SIZE FRACTIONS									OVERALL	
Size Fraction	Product	% WT	Sn		Sol. Sn		Fe		WO ₃		Sn	
			%	% distn.	%	% distn.	%	% distn.	%	% distn.	%	% distn.
Total +300	assay head		0.76		0.86		16.3		.175			
	assay head	100.00	0.33	100.00	0.38	100.00	11.1	100.00			0.33	0.09
-300/+106	magnetics	36.67	2.08	98.36	2.10	98.38	36.8	80.08	0.44	92.72	2.08	48.78
	non-mags	63.33	0.02	1.64	0.02	1.62	5.3	19.92	0.02	7.28	0.02	0.81
	assay head		0.76		0.88		16.8					
	calc head		0.77	100.00	0.78	100.00	16.85	100.00	0.17	100.00		
-106/+38	magnetics	28.17	2.37	97.89	2.27	95.70	4.89	79.32	0.50	90.74	2.37	21.09
	non-mags	71.83	0.02	2.11	0.04	4.30	5.0	20.68	0.02	9.26	0.02	0.46
	assay head		0.69		0.79		16.0					
	calc head		0.68	100.00	0.66	100.00	17.4	100.00	0.15	100.00		
-38	assay head		0.83		0.89		15.7					
- 38/+6	magnetics	27.17	2.19	82.78	2.09	82.10	47.7	78.76			2.19	11.56
	non-mags	72.83	0.17	17.22	0.17	17.90	4.8	21.24			0.17	17.22
	assay head								0.19			
	calc head		0.71	100.00	0.69	100.00	16.46	100.00				
- 6	calc head		0.98	100.00	0.38	100.00	16.1	100.00			0.98	14.51

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EPC		IN SIZE FRACTIONS								OVERALL		
Size Fraction	Product	% WT	Sn		Sol. Sn		Fe		WO ₃		Sn	
			%	% distn.	%	% distn.	%	% distn.	%	% distn.	%	% distn.
Total	assay head	100.00	1.45	100.00	0.56	100.00	26.25	100.00	0.08		1.45	100.00
-300/+106	magnetics	71.02	1.32	82.63	0.45	80.33	40.3	98.02			1.32	27.23
	non-mags	28.98	0.68	17.37	0.27	19.67	2.0	1.98			0.68	5.72
	assay head		1.17		0.42		29.1		0.07			
	calc head		1.13	100.00	0.40	100.00	29.2	100.00				
-106/+38	magnetics	58.49	1.50	53.87	0.49	58.49	48.3	97.42			1.50	15.51
	non-mags	41.51	1.81	46.13	0.49	41.51	1.8	2.58			1.81	13.29
	assay head		1.62		0.49		28.5		0.08			
	calc head		1.63	100.00	0.49	100.00	29.0	100.00				
- 38	assay head		1.67	100.00	0.78	100.00	21.0	100.00	0.10	100.00	1.67	38.25

EPD		IN SIZE FRACTIONS									OVERALL	
Size Fraction	Product	% WT	Sn		Sol. Sn		Fe		WO ₃		Sn	
			%	% distn.	%	% distn.	%	% distn.	%	% distn.	%	% distn.
Total	assay head	100.00	0.99	100.00			20.5	100.00	0.05	100.00	0.99	100.00
-300/+106	magnetics	54.80	0.94	53.02	0.98	51.93	26.8	70.96			0.94	22.49
	non-mags	45.20	1.01	46.98	1.10	48.07	13.3	29.04			1.01	19.93
	assay head		0.97		1.14		20.7		0.05			
	calc head		0.97	100.00	1.03	100.00	20.7	100.00				
-106/+38	magnetics	45.98	0.88	43.32	0.90	41.95	30.5	66.80			0.88	9.35
	non-mags	54.02	0.98	56.68	1.06	58.05	12.9	33.20			0.98	12.23
	assay head		0.93		1.10		20.5		0.05			
	calc head		0.93	100.00	0.99	100.00	21.0	100.00				
- 38	assay head		1.07		1.22		20.2		0.05		1.07	36.00
- 38/+26	magnetics	59.20	0.97	50.49	1.06	51.82	42.8	76.01			0.97	0.66
	non-mags	40.80	1.38	49.51	1.43	48.18	19.6	23.99			1.38	0.64
	calc head		1.14	100.00	1.21	100.00	33.3	100.00				

EPD		IN SIZE FRACTIONS									OVERALL	
Size Fraction	Product	% WT	Sn		Sol. Sn		Fe		WO ₃		Sn	
			%	% distn.	%	% distn.	%	% distn.	%	% distn.	%	% distn.
-26 +20	magnetics	51.32	1.02	44.34	1.11	43.18	40.8	71.55			1.02	1.73
	non-mags	48.68	1.35	55.66	1.54	56.82	17.1	28.45			1.35	2.17
	assay head		1.18	100.00	1.32	100.00	29.3	100.00				
	calc head											
-20 +14	magnetics	43.55	0.83	40.01	0.96	40.24	32.5	66.91			0.83	1.27
	non-mags	56.45	0.96	59.99	1.10	59.76	12.4	33.09			0.96	1.90
	assay head		0.90	100.00	1.04	100.00	21.1	100.00				
	calc head											
- 14 +6	magnetics	36.48	0.84	35.31	0.92	34.47	34.6	62.64			0.84	2.57
	non-mags	63.62	0.88	64.69	1.00	65.53	11.8	37.36			0.88	4.71
	assay head		0.87	100.00	0.97	100.00	20.1	100.00				
	calc head											
- 6	calc head		1.18	100.00	1.13	100.00	17.5	100.00			1.18	20.35

EPE		IN SIZE FRACTIONS									OVERALL	
Size Fraction	Product	% WT	Sn		Sol. Sn		Fe		WO ₃		Sn	
			%	% distn.	%	% distn.	%	% distn.	%	% distn.	%	% distn.
Total +300	assay head		1.03		0.45		36.1		0.11			
	assay head	100.00	0.72	100.00	0.29	100.00	40.3	100.00	0.08	100.00	0.72	2.36
-300/+106	magnetics	74.23	1.02	88.55	0.36	83.16	52.0	97.27			1.02	33.99
	non-mags	25.77	0.38	11.45	0.21	16.84	4.2	2.73			0.38	4.40
	assay head		0.89		0.34		39.6		0.10			
	calc head		0.86	100.00	0.32	100.00	39.7	100.00				
-106/+38	magnetics	68.96	1.07	71.88	0.33	73.82	54.5	97.43			1.07	17.30
	non-mags	31.04	0.93	28.12	0.26	26.18	3.2	2.57			0.93	6.77
	assay head		1.04		0.33		38.9		0.10			
	calc head		1.03	100.00	0.31	100.00	38.6	100.00				
- 38	assay head		1.29		0.73		27.7		0.14		1.29	35.18
- 38/ +26	magnetics	83.19	0.95	45.29	0.22		62.0	98.65			0.95	0.71
	non-mags	16.81	5.68	54.71			4.2	1.35			5.68	0.85
	calc head		1.75	100.00			52.3	100.00				
- 26 +20	magnetics	91.61	0.88	53.15	0.23		61.1	99.23			0.88	2.16
	non-mags	8.39	8.47	46.85			5.2	0.77			8.47	1.90
	calc head		1.52	100.00			56.4	100.00				

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EPE		IN SIZE FRACTIONS									OVERALL	
Size Fraction	Product	% WT	Sn		Sol. Sn		Fe		WO ₃		Sn	
			%	% distn.	%	% distn.	%	% distn.	%	% distn.	%	% distn.
-20 +14	magnetics	69.36	0.81	47.58	0.38	76.79	55.9	97.46			0.81	1.36
	non-mags	30.64	2.02	52.42	0.26	23.21	3.3	2.54			2.02	1.49
	calc head		1.18	100.00	0.34	100.00	39.8	100.00				
-14 +9	magnetics	56.33	0.72	40.94	0.47	68.41	55.6	95.60			0.72	1.23
	non-mags	43.67	1.34	59.06	0.28	31.59	3.3	4.40			1.34	1.77
	calc head		0.99	100.00	0.39	100.00	32.8	100.00				
-9 +6	magnetics	63.12	0.74	51.98	0.58	75.62	55.2	96.92			0.74	1.34
	non-mags	36.88	1.17	48.02	0.32	24.38	3.0	3.08			1.17	1.23
	calc head		0.90	100.00	0.48	100.00	35.95	100.00				
- 6	calc head		1.37	100.00			16.9	100.00			1.37	21.14

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EPF		IN SIZE FRACTIONS									OVERALL	
Size Fraction	Product	% WT	Sn		Sol. Sn		Fe		WO ₃		Sn	
			%	% distn.	%	% distn.	%	% distn.	%	% distn.	%	% distn.
Total	assay head		0.91		0.68		46.3		0.01			
+300	assay head	100.00	1.05	100.00	0.72	100.00	45.1	100.00	0.01		1.05	5.88
-300/+106	magnetics	80.14	0.84	75.50	0.58	75.49	61.5	98.77			0.84	33.91
	non-mags	19.86	1.10	24.50	0.76	24.51	3.1	1.23			1.10	12.63
	assay head		0.88		0.66		49.5		0.01			
	calc head		0.89	100.00	0.62	100.00	49.9	100.00				
-106/+38	magnetics	76.98	0.66	56.34	0.44	53.48	64.1	98.26			0.66	12.25
	non-mags	23.02	1.71	43.66	1.28	46.52	3.8	1.74			1.71	9.50
	assay head		0.90		0.63		50.0		0.01			
	calc head		0.90	100.00	0.63	100.00	50.2	100.00				
- 38	assay head		0.98	100.00	0.80	100.00	33.6	100.00	0.02	100.00	0.98	20.83

EPG		IN SIZE FRACTIONS									OVERALL	
Size Fraction	Product	% WT	Sn		Sol. Sn		Fe		WO ₃		Sn	
			%	% distn.	%	% distn.	%	% distn.	%	% distn.	%	% distn.
-425+300	magnetics	56.38	0.90	87.91	0.54	90.88	31.4	91.65			0.90	7.45
	non-mags	43.62	0.16	12.09	0.07	9.12	3.7	8.35			0.16	1.03
	calc head		0.58	100.00	0.34	100.00	19.3	100.00				
-300+212	magnetics	51.06	0.91	81.89	0.54	81.25	35.6	90.50			0.91	6.25
	non-mags	48.94	0.21	18.11	0.13	18.75	3.9	9.50			0.21	1.38
	calc head		0.57	100.00	0.34	100.00	20.1	100.00				
-212+150	magnetics	48.47	0.90	74.48	0.52	76.53	38.1	89.73			0.90	4.29
	non-mags	51.53	0.29	25.52	0.15	23.47	4.1	10.27			0.29	1.47
	calc head		0.59	100.00	0.33	100.00	20.6	100.00				
-150+106	magnetics	44.40	0.88	66.75	0.50	66.63	42.4	89.43			0.88	3.39
	non-mags	55.60	0.35	33.25	0.20	33.37	4.0	10.57			0.35	1.69
	calc head		0.58	100.00	0.33	100.00	21.0	100.00				

EPG		IN SIZE FRACTIONS									OVERALL	
Size Fraction	Product	% WT	Sn		Sol. Sn		Fe		WO ₃		Sn	
			%	% distn.	%	% distn.	%	% distn.	%	% distn.	%	% distn.
-106+75	magnetics	40.77	0.82	55.10	0.45	59.60	46.0	89.03			0.82	2.97
	non-mags	59.23	0.46	44.90	0.21	40.40	3.9	10.97			0.46	2.43
	calc head		0.61	100.00	21.1	100.00						
-75 +53	magnetics	35.24	0.79	42.15	0.42	45.84	50.3	87.53			0.79	1.58
	non-mags	64.76	0.59	57.85	0.27	54.16	3.9	12.47			0.59	2.18
	calc head		0.66	100.00	0.32	100.00	20.2	100.00				
-53 +38	magnetics	32.90	0.82	37.50	0.42	39.16	50.3	87.57			0.82	0.65
	non-mags	67.10	0.67	62.50	0.32	60.84	3.5	12.43			0.67	1.08
	calc head		0.72	100.00	0.35	100.00	18.9	100.00				
- 38	assay head		0.87		0.53		13.2				0.87	19.52
-38 +26	magnetics	58.70	0.57	24.33	0.24	41.54	60.3	89.83			0.57	0.18
	non-mags	41.30	2.52	75.67	0.48	58.46	9.7	10.17			2.52	0.56
	Calc head		1.37	100.00	0.34	100.00	39.4	100.00				

EPG		IN SIZE FRACTIONS									OVERALL	
Size fraction	Product	% WT	Sn		Sol. Sn		Fe		WO ₃		Sn	
			%	% distn.	%	% distn.	%	% distn.	%	% distn.	%	% distn.
-26 +20	magnetics	62.76	0.78	36.77	0.38	45.09	57.6	91.77			0.78	0.74
	non-mags	37.24	2.26	63.23	0.78	54.91	8.7	8.23			2.26	1.28
	calc head		1.33	100.00	0.53	100.00	39.4	100.00				
-20 +14												
-20 +14	magnetics	28.95	0.85	28.47	0.46	31.37	50.8	85.54			0.85	0.53
	non-mags	71.05	0.87	71.53	0.41	68.63	3.5	14.46			0.87	1.32
	calc head		0.86	100.00	0.42	100.00	17.2	100.00				
-14 +9	magnetics	22.22	0.79	21.38	0.40	22.66	51.5	83.06			0.79	0.46
	non-mags	77.78	0.83	78.62	0.39	77.34	3.0	16.94			0.83	1.68
	calc head		0.82	100.00	0.39	100.00	13.8	100.00				
-9 +6	magnetics	20.34	0.68	16.96	0.35	15.70	55.1	81.94			0.68	0.40
	non-mags	79.66	0.85	83.04	0.48	84.30	3.1	18.06			0.85	1.94
	calc head		0.81	100.00	0.45	100.00	13.7	100.00				
-6	calc head		0.82		0.72		31.3				0.82	10.43

DU 140

APPENDIX 5

MEMORANDUM : DIAMOND DRILLING PROGRAM -
ST.DIZIER AREA

TO: CHIEF GEOLOGIST
FROM: EXPLORATION GEOLOGIST
DATE: 18th AUGUST, 1981
SUBJECT: DIAMOND DRILLING PROPOSAL - ST DIZIER AREA

Diamond drilling at St Dizier has outlined a deposit with a potential size of 2-3 million tonnes, in metallurgically complex skarn mineralization, averaging 0.5 to 0.7% Sn.

At present it appears that the mineralization occurs in two or more discrete bodies, however, continuity between ore intersections has not been established because they are generally too widely spaced. Infill drilling is therefore required before a meaningful evaluation of the deposit's economic potential can be made.

Any new drilling within the three existing leases should follow an overall strategy for closing up the existing drillhole pattern so that the mineralization will eventually be drilled out in a logical manner. An appropriate spacing at this stage of exploration is 60 metres. As the attached longitudinal section shows (plan 1), this should fit in with the existing drill pattern quite well. A total of sixteen drillholes averaging 250 metres deep each (4,000 metres in all) is suggested by this approach.

1,000 to 1,500 metres of diamond drilling is planned in the current program. Of this, no more than 750 metres should be carried out within the existing leases if a fourth lease is granted by the State Mines Department. As the land tenure situation is still unresolved, only two drillholes are proposed at this time, DDH's SD16 and SD17. Details are as follows:

SD16:

- Aims - to intersect near-hangingwall mineralization within the skarn half-way between the two intersections in SD10 (3m horizontal thickness at 0.44% Sn) and SD13 (11m horizontal thickness at 0.65% Sn).
- to intersect near-footwall mineralization between SD9 (3m horizontal thickness at 0.82% Sn) and SD13 (>5m h.t. at 0.21% Sn).
 - to intersect the granite.

Collar Co-ordinates - 5 367 719 N / 345 160 E

Orientation - 180° azimuth, -57° inclination

Anticipated depth - 350 metres

130

SD17:

- Aims - to intersect near hangingwall mineralization within the skarn between SD13 (11m h.t. at 0.65% Sn) and SD15 (26m h.t. at 0.47% Sn), downdip from SD13 but at about the same R.L. as the SD15 intersection.
- to intersect the granite on the northern side of an interpreted trough-shaped contact.

Collar co-ordinates - 5 367 468 N / 345 313 E

Orientation - 347° azimuth, -58° inclination

Anticipated depth - 315 metres

In both of these holes, as well as any further infill drilling, every attempt must be made to maximize core recovery and to keep hole deviation to an absolute minimum. In both cases the target is anticipated at depths of 220 metres or more. A deviation of 5° at 220 metres would result in an intersection 19 metres off target.



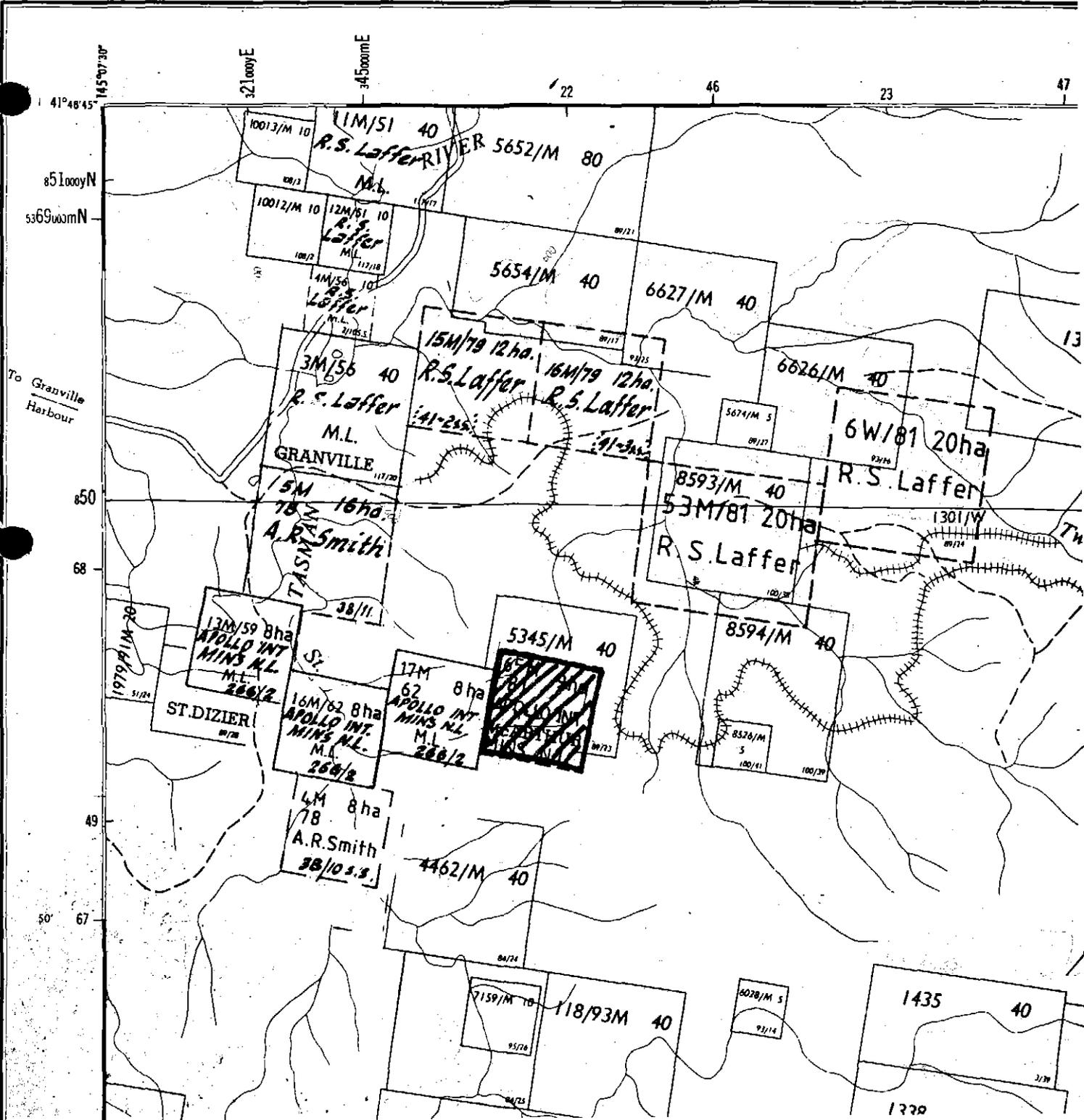
P.A. ROBERTS

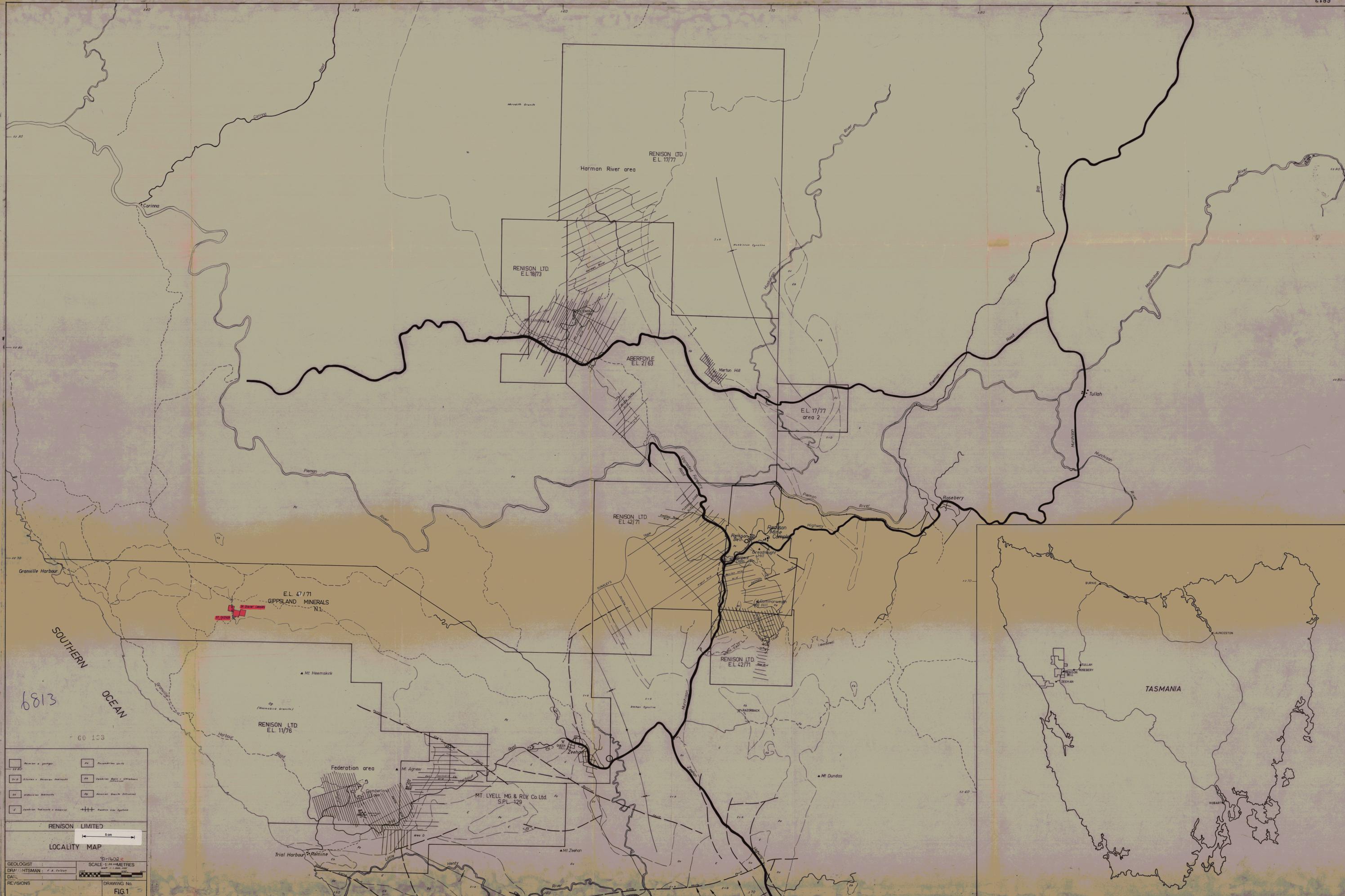
Extra Lease payed out Oct 1981
after reversal of decision of July 1981

J. 29-10-81.

5 cm

AUSTRALIA 1:15,840





6813
SOUTHERN OCEAN
60 103

RENISON LIMITED
LOCALITY MAP
SCALE: 1:50,000 METRES
GEOLOGIST: [Name]
DRAWN BY: [Name]
DATE: [Date]
REVISIONS: [List]
DRAWING No. FIG. 1

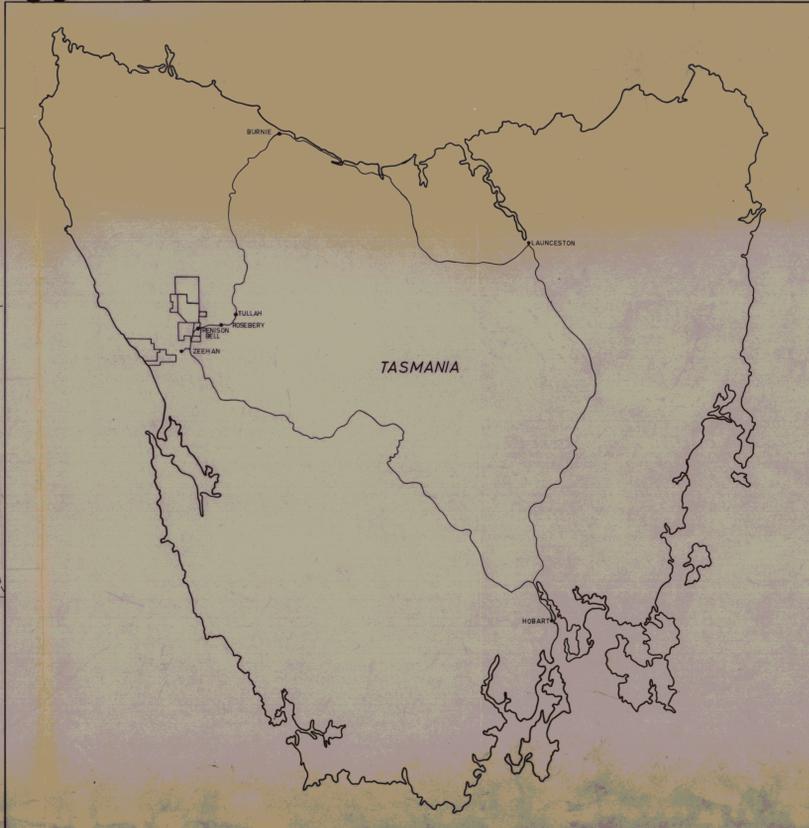
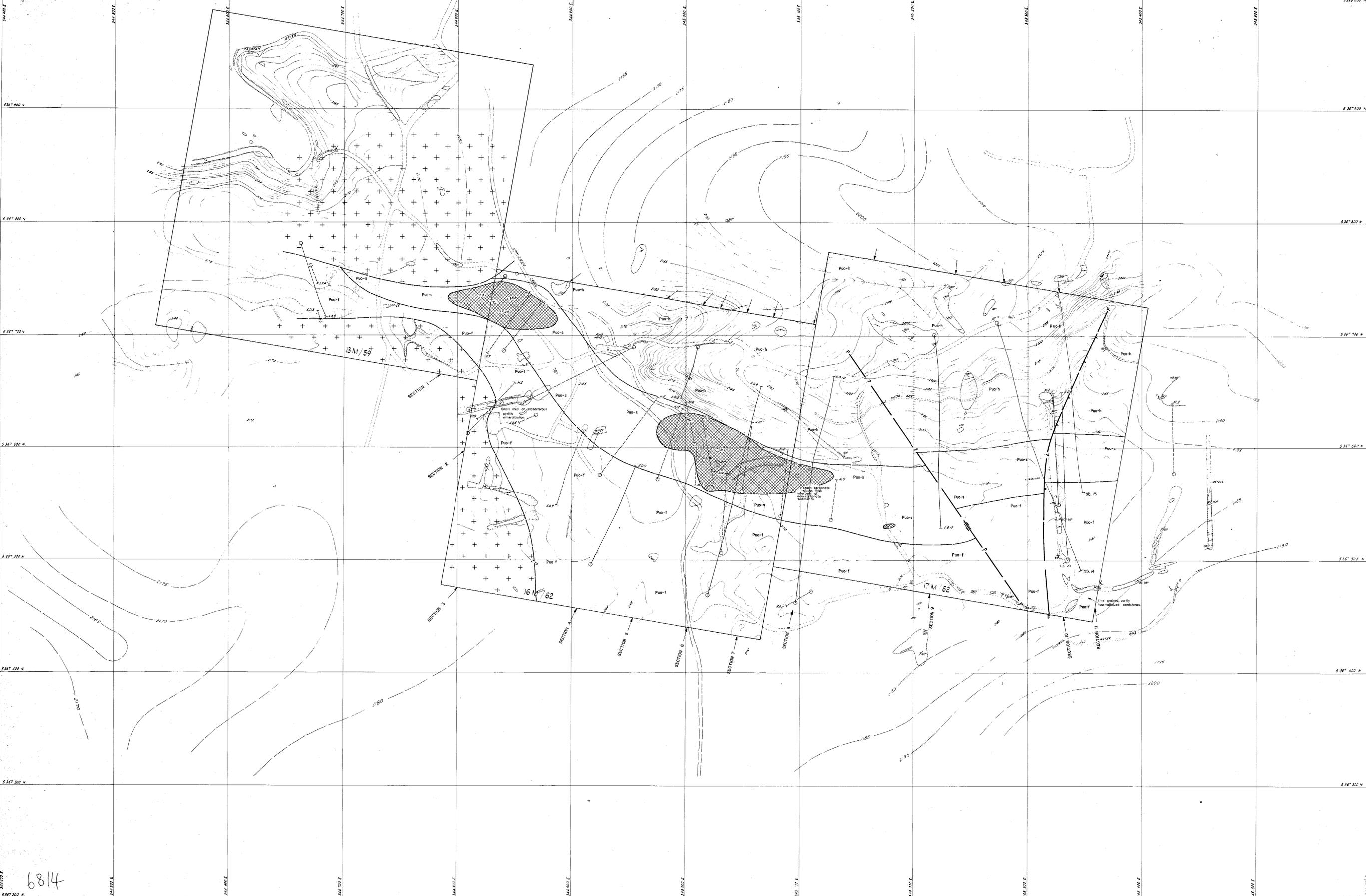


FIGURE 1



6814

GEOLOGY		METEORIC ROCKS		SYMBOLS		DIAMOND DRILL HOLES	
Puo-h	Hanging Well Quartzites	+ +	Fine to medium grained granitic orthogneiss (Hemlock Granite)	\backslash 30°	Bedding, with dip.	\bigcirc —	Located or surveyed by Reison.
\backslash 30°	Overturned bedding, with dip.	\bigcirc - - -	Not located by Reison.	—	Geological contact - position approximate.	$\text{F} \text{---} \text{F}$	Fault, position approximate, showing dip orientation.
\backslash	Vertical bedding.	$\text{F} \text{---} \text{F}$	Fault, position inferred.	\bigcirc	Mapped outcrop location.		
\backslash 30°	Vein or joint, with dip.						
\backslash	Vertical vein or joint.						
\rightarrow	Direction of younging from cross-bedding.						

REISON LIMITED

ST. DIZIER AREA

INTERPRETATIVE GEOLOGY MAP

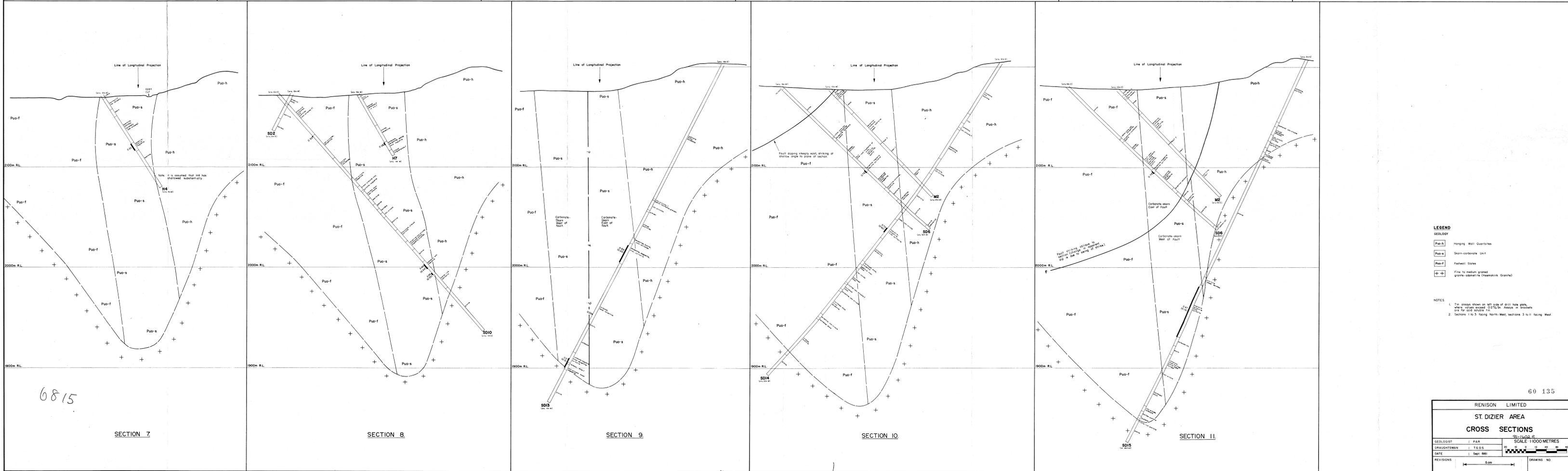
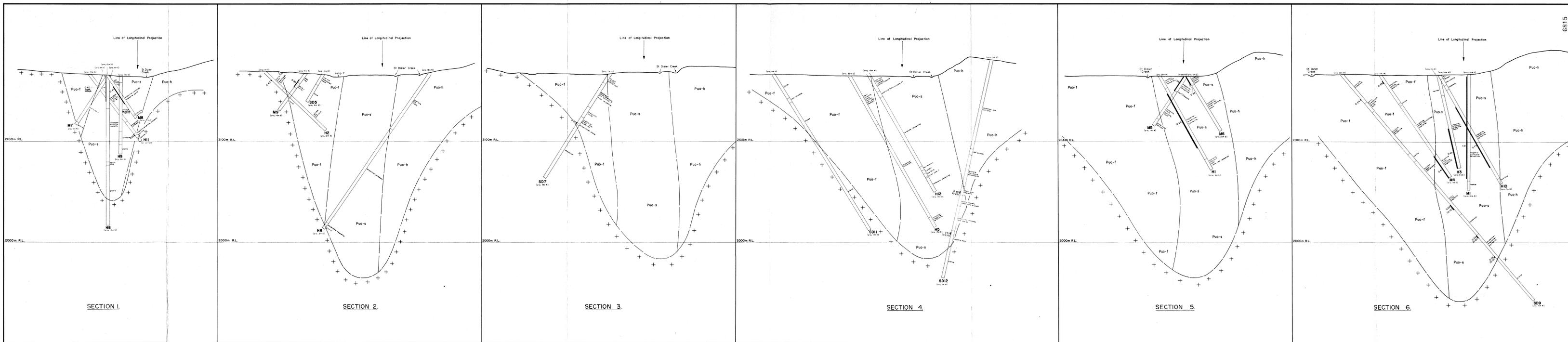
GEOLOGIST : P.A.R. SCALE 1:1000 METRES

DRAUGHTSMAN : T.G.D.S.

DATE : Sept. 1981

REVISIONS

DRAWING No.



LEGEND

SECTION

Pup-h Hanging Wall Quartzites

Pup-s Skarn-carbonate Unit

Pup-f Footwall Slates

++ Fine to medium grained granite-schistite (Heaslake Granite)

NOTES

1. The boreholes shown on left side of drill hole logs, where a '0' is shown, are 0% in. Anhydrous in sections.

2. Sections 1 to 5 facing North-West, sections 3 to 11 facing West.

RENISON LIMITED

ST. DIZIER AREA

CROSS SECTIONS

SCALE 1:1000 METRES

GEOLOGIST : P.A.R.

DRAUGHTSMAN : T.G.D.S.

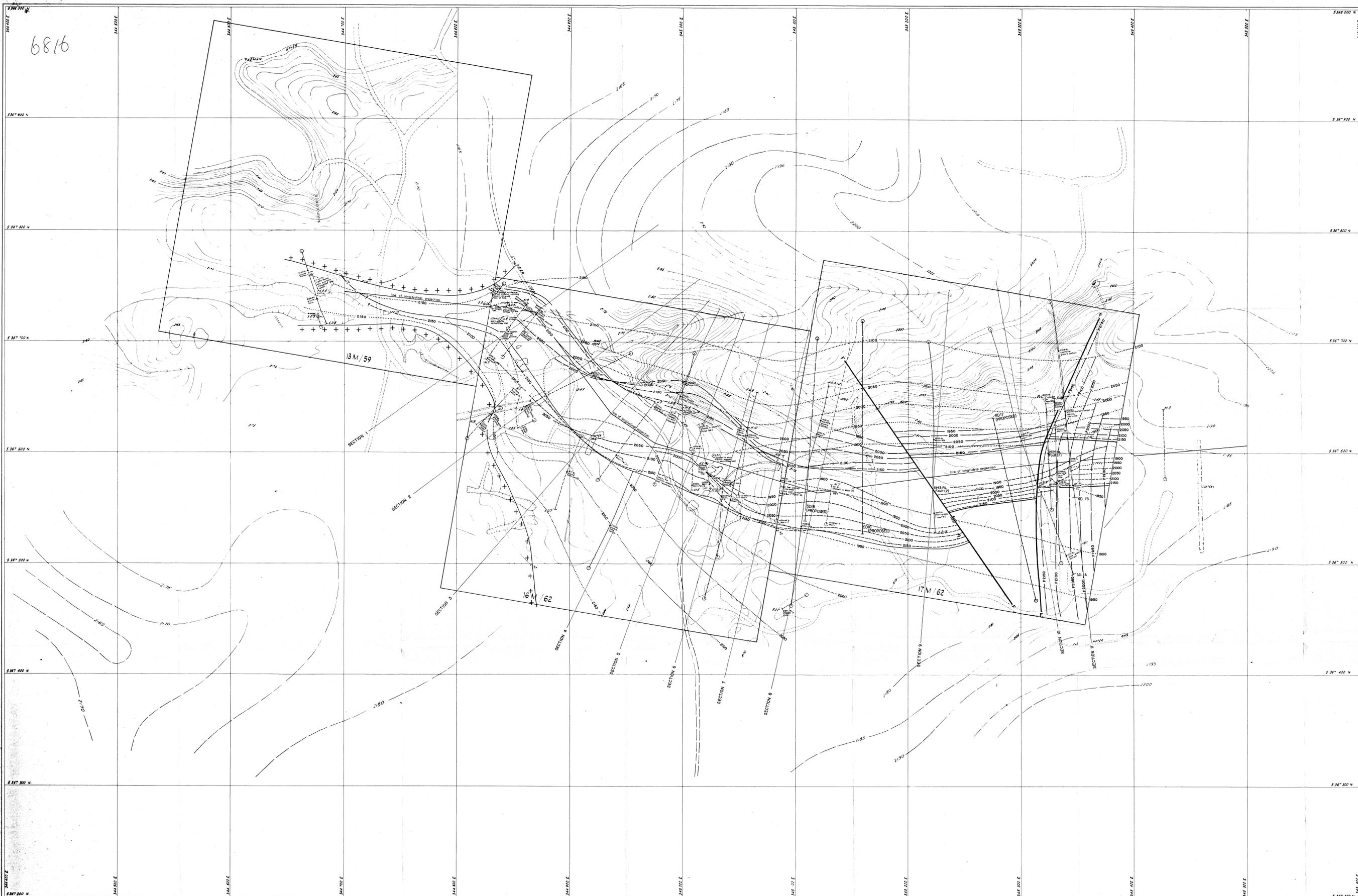
DATE : Sept. 1961

REVISIONS : 5cm

DRAWING NO. 60 135

6816

6816

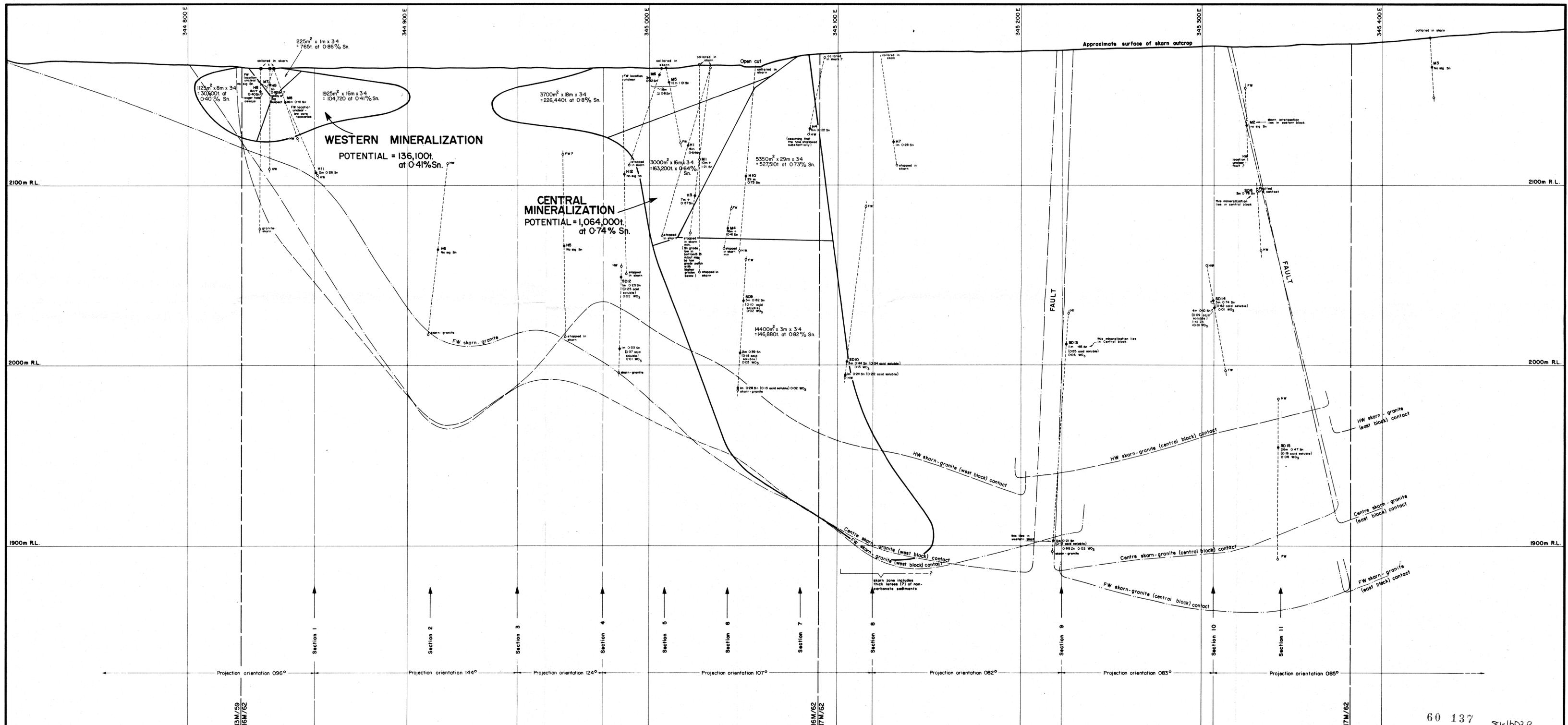


CONTOURS
 - - - - - Top of Granite
 - - - - - Schist FW
 - - - - - Schist HW
 - - - - - Fault
 Contour Interval 50m.

LEGEND
GEOLOGY
 - - - - - Granite contact
 - - - - - Schist contact
 - - - - - Fault
 - - - - - Interpreted

DIAMOND DRILL-HOLES
 ○ Located or surveyed by Renison
 ○ - - - - - Not located by Renison

RENISON LIMITED
ST. DIZIER AREA
STRUCTURAL CONTOUR MAP
 GEOLOGIST : PAR
 DRAUGHTSMAN : T.G.D.S.
 DATE : Sept. 1961
 REVISIONS :
 SCALE 1:1000 METRES
 DRAWING No. 60 136



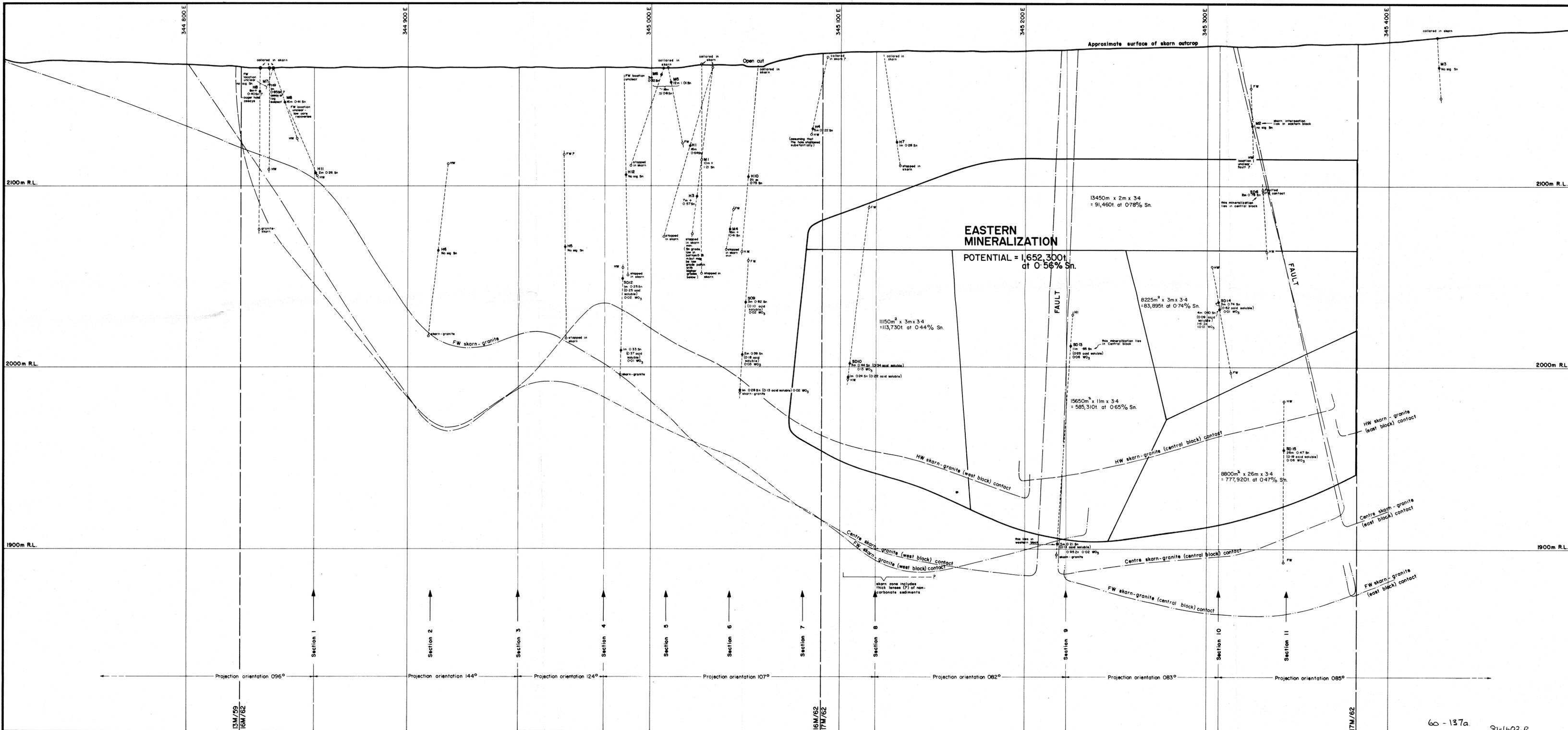
LEGEND

- Diamond Drill Hole
- Centre of skarn intersection or, where mineralized centre of mineralized intersection

NOTE: Projected approximately normal to strike along cross section reference line; vertical dashed lines indicate change in projection orientation; zero R.L. = S.L. - 2000m

RENISON LIMITED	
ST. DIZIER SKARN ZONE	
LONGITUDINAL PROJECTION - LOOKING NORTH	
ORE POTENTIAL -	
NEAR FOOTWALL TO CENTRE SKARN MINERALIZATION	
GEOLOGIST : PAR	SCALE 1:1000 METRES
DRAUGHTSMAN : T.G.D.S.	
DATE : SEPT 1981	DRAWING NO.
REVISIONS :	5 cm

60 137 81-1602/2



EASTERN MINERALIZATION
 POTENTIAL = 1,652,300t
 at 0.56% Sn.

13450m x 2m x 34
 = 91,460t at 0.78% Sn.

8225m² x 3m x 3.4
 = 83,995t at 0.74% Sn.

11150m² x 3m x 3.4
 = 113,730t at 0.44% Sn.

15650m² x 11m x 3.4
 = 585,310t at 0.65% Sn.

8800m² x 26m x 3.4
 = 777,920t at 0.47% Sn.

LEGEND

- Diamond Drill Hole
- Centre of skarn intersection or, where mineralized centre of mineralized intersection

NOTE: Projected approximately normal to strike along cross-section reference line; vertical dashed lines indicate change in projection orientation; zero R.L. = S.L. - 2000m

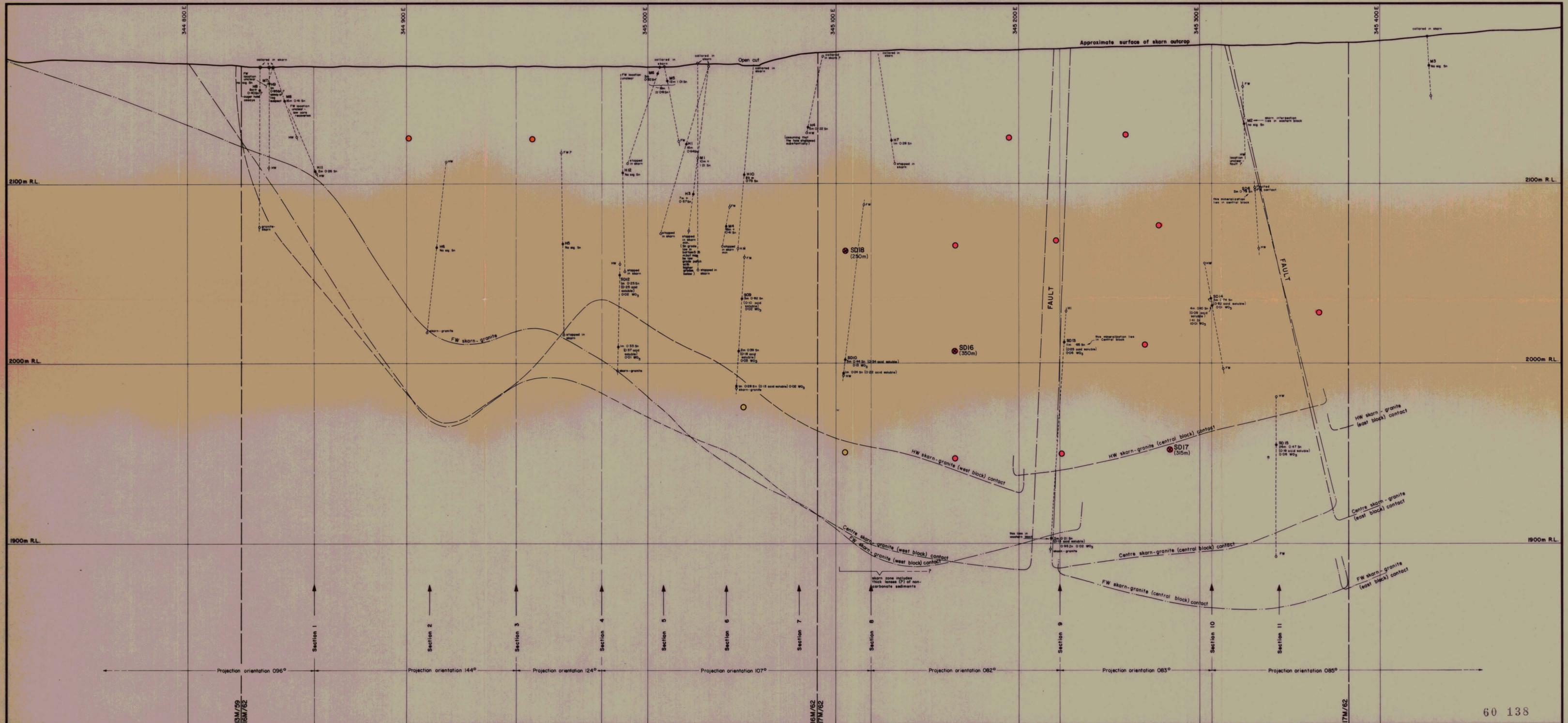
RENISON LIMITED

ST. DIZIER SKARN ZONE
 LONGITUDINAL PROJECTION - LOOKING NORTH
 ORE POTENTIAL-NEAR HANGINGWALL MINERALIZATION

GEOLOGIST : P.A.R.	SCALE 1:1000 METRES
DRAUGHTSMAN : T.G.D.S.	20 10 0 10 20 30 40
DATE : SEPT 1981	
REVISIONS :	DRAWING NO.

5 cm

6818



60 138

LEGEND

- Diamond Drill Hole
 - Proposed drillhole (future program), 60m drill spacing
 - ⊗ Proposed drillhole (current program), total anticipated depths in brackets
 - Centre of skarn intersection or, where mineralized centre of mineralized intersection
- NOTE:** Proposed drillholes colour coded on the basis of target type:
 (1) red = near hangingwall mineralization
 (2) orange = centre skarn mineralization
 (3) yellow = near footwall mineralization
- NOTE:** Projected approximately normal to strike along cross-section reference line, vertical dashed lines indicate change in projection orientation, zero RL = S.L. - 2000m

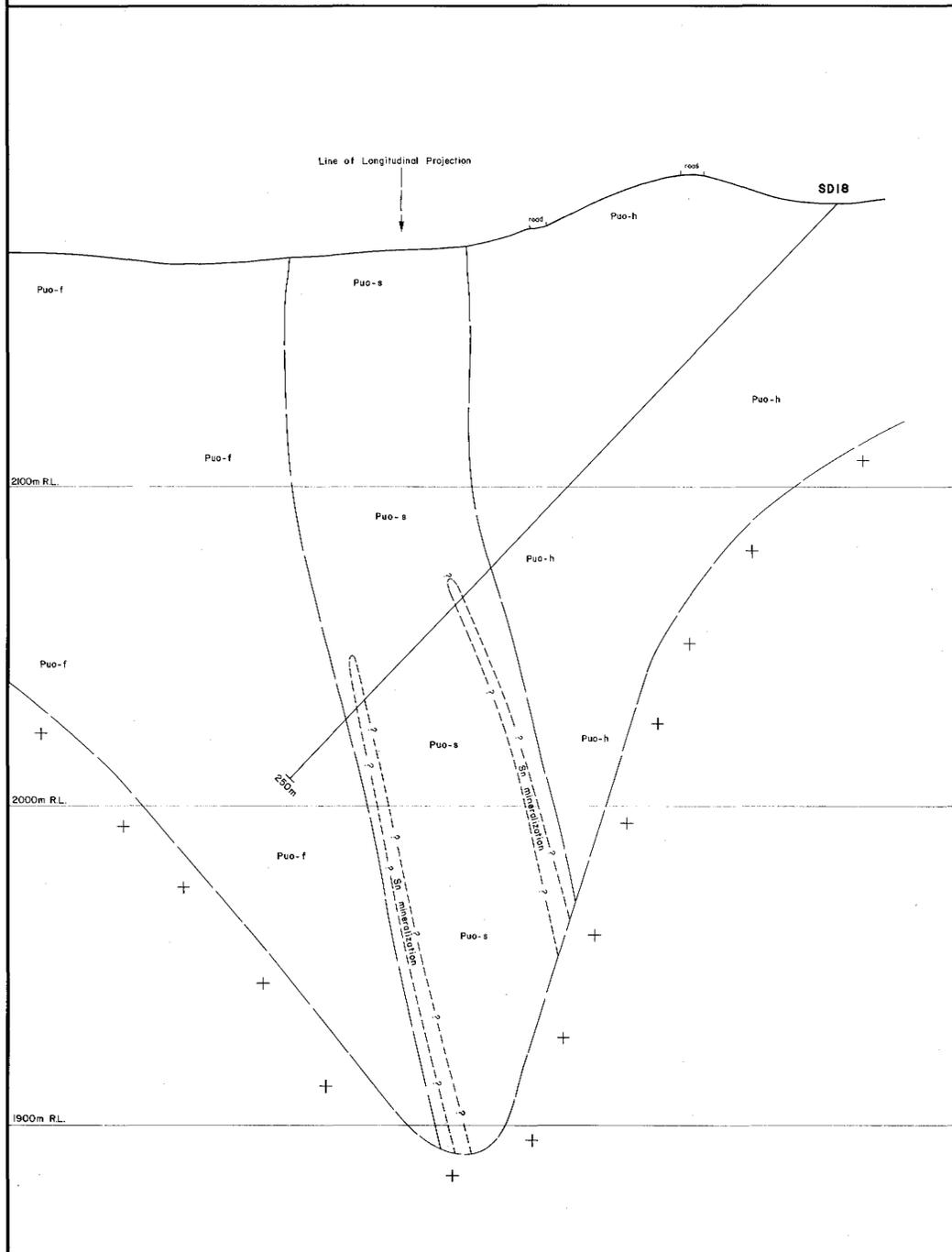
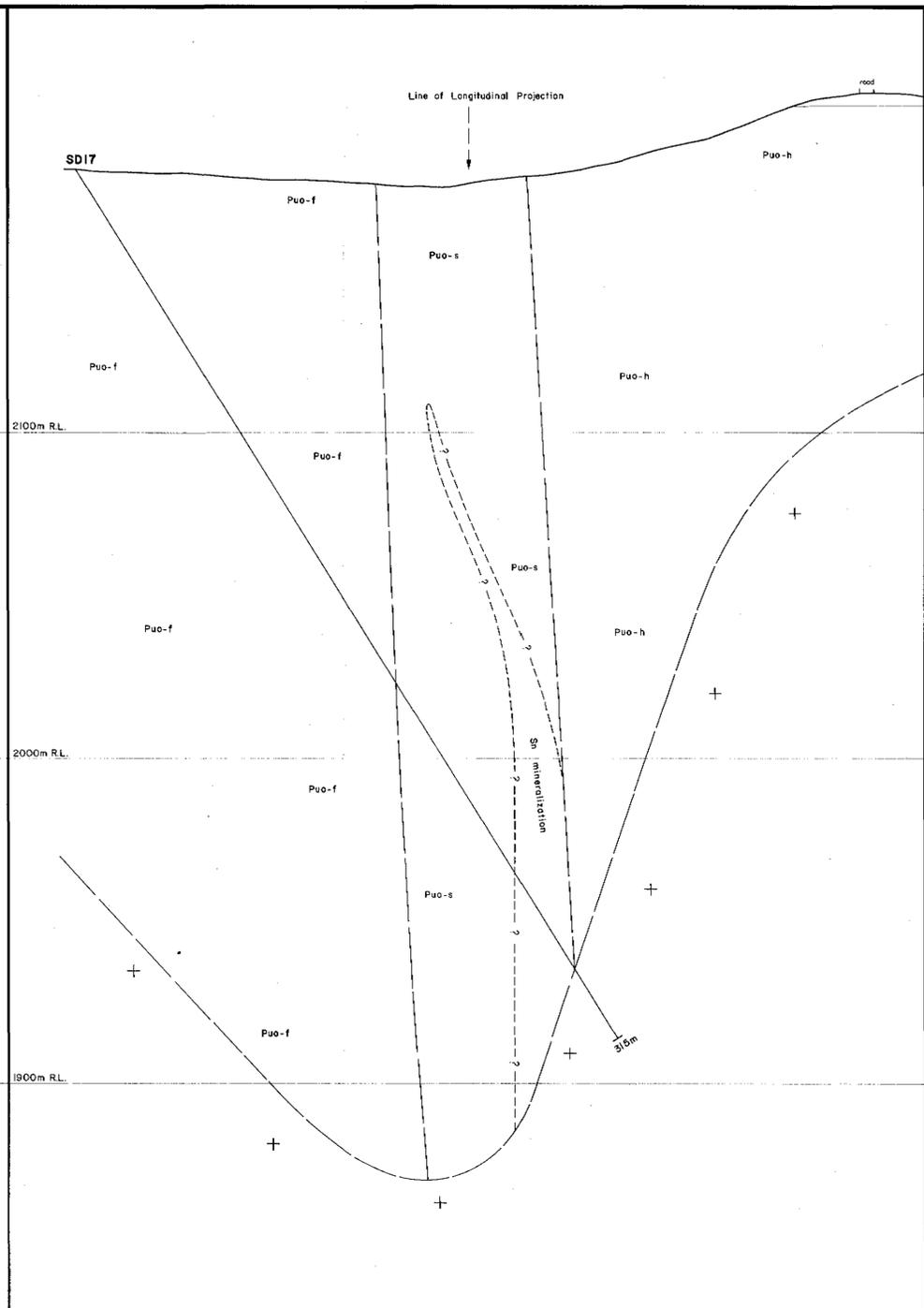
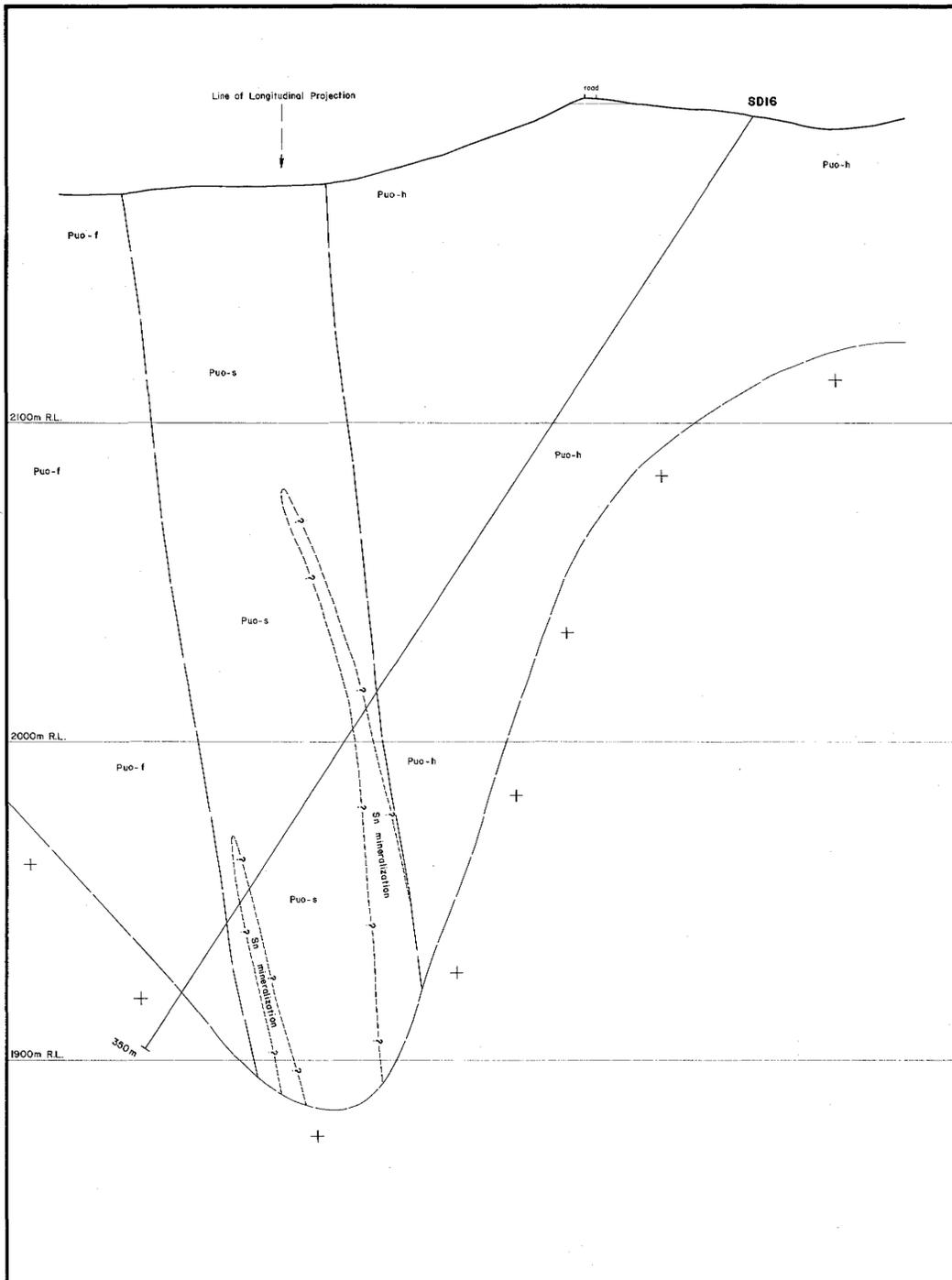
RENISON LIMITED

**ST. DIZIER SKARN ZONE
LONGITUDINAL PROJECTION - LOOKING NORTH
PROPOSED DRILL PATTERN**

81-1602R

GEOLOGIST : P.A.R.	SCALE 1:1000 METRES
DRAUGHTSMAN : T.G.D.S.	
DATE : SEPT. 1981	
REVISIONS	DRAWING NO.

5 cm



LEGEND

GEOLOGY

Puo-h	Hanging Wall Quartzites
Puo-s	Skarn-carbonate Unit
Puo-f	Footwall Slates
++	Fine to medium grained granite-schist (Heemskirk Granite)

60 139

RENISON LIMITED	
ST. DIZIER AREA	
PROPOSED DIAMOND DRILL HOLE SECTIONS	
81-1602 D	
GEOLOGIST : PR	SCALE: HICOMETRES
DRAUGHTSMAN : T.G.D.S.	0 10 20 30 40
DATE : Sept 1981	5 cm
REVISIONS	DRAWING NO