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PROGRESS REPORT

EXPLORATION LICENCE 1/63

FOR THE PERIOD

AUGUST 12, 1980 - JANUARY 13, 1981

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TRANSPARENCIES OF ALL PLANS.
ARE AVAILABLE.

1. SUMMARY

Four new grid lines at 500m spacing were investigated in the Magnet Range area where anomalous geochemistry was encountered in some parts. Preliminary attempts were made to correlate this area with the Mine area.

Many rocks from various areas in the licence were examined in thin section to help understand regional correlations.

Compilation of geological data onto common scale base sheets was almost completed. Compilation of geophysical and geochemical data will continue. A topographic base plan was obtained from new aerial photography.

Preparations to cover the entire licence with an airborne E.M. survey were completed.

2. INTRODUCTION

Exploration licence E.L. 1/63 is situated in the north-west of Tasmania, 98 kilometres from Burnie at 41°28' S, 145°24' E.

This exploration licence surrounding the Cleveland Tin Limited Mining Lease (M.L. 27M/71 formerly M.L. 43/66) was granted to Aberfoyle Tin Development Partnership in August, 1963. It has been held by subsidiaries of the Aberfoyle Group of companies since 1963 and is presently held by Cleveland Tin Limited.

A. PREVIOUS EXPLORATION

Original reconnaissance geological mapping on E.L. 1/63 was undertaken by Cox (1967) and Glasson and Cox (1969). This work involved stream sediment sampling and analysis, ground magnetometer traverses and some self potential evaluation. On completion of this preliminary work (from 1964 until 1968), Cox (1969) delineated 13 areas within E.L. 1/63 which required follow-up geological evaluation.

Follow-up work included geological mapping, soil, bedrock, stream sediment and water geochemistry with some ground and airborne magnetics, self potential and induced polarization surveys. This work has been summarized in McWatt (1971), Sale (1972), Ransom & Hunt (1972), Ransom (1972), Ransom & Simpson (1973), Ransom (1973), Sale (1974), Stuart-Smith (1974), Palmer (1975a & 1975b), Ransom (1976a & 1976b) and Gentle (1976). No outcropping orebodies were found outside the Mine area.

Statistical analysis of the geochemical data (Ransom 1977a & 1977b) showed the Mine/Falls Creek sequence was the most prospective rock unit for further exploration.

An escalation of Mine Exploration in 1978 resulted in no exploration being done within E.L. 1/63 from January, 1978 to December, 1978.

In late 1978 exploration recommenced with surface mapping south of the Mine, diamond drilling 500 metres north of the mine and a UTEM survey in selected areas north and south of the mine. The mapping (Eadie, 1979) showed Hall's Formation continued north and south of the immediate mine area. The UTEM survey failed to recognise the B-South mineralization but did delineate several weak electrical conductors in Hall's Formation.

During the year ending in August, 1980 several anomalous areas were further investigated (Ellis 1980a & 1980b). After check mapping in the Washington Hay area two diamond drill holes were drilled to test the anomalous geochemical zone. These intersected a brecciated fault zone with weak sub-economic mineralization. Mapping to the east and south of the mine showed a sequence of barren shales, volcanics and sandstone. A DIGHEM survey of the granite contact zones in the eastern areas of the licence showed one weakly anomalous zone.

B. EXPLORATION OBJECTIVES (THIS PROGRAM)

The previous exploration delineated several areas which required follow-up evaluation in varying degrees of detail. The areas and the work proposed were as follows:-

(a) Magnet Range Area

The general area was prospective due to its position between the known Cleveland and Magnet zones of mineralization.

Previous poorly documented work showed that this area contained several areas with anomalous Zn soil geochemistry.

The exploration objective in this area was to provide a complete geological interpretation and to further delineate areas of anomalous soil geochemistry for possible follow-up work.

(b) Whyte Hill - W Prospect Area

Barren limestones stratigraphically equivalent to the lode sequences of Hall's Formation occur on Z.500 section 500m north of the mine. Anomalous Zn soil geochemical values in this area may be due to the presence of volcanics or a Zn halo around Cleveland style mineralization.

The exploration objective was to locate and follow the northern continuation of Hall's Formation and to unravel the apparent structural complexity in the area.

(c) Washington Hay Area

This area was thought to be the faulted equivalent of Hall's Formation. However, work last period showed the presence of ultrabasic rocks with cherts and shales. These rocks and their anomalous soil geochemistry may represent possible host rocks for economic mineralization.

The exploration objective was to elucidate the stratigraphy of the area and determine the cause of the unexplained geochemical anomalies.

(d) Eastern Sediments

Previous work showed the sedimentary and volcanic sequence to the east of the Mine stratigraphy contained several limestone units. These represent favourable host horizons for Cleveland style mineralization.

The exploration objective was to further investigate the sequence of sediments east of Hall's Formation.

(f) General Work on E.L. 1/63

(i) Compilation of existing data onto common base plans will continue.

(ii) The entire exploration licence will be covered by an airborne DIGHEM survey on 250m spaced east-west lines.

3. EXPLORATION AND DEVELOPMENT

The exploration program outlined above was planned for the Aberfoyle parent company for the 1980 and 1981 company years. The period detailed in this report represents one phase of a continuing exploration program, and covers the exploration activity for the period from the 12th August, 1980 to the 13th January, 1981 (this period) as well as outlining the proposed exploration for the following six month period (next period). The last period refers to the six month period ending on the 11th August, 1980.

A. MAGNET RANGE AREA

(i) Completed Exploration

A brief review of the early exploration in this area has been given in Ellis (1980b). Last period a start to the present exploration program was made when a baseline and four grid lines were cut.

All grid lines were surveyed using chain, compass and clinometer and pegged at 25 metre slope distance intervals. The lines were then geologically mapped, traversed by Magnetometer and the C horizon of the soil profile was sampled at 25m intervals. A chert unit was traced along strike from the northern edge of E.L. 1/63 to the Waratah-Corinna road. At present this work is being plotted onto 1:1000 base sheets.

Preliminary plots of the geology at 1:5000 scale (sheets SG-OC-001 & 002) show a largely uninterrupted sequence of vertically dipping sediments, basalts and dolerites striking approximately 015° / 195° . Only minor faulting and folding has been observed in the large exposures, such as the shale quarry at the intersection of NL.14 and the Magnet road. Although numerous, most of the faults in the shales had only very small displacement. A major structure occurs in the vicinity of Whyte Hill and the Waratah-Corinna road where the cherts and shales (adjacent to a purplish brown basalt) are displaced approximately 400 metres to the east (relative to the northern Magnet Range area). This structure requires further investigation.

Intruded into the major chert/shale horizon forming the main Magnet Range ridge are ultrabasic rocks. These are generally gabbroic to doleritic (Appendix I) although in some places they are serpentized. These intrusives are sub-parallel to the strike of the chert/shale.

To the west the shale/chert horizon is bounded by a serpentized doleritic ultrabasic complex. Sandstones (with minor shale and chert) occur further to the west which in turn are intruded by another serpentized ultrabasic complex which is similar to that west of the Cleveland Mine.

To the east of the shale/chert Magnet Range horizon occurs purple brown basalt which is truncated to the east by an ultrabasic complex containing dominantly gabbroic and doleritic rocks.

In the northern area the sequence of basalt and ultrabasics to the east of the main chert/shale horizon are replaced by tuffs and lithic sandstones (with shales) of the Magnet Mine sequence. The structural relationship of this block is unknown at this stage.

Generally, in the study of this area, the magnetometer traverses (sheets SP-CO-001 & 002) have delineated accurately the boundaries of the various rock units. This is particularly true in the location of ultrabasic contacts.

The geochemical soil samples were analysed for Cu, Pb, Zn, Sn, Ni, As and WO_3 (Appendix IV). Several anomalous areas were found (Sheets SC-CO-001 & 002). All areas termed anomalous consisted of two or more adjacent sample points with values for generally more than one element that were significantly higher than the background values. Before any of these anomalies are classed as significant they will be checked by resampling at a 12.5m spacing.

Although the anomalies tended to occur in similar stratigraphic positions on adjacent lines past experience has shown that correlation of anomalies over more than about 200 metres is doubtful.

Although the work in the Magnet Range area has only been an initial preliminary probe, the results show potential requiring follow-up work.

(ii) Future Work Recommended

In the next period it is proposed that all the anomalous geochemical areas will be resampled at 12.5m intervals. Again the C soil horizon will be the zone sampled.

It is also proposed that intermediate grid lines are cut between the existing grid lines with additional lines to the north of NL.10 and south of NL.22. These 18 lines at 125m spacings, involve a total of 32 kilometres of grid cutting which will then be surveyed using chain, compass and clinometer before being traversed with a proton magnetometer, geological mapping and further geochemical soil sampling.

The analysis of the results of this work together with the results of the DIGHEM survey (see section 3.F) will indicate whether this Magnet Range area in the northern portion of E.L. 1/63 has potential for further detailed exploration.

B. WHYTE HILL - W PROSPECT AREA

(i) Completed Exploration

Initial mapping of this area, by Cox (1969) in the period 1964 to 1969, was along grid lines at spacings of approximately 150 metres. From this original mapping fact several vastly different structural interpretations have been made for the area with only minor additional field work.

One later interpretation by Collins in 1979 showed a major east-west fault to the north of the H.E.C. power line about 500 metres north of the W prospect. The second interpretation (by Tulp and Ellis) showed a gentle flexing of the stratigraphy to fit the original mapping fact.

In this period, strike mapping of continuously outcropping chert horizons was undertaken in the area of this fault/fold conflict. On Crescent Spur the strike mapping has not detected any major fault between G3 and G9 (Sheets SG-OC-002 & 003). However, the sudden truncation of the chert unit south of G3 and north of G9 requires further detailed mapping.

During this period all of the old grid lines which could be located were traversed by ground proton magnetometer. Once readings have been fully corrected and plotted, the resulting profiles will greatly assist correlation of units.

(ii) Future Work Proposed

In the next period the results of the magnetometer survey used in conjunction with further strike mapping of continuously outcropping units will enable a less contentious interpretation of the area to be made. Depending on results, drilling may be warranted to test favourable stratigraphy at depth.

C. WASHINGTON HAY AREA

(i) Completed Exploration

During the last period the northern portion of the Washington Hay area (north of RA12) was geologically mapped. The mapping was included in plans in last period's six monthly report.

No further work was done in the Washington Hay area during this period. However, thin section preparation and descriptions of rock samples from the area were completed. These have been included in this report (Appendix II).

(ii) Future Work Proposed

As there are problems with the correlation of the stratigraphy and structure south of RA12 and to the west of the holes drilled in the last period the work proposed is mainly strike mapping of continuously outcropping horizons. This will be assisted by proton magnetometer traverses on all the existing grid lines in the area. Further assistance to the geological mapping will be provided by costeaning.

Two costeans are proposed at present - one to the south of RA8 to expose a suspected fault; the other on the eastern side of the Washington Hay ridge to provide exposure of the chert/basalt/sandstone sequence. Further costeans will depend on the results of strike mapping.

D. EASTERN SEDIMENTS(i) Completed Exploration

Surface mapping in the area to the south of the Cleveland Mine has shown that the mine sequence (Hall's Formation) possibly extends 700 metres south of subsurface mapping information. However, surface outcrop is poor and little information can be gained about detailed stratigraphy or local structure.

Good outcrop was obtained in the eastern area where forestry clearing has resulted in tracks being cut across the stratigraphy (Sheets SG-OC-003 & 004). Some of the results of the petrological examination of rocks from this area have become available. These have been included in this report (Appendix II).

(ii) Future Work Proposed

To provide knowledge of Hall's Formation south of the mine it is proposed to drill a stratigraphic diamond drill hole on Ax section (500 metres south of the present unit of information), from the eastern sediments westerly through the Deep Creek Volcanics, Hall's Formation and part of the Crescent Spur Mica Sandstone.

The site and access for this hole has been prepared.

E. GRANITE CONTACT ZONE(i) Completed Exploration

As stated in the report for the last period the Granite Contact Zone in the east of E.L. 1/63 has been covered by an airborne electromagnetic survey (DIGHEM). The survey showed up one weakly anomalous area in the Wombat Flats region.

In this period, three existing grid lines in the area of the anomaly were located and a start made on magnetometer traversing to accurately locate the anomaly on the ground.

(ii) Future Work Proposed

Once the DIGHEM anomaly has been located on the ground the area will be geologically mapped, which may require costeaning.

The results of the mapping would be evaluated before further work was attempted.

F. GENERAL WORK ON E.L. 1/63

(i) Aerial Photography

During the last period the whole of E.L. 1/63 was covered by aerial photography. In this period a 1:10000 scale base plan of the licence showing roads, streams and 10 metre contours was produced (Sheet TP-TP-024). The production of these plans required that control stations and aerial targets be surveyed into the mine grid co-ordinate system.

Colour prints at 1:15000 and 1:30000 scales have been obtained covering the entire licence.

(ii) Compilation

The compilation of all existing data onto common base sheets continued during this period. At present all geological mapping has been enlarged or reduced onto 1:1000 scale work sheets from various old scales. These will be converted to final plans during the next period.

Next period a start will be made to the compilation of all geophysical and/or geochemical data onto the same common base sheets.

On completion of this work a comprehensive re-interpretation of all the data will be made at 1:5000 and/or 1:10000 scale.

(iii) DIGHEM Survey

Preparations for a DIGHEM survey over the entire licence have been completed and flying is expected early in the next period.

4. EXPENDITURE

Expenditure for the period August 11, 1980 to January 13, 1981, was as follows:

Geology	\$ 12,668
Survey	6,610
Aerial Photography & Photogrammetry	11,881
Geophysics	1,419
Geochemistry	4,502
Costeaining & Access Dozing	3,312
Tenure	386
Petrology	1,070
Miscellaneous	335
Total:	<u>\$ 42,183</u>

5. CONCLUSIONS

The Magnet Range area was gridded with a baseline and four preliminary cross lines which were mapped, sampled and traversed with a magnetometer survey. The results showed several anomalous zones which require follow-up investigations.

Attempts were made to correlate the Magnet Range/Whyte Hill area to the geology of the Mine Sequence by shilce mapping and magnetometer traverses. These results were promising but further work is required to obtain a complete interpretation.

Petrological examination of thin sections of rock samples from the Eastern Sediments and Washington Hay areas have been completed. Thin section examination of rocks from the Magnet Range area is continuing.

A DIGHEM anomaly in the eastern portion of the licence remains to be investigated. The remainder of this licence will also be covered by a DIGHEM survey.

A topographic base plan of E.L. 1/63 has been obtained from aerial photography. Most of the geological data for the licence is now at 1:1000 scale (to be drawn on final plans). Geophysical and Geochemical data remains to be compiled onto similar base plans. This work will continue next period.

The total expenditure for the period from August 11, 1980 until January 13, 1981, was \$42,183.

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APPENDIX I

BRIEF DESCRIPTION OF ROCK SAMPLES

183801 MUDSTONE: Soft, partially weather khaki mudstone - partially silicified.
 183802 SILTY SHALE: Banded fine grained silty shale - interspersed with partially silicified bands - light brown.
 183803 SANDSTONE: Fine grained qtz. rich sandstone with some larger qtz and Fe rich minerals - light orangy brown.
 183804 SILICIFIED BRECCIA: Course grained silica rich - possibly chert or altered dolerite - many dark minerals (TM).
 183805 CHERT/SHALE: Very fine silicified shale / chert - originally mid grey now weathered to brown grey.
 183806 ALTERED ULTRABASIC: Very weathered - qtz. or silica grains in orange red clay.
 183807 CHERT/ALTERED BASALT: Apparently silica rich with orange oolites throughout -(difuse boundaries) chert.
 183808 SILTY - POSSIBLY ALTERED BASALT: Fine grained silty material - silicious - not chert - weathered to orange brown.
 183809 ALTERED BASALT: Very distorted chert, shale, mudstones - reds, oranges, whites & browns - vesicule
 183810 FERRUGINOUS TUFT: Very fine grained red brown shale - some chert veins through it - interspersed with light brown shale.
 183811 CHERT: Light grey to red grey chert - fractured.
 183812 BROWN SHALE: Very fine grained red brown shale with light brown shale through it - similar to 183810.
 183813 SILICIFIED SHALE: Light grey brown chert / silicified shale - not completely silicified.
 183814 CHERT: Fractured light grey brown chert.
 183815 CHERT: Hard black massive chert.
 183816 CHERT: A selection of chert (not outcrop) from ridge top - mainly fractured.
 183817 CHERT: Fractured light grey chert - altered to brown white by weathering.
 183818 SANDSTONE: Fine grained qtz. mica rich sandstone - light grey to white.
 183819 CHERTY: Very weathered - brown Fe stained matrix around chert & qtz. grains.
 183820 CHERT: Fractured light grey chert.
 183821 SILTSTONE/MUDSTONE: Fine red brown siltstone.
 183822 SILICIFIED GREY SHALE: Fine - silicified brown grey shale with distorted corner - weathered distorted.
 183823 CHERT BRECCIA: Very weathered - distorted chert frags in Fe rich matrix.
 183824 CHERT BRECCIA: Very weathered - distorted chert & qtz frags in Fe rich matrix - similar to 183823 but more chert.
 183825 SILICIFIED SHALE: Grey silicified shale - distorted area on one side.
 183826 SILTSTONE: Very fine grained grey brown siltstone - partially silicified - many qtz./chert veins.
 183827 SILTSTONE: Similar to 183826 but more weathered & more coarse - coarse distorted zone on one end.
 183828 BASALT: Mid grey - many dark minerals - partially weathered.
 183829 TUFF/SANDSTONE: Partially weathered - light brown grey green - course grained.
 183830 GOSSANOUS: Silica rich in silty shale.
 183831 SILICIFIED TUFF: Light brown, silty, hard.
 183832 TUFF/BASALT: Weathered to orange brown - fine grained.
 183833 SILICIFIED BASALT: Light brown - very fine - gossanous veins.

- 183834 GOSSAN SHEARED BASALT: Grey silty silicious material with pyrite grains throughout - most weathered to orange.
- 183835 SHALE: Very fine grained silicious shale - part replaced by silica.
- 183836 TUFF: Fine grained - probably tuff - gossanous veins.
- 183837 SHALE BRECCIA: Very fine grained silicious shale (similar to 183835) with veins & tuffaceous piece (similar to 183836).
- 183838 SILTY SHALE: Very fine grained light grey silicious silty shale - gossanous veins.
- 183839 GOSSANOUS SHALE: Fine grained silicious silty shale - chaotic in parts - gossanous veins - replaced & altered crystals.
- 183840 GOSSAN BRECCIA: Fine sand-sized - white to light grey - chaotic with shale & tuff in parts - gossanous.
- 183841 TUFF/BASALT: Fine to medium grained - weathered to brown.
- 183842 SHALE BRECCIA: Fine grained silty shale - fractured - silicified - mineralized on veins - light brown grey.
- 183843 TUFF: Very weathered - possibly tuff - fine to medium grained - gossanous veins.
- 183844 GOSSAN: Qtz. galena & limonite.
- 183845 TUFF: Very fine grained - silty shale or tuff.
- 183846 TUFF: Very fine grained - possibly tuff or silty shale - weathered from light grey to brown.
- 183847 SILTY SHALE: Very fine grained - silty shale - silicified.
- 183848 BASALT: Fine grained - weathered - sandstone or tuff?
- 183849 BASALT: Fine grained tuff? - silicified - gossanous veins.
- 183850 BASALT: Fine grained tuff? - weathered.
- 183851 BASALT: Fine grained tuff? - weathered - mineralized.
- 183852 BASALT: Very weathered - fine grained.
- 183853 TUFF: Very weathered tuff.
- 183854 TUFF: Coarse - up to 1/2mm particles - welded in parts.
- 183855 TUFF: Very fine silty material - banded in centre.
- 183856 TUFF: Very coarse - up to 1.5mm particles.
- 183857 TUFF: Very coarse - partially weathered.
- 183858 BASALT: Fine to medium grained - Qtz. fl vein on one end.
- 183859 TUFF: Coarse at top (some py, cpy & black mineral, lithic fragments) - to medium to fine banded at base.
- 183860 TUFF/BASALT: Basalt at base (with needle like crystals) & tuff at top (fine grained with bands of very fine tuff).
- 183861 TUFF: Fine to medium grained - lithic fragments common.
- 183862 TUFF: Very fine grained, weathered to light greenish brown, massive.
- 183863 TUFF: Coarse in parts with rock frags - banded - rock frags elongated.
- 183864 BASALT: Hard fine grained - some pyrite mineralization.
- 183865 SANDSTONE: Fine to medium grained - many rock frags - light grey.
- 183866 SANDSTONE: Medium grained - Qtz. with rock frags - grey brown.
- 183867 SANDSTONE: Fine grained - Qtz grains with rock frags.
- 183868 HARD SANDSTONE: Dark grey - medium grained.
- 183869 SANDSTONE: Partially weathered - fine grained.

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- 183870 TUFF: Very weathered - tuff - orange brown - possibly sandstone.
- 183871 BASALT: Fine grained - pyrite mineralization.
- 183872 TUFF: Weathered - orange brown.
- 183873 TUFF/BASALT: Very weathered & broken - either tuff or basalt;
- 183874 BASALT: Fine grained - pyrite mineralization.
- 183875 BROWN SHALE: Very fine grained red brown shale - qtz. veins in parts.
- 183876 Very weathered- very fine - basalt or tuff.
- 183877 BROWN SHALE: Very fine grained red brown shale.
- 183878 BROWN SHALE: Very weathered - dark red brown banded shale.
- 183879 TUFF/BASALT: Very weathered - red brown tuff or basalt - fine grained.
- 183880 TUFF: Weathered - tuff - fine grained.
- 183881 TUFF/BASALT: Weathered - tuff or basalt - fine grained.
- 183882 BASALT: Very fine grained - pyrite mineralized veins.
- 183883 BASALT: Very fine grained.
- 183884 TUFF?/BASALT: Very weathered - fine to medium grained - probably tuff.
- 183885 BASALT: Very weathered - light brown khaki - basalt.
- 183886 BASALT: Fine grained - probably basalt.
- 183887 BROWN SHALE: Weathered dark red brown shale.
- 183888 CHERT: Light grey with green & red parts.
- 183889 TUFFACEONS BRECCIA: Very weathered - part is medium grained tuff (brown) - then contorted zone
with fragments of chert, shale, basalt & tuff in a tuffaceous matrix.
- 183890 SILICIFIED TUFF: Weathered, very fine grained, partially silicified, massive, brownish green -
grey chert - hard.
- 183891 TUFF: Weathered, very fine grained, light green grey to orange brown, distorted in parts.
- 183892 TUFF/ULTRABASIC: Very weathered & clayey - coarse grained, light khaki - distorted- some
ultrabasic characteristics.
- 183893 TUFF: Very weathered & clayey - very fine grained, light khaki to orange brown.
- 183894 TUFF: Very weathered & clayey - medium grained, orange khaki, broken.
- 183895 SILICIFIED TUFF: Very fine grained, light khaki to brown, massive, hard.
- 183896 PARTIALLY SILICIFIED TUFF: Very fine grained, light khaki to brown, massive, hard.
- 183897 TUFFACEONS BRECCIA: Very weathered & broken - orange brown, tuffaceous matrix with fragments of
shale.
- 183898 TUFF: Very weathered & clayey - slickensides common, medium grained, orange brown, some ultrabasic
features.
- 183899 BASALT: Medium grained, partially weathered to overall brown - many dark minerals with feldspars.
- 183900 BASALT: Medium grained, less weathered to overall green brown - dark minerals with feldspars.
- 183901 BASALT: Dark olive green with black wisps & white crystalline minerals - weathered along joints
& edges.
- 183902 TUFF: Very fine grained - finely banded - khaki green - jointed & faulted.
- 183903 CHOCOLATE SHALE: Dark red brown - very fine grained - massive.
- 183904 TUFFACEONS GREYWACKE: Tuff, brown shale, chert fragments in a tuffaceous matrix - overall dark
green to blue color - medium to coarse grained.
- 183905 BANDED TUFF: Generally very fine grained with up to 5mm thick medium grained bands - weathered
to a brownish green khaki - faulted.

- 183906 BANDED TUFF: Fairly fine grained - dark brown green - erosion surface between two tuff flows.
- 183907 TUFF/BASALT?: Weathered to orange brown with Fe/Mn rich joints - medium grained.
- 183908 TUFF: Weathered to orange brown with Fe/Mn rich joints - fine grained.
- 183909 CHOCOLATE SHALE GREYWACKE: Dominantly dark red brown fine grained shale with fragments of tuff, basalt & chert - banded.
- 183910 CHOCOLATE SHALE: Very fine grained red brown shale - very finely banded two rounded fine grained fragments aligned in bedding.
- 183911 BANDED TUFF: Partially silicified - fine grained tuff with some coarse grained tuff bands - distorted, folded & faulted, - mid yellow green to dark green.
- 183912 DISTORTED TUFF: Fine grained, broken & distorted - altered (by water) to green brown color.
- 183913 CHOCOLATE SHALE: Very dark brown red shale - fine grained - finely banded - hard.
- 183914 SILICIFIED TUFF: Originally a fine grained tuff containing pyrite crystals - pyrite now weathered to limonite (one piece of pyrite remains) - may have been a pyrite shale - very dense - greeny brown to pink colored - possibly clayey.
- 183915 CHOCOLATE SHALE: Fine grained silty shale - bedded - some coarse tuffaceous beds - some cross bedding.
- 183916 SANDSTONE: Weathered brown green khaki - qtz. rich sandstone - some mica, some tuff & chert fragments.
- 183917 CHOCOLATE SHALE: Fine grained silty shale - orange red with some darker red to black bands - bedding visible - minor erosion & faulting - some graded bedding.
- 183918 BASALT: Fine to medium grained - dark green overall - some black & white minerals - hard - some pyrite.
- 183919 BASALT: Fine grained - feldspars weathered - dark olive green but weathered to orange brown along joints.
- 183920 TUFF/SHALE: Very fine grained, massive - weathered to khaki brown in centre & orange on sides - probably tuff.
- 183921 TUFF: Very fine grained massive - khaki brown partially weathered.
- 183922 CHERT SILICIFIED SHALE: Originally very fine grained shale - since been silicified to a hard grey chert/silicified shale.
- 183923 SHALE/TUFF: Very fine grained, massive, purplish color in centre to a weathered orange brown edge.
- 183924 BASALT: Fine grained, olivine rich with feldspars & dark minerals.
- 183925 GOSSAN: Probably originally a tuff/basalt which has been silicified & mineralized - most of tuff/basalt now been removed to leave qtz. & limonite.
- 183926 TUFF: Very weathered - contains a black mineral in a weathered orange matrix - medium to fine grained.
- 183927 CHOCOLATE SHALE: Fine grained - distorted, bedded.
- 183928 BANDED TUFF: Fine grained, apparently some bands (purplish) contain chocolate shale.
- 183929 BANDED TUFF: Similar to 183928 - but more tuffaceous - fine grained.
- 183930 BASALT?: Fine grained, green khaki partially weathered, many dark minerals.
- 183931 CHOCOLATE SHALE: Fine grained, massive, thin black bands through it (possibly bedding?).
- 183932 CHOCOLATE SHALE: Basically chocolate shale with many fragments of basalt, tuff & shale - subrounded to angular particles - aligned.
- 183933 BANDED CHOCOLATE SHALE: Fine grained - some courser beds - some graded bedding.

- 183934 CHOCOLATE SHALE: Red brown, fine, grained, massive - some very fine black films (possibly bedding?).
- 183935 BANDED CHOCOLATE SHALE: Fine grained but silty - some white pieces scattered throughout - finely banded.
- 183936 SANDSTONE: Dirty with many rock fragments - shales, chert, basalt - fairly fine grained - greyish in color.
- 183937 BASALT: Fine grained, hard - interlocking dark mineral lattice - typical basalt texture - greenish.
- 183938 BANDED TUFF: Very fine grained, finely banded, greenish in color - minor faulting - silicified in parts.
- 183939 CHOCOLATE SHALE: Red brown - mostly massive but some fine banding on one side - fine grained.
- 183940 SANDSTONE: Fine grained - dirty with many rock fragments (shale, chert, basalt).
- 183941 CHOCOLATE SHALES: Red brown - hand specimen looks distorted - cut face shows massive, fine grained some distorted & disoriented pieces - minor distort tuff inclusions.
- 183942 TUFF/BASALT: Very fine grained, partially weathered - probably tuff - greenish brown.
- 183943 TUFF: Fine grained - light brownish green - includes fragments of chocolate shale.
- 183944 CHOCOLATE SHALE BRECCIA: Distorted chocolate shale with included fragments of weathered shale, tuff, basalt, chert - orientated & elongated.
- 183945 DISTORTED CHOCOLATE SHALE: Red brown chocolate shale with a darker chocolate shale injected during movement (faulting) into it.
- 183946 WEATHERED SHALE BRECCIA: Originally a partially silicified shale which was deformed (sheared) - now a light grey brown distorted soft shale with inclusions of chocolate shale, tuff & basalt.
- 183947 TUFF/BASALT: Very weathered orange brown - fine grained.
- 183948 TUFF: Partially weathered light brownish green - fine grained - probably unweathered sample 183947 - has a preferred orientation.
- 183949 TUFF: Very fine grained, soft, partially weathered, light brown grey - has a high fine clayey component.
- 183950 TUFF?/SHALE: Extremely fine grained - shale with tuffaceous component - light brownish grey.

- 249401 TUFF: Very fine grained weathered orange brown.
- 249402 TUFF: Fine grained weathered orange brown.
- 249403 TUFF: Fine to medium grained, partially weathered greenish brown, chocolate shale in joint openings.
- 249404 SILICIFIED CHOCOLATE SHALE: Red brown, fine grained, banded - secondary silicification to a chert - gossanous veins with pyrite & ~~Tin~~.
- 249405 SILICIFIED CHOCOLATE SHALE: Red brown, fine grained, banded, graded bedding - silicified to chert.
- 249406 BASALT: Very weathered orange brown - many needle like crystals throughout - medium grained.
- 249407 BASALT: Very fine grained - partially weathered - fine needle like crystals in parts.
- 249408 TUFF/BASALT: Extremely weathered - fine grained - orange brown.
- 249409 CHOCOLATE SHALE: Dark brown - dirty chocolate shale - fine grained - contains other rock fragments.
- 249410 BANDED SHALE: Very fine grained - silty - light grey to light brown - one band had small Fe rich nodules.
- 249411 BASALT/TUFF: Very fine grained - brownish green - partially weathered - some needle like crystals.
- 249412 BASALT: Fine grained, light brown - partially weathered, needle like crystals.
- 249413 BASALT: Fine grained - very weathered - orange brown - many dark minerals.
- 249414 BASALT: Fine grained - hard - relatively unweathered - dark green grey - many dark minerals.
- 249415 BASALT: Very weathered - fine grained - orange light brown - fractured.
- 249416 SILICIFIED TUFF/SHALE: Very fine grained - light greenish grey - very hard - fractured badly.
- 249417 CHOCOLATE SHALE: Very fine grained - red brown color - apparently finely banded - partially silicified.
- 249418 SILICIFIED TUFF/SHALE: Very fine grained - dark greenish with altered brown & red areas - very hard - similar to 249416.
- 249419 SILICIFIED TUFF/SHALE: Similar to 249418 - very fine grained, hard, dark greenish.
- 249420 CHOCOLATE SHALE: Red brown - very fine grained - not silicified - possibly some banding.
- 249421 SILICIFIED TUFF/SHALE: Similar to 249419 - very fine grained, hard, dark green grey - altered to red/white round veins.
- 249422 CHOCOLATE SHALE: Red brown - very fine grained - finely banded in parts.
- 249423 SILICIFIED TUFF/SHALE: Similar to 249419 - very fine grained, hard - silicified - dark green except where altered by qtz. veining.
- 249424 BASALT/TUFF?: Very weathered - fine to medium grained - light brown - many dark minerals.
- 249425 TUFF?: Weathered to orange brown - some coarse grains of basalt, shale, chocolate shale in fine grained tuffaceous matrix.
- 249426 BASALT/TUFF?: Very weathered - medium grained - orange yellow many dark pieces.
- 249427 BASALT: Fine grained - weathered to orange brown - many dark minerals as crystals & wisps.
- 249428 BASALT/TUFF: Fine to medium grained - weathered to an orange brown - many dark minerals.
- 249429 TUFF: Fine to medium grained, weathered to orange brown - fragments of shale in tuffaceous matrix.
- 249430 BASALT: Fine grained weathered to orange brown - many wisps & spots of black minerals.
- 249431 BASALT: Partially weathered - light grey - many needle - like crystals - fine grained.
- 249432 BASALT: Very fine grained - dark to mid grey - needle - like crystals throughout.
- 249433 BASALT: Very fine grained - mid to dark greeny grey - needle - like truncated crystals.
- 249434 BASALT/TUFF & CHOCOLATE SHALE: Mixture of fine basalt, fine tuff & chocolate shale.
- 249435 BASALT: Fine to medium grained - greenish grey - many dark & grey minerals - interlocking crystals.
- 249436 BASALT: With qtz. vein & epidote - basalt altered by veins - now silicified & epidote rich - fine grained light green.

- 249437 BASALT: Deformed with qtz. & epidote alteration - very similar to 249436 except with deformation.
- 249438 BASALT: Fine grained many grey & black minerals - generally greenish grey, hard, crystalline.
- 249439 CHOCOLATE SHALE: Dark red brown colored - very fine grained - featureless.
- 249440 BASALT & TUFF(SILICIFIED): Basalt hard, fine, dark grey green. Tuff- fine silicified grey green.
- 249441 QUARTZ VEINS: Cryptocrystalline white qtz. - some large crystals - some stained areas (orange) - possibly host rock silicified - some epidote.
- 249442 CHOCOLATE SHALES: Dark red brown - thin bands of qtz. rich fine siltstone - spotted appearance due to weathering.
- 249443 TUFFACEOUS SILTSTONE/SANDSTONE: Fine grained, massive, light orange brown - semiconchoidal fracture
- 249444 CHERT: Light grey, fine grained, massive - fractured - possibly originally tuffaceous, hard.
- 249445 MIXED FLOAT: Banded fine grained tuff; fine grained basalt - silicified tuff; chert; silicified brown shale.
- 249446 BASALT: Fine grained - dark greenish grey, hard, massive, many dark minerals.
- 249447 TUFF: Very fine grained, hard, silicified in parts - dark greenish, massive.
- 249448 BASALT: Dark greenish grey, very fine grained, massive hard many dark minerals.
- 249449 BASALT: Very fine grained, partially weathered to a light to mid greenish grey, massive.
- 249450 SILICIFIED TUFF: Very fine grained, light to mid greenish, veins of qtz. & epidote.
- 249451 BASALT: Fine grained, dark greenish grey, hard, massive, many dark minerals.
- 249452 ULTRABASIC: Hard unweathered - grey green - many interlocking needle crystals.
- 249453 ULTRABASIC?: Very weathered - medium to coarse grained - brownish yellow colored.
- 249454 ULTRAMATIC?: Very weathered - yellow brown colored - similar to 249453 except more weathered.
- 249455 RUBBLE HEAP: Chocolate shales, cherts, ultramatics - similar to other rock from area.
- 249456 ULTRAMATIC: Fine grained, fairly weather, brownish yellow - mainly white to light minerals.
- 249457 SILICIFIED CHERT: Dark grey chert - minor fractured? then silicified? weakly in an unusual pattern.
- 249458 TUFF/ULTRABASIC: Very fine grained, hard unweathered, grey green - several tension veins - 2nd. piece has coarse white grains.
- 249459 TUFF/ULTRABASIC: Very weathered & clayey - yellow orange color - fine to medium grained.
- 249460 TUFF/ULTRAMATIC: Very weathered - dark yellow brown colored - very clayey - fine to medium grained.
- 249461 TUFF/ULTRAMATIC: Weathered to an orange brown color - clayey - medium grained.
- 249462 ULTRAMATIC?: Very weathered - yellow brown - fine to medium grained - many white minerals.
- 249463 ULTRAMATIC?: Very weathered - yellow brown - similar to 249462 - finer grained.
- 249464 GOSSANOUS CONGLOMERATE BRECCIA: Angular fragments of chocolate shale, chert. ultramatics, shale & basalt - fault breccia - bonded by an iron rich goossanous matrix.
- 249465 SILICIFIED FRACTURED CHERT: Light grey chert - fractured & then infilled with qtz. veins.
- 249466 TUFF/ULTRABASIC: Orange brown weathered - many white grains - medium grained.
- 249467 CONGLOMERATE BRECCIA: Similar to 249464 - angular fragments of chocolate shale, chert, ultramatic, shale, basalt & sandstone - iron rich matrix - fault breccia.
- 249468 SILICIFIED CHOCOLATE SHALE: Red brown colored shale - silicified with much free silica - prior to silicification parts were brecciated.
- 249469 CHOCOLATE SHALE: Very fine grained, dark red brown - no visible banding.

- 249470 ULTRAMATIC: Very weathered & clayey - fine to medium grained - yellowish brown color.
- 249471 SILICEOUS ULTRAMATIC: Very fine grained - mid grey with dark grey spots - altered around veins.
- 249472 ULTRAMATIC: Weathered to a yellow brown - rich in light colored minerals - medium to coarse grained.
- 249473 CHOCOLATE SHALE: Light brown shale - very fine - massive - no bedding - generally featureless.
- 249474 CHOCOLATE SHALE: Dark red brown shale - very fine grained - massive - generally featureless.
- 249475 ULTRAMATIC: Hard, fine - light grey with dark spots - very siliceous.
- 249476 ULTRAMATIC: Weathered & altered - brown/yellow colored - gossanous nature in parts - fine to medium grained.
- 249477 CHOCOLATE SHALE: Light khaki to brown shale - very fine grained - generally featureless.
- 249478 VOLCANIC TUFF: Fine grained - light grey - gradation grain boundaries - minor pyrrhotite - maybe sandstone?
- 249479 ULTRABASIC: Very similar to the Washington Hay rocks - silicified, hard fine to medium grained, light grey - minor Qtz. veins.
- 249480 ULTRABASIC: Medium grained, gradational grain boundaries - weathered - a preferred orientation (distortion)
- 249481 VERY WEATHERED: Qtz. rich with some mica - possibly a sandstone - maybe ultrabasic.
- 249482 ULTRABASIC: Partially weathered - medium grained - indistinct boundaries mid grey.
- 249483 CHERT/SILICIFIED ULTRABASICS: One piece mid grey chert - another piece has chert beside very weathered ultrabasic? - free Qtz. & mica.
- 249484 IGNEOUS ROCK (DOLERITE): Two pieces fine grained with some large feldspars (dolerite) - one piece very fine light grey with black spots - sheared with angular dolerite at bottom.
- 249485 ULTRABASICS: Dolerite - fine grained - larger pieces of feldspar - one piece very weathered.
- 249486 ULTRABASIC & SILICIFIED SHALE: One piece fine grained ultrabasic - one piece very fine silicified shale with mineral banding (could be igneous), many micro faults - 3rd. piece is brecciated silicified shale.
- 249487 IGNEOUS ROCK: Outcrop - probably a tuff with small (1mm) diameter pieces of ultramatic rock in a fine matrix - one piece is sheared.
- 249488 ULTRABASIC & CHOCOLATE SHALE: Red brown shale appears to be serpentized in parts - other piece similar to 249487 with euhedral crystal grains.
- 249489 CHOCOLATE SHALE: Recrystallized & altered - contains fragments of dolerite, ultramatic black serpentized in parts - hard.
- 249490 CHOCOLATE SHALE: Two pieces - similar to 249489 except one piece has been altered much more.
- 249491 ULTRABASIC: Many fine needles - parts almost doleritic others more serpentized - one piece weathered.
- 249492 ULTRABASIC: Very similar to 249491 except has many more dark minerals - fine grained many needles.
- 249493 ULTRABASIC/TUFF: Very fine grained & weathered, some inclusions of rounded rock fragments - tuff like in appearance.
- 249494 ULTRABASIC/SILICIFIED ULTRABASIC/SILICIFIED BRECCIA ULTRABASIC?: 1st. piece fine grained with much pyrite - next is coarse but silicified - 3rd. almost chert with fine grains of feldspars - most fibrous.

- 249495 ULTRABASIC: Very coarse grains - graphic intergrowths of feldspars & dark minerals - parts very weathered.
- 249496 ULTRABASIC: Very coarse - altered - similar to Washington Hay except very much courser - intergrowths of crystals.
- 249497 ULTRABASIC: One p/ce very fine grained & hard - 2nd. p/ce coarse altered - 3rd. p/ce sheared & flow banded with fragments of fine & coarse altered ultrabasics.
- 249498 ULTRABASIC/SILICIFIED ULTRABASIC BRECCIA: Very fine grained doleritic ultrabasic - breccia contains fine p/ces of brown shale - much ultrabasic - altered by silicification.
- 249499 ULTRABASIC: (Doleritic) - very coarse grained - doleritic/gabbroic ultramafic - many dark minerals.
- 249500 ULTRABASIC: Similar to 249499 but with alteration around some of the light colored crystals - gabbroic.
- 249501 ULTRABASIC: Similar to 249500 - a gabbroic type - coarse grained - crystallization about points.
- 249502 CHOCOLATE SHALE/SANDSTONE: One p/ce has sandstone overlying shale (irregular) - other p/ce is silty shale.
- 249503 BASALT?: Many fine dark needles - minor zones similar to ultrabasics - fairly weathered general basaltic texture - medium grained.
- 249504 TUFF: Fine to medium grained - contains fragments of sandstone, shale, basalt - weathered to brown
- 249505 QUARTZ VEIN with ULTRABASIC FRAGMENTS: Generally coarse qtz. crystals in vein - one p/ce of altered ultrabasic included.
- 249506 ULTRABASIC: Very weathered & clayey - fine to medium grained - tuffaceous in parts.
- 249507 SANDSTONE: Fine grained - greywacke type with many rock fragments - preferred orientation - tuffaceous in parts.
- 249508 SHALE/SANDSTONE: Mainly massive shale - weathered - much sandstone in one half - sandstone fills holes in shale surface - sandstone is greywacke type.
- 249509 SANDSTONE: Gery brown - fine to medium - dirty greywacke - one p/ce red stained - very fine (maybe basalt or tuff) - preferred orientation.
- 249510 TUFF: Fine grained with some larger p/ces - greeny brown - partially weathered - angular fragments of shale.
- 249511 SANDSTONE/SHALE: One p/ce greywacke sandstone (fine) - one p/ce brown shale with sandstone bands - one p/ce sandstone/tuff stained - one p/ce massive brown shale - one p/ce of siltstone altered - one p/ce of tuff (red stain).
- 249512 SHALE/SANDSTONE: One p/ce of massive brown shale - two p/ces of fine greywacke type sandstone.
- 249513 BROWN SHALE: Finely laminated silty brown shale - virtually featureless - almost massive.
- 249514 SANDSTONE: Mainly fine to medium - dirty sandstone (greywacke) - one p/ce of fine siltstone & one p/ce of banded (sediment) shale.
- 249515 SANDSTONE: Fine to medium grained - dirty sandstone (greywacke) - some larger fragments.
- 249516 SANDSTONE: Fine to medium grained - dirty sandstone (greywacke) - one p/ce is stained red - this p/ce has irregular contact of sandstone & finer siltstone.
- 249517 SANDSTONE/SHALE: One p/ce is fine to medium grained dirty sandstone with qtz. vein - one p/ce is sandstone with irregular contact with brown shale - one p/ce brown shale with coarse fragments.
- 249518 SHALE: Brown shale with many fragments (larger) similar to fragments in the dirty sandstones.
- 249519 SANDSTONE: Fine grained dirty sandstone - preferred orientation - some bands of coarse material.

- 249520 SILTY SHALE: Banded silty brown shale - very fine grained - some bands of shale without silt.
- 249521 SANDSTONE: One p/ce fine sandstone with thin fine grained dolerite dyke cutting through - one p/ce of sandstone with brecciated zone - one p/ce of brown shale with tension zone with possibly mineralized vein.
- 249522 SILTSTONE: Dominantly brown shale components with fine silt sized rock fragments similar to the sandstone.
- 249523 SANDSTONE/SILTSTONE: Very fine grained dirty sandstone - almost fine enough to be a siltstone - massive.
- 249524 SANDSTONE/SILTSTONE: One p/ce of fine grained dirty sandstone - othe p/ce fine siltstone - both massive.
- 249525 SHEARED ZONE: P/ces of chert, ultramafic in a contorted altered zone - angular & twisted p/ces with brown matrix.
- 249526 TUFF: Very coarse & angular fragments - contorted - some basalt, chert, shale & tuff fragments.
- 249527 TUFF: Very coarse & angular fragments - almost identical to 249526.
- 249528 TUFF?: Very coarse - very weathered - possibly similar to 249526 but tends to have an ultrabasic appearance in texture.
- 249529 SHALE: Massive, fine grained, silicified, light brown khaki, many qtz. veins throughout.
- 249530 SILICIFIED SHALE: Very fine, massive light khaki shale - silicified & hard - fractured in places.
- 249531 SILICIFIED SHALE: Very fine grained - massive - light khaki to brown - shale silicified - qtz. veins throughout - similar to 249532.
- 249532 SILICIFIED SHALE: Very fine grained - massive - shale - silicified throughout - light brownish pink fractured throughout - some qtz. veins.
- 249533 ULTRABASIC: Gabbroic - two p/ce very coarse with pyrite - two p/ces very fine - all ultrabasic.
- 249534 ULTRABASIC: Gabbroic - very coarse grained - greenish grey - many needles - minor pyrite.
- 249535 CHOCOLATE SHALE: Red brown, fine grained massive shale - very hard - silicified some qtz. veins - featureless.
- 249536 CHOCOLATE SHALE: Similar to 249535 except more brown than red - massive featureless - less hard.
- 249537 ULTRABASIC, GREY SILICIFIED SHALE, RED JASPER/CHERT: Creek pebbles of coarse ultrabasic, grey silicified shale, red jasper/chert - ultrabasic similar to 249533 grey shale - hard massive - red chert - essentially brown shale - very hard & brittle.
- 249538 DARK GREY SILICIFIED SHALE: Very fine grained - massive although one p/ce banded in parts - silicified to form hard chert.
- 249539 SILICIFIED SHALE: One red brown, one light brown, one black & one grey - generally all massive & featureless - grey piece has cross beds & graded beds - all silicified.
- 249540 SILICIFIED SHALES: Both grey (one stained brown by weathering on joints & veins) - banded - cross bedded - hard, silicified.
- 249541 SILICIFIED SHALES: All originally grey shales - but weathering & veins changed color to reds & browns & whites - massive - silicified - qtz. veins.
- 249542 ULTRABASIC BASALT?: Light greenish grey - fine to medium grained - crystalline - small dark fine grained spots occasionally.
- 249543 ULTRABASIC: Very fine grained - dark green to black - contorted & weathered - fragments of chert included - angular fragments.

- 249544 ULTRABASIC/BASALT?: Similar to 249542 but much darker - very fine to medium grained - dark green to black with some lighter areas.
- 249545 SHEARED ULTRABASIC: Light greenish grey - sub rounded fragments of ultramafic with some chert & shale fragments.
- 249546 SHEARED ULTRAMAFIC/BASALT: Light green brown - due to weathering - fine grained - sheared & contorted - brecciated.
- 249547 SCREE MIX: Chocolate shale - bleached chocolate shale - brecciated shale - all been silicified - & one piece of brecciated ultramafic.
- 249548 CHOCOLATE SHALE: Red brown - very soft & weathered - not silicified although some qtz. veins.
- 249549 CHOCOLATE SHALE: Fine grained - some silty particles - red brown - massive - no bedding - featureless.
- 249550 SILICIFIED SHALE: Generally light grey but stained by iron or alteration - one piece sheared & brecciated - most are fractured.
- 249551 CHOCOLATE SHALE: Mainly red brown fine massive featureless shale - some bands of silty nature.
- 249552 CHOCOLATE SHALE BRECCIA: Dominantly a chocolate shale matrix with weathered angular ultrabasic fragments.
- 249553 CHOCOLATE SHALE BRECCIA: Similar to 249552 - more weathered - also sheared & contorted.
- 249554 SILICIFIED GREY SHALE: Very fine grained, light grey to white silicified shale/chert - fractured with qtz. veins.
- 249555 SEMI-SILICIFIED SHALE: Mainly chocolate shale but one piece of white to light grey - massive, featureless - fine grained bleached along fractures.
- 249556 SILICIFIED SHALE: Fine grained, massive, hard, featureless - one piece orange almost jasper brown other red brown - many qtz. veins.
- 249557 DISTORTED CHOCOLATE SHALE?: Very weathered - soft red brown shale - brecciated with many veins one piece almost all veins.
- 249558 BASALT: Finely crystalline - many needles - includes some contorted chocolate shales.
- 249559 BASALT/TUFF: Basically chocolate shale colored with a tuffaceous component - distorted - much fine silica.
- 249560 BASALT/TUFF: Very fine light grey brown - massive - some breaks infilled with material similar to 249559.
- 249561 ULTRABASIC/BASALT?: Medium grained - greenish grey - weathered to brownish - crystal growth similar to ultrabasic - few needles - flow banded in parts.
- 249562 ULTRABASIC/BASALT: Very weathered - medium grained - brownish grey - similar in texture to 249561 but more weathered.
- 249563 ULTRABASIC/BASALT?: Very weathered - fine to medium grained - distorted - orange brown - similar texture to 249561
- 249564 CHOCOLATE SHALE: Dominantly red brown to dark brown chocolate shale but with sand sized piece of chert & silica - similar to 249559.
- 249565 CHOCOLATE SHALE: Red brown - very fine grain - some coarse grains of granular black material.
- 249566 ULTRABASIC/BASALT?: Coarse crystalline - many large feldspar needles - probably doleritic - green grey colored.
- 249567 CHOCOLATE SHALE: Orientated specimen - red brown, fine grained shale - massive - no bedding.

- 249568 SILICIFIED SHALE/TUFF?: Very fine grained - silty - greenish grey - hard - silicified - massive many qtz. veins.
- 249569 SILICIFIED SHALE/TUFF?: Similar to 249568 - very fine grained, hard, massive - more weathered - more veins - silicified.
- 249570 SILICIFIED CHOCOLATE SHALE: Very fine grained red brown shale - completely silicified - orientated many qtz. veins - some bedding.
- 249571 SILICIFIED SHALES: Mainly grey - one red brown - all massive - completely silicified - many qtz. veins - mainly weathered to brown.
- 249572 CONTORTED CHOCOLATE SHALE: Fine grained red brown shale - orientated specimen - but contorted & twisted - some qtz. veins.
- 249573 BASALT/TUFF: Basically a chocolate shale matrix with coarse fragments of an igneous source - similar to 249559.
- 249574 ULTRABASIC/BASALT: Very weathered - fine to medium grained - orange brown - many needles crystals.
- 249575 CHOCOLATE SHALE: Red brown - fine grained - some banding - several qtz. veins - partially silicified.
- 249576 ULTRABASIC/BASALT?: Fine to medium grained - khaki brown weathered - many fine needle crystals.
- 249577 ULTRABASIC/BASALT?: Very fine grained needle crystals - inlocking - khaki brown weathered - many weathered iron rich nodules.
- 249578 SHALE/ULTRABASIC BRECCIA: Weathered to orange brown - many piece of silicified chert fragments in an apparently ultrabasic matrix.
- 249579 ULTRABASIC/BASALT: Very weathered - generally orange brown with dark green to black nodules - similar to those in 249577.
- 249580 ULTRABASIC: Coarse grained interlocking needle crystals - hard - partially weathered - altered crystals.
- 249581 ULTRABASIC/BASALT?: Partially weathered, hard, orange brown - iron rich nodules throughout - medium grained.
- 249582 ULTRABASIC/BASALT?: Similar to 249581 only more weathered - khaki brown - interlocking needles crystals.
- 249583 SILICIFIED ULTRABASIC BRECCIA: Similar to 249578 - angular fragments of shale & ultrabasic in silicified matrix.
- 249584 CHOCOLATE SHALE: Red brown, fine grained shale - massive - silicified in parts - minor qtz. veining.
- 249585 ULTRABASIC/BASALT?: Very fine grained - dark brown - weathered - massive - almost featureless some interlocking crystals.
- 249586 ULTRABASIC/BASALT?: Very fine grained - igneous texture - needle crystals - full of small spherical ball of silica - (like agate).
- 249587 ULTRABASIC?: Very weathered - bluey green with orange brown - fine needles like crystals - coarse to medium grained.
- 249588 BASALT: Dominantly fine grained weathered igneous fragments in a brown shale type of matrix.
- 249589 ULTRABASIC/BASALT?: Dark greeny brown - weathered - fine grained with large iron rich nodules - interlocking crystals - almost tuffaceous in parts.
- 249590 ULTRABASIC/BASALT: Very fine grained - some short needle crystals - small pieces of silica as balls - apparently some chocolate shale included.
- 249591 ULTRABASIC/BASALT: Fine grained - hard - one band apparently containing some chocolate shale as matrix.

- 249592 BASALT/ULTRABASIC: Hard, fine, dark grey with brown & white bands - some vesicules some with green mineral.
- 249593 BASALT/ULTRABASIC: Very fine grained - dark brown - some vesicules - very weathered - some small crystals.
- 249594 ULTRABASIC: Very weathered - crystal outlines discernable - course grained - doleritic - light orange brown.
- 249595 ULTRABASIC/BASALT?: Very weathered - orange brown - to dark orange brown - fine grained - some darker areas.
- 249596 ULTRABASIC/BASALT: Very weathered & soft - many needles - includes some chocolate shale in bands - medium grained.
- 249597 TUFF/BASALT?: Light green piece - many glass fragments - pieces of chert etc. many round iron rich areas - brown piece - much chocolate shale but many black needles in white veins - both flow banded.
- 249598 VERY WEATHERED ULTRABASIC/CHOCOLATE SHALE BRECCIA: Very soft - soft light to mid brown - many ultrabasic textured areas with brown fine shale matrix.
- 249599 BASALT: Very fine grey basalt - one piece with qtz. & epidote veins - one piece of red chert - veins for thin section.
- 249600 BASALT: Very hard fine mid to dark grey - few dark coarse pieces - similar to basalt in 249599.
- 249601 BASALT: Brown fine grained shale like material with ultramafic textured coarse fraction - many green minerals (translucent).
- 249602 BASALT: Fine grained brown shale with many white needles growing in it - similar to 249601 - some coarser minerals.
- 249603 GREY SHALE: Very fine grained, dark grey, featureless, silicified - one piece brecciated & cemented with silica.
- 249604 BASALT: Similar to 249602 & 249601 - mid brown fine grained with basaltic like crystal (needle) growths.
- 249605 BASALT: Similar to 249604 except partially silicified - also many dark minerals.
- 249606 BASALT: Very fine grained grey basalt - one piece has minor chocolate shale other piece has more chocolate shale - similar to 249605.
- 249607 BASALT: Very fine grained grey basalt - one piece has minor chocolate shale other piece has more chocolate shale - similar to 249605.
- 249608 BASALT: Dominantly basalt as in 249607 - one piece of red chert with grey shale inclusions - one piece of grey shale (silicified) - one piece of basalt with brown shale but altered - as in 249609.
- 249609 ULTRABASIC?: Possibly ultramafic/basalt - similar in some respects to basalt but altered & broken - flow banded.
- 249610 ULTRABASIC: Similar to 249609 but much larger crystals - becoming doleritic - still appears to contain chocolate shale.
- 249611 ULTRABASIC: Bluey grey in color, coarse crystalline, gabbroic to doleritic - some very coarse fragments.
- 249612 VESICULAR BASALT: Fine grained red grey basalt - similar to 249606 but with iron rich clay filled vesicules - some hard green mineral.

- 249613 SHEARED BASALT/ULTRABASIC: Fine grained red grey basalt similar to 249606 - sheared & distorted with ultrabasic type zone.
- 249614 STREAM BOULDERS: Mainly basalt - as in 249606 - one piece includes red shales & grey shales - two pieces of brown shale & two pieces of grey shale.
- 249615 VESICULAR BASALT: Very fine grained grey basalt - similar to 249612 - many vesicules - some with iron rich others with agates?
- 249616 BASALT: Fine grained grey basalt - mostly weathered but some unweathered parts - fairly massive & featureless.
- 249617 CHOCOLATE SHALE: Fine grained brown shale, silicified to chert, featureless massive.
- 249618 CHERT/SILICIFIED SHALE: Silica rich hard fine grained chert/grey shale many qtz. veins.
- 249619 MICACEOUS SANDSTONE: Fine to medium grained - very weathered - qtz. & mica grains visible - some feldspars.
- 249620 MICACEOUS SANDSTONE/GREY SHALE: Many pieces of micaceous sandstone like 249619 - one piece of silicified fine grained grey shale.
- 249621 SILICIFIED GREY SHALE/SILTSTONE: Very fine grained, grey, banded - very hard - silty well silicified.
- 249622 SILICIFIED SHALE: Very fine grained grey shale - similar to 249621 - except more silicious & finer - not banded.
- 249623 CHOCOLATE SHALE: Very fine grained soft red brown shale - some banding is present, featureless, massive.
- 249624 SANDSTONE/CONGLOMERATE: One piece of fine grained khaki colored silty sandstone - two piece of fine conglomerate - mica, rock fragments (chert, brown shale, sandstone) up to 2mm diameter.
- 249625 SANDSTONE: Medium grained - micaceous - some coarser pieces - dirty with rock fragments - similar to 249624.
- 249626 SANDSTONE: Medium grained - micaceous - similar to 249625 - many rock fragments.
- 249627 SANDSTONE: Very weathered - medium grained micaceous sandstone - now orange brown & soft.
- 249628 MICACEOUS SANDSTONE/CHOCOLATE SHALE SANDSTONE: Both are micaceous - the sandstone is like 249627 - the chocolate shale/sandstone is finer with a brown color many dark minerals some needles.
- 249629 ULTRABASIC?: Fine grained, hard bluey grey - minor veining some with pyrite - almost doleritic.
- 249630 ULTRABASIC/CHOCOLATE SHALE -CHERT: One piece of coarse weathered orange brown ultrabasic - one piece of red brown silicified shale/chert - fine grained - slightly silty.
- 249631 ULTRABASIC: Medium to coarse grain - bluey grey - mineralized with pyrite & pyrochlore - many light minerals.
- 249632 ULTRABASIC: Very similar to 249631 - medium to coarse grained - gabbroic - not as much mineralized.
- 249633 ULTRABASIC: Coarse - mainly light minerals - similar to 249632 - but altered by weathering.
- 249634 ULTRABASIC: Very coarse light minerals - fine darker minerals - similar to 249633 - these in series.
- 249635 ULTRABASIC: Very coarse light minerals - fine darker minerals - some mineralization similar to 249634 - but coarser.

- 249636 SILICIFIED GREY SHALE /SILTSTONE: Very hard - fine grained silt in parts - massive featureless many silica veins.
- 249637 SILICIFIED SHALES: Mainly red but some grey - all have been fractured & resilicified, hard, fine, massive.
- 249638 SILICIFIED SHALES WITH MINOR ULTRABASIC: Mainly red cherts - some grey - massive, silicified, hard, fine - one piece of ultrabasic - fine, dark.
- 249639 ULTRABASIC: Medium to coarse - bluey grey - lighter minerals not coarse - even grained - some mineralization.
- 249640 ULTRABASIC: Very fine to medium grained - similar to 249639 - bluey grey - many dark minerals.
- 249641 SILICIFIED GREY SHALE: Fine grained, massive light grey - jointed & fractured - stained red along joints.
- 249642 ULTRABASIC: Very fine grained, greenish grey - some larger grains - some radiating crystals possibly basalt - one piece has qtz. veins with mineralization.
- 249643 ULTRABASIC: Overall greenish grey - many crystal intergrowths - many feldspars coarse grained.
- 249644 ULTRABASIC: Similar to 249643 - but much coarser - green grey color - light minerals coarse - darker minerals fine.
- 249645 ULTRABASIC: Medium to coarse grained - mainly feldspars - finer dark minerals - more even grained.
- 249646 ULTRABASIC: Very similar to 249645 - many crystal intergrowths bluey grey color some qtz. veins.
- 249647 BASALT?: Brownish grey - very fine grained - some chocolate shale content - some coarser grains - needle crystals.
- 249648 BASALT: Very weathered - mainly fine grained brown with some coarse dark grains.
- 249649 BASALT: Very fine grained - some brown pieces mainly grey & white - similar to 249647.
- 249650 BASALT: Similar to 249649 - very fine grained grey with red brown staining & patches - basalt.
- 249651 BASALT: Similar to 249650 - very fine grained but with white minerals in small vesicles - feldspars - basalt?.
- 249652 BASALT: Similar to 249650 - but more weathered - fine grained - massive featureless - much feldspar.
- 249653 BASALT: Very coarse, weathered - distorted & brecciated - silicified in parts flow banded - some fine pieces like 249652.
- 249654 BASALT/SHALE: Mainly fine grained ultrabasic similar to 249650 - one piece of red brown silicified shale, one piece of grey silicified shale.
- 249655 SHALES: Initially all grey featureless shale - massive - one piece silicified - fractured weathered to light yellow khaki.
- 249656 SILICIFIED GREY SHALES: Massive dark grey, fine although parts silty, weathered to yellow khaki - qtz. veining.
- 249657 ULTRABASIC: Grey medium to coarse - doleritic to gabbroic - minor mineralization one piece very weathered.
- 249658 ULTRABASIC: Similar to 249657 - but coarser - many large feldspar crystals fine dark matrix.
- 249659 ULTRABASIC: Very fine grained - doleritic - greenish grey - minerals hard to identify - massive, hard.
- 249660 ULTRABASIC: Medium to coarse - similar to 249657 - many coarse feldspars with fine dark minerals, hard, massive.
- 249661 MIX: Two pieces of ultrabasic similar to 249660 & 249659 - one piece of distorted ultrabasic with inclusions of silicified shale - one piece of brecciated grey silicified shale - one piece of silicified grey shale.

- 249662 SILICIFIED SHALES: One piece of fractured grey shale - one piece of brownish grey shale - fine massive silicified.
- 249663 SILICIFIED CHOCOLATE SHALE. Red brown, hard, massive, featureless, fine grained - silicified partially.
- 249664 SILICIFIED SHALES: Mainly grey or brown grey, hard, massive, fine grained many qtz. veins.
- 249665 SILICIFIED SHALE: Hard, grey silicified shale - fractured, fine grained many qtz. veins.
- 249666 SILICIFIED SHALES: Hard, grey or brown, silicified - grey shales fractured with much qtz. - brown is less brittle.
- 249667 CHERT/SILICIFIED SHALES: Hard grey - silica rich - some grey chert with many qtz. veins.
- 249668 SILICIFIED SHALES: Mostly brown silicified shales - one piece of grey - one piece of brown shale has coarse brecciated zone.
- 249669 SILICIFIED SHALES: Grey shale - fine hard brittle - one piece has dark grey sandstone in one portion.
- 249670 SILICIFIED SHALES/ULTRABASIC: Mainly silicified shales - grey & brown - one piece of fine grained doleritic ultrabasic - greenish.
- 249671 ULTRABASIC: One piece fine - other coarse - blue grey - doleritic - minor sulphides included - coarse light minerals - fine dark minerals.
- 249672 SANDSTONE: Very fine grained - micaceous - light brownish grey - some darker concentrations of secondary minerals.
- 249673 SANDSTONE: Qtz. muscovite rich - many rock fragments as well - weathered to light orange brown.
- 249674 ULTRABASIC/SILICIFIED SHALE/SANDSTONE: Mainly coarse ultrabasic - similar to 249671 - one piece of sandstone similar to 249672 & one piece of grey silicified shale.
- 249675 SANDSTONE/SILTSTONE: Fine grained micaceous sandstone & fine grained micaceous siltstone - light brown grey - weathered.
- 249676 SILICIFIED SHALE: Grey hard brittle - infilled veins of black - silica rich - fractured.
- 249677 SANDSTONE: (Minor silicified shale) - sandstone is grey - slightly weathered - not hard - fine with many lithic fragments - minor mica - silicified shale is like 249676.
- 249678 SANDSTONE/SILTSTONE: Very fine grained - not hard - similar to 249677 - minor mica - some brecciated zone.
- 249679 SHALE/SILICIFIED SHALE: One piece hard - other piece weathered - originally grey shale/siltstone - fine grained - silicified in parts.
- 249680 SILICIFIED SHALE/SILTSTONE: Fine grained, grey hard siltstone/shale - silicified massive.
- 249681 SANDSTONE: Yellow brown partially weathered fine grained micaceous sandstone, massive.
- 249682 SILICIFIED SHALE/CHERT: Hard fine grained grey shale - brittle, fractured silica rich.
- 249683 SILICIFIED SHALE: Similar to 249682 - hard, fine grained grey, fractured qtz. veins.
- 249684 ULTRABASIC/SANDSTONE: Sandstone - weathered similar to 249681 - ultrabasic unweathered - coarse, bluey green hard many light minerals gabbroic.
- 249685 SERPENTINE ULTRABASIC: Black ground mass - soft with fine white to green white veins & nodules.
- 249686 ULTRABASIC?: Very fine grained bluey grey - partially weathered - possibly very fine siltstone.
- 249687 ULTRABASIC/SILICIFIED SHALE: Silicified brown shale - hard, massive, fine - ultrabasic is coarse hard bluey green.
- 249688 ULTRABASIC/SILICIFIED SHALE: Ultrabasic is medium grained/dolerite hard - shale is hard, fine greeny blue - possibly fine ultrabasic.

249689 ULTRABASIC: Coarse, hard green blue grey - light grains coarse - fine dark grains doleritic.
249690 ULTRABASIC: Very fine grained greeny grey doleritic - many dark minerals - fine banding - possibly siltstone? - some pyrite.
249691 ULTRABASIC: Very fine grained - flow banded - bluey green - partially weathered maybe fine siltstone? - some pyrite.
249692 ULTRABASIC: Fine grained - possibly combination of black serpentine & doleritic - soft - black in parts rest blue green like doleritic.
249693 ULTRABASIC: Coarse - weathered to red brown (dark minerals) - light minerals coarse.
249694 ULTRABASIC: Medium grained blue greeny grey - hard - doleritic minor pyrite.

APPENDIX II

THIN SECTION PETROLOGY OF ROCK SAMPLES



98C036

The Australian
Development
Laboratories

amdel

Street, Frewville,
South Australia 5063
Adelaide 79 1662
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24 December 1980

Please address all
correspondence to
Box 114 Eastwood
SA 5063

In reply quote:

GS 3/43/6/0

Cleveland Tin Limited,
LUINA, Tas. 7321.

Attention: G.J. McArthur
Senior Mine Geologist

REPORT GS 3033/81

YOUR REFERENCE: Purchase Order 12279 and letter dated 28 November
1980

MATERIAL: 41 rock samples (two with same number)

LOCALITY: Area of Cleveland Mine Exploration Licence

IDENTIFICATION: Sample numbers listed in report

DATE RECEIVED: 4 December 1980

WORK REQUIRED: Brief petrographic description (21) and routine
description (20)

Investigation and Report by: Sylvia Whitehead

Manager, Geological Services Division: Dr Keith J. Henley

Keith Henley

for Norton Jackson
Managing Director

jd/44

SUMMARY OF SAMPLESSample and
TS No.

- 183891
TSC31461 Weathered and stained, recrystallized shale which has been subjected to mild tectonic stress.
- 183892
TSC31462 Probably a weathered serpentinite or chlorite-tremolite rock. Relict textures suggest it had some skeletal and/or fibrous crystals. It was probably an ultrabasic igneous rock but is too extensively altered for its original composition to be determined with certainty.
- 183895
TSC31463 Slightly silty shale with a few cherty layers. Detrital material is too fine-grained for its origin to be determined.
- 183897
TSC31464 Slightly silty shale with a fragmental structure possibly intraformational breccia. There has certainly been some soft-sediment deformation followed by later fracturing and invasion by an unidentified secondary mineral (now weathered).
- 183928
TSC31465 Weathered, fine-grained, tuffaceous sandstone or tuff of intermediate or basic composition. Grains were moderately well sorted.
- 183929
TSC31466 Very similar to sample 183928 but with at least one coarser-grained layer.
- 183936
TSC31467 Tuff or tuffaceous sandstone composed of well sorted detrital grains derived from volcanic rock possibly of andesite composition. Relict textures are better preserved than in samples 183928 and 183929.
- 183942
TSC31468 Coarse-grained basalt.
- 249411
TSC31469 Fine-grained basalt which is slightly porphyritic.
- 249425
TSC31470 Weathered basalt coarser-grained than 249411 and probably similar to 183942.
- 249431
TSC31471 Fine-grained basalt similar to 249411 but plagioclase has been almost completely altered to sericite or clay in some zones.
- 249446
TSC31472 Porphyritic basalt containing less interstitial chlorite than samples 183942-249431 (described above).

- 249478
TSC31473 Fine-grained, volcanic-lithic sandstone or fine-grained greywacke.
- 249543
TSC31474 Deformed serpentinite showing relict textures which could be interpreted as having been derived from a relatively fine-grained ultrabasic rock.
- 249557
TSC31475 Altered vesicular volcanic glass or pumice now mainly clay and iron oxide.
- 249558
TSC31476 Decomposed and iron oxide-stained basalt.
- 249561
TSC31477 Decomposed lava which was probably basic in composition. It is now mainly chlorite and clay stained by iron oxide.
- 249570
TSC31478 Argillaceous chert with numerous intersecting quartz veins.
- 249578
TSC31479 Decomposed vesicular volcanic glass showing evidence of flow movement. It probably had a basic composition and therefore may have been tachylyte.
- 249586
TSC31480 Completely altered, amygdaloidal basaltic rock. Amygdales contain quartz.
- 249401
TSC31481 Weathered vitric tuff originally composed mainly of well sorted small fragments of volcanic glass.
- 249404
TSC31482 Laminated argillaceous and slightly ferruginous chert. (some layers could be cherty argillite).
- 249417
TSC31483 Ferruginous and argillaceous chert very similar to sample 249404.
- 249441
TSC31484 Epidotized rock has been invaded and partly replaced by vein quartz.
- 249443
TSC31485 Indurated and weathered, vitric tuff.
- 249458
TSC31486 Metasomatically altered rock probably a fine-grained tuff.
- 249471
TSC31487 Silicified, fine-grained sediment which contained at least some siltstone.

- 249486
TSC31488 Feldspathic and micaceous sandstone (or arkose) composed of poorly sorted, immature detrital material.
- 249486-A
TSC31488-A Vein quartz and a silicified rock which once contained chlorite and at least a little pyrite.
- 249487
TSC31489 Sheared and weathered chloritic schist of undetermined origin but possibly altered basaltic rock.
- 249499
TSC31490 Dolerite containing both clino- and orthopyroxene.
- 249503
TSC31491 Extensively weathered, fine-grained dolerite.
- 249504
TSC31492 Weathered and stained, volcanic-lithic sandstone.
- 249559
TSC31493 Weathered vesicular or amygdaloidal volcanic rock almost certainly basalt.
- 249577
TSC31494 Weathered basalt.
- 249580
TSC31495 Weathered, porphyritic dolerite.
- 249585
TSC31496 Weathered vesicular, fine-grained basalt from a chilled margin or surface of a lava flow.
- 249590
TSC31497 Weathered, fine-grained vesicular basalt.
- 249591
TSC31498 Weathered, porphyritic dolerite in which there is some unaltered pyroxene.
- 249592
TSC31499 Fine-grained amygdaloidal basalt.
- 183932
TSC31500 Probably a pyroclastic rock of basic or intermediate composition. It contains some fragments of basaltic rock. There is some evidence suggesting flow movement and therefore it could have been an ash flow but textures in the matrix have not been preserved.

DESCRIPTION OF ROCKS IN CLEVELAND MINE EXPLORATION AREA

Sample: 183891; TSC31461

Hand Specimen:

A weathered rock which is very fine-grained and is now a pale orange to salmon-pink colour. There are some films of black iron and/or manganese oxides along some of the joint planes and adjacent to some of the joints, portions of the rock appear to have been bleached.

Etching with hydrofluoric acid and staining with cobaltinitrite does not show any definite potash feldspar.

Thin Section:

The rock is composed mainly of very fine-grained muscovite and sericite with minor, fine-grained detrital quartz and possibly some weathered and iron oxide-stained chlorite. Accessory minerals include a trace of leucoxene, very minute traces of tourmaline and zircon and a little iron oxide.

This is a fine-grained sediment originally composed predominantly of clay minerals with a little very fine-grained detrital muscovite and 1 to 2% of silt-sized detrital quartz. There are a few small grains now composed of leucoxene and one or two tiny tourmaline and zircon grains less than 0.05 mm in size. The argillaceous material has recrystallized to sericite which shows a preferred orientation imparting an incipient foliation but there has been some slight deformation and fracturing and therefore the direction of this foliation varies slightly. There are a few small lenticular patches up to 0.5 mm long and 0.3 mm thick which contain slightly higher concentrations of silt-sized detrital material and elsewhere thin bedding is suggested by slight variations in concentration of brown iron oxide staining. There are a few grains about 0.02 to 0.03 mm in size now composed of reddish-brown iron oxide which could represent oxidized pyrite but only one or two of these appear to have been cubic crystals which would confirm this. No definite evidence in the form of relict textures could be found to suggest that the rock originally contained volcanic shards but, if such evidence existed, it could have been obliterated by recrystallization and weathering.

Conclusion:

Weathered and stained, recrystallized shale which has been subjected to mild tectonic stress.

Sample: 183892; TSC31462

Hand Specimen:

A very weathered rock now composed mainly of greenish-grey to yellowish-grey clay with films of iron and manganese oxide on joints. The rock is soft and friable.

Thin Section:

The rock is extensively weathered and altered to clay minerals but, in many areas, relict textures are moderately well preserved and these suggest that, at one time, the rock was probably composed predominantly of serpentine minerals with some long, almost fibrous crystals of silicate, possibly amphibole but this suggestion is only tentative. There are some areas showing fine, almost skeletal intergrowths and feathery intergrowths of crystallites and embryonic crystals and there are a few relicts of fibrous crystals up to 2 mm long. These textures are similar to those found in some moderately fine-grained ultrabasic rocks but in this sample, it is uncertain whether these fibrous crystals were tremolite or pyroxene or some other silicate. In one area, relict textures suggest the former presence of a crystal of either pyroxene or olivine about 1.5 mm long and there were other smaller crystals up to about 0.5 mm in size in which relict textures suggest that they may have been olivine replaced by serpentine. There are many areas in the rock where relict textures are not well preserved and where there appears to have been some deformation or shearing.

Conclusion:

Very weathered rock which was possibly a serpentinite or a chlorite-tremolite rock derived from an ultrabasic igneous rock. This suggestion should be regarded as tentative as alteration has been too extensive for its original composition to be determined with certainty.

Sample: 183895; TSC31463

Hand Specimen:

A pale grey, very fine-grained rock stained orange to pale brown on the weathered surface and along many small joints.

Thin Section:

This is a very fine-grained sedimentary rock now composed mainly of sericite or extremely fine-grained argillaceous material with relatively minor fine-grained quartz and it may once have contained chlorite. In one zone there are some layers containing silt-sized detrital quartz and also tiny spheres and bodies now composed of chalcedonic quartz. There is a trace of leucoxene and one very small authigenic tourmaline crystal was found.

Throughout most of the area sectioned, the rock is composed of argillaceous material and sericite with less than 10% of silt-sized detrital quartz grains, a few very small biotite flakes and a trace of leucoxene. Much of the sericite does show a preferred orientation but this incipient foliation has been disturbed by fracturing and shearing.

Near one end of the section, there are numerous tiny spheres mainly between 0.03 and 0.06 mm in diameter which are now composed of very fine, chalcedonic quartz and there is also a larger pseudomorph of chalcedony which is almost rectangular in shape and 0.1 x 0.2 mm in size. These layers contain higher proportions of chalcedonic quartz than sericite and could be classified as chert but the origin of the tiny spheres is uncertain.

Conclusion:

This is a slightly silty shale with a few cherty layers. The detrital material is too fine-grained for its origin to be determined.

Sample: 183897; TSC31464

Hand Specimen:

A weathered, fine-grained rock which now appears to be composed mainly of clay minerals stained pinkish-orange and pale reddish-brown. Variations in staining suggest the presence of small lenticular particles or patches of sediment 2 to 3 mm long. These colour variations suggest that the original sediment contained some small fragments or reworked patches of clay which were drawn out in a direction of incipient foliation.

Thin Section:

The rock is very weathered and is now composed mainly of clay minerals and sericite or very fine-grained muscovite but there are some zones and lenticular patches which contain a little silt-sized detrital quartz, muscovite, biotite and plagioclase. There are very small, lenticular patches of this silty shale less than 1 mm long and there are also larger patches of similar shale 2 to 3 mm in size, some of which are elongate or lenticular and others are of irregular shape. There are also a few small patches or fragments of orange-stained clay and one or two larger quartz grains about 0.1 mm in size. These are scattered through a matrix of partly recrystallized shale now composed almost entirely of sericite and clay minerals stained by iron oxide. No relict textures were found which would suggest that any of the elongate or lenticular patches were fragments of volcanic rock or volcanic glass but, as much of the detrital material originally present in this rock was very fine-grained, the possibility that some of it was derived from volcanic rock cannot be excluded.

The rock has been fractured and there are some relict textures which suggest that it was invaded by a few small veins and/or patches of a secondary mineral which has now been completely decomposed and only relict textures defined by iron oxide staining remain. These textures are not sufficiently distinctive for the secondary mineral to be identified.

Conclusion:

The sample is predominantly a slightly silty shale with a fragmental structure which could indicate intraformational breccia and almost certainly there has been some soft-sediment deformation. The rock has also been fractured and invaded by an unidentified secondary mineral.

Sample: 183928; TSC31465

Hand Specimen:

A weathered, greyish-orange to dull brown, moderately fine-grained rock. When a freshly cut surface was etched with hydrofluoric acid and stained with cobaltinitrite, some poorly defined layering was emphasized and it can be seen that the rock is composed of well sorted small grains.

Thin Section (Two were prepared):

This is an extensively weathered rock which is now composed predominantly of clay minerals stained to varying degrees by iron oxide but relict textures are moderately well preserved and show that it was originally composed of detrital grains or fragments mainly between 0.05 and 0.2 mm in size. There were, however, a few larger, elongate fragments, some of which may have been reworked sedimentary material. Many of the original grains are now heavily stained by iron oxide and their origin cannot be determined, others are composed entirely of clay and show only a flattened or rounded outline but there are, at least, a few which appear to have been vesicular and were probably fragments of volcanic glass or shards. Some of the darker fragments were probably volcanic rock but in general, relict textures are not sufficiently well preserved to confirm this. There are a few dark grains, some of which may be leucoxene and some are certainly secondary iron oxide but no other heavy mineral grains were found.

In the area sectioned, there is one very thin layer of finer-grained sediment and this has been gently folded and also microfaulted. In another zone, there are a few slightly larger, decomposed lithic grains up to 0.3 mm long and in one of these there is some evidence of relict texture similar to that in andesite or basalt.

Conclusion:

Weathered, fine-grained tuff or tuffaceous sandstone. It was probably of intermediate or basic composition and is now composed largely of clay and iron oxide.

Sample: 183929; TSC31466

Hand Specimen:

A pinkish-orange to greyish-brown, fine-grained rock with a sandstone-like texture. Etching and staining with cobaltinitrite emphasize some poorly-defined layering which is not uniform but, in places, is lenticular and there are some layers containing a higher proportion of grains which have been replaced by almost white clay.

Thin Section:

This is essentially very similar to sample 183928 and therefore a full description will not be repeated. It differs from sample 183928 in that there is a greater variation in grain size in different layers and one coarser-grained layer originally contained a fairly large proportion of lithic grains 0.2 to 0.4 mm long. These were almost certainly of volcanic rock which may have been andesitic or basaltic in composition. Other layers were finer-grained and similar to much of the rock in sample 183928. A few of the grains which have been replaced by clay have roughly rectangular sections and it is therefore possible that they were veins or fragments of feldspar.

Conclusion:

Weathered tuff or tuffaceous sandstone very similar to sample 183928 but with at least one coarser-grained layer. The grains were moderately well sorted.

Sample: 183936; TSC31467

Hand Specimen:

A massive, grey rock which has a uniform grain size with no evidence of layering. It is harder than the previous two samples and has a smooth to slightly conchoidal fracture.

Staining with cobaltinitrite showed no potash feldspar.

Thin Section:

This is similar to samples 183928 and 183929 in that it is now composed largely of clay minerals stained with varying degrees by iron oxide but relict textures show that it was originally composed of moderately well sorted detrital grains, many of which were between 0.1 and 0.2 mm in size with a few larger grains. This differs from the two previous samples in the following feature.

Relict textures are better preserved and show that many of the grains were derived from volcanic rock with either andesitic or basaltic texture and some of these have been at least slightly rounded. There are some grains which are now composed of chlorite and there are a few composed of sericite. Many of the grains now composed of clay were almost certainly originally volcanic glass and there are a few which show some evidence of former vesicular texture.

This sediment contains 1 to 2% of turbid feldspar grains and up to 1% of angular quartz grains.

It is possible that replacement of much of the volcanic glass by clay minerals is not purely a result of weathering but occurred earlier in the history of this sediment.

Conclusion:

Tuffaceous sandstone or tuff composed of well sorted detrital material derived from volcanic rock possibly of intermediate composition.

Sample: 183942; TSC31468

Hand Specimen:

A massive, moderately fine-grained rock which is stained pale orange-brown by weathering but in the interior of a freshly cut surface, there is a zone of unweathered, grey rock.

Staining with cobaltinitrite shows no potash feldspar.

Thin Section:

This is a moderately fine-grained igneous rock containing at least 55% of plagioclase crystals, at least 25 to 30% of weathered pyroxene, a moderate amount of interstitial chlorite and 3 to 5% of opaque iron-titanium oxide.

Plagioclase crystals vary in length from 0.5 mm to 2 mm and they are intergrown with random orientation to give a rather decussate texture. Many are turbid and they show some alteration to sericite. Interstices between the plagioclase crystals contain crystals and aggregates of clinopyroxene varying in grain size from less than 0.05 mm to 0.4 mm, associated with varying proportions of interstitial chlorite. Most of the pyroxene has been stained orange to brown by iron oxide and some has been replaced by clay and goethite. There are also small crystals of opaque iron-titanium oxide, most of them less than 0.2 mm in size and many of these show skeletal or small-scale dendritic patterns similar to those commonly found in magnetite in basaltic rocks. In the area sectioned, there are two small spherical bodies 0.8 to 1 mm in diameter composed mainly of chlorite with lesser epidote and some goethite and these are probably small amygdales.

There are a few small fractures or shearing planes along which there are concentrations of epidote and chlorite and adjacent to some of these the rock is more heavily stained by goethite.

Conclusion:

This is a coarse-grained basalt.

986048

Sample: 249411; TSC31469

Hand Specimen:

A massive, greyish and yellowish-green, fine-grained rock cut by small fractures stained by iron oxide.

Thin Section:

This is a basaltic rock which is finer-grained than sample 183942. It contains over 50% of plagioclase, a moderate amount of heavily stained and partly altered clinopyroxene, very fine-grained interstitial material which may originally have been volcanic glass and at least 5% of opaque iron-titanium oxide.

Most of the plagioclase crystals are between 0.1 and 0.5 mm long but there are a few larger crystals up to 1 mm long which give the rock a slightly porphyritic texture. Interstices between the intergrown plagioclase crystals contain partly altered and brown-stained clinopyroxene varying in grain size up to 0.15 mm, some chlorite and some very turbid, very fine-grained indeterminate material which may have been volcanic glass. There is a slightly higher concentration of opaque iron-titanium oxide than in sample 183942 and this occurs as very small crystals and crystalline aggregates, some of which are elongate. In the turbid, very fine-grained material there is also some much finer-grained iron oxide.

Epidote was not found in this sample but many of the plagioclase crystals have been invaded by chlorite. There are a few small intersecting veins containing chlorite and goethite.

Conclusion:

Fine-grained basalt which is slightly porphyritic.

Sample: 249425; TSC31470

Hand Specimen:

A massive, moderately fine-grained rock which is now stained dull orange to reddish-brown as a result of weathering. In one zone in the sample there are a few spherical bodies up to 5 mm in diameter now composed of iron oxide-stained clay and goethite and, from the general appearance of these, it is suggested that they may be weathered amygdaloids.

Thin Section:

This is a basaltic rock containing at least 55 to 60% of plagioclase, over 25% of very weathered pyroxene, a moderate amount of interstitial and secondary chlorite and 2 to 4% of opaque iron-titanium oxide. There is a trace of epidote and a very weathered vein which may once have contained a little amphibole.

The rock is moderately coarse-grained for a basalt and contains a fairly large proportion of intergrown plagioclase crystals, mainly between 0.3 and 1 mm long and a few of these appear slightly bent or deformed. The ferromagnesian mineral occurring in interstices between the plagioclase crystals was probably pyroxene but most of it has been completely altered and replaced by clay minerals heavily stained by iron oxide and, although the general shape of crystals and texture suggest that this was pyroxene no remnants remained to confirm it. Interstices also contain an abundance of green to orange-stained chlorite and this has penetrated numerous small fractures and has invaded some of the plagioclase as well as altered pyroxene. Opaque iron oxide crystals are about 0.05 to 0.1 mm in size with a few up to 0.2 mm.

Only a small portion of the one of the spherical bodies is included in the section and this is mainly weathered chlorite but there is another possible amygdaloid of irregular shape which contains orange-stained chlorite and a trace of epidote. Along a fractured or sheared zone there is a vein up to 2 mm thick containing chlorite and possibly some remnants of altered and stained ?amphibole.

Conclusion:

This is a weathered basalt.

Sample: 249431; TSC31471

Hand Specimen:

A massive, fine-grained rock which has weathered a dull greyish-green. There are a few small, almost white bodies which are probably weathered amygdales.

Thin Section:

A fine-grained basalt containing abundant, partly altered plagioclase, very fine-grained interstitial material which is now heavily stained reddish-brown by iron oxide and at least 5% of iron-titanium oxide.

This basalt is finer-grained than sample 249425 and, in general texture, it is similar to sample 249411. Many of the plagioclase crystals are very small and only 0.1 to 0.3 mm long but there are scattered, larger plagioclase crystals about 1 mm long. Interstices contain very fine-grained, reddish-brown material, much of which was probably originally volcanic glass but there is also at least some weathered and stained ?pyroxene and chlorite. Much of the iron oxide has a grain size of about 0.02 mm and it tends to form elongate and skeletal aggregates. Finer-grained iron oxide occurs in some of the turbid, brown-stained material. In some zones in the rock, the plagioclase has been almost completely replaced by sericite and clay.

There are a few small spherical amygdales, most of them less than 0.5 mm in diameter and these contain chlorite and traces of epidote. There are a few irregular and discontinuous veins or shearing planes containing epidote, chlorite, a trace of quartz and possibly a trace of feldspar.

Conclusion:

Fine-grained basalt which is similar to sample 249411.

Sample: 249446; TSC31472

Hand Specimen:

A massive, fine-grained grey rock weathering reddish-brown. It contains a few almost white crystals 1 to 2 mm long which were found in thin section to be plagioclase phenocrysts.

Thin Section:

This is a medium-grained basalt containing abundant, partly altered plagioclase intergrown with at least 35% of clinopyroxene, minor chlorite and 5 to 7% of opaque iron-titanium oxide.

The groundmass of the rock contains a large proportion of plagioclase crystals 0.2 to 0.5 mm long intergrown with small crystals and crystalline aggregates of partly altered clinopyroxene, much of which has a common grain size of 0.05 to 0.1 mm but there are a few larger pyroxene crystals up to 0.3 mm in size. The texture of this rock is slightly different from that in the samples of basalt already described (samples 183942-249431) in that most of the plagioclase crystals are separate and appear to be intergrown with the aggregates of pyroxene. The plagioclase has been extensively altered to sericite, chlorite and possibly clay but the outline of the crystals has been clearly preserved. In some of the turbid, partly altered plagioclase crystals there may be a little very fine-grained zoisite associated with the sericite. In weathered portions of the rock the pyroxene is more or less heavily stained by reddish-brown iron oxide but in unweathered zones the pyroxene is relatively fresh. A few interstices contain very fine-grained, dark green chlorite. Iron oxide crystals vary in size from less than 0.05 mm to 0.2 mm.

There are a few larger crystals or phenocrysts of plagioclase 0.5 mm to 2 mm long scattered through the finer-grained groundmass and some of these are intergrown to form aggregates of phenocrysts. There are also one or two crystals of clinopyroxene up to 1 mm long. Amygdales were not found in the area sectioned nor in the hand specimen. Small fractures or veins contain chlorite, secondary goethite and a little epidote.

Conclusion:

Porphyritic basalt containing less interstitial chlorite than samples 183942-249431 and it probably had no interstitial volcanic glass.

Sample: 249478; TSC31473

Hand Specimen:

A fine-grained, grey rock weathering greyish-red to brown. There are a few leached voids and open fractures.

Thin Section:

This is a sedimentary rock composed of poorly sorted, immature detrital material. Detrital grains vary in size from less than 0.05 mm to 0.5 mm and they include very numerous grains now composed of chlorite, about 10 to 15% of detrital quartz, grains which are now composed of sericite, minor detrital feldspar probably plagioclase, some recognizable lithic grains, opaque oxide grains and leucoxene and a few detrital flakes of muscovite. Most of the quartz grains and harder lithic grains are angular and elongate grains tend to be subparallel, probably to the direction of bedding. Some of the harder lithic grains were clearly derived from volcanic rock of acid or intermediate composition, a few are predominantly feldspar, probably plagioclase and a few are of microcrystalline quartz. There are other lithic grains which appear to have been derived from more basic volcanic rock and probably many of the grains now composed mainly of chlorite and a little iron oxide were also derived from basic or intermediate volcanic rock. There are numerous small grains composed of sericite and some of these could represent sericitized plagioclase. Opaque oxide grains vary in size from less than 0.05 mm to 0.2 mm and the few detrital muscovite flakes present (mainly in one layer) are about 0.5 mm long.

These detrital grains are closely packed and probably many of the chloritic and sericitic grains have been deformed during compaction of the sediment. They are now cemented mainly of very fine-grained chlorite which merges with, and is generally indistinguishable from that comprising many of the detrital grains.

Conclusion:

A fine-grained, volcanic-lithic sandstone or fine-grained greywacke.

Sample: 249543; TSC31474

Hand Specimen:

A dark greenish-grey, fine-grained rock with a rather nodular or nobbly appearance and a slightly slippery feel. A freshly cut surface has a rather patchy appearance with small, paler-coloured zones and veins.

Thin Section:

The rock is composed predominantly of serpentine and chlorite minerals with minor secondary, migratory quartz. It is weathered and stained by brown iron oxide.

In many areas, the serpentine and chlorite minerals are very fine-grained and show little evidence of earlier textures but there is one elongate zone where there are relict textures and also possibly a few remnants of very small, elongate crystals which in cross section are only about 0.05 mm in size and could have been crystallites of olivine or pyroxene or tiny crystals of amphibole. In another area, there are poorly preserved relict textures derived from fibrous and skeletal crystals and aggregates showing textures similar to those found in some fine-grained ultrabasic rocks. (Similar textures were found in a few areas in sample 183892). In one area, relict textures defined by staining suggest that there could have been some very small vesicles but this evidence is not very conclusive.

The rock has been fractured and sheared and there are now intersecting shears and vein-like patches composed of fine, fibrous minerals resembling chrysotile in general texture. There are also small patches of fine-grained, secondary quartz which has invaded the sheared and deformed rock.

Conclusion:

Deformed serpentinite showing some relict textures which could be interpreted as having been derived from a relatively fine-grained ultrabasic rock.

Sample: 249557; TSC31475

Hand Specimen:

A weathered rock now composed of clay stained greyish-red and pale orange by iron oxides. In small parts of the rock where relict textures are preserved they show small spheres and ovals of white clay which, in some areas have been drawn out and/or flattened.

Thin Section:

The rock is now composed entirely of clay minerals and iron oxides but relict textures are clearly preserved and show that it was once very vesicular volcanic glass or pumice with closely-spaced vesicles 0.05 mm to 0.5 mm in size and a few larger voids up to 1 mm. These former vesicles are outlined by thin lines of iron oxide and in some areas, they have been drawn out or elongated probably by flow movement.

In some interstices between the former vesicles there are traces of leucoxene and in some areas there are traces of chlorite.

Conclusion:

Altered vesicular volcanic glass or pumice now mainly clay and iron oxide.

Sample: 249558; TSC31476

Hand Specimen:

A very weathered, moderately fine-grained rock which is now mainly clay stained reddish brown by iron oxide. Relict textures suggest that the rock was massive with no evidence of layering or of a foliation.

Thin Section:

The weathered rock is now composed almost entirely of clay minerals and opaque oxides probably mainly iron oxide but relict textures have been moderately well preserved. These textures show that the rock once contained numerous elongate or tabular feldspar crystals 0.3 to 0.6 mm long intergrown with random orientation to give the rock a basaltic texture. Interstices between these altered feldspar (probably plagioclase) crystals contain iron oxide-stained clay and some very fine skeletal or dendritic intergrowths of opaque iron-titanium oxide. A few interstices show some thin colloform layers of iron oxide-stained clay or altered chlorite.

There are a few areas with rather confused textures where there may have been some small vesicles or amygdales. Some zones in the rock have been fractured or sheared and extensively replaced by iron oxide.

Conclusion:

Decomposed and iron oxide-stained basalt.

Sample: 249561; TSC31477

Hand Specimen:

A pale greenish-brown to greenish-grey, weathered rock which is moderately fine-grained.

Thin Section:

The rock has been extensively altered and now contains a large proportion of chlorite and secondary clay minerals, iron oxide staining, minor opaque iron-titanium oxide and minor secondary quartz.

Although the rock has been completely replaced by secondary minerals, in many areas there are relict textures defined mainly by variations in the concentration of iron oxide staining and these suggest that it was a patchy and possibly very vesicular lava or ash flow. There are some zones with relict textures inherited from elongate or prismatic crystals up to 0.6 mm long and these zones contain small crystals of opaque iron oxide or iron-titanium oxide averaging about 0.05 mm in size. These areas could have been basaltic but the textures are not sufficiently well preserved for this to be absolutely certain. There are relict textures of vesicles or amygdales less than 1 mm in size and there could have been a few phenocrysts about 0.5 mm in size but, because of deformation and alteration, the outline of these is not clearly preserved and the suggestion is tentative. Towards one side of the thin section there is a zone which appears to have been more vesicular and finer-grained but in general, textures in this rock are very confused. It could represent the vesicular and fragmented surface of a lava flow which was deformed during movement of the lava.

Conclusion:

Decomposed lava probably of basic composition which is now mainly chlorite and clay stained by iron oxide.

Sample: 249570; TSC31478

Hand Specimen:

The least-altered zone of the rock is dark greyish-red and very fine-grained. It is cut by numerous intersecting veins found in thin section to be mainly quartz and towards the weathered surface of the rock, it is a paler colour and stained orange to brown by iron oxide. The unaltered zone of the rock is very hard suggesting it is predominantly quartz.

Thin Section:

The rock is extremely fine-grained and has a background or matrix of crypto-crystalline to microcrystalline quartz which is so fine-grained that it is almost isotropic in the thin section. This extremely fine-grained matrix contains up to 20% of very small flakes of muscovite or sericite, chlorite and possibly a trace of biotite and also numerous tiny particles of dark iron oxide. Many of the micaceous flakes are orientated in the same direction and, as at least some of these appear to be detrital flakes, this could be the direction of bedding. In some areas, there is a faint suggestion of relict textures which could be interpreted as having been derived from very small volcanic shards but this evidence is not sufficiently clear to be conclusive and the suggestion must be regarded as very tentative. All of the detrital material in this rock was extremely fine-grained, much of it probably with a grain size of only a few microns.

The rock is now cut by numerous intersecting veins varying in thickness from less than 0.1 mm to over 1 mm and most of these contain quartz. Along the edges of some of these veins there is a little feldspar probably plagioclase and a little iron oxide-stained mica. In one of the larger veins there is a small group of crystals now composed of leucoxene.

Conclusion:

Argillaceous chert with numerous intersecting quartz veins.

986058

Sample: 249578; TSC31479

Hand Specimen:

A very weathered, friable rock stained orange to brown by iron oxides. Relict textures are defined by variations in colour and these show rather confused patterns of small patches, swirls and streaks and possibly tiny vesicles.

Thin Section:

The rock is now composed mainly of chloritic and clay minerals stained to varying degrees by iron oxide and it contains minor opaque iron oxide and leucoxene.

Relict textures are clearly preserved and show that this was originally very vesicular volcanic glass with some areas containing almost spherical vesicles up to about 0.5 mm in diameter but, between the zones containing undeformed vesicles there is evidence of flow movement with streaks and swirls and vesicles which were deformed and drawn out. In general, there is no evidence of crystallites but in a few places there are relicts or remnants of tiny ?feldspar crystals or crystallites generally less than 0.4 mm long and in some patches of clay, there is now a little turbid leucoxene.

In one zone in the rock there is a little secondary chalcedonic quartz which contains tiny inclusions of carbonate.

Conclusion:

Decomposed, vesicular volcanic glass showing evidence of flow movement. It probably had a basic composition and therefore may have been tachylyte.

Sample: 249586; TSC31480

Hand Specimen:

A greyish-orange to brick-red, fine-grained rock containing an abundance of spherical to oval amygdales up to 6 mm in diameter. Most of these amygdales are hard and composed mainly of quartz.

Thin Section:

The groundmass of the rock is completely altered and is now composed of clay minerals and iron oxides but relict textures are moderately well preserved and show that it was a basaltic rock containing at least moderately abundant feldspar probably plagioclase crystals 0.2 to 0.6 mm long intergrown with random orientation to give a basaltic texture. Interstices between the altered plagioclase crystals contain clay stained by red and orange iron oxides and there is also a little very fine-grained opaque iron oxide or iron-titanium oxide and leucoxene. In some areas there are interstices which now contain secondary, microcrystalline quartz.

The rock was originally very vesicular and there are now numerous amygdales, some of which are spherical and others are of irregular shape and interconnected. Some have been almost completely filled by quartz, some of which occurs as radiating aggregates of fibrous chalcedonic quartz and some is moderately coarse-grained. Some amygdales contain altered chlorite, most of which is now stained orange to brown by iron oxide but in a few amygdales there are remnants of bright green chlorite, generally closely associated with microcrystalline quartz. Some of these amygdales also contain extremely fine-grained, dark red hematite.

Conclusion:

Decomposed, amygdaloidal basalt in which many of the amygdales contain quartz.

Sample: 249401; TSC31481

Hand Specimen:

A pinkish-orange, fine-grained rock which now appears to be composed mainly of clay stained by iron oxide. When a freshly cut surface is examined under low magnification, very small grains of different colours can be seen and these all appear to be of fairly uniform size. There is no evidence of bedding but the rock is cut by joints in various directions and these joint surfaces are stained by iron and/or manganese oxides.

Thin Section:

A visual estimate of the minerals now present is as follows:

	%
Clay minerals	>85
Goethite staining	10-15
Opaque oxides	trace-1
Leucoxene	trace
Quartz	minute trace

This rock has been completely altered but much of the original texture has been preserved mainly by iron oxide staining. Relict textures show that the rock was originally composed of moderately well sorted grains mainly between 0.1 and 0.2 mm in size with a few longer grains up to 0.4 mm long and a large proportion of these were fragments of volcanic glass and/or shards. Some were clearly vesicular fragments of volcanic glass and, as many of the boundaries are no longer clearly defined, it is possible that at least some of them were soft at the time they accumulated. Mixed with the altered fragments of volcanic glass there are darker grains now heavily stained by reddish-brown iron oxide and it is not certain whether these were also volcanic glass or small fragments of volcanic rock. In a few there is a suggestion of relict texture inherited from very small elongate crystals, possibly feldspar and it is therefore possible that at least some of these darker fragments were volcanic-lithic fragments. There are a few opaque grains possibly of iron-titanium oxide generally less than 0.1 mm in size and in a few places there is some extremely fine-grained iron oxide which could represent oxidized pyrite. A few very small patches or grains of quartz were found in the area sectioned and one of these could have come from a small amygdale.

The fragments of volcanic glass and darker lithic fragments were closely packed and it is possible that some of the fragments of volcanic glass were welded. There is no definite evidence to suggest the presence of any interstitial matrix and most of the fragments have now been replaced by clay minerals with the outline or shape preserved by lines of iron oxide.

Conclusion:

Weathered vitric tuff which was originally composed mainly of small fragments of volcanic glass. These fragments were well sorted.

Sample: 249404; TSC31482

Hand Specimen:

A dark greyish-red, very fine-grained rock which is moderately hard and, at least in some zones, is barely scratched by a steel point. Variations in colour on a freshly cut surface show that the rock is finely laminated.

Thin Section:

This rock is extremely fine-grained and therefore it is not possible to give an accurate estimate of the constituent minerals by microscopic examination. The visual estimate of minerals given below will therefore probably not be very accurate. It contains the following minerals:

	<u>%</u>
Cryptocrystalline to micro-crystalline quartz	50-60?
Hematite staining	10-15
Sericite and clay	30-35?
Leucoxene	trace

The rock now contains a relatively large proportion of cryptocrystalline to microcrystalline quartz stained to varying degrees by concentrations of minute particles of red iron oxide probably hematite. Colour variations which define the layering in this rock are due mainly to variations in the intensity of this iron oxide staining and in general, there is little or no other evidence of bedding. The siliceous matrix contains an undetermined amount of fine-grained clay which is probably obscured by the iron oxide and there are also tiny flakes of muscovite or sericite, many of which show a preferred orientation parallel to the layering as defined by variations in colour. There are also very small, almost opaque grains which are probably also iron oxide. In some layers, there are relicts or remnants of thin wisps or shreds which are now also represented by concentrations of dark red iron oxide.

In many of the layers there are tiny spheres of clear microcrystalline and chalcedonic quartz and most of these are between 10 and 30 microns in diameter. They vary in concentration and are more abundant in a pale-coloured zone near one end of the section. In a few of the layers there are one or two small pseudomorphs now composed of microcrystalline quartz and these have retained the shape of earlier crystals 0.1 to 0.3 mm in size. A few of these pseudomorphs have a rhomb-shaped cross section suggesting the possibility of former carbonate crystals but at least two of these pseudomorphs appear to have been aggregates of crystals and the possibility of an evaporite mineral cannot be entirely excluded.

The rock is cut by small fractures and microfaults and along some of these there are clay minerals, very fine-grained quartz and a little iron oxide-stained ?chlorite.

Conclusion:

Argillaceous and slightly ferruginous chert. It is possible that some of the layers could be classified as cherty argillite.

Sample: 249417; TSC31483

Hand Specimen:

This is a dark greyish-red, very fine-grained, hard rock which is very similar to sample 249404. It also shows some evidence of layering due mainly to slight variations in colour and in places, it tends to split along some planes parallel to this layering. There are also numerous joints cutting the rock at high angles to the layering.

Thin Section:

This is similar to sample 249404 and is too fine-grained for the relative proportions of the constituent minerals to be accurately determined by microscopic examination. The following minerals are present:

	<u>%</u>
Cryptocrystalline to micro-crystalline quartz	60-70?
Hematite	10-20 (varies)
Argillaceous material	10-20?

This is an extremely fine-grained, siliceous sediment which is essentially very similar to sample 249404 in that it is composed largely of cryptocrystalline to microcrystalline quartz stained by varying concentrations of extremely fine-grained red to brown iron oxide. There are a few small grains or particles of almost opaque iron oxide and tiny flakes of muscovite or sericite but these tiny flakes are present in lower concentration than in sample 249404. There is probably some argillaceous material obscured by the iron oxide staining and the amount cannot be determined by microscopic examination.

This rock also contains some tiny spheres of microcrystalline or chalcedonic quartz 10 to 30 microns in diameter but no other pseudomorphs of microcrystalline quartz were found in the area sectioned.

The layering as defined by variations in the concentration of iron oxide has been deformed by small folds and microfaults and along some of the fractures, there are small veins containing very fine-grained quartz and some iron oxide-stained chlorite or clay.

Conclusion:

Ferruginous and argillaceous chert very similar to sample 249404.

Sample: 249441; TSC31484

and Specimen:

The sample contains portion of a moderately large white quartz vein at least 2 cm thick and some portions of orange to yellow, weathered rock which have been cut a network of quartz veins and partly replaced by quartz spreading out from these veins.

and Section:

The composition varies in different zones in the rock and therefore the quantitative estimates given may not be accurate for the sample as a whole. The section contains the following minerals:

	<u>%</u>
Quartz	>50
Partly altered epidote	25-30
Clay	varies
Microcrystalline quartz	minor

The orange and yellow-stained zones in this rock contain masses of intergrown epidote crystals, many of which are between 0.5 and 1 mm long. A few interstices between some epidote crystals contain a little iron oxide-stained clay but in general no other mineral is associated with the epidote and no relict textures could be found from which to identify the rock which may have been replaced by the epidote. In some areas this epidote has been extensively altered and replaced by orange-stained, clay-like material.

The epidotized rock has been invaded by quartz which now forms coarse-grained masses and veins, some of which enclose crystals and remnants of epidote. Some of the quartz adjacent to aggregates of epidote contains a few small inclusions of epidote and in most areas where the two minerals are in contact, textural evidence shows that the quartz crystallized after the epidote. Some of the masses of extensively altered epidote are cut by small quartz veins.

In some of the more porous zones in the rock, there is a little very fine-grained or microcrystalline quartz lining numerous voids.

Conclusion:

Epidotized rock has been invaded and partly replaced by vein quartz.

Sample: 249443; TSC31485

Hand Specimen:

A pale brownish-orange, fine-grained rock which, when examined under low magnification can be seen to be composed of small grains of various colours. These are of uniform size and in the sample submitted there is no layering or evidence of a foliation.

Thin Section:

A visual estimate of the minerals now present is as follows:

	%
Chlorite and clay minerals	>75
Goethite staining	15-20
Epidote	trace
Quartz grains	trace
Opaque iron oxide	trace
Leucoxene	trace

The original constituents of this rock have been almost completely replaced by very fine-grained chlorite and/or clay but much of the original texture has been preserved by lines of orange to brown iron oxide and by variations in intensity of staining by iron oxide. These relict textures show that this was a sedimentary rock originally composed of angular fragments 0.05 to 0.2 mm in size with a few larger, elongate fragments up to 0.5 mm long and most of these were almost certainly volcanic glass. A few have shapes typical of volcanic shards and a few were clearly vesicular fragments. Relict textures in some of the larger fragments suggest that they may have contained a few tiny crystallites probably of feldspar. A few of the fragments show thin lines suggesting flow structure. These fragments of altered volcanic glass are very similar to those in sample 249401 and this differs from sample 249401 mainly in that it contains a lower proportion of dark fragments heavily stained by iron oxide. Most of the fragments of volcanic glass have been replaced by chlorite and/or secondary clay minerals but in a few there are traces of epidote. Most of them are angular and elongate fragments are subparallel possibly indicating the direction of bedding.

Other detrital material includes a few angular quartz grains up to 0.2 mm in size, some darker grains which are heavily stained by iron oxide, one or two small feldspar grains and a few grains of opaque iron oxide and leucoxene. There is one grain composed of microcrystalline quartz.

The fragments of volcanic glass were closely packed and there is no evidence to suggest that the rock ever contained any interstitial material. Some of the fragments may have been welded but in general, the outline of the original shards and fragments is clearly preserved.

Conclusion:

This is an indurated vitric tuff which has been weathered and stained by iron oxide.

Sample: 249458; TSC31486

Hand Specimen:

A dark greyish-green, very fine-grained rock which appears massive with no evidence of a foliation or of layering. There are a few small white veins, some of which appear to have formed in tension fractures.

Staining with cobaltinitrite shows moderately abundant potash feldspar throughout the body of the rock and the small veins are of potash feldspar.

Thin Section:

A visual estimate of the minerals now present is as follows:

	<u>%</u>
Chlorite	65-70
Potash feldspar	25-30
Quartz	3-5? (possibly more)
Leucoxene	trace
Biotite	minute trace
Secondary opaque material	2-3

This rock is now very fine-grained and all of the original constituents have been completely replaced by secondary minerals but there are suggestions of relict texture although these are not very well preserved.

The general matrix of the rock is composed of very fine-grained chlorite (grain size less than 0.02 mm) intergrown with equally fine-grained potash feldspar and possibly a little microcrystalline quartz. The chlorite does not show any preferred orientation and therefore the rock does not have a foliation. There are, however, a few tiny flakes of biotite up to 0.1 mm long orientated in approximately the same direction. There are a few very small dark grains and aggregates, some of which are almost certainly leucoxene and others may be secondary iron and/or manganese oxides. No definite relict textures could be found in this very fine-grained matrix but, scattered through the section there are areas 0.1 to 0.3 mm in size which are composed almost entirely of chlorite. Some of these are approximately rectangular and 0.1 x 0.2 mm in size, others appear equidimensional and a few are roughly round to oval. The shape of these masses of chlorite is, however, not sufficiently distinctive for their origin to be determined. There are a number of small, coarser-grained areas in the rock and these contain quartz varying in grain size up to 0.05 mm intergrown with chlorite and potash feldspar. These areas of coarser-grained material also have no distinctive shape or pattern.

The area sectioned contains one large vein 1 to 1.5 mm thick and several intersecting and interconnected, smaller veins all of which contain slightly turbid potash feldspar. Almost certainly these have formed by lateral secretion into small tension or shearing fractures.

Conclusion:

A metasomatically-altered rock which was probably a fine-grained tuff but original textures are not sufficiently well preserved to confirm this.

Sample: 249471; TSC314287

Hand Specimen:

A very fine-grained, grey rock which is very hard. There are a few irregular veins of paler-coloured minerals.

Staining with cobaltinitrite showed no potash feldspar and staining with rhodizonate for plagioclase gave rather indefinite results but suggests that the rock contains minor plagioclase, some of it along veins.

Thin Section:

The rock is very fine-grained and an accurate estimate of its mineralogy could best be obtained by X-ray diffraction. A visual estimate suggests the following minerals:

	<u>%</u>
Quartz (mainly microcrystalline)	>75
Weathered chlorite	10-15
Plagioclase	5-10?
Opaque material	2-3

The rock is now composed predominantly of microcrystalline and very fine-grained quartz and almost certainly much of this is secondary and has replaced the earlier rock. Small patches and flakes of chlorite are scattered through much of the fine-grained quartz and there are also tiny black opaque particles which cannot be identified in thin section but which could be carbonaceous material. There are at least a few very small crystals of plagioclase but most of the plagioclase which can be positively identified in the thin section is concentrated along small veins. In general, former textures are not preserved in the mass of quartz but there is at least one area where dusty iron oxide staining suggests that there were originally very small detrital grains, many of them less than 0.05 mm in size which are now surrounded by overgrowths of secondary quartz and, in places, include within the secondary quartz.

There are some zones or bands in the rock which contain concentrations of pseudomorphs about 0.1 mm in size now composed of yellow to orange-stained chlorite or clay. Many of these have a square cross section, a few have rectangular cross sections and a few have hexagonal cross sections. It is not certain whether the chloritic material replaced crystals of an earlier mineral or filled voids left by solution of an earlier mineral. The identity of the former mineral cannot be suggested with any degree of confidence and although pyrite commonly gives square and hexagonal cross sections, the general appearance of these chloritic or clay pseudomorphs does not strongly suggest pyrite. They appear to be concentrated in a zone or layer where relict textures suggest that the rock was originally composed largely of silt-sized detrital grains and a few tiny micaceous flakes.

The rock is cut by numerous small veins, some of which are entirely quartz, others contain plagioclase with and without quartz.

Conclusion:

This is a silicified, fine-grained sediment which almost certainly included some zones or bands of siltstone. The detrital material appears to have been too fine-grained for its origin to be determined and there is therefore no definite evidence to suggest that the sediment was tuffaceous. There are some unusual chloritic or clay pseudomorphs after small crystals of an unidentified mineral.

Sample: 249486; TS's C31488 and 31488-A

The bag labelled 249486 contained two samples of rock both with a painted number 249486 and these differ considerably in grain size and texture. One of the samples (the coarser-grained rock) was therefore given the number 249486-A. Two thin sections were prepared from these two rocks and they will be treated separately.

Sample: 249486; TSC31488

Hand Specimen:

This is pale grey, fine-grained rock containing a trace of muscovite. The composition appears to be uniform and no evidence of layering could be found.

Staining with cobaltinitrite shows relatively minor potash feldspar.

Thin Section:

A visual estimate of the minerals is as follows:

	%
Quartz	50-55
Potash feldspar	15-20?
Plagioclase	5-10
Detrital mica	10-15
Chloritic grains	2-3
Lithic grains	1-2
Sericitic grains	1-2
Opaque grains and leucoxene	1-2
Garnet grains	trace
Zircon	trace
Interstitial chlorite and clay	5-10

This is a sedimentary rock composed of poorly sorted grains which vary in size from less than 0.05 mm to 0.8 mm and most of these are angular. Quartz predominates but there are also many angular grains of feldspar including both potash feldspar and plagioclase. There are grains which are composed entirely, or almost entirely, of chlorite and there are a few which are composed of sericite. There are a few recognizable lithic grains, some of which are composed of microcrystalline quartz with and without sericite or fine-grained muscovite and there are a few which may have been derived from fine-grained sediment or metasediment. No grains were found which could be definitely identified as having been derived from volcanic rock. There are some detrital muscovite flakes and also a few altered and partly bleached biotite flakes. There are a few heavy mineral grains, mainly opaque oxide and leucoxene but also including a few angular garnet grains and a few very small zircon grains.

The detrital grains are closely packed with the smaller grains filling many of the interstices between the larger grains. Very few of the quartz and feldspar grains have become welded and most of them are separated by at least thin films of argillaceous material. The remaining interstices contain varying proportions of chlorite and sericite and probably some clay and this interstitial material is lightly stained by iron oxide.

Conclusion:

Feldspathic and micaceous sandstone or arkose composed of poorly sorted, immature detrital material.

Sample: 249486; TSC31488-A

Hand Specimen:

The rock is composed mainly of aggregates or masses of relatively coarse-grained quartz which shows a patchy grey staining. There are a few open fractures and leached voids and a thin zone containing some clay or chloritic material.

Staining with cobaltinitrite does not show any potash feldspar.

Thin Section:

This sample is composed almost entirely of quartz with less than 10% of chlorite and very minor opaque iron oxide, some of which could be oxidized pyrite.

The quartz varies in grain size and includes some zones with a common grain size of less than 0.1 mm in contact with zones and veins of much coarser-grained quartz, containing a few individual crystals up to 2 mm in size. Some areas of finer-grained quartz contain small wisps and shreds of weathered and stained ?chlorite and the general appearance suggests that these may be remnants of an earlier rock which has been extensively replaced by the quartz. Some of the areas containing chlorite also have a few opaque grains and crystals varying in size from 0.02 to 0.2 mm and some of these are cubic crystals probably of oxidized pyrite.

Much of the coarse-grained quartz is clearly vein quartz but it has been subjected to tectonic stress which has resulted in fracturing, the development of strain and local granulation. Some of the quartz contains extremely fine-grained, black opaque material which cannot be identified in thin section but which could be carbonaceous material.

Conclusion:

The sample is partly vein quartz and partly a silicified rock which once contained chlorite and probably also some pyrite.

986069

Sample: 249487; TSC31489

Hand Specimen:

An orange to brown-stained, weathered rock which is fine-grained and has a definite foliation. A few small paler-coloured grains, most of them less than 1 mm in size, can be seen in a freshly cut surface.

Thin Section:

A visual estimate of the minerals is as follows:

	%
Weathered chlorite or clay	>80
Goethite staining	10-15
Quartz	1-2
Plagioclase	trace
Lithic fragments	trace

This is a weathered and stained rock now composed predominantly of weathered chlorite or clay lightly stained by iron oxide. There is a distinct foliation due to orientation of the micaceous chloritic material but textures in the rock suggest that it has been deformed and sheared. A careful search did not reveal any recognizable relict textures in the chloritic material and probably these have all been obliterated by the extensive deformation and shearing.

Scattered through the mass of chloritic material there are a few oval and elongate aggregates of generally harder minerals and these include some of microcrystalline and fine-grained quartz, a few fragments of coarser-grained quartz and a larger mass about 3 mm long of relatively coarse-grained secondary quartz or vein quartz. There is one apparently rounded grain of plagioclase 0.6 mm long and there are a few other fragments composed of finer-grained chloritic or clay-like material showing less iron oxide staining. It is tentatively suggested that these elongate and oval bodies are remnants of harder minerals or harder portions of the rock which survived extensive shearing and all other textures have been obliterated by the shearing.

In the general mass of orientated and probably sheared chlorite, there are scattered small crystals 0.05 mm to 0.2 mm in size which have been replaced by brown iron oxide and some of these have a rhombohedral shape suggesting that they may have been crystals of carbonate.

Conclusion:

Sheared and weathered chloritic schist of undetermined origin.

Note: There is another portion of the rock with the same number in the same bag and this is composed of similar weathered and iron oxide-stained chloritic material but it shows numerous small oval spots or bodies about 1 mm in size which show a strong resemblance to small amygdalae. It is therefore possible that this chloritic rock is an extensively altered basalt. This portion of rock was not sectioned.

986070

Sample: 249499; TSC31490

Hand Specimen:

A brownish grey, medium-grained rock with a porous, weathered skin which is a paler brown colour.

Thin Section:

A visual estimate of the minerals is as follows:

	<u>%</u>
Calcic plagioclase	40-45
Clinopyroxene	25-30
Orthopyroxene	25-30
Opaque oxide	trace
Biotite and chlorite	trace

This is a medium-grained igneous rock containing some moderately large crystals of clinopyroxene up to 3 mm long and generally smaller crystals of orthopyroxene intergrown with crystals and aggregates of plagioclase which is generally finer-grained than the pyroxene. Much of the plagioclase occurs as aggregates of intergrown elongate or tabular crystals 0.3 to 0.8 mm long and these aggregates tend to occur in interstices between the larger pyroxene crystals but there are also a few small plagioclase crystals included within some of the pyroxene crystals (both ortho- and clinopyroxene). A few of the larger orthopyroxene crystals contain numerous small inclusions of plagioclase and these areas resemble small patches of ophitic texture.

Most of the pyroxene occurs as separate crystals of either orthopyroxene or clinopyroxene but there is one orthopyroxene crystal about 1.5 mm long surrounded by an outer rim of clinopyroxene and the boundary between the ortho- and clinopyroxene is very irregular and almost certainly a result of reaction. There are a few orthopyroxene crystals which have small zones generally near the boundary in which there are very fine intergrowths possibly of ortho- and clinopyroxene and this is also an indication of reaction during solidification and cooling of the rock.

This rock has very little opaque iron-titanium oxide and there are only a few small crystals and aggregates of skeletal and/or dendritic opaque oxide generally intergrown with plagioclase. In some areas there are traces of secondary, fine-grained biotite or chlorite occurring in interstices and also in a little of the plagioclase.

Conclusion:

Dolerite containing both clinopyroxene and orthopyroxene.

Sample: 249503; TSC31491

Hand Specimen:

A massive, moderately fine-grained rock most of which is weathered and stained orange to pale brown by iron oxide but in the core of the sample submitted, there is a zone of less altered, predominantly grey rock.

Thin Section:

A visual estimate of the minerals is as follows:

	<u>%</u>
Extensively altered plagioclase	50-55
Partly altered pyroxene (mainly clino)	30-35
Opaque oxide	5-10
Secondary chlorite and biotite	5-10 (varies)
Sphene	trace
Quartz (probably secondary)	1-2

This is a moderately fine-grained, basic igneous rock which has been extensively altered. In the least-altered zones there are plagioclase crystals averaging about 0.5 mm long with some up to 1 mm and interstices between many of these plagioclase crystals contain pyroxene. In many areas there are relatively large crystals of pyroxene with some optically continuous patches up to 1 mm in size which enclose, or partly enclose, numerous small plagioclase crystals forming zones or patches of typical ophitic texture. Crystals of opaque iron-titanium oxide mainly between 0.05 and 0.3 mm in size are scattered throughout the rock and at least some of these have external crystal shapes suggesting that they were originally magnetite. Other elongate opaque crystals were probably ilmenite and some of these are now mainly leucoxene or very fine-grained sphene.

In the area sectioned, there are a few relatively large phenocrysts of altered ?feldspar up to 5 mm long.

In much of this rock the plagioclase has been partly or completely replaced by clay minerals and the pyroxene has been partly altered and heavily stained by orange to reddish-brown iron oxide. In some of the altered pyroxene there is a heavily stained micaceous mineral which is either secondary biotite or stained chlorite. In the altered zones there are small patches of moderately fine-grained quartz generally associated with patches and thin veinlets of iron oxide-stained chlorite or secondary biotite.

Conclusion:

Fine-grained dolerite which has been extensively weathered.

986072

Sample: 249504; TSC31492

lab Specimen:

A slightly greenish-brown, moderately fine-grained rock which, when examined under low magnification can be seen to contain small grains of fairly uniform size.

thin Section:

The rock is weathered and heavily stained by goethite and therefore the visual estimate of constituents given below may not be strictly accurate. It contains the following minerals:

	<u>%</u>
Lithic grains	30-40?
Grains probably composed of chlorite now weathered	20-30
Fragments of shale	10-15
Quartz grains	5-10
Opaque oxide	trace
Interstitial chlorite, clay and goethite	15-20

This is sediment composed of grains which vary in size from 0.05 mm to 0.5 mm and there is some variation in grain size in poorly defined layers. Lithic grains probably predominate but, because of the extensive weathering and staining it is not possible to give an accurate estimate of the relative abundance of these lithic grains. They include many grains which were clearly derived from fine-grained volcanic rock of varying composition and texture, some of microcrystalline quartz and of quartz and sericite of undetermined origin and there is one grain which appears to be fine-grained quartzite. There are also numerous grains now composed of chlorite or clay and some of these show textures strongly suggesting that they were fragments of volcanic glass including some vesicular fragments. In one zone or layer in the rock there are also numerous elongate fragments of shale 2 mm to 4 mm long which probably represents fragments of disrupted bottom sediment. Quartz grains scattered throughout the rock are predominantly angular.

These detrital grains and fragments were probably closely packed and they are now cemented by very turbid chlorite and/or clay heavily stained by goethite. This interstitial material merges with, and was probably at least partly derived from, deformed lithic and chloritic grains.

There are a few small grains of almost opaque iron oxide and leucoxene but no other heavy mineral grains were found in the section.

Conclusion:

Weathered and stained, volcanic-lithic sandstone. It could also be classified as a fine-grained greywacke.

Sample: 249559; TSC31493

Hand Specimen:

A very weathered dark greyish-red, fine-grained rock which is now composed mainly of clay stained by iron oxide. Some zones contain small, almost white grains or bodies and there are a few larger white patches and thin veins.

Thin Section:

A visual estimate of the minerals now present is as follows:

	<u>%</u>
Clay minerals	>80
Iron oxide-staining	10-20
Leucoxene	trace

This rock has been completely decomposed by weathering but relict textures are moderately well preserved and are defined mainly by variations in concentration of iron oxide staining. These relict textures show that this was a volcanic rock containing a large proportion of intergrown, small prismatic or elongate crystals up to 0.5 mm long but the textures are not sufficiently well preserved for this former mineral to be identified. The general appearance, however, is strongly suggestive of basaltic texture possibly in a fine-grained, chilled margin where there were some fine crystallites. Relict textures also show that there were small phenocrysts 0.2 to 0.6 mm in size, some of which occurred in groups and the external shape of these phenocrysts indicates either olivine or pyroxene. There are a few with a lozenge shape typical of the crystal form of olivine and very probably there were at least a few small phenocrysts of olivine. In one area, there were two small phenocrysts of feldspar up to 1 mm long.

Relict textures show that some zones in this rock were very vesicular and contained numerous small spherical, irregular and interconnected vesicles. These now contain almost colourless clay and surrounding these vesicles the decomposed rock is more heavily stained by iron oxide and at least some of it may have been glassy basaltic rock. Relict textures also show that some of the larger vesicles once contained small crystals.

Conclusion:

Weathered vesicular or amygdaloidal volcanic rock which was probably fine-grained basalt.

Sample: 249577; TSC31494

Hand Specimen:

A very weathered, reddish-grey rock which appears to be massive.

Thin Section:

A visual estimate of the minerals now present is as follows:

	<u>%</u>
Clay minerals	>75
Iron oxide staining	15-25
Leucoxene	1-2
Quartz veins	trace

This is similar to sample 249559 in that it has been completely altered and replaced by clay minerals and iron oxide but its original basaltic texture is more clearly visible than in sample 249559. It once contained a large proportion of intergrown, elongate feldspar crystals almost certainly plagioclase, many of them between 0.5 and 1 mm long and these have been replaced by almost white or colourless clay. Interstices between the former plagioclase crystals now contain clay stained by varying concentrations of orange to reddish-brown iron oxide and also patches of opaque, very fine-grained iron oxide probably secondary hematite. In some of these interstices relict textures marked by staining suggest the former presence of some curved crystallites and radiating or feathery aggregates of crystallites (possibly of pyroxene?). Some interstices also contain small grains and aggregates of leucoxene.

In some zones in the rock there were once a few small vesicles now represented by clear, almost colourless clay but no evidence of phenocrysts was found in the area sectioned.

There are some irregular patches and possibly veins containing clay and iron oxide and there are also a few small veins containing quartz and patches of goethite.

Conclusion:

Very weathered basalt.

Sample: 249580; TSC31495

Hand Specimen:

A yellowish-grey, medium-grained weathered rock containing scattered, larger crystals or aggregates about 5 mm in size.

Thin Section:

A visual estimate of the minerals is as follows:

	<u>%</u>
Partly altered plagioclase	50-60
Pyroxene remnants	5-10
Secondary chlorite, clay and iron oxide (some after pyroxene)	30-35
Opaque oxide and leucoxene	2-3

This is a weathered, medium-grained basic igneous rock which has a porphyritic texture. The groundmass contains abundant elongate or tabular plagioclase crystals 1 to 2 mm long and in some zones in the rock these have been extensively replaced by clay and a little sericite but the outline has been clearly preserved. Interstices between these plagioclase crystals once contained medium-grained pyroxene with at least some crystals about 1 mm in size but most of these pyroxene crystals have been extensively replaced by orange-stained chlorite or clay and in many there are only corroded remnants of pyroxene. In some zones in the rock the pyroxene has been completely replaced by secondary minerals. Some interstices contain crystals and crystalline aggregates of opaque iron-titanium oxide up to 0.5 mm in size and some of this was almost certainly titaniferous magnetite. There are some elongate opaque crystals up to 1 mm long which were probably ilmenite now at least partly replaced by leucoxene.

In this groundmass there are numerous rather irregular, generally interstitial bodies now composed of clay minerals and iron oxides with small patches or remnants of chlorite. In some of these there is some colloform banding and evidence of portions of spherulites or spherulitic aggregates. Some of these bodies show similarities to amygdales but in general, they are not spherical or oval.

The rock contains scattered phenocrysts of partly altered plagioclase 3 to 6 mm long and up to 3 mm thick and most of these have been extensively replaced by sericitic material.

Conclusion:

Weathered, porphyritic dolerite.

Sample: 249585; TSC31496

Hand Specimen:

A greenish and reddish-grey, fine-grained rock which is weathered and partly friable.

Thin Section:

This rock is composed almost entirely of iron oxide-stained clay and an estimate of the relative proportions of these would have little meaning.

The rock has been completely altered but original textures are clearly preserved and show that it was a very fine-grained basaltic rock containing very numerous, very small vesicles, some of them less than 0.1 mm in size but varying up to 0.5 mm long. Relict textures suggest that the basaltic rock itself contained an abundance of tiny crystallites, some of them occurring as radiating and feathery aggregates and it may also have contained some vitreous material. In some places lines of staining suggests flow structure and in some zones, the small vesicles have clearly been drawn out in a common direction. This flow structure changes direction and flow movement in the lava was probably not uniform. There may also have been a few fragments of the solidified surface of the lava incorporated in the moving, still molten material.

One altered phenocryst about 1 mm in size was found in the area sectioned and there are a few slightly larger, oval vesicles or amygdales containing traces of quartz and weathered chlorite.

Conclusion:

Weathered, vesicular, fine-grained basalt from a chilled boundary or surface of a lava flow.

Sample: 249590; TSC31497

Hand Specimen:

A pinkish-grey, fine-grained, weathered rock with a few, almost parallel elongate bodies of clay 1 to 2 mm wide.

Thin Section:

This rock is similar to other samples in that it is also now composed of clay minerals and iron oxides but the texture is clearly preserved and a visual estimate of its former constituents is suggested as follows:

	<u>%</u>
Plagioclase (completely altered)	50-55
Interstitial silicates	35-40
Iron-titanium oxides	3-5?
Vesicles and/or amygdales	3-5 (more locally)

The rock is now composed almost entirely of clay and iron oxides but relict basaltic texture is clearly preserved and shows that it originally contained an abundance of elongate, thin plagioclase crystals, many of them between 0.3 and 0.6 mm long with a few larger crystals up to 1 mm long. Interstices once contained very fine-grained silicate minerals and possibly some volcanic glass now replaced by clay and iron oxide and in general, relict textures are not clearly preserved in this interstitial material. There were, however, some skeletal and/or dendritic aggregates of fine-grained iron oxide possibly magnetite and there are now a few small grains or aggregates of leucoxene possibly derived from ilmenite. Many interstices now contain clear, almost colourless clay and similar clay is present in numerous small amygdales or vesicles. Some of these small vesicles were interstitial and possibly originally contained chlorite, others are larger (up to 0.5 mm in size) and almost spherical.

The subparallel, elongate bodies of clay noted in the hand specimen have very irregular boundaries and some appear to be interconnected amygdales or vesicles. Textures suggest that they once contained radiating aggregates of chlorite now altered and stained orange to reddish-brown by iron oxide. These subparallel bodies may represent small channels along which steam and other volatiles escaped from the cooling lava.

Conclusion:

Weathered, fine-grained, vesicular or amygdaloidal basalt.

Sample: 249591; TSC31498

Hand Specimen:

A purplish-grey, medium-grained rock which appears to be massive but there are some parallel bands or iron oxide staining which are very probably superficial and due to weathering. It contains a few larger pale-coloured crystals found in thin section to be plagioclase phenocrysts.

Thin Section:

A visual estimate of the minerals is as follows:

	<u>%</u>
Plagioclase	50-55
Partly altered pyroxene	30-35
Interstitial chlorite and clay	5-10
Opaque oxide (some secondary)	5-10
Quartz	trace

This is a medium-grained basic igneous rock containing thin, elongate plagioclase crystals mainly between 0.5 and 1 mm long and these are intergrown with random orientation. A few of the plagioclase crystals appear slightly bent or fractured but in general there is no other evidence of deformation. Many interstices between the plagioclase crystals contain very pale-coloured clinopyroxene with a common grain size of 0.2 to 0.5 mm and this clinopyroxene has been partly replaced by clay-like minerals stained by iron oxide. Interstices also contain varying concentrations of opaque iron oxide, some of which is probably primary magnetite and/or ilmenite but in bands in the rock which appear more heavily stained in the hand specimen, there is certainly some secondary opaque iron oxide probably hematite filling some interstices between plagioclase crystals. Some of this secondary iron oxide has also penetrated along grain boundaries and along a few cleavage planes in plagioclase. A few interstices contain very fine-grained chlorite or clay and a few contain quartz which appears to be secondary and may have replaced earlier chloritic material.

The larger crystals noted in the hand specimen are phenocrysts of plagioclase several millimetres in size.

There are some zones of fracturing and/or shearing along which the rock has been more extensively altered and replaced by clay and iron oxides. There are also thin, irregular bands in which there are concentrations of reddish-brown iron oxide.

Conclusion:

Weathered, porphyritic dolerite in which there is still some unaltered pyroxene.

Sample: 249592; TSC31499

Hand Specimen:

A reddish-grey, fine-grained rock with a few small, almost white, spherical aggregates resembling tiny amygdales. There are also some larger, almost cylindrical voids similar to those sometimes found in basaltic rocks. A freshly cut surface of the rock shows some wavy colour banding which is very probably superficial staining, somewhat similar to Liesegang rings.

Thin Section:

A visual estimate of the minerals is as follows:

	<u>%</u>
Plagioclase	50-55
Partly altered pyroxene	35-40
Opaque oxide and leucoxene	5-10
Chlorite and clay	3-5
Prehnite (in amygdales)	trace

This rock has the texture of a fine-grained basalt and it contains abundant very thin plagioclase crystals 0.2 to 0.4 mm long which, in many places show a preferred orientation imparting a flow structure to the rock but the direction of this flow structure varies giving some local swirl-like patterns. Interstices between these small plagioclase crystals contain very fine-grained pale-coloured and slightly turbid clinopyroxene which varies in grain size up to about 0.05 mm. There are also very small crystals and crystalline aggregates of opaque iron oxide or iron-titanium oxide, some of which is probably primary magnetite and some of it is clearly secondary iron oxide staining. Some interstices contain very fine-grained, pale yellowish-green to almost colourless chlorite and clay.

There are a few almost spherical amygdales varying in size up to about 1 mm in diameter and these contain a variety of minerals. Some contain fine-grained chlorite, some contain prehnite, some contain epidote and some contain plagioclase. Most of the amygdales contain two or three different minerals and plagioclase is generally associated with either prehnite or epidote. A few larger vesicles remain empty, a few have been filled by plagioclase with only traces of other minerals.

Zones of secondary iron oxide staining can be clearly seen in the thin section and some of these follow small joints although other zones of staining do not appear to be controlled by joints:

Conclusion:

A fine-grained, amygdaloidal basalt.

986080

Sample: 183932; TSC31500

Hand Specimen:

A dark greyish purple rock containing paler-coloured grains or fragments generally less than 2 mm in size but varying up to 10 mm long in a very fine-grained matrix. Most of the elongate fragments are subparallel to a lineation.

Thin Section:

It is not possible to give an accurate quantitative estimate of the minerals in this rock and therefore a brief description will be given.

The dark purplish matrix of this rock is extremely fine-grained and is now composed mainly of clay minerals stained by minute particles of hematite. It contains parallel, thin streaks of darker iron oxide and the general streaky appearance is suggestive of flow structure. In general, there are no recognizable relict textures.

Numerous lithic grains or fragments of very variable size are scattered through this fine-grained matrix and these include some fragments of altered or weathered basaltic rock up to 5 mm long and some darker fragments which were probably also basaltic rock but which are now mainly opaque and contain small, thin crystals of altered plagioclase. Some fragments are now composed mainly of chlorite and/or clay and others contain sericite and in general these show little or no evidence of relict textures. There are also a few small, angular fragments of quartz and there may have been a few small fragments of plagioclase now replaced by clay. The darker wisps and streaks in the fine-grained matrix curve around the larger lithic fragments and in general, this resembles flow structure but the possibility that it could be due to compaction cannot be entirely excluded. Most of the fragments are angular and do not appear to have been deformed.

Conclusion:

This is probably a pyroclastic and, as it contains fragments of basaltic rock and little or no quartz, it probably had a rather basic composition. As original textures have not been preserved in the matrix its exact mode of formation is uncertain but, as there is some evidence of flow movement, it could have been an ash flow tuff.

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MINERALOGICAL REPORT NO. 3173

by A.C. Purvis, PhD

21st January, 1981

TO:

Mr. G.J. McArthur,
Senior Mine Geologist
Cleveland Tin Ltd.,
LUINA, TASMANIA 7321

YOUR REFERENCE:

Your letter dated 28.11.80

MATERIAL:

Rock samples, representing outcrop
from surface mapping programme,
around Cleveland Mine Exploration
Licence.

IDENTIFICATION:

183901 to 183947 (9, not consecutive)
249416 to 249658 (38, not consecutive)

WORK REQUESTED:

Petrographic descriptions,
comments on genesis

SAMPLES & SECTIONS:

Returned to you
under separate cover



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1.

INTRODUCTION

Each sample is given an essential petrographic description, and these descriptions are arranged in lithologic (or petrogenetic) groupings which are more or less defined below as summary-comments.

As requested, the history of each rock is also discussed, partly in the individual descriptions, but mainly in the summary-comments.

The rocks submitted are from outcrop in the vicinity of the Mt Cleveland Tin Mine. Their petrology and genetic interpretation is described and discussed objectively in this report; also, in an attempt to provide as much information as possible, suggestions are made where appropriate regarding the possible representation of geological units in the vicinity of the Cleveland Mine Area, as recorded by Ransom and Hunt in Economic Geology of Australia and Papua New Guinea, Aus.I.M.M. 1975, Vol. 1 pp.584 to 590.

Whereas the samples appear to be similar to various facies described by Ransom and Hunt, they generally differ in metamorphic grade, and they lack economic mineralisation.

SUMMARY OF ROCK TYPES

The rocks in this suite are divided into the following groups -

A Sediments

- i) lithic felspathic or micaceous sandstones represented by
249493, 249522, 249628 (and layers in 249508)
- ii) volcanoclastic sandstones or tuffs
183904, 249510, 183908 (altered silt size equivalent of 183904?)
- iii) siltstones, claystones, mudstones
183908, (see above), 183914, 183934, 249468, 249502,
249508, 249568, 249621
- iv) impure cherts and cherty-albite rocks
183922 (ab)
249416, 249465 (breccia), 249475 (ab), 249494 (oolitic-ferruginous)

B Basalts, dolerites, gabbros, ultramafics

- i) basalts (commonly albitised)
183901 (olivine), 183907 (or microdolerite), 183925,
183947 (or microdolerite), 249424 (or microdolerite),
249435, 249542 (spilite), 249596, 249597 (breccia),
249599 (spilite), 249607, 249612, 249613 (olivine) 249651
- ii) breccia/agglomerate of glassy basaltic composition (silicified)
249526, 249545
- iii) dolerites and gabbros
183907 (or coarse basalt), 183947 (or coarse basalt),
249424 (or coarse basalt), 249466, 249472, 249629,
249631 (coarse pegmatoidal), 249635, 249646 (?diorite),
249658
- iv) quartz-epidote rocks
249436, 249540
- v) ultramafic rocks : pcrites and peridotites
249453, 249462, 249657

C. Unclassified

249464 (weathering breccia ?)

COMMENTS ON GENESIS OF ABOVE ROCK GROUPS

The Group A sediments are largely of non-volcanic origin, or only possibly, partly volcanically derived, except for the two volcanoclastic sands in Group A(ii). The sandstone 249628 may represent parts of the micaceous sandstone sequence of Ransom & Hunt. The siltstone 183908 may be a distal equivalent of the basic volcanoclastic sand 183904. Some of the siltstones, claystones and mudstones (Group A iii) and cherts (Aiv) may represent the lode-bearing, grey argillite sequence (Hall's Formation), however these outcrop samples are extensively weathered reddish and brownish rather than grey. The cherts are generally 'impure', gradational to cherty mudstone, some are brecciated, and they commonly contain quartz veins $\pm$ sericite, albite, epidote, ?pumpellyite.

The Group B rocks, notably the basalts, probably belong to the basic-volcanic unit described by Ransom & Hunt. These basalts are albitised, i.e. spilitic. No mineralisation other than sparse pyrite was recognised in the basalts.

Petrological characteristics in these basic lavas are not particularly diagnostic of any particular environment although the rarity of olivine-basalts is noted. Also, two samples (249453, 249462) appear to be picritic basalts, and although difficult to classify petrographically, they may be related to Ti-depleted ophiolitic basalts. The other ultramafic rock (249657) is a normal olivine (peridotitic) cumulate, with post-cumulus clinopyroxene, and possibly plagioclase (now chlorite).

The metamorphic grade in the suite appears to be generally lower than the albite-actinolite-chlorite assemblages reported by Ransom & Hunt. Most of the Group B rocks are albite-iron oxide (chlorite/clay) with very rare actinolite, (only in one metadolerite 249658). Diagnostic minerals in the other (mostly Group B) rocks indicate two metamorphic facies :-

- a. an epidote facies (samples 183922, 183925, 249435, 249436, 249450, 249466, and 249599) which includes the two quartz-epidote rocks (Group B iv).
- b. a prehnite $\pm$ pumpellyite facies (samples 249629, 249635, 249646, 249651 and 249688).

Sample 183922 is a transitional one with both epidote and pumpellyite.

Sample 249597 has vesicles filled by celadonite, and sample 249475 has euhedral poikiloblastic chlorite crystals.

Sample 249464 is too highly weathered without adequate relict textures, to allow a positive genetic interpretation. It is a breccia of weathered rocks and quartz-vein fragments, and may be a weathered tectonic breccia, or a superficial weathering breccia of residual fragments, cemented by (lateritic) limonite.

INDIVIDUAL DESCRIPTIONS

(Arranged in order of groups summarised at
beginning of this report.)

A (i) SANDSTONES

249493 : medium grained lithic sandstone
(possibly partly of volcanic derivation)

This is a lithic quartz sandstone with mudstone clasts to 2 mm and quartz grains to 0.5 mm. Abundant detritus of chloritic-clay and clay-sericite fragments, chert fragments and plagioclase are widespread with an average size of 0.2 mm. Minor detrital mica, mostly white mica is also scattered.

All components occur in a limonitised clay matrix.

249522 : fine to medium grained lithic feldspathic sandstone
(? partly volcanically derived)

This sample is very similar to 249493. It is a limonite-rich sandstone with grains about 0.2 mm composed of angular feldspar, chert, clay-altered lithic fragments, and minor detrital micas. The feldspar includes possible checkerboard albite after microcline. Angular dark limonite areas up to 1.5 mm appear to be altered fragments, possibly equivalent to the mudstone clasts in 249493.

There is a dense limonitic cement, and the rock is cut by lenticular veins of sericitised albite.

249628 : micaceous quartz sandstone

This sample is a micaceous quartz sandstone with 30% angular quartz grains 0.2 - 0.7 mm, and 10% detrital white mica flakes about 0.5 mm long, all in a matrix of limonitic clays. Minor detrital feldspar, sericite schist and clay-altered lithic fragments, lesser opaque fragments to 0.4 mm, and rare claystone fragments to 1 mm are also randomly scattered.

There are narrow zones in which the matrix is limonitic-free, up to 4 mm wide, running through the rock, partly in a ptygmatic pattern. They are cut by limonitic fractures.

A(ii) VOLCANICLASTIC SANDSTONES

183904 : volcanic sandstone or tuff of
essentially basaltic derivation

This rock consists of a massive, fairly tight packed aggregate of lithic fragments of basic volcanic composition, average size 0.3 mm. They are variably glassy through variolitic to skeletal in texture, and variably altered to serpentine, carbonate, alkali feldspar and albite. Minor scattered quartz grains (5 - 7%) are of uncertain origin.

The skeletal basalts have microlites of plagioclase in an opaque-rich altered glassy groundmass, while the glassy fragments are altered to brown clouded alkali feldspar or albite, and have clay-filled vesicles. Many of the fragments are dusted with calcite.

There are rare (1%) scattered grains of fresh pyroxene, mostly angular in shape, and about 0.1 mm across, also scattered grains of graphic quartz-alkali feldspar intergrowths to 0.5 mm.

294510 : volcanic sandstone or tuff

This is a similar sandstone or tuff to sample 183904, but with slightly more scattered quartz and felspar grains to 0.5 mm, as well as abundant clay, and clay-limonite-altered basaltic clasts, and minor chert fragments. Textural preservation is not as good as in sample 183904 and there is no carbonate. Some holocrystalline basalt fragments are well-preserved.

The clays are more highly birefringent and are orange coloured, suggesting iron-rich or iron-stained saponite.

Coarse (0.2 mm) orange clays are possibly pseudomorphs after pyroxene, and several limonite-rimmed cavities up to 1.5 mm are possibly after pyrite

A(iii) SILTSTONES, MUDSTONES, CLAYSTONES

183908 : extensively limonitised and argillised lithic
siltstone, derived from a basaltic source rock

This rock is dominated by a compact mass of limonitised chloritic-clay detritus, average grain size 0.03 mm. Relatively minor (7 - 10%) angular quartz grains and near-opaque Fe or Ti grains (10%) are scattered. Rare fragments of altered basalt? are also present.

All of these components occur in a matrix of limonitic-clay. The evidence suggests a fine sediment derived from a basaltic terrain, and may be a fine grained (distal) equivalent of 183904 (? and 249510).

183914 : claystone (of unspecified genesis) with authigenic quartz, clay pseudomorphs after an authigenic mineral (indeterminate), and cavities possibly after pyrite

This sample consists essentially of fine grained well-oriented clays. The orientation varies slightly due to the movement of blocky domains along shear surfaces, locally occupied by limonite veins.

In one layer there are small patches of granular authigenic quartz, and clay patches with possibly crystal outlines, about 0.1 mm across. Limonite-leucoxene patches are common and also 0.1 mm across.

Cavities to 2 mm across are locally cubic in shape and partly limonite-lined. They probably represent leached out pyrite cubes.

183934 : limonitic mudstone

This is a limonite-rich mudstone composed almost entirely of a compact sequence of fine laminations of well-oriented, iron impregnated clays. Thin laminae and lenses of fine quartz silt and mica are intercalated throughout up to 0.1 mm wide, but form <10% of the rock. Small lenses or fragments of dense clay to 0.5 x 0.2 mm form 3 - 5% of the sample.

249468 : limonitic micaceous mudstone
with clay-quartz veins

This is a fine limonite-rich mudstone composed essentially of well-oriented clays and abundant disseminated, well-oriented fine mica flakes to 0.05 mm long.

It is cut by quartz veins locally rich in lemon-coloured clay mostly <0.2 mm wide.

249502 : brecciated limonitic mudstone with
fracture network filled by 'chloritic-clays'

This is a massive mudstone with brown limonitic clays, well-oriented as in sample 183934, but with fine quartz silt and mica grains randomly scattered throughout rather than in laminae.

The rock is fractured, with complex, fine breccia domains grading to minor random microfissures. The breccia domains are filled by chloritic clays of uncertain genesis.

249508 : mudstone, with lenses of quartz-lithic sandstone
(similar to 249493)

This is a fine, slightly brecciated mudstone composed of well-oriented limonitic clays with fine detrital clay and quartz silt grains.

Lenses and layers of fine quartz-lithic sandstone to 10 mm across include fine-scale, load casts extending into the mudstone; also they are offset by several microfaults.

Clasts in the sandstone are about 0.5 mm across and include quartz, chert and clay-rich altered lithic fragments as well as altered detrital micas. Some of the lithic fragments are possibly altered glassy basalts with small clay-filled circular vesicles about 0.1 mm across. These sandy layers are similar to 249493.

249568 : massive sericitic mudstone, minor stringers and thin veins of quartz ± albite and trace pyrite

This is a homogeneous mudstone composed of a mass of ultrafine clays of indeterminate composition and structure, crowded with subordinate extremely fine sericite, which is mainly dispersed at random. Titaniferous dust is also dispersed.

A set of roughly parallel and braided stringers and thin veins of quartz, are more abundant in some parts of the rock than in others. Some of these are truncated by ill-defined slaty cleavage planes.

Abundant minute prisms of albite and a single oxidised pyrite crystal occur in two of the thin veins.

249621 : micaceous, chloritic claystone

This is a fine claystone composed of ultrafine well-oriented clays, with minor disseminated flakes of sericite up to 30 microns across, and lesser irregular chlorite flakes.

The rock is laminated on a scale of 0.2 - 1 mm, with thin chloritic laminae alternating with less chloritic laminae.

A random network of limonite stringers (threads) is widespread, but without any evidence of epigenetic 'mineralisation'.

A(iv) CHERTS AND CHERTY ALBITE ROCKS

183922 : cherty-albite rock, with quartz epidote
and possibly actinolite;
veins of quartz + epidote and ?pumpellyite

This rock consists predominantly of an extremely fine quartzofeldspathic mosaic with a grain size of about 10 microns. At least some, and possibly most of the mosaic is composed of albite. At this fine size it is difficult to optically distinguish from quartz. Scattered twinned albite grains to 100 microns are recognisable however.

Scattered throughout are small (0.01 - 0.02 mm) aggregates of epidote and fine needles of amphibole which are rarely large enough to give recognisable optics (most are < 5 microns). The larger needles are green and probably actinolite.

The rock is cut by quartz veins up to 0.2 mm wide, some carry minor epidote as grains and prisms to 0.15 mm. Aggregates of thin prisms in one vein are possibly of pumpellyite.

249416 : impure chert to cherty mudstone with
sericite-quartz veins (including oxidised ?biotite)

This sample consists of ill-defined 'beds' of chert with minor fine sericite, and of a more sericite-rich facies approaching a cherty mudstone in composition, also a lens of claystone up to 1 mm wide (similar to 249568).

The rock is cut by a complex network of quartz veins with various proportions of sericite, also by sericitic limonite-lined stylolites. Elongated areas of limonite in the vein network appear to be selectively oxidised Fe-rich micas (?biotite) or possible fibrous amphibole.

249465 : brecciated chert and chert breccia;
(contemporaneously silicified chert-breccia)

This sample contains numerous small irregularly rounded areas of chert to 5 mm, composed of patchy fibrous chalcedony. These are randomly disposed through a matrix of finer fibrous chert (with fibres 2 - 5 microns) containing scattered carbonate grains and rhombs to 0.2 mm.

The combined complex textural relationships between the different, chaotic cherty domains indicates a probable 'primary chert breccia', later brecciated and cemented by chalcedonic silica.

249475 : impure albitic chloritic chert, minor albite stringers, and scattered euhedral crystals of glauconite? or chlorite

This is a fine grained impure 'chert' (probably mostly fine albite), with ubiquitous ultrafine chlorite or chloritic-clay dispersed throughout.

The same clay also occurs as coarser (0.15 mm) discrete, euhedral, tabular to hexagonal (poikiloblastic) crystals scattered throughout. The precise identity of these could not be determined optically. Their genesis is also obscure; they are probably authigenic/diagenetic, but possibly due to superimposed low-grade contact metamorphism.

The rock is cut by minor stringers of bladed albite crystals; and minor lenses and veinlets of limonite.

249494 : fine layered, irregularly oolitic (and limonitic) chert, numerous chalcedony-quartz veins

This sample is irregularly thin layered due to limonite and ill-defined siliceous oolites being more abundant in some layers than in others. The oolites consist of ultrafine chert; they are 0.05 - 0.2 mm diameter and occur in a matrix of slightly coarser fibrous chert.

In different parts of the slide these oolites, or the matrix, are stained by limonite and/or leucoxene. Numerous quartz veins and lenses 0.02 - 1 mm wide, commonly have selvages of fibrous chalcedony up to 1 mm wide. The chalcedony is partly length fast and partly length slow.

GROUP B(i) BASALTS

183901 : altered (including albitised) olivine basalt

This sample is an altered olivine basalt with rare residual clinopyroxene grains, largely altered to a quartz-albite carbonate-serpentine assemblage.

Serpentine-carbonate-quartz assemblages replace the scattered (5%), medium sized (1 mm) olivine phenocrysts, which are identified mainly on shape and the presence of inclusions of picotite. Pyroxene pseudomorphs are similar but contain sphene and are more elongate (e.g. 1 x 0.3 mm) and there is minor fresh clinopyroxene.

The groundmass is mostly sericitised and albitised plagioclase laths about 0.2 mm across with minor interstitial quartz, scattered ragged carbonate grains and patches of clay minerals. There are disseminated sphene and opaque grains.

The rock is cut by irregular veinlets of quartz, carbonate and clays.

183907 : extensively weathered, probable altered fine dolerite (or possibly a coarse basalt)

This rock is composed largely of clays and limonite, with only ill-defined relict textures and rare relict minerals of the original rock type, as follows -

- 1) poorly preserved interlocking feldspar shapes to 1 mm long of pale clay in more limonitic clay;
- 2) scattered, partly leucoxenised, partly skeletal opaques, with shapes typical of those in coarse basalt or fine dolerite.

It has scattered patches of interstitial quartz to 0.2 mm and clay-limonite pseudomorphs after mafic phenocrysts.

The rock is cut by a random network of dense limonite 'veins' up to 10 mm wide.

183925 : extensively weathered, altered basalt, with epidote-quartz veins

This rock has large areas of clays and limonite with a poorly preserved basaltic texture, up to 20 mm across.

The basalt texture has poorly preserved feldspar shapes and scattered opaque grains, and an average grain size of 0.1 - 0.2 mm.

Numerous patchy veins of irregular quartz grains to 3 mm, and lesser epidote prisms, up to 3 mm, are themselves veined by finer grained quartz. Some coarser veins have a pallasite texture with columnar quartz grains to 2 mm long.

249424 : weathered, altered basalt or microdolerite

This is a clay-limonite rock with clear textural evidence of the former presence of unoriented plagioclase laths, generally <1 mm long, with interstitial ferromagnesian minerals and scattered weakly altered opaque grains 0.1 - 0.2 mm across. These features are all characteristic of an original basalt.

The rock is cut by limonitic clay veins.

249435 : altered (including albitised) basalt with fresh clinopyroxene) cut by epidote veins

This is an altered basalt with scattered albitised plagioclase phenocrysts, generally < 1 mm across in a groundmass with subophitic clinopyroxene aggregates to 0.5 mm diameter and albitised euhedral plagioclase laths to 0.5 mm long. Scattered skeletal opaque grains about 0.1 mm across are weakly leucoxenised. Pale olive clays occur abundantly in interstitial areas possibly replacing glass.

—
Veins cutting the rock are composed of epidote and limonite-lined voids in patches up to 1 mm long, and may have been epidote-pyrite veins.

249542 : albitised basalt (spilite)

This sample is composed of interlaced albitised plagioclase laths about 0.5 mm long with abundant (25 - 30%) interstitial chlorite and minor (5 - 7%) anhedral quartz. The texture is basaltic to sub-variolitic.

Some chloritic patches are over 1 mm across and have cores of a different phyllosilicate (paler with higher birefringance and lower refractive index) or of quartz. These patches may be irregular vesicle-fillings.

The rock is cut by thin quartz veinlets.

249596 : weathered, altered (olivine) basalt,
fragmented probably by weathering and invaded by a
matrix (cement) of chalcedonic, limonitic clays

This rock consists of flat flaggy fragments of basalt 5 - 10 mm wide, set within a vein network (matrix) between series of the fragment layers, and less commonly cutting across them. This 'matrix' consists of extremely fine chalcedony admixed with brownish, limonitic clays.

The basalt has orange clay pseudomorphs after pyroxene grains and colourless clay pseudomorphs after olivine crystals about 0.1 - 0.3 mm across, set in an aggregate of elongate clay pseudomorphs after plagioclase laths to 0.5 mm with interstitial limonite.

249597 : weathered, altered, basalt-(pillow)-breccia;
vesicles filled with celadonite

This rock has a gross (primary) breccia texture. Individual rock domains consist of 25%, flow-oriented plagioclase laths 0.2 - 1 mm long, and rare phenocrysts to 2 mm, in an altered groundmass of sparsely to densely limonitised basaltic glass. The distribution of the most densely limonitised material suggests a triangular junction between the breccia domains, which appear to be small pillows.

Vesicles are abundant throughout, and are circular to highly irregular in outline. They are filled with fibrous celadonite pleochroic in shades of bluish-green.

249599 : weathered spilite with veins of albite
epidote and quartz

This rock is composed largely of felted plagioclase laths, in part curved, 0.1 - 0.5 mm long, altered to albite and clay minerals, set in a matrix of iron oxides. Rare plagioclase phenocrysts to 4 mm across occur in the rock, and there are scattered circular clay-filled, opaque-rimmed vesicles.

Numerous veins (0.5 - 2 mm), consist mainly of albite laths, but some are composed of coarse epidote to 3 mm, with or without quartz. These veins are younger than, and cut across, the albite veins, as do irregular lenticular tension veins of clear granular quartz.

249607 : weathered altered (including albitised)
porphyritic amygdaloidal basalt

This rock has scattered albitised plagioclase phenocrysts to 2 mm across in clusters to 5 mm across, in a groundmass of felted albitised plagioclase laths to 1 mm long with interstitial iron oxides. Scattered circular vesicles about 0.3 mm across are filled by clays and rimmed by iron oxides.

The rock is cut by veins of fine grained albite with irregular open cavities. The veins are up to 0.5 mm wide and narrow down to limonite-lined cracks.

249612 : weathered altered (including albitised)
amygdaloidal basalt

This is a more rapidly chilled version of sample 294607, with identical albitisation and similar veins. Differences, in part due to chilling, are :-

- 1) there are no plagioclase phenocrysts;
- 2) there is a sericite arrangement of plagioclase grain sizes from very small to 2 mm
- 3) the plagioclase laths are more skeletal with feathery or hollow ends;
- 4) the vesicles are larger (about 1.5 mm) and more abundant with thicker iron oxide rims

There are fewer cavities in the albite veins, which are thicker (to 2 mm wide) and appear to be composite, with internal screens of iron oxide.

249613 : weathered altered porphyritic olivine basalt,
weakly brecciated and veined

This sample has 10% scattered clay pseudomorphs of olivine phenocrysts, about 0.5 mm across, with small euhedral inclusions of picotite. The groundmass consists of small albitised felspar laths to 0.2 mm long with a weak flow orientation in a matrix of iron oxides.

There are numerous irregular veins of granular quartz and thin irregular veins of clay minerals. Open cavities lined by limonite-stained clays may have been filled by pyrite. Some are partly filled by porous limonite. There are also limonite-lined open fractures.

249651 : altered amygdaloidal basalt with calcite prehnite,
chlorite and minor pumpellyite

This is a fine grained basalt with flow oriented felspar laths (albitised) to 0.3 mm long and interstitial granular clinopyroxene (0.1 mm) as the main constituents. Other interstitial minerals are clays and iron oxides.

There are abundant circular to elliptical vesicles up to 5 mm across. The largest vesicles are filled with granular calcite and the small circular vesicles (to 1 mm) with fibrous chlorite. Intermediate sized vesicles (2 mm) have chlorite rims and cores of prehnite. One has a few thin prisms of pumpellyite in a layer between the chlorite and the pumpellyite, and a single anhedral grain of epidote.

B(ii) BRECCIA/AGGLOMERATE

249526 : breccia of altered, amygdaloidal, glassy
basalt fragment and altered pyroxene
crystals; silicified

This rock is composed of basic lava fragments to 5 mm across with vesicular textures, and now consisting of serpentine, talc, possibly fibrous tremolite and quartz, all probably derived from amygdaloidal glassy basalts. Some of the fragments have a porphyritic texture, with fibrous ?tremolite after pyroxene phenocrysts to 2 mm long.

Similarly, pseudomorphed pyroxene crystals occur individually to 3 mm across. Accessory scattered opaque crystals to 0.5 mm across are present.

Vesicles are filled with clays or quartz mosaic and range from 0.2 - 1 mm across.

The matrix between the fragments is mostly spherulitic chalcedony, with spherulites 0.1 mm across, also fine grained clays.

249525 : breccia of porphyritic amygdaloidal
basalt fragments; silicified

This sample has some similarities with sample 249526 in mineralogy and in the textures present in the rock fragments. Some of the fragments in this rock are, however, over 20 mm across (others are only a few mm across), and there are granular quartz aggregates apparently replacing some of the pyroxene or plagioclase phenocrysts as well as filling small vesicles. Most of the phenocrysts are 0.5 - 3 mm across and are replaced by clays.

The vesicles are 0.5 - 1 mm across, circular to elliptical and concentrically zoned. They are filled by clays and/or quartz. They form up to 40% of some fragments.

There is little or no matrix; the rock being largely composed of volcanic fragments.

B (iii) DOLERITES AND GABBROS

183947 : deeply weathered, altered, microdolerite
(or possible coarse basalt)

This rock is extensively weathered and now consists essentially of a mass of clays thoroughly impregnated by limonite. Relict textures within this mass however clearly indicate an original aggregate of randomly interlocking plagioclase laths, with subordinate more or less interstitial irregular grains of a mafic-silicate phase.

Rare clay-limonite pseudomorphs after small phenocrysts of ?pyroxene and/or plagioclase are scattered. Disseminated granules of secondary Fe-Ti oxides (7%) represent original titaniferous magnetite and/or limonite.

This rock is almost identical in degree of weathering and in the nature of relict textures to samples 183907 and 249466.

249466 : weathered, altered, probable dolerite
(possible microgabbro)

This rock consists of weathered clay patches after ophitic pyroxene grains to 4 mm across, enclosing albitised plagioclase laths about 0.2 - 2 mm long. Patches of dense leucoxene to 0.5 mm represent weathered, original opaque grains, and some of the plagioclase has been replaced by prismatic epidote.

This basic rock is coarser crystalline than sample 183947 rather characteristic of a dolerite (but possibly gradational to microgabbro).

249472 : extensively weathered, altered, equivalent
of the dolerite or microgabbro sample 249466

This rock consists essentially of a mass of clays extensively permeated by limonite. In thin section a relict crystalline aggregate texture is well preserved, which is virtually identical to the texture of 249466, and thus no doubt reflects the same primary mineralogy.

Accessory granules of secondary Fe-Ti oxides have the same abundance and mode of occurrence as in sample 249466; scattered through the limonitised replicas of interlocking plagioclase laths and subordinate ophitic pyroxene.

249629 : altered dolerite with prehnite-pumpellyite
veins and fresh clinopyroxene

This rock consists of a medium grained crystalline aggregate of stubby albitised plagioclase laths about 0.5 mm long, in places dusted with clay spots, also granular clinopyroxene aggregates up to 1 mm across, scattered leucoxenised opaque grains, and patches of pale yellow clays. There are also rare partly weathered anhedral pyrite grains to 1 mm across.

There are abundant veins cutting the rock. The thinner veins (to 0.2 mm wide) are composed entirely of fibrous pale-apple-green pumpellyite, but the wider veins contain anhedral prehnite and patches of yellow clay. One vein changes along its length from a nearly pure prehnite 2 m vein 2 mm wide with coarse anhedral prehnite grains, to a 1 mm wide pumpellyite vein with fibres of pumpellyite to 0.5 mm.

249631 : altered dolerite or gabbro
 with fresh clinopyroxene
 (coarse equivalent of 249629)

In this sample the plagioclase (50%) is mostly sericitised, and occurred as coarse crystals 1 - 5 mm across. There were large poikilitic orthopyroxene grains to 10 mm, now replaced by cream clays with a uniform orientation within each pseudomorph (15%), and there are fresh granular to weakly poikilitic clinopyroxene grains up to 2 mm across (30%).

The opaques (5%) are also strongly poikilitic and up to 4 mm across; they appear to be magnetite.

This rock is essentially a coarser crystalline equivalent of 249629 (without the prehnite pumpellyite veins).

249635 : coarse pegmatoidal gabbro; albitised and
 with minor clays and prehnite

This rock has a highly distinctive texture, dominated by coarse elongate crystals of albitised plagioclase (40%), and fresh clinopyroxene (50%), 4 - 8 mm in size. Parts of the pyroxene crystals were possibly originally of orthopyroxene and are now replaced by fine chloritic clays. There are some irregular coarse granophyre-like pyroxene-plagioclase intergrowths.

Weakly leucoxenised titanomagnetite grains (5%) are skeletal and up to 4 mm across. There is also minor pyrite to 1 mm.

Interstitial patches about 1 mm across are filled by chlorite flakes or by prehnite.

249646 : hornblende (quartz) diorite or uralitised
quartz dolerite; minor prehnite and albite veins

This sample has 35 - 40% pale-green amphibole as poikilitic anhedral to 1 mm, enclosing small plagioclase laths, and separated by weakly sericitised albitised plagioclase grains to 0.5 mm across.

Irregular interstitial 'pods' of quartz (3%) to 1 mm across, are marginally intergrown with very minor alkali felspar. A coarse pegmatoidal patch consists of plagioclase laths over 1 mm long and anhedral quartz grains about 2 mm across.

There are lenticular albite veins to 1 mm wide, and a small (0.5 mm) patch of prehnite.

249658 : completely sericitised/uralitised dolerite
with prehnite veins

This was originally a mafic dolerite with 40% plagioclase (now albitised and sericitised) and coarse prismatic to subophitic pyroxene. Some of the pyroxene is replicated by green non-fibrous actinolite and some is replaced by unoriented fibrous actinolite. The latter replaces especially the rims of the pyroxene grains, and those pyroxenes in crudely granophyric intergrowths with plagioclase.

The scattered skeletal opaque grains are about 0.2 - 0.5 mm across and are largely replaced by leucoxene. Irregular pyrite grains occur in some of the prehnite veins.

The prehnite veins are irregular and about 0.1 mm wide.

B(iv) QUARTZ-EPIDOTE ROCKS

249436 : quartz-epidote rock derived from basalt

This rock consists large of an irregular patchy granular aggregate of epidote, with scattered leucoxenised skeletal opaque typical of the previously described altered basalts.

Large areas of this aggregate to 20 x 10 mm, are rimmed by short prismatic epidote crystals set in a matrix of granular 'vein' quartz with scattered epidote prisms. Older veins of quartz-free epidote, and younger veins of epidote-free quartz cut the rock.

This assemblage conceivably represents extensive deuteric 'mineralisation' associated with (? and localised within) the basic igneous rocks described above.

249450 : fine massive epidote-'clay' rock;
(saussuritised fine basalt or pelitic sediment);
associated epidote-quartz veins

The rock is composed of a band of dense isotropic 'clay' studded with epidote granules. It may have been an extremely fine basalt, or a mudstone, which has been completely pervaded by saussuritic alteration materials related to the sample 249436, and/or to the veins.

Extensive random veins cutting through this rock are composed of irregular quartz crystals, including one 20 x 2 mm, and prismatic epidote crystals averaging 0.5 mm long and generally lining the walls of the vein.

B(v) ULTRAMAFIC ROCKS

249453 : serpentinised, chilled, picritic basalt

This is a highly picritic volcanic or subvolcanic igneous rock which is completely altered but with excellent textural preservation.

Serpentinised olivine phenocrysts from 0.1 to 1.2 mm across are abundant (25 - 30%), and are set in a matrix composed of trellis-like domains of quench pyroxene, now completely altered to serpentine or fibrous tremolite. There are scattered grains of picotite to 0.1 mm. The rock is veined by limonite.

249462 : serpentinised possible picritic volcanic
 or subvolcanic rock, or pyroxene peridotite

This rock has some similarities with sample 249453 in that it has 35 - 40% serpentinised olivine crystals 0.2 - 1 mm across, in a matrix of brown fibrous altered trellis-textured pyroxene, of probable quench origin, in domains about 0.2 - 1 mm across.

The rock is cut by thick contorted veins of serpentine and is heavily limonitised, with both disseminations and veins.

249657 : altered cumulus peridotite

This sample has 35 - 40% cumulus prismatic-domal olivine grains 0.5 - 3 mm, partly to completely serpentinised, set in large (5 - 10 mm) interstitial (post-cumulus) oikocrysts of fresh clinopyroxene (30%). The irregular pyroxene crystals are separated by minor isotropic chlorite (?), and grey unidentified mineral probably replacing plagioclase grains.

Both primary and secondary oxide grains are present. The primary grains are rarely translucent (chromite). The secondary oxide occurs as both dust and veinlets.

There are rare small grains of primary hornblende (titanpargasite) and biotite (phlogopite).

C. UNCLASSIFIED

249464 : limonite-cemented 'breccia',
probably a talus (weathering breccia);
possibly a tectonic breccia

This rock consists of a chaotic, unsorted, loose-packed aggregate of angular rock fragments of variable composition cemented by irregular patches of dense limonite.

The fragments consist essentially of the following, listed in order of decreasing abundance -

- .. limonitised, weakly silty mudstone
- .. 'chert' + sericite, clays and possibly albitic
- .. microcrystalline quartz mosaic ('microquartzite')
- .. clasts of clay-sericite-ultrafine silica, with a vague relict volcanic texture
- .. angular grains of single crystal or vein quartz.

The evidence suggests a tectonic breccia within a fairly complex rock sequence, or a partly residual and partly transported superficial talus (weathering breccia); cemented by supergene limonite of lateritic affinities.

986116

Central Mineralogical Services				
Sample No.	Rock Type - Composition	Fabric	Minor Minerals	Comments
183 804	?Dolerite Breccia. Fragments of altered dolerite, with augite and plagioclase; massive prehnite veins. Patches of crushed, altered dolerite components.	Strong tectonic breccia fabric, almost mylonitic in places.	Chlorite patches and veins. Leucogenised magnetite.	Intense brecciation; relict fragments suggest dolerite-microgabbro, perhaps originally porphyritic.
183 806	Altered ?Ultramafic. Antigorite pseudomorphs after small pyroxene crystals, and ?olivine; limonite after needles of ?clinopyroxene. No quartz.	Very distinctive quench-textures similar to "spinifex" textures.	Antigorite veins. Fine chromite grains (primary).	Relict textures suggest a rapidly cooled ultramafic (peridotitic) rock, either extrusive or a chilled margin.
183 809	Altered Lava-Flow Breccia. Small and large fragments/lenses of altered scoriaceous glassy lava in flow-banded mass of the same material.	Good flow-breccia and flow-banding fabric. Highly vesicular.	Fine leucogene. Goethite patches, streaks. Igneous xenoliths.	Completely altered, iron-stained, but original rock probably a mafic lava (i.e. basaltic), or ultramafic?
183 810	Fine Ferruginous Tuff. Very fine splinters of quartz, feldspars; glass shards, ultrafine ?clay matrix, pervasively Fe-stained.	Extremely fine-grained, with slump-structures. Bedded.	Contorted lenses and layers of unstained, pale tuff.	A compact fine ash, probably sub-aqueously deposited and deformed before lithification; broadly "rhyolitic" composition.
183 817	Chert. Mostly microcrystalline quartz, but with irregular patches of amorphous/cryptocrystalline SiO ₂ . Fine carbonate, clay flakes throughout.	Formless, very fine-grained, no bedding. Polygonal micro-fractures.	Some amorphous patches have abundant ultrafine leucogene.	Featureless chert, diagenetically crystallized for the most part, but amorphous patches are unusual.
183 825	Argillaceous Chert Breccia. Irregular fragments of argillaceous chert-cherty argillite; interstitial fibrous clay and leached chert, with limonite.	Fabric suggests semi-plastic deformation and brecciation.	Veins of porous goethite and MnO ₂ .	Original rock was a dark, carbonaceous impure chert grading into siliceous argillite, and was autobrecciated.
183 826	Siliceous Argillite. Fine clay flakes and ultrafine ?leucogene, embedded micas, quartz, possible fine ash; semi-amorphous siliceous matrix.	Uniform, featureless, but extensively veined with accompanying brecciation.	Many quartz-chlorite veins forming networks.	Possibility of a fine tuff (ash) component cannot be excluded, but evidence poor; related to 183810?
183 828	Microdiorite. Small subparallel laths of oligoclase-andesine, abundant magnetite and leucogene, minor chloritised ferromagnesian minerals.	Lineated, "trachytic" fabric, verging on fine-grained. Brecciated.	Fracture-fillings of goethite, MnO ₂ . Quartz veinlets.	Fabric suggests an extrusive rock, but textures are rather coarse. Unusual, distinctive composition. Could be termed a "melaphyre".
183 829	Micaceous, Lithic Arkose. Angular fragments of quartz, K-feldspar, plagioclase, metaquartzite, mica schist; biotite, muscovite flakes; sericite-quartz cement.	Poorly-sorted/sized, weakly bedded. Medium-grained.	Leucogene, zircon grains. Lightly ferruginised throughout.	Rapid deposition and burial, unstable conditions; low-grade metamorphic, felsic igneous source rocks.
183 831	Vitric Tuff. Closely packed, comparatively large shards of devitrified, chloritised glass, and altered magnetite; a few scoriaceous fragments.	Quite well-sorted/sized, distinctly bedded. Medium-grained.	Volcanic grains with quench-textures. Stray quartz grains.	Basic tuff, i.e. of basic origin, quite possibly closely related to 183 809 in composition, source.

986117

				Central Mineralogical Services
Sample No.	Rock Type - Composition	Fabric	Minor Minerals	Comments
183 832	Altered Chlorite Rock. Dominantly small radiating patches of oxidised chlorite, with occasional microphenocrysts of calcic plagioclase (altered).	Uniform, fine-grained fabric; possible devitrification textures.	Goethite-limonite throughout. Sericite veins, patches.	Believed to have been glassy basalt or similar rock, but evidence poor because of alteration.
183 833	Altered ?Basalt. Numerous small random laths of argillised feldspar, interstitial goethite and leucoxene; scattered feldspar microphenocrysts.	Fine relict igneous textures; some brecciation, veining.	Quartz-sericite veins, and oxidised ?pyrite veins.	Textures, alteration minerals suggest basic igneous rock, perhaps basaltic lava-breccia.
183 834	Sheared, Altered ?Basalt. Fragments of altered ?basalt (cp. 183833); extensive, sheared chlorite patches with brecciated quartz veins. Conspicuous oxidised ?pyrite.	Relict fine-grained igneous textures; replacement, shearing, brecciation.	Younger quartz-sericite veins postdating chloritisation.	Complex tectonic and vein history; pyrite probably introduced at a late stage.
183 837	Cherty Argillite Breccia. Angular fragments of cherty argillite (fine clays and chert) extensively quartz-veined, with later goethite/MnO ₂ veins.	At least two episodes of veining, with intervening brecciation.	More massive goethite probably after sulphides.	Rock was an argillite with cherty cement; diagenetically quartz-veined, brecciated, further veining.
183 838	Argillaceous Siltstone. Silt-sized mica/clay flakes, quartz grains, possible altered pyroclastic material (?ash); ferruginised and veined.	Extensive veining and some brecciation in places. Fine-grained, unbedded.	Wedges/veins of chlorite-goethite-fibrous quartz.	Uniform, featureless, essentially unmetamorphosed sediment. Massive goethite (in veins) after sulphides.
183 841	Altered ?Basalt/Dolerite. Clay-chlorite pseudomorphs after random small feldspar laths; interstitial chlorite/leucoxene after pyroxene; a few phenocrysts.	Well-preserved igneous fabric typical of basic rocks. Fine/medium.	Scattered amygdales with quartz-chlorite fillings. Iron-staining.	Coarser than the other ?basalts, but quite possibly related. Alteration precludes accurate classification.
183 842	Brecciated Argillite. Ultrafine clays, all recrystallized to illite-sericite, fine silt-sized quartz grains. Extensively fractured and veined.	Uniform rock without banding. Fracturing with minor displacement.	Quartz veins, younger goethite (?sulphide) veins. Stringers of oxidised pyrite.	Featureless rock, apparently conventional sediment; no evidence of pyroclastics. Complex vein history, cp. 183837.
183 844	Vein-Quartz. Mainly fine matted quartz crystals, with coarser euhedral crystals; patches of goethite, MnO ₂ , ?covellite, possible cuprite.	Typical vuggy vein-quartz with compact fine patches and coarse crystals.	Small carbonate grains, sericite patches, shreds of phlogopite.	Evidently a quartz-sulphide vein now oxidised, with secondary copper sulphides.
183 846	Brecciated Argillite/Siltstone. Banded argillaceous siltstone grading into argillite, with thinner bands rich in recrystallized radiolaria and other fossils.	Fine-grained, banded, with veining and brecciation. Soft-sediment deformation.	Veins of quartz with sericite, goethite, oxidised chlorite.	This rock was deformed before lithification, then brecciated and veined later.

986118

Sample No.	Rock Type - Composition	Fabric	Minor Minerals	Central Mineralogical Services Comments
183 847	<u>Fossiliferous Argillite</u> . Deformed lenses of chalcedonic fossils set in a mass of fine recrystallized clay and minor silt-sized quartz.	Fairly structureless except for minor deformation due to compaction.	Random patches of limonite; goethite veinlets.	Fossil fragments are chalcedony, and are tubular and cylindrical - possibly echinoid/crinoid.
183 848	<u>Altered Basalt or Andesite</u> . A few andesine microphenocrysts randomly set in fine mass of oligoclase laths, interstitial pale chlorite, limonite patches.	Typical fine-grained, random, igneous fabric, probably intrusive.	Veins of radiating-fibrous green chlorite, with goethite.	Similar to other ?basalts described, but possibly more andesitic originally; thought to be intrusive.
183 849	<u>Altered ?Basalt</u> . All secondary minerals - quartz, chlorite, clays, with poorly-defined fibrous and devitrification textures.	Vague quench textures in places, otherwise fine-grained, ?devitrified glass.	Breccia zones with zeolite (?laumontite) and goethite.	Little doubt of igneous origin; composition unknown, but very probably intermediate/basic.
183 851	<u>Altered ?Basalt</u> . Abundant fine fibrous chlorite, small goethite patches, pseudomorphs of quartz/clay after plagioclase laths.	Fairly homogeneous, fine-grained, random. Poorly-preserved textures.	Veins of degraded chlorite or serpentine (?chrysotile).	Clearly fine-grained igneous rock, possibly more picritic than basaltic, i.e. with more mafic minerals.
183 852	<u>Altered ?Basalt</u> . Many small altered (serpentinized) pyroxene and/or olivine phenocrysts in goethite-chlorite groundmass with fibrous textures.	Variety of textures, fabrics; some shearing and brecciation. Fine-grained.	Quartz-chlorite-goethite veins and shears.	Possibly a lava breccia; secondary minerals and textures suggest picritic or ultramafic composition.
183 858	<u>Oligoclase-Dolerite</u> . Mainly stout, random, cloudy oligoclase laths, with intergranular augite, oxide opaques, minor brown hornblende.	Good medium-grained igneous fabric with coarser patches.	Irregular zones of replacive chalcedony with coarse hornblende.	Reasonably fresh rock with all major primary minerals preserved. Minor intrusive.
183 859	<u>Tuff</u> . Coarser and finer bands of andesite and ?trachyte fragments with quartz, feldspar splinters, shards of devitrified green/brown glass.	Well-sorted, bedded; finer tuff is finely laminated, weakly graded.	Oxide opaques, pyroxene amphibole, degraded biotite.	Good sorting, bedding, grading suggests subaqueous deposition. Mainly intermediate-basic source rocks.
183 860	<u>Tuff</u> . Bands composed of silt-sized altered glass, fresh plagioclase fragments, pyroxene, amphibole, oxide opaques, in varying proportions.	Well-sorted/sized and -bedded; some intra-formational brecciation.	A few calcite patches or grains.	Grading in some beds indicates that rock is right way up. Subaqueous tuff of intermediate-basic origin.
183 861	<u>Vitric Tuff</u> . Mostly cloudy, altered, devitrified glass fragments, with interspersed feldspar, quartz, pyroxene splinters.	Uniform, well-sized/sorted, weakly graded. Fine-sand size.	Occasional lithic grains of andesitic composition.	Good sorting/sizing suggests subaqueous deposition. Intermediate-basic volcanic source. ?Crimson Creek formation.

986119

				Central Mineralogical Services
Sample No.	Rock Type - Composition	Fabric	Minor Minerals	Comments
183 864	<u>Dolerite</u> . Small, stubby, random oligoclase-andesine laths, intergranular augite and conspicuous magnetite. A few augite phenocrysts.	Typical medium-grained igneous fabric, generally uniform.	Small interstitial chlorite patches.	Relatively fresh rock, similar to 183858, i.e. with oligoclase-andesine instead of more normal labradorite.
183 865	<u>Micaceous Feldspathic Sandstone</u> . Framework of subangular quartz grains, muscovite flakes, degraded feldspar grains; fine clay-quartz cement.	Moderately sorted/sized, crudely bedded, medium-grained.	Detrital tourmaline, iron-stained ?lithic grains.	Weathered, immature sediment, fairly featureless. Not metamorphosed.
183 866	<u>Ferruginised Sandstone</u> . Generally small, subangular quartz grains, scattered muscovite flakes, fine illite/sericite-quartz cement, with fine goethite.	Poorly-sorted and -sized, with pre-consolidation deformation/disruption.	Detrital tourmaline; veinlets of compact goethite.	May be related to 183865; broadly similar lithology; evidently affected by pre-lithification movements.
183 868	<u>Micaceous Sandstone</u> . Subangular to splintery quartz grains, subparallel flakes of muscovite, biotite, chlorite; interstitial sericite, fine hematite.	Moderately-sorted/sized; bedding-alignment of elongate grains. Medium-grained.	Small chlorite grains - similar to glauconite. Detrital tourmaline.	Abundance of glauconite-like material suggests reducing conditions of rapid deposition; hematite is diagenetic.
183 869	<u>Micaceous, Feldspathic Sandstone</u> . Mostly small subangular quartz grains, with muscovite and biotite flakes, feldspar fragments; interstitial sericite, chlorite, hematite, quartz.	Moderately-sorted/sized, medium-grained, quite well-bedded.	Lithic grains (chert, altered ?igneous material). Oxidised pyrite cubes.	Possibly partly tuffaceous or with reworked volcanics, i.e. a volcanomict sandstone.
183 871	<u>Meladolerite (Ankaramite)</u> . Small random laths of oligoclase; very abundant small ophitic augite patches, scattered magnetite crystals.	Medium/fine-grained igneous fabric verging on basaltic.	A few small epidote-filled amygdalae. Pyrite patches. Chlorite patches.	May be related to other ankaramite bodies (dykes/sills) in W. Tasmania, ?Jurassic.
183875	<u>Ferruginous Shale Breccia</u> . Contorted, deformed lenses of shale composed of small parallel clay/mica flakes, silt-sized quartz, ultrafine hematite.	Fabric suggests intraformational, soft-sediment brecciation.	Small illite lenses and nodules.	Complex, small-scale structures due to deformation, brecciation during deposition.
183 876	<u>Altered, Brecciated ?Basalt</u> . Angular fragments with varying fabrics; pseudomorphs after phenocrysts and laths of plagioclase in clay-limonite mass with magnetite.	Relict fine-grained porphyritic igneous fabric well-preserved.	Clay and goethite veins.	Very similar to the other ?basalts; severely weathered, but magnetite is preserved.
183 879	<u>Welded Vitric Tuff</u> . Consists mainly of altered highly contorted glass, with embedded grains of ferruginised ?andesite or basalt and other material.	Fairly fine-grained (0.1 - 0.3 mm), with strongly welded textures.	Occasional small quartz fragments.	Probably intermediate igneous composition; may be correlatable with Crimson Creek formation elsewhere.

Central Mineralogical Services

[illegible]

REPORT CMS 80/12/8Notes:

Due to the generally weathered nature of these rocks, brief petrological descriptions were prepared in tabulated form. These incorporate data from stereobinocular and petrological microscopic examination of representative thin-sections and related offcuts and include comments on interpretation and, where relevant, probable correlations. Problematically, much finer detail is obscured by weathering effects and late ferruginisation.

Major lithologies comprise impure cherts/cherty argillites of chemical sedimentary character, but grading into orthodox detrital psammopelites. These rocks are variably fractured in at least two phases, with minor sulphide mineralisation associated with an early generation of quartz veining. Similar deformation alteration trends are variously represented in subordinate lithological groups of basic and ultramafic igneous rocks.

Contact-metamorphic effects are evident, but appear of strictly limited distribution and, where present, are of marginal character (spotted hornfelses). There is a general absence of contact-metasomatic features.

D. Cowan, B. Sc.

Sample No.	Classification - Composition	Fabric	Accessories	Comments
183 802 (T.S. 35131)	Cherty Argillite. Random to incipiently orientated, semi-sericitic illite-hydromuscovite, subordinate to minor closely intergrown microcrystalline quartz. Rare quartz veinlets.	Massive to faintly laminated with millimetric interbeds of pelletal chert breccia.	Leucoxenic TiO_2 , traces partly degraded (bleached) carbonaceous matter, oxidised carbonate.	Load-metamorphosed (sub-greenschist) argillite with intraformationally brecciated chert bands. No metasomatic features.
183 803	Spotted Hornfels. Semi-sericitic white mica and microgranular quartz, abundant sericitised ?cordierite porphyroblasts.	Fine-grained, hornfelsic (mean 10 μ), porphyroblasts mean 100 μ . Relict breccia fabric.	Oxidised/leucoxenised clastic opaques, degraded pale metamorphic phlogopite.	Marginally hornfelsed pelitic soft-pebble conglomerate (intraformational breccia). Primarily a massive quartz-mica siltstone/silty shale.
183 805	Argillaceous Chert. Cherty crypto- to microcrystalline quartz, subordinate to minor clastic white mica flakes. Frequent quartz-chlorite (after phlogopite) veinlets.	Massive to shale-parted, closely fractured to crudely brecciated.	Carbonaceous matter (shale partings). Traces oxidised/leached carbonate (veinlets).	Affinities with 183802. Impure chert with carbonaceous shaly partings. Brittle style of deformation with associated quartz-mica(-carbonate)
183 807	Cherty Argillite. Cherty, microcrystalline quartz and clastic mica flakes in near-equant proportions, subordinate to minor fine silt-sized clastic quartz. Frequent degraded ?cordierite blasts.	Relict submillimetric-scale pelitic banding. Closely microfractured to granulated.	Limonite clots (mean 150 μ) after ?cordierite. Rare clots albite.	Affinities with 183803, (803, 805, 807). Argillaceous chert/cherty argillite with incipient hornfelsing effects pre-dating semi-brittle deformation.
183 808	Silty Shale. Semi-orientated, Fe-stained sericite with minor (5-10 %) fine silt-sized clastic quartz, white mica flakes. Sparse veinlets chloritised phlogopite ($\pm$ albite).	Incipiently banded. Contorted to segmented incipient slaty cleavage.	Late limonitic microfractures.	Relatively marked clastic characteristics. Veinlets post-date semi-brittle deformation of incipient cleavage.
183 813	Cherty Argillite. Cherty cryptocrystalline quartz, fine silt-sized clastic white mica flakes, minor clastic quartz. Frequent sericitic microfractures.	Massive to incipiently laminated. Irregular zones of fracturing/brecciation.	Rare lenses of chalcodonic ?radiolaria, fragmented spicules.	Affinities with 183802, etc. Well-indurated with typical semi-brittle deformation effects. ?Microfossils are poorly resolved.
183 815	Carbonaceous, Argillaceous Chert. Crypto- to microcrystalline quartz with pervasive ultrafine carbonaceous matter, fine silt-sized clastic white mica flakes.	Weakly laminated on submillimetric scale. Weakly stylolitic.	Minor traces oxidised pyrite (disseminated) and carbonate (stylolites).	Affinities with 183802, etc., but strongly carbonaceous, incipiently pyritic (syngenetic).
183 818	Sericitised Sandstone. Framework of sericitised, indeterminate feldspar, lithic clasts, angular to subangular quartz in near-equant proportions. Leucoxene-stained sericitic matrix.	Weakly bedded silty fine sandstone. Sporadic sericitic microfractures.	Pervasive kaolin (after sericite). Traces detrital tourmaline, zircon.	Lithic arkose or feldspathic, lithic sandstone. Includes detrital pelite clasts, but bulk of framework is indeterminate due to argillic alteration.
183 819 (T.S. 35139)	Steatitised Serpentinite. Fine-grained, mesh-structured talc pervaded by late secondary limonite. Disseminated fine-grained magnetite.	Relict granular, medium-grained fabric. Pyroxene- and olivine-derived mesh-textures.	Minor traces degraded/Fe-stained carbonate.	Primarily a granular peridotite, serpentinised, thoroughly steatitised and weathered/ferruginised.

				Central Mineralogical Services
Sample No.	Classification - Composition	Fabric	Accessories	Comments
183 821 (T.S. 35140)	Ferruginised Siltstone. Relict clastic fine silt-sized quartz, sericitised/ferruginised feldspar and variably ferruginised white mica flakes in near-equant proportions. Fe-stained ^{sericitic matrix.}	Well sorted, planar to lenticularly bedded silty clastic fabric. Quartz-chlorite veinlets.	Oxidised/leucoxenised clastic opaques. Minor traceoxidised carbonate (veinlets).	Veinlet chlorite probably represents degraded phlogopite or biotite. Sericitic alteration obliterates finer detail. Arkosic.
183 822	Sheared Serpentinite. Partly weathered/Fe-stained antigorite, subordinate, degraded/ferruginised carbonate clots. Minor stressed/boudinaged vein-quartz.	Phyllitic with deformed mesh-textures.	Disseminated fine-grained martite-magnetite. Minor degraded talc, rare films Mn-	Affinities with 183819, but detail obliterated by tectonic overprint. Carbonated/weakly steatitised schistose serpentinite.
183 824	Sheared Breccia. Irregular clasts of sericitic pelite, crenulated sericite phyllite, degraded serpentinite, minor vein-type quartz. Sericitic matrix. Pervasive Fe-staining.	Random, poorly sorted clasts, poorly resolved against similarly sheared matrix.	Degraded/ferruginised ^{oxide} carbonate, martitised fine magnetite (serpentinite clasts).	Fabric consistent with fault breccia. Finer detail obliterated by shearing, and weathering/Fe-staining.
183 827	Altered Basalt Breccia. Angular to irregular clasts of chloritised feldspar microlitic, hematitic basalt/chloritised-silicified microgabbro. Chloritic interclast cement (?after ^{phlogopite}).	Oxidised lava flow breccia with chilled ferruginised contact against brecciated micro-	Martitised magnetite.	Fracturing/alteration of microgabbro postdates contact. Probably a megaclastic flow-marginal breccia, but dependent on field evidence.
183 830	Altered Breccia. Vein-type quartz with crude foliae of sericite, disseminated sericitised "pelite" clasts, patchy chloritised/degraded phlogopite. Semi-pervasive late limonite.	Sheared to granulated ^{gabbro} ; sericite-recemented, quartz-healed breccia.	Degraded/ferruginised carbonate. Sparse pyrite boxworks (in vein-quartz). Trace ^{sphene} .	Lithic clasts poorly resolved due to late ferruginisation; may include a minor talc-schist (altered ultramafic) component. Assay for Sn warranted.
183 839	Stressed Breccia. Segmented clasts of cherty argillite/sericitic pelite, phlogopitic rock, vein-type quartz. Semi-pervasive late limonite, minor Mn-oxide.	Closely analogous to 183830.	Minor degraded/ferruginised carbonate. Rare pyrite boxworks.	Close affinities with 183830, but with prominent cherty argillite clast component.
183840	Stressed Breccia. Variably ferruginised clasts of chloritised/sericitised "basalt", vein-type quartz healed with quartz-sericite aggregates. Patchy late Mn-oxide films, impregnations.	Analogous to 183830, 183839.	Minor degraded/ferruginised carbonate. Sparse pyrite, pyrrhotite, ?chalcopyrite	Similarities with 183830, 183839, but main clast component is thoroughly altered, basaltic-textured volcanic. Sulphide disseminations in stressed
183 867 (T.S. 35147)	Sericitised Lithic Sandstone. Framework of sericitic shale pellets, sericitised indeterminate lithic clasts, feldspar grains, angular to subangular quartz. VArIably ferruginised ^{sericitic matrix.}	Weakly bedded silty fine sandstone.	Clastic muscovite flakes, degraded biotite, traces tourmaline, leucox. opaques.	Affinities with 183818, 821. ^{quartz.} Marked pervasive sericitisation obliterates finer detail, but evidently a feldspathic lithic sandstone. Ultrafine
			Traces carbonaceous matter, pyrite.	^{syngenetic pyrite.}

Sample	Classification	Composition	Structure	Accessories	Comments
183 872 (T.S. 35148)	Porphyritic Basalt. Chloritised/epidotised pyroxene phenocrysts, albitised plagioclase microphenocrysts in similarly altered micro-lathic groundmass with montmorillonitic, glassy		Evenly disseminated phenocrysts, basaltic-textured groundmass. Minor epidote veinlets.	Conspicuous, very fine, partly martitised magnetite.	Homogeneous fabric suggestive of flow-core zone or, conceivably, a minor intrusive.
183 877	Ferruginised Pelite. Pervasively Fe-stained sericite, subordinate to minor, fine silt-sized relict detrital quartz, white mica flakes.		Microlaminated silty shale with incipient concordant slaty cleavage.	Sparse oxidised/leucoxenised clastic opaques. Minor traces oxidised "syngenetic" pyrite.	Load- or burial-metamorphosed pelite with sparse microframboidal pyrite. Bulk of limonite is introduced. No metasomatic alteration features.
183 878	Hematitic Talc Phyllite. Partly degraded, fine to ultrafine talc, pervasive, partly oxidised ultrafine hematite.		Microschistose with vague deformed mesh-textures.	Rare quartz.	Problematical interpretation, but vague relict fabric consistent with a steatitised/sheared serpentinite.
183 880 (T.S. 35151)	Basic Tuff. Thoroughly argillised (montmorillonitic) basic lava fragments, indeterminate mineral grains, shards, conspicuous oxidised/martitised magnetite. Fe-stained montmorillonitic matrix.		Weakly bedded, moderately to well sorted, fine sandy clastic fabric.	Rare clastic quartz grains.	Subaqueous "basaltic" tuff, possibly mildly reworked (tuffaceous greywacke). Finer detail obliterated by marked argillic alteration.

APPENDIX III

MAGNETOMETER TRAVERSE RESULTS

986126

CLEVELAND TIN LTD.

MAGNETOMETER TRAVERSE

INSTRUMENT: G 816OPERATORS: M.E. & N.H.

DATE: _____

LINE N° NL 10E

STATION IDENTITY	TIME	AVERAGE READING	TIME CORRECTED	ADJUSTED READING
0	9:24	62395	62392	62410
25	9:26	62393	62390	62408
50	9:27	62474	62471	62489
75	9:28	62327	62324	62342
100	9:29	62282	62279	62297
125	9:31	62353	62350	62368
150	9:32	62324	62321	62339
175	9:33	62342	62339	62357
200	9:34	62416	62413	62431
225	9:36	62384	62381	62399
250	9:37	62412	62410	62428
275	9:38	62435	62433	62451
300	9:39	62451	62449	62467
325	9:41	62479	62477	62495
350	9:42	62578	62576	62594
375	9:43	62980	62978	62996
400	9:45	62645	62643	62661
425	9:46	62404	62402	62420
450	9:48	62622	62620	62638
475	9:50	62712	62710	62728
500	9:51	62676	62674	62692
525	9:52	62650	62648	62666
550	9:54	62780	62778	62796
575	9:55	62869	62867	62885
600	9:57	62755	62753	62771
625	9:58	62564	62562	62580
650	9:59	62760	62758	62776
675	10:01	62819	62817	62835
700	10:02	62964	62962	62980
725	10:04	62444	62443	62461
750	10:05	62698	62697	62715

986127

CLEVELAND TIN LTD.

MAGNETOMETER TRAVERSE

INSTRUMENT: G 816OPERATORS: M.E. & N.H.

DATE: _____

LINE N^o NL 10E cont.

STATION IDENTITY	TIME	AVERAGE READING	TIME CORRECTED	ADJUSTED READING
775	10:07	62713	62712	62730
800	10:08	62523	62522	62540
825	10:12	62973	62972	62990
850	10:13	62920	62919	62937
875	10:15	62499	62498	62516
900	10:16	62494	62493	62511
925	10:17	62562	62562	62580
950	10:19	62663	62662	62680
975	10:20	62922	62921	62939
1000	10:21	62686	62685	62703
1025	10:22	62714	62713	62731
1050	10:23	62699	62798	62816
1075	10:25	62712	62711	62729
1100	10:26	62686	62685	62703
1125	10:28	62790	62789	62807
1150	10:29	62750	62749	62767
1175	10:30	63038	63038	63056
1200	10:32	62886	62886	62904
1225	10:33	62946	62946	62964
1250	10:34	62859	62859	62877
1275	10:36	63176	63176	63194
1300	10:37	62854	62854	62872
1325	10:39	62928	62928	62946
1350	10:40	62934	62934	62952
1375	10:41	63245	63245	63263
1400	10:43	63143	63143	63161
1425	10:44	63135	63135	63153
1450	10:46	63064	63064	63082
1475	10:47	63055	63055	63073
1500	10:49	62762	62762	62780
1525	10:51	62999	62999	63017

CLEVELAND TIN LTD.

986128

MAGNETOMETER TRAVERSE

INSTRUMENT: G 816

OPERATORS: M.E. & N.H.

DATE: _____

LINE No. NL 10E cont.

STATION IDENTITY	TIME	AVERAGE READING	TIME CORRECTED	ADJUSTED READING
1550	10:52	62872	62872	62890
1575	10:53	62896	62896	62914
1600	10:55	62556	62556	62574
1625	10:58	62372	62373	62391
1650	11:00	62212	62213	62231
1675	11:01	62168	62169	62187
1700	11:03	62164	62165	62183
1725	11:04	62197	62198	62216
1750	11:05	62209	62210	62228
1775	11:07	62324	62325	62343
1800	11:08	62277	62278	62996
1825	11:09	62322	62321	62339
1850	11:10	62254	62255	62273
1875	11:12	62238	62239	62257
1900	11:13	62240	62241	62259
1925	11:15	62232	62233	62251
1950	11:18	62260	62261	62279
1975	11:19	62283	62284	62202
2000	11:20	62290	62291	62309
2014	11:21	62301	62302	62320
BL 0	12:03	62389	62392	62410

986129

CLEVELAND TIN LTD.

MAGNETOMETER TRAVERSE

INSTRUMENT: G 816

OPERATORS: M.E. & N.H.

DATE: _____

LINE N^o. NL 14E

STATION IDENTITY	TIME	AVERAGE READING	TIME CORRECTED	ADJUSTED READING
0	1:47	62158	62169	62193
25	1:48	62183	62194	62218
50	1:49	62199	62210	62234
75	1:51	62229	62240	62264
100	1:53	62259	62269	62293
125	1:56	62290	62300	62324
150	1:57	62323	62333	62357
175	1:58	62366	62376	62400
200	1:59	62396	62406	62430
225	2:00	62434	62443	62467
250	2:01	62558	62567	62591
275	2:03	62362	62371	62395
300	2:04	62347	62356	62380
325	2:05	62343	62352	62376
350	2:07	62030	62039	62063
375	2:08	62117	62125	62149
400	2:12	62210	62218	62242
425	2:13	62366	62374	62398
450	2:14	62034	62042	62066
475	2:16	61944	61951	61975
500	2:17	62074	62081	62105
525	2:18	62066	62073	62097
550	2:20	62046	62053	62077
575	2:21	62079	62086	62110
600	2:23	62163	62170	62194
625	2:24	62323	62329	62353
650	2:25	62240	62446	62270
675	2:26	62335	62341	62365
700	2:28	62133	62139	62163
725	2:29	62069	62075	62099
750	2:30	62020	62026	62050

CLEVELAND TIN LTD.

986130

MAGNETOMETER TRAVERSE

INSTRUMENT: G 816

OPERATORS: M.E. & N.H.

DATE: _____

LINE N^o. NL 14E cont.

STATION IDENTITY	TIME	AVERAGE READING	TIME CORRECTED	ADJUSTED READING
775	2:32	62068	62073	62097
800	2:33	62086	62091	62115
825	2:42	62126	62130	62154
850	2:43	62324	62328	62352
875	2:45	62149	62153	62177
900	2:46	62123	62127	62151
925	2:47	62151	62155	62179
950	2:48	62274	62277	62301
975	2:49	62220	62223	62247
1000	2:50	62223	62226	62250
1025	2:52	62176	62179	62203
1050	2:53	62414	62416	62440
1075	2:54	62591	62593	62617
1100	2:55	62103	62105	62129
1125	2:56	62038	62040	62064
1150	2:58	62006	62007	62031
1175	2:59	62198	62199	62223
1200	3:00	62010	62011	62035
1225	3:01	62033	62034	62058
1250	3:03	62052	62052	62076
1275	3:04	62060	62060	62084
1300	3:05	62068	62068	62092
1325	3:07	62074	62074	62098
1350	3:08	62087	62087	62111
1375	3:09	62102	62102	62126
1400	3:11	62100	62099	62123
1425	3:12	62102	62101	62125
1450	3:13	62106	62105	62129
1475	3:14	62112	62111	62135
1500	3:15	62122	62121	62145
1525	3:17	62124	62123	62147

CLEVELAND TIN LTD.

986131

MAGNETOMETER TRAVERSE

INSTRUMENT: G 816OPERATORS: M.E. & N.H.

DATE: _____

LINE N°: NL 14E cont.

STATION IDENTITY	TIME	AVERAGE READING	TIME CORRECTED	ADJUSTED READING
1550	3:18	62130	62128	62152
1575	3:19	62136	62134	62158
1600	3:20	62142	62140	62164
1625	3:21	62133	62131	62155
1650	3:22	62135	62133	62157
1675	3:23	62158	62156	62180
1700	3:24	62133	62131	62155
1725	3:26	62085	62082	62106
1750	3:28	62124	62121	62145
1775	3:29	62109	62106	62130
1800	3:30	62098	62095	62119
1825	3:31	62104	62101	62125
1850	3:32	62115	62112	62136
1875	3:34	62152	62148	62172
1900	3:35	62247	62243	62267
1925	3:36	62154	62150	62174
1950	3:37	62158	62154	62178
1975	3:38	62203	62199	62223
2000	3:39	62217	62213	62237
2010	3:40	62239	62235	62259
BL 0	4:26	62179	62169	62193

986132

CLEVELAND TIN LTD.

MAGNETOMETER TRAVERSE

INSTRUMENT: G 816OPERATORS: M.E. & N.H.

DATE: _____

LINE N° NL 14W

STATION IDENTITY	TIME	AVERAGE READING	TIME CORRECTED	ADJUSTED READING
0	2:37	62155	62161	62193
25	2:39	62143	62149	62181
50	2:41	62119	62124	62156
75	2:43	62114	62119	62151
100	2:45	62099	62103	62135
125	2:46	62174	62178	62210
150	2:48	62151	62155	62187
175	2:50	62096	62099	62131
200	2:52	62237	62240	62272
225	2:54	62106	62108	62140
250	2:56	62098	62100	62132
275	2:58	62123	62125	62157
300	2:59	62088	62089	62121
325	3:00	62071	62072	62104
350	3:02	62034	62035	62067
375	3:03	62021	62022	62054
400	3:04	62028	62028	62060
425	3:06	61979	61979	62011
450	3:07	61958	61957	61989
475	3:08	62079	62078	62110
500	3:10	62205	62204	62236
525	3:12	62368	62366	62398
533	3:14	62412	62410	62442
BL	3:33	62167	62161	62193

CLEVELAND TIN LTD.

986133

MAGNETOMETER TRAVERSE

INSTRUMENT: G 816

OPERATORS: M.E. & N.H.

DATE: _____

LINE N^o NL 18E

STATION IDENTITY	TIME	AVERAGE READING	TIME CORRECTED	ADJUSTED READING
0	1:54	62090	62095	62102
25	1:56	62113	62118	62125
50	1:57	62168	62173	62180
75	1:58	62271	62276	62283
100	1:59	62478	62483	62490
125	2:00	62541	62546	62553
150	2:01	62280	62285	62292
175	2:03	62211	62216	62223
200	2:04	62034	62039	62046
225	2:05	62100	62104	62111
250	2:06	62119	62123	62130
275	2:09	62126	62130	62137
300	2:11	62163	62167	62174
325	2:12	62193	62197	62204
350	2:14	62286	62290	62297
375	2:15	62234	62238	62245
400	2:16	62269	62273	62280
425	2:17	62225	62229	62236
450	2:18	62322	62326	62333
475	2:19	62359	62363	62370
500	2:20	62447	62451	62458
525	2:22	62720	62724	62731
550	2:22	62647	62651	62658
575	2:23	62483	62487	62494
600	2:25	62549	62552	62559
625	2:26	62516	62519	62526
650	2:27	62375	62378	62385
675	2:28	62222	62225	62232
700	2:29	62072	62075	62082
725	2:30	61981	61984	61991
750	2:31	62269	62272	62279

CLEVELAND TIN LTD.

986134

MAGNETOMETER TRAVERSE

INSTRUMENT: G 816OPERATORS: M.E. & N.H.

DATE: _____

LINE N^o: NL 18E cont.

STATION IDENTITY	TIME	AVERAGE READING	TIME CORRECTED	ADJUSTED READING
775	2:32	62192	62195	62202
800	2:33	61954	61957	61964
825	2:35	62098	62101	62108
850	2:36	62051	62054	62061
875	2:38	61938	61941	61948
900	2:39	61954	61957	61964
925	2:40	61973	61976	61983
950	2:42	61940	61943	61950
975	2:43	61905	61908	61915
1000	2:44	61946	61948	61955
1025	2:45	61915	61917	61924
1050	2:46	61923	61925	16932
1075	2:47	62030	62032	62039
1100	2:49	61938	61940	61947
1125	2:50	61952	61954	61961
1150	2:51	61951	61953	61960
1175	2:52	61965	61967	61974
1200	2:54	61982	61984	61991
1225	2:55	61957	61959	61966
1250	2:56	61963	61965	61972
1275	2:57	61930	61932	61939
1300	2:58	61932	61934	61941
1325	3:08	61936	61937	61944
1350	3:10	61940	61941	61948
1375	3:11	61952	61953	61960
1400	3:12	61965	61966	61973
1425	3:13	61965	61966	61973
1450	3:15	61960	61961	61968
1475	3:17	61970	61971	61978
1500	3:18	61964	61965	61972
1525	3:20	61994	61995	62002

CLEVELAND TIN LTD.

986135

MAGNETOMETER TRAVERSE

INSTRUMENT: G 816OPERATORS: M.E. & N.H.

DATE: _____

LINE N^o NL 18E cont.

STATION IDENTITY	TIME	AVERAGE READING	TIME CORRECTED	ADJUSTED READING
1550	3:21	62164	62165	62172
1575	3:23	62074	62074	62081
1600	3:24	62205	62205	62212
1625	3:25	62145	62145	62152
1650	3:26	62022	62022	62029
1675	3:29	61940	61940	61947
1700	3:30	61884	61884	61891
1725	3:31	62026	62026	62033
1750	3:32	61976	61976	61983
1775	3:33	62437	62437	62444
1800	3:34	61890	61890	61897
1825	3:35	61905	61905	61912
1850	3:36	61919	61919	61926
1875	3:37	61923	61923	61930
1900	3:38	61949	61949	61956
1925	3:39	62000	62000	62007
1950	3:40	61898	61898	61905
1975	3:42	61928	61927	61934
2000	3:46	61936	61935	61942
2010	3:46	61936	61935	61942
0	4:48	62099	62095	62102

CLEVELAND TIN LTD.

986136

MAGNETOMETER TRAVERSE

INSTRUMENT: G 816

OPERATORS: M.E. & N.H.

DATE: _____

LINE N° NL 18W

STATION IDENTITY	TIME	AVERAGE READING	TIME CORRECTED	ADJUSTED READING
0	9:30	62097	62093	62102
25	9:32	62034	62030	62039
50	9:34	61991	61987	61996
75	9:36	61955	61951	61960
100	9:38	61895	61891	61900
125	9:39	62043	62039	62048
150	9:40	62376	62372	62381
175	9:41	61909	61905	61914
200	9:42	63608	63604	63613
225	9:44	62575	62571	62580
250	9:45	62839	62835	62844
275	9:46	63933	63929	62938
300	9:48	62064	62060	62069
325	9:49	62175	62171	62180
350	9:50	61885	61882	61891
375	9:51	61915	61912	61921
400	9:52	62389	62386	62395
425	9:54	62015	62012	62021
450	9:55	61971	61968	61977
475	9:56	61957	61954	61963
500	9:57	61906	61903	61912
525	9:58	61921	61918	61927
550	9:59	61915	61912	61921
575	10:01	61916	61913	61922
600	10:05	61971	61968	61977
625	10:07	61973	61970	61979
650	10:08	61954	61951	61960
675	10:09	61956	61953	61962
700	10:10	61962	61959	61968
725	10:12	61964	61961	61970
750	10:13	61966	61963	61972

986137

CLEVELAND TIN LTD.

MAGNETOMETER TRAVERSE

INSTRUMENT: G 816OPERATORS: M.E. & N.H.

DATE: _____

LINE N^o. NL 18W cont.

STATION IDENTITY	TIME	AVERAGE READING	TIME CORRECTED	ADJUSTED READING
775	10:14	62008	62005	62014
800	10:15	62012	62009	62018
825	10:16	62032	62029	62038
850	10:17	62034	62031	62040
875	10:19	62394	62391	62400
900	10:20	62174	62171	62180
925	10:21	62164	62161	62170
950	10:22	62192	62189	62198
975	10:23	62135	62132	62141
1000	10:26	62155	62152	62161
1025				
1030				
0	1:54	62090	62093	62102

CLEVELAND TIN LTD.

986138

MAGNETOMETER TRAVERSE

INSTRUMENT: G 816OPERATORS: M.E. & N.H.

DATE: _____

LINE N°: NL 22E

STATION IDENTITY	TIME	AVERAGE READING	TIME CORRECTED	ADJUSTED READING
0	11:06	62027	62032	62037
25	11:05	62022	62027	62032
50	11:03	62030	62035	62040
75	11:01	62025	62030	62035
100	10:59	62027	62031	62036
125	10:57	62030	62034	62039
150	10:55	62032	62036	62041
175	10:54	62036	62040	62045
200	10:52	62080	62083	62088
225	10:50	62112	62115	62120
250	10:48	62212	62215	62220
275	10:46	62117	62120	62125
300	10:45	62109	62111	62116
325	10:43	62395	62397	62402
350	10:40	62202	62204	62209
375	10:38	62744	62745	62750
400	10:36	62220	62221	62226
425	10:34	62207	62208	62213
450	10:32	62107	62108	62113
475	10:31	62077	62077	62082
500	10:29	62030	62030	62035
525	10:28	62033	62033	62038
550	10:26	62047	62047	62052
575	10:24	62054	62053	62058
600	10:21	62087	62086	62091
625	10:19	62249	62248	62253
650	10:18	62285	62284	62289
675	10:16	62578	62576	62581
700	10:15	62652	62650	62655
725	10:14	62304	62302	62307
750	10:07	61787	61784	61789

CLEVELAND TIN LTD.

986139

MAGNETOMETER TRAVERSE

INSTRUMENT: G 816OPERATORS: M.E. & N.H.

DATE: _____

LINE N^o. NL 22E *cont.*

STATION IDENTITY	TIME	AVERAGE READING	TIME CORRECTED	ADJUSTED READING
775	10:05	61909	61906	61911
800	10:02	61830	61826	61831
825	10:00	61907	61903	61908
850	9:59	62126	62122	62127
875	9:57	62267	62263	62268
900	9:55	62364	62359	62364
925	9:53	62494	62489	62494
950	9:52	62659	62654	62659
975	9:51	62761	62756	62761
1000	9:49	62248	62242	62247
1025	9:48	61826	61820	61825
1050	9:46	61823	61817	61822
1075	9:45	61857	61851	61856
1100	9:43	61885	61879	61884
1125	9:42	61899	61892	61897
1150	9:40	61921	61914	61919
1175	9:39	61930	61923	61928
1200	9:37	61929	61922	61927
1225	9:35	61932	61925	61930
1250	9:34	61947	61939	61944
1275	9:32	61954	61946	61951
1300	9:31	61951	61943	61948
1325	9:29	61933	61925	61930
1350	9:28	61930	61922	61927
1375	9:26	61943	61934	61939
1400	9:25	61942	61933	61938
1425	9:22	61944	61935	61940
1450	9:21	61947	61938	61943
1475	9:19	61949	61939	61944
1500	9:17	61960	61950	61955

CLEVELAND TIN LTD.

MAGNETOMETER TRAVERSE

INSTRUMENT: G 816

OPERATORS: M.E. & N.H.

DATE: _____

LINE N^o. NL 22E cont.

STATION IDENTITY	TIME	AVERAGE READING	TIME CORRECTED	ADJUSTED READING
1512	9:16	61959	61949	61954
1512	11:58	61938	61949	61954

986141

CLEVELAND TIN LTD.

MAGNETOMETER TRAVERSE

INSTRUMENT: G 816OPERATORS: M.E. & N.H.

DATE: _____

LINE N° NL 22W

STATION IDENTITY	TIME	AVERAGE READING	TIME CORRECTED	ADJUSTED READING
0	9:59	62034	62033	62037
25	10:01	62040	62039	62043
50	10:03	62034	62033	62037
75	10:05	62036	62035	62039
100	10:06	62033	62032	62036
125	10:08	62035	62034	62038
150	10:10	62053	62052	62056
175	10:11	62101	62100	62104
200	10:12	62120	62119	62123
225	10:14	62111	62110	62114
250	10:15	62043	62042	62046
275	10:18	61874	61873	61877
300	10:19	61976	61975	61979
325	10:21	62117	62116	62120
350	10:22	61979	61978	61982
375	10:24	61973	61972	61976
400	10:25	61973	61972	61976
425	10:26	61973	61972	61976
450	10:27	61919	61918	61922
475	10:31	61948	61947	61951
500	10:34	61958	61958	61962
525	10:35	61959	61959	61963
550	10:36	61971	61971	61975
575	10:37	61968	61968	61972
600	10:39	61992	61992	61996
625	10:40	62001	62001	62005
650	10:42	62010	62010	62014
675	10:44	62019	62019	62023
700	10:46	62022	62022	62026
725	10:47	62009	62009	62013
750	10:48	62050	62050	62054

986142

CLEVELAND TIN LTD.

MAGNETOMETER TRAVERSE

INSTRUMENT: G 816OPERATORS: M.E. & N.H.

DATE: _____

LINE N^o: NL 22W cont.

STATION IDENTITY	TIME	AVERAGE READING	TIME CORRECTED	ADJUSTED READING
775	10:50	62041	62041	62045
800	10:53	62026	62026	62030
825	10:55	62001	62001	62005
850	10:58	61992	61992	61996
875	11:00	61958	61958	61962
900	11:02	61920	61920	61924
925	11:04	61895	61895	61899
950	11:06	61870	61870	61874
975	11:07	62160	62160	62164
1000	11:09	62144	62144	62148
1025	11:11	61822	61822	61826
1050	11:13	61948	61948	61952
1075	11:15	62048	62048	62052
1100	11:16	62135	62135	62139
1125	11:19	62205	62205	62209
1150	11:21	62272	62272	62276
1175	11:23	62296	62296	62300
1200	11:25	62406	62405	62410
1225	11:27	62440	62440	62444
1250	11:28	62470	62470	62474
1275	11:30	62765	62765	62769
1300	11:34	62308	62308	62312
1325	11:36	62114	62114	62118
1350	11:38	62024	62025	62029
1375	11:41	62010	62011	62015
1400	11:43	62018	62019	62023
1425	11:45	62001	62002	62006
1450	11:46	61983	61984	61988
1475				
1487	11:48	62005	62006	62010
0	1.15	62031	62033	62037

APPENDIX IV

RESULTS OF GEOCHEMICAL SOIL SURVEY

986144

Note: Intervals not analysed should be recorded such that a complete hole is itemised.

For any section not analysed, a value

☐ -5.00 should be entered in the ☐ relevant assay columns.

It is not necessary to record a zero.

SOIL SAMPLES

PAGE 1 OF 5

[illegible]

986145

Note: Intervals not analysed should be recorded such that a complete hole is itemised. For any section not analysed, a value $\bigcirc$ -5.00 should be entered in the $\bigcirc$ relevant assay columns. It is not necessary to record a zero.

SOIL SAMPLES

PAGE 2 OF 5

PROGRAM								PROGRAMMER																																												DATE																																											
IDENT.								DISTANCE FROM TO BOTTOM OF (metres)								ASSAY ppm SNT								ASSAY ppm ~~STANDARD~~ AS								ASSAY ppm COPPER								ASSAY ppm ZINC								ASSAY ppm LEAD								ASSAY ppm TUNGSTEN								grammes per Tonne SILVER								grammes per Tonne GOLD								Assay ppm Ni								SAMPLE No.							
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80																
MLIC								500								25								<10								120								180								50								<20																								80								268021							
								525								25								<10								100								220								140								<20																								80								22							
								550								50								<10								140								120								70								<20																								70								23							
								575								20								<10								90								60								40								<20																								30								24							
								600								110								<10								90								60								30								<20																								30								25							
								625								560								10								10								50								30								<20																								10								26							
								650								35								<10								80								180								70								<20																								80								27							
								675								500								<10								90								160								70								<20																								80								28							
								700								35								<10								90								100								60								<20																								70								29							
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								750								50								<10								90								180								80								<20																								90								31							
								775								70								10								120								460								140								35																								50								32							
								800								15								<10								45								70								70								20																								40								33							
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								975								40								<10								160								90								40								30																								40								40040							

986146

Note: Intervals not analysed should be recorded such that a complete hole is itemised.

For any section not analysed, a value

-5.00 should be entered in the relevant assay columns.

It is not necessary to record a zero.

SOIL SAMPLES

PAGE 3 OF 5

[illegible]

986147

Note: Intervals not analysed should be recorded such that a complete hole is itemised.
For any section not analysed, a value -5.00 should be entered in the relevant assay columns.
It is not necessary to record a zero.

PAGE

SOIL SAMPLES

PAGE 4 OF 5

[illegible]

986148

Note: Intervals not analysed should be recorded such that a complete hole is itemised.
For any section not analysed, a value -5.00 should be entered in the relevant assay columns.
It is not necessary to record a zero.

SOIL SAMPLES

PAGE 5 OF 5

PROGRAM								PROGRAMMER										DATE																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
								DISTANCE ~~(metres)~~	ASSAY ~~Ppm~~ SNT	ASSAY ~~Ppm~~ ~~MS~~	ASSAY ~~Ppm~~ COPPER	ASSAY ~~Ppm~~ ZINC	ASSAY ~~Ppm~~ LEAD	ASSAY ~~Ppm~~ TUNGSTEN	~~grams per Tonne~~ SILVER	~~grams per Tonne~~ GOLD	ASSAY ~~Ppm~~ Ni	SAMPLE No.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
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986149

Note: Intervals not analysed should be recorded such that a complete hole is itemised.
For any section not analysed, a value -5.00 should be entered in the relevant assay columns.
It is not necessary to record a zero.

SOIL SAMPLES

PAGE 1A OF 5A

PROGRAM										PROGRAMMER										DATE																																																																																																			
LINE ~~LINE~~ ~~IDENT.~~										DISTANCE ~~100 TO~~ ~~FROM~~ ~~START~~ (metres)										ASSAY ~~%~~ ~~PPM~~ SNT										ASSAY ~~%~~ ~~PPM~~ ~~STANDARD~~ AS										ASSAY ~~%~~ ~~PPM~~ COPPER										ASSAY ~~%~~ ~~PPM~~ ZINC										ASSAY ~~%~~ ~~PPM~~ LEAD										ASSAY ~~%~~ ~~PPM~~ TUNGSTEN										grammes per Tonne ~~SILVER~~										grammes per Tonne GOLD										Assay ~~PPM~~ Ni										SAMPLE No.									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80																																								
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										25° E					30					< 10					30					20					30					< 20															10					268102																																																											
										50° E					45					10					40					30					10					30															10					103																																																											
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										300° E					85					10					140					200					40					< 20															70					113																																																											
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										350° E					20					20					120					240					60					< 20															70					115																																																											
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										400° E					330					15					70					250					50					< 20															60					117																																																											
										425° E					220					15					160					160					50					< 20															80					118																																																											
										450° E					40					20					220					200					40					< 20															50					119																																																											
										475° E					60					20					140					150					40					< 20															60					268120																																																											
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80																																								

986150

Note: Intervals not analysed should be recorded such that a complete hole is itemised.
For any section not analysed, a value ☒ -5.00 should be entered in the ☐ relevant assay columns.
It is not necessary to record a zero.

SOIL SAMPLES

PAGE 2A OF 5A

[illegible]

986151

Note: Intervals not analysed should be recorded such that a complete hole is itemised.
For any section not analysed, a value ☐ -5.00 should be entered in the ☐ relevant assay columns.
It is not necessary to record a zero.

SOIL SAMPLES

PAGE 3A OF 5A

PROGRAM								PROGRAMMER																																												DATE																																											
LING ~~HOLE~~ ~~IDENT.~~								LING DISTANCE ~~COLLECTOR TO~~ ~~BOTTOM~~ ~~SAMPLE~~ (metres)								ASSAY ~~ppm~~ SNT								ASSAY ~~ppm~~ ~~SAMPLE~~ 175								ASSAY ~~ppm~~ COPPER								ASSAY ~~ppm~~ ZINC								ASSAY ~~ppm~~ LEAD								ASSAY ~~ppm~~ TUNGSTEN								~~grammes~~ ~~per~~ Tonne SILVER								~~grammes~~ ~~per~~ Tonne GOLD								Assay ~~ppm~~ Ni								SAMPLE No.							
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80																
NL14E								1000°E								40								20°								80°								140°								80°								<20°																								60								268141							
								1025°E								25								15°								60°								140°								60°								<20°																								40								142							
								1050°E								20								20°								140°								120°								120°								<20°																								60								143							
								1075°E								50								10°								80°								70°								80°								20°																								40								144							
								1100°E								10								20°								60°								120°								70°								20°																								30								145							
								1125°E								30								10°								50°								50°								40°								<20°																								20								146							
								1150°E								15								30°								30°								50°								50°								<20°																								80								147							
								1175°E								30								10°								70°								50°								40°								<20°																								40								148							
								1200°E								<10								20°								30°								20°								20°								20°																								<10								149							
								1225°E								30								15°								50°								140°								60°								<20°																								30								268150							
								1250°E								10								15°								40°								60°								30°								30°																								10								151							
								1275°E								90								15°								50°								80°								40°								20°																								50								152							
								1300°E								60								<10°								50°								50°								100°								40°																								20								153							
								1325°E								30								10°								30°								40°								10°								20°																								10								154							
								1350°E								25								10°								40°								20°								140°								40°																								20								155							
								1375°E								50								15°								100°								40°								20°								40°																								20								156							
								1400°E								40								15°								30°								30°								20°								30°																								10								157							
								1425°E								20								<10°								40°								40°								20°								30°																								10								158							
								1450°E								35								10°								60°								60°								40°								20°																								20								159							
								1475°E								70								15°								140°								60°								140°								<20°																								20								268160							
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80																

986152

Note: Intervals not analysed should be recorded such that a complete hole is itemised.
 For any section not analysed, a value $\bigcirc$ -5.00 should be entered in the relevant assay columns.
 It is not necessary to record a zero.

SOIL SAMPLES

PAGE 4A OF 5A

PROGRAM								PROGRAMMER																								DATE																																															
LINE HOLE IDENT.								LINE DISTANCE FROM OCEAN TO BOTTOM OF SAMPLES (metres)								ASSAY Pb ppm SNT				ASSAY Zn ppm STANNITE AS				ASSAY Cu ppm COPPER				ASSAY Zn ppm ZINC				ASSAY Pb ppm LEAD				ASSAY Pb ppm TUNGSTEN				~~grammes per Tonne SILVER~~								~~grammes per Tonne GOLD~~								ASSAY Pb ppm Ni								SAMPLE No.															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
ML14E								1500'E								30				25				50				40				120				30																				30								268161															
								1525'E								20				15				40				50				40				30																				20								162															
								1550'E								30				10				50				50				20				30																				10								163															
								1575'E								45				20				40				60				20				40																				10								164															
								1600'E								40				15				30				40				20				20																				10								165															
								1625'E								20				10				40				40				20				20																				20								166															
								1650'E								20				10				40				30				20				50																				20								167															
								1675'E								120				25				140				80				40				220																				50								168															
								1700'E								25				10				60				70				40				20																				40								169															
								1725'E								35				15				30				80				40				50																				60								268170															
								1750'E								35				15				50				90				80				30																				20								171															
								1775'E								10				25				20				40				60				220																				10								172															
								1800'E								45				10				60				40				40				20																				10								173															
								1825'E								25				15				40				30				20				40																				10								174															
								1850'E								30				15				50				60				20				40																				30								175															
								1875'E								35				20				80				80				60				220																				90								176															
								1900'E								15				10				40				50				30				20																				20								177															
								1925'E								25				10				10				30				10				30																				20								178															
								1950'E								25				10				30				70				20				220																				80								179															
								1975'E								25				10				20				50				20				220																				120								268180															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80

986153

Note: Intervals not analysed should be recorded such that a complete hole is itemised.
For any section not analysed, a value $\emptyset$ -5.00 should be entered in the relevant assay columns.
It is not necessary to record a zero.

SOIL SAMPLES

PAGE 5A OF 5A

PROGRAM								PROGRAMMER										DATE																																																													
LINE HOLE IDENT.								LINE DISTANCE FROM BOREHOLE TO SECTION OF SAMPLE (metres)								ASSAY Pb fpm SNT		ASSAY Pb fpm STANITE		ASSAY Pb fpm COPPER		ASSAY Pb fpm ZINC		ASSAY Pb fpm LEAD		ASSAY Pb fpm TUNGSTEN		grammes per Tonne SILVER					grammes per Tonne SOLD					Assay fpm Ni		SAMPLE No.																																							
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
NL14E								2000'E								35		<10		20		40		20		20												160				268181																																					
								2010'E								15		<10		40		60		20		20												240				182																																					
NL14E								Right 363'E Creek								25		15		870		160		40		<20												40				268183																																					
								Left 363'E Creek								15		15		70		220		40		<20												50				184																																					
								Left 363'E Creek								320		25		80		200		50		<20												40				185																																					
								Right 551'E Creek								60		20		80		120		40		30												140				186																																					
								Left 551'E Creek								10		20		60		160		40		<20												140				187																																					
								Left 551'E Creek								10		15		100		120		40		<20												180				188																																					
								Right 760'E Creek								10		<10		20		90		<10		<20												120				189																																					
								Left 760'E Creek								25		<10		30		140		20		20												220				268190																																					
								Left 760'E Creek								30		<10		30		140		10		40												190				191																																					
								Right 1270'E Creek								50		<10		20		80		10		20												60				192																																					
								Left 1270'E Creek								40		30		30		30		40		<20												230				193																																					
								Left 1270'E Creek								35		10		40		140		30		30												140				194																																					
								Right 1745'E Creek								40		<10		40		60		20		<20												70				195																																					
								Left 1745'E Creek								40		10		20		80		20		<20												70				196																																					
								Left 1745'E Creek								25		15		20		60		<10		40												60				197																																					
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80

986154

Note: Intervals not analysed should be recorded such that a complete hole is itemised.
For any section not analysed, a value ☐ -5.00 should be entered in the ☐ relevant assay columns.
It is not necessary to record a zero.

SOIL SAMPLES

PAGE 1 OF 2

[illegible]

986155

Note: Intervals not analysed should be recorded such that a complete hole is itemised.

For any section not analysed, a value

() -5.00 should be entered in the

① relevant assay columns.

It is not necessary to record a zero.

Soil Samples

PAGE 2 OF 2

[illegible]

986156

Note: Intervals not analysed should be recorded such that a complete hole is itemised.
 For any section not analysed, a value $\bigcirc$ -5.00 should be entered in the relevant assay columns.
 It is not necessary to record a zero.

SOIL SAMPLESPAGE 13 OF 53

PROGRAM								PROGRAMMER																								DATE																																															
LINE IDENT.								LINE DISTANCE OF SAMPLE (metres)								ASSAY % SNT		ASSAY % SNT		ASSAY % COPPER		ASSAY % ZINC		ASSAY % LEAD		ASSAY % TUNGSTEN		grammes per Tonne SILVER		grammes per Tonne GOLD		ASSAY Ni								SAMPLE No.																																							
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
ML18E								25'E								10		10		20		30		30		80																						20		268		266																											
								50'E								<10		10		10		20		20		90																				20		267																															
								75'E								15		10		120		80		20		70																		200		268																																	
								100'E								10		30		80		90		30		60																260		269																																			
								125'E								30		15		50		80		30		50																240		270																																			
								150'E								15		10		20		120		40		<20																440		271																																			
								175'E								15		10		10		20		10		40																40		272																																			
								200'E								10		<10		10		10		10		80														<10		273																																					
								225'E								15		<10		10		10		10		120														<10		274																																					
								250'E								<10		<10		10		10		10		90												<10		268		275																																					
								275'E								15		<10		<10		20		<10		<20												<10		276																																							
								300'E								NO		SAMPLE TAKEN								ROADWAY										277																																											
								325'E								25		<10		20		10		10		20														<10		278																																					
								350'E								35		10		10		30		20		<20												<10		279																																							
								375'E								10		<10		30		40		20		30												10		280																																							
								400'E								15		10		10		20		20		20												10		281																																							
								425'E								10		<10		120		120		20		<20										100		282																																									
								450'E								15		<10		90		100		20		<20										50		283																																									
								475'E								90		15		70		140		90		<20										40		284																																									
								500'E								<10		<10		70		60		30		<20										40		268		285																																							
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80

986157

Note: Intervals not analysed should be recorded such that a complete hole is itemised.
 For any section not analysed, a value ϕ -5.00 should be entered in the relevant assay columns.
 It is not necessary to record a zero.

SOIL SAMPLES

PAGE 2B OF 5B

PROGRAM								PROGRAMMER								DATE																																																															
LINE IDENT.								DISTANCE FROM GROUND TO SAMPLE (metres)								ASSAY % SNT		ASSAY % SNT		ASSAY % COPPER		ASSAY % ZINC		ASSAY % LEAD		ASSAY % TUNGSTEN		grammes per Tonne SILVER		grammes per Tonne GOLD		ASSAY Ni		SAMPLE No.																																													
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
ML18E								525	E						10						<10						140						140						40						<20																		50						268	286									
								550	E						30						<10						220						180						40						<20												70																		287				
								575	E						30						<10						50						160						20						<20												30												288										
								600	E						15						<10						70						140						30						<20												40												289										
								625	E						20						<10						70						240						30						<20												50												290										
								650	E						20						<10						60						180						50						<20												40												291										
								675	E						20						<10						70						90						50						<20												50												292										
								700	E						15						<10						80						80						40						<20												60												293										
								725	E						160						<10						20						40						350						30												30												294										
								750	E						40						10						80						160						50						<20												50						268	295															
								775	E						13						10						160						300						80						<20												70												296										
								800	E						10						10						80						220						70						<20												60												297										
								825	E						15						<10						50						90						60						<20												50												298										
								850	E						20						10						80						140						60						<20												70												299										
								875	E						30						<10						60						140						60						<20												50												300										
								900	E						15						10						50						160						60						20												30												301										
								925	E						15						<10						120						200						100						<20												60												302										
								950	E						30						10						60						70						100						<20												40												303										
								975	E						10						<10						70						120						100						<20												50												304										
								1000	E						10						20						60						100						80						<20												50						268	305															

986158

Note: Intervals not analysed should be recorded such that a complete hole is itemised.
For any section not analysed, a value should be entered in the relevant assay columns.
It is not necessary to record a zero.

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PROGRAM								PROGRAMMER																																												DATE																											
LINE MOLE IDENT.								LINE DISTANCE FROM SURFACE OF MINERAL (metres)								ASSAY % SNT				ASSAY % SE TE 25				ASSAY % COPPER				ASSAY % ZINC				ASSAY % LEAD				ASSAY % TUNGSTEN				grammes per Tonne SILVER				grammes per Tonne GOLD				ASSAY Ni				SAMPLE No.																											
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
ML18E								1025'E								20				<10				70				140				80				<20																70				268306																							
								1050'E								<10				<10				120				220				70				<20																120				307																							
								1075'E								<10				<10				30				80				40				<20												220				308																											
								1200'E								<10				<10				40				70				40				<20												200				309																											
								1125'E								<10				10				70				100				60				<20												140				310																											
								1150'E								<10				<10				20				60				40				50												60				311																											
								1175'E								10				<10				80				70				50				<20												340				312																											
								1200'E								20				<10				50				60				40				30												220				313																											
								1225'E								90				<10				30				60				40				<20												400				884																											
								1250'E								<10				<10				30				50				40				<20												180				268315																											
								1275'E								<10				<10				120				90				40				<20												230				316																											
								1300'E								<10				10				90				90				50				20												260				317																											
								1325'E								<10				<10				60				140				70				<20												240				318																											
								1350'E								<10				15				30				70				80				20												80				319																											
								1375'E								10				10				50				140				90				<20												200				320																											
								1400'E								<10				<10				30				50				60				20												70				321																											
								1425'E								10				<10				40				50				30				<20												60				322																											
								1450'E								30				<10				70				50				40				<20												60				323																											
								1475'E								<10				<10				60				50				40				<20												50				324																											
								1500'E								<10				<10				50				50				40				<20												140				268325																											
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80

986159

Note: Intervals not analysed should be recorded such that a complete hole is itemised.
For any section not analysed, a value ☐ -5.00 should be entered in the ☐ relevant assay columns.
It is not necessary to record a zero.

SOIL SAMPLES

PAGE 4B OF 5B

PROGRAM								PROGRAMMER																																												DATE																											
LINE DISTANCE FROM TOP TO BOTTOM SAMPLE (metres)								ASSAY % SNT				ASSAY % STANNITE				ASSAY % COPPER				ASSAY % ZINC				ASSAY % LEAD				ASSAY % TUNGSTEN				grammes per Tonne SILVER				grammes per Tonne GOLD				ASSAY Ni				SAMPLE No.																																			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
ML18E								1525'E				<10				<10				20				20				10				<20												10				268326																															
								1550'E				<10				<10				70				80				30				<20												160				327																															
								1575'E				<10				<10				60				50				40				<20												140				328																															
								1600'E				25				<10				160				120				50				<20												240				329																															
								1625'E				10				<10				120				90				30				<20												200				330																															
								1650'E				<10				<10				50				60				20				<20												140				331																															
								1675'E				<10				<10				40				60				20				<20												180				332																															
								1700'E				<10				10				20				40				20				<20												120				333																															
								1725'E				<10				<10				30				50				20				<20												220				334																															
								1750'E				<10				<10				10				50				20				<20												70				268335																															
								1775'E				<10				15				10				20				20				<20												60				336																															
								1800'E				<10				<10				20				58				10				<20												70				337																															
								1825'E				<10				10				50				60				20				<20												240				338																															
								1850'E				15				<10				40				60				20				<20												140				339																															
								1875'E				<10				<10				30				40				20				<20												120				340																															
								1900'E				<10				<10				60				90				30				<20												140				341																															
								1925'E				<10				10				50				60				20				<20												50				342																															
								1950'E				<10				<10				50				80				30				<20												140				343																															
								1975'E				<10				15				40				90				40				<20												160				344																															
								2000'E				<10				<10				40				120				40				<20												40				268345																															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80

986160

Note: Intervals not analysed should be recorded such that a complete hole is itemised.
For any section not analysed, a value ☒ -5.00 should be entered in the ☐ relevant assay columns.
It is not necessary to record a zero.

SOIL SAMPLES

PAGE 53 OF 53

[illegible]

986161

Note: Intervals not analysed should be recorded such that a complete hole is itemised.
For any section not analysed, a value -5.00 should be entered in the relevant assay columns.
It is not necessary to record a zero.

SOIL SAMPLES

PAGE 1 OF 3

[illegible]

986162

Note: Intervals not analysed should be recorded such that a complete hole is itemised.

For any section not analysed, a value ☐ -5.00 should be entered in the ☐ relevant assay columns.

It is not necessary to record a zero.

SOIL SAMPLES

PAGE 2 OF 3

[illegible]

986163

Note: Intervals not analysed should be recorded such that a complete hole is itemised.
For any section not analysed, a value -5.00 should be entered in the relevant assay columns.
It is not necessary to record a zero.

PAGE 3 OF 3

[illegible]

986164

Note: Intervals not analysed should be recorded such that a complete hole is itemised.

For any section not analysed, a value

-5.00 should be entered in the

relevant assay columns.

It is not necessary to record a zero.

Soil Samples

PAGE 1 OF 4

PROGRAM									PROGRAMMER																	DATE																																																																		
LINE IDENT.									CAMP DISTANCE SEE (metres)							ASSAY % SNT							ASSAY % COPPER							ASSAY % ZINC							ASSAY % LEAD							ASSAY % TUNGSTEN							grammes per Tonne SILVER							grammes per Tonne GOLD							ASSAY Ni							SAMPLE No.																				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80													
ML22E									0.E							<10							20							70							60							140																					20							268359																				
									25.E							20							20							30							20							20							<20																					10														360						
									50.E							15							<10							25							60							30							80																					10														361						
									75.E							50							20							50							30							30							40																					10														362						
									100.E							35							15							15							20							30							<20																					10														363						
									125.E							35							15							15							40							40							<20																					20														364						
									150.E							15							15							5							10							30							20																					10														365						
									175.E							<10							15							60							120							40							<20																					130														366						
									200.E							<10							30							65							160							50							<20																					300														367						
									225.E							320							20							70							120							50							<20																					240														268368						
									250.E							<10							15							30							50							40							<20																					70														369						
									275.E							10							25							50							50							30							<20																					130														370						
									300.E							<10							20							50							60							40							<20																					100														371						
									325.E							10							20							80							40							40							<20																					40														372						
									350.E							<10							<10							90							60							50							120																					120														373						
									375.E							<10							20							40							170							50							<20																					700														374						
									400.E							30							10							140							70							50							<20																					80														375						
									425.E							30							10							40							50							60							<20																					60														376						
									450.E							<10							20							70							50							40							<20																					70														377						
									475.E							<10							15							20							20							20							40																					20														268378						
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80													

986165

Note: intervals not analysed should be recorded such that a complete hole is itemised.

For any section not analysed, a value

-5.00 should be entered in the

relevant assay columns.

It is not necessary to record a zero.

SOIL SAMPLES

PAGE 2 OF 4

PROGRAM									PROGRAMMER																																												DATE																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
LINE FMS IDENT.									DISTANCE COORDINATE OCCURRENCE (metres)					ASSAY % SNT					ASSAY % SEAMITE 605					ASSAY % COPPER					ASSAY % ZINC					ASSAY % LEAD					ASSAY % TUNGSTEN					~~grammes per Tonne SILVER~~					~~grammes per Tonne GOLD~~					Assay Ni																SAMPLE No.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
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986166

Note: Intervals not analysed should be recorded such that a complete hole is itemised.
 For any section not analysed, a value -5.00 should be entered in the relevant assay columns.
 It is not necessary to record a zero.

SOIL SAMPLES

PAGE 3 OF 4

PROGRAM								PROGRAMMER								DATE																																																															
LINE IDENT.	DISTANCE FROM BOTTOM OF HOLE (metres)	ASSAY % SNT	ASSAY % SNT	ASSAY % COPPER	ASSAY % ZINC	ASSAY % LEAD	ASSAY % TUNGSTEN	grammes per Tonne SILVER	grammes per Tonne GOLD	Assay Ri	SAMPLE No.																																																																				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
NL22E	1000.E	20	35	40	210	40	40				30	268399																																																																			
	1025.E	25	15	20	200	40	<20				50	200																																																																			
	1050.E	15	20	70	130	50	20				50	401																																																																			
	1075.E	30	15	110	140	40	40				150	402																																																																			
	1100.E	25	25	130	110	40	40				140	403																																																																			
	1125.E	25	<10	130	80	40	40				120	404																																																																			
	1150.E	65	25	240	100	40	<20				190	405																																																																			
	1175.E	40	15	50	120	40	40				120	406																																																																			
	1200.E	20	<10	40	50	30	100				40	407																																																																			
	1225.E	50	20	100	80	40	<20				100	408																																																																			
	1250.E	35	25	80	70	30	40				80	268409																																																																			
	1275.E	40	20	30	30	30	80				30	410																																																																			
	1300.E	35	25	20	40	30	<20				40	411																																																																			
	1325.E	50	15	50	40	40	60				40	412																																																																			
	1350.E	20	15	30	50	40	40				50	413																																																																			
	1375.E	30	15	30	60	40	40				70	414																																																																			
	1400.E	20	<10	20	20	20	60				20	415																																																																			
	1425.E	45	<10	10	10	30	60				20	416																																																																			
	1450.E	15	10	100	20	30	40				20	417																																																																			
	1475.E	<10	20	10	10	30	40				20	268418																																																																			

986167

Note: Intervals not analysed should be recorded such that a complete hole is itemised.

For any section not analysed, a value -5.00 should be entered in the relevant assay columns.

It is not necessary to record a zero.

SOL SAMPLES

PAGE.....4..... OF 4.....

[illegible]

986168

Note: Intervals not analysed should be recorded such that a complete hole is itemised.

For any section not analysed, a value

-5.00 should be entered in the

relevant assay columns.

It is not necessary to record a zero.

SOIL SAMPLES

PAGE 1A OF 4A

PROGRAM								PROGRAMMER																																												DATE																											
LINE IDENT.								DISTANCE (metres)								ASSAY PPM SNT				ASSAY PPM STANNITE AS				ASSAY PPM COPPER				ASSAY PPM ZINC				ASSAY PPM LEAD				ASSAY PPM TUNGSTEN				~~Ag PPM grammes per Tonne SILVER~~				~~grammes per Tonne GOLD~~				Assay PPM Ni				Rb PPM				SAMPLE No.																							
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
ML22W								25W								160				<10				140				30				20				80												20				268427																											
								50W								<10				<10				30				30				20				120												10				28																											
								75W								80				<10				60				30				20				60												30				29																											
								100W								~~NO~~				~~SAMPLE~~				<del></del>				<del></del>				<del></del>				<del></del>				<del></del>				<del></del>				<del></del>				<del></del>				30																							
								125W								<10				<10				30				20				10				100												20				31																											
								150W								15				<10																60				<10								160				32																											
								175W								<10				20				50				30				25				<20												70				33																											
								200W								10				<10				20				30				10				40												30				34																											
								225W								200				<10				150				30				20				40												20				35																											
								250W								20				20				25				25				20				60												20				36																											
								275W								25				20				70				100				40				40												240				37																											
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								325W								25				<10				100				100				40				20												70				39																											
								350								10				<10				20				30				20				20												20				40																											
								375								15				<10				20				50				20				20												20				41																											
								400								30				15				50				50				30				20												30				42																											
								425								15				15				30				50				40				40												40				43																											
								450								10				20				130				100				50				20												70				44																											
								475								10				20				40				60				30				20												30				45																											
								500								10				30				50				50				50				20												60				46																											
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80

986169

Note: Intervals not analysed should be recorded such that a complete hole is itemised.

For any section not analysed, a value

☐ -5.00 should be entered in the ☐ relevant assay column.

It is not necessary to record a zero.

SOIL SAMPLES

PAGE 2A OF 4A

[illegible]

986170

Note : Intervals not analysed should be recorded such that a complete hole is itemised.

For any section not analysed, a value -5.00 should be entered in the relevant assay columns.

It is not necessary to record a zero.

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PROGRAM								PROGRAMMER																																												DATE																											
CODE IDENT.								DISTANCE FROM COAST TO BOTTOM GEOMETER (metres)								ASSAY SNT				ASSAY SEAMATE				ASSAY COPPER				ASSAY ZINC				ASSAY LEAD				ASSAY TUNGSTEN				grammes per Tonne SILVER				grammes per Tonne GOLD				Assay PPM Ni Rb Hm								SAMPLE No.																							
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
HL22W								1025								15				10				70				80				20				<20												1180								67																							
								1050								15				<10				60				60				20				<20												570								68																							
								1075								15				15				60				60				20				<20												300								69																							
								1100								20				10				90				70				20				<20												600								70																							
								1125								30				<10																<20				<10								20								71																							
								1150								10				<10				70				70				10				<20												420								72																							
								1175								15				20				40				90				20				<20												370								73																							
								1200								10				15				60				60				10				<20												430								74																							
								1225								20				<10				40				70				10				<20												440								75																							
								1250								35				<10				60				70				20				<20												410								76																							
								1275								15				15				110				50				10				<20												190								77																							
								1300								30				<10				120				100				20				40												80								78																							
								1325								10				<10				70				100				10				<20												60								79																							
								1350								20				10				50				90				10				<20												60								80																							
								1375								10				<10				80				70				20				20												50								81																							
								1400								<10				<10				90				50				20				<20												70								82																							
								1425								<10				20				80				90				10				<20												50								83																							
								1450								<10				15				80				70				70				<20												50								84																							
								1487								<10				15				110				80				20				20												120								85																							
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80

986171

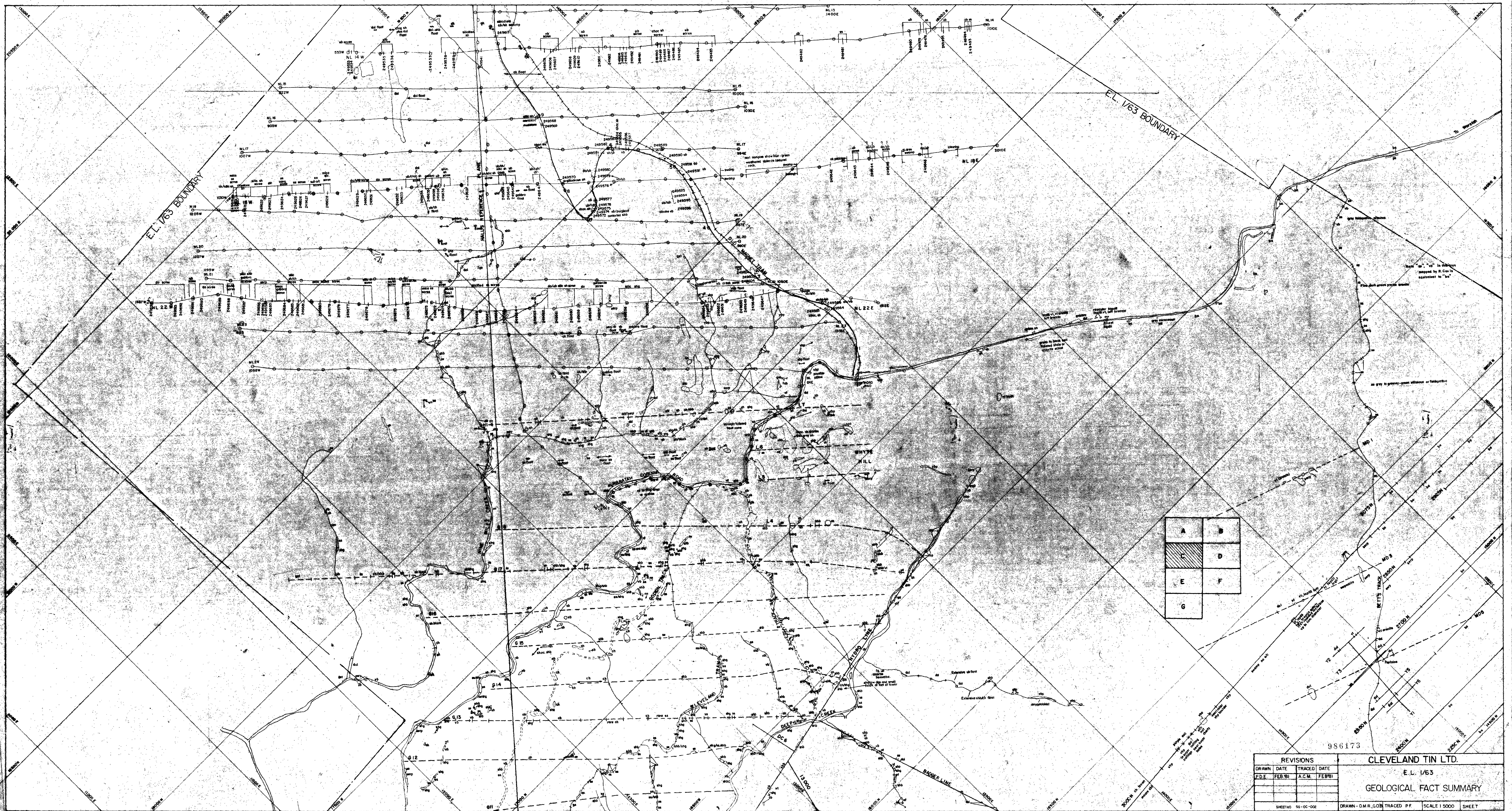
Note: Intervals not analysed should be recorded such that a complete hole is itemised.

For any section not analysed, a value $\bigcirc$ -5.00 should be entered in the $\bigcirc$ relevant assay columns.

It is not necessary to record a zero.

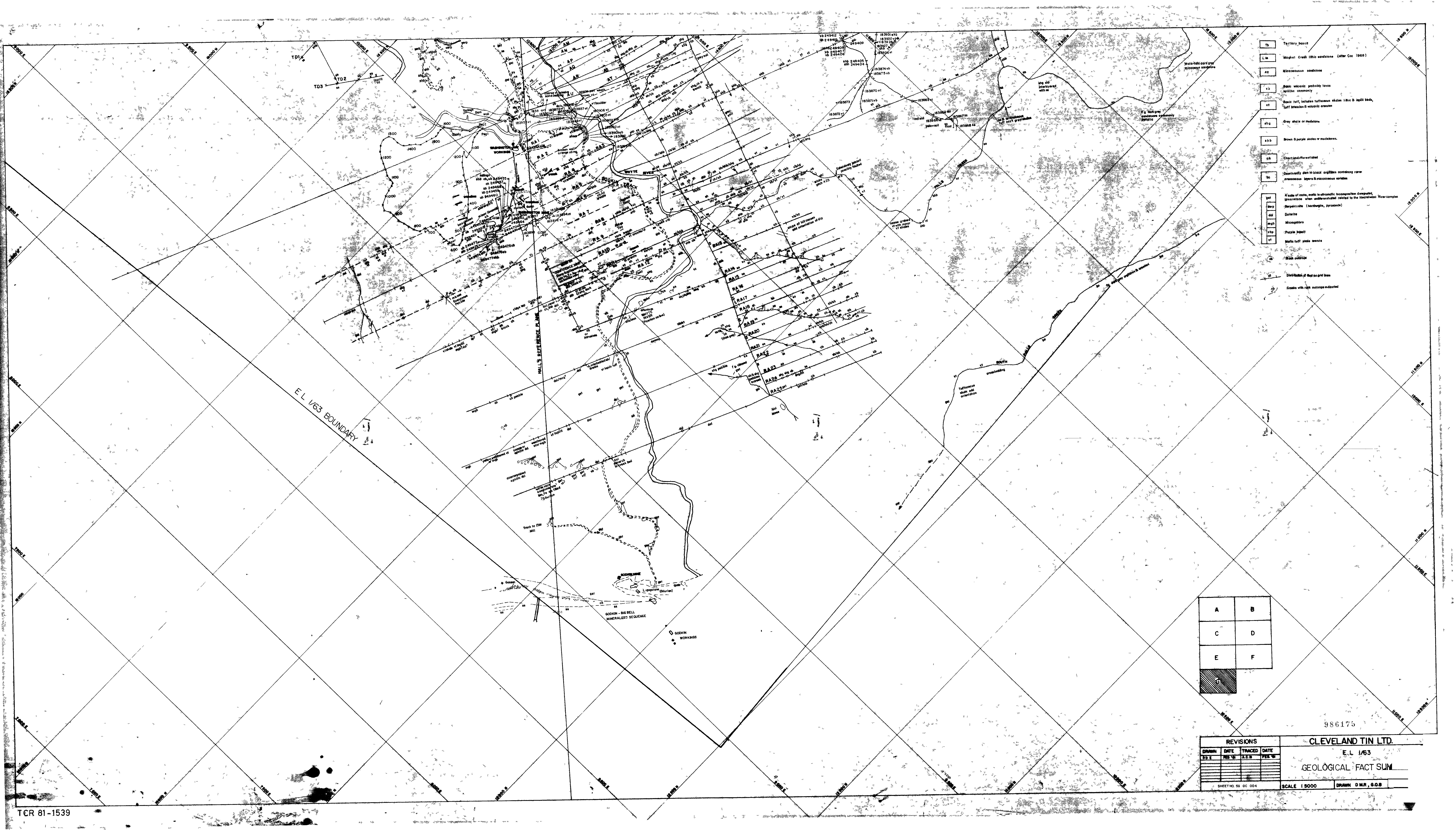
PAGE 4A OF 5A

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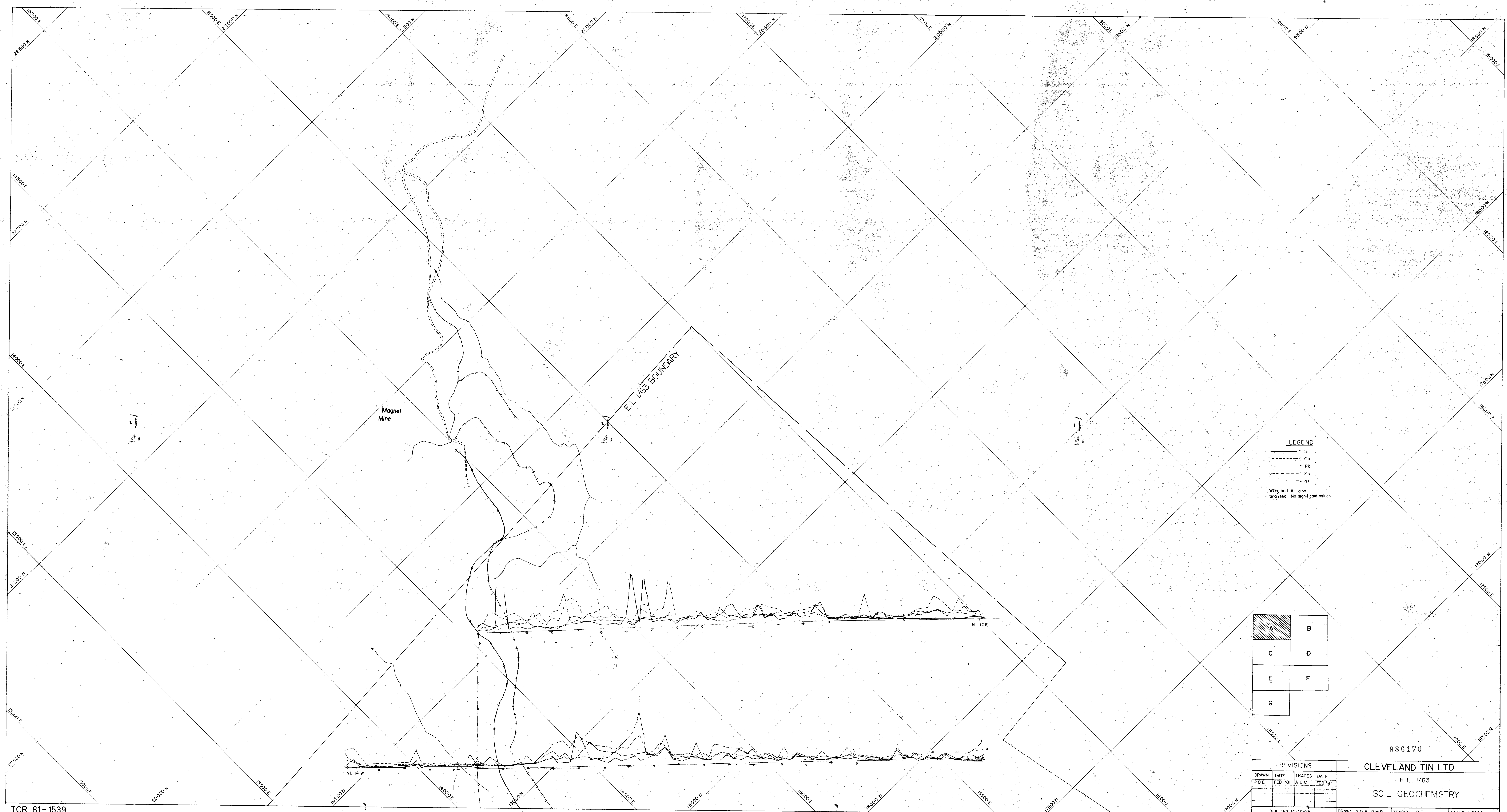
REVISIONS				CLEVELAND TIN LTD.			
DRAWN	DATE	TRACED	DATE	E.L. 163			
P.D.E.	FEB/91	A.C.M.	FEB/91	GEOLOGICAL FACT SUMMARY			
SHEETNO 50-00-002				DRAWN-D.M.R.G.O.B. TRACED-P.F. SCALE 1:5000 SHEET			



- Th Tertiary basalt
- LW Magnet Creek (lithic sandstone (after Cox 1968))
- MS Micaceous sandstone
- VB Basic volcanic probably lavas with common
- BT Basic tuff, includes tuffaceous shales lithic & lignitic beds, tuff breccias & volcanic breccias
- SHS Gray shale or mudstone
- SHD Brown & purple shales or mudstones
- SH Chert and/or fossiliferous
- SO (Continuously dark to black) argillites containing rare micaceous layers & micaceous nodules
- gsl A suite of rocks, mafic to ultramafic, composition designated as gneiss, when unaltered, related to the Hotwood River complex (Serpentine (hornblende, pyroxene))
- dal Dolerite
- mg Microgabbro
- vp Purple basalt
- vt Mafic tuff, shale, breccia
- sh Rock outcrop
- sh Distribution of that on grid lines
- sh Cracks with rock outcrops indicated

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REVISIONS				CLEVELAND TIN LTD.	
DATE	DATE	TRACED	DATE	E.L. 1/63	
1963	1963	1963	1963	GEOLOGICAL FACT SUM	
1963	1963	1963	1963	SCALE 1:5000	
1963	1963	1963	1963	DRAWN D.M.R., G.O.B.	



LEGEND

- Sn
- Cu
- Pb
- Zn
- Ni

W03 and As also analysed No significant values

A	B
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REVISIONS

DRAWN	DATE	TRACED	DATE
PDE	FEB '81	ACM	FEB '81

CLEVELAND TIN LTD.

E.L. 1/63

SOIL GEOCHEMISTRY

SHEET NO SC-00-001

DRAWN G.O.B./DMR

TRACED P.F.

SCALE 1:5000

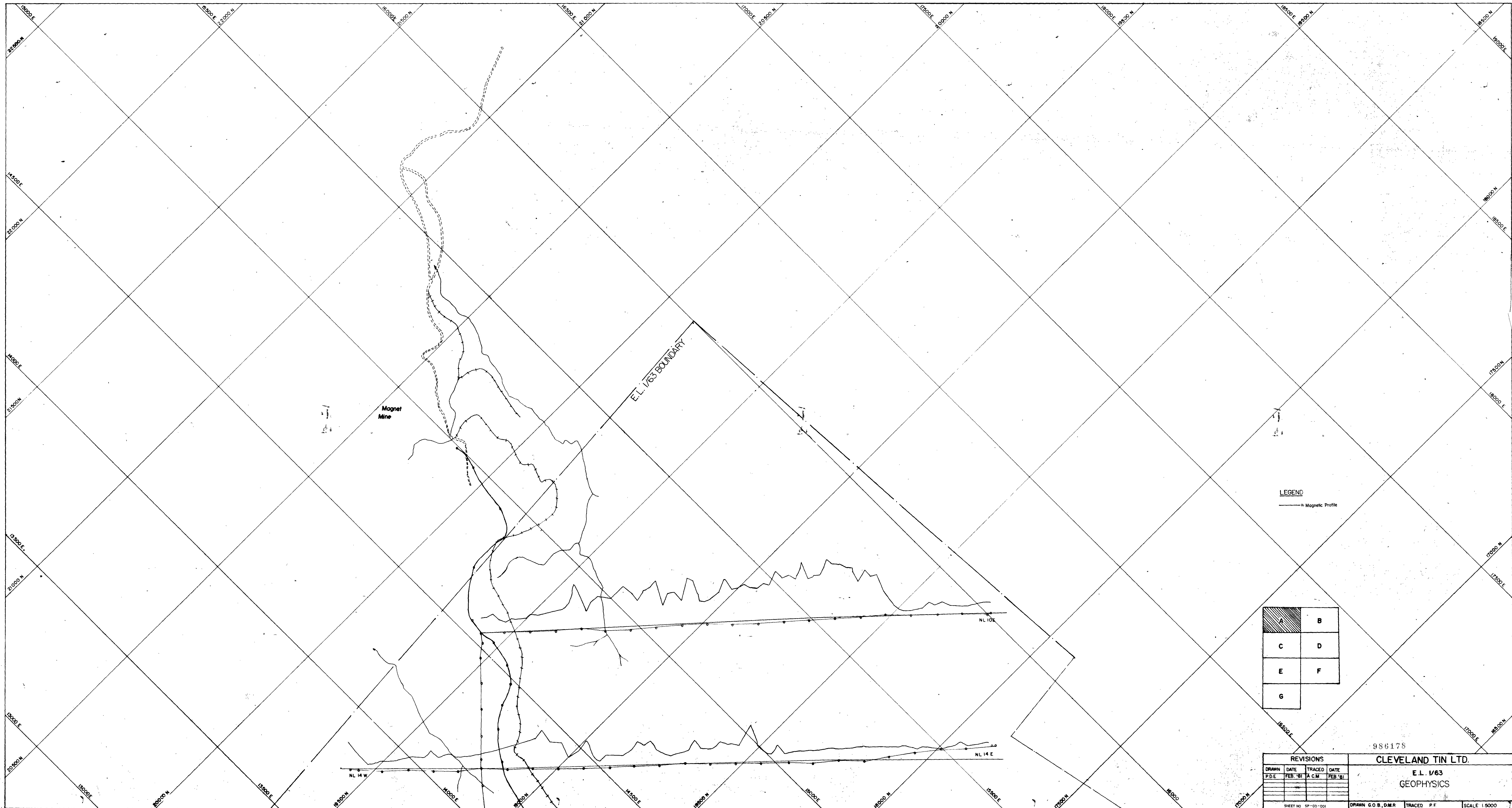


LEGEND

- Sn
 - Cu
 - Pb
 - Zn
 - Ni
- WO₃ and As also analysed No significant values

A	B
C	D
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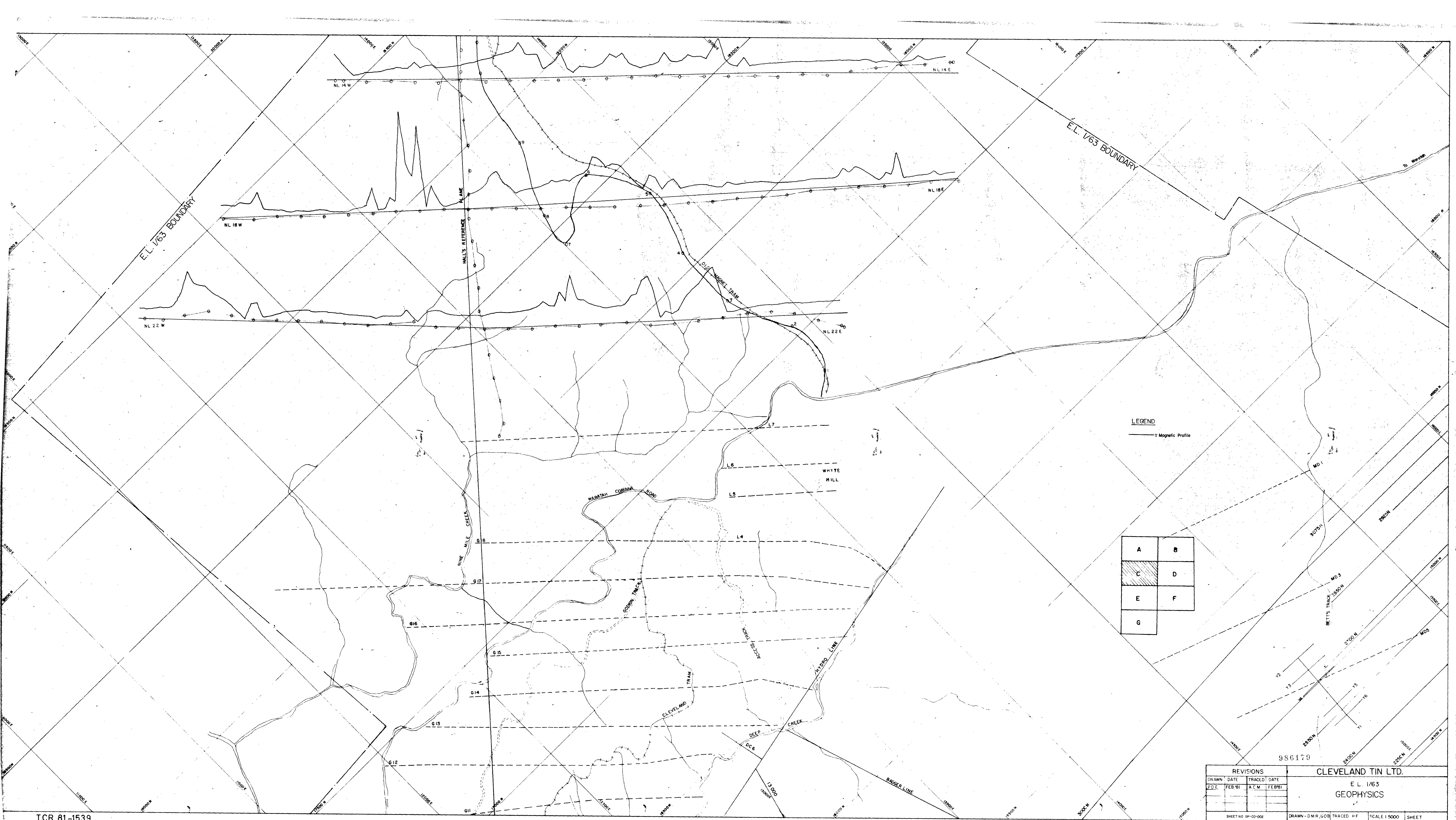
REVISIONS				CLEVELAND TIN LTD	
DRAWN	DATE	TRACED	DATE	E.L. 1/63	
P.D.E.	FEB 61	A.C.M.	FEB 61	SOIL GEOCHEMISTRY	
SHEET NO. 50 OF 000				DRAWN - G.M.R. 608 TRACED - P.F. SCALE 1:5000 SHEET	



LEGEND
— Magnetic Profile

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986178				CLEVELAND TIN LTD.			
E.L. 1/63				GEOPHYSICS			
REVISIONS				DRAWN G.O.B., D.M.R.			
DRAWN	DATE	TRACED	DATE	SCALE 1:5000			
P.D.E.	FEB '81	A.C.W.	FEB '81				
SHEET NO. SP-CO-001							



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REVISIONS				CLEVELAND TIN LTD.	
DRAWN	DATE	TRACED	DATE	E.L. 1/63	
P.D.E.	FEB/61	A.C.M.	FEB/61	GEOPHYSICS	
SHEET NO 59-00-002				DRAWN - DMR, GOR	TRACED - PF
				SCALE 1:5000	SHEET

LUINA MINE LEASE AREA

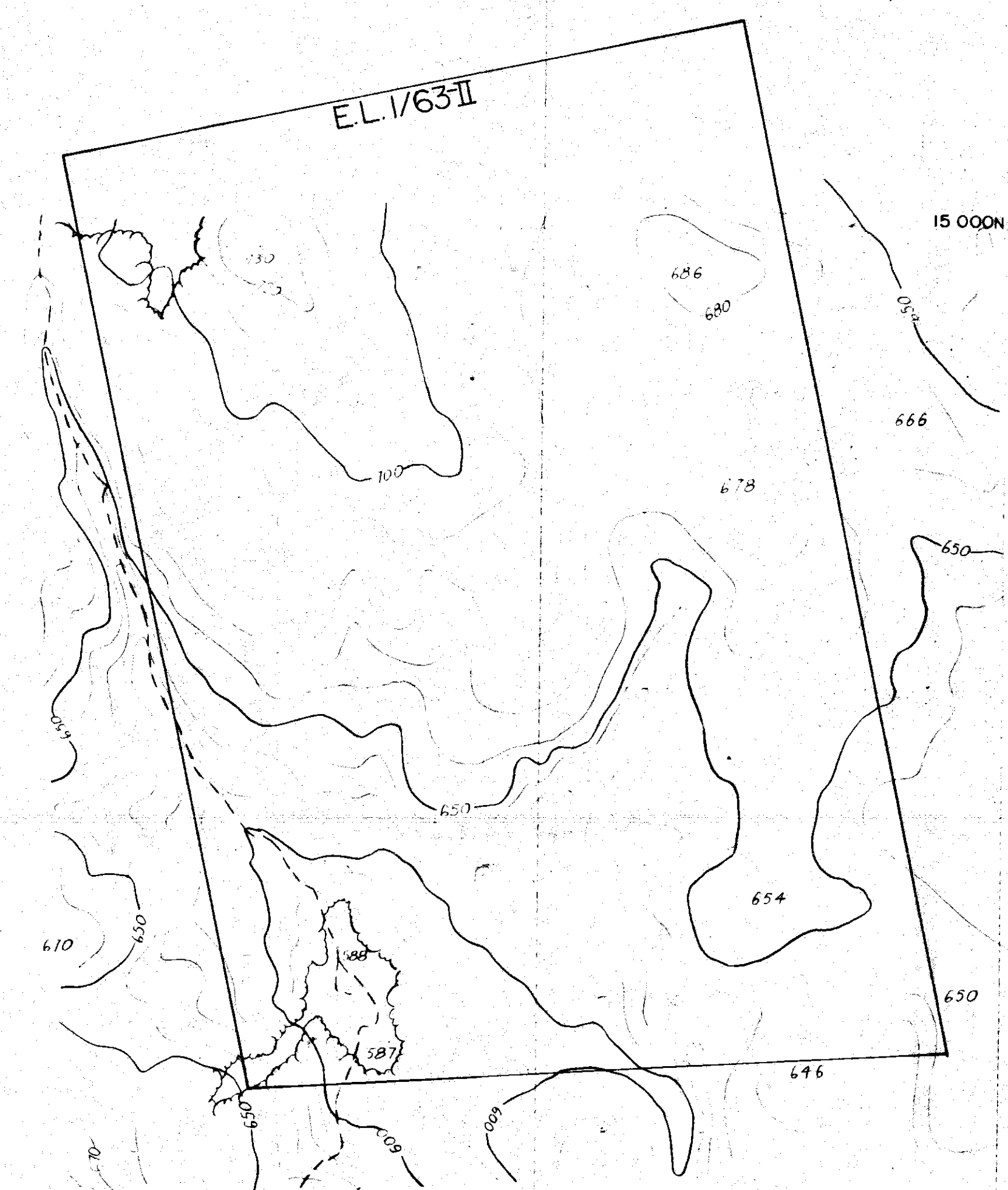
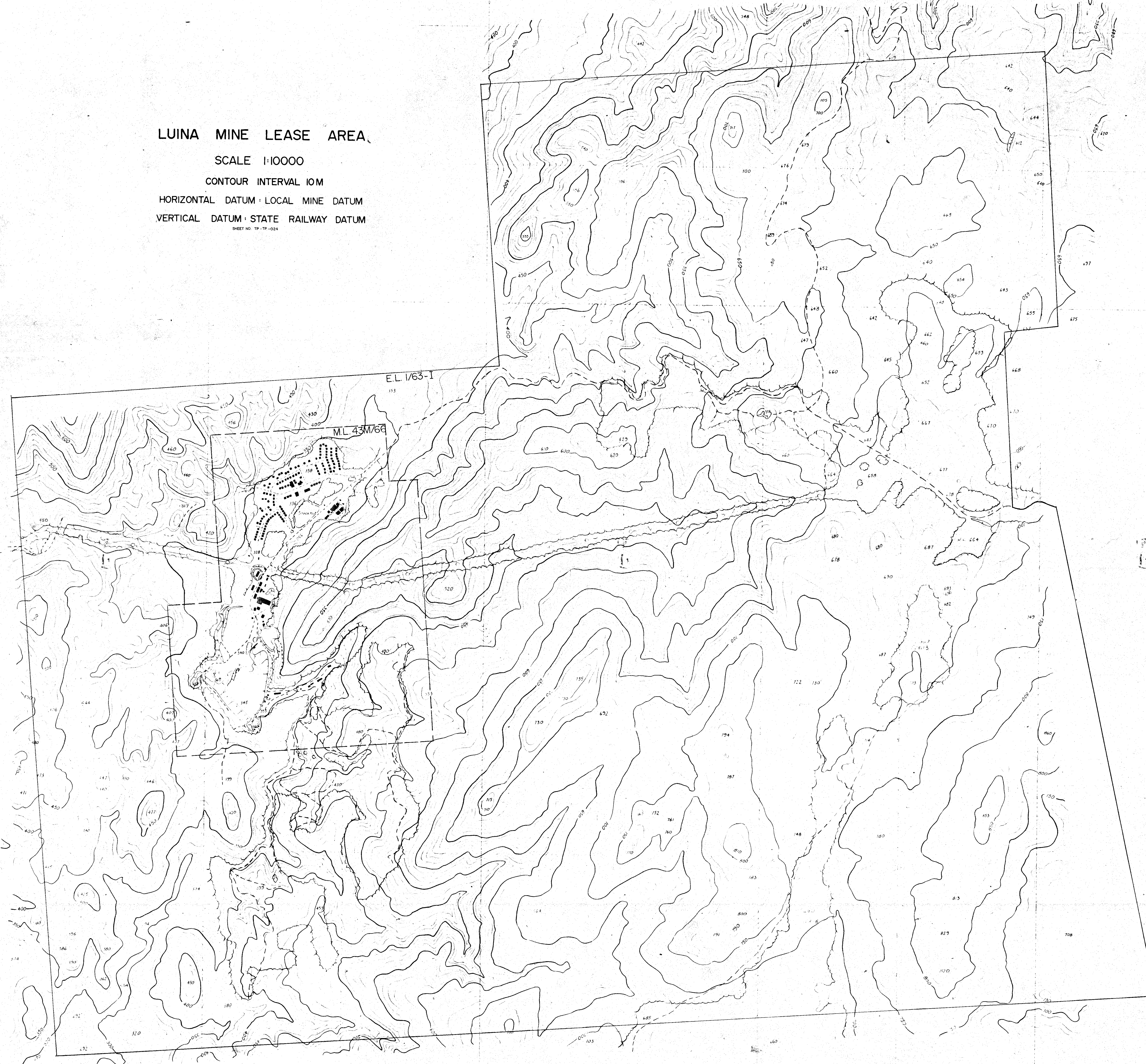
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CONTOUR INTERVAL 10M

HORIZONTAL DATUM: LOCAL MINE DATUM

VERTICAL DATUM: STATE RAILWAY DATUM

SHEET NO. TP-TP-024



Photogrammetric plot by Stereometric Services,
for Cleveland Tin Ltd, done in October 1980
from aerial photos taken in July 1980.

Note: In areas of dense vegetation
contours are approximate only.