112001

PROGRESS REPORT

ON

MT TYNDALL LEASE

E L 9 / 66

Up to June 1968

68_527

AMG REFERENCE POINTS ADDED

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ABSTRACT:

The Tyndall Lease, E.L. 9/66, consisting of 83 square miles of rugged country between Queenstown and Rosebery was acquired by Renison Ltd., in 1966 for exploration purposes (Ref. Locality Map.)

The Mt. Lyell Mining & Railway Company Ltd., has carried out exploration work in the 1966/67 and 67/68 field seasons on the lease. The following report deals chiefly with the work completed in the area during the 67/68 field season, and with recommendations for 68/69.

During the 67/68 season, geophysical, geochemical and geological survey data was recorded on 500' to the inch plans and profiles. However, due to road surveying and drafting difficulties, all maps presented in this report are of a standard 40 chains to the inch scale with a few exceptions.

1. SUMMARY OF PREVIOUS WORK:

The major previous exploratory work in the Mt. Tyndall Lease area can be conveniently classified into two sections:

1.1. The Rio Tinto exploration of 1956-59.

1.2. Mt. Lyell exploration in 1966-67.

Both programmes involved geophysical and geological surveys.

1.1. RIO TINTO EXPLORATION:

Rio Tinto Exploration, in conjunction with the Electrolytic Zinc Co., was involved in regional and detailed exploration in Western Tasmania from 1956-1960. Their findings are recorded in a lengthy report published in February 1960. This report is divided into two main sections:

(a) A generalized field study and analysis of sedimentation, tectonism and mineralization in Western Tasmania and North-West Tasmania.

(b) Detailed work in smaller areas which they considered to be of greatest economic importance. This detailed work involved geological mappings and E.M. geophysical surveys.

Rio Tinto located four areas of particular interest, mainly on the basis of E.M. and geological data, which fall within the Mt. Tyndall Lease:

(a) White Spur Area,
(b) Gooseneck Area (Red Hills)
(c) Mt. Tyndall Area
(d) Lake Dora Area

The White Spur and Gooseneck anomalies were drilled but revealed only minor mineralization. The Mt. Tyndall anomaly is the only one of immediate interest as it falls within the area covered by Mt. Lyell in the 66/67 season. Further references will be made to these areas elsewhere in this report.

1.1 RIO TINTO EXPLORATION (Cont.)

It is expected that the E.M. and drill hole information from the Rio Tinto report will be of considerable use to us in 68-69, together with their regional geological mapping and resultant interpretive work.

1.2. SUMMARY OF 66/67 FIELD SEASON:

This Company was actively involved in field exploration and development for approximately six months in the 66/67 field season. The exploration programme consisted of:

1.2.1 Road development and track cutting.

1.2.2 Reconnaissance Geophysical surveys (I.P.)

1.2.3 Geological mapping.

All work was confined to the S.W. section of the lease, west of the Tyndall Range and east of the Henty River. Only a brief summary of the 66/67 season is included in this report.

1.2.1. Road Development and Track Cutting:

Approximately 6.5 miles of road were constructed to give vechicular access to the area. Thirty-two miles of traverse lines were cut on a regular E-W grid, the lines being spaced at approximately one-quarter mile intervals. This grid enabled the area to be covered systematically by a geophysical survey and was also used this season for geochemical, geological, and further geophysical work.

1.2.2. Reconnaissance Geophysical Survey:

McPhar Geophysics Ltd., contracted to cover the complete grid using the I.P. method. The survey was of a purely reconnaissance nature, designed to delineate anomalous areas. The results and recommendations of this survey have been submitted to this Company and distributed to syndicate members. Most of the recommendations contained in this McPhar report were acted upon in the 67/68 season.

1.2.3. Geological Mapping:

A geologist, J. Ekstrom of N.C.G.F.A. worked in this area for approximately two months. He mapped as much of the area covered by geophysics as time permitted, and produced a brief geological report but no maps. This geological report was incorporated in the Mt. Tyndall 66/67 Field Season Report.

Ekstrom's report was of limited use as a foundation report on which future geological work could be based, mainly due to the lack of maps. As a result of this, all geological mapping commenced afresh in the 67/68 season.

The extent of track and road construction at the conclusion of the season is shown on Map 1.

2. REPORT ON 1967-68 FIELD SEASON:

2.1 Introduction:

All major work for the season was confined to the S.W. section of the lease. This area represented approximately one-quarter of the total lease area, and can be conveniently subdivided into two main areas:

1. Eastern Section: West of the Tyndall Range, and east of the Henty River.

and 2. Western Section: West of the Henty River.

The area consists essentially of a plateau, approximately 1600' above S.L., deeply disected by the Henty River and to a lesser extent by, Newton, White Spur, and Hall's Creeks. The Tyndall Range rises 2000' above the plateau to the east of the area worked in.

Vegetation varies considerably with very thick rain forests in the major river valleys, and lighter scrub and low timber on the flatter plateau areas.

The long, broad valley west of the Tyndall Range representing a glacial valley, is covered by various thicknesses of till (gravel) and peat. This poor, transported soil supports very little vegetation other than light scrub and ti-tree patches along meandering water courses, and button grass. These areas have presented obvious difficulties in road construction, soil sampling and drilling.

2.1. Introduction (Cont.)

The till may vary in thickness from a few inches up to at least sixty feet, probably much more in places, especially immediately adjacent to the Tyndall Range.

Access to the Eastern Section is by means of a four wheel drive road, which leaves the main Zeehan-Queenstown road approximately 8 miles from Queenstown, and runs northerly, for about 9.5 miles, roughly paralleling the Henty River. The first 4.6 miles of this road, popularly known as Bradshaw's Road, were constructed by Bradshaw, a timber getter in the area. The road was extended a further 5 miles by Mt. Lyell as part of the Exploration programme in 1966/67.

Access to the Western Section is by means of a third class road which leaves the Queenstown-Zeehan road approximately 13 miles from Queenstown. This road, popularly known as Howard's Road, was constructed as far as the lease boundary by Howard, a timber getter in this area, and extended this year by Mt. Lyell, to give access to desired areas in the west.

Work commenced in mid - September 1967. Drilling and minor exploration is still in progress but all major work finished in late March.

2.2. OBJECTIVES:

Work was planned to proceed along the same lines as in 66/67, extending and integrating to a larger extent, geological, geochemical and geophysical surveys. The major part of the work was to be concentrated on the sequence of Cambrian sediments and volcanics west of the Tyndall Range. On the basis of these surveys, it was planned to delineate zones of importance, which were to then be regarded as immediate drilling targets or as areas requiring more follow up work prior to possible drilling. These surveys necessitated the extension of already existing roads and traverse lines. The geophysical programme was designed to include all recommendations for the Eastern Section suggested by McPhar in their 1967 report as well as a reconnaissance survey over most of the Western Section.

It was planned to cover as much of both Eastern and Western Sections with Geological mapping and soil sampling programmes as time would permit.

2.3. WORK COMPLETED:

2.3.1. Road and Traverse Line Construction:

All road and traverse line construction has taken place under the supervision of Mt. Lyell's Exploration Foreman, Stan Gunton.

2.3.1. Road and Traverse Line Construction (Cont.)

The Eastern road was not extended further this season, however minor repairs and surface metalling were carried out on a one mile section of the road south of Newton Creek. Four trucks together with Bradshaw's bulldozer completed this work.

The Western road was extended both to the north and south. The northern extension involved the construction of three miles of road and two substantial bridges. The road is negotiable in part only by four wheel drive vehicles. This road links up with the Williamsford - Rosebery road.

The southern road extension involved constructing 2.5 miles of four wheel drive road and one minor bridge. Road construction was contracted to McCutheon of Zeehan.

Traverse Line Preparation:

1. Eastern Section: Subsidiary traverse lines were cut parallel to major grid lines in anomalous I.P. zones, (as recommended by McPhar in their 1967 report) to facilitate detailed I.P. work in these areas. Six bushmen were employed to cut these lines from early October till mid - November, 1967, and two short periods in 1968. These lines were cut either 200' or 400' North and South of the main lines.

2. Western Section: Fourteen major E-W grid lines were cut in the Western Section, from the Western lease boundary to the Henty River. Line spacing was one-quarter mile and a total of 2 6 miles was cut.

2. Western Section (Cont.)

Work commenced on these lines in the west in mid-November, 1967 and was completed in mid -March, 1968. Initially six bushmen were involved on the work but later in the season, this number was reduced to four.

All traverse line and road constructions completed in 67/68 are shown on Map. 1.

2.3.2. Geophysical Survey:

McPhar Geophysics Ltd., contracted to complete all the detailed I.P. work required on the Eastern Section and also to carry out a reconnaissance I.P. survey on the Western Section over the area covered by traverse lines.

The Geophysical team which consisted of one Mt. Lyell and four McPhar employees, commenced work on the Eastern Section in early-January, 1968. The detailed survey was completed by early - February and the crew commenced the survey on the Western Section. All the required I.P. work was completed by mid - April.

Total operating days were:

Eastern Section	29.5 days
Western Section	29 days

Complete survey coverage is shown on Map 1.

2.3.3. Geochemical Survey:

A systematic soil sampling programme was designed to cover all main grid lines in both East and West Sections if time permitted. The survey commenced in early November and concluded in late February. In the initial stages, one geologist and one field assistant were involved and in the latter stages of the season, the survey was completed by two field assistants.

The complete Eastern Section and approximately half the Western Section grids have been sampled. An approximate total of 2000 samples was taken from 1500 sample points. Stream sediment samples were also taken where traverse lines intersected water courses. A number of rock chip samples were obtained at random, as a possible guide to rock background values.

The total geochemical coverage is shown on Map 1.

2.3.4. Geological Mapping:

One geologist has worked continuously since early October and has been assisted for much of this time by one field assistant. Most of the Eastern Section has been mapped in a fairly broad manner but there has been little work done on the Western Section.

2.3.4. Geological Mapping (Cont.)

Mapping for the most part has not been of a very detailed nature, due mainly to the large area to be covered in a short field season with limited manpower.

Three major problems were encountered; the rugged terrain, poor outcrop, and complex nature of the volcanics mapped.

2.4. GEOPHYSICAL RESULTS:

Preliminary reports on the I.P. and resistivity surveys have been received from McPhar Geophysics Ltd., together with copies of all profiles produced during the survey.

2 .4.1. Western Section:

The reconnaissance survey conducted on the 14 grid lines in this area has delineated several strong I.P. anomalies, and quite a number of weaker ones. Surface projections of these anomalies are shown on Map 2.

McPhar Geophysics Ltd., claim there are eight major anomalous zones in this area (Zone I... to Zone VIII). They have recommended more detailed work over each of these zones, by using smaller electrode intervals and in most cases, by doing further work on lines 200' N and S. of the main lines.

2.4.1. Western Section (Cont.)

These are sound recommendations from a purely geophysical point of view. However, at Tyndall there are extensive beds of black, pyritic shale in the Western Section which coincide with some of the eight anomalous I.P. zones, and remembering that the I.P. method locates sulphide mineralization, including pyrite, it would appear that more geological mapping is warranted in the Western Section in the vicinity of these 8 zones with the aim of possibly accrediting some of the anomalies to pyritic rocks, thus reducing the detailed work suggested by McPhar Geophysics Ltd.

On plan, the anomalous zones plot in a roughly N-S direction. Ref. Map 2. However geological structures in the area trend generally S.S.E, and it is felt that any mineralization in the area is most likely to be concordant with these structures in this generally well-bedded sequence. So it is possible that mapping of the Western Section may result in a reinterpretation of the trends of these I.P. anomalies.

Naturally, with the presence of large amounts of pyrite at Tyndall, there are grounds for scepticism as to the usefulness of I.P. surveys in this area.

2.4.2. Eastern Section: The detailed survey in the Eastern Section was designed to cover anomalous zones located by the 1966/67 reconnaissance survey on 16 of the 19 major grid lines. Work was conducted with either 100' or 200' electrode spreads on lines 200' N and S of the main lines in the relevant areas. On the basis of this detailed work, McPhar have defined 5 anomalous zones, one of these being divisible into 4 sub-zones. The zones are outlined on Map 2. Estimates of source depths and strengths for each of these zones together with drilling recommendations are included in McPhar's preliminary report. As they state in this report, they lacked geological knowledge of the area and that this may have some bearing on the suggested drill holes. So in the light of geological information available, it is proposed to consider each of these 5 zones further.

ZONE A: A moderately strong anomaly at depth, on which McPhar recommended one drill hole to attain a depth of 300'.

SUMMARY OF GEOLOGY: The anomaly is located near the margin of a massive, green (chloritized) hornblende albite porphyry. The rock will be described more fully later in this report. The field relationships of the rock suggest that it is a small intrusive, probably andesitic. Here the porphyry intrudes a sequence of well cleaved, siliceous slates, and quartzites. The porphyry does not appear economically interesting at this stage (on the basis of geology, geochemistry

SUMMARY OF GEOLOGY (Cont.)

and geophysics) so it might optimistically be hypothesized that the porphyry in marginal areas such as Zone A is thin (less than 300') and a rock unit containing sulphide mineralization lies beneath it. However, at present, other zones appear of greater interest than Zone A, and are being treated in more detail first.

ZONE B: McPhar have delineated a broad, moderate anomaly here, of variable depth.

SUMMARY OF GEOLOGY:

Geologically, this region is similar to zone A, lying close to, but within, the margin of the hornblende-albite porphyry. However, there is no evidence that the position of these anomalies (Zones A and B) is controlled by or associated with the margin of the porphyry. Nevertheless, the spatial relationship exists.

Transported glacial material covers a considerable portion of this zone but by extrapolation of the bedding directions of rock units further to the north, it is possible that shales, tuffs and quartzites underlie both this glacial material and the porphyry.

No drilling is planned on Zone B until drilling information is obtained from stronger zones to the north. These zones are probably along strike from Zone B.

ZONE C:

McPhar Geophysics Ltd., have divided this long zone into 4 subzones which "extend along strike in a discontinuous manner, across the entire length of the Tyndall grid north of Line 12" But geological mapping suggests that zones C1, C2 and C3 are possibly better regarded as one zone. However, the four sub-zones will be described individually.

ZONE C1: The anomaly is very strong on Line 12 at an estimated depth of 200' and represents a broad mineralized zone.

Summary of Surface Geology:

The centre of the anomaly is located beneath a ridge of granitic material which appears to have intruded a sequence of quartzites and agglomerates, which outcrop on the western slope of this ridge. The banded quartzites dip 40-50° E.N.E., but the bedding (banding) has been contorted and disrupted, presumably by the nearby intrusion. Hornblende-albite porphyry, containing small amounts of pyrite in places, outcrops to the immediate North and west of the ridge. There is a small, isolated outcrop of albitized, serpentinized, finer granitic rock 500' E of the anomaly. The tuffs and shales of zone C2 may occur in the C1 zone also, although not seen at the surface.

No mineralization is visible at the surface but on the basis of the favourable rock types either at or near this anomalous zone, it was decided to drill here. This drilling is presently

Summary of Surface Geology (Cont.)

in progress and it is hoped to complete this hole by the end of June. The hole is collared 2650' E on line 12, drilling due W, inclined at 40°, which should intersect the suggested target at 2400' E at a depth of 175' to 200'.

ZONE C2: This is the strongest anomaly in the area, being well defined on lines 16 and 18 at a depth of 125' to 175'.

Summary of Geology:

The sequence of tuffs, agglomerates, shales and coarse, arkosic sediments occurring in this area is described more fully in the geological report. A small quantity of pyrite was found in one specimen of chloritic tuff.

It is planned to drill at least one hole on this anomaly but the exact location of the site has not been determined yet and will be governed somewhat by the outcome of the first drill hole on Zone C1. Trenching for bedrock on Line 18 is at present in progress.

ZONE C3: McPhar Geophysics Ltd., point out that whilst this anomaly is definite, it occurs in a region of high resistivities, consequently it is difficult to assess the potential of this zone.

Summary of Geochemistry and Geology:

The anomaly is situated adjacent to the hornblende porphyry margin, and falls, in part, over a steeply dipping haematitic tuff bed which may extend further west than presently thought. The porphyry is most likely producing the high resistivities.

Geochemical work in this area showed a broadly anomalous region in the vicinity of C2-C3 especially on Lines 20 and 22, for Pb-Zn. This is the area Rio Tinto called "Howard" or "Mt. Tyndall" which their E.M. Survey showed to be anomalous. This zone should not be poorly regarded because I.P. results were not as strong as in other zones, as it is well known that often relatively weak I.P. anomalies are more economically significant than stronger ones. It would be wise to carry out more detailed soil sampling in this zone, prior to a decision on drilling.

ZONE C4: A long narrow, relatively weak zone which at this stage appears to have limited potential.

Summary of Geochemistry and Geology:

The Cu-Pb-Zn contents of the soil samples taken across this zone were generally below the regional backgrounds. The weakly anomalous zone on Line 38 falls within a mapped shale bed which immediately renders this anomaly of doubtful importance as shales in the area are generally pyritic, even though in this area, the presence of pyrite was not noted in the surface rocks.

Summary of Geochemistry and Geology (Cont.)

Adjacent to the anomalous zone on Line 30, there is an outcrop of chloritic-sericitic schist, containing pyrite up to 2% in some samples, and very small amounts of chalcopyrite and spalerite. An old shaft or prospect pit has been sunk in this outcrop. Schistosity is vertical, striking along the trend of C4. Nine soil samples were taken in a systematic manner adjacent to this shaft but results were low. On Line 28, the anomalous zone lies either across or close to the unobserved contact of a pink-soda-rhyolite and the greenschists.

If Zone C4 is extended south almost to Line 26, it would pass directly over the old Tyndall Mine which was worked at the turn of the century, but produced very little. No further work is planned on this zone unless drilling and extended geochemistry on Zones C1, C2, and C3 proves encouraging.

ZONE D: A strong, narrow, shallow zone, centered on Line 30.

Summary of Geochemistry and Geology:

Black, pyritic shales outcrop 500' S of Line 30 and their strike direction is along Zone D. This shale bed is a thin 20' or 30' and is relocated well to the north on Lines 34, 36 and 38., though only weakly pyritic here. The Cu-Pb-Zn soil contents over the zone are below background values.

Summary of Geochemistry and Geology: (Cont.)

On the basis of known geology and geochemistry, no further work is planned on this zone.

ZONE E: This zone extends N of the present grid and so a full evaluation is not possible at this stage. Geochemistry in the area was generally weak and there was no observable outcrop.

Conclusions on Eastern Section:

All necessary, possible, I.P. work has now been completed in the Eastern Section, and no future extensions are envisaged. As a result of the I.P. work, drilling is planned on two of the anomalies located and further geological and geochemical work is considered desirable over two of the remaining three zones.

2.4.3. Review of Rio Tinto's E.M. Survey (1957-59)

Rio Tinto's ground E. M. Survey has located one area of present interest, west of Mt. Tyndall, adjacent to the contact of the Ordovician Owen Conglomerate (Tyndall Range) and the massive volcanics and interbedded sediments.

The coverage of their survey was restricted to an area extending approximately 1000' either side of the road between Lines 18 and 30. Several S.S.E. trending anomalies were located and appear to correspond with I.P. zones C2 and C3. (Rio Tinto maps are somewhat rough).

2.4.3. Review of Rio Tinto's E. M. Survey (1957-1959) Cont.

The E. M. Survey was terminated prematurely to the north and south and so the extent of the anomalies in these directions were not known. Rio Tinto felt the anomaly warranted drilling but they also expressed the opinion that the Cambrian rocks exposed in the vicinity of the anomaly were probably too massive to be a favourable setting for mineralization, no drilling was carried out here. More detailed mapping by Mt. Lyell geologists this season has in fact revealed haematitic tuffs and coarser pyroclastics in this area which would be quite favourable to mineralization.

2.4.4. Brief Criticism of I.P. Survey Method.

In common with E.M. methods, I.P. cannot discriminate between pyrite and more valuable sulphides. A small pyrite body may produce a stronger anomaly than can a larger body of a sulphide such as chalcopyrite or galena. However, this weakness is not so important in Western Tasmania where much significant economic mineralization is associated with pyrite. Obviously, it is desirable to attempt to show whether or not each anomalous I.P. zone is anomalous geochemically and/or favourable geologically to other forms of sulphide mineralization. However, at Tyndall, this is not easily done in areas where much of the soil in anomalous zones is transported and outcrop is often poor.

2.4.4. Brief Criticism of I.P. Survey Method (Cont.)

A second criticism, which is very relevant to the Tyndall area, is the cover given by the I.P. survey. In the reconnaissance survey, operating on a 300' electrode spread, there exists a gap of approximately 1000' to 1500' between the last full set of readings and the last electrode position. Since the Henty River generally marked the position of the last electrode, there now exists a strip of land, approximately 1500' wide on either side of the Henty River, which has not been covered by the I.P. surveys. Also I.P. equipment is relatively bulky and heavy and thus it may prove very difficult to operate in the extremely rugged land in the eastern half of the Tyndall lease, yet to be covered.

A minimum crew of four men is required for an I.P. survey and consequently operating costs are high.

It would therefore appear that there is a definite need at Tyndall for geophysical survey equipment, other than I.P.., which is truly portable, lightweight, capable of operating in a wide variety of terrains, relatively inexpensive and capable of producing valuable information.

2.4.4. Brief Criticism of I.P. Survey Method (Cont.)
Portable two-man E.M. equipment is suggested as a possible replacement or complement to the I.P. surveying. Electromagnetic surveys conducted around Mt. Lyell have shown that this method is as good an indication of sulphide mineralization as are I.P. surveys in the same areas.

2.5. GEOCHEMICAL RESULTS:

Soil samples were taken every 200' along all the major traverse lines in the Eastern Section, and in some cases the survey was extended to the Henty River where lines were not cut. Seven lines were also sampled in the Western Section.

All samples were spectrographically analysed for Cu-Pb-Zn by Geochemical and Mineralogical Laboratories Pty. Ltd., The results were plotted on 1" -500' plans and contoured. Zones considered anomalous are shown on Maps 3(a), 3(b) and 3 (c). Geochemical profiles were constructed for each traverse line but these have not been included in this report. The results were statistically analysed in an attempt to quantitatively define anomalous zones.

It was originally planned to sample the A - horizon at each point and also sample other main horizons if developed. Sampling was by means of a mechanical soil

2.5. Geochemical Results (Cont.)

auger which could attain depths of approximately 4 feet. Many difficulties were encountered during the survey and in the interpretation of results. The following points should be kept in mind when attempting an interpretation of the results.

2.5.1. The irregular nature of the soil types: Soil types at Tyndall could be divided into two broad categories, residual and transported, and each of these sub-divided several times. The distributions of both these soil types was very irregular. It is often stated, that residual soils are better concentrators of the elements being sought than transported soils but this was not supported statistically by this survey. The main problem is one of interpretation. The Cu-Pb-Zn content of a transported soil sample is not necessarily a true reflection of the content of the rocks immediately beneath the soil. Anomalous zones were located in the transported soils but it is difficult to suggest source areas. Samples in transported soils were taken as deeply as possible in the profile to reduce transport factors.

The problem was made more complex by the fact that there were two major varieties of transported soils, peat and glacial till. The peat can be very thick in places, with a great deal of vertical and lateral ground water movement.

2.5.1. The irregular nature of the soil types: (Cont.)
The till is generally coarse and of unknown thickness in part.
Residual soils also present problems because each major rock type produces a different residual soil profile. There appears to be no sure way of dealing with this situation other than sampling as close to bedrock as possible, that is by means of a B or C - horizon survey rather than an A - horizon survey.

2.5.2. The interval and profile to sample: With the large area and difficult conditions of Tyndall in mind, a 200' sample interval was chosen. Because this is a comparatively large interval, the survey should be regarded as a reconnaissance survey.

It would have been desirable to sample one horizon uniformly, because of the varying concentrating powers of the different horizons, with respect to the elements sought. The A-horizon was initially chosen but two major problems were (a) transported soils and (b) the absence of the A-horizon in some profiles. B - horizon sampling is preferable from a geochemical point of view because of clays in this horizon. However B - horizon development was not widespread. The C - horizon was sampled where it was reached. Perhaps the best way of overcoming this difficulty somewhat in future surveys would be to adopt a policy of sampling as close to bedrock as practicable.

2.5.3. Topographic and Vegetation Influences:

Vegetation can have very complex effects on the chemical content of soils. Tall vegetation with deep roots may "leach" elements from all horizons but concentrate it in a cyclic manner in the A-horizon by way of fallen leaves, and branches. Where only a low, light vegetation cover is present, it exerts strong influences on the A-horizon, either reducing or concentrating the element contents of interest, but has relatively little effect on deeper horizons. Button-grass flats also present rather unique problems, because the underlying peaty soil is largely composed of decaying vegetation. Then there are the till slopes near the Tyndall Range, almost devoid of vegetation, which further complicate the problem.

The Topographic influence on geochemical patterns is well known and relatively simple to interpret. The effect is probably of considerable importance in the Henty River Gorge.

2.5.4. STATISTICAL TREATMENT OF RESULTS: All results were treated with certain standard statistical methods. Background values (arithmetic means), were established for each element sought. Initially, possible and probable anomalous levels were defined as those values, two and three standard deviations in excess of the backgrounds. However, this method of treatment proved unsatisfactory at Tyndall because these values proved too low.

	Background	Threshold	Probably Anomalous
Cu	6.25	28	40
Pb	17.25	73	90
Zn	20.7	81	100

Table 1: Statistical Levels in p.p.m.

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	All residual soils	All transported soils	RESIDUAL SOILS		
			Porphyry	Rhyolite	Regional
Numbers of Samples	635	327	175	25	635
Background	17.6 p.p.m.	16.1. p.p.m.	22 p.p.m.	9.2p.p.m.	17.6p.p.m

Table 2. Comparison of Certain Pb Backgrounds.

2.5.4. Statistical Treatment of Results (Cont.)

This was attributed to the irregular statistical distribution of the results which, when graphed as relative frequency curves, were strongly positively skewed. This invalidated to a large extent normal statistical treatments which are based on normal distributions and which consequently should place 2.5% of all readings in excess of the threshold levels and 0.5% in the "probably anomalous zone". However the irregular Pb and Zn graphs for Tyndall samples raised these levels to 8% and 5% respectively. Consequently, new levels were established so that the 2½% and 0.5% levels were adhered to. The results of this work are tabulated in Table 1. One thousand and fifty samples were involved in this study.

Other statistical work included a comparison of background levels for residual and transported soils for Pb only, and also a comparison of the background values for residual soils developed over pink rhyolite and over the hornblende-porphyry, again only for Pb. The results of these two studies are shown in Table 2. A criticism of the small number of samples of residual soil over the rhyolite is justifiable, in that it only represents 2.4% of all samples. However, the object was not to show the influence of the rhyolite values on the regional backgrounds but to compare it with other backgrounds.

2.5.4. Statistical Treatment of Results (Cont.)

Conclusions resulting from these values are: (I) There appears to be no significant difference in the background values between the transported and residual soils. The difference is one of interpretation; and (ii) the background value for hornblende porphyry is probably much higher than for the rhyolite, which probably emphasis the problems of interpretation of regional values derived from soils developed over many different rock types.

Brief Criticism of a Statistical Approach: If all soil samples were taken from the one horizon in similar soil profiles, over the one rock type, then a purely statistical approach would be sound. However, actual sampling involved a large number of variables, so a qualitative treatment of results plotted on plans and profiles to delineate broad areas requiring more detailed work was considered to be at least equally satisfactory.

2.5.5. Orientation Survey: A small orientation survey was completed over the old Tyndall Copper Mine as a possible guide to the interpretation of results of the main survey. This mine was based on a galena-chalcopyrite-pyrite - tetrahedrite bearing quartz vein, several feet wide and running N.W. for approximately one chain along a creek bed.

Samples were taken at 200 ft. intervals on three N-S- traverse lines, spaced at 200' and lying between Lines 26

2.5.5. Orientation Survey (Cont.)

and 28, approx. 2000' to 2600' West of the Eastern Road. A total of 24 soil and 3 stream sediment samples were taken and analysed for Cu-Pb-Zn.

The area covered was bisected by a S.E. trending creek, which marked the contact between fine rhyolites to the N and green-schists (sheared volcanics) to the S. The mineralized quartz vein has intruded along this contact. No evidence of mineralization of either the adjacent rhyolite or of the schists was noted.

All sample values were relatively low. However, stream sediment samples were high as would be expected. The survey proved to be of little value as a guide to further work, probably because of the very limited extent of the mineralization.

2.5.6. Summary of Copper Results:

Copper values for both regions are generally low.

(i) Eastern Section: There are few areas in the east which appear anomalous at this stage, apart from the odd isolated high value, but these hardly warrant more detailed work, unless there is other supporting evidence.

2.5.6. Summary of Copper Results (Cont.)

(ii) Western Section: Results in the west are somewhat more encouraging than in the east but the survey is not complete here yet. Again there are several isolated high zones, but there is one zone which is more extensive and more significant than the rest, in the Henty Valley, between Lines 16 and 28. This area has not been covered by the I.P. surveys because of terrain and technical difficulties.

This zone, now referred to as Cu I, also appears interesting geologically from the small amount of work completed here to date, with the presence of (a) pyritic quartz - sericite schists similar to Mt. Lyell rocks, (b) chalcopyrite blebs in some of the pyroclastics in the zone and (c) a small serpentine stock(?) just to the N. of the zone.

2.5.7. Summary of Lead Results: Several encouraging areas warranting further work have been delineated.

(i) Eastern Section:- There are three major anomalous zones and two smaller zones in this section.

(a) Zone Pb I:- A fairly broad, anomalous zone located 1000' W to 2000' W on Line 22, narrowing S but still present on Line 20.

This zone coincides with I.P. anomaly C3.

2.5.7. Summary of Lead Results (Cont.)

(b) Zone Pb. II:- A very strong anomalous zone, located 2500' W to 3500' W on Line 10. The I.P. coverage was extended to cover this area but the results were discouraging. However further soil sampling together with a geophysical resurvey of this area seems desirable.

(c) Zone Pb.III:- A long, narrow, discontinuous zone, largely in transported soils, trending N.W., which coincides in places with I.P. zones B and Cl. Because of the difficulties encountered geochemically, it seems wise to rely more on I.P. and surface geology, possibly with some trenching to bedrock to assess the prospects of this area.

The two minor zones on Lines 6 and 28 have no I.P. confirmation and there is no encouraging geological information on either zone.

(ii) Western Section:- The main areas of interest are narrow and restricted to Lines 28 and 26 in the far north of the grid, and until the survey is extended further to the N, detailed comment is premature.

At this stage, it could be said that I.P. - Geochemical correspondence on Line 28 is fairly good.

2.5.8. Summary of Zinc Results:

(i) Eastern Section: Three zones of interest have emerged and they correspond reasonably well with Pb I, II and III.

(a) Zone Zn I: Corresponds approximately with Pb I, being strongest on Line 20 and becoming narrower and weaker on Line 22.

The Pb I-Zn I - C3 - E.M. anomaly coincidence would suggest a need for further geochemistry here.

(b) Zone Zn II: Corresponds to Pb II on Line 10, narrowing and weakening slightly on Line 12. It is difficult to assess this zone's potential in the absence of I.P. anomalies. Geochemical values here are the highest obtained to date at Tyndall.

(c) Zone Zn III: This is a broad discontinuous zone, trending N.W., largely in transported soils, coinciding in part with Pb III and also in part with both I.P. zones B and C1. Remarks made on Pb III also apply in general to Zn III.

(ii) Western Section: No strong anomalies have so far been located, but several possibly anomalous zones do exist, and appear to be narrow, trending N.N.W., concordantly with certain regional geological trends.

2.5.9. Conclusions: This survey should be regarded primarily as a reconnaissance survey, designed to cover a large area in as short a time as possible, but still capable of locating zones of interest. True assessments of these zones can only be made by means of the future detailed work listed later in this report.

2.6. GEOLOGICAL REPORT:

2.6.1. Introduction:

The S.W. corner of the Tyndall Lease can be regarded as a small segment of the major geosynclinal trough fringing the Pre-Cambrian craton of Central Tasmania.

Extensive infilling of this trough by argillaceous sediments and volcanics in Cambrian times was followed by a general uplifting of the region in late Cambrian or early Ordovician times resulting in the subsequent deposition of large thicknesses of immature Ordovician sediments. Silurian elements are absent in this section of the lease but are present to the South and West. The area was probably influenced by two major periods of diastrophism. Four small post Cambrian (?) intrusions are discordantly present in the middle and upper Cambrian sequence.

2.6.1. Introduction (Cont.)

Reference should be made to Map 4 in this report.

2.6.2. Stratigraphy: 1. Cambrian:

Regionally, the Cambrian succession consists of a thick sequence of well bedded argillaceous sediments and volcanics, generally dipping east and striking S.S.E. No evidence of overturning has been seen.

Lower Cambrian: Consists of a sequence of sandstones, shales, slates and pyroclasts, including zones of weakly sheared rocks.

The sequence extends from near the western lease boundary where it makes contact with Ordovician limestones and where it is also intruded by dacitic and small gabbroic bodies, to approx. 2000' E. of the Henty River, where it is conformably overlain by Middle to Upper Cambrian volcanics.

All major bedding trends are S.S.E., generally dipping steeply East. Mapping in the western section of the Lower Cambrian succession has not been completed yet but some generalized observations have been made.

In the far west (basal beds?), there is a thick, well bedded sequence of shales and slates with minor coarser sandy bands. The sequence contains a tuffaceous component, and is pyritic in places. Jointing and schistosity planes

2.6.2. Lower Cambrian (Cont.)

are usually vertical but with variable strikes. Cleavage - bedding relationships are rather confusing, having similar strikes but widely variable and differing dips. This could mean that the shales, as well as dipping steeply, are also tightly folded, and consequently the actual thickness of the shale beds may not be as great as the outcrop would suggest. Sharp contacts between the shales and included sandy lenses exposed on the road between Lines 20 and 22 indicate rapid fluctuations in the depositional environments prevailing. The western slates and shales are generally black, especially when pyritic. The pyrite occurs as finely disseminated films on bedding and cleavage planes.

The western contact between these argillites and the rhyolite (or dacite?) flows, is well exposed on the timber track between Lines 18 and 24. The contact is sharp, and the sediments adjacent to the intrusives appear to have undergone little alteration. However numerous fragments of shale, only slightly hornfelsed, are caught up in the flows, giving them an agglomerate texture in places.

A sequence of slightly sheared feldspathic sandstones conformably overlies the shales and slates. Shearing has only been intense enough to produce low grade, buff-white,

2.6.2. Lower Cambrian (Cont.)

quartzitic schists and friable quartzites. These rocks are also pyritic in part. Two jointing (cleavage) directions are generally observable but vary considerably in strike and dip.

The boundary between the shales and these quartzitic sediments is, like all the contacts between units in the Lower Cambrian, rather arbitary, with no major contacts having been observed.

The quartzites and schists pass easterly into a thick sequence of deeply intertonguing dirty sandstones and gray to black shales. The contact between this sequence and the underlying Cambrian rocks was not observed but because of their maintaining a similar bedding direction, they were considered conformable with the underlying beds. This is a thick sequence which extends east of the Henty River in places. The sandstones are generally light gray - brown, medium to fine grained, the grains are moderately well-rounded. A muddy matrix material constitutes up to 35% of the rock, which is usually more indicative of fluvial or lacustrine sandstones than of marine ones. Towards the top of the sequence, near the Henty, where the shale members are predominate, the

2.6.2. Lower Cambrian (Cont.)

sandstones are often calcic and/or dolomitic, sometimes containing thin irregular calcite veins and possibly some calcic content in the matrix. When the sandstones are calcic, they generally also contain small anhedral grains of finely disseminated pyrite(up to 2% FeS_2).

The interbedded shales are usually dark gray-purple, often calcic and pyritic (especially in the central and southern regions) and dip steeply east. The shales are thicker in the north than in the south. Dark - gray and black siliceous and calcic shales and usually indicative of reducing environments, especially if pyritic. Reducing environments are found in stagnant or deep water conditions such as swamps, restricted lagoons or oceanic troughs. A swampy, near shore environment could easily account for the interfingering of the dirty sandstones with these dark pyritic shales.

An irregular thickness of quartz schists and quartz - sericite schists overlies the shales and sandstones. The schistosity is generally in the 130° - 160° range. The schists are pyritic in places, and also contain minor lenses of coarse pyroclastics and shales.

2.6.2. Lower Cambrian (Cont.)

Outcrop East of the Henty River Gorge was poor and mapping was patchy. The area is complicated by uneven metamorphism (shearing), and the intrusion of several small igneous bodies, which are described more fully later in this report.

Middle and Upper Cambrian: The boundary between the Lower Cambrian and the Middle-Upper Cambrian sequences is a somewhat vague genetic one. The Lower Cambrian is essentially sedimentary whilst the Middle-Upper Cambrian is chiefly volcanic.

The volcanics consist of a wide variety of both massive and well bedded units, lying between the Henty River shales and quartzites, and the conglomeratic Tyndall Range. They consist chiefly of pyroclastics (tuffs and agglomerates) and lavas. These volcanics are part of the major Rosebery Volcanic Arc which fringed the central pre-Cambrian craton. Geosynclinal volcanic arcs are typically unstable with numerous on and off shore vents. No such vents have been found in or near the Eastern Section of Tyndall, probably having been covered by post-Cambrian sedimentation. Moderate shearing and associated metasomatic activity has converted some of the more westerly volcanics into low grade quartz-sericite and quartz-sericite-chlorite schists.

Middle and Upper Cambrian (Cont.)

The bedded and sheared volcanics appear conformable with the Lower Cambrian sediments in the west, striking S.S.E. and dipping between 50° - 80° E.

The lower members of the volcanic sequence consist largely of massive porphyritic volcanics which have been weakly sheared in isolated areas. The unsheared porphyries are best exposed adjacent to the lower reaches of Newton Creek. They are very variable in appearance but generally consist of a fine grained, dark gray groundmass with phenocrysts, to 3 mms. of highly kaolinized feldspar. The feldspar composition is difficult to determine in thin section because of the alteration. Corroded margins and overall partial resorption of the feldspar by the groundmass together with streaming of the groundmass around the unorientated feldspars suggests an early formation of feldsper (calcic) but resorption has probably left the corroded feldspars sodic. The porphyries often contain small quantities of free calcite. Overall, these basal volcanics are characterized by their large variation in texture, colour, composition and probably also their genesis. When the volcanics were sheared they were apparently converted into schists which in some cases are very similar to those of Mt. Lyell. Pyrite is present in most of the schist types.

Middle and Upper Cambrian (Cont.)

but not in the non-schistose volcanics. However, this does not mean that pyrite mineralisation was a result of shearing or other associated processes because pyrite is also present in shales and sandstones adjacent to the schists.

Because of the localized occurrence of schists it is now thought that shearing forces were generally weak, and had their greatest effect on rocks preconditioned by very localized metasomatic or hydrothermal activity.

The volcanics east of the schists are well bedded, generally unsheared and of a very variable nature, consisting in the main of tuffs, agglomerates, small lava flows, with associated sediments, generally thin shale or sandstone bands.

These pyroclastics are of particular interest as they occur in the major C2-C3 and Pb I-ZnI zones, and possibly in the C1 zone. There are two major tuff types: a green spotted chloritic tuff and a reddish speckled haematitic tuff, both striking S.S.E. and dipping either vertically or steeply east, the haematitic tuff lying stratigraphically above the chloritic tuff. They are both very fine grained and the chloritic tuff contains coarse pyrite (up to 1%) in places. Exposures of these tuffs is poor and it is hoped that future drilling in this area will assist in understanding the complex geology

Middle and Upper Cambrian (Cont.)

of these volcanics. Red chert beds and iron gossans are developed adjacent to the chloritic tuffs whilst extensive psilomelane "gossans" are developed near the haematitic tuffs.

Lying stratigraphically and conformably above the tuffs is a bedded sequence of agglomerates and coarse sediments. The nature of these rocks varies considerably and they stretch from Line 12 in a N.N.W. direction to the northern limit of the present grid. Dips are generally 40°-60° E. The true nature of some members of this sequence is debatable. The agglomerates in places look very much like arkoses or sub-graywackes and may well be. Bedding is thick but definite, especially on weathered surfaces.

The agglomerates are generally coarse, with numerous angular chert, shale and lithic fragments in a quartz - feldspathic, often chloritized groundmass. Fragment sizes vary greatly. A considerable amount of post depositional transformation has taken place. Albitization and chloritisation is widespread.

Stresses on these agglomerates possibly associated with hydrothermal activity have resulted in the formation of small but numerous chlorite filled en echelon tension gashes in the rocks. The agglomerates are well exposed 500' W of the drill site on Line 12 and also on the access road to the drill site so it is possible that they underlie as well as overlie, the tuffs.

Middle and Upper Cambrian (Cont.)

Towards the top of the sequence, the rocks have the appearance more of a true coarse sediment (arkose or sub-graywacke) than an agglomerate. Cherty or very fine grained nodules are common and well seen on weathered surfaces of these rocks. Some of these nodules are pure chert "pebbles" and suggest the rock is an "altered" conglomerate but others are simply fine grained seregations in a coarser matrix. Crystalline pyrite, rimmed by magnetite is present in one of the nodulitic beds, just south of Line 16, and 2000' from the road.

There is a thin, black, pyritic shale bed lying conformably on the pyroclasts between Lines 28 and 38. Immediately to the west of this shale between Lines 28 and 30, there are several small outcrops of an extremely immature sediment which dips approximately 45° west and which Rio Tinto mapped as Jukes Breccia. Immediately to the east of the shale lie the Ordovician quartzites and conglomerates of the Owen Series. The shale gives the impression of being conformable with the quartzites but this is a false impression, produced by the highly variable dip of this contorted quartzite which is definitely a member of the Owen sequence. The shale outcropping on the road midway

Middle and Upper Cambrian (Cont.)

between Lines 28 and 30 clearly demonstrates the strong uncomformity between the Cambrian and Ordovician sequences.

There are two small lava "flows" in this zone of Cambrian volcanics, one just west of the chloritic tuffs on Line 14, which may only be a small segregation, having a basaltic appearance within the hornblende porphyry, and the other within the rhyolites on Lines 28 and 26. Both have the appearance of small fissure eruptions or concordant dykes, or condordant sills if they formed before the tilting of the Cambrian beds. Both are dark gray, fine grained, with a basaltic appearance. The northerly one contains vesicles of calcite, and very small amounts of chalcopyrite (?). Vesicles in the southern are filled with siliceous material, and are badly weathered.

There are two major, apparently discordant, members within the Cambrian succession:- a pink soda-rhyolite and a more extensive massive hornblende porphyry. Though not actually observed, both of these bodies appear to have intruded, and/or flowed over the bedded Cambrian volcanics and sediments.

Middle and Upper Cambrian (cont.)

The soda rhyolite is probably synonymous with the quartz-keratophyres referred to by Solomon in his work on the area. It is a very fine grained, structureless rock, with clear quartz phenocrysts and occasionally a polysynthetically twinned soda-feldspar phenocryst. In thin section, the groundmass is seen to consist dominantly of quartz and lesser amounts of feldspar. The flow is approximately 1.5 miles long and 0.3 miles wide lying West of the eastern road between Lines 24 and 36, trending roughly N.N.W. Flow structures are rare and when present yield little to suggest possible vent locations or flow directions. Probably post-Cambrian age, it discordantly intersects the pyroclastics west of the Tyndall Range, but nowhere intersects the Owen sequence. Blocks of the adjacent pyroclastics are marginally caught up in the rhyolite but these zenoliths are not altered to any great extent, so probably the rhyolites cooled rapidly from a comparatively low temperature.

The hornblende albite porphyry is a fairly large structureless body which covers much of the S.E. section of the region mapped. Generally a dark grey, fine grained rock with phenocrysts of hornblende, and feldspar and less commonly quartz and pyroxene. The groundmass often has a greenish colour due mainly to weathering of ferro-magnesians

Middle and Upper Cambrian: (Cont.)

present. The labradoritic - albitic feldspar phenocrysts are generally euhedral, corroded laths, varying from 0.1 mms to 2.0 mms. In marginal specimens of this rock, the groundmass often consists of considerable amounts of fine, sub-euhedral clinopyroxenes. Second order colours produced in polarized light by these badly altered pyroxenes, suggests they are alkaline, possibly augites or aegirine augite but the crystals are too badly altered to permit further determinations. The pyroxene is often extensively uralitised and resorbed by the groundmass and specimens containing pyroxene are usually hornblende poor. It would appear that cooling was fast enough marginally to prevent complete resorption of early formed pyroxenes.

Hornblende laths up to 1.m.m. have been observed. In thin section, they are green-brown, showing good 120° amphibole cleavage on end sections, and strongly pleochroic. Marginal corrosion is frequently well advanced and small quartz inclusions are common. These inclusions, up to 1.5 mms in diameter, are often strained. Hornblende laths are always randomly orientated and no flow structures have been observed, either macro-, or microscopically. Haematite is present in small quantities either as rims to the hornblende laths or as small discrete grains in the groundmass.

Middle and Upper Cambrian: (Cont.)

The hornblende porphyry is probably of comparable age to the soda - rhyolite. If this is a normal intrusive body, it is difficult to see why there wasn't some alignment of the hornblende. Scott (Ref. 3), believes that the hornblende crystals were formed by post solidification regional metasomatic activity. Solomon believes that this small type of andesitic body is probably an offshoot of a parent calc-alkaline basaltic body. The porphyry appears to intrude the mid and upper Cambrian sequence.

There are two other intrusive bodies in the area. Both are small, and both close to the first drill hole location. The first of these is a granitic rock forming a narrow N-S ridge over the target area for this drill. In hand specimen, it is a leucocratic, medium grained, equigranular plutonic rock, consisting of clear rounded quartz grains up to 2 mms and feldspar laths in a fine, white kaolinized groundmass. There are some dark patchy inclusions in the rock especially on the northern section of this ridge where this body appears to have intruded Upper Cambrian agglomerates and siliceous, bedded sediments. In thin section, the purer specimens have an approximate composition of:

Quartz 35-40%

Feldspar 25-30%

very fine Qtz-feld. groundmass 30-40%.

Middle and Upper Cambrian: (Cont.)

The quartz is anhedral, fairly well rounded and contains numerous inclusions of a non-pleochroic, highly birefringent mineral. The feldspar is sodic (oligoclase-andesine), subhedral, exhibiting both carlsbad and polysynthetic twinning, occurring as discrete laths or in clusters of small laths. Compositional zoning is present in a few of the more anhedral grains. Several cross hatched but badly corroded and altered orthoclase grains are also present. It is possible that this rock is a small dyke like offshoot of a larger granitic body which was intruded concordantly in to the Cambrian volcanics, but it is difficult to determine whether it intruded before or after the nearby hornblende porphyry.

This rock has a content of 550 p.p.m. of total Cu-Pb-Zn, and the ridge corresponds to a very strong I.P. anomaly.

The second of these small igneous outcrops is 500' S.E. of the drilling target. It is a small outcrop, approx. 50' long in the middle of a glacial valley. In hand specimen, the rock is leucocratic, medium grained, with rounded feldspar and quartz phenocrysts, patches of ferro-magnesians (pyroxene) and thin serpentine veins. The rock is extensively albitized, and there are a few small

Middle and Upper Cambrian: (Cont.)

grains of chalcopyrite (?). In thin section, the composition is approx:

is approx:	quartz	35-45%
	feldspar	30-40%
	pyroxene	10-15%
	serpentine	10-15%

The quartz generally occurs either as mosaic clusters or as larger strained grains. Feldspar inclusions are common in the larger quartz grams.

The feldspar is of albite-oligoclase composition (15° for both carlsbad and polysynthetic twinning types on 010 sections). Pyroxene is pale green-brown, non-pleochroic, with high extinction angles and is thus in the diopside-augite range, but alteration is extensive and identification is difficult. Small iron (haematite/ilmenite) inclusions are common. This acid plutonic rock could be classified as a soda granophyre. Chip sample values were low and the area was not geophysically anomalous.

2. Ordovician Stratigraphy:

Towards the end of the Cambrian there was widespread tectonism in Western Tasmania, resulting in the production of large graben structures which were infilled by very

2. Ordovician Stratigraphy: (Cont.)

coarse immature sediments in the Ordovician. These rocks are represented in the Mt. Tyndall area by considerable thicknesses of Jukes Breccia and Owen Conglomerate. Lengthy accounts of the lithologies of these formations are included in the Rio Tinto report, and will only be discussed briefly here.

Both the Jukes Breccia and Owen Conglomerate Formations are regarded as economically unimportant.

The strong angular unconformity between the Cambrian sequence and the Ordovician sediments is obvious in the Lake Julia - Newton Creek area where the shallow westerly dipping Jukes Breccia overlaps the steeply, easterly dipping Cambrian shales and volcanics.

The Jukes Breccia is restricted to a narrow zone immediately West of the eastern road and extending North from Newton Creek for approx. quarter of a mile. The breccia is very coarse, consisting largely of fragments of Cambrian material with minor lenses of finer sub-graywacke.

2. Ordovician Stratigraphy: (Cont.)

The Owen Conglomerate, well represented by the Tyndall Range in the region mapped, is similar to the Owen Conglomerate elsewhere in the West Coast Ranges. It is massively bedded with shallow dips on top of the range, steepening on the upper flanks and shallowing on the lower flanks, giving the impression of having been draped over the range.

Stratigraphically beneath the Owen Conglomerate West of Lake Julia, there is a considerable thickness of saccharoidal quartzites which has been severely contorted by regional tectonism. The quartzites represent a basal member of the Owen Conglomerate. The attitude of these friable quartzites varies sharply over extremely short distances and appear to have been "concertina-ed" by the compressional forces which warped the Owen Conglomerate, with numerous minor tight folds, and faults, developed on the limbs of major, also tight, folds. The quartzites are abruptly but conformably overlain by Owen Conglomerate. This sharp contact is well displayed west of Lake Julia on a steep cliff and it must represent an abrupt change in the depositional environments, with only minor conglomerate intercalations present in the upper quartzite beds.

3. TERTIARY DEPOSITS:

Glacial till and wash, together with recent peat and swamp flats comprise the major tertiary deposits. Till forms either the lower part of the western flank of the Tyndall Range, or moraines, the best developed of which is a large terminal moraine on the northern shore of Basin Lake just south of the lease boundary, and possibly a few smaller lateral moraines in the vicinity of Lines 18 and 16 close to the eastern road. Till varies in thickness from a few inches to unknown but considerable thicknesses on the Tyndall Range slopes. Glacial activity appears to have been confined generally, to the broad major N-S, one sided U - shaped valley West of this range, Glacial erratics are common over the entire Eastern and Western Sections. and small tongues of the major glacier may have extended over these regions.

2.6.3. Regional Tectonism:

At least two periods of diastrophism appear to have affected the south-west section of the Tyndall Lease. In order to gain a more complete understanding of the tectonic framework of the area, a summary is given here of the major structural elements present between Rosebery and Queenstown. Most of this is based on Rio Tinto work in this area. An understanding of the tectonism which affected the Tyndall

2.6.3. Regional Tectonism: (Cont.)

rocks is important and will probably affect future work in the area greatly because of the possible relationship between tectonism and mineralisation.

Three major periods of diastrophism have affected this region:

1. Upper Cambrian - Lower Ordovician graben - type faulting.
2. Lower Devonian folding and shearing.
3. Upper Devonian transcurrent movements.

Rio Tinto also believe that there were minor Lower Cambrian and post-Devonian movements.

The Upper Cambrian - Lower Ordovician faulting resulted in the formation of two large parallel N-S tension faults viz. the Owen Rift (Great Lyell Fault) and the Dora Rift. Rio Tinto believe they were merely accentuations of pre-existing Lower or Pre-Cambrian lineaments, caused by increased tensional forces resulting from widespread epeirogenic slumping in the Rosebery Volcanic Arc bordering the Tyennan Craton. The graben produced between the Dora and Owen Rifts will be referred to as the Tyndall Graben. Large quantities of immature terrestial and marine sediments were poured into this graben in Ordovician times on top of the massive Cambrian volcanics.

2.6.3. Regional Tectonism: (Cont.)

The Dora Rift apparently fades out before it reaches the Mt. Murchison area. The Dora Rift coincides approximately with the contact of pre-Cambrian quartzites and Cambrian schists, whilst the Owen Rift strikes North along the Western margin of the Tyndall Range.

Following the Ordovician sedimentation, mild E-W compressional forces of early Devonian age (early Orogeny) produced uniform folding and mild possibly localized shearing. All major fold axes and schistosity trends are S.S.E. These forces were not as intense to the North near Rosebery as at Queenstown with the result that the Rosebery host rocks are not as sheared and distorted as at Mt. Lyell and at places in the Mt. Tyndall area.
The irregular and patchy occurrence of green schists within unaltered volcanic sequences west of Lake Julia and in the Tyndall Graben suggests either widely varying compressional and shearing forces, or the presence of other factors such as localized hydrothermal conditioning of rocks in particular zones either preceding or concurrent with the mild shearing forces. Zones of hydrothermal activity may have been along lines of weakness such as fold crests and minor faults or in localized "hot spots" such as hydrothermal springs or small volcanic vents and fissures. Most of the schists occur

2.6.3. Regional Tectonism: (Cont.)

adjacent to the Owen and Dora Rifts and it is possible that the schist producing shearing forces were produced by small Lower Devonian movements on these rifts. Usually these schists are mineralized to some extent.

Rio Tinto geologist believed shearing was pre-Ordovician because of the presence of sheared Cambrian rocks in the Ordovician conglomerates, even though the Owen Conglomerate has also been sheared.

This would suggest two periods of shearing, one pre-Ordovician, the other Lower Devonian, However it is possible that the schistosity in the Cambrian pebbles is the same as in the rest of the Conglomerate.

During the Middle Devonian (Tabberabberan Orogenic period), the transcurrent E-W thrusting of the Lower-Devonian increased, forming two major N-E trending transcurrent faults south of Rosebery and also uplifting, buckling and tilting the Tyndall Graben sediments. Rio Tinto named the thrust faults the Jupiter and Henty Faults and the faulted block between them, the Mt. Read Block. The Mt. Read Block moved approximately four miles S.S.W. along the Jupiter and Henty Faults, thus displacing part of the Rosebery host rocks to the Hercules area.

2.6.3. Regional Tectonism: (Cont.)

Secondary Devonian faults also cut across the Owen and Dora Rifts in the Tyndall Graben where large blocks of the Owen Conglomerate are dipping vertically and are strongly folded. Much of the movement here may have been merely isostatic adjustment in response to the enormous thicknesses of immature sediments deposited.

Conclusions based on Tectonism:

Areas of obvious interest on the basis of known structural elements and mineralization would be Cambrian sequences adjacent to the Henty Fault and the Owen and Dora Rifts. In particular

1. Gooseneck - Red Hills region.
2. Lake Dora region.
3. White Spur and the region South of White Spur.
4. Mt. Tyndall ("Howard") region.

These four areas were considered anomalous by Rio Tinto on the basis of ground E.M. Surveys. Gooseneck and White Spur were drilled. All information resulting from this work is available.

2.6.4. Mineralization and Suggested Controls:

All known mineralization in the Rosebery to Queenstown region that has been of any significance is listed in Table 3. (appended). All significant mineralization occurs in Cambrian rocks. Mineralization is now considered to have taken place in the Cambrian because:-

1. All mineralization is confined to the Cambrian rocks. There is no known mineralization in the Owen Conglomerate even when orebodies (at Lyell) run right up to the conglomerate contact.
2. Mineralization at Lyell pre-dates shearing and folding. Ore minerals are sheared, and there is evidence that orebodies suffered erosion in pre-Owen times.
3. The Rosebery-Hercules mineralization has been faulted by the early Devonian Jupiter Fault which dates mineralization at least pre-Devonian.

However mineralization is not necessarily confined to the sheared areas of Cambrian rocks (e.g.) Rosebery and Hercules host rocks have suffered very little shearing. It is likely however that the syngenetic ores of Lyell were remobilized and in some cases, concentrated by later structural developments and associated hydrothermal activity.

MINE	MINERALIZATION	HOST ROCK	REMARKS
MT. LYELL	Cu -Au -Ag -FeS_2	Schists produced from Cambrian Volcs.	Adjacent to Owen Rift.
+ LAKE DORA	Cu	Sheared Cambrian porphyries (Volcanics)	Adjacent to Dora Rift. (after Rio Tinto).
+ LAKE SELINA	Cu	Sheared Cambrian porphyries (Volcanics)	Adjacent to Dora Rift. (after Rio Tinto).
+ RED HILLS	Cu -Zn- FeS_2	Sheared Cambrian porphyries	Adjacent to Owen Rift. Henty Fault Intersection.
ROSEBERY	Cu-Pb-Zn	Moderately sheared slates and proclastics	Adjacent to Owen Rift. Jupiter Fault Intersection.
HERCULES	Cu-Pb-Zn	Moderately sheared Cambrian slates and pyroclastics	Adjacent to Owen Rift - Jupiter Fault Intersection.
CHESTER	Cu-FeS_2	Cambrian Slates and tuffs.	Adjacent to Owen Rift.
+ TYNDALL	Cu-Pb-Zn-Ag-Fe.	Quartz vein.	Adjacent to sheared volcanics. (greenschists) and rhyolites.

TABLE 3: MAIN AREAS OF MINERALIZATION IN ROSEBERY - QUEENSTOWN AREA.
Mines marked (+) were [illegible]ndoned.

2.6.4. Mineralization and Suggested Controls: (Cont.)
All major mineralization occurs along either the Owen or Dora Rifts and would thus appear to have been closely associated with movements along the rifts from Upper Cambrian to Devonian times.

The above points are a useful guide in selecting regions for future work provided they are valid. It would appear logical to concentrate on areas of Cambrian vulcanism and sedimentation, either sheared or unsheared, adjacent to Cambrian faults.

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3. RECOMMENDATIONS FOR 1968/1969 FIELD SEASON:

Recommendations for the 1968/69 field season are set out in general fashion below. This is done because there are a number of variables which cannot be resolved at this stage. For instance, whether or not use of reconnaissance eledtro-magnetic equipment can reduce the amount (and cost) of contract Induced Polarisation surveying, and whether bulldozing can be effectively used in some areas to expose bedrock, or whether drilling will be necessary. These and other factors introduce uncertainties into planning, and as a consequence several alternatives have been considered for some phases of work.

3. Recommendations for 1968/1969 Field Season: (Cont.)

Work recommendations are subdivided under headings of Eastern and Western Sections.

1. Eastern Section:

1.1 Geophysics:

The geophysical coverage should be extended to cover the Henty River valley. Because of the steep and rugged nature of the terrain, it is probable that only reconnaissance E.M. surveying using very portable equipment will be possible.

If testing of reconnaissance E.M. techniques proves them to be of little value, thought will have to be given to use of lightweight McPhar P.650 I.P. equipment. This will be expensive, and could also prove impracticable to use in the terrain. However the attempt may have to be made because at this stage the Henty River area appears to be important.

A maximum of 25,000 ft. of track will have to be cut to facilitate this work. The work consists of extending lines 4 to 20 to the Henty River.

1.2 Geochemistry and Geology:

1.2.1 Detailed geochemistry, and where possible, geology, should be carried out on certain geochemical anomalies obtained in the course of last season's work. In particular, those on the western extremities of Lines

1.2.1 cont.

8 and 10, and those west of the road on Lines 18, 20, and 22, need further work.

1.2.2 More detailed work is required over I.P. anomalies A, B, and C.

In order to gain improved exposures in the vicinity of I.P. anomalies (and geochemical anomalies) bulldozing is recommended. Attempts should be made to bulldoze the best possible exposures over anomalies lying between Lines 20 and 30 inclusive. Not only would bulldozing provide exposure, but would enable much more confident geochemical sampling and interpretation to be carried out. Estimates of bulldozing time required are difficult until work is actually attempted in the area. A figure of 50 hours is suggested.

1.2.3 It has been already stated in section 1.1 that the Henty River valley appears to be an important area. The limited geochemical and geological work carried out last season was certainly encouraging, and a full study of geochemical and geological aspects of the area should be made. This would take the form of detailed mapping, with stream sampling, including tributaries, and soil sampling of banks along the full length of the Henty River from the southern lease boundary to Lake Julia.

1.3 Road Construction:

It is recommended that the present Eastern Road be extended

1.3 Road Contruction: (Cont.)

2 - 3 miles further North to give much improved, and necessary access to the Mt. Read - Red Hills areas. Without this road, the traverse line cutting and geophysical work recommended below for the White Spur Creek - Mt. Read area would be a very long and tedious job, with considerable loss of working time. (This road has not been shown on the progress map appended).

2. <u>Western Section</u>

2.1 Geophysics:

2.1.1 It is recommended that geophysical work be subordinated to geochemical work in that part of this section which was covered by reconnaissance I.P. last season. (lines 28 to 2). I.P. Anomalies still considered to be important after completion of geochemical work listed below would be covered by detailed E.M. or I.P. surveys. Indications are that transported cover is relatively thin in this section, giving rise to hope that economical E.M. techniques can be used.

2.1.2 It is hoped that reconnaissance geophysical coverage can be extended north of line 28 to complete coverage of the entire Cambrian belt west of the Tyndall Range, north to Mt. Read. This work would test for northern extensions of I.P. anomalies IV, VI, VII, and VIII, and also test the easterly extension of the E.M. anomalies obtained by Rio Tinto in the White Spur area.

2.1.3 General: It is proposed to test McPhar V.H.E.M. and H.E.M. units over I.P. Anomalies in the Eastern Section, and if these tests are successful, it is recommended that E.M. replace I.P. as the geophysical survey method used this season.

If however, these tests are unsatisfactory, then I.P. would have to be used again this season to give a reconnaissance coverage of the remainder of the western half of the lease.

2.2 Geochemistry and Geology

2.2.1 The reconnaissance geochemical survey started last season must be completed. This entails a coverage of Lines 2 to 16 at a 200 ft. sampling interval.

2.2.2 Detailed geochemistry, on a 100' sampling interval over the I.P. anomalies I to VIII should be carried out. Geochemical coverage of these anomalies rather than a detailed geophysical coverage is recommended because many of these anomalies are undoubtedly produced (in part at least) by pyritic shales and volcanics.

2.2.3 Concurrent geological mapping should be carried out with geochemical work listed under 2.2.1 and 2.2.2

2.3 Traverse Line Preparation, Earth Moving, etc.

2.3.1 Many of the anomalies in the western section are covered by relatively thin amounts of glacial and other transported material and experience with present roads in the area has shown that bulldozing to a relatively

2.3.1 cont.

shallow depth greatly improves outcrop and also permits improved geochemical sampling. Therefore it is recommended that most of the I.P. anomalies in the west be trenched by a bulldozer prior to the detailed geochemical and geophysical coverage recommended above. Track cutting over anomalies would be carried out only where bulldozing proves to be a local failure.

An estimated 387 hours of bulldozing appears to be necessary.

2.3.2 To complete the reconnaissance coverage of the western section north of Line 28 to Mt. Read and east to Red Hills, 17 east-west traverse lines, spaced at ¼ mil intervals will be needed. Total footage of traverse line to be cut will approximate to 180,000 feet. It is recommended that this work be done on contract, rather than the wages basis of other seasons.

2.3.3 It would appear worthwhile to re-open about 4 miles of the old pack track from Hercules to Tyndall. Access throughout the area would be considerably improved by this work.

3. Staffing

If the above listed work is to be accomplished, the following staff will be required.

3.1 Geologists: 2

3.2 Students: 2 These students would be employed as field assistants, with duties of assisting the geologists in mapping, and in carrying out geochemical sampling and much of the geophysical surveying. It is likely that

3.2 Students: (Cont.)

students labour could handle most if any magnetometer surveying carried out.

3.3 Bushmen: 4 In the previous two seasons somewhat disappointing performances were put up by bushmen on a fixed daily rate. It is proposed that this season a contract system should be introduced, based on a payment basis of $40 per 1000 ft. or less.

If it is assumed that a contract track cutter can average 800 ft. of track per day, then four bushmen should complete the worked planned in 80 working days, which is acceptable. Work should be started as soon as possible.

3.4 Field Accommodation: It will almost certainly be necessary to provide some adequate living and office accommodation in the field, especially as work proceeds to the north. It is suggested that a World Wide Camp unit or 2 caravans are considered for this purpose.

4. <u>Cost Estimates</u>

4.1	Salaries (2 Geologists, 2 students)	$ 8,000
4.2	Consultants Expenses (D. Campbell)	$ 1,000
4.3	Geological Field Expenditure (Includes camp $4000)	$ 6,500
4.4	Equipment	$ 1,000
4.5	Geophysics:	
4.5.1	E.M. coverage of whole area (Includes equipment costs and consultants fees)	$ 8,000
or		
4.5.2	Combined I.P. and E.M. coverage (Henty River by E.M., N.W. of line 28 by I.P.)	$16,000

4.6	Geochemistry (Analytical charges only - 3000 samples)	$ 4,000
4.7	Road Construction (3 mile extension of Eastern Road)	$25,000
4.8	Road Improvement (East and West)	$ 2,000
4.9	Bulldozing of tracks over anomalous areas (437 hours at $16/hour)	$ 7,000
4.10	Track cutting (Contract)	$11,000
4.11	Surveying	$ 1,000
4.12	Vehicle Hire (10¢ mile)	$ 2,000
4.13	Diamond Drilling	$ 6,500
4.14	Contingencies	$10,000
	TOTAL (based on 4.5.1)	$93,000
	TOTAL (based on 4.5.2)	$101,000

5. **Summary:**

A total of two geologists, two students, and four bushmen is proposed to work in the Tyndall lease this year. In addition a McPhar I.P. crew may be needed. Accommodation of reasonable standard will be required for the geologists, students, and possible McPhar personnel. Contract bushmen could be provided with tents or expected to provide their own accommodation.

No provision has been made for a field foreman. It is hoped that the part-time services (2 days per week) of Mt. Lyell bush foreman can be obtained.

The aim of the suggested program of work is to complete the reconnaissance geophysical, geochemical, and geological

5. Summary (Cont.)

coverage of the Cambrian belt west of the Tyndall Range and to carry out detailed work in the Henty River valley and in previously located anomalous areas.

Completion of the program of work will mean that a sound reconnaissance assessment of the general merits of the western Cambrian belt will be available. As a consequence the most economical and intelligent selection of targets for drilling and other follow-up work will be possible. This in contrast to our present ability to consider only a portion of the area, a portion of which may not be the most promising for the heavy expenditure of drilling.

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4. ACKNOWLEDGEMENTS:

I would like to thank Messrs. Elms and Reid of the Mt. Lyell Geological Department for their continual and invaluable guidance given to me during the 67/68 season, and also Stan Gunton, the Exploration Foreman, for his assistance in the field.

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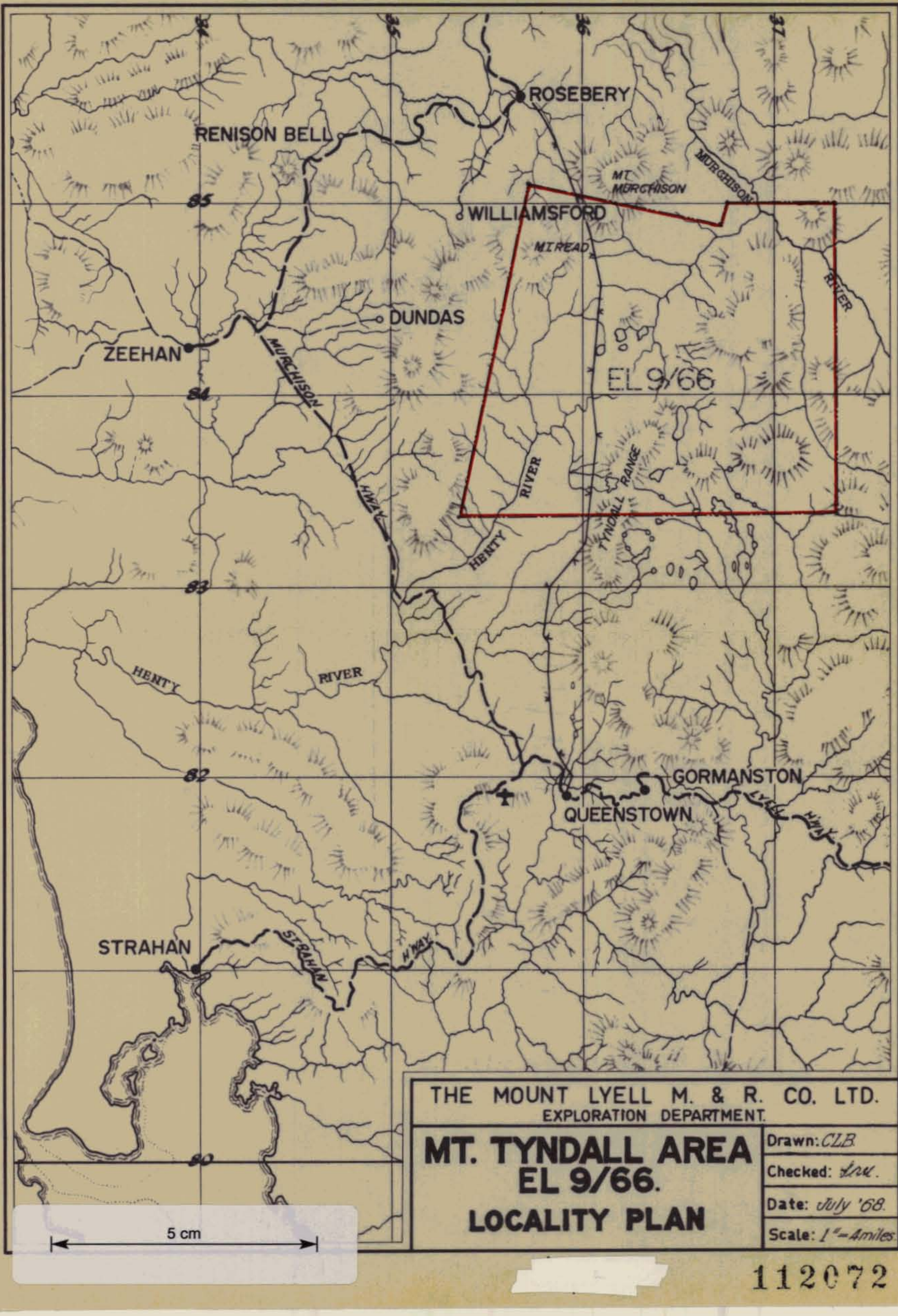

THE MOUNT LYELL M. & R. CO. LTD.
EXPLORATION DEPARTMENT.

MT. TYNDALL AREA EL 9/66.

LOCALITY PLAN

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Scale: 1" = 4 miles.

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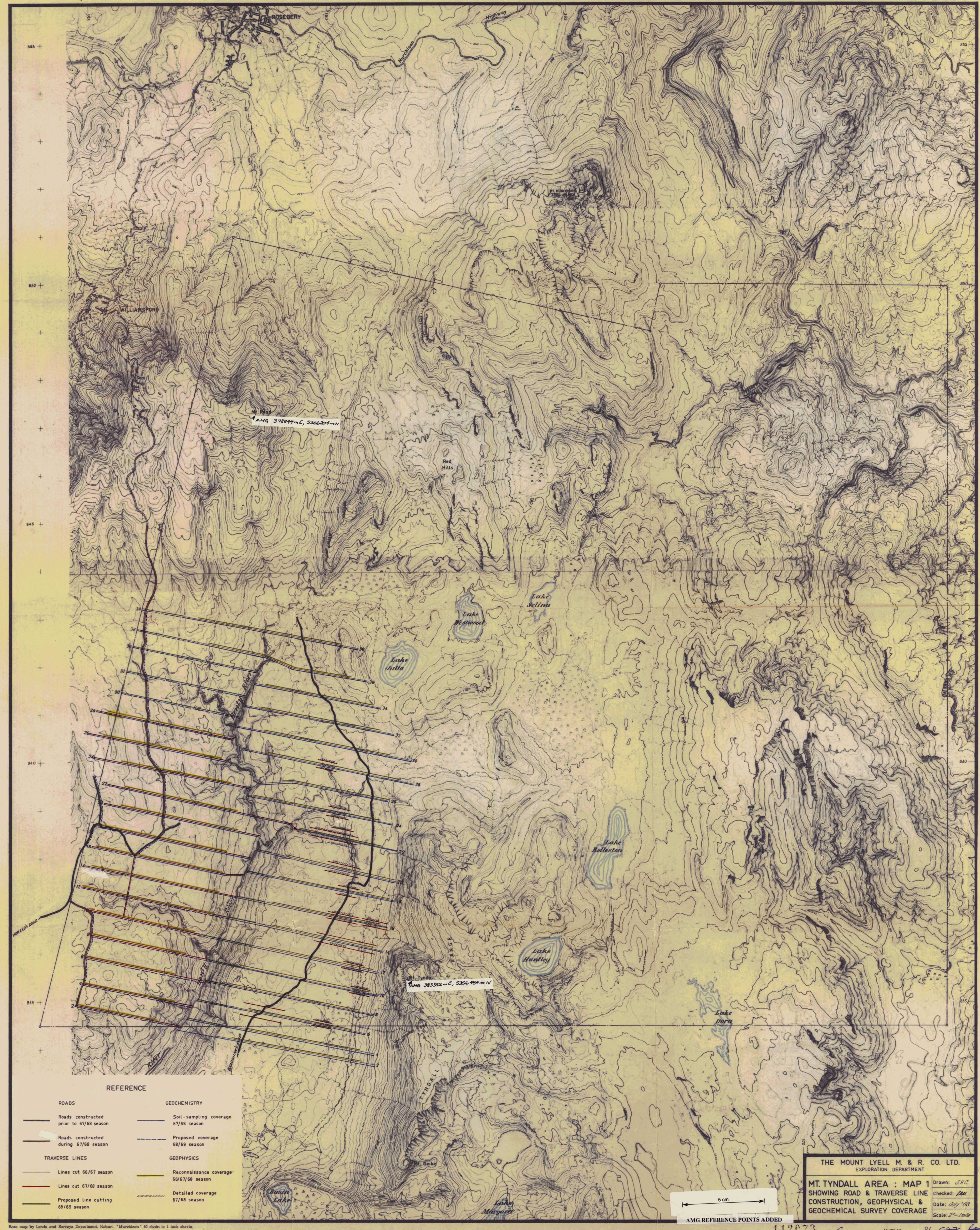

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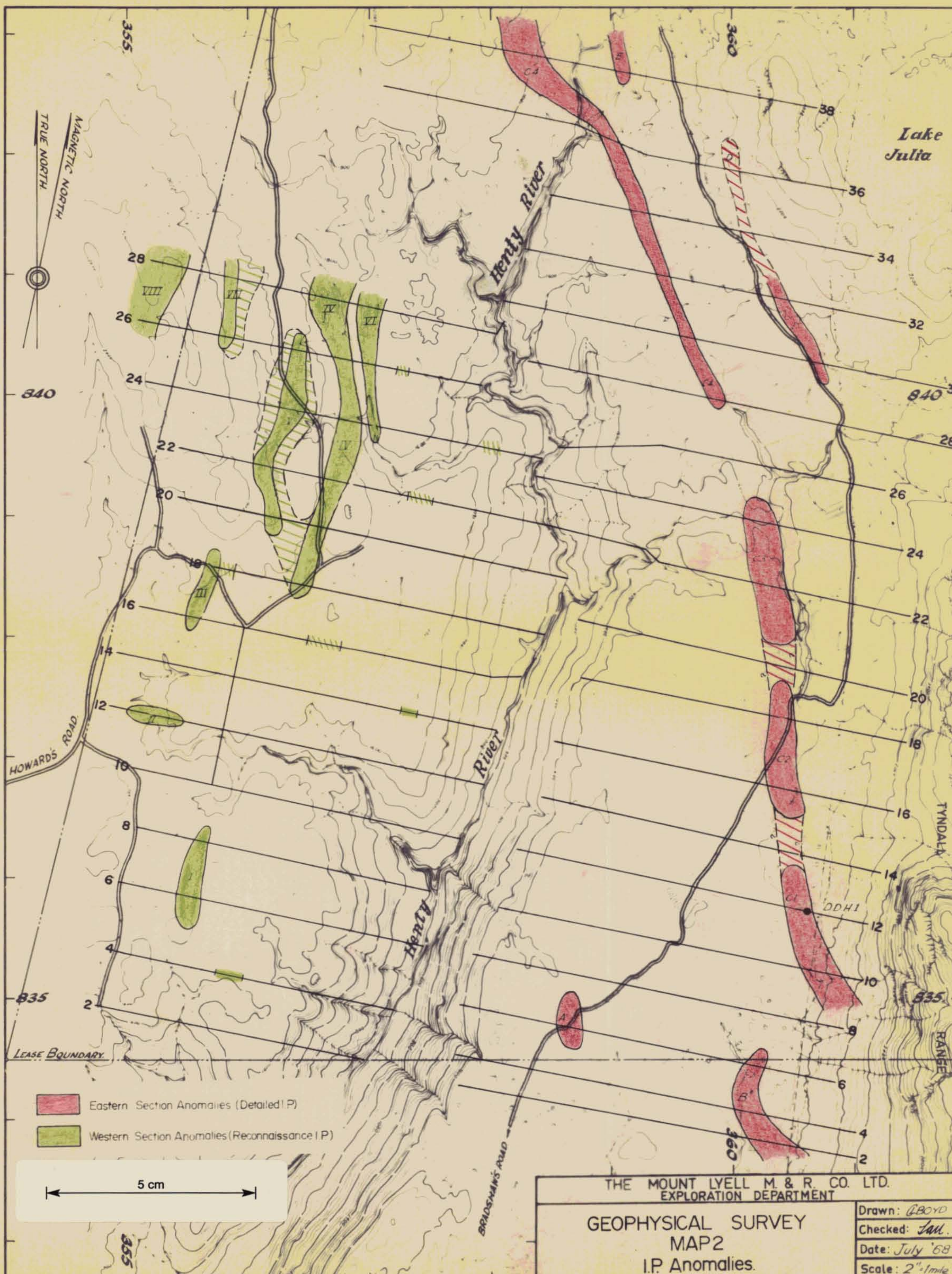

Base map by Lands and Surveys Department, Hobart. "Murchison" 40 chain to 1 inch sheets.

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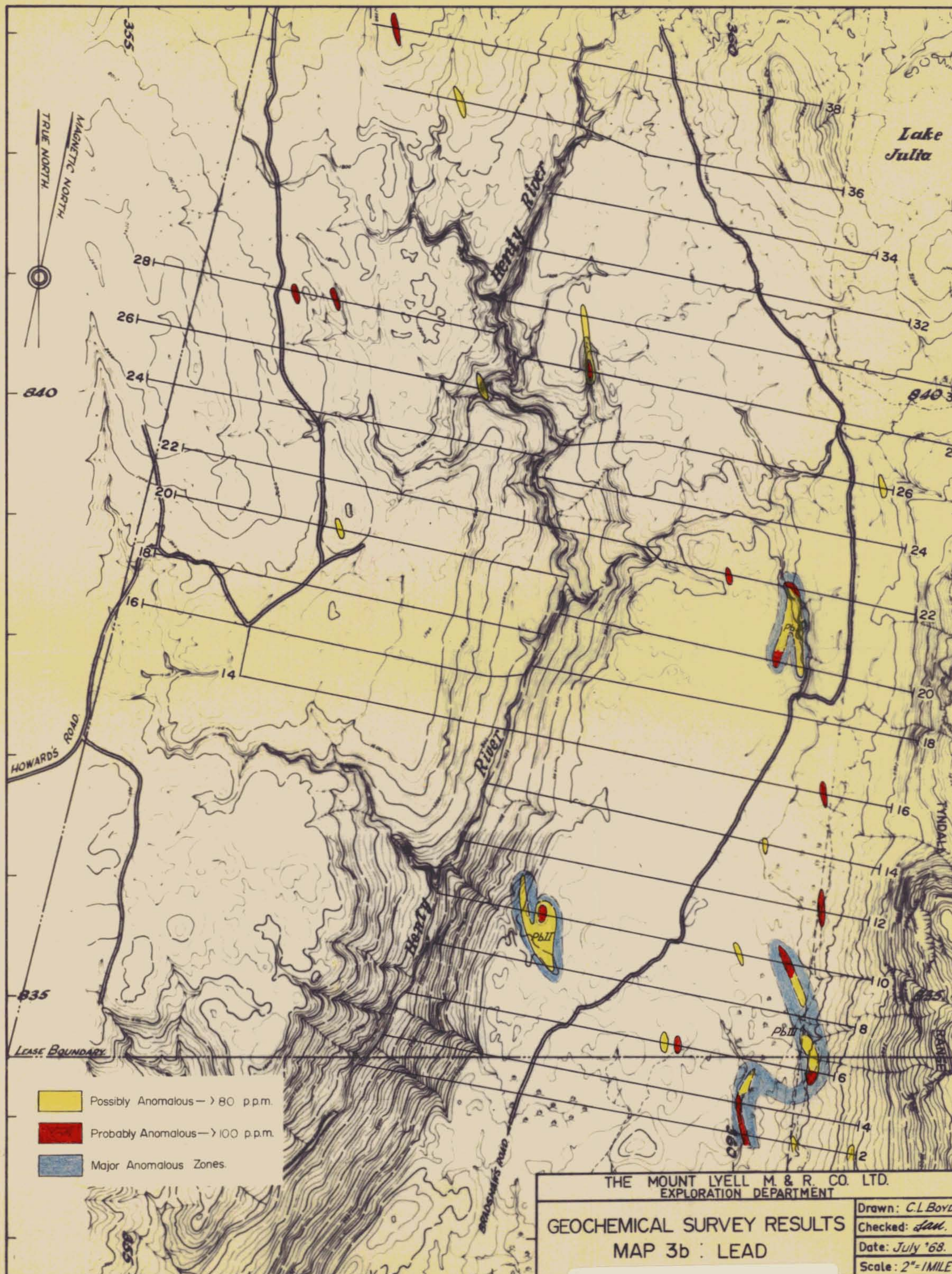

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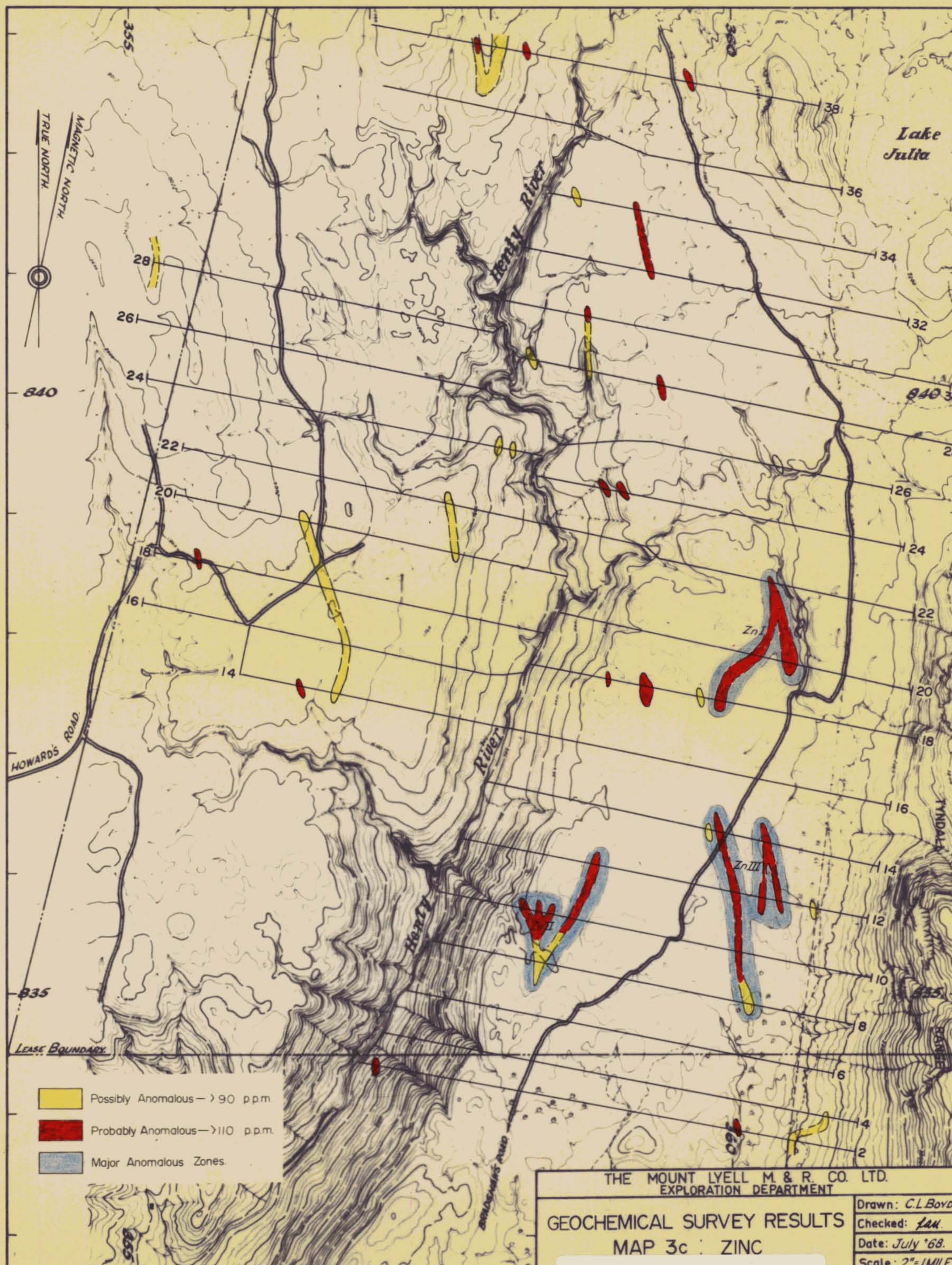

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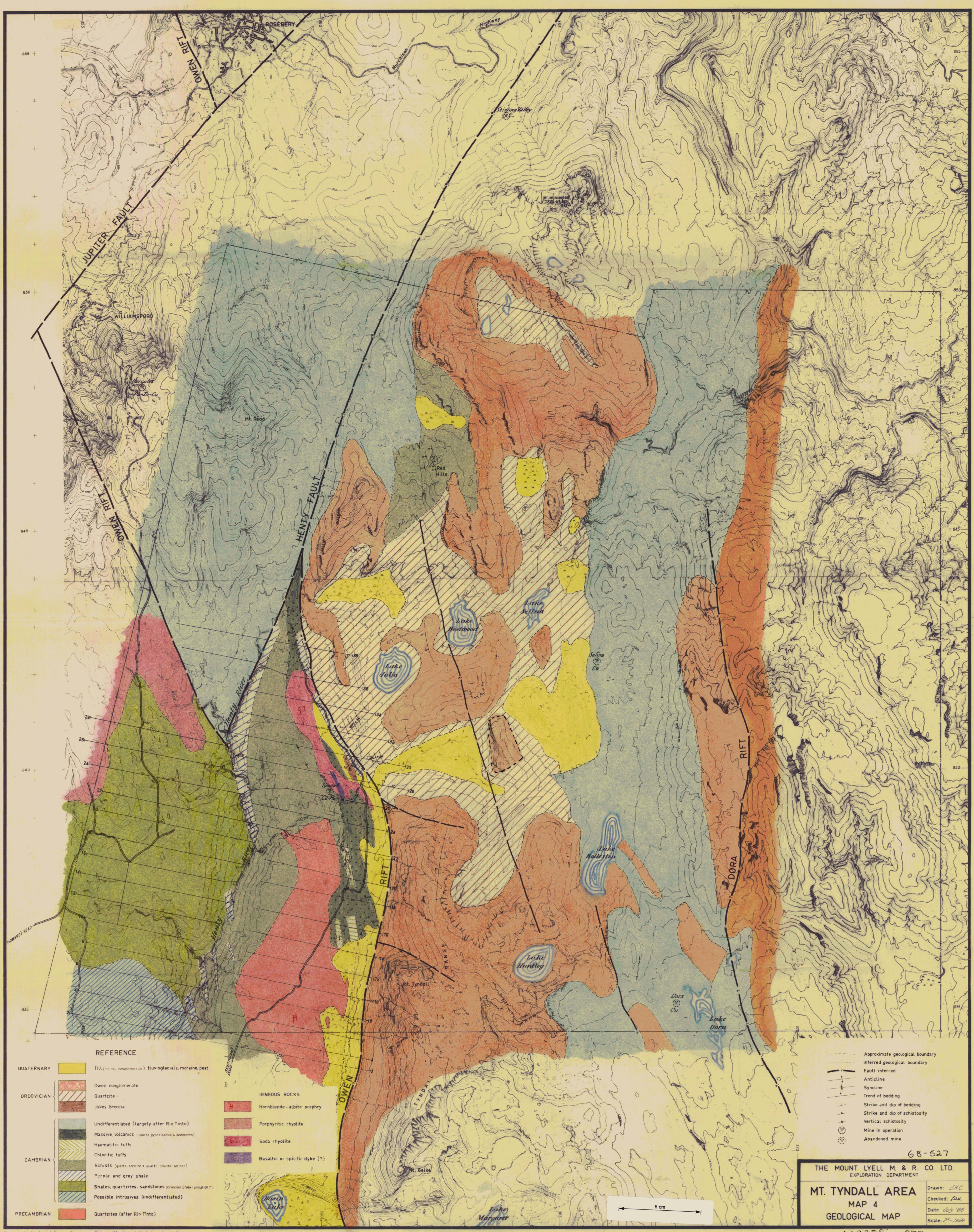

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