

06_5286

The Mineralized Rift Valley of Tasmania

Rio Tinto Australian Exploration Proprietary Limited*
Campana, B.; Dickinson, S.B.;

No comment.

RIO TINTO AUSTRALIAN EXPLORATION PTY. LIMITED
MELBOURNE, AUSTRALIA

PROJECT:— PRP/7/100

REPORT No.:— Miscellaneous 1958

Disc. *see Hardy/Cottle 31/3/58*
" " " " " " " "

Part II
→ 1st paper to Edwards.

see also
2nd edition

THE MINERALIZED RIFT VALLEY
OF TASMANIA

by

B. Campana
S.B. Dickinson
D. King
R.S. Matheson

06_5286

The Mineralized Rift Valley of Tasmania

Rio Tinto Australian Exploration Proprietary Limited*
Campana, B.; Dickinson, S.B.;

FILE REFERENCE:— 8D/20

MAP REFERENCE:—

DATE:— 11/3/1958

THE MINERALIZED RIFT VALLEYS OF TASMANIA

by
B. Campana, S.B. Dickinson, D. King and R.S. Matheson

CONTENTS.

	<u>Page</u>
INTRODUCTION	1
SUMMARY	2
THE ROCK SUCCESSION AND ITS MINERALISATION CHARACTERISTICS	3
1. Quaternary	4
2. Tertiary	4
3. Jurassic	5
4. Permo-Carboniferous	5
5. Devonian	5
6. Silurian	5
7. Ordovician	5
8. Cambrian	7.
9. Precambrian	9
THE EVOLUTION OF THE OWEN RIFT VALLEY	9
MINERALIZATION ALONG THE OWEN RIFT VALLEY	12
A. The Western Edge - The Owen Rift Fault	12
B. The Eastern Edge - The Lake Dora Fault Zone	14
C. Mineralisation in the Porphyry Flows	15
THE ADAMSFIELD RIFT VALLEY	15
REFERENCES	

INDEX OF PLATES

- Plate I. Geological Sketch Map of Tasmania, 1 inch - 16 miles showing the major structural units of West Tasmania and the related lines of mineralisation.
- Plate II. General geological map of West Tasmania, 1 inch - 8 miles.
- Plate III. Preliminary Geological map of the Mt. Darwin - Mt. Lyell - Mt. Bischoff zone of mineralisation, 1 inch - 2 miles.
- Plate IV. General geological section across the Mt. Lyell - Rosebery zone (fig. A - F), with a diagrammatic longitudinal section along Mt. Lyell - Mt. Bischoff.
- Plate V. Geological evolution and mineralisation phases of the fossil Owen rift-valley.

water =
20/4/58 version
of 11/3/58 paper

INTRODUCTION

Commencing in 1956, Rio Tinto Australian Exploration Pty. Limited, in association with Electrolytic Zinc Co. of Australasia Limited, have been carrying out a regional mineral prospecting programme in North-West Tasmania over an area of about 4,000 square miles.

The programme has comprised extensive airborne geophysical surveys, ground geophysics, geochemistry, and geological mapping. Out of the vast ^{weakest} ~~accumulation~~ ^{detailed} of new data, and the examination of old records, there has emerged a new structural concept of regional ore control and distribution in North-West Tasmania.

This concept is based on the discovery of an ancient "fossil" rift valley or graben named the Owen Rift Valley, along which are located ^{out} ~~all~~ the known major mines and ^{numerous} ~~some~~ well-known prospects.

The known mines and prospects from north to south include Mt. Bischoff (tin), the Pinnacles (zinc, lead, copper), the Chester (pyrites), Rosebery-Hercules (lead, zinc, copper, silver, gold), Mt. Read (lead, zinc, copper), Mt. Tyndall (lead, copper, zinc), Comstock and Tasman (copper, lead, zinc), Mt. Lyell (copper, pyrites, gold), Mt. Jukes and Mt. Darwin (copper).

The identification of the West Coast (Owen Conglomerate) Range as a fossil rift valley is due to Dr. B. Campana, who carried out extensive geological mapping and interpretation work, and who, with S.B. Dickinson, ^{is a} ~~are the~~ senior authors of this paper. S.B. Dickinson, who introduced B. Campana to the geological problems of West Tasmania, had previously investigated the Mt. Lyell and Rosebery mining field, to which reference is made in this work.

D. King assisted in the regional mapping and in providing many data on the mineral distribution of the area. R.S. Matheson

contributed to the findings on ore emplacement and control in the many discussions held on this subject. They are accordingly included as joint authors of this paper.

Credit is also due to E. McCarthy, who interpreted the geophysical results, and to J.H. Rattigan, who compiled the preliminary geological maps from published documents and by photo-geological methods.

G. Hall and V.H. Cottle, of the Electrolytic Zinc Co. in Rosebery, provided invaluable geological data and suggestions in the course of the survey. *and made a constructive criticism of the manuscript of this work*

The airborne geophysical survey carried out by the Adastra-Hunting Geophysics Ltd. company, furnished useful data which substantiated many of the findings on the stratigraphic and structural relationship.

The Mines Department of Tasmania and S.W. Carey, Professor of Geology at the University of Tasmania, were instrumental in initiating the regional survey and made available the published and unpublished geological literature on the area.

The assistance received from the Mt. Lyell Mining and Railway Co. in Queenstown is also gratefully acknowledged.

T. Wade & Son

SUMMARY

The fundamental finding of the current exploration programme in West Tasmania is that the geological evolution and the emplacement of the ore bodies of the West Coast Range were largely controlled by deep-seated rift-valley structures directed north-south, which channelled the mineralized solutions and controlled the ore deposition. All the important mines are thus found at or near the contact of one of these structures- the Owen Rift Fault, which marks the western edge of the Owen Rift Valley, and links all the major mines *along its run* from Elliott Bay in the south to The Pinnacles in the north, and possibly to Mt. Bischoff - a distance of over 100 miles (Figs. 1-4).

*In its central portion between Mt. Sedgwick and Mt. Owen
the Owen Rift f.t. coincides with the Mt. Lyell f.t. as
described by Gregory*

Mineralisation is present all along the known length of the Owen Rift Fault,^x and this suggests that the structure has a substantial depth penetration to tap an extensive underlying igneous mineral reservoir. It is also believed that the same reservoir, at an earlier date, supplied the porphyry lava flows and other extrusive and intrusive rocks of the Dundas group, which issued from volcanic vents and fissures along the rift structure (Fig. 5)

Repeated movements along this rift structure have developed the schists and the highly altered and brecciated and mineralised zones. The main known mines are Mt. Lyell, which has produced over 500,000 tons of metallic copper and also appreciable amounts of gold and pyrites; Rosebery and Hercules, with a production of over 2½ million tons of ore, containing 6% lead, 20% zinc, 0.5% copper and gold; and Mt. Bischoff, with a recorded production of 5.5 million tons of tin ore of 1% grade and better.

The great extent of the Owen Rift Fault, the abundance of mineralisation phenomena along it and the importance of the ore bodies already found along its strike, make it one of the greatest mineralized structures in the world.

The discovery of the Owen Rift Valley drew attention to the possibility that another major graben structure, or a system of grabens, may form to the east the regional control of a lesser-known group of mining fields, namely, Adamsfield (osmiridium), Mt. Pelion (tin, copper, wolfram), Moina-Lorinna (tin, tungsten, bismuth, molybdenum), Mt. Claude (silver, lead, zinc), and Penguin-Dial Ranges. This eastern rift system is tentatively designated the "Adamsfield Rift Valley". (Figs. 1, 2).

THE ROCK SUCCESSION AND ITS MINERALISATION CHARACTERISTICS

The data on which our conclusions are based were obtained in the area between Mt. Lyell and Rosebery, which was geologically investigated and mapped in detail. The tectonic dislocations

Gregory
Solomon
Wood
Hills

described by previous workers, and in particular by Alexander (1953), Bradley (1954), Carey (1953), Hall and Cottle (1953) and Hills (1913-1915); the well-known distribution of mineral deposits along local zones of shearing, and the igneous activities of this area and the metamorphic zones were carefully scrutinized. It was, however, the study of the general tectonic and stratigraphic setting that led one of us (B.C.) to regard the West Coast Range as an uplifted and dissected fossil graben (Figs. 4, 5) and not an ^{geosynclinal} anticlinorium as previously described by Carey (1953). It is not intended to describe in this work the general stratigraphic succession of West Tasmania, which has been admirably outlined by the early investigators (Gregory, 1905; Hills, 1913-1915; Twelvetrees, 1901; Twelvetrees and Ward 1910; Ward, 1908); and adequately reviewed in more recent works (Banks, 1956; Elliston, 1954; Gill and Banks, 1950; Thomas and Henderson, 1945). Some remarks on the facies and the relationships of the local rock units are, however, necessary to illustrate the stratigraphic data from which the new structural concepts have been deduced.

For the purpose of this paper, it is convenient to sub-divide the rock formations according to a time scale. This arrangement not only helps to differentiate clearly each major rock grouping but also to bring out their relative importance in relation to ore possibilities.

1. Quaternary

Alluvium, screes, glacial deposits, up to 150 feet in thickness are found over extensive areas and largely mask the underlying mineralised rocks. They do not contain any important deposits, except for a few minor alluvial sedimentary concentrations.

2. Tertiary

Basaltic flows up to several hundred feet in thickness are found in the northern areas. They are not mineralised, and also mask large areas of mineralised ~~rock~~.

basement

3. Jurassic

Dolerite sills up to 1600 feet in thickness are found in a few areas. They are unrelated to mineralisation.

4. Permo-Carboniferous

A few isolated inliers of tillitic material, remnants of a glacial blanket which could have covered an extensive area, are present. They are not mineralised. Those near Zeehan were previously thought to be Pre-Cambrian, but recent investigations have proved their Permian age (Campana and King, 1953).

5. Devonian

Granites and other igneous rocks, to which a Devonian age has been attributed by early investigators, outcrop in isolated masses. Their relationship to the adjoining sediments and to their mineralisation are now being critically reviewed.

6. Silurian

Up to 10,000 feet of sandstones, alternating with shales, and well dated by abundant Silurian fossils are present. Of marine origin and transgressive over earlier land surfaces they now occur as isolated infolded remnants in synclinal zones adjacent to the West Coast Range. They are not visibly metamorphosed, and their relationship to the igneous rocks of the area is being investigated. They contain no known important mineral deposits.

7. Ordevician

Two distinct formations are considered to be of Ordevician age.

- A. Gordon Limestone - upper formation
- B. Owen Conglomerate - lower formation

A. The Gordon Limestone - is well developed in the Zeehan area where it contains lead deposits extensively worked at Oceana Mine. The limestones of Linda Valley and the sandy clays in which native copper was found in the Lyell Blocks and King Lyell Mines may also belong to this formation. The Gordon Limestone is a marine formation, well dated by fossils, and considered (by us) as transgressive over all the older formations, including the Owen Conglomerate (Fig. 5). (The nature of the mineralisation in this formation is being studied.)

B. The Owen Conglomerate - The most conspicuous formation of the West Coast Range, the Owen Conglomerate, has been studied in some detail by various investigators, in particular by Bradley (1954) and Hills (1913-1915). Its distribution is well known. It tops the rugged and narrow chain of mountains which extend north-southerly at the longitude of Mt. Lyell, over a distance of 40 miles, and comprises the peaks of Mt. Darwin, Mt. Owen, Mt. Lyell, Mt. Sedgwick, Mt. Murchison and Mt. Farrell. The Owen Conglomerate overlies with angular unconformity ^{precamb} fossiliferous sediments and effusive rocks of middle Cambrian age and is overlain by fossiliferous Silurian beds. It is thus considered Ordovician in age, although no fossil remains permit a direct dating. At its base the Owen Conglomerate locally consists of a coarse unstratified breccia (Jukes Breccia horizon), succeeded by massive unsorted pebbles and boulder layers grey-white or pinkish in colour (Fig. 6). These are overlain by quartzites and micro-breccias of reddish to deep-purple tinges, merging upwards in light-coloured quartzites and sandstones.

The Owen Conglomerate has been considered by previous workers as a marine shallow-water formation, representing a shore deposit around an emergent Precambrian core which at present flanks the Conglomerate to the east and forms the Sticht Ranges. But the lithology, the poor sorting and bedding, the violent lateral and vertical variations, the

widespread pink and purple tinges, the sharp and crude cross-bedding, and the general absence of fossils and other features characteristic of marine sedimentation, leave little doubt that the Owen Conglomerate is a continental formation. It is regarded by us as the gravelly and sandy infilling of an old rift-valley.

This view accounts for another striking feature of the Owen Conglomerate, i.e. its most unusual distribution and thickness along the West Coast Range (Figs. 2-4). In a north-south direction, it extends for more than 40 miles. Its width, however, is less than 3 miles; and its thickness which may reach several thousand feet in the more central portion of the Range decreases abruptly from as much as 4,000 feet to nil at the edges.

The curious contacts of the Owen Conglomerate with the underlying rock, its distribution, its thickness and facies characteristics, substantiate its emplacement as a continental rift infilling. Without confining walls in a continental trough or rift, it is difficult to imagine it standing as a stable mass, especially in a marine environment. The peculiarities of its contact with the underlying rocks can only be satisfactorily explained by postulating a rift-valley condition.

The Owen Conglomerate contains no known significant ore bodies, but it is the main attraction to geologists and prospectors searching for new copper deposits as most of the major known deposits at Mt. Lyell have been worked just beneath its contact with the underlying rocks.

8. Cambrian

The Cambrian beds of the West Coast are the most important for ore. They have been collectively referred to in the past as the Dundas Group and numerous sub-divisions have been put forward by various workers for small disconnected areas without any clearcut overall correlation having been made. The present mapping is not sufficiently

enlarged

advanced to suggest any detailed correlations. However, on the basis of their mineral characteristics, facies and origin, two major Cambrian divisions have been distinguished and mapped. They are -

- A. The Massive Pyroclastics (Queenstown-Rosebery area)
- B. The "Bedded Fossiliferous Formations" (Dundas-Zeehan area)

The basal portion of the fossiliferous strata are regarded by us as older than the Massive Pyroclastics. But the tuffaceous members found at higher levels would derive from finer ejectamenta of the volcanic phases which brought about the Massive Pyroclastics and are thus considered as coeval with these (Fig. 5)

A. The Massive Pyroclastics. The effusive nature of the rocks underlying the Owen Conglomerate - the Massive Pyroclastics of Hall and Cottle (1953) - appears to us unquestionable. We regard these formations as a Cambrian volcanic assemblage - acid to intermediate lavas and porphyries, emplaced as flows or hypabyssal bodies, to which are associated volcanic breccias, and agglomerates and minor layers of slates. They represent repeated volcanic ejections along the Owen Rift Fault and include at certain levels large bodies of quartz porphyries, quartz felspar porphyries and felsites, emplaced as large flows and in places as sill-like masses and hypabyssal bodies. They locally reach 10,000 feet in thickness and flank the Owen Rift margins, which were largely the loci of their extrusion. As they are abundantly represented as fragments and boulders in the basal beds of the Owen Conglomerate, notably in the "Jukes Breccia" horizon, their emplacement clearly pre-dates the infilling of the old rift valley by the Conglomerate. Numerous mineral deposits of the replacement type are in these rocks, extending from Mt. Darwin in the south to the Pinnacles in the north (Figs. 3, 4). In the Rosebery area, the Massive Pyroclastics form the hanging wall of the lead-zinc ore bodies,

with them.

B. The Fossiliferous Bedded Formation of the Dundas Group

To the west of the volcanic belt, there are extensive developments of vari-coloured argillites, black slates, shales, with layers of agglomerates, tuffs and ashbeds. At various levels, fossils of middle and upper Cambrian age have been found. As already indicated, the basal beds of this sequence are believed to be older than the "Massive Pyroclastics", but the upper ones are coeval with these, with which they inter-finger. This interfingering would explain the difficulties of the earlier workers in their stratigraphic studies.

These Dundas beds are mineralised extensively, and contain a number of rich lead, zinc, silver and tin deposits, notably in the Zeehan, Dundas, and Renison Bell areas. Most of the deposits worked, however, have been small. While emphasis is presently being placed on the Massive Pyroclastics in the search for new ore, it is intended to do further mapping in these beds and particularly to study the serpentine and ultrabasic complexes in them. Reference to the serpentine occurrences is omitted from this paper, as they are not directly concerned with this rift valley mineralisation.

9. Precambrian

Underlying the Cambrian beds unconformably is a succession of unfossiliferous slates, shales, quartzites, schists and dolomites, etc. They have not been examined except at Mt. Bischoff, where the Owen Rift Fault would penetrate them. At Mt. Bischoff these Precambrian rocks contain extensive tin mineralisation. They form the basement rocks of the area and are not as extensively mineralized as the Cambrian formations.

THE EVOLUTION OF THE OWEN RIFT VALLEY (Fig.5)

The Owen Rift Valley had its beginning in regional north-south faulting in Cambrian times. Along these regional faults, fissures

and vents developed, from which was extruded the volcanic assemblage of rocks which make up the Massive Pyroclastics of the Queenstown-Rosebery area.

With the cessation of igneous activity, movements along the marginal faults clearly continued. The development of the Jukes Breccia, a scree formation of broken blocks of porphyry and pyroclastic rocks, indicates that a deep rift valley was forming as a striking physiographic feature in Ordovician time. Of the order of 3-5 miles wide, and of considerable depth, it extended in a north-south direction for many tens of miles. As subsidence proceeded, this rift valley was gradually filled in with the coarse, poorly sorted gravels and sand of the Owen Conglomerate. After the infilling, the whole area was covered by a transgressive sea, in which took place the deposition of the Gordon Limestone, now preserved as isolated outliers. Possibly the same marine transgression was responsible for the deposition of the Silurian sediments which conformably overlie the Gordon River Limestone. The Silurian sea must have covered the largest part of West Tasmania, as we have now found remnants of Silurian sediments well to the east and west of the Owen Rift Valley.

In Devonian times further movements took place along the Rift Valley with possible intrusion of granitic magmas adjacent thereto and acid and porphyry dykes and tin mineralisation. During this period, the folding, fracturing and alteration of rocks along the marginal faults are believed to have undergone their greatest deformation and alteration. For example, the Mt. Lyell schists probably assumed their present form derived from the shearing and alteration of the pyroclastic formations, but also incorporating remnants of other deposits, such as the Owen Conglomerate and Dundas shales, that happened to be caught in the severe faulting movements.

The complex problems posed by the contact of the Owen Conglomerate with the volcanic formations on which it rests - porphyries, lavas, pyroclastic deposits, schists, etc. - are well known to investigators of West Tasmanian geology.

This contact has been variously interpreted as stratigraphic, tectonic, intrusive, metamorphic in character, according to the area studied and the methods of approach.

These conflicting views are largely reconciled by considering the Owen Conglomerate as the continental infilling of a lower Palaeozoic graben which has been repeatedly dislocated in later times, particularly along the original marginal faults (Fig. 5). Sharp and steep stratigraphic contact at the edge of the old rift-valley; imbricated and overturned structures along the fault planes bounding the graben; shearing, metamorphic and mineralisation effects along these planes; local and sharp angular unconformities at the base and within the Conglomerate Succession, are readily accounted for. They are the results of movements which date back to Cambrian times and which are possibly still active, repeating and superimposing and often obscuring their effects. Indeed, as the new investigations proceed, the graben structure of the West Coast Range becomes of compelling validity.

The Owen Rift did not necessarily reach its present elevation in Devonian times. The important change was that the margin of the rift was no longer a simple contact between conglomerates and volcanics, and other sediments. Instead, it became an irregular and intricate contact between schisted porphyries and stretched conglomerates with all manner of minor cross-faulting displacements taking place during the intense movements of the Devonian orogeny. The elevation of the Owen Rift Valley at its present level would be the result of a major regional uplift in early Tertiary times. This uplift was followed by differential erosion, and the old Rift Valley is outlined by the resistant slabs of the Owen Conglomerate which tops the mountains of the West Coast Range. The marginal shears of the Rift show up well along the conglomerate edges and along them and adjacent to them will be concentrated the further search for new ore bodies. The shears will also be followed beyond the limits of the conglomerate, as these now can be traced or inferred with precision on the basis of the geological and geophysical knowledge presently acquired.

MINERALIZATION ALONG THE OWEN RIFT VALLEY

The nature and distribution of mineralisation along the Owen Rift Valley can only be described in general terms as these studies largely concern the next phase of field work which has only just commenced. It is proposed to deal separately with the marginal faults and their ore associations and to briefly refer to the possibilities for ore in the rocks within and adjacent to the rift structure.

A. The Western Edge - The Owen Rift Fault

The western edge of the Owen Rift Valley is the Owen Rift Fault, believed to be one of the greatest mineralised structures discovered so far in the world. It can be traced from Elliot Bay in the south to Silver Falls north of Rosebery, and probably to Mt. Bischoff, over a distance of 110 miles. Along its strike, it brings in tectonic contact all the local geological formations, from the Precambrian to the Silurian (Figs. 1-4), and the larger orebodies of the area, as well as numerous other deposits lying on this fault zone, which reaches in places $\frac{1}{2}$ mile in width.

Owing to a general south pitch, erosion has exposed, from south to north, older and older rocks along the surface trace of this fault (Fig. 4).

Correspondingly, as the mineralised fault intersects deeper and deeper geological levels, there is a notable change of mineral association in the main orebodies. These may be briefly described as follows:-

(a) The Copper Zone (Mt. Darwin-Mt. Lyell-Mt. Tyndall)

From south to north, the Owen Rift Fault is first marked by the mineral occurrences of the Elliot Bay area, succeeded by the Mt. Darwin-Mt. Lyell-Mt. Tyndall copper zone, 30 miles long, and confined largely to the contact of the Massive Pyroclastics and porphyries with the Owen Conglomerate (Alexander, 1953; Edwards, 1939).

The more important orebodies are large irregular masses of cupriferous pyrites in the schisted porphyries along the Owen Rift Fault. Additionally, there are widespread disseminations of chalcopyrite, bornite, and pyrite in the schists. On the actual contact with the conglomerate, these disseminations are known to grade into massive high-grade lenses (5-10% copper).

The copper orebodies represent replacement of the schisted porphyries. The copper mineralisation is well-marked as far north as Comstock, beyond which the structure is largely covered by glacial moraines. Nine miles north of Comstock, however, at Mt. Tyndall, copper is again in evidence, in association with lead and zinc, in porphyritic rocks underlying the Owen Conglomerate. Beyond Mt. Tyndall the rising pitch of the rocks takes the Owen Conglomerate out of the ground and the mineralised fault comes in contact with older formations.

(b) The Lead-Zinc Zone (Mt. Read-Rosebery-Pinnacles)

Progressing north from Mt. Read, it is noted that the fault plane first intersects lower beds of the Massive Pyroclastics and progressively deeper horizons as one proceeds towards Rosebery and the Pinnacles. The lead-zinc zone of mineralisation is dominant and it extends over 15 miles. Galena and sphalerite are usually associated with pyrite in large replacement lenses which have some similarity to those at Mt. Lyell in shape and mode of occurrence. Minor amounts of copper minerals are present and also gold indicating a common association of minerals along this fault. At the Chester Mine a massive pyrite deposit is present and further north, along the fault, at the Pinnacles, lead, zinc and copper sulphides, similar to the Rosebery mineral association, are found.

*plane
where is it
zone??*

(c) The Tin Zone (Mt. Bischoff)

North of the Pinnacles to Mt. Bischoff, the mineralised fault has not been studied in detail. In fact, it is definitely obscured over a length of about 10 miles by a sub-horizontal sheet of Tertiary basalt 300-500 feet thick. At Mt. Bischoff, however, the fault would re-appear, bringing in contact Precambrian rocks with the tuffaceous beds of the Dundas Group. At this low stratigraphic level the lead-zinc mineralisation has given way to the tin mineralisation, the tin having been introduced by well-developed tin-bearing intrusive porphyries (Reid, 1923; Knight, 1953).

The conclusion that may be drawn from this regional zoning of minerals is that there is a chance of finding ore over a considerable vertical range and, in particular below the old mines, which could have ore, as rich if not richer than the ore at the surface. Also, if orebodies of substantial vertical dimension are found, these can be expected to exhibit changing mineral associations with depth.

This striking regional zoning of minerals is not brought forward, as a hydrothermal effect, but as a factual relation of certain stratigraphic horizon with particular mineral group. The hydrothermal aspects of the mineralisation cannot be clearly understood until its genetic relationship with the igneous rocks of the area and the age problems are fully elucidated - a work which is now in progress.

B. The Eastern Edge - The Lake Dora Fault Zone.

A zone of brecciation and imbricated structures between the Precambrian quartzites of the Sticht Ranges and the Owen Conglomerate of Walford Peak-Lake Dora marks the eastern edge of the fossil graben. This zone is of the order of $\frac{1}{2}$ mile in width, and the steep and narrow synclinal wedges of Owen Conglomerate pinched and squeezed between the Massive Pyroclastics formations stand out in striking contrast with the gently folded or sub-horizontal structures of the Conglomerate westerly of this zone (Fig. 4). At one point,

however, the Owen Conglomerate is seen resting with undisturbed angular unconformity on the Precambrian quartzites. Angular boulders, up to 4 feet across and lithologically identical to the quartzites on which they rest, furnish an admirable evidence of talus-type deposits along the fossil rift-valley (Fig.).

A series of copper-lead deposits marks a line of mineralisation which follows the imbricated zone for many miles. Its north-southern strike, rock and mineral association, stratigraphic and tectonic characteristics are similar to those of the Mt. Darwin-Mt. Lyell-Red Hill copper zone; and although no major ore bodies have been discovered so far along this structural zone, its largely unexplored economic potentialities cannot be overlooked.

When traced fully, it is possible that the eastern fault zone of the Owen Rift Valley could have a similar length to that of the better-known western edge.

C. The Mineralisation in the Porphyry Flows

Whilst it seems likely that the rich concentrations of ore along the Owen Rift Valley will be confined to the marginal mineralized fault zones, there is evidence to believe that the adjoining rocks, notably in the porphyry lava flows, may contain large disseminated mineral deposits, especially of copper, workable by open cuts. The study of this mineralization type, and in particular of their genetic relationship with the porphyritic host rocks, is in progress.

THE ADAMSFIELD RIFT VALLEY

A second major mineralised rift valley (or rift-valley system) in Tasmania has been inferred from published geological maps and reports. It is suggested by the following considerations :

1. In the south, a narrow corridor of Cambrian, Ordovician, and Silurian rocks striking north-south has been recognised in the Adamsfield-Prion Bay area, where typical Owen Conglomerate

is also present.

2. North of this corridor, the contact between the dolerite plateau of Central Tasmania and the Precambrian Block to the west appears to reflect an ancient deep-seated line of weakness which has been intermittently active from Cambrian to post-Jurassic times, as in the case of the Owen Rift Valley.
3. Major zones of mineralisation are also found along this zone, notably :-
 - (a) the osmiridium deposits of Adamsfield.
 - (b) the tin, copper, lead, zinc, gold occurrences at Mt. Pelion which are associated with quartz felspar porphyries and felsites.
 - (c) the tin, tungsten, bismuth and molybdenum mineralisation of the Moina-Lorinna tin field.
 - (d) the silver-lead field of Mt. Claude.
4. Further north on the Coast, in the Penguin-Dial Ranges, conditions analogous to those of the Owen Rift Valley are present, with mineralisation at the base of Owen Conglomerate near its contact with volcanic rocks.

Pending further field studies, this view is advanced as a working hypothesis which may well prove useful in the investigation of the regional mineralisation control of these mining fields.

The mineralised rift valleys of Tasmania clearly provide favourable environments for the search for new major ore bodies. The task is still ahead to select drilling targets, but for the first time, we have as guide soundly reasoned criteria of possible ore repetitions at great depth and over tens of miles laterally.

Melbourne

11th March, 1958

REFERENCES

- ALEXANDER, J.M., 1953. - Geology of the Mount Lyell Field; in GEOLOGY OF AUSTRALIAN ORE DEPOSITS, 5th Emp. Min. Metall. Cong. I, 1129-44.
- BANKS, M.R., 1956. - The Middle and Upper Cambrian Series. (Dundas Group and its Correlates) in Tasmania. XX Cong. Geol. Int., Tomo II, Part II, 165-212.
- BRADLEY, J., 1954. - The Geology of the West Coast Range of Tasmania, Pt. I: Stratigraphy and Metasomatism. Pap. Roy. Soc. Tas., 88, 193-243.
- 1956, Pt. II: Structure and Ore Deposits. Pap. Roy. Soc. Tas., 90, 65-129.
- CAMPANA, B. and KING, D., 1958 - The Age of the Zeehan Tillite. Aust. J. Sc. 1958 (in press).
- CAREY, S.W. 1953. - The Geological Structure of Tasmania in relation to mineralisation; in GEOLOGY OF AUSTRALIAN ORE DEPOSITS. 5th Emp. Min. metall. Cong., I, 1108-28.
- and BANKS, M.R., 1954. - Lower Palaeozoic unconformities in Tasmania, Pap. Roy. Soc. Tas., 88, 245-69.
- CONOLLY, H.J.C., 1947. - Geology in exploration: Mount Lyell example. Proc. Aust. Inst. Min. Metall, 147 (N.S.), 1-22.
- EDWARDS, A.B., 1939. - Some observations on the Mineral Composition of the Mount Lyell Copper Ores, Tasmania, and their modes of occurrence. Proc. Aust. Inst. Min. Metall. 114 (N.S.), 67-109.
- 1943. - The copper deposits of Australia. Proc. Aust. Inst. Min. Metall. 130 (N.S.) 158-65.
- ELLISTON, J., 1954. - Geology of the Dundas district, Tasmania. Pap. Roy. Soc. Tas., 88, 161-83.
- FINUCANE, K.J., 1932. - Preliminary report on geological Survey of the Rosebery District, Tasmania. Chem. Engng. Min. Rev.
- GILL, E.D. and BANKS, M.R. - 1950. - Silurian and Devonian stratigraphy of Zeehan Area. Pap. Roy. Soc. Tas., 1949, 259-72.
- GREGORY, J.W., 1905. - The Mount Lyell Mining Field, Tasmania. Trans. Aust. Inst. Min. Engrs. 10, 26-196.
- HALL, G., COTTLE, V.M., ROSENHAIN, P.B., and MCGHIE, R.R., 1953. The lead-zinc deposits of Read-Rosebery and Mount Farrell; in GEOLOGY OF AUSTRALIAN ORE DEPOSITS. 5th Emp. Min. Metall. Cong., I, 1145-59.
- HILLS, L., 1913. - The Jukes-Darwin Mining-field. Tas. geol. Surv. Bull. 16.
- 1914. - The zinc-lead sulphide deposits of the Read-Rosebery District, Pt. I (Mount Read Group). Tas. geol. Surv. Bull. 19.
- 1915. - The Zinc-lead sulphide deposits of the Read-Rosebery District, Pt. II (Rosebery Group) Tas. Geol. Surv. Bull. 23.
- KNIGHT, C.L., 1953. - Mount Bischoff Tin Mine; in GEOLOGY OF AUSTRALIAN ORE DEPOSITS. 5th Emp. Min. Metall. Cong., I, 1185-93.

REFERENCES (c o n t d.)

- NYE, P.B., and BLAKE, F. , 1938. - The Geology and Mineral Deposits of Tasmania. Tas. Geol. Surv. Bull. 44.
- REID, A.M., 1923. - The Mount Bischoff Tin-field. Tas. Geol. Surv. Bull. 34.
- THOMAS, D.E., and HENDERSON, Q. J., 1945. - Some Fossils from the Dundas Series, Dundas. Pap. Roy. Soc. Tas., 1944, 1 - 8.
- TWELVETREES, W. H., 1901. - Report on the Mineral Districts of Mounts Huxley, Jukes and Darwin. Sec. Min. Rep. 1900-1. Tas. Parl. Pap. 4. (Also issued separately by the Tas. Dep. Min.)
- and PETTERD, W. F., 1899. - On the Felsites and Associated rocks of Mount Read and Vicinity. Sec. Min. Rep. 1898-99. Tas. Parl. Pap. 69, XXIX-XXXII. (Also in Pap. Roy. Soc. Tas., 1899.
- and WARD, L.K., 1910. - The Ore Bodies of the Zeehan Field. Tas. Geol. Surv. Bull. 8.
- WARD, L.K., 1908. - The Mount Farrell Mining Field. Tas. Geol. Surv. Bull. 3.

STATE ECONOMIC PLANNING AUTHORITY
1947

SKETCH MAP OF GEOLOGY

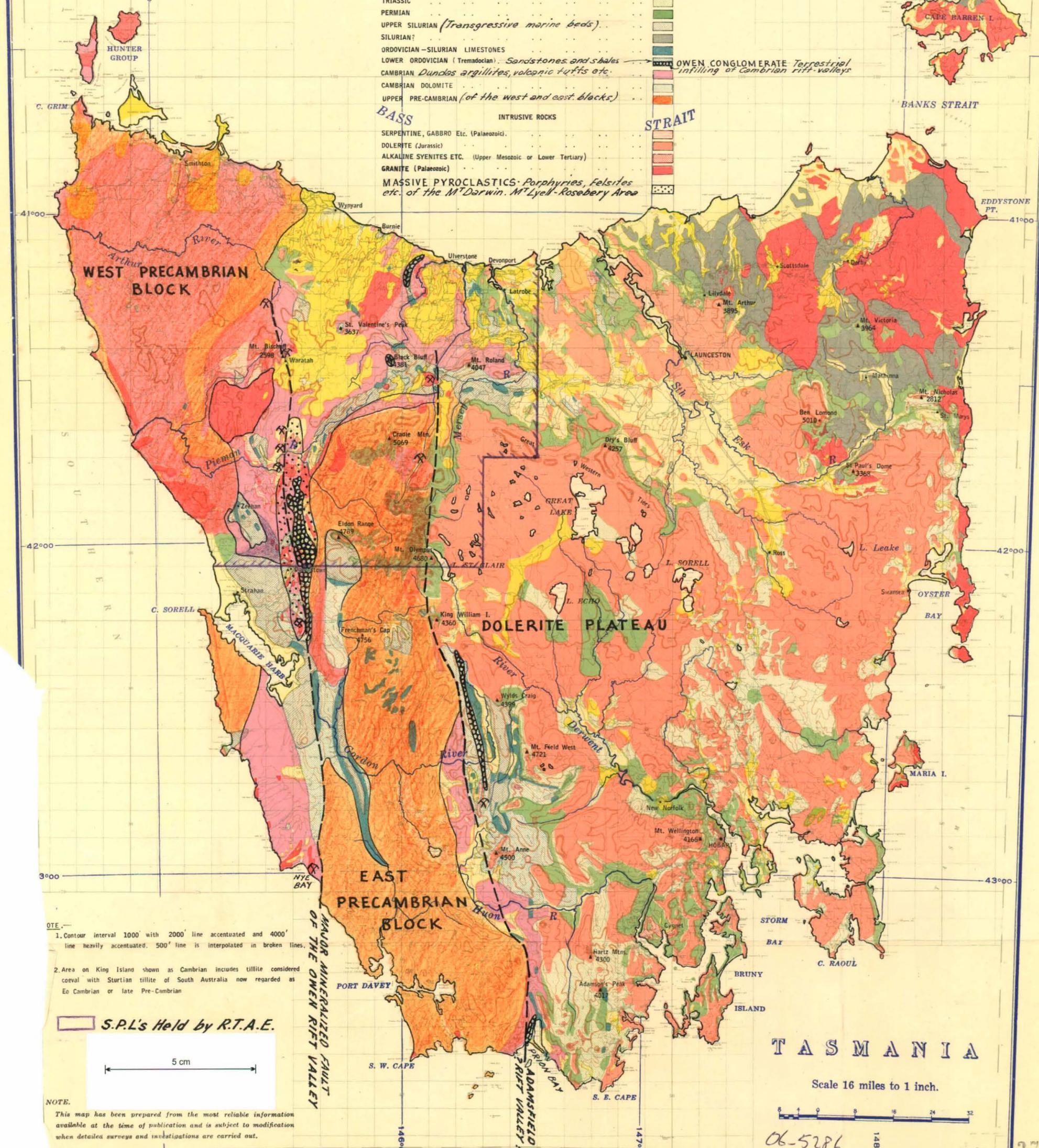
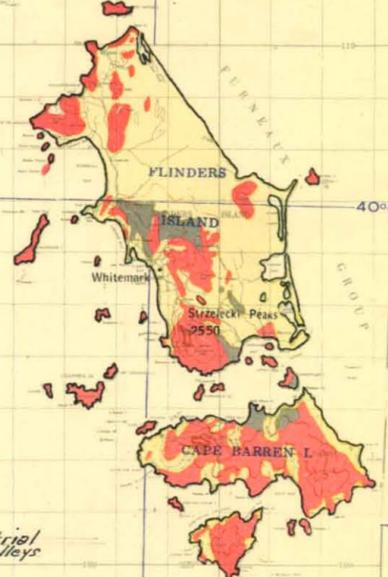
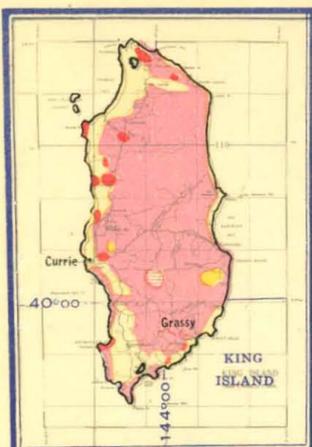
Prepared from information supplied by the Geological Survey
Department of Mines

SHOWING THE MAJOR STRUCTURAL UNITS OF WEST TASMANIA AND THE RELATED LINES OF MINERALIZATION STRATIFIED ROCKS

- TERTIARY & RECENT
- TERTIARY BASALT
- TRIASSIC
- PERMIAN
- UPPER SILURIAN (*Transgressive marine beds*)
- SILURIAN?
- ORDOVICIAN-SILURIAN LIMESTONES
- LOWER ORDOVICIAN (Tremadocian) *Sandstones and shales*
- CAMBRIAN *Dundas argillites, volcanic tufts etc.*
- CAMBRIAN DOLomite
- UPPER PRE-CAMBRIAN (*of the west and east blocks.*)

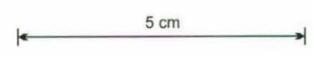
- OWEN CONGLOMERATE *Terrestrial infilling of Cambrian rift-valleys*

- INTRUSIVE ROCKS
- SERPENTINE, GABBRO Etc. (Palaeozoic)
- DOLERITE (Jurassic)
- ALKALINE SYENITES ETC. (Upper Mesozoic or Lower Tertiary)
- GRANITE (Palaeozoic)
- MASSIVE PYROCLASTICS: *Porphyries, felsites etc. of the Mt Darwin, Mt Lyell-Rosebery Area*



NOTE.—
1. Contour interval 1000' with 2000' line accentuated and 4000' line heavily accentuated. 500' line is interpolated in broken lines.
2. Area on King Island shown as Cambrian includes tillite considered coeval with Sturtian tillite of South Australia now regarded as Eo Cambrian or late Pre-Cambrian

S.P.L's Held by R.T.A.E.



NOTE.
This map has been prepared from the most reliable information available at the time of publication and is subject to modification when detailed surveys and investigations are carried out.

TASMANIA

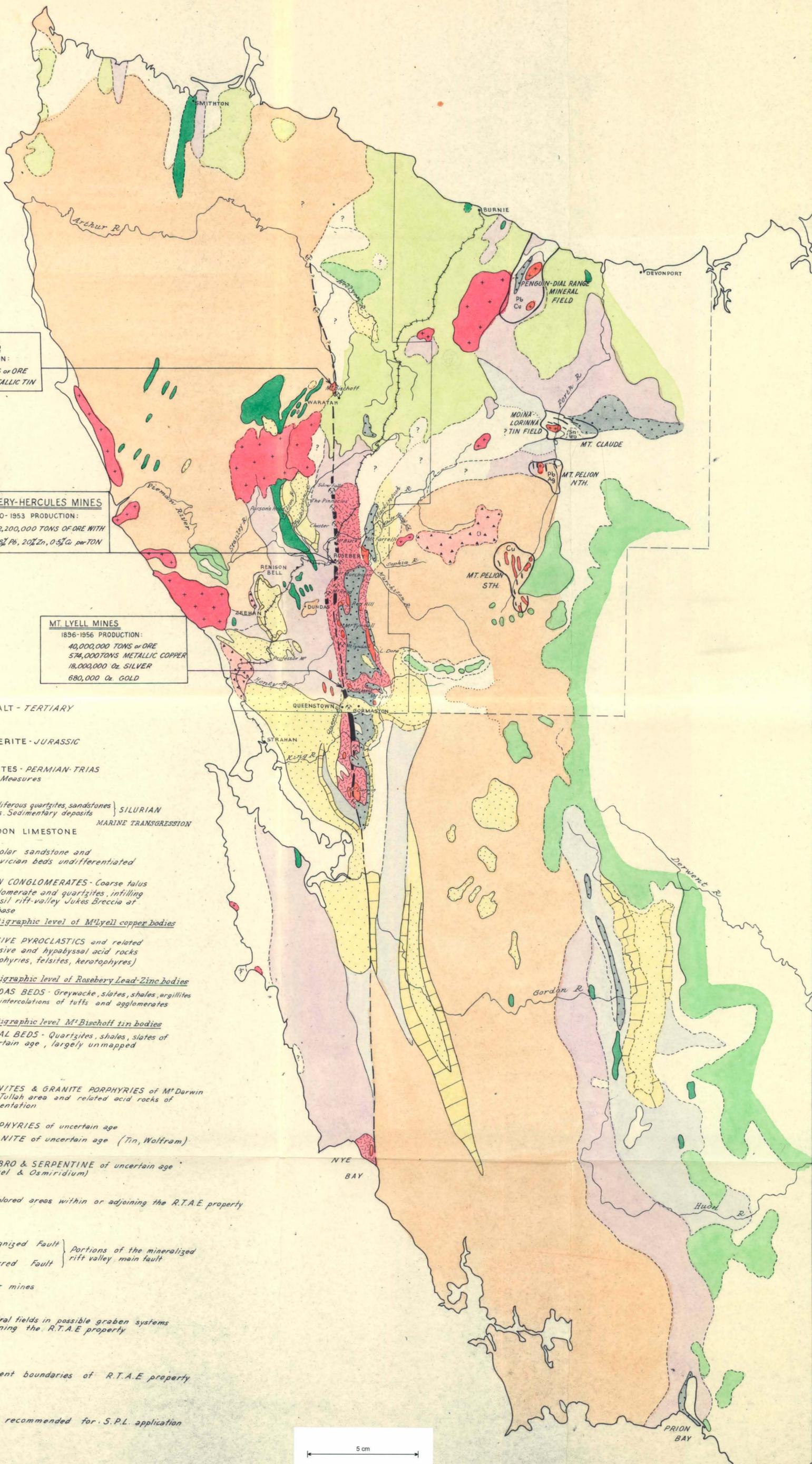
Scale 16 miles to 1 inch.



06-5286

MERCURY OFFSET

PLATE 1



MT. BISCHOFF MINES
 1874-1928 PRODUCTION:
 5,500,000 TONS OF ORE
 54,000 TONS METALLIC TIN

ROSEBERY-HERCULES MINES
 1900-1953 PRODUCTION:
 2,200,000 TONS OF ORE WITH
 6% Pb, 20% Zn, 0.5% Cu per TON

MT. LYELL MINES
 1896-1956 PRODUCTION:
 40,000,000 TONS OF ORE
 574,000 TONS METALLIC COPPER
 18,000,000 Oz SILVER
 680,000 Oz GOLD

- BASALT - TERTIARY
- DOLERITE - JURASSIC
- TILLITES - PERMIAN-TRIAS
Coal Measures
- Fossiliferous quartzites, sandstones } SILURIAN
shales, Sedimentary deposits } MARINE TRANSGRESSION
- GORDON LIMESTONE
- Tubicolour sandstone and Ordovician beds undifferentiated
- OWEN CONGLOMERATES - Coarse talus conglomerate and quartzites, infilling a fossil rift-valley Jukes Breccia at its base
Stratigraphic level of Mt Lyell copper bodies
- MASSIVE PYROCLASTICS and related extrusive and hypabyssal acid rocks (Porphyries, felsites, keratophyres)
Stratigraphic level of Rosebery Lead-Zinc bodies
- DUNDAS BEDS - Greywacke, shales, slates, argillites with intercalations of tuffs and agglomerates
Stratigraphic level Mt Bischoff tin bodies
- BASAL BEDS - Quartzites, shales, slates of uncertain age, largely unmapped
- GRANITES & GRANITE PORPHYRIES of Mt Darwin and Tullah area and related acid rocks of segmentation
- PORPHYRIES of uncertain age
- GRANITE of uncertain age (Tin, Wolfram)
- GABBRO & SERPENTINE of uncertain age (Nickel & Osmiridium)
- Unexplored areas within or adjoining the R.T.A.E property
- Recognized Fault } Portions of the mineralized rift valley, main fault
- Inferred Fault }
- Major mines
- Mineral fields in possible graben systems adjoining the R.T.A.E property
- Present boundaries of R.T.A.E property
- Area recommended for S.P.L. application

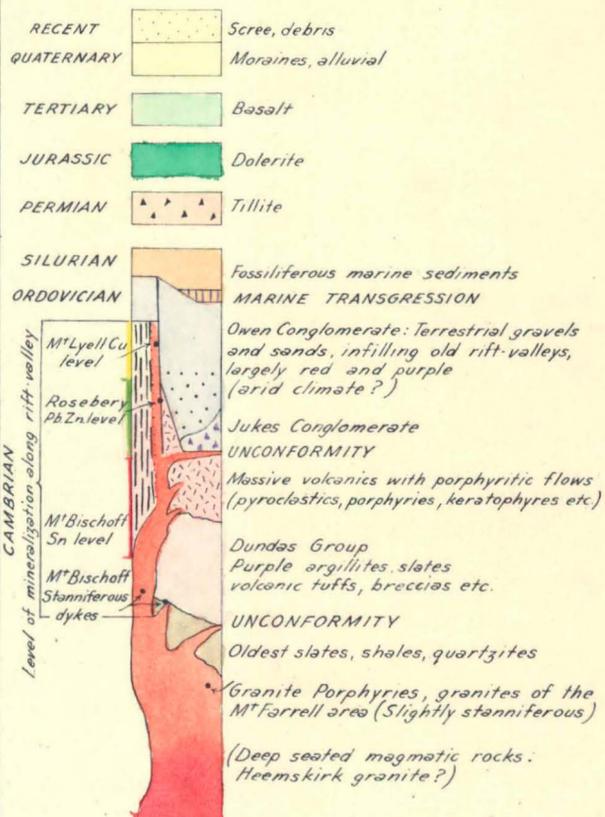
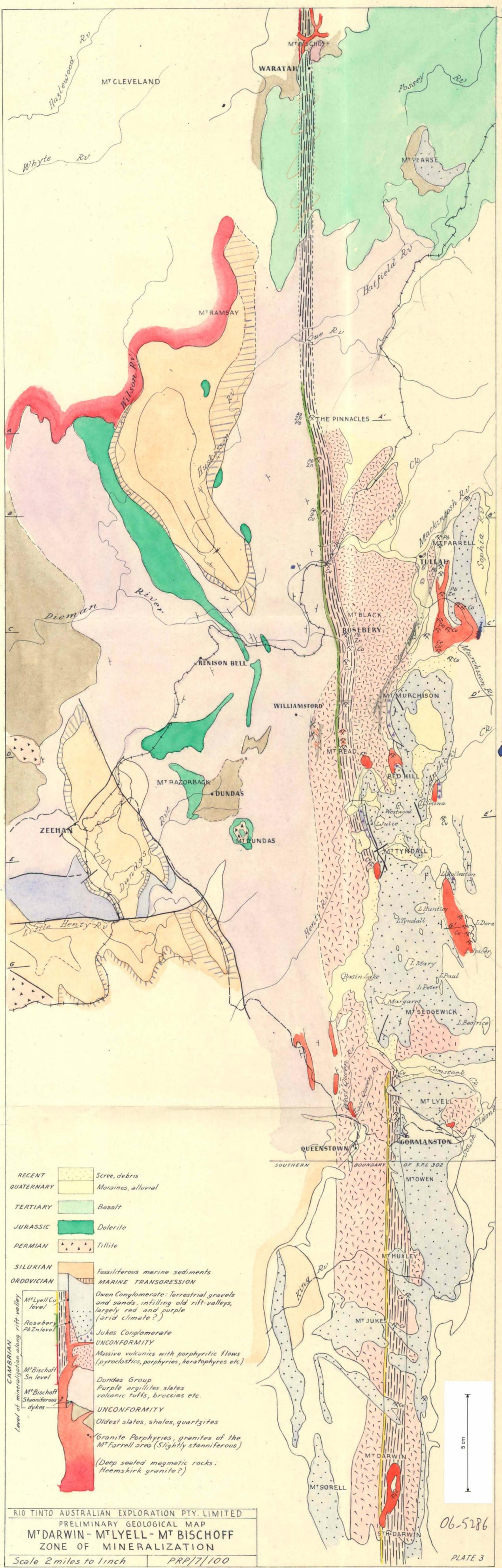


NOTE - Compiled from detailed geological mapping in the Mt Darwin-Mt Lyell-Mt Murchison area only. For other areas the map is based on documents obtained from the Tasmanian Dept. of Mines Hobart. These are either local mining plans and/or reports, broad reconnaissance traverses. Some critical zones within or adjoining R.T.A.E S.P.L.s have been left blank as geological data is scanty and contradictory.

06-5286

RIO TINTO AUSTRALIAN EXPLORATION PTY. LIMITED
**GENERAL GEOLOGICAL MAP of
 WESTERN TASMANIA**

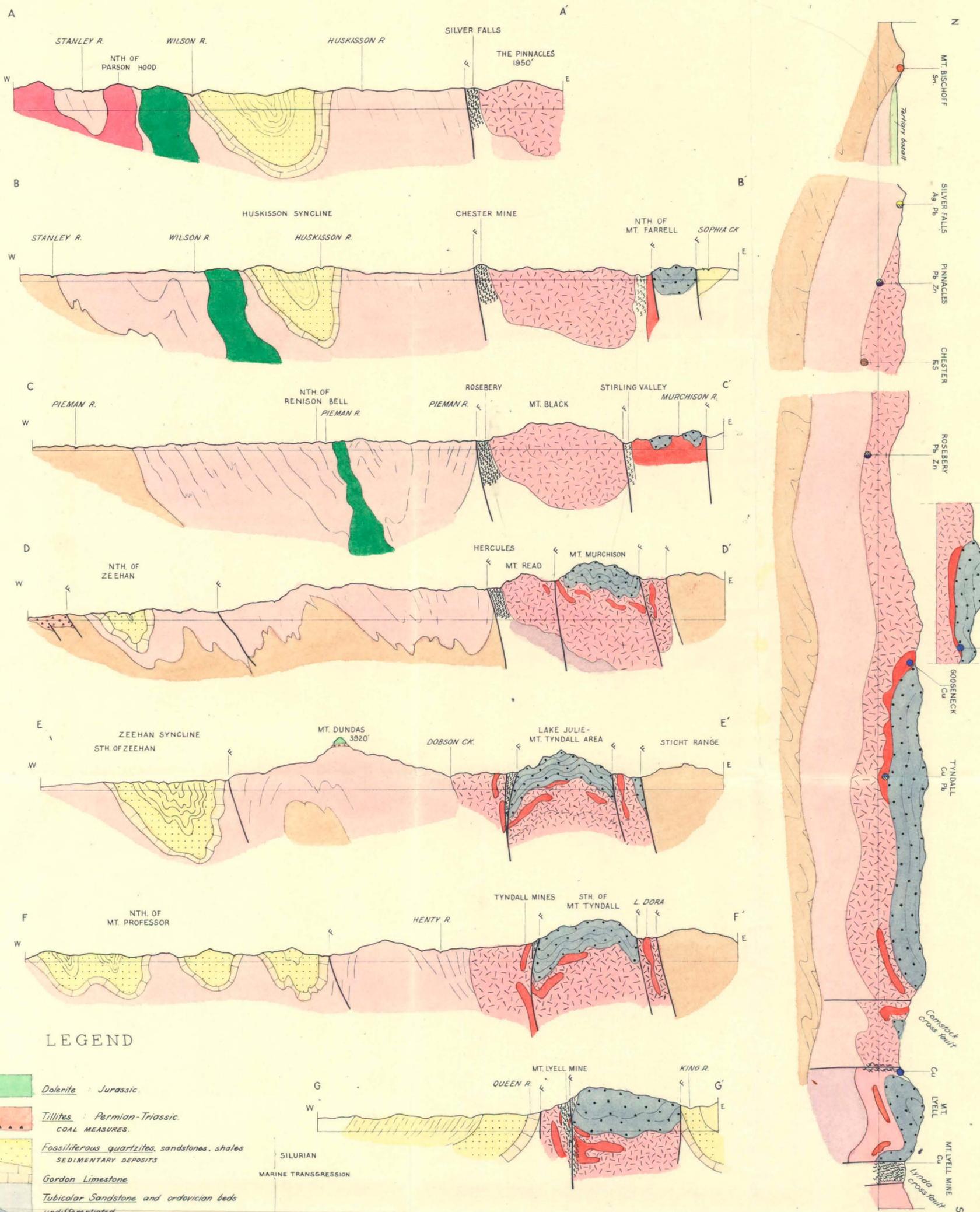
DATE Dec 1957	SCALE 8 miles to 1 inch
Geologist B. Campana	
Draftsman A.T.N.	Authority PRP/7/100 Plate 2



RIO TINTO AUSTRALIAN EXPLORATION PTY. LIMITED
 PRELIMINARY GEOLOGICAL MAP
M^tDARWIN - M^tLYELL - M^tBISCHOFF
 ZONE OF MINERALIZATION
 Scale 2 miles to 1 inch | PRP/7/100

06-5286
 PLATE 3
 7319

DIAGRAMMATIC LONGITUDINAL SECTION ALONG MT. LYELL - MT. BISCHOFF
SHOWING A REGIONAL RISE BRINGING THE BASEMENT ROCKS TO THE SURFACE



LEGEND

- Dolerite* : Jurassic.
- Tillites* : Permian-Triassic.
COAL MEASURES.
- Fossiliferous quartzites, sandstones, shales*
SEDIMENTARY DEPOSITS
- Gordon Limestone*
- Tubular Sandstone and ordovician beds*
undifferentiated.
- Owen Conglomerate* : coarse talus conglomerate
and quartzites infilling a fossil rift valley.
Jukes Breccia at its base.
STRATIGRAPHIC LEVEL OF MT LYELL COPPER LODES
- Massive pyroclastics and related extrusive and*
hypabyssal acid rocks (porphyries, felsites, keratophyres)
- STRATIGRAPHIC LEVEL OF ROSEBERY LEAD-ZINC BODIES
- Dundas Beds* : greywacke, slates, shales, argillites
with intercolations of tuffs and agglomerates.
STRATIGRAPHIC LEVEL OF MT BISCHOFF TIN BODIES
- Basal beds* : quartzites, shales, slates of
uncertain age, largely unmapped.
- Granites and granite porphyries of Mt Darwin*
and Tullah area and related acid rocks
of segmentation.
- Porphyries of uncertain age.*
Granite of uncertain age (tin, wolfram).
- Gabbro and serpentine of uncertain age (nickel, osmiridium).*
- Mineralised schists along the main rift valley fault*
of Mt Lyell - Rosebery.

SILURIAN
MARINE TRANSGRESSION

ORDOVICIAN

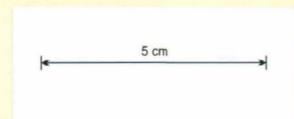
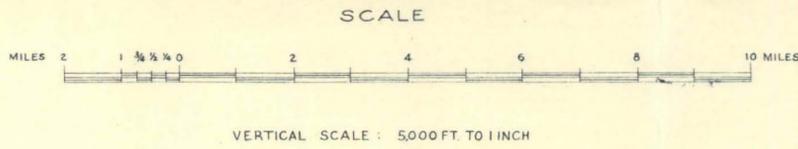
UNCONFORMITY

CAMBRIAN

UNCONFORMITY

LOWER CAMBRIAN
PROTEROZOIC?

CAMBRIAN



RIO TINTO AUSTRALIAN EXPLORATION PTY. LIMITED

GENERAL GEOLOGICAL SECTIONS
ACROSS THE
MT. LYELL - ROSEBERY ZONE 06-5286

Scale : 2 miles to 1 inch

Geologist B. Campana
Draftsman J.L.P.

P.R.P/7/100

PLATE 4
T 305

W

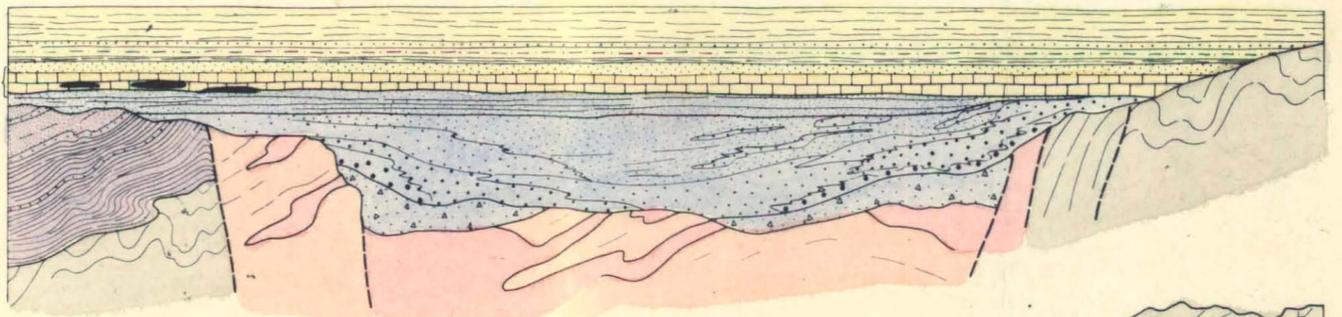
MT. DARWIN - MT. LYELL - MT. TYNDALL - MT. MURCHISON - MT. FARRELL RANGES

E

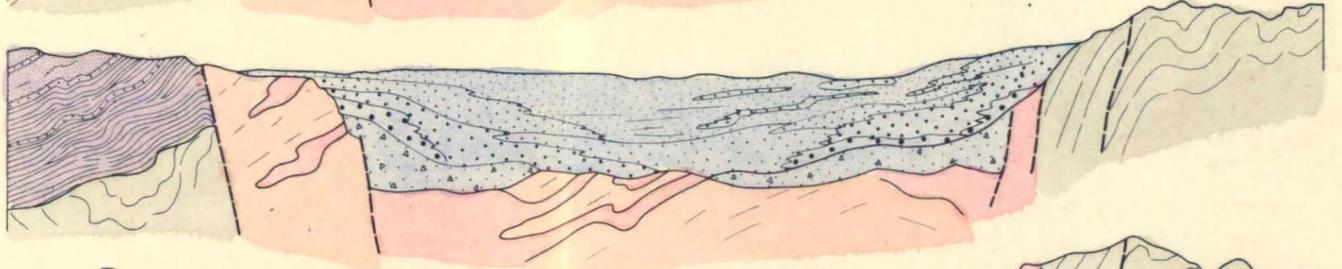
7. **DEVONIAN & POST DEVONIAN PHASES**
 Folding, faulting, uplift, erosion
 Devonian mineralization?



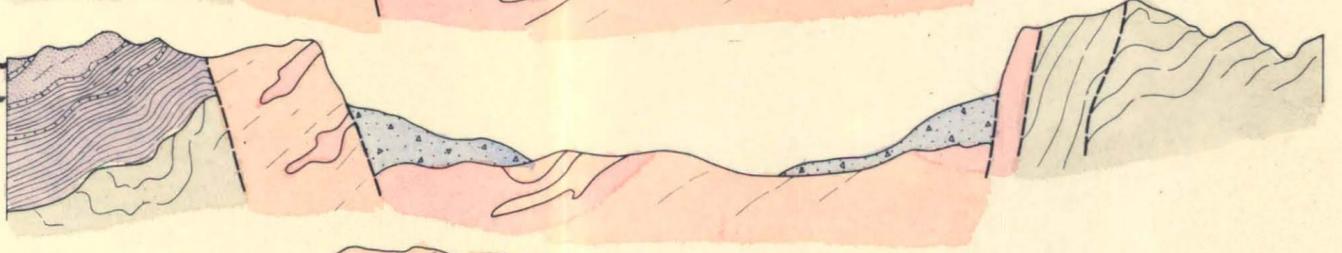
6. **SILURIAN PHASE**
 MARINE TRANSgression AND DEPOSITION OF RICHLY FOSSILIFEROUS BEDS
 Reworked Epigenetic deposits:
 Copper-clays at Mt Lyell. Lead at Oceana Mine?
 Copper carbonate in quartzite and shales



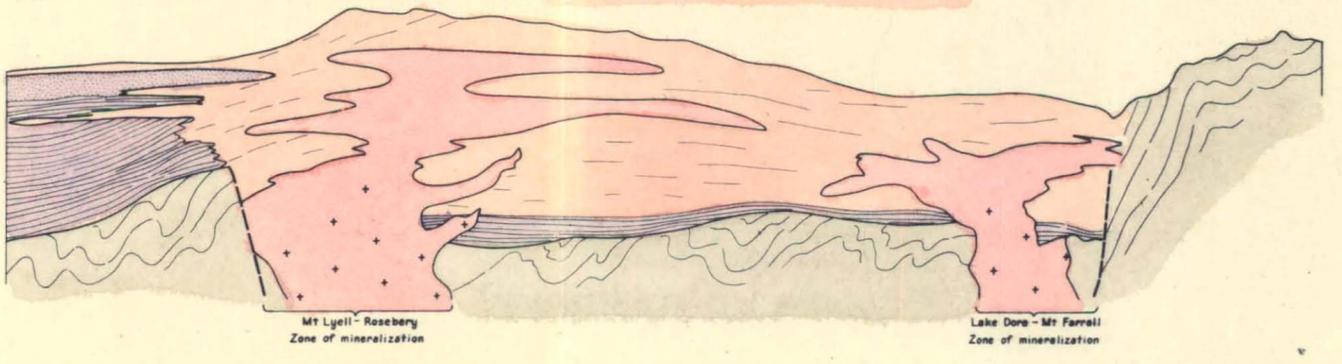
5. **ORDOVICIAN PHASE**
 INFILLING OF THE RIFT-VALLEY WITH COARSE GRAVEL AND SAND, POSSIBLY UNDER ARID CLIMATE (RED BEDS FACIES OF THE OWEN CONGLOMERATE)



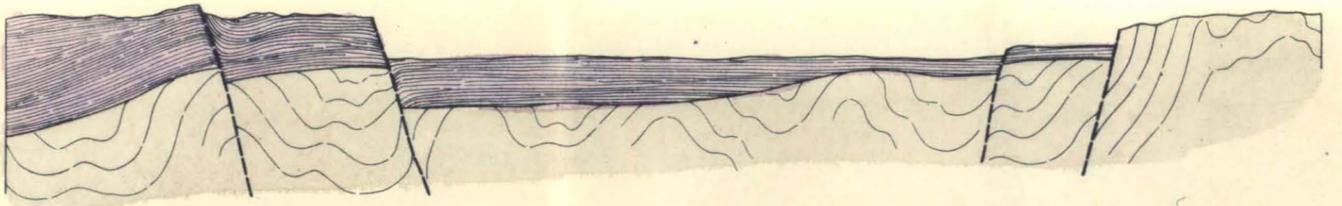
4. **LOWER ORDOVICIAN PHASE**
 FOLDING AND FAULTING PERIOD
 FORMATION OF THE "OWEN RIFT VALLEY"
 Deposition of the Jukes Breccia conglomerate
 Pelus breccias and conglomerate with abundant volcanic rocks as boulders & pebbles



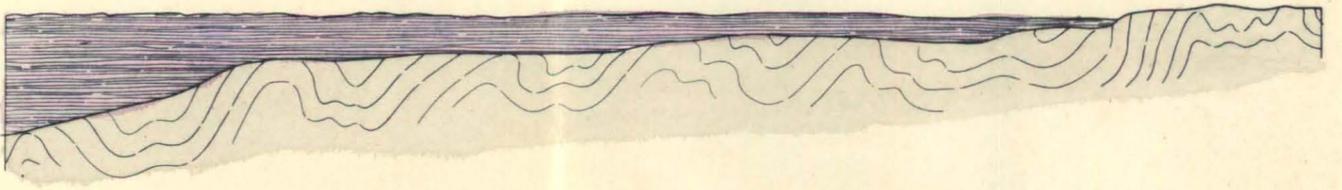
3. **MIDDLE TO UPPER CAMBRIAN PHASES**
 EARLY MINERALIZATION
 Repeated volcanic activity mainly along large marginal faults.
 Emplacement of copper-bearing porphyries, felsites, keratophyres as flows and hypabyssal bodies.
 Ejection of coarse pyroclastics and breccias near volcanic necks.
 Deposition of marine beds with intercalations of tuffs and ash-beds further afield, in the Dundas-Zeehan-Pisman areas.
 Deepening of the "Owen graben"



2. **MIDDLE CAMBRIAN PHASE**
 Large scale faulting, giving rise to the graben structure



1. **UPPER PRECAMBRIAN TO MIDDLE CAMBRIAN PHASES**
 Deposition of the basal Dundas beds (Argillites, slates, etc.)



GEOLOGICAL AGE

ROCK UNITS AND FACIES

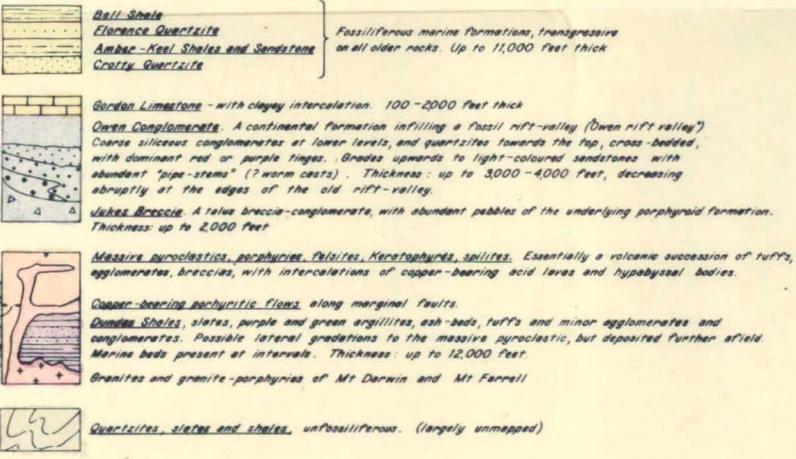
MINERALIZATION TYPE (Unrelated to Geological Age)

SILURIAN
(Eridon Group)

ORDOVICIAN
(Junee Group)

CAMBRIAN
(Dundas Group)

PRECAMBRIAN
(Carbine - Davey Group)



Fossiliferous marine formations, transgressive on all older rocks. Up to 11,000 feet thick

Epigenetic lead lode at Oceana Mine, Zeehan
Sedimentary copper-clays at Mt Lyell.

Sedimentary iron formations
Possible copper deposits at the base

Copper, zinc, lead and silver mineralization
Mt Darwin - Lyell - Lake Dore area

Silver, lead, zinc mineralization
Rosebery - Tullish area

Tin mineralization at Mt Bischoff and elsewhere



06-5286

RIO TINTO AUSTRALIAN EXPLORATION PTY. LIMITED

GEOLOGICAL EVOLUTION AND MINERALIZATION PHASES OF THE FOSSIL OWEN RIFT-VALLEY (WEST TASMANIA)

Geologist: B. Compans P.R.P./100 13-12-1957 Page 5