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RIO TINTO AUSTRALIAN EXPLORATION PTY LTD
MELBOURNE , AUSTRALIA

DISCOVERY OF AN ANCIENT MINERALISED RIFT-VALLEY IN WEST TASMANIA

by

B Campana

December 1957

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by

B. Campana

I INTRODUCTION

As instructed by the Managing Director of our Company, S.B. Dickinson, who investigated West Tasmanian mining fields in previous years, and introduced me into the geology of this area, I undertook the regional study of our West Tasmania property in March 1957 with a view to recognise the geological controls of the numerous mineral deposits occurring in it.

The work was continued in the winter season (June-December) with the assistance of D. King, resident geologist in Zeehan. The progress of field investigations was outlined in monthly reports to the Company, new data and new interpretations being regularly discussed at the Company Head Office and in the field, with the Managing Director and the Exploration Manager (Mr. R.S. Matheson).

The following work procedures were adopted:-

1. Perusal of the local geological literature and mining reports.
2. Selection of favourable areas for detailed stratigraphical, structural and mineralisation studies, using as a basis preliminary maps prepared from existing geological documents and by photo-geological methods.
3. Study of the geophysical data obtained by aerial magnetic and electro-magnetic surveys previously carried out by our Company.
4. Study of the geological controls of major ore-bodies within or outside the boundaries of our property, in

particular the Mt. Lyell, Rosebery, Hercules and Mt. Bischoff base-metals deposits.

5. Accurate geological mapping of selected areas, at the scale of 4 inches - 1 mile, using aerial photographs as a topographical basis.
6. Detailed investigations of stratigraphical and structural characteristics, igneous activity, and their relation with the emplacement of ore bodies.
7. Age, type, economic importance and possible extension of the mineral deposits.
8. Compilation of preliminary maps, sections, sketches and explanatory notes to guide mining and geophysical ground surveys.

In spite of the rugged, trackless, heavily timbered ground, and long periods of rain, the regional study has been most rewarding. Indeed the fundamental geological features controlling the mineralisation of the area have been recognised and integrated in what is thought to be a new, clear, and factual geological frame. The conclusions reached so far are illustrated by plates I -XVII. Except for plates 6 and 8 these illustrations are entirely based on the work carried out "ab novo" in the past nine months. The following explanatory text is not intended as a final geological report, but merely as a preliminary note to assist the future operations of our company in West Tasmania. The economic aspects involved will be dealt with by the Managing Director in a separate report.

11 THE ROCK UNITS AND THEIR MINERALIZATION PHENOMENA

The most important result of our regional investigations in West Tasmania is no doubt the discovery that the geology and the mineralisation of this area are largely controlled by deep-seated lines of weakness directed north-south; that these lines of weakness gave rise to very ancient rift-valleys (graben) bounded by major marginal faults; and that these faults acted as channels through which igneous rocks and mineralised solutions reached the upper layers of the geological column.

To demonstrate this a brief outline of the West Tasmania rocks succession is necessary.

The major rock units of West-Tasmania are illustrated by plates I - V and their general distribution by the attached geological maps. From the top to the bottom of the exposed rock sequence is as follows:-

1. Quaternary:
   Alluvial, screes and morainic deposits, up to 150 feet thick. Sedimentary mineral deposits in form of placers.
2. Tertiary:
   Basaltic flows, up to several hundreds feet in thickness. Not mineralised.
3. Jurassic:
   Dolerite flows and sills up to 1600 feet thick. Not mineralised.
4. Permo-Carboniferous:
   In the region studied so far by the writer this period is represented by small inliers of tillite deposits, remnants of what must have been a glacial blanket covering the whole area and largely eroded since. Elsewhere in the north, and easterly of our property, the Permo-Carboniferous beds are thicker, more continuous and lithologically more complex, and contain layers of coal and oil shales.
5. Devonian:
   Large granitic and basic bodies are attributed to this period by previous investigators. The age of these rocks, which are certainly responsible for widespread mineralisation phenomena, is under review.
6. Silurian:
   An alternation of sandstones and shales, up to 10,000 feet thick, is well dated as Silurian by abundant fossil remains. This sequence is distinctly transgressive over all the older rock types. The Silurian marine transgression must

have covered a large portion of West Tasmania, but the related deposits have been deeply eroded since, and are found now as local sinclinal inliers in deeply folded or faulted zones.

In the area studied by us these formations are neither mineralised nor metamorphosed or intruded by igneous rocks; but it is possible that they contain sedimentary concentrations of minerals, derived from pre-existing deposits.

7. Ordovician:

Two distinctive and important formations of the West Tasmania geological sequence are considered Ordovician in age.

The upper formation is the Gordon Limestone, a fossiliferous marine deposit of variable thickness, which contains in the Zeehan area economic deposits of lead. These were considered by previous investigators as hydrothermal in origin and attributed to a Devonian metallogenic epoch. There are, however, evidences pointing out an epigenetic origin for these deposits, which would possibly represent in-fillings of limestone cavities and fissures by ascending or descending atmospheric waters. If this is correct, the age of many mineralisation phenomena within our property would have to be revised, and important implications would follow for future prospecting operations in the Zeehan area.

The lower member of the Ordovician sequence is the Owen Conglomerate, the most conspicuous formation of the West Tasmania coast. It forms the rugged and bare chain of mountain which extends 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 attracted the attention of the early geologists and prospectors for numerous mineral deposits occur all over the chain just beneath its contact with the underlying beds. At the base, this formation consists of greywacke-breccia ("Jukes Breccia"), which is overlain by siliceous, coarse and massive light coloured conglomerates. These merge upwards into pink and purple quartzites, succeeded by light-coloured sandstones and shales.

The lithology (Plate X - XI) the dominant red and purple tinge, the crude stratification, and the general occurrence of cross-bedded and slump-structures, leave no doubt that the Owen Conglomerate is a continental formation, and not a marine deposit as interpreted by previous students. This is clearly confirmed by the peculiar distribution and by the lateral changes in thickness of the formation, which can be followed along its north-southern strike for more than 40 miles, although across the strike it extends only for 3 miles or less. Another most striking feature is the sudden change which takes place at the edges of this formation, where the thickness abruptly decreases from 4,000 feet to nil (Plate VI).

Finally, every attempt made, so far, to explain satisfactorily the puzzling contact of the Owen Conglomerate with the underlying rocks has failed, for this contact could not be interpreted as a normal stratigraphic feature, nor could it be entirely attributed to faulting (Plate XII).

After several months of field researches, it became clear to the writer that the mineralisation phenomena of the area occupied by the conglomerate, the facies of this formation, its distribution, its thickness, and its contact with the underlying beds could only be satisfactorily explained by postulating that the Owen Conglomerate is in fact the gravelly and sandy infilling of an older mineralised rift-valley.

The economic significance and the geological implications of this discovery will be discussed below.

It may be added here that, within our property at least, the Owen Conglomerate has not been found affected by hydrothermal mineralisation. However, it contains iron-rich beds of unquestionable sedimentary origin, so that one cannot rule out the possibility of finding valuable mineral concentrations in it.

8. Cambrian:

The Cambrian beds of our property are particularly important, for they contain all the major ore bodies of West Tasmania. They are known as the Dundas Group. On the basis of local sections, these beds have been subdivided by previous students in numerous stratigraphical units, often named and renamed in a redundant and confusing manner. However, as these units have not been regionally mapped, they are of little use for the purposes of our investigations. With regard to their facies and mineralisation characteristics, the writer has distinguished and mapped, to begin with, two major Cambrian sequences - the "Massive pyroclastics" of the Queenstown-Rosebery area, and the "Bedded fossiliferous sequence" of the Dundas-Zeehan zone (Plate XVI).

(a) The "Massive phroclastics" and related porphyries.

This unit is essentially a volcanic assemblage consisting of lavas, tuffs, volcanic breccias and minor slaty bands, which is considered by the writer as younger than the basal beds of the fossiliferous Dundas sequence (Plate V). The "Massive pyroclastics", which locally reach 10,000 feet in thickness, flank, all over the area, the western and also the eastern edges of the Owen Conglomerate. As they are abundantly represented as pebbles in the basal beds of this Conglomerate ("Jukes Breccia horizon") their emplacement pre-dates the rift-valley infilling, from which they are separated by an angular unconformity. The "Massive pyroclastics" are the products of repeated volcanic ejections along the Cambrian rift-valley and they include, at certain levels, large bodies of quartz porphyries, quartz-felspar porphyries and felsites, emplaced as large rhyolitic flows and locally as hypabissal bodies. Numerous mineral deposits of the replacement type, among which the large ore bodies of Mt. Lyell, are associated with the porphyritic rocks from Mt. Darwin to the latitude of the Pinnacles, over a distance of about 40 miles (Plate I - IV). In the Rosebery area, the massive pyroclastic form the hanging wall of the lead-zinc ore bodies worked at Rosebery and at the Hercules Mines, while further to the north, these rocks contain large sulphide lenses at Mt. Chester and Pinnacles Mines. Thus the "Massive pyroclastics", and in particular their porphyritic members, form one of the most important units of our property, for the copper deposits and the lead-zinc deposits of Mt. Lyell-Rosebery area are associated with rocks of these unit.

(b) The bedded formations of the Dundas Group.

West of the "Massive pyroclastics" belt there are varicoloured argillites, black slates, shales, with layers of agglomerates, tuffs and ashbeds, which contain at various levels, fossils of Middle Cambrian and Upper Cambrian age (Ptychagnostus gibbus and Glyptagnostus reticulatus zones).

The basal portions of these formations are, in the writer's views, older than the "Massive pyroclastics". But at higher levels the agglomerate and tuffaceous members are thought to derive from finer volcanic ejectamenta of the volcanic phases which brought about the "Massive pyroclastics" and would therefore be coeval with these (Plate V).

The formation of the Dundas Group are mineralised over large areas of our property. In particular, they contain many of the lead and silver deposits of the Zeehan and Dundas field, as well as the tin deposits of the Dundas - Renison Bell area; but most of these deposits are fissure infillings, often showing a high-grade but a limited tonnage. As these deposits appear of subordinate interest for our Company, the bedded formations of the Dundas Group have not been regionally investigated by us.

9. Upper Precambrian (?):
Underlying the Cambrian beds, and separated from them by an angular unconformity, there are a succession of slates, shales, quartzites and schists which occupy large zones in the western and eastern parts of our property. Except for the Mt. Bischoff area these formations have not been, so far, investigated by the writer, although mineral deposits are known to occur in them. They are unfossiliferous, although largely unaltered, and it is thus inferred that they range from Upper Precambrian to Lower Cambrian in age.

III THE FOSSIL RIFT-VALLEY OF MT. OWEN - MT. MURCHISON

We have pointed out in the preceding paragraph that the most conspicuous geological formation of West Tasmania, the Owen Conglomerate, represents the terrestrial infilling of an old graben to which we shall refer as the "Owen rift-valley". The Owen rift-valley came about by large-scale faulting in Cambrian time, and was followed by an intense volcanic activity and mineralisation along its marginal faults. Reference can now be made to the extension of these faults, to the type and age of the mineral deposits controlled by them, and to the future prospecting operations along their runs.

A. The Western edge of the Owen rift-valley: the mineralised fault of Mt. Darwin - Mt. Lyell - Rosebery - Mt. Bischoff.

The western edge of the Mt. Owen-Mt. Murchison rift-valley is the Mt. Darwin-Mt.Lyell-Mt. Bischoff fault line, believed to be one of the greatest mineralised structures discovered so far in the world.[2] It strikes straightly in a northern direction from Nye Bay to Mt. Bischoff at least, over a distance of 110 miles, bringing in mechanical contact all the above described formations, from the Precambrian to the Silurian (see maps, sections, Plates I, IV, VII, VIII, XII, XIII, XVI, XVII).

The width of the mineralised fault line is of the order of ½ mile and all the major ore bodies discovered so far in West Tasmania, as well as numerous other deposits of less importance, lie on it.

Levels of mineralisation and major ore bodies

The attached geological maps (Plates I - III) and sections (Plates IV) illustrate an important feature of the Mt. Darwin - Mt. Bischoff line of mineralisation. Owing to a northern axial rise of the chain, erosion has exposed, from south to north, older and older rocks.

Correspondingly, the mineralised fault intersects deeper and deeper geological levels, each level being broadly characterised by a different mineralisation type. One can truly speak of a large-scale vertical distribution of ore deposits, brought near the surface by tilting and planation of the country after their deposition.

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

From south to north, the mineralised fault is first marked by the Mt. Darwin - Mt. Lyell - Mt. Tyndall copper zone, 30 miles long and confined to a narrow fringe of the "Massive pyroclastics" formation at the base of the Owen Conglomerate. The more important ore bodies occur as large, irregular masses of cupriferous pyrites along or near the fault plane (Plate VIII, XII). They undoubtedly represent replacement bodies which are, in the writer's opinion, genetically related to the emplacement of the porphyries. Our Managing Director, independently reached the same conclusions many years ago while studying the Mt. Lyell field; and in the course of the past month I observed a general association of quartz and quartz-felspar porphyries with the disseminated copper deposits at Red Hill and Lake Dora, within the same porphyritic belt (Plates III, IV). Bornite and chalcopyrite, are the main copper minerals, while fine-grained pyrite is always present, either in massive lenses or sparsely disseminated over wide zones of schists.

The paragenetic assemblage, the mode of occurrence, the rock-minerals relations and the magnitude of these copper deposits closely recall the Rio Tinto ore bodies in Spain. It is thus suggested they belong to a comparable class.

From the south to the north the copper level is marked by the following mining fields or ore bodies :-

The Mt. Jukes - Mt. Darwin Mining field. This is essentially characterised by copper minerals, with minor amount of silver and gold, associated with magnetite and hematite. The copper occurrences are strictly confined to porphyries (and granite-porphyries) of the "Massive pyroclastics" succession, at the base of the Owen Conglomerate (Plate III).

The Mt. Lyell Mining Field. Nine major copper ore bodies have been discovered in this area in the course of the past fifty years, which produced so far 40 million tons of copper ore. Their reserves are of the order of plus 45 million tons. As a rule these bodies are also associated with porphyritic members of the "Massive pyroclastics", along the west edge of Owen Conglomerate (Plates III, VIII).

The Comstock Mines. Situated at the southern boundary of our property, these mines also characterised by copper mineralisation which occurs, like the preceding deposits, in schisted porphyroid rocks, near their contact with the Owen Conglomerate (Plates III, VII).
North of Comstock the line of mineralisation is largely covered by moraines (Plate XIV) but the copper level is again exposed at the latitude of Mt. Tyndall, 9 miles to the north.

The Tyndall and Gooseneck deposits, in the southern portion of our property, which contain copper, lead and zinc and are confined to porphyritic rocks and felsites underlying the Owen Conglomerate. Owing to a northern axial rise of the structures, this formation strikes into the air 3 miles north of the Tyndall deposits, at the latitude of Gooseneck, where other copper deposits occur, in identical geological conditions. Thus the mineralised fault plane intersects, north of the Tyndall-Gooseneck area, older formations and deeper levels of mineralisation.

(b) The Lead-zinc level (Mt. Read-Rosebery-Pinnacles zone). At the latitude of Mt. Read the fault plane first intersects the lower beds of the "massive pyroclastics" and then the base of this formation in the Rosebery-Pinnacles area (Plates III, IV). At these levels, the copper mineralisation of the Mt. Lyell - Mt. Tyndall zone gives gradually way to a zone of lead and zinc mineralisation, which can be traced along the fault line for 15 miles. It includes the high-grade deposits of Rosebery and Hercules Mines, and also those of Mt. Read and Pinnacles Mines, of lower metal content. Galena and sphalerite are usually associated with pyrites in large replacement lenses, much similar in shape and mode occurrence to the copper ore bodies of Mt. Lyell. The fine-grained pyritic gangue of Mt. Lyell is again found in the Rosebery zone, forming sometimes huge massive deposits, as for instance at Chester Mine. Minor amounts of copper minerals are always present, thus stressing even more the fundamental unity of this line of mineralisation.

The Mt. Read Mine, not studied as yet by the writer, has been prospected by shallow works at the beginning of the century. W.H. Twelvetrees, an outstanding observer and former Government Geologist, describes the Mt. Read ore body as "a huge", (but low-grade) "lenticulat mass of zincy lead-copper sulphide, between 800 and 900 feet in length, the greatest width at the surface being 83 feet".

The Rosebery-Hercules Mines Plate XVI) has produced, to date, about 2,500,000 tons of ore, averaging 6% lead, 20% zinc, 0.5% copper, 7 oz. per ton of silver and 2 dwt. per ton of gold. The reserves of this mine appears to be at least as great.

The Chester Mine, with a large pyrite ore body, was worked from 1909 to 1913. The proved reserves are of the order of 2,800,000 tons.

The Pinnacles Mines, not studied by us, has been described by A. McIntosh, former Government Geologist, as showing "encouraging lodes... whose most striking features are their width and continuity". Petrologically, the zinc-lead-copper ore is much similar to that of Rosebery sulphide bodies, although its grade has been found lower and irregular.

(c) The tin level (Mt. Bischoff zone)

North of the Pinnacles mines, and up to the latitude of Mt. Bischoff, the stretch of country intersected by the Mt. Lyell - Rosebery fault has not yet been studied, or even recognised, by ground surveys. A recent aerial reconnaissance carried out by the writer has shown that this portion of the mineralised line is covered, over a length of about 10 miles, by a sub-horizontal sheet of Tertiary basalt, 300-500 feet thick; the remaining part, about 12 miles in length, is entirely masked by thick myrtle forests, scrubs and deep soil blankets.

The mineralised fault reappears, however, at Waratah, (Plates III, IV), where it brings in contact purple and green argillites of the Dundas Group with slates and quartzites of the Upper Precambrian sequence (Plate XVII). At this lowest stratigraphic level, the lead-zinc mineralisation is succeeded by tin mineralisation undoubtedly

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brought about the <u>tin-bearing porphyries of Mt. Bischoff</u>, ½ mile north of Waratah.

These conspicuous porphyry bodies intersect the sediment strike at any angle, forming vertical dykes up to 150' thick and over 2 miles in length. They contain at intervals disseminated grains of cassiterite in association with pyrrhotite; but as a rule their grade is too low to be economic. The Mt. Bischoff production consisting of 5,500,000 tons of ore and 50,000 tons of metallic tin, has been almost entirely won from a highly mineralised dolomitic bed, which contained in places massive lenses of almost pure cassiterite.

The origin of this extraordinary tin deposit gave rise to various and controversial interpretations. Early students assumed that the deposit was due to replacement of dolomitised basic rocks by tin-bearing solutions. More recently, it has been suggested that these solutions replaced a layer of sedimentary dolomite of the Precambrian sequence. However, none of these views is entirely satisfactory, for on the one hand the dolomitic bed appears in fact to be sedimentary in origin; but on the other hand this bed seems younger than the country rocks in which it occurs, which show angular relations with the dolomite. I am therefore inclined to believe that the major cassiterite body at Mt. Bischoff is epigenetic, the enrichment being brought about by sedimentary concentrations.[2] It would possibly represent a fossil "placer", derived from the destruction "in situ" of the local stanniferous porphyries(and related fissure veins).

If our views are correct the future search for tin in this area would have to be based on criteria quite different from those followed in the past. Indeed it is probable that the mineralised fault line continues to the north, beyond the Waratah River, in the geologically unknown and densely timbered area comprised between Mt. Bischoff and the head of Arthur River.

B. The eastern edge of the Owen rift-valley: the mineralised fault of Lake Dora - Mt. Farrell.

The eastern edge of the Owen rift-valley is largely masked by soil and alluvial deposits as far as the latitude of Lake Dora. North of Lake Dora the eastern rift-valley edge is well exposed, over a distance of 15 miles, up to Mt. Farrell. Abnormal contacts between the volcanic "Massive pyroclastics" formation and the Owen Conglomerate mark again the bounding fault line. Along this line widespread mineralisation phenomena occur in conditions quite similar ro those of the Mt. Darwin - Mt. Lyell - Rosebery zone.

Again, from south to north, the regional levels of mineralisation described above progressively crop out.

At Lake Dora, in the south, the copper level is marked by low-grade mineralisation, associated with large porphyritic flows, near the contact of the Owen Conglomerate. The structure of this copper belt, which runs for 3 - 4 miles from Lake Dora to Lake Selina, is little known, and its mineral deposits are practically unexplored in depth. A reconnaissance study carried out by the writer has clearly shown that the rocks-minerals association, the mode of occurrence and the panagenetic assemblage are identical to those of the Mt. Darwin - Mt. Tyndall copper belt.

North of Lake Selina, in the wild and almost impenetrable tract of country comprised between Anthony River and Murchison River, the copper mineralisation is gradually succeeded by the lead-silver level, worked in the Mt. Farrell area since the beginning of this century.

The Mt. Farrell Mines have produced, to date, 631,000 tons of ore, from which 80,000 tons of lead and 8,630,000 oz of silver have been recovered.

IV OTHER MINERALISED RIFT-VALLEY SYSTEMS, OUTSIDE OUR PROPERTY.

The discovery of the Owen rift-valley, threw our attention on the structural and mineralisation setting of the area which stretches from Prion Bay to Black Bluff and Burnie, along the eastern edge of the "east Precambrian bloc" (Plates I, II). This area lies entirely outside our property, so that no field studies have been carried out by us there. However, some features described in published Government maps and papers lead us to believe that another major graben structure runs from Prion Bay, in the south, to Black Bluff - and possibly up to the Burnie area - in the north, which we shall refer to as the "Adamsfield rift-valley".

The existence of this rift-valley is suggested by the following data:

1. A long and narrow "corridor" of Cambrian, Ordovician and Silurian rocks is found ~~in~~ along the southern run of this structure, striking north-south (Plate I and II). A band of coarse Owen Conglomerate marks the possible course of the old rift-valley north of Adamsfield and at Prion Bay.

   In the northern portion of the graben, up to the latitude of Black Bluff, the Cambro-Silurian formations, if present, would be masked by the Permian beds which cover there the bottom of the "corridor".

2. As shown by Plate I, the contact between the Dolerite Plateau of East Tasmania and the "east Precambrian bloc" generally lies along the eastern edge of the inferred "Adamsfield rift-valley". There is little doubt in my mind that this feature reflects ancient deep-seated line of weakness, which was intermittently active from the Cambrian to post-Jurassic times.

3. The following major zones of mineralisation are found along this line:-

   (a) The osmiridium deposits at Adamsfield, discovered in 1925, associated with ultra-basic rocks which flank the Owen Conglomerate. They contain iridium, osmium, ruthenium, platinum, rhodium, palladium, gold and chromite.

(b) The Mt. Pelion mining fields, with cassiterite, chalcopyrite, galena, gold, sphalerite and wolfram, associated with quartz-felspar porphyries and felsites of the porphyroidal series. A. McIntosh, former Government Geologist, describes the copper lodes as "enormous low-grade copper-bearing ore-bodies" and mentions the following copper contents: 0.16%, 0.40%, 0.10%, 2.32%, 1.65% Cu.

These deposits are no doubt of the same class as the Lake Dora - Red Hill ore bodies described above.

(c) The Moina - Lorinna tin field, with tin, tungsten, bismuth and molybdenum mineralisation.

(d) The Mt. Claude silver-lead field, with galena - chalcopyrite - sphalerite mineralisation.

4. Further to the north, along the same general strike, are the Penguin - Dial Ranges mineral deposits, some of which at least occur in analogous conditions as those of the Mt. Darwin - Mt. Lyell fault line - i.e., at the base of the Owen Conglomerate, in rocks of volcanic facies.

From these various lines of evidences, and pending further field investigations we conclude that other rift-valley faults must occur in the areas adjoining our property to the west, which are geologically unmapped.

It is thus suggested that our Company applies for another "special prospecting licence" as indicated by Plates I and II.

B. Campana.

B. Campana,
Senior Geologist.

31st December, 1957.

Drawn and reproduced by the Department of Lands and Surveys, Mapping Branch, Hobart.

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Plate 1

ELECTRICITY AND WATER RESOURCES

Tasmania possesses more than half hydro-electric power potential of Commonwealth of Australia. Constant expansion and development of water storage and hydro-electric power.

The total installed capacity of the present eight hydro-electric power stations is:

Turbines—545,200 h.p.

Generators—391,700 k.w.

Important secondary industries based on cheap hydro-electric power.

PRESENT DEVELOPMENT—

Tasmania possesses more than half of the hydro-electric power potential of the Commonwealth. The commencement of hydro-electric development in Australia dates from 1895 when the municipal council of the city of Launceston, Tasmania, made use of the waters of the South Esk River to generate 600 h.p. at its power station at Duck Reach. The capacity of the station was increased to 1,600 h.p. in 1905 and 2,600 h.p. in 1919. The undertaking was acquired by the Hydro-Electric Commission on behalf of the State, in 1944, and will continue contributing to the system output until the Trevallyn scheme commences operation in June, 1955.

In 1911 the Hydro-Electric Power and Metallurgical Company built a small dam at the outlet from Great Lake to control the flow of water to Waddamana, where it was intended to generate 10,000 h.p. In October, 1914, the assets of the Company were purchased by the State Government and placed under the direction of the Hydro-Electric Department which, in 1930, became the Hydro-Electric Commission. By May, 1916, two (2) 5,000 h.p. turbo-alternators had been installed at Waddamana and generated power for treatment of complex ores, domestic lighting and tramway operation in Hobart. A programme of construction was begun in 1919 for the installation of further power plant to increase the capacity to 65,800 h.p. This utilises an average flow of approx. 610 cubic feet of water per second (330 million gallons per day) and a fall of 1,120 feet.

To supply power to its mine the Mt. Lyell Mining and Railway Company completed in 1914 a hydro-electric power station at Lake Margaret, and by 1924 surplus power from this source was made available for domestic use in the town of Queenstown. In recent years the demand for electricity at Queenstown has increased and the Hydro-Electric Commission now supplies part of the power required by the mine and all of the power used in the town.

Water flowing from the Great Lake drops some 300 feet from the Lake to the intake of the Waddamana Canal. By 1934 a power station had been built at Shannon to utilise 258 feet of this fall. The installed capacity at this Station is 14,500 h.p.

A second power station has since been constructed at Waddamana "B". Its capacity is 66,800 h.p. making a total of 132,600 h.p. installed capacity at Waddamana.

The next development (1938) was the Tarraleah Power Development in which water is diverted from the Derwent River by a canal system to the Tarraleah power station.

Since the completion of the Clark Dam at Butler's Gorge, a short distance above the intake to the Tarraleah canal, some 900 cubic feet of water per second, (485 million gallons per day) pass continuously through a power station at the foot of the dam where the installed capacity is 17,100 h.p. It then passes to the Tarraleah power station where 126,000 h.p. is installed under a static head of 981 feet. A second canal carries to Tarraleah a further 300 cubic feet of water a second (160 million gallons per day) from the storage behind Clark Dam.

The waters of the Nive River were the next to be utilised (1953). By the construction of a dam at Pine Tier, the waters are diverted through a canal and thence through a series of small lakes (formerly marshes) which provide storage as well as acting as a conduit. The water then passes to Tungatinah power station where the installed capacity is 175,000 h.p. and the static head 1,005 feet. Water from Lake Echo will be conveyed by canal and pipeline to Lake Echo Power station (under construction) on the River Dee where a 45,000 h.p. turbine will be installed. The static head at this station will be 567 feet. The water will then pass through a tunnel into the Tungatinah scheme. The large storage to be created by damming Lake Echo will ensure continuity of operation of the Tungatinah Station.

The Trevallyn power development is the first to have been undertaken by the Hydro-Electric Commission outside the Central Plateau region. In this scheme the waters of the South Esk River are diverted by a dam through two miles of tunnel and pipeline to Trevallyn power station on the Tamar River near Launceston. This station came into operation during 1955 and has an installed capacity of 112,000 h.p. with a static head of 415 feet.

The latest power development to be undertaken is the Wayatinah scheme where the available head will be developed at two power stations. These stations will, in turn, utilise all the water discharged by the Tarraleah and Tungatinah power stations, together with natural flows in the river. The water will be led by means of a tunnel four miles long to Wayatinah "A" Station where the installed capacity will be 117,000 h.p. and the static head 369 feet. A dam being constructed below the site of the "A" Station will then divert the water through two miles of tunnel and pipeline to Wayatinah "B" where 66,000 h.p. will be installed with a static head of 200 feet. The lower station, Wayatinah "B", is being constructed first.

Below Wayatinah "A" and "B" further development appears practicable and intensive investigations are now in progress. Concurrently investigations are nearing completion on a scheme to divert the waters of the Great Lake in a northerly direction where a gross head of approximately 2,700 feet is available compared with 1,125 feet at Waddamana. The estimated installed capacity would be about 500,000 h.p. and the average output 200,000 h.p.

FUTURE RESOURCES—

The proposals summarised below have been prepared on the information at present available. They are tentative only and subject to amendment at any time as more information becomes available. Industrial expansion and hence location of power requirements as well as actual cost of construction may influence the order in which the various schemes will be developed.

NORTH-WESTERN REGION—

The rivers in this region, in general, rise in areas of heavy rainfall, and therefore possess a high power potential. It is unfortunate that the terrain is so divided that each river drains a relatively small catchment area. Each falls rapidly in its course to the sea and storage could only be obtained by the erection of costly dams. Possible sites for power development have been selected and investigations are proceeding to determine the relative economy of the various schemes. The total power resources can be outlined as:—

Mersey-Forth-Wilmot Rivers:

Estimated output 240,000 h.p. with an installed capacity of 420,000 h.p.

Arthur-Emu-Leven Rivers:

These three rivers are each capable of providing relatively small quantities of power of the order of 13,000—20,000 h.p.

NORTHERN REGION—

The only major development is the Trevallyn Power Development which is due for completion mid 1955.

WESTERN REGION—

The water resources of this region are embraced in the catchment areas of the Pieman, King, Franklin and Gordon Rivers. Some investigation has been made of a scheme to utilise the waters of the King River with an estimated average capacity of 65,000 h.p. River flow records are being collected and tentative investigations show that other major developments are possible on the Pieman, Franklin and Gordon Rivers.

The Pieman River carries a great volume of water and the average output available is estimated to be about 240,000 h.p.

MIDLANDS REGION—

Hydro-electric power development is confined to the Central Plateau which occupies the western portion of the region. This area includes the existing power stations at Waddamana, Shannon, Tarraleah, Butler's Gorge and Tungatinah, together with Lake Echo, Wayatinah "A" and Wayatinah "B" which are under construction. Other possible developments exist on the Derwent below Wayatinah and on the Florentine River.

Development of the Arthur Lakes by pumping water into Great Lake is envisaged as part of the Great Lake North scheme.

SOUTH-EASTERN REGION—

There is a very low power potential in this area due to low rainfall and few mountains.

SOUTHERN REGION—

The main river in this region is the Huon River. Two sites are available for the construction of dams for major developments. Flow records have been collected for many years above Judbury, and further hydrological data is being collected. Surveys have been made and investigations are proceeding. The Huon River offers possibilities for development of a low head scheme, with an estimated average capacity of 55,000 h.p.

Government Film Unit

Aerial view of Lake King William and Clark Dam.

57-181


SMITHTON
BURNIE
DEVONPORT
Arthur R.
PENGUIN-DIAL RANGE MINERAL FIELD
Pb Cu
MOINA-LORINNA TIN FIELD
Sn Wo
MT. CLAUDE
Forth R.
MT. PELION NTH. MINING FIELD
Pb Ag
MT. PELION STH. MINING FIELD
Cu
Mt BISCHOFF MINES
1874-1928 production
5,500,000 tons ore
54,000 tons metallic tin
Bischoff
WARATAH
Pieman River
ROSEBERY-HERCULES MINES
1900-1953 production
2,200,000 tons of ore with
6% Pb, 20% Zn, 0.5% Cu per ton
ROSEBERY
RENISON BELL
ZEEHAN
DUNDAS
Mt LYELL MINES
1896-1956 production
40,000,000 tons of ore
574,000 tons metallic copper
18,000,000 ozs of Silver 680,000 ozs of Gold
Henty R.
QUEENSTOWN
GORMANSTON
STRAHAN
King R.
Derwent R.
Gordon R.
ADAMSFIELD
NYE BAY
Huon R.
PRION BAY
BASALT - TERTIARY
DOLERITE - JURASSIC
TILLITES - PERMIAN-TRIAS
Coal Measures
Fossiliferous quartzites, sandstones shales Sedimentary deposits } SILURIAN
MARINE TRANSGRESSION
GORDON LIMESTONE
Tubicolar 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, slates, shales, argillites with intercolations of tuffs and agglomerates
Stratigraphic level Mt Bischoff tin bodies
BASAL BEDS - Quartzites, shales, slates of uncertain age, largely unmapped
Mineralized schists along the major fault of Mt Darwin, Lyell, Rosebery, Mt Bischoff
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
Inferred Fault
} Portions of the mineralized rift valley main fault
Major mines
Pb Cu
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
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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
5 cm
T 311

R51
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Mt BISCHOFF
WARATAH
Mt CLEVELAND
Hazlewood Rv
Whyte Rv
Fossey Rv
Mt PEARSE
Hatfield Rv
Que Rv
Mt RAMSAY
Wilson Rv
Huskisson Rv
THE PINNACLES
A
A'
B
B'
C
C'
D
D'
E
E'
G
Mackintosh Rv
Mt FARRELL
TULLAH
Sophia Rv
Pieman River
Mt BLACK
ROSEBERY
Murchison Rv
RENISON BELL
WILLIAMSFORD
Mt MURCHISON
Mt READ
RED HILL
Mt RAZORBACK
DUNDAS
Mt DUNDAS
ZEEHAN
Dundas Rv
Mt TYNDALL
L. Westwood
L. Julia
L. Selina
L. Rolleston
L. Huntley
L. Tyndall
L. Dora
L. Spicer
Little Henty Rv
Henty Rv
Basin Lake
L. Mary
L. Paul
L. Peter
L. Margaret
Mt SEDGEWICK
L. Beatrice
Comstock Ck
Mt LYELL
QUEENSTOWN
GORMANSTON
SOUTHERN BOUNDARY OF S.P.L. 302
Mt OWEN
Mt HUXLEY
King Rv
Mt JUKES
Mt DARWIN
Mt SORELL
Sth DARWIN
5 cm
RECENT — Scree, debris
QUATERNARY — Moraines, alluvial
TERTIARY — Basalt
JURASSIC — Dolerite
PERMIAN — Tillite
SILURIAN — Fossiliferous marine sediments
ORDOVICIAN — MARINE TRANSGRESSION
CAMBRIAN
Level of mineralization along rift-valley
Mt Lyell Cu level
Rosebery Pb Zn level
Mt Bischoff Sn level
Mt Bischoff Stanniferous dykes
Owen Conglomerate: Terrestrial gravels and sands, infilling old rift-valleys, largely red and purple (arid climate?)
Jukes Conglomerate
UNCONFORMITY
Massive volcanics with porphyritic flows (pyroclastics, porphyries, keratophyres etc.)
Dundas Group
Purple argillites. slates volcanic tuffs, breccias etc.
UNCONFORMITY
Oldest slates, shales, quartzites
Granite Porphyries, granites of the Mt Farrell area (Slightly stanniferous)
(Deep seated magmatic rocks. Heemskirk granite?)
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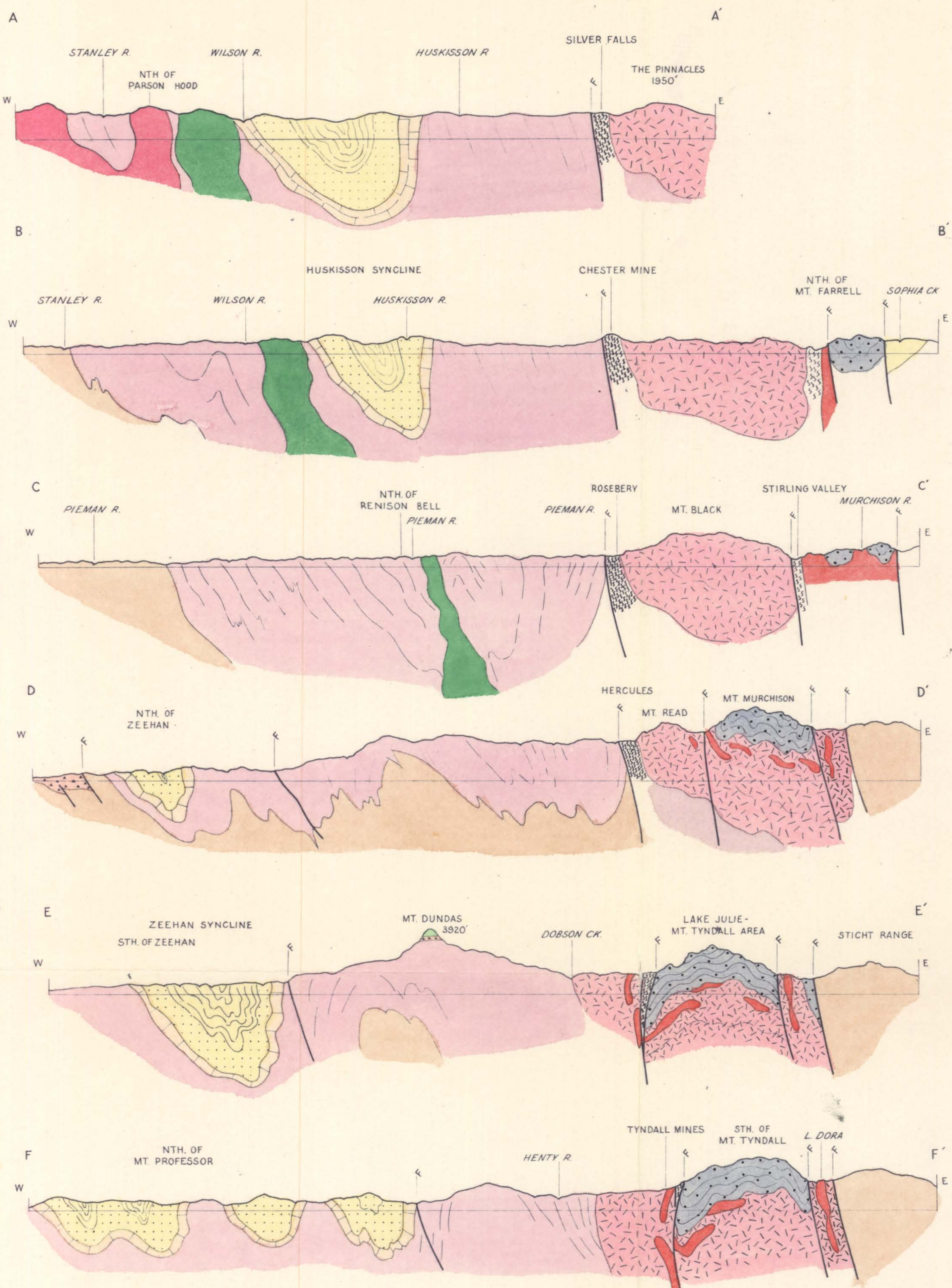
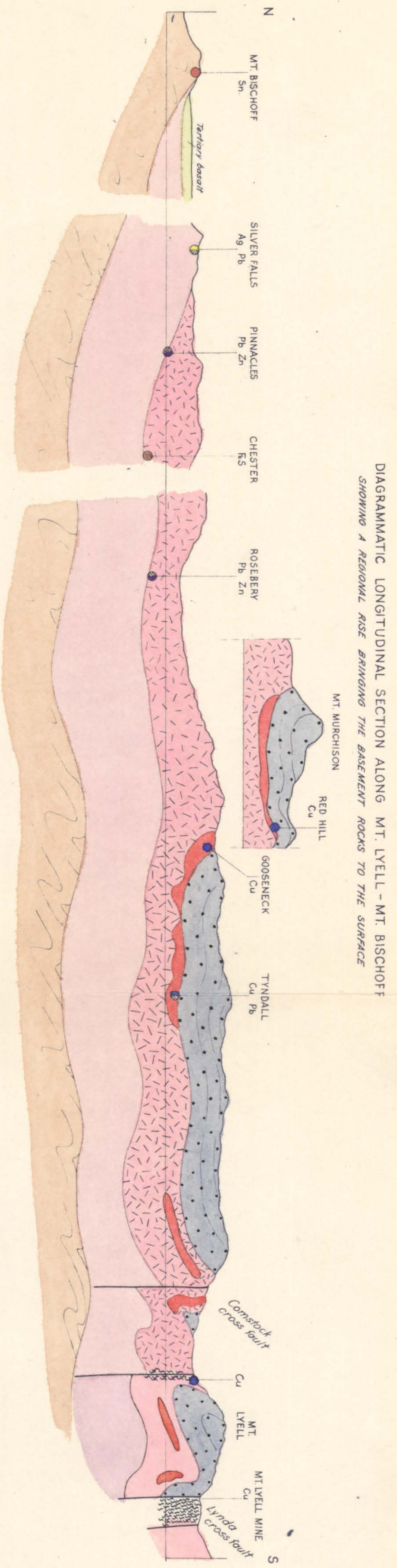
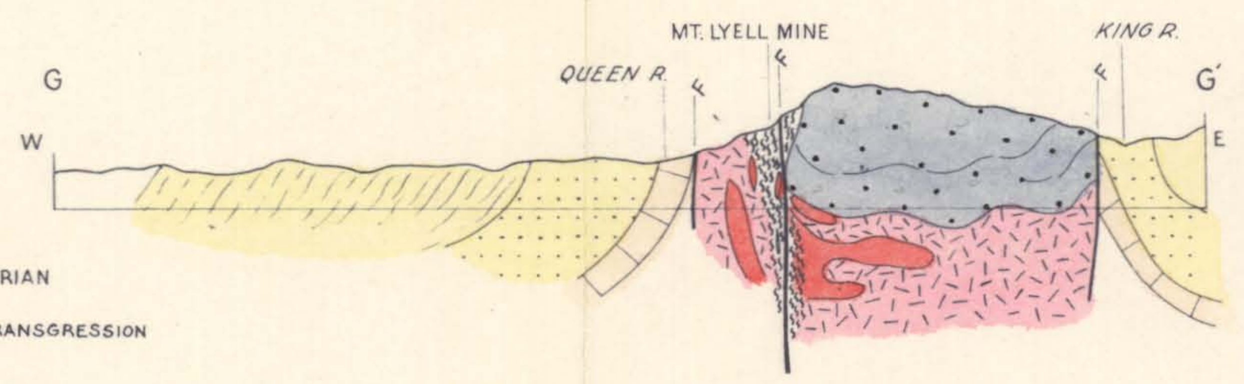
RIO TINTO AUSTRALIAN EXPLORATION PTY. LIMITED
PRELIMINARY GEOLOGICAL MAP
Mt DARWIN - Mt LYELL - Mt BISCHOFF
ZONE OF MINERALIZATION
Scale 2 miles to 1 inch
PRP/7/100
PLATE 3
T 319





LEGEND

- *Dolerite* : Jurassic.
- *Tillites* : Permian-Triassic. COAL MEASURES.
- *Fossiliferous quartzites*, sandstones, shales SEDIMENTARY DEPOSITS — SILURIAN
- *Gordon Limestone* — MARINE TRANSGRESSION
- *Tubicolar Sandstone* and ordovician beds undifferentiated. — ORDOVICIAN
- *Owen Conglomerate* : coarse talus conglomerate and quartzites infilling a fossil rift valley. Jukes Breccia at its base.
- STRATIGRAPHIC LEVEL OF MT. LYELL COPPER LODES — UNCONFORMITY
- *Massive pyroclastics* and related extrusive and hypabyssal acid rocks (porphyries, felsites, keratophyres). — CAMBRIAN
- 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 — UNCONFOMITY
- *Basal beds* : quartzites, shales, slates of uncertain age, largely unmapped. — LOWER CAMBRIAN PROTEROZOIC ?
- Granites and granite porphyries of Mt Darwin and Tullah area and related acid rocks of segmentation. — CAMBRIAN
- 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.



SCALE

VERTICAL SCALE : 5,000 FT. TO 1 INCH

5 cm

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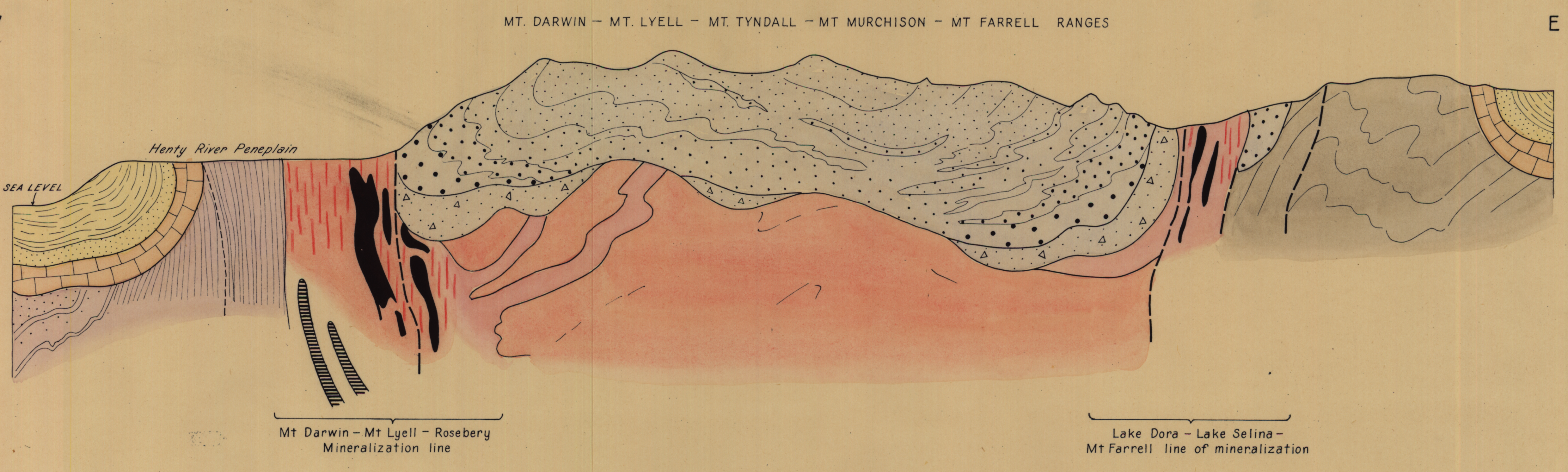
RIO TINTO AUSTRALIAN EXPLORATION PTY. LIMITED

GENERAL GEOLOGICAL SECTIONS ACROSS THE MT. LYELL - ROSEBERY ZONE

Scale 2 miles to 1 inch

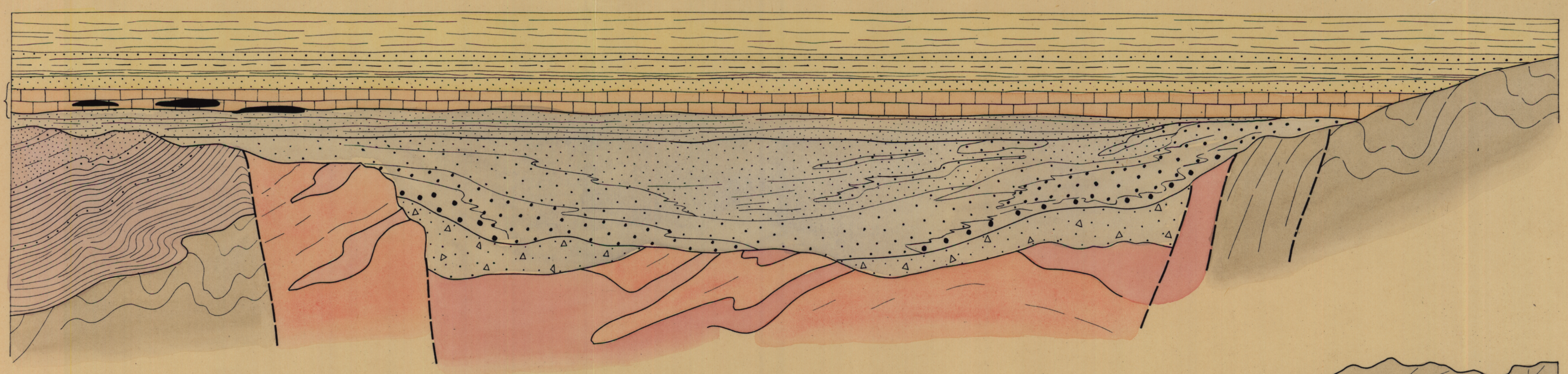
Geologist	B. Campana B.C.		PLATE 4
Draftsman	J.L.P.	P.R.P./7/100	T 305

57-181



7. *DEVONIAN & POST DEVONIAN PHASES*

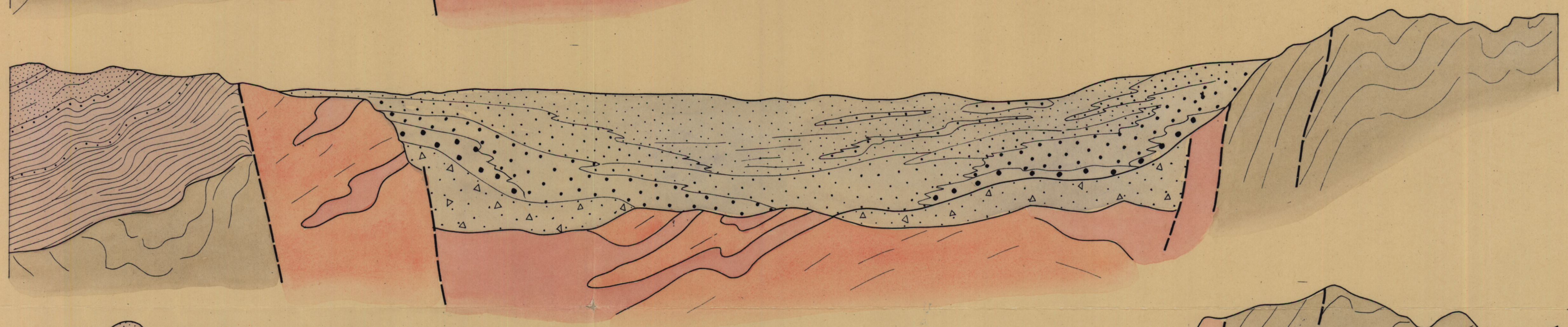
Folding, faulting, uplift, erosion
Devonian mineralization ?



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



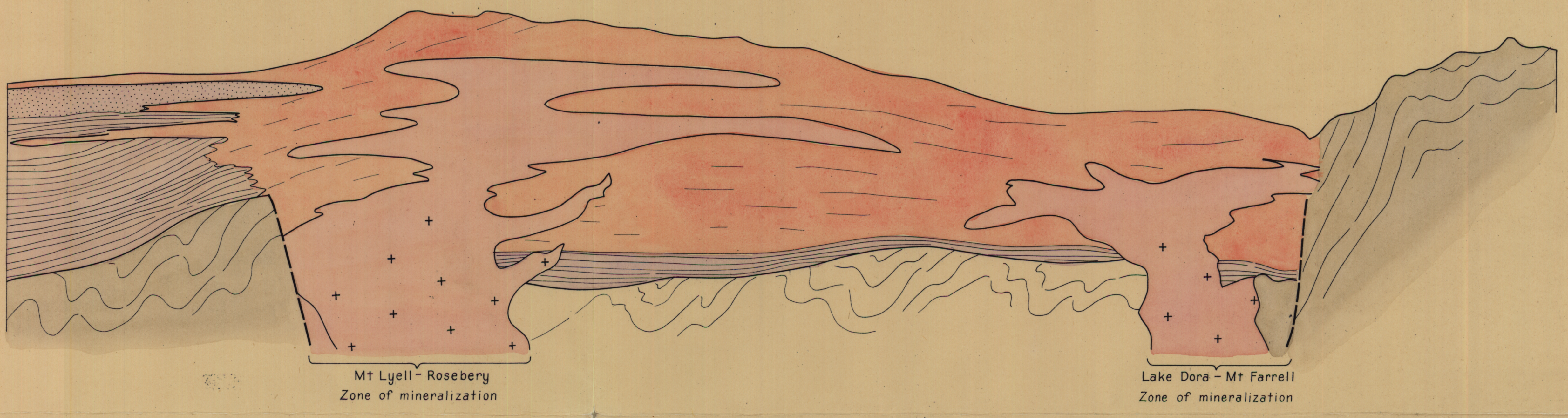
5. *ORDOVICIAN PHASE:*

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"

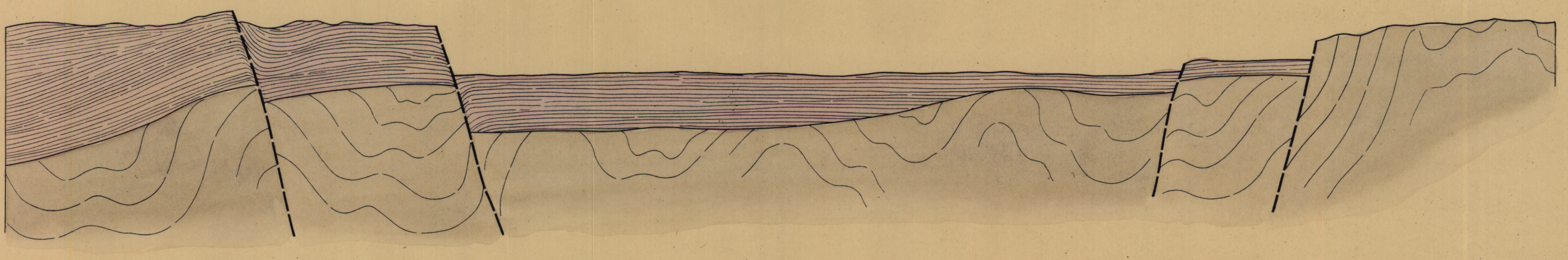
Deposition of the Jukes Breccia conglomerate (talus breccias and conglomerate with abundant volcanic rocks as boulders & pebbles)



3. *MIDDLE TO UPPER CAMBRIAN PHASES:*

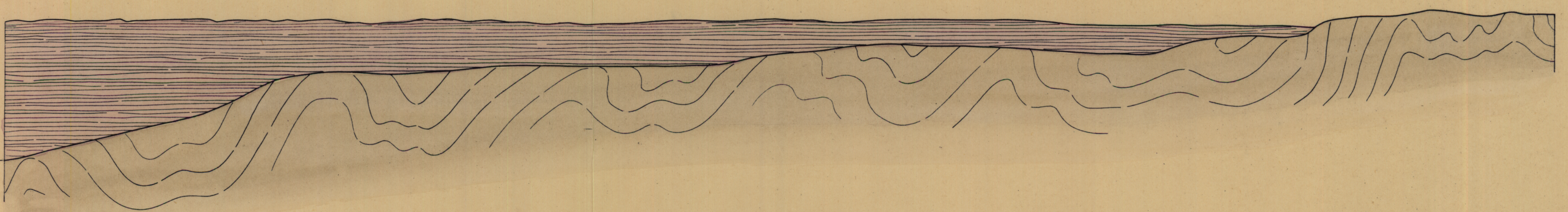
EARLY MINERALIZATION

Repeated volcanic activity mainly along large marginal faults.
Emplacement of copper-bearing porphyries, felsites, keratophyres as flows and hypabissal 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 – Pieman areas.
Deepening of the "Owen graben"



2. *MIDDLE CAMBRIAN PHASE:*

Large scale faulting, giving rise to the graben structure



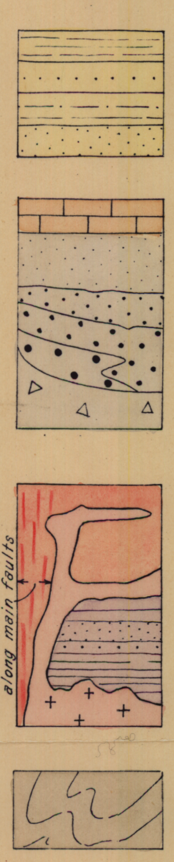
1. *UPPER PRECAMBRIAN TO MIDDLE CAMBRIAN PHASES*

Deposition of the basal Dundas beds (Argillites, slates, etc.)

Unconformity

Folding of the Precambrian basement rocks

GEOLOGICAL AGE — *ROCK UNITS AND FACIES* — *MINERALIZATION TYPE* (Unrelated to Geological Age)



SILURIAN (Eldon Group)

- Bell Shale
- Florence Quartzite
- Amber – Keel Shales and Sandstone
- Crotty Quartzite

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

Mineralization: Secondary copper minerals

ORDOVICIAN (Junee Group)

Gordon Limestone – with clayey intercalation. 100 – 2,000 feet thick

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

Owen Conglomerate. A continental formation infilling a fossil rift-valley ("Owen rift valley") Coarse siliceous conglomerates at lower levels, and quartzites towards the top, cross-bedded, with dominant red or purple tinges. Grades upwards to light-coloured sandstones with abundant "pipe-stems" (? worm casts). Thickness: up to 3,000 – 4,000 feet, decreasing abruptly at the edges of the old rift-valley.

Jukes Breccia. A talus breccia-conglomerate, with abundant pebbles of the underlying porphyroid formation. Thickness: up to 2,000 feet

Mineralization: Sedimentary iron formations; Possible copper deposits at the base

CAMBRIAN (Dundas Group)

Mineralized schists along main faults

Massive pyroclastics, porphyries, felsites, Keratophyres, spilites. Essentially a volcanic succession of tuffs, agglomerates, breccias, with intercalations of copper-bearing acid lavas and hypabyssal bodies.

Copper-bearing porhyritic flows along marginal faults.

Mineralization: Copper, zinc, lead and silver mineralization; Mt Darwin – Lyell – Lake Dora area

Dundas Shales, slates, purple and green argillites, ash-beds, tuffs and minor agglomerates and conglomerates. Possible lateral gradations to the massive pyroclastic, but deposited further afield. Marine beds present at intervals. Thickness: up to 12,000 feet.

Granites and granite-porphyries of Mt Darwin and Mt Farrell

Mineralization: Silver, lead, zinc mineralization; Rosebery – Tullah area

PRECAMBRIAN (Carbine – Davey Group)

Quartzites, slates and shales, unfossiliferous. (largely unmapped)

Mineralization: Tin mineralization at Mt Bishoff and elsewhere

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RIO TINTO AUSTRALIAN EXPLORATION PTY. LIMITED

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

Geologist: B. Campana	P.R.P/7/100	13-12-1957	Plate 5

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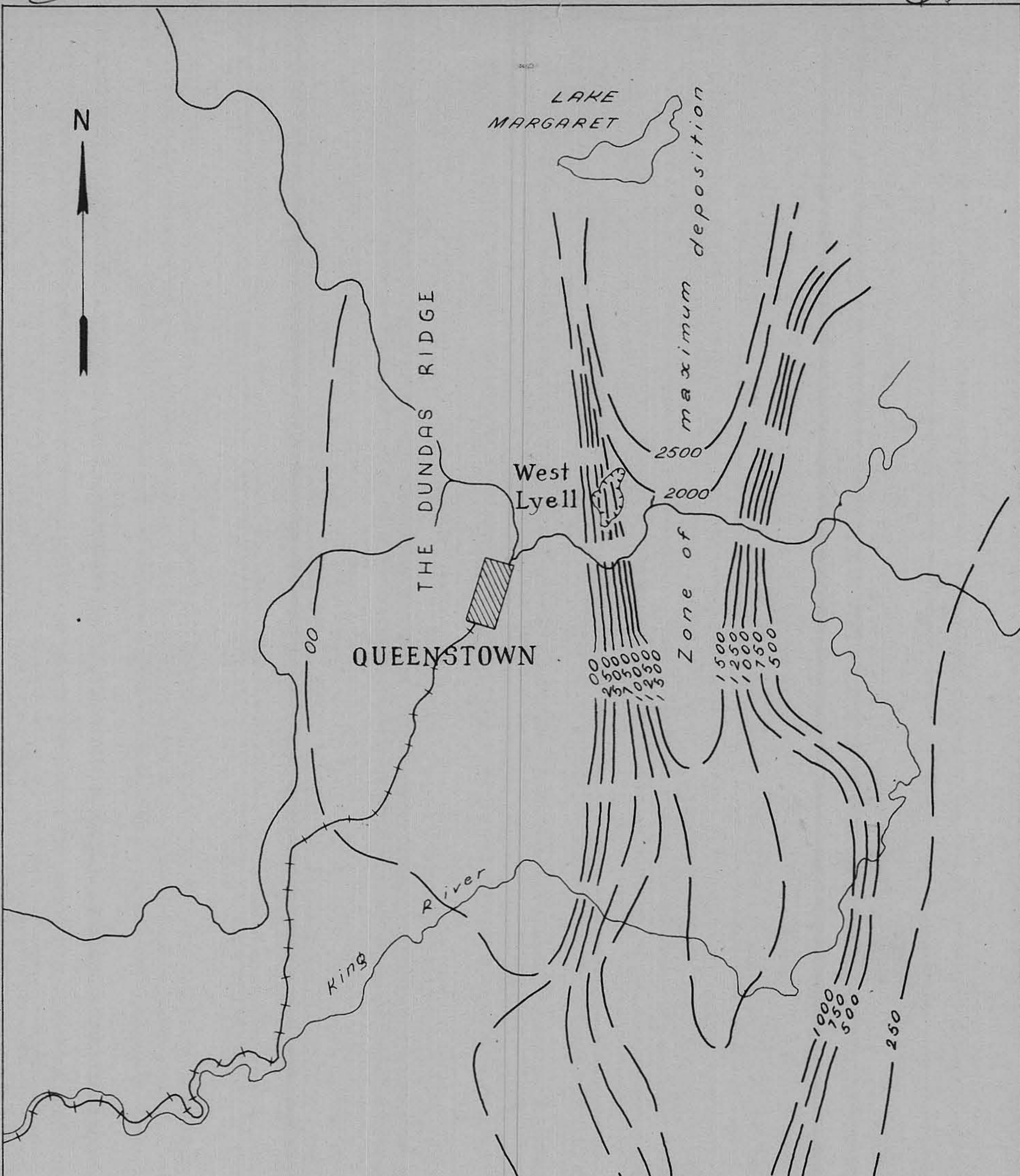


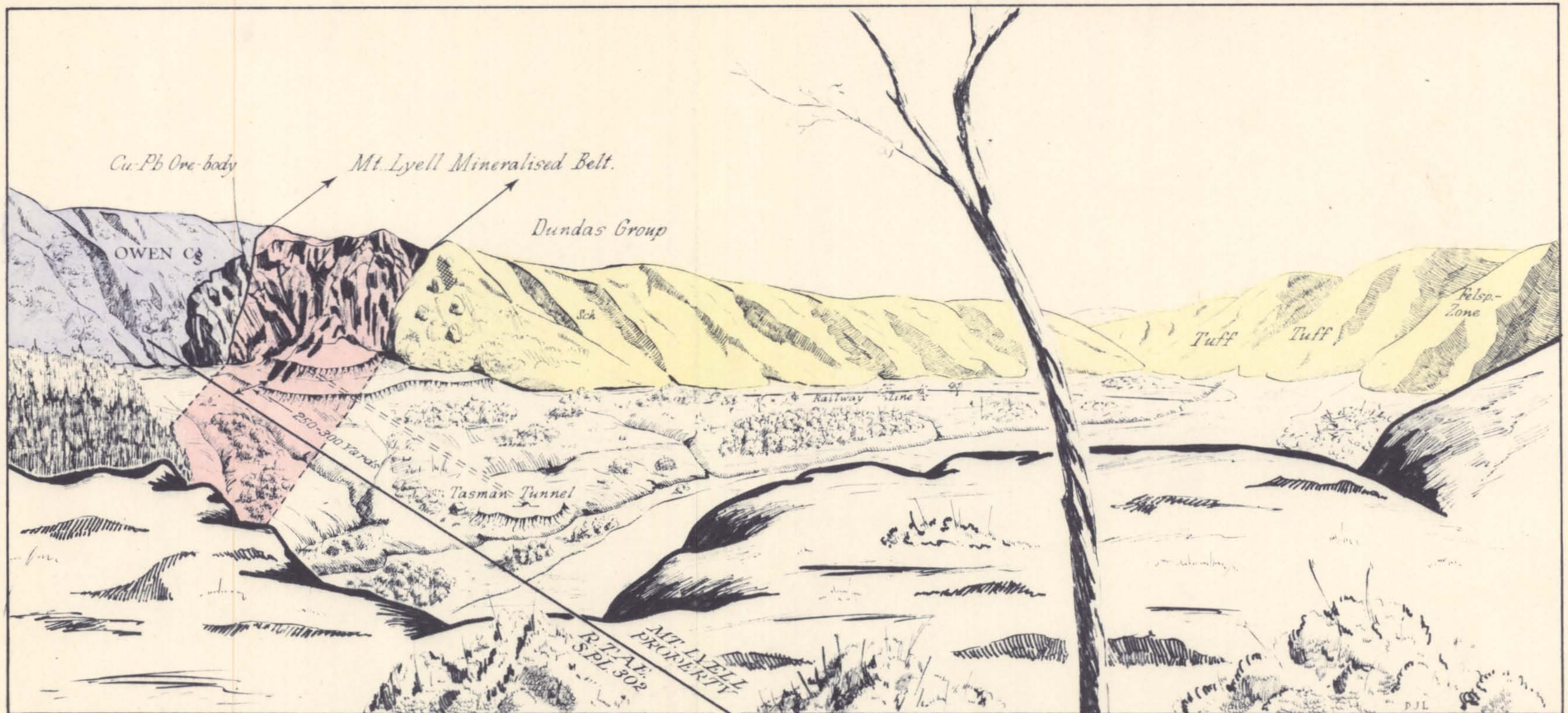
ISOPACHYTES OF THE OWEN CONGLOMERATE

SHOWING THE ABRUPT DECREASE IN THICKNESS AT THE EDGES OF THE RIFT VALLEY

0 1 2 4 6 8 MILES

After M. Wade & M. Solomon

PLATE 6



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— LEGEND —

(blue)	*Upper Owen Conglomerate, dense quartzite, hematitic, in beds of 3-10ft in thickness; ~ vertical.*
(pink)	*Dundas "porphyroids" felspathised tuffs and slates; Mineralised.*
(yellow)	*Dundas beds: tuffs, schistose pyritic beds, conglomerates, felspathised in part.*
(white)	*Glacial and fluvio-glacial, up to 100ft. visible thickness.*

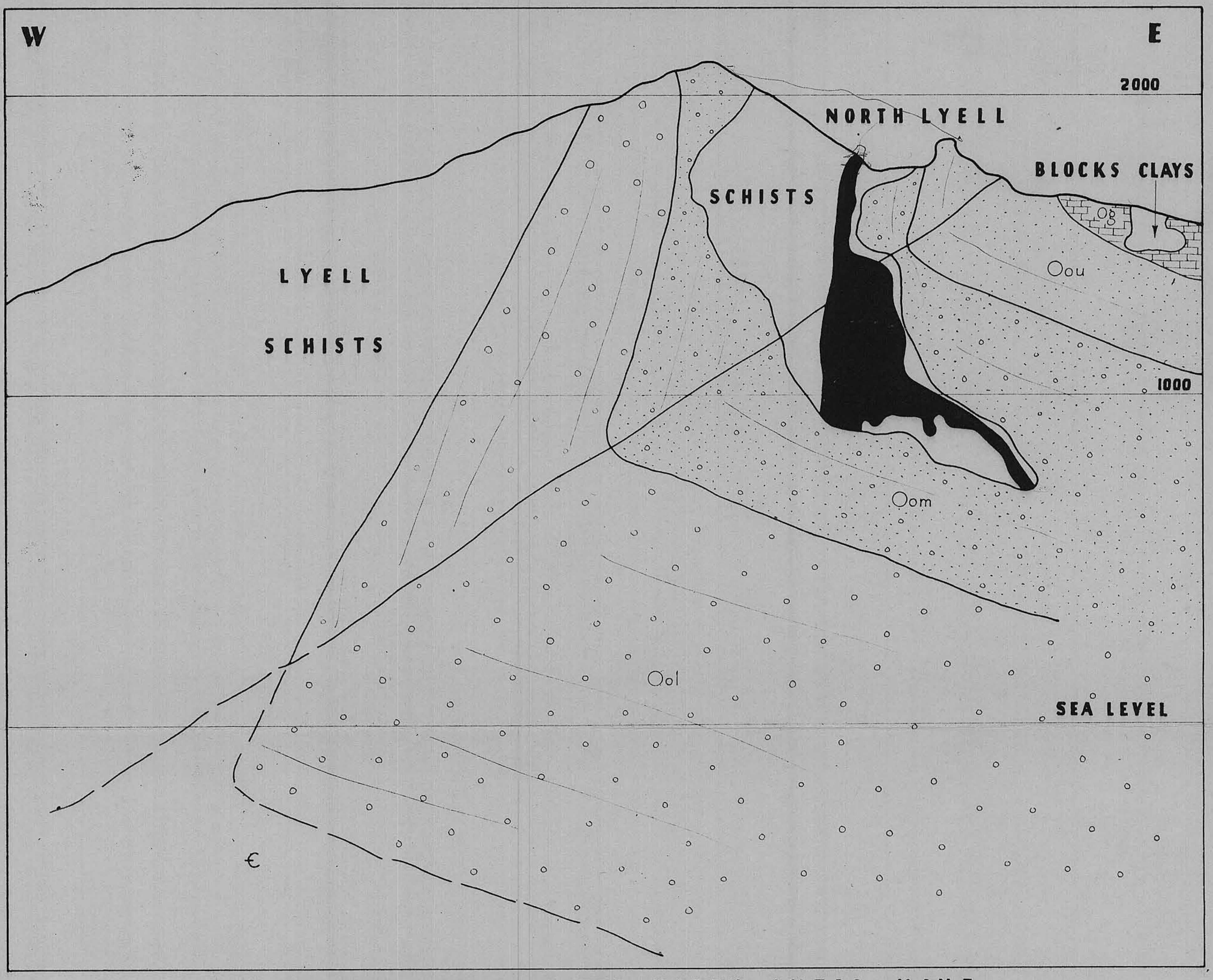
RIO TINTO AUSTRALIAN EXPLORATION PTY. LIMITED

THE COMSTOCK VALLEY, - SEEN FROM THE N.-E.

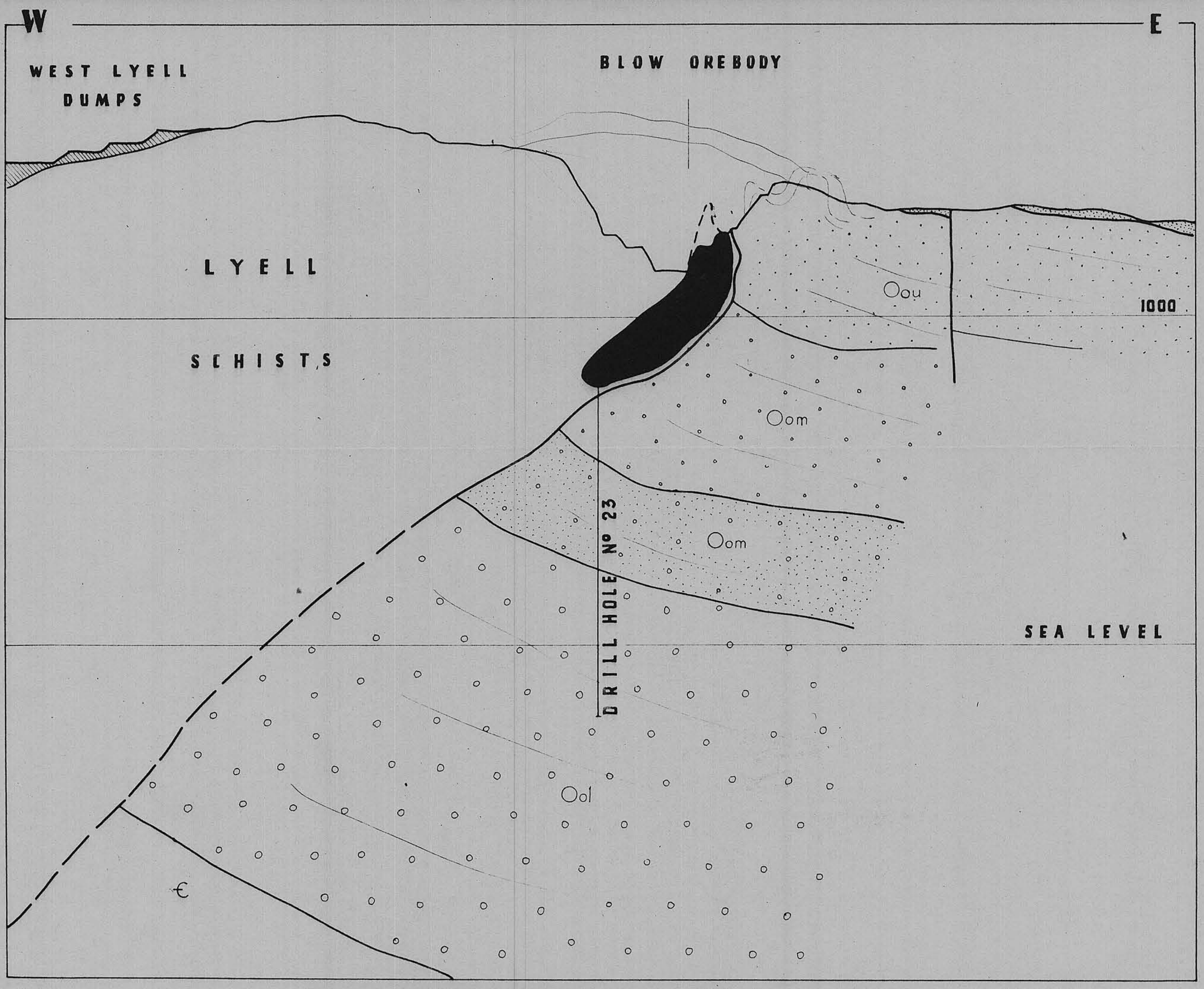
Showing the mineralised portion (Cu-Pb ore-body) of the Dundas formation (lyell schists) in contact with Owen Conglomerate along the Nth. Lyell shearing-Zone and at the intersection of the E-W Comstock faulted flexure.

DATE : August, 1957.		PLATE 7
Geologist B. Campana.	B.C.	
Draftsman D. Lawford.	Authority P.R.P. 7/100	

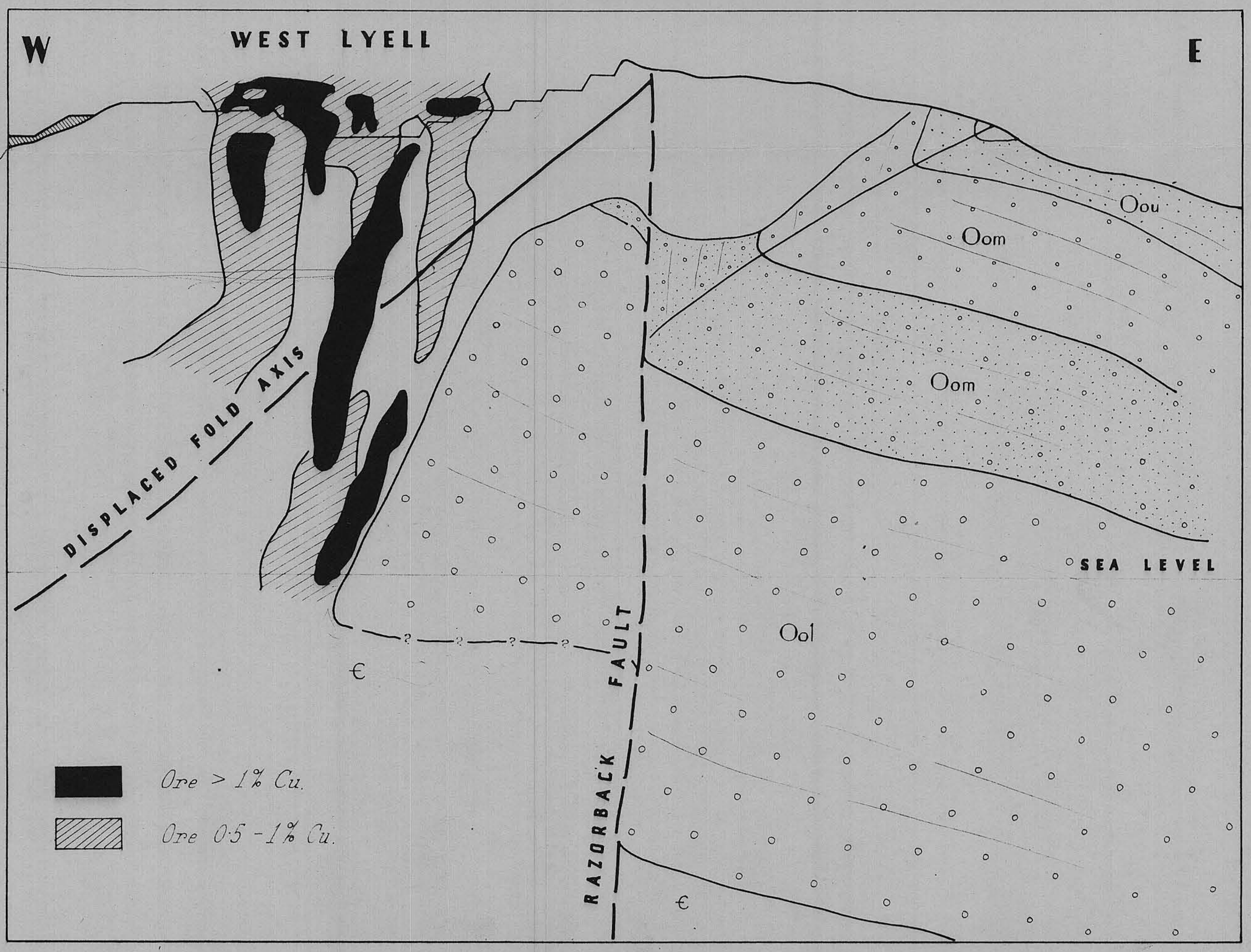
T 62



E.-W. SECTION THROUGH THE NORTH LYELL MINE
SCALE 1 in. = 400 Ft.



E.-W. SECTION THROUGH THE BLOW
SCALE 1 in. = 400 ft.



E.-W. SECTION THROUGH WEST LYELL
SCALE 1 in. = 400 ft.

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After M. Wade, and M. Solomon.

PLATE 8

D.J.L. DEC '57

T. 312.

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Mt Darwin - Mt Lyell - Rosebery - Mt Bischoff Mineralization Line

PLATE IX

5 cm

57-181

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AEROMAGNETIC SURVEY OF NORTH WEST TASMANIA 1956

RIO AUSTRALIAN EXPLORATION

Scale: 4 Miles to 1 Inch

Flown and Compiled by
ADASTRA HUNTING GEOPHYSICS PTY. LIMITED
41-45 VICKERS AVENUE
MASCOT, N.S.W.

A HUNTING GROUP ASSOCIATE COMPANY

Plate - X

FACIES OF THE OWEN CONGLOMERATE

Interpreted as the terrestrial infilling of an ancient rift- valley.

5 cm

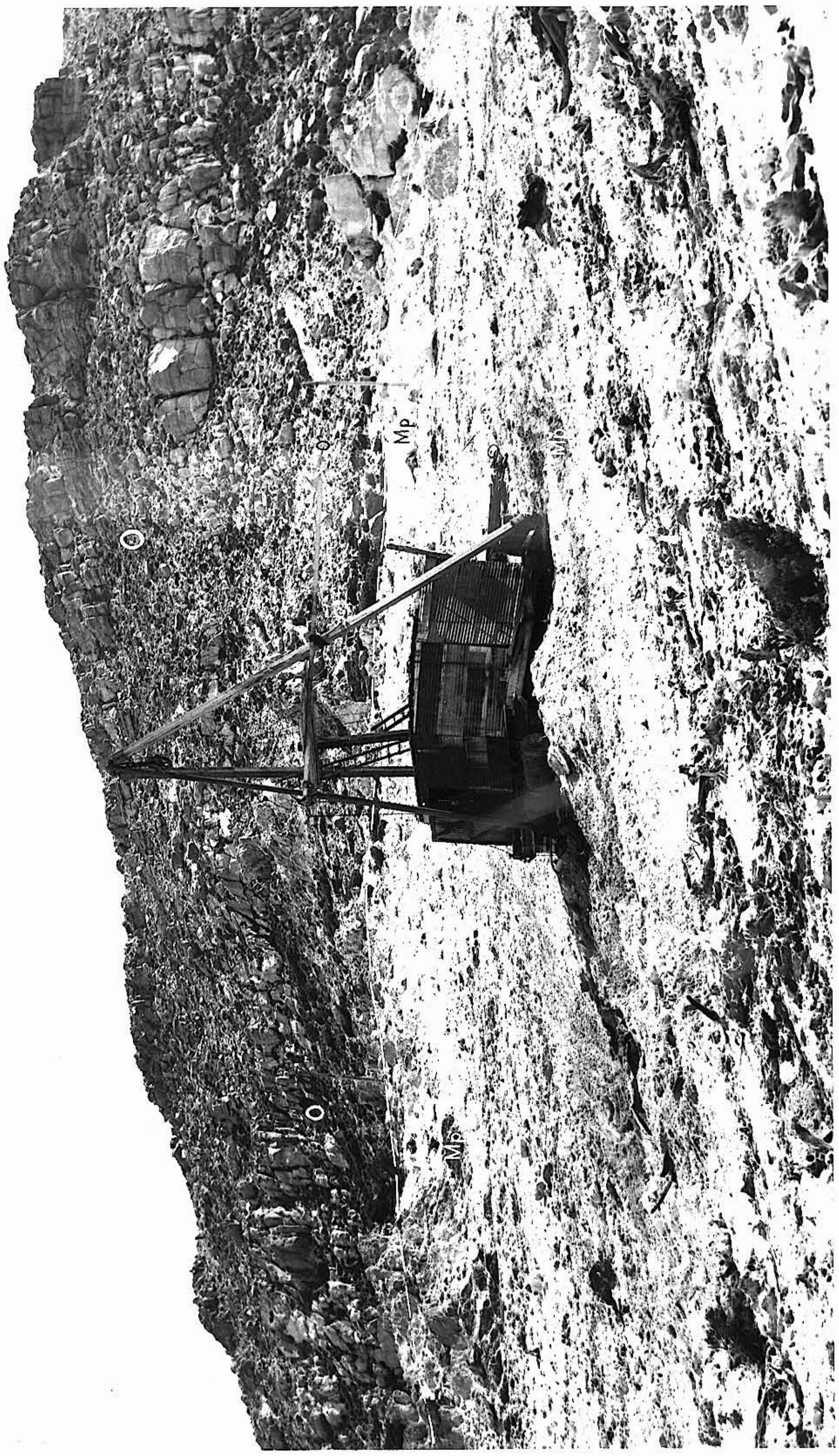
Plate - XI

FACIES OF THE OWEN CONGLOMERATE

Showing its unsorted character and its crude fluviatile stratification.

5 cm

Plate XII



THE WESTERN EDGE OF THE OWEN RIFT-VALLEY

AT MT. LYELL

In the background : The Owen Conglomerate - O

In the foreground : Mineralised schists of the "Massive pyroclastics" - Mp.

The drill-hole intersected important copper ore bodies, indicated at the surface by aero-magnetic anomalies only.

Plate XIII

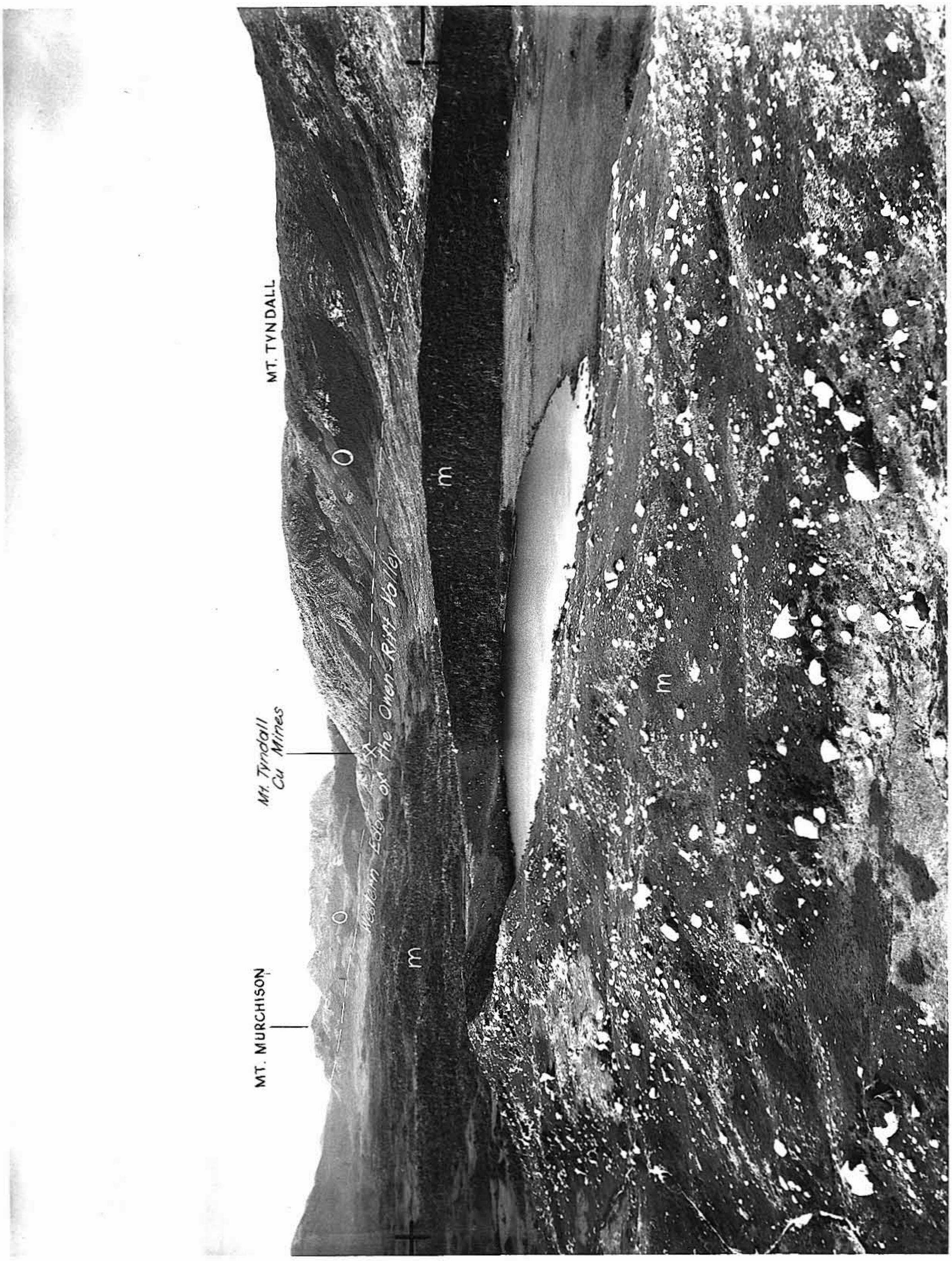
THE COPPER LEVEL AT THE LATITUDE OF MT.LYELL

O - Owen Conglomerate

Mp - Schisted "Massive pyroclastics" and porphyries

The Mt. Lyell open cut is seen on the left of Mt. Owen.

Plate XIV



THE COPPER ZONE NORTH OF MT. LYELL

Between Comstock and Mt. Lyndall, covered by Pleistocene moraines (m)

On the left, the Owen Conglomerate (O) marks the western edge of the mineralised rift-valley.

Plate XV

THE AXIAL RISE OF THE STRUCTURES IN THE

RED HILL AREA

Porphyries flows (p) with copper mineralisation are brought at the surface by the axial rise, beneath the Owen Conglomerate (O).

The eastern edge (ee) of the Owen rift-valley and the "east Precambrian bloc" are seen in the background.

Plate XVI

THE LEAD-ZINC LEVEL IN THE ROSEBERY AREA

The mineralised fault line brings in contact the "Massive pyroclastics" (Mp) with the bedded formations of the Dundas Group (bf).

The Rosebery lead-zinc lode (lz) is seen near the base of the Massive pyroclastic.

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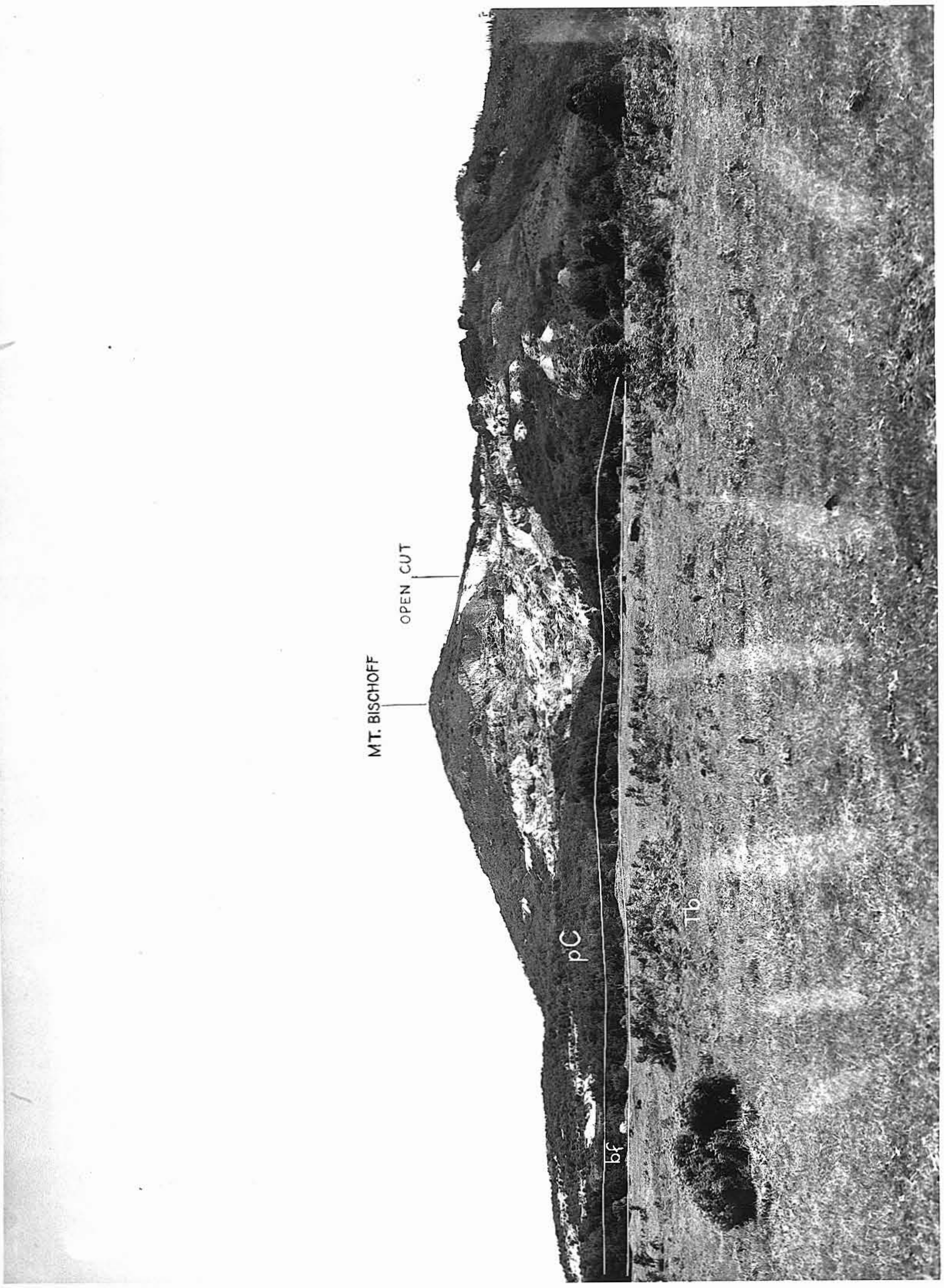
Plate XVII



THE TIN LEVEL IN THE MT. BISCHOFF AREA

The mineralised fault-line brings in contact the Precambrian Mt. Bischoff beds (pc) with the bedded formation of the Dundas Group (bf) largely covered by Tertiary basalt (tb).