MINERAL BELTS SELECTED FOR GEOPHYSICAL SURVEYS.

1. THE PORPHYROID SCHIST BELT OF TASMANIA.

Introduction

The Porphyroid Schist belt of the Western Division contains the most extensive, the most important, and the greatest variety of the ore-deposit in Tasmania. In this belt are found the Mt. Lyell Copper ore deposits, the Tasman and Crown Lyell zinc bodies, the Read and Rosebery Zinc-lead-copper orebodies, the Pinnacles and Ross Creek lead-zinc deposits, and the Mt. Block barytes-lead bodies. In addition are known in these schists many lead and copper lodes too numerous to mention here, and several gold-quartz bodies.

This belt extends in an unbroken line from the south-eastern end of Macquarie Harbour to Mt. Block, a distance of 60 miles, and is three to five miles in width. Detached areas north and south show that its full lineal extent is from Low Rocky Point on West Coast to the North Coast, a distance of 120 miles. This belt from one end to the other is mineral bearing, containing here and there deposits of copper, lead, and zinc ores, barytes, and gold in commercial concentrations. Some members of the series are found in parallel lines to the eastward of the main belt.

Both igneous and sedimentary rocks are included in the porphyroid series.

It is to these that one naturally turns when asked to express opinion as to the most favourable localities for geophysical explorations. Our present knowledge of certain sections of these schists is considerable, but a more extended and a more intensive survey is desired - a work too great to be undertaken just now by the Department on a scale commensurate with its magnitude and importance. The Mines Department, therefore, invites the attention of the Geophysical Executive to the consideration of this as one of the most suitable areas for investigation.

Topography

The country under review embraces one of the most rugged portions of the Western Division - a series of high mountains and deeply dissected valleys, heavily clothed with dense forest growth, follow one another seemingly in endless succession. The most prominent topographic features are due to erosion-resisting porphyroids capped with quartz conglomerate, and to the bold configuration resulting from the corroding effects of the many west flowing streams and of Pleistocene glaciation.

The mountain ranges are the highest erosion residuals of an old peneplain. Some of these mountains attain to 4,000 feet above sea-level, and 3,500 above the piedmont, which marks a lower and younger peneplanated surface extending from Zeehan to Lyell. Many of the broad valley floors are covered with glacial debris, which completely obscures the mineral-bearing formations.

The winter climate is rigorous and severe. Snow caps the mountain ranges from June to October. The yearly rainfall is 109 inches and is distributed through all seasons, but is much heavier during winter than summer.

Igneous Rocks

The igneous types represented range from fragmental rocks to felsites, keratophyres, and porphyries. The various elements are so irregularly associated that it is at once apparent that the exposed rocks of the group belong to one igneous mass of contemporaneous lava flows pyroclastic breccias, tuffs, and intrusive dykes and sheets. Variations in texture from felsites through feldspar porphyry to quartz-feldspar porphyry take place transitionally, and show that these rocks are differentiation products of one magma. All the members of the porphyroid group are similar in composition in that the dominant feldspar component is albite, and, with quartz, is an essential constituent. Secondary minerals due to metamorphism are sericite, epidote, chlorite, pyrophyllite, calcite, and actinolite.

The tuffs present a rude stratified arrangement of successive beds directly overlying the uppermost sedimentary formation, and again as intercalated beds between lava flows. The lower beds of tuff and larger volcanic ejectamenta are usually mixed with much sedimentary material, and merge by imperceptible gradations into true sedimentary rocks. The original pyroclastic texture of the tuffs is usually obscured on account of subsequent alteration, making the dividing line between pyroclastic and clastic formations extremely difficult of determination. The tuffaceous character is recognizable only on the weathered surfaces of the hard compact varieties, the more resistent components of which, standing out in high relief, emphasise the fragmental nature of the rock.

The intrusive members of the porphyroid formation, being the products of magmatic differentiation at depth, differ considerably in structure and texture, and slightly in composition, from the extrusive members. The intrusive are generally much more feldspathic, and have suffered more from the effects of chemical and dynamic change.

The extrusive members, excepting the tuffs and other fragmental rocks, are the predominant members of the formation. They are found as a series of successive lava flows in irregular association with other members. The line of demarcation between successive flows is not distinct; in general, narrow beds of tuffaceous material occurring in the porphyroid establish the partings. Flow alignment of the feldspar phenocrysts can readily be detected by eye. The felsites in places are vesicular, having elongated gas cavities from half to an inch in length. Amygdules containing calcite, and geodes containing perfectly crystallised quartz, are commonly seen in these rocks.

Sedimentary Rocks

The Read-Rosebery Schists are from an economic point of view, the most important of the rocks, for in them are contained the most extensive and the richest orebodies. These rocks extend along the igneous belt, and consist of clastic and pyroclastic accumulations, the original mineral components of which have been replaced in some places by

secondary products of deposition. The schistose character has been induced by regional folding, the pyroclastic rocks suffering more severe deformation than the softer, more pliable, clastic sediments. The schists present four main lithologic facies, namely, the argillaceous, chloritic, quartzitic, and valvareous varieties. The calcareous beds, in which are the most important orebodies, are found at one particular horizon. These schists rest conformably upon a base consisting of the Dundas series of slates, breccias, quartzites, and conglomerates. The conclusion has been arrived at that these schists are metamorphosed and folded sedimentary and pyroclastic rocks. Structural complications in them are caused by the peculiarity of the folding which is exhibited in two distinct series. Loftus Hills in Bulletins 19 and 23 gives an account in detail of the results of a thorough investigation of the Read-Rosebery (zinc-lead-sulphite) section of the schist belt, and P.B. Nye in an unpublished report deals fully with the Tasman and Crown Lyell zinc-lead bodies. Between the two sections is a large uninvestigated area in which prospectors report the presence of other lodes.

Mt. Lyell copper district has been investigated by Loftus Hills, but his report has not been published. Here all the orebodies are contained in or associated with the porphyroids.

Mineralogical Composition of Read-Rosebery Ores

Zinc-blende	43.3 per cent.
Pyrite	31.0 " "
Galena	10.4 " "
Quartz	5.5 " "
Silicate of Alumina	2.5 " "
Calcite	2.4 " "
Barytes	1.5 " "
Chalcopyrite	1.2 " "
Rhodochrosite	1.2 " "
Tetrahedrite	0.1 " "
Silver	10 oz. per ton
Gold	3 dwt. per ton

The Vertical Range of the Ores of Read-Rosebery District

It will prove of interest to present here a statement showing the vertical range of the deposits and their average values.

The total vertical range observed of the Zinc-lead sulphide deposits is 2,700 feet, viz., 3,100 feet above sea-level at Dunne's Blocks and 400 feet above sea-level in the 500 feet bore at the Primrose Mine.

The fact that the zinc-lead sulphide at the lowest limit observed at Rosebery is exactly similar to that at the extreme upper limit, is shown in the following table:-

Height above Sea-level	Particulars of Ore	Assay			
		Au. oz.	Ag. oz.	Pb. %	Zn. %
3000	Average ore Mt. Read Mine	0.23	10.84	10.5	24.3
2800	Average content 135000 tons of ore from Hercules Mine	0.20	12.7	9.3	28.0

Height above Sea-level	Particulars of Ore	Assay			
		Au. oz.	Ag. oz.	Pb. %	Zn. %
1700	Average ore, Koonya Mine	0.38	4.0	12.0	19.8
1300	Average content 200 tns. N. Tasmania Copper Mine	0.125	8.0	6.5	28.0
800	Average content 95000 tns from Tasmanian Copper & Primrose Mines	0.15	12.4	9.0	29.0
650	Average content main addit level Primrose & Tasmanian Copper Mines	0.15	10.0	8.5	29.0
400	Ore in 500 foot bore Primrose Mine	0.135	10.2	8.5	28.0

Summary

The large zinc-lead and copper sulphide deposits are replacements of metamorphosed dolomitic and calcitic beds of the schist series, conforming to the folds and belonging to one horizon. Copper ores are also contained in the chloritic schist members, and in the schistose porphyries; but these are not of any great importance.

The gold-quartz veins are contained in or closely associated with quartz porphyry rocks of the porphyroid series, and in some places (at Minnow, for instance) the gold is distributed through the body of the porphyry. Small natural concentrations of commercial importance have been found, but generally the average value of the narrow dykes of quartz porphyry is low, in few places exceeding in bulk one pennyweight per ton of stone.

All the bar type deposits of Tasmania are contained in the porphyroid schists, usually in association with lead and zinc sulphides. In some places the barytes is quite subordinate, in others it forms the bulk of large deposits and is contaminated little by lead and zinc sulphides.

The zinc-lead sulphide orebodies of the Read-Rosebery belt are of great size and extent, and probably after those of Broken Hill are the most important in Australia. Their northern and southern extensions have not been thoroughly explored, yet in the northern part very large but low-grade bodies are known. Attention is directed particularly to these.

Mt Lyell is the one great copper mine in operation in Australia today. Total production exceeds £17,000,000. The deposits are contained in an area of complicated faulting not yet satisfactorily deciphered. The possibilities of tracing the extensions of these copper ore deposits by

geophysical methods of exploration cannot be stressed too strongly.

2. ZEEHAN GALENA-SPHALERITE VEINS

Introduction

This field, at one time a considerable producer of very high-grade silver-lead ore, is now receiving very little attention. The veins, of which there are a great number, are not large nor very extensive, but the vein-fillings are rich in silver and lead, and, in some, zinc ore is abundant. The field has produced about £8,000,000 worth of ore, and a few years ago supported a population of 7000 people. Today the 2000 inhabitants are dependent upon tin ore mines in the neighbourhood, and upon the works of the Electrolytic Zinc Company, who draw supplies for their treatment plant from the Read-Rosebery group of zinc-lead mines.

Physiography

Zeehan district is one of marked, though not sharply defined relief, where a number of dissected ridges and well-moulded hills occupy a position between the granite mountain ranges of Heemskirk and Agnew and the broad relatively low peneplain south west of Mt. Dundas extending toward Mt. Lyell. The western portion of the district reaches its highest point at Oonah Hill, about 1,200 feet above sea-level, and the broad valley in which the town is situated is about 500 feet above sea level.

A great part of the area was at one time clothed with a forest of beech; today little of the forest remains. The outlying areas are covered with button grass growing on a shallow peaty soil. Every part of the field is thus easily accessible.

Geologic Relations

In the Zeehan area are sediments of Cambro-Ordovician, Silurian, and Permo-Carboniferous ages, the last represented by remnants of glacial hill only. The lower of the Cambro-Ordovician are sandstones and slates; the upper are slates and sandstones with intercalated keratophyric tuffs or splitic lavas and tuffs. The Silurian are represented by quartz conglomerates, sandstones, shales, slates, and limestones.

The sedimentary formations referred to have been intruded by Devonian granites and other acidic rocks, and by gabbro-amphibolite and serpentine. These intrusives are not prominent in Zeehan area proper but outcrop at the western end. Apophyses of the main bodies do protrude here and there through the stratified rocks towards the centre of the field, but they are of small size and extent.

Block faulting has complicated the structure of the formations.

The Vein Types

The following vein types are represented in the Zeehan field proper:-

1. The Pyritic Belt, including:-

   (a) pyrite-sphalerite-galena
   (b) pyrite-galena
   (c) stannite-pyrite-chalcopyrite
   (d) pyrite-stannite-galena
   (e) quartz-pyrite-galena-sphalerite

2. The Sideritic Belt

   (a) siderite-galena
   (b) quartz-siderite-galena-sphalerite.

It has been definitely established that the galena content of the numerous veins gives out at sea-level or 500 feet below the level of the township. In making the statement it is not suggested that there is any casual connection in that coincidence-it just happens to be the vertical limit of the lead sulphide ore. At that level siderite forms the bulk of the vein matter, quartz becomes prominent, chalcopyrite appears, and sphalerite and galena are in very small proportion.

At the Oonah and Queen No. 4 mines stannite with chalcopyrite and silver is found in veins at the surface. The veins are two to three feet wide and contain shoots of ore up to 300 feet long. They have not been explored below 300 feet in depth.

Cassiterite veins and orebodies are being developed in the northern and western areas, and nickel ore-deposits are known there.

Summary

Zeehan field offers considerable inducement for the testing of geophysical methods of exploration being easily accessible, not mountainous, and being thoroughly explored in parts. At the northern end the veins are marked at surface by quartz which constitutes the bulk of the filling. There the veins have been protected from agents of erosion by a covering of Permo-Carboniferous rock. The sulphides, therefore, have not been greatly reduced in that quarter. At the southern end of the field are large quartz-galena-sphalerite bodies covered, in the plateau parts, with gravels and peat, and exposed only where streams have deeply entrenched themselves in the containing rocks.

In those two areas very little exploration has been performed owing to the difficulty in finding indications at surface.

Exploration may be performed with advantage in the main part of the field also.

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