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# PRELIMINARY REPORT ON THE GEOLOGICAL SURVEY OF THE ROSEBERY DISTRICT.

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INTRODUCTION: The systematic geological and topographical mapping of the Rosebery District was undertaken as portion of the Development & Migration Commission's scheme for the geological mapping of the Lower Palaezoic rocks in Tasmania. In Tasmania these rocks are the repositories of the principal metalliferous deposits, and it was thought that the elucidation of their structure and an examination of the contained ore bodies would add materially to the knowledge concerning the origin and mode of deposition of the principal ore bodies. Furthermore it was considered that the work undertaken would form an admirable basis on which future prospecting operations could be carried out.

Rosebery was the first mining district to be mapped under this scheme, and the geological bulletin embodying the results of the work is now in course of preparation for printing. The present report is intended to give a general idea as to the conclusions arrived at during the course of the investigation.

GEOGRAPHY AND PHYSIOGRAPHY: The Rosebery district is situated on the West Coast of Tasmania. It is served by the Emu Bay Railway, the Rosebery Station being about 71 miles from Burnie. The portion of the district mapped has an area of approximately 12 square miles and forms a rectangle whose eastern and northern sides extend 3 miles south and 3½ miles west, respectively, from the summit of Mt. Black.

The country is extremely rugged and mountainous. Some idea of its nature may be gleaned from the fact that the gorge of the Pieman River is only 250 feet above sea level while the summit of Mt. Black, the highest point in the area, rises to a height of 3037 feet. Other prominent hills in the locality are Bald Hill (2047') and Colebrook Hill (1767'). The drainage of the area is effected principally by the Pieman River and its tributary the Stitt.

Climatic conditions are rather severe, the district being an extremely wet one. The average annual rainfall in the Rosebery township is 82.7 inches and in the surrounding hills and mountains it is considerably greater. The average monthly rainfall from December to March is five inches. This may be regarded as the driest period of the year. The heaviest rainfall occurs between July and September when the monthly average approaches 9 inches. The high annual rainfall is reflected in the dense forest growths which cover the greater portion of the area.

GEOLOGY:

(a) Outline of the General Geology:

The western half of the mapped area is composed principally of Lower Palaezoic sediments

which strike in a general north and south direction and dip to the west at a steep angle. These rocks are divisible into two conformable series, viz. the Rosebery or pre-Dundas series and the Dundas series. The Rosebery series is regarded as being of Cambro-Ordovician age and the Dundas series as Ordovician.

The rocks occurring in the eastern half of the area are principally quartz and felspar porphyries. These are definitely intrusive into the Lower Palaezoic sediments and are probably of Devonian age. Along certain belts the porphyries have been highly sheared and altered, and contain a few isolated blocks of sedimentary rock which have probably been derived from the intruded sediments.

A small outcrop of gabbro and a dyke of serpentine occur in the south western corner of the area. These are also of Devonian age.

Deposits of river gravels of upper Tertiary age and Pleistocene? glacial deposits overlie the older rocks. River gravels are being formed in the beds of some of the present streams.

(b) The Sedimentary Rocks:

The following table shows the sequence of the sedimentary rocks:-

| System. | Series. | Lithological Character. |
|---|---|---|
| Cambro-Ordovician. | Rosebery or pre-Dundas. | Slates, quartzites and breccia conglomerate. |
| Ordovician | Dundas. | Purple and light colored slates and fine-grained breccias. |
| Upper Tertiary | | Conglomerates gravels sands and clays. |
| Pleistocene | | Boulder clays sands and morainal deposits. |
| Recent | | Conglomerates and gravels. |

Rosebery Series: The rocks of this series consist of slates, quartzites and breccia-conglomerates. The slates may be grey, green, black or purple in colour. Usually they occur inter-bedded with quartzites, the latter forming the predominant rock type of the series. The breccia conglomerate is a coarse grained rock composed of angular and rounded fragments of chert and slate. A peculiar feature of this rock is that it is impregnated with bright green fuchsite.

These rocks have a total thickness of 5000 to 6000 feet. They occupy the eastern portion of the western half of the area. The general succession from east to west is -

2400' of slates and quartzites.
350' of breccia conglomerate and slates.
300' of purple slates.
2000' of slates and quartzites.

The general strike of these rocks is true north and south and the dip is to the west at 65° to 75°. There is some slight folding in some of the rocks but this is only of minor importance and does not affect the general structural features.

From the fact that they underlie the Dundas series, which are of Ordovician age, the rocks of the Rosebery series have been referred to the Cambro-Ordovician.

Dundas Series: These consist of purple, grey, green or black slates and fine grained breccias. The breccias are fine grained, bluish-grey or greenish rocks which closely resemble a basalt. They are composed principally of angular fragments of augite, chlorite, felspar and quartz. They occur inter-bedded with the slatey members of the series. On weathering, these rocks produce a reddish brown soil containing numerous particles of slate.

These rocks occupy a strip some forty to fifty chains wide which runs parallel to the western boundary of the area. They appear to be conformable with the rocks of the Rosebery series. In this area there is little evidence of folding and the rocks appear to strike in a true north and south direction, and dip to the west at a steep angle. However, in the country to the south and south west there is abundant evidence of folding within this series.

On evidence afforded by the re-examination of some graptolites, the age of the Dundas series has been placed as Ordovician.

Tertiary: (The Older River Gravels). These consist of unconsolidated conglomerates, gravels, sands and clays which form the dissected terraces of the Pieman River. They are overlain by the Pleistocene glacial deposits and therefore have been referred to the Tertiary. They occur at elevations ranging from 250 feet to 450 feet above sea level.

Pleistocene Glacial Deposits: These consist of typical morainal deposits and boulder clays with occasional thin beds of sand. In addition, innumerable large erratics of West Coast Range Conglomerate are scattered over a large portion of the district.

Recent Deposits: (The Younger River Gravels). These consist mainly of gravels and conglomerates forming in the beds of the present rivers and creeks.

(c) The Igneous Rocks.

The Igneous rocks of the district are divisible into the following groups:-

1. Quartz Porphyries and Felsites.
2. Felspar Porphyries,
   (i) Massive felspar porphyries.
   (ii) Sheared felspar porphyries etc.
3. Gabbro & Serpentine.

(1) Quartz Porphyries and Felsites:

The rock most typical of this group is a pale-greenish or whitish rock containing phenocrysts of quartz alone. The felsites associated with the quartz porphyries are dense, flint-like rocks which vary in colour from greyish green to green to white.

Generally these rocks are all more or less sheared, and in many places are intensely contorted. They occur along the western margin of the main porphyry mass and represent a more acid phase of the intrusion of the porphyries. In some places they pass by insensible gradations into the felspar porphyries.

(2) Felspar Porphyries:

(i) Massive types. The felspar porphyries are represented by three main rock types, viz. orthoclase porphyries, albite porphyries and porphyrites. The orthoclase porphyries are the most common. They vary in colour from dark green to greenish white to white, some types are pink while others are black and have the appearance of a chert. They are composed principally of phenocrysts of orthoclase and albite, with varying amounts of chlorite, set in a fine grained ground mass. The albite porphyries are whitish rocks similar in general appearance to some of the orthoclase porphyries. The main distinction between the two types is the predominance of either orthoclase or albite.

The porphyrites are dense greenish rock composed largely of chlorite. They contain scattered phenocrysts of felspar.

These rocks occupy the eastern half of the mapped area.

(ii) Sheared types. Closely associated with the massive porphyries described above are sheared porphyries, chloritic schists and quartz-sericite schists. These are alteration products of the massive porphyries and have been formed as a result of the shearing which preceded ore deposition and the hydrothermal action which accompanied it.

These rocks occur as two main belts. The largest of these occurs in the vicinity of the Rosebery township and its eastern edge coincides generally with the footwall of the large zinc-lead sulphide ore-body of the Rosebery mine. The second belt occurs on the Koonya and Rosebery Lodes leases.

There is abundant evidence that these schistose rocks are really derived from the massive types of porphyry. In the field every gradation may be observed from massive porphyries through sheared porphyries to chloritic and quartz-sericite schists. Furthermore the sheared porphyries and schists often contain the remains of felspar phenocrysts which may be readily observed on microscopic examination of the rocks. The chemical evidence also lends strong support to this view.

(3) Gabbro & Serpentine:

A small outcrop of gabbro occurs on the banks of the Pieman River, about fifty chains below the mouth of Natone Creek.

A broad serpentine dyke occurs along a spur which trends north west from Colebrook Hill. Two small dykes have also been observed along the Wilson River track just beyond the western boundary of the area. No osmiridium appears to have been shed from these dykes.

(d) Sedimentary rocks occurring within the massive and sheared porphyries.

Four isolated areas of sedimentary rock occur entirely enclosed by the massive and sheared porphyries. They consist principally of black and grey slates with subordinate bands of dark grit and calcareous rocks. The exact processes by which these rocks attained their present positions cannot be fully explained but it is probable that they have been derived from the Rosebery series or from rocks which were underlying them. They may be regarded therefore as xenoliths or roof pendants.

The most important belt occurs on the hanging wall of the zinc lead ore-body of the Rosebery Mine. The rocks of this belt consist mainly of black slates. They form an elongated band 4400 feet long by 200 feet wide which dips to the east at an average angle of 45°.

Another large belt of slates occurs immediately west of the ore bins and the third one extends southwards from the recreation reserve. A small lens of black slates also occurs in the lower workings of the Salisbury Mine which are entirely within the quartz porphyries.

What is possibly another of these lenses occurs on the Rosebery Lodes Mine. It does not outcrop at the surface but some black slates were observed on the dump of an old shaft sunk in sheared porphyries.

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## PART II

### THE ORE DEPOSITS.

Zinc and lead form the chief metal products of the district, the whole of the output being produced by the Electrolytic Zinc Company's Rosebery Mine. In addition there are lodes containing tin and copper. Other small quartz-tourmaline and fluorite veins contain variable amounts of metallic sulphides. Small quantities of alluvial gold occur in several of the creeks and in the Tertiary river gravels.

The Zinc lead ore Bodies. These are massive sulphide lodes consisting of a fine grained intimate admixture of zinc-blende, pyrite and galena, with minor quantities of carbonates and quartz as gangue minerals. The ore is usually banded.

The average mineralogical composition of the ore is given by the following table:

| Metallic Minerals. | | Non-Metallic Minerals. | |
|---|---|---|---|
| Sphalerite | 35.2 | Quartz | 7.8 |
| Pyrite | 31.0 | Sericite & Aluminous Silicates | 6.7 |
| Galena | 7.3 | Barite | 2.5 |
| Chalcopyrite | .9 | Rhodochrosite | 2.2 |
| Arsenopyrite | .7 | | |
| Tetrahedrite & Bournonite | .25 -.40 | Dolomite) | |
| Magnetite and Ilmenite | .5 | Calcite ) | 3.2 |
| | | Ankerite ) | |
| | | Orthoclose & Albite | 1.6 |
| | 76% | | 24% |

The average assay value is as follows:-

| Zn% | Pb% | Cu% | Ag ozs. | Au dwts. |
|---|---|---|---|---|
| 21.3 | 6.4 | .5 | 8.5 | 2.12 |

The most important of the zinc-lead lodes is that of the Rosebery mine. This lode extends over a total linear distance of four thousand feet. It lies for the greater part of its length on the western side of an elongated belt of slates occuring within the porphyries. The slate belt is 4,400 feet long and has an average thickness of 200 feet. It strikes N 20°W and dips to the east at an average angle of 45°. The lode conform to the slates both in strike and dip. The rocks on the eastern side of the slates are all massive porphyries. Those on the western side, i.e. .. forming the footwall of the lode, consist of sheared porphyries, chloritic schists and quartz sericite schists. Although the lode may be said to be continuous over a total length of four thousand feet there are at least four fairly consistent breaks in the continuity of the massive sulphide ore, so that the lode may be split up into five shoots or lenses. The No.1 lens occurs at the southern end of the mine. It has a length of 1000 feet and an average width of 20 to 25 feet. Its maximum width is approximately 60 feet. The No. 2 lens occurs immediately north of No.1 but is separated from it by a low grade portion

of the lode which varies in length from 30 feet to 200 feet. No.2 lens varies in length from 300 to 600 feet and has an average width of 20 feet. No. 3 lens occurs about two hundred feet north of No. 2. It is a comparatively small low grade shoot. The remaining lenses have been called Nos. 4A and 4B respectively. It seems probable that these will junction in depth and they should yield a large quantity of ore.

Other smaller zinc-lead occurring in the area are those of the Koonya, Dalmeny and Black P.A. sections. These are situated entirely within sheared porphyries &c. They are of little or no value.

Two possible modes of deposition of the zinc-lead deposits are:-

(1) replacements of the sheared porphyries, and quartz-sericite schists &c.

(2) simple fissure veins.

Evidence as to replacement is afforded by the presence of sericite, chlorite, magnetite and ilmenite. On the other hand the walls of the lodes are often sharp and well defined, and, in many cases, a number of vein like tongues may be seen penetrating the slate hanging walls of the Rosebery Mine. The lodes on the Hercules Mine, some five miles to the south of Rosebery, appear to be replacement deposits.

Tourmaline and Fluorite Veins. These are mainly simple fissure veins containing pyrite, chalcopyrite, galena, jamesonite, bismuthinite, sphalerite, tourmaline, fluorite, quartz, siderite, ankerite and calcite. In addition small amounts of gold and silver are generally present. The relative amounts of these minerals present in the several veins shows considerable variation.

The largest veins of this type are situated on the Mt. Black, Chamberlain, Salisbury and Rosebery Lodes Mines. They occur either in massive or sheared porphyries. A small galena-jamesonite-fluorite vein on the Salisbury mine ocurs on the eastern margin of a very small lens of slate occurring in a quartz porphyry.

The tourmaline and fluorite veins are of no economic value.

Pyritic Copper Ore. The only deposit of this type is that occurring in the Grand Centre Adit, which is situated a little to the south of the Koonya workings. The ore body is about thirty feet long and one foot wide, and consists of a dense pyrite-chalcopyrite vein containing a little quartz and siderite as gangue minerals. The deposit is of no value.

The Axinite-chalcopyrite Deposits of Colebrook Hill. These contain pyrrhotite, chalcopyrite and arsenopyrite. The gangue minerals are chiefly axinite, actinolite and calcite. Axinite and actinolite constitute at least 75% of the ore.

These deposits occur entirely within the Dundas slates and breccias and have been deposited by processes of replacement. They are irregular in shape. They vary in length from 50 to 100 feet and in width from 20 to 60 feet. The average copper content is .5%.

Tin Deposits. These consist mainly of quartz veins containing pyrite, cassiterite, chalcopyrite, actinolite and tourmaline. The veins occur entirely within the

Dundas slates and breccias, and penetrate small joints, fractures and bedding planes within these rocks. The largest vein has been traced over a distance of 500 feet on the surface and for 120 feet underground. The highest assay from this vein was 1% Sn.

The tin bearing veins occur in the south west corner of the area.

## RELATIONSHIPS BETWEEN THE ORE BODIES AND THE GEOLOGICAL FEATURES

Viewed broadly, the area is divisible into two main portions, viz. a western portion composed mainly of sedimentary rocks ranging in age from Cambrian to ordovician, and an eastern portion composed of acid porphyries. The contact between the sedimentary and igneous rocks, being fundamentally a line of weakness, has provided relief for dynamic earth movement the major portion of which has taken place within the quartz porphyries and along the western margin of the felspar porphyries. Furthermore the shearing forces have attained their maximum in the vicinity of isolated areas of sedimentary rock occuring within the porphyries.

Theoretically, this sheared margin of the acid igneous rocks should form a favourable zone for the formation of metalliferous deposits, and, in fact, this has been the case. Ore deposits have been formed within the quartz porphyries, within the sheared felspar porphyries, along the contacts of sheared porphyries with included sedimentary xenoliths, and occasionally, within massive porphyries.

The ore bodies occurring within massive felspar porphyries are of no importance and consist mainly of quartz-tourmaline-pyrite veins. The lodes occurring within the quartz porphyries are of a similar type.

The sheared felspar porphyries, with which are included the quartz-sericite and chloritic schists, contain lodes of greater relative importance. These include the zinc-lead lodes of the Koonya, Dalmeny and Black P.A. sections. In the vicinity of these lodes the porphyries often exhibit a considerable degree of alteration, the extent and nature of which is roughly proportional to the size of the contained ore body. Although the sheared porphyries have produced lodes which may have warranted prospecting, they have so far produced no ore body of any value most of the lodes being too small to be of economic value.

The most important and only payable lode within the district is the zinc-lead ore body of the Rosebery Mine. This occurs along the contact of a large isolated belt of sedimentary rocks, consisting principally of slates, which is enclosed within massive and sheared porphyries etc. The longitudinal extent of the lode coincides roughly with that of the slates, and, although the point of termination of the lode, at both its northern and southern ends, does not coincide exactly with that of the slates, it is apparent that the contact between the slates and the sheared porphyries has provided a favourable line of weakness for the injection of the metalliferous solutions.

Other smaller lodes associated with included slatey bands are the small galena-jamesonite-fluorite vein on the Salisbury Mine and possibly the pyrite-jamesonite-tourmaline vein on the Rosebery Lodes Mine. In these cases the sedimentary bands were not sufficiently large to provide adequate lines of weakness for the circulation of the ore bearing solutions.

Among the sedimentary rocks of the western belt, the Dundas slates and breccias alone have been found to contain metalliferous deposits. Neither of the deposits occuring in the slates and breccias, viz.

the tin veins and the axinite-chalcopyrite deposits, are of any economic importance, but, as the Dundas slates and breccias have been found to contain payable ore bodies elsewhere, they must not be regarded as being barren, and, though they themselves are not to be regarded as a possible source of mineralising solutions, they form favourable hosts for their deposition.

The relationships between the ore bodies and the geological features indicate that, with the exception of the Dundas slates and breccias, the sedimentary rocks are likely to prove barren, and that the most favourable zone for future prospecting operations in the vicinity of this area is the sheared and fractured margin of the porphyries. Furthermore, payable ore bodies are most likely to occur near isolated sedimentary belts occurring within this sheared margin. The fact that there are included sedimentary bands with which no ore bodies are associated does not detract from the value of this theory and it must be regarded as significant that the only payble zinc-lead ore bodies of both the Rosebery and Mt. Read districts are associated with isolated areas of slatey sedimentary rocks which are enclosed by massive and sheared porphyries. The nature of the association is slightly different in each of these deposits but the underlying principle remains the same, viz. that the vicinity of these large sedimentary bands provides an adequate line of weakness for the injection and percolation of the mineralising solutions.

GENESIS OF THE ORE DEPOSITS

The mineralising solutions are regarded as being derived from the same primary magma as the porphyries. The various types of ore deposits are regarded as distinct phases of one general period of ore deposition.

ALLUVIAL GOLD

Small amounts of alluvial gold occur in many of the Recent and Tertiary gravels and in the beds of the present streams but the amount present is never sufficient to enable it to be mined at a profit. The greater portion of this gold has been shed from the oxidised lode capping of the Rosebery and Hercules Mines. Gold occurring in gravels to the north of the Stitt River has been derived from the Rosebery and that in the gravels of the Natone Valley has been derived from the Hercules, and Mt. Read lodes.

In view of recent activities in connection with the Williamsford Deep Lead there has been much speculation as to the probable position of the outlet at Rosebery. The main bed of gravels, sands and glacial beds extends along the Natone Valley and passes between the 70½ and 71 mile pegs, on the Emu Bay Railway line. It enters the Pieman between the mouth of the Stitt River and Natone Creek. From the following considerations it is highly improbable that gold is present in payable quantities in the gravels of this old valley. There are:-

(1) Any gold present in these gravels must have been derived from the Hercules and Mt. Read Mines.

(2) The Williamsford Deep Lead, which is quite close to the source of the gold has been proved, quite definitely, to be unpayable.

(3) As the distance from the source of the gold increases the gold content of the gravels will decrease. The deeper ground in this district is at least five miles from the source of the gold.

CONCLUSIONS

The future of the district depends entirely on that of the Rosebery Mine. The other zinc-lead ore bodies are quite unlikely to yield the large quantities of ore which are necessary to make a successful mine. The Black P.A. and Dalmeny sections do not warrant further prospecting or development work. The Konnya mine offers greater promise than either of these and may yield a very small quantity of ore, but no extensive developments are to be expected from this mine.

With regard to the Rosebery Mine there is ample scope for future development work. The Nos. 2, 4A and 4B lenses should yield a large quantity of ore above No.8 level, and conditions are favourable for the downward continuation of Nos. 1 and 2 lenses below No.8 level. The profitable working of this mine is dependant on the ruling prices for lead and zinc. The present detailed survey has revealed some interesting and useful facts regarding the general and economic geology of the district. Chief among these, from the economic standpoint, are:-

(1) The greater number of the ore bodies occur along the sheared and fractured margin of the porphyries; and

(2) Ore bodies are likely to occur along the margin of large sedimentary xenoliths occurring within the sheared porphyries.

These facts should be generally applicable to the main belt of porphyries of the West Coast and should be borne in mind in future prospecting operations along that belt.

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