SULPHIDE DEPOSITS SUITABLE FOR THE PRODUCTION OF SULPHUR OR SULPHURIC ACID

Although Tasmania does not contain deposits of native sulphur, it does possess several large sulphide deposits. These are of such a nature that they can be used for the production of sulphur or, what is more probable, for the manufacture of sulphuric acid.

Pyrite occurs at the Mt. Lyell Mine and also at the Chester Mine. Zinc-lead sulphide ores consisting of an intimate mixture of galena and sphalerite occur in the Mt. Read and Rosebery districts. Pyrrhotite and marcasite containing cassiterite occur at Mt. Bischoff and Renison Bell and form large low grade tin deposits which may possibly be used for their sulphur content in the future. The pyrite from the Mt. Lyell and Chester Mines has been exported in considerable quantities for the manufacture of sulphuric acid. The Electrolytic Zinc Coy. are commencing to use con-centrated ores from the Read-Rosebery deposits for the manufacture of sulphuric acid and then superphosphate.

PYRITIC DEPOSITS.

1. Chester Pyritic Deposit - This deposit is situated on the eastern fall of Mt. Kershaw, 7½ miles to the north of the township of Rosebery on the West Coast district. Transport facilities are good, the mine being connected by one mile of narrow-gauge tramway with Chester siding. The latter is situated on the Emu Bay Railway 63 miles from the Seaport of Burnie on the North Coast. This railway also connects the field with Zeehan and also the port of Strahan on Macquarie Harbour.

The ore-body occurs in sheared porphyries, chloritic schists and quartz-sericite schists which form the margin of an intrusive series of porphyries of Devonian Age.

The predominant mineral constituent of the ore-body is pyrite; accessary minerals are chalcopyrite, galena, sphalerite, haematite, and limonite. Associated gangue minerals are pyrophyllite, barite, calcite dolomite, chlorite and talc. The ore-bodies consist essentially of pyrite in schistose and siliceous gangue - mostly pyrophyllite and quartz.

The pyrite deposits are typically lenticular in form, coinciding in strike and dip with the planes of schistosity of the enclosing rock. The strike varies from 10° to 20° east of north; the dip is 60° to 65° in a south-easterly direction. The thickness of the lenses varies from 20 to 280 feet, their horizontal length on the surface at the main workings has been proved to exceed 600 feet, and may be continuous with the south-west workings 1500 feet distant. The extent and value of the ore-body has been proved by diamond drilling to a depth of 300 feet below the outcrop.

The ore-body is not homogeneous throughout, but contains lenses of varying composition from those with less 10 per cent. sulphur to those with over 30 per cent. sulphur.

The deposit was worked by the Mount Lyell Mining and Railway Coy. the pyrite being shipped to Melbourne for manufacturing sulphuric acid in their superphosphate works. The outcrop was favourably situated for working by open cut and adits and these methods were adopted.

The estimate of probable ore down to the depth at which drilling has been carried out is 2,856,000 metric tons containing over 20 per cent. sulphur. Below this depth there are large possible reserves. The reserves of sulphides containing over 35 per cent. sulphur form a small proportion of the above but cannot be expressed in figures.

The total quantity of ore sent to the sulphuric acid works up till 30th September is given as 36,223 tons with an average of 37.25 per cent sulphur, the total number of units of sulphur being 1,349,412. Fuller particulars of this deposit and the working thereof are given in Tasmanian Geological Survey Bulletin No. 28.

2. The Mount Lyell Pyritic Deposit - The Mt. Lyell Group of mines is situated in the vicinity of the townships of Queenstown and Gormanston in the West Coast district of Tasmania. Queenstown is connected by railway with the port of Strahan on Macquarie Harbour, which is connected by Government Railway with Zeehan and thence by the Emu Bay Line with the Railway System of the State.

The ore-bodies of Mt. Lyell occur in a series of schists in faulted relation to which a series of conglomerates are found. The main fault has a general north and south direction and numerous traverse faults are associated with it. The schists lie to the west of the main fault and the conglomerates to the east.

The deposits are of two types (1) mineralised bands of schist and (2) great lens-shaped masses of very pure sulphide ores. It is the latter type that is being considered here and of this type the Mt. Lyell and South Lyell bodies are the most important. These two deposits consist almost entirely of pyrite containing copper, gold and silver. The Mt. Lyell ore-body is described by J.W. Gregory as being "irregularly boat-shaped in form consisting of an elliptical mass, which tapers gradually downward and is then cut off below with a rounded base". The length at the outcrop was 800 feet and the width 200 feet. It has been worked to a depth of several hundred feet by a large open-cut and to still greater depths by underground workings, the depth of the deposit being about 730. The South Lyell deposits probably represent the faulted extension of the Mt. Lyell deposit at depth. The ores of the deposit are of remarkable uniformity and purity. They consist almost entirely of iron pyrites containing copper, gold, and silver. There is a little galena and less sphaleritie present. The only important minerals forming gangue are quartz and barite.

The average composition of the ore it was considered payable to extract in 1902 was:-

Iron	40.30	per cent
Silica	4.42	" "
Barium sulphate	2.50	" "
Copper	2.35	" "
Alumina	2.04	" "
Sulphur	46.50	" "

Small shoots of richer ore (as regards copper, gold, silver) occurred but were soon extracted. They were more silicious and the copper minerals were barite and chalcopyrite. The average analysis of these ores was:-

Iron	24.75	per cent
Silica	30.69	" "
Barium Sulphate	1.48	" "
Copper	5.33	" "
Alumina	6.30	" "
Sulphur	30.00	" "

Other rich and small shoots contained tetrahedrite, redruthite and argentite and were also found and extracted.

The estimate of reserves by Mr. R.M. Murray, General Manager, at 30th September, 1924, are:-

Actual:-	1,666,680 metric tons
Actual in 1931	1,616,894 tons averaging $44^{o}6S$.
Probable)	Very small
Possible)	

The material varies in quality from footwall to hanging wall, that on the latter being the purer pyrite. The following approximate analysis may be taken as an average of the whole reserve:-

Copper	0.5	per cent
Gold	0.04	ozs.
Silver	1.5	
Iron	38.0	per cent
Sulphur	44.0	" "
Lead	1.5	" "
Zinc	2.0	" "
Arsenic	0.3	" "
Insoluble (including SiO_2 $Al2O_3$ & BaSO4)	13.7	" "

The ore from the Mt. Lyell mine, together with that from other neighbouring mines, e.g. the North Mt. Lyell has been smelted since 1896 by the Mt. Lyell Mining and Railway Coy. for the production of blister copper containing gold and silver.

In addition large amounts of the pyrite from the Mt. Lyell mine itself have been exported to Melbourne and utilized in the Company's Sulphuric Acid and Superphosphate plant for the manufacture of these materials, thus taking advantage of the sulphur content of the ore.

THE READ ROSEBERY ZINC LEAD SULPHIDE DEPOSITS.

These deposits occur in an area embracing Mt. Read and the township of Rosebery in the West Coast district of Tasmania.

The Emu Bay Railway from Burnie (a seaport on the North Coast) to Zeehan passes through Rosebery (71 miles from Burnie). A road four miles in length connects Williamsford with Rosebery. Williamsford is also connected by the North East Dundas tramway (two foot gauge) from Zeehan. Zeehan is connected by the Government Railway with Strahan on Macquarie Harbour.

The area in which the ores occur is composed of Ordovician and Cambro-Ordovician strata consisting of slates, breccias and quartzites. These are intruded by Devonian porphyries. Along their contact with the sedimentary rocks, the prophyries are sheared and altered and have been converted into quartz-sericite and chloritic schists.

The ore bodies occur in association with sedimentary xenaliths occurring in these sheared porphyries. The ores are chiefly those of zinc and lead and are referred to as Zinc-lead sulphide deposits. The deposits are considered to be genetically associated with the intrusions of Devonian porphyry.

The ore is generally very fine grained and consists of an intimate mixture of sphalerite, pyrite, galena, etc. but veins of coarsely crystalline minerals also occur. The ore is typically banded due to the occurrence of alternating bands of varying composition. The boundary between ore and country rock is sharp.

The average zinc lead sulphide ore has the following mineralogical composition:-

K.J.Finnucane 1932

Zinc blende	43.3 per cent	35.2 percent
Pyrite	31.0 " "	31 "
Galena	10.4 " "	7.3 "
Quartz	5.5 " "	7.8
Silicate of alumina	2.5 " "	6.7 "
Calcite (& ankerite & Dolomite 1932)	2.4 " "	3.2 "
Barite	1.5 " "	2.5 "
Chalcopyrite	1.2 " "	.9 "
Rhodochrodite	1.2 " "	2.2 "
Tetrahedrite & Bournanite(1932)	0.1 " "	.25-.40"
Silver	10oz. per ton	8.5 ozs.
Gold	3 dwt.	2.12 dwts.
Arsenopyrite		.7 per cent
Orthoclase & Albite		1.6 " "

Although a great part of the ore-bodies contains over 90% sulphides yet on the average they contain approximately 76% sulphide and 24% gangue. The chemical composition of the average zinc-lead sulphide is:-

Sulphur	36.2 per cent	28.7
Zinc	27.3	21.3
Iron	18.0	16.9
Silica	7.2	9.5
Lead	7.1	6.4
Alumina	2.2	6.10
Copper	0.9	.5
Magnesia	0.2	.5
Lime	Trace	.3
Silver	10.5 ozs. per ton	8.5
Gold	0.15 " " "	2.12

The size of the ore-bodies as discolosed by mine workings is indicated in the following table :9

Name of Ore-body	Length ft.	Max Width ft.	Av.Width ft.	Proved Vert.Extent ft.
"E" Ore-body Hercules	300	100	50	400
"B" C,D" Ore body	400	75	60	250
"A" Ore body	300	40	20	250
Large Lens Mt.Read	450	100	50	110
Ore-body Rosebery	200	60	25	800 feet

In June 1927 the ore reserves were estimated at a minimum of 1,400,000 tons, the development work since that time has added considerably to these reserves and the amount of 2,000,000 tons could probably be taken as a conservative figure. Based on a 28.7 sulphur content, the equivalent reserve of sulphur would be equal to 574,000 tons.

Up till recent years attempts were made to mine and in some cases treat the ores from the numerous mines separately, but these ventures were almost entirely unsuccessful. The production of zinc lead ore during this period amounted to 301,652 metric tons, with a value of £383,416.

The first attempt to amalgamate interests was made by the Mt. Lyell M. & R. Coy. who included the Hercules, Tasmanian Copper and Primrose Mines with others under the title of the Mt. Read and Rosebery Mines Ltd. Later the Electrolytic Zinc Coy. took over these properties and are now operating thereon. The ore is mined and then transported by rail to the treatment plant at Zeehan. It is then treated in order to effect as complete a separation of the zinc and lead portions as possible. The argentiferous galena is shipped to the lead smelters at Pt.Pirie, South Australia. The zinc concentrates are roasted and the calcined material (approx. 6% sulphur) shipped to Risdon. The sulphur dioxide from this process is not utilized at present for sulphuric acid manufacture.

The calcines from Zeehan and those from Broken Hill, N.S.W. (which at present form the bulk of the supply) are then used for the production of electrolytic zinc. They are first roasted to further reduce the sulphur content (6%) and then dissolved in the acid solution from the cells. The undissolved and suspended material is removed from the solutions in two stages. The coarser material is removed first and consists mainly of unoxidised zinc sulphide. This product is further utilized in the manufacture of sulphuric acid and subsequently superphosphate, and also of electrolytic zinc. It is dried and then roasted in Herreshoff furnaces the sulphur dioxide gas being used in the sulphuric plant (Schmiedel Process), while the calcined material is taken back into the main process for the manufacture of electrolytic Zinc.

Part of the sulphur of zinc-lead sulphide ores, both from Tasmania and Broken Hill is thus being used in the manufacture of sulphuric acid and Superphosphate.

LOW-GRADE TIN-BEARING PYRITIC DEPOSITS

Large deposits of pyritic minerals containing cassiterite occur at several localities in Tasmania. The principal ones are those at Mt. Bischoff and Renison Bell.

Mt. Bischoff is the locality of the well known tin mine of that name. It is situated at Waratah in north-western Tasmania which township is connected by a branch line, 10 miles in length, with the Emu Bay Railway at Guildford 38 miles from Burnie. Various types of lodes and ore bodies occur within this mine, and have, and are being, worked for their tin content. One type consists of bodies of pyritic minerals

containing small amounts of cassiterite. These ore-bodies represent replacements of dolomites which were formed by alteration of ultrabasic intrusive rocks. The pyritic ore mineral is mainly phyrrhotite, but large amounts of marcasite probably formed from the phyrrhotite are also found. The pyrite in the ore at present being treated is recovered on concentrating tables and then calcined prior to further treatment for its content of cassiterite. The sulphide dioxide from the calcination is not utilized at present.

In the treatment of the whole of these pyritic deposits, the possibility of the utilization of the sulphur as well as the tin content of the ore must be taken into consideration.

Similar low grade pyritic tin deposits occur at the Renison Bell mine. This mine is situated adjacent to the siding of the same name on the Emu Bay Railway from Burnie to Zeehan, being 78 miles from the former terminus and port. These deposits are of the same nature and occur under similar geological conditions as the pyritic ones at Mt. Bischoff. There is the same possibility of utilization of the ore for both the tin and sulphur content.

signed

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