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THE MOINA TUNGSTEN-TIN-BISMUTH
PROJECT

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Tungsten - Tin - Bismuth

Project

by

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Tungsten - Tin - BismuthProject1. Past Mining Operations.

The present project is designed to reopen and work the S. & M. Mine at Moina, Tasmania.

The S. & M. lodes were discovered in 1893. Surface trenching during the next few years disclosed seven lodes. The Shepherd and Murphy Tin Mining Coy, was formed in Launceston in 1895. That Company drove the adits including the lowest (No.3) which constituted the main haulage level for many years. But the complexity of the concentrates prevented adequate profits and operations were suspended. In 1906 Mr. A. Hinman one of the Directors succeeded in interesting a London group and the S. & M. Syndicate (London) took over the mine. A mill was erected but the concentrates again presented a difficulty. In 1907 the writer was engaged to tackle the problem. A successful process was evolved based on electro-magnetic separation and a plant erected in Launceston to treat the concentrates. For the next 10 years (1908-1918) good profits were made and yearly dividends of upwards of 50% were paid.

Late in 1918 a bushfire destroyed all surface equipment including the mill. A new mill was erected incorporating the electro-magnetic separation plant transferred from Launceston. This was completed in 1921 and milling was resumed. However, the only ore treated was that which had been mined during the interval and stored in stopes and ore-passes. No Mining was done after the mill started because in 1922 the collapse of the metal market compelled the London Directors to order all operations to cease.

The mine has remained idle since then.

The complete mill was subsequently sold to the Aberfoyle Coy.

From first to last the S. & M. Mine yielded 75,000 tons of ore which produced 1300 tons of saleable concentrates. At present prices those concentrates would have been worth £1,300,000.

2. The Known Lodes.

As originally exposed by trenching, seven lodes were proved to exist. From south to north these were named, 1, 2, 3, 4, 5A, 5 and 6. A little later the North-West branch of No. 6 was located. Of these lodes only Nos. 2, 4, 6 and the North-West Branch were worked by the S & M.

Since the closing down in 1922 a group of 3 more lodes about 100 feet north of the eastern portion of No.6 Lode were discovered. They have been exposed by trenches and a short adit.

The Proved length of the lodes as worked underground are:-

No.2 Lode 650 feet.
No.4 Lode 1200 feet.
No.6 Lode 700 feet.
North-West Branch 300 feet.

The general width of these four lodes as worked is from 9 inches to 18 inches reaching 24 inches as a usual maximum, although the North-West Branch widens to 36 inches at No.3 level. Occasionally the lodes split into two branches the combined width of which equals the unsplit lode. These were mined in the one stope and this explains the 7 feet width of some old stopes.

The primary unoxidised ore consists of a quartz gangue with disseminated cassiterite, wolfram, bismuthinite and pyrite. Each mineral has a separate entity and there is very little if any intergrowth. The ore is thus easily free-milling requiring simple cracking rather than grinding. The values are evenly distributed along the whole length of the lodes, there being no evidence of "ore shoots". The cassiterite tends to concentrate along the walls. The character and value of No.6 lode at the deepest level (150 feet below No.3 Adit) show no change or diminution; the other lodes have not been opened up at that deepest level.

Lodes Nos. 1, 3, 5 and 5A where exposed in trenches are narrower than the four worked. They are of the same general character and although ignored in the past should not be neglected in the future.

The group of 3 Lodes north of No.6 show at their single exposures a width of from 9 inches to 12 inches with characteristics similar to the worked lodes.

3. Scope for Exploration in Geologic Structure.

As the outcome of a recent investigation of the geologic structure of the area made by the writer an important possibility has emerged. To understand and appreciate this, cognisance of the following geologic facts is essential:-

- (1) The S. & M. lodes strike east-west and are practically vertical.
- (2) The eastern two-thirds of the length of the proved lodes occur in quartzites and sandstones striking north-south and dipping west at 20 degrees - 40 degrees; the western one-third occurs in garnet rock or "skarn" (metamorphosed limestone) which overlies conformably the quartzites and therefore also dips westwards.
- (3) The "contact" between the quartzites and "skarn" strikes north-south.
- (4) Thus the S & M. locality has a north-south strike, whereas both to east and west the strike of both rock-types is about east-west.
- (5) The explanation of this previously unexplained anomaly is that the S. & M. consists of an anticline with east-west axis pitching westwards at from 30 deg. - 40 deg.
- (6) The known S. & M. lodes in the southern limb of the anticline.
- (7) The northern limb of the anticline is covered by surface basalt and has never been seen.

- (8) The S. & M. mineralisation comes from a granitic cupola which rose into the anticline, metamorphosed the limestone and emitted the ore-bearing solutions which traversed the fractures formed during the folding movements.

There are therefore intriguing possibilities for exploration within the northern half of the anticline which is virgin ground. There are no valid reasons why fracturing would be confined to one half of the anticline. Pronounced puckering occurs in the "skarn" rock indicating intense pressure within the fold. Shearing can be expected throughout the anticline. It is quite clear incidentally that the past S. & M. operations did not disclose all the lodes because they did not find the three lodes later exposed north of No. 6 Lode.

A recent discovery of considerable significance is that of a replacement deposit in the "skarn" on the east side of the "glory-hole" emergence of the ore-pass down to No. 3 Adit. Over a width of 5 feet, cassiterite and wolfram occur in a decomposed partly silicified "skarn". Nothing like this was ever worked ore recorded in the S. & M. days. But during the removal for road-metal of the No. 3 Adit mullock dump, a patch of such silicified replacement material was spotted and washed for the recovery of 3 cwt. of concentrates or about 10%. Tracing the progress of the dumping from No. 3 adit, the location of this patch would correspond to that part of the adit near the ore-pass. Was it passed through unnoticed when the No. 3 Adit was driven? That would be in May 1901, 3 months after G.A. Waller visited the mine. By the time W.H. Twelvetrees visited the mine in 1907, the white quartz lodes had been cut and attention was focussed on them. It is some-what difficult to realise that such rich ore was missed, but its appearance is so similar to the "skarn" that those looking for quartz lodes could conceivably pass it by.

No. 3 Adit has collapsed at the portal and must be picked up and retimbered before this interesting problem can be solved.

The structural environment is undoubtedly conducive to shearing and the forming of replacement deposits. The known lodes are fissure fillings. The long-known disseminations of bismuthinite in the "skarn" (so far too sparse to have any economic importance) are replacements. Are there partially silicified replacement bodies to be found and worked? The task of exploring for them lies ahead.

The North-West Branch Lode is a Counter Lode. Such structural types do not usually occur singly. For example at Kalgoorlie the Counter Lodes, scarcely recognised in the earlier days, now yield an appreciable portion of the output. Future mining operations at the S. & M. must look for them.

4. Initial Basis of Mining Operations.

Nos. 2, 4, 6 and North-West Branch Lodes form a sound basis for initiating mining operations. It is best to assume that these lodes have been worked out above the No. 3 Adit Level (No. 1 level) The Main Shaft was sunk to 175 feet below No. 3 Adit with No. 2 Level at 75 feet and No. 3 Level at 150 feet.

At No. 2 Level only No. 6 Lode was crosscutted to. It was driven on for 700 feet and has been stoped up to No. 1 Level.

At No. 3 Level Nos. 6, 5, 4 and 2 were cut but only No. 6 opened up. The latter lode was driven on for 630 feet and the North-West Branch for 380 feet. Stopping was commenced but had not proceeded far when mining ceased.

Thus the position at present is:-

No. 6 Lode: - Greater part untouched between Nos. 3 and 2 Levels.

North-West Branch:- Greater part untouched between Nos. 3 and 2 Levels.

No. 5 Lode:- Untouched between No. 3 Level and No. 1 Level.

No. 4 Lode:- Partly driven on at No. 3 Level. Virgin between Nos. 3 and 1 Levels.

No. 2 Lode:- Virgin between Nos. 3 and 1 Levels.

Therefore, following upon unwatering, reconditioning and equipping the Main Shaft (3 compartments each 4 feet by 4 feet) with winding engine etc., stoping, preparation for stoping and driving could immediately proceed. It would be advisable to concurrently start sinking the shaft another 100 feet.

5. The Exploratory Campaign.

While the known lodes are being so exploited exploration for new lodes should begin. First of all will be an examination of No. 3 Adit north of No. 6 Lode to see whether the replacement lode was actually cut or not. Depending on the details observed driving eastward may be justified.

A diamond-drilling outfit equipped for underground drilling should be set to work at the No. 3 Level. Drilling should begin near the eastern end of the drive on No. 6 Lode, directed horizontally northwards to locate the group of three lodes.

Systematic northward directed horizontal drill-holes will initiate the search for lodes - fissure-fillings or replacements - in the northern limb of the anticline.

The search for evidence of Counter Lodes in the old workings must be regarded as part of the task of exploration. A detailed examination of all cross-cuts for evidence of replacement deposits should be undertaken as soon as possible.

6. The Essentials in Milling.

The economic minerals in the ore occur as separate aggregates and are recoverable in sizes from $\frac{1}{2}$ inch downwards. Simple cracking by jaw-breakers and rolls effects the freeing of the three economic minerals - cassiterite, wolfram and bismuthinite.

The presence of Pyrite in the primary ore necessitates the production of two types of concentrates - firsts and seconds. The firsts are amenable to electro-magnetic separation with the production of immediately saleable products. Direct electro-magnetic separation of the seconds produces an immediately saleable wolfram product together with a non-magnetic residue which needs further

treatment. Such treatment consists of closely controlled low-temperature roasting, followed by electro-magnetic separation, which yields a non-magnetic residue of tin-bismuth. This has to be raised in grade by retabing or hand-sluicing to eliminate quartz, flourspar and other gargue material. The final product is the saleable one.

An essential feature in milling which must always be borne in mind is to recover the economic mineral immediately it is freed from the gangue.

Attention must be drawn to the fact that in past mining operations it was found impossible to mine the lode material without taking appreciable amounts of wall-rock. This is because there is no "selvage" or "dig" on the walls, the lode being "frozen" on to the wall-rock. In practice it was found that the crude ore sent to the mill consisted of 75% of wall-rock. This condition will characterise the future. Face sampling of the lodes therefore is not a measure of the value of the mill-feed.

The recovery in the S. & M. mill with the total throughput of 75,000 tons was 1.8% of concentrates. This remained remarkably constant over the 12 years. It is interesting to note that at Aberfoyle at present the recovery of concentrates is also 1.8%.

7. Steps Leading to Production

The Moina Tungsten-tin-bismuth project is rather exceptional in that mine reopening and mill construction can proceed immediately and coincidentally. The mill-site should be adjacent to the shaft-head.

Fortunately the old water-race which supplied power to the old S. & M. is in good order. The first step, apart from reopening No. 3 Adit, is to instal a new penstock and pipe-line. This power will be used for unwatering the shaft. The static head is 390 feet.

Erection of head frame at the shaft and winding engine, reconditioning of the shaft and No. 3 Level, erection of the mill and the provision of housing should proceed concurrently.

The design of the mill should be based on that at Aberfoyle which is a remodelled form of the old S. & M mill. The capacity of the first unit should be 5 tons per hour.

In the old S. & M. days the power supply was subject to summer failure. Water-power yielded 37 H.P. but in dry seasons this source failed and milling was often suspended during summer months. The winding engine was driven by a steam plant and an auxiliary steam-plant ran the air-compressors in dry periods.

It is clear therefore that apart from the utilisation of the 37 H.P. from the water-race it will be necessary to use diesel power. The State Hydro Electric power lines at Eriba are within 4 miles of the mine but at the present time the Government is not in a position to provide the extension. However, such connection with the State's Hydro Electric grid system is an important economic factor which should be availed of at the earliest possible date.

There are no difficulties of access as a good motor road goes right to the mine. The total distance by road from Devonport is 30 miles.

There is no fundamental reason why production should not begin in 6 months from the initiation of operations.

8. Capital Cost.

No really heavy equipment is called for. Milling at the rate of 500 tons per month on a one-shift basis will require only light units. The shaft equipment to provide for the first five years work need be no more than that required for a 500 ft. lift. There will be no large buildings, that to house the mill being the largest.

Housing for staff and employees will have to be provided, but this position will be eased, at least in the early stages by motor transporting of workers from Wilmot (11 miles).

Apart from the cash outlay on equipment and wages and salaries during the construction campaign, it is essential to have an adequate reserve of working capital. It would be safest to allow for an unproductive period of 12 months.

It is estimated that £150,000 will meet the anticipated requirements and allow reasonable provision for contingencies.

9. Operating Costs and Estimated Profit.

All standards of operating costs have been massacred by inflation. Nevertheless there is some significance in the following conditions which characterised the old S. & M. days:-

Miners	8/4 per shift.
Tin	22/- per unit
Wolfram	60/- per unit
Bismuth	3/2 per lb.

The conditions today are:-

Miners	45/- per shift
Tin	110/- per unit
Wolfram	570/- per unit
Bismuth	18/9 per lb.

It is clear from the above figures that resumption of mining and milling at the S. & M. must be profitable.

Moreover, there exists at the Aberfoyle in Tasmania an enterprise of the same type as that projected at Moina. At Aberfoyle four lodes are worked of comparable widths to the four worked in the S. & M. The recovery of concentrates from the crude ore of both is 1.8%. The present profit per ton at Aberfoyle is £10/3/9 after paying all mining, milling, administrative, Income Tax and development expenses. It is interesting to note that at Aberfoyle the ratio of wolfram to cassiterite is 1:3 while at the S. & M. it is 1:2, and Aberfoyle carries no bismuth.

The S. & M. concentrates contain the following:-

Tin	40%
Tungstic Acid	22%
Bismuth	6%

On the basis of a throughput of 500 tons per month or 6,000 tons a year an annual profit of £60,000 should be achieved.

This can be taken as a minimum since it assumes that the mill works only one shift. It will not be difficult to increase the output of crude ore sufficient to run the mill two shifts. It is thus clear that the policy of the Company, once it reaches the production stage, must be to concentrate on mining development. The annual profit will be proportional to that development.

10. Probable Life

At the rate which the old S. & M. worked, a life of 12 years was achieved within a vertical range of 300 feet without exhausting the lode contents within that space.

On the geological evidence the vertical range both of lodes and values can be confidently expected to reach 1,000 feet. The only likely variation may be a decrease in the bismuth content. A life of 25 years can be confidently anticipated.

There is no need at the present juncture to say any more. The known lodes in their vertical extension constitute an attractive mining proposition down to 1,000 feet. Any further vertical persistence, although probable, is a prospect for a much longer life. The probability of disclosing additional lodes adds an element which with all the rest increases the prospect of a far longer life than the minimum requirement of a sound mining proposition which incidentally is 11 years.

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HOBART

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