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Lutwyche Bulk Sampling Results

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Contents

1. Introduction

Ore grades in the Lutwyche veins are critical in determining the economic viability of mining that ore. Several attempts have been made in the past to obtain grades by sampling, but these have produced widely varying results (Krummei, 1970). Because of this it was decided to bulk sample the Lutwyche orebody to obtain ore grade information for planning purposes.

2. Sample Selection

2.1 Sample Size

It was decided that a sample size of 1000 t would be treated in the mill. This would allow five milling shifts to be run on Lutwyche ore, and would approximate a week's budget production from the mill. Consequently, normal reporting procedures could largely be used to provide the required information on the sample.

To provide 1000 t, for a week's milling, 1200 t was required to be mined in order to allow some of the sample to be used to flush out the mill circuit before the actual test began.

2.2 Sample Location

As some of the sample was to come from a trial open stope, it was decided to suspend level development so that the entire sample could be mined over a stoping width of 1.2m or less.

Because of water problems associated with Hangingwall Vein, and the doubtful economics of Pay Vein, it was decided to concentrate the sampling on Footwall and Battery Veins as these will probably be the first veins mined.

No attempt was made to sample selectively. Up-dip development, pillar driving and trial stoping continued as planned before the decision to sample the veins was made.

Areas mined for the sample are illustrated in Figure 1.

3. Mining the Sample

Mining of the sample commenced on September 3rd 1979, with two miners on stope development in Footwall Vein and one rising and pillar driving in Battery Vein. Ore was stored in stopes and the ore passes as much as possible. When it was necessary to hoist, it was tipped through the surface mullock bin and stockpiled on the ground.

Mining was interrupted by a week long strike by Australian Workers' Union underground members commencing on September 17th 1979. Just before this strike, a trial open stope was commenced in Footwall Vein North by opening out a rise with 1.5m wide slices. However, when the stope was only 6m strike length, the condition of the hanging wall deteriorated and stoping was suspended.

By October 15th, 1000 tonnes of Lutwyche ore had been mined. It was then decided to mill the sample during the week beginning October 23rd.

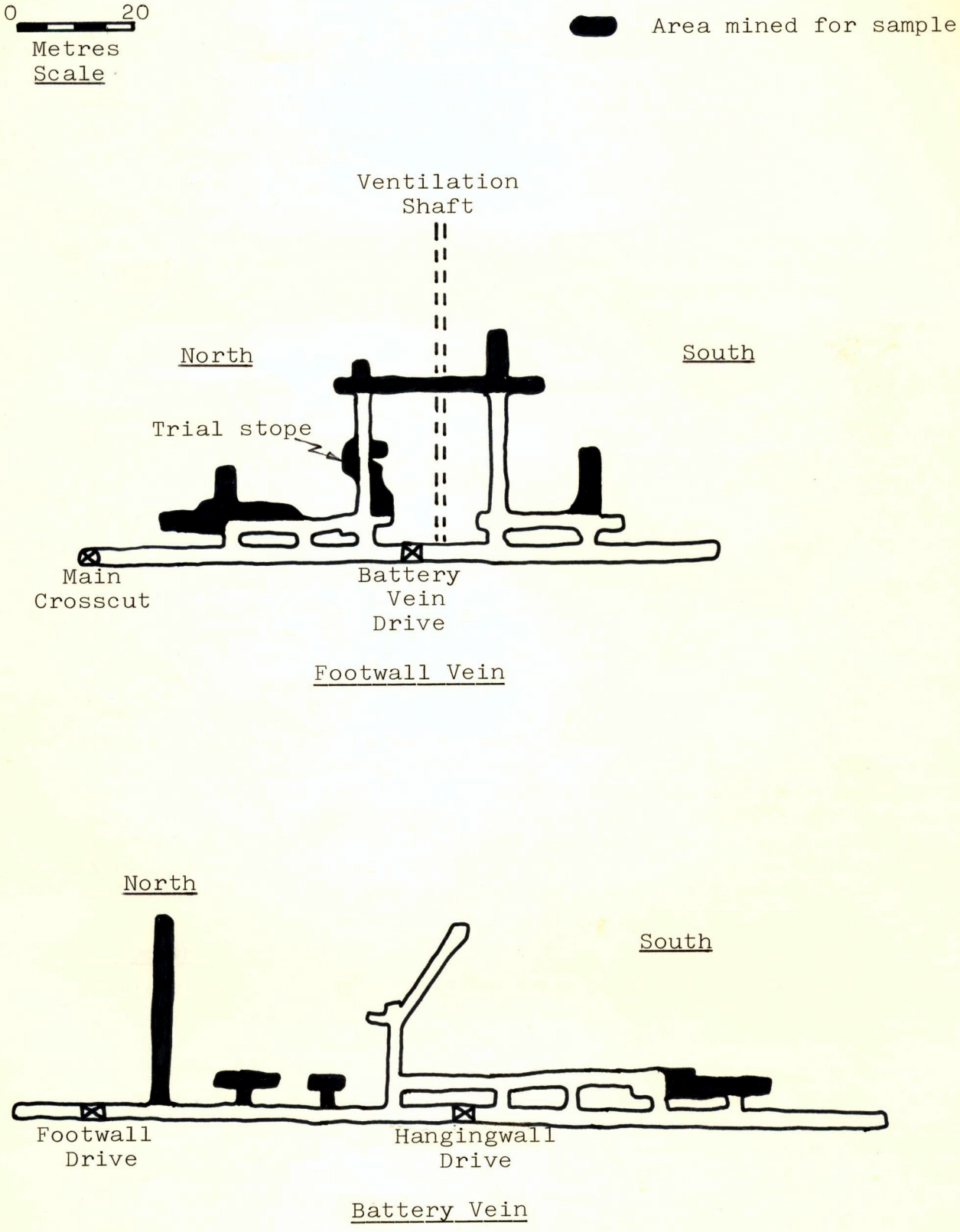

Figure I : Lutwyche Bulk Sample Location

4. Milling the Sample

4.1 Preparations

During day shift October 19th, 157 tonnes of Lutwyche ore was milled to flush out the milling circuit. On the following Tuesday, fines and sink were run through the mill for four hours so that the fines tank, sink bin and slimes thickener could be completely cleaned out. Metal extracted from this process was stockpiled until after the Lutwyche ore had been milled.

4.2 Milling

Beginning on October 24th, 985 tonnes of Lutwyche ore was milled over six milling shifts. The sixth shift was made necessary when 4 hours were lost in the concentrator due to breakdowns on the Thursday night.

4.3 Cleaning Up

On Monday 29th October, the process of cleaning out the fines tank, sink bin and slimes thickener was repeated and the metal recovered was included with that recovered during the milling shifts to give an accurate metallurgical balance for the Lutwyche ore. Results of this balance are listed in Table 1.

4.4 Recovery

Recovery, at 80.4% combined, was generally good. The only problem appeared to be a tendency for some wolfram to float in the heavy media seperator. This resulted in a 0.01% increase in the float assay, which was 0.07% combined metals. The H.M.S. rejection rate was 63.4%. Normally it is in the range of 60 to 62%.

Concentrate grades were normal, despite a greatly increased volume of sulphides in the ore. Sulphide tailings flow rate was 0.23 tonnes per hour compared to a normal rate of about 0.1 t.p.h. Assays of the sulphide tail showed that the content of tin and wolfram was not greater than normal. A sample of this tail will be assayed for content of other metals. High zinc and copper values are expected.

5. Stope Head Grades

While mining the bulk sample from Lutwyche, a record of the truck loads of ore, visual grade as determined by the shift boss, stope width and vein width of each section of the ore veins was kept.

After milling the sample, then, it was possible to reconcile both the amount of ore milled and head grade with these records. The result was a table of the reconciled ore milled and head grade for each vein section. From these head grades, it was also possible to calculate the expected head grade if the normal amount of mullock (say 10%) had been sorted from the bulk sample. The result of these calculations are enclosed as Table 2, and an outline of the method of their calculation is shown in Appendix I.

Stope and vein widths in the stope sample areas are listed in Appendix II.

Ore Milled :	985 t.	
Recovery :	83.4% Sn 77.3% WO_3	80.4% combined
Head Grade :	0.48% Sn 0.45% WO_3	0.93% combined
Concentrate Grades :	74.3% Sn 72.5% WO_3 (A) 58.0% WO_3 (B + C) (assumed) 10.2% Sn 27.1% WO_3	Flue Dust
Concentrate Produced :	5.25 t. Sn 4.50 t. WO_3 (A) 0.26 t. WO_3 (B + C) 0.19 t. Flue Dust	
Metal Produced :	392.0 M.T.U. Sn 346.4 M.T.U. WO_3	

Table I Results of Lutwyche Metallurgical Balance

Vein	Ore Milled	Visual Grade	Stope Head Grade	Expected Stope Head Grade with 10% Sorting	Stope Width	Vein Width
	Tonnes	% Metals	% Metals	% Metals	metres	cms.
Battery Vein South	114	1.02	0.60	0.65	1.17	24
Battery Vein North	233	2.45	1.45	1.57	1.18	57
Footwall Vein South	273	1.30	0.77	0.83	1.21	40
Footwall Vein North	365	1.38	0.82	0.89	1.15	33
TOTAL	985	-	0.93%	1.01%	1.18	43

Table 2 : Results of Head Grade Calculations

6. Conclusions

As a result of the bulk sampling of the Lutwyche orebody, the following conclusions can be made :-

(i) The Lutwyche potential is estimated to be 800,000 tonnes of ore at 0.9% combined grade. The basis of this estimate is contained in Table 3. Note that no account is taken of the ore potential of Pay Vein or the veins below 13 level.

(ii) Mill recovery for Lutwyche ore can be expected to be around 80%.

(iii) The trial stope in Footwall Vein indicated that open stoping of that vein may not be possible, but further trials are needed with more effective hangingwall support to confirm this. At present, cut and fill stoping using up-holes appears to be the most likely mining method for the flat dipping veins, with Battery Vein being ideally suited for shrink stoping.

(iv) Indications are that the milling of Lutwyche ore will more than double the amount of sulphide tail produced. The economic potential of this product should be investigated.

Vein	Ore * Potential Tonnes	Grade Potential %Combined Metals	Comments
Battery Vein	106,000	1.57	Grade from sample, could be optimistic.
Hangingwall Vein	190,000	0.80	Visual information only, could be conservative.
Footwall Vein	90,000	0.86	Grade from sample.
Lutwyche Veins	250,000	0.86	Extensions of Footwall Vein.
Johnson's Veins (excl. Pay Vein)	65,000	0.65	Present Battery Vein South could be Johnson's Veins. Grade from sample.
Kookaburra Veins	130,000	≃ 0.80	No grade information.
	831,000	0.91%	

say 800,000 tonnes @ 0.90% combined metals.

(+ above 13 Level)

* Tonnages from Palmer, 1979.

Table 3 : Lutwyche Ore Potential

References

Krummei G. : Memo to Tester D.K. "Lutwyche Comparative Sampling", 6.2.1970.

Palmer K.G. : Memo to Houston M.L. "Lutwyche", 30.4.1979 . Page 5-6.

Appendix I - Calculation of Ore Milled and Head Grades

1. Ore Milled

Total trucks (nominal capacity 0.75 tonnes per truck)

tipped into orepass	1748	
Less: mullock off grizzly	44	(i.e. 2.5% mullock sorting)
	1704	

$\therefore$ nominal wet ore hoisted and milled = 1704 x 0.75
= 1278 tonnes

Measured ore over mill weightometer :

Friday (circuit flushing)	157 tonnes
Wednesday to Monday (milling sample)	1013

$\therefore$ measured wet ore hoisted and milled = 1170 tonnes

$\therefore$ hoisting and haulage factor = $\frac{1170}{1275}$ = 0.915

Thus nominal wet ore milled Friday = $\frac{157}{0.915}$ = 172 tonnes
= $\frac{172}{0.75}$ = 229 trucks

$\therefore$ nominal wet ore milled in sample = 1278 - 172 = 1106 tonnes
= $\frac{1106}{0.75}$ = 1475 trucks

$\therefore$ number of trucks of ore mined in sample = $1475 + \frac{1475.44}{1704}$
= 1513 trucks

number of trucks of ore mined, milled Friday = 235 trucks

Dry tonnes milled in sample = 985

$\therefore$ factor :- trucks to dry tonnes milled = $0.75 \times \frac{985}{1106}$
= 0.668

The reconciliation is thus :

Area	Trucks Mined	Trucks Mined less Mullock sorted (A)	Dry Tonnes Milled (A x 0.668)
Battery Vein South	175	171	114
Battery Vein North	359	350	233
Footwall Vein South	419	408	273
Footwall Vein North	560	546	365
TOTAL	1513	1475	985

less mullock off grizzly	38
trucks hoisted and milled	1475

2. Head Grades

Estimated Visual Grades were :-

Area	Ore Milled Tonnes	Visual Grade % Metals
Battery Vein South	114	1.02
Battery Vein North	233	2.45
Footwall Vein South	273	1.30
Footwall Vein North	365	1.38
TOTAL	985	1.57

Actual head grade was 0.93% combined metals

$\therefore$ Factor - visual grade to head grade $= \frac{0.93}{1.57}$

$= 0.592$

Sample head grade represents 2.5% mullock sorting.
Normally, run of mine ore is at least 10% mullock sorted.

Let X be dry tonned milled with 2.5% mullock sorting.
Let Y be the visual grade.

Then the unsorted head grade is

$$\frac{X \times Y \times 0.592 + 0.025 \times X \times 0}{1.025 \times X}$$

$$= \frac{0.592 \times Y}{1.025} \quad \%$$

and the 10% mullock sorted head grade is

$$\frac{1.025 \times X \left(\frac{0.592 \times Y}{1.025}\right) - 0.1 \times 1.025 \times X \times 0}{0.9225 \times X}$$

$$= \frac{0.592 \times Y}{0.9225} \quad \% \text{ combined metals}$$

Using these factors, Table 2 can be compiled.

Appendix II - Stope and Vein Widths

Battery Vein South			Battery Vein North			Footwall Vein South			Footwall Vein North		
Length of round	Stope Width	Vein Width	Length of round	Stope Width	Vein Width	Length of round	Stope Width	Vein Width	Length of round	Stope Width	Vein Width
m	m	cms	m	m	cms	m	m	cms	m	m	cms
1.5	1.2	25	1.5	1.2	64	1.5	1.2	25	1.5	1.2	43
1.5	1.2	25	1.5	1.2	25	2.45	1.1	38	1.5	1.2	25
1.5	1.15	20	1.5	1.2	25	1.5	1.37	41	1.5	1.22	61
0.9	1.1	25	0.9	1.2	66	1.5	1.37	41	1.5	1.37	36
			0.9	1.2	66	1.5	1.1	20	1.5	1.22	61
			1.5	1.1	63	1.5	1.2	28	1.4	1.5	25
			1.5	1.2	68	1.5	1.2	36	1.5	0.9	25
			0.9	1.2	69	1.5	1.1	38	1.5	1.0	25
			1.5	0.9	61	1.5	1.1	38	1.5	1.3	23
			1.5	0.9	51	1.5	1.2	36	1.5	0.9	33
			1.5	1.2	51	1.5	1.2	51	5.0	1.2	28
			1.5	1.2	51	1.5	1.2	51	1.5	0.9	33
			1.5	1.2	61	1.5	1.3	53	1.2	0.9	33
			1.5	1.2	61	1.5	1.2	38	1.5	1.1	33
			0.9	1.2	61	1.5	1.3	53	1.5	1.1	33
			1.5	1.2	51	1.5	1.3	48	2.4	1.2	31
			1.5	1.2	51	1.5	1.3	43			
			1.5	1.2	65	1.5	1.2	33			
			1.5	1.2	65	1.5	1.2	56			
			1.5	1.3	58						
			1.5	1.2	69						
			1.5	1.2	69						
			1.5	1.3	48						
5.4	1.17	24	32.1	1.18	57	29.5	1.21	40	28.0	1.15	33

Average/Totals

Distribution List -

N. A. Gilberthorpe
J. M. Scarborough
M. L. Houston
I. W. Pond
P. J. Reynolds
File.