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DEPARTMENT OF MINERAL RESOURCES

NEW SOUTH WALES

CHEMICAL LABORATORY BRANCH

# RECOVERY OF GOLD FROM LONG GULLY MINE ORE NEAR CARGO, N.S.W. (PRELIMINARY INVESTIGATION)

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ABSTRACT

A preliminary investigation was conducted to determine suitable processes for concentration of gold at economic recoveries from Long Gully Mine ore at Cargo, NSW in form of marketable products and to assess effect of mine water from the mine on relevant processes.

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## Introduction

The Department was approached by Mrs K M O'Connell with a request for assistance to establish a suitable treatment process for recovery of gold from Long Gully mine ore at Cargo and to determine whether mine water from the mine can be used in a potential treatment plant without deleterious effect on production.

Several samples of ore, panned concentrates and mine water were delivered on 21 January 1981. Later an agreement was reached that the following samples will be tested as most likely representing the ore to be mined from the deposit and treated:

### Samples 1/A, 1/B

Face sample from back of stope, 1 meter towards shaft from shaft end of stage.

### Sample 2

Sample back of stope dam end 1 meter towards dam from dam end of stage (the original description of the samples by the operator was retained).

## Summary of Investigation

### 1. Visual and Brief Microscopic Examination

Small quantities of free gold was detected (largest gold particle of approximately 100 microns); prevalent majority of free gold is disseminated as fine gold particles in gangue and some gold is probably associated with sulphide minerals.

### 2. Semi-Quantitative Optical Emission Scan of Panned Concentrates

Fe > 1% ; Cu 2,500 ppm ; Mn 2,500 ppm ; Ba 2,500 ppm ; Ti 2000 ppm ; Zr 600 ppm ; Pb 500 ppm ; Co 250 ppm ; Zn 75 ppm ; Bi 75 ppm ; Ni 25 ppm ; V 25 ppm ; Cr < 50 ppm ; Ag > 25 ppm ; Sn, Mo, Cd, Sb, B, As, W - n.d.

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## 3. Analysis of Mine Water

pH 7.0

| | | | |
|---|---|---|---|
| Bicarbonate | 450 ppm | Antimony | 0.1 ppm |
| Chloride | 1 200 ppm | Cadmium | n.d. |
| Sulphate | 445 ppm | Copper | 0.1 ppm |
| Calcium | 250 ppm | Lead | 0.1 ppm |
| Magnesium | 236 ppm | Zinc | 0.2 ppm |
| Potassium | 4 ppm | Cobalt | n.d. |
| Sodium | 460 ppm | Nickel | n.d. |

## 4. Gravity Separation of Ore

The individual ore samples were subjected to heavy media separation testing in tetrabromoethane of specific gravity 2.94 and due to rather disappointing upgrading of gold content in sink fractions, separation in Clerici's Solution of specific gravity 4.32 was tested.

### a. Separation in Tetrabromoethane - S.G. 2.94

Ore samples were crushed and sieved. The sieve fractions:

0 - 75 microns
75 - 150 microns
150 - 250 microns
250 - 425 microns
425 - 600 microns

The 0 - 75 micron fractions were excluded from HMS testing.

Sample 1/A

| Fraction in microns | Au Assay of sink fraction g/t | Au Recovery % | Upgrading conc/feed |
|---|---|---|---|
| 75 - 150 | 68.0 | 48.15 | 5.7 |
| 150 - 250 | 43.0 | 79.17 | 3.6 |
| 250 - 425 | 44.2 | 81.44 | 3.7 |
| 425 - 600 | 45.9 | 83.55 | 3.8 |

Feed grade of the sample was calculated at 11.96 g/t Au ; 0 - 75 micron fraction assayed 10.2 g/t Au ; calculated tailings assay (without 0 - 75 micron) 3.04 g/t Au.

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Sample 1/B

| Fraction in microns | Au Assay of sink fraction g/t | Au Recovery % | Upgrading conc/feed |
|---|---|---|---|
| 75 - 150 | 17.8 | 64.73 | 3.7 |
| 150 - 250 | 18.8 | 90.83 | 3.9 |
| 250 - 425 | 18.8 | 94.04 | 3.9 |
| 425 - 600 | 24.3 | 94.02 | 5.0 |

Feed grade of the sample was calculated at 4.86 g/t Au ; 0 - 75 micron fraction assayed 4.06 g/t Au ; calculated tailings assay (without 0 - 75 micron) 0.69 g/t Au.

Sample 2

| Fraction in microns | Au Assay of sink fraction g/t | Au Recovery % | Upgrading conc/feed |
|---|---|---|---|
| 75 - 150 | 19.3 | 71.84 | 5.5 |
| 150 - 250 | 21.6 | 92.41 | 6.2 |
| 250 - 425 | 10.9 | 89.28 | 3.1 |
| 425 - 600 | 6.8 | 73.16 | 2.0 |

Feed grade of the sample was calculated at 3.48 g/t Au ; 0 - 75 micron fraction assayed 4.15 g/t Au, calculated tailings assay (without 0 - 75 micron) 0.79 g/t Au.

Although the recoveries of gold could be considered satisfactory (recoveries of 75 - 150 micron fraction can be occasionaly distorted due to high viscosity of the liquid), inclusion of fractions 0 - 75 microns in metallurgical balance would lower overall recoveries due to problematic response of fine particles to gravity treatment. Grades of concentrates are not of a marketing standard and the concentrates would have to be re-treated (probably in several cleaning stages) to increase gold content up to a marketable grade.

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In order to test further possibility of upgrading the concentrates and to assess corresponding recoveries, further HMS tests were carried out in Clerici's solution at S.G. 4.32.

b. Separation in Tetrabromoethane S.G. 2.94 Followed by Separation in Clerici's Solution S.G. 4.32.

More of ore samples were crushed and sieved. Only the fractions 150 - 250 microns were subjected to HMS separation in tetrabromoethane and sink fractions from these tests separated further in Clerici's solution; resulting products are evaluated in the following tables:

sink fractions - concentrates
float fractions - midlings

Sample 1/A

| Product | Weight % | Au Assay g/t | Au Recovery % | Upgrading product/feed |
|---|---|---|---|---|
| Concentrate | 1.50 | 215.0 | 34.21 | 22.8 |
| Midlings | 31.40 | 18.3 | 60.95 | 1.9 |

Feed grade of the sample was calculated at 9.42 g/t Au.

Sample 1/B

| Product | Weight % | Au Assay g/t | Au Recovery % | Upgrading product/feed |
|---|---|---|---|---|
| Concentrate | 2.78 | 636.0 | 55.81 | 20.1 |
| Midlings | 10.14 | 133.5 | 42.73 | 4.2 |

Feed grade of the sample was calculated at 31.67 g/t Au which appears to be rather an anomaly though the general trend can be taken into consideration.

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Sample 2

| Product | Weight % | Au Assay g/t | Au Recovery % | Upgrading product/feed |
|---|---|---|---|---|
| Concentrate | 1.51 | 160.0 | 61.67 | 40.8 |
| Midlings | 24.86 | 5.3 | 33.63 | 1.35 |

Feed grade of the sample was calculated at 3.92 g/t Au.

The tests indicate that production of commercialy viable gold concentrate by gravity separation only, would result in unacceptable losses of gold, even when a relatively sophisticated gravity separation circuit is applied; consequently, cyanidation was considered and tested as a most suitable supplementary or alternative treatment method.

## 5. Cyanidation

Cyanidation was tested using composite ore samples at 1:1:1 ratio of 1/A, 1/B, 2 ores. The samples were ground to approximately 70% - 75 microns (200 mesh). Duration of cyanidation - 24 hours; slurry agitated by a stirrer which simultaneously pumped air through the slurry; density 33% solids by weight; pH during cyanidation maintained by lime at pH 9.5 - 10.0. Strength of cyanide solution varied from 0.05 - 0.25%, for comparative tests 0.2%. Lime consumption with both, mine water and tap water, approximately 7.0 Kg/tonne of ore; cyanide consumption for tap water 2 - 2.5 Kg/tonne, for mine water 3 - 4 Kg/tonne.

### a. Cyanidation with Tap Water

1.a. Recovery: 86.78% Au
Feed grade (calculated): 9.68 g/t Au
Tailings grade (assayed): 1.28 g/t Au

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2.a. Recovery: 88.17 % Au
Feed grade (calculated): 5.49 g/t Au
Tailings grade (assayed): 0.65 g/t Au

3.a. Recovery: 88.53 % Au
Feed grade (calculated): 5.49 g/t Au
Tailings grade (assayed): 0.63 g/t Au

b. Cyanidation with Mine Water

1.b. Recovery: 88.81 % Au
Feed grade (calculated): 7.33 g/t Au
Tailings grade (assayed): 0.82 g/t Au

2.b. Recovery: 90.85 % Au
Feed grade (calculated): 6.34 g/t Au
Tailings grade (assayed): 0.58 g/t Au

Individual samples: 200 g of ground composite sample of ore; 400 mLs of water; 1 g Sodium Cyanide; pH 9.5 - 10.0; cyanidation time - 24 hours.

No deleterious effect of mine water on cyanidation recovery was detected.

## 6. Amalgamation

Comparative tests of barrel amalgamation using mine water and tap water were conducted. A sample of high grade ore (sample 3) was ground, divided into two equal portions by weight and the samples were amalgamated under identical conditions (one sample slurried with mine water another sample slurried with tap water) for 5 hours. There were no difficulties to recover amalgam (no flouring of mercury). Recovery of gold was calculated at 98% in both cases with marginal difference in favour of mine water.

## 7. Magnetic Separation and Flotation

Exploratory tests of magnetic separation as a method of pre-concentration of gold were unsuccesfull. Flotation produced poor recovery of gold.

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## 8. Discussion

The most succesful method of treatment of Long Gully Mine ore appears to be cyanidation, which even during this limited investigation produced satisfactory results. There is a distinctive probability, that more refined conditions of cyanidation will result in further improvement of gold recovery. The method is particularly effective for recovery of very fine gold particles whether free, disseminated in gangue matrix or associated with (prevalent) iron sulphide minerals. In view of the fact that the samples indicate substantial quantities of fine and very fine gold, cyanidation will have to be incorporated in any treatment process of Long Gully Mine ore if an efficient gold extraction is to be achieved.

Although gravity treatment does not indicate desirable recoveries of a marketable grade concentrate, it can be considered as a useful supplementary method to cyanidation (preferably followed by cyanidation) to recover relatively coarse free gold, gold rich midlings and probably facilitate conditions for shorter cyanidation time, simultaneously enhancing overall recovery of gold. However, economy will have to be carefully considered.

Amalgamation could be as well considered as a possible supplementary method (i.e. amalgamation tables or gold traps prior to cyanidation) if economicaly justifiable, or as barrel amalgamation for recovery of gold from gravity concentrates.

## 9. Conclusions

1. A substantial proportion of gold content is disseminated in gangue as fine and very fine free gold particles.

2. Application of gravity concentration only will result in considerable losses of gold if a marketable grade concentrate is to be produced.

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3. Cyanidation will result in recoveries higher than 90% of gold contained in the feed.

4. Ore is amenable to amalgamation, but it is not suitable as a sole treatment method.

5. Mine water does not have any recovery related deleterious effect either on cyanidation or amalgamation.

6. Average grade of all ore samples used for investigation was calculated at 9.84 g/t Au.

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