

Mining assessment of Ereen gold ore in Mandal Soum, Selenge province Mongolia

The Ereen deposit lies within the North Khentei gold belt, which is bounded by the north-west by the Bayangol fault system and to the south-east by the Yeroogol (or Sujigtei) fault system. The preliminary exploration has just been conducted at the deposit, where the resource estimation achieved indicates a possible medium-scale mine, cut-off grade has not been finalized and therefore the mining boundary cannot be defined. The cut-off grade will be achieved by thorough economic and technical study. The findings from the site visit and the current exploration are favourable for open pit mining; however, the parameters for the pit development will need to be included in the project feasibility study and mine design in the future. The current engineering geology and hydrogeology study are still very basic and cannot satisfy the mine design requirements in the future. For the future mining operation, the company needs to engage in a contract with the local electricity supply. The site visit found that water supply seems sufficient.

Keywords: Ereen deposit, mining assessment, gold, prospecting.

1. Introduction

The North Khentei gold belt has a long history of placer mining and includes gold reserves in both placer and bedrock deposits. Gold placer deposits form a series of geographically distinct placer districts preferentially located in the vicinity of the bounding faults of the North Khentei trend. Zamar, Bumbat and Sharingol placer districts are roughly parallel to the Bayangol fault system; Huder, Tolgoit, Ikh Alt, Yalbag and Gatsuurt placer districts are located in the vicinity of the Yeroogol fault. Reserves of the Zamar and Sharingol gold placer districts totalling approximately 3.0 M oz. The Bumbat deposit (0.6 M oz Au), the Gatsuurt, and Boroo deposits (1.2 M oz Au) are bedrock gold deposits within the belt.

The Ereen property is located in north-central Mongolia approximately 42 km to SW from the centre of Mandal Soum,

Selenge province and 140 km to NNW of Ulaanbaatar, capital of Mongolia. The Dzüünharaa, one of the largest stations on the Trans-Mongolian Railway is located 35km to the north. The main towns in the area are served by good infrastructure including power, water and communications. It is the detailed location in north-central Mongolia. There are two main access routes to the Ereen site; by paved road from Ulaanbaatar to Bornüür (110km) and then approximately 50km on dirt road to the site, or 136km to the north of Ulaanbaatar to Boroo gold mine's improved earth road, and then approximately 30km by unpaved road to the site.

2. Geology of the region and deposit

Ereen deposit is located near to the principal gold deposit in the district, Gatsuurt mine, developed by Centerra Gold Corporation. The Sujigtei fault separates Devonian rhyolites (which host Ereen) in the west from palaeozoic granites in the east. Therefore, certain Gatsuurt ore controlling features could be similar to Ereen ore-controlling factors. Stratigraphic section of the Ereen area is consecutively represented by Cambrian-Ordovician Kharaa group formation, Ordovician-Silurian Undur formation, Silurian Mandal group formation, Devonian Uaan Undur formation, Jurassic-Cretaceous Ajnai white fracture formation, lower Cretaceous Shariin Gol formation, quaternary holocene sedimentary formation. Plutonic rocks are spread moderately in the project area. From the previous research the following groups of plutonic rocks were identified on the basis of the geologic-structural location, stratigraphy deposition and border relation towards each other, petrography, and petrochemical characteristics.

1. Medium late Ordovician Boroo river formation
2. Late Ordovician Ikh Tashir formation
3. Medium Devonian rock formation
4. Permian Guadeloupean small Khentii formation
5. Early Triassic Tukhum formation

3. Mine geology

Gold grades vary from trace to 409g/t along the strike and depth extension of the vein. Better grades (from 14g/t to 363.4g/t) of Au are distributed in the middle and deeper parts of the vein, with near-surface grades (down to 40m)

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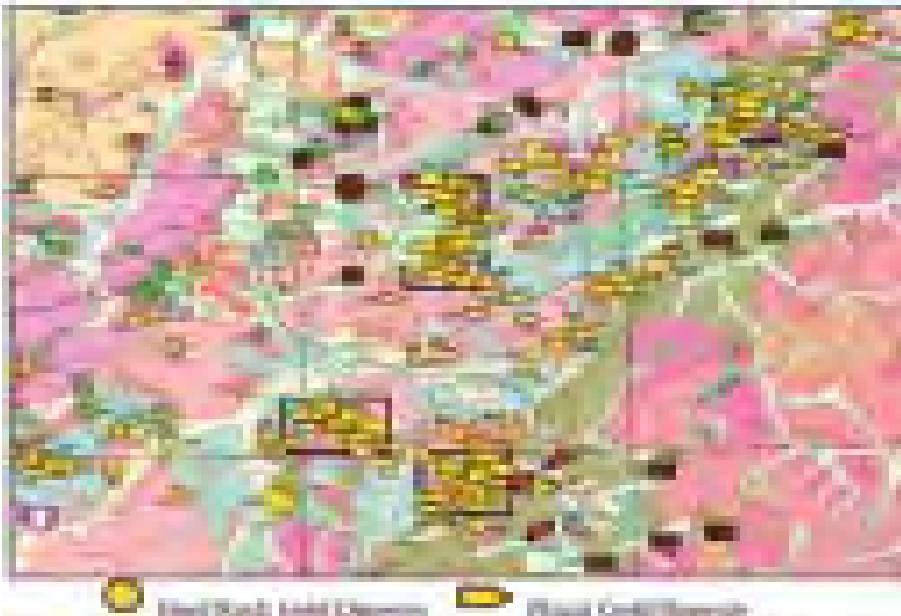


Fig.1 Distribution of lode and placer gold deposits in North Khentii terrain (442 is Ereen deposit)



Fig.2 Regional geology of Bayangol terrain

considered uneconomic. The average gold grades are 18-23g/t in different blocks.

Ore minerals are pyrite, arsenopyrite, tetrahedrite, chalcopyrite, sphalerite, galena, scheelite, malachite, azurite, limonite and free gold. Free native gold is associated with quartz, galena and arsenopyrite. The average size of visible Au is reported 1mm.

Vein 2 is located in the north-east part of the deposit, strikes north-east and dips gently (12°) to the north-west. It has a strike length of 200m and an average thickness of 0.4m. Trenching undertaken between 1959 and 1960 showed the

average thickness of the vein to be 1m on surface and to be surrounded by a 7m wide silicified halo. Gold grade varied from 0.5g/t to 2.7g/t on the surface.

4. Mining conditions

4.1 CLIMATE AND RESOURCE CONDITIONS

The licence area is located approximately 140km to the north-west of Ulaanbaatar and approximately 35km to the south of Zuunharaa which is one of the largest stations on the Trans-Mongolian Railway. Bornuur town is connected to Ulaanbaatar by paved road (105km). The main towns in the area are served by good infrastructure including power, water and communications. The climate of the Ereen area is harsh, with rain in the summer season and snow cover reaching 0.5m-1.0m in winter. The mineralization thickness ranges from 1 to 7m and the average thickness is about 2m. The material bulk density is about $2.7t/m^3$ and the overburden thickness is about 20 to 30m. The geological deposit model is indicated in Fig.3.

4.2 ENGINEERING AND HYDROGEOLOGICAL CONDITIONS

Geotechnical logging has been undertaken by CAML since geotechnical data is required for mine design and feasibility studies. Rock quality designation (RQD) is used in conjunction with the number of fractures per metre (FPM) to provide a measure of rock quality, and is the minimum data set required for geotechnical work. The engineering geology works conducted are not sufficient to support the future mine design and continuous studies are still required. We did not find any hydrogeological data and we suggest hydrogeological works to be conducted before the project feasibility study and mine design.

5. Deposit development

Using a 1g/t Au cut-off, an inferred resource of 9.7Mt @1.73g/t Au has been estimated, with a further 57kt @ 1.43g/t Au in measured + indicated. No work has been undertaken

on the potential mineability of the mineralization, though the geometry, size and depth of the mineralization with respect to the topography would tend to indicate an open pit operation.

We believe open pit mining might be appropriate; however, the topography is also favourable for underground mining. Further study can be conducted to compare and determine a proper way of development. The Fig.4 indicates the open pit hypothesis. As the preliminary exploration has been just completed and project feasibility study and mining design have not been conducted, based on site inspection and data collected, W.E. achieved the following assumption of the possible open pit. CAML estimated a stripping ratio of 2.45:1 (m^3/m^3), based on its deposit model.

Bench height: 8 to 10m

Bench slope angle: 65° to 70°

Bench width: 10 to 12m

Ramp width: 6 to 8m

Final wall angle: 45° to 49°

Mining loss: 5 to 10%

Mining dilution: 5 to 10%

The current resource estimation indicates a possible medium scale mine; considering a reasonable span of mine life, a 1500tpd to 2000tpd production is considered to be appropriate. The possible resource expansion may support a bigger scale of production. From the mine geology, site visit finding and in comparison with other similar mines, we made the following hypotheses: Based on the present resource estimation of 9.8Mt, average gold grade of 1.73gpt and 0.6Mtpa production the mine life is estimated at 16 years. Considering a 5% mining loss and 85% processing recovery, the annual gold production is about 830kg and from the current gold price the annual revenue is about USD 27 millions.

It is estimated by the stripping ratio of 2.45:1 that the annual waste stripping tonnage to be 1.47Mt and total mined

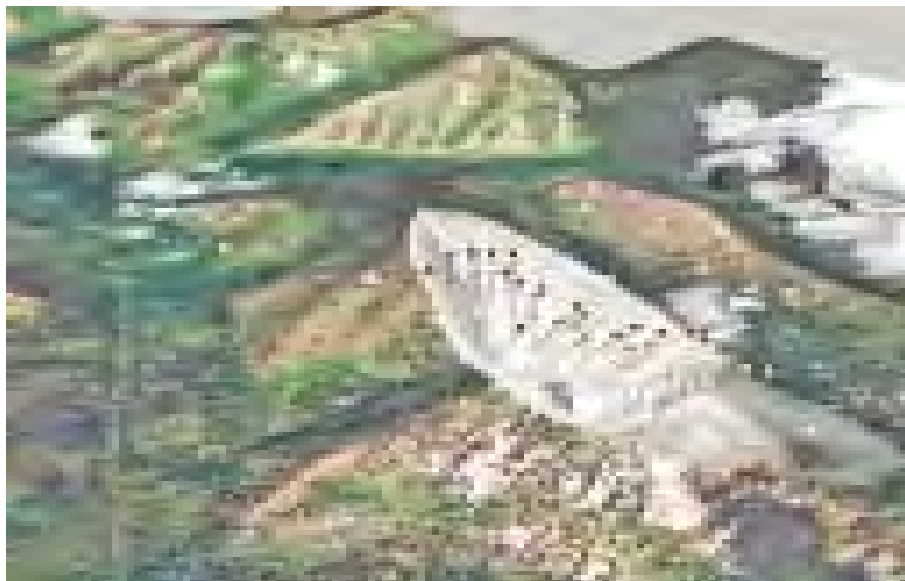


Fig.3 Schematic of typical pit at Ereen

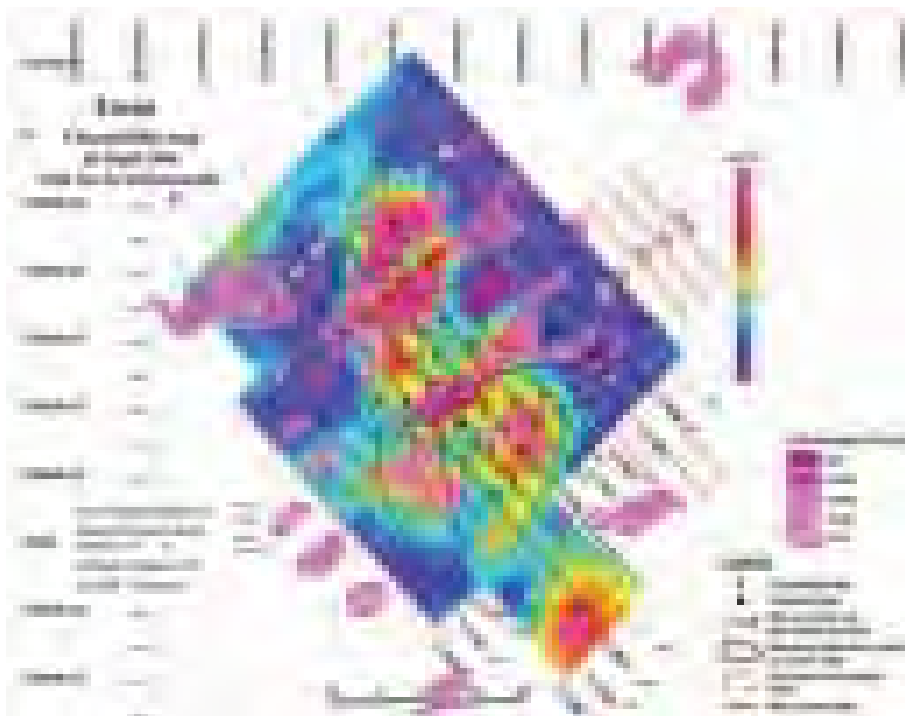


Fig.4 Ereen chargeability and gold in soil map

tonnage to be 2.07Mt. W.E. hypothesizes that the operation cost would be USD1.5 per tonne of mined and therefore the annual operational cost would be USD 3.1M for mining; the processing cost is hypothesized as USD 8 per tonne and therefore the annual operational cost for processing would be USD 4.8M. By addition of other operation cost, the total annual mine operational cost would be USD 10M. In comparison with similar mines, we hypothesized that the capital cost would be USD 36 to 42M

6. Environmental assessment

6.1 LAND DISTURBANCE

The main impact on the surrounding ecological environment is due to disturbance and contamination caused by surface stripping, waste rock storage, site drainage, waste water, explosions, transportation and associated buildings that are erected. If effective measures are not taken to consideration and rehabilitate the disturbed areas, the surrounding land can become polluted and the land utilization function will be changed, causing an increase in land degradation, water loss and soil erosion. The Ereen gold deposit is located in the Zuunmod area of Mandal district, Selenge district, Mongolia.

The Ereen mining and exploration licenses cover a total area of 3,007 ha. The Ereen project exploration camp and road construction EIA reports of disturbances for the Ereen project only in relation to road construction and the exploration camp construction but provide no meaningful details on areas of project disturbances. CAML have stated they have not recorded areas of disturbance at the Ereen project site and, at the time of the site visit, no rehabilitation work has been carried out. W.E. recommends that CAML establish an annual process to survey and record of all areas of disturbances present and future to allow for effective rehabilitation planning.

6.2 WASTE ROCK AND TAILINGS MANAGEMENT

During website visit only exploration works had been undertaken and no waste rock had been excavated. It provided no information concerning waste rock dumps (WRD) designs or decided on locations, although it is assumed they will be adjacent to the open-pit areas at site. The project EIA provided for review only being for the exploration camp and road construction made no mention as to the amount of waste rock to be excavated or the rate at which it would be produced. CAML plans to transport ore offsite for processing at another company's processing plant; hence no tailings would be produced at site and no tailings storage facility (TSF) would be required to be constructed at site. CAML have stated no geochemical characterization or acid rock drainage (ARD) assessment has been conducted for the Ereen project. W.E. recommends conducting geochemical characterisation assessment of waste rock to help determine effects on pH and its impact on leaching heavy metals and to develop a record of monitoring of downstream groundwater from the WRD to confirm impacts upon groundwater resources. W.E. also recommends topsoil should be stockpiled in piles no more than 2 metre high to ensure the fertility of the soil.

6.3 WATER ASPECTS AND IMPACTS

The Ereen Project's Exploration Camp and Road Construction EIA makes no reference to the amount of water that will be used during mining operations or treatment/

management measures for waste water produced by the project. The EIA though does state that road construction will impact water quality at river crossing points. CAML reported to us that ore will be transported offsite for processing, therefore water supply for processing will not be required and no processing waste water will be produced by the project at site, we were provided with a hydrogeological study report for the Ereen project for review. The report in conclusion states, "The most favourable hydrogeological structure for water supply for drinking and technical need is the layered porous water of alluvial deposits of Boroo river valley and Zuunmod river, Sujigtei river. Groundwater of that hydrogeological structure by physical and chemical properties fully satisfies the standard of the drinking water of Mongolia. That is why the source of the supply for the area we should concentrate on the one of river valley. Therefore it is necessary to conduct in those area detailed in hydrogeological research". It was provided with no further information on plans for continued hydrological studies for the Ereen project. Conceptual details for an environmental monitoring programme for the Ereen project was included as part of the project EIA, but do not constitute an operational monitoring programme.

7. Conclusion and suggestions

The preliminary exploration has just been conducted at the deposit, where the resource estimation achieved indicates a possible medium scale mine. However, exploration only covered a small area of the licensed area; therefore, there are potentials on the escalation of the resource estimation. The following items need to be noted:

1. The project feasibility study has not been produced; therefore a thorough review on the mining and economic details cannot be achieved at this stage.
2. The cut-off grade has not been finalized, and therefore the mining boundary cannot be defined. The cut-off grade will be achieved by thorough economic and technical study.
3. The findings from the site visit and the current exploration are favourable for open pit mining; however, the parameters for the pit development will need to be included in the project feasibility study and mine design in the future.
4. The current engineering geology and hydrogeology study are still very basic and cannot satisfy the mine design requirements in the future.
5. For the future mining operation, the company needs to engage in a contract with the local electricity supply. The site visit found that water supply seems sufficient.

References

1. Technical Review of Ereen Gold Project Mandal Soum, Selenge Province, Mongolia[R].WE Consulting. 2008.

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