Water—The Biggest Factor in the Development of the Highest Grade Gold Deposit of the Philippines

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ABSTRACT

The highest grade known gold deposit of the Philippine is located at Barrio Longos, in the municipality of Paracale and province of Camarines Norte which is at 14 -17'-15" latitude and 122 -47'-45" longitude. The property is near the Pacific Ocean. The deposit was discovered in the early 30' and has been operated since 1937. Its operations were temporarily suspended during the outbreak of the Second World War. Mining of the property was resumed in 1952. The mine was wet and the inflow increased during wet seasons, but inflow did not apparently increase as the mine was deepened.

The rise of the price of the yellow metal in the early 70's ushered the renewed interest in the property by a joint Filipino-Australian group. An aggressive diamond drilling program over the area yielded positive results. A 1.48 MM tonne deposit with 13.8 gm/T gold and 16.8 gm/T silver values respectively was delineated. Thus, the Longos deposit was established as the highest grade gold deposit in the Philippine Archipelago.

Development of the Longos deposit was finally started in 1980 after a major change over in management. The Australian group sold out their share in the corporation to another Filipino group.

The sky rocketing of the gold price in the first two years of the decade sent the project activities to feverish heights. Two new shafts, the Ventilation and Main Shafts were sunk to develop the rich orebody which is a down dip extension of the vein abandoned in 1952. With hindsight it was a mistake to leave these overlying old workings full of water.

The Ventilation Shaft was affected by a 1450 LPM inflow of water in October 1981 when the shaft was 150 meters below sea level and approaching the Longos vein.

The Main Shaft was also flooded when it approached the Longos vein (at a depth of some 300 meters) in March 1983. This inflow effected the sudden fall in the level of the water in the old stopes.

The owners had at this stage expended their funds on plant, equipment and infrastructure and were unable to fund the necessary recovery work.

In 1987 Abcar-Paragon acquired the right to develop the property. Abcar-Paragon have approached the water problems in a systematic and scientific manner using the skills and experience of BHP Engineering and Australian Groundwater Consultants.

This paper presents the methods used in compiling the necessary hydrological and geotechnical information necessary to control the water inflow and permit safe working conditions in the mine.

LOCATION

The Republic of the Philippines is one of the major gold producing countries of the Free World. The better known gold regions of the Philippines are the Baguio, the Panganiban-Paracale, the Masbate, the Surigao and the Masara districts. ABCAR-PARAGON Mining Corporation (APMC) presently has the highest grade gold deposit in the country. The gold property is located at the municipality of Paracale, the province of Camarines Norte. It lies at 14 -17'-15" latitude and 122 -47'45" longitude (Figure 1). The mine is very near the Pacific Ocean. It is 345 kilometers south of Manila by road. It can be reached overland in seven (7) hours of driving, or by air in about one (1) hour flying to Daet, the capital town of Camarines Norte. Daet is 40 km. South of Paracale.

HISTORICAL BACKGROUND

The Longos deposit was explored in 1933. Development was started by United Paracale Mining Company (UPMC) before 1937 by sinking No. 1 Shaft. Stoping and actual mining were done at Levels 1 and 2 in 1937. Level interval is about 30 meters (100 feet). Eventually, mining activities progressed down to Levels 3 and 4. Mining operations were stopped because of the outbreak of the Second World War in 1941. The total tonnage mined was 203,000 tonnes.

In 1952, the mine was reopened. Development and mining activities yielded about 40,600 tonnes of ore till 1953 when the management of UPMC decided to stop the operations in the area. This move was precipitated by the flooding of the Baluarte area which supplied the bulk of ore to the mill. The production from the Longos area alone could not support the full operations of the mill.

In the early 70's, renewed interest in the gold deposit brought Metals Exploration Limited (MEL) of Australia to the Jose Panganiban-Paracale Gold District. A joint venture agreement was forged between MEL and the managing company of UPMC, Marsman Company. Longos was part of the mining areas taken in by the new corporation, Metals Exploration Asia (MEA) Inc. A total of 188 claims with an area of 1583 hectares were controlled by MEA through this agreement.

In 1974 and 1975, extensive diamond drilling of Longos was done. Forty two (42) holes were sunk with an aggregate depth of 12,985 meters. Evaluation of all geologic information and the drilling data gathered yielded the following figures:

		Tonnes	Au gm/T
Geologic Reserve	-	1,437,270	14.02
Mineable Reserve	-	1,486,820	13.75

The mathematical computation of the reserves was backed up by reliable assay data. Sample preparation and assaying of the drill cores were made in Australia. Satisfactory confirming check fire assays were done by the Australian Mineral Development Laboratories (AMDEL). The above findings of MEA were also verified and confirmed by the Philippine Bureau of Mines and Geo-Sciences (BMGS) in 1977.

MEA prepared a feasibility study which was never implemented till the Rustan Investment and Management Corporation (RIMCO) gained control of the corporation in 1979. MEL and some other local shareholders eventually sold out to RIMCO. Subsequently, the name of the corporation was changed to Philippine Eagle Mines, Inc. (PEMI).

RIMCO started the development of the property in 1980. A 500 TPD flotation-cyanidation mill using brand new pieces of equipment was constructed. Simultaneously, the Ventilation and Main Shafts were collared and sunk. The former was supposed to be sunk down to Level 8 or about 240 meters below sea level (RL -240m) and latter down to Level 14 or RL -420m. Activities at both shafts were suspended when water inflows of 24 LPS and 252 LPS respectively, were encountered. The Ventilation Shaft was at RL -150m while the Main Shaft was at Rl -270m. The shaft sinking crew were not equipped to handle the above water inflows. The Main Shaft flooding happened even after the intensive grouting was done at the shaft from Level 8 downwards. The behaviour of the water levels at the Ventilation and the Number 3 Shafts were monitored while the water level at the Main Shaft was rising. This, together with some other evidences led PEMI to believe that all the three shafts are interconnected. The main structure and vein acted as the acquifer and connecting medium. This was confirmed by PEMI's consulting hydrologist.

After the Main Shaft flooding incident, PEMI's activities were solely devoted to the previously approved water control program. A grout curtain between the sea and the old mine workings was placed. The Main Shaft flooding also re-directed PEMI's development thrust to the shallower remnant ore at Level 4 up to Level 2. With this plan, PEMI successfully recovered Number 3 Shaft down to Level 3 after some difficulties. A 19.50 meter cross-cut was driven at the haulage of Level 3 which led to the discovery of an 8 meter thick strong mineralization at the HW of the Longos orebody. Furthermore, four (4) of the grout holes from the surface intercepted some good mineralization too. All these developments supported the plans of PEMI to mine the upper (Level 4 up to Level 2) horizon of the deposit plus the possible open-pitable reserve.

PEMI conducted confirmatory diamond drilling of the open pitable ore. Positive results were gathered. Unfortunately, before the mining proper was put on stream, the Philippine Peaceful Revolution of 1986 came. Eventually, the major stockholder of PEMI fled the country and abandoned the Project. Subsequently, the bank which loaned the money for the development of the Project foreclosed the assets of PEMI and offered them to public bidding. APMC won the bidding and acquired the assets of PEMI.

PROJECT RE-EVALUATION

The new Project developer, APMC is a joint Filipino-Australian venture. The local company is ABCAR Mining Corporation. The Australian group is PARAGON Resources NL of Western Australia.

APMC made an in depth evaluation of the Project soon after its acquisition. The open pitable deposit was re-drilled yielding ore reserve figures of 366,369 tonnes of ore with gold value of 4.20 grams per tonne. Ore to waste ratio is 1:3 with the pit bottom of RL -50m. Thus, APMC firmed up the production strategy of starting the operations with the lower grade open pit mines and subsequently going to the much richer underground orebody.

Considering the wet background of the Longos area, the services of BHP Engineering were engaged primarily to undertake investigations and to provide designs for the effective water control measures to enable the mining of the open pitable ore. Also included in the BHP Engineering responsibility was the appraisal of the requirements for recovering the shafts for the re-opening of the underground mine. As sub-consultants, BHP Engineering tapped the services of Australian Groundwater Consultants Pty. Ltd., and Reidel and Byrne Consulting Engineers Pty. Ltd. to assist in the areas of dewatering and coastal design waves and water levels. A Philippine consulting company,

Geotecnica, was also contracted to undertake seismic refraction traverses of the corals in connection with the cut-off requirements of the proposed cofferdam.

WATER CONTROL MEASURES

The Project has three (3) prominent sources of water inflows, namely, the sea, the surface rainfall and run-off and the ground water. Each has been studied to assess the physical controls on the inflow to be able to define concrete engineering solutions.

As the Longos open pit mine is very near the ocean, a cofferdam is being constructed to protect the open pit from the sea water. The position of the dam considered the minimum allowable distance from the pit and the maximum distance from the edge of the reef. The design height of the cofferdam is 11 meters from the toe. Mine waste from the pit is being used. The rocky materials are placed on the sea side of the cofferdam. A final protection from the incessant on slaught of wave action at the structure will be provided by rock armour units which size can go up to as much as 9 tonnes (Figure 2).

The Philippines has two distinct seasons, the dry and the wet. The Longos area has a 4,230 mm annual rainfall. About half of the rainfall pours during the months of October to December.

Site drainage has been based on run off peak 10 year return period floods via culverts and diversion channels. Estimates were based on short duration rainfalls and rational formula approach.

To skirt off the open pit mine during the pre-production stage, a diversion drain and culverts were constructed and installed. Eventually, as the final stages of the pit is approached, a diversion dam will be constructed coupled with a spillway to catch and tap most of the run off water which will be re-routed out to the sea (Figure 2).

The Longos Lode is considered to be the major passageway of groundwater. Secondary groundwater movements are also believed to be present along cross-cutting faults and subsidiary lode mineralization. Also, the sub-horizontal contact between the ultrabasic rock and the granodiorite is potentially a major source of water inflow, particularly when in hydraulic connection with the Longos Lode.

Both the HW and FW rocks are considered minor sources of groundwater.

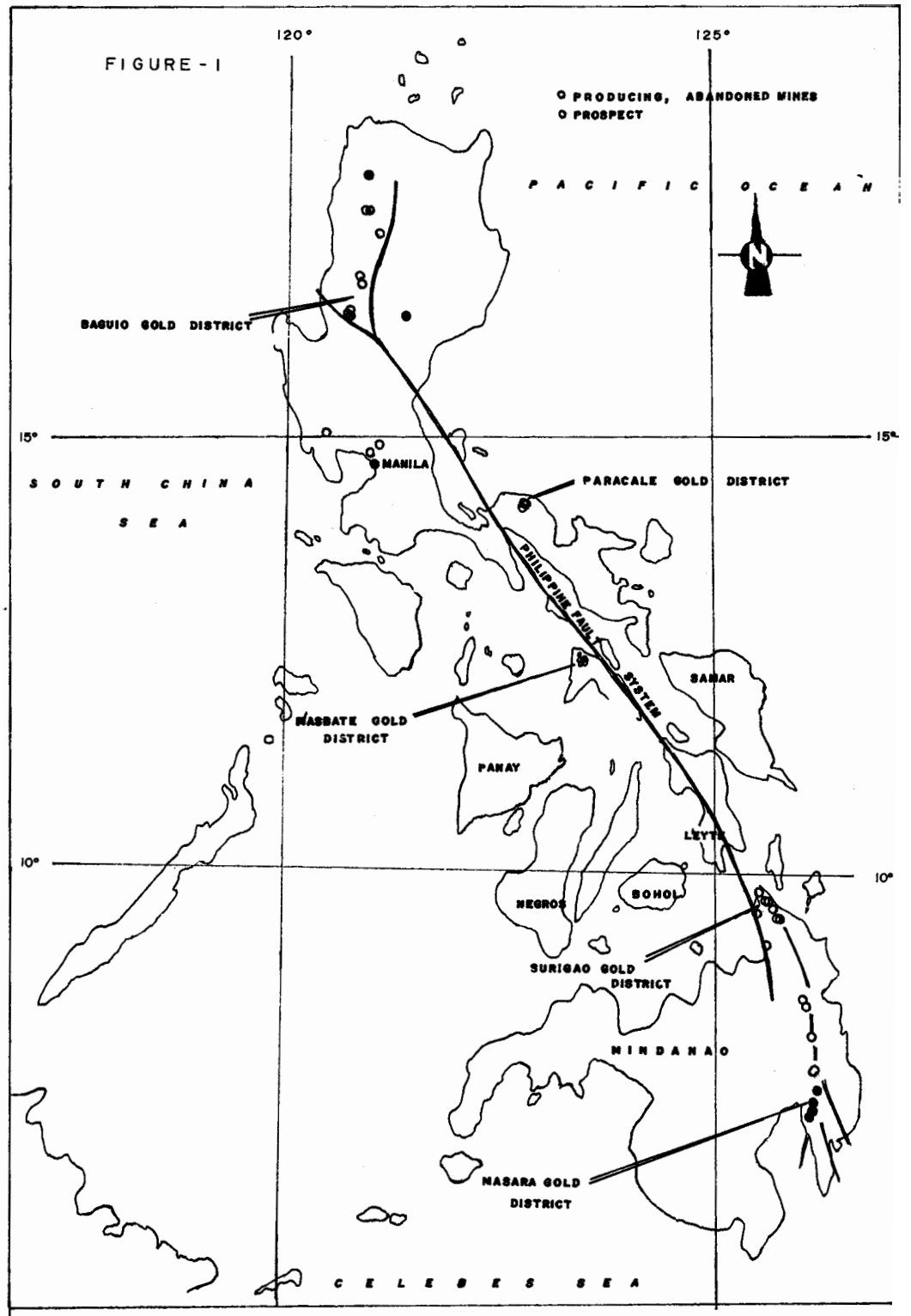
Computer modelling of the groundwater data was undertaken adopting representative values for the hydraulic parameters and various aquifer geometrics. Both analytical and two-

dimensional finite difference models were set-up and the model configuration and parameters established by calibrating model predictions against historical data. The two-dimensional finite difference model was unable to adequately reproduce historical groundwater trends at the site. On the other hand, the more simplified analytical model was successfully calibrated and consequently used to simulate the first six month dewatering requirements of the open pit.

The general concept of the dewatering is to concentrate on drawing water from the Longos Lode to drain the pit. This scheme is considered not only more cost effective but also safer compared with grouting or with in pit pumping. Interception drainage wells (Figure 2) will also assist in pit slope stability. The four interception wells at the HW are designed to intersect the Lode. Pumping from Number 3 shaft is also part of the pit dewatering scheme. This shaft is connected to the Lode of all working levels. Pumping activities at Number 3 Shaft and the interception wells which are located on the opposite sides of the pit, will depress the water level at the pit. Additionally, sub-horizontal drainage bores are required both at the HW and FW.

CONCLUSION

The exploitation of the presently known highest grade gold deposit in the Philippines is under way. Considering the systematic and scientific manner in which the issues and problems are addressed to and handled, APMC, with continuing help from skilled and highly experienced consultants, is very confident that the Longos mining operations will be successful.



GOLD DEPOSITS OF THE PHILIPPINES

The Third International Mine Water Congress, Melbourne Australia, October 1988