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MINE DESIGN & PLANNING AT EFEMÇUKURU GOLD PROJECT

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ABSTRACT: The purpose of this paper is to provide an overview of die development and mining plan for the Efemçukuru Gold Project located in western Turkey. The development program for the mine has been designed to minimise environmental impacts during construction, operation and closure. This aim has been a primary factor in the selection of die ore processing method, tailings treatment and disposal, selection of mining methods, and *the* design of all project facilities.
Total mineable resources at Efemçukuru are 2,499,750 metric tons at an average grade of 12.65 g/t Au. Mechanised overhand cut and fill has been selected as primary mining method in order to produce 800 tonnes of ore per day or approximately 250,000 t/year from the mine.
A gravity concentrate will be treated on site to produce gold/silver dore and a flotation circuit will produce a gold concentrate, which will be shipped off-site for final gold recovery. Approximately 60 % of the tailings from the mill, will be de-watered and backfilled into open stopes using a paste-fill system. The remaining tailings will be stored on site in a Dry Stack tailings disposal area.

1. INTRODUCTION

1.1. Location

The Efemçukuru Gold Project is located in western Turkey approximately 15 km southwest of die port city of İzmir. The project receives its name from the village of Efemçukuru (population about 500), which is located 2 km to the southwest of the deposit. (Fig. 1)

1.2. History

The Efemçukuru project was discovered in 1992 by Tüprag Metal Madencilik while carrying out reconnaissance work in western Turkey. Tüprag completed a total of 12,000 meters of core drilling on the deposit between 1992 and 1997, as well as detailed metallurgical and engineering studies. A pre-feasibilty study was completed in 1999 detailing the technical and economic performance of the project.

1.3. Geology

The Efemçukuru deposit is a low sulfidation epithermal gold and silver vein which crosscuts homfels and phyllites.

The mineralised vein structure has an approximate strike length of 1,100 meters and has been traced by drilling over a vertical interval of 350 meters. Three ore shoots exhibiting and continuity along strike and down dip have been identified within the vein; (1) the South Ore Shoot (S.O.S.), (2) the Middle Ore Shoot (M.O.S.), and (3) the North Ore Shoot (N.O.S.).

2. THREE DIMENSIONAL ORE BODY MODELLING AND RESOURCE ESTIMATES

A project database containing drill hole, sampling and assaying information was prepared in Microsoft Access. A tfiree dimensional model was then prepared using Gemcom geological modeling software. To accomplish this, the mineralised vein was first defined on cross sections spaced 5 m apart in the South and Middle Ore Shoots and 25m apart in the North Ore Shoot. The vein outlines were then wire framed in to a three dimensional solid. A similar process was used to create a low-grade ore envelope around the vein that was used to estimated the grade of dilution material.

Block models were generated for the mineralized vein and envelope then ordinary kriging was used to assign gold grades to all blocks within the envelopes. Percentage block models were also created to define the amount of vein and envelope wimin each block.

The percentage models were then used to evaluate The volume of the material witiiin the mineralized vein. A specific gravity of 2.8 was then applied to determine the tonnage present.

Table I summarizes the Measured and Inferred resources for each of the ore shoots. A cut off grade of 6 g/t Au and 1.5 meter minimum mining width were assumed.

The resource was later reclassified to determine what portion could be moved into a proven and probable reserve category. Accordingly, 70% of the resource has been classified as reserves.

Table 1 : Geologie Resource of Efemçukuru veins.

ORE SHOOT	MEASURED / INDICATED			INFERRED		
	TONNES	GRADE G/t	Ounces Gold	TONNES	GRADE g/t	Ounces Gold
SOUTH	859,000	12.69	350,417	443,000	11.25	161,998
MIDDLE	934.000	16.09	483,231	142,000	15.92	72,703
NORTH	81,000	9.75	25.381	61,000	9.75	19,124
TOTAL	**1,674,000**	**14.26**	**859,029**	**651,000**	**12.13**	**253,825**
				TONNES	GRADE 9ft	Ounces Gold
TOTAL MEASURED / INDICATED & INFERRED				2,525,000	13.71	1,112,854

3. MINE DESIGN

3.1. Mineable Resources

The measured, indicated and inferred resource was used as the basis for establishing a mining resource.

Based on the geometry of the ore and selective mining methods, a mining recovery of 90% has been estimated. Dilution of mineable ore by low-grade ore and waste material from overbreak in the stopes has been estimated at 10%, containing an average grade of 2.0 g/t Au.
Total mineable ore resources are estimated to be 2,499,750 tons at an average grade of 12.65 g/t Au.

3.2. Mine Design and Layouts

The mine planning and design work presented below has been restricted to the MOS and SOS. The N.O.S. has not been factored into the current mining plan due to limited information.

The Efemçukuru underground three dimensional mine design and development layouts were produced using Gemcom mine planning software after completion of ore body modeling.

The mine is designed to operate at an average production rate of 800 tonnes of ore per day, to achive an overall annual production of 250,000 tonnes of ore per year for approximately 10 years.

The orebody model and geotechnical information from drill core were used for the mine design and development layouts. The mine planning, software provided a very effective working environment for the mining engineer through all phases of the planning , including detailed design, planing and production scheduling.

3.3. Mine Access

The type and location of access for underground mining has been influenced by following factors:
. Environmental considerations
. Site topography
. Geometry of the deposit
. Planned locations for surface facilities
. Requirements for the movement of men, materials and ore
. Requirements for mine ventilation and emergency egress system.

After consideration of the above factors, it was decided to access the mine from an adit. The geometry of the deposit and overlaying topography have combined to allow the main access to intersect the deposit at the 584 meter elevation, slightly above the deposit midpoint. The main portal will be located approximately 250 meters north of the concentrator building on the east side of the Kokarpinar valley. A 350 meter decline will be driven east from the 600 meter elevation through the hangingwall and the ore. All underground development will be located in the footwall homfels, which is geotechnical ly very competent. The adit will pass through the gap currently defined in the mineralised zones between the S.O.S. and M.O.S. Initial geotechnical drilling in this area indicates the hangingwall homfels is very competent in this region and that only conventional support will be required in this decline.

The vertical extension of the deposit is currently limited to approximately 225 meters below the adit level, hence installation of a vertical shaft for ore handling was not considered necessary.

A second underground access will be provided from the 623 meter adit level located in the unmineralised gap area between the SOS and MOS, on the footwall side of the deposit. This adit will intersect the 620 meter footwall haulage drift, providing additional access for the movement of men and materials.

A third access adit at the south end of the orebody will be located at the 650 meter elevation. Once in service it will be used for hauling mine waste and to discharge exhaust air.

The middle and south ore shoots have been divided into three stoping areas down to the 368 meter level. The main mining levels are at the nominal elevations of 584, 494 and 404 meters. Stoping will be started from 584 meter level in both shoots and proceed up dip to the surface crown pillar. Concurrent development of the 494 meter level will provide a second production horizon to replace the 584 meter level as it İs depleted. This will be repeated for die next level at the 404 meter level.

Separate central ramp systems (4.0m x4.5m) will service each of the ore shoots. Three main haulage drifts will be developed between the shoots at the 620, 584 and 494 meter elevations.

Crosscuts (4.0m x4.5m) will be driven at 18m intervals to intersect the footwall drifts from the ramp. Ore and waste pass dumps will be located mid way along these crosscuts. Footwall drifts (3.2mx4.0m) will be developed north and south from the crosscuts to establish access to the ore. The length of each footwall drift will vary depending on the strike length of the ore. In the M.O.S., where longhole mining is planned, İt will be possible İn some areas to access the ore directly from the crosscuts.

3.4. Mining Memods

From a mining perspective, the Efemçukuru deposit can be described as:
. Steeply dipping - 64 to 68 degrees^0
. Extending 1,100 m on strike, with an explored depth of 350 metres
. Variable width <1.0m to 15m plus
. Tabular structure with vein splays, separating at depth
. Minor fault zones in ore and host rock parallel to mineralised structure
. Rock mass rating fair to good

The selection of suitable mining methods for the Efemçukuru deposit has been based on a conventional approach. The following criteria have been considered.
. Ore body geometry and continuity
. Ground conditions in the ore zone as well as hangingwall and footwall rocks
. Ore recovery and dilution factors
. Environmental factors

The use of open pit mining methods for extraction of the upper portion of the vein, especially in the M.O.S. was considered. However, in order to minimize both surface disturbance and the amount of waste rock generated, underground mining only has been selected for this deposit.

Overhand cut and fill will be the primary mining method for Efemçukuru. This method offers the greatest flexibility for handling the variable widths and changing dip directions expected during mining. It also allows selective mining of ore-grade material to maintain high recoveries and grades, while reducing dilution. In-stope mining will provide excellent ground control to minimize dilution from low-grade wall rock. Paste backfilled tailings will provide additional regional support and should further improve the already good ground conditions.

Multiple entry stope access crosscuts will be utilised in cut and fill slopes to accommodate mechanised equipment, for increased productivity.

Broken ore and waste will be hauled by 2.7 yd LH D units to the ore/waste pass system. Ore will be pulled from ore chutes on the main haulage levels and hauled by 20 ton trucks to a surface stockpile via the north and south ramps to the 600 level portal. Waste rock from mine development will be hauled to the mine waste dump by trucks via the 650 waste haulage adit during production.

Mining sublevels are placed at every 18m vertically throughout the ore body. For cut and fill stoping each sublevel contains six 3m high cuts. The first cut will be accessed by a stope access drift driven at -15% from the footwall drift. Successive cuts are accessed by taking down the back of the crosscut until it achieves its maximum grade of+17% for the sixth and final cut. The next mining level and its series of six cuts is accessed from the next sublevel off the main ramp. (Fig.2)

Sublevel longhole stoping will be applied in the M.O.S. where the ore widths extend to 20 meters. Maximum stope widths will be determined by geotechnical assessment of the wall rock and vein. Depending on the design parameters established, longitudinal stones or transverse slopes with primary and secondary sequencing will be mined. Stope heights will initially be established at 18 meters. Paste backfill will provide competent fill as in the primary stopes, reducing dilution from fill during secondary mining. (Fig.3)

4. ORE PROCESSING

Ore recovered from underground will be processed on site in a flotation and gravity concentrate plant. Based on metallurgical testwork, it has been demonstrated that the Efemçukuru ore is amenable to processing by either direct cyanidation or flotation techniques. The overall recovery of gold varies between the two processes by 4 %, with cyanidation averaging 90 % recovery and flotation, followed by cyanidation of the concentrate, yielding 86 % - 88 % recovery.

The decision to proceed with flotation and gravity concentrate recovery of gold at Efemçukuru has been based on the technical merit of this process as well as acceptance by regulatory agencies. Final cyanidation of the concentrate will be carried out offsite.

Given the current controversy surrounding the use of cyanide for gold recovery in Turkey, this approach provides'a clearer path along which Tüprag can proceed with permitting and development of the project. It is in keeping with the overall philosophy of minimizing the impact of the operation on the general environment.

5. WASTE MANAGEMENT

5.1 .Waste Rock Dump

Waste rock from the underground mine development originates predominantly from footwall hornfels, which over the mine life will be impounded in a natural valley located at the southern end of the ore body.

Rehabilitation of the mine waste dump during operation and at closure of the mine will include contouring of the surface to blend with surrounding topography, soil replacement and revegetation.

5.2. Tailings Disposal

In order to minimise the surface area required for the disposal of mil) tailings, a paste backfill system will be used to inject de-watered tailings into mined out stopes. Normal Portland cement will be added to the back-filled tailings to facilitate consolidation and increase the overall compressive strength.

Tailings from the plant, will dewatered to about 17% moisture content and approximately 60 % of the tailings will be used as a backfill material for the open stopes. The remainder of the tailings will be deposited in a designated Dry Stack Tailings disposal area. Rehabilitation of the tailings will be carried out concurrently with operations. The ultimate objective of the rehabilitation program is to return the area to a natural state. The Dry Stack Tailings disposal method provides the opportunity to carry out Ulis work prior to mine closure. The application of this technology is intended to further reduce environmental impacts and enhance post closure land usage.

6. CONCLUSION

The technical and economic viability of the Efemçukuru Gold Project has now been demonstrated at the pre-feasibility level. The ability to develop a workable mine plan to deal with the orebody characteristics and geometry has been an integral part of meeting the objectives of the project.

Continued effort will be made by Tüprag to further define this deposit and refine the technical approach to mining and processing the ore. Work is ongoing to secure the necessary environmental and operational permits required, prior to moving the project to the feasibility study stage.

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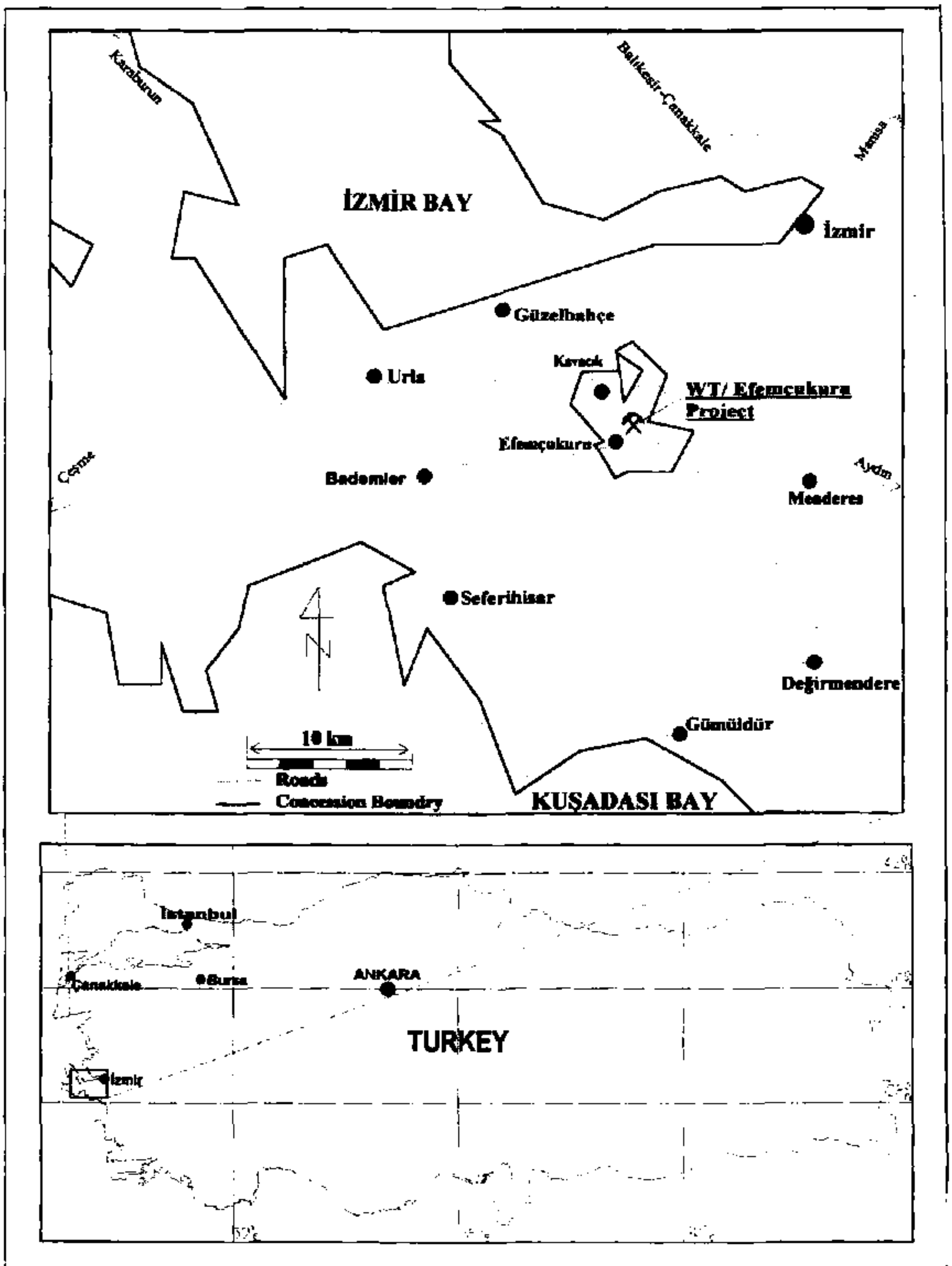
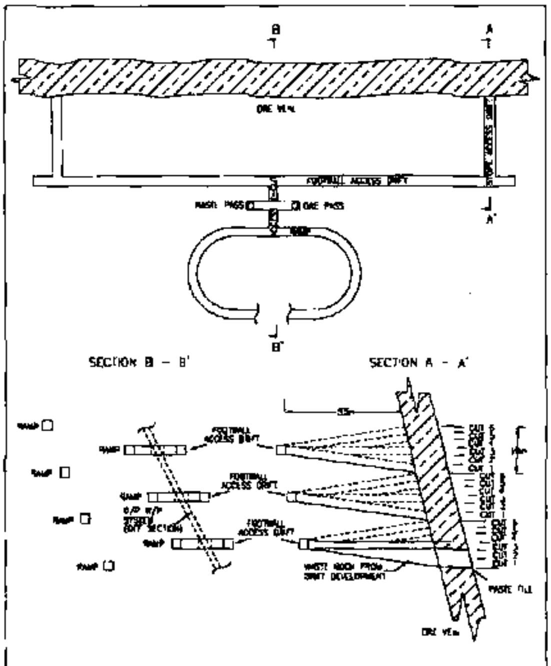
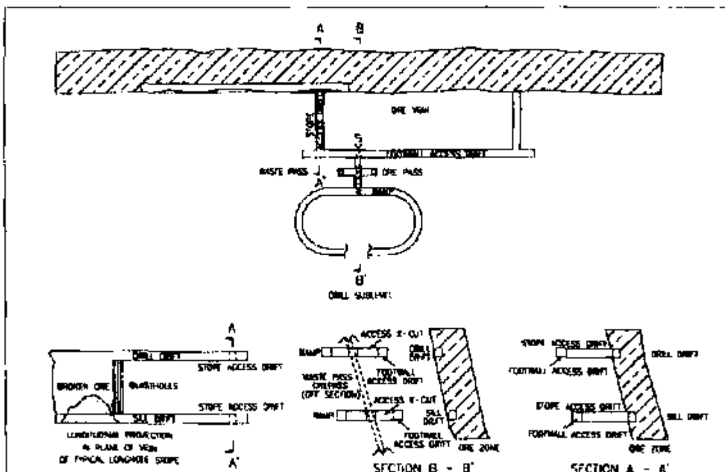
Figure 1. Efemcukuru Project Location Map.





CUT AND FILL MINING METHOD

Figure 2



LONGHOLE MINING METHOD

Figure 3