

THE ACCESS DATABASE FOR THE CUKAR 2 EAST ORE BODY BUCHIM MINE, REPUBLIC NORTH MACEDONIA

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Abstract: The present Access database for the Cukar 2 East ore body as one of the constitutional parts of the Buchim ore deposit was developed as an integral part of the mega-European project ProMine, which aimed to define the data processing and their presentation in the Pan-European GIS database for primary ore deposits and anthropogenic mineral resources. The implementation of this project aimed at forecasting and estimating the mineral resources at the Pan-European level, thus constituting a modern overview of European metallurgy. For successful completion of work package 1 within the ProMine project, databases for primary and secondary mineral resources (ProMine-MD) and anthropogenic concentrations (ProMine-AC) have been created. Our Access Database that we created (in Microsoft Access) is an integral part of the large ProMine-MD database, which covers 34 European countries and has about 12,979 records for mines, ore deposits and ore occurrences.

The Cukar 2 East ore body database, is a preliminary effort to compile geological surveys and their data for this ore body into an understandable database that will be available to interested parties. The organization of databases for other metal deposits in the Republic of Northern Macedonia and the experiences gained, enabled us to construct a respectable database for the ore body Cukar 2 East, Buchim mine. Our paper explains the steps we took to create the Microsoft Access database using the representative and available data for the Cukar 2 East ore body. The database in question is constructed with the most important data that refer especially to the geological, metallogenetic and economic parameters of this ore body. Particular attention should be paid to the main economic parameters that are an integral part of this database. Namely, it is an ore body with active mining (Solway company) with proven reserves of 27,161 Mt ore where the content of copper is 0.206% Cu and gold with 0.165 g / t Au. In the part of the mineralization and the surrounding rocks, we entered reliable data that clarify the age of the mineralization (16.4-13.6 Ma relative 16 Ma absolute) while the age of the rock in which the mineralization is located was determined as relative one between 28.4 - 23, 03 Ma while the absolute method (K/Ar) showed 27 Ma. From a petrological point of view we want to emphasize that the geological setting is composed of rocks with composition: gneiss, andesite and latite. From an economic point of view, it is important to emphasize that proven mineral reserves of 27,161 Mt (from 2017) give serious economic expectations from copper metal potential of 55 952 t and gold of 448 kg Au. The database in question also provides additional information in support of the positive economic effects expected with the exploitation of the ore from the Cukar 2 East ore body.

Keywords: Ore body, Cukar 2 East, Buchim deposit, Access database, ore reserves, mineral economy

1. INTRODUCTION

On the contact between the Serbo-Macedonian Massif (SMM) and the Vardar Zone (VZ) is located the well-known Bučim porphyry Cu deposit. This Buchim ore deposit is constitutional part of the Buchim-Damjan-Borov Dol ore district, which spatially is located in the eastern parts of the Republic North Macedonia. The metallogenetic studies of this ore deposit confirmed that it belongs to the metallogenic zone Lece-Halkidi defined by Serafimovski (1990), which in turn is an integral part of the Alpine-Balkan-Carpathian-Dinarid metallogenetic zone as explained by Heinrich and Neuber (2002). The intrusions in the Buchim-Damjan Borov Dol ore district are defined as members of the Late Eocene-Oligocene magmatism, which as a younger one intersects the older tectonic structures defined by Schefer et al. (2011, 2013). More detailed information on all genetic, geochemical and metallogenetic characteristics of the Buchim ore deposit is available in the works of Cifliganec, (1993); Serafimovski et al. (2010); Volkov et al. (2010), Serafimovski et al., (2016) etc.

The Chukar 2 East ore body is defined as an integral part of the complex Buchim ore deposit, during geological research carried out during the active exploitation in the well-known Buchim Mine. This ore body is a direct continuation of the former, already exploited ore body Chukar 2 (exploitation completed in 2010), to the east. Detailed geological research (exploitation drillholes along the existing drillholes net) was conducted on two occasions, in 2012 and in 2016. The results of those detailed geological surveys enabled an accurate calculation of the geological ore reserves in this ore body (Serafimovski, 2017). Here we want to emphasize that in 2012, during the detailed geological research of this ore body, 11 drillholes with a volume of 2100 m were realized, while in 2016, 12 exploitation drillholes with a volume of 1601 m were made, while together with the previous exploration that area is covered with 60 drillholes in a total volume of respective 10 976 m [Serafimovski, 2017]. Exactly this large amount of research data was the reason for the calculation of geological reserves of ore in the ore body Chukar 2 East of 27 161 276 t with 0.206% Cu and 0.165 g / t Au. Such solid figures provide economic justification for the exploitation of copper and gold ores from this ore body.

In the context of the European directives and of course the initiative of our Ministry of Economy, we started to prepare modern databases for certain ore deposits (following the example of the BRGM Mineral database-ProMine), in the Republic Northern Macedonia. In this particular case, our sincere intention was to create a database that would contain the most representative features of the ore body Cukar 2 East, which in turn exists as an integral part of the Buchim ore deposit. Starting with such an idea, we compiled in detail the numerous data that resulted from detailed geological research that lasted continuously for about twenty years. The design of the database in question has been carried out in several main areas, as has been done by more experienced Western European countries in their GIS databases, detailed information of which can be found in the work of Casard and Itard (2003); Itard et al. (2002); Barnett and Williams (2006); Vuolo et al. (2010), Cassard et al., (2012).

2. SOME GEOLOGICAL AND MINERALOGICAL FEATURES

As we have already mentioned, and as its name suggests, the ore body Cukar 2 East is located on the east of the already exploited ore body Chukar 2, all of them as an integral part of the complex Buchim ore deposit.

The lithological composition of this ore body consists mainly of rocks of the order of andesite, gneiss and latite. The productive ore mineralization is located in the areas where the gneiss is cut with knots of andesitic composition. The morphology of the mineralization is characterized mainly in the form of veinlets and less often in the form of impregnations. Vein-veinlets mineralization in the Cukar 2 East ore deposit mainly consists of chalcopyrite and pyrite veins, then chalcopyrite monomineral veins, associated by quartz-feldspar-pyrite-chalcopyrite veins. The latest detailed geological research and the current exploration of the ore body Cukar 2 East, indicate a complex ore body with a stockwork-impregnated isometric shape, whose contour boundaries are variable with the change of depth. The main minerals in this ore body are: chalcopyrite, magnetite, pyrite, chalcocite, pyrrhotite, covellite, Fe-hydroxide, sphalerite, galena, enargite, molybdenite, malachite, anglesite, bornite and others (Cifliganec, 1993).

3. DISCUSSION

The database generated by us was built on several main pillars:

The general data sheet is mainly made up of segments that contain information about the concessionaire company, the operating status of the company, latitude / longitude, the name of the ore area, any significant comments, and so on. (Figure 1). On the example of the database for ore body Chukar 2 east, mine Buchim, special attention is paid to the data that it is a mine with active exploitation, that this ore body has its own reliable economic potential in terms of concentrations and reserves of copper and gold. , but also other associated metals (Ag, Cd, Pb, Zn, etc.).

Fig. 1. General information datasheet of the database

The screenshot shows a software interface for a mineral database. The main title is 'Description of the deposit' with the identifier 'MKD-00048' and name 'Buchim (CUKAR 2 East Ore Body)'. The commodity is listed as 'Cu + Au'. The form is divided into several sections: 'General information' (Identifier, Mining company, District, Status, Longitude, Latitude, Countries), 'Ore-deposit names' (Buchim, Cukar 2, Vrank, Radoviste, Buchim), 'Comment' (Detailed geological research and exploitation data), 'URL', 'Source', 'Database name', and 'Identifier in the database'. There are also buttons for 'Back to the main menu', 'Preview for this deposit', 'Add a new deposit', 'Duplicate this deposit', and 'Delete this deposit'. The bottom status bar shows 'Record: 16 of 301'.

Here we want to emphasize that this section also contains information about the coordinates of the ore deposit, the holder of the exploration concession, common toponyms used by the local population and possible comments that would clarify the ore body itself.

The most important properties of the ore body, given in the general characteristics sheet, are in direct accordance with the style of the ProMine database. Namely, this sheet contains information on details such as: primary and secondary morphology of the ore body, and of course information on the type of deposit (Figure 2). For the ore body yukar 2 East within this sheet it was emphasized that it is a polymetallic porphyry type of Cu-Au mineralization, which is sometimes accompanied by a zone of cementation, ie, secondary copper sulfides.

Fig. 2. Datasheet of the database targeting deposit features

Data on the age of mineralization and rocks (relative and absolute), the mineralogical composition of the ore, the mineralogical composition of the tailings, the types of hydrothermal alterations, the composition of the rocks in which the mineralization is located and other data are placed on an information sheet called Mineralization/rocks (Figure 3).

Fig. 3. Datasheet of the database describing mineralization-rocks features

This database sheet, as required by the European Databases, contains information on the mineralogy of the ore (pyrite, magnetite, hematite, chalcopryrite, valerite, cubanite, chalcose, natural gold, velerite, etc.), relative (16.4-13, 6 Ma) and absolute (16 Ma) age of mineralization. This info sheet also provides data on the type of alterations (kaolinization, sericitization, chloritization, etc.), tailings mineralogy (zircon, quartz, apatite, biotite, etc.). Another informative data was the information on the relative age of the host rock (28.4-23.03 Ma) as well as their absolute age (K / Ar) determined at 27 Ma, as well as information on the composition of the lithological environment (dacite, andesite and gneiss).

The economic data sheet from the database contains important information about possible previous production, type of reserves, resources, type of reserves, average estimate of possible annual production, numerous economic parameters for the type of ore is organized in the window called Economy (Figure 4) .

This sheet from the database for the subject ore body Cukar 2 East, contains numerous data in regards to main ores, composition of primary and secondary mineralization (sulfides as well as sulfosalts), type of exploitation activities and others.

Fig. 4. Economy information datasheet of the database

The screenshot displays the 'Economy' information datasheet for the Bucim (CUKAR 2 East Ore Body) database. The window is titled 'Description of the deposit' and includes tabs for General information, Deposit, Mineralisation/Rocks, Economy, High-Tech Metals, Comments, Iconography, and Bibliography. The 'Economy' tab is selected, showing fields for Ore (Cu), Production unit (t(1000 kg)), Grade unit (g/t), and a summary table with columns for Former production, Reserves, and Resources. The summary table shows values for Former production (0 Mt), Reserves (27.16 Mt), and Resources (8 Mt). A 'Calculation' button is visible at the bottom right.

In the info sheet from the subject database entitled Economy it was given information that in the area related to the ore body Cukar 2 East there was no previous production and that this ore body itself is a complete unit with proven ore reserves of 27 Mt (by 0.206% Cu and 0.165 g / t Au). Also, we provided information on possible other useful components of the order Ag and Cd.

The High-Tech Metals Database section provides the potential user with information on (i) The potential of certain rare or high-tech metals or (ii) potential capacities where anthropogenic processing could take place smoothly. Selection of rare and high-tech metals is done by the user himself by personally selecting the specific metal (ex. Se, Re, Ga...), and then he can use information from the database which are actually the parent minerals (for example, molybdenite) that are carriers of the particular component, the amount of host minerals in the ore and other information. The other part of this information sheet in the subject database provides information on possible processing sites (mill, smelter, concentrator). Due to the fact that this is a newly defined ore body, mainly with economic reserves of copper and gold, we did not compile additional data in this fact sheet. However, as an open option remains during the active production, if the appropriate knowledge of these rare and high-tech metals is obtained, the sheet in question should be additionally filled with the relevant useful information.

The information sheet from the database called Comments is conceptualized in two parts where the creator of the database can enter text data that would give an additional description of the geology of the ore body, the possible economic justification from the valorization of the ore body Chukar 2 East. This is certainly a great opportunity for

potential users to gain as much information as possible about the ore body in question (Figure 5). Exactly in this part of the information sheet we have enriched it with a detailed text in which detailed data on the geology and mineralogy of the ore body are given, which until that moment have not been entered in the other information sheets from the subject database (Figure 5). Exactly in this part of the database we emphasized that the ore body Chukar 2 East in the mine Buchim is a new, newly explored, mineralized body, with a low coefficient of mining of 0.40. This mineralization coefficient emphasizes the fact that as much as 60% of the space in this ore body is non-mineralized. Undoubtedly, the future user will also benefit from the information that this ore body belongs in the group of uneven mineralized (43-100%), which is confirmed by the coefficient of variation (71.39%).

Fig. 5. Information datasheet of the database named Comments

In the lower part of the information sheet named Comments were given a whole series of information about the prices of the metals in question (gold and copper), the value of the ore body at the time of the construction of the database (2017). Of course, as useful information that was shared was the period of 5.2 years for which the working life of the Buchim mine will be extended with the discovery of the ore body Chukar 2 East.

The Iconography sheet allows you to attach photos of the ore body in question. Of course, for such a thing, it is initially necessary to give the directions from where the database should upload them (photo directory) and who would be the generic photo viewer (eg Picasa ..).

The references used in the construction of the database are given in the sheet entitled Bibliography. Namely, there is an extensive overview of the numerous geological bibliography (which refers to the numerous characteristics of the ore body in question), and of course bibliographic units / references were pointed out that define the economic parameters of the ore body (Figure 6).

Fig. 6. Bibliography information datasheet of the database

In this section we want to emphasize that with the development of this database for the ore body Chukar 2 East, which is an integral part of the famous porphyry deposit of copper and gold Buchim, we have made an appropriate contribution to three types of data (geological characteristics, economic parameters). and bibliography, ie, references). The most commonly used references to this ore deposit are an integral part of this information sheet from the database.

4. CONCLUSIONS

As an indisputable conclusion at the end of this paper on the preliminary database for the ore body Chukar 2 East crystallizes the fact that our efforts resulted in information that definitely leads to a more realistic reassessment of the primary copper (gold) mineral resources in the Republic of Northern Macedonia. The significant amount of information contained in the subject database enables smooth and impartial reassessment of the mineral potential of the ore body in question, as well as its value assessment, in terms of time factor and the price factor of the mineral raw material. The developed database for the ore body Chukar 2 East definitely emphasizes the certain directions in the evaluation of this important ore body. Namely, the natural indicators and the qualitative-quantitative parameters are put into operation here, which should result in economically justified exploitation of the metals of the order of gold and copper. Of course, we should not forget the findings that the ore body Chukar 2 East has reached an advanced level of research and readiness for exploitation of gold and copper, but of course it will be possible to valorize the elements of silver, iron and others. The economic benefit is easily seen through the prism of proven mineral reserves of 27,161 Mt (with 0.206% Cu and 0.165 g / t Au) whose value at today's price level reaches a staggering \$ 300 million. In terms of metallogenetic characteristics, the fact was confirmed once again that the calc-alkaline magmatism of Tertiary age (Oligocene) was the main mechanism that led to mineralization in the subject area.

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