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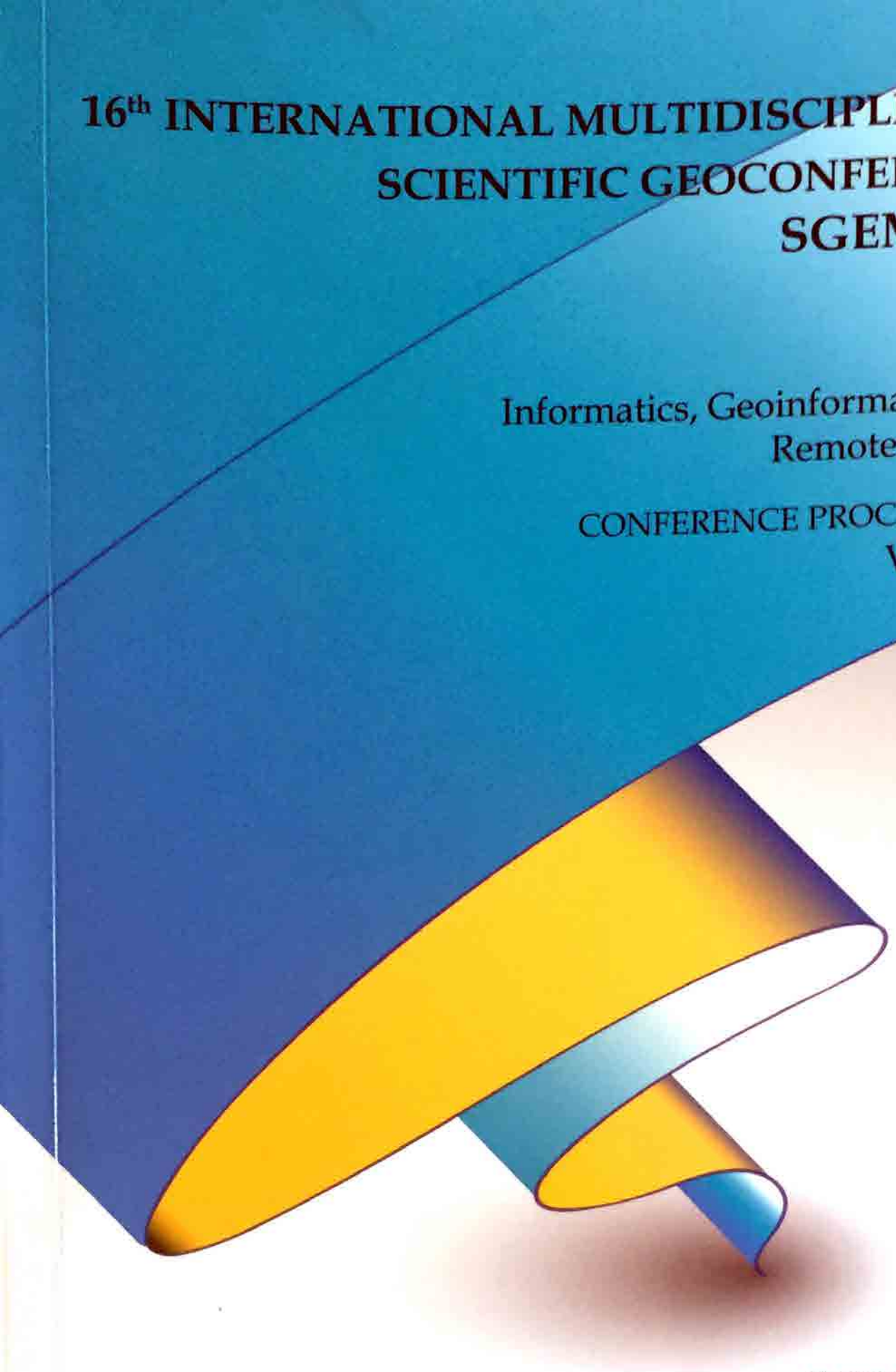
Volume I



INFORMATICS
GEOINFORMATICS

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SECTION GEOINFORMATICS

ORGANIZATION OF THE ZLETOVO's Pb-Zn DEPOSIT MINERAL AND ANTHROGHENE ACCESS DATABASES, REPUBLIC OF MACEDONIA

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ABSTRACT

The Republic of Macedonia has been and still is one of the leading European lead-zinc producers. One fraction of that lead-zinc production comes from the Zletovo lead-zinc mine, near the city of Probistip in eastern parts of the country. Our latest paper focuses on efforts we made to organize Microsoft Access database with the most representative data for this particular lead-zinc deposit in the Republic of Macedonia. At the very beginning, with the software package "Microsoft Access" we have organized database with information of the most important geological, metallogenic and economic features of the deposit. Also, we didn't forgot the fact that, long history of mine exploitation inevitably produced significant anthropogenic input to the environment, so we have structured and anthropogenic database too. These two kinds of databases were adapted for simple and sophisticated querying of particular deposit and anthropogenic features and allows edition of reports and a geographic display of the queried information.

Keywords: Pb-Zn deposit, Access database, reserves, anthropogenic input, economy.

INTRODUCTION

As we already mentioned at the territory of the Republic of Macedonia there are three active lead-zinc producing deposits: Sasa, Toranica and Zletovo, which has been exploited during last several decades. The latest one being subject of this particular paper. The Zletovo mine is located in the vicinity of the city of Probistip, Macedonia. The mine started operation in 1940 and its production lasts until today with certain short-term interruptions. As it is well known the mineralization is related to Tertiary calc-alkaline magmatic rocks, mostly dacites and andesites [1, 2]. Detailed information about the mineral paragenesis and geochemical features of major minerals in ore veins is provided in extensive literature [1, 2]. The main ore mineral association is composed of galena and sphalerite, followed by tetrahedrite, pyrrhotite, magnetite, chalcopyrite, pyrite, and Mon oxides are also common. Production during certain periods have reached 300000 t of ore annually, with ore grades higher than 9% Pb and 2% Zn, and variable concentrations of Ag, Bi, Cd, and Cu.

The problem with environmental pollution around the Zletovo mine and facilities associated with its production has been generally related to the fact that the ore was concentrated by flotation at Probistip and tailings were disposed of in two impoundments

situated in adjacent river and stream valleys. One of them, the river Kiselica, drains the flotation plant at Probistip while the Koritnica River drains the area containing the main workings of the Zletovo mine. Both of them join the River Zletovska, which empties into Bregalnica River that is the biggest water flow in the Eastern Macedonia. Honestly, up to date, in the Republic of Macedonia there weren't professional databases that should be in accordance to the European directives, although there is an initiative in ours Ministry of Economy that such database(s) should be prepared and included in similar modern European databases (ex. BRGM Mineral database).

We were aiming to organize both databases with an information about some of the most representative Zletovo deposit features, regarding natural and anthropogenic issues. Bearing in mind that the Zletovo deposit and former mine have a long history of exploration and exploitation, we knew that building aforementioned databases is not an easy task to fulfill. We had to systematize data from exploration longer than seven decades and exploitation longer than half a century. Also, we were aware of the problem with environmental pollution around the Zletovo deposit vicinity. There increased lead, zinc, cadmium, indium and some other heavy metals could pose serious risk for the human environment and health. Organization of the both Access databases was carried out under several main topics, which are in accordance with the GIS related mineral databases principles given elsewhere [3], [4], [5], [6], [7], [8], [9].

DISCUSSION

The particular mineral database itself was structured under the following main topics:

General information where has been enclosed information about the mining company, status, latitude/longitude, ore district name, comments etc. (Figure 1).

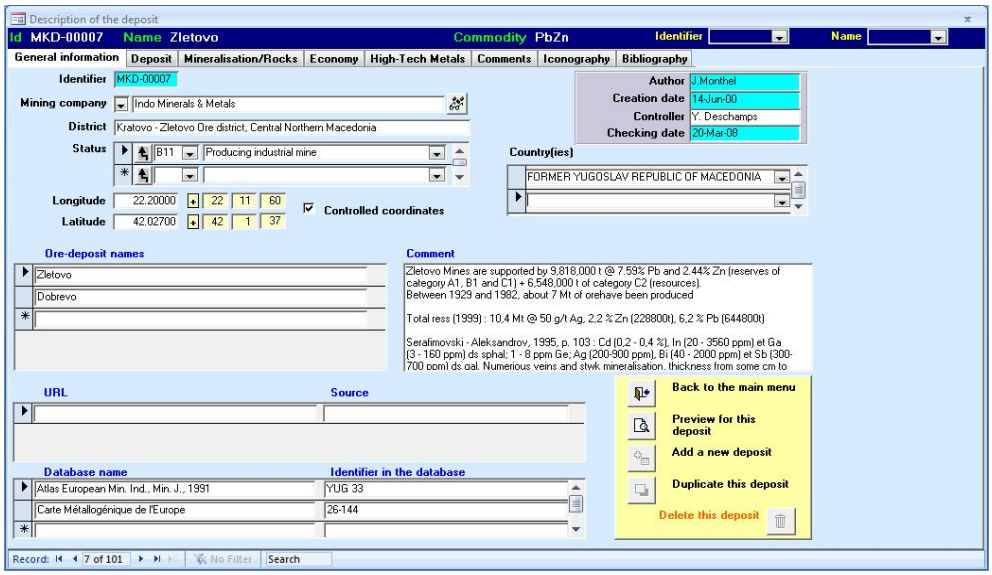

Fig. 1. General information datasheet of the database

For example on our sample of the Zletovo deposit we gave an accent that it is a producing industrial mine with certain potentials in regards to lead, zinc, silver, indium, cadmium and some other rare metals. That information was followed by detailed coordinates and name of the company owner of the mine and production facility, as well as familiar names used by locals for the mine and short general comments.

Deposit features sheet is organized in a manner that should be given details about the parameters: deposit type, main morphology and secondary morphology (Figure 2).

On our example deposit, Zletovo, we have entered data about the deposit's combined type where we have pointed out the low-sulphidation epi- to mesothermal polymetallic Pb-Zn±Ag veins with elements of atypical epithermal deposit type morphology.

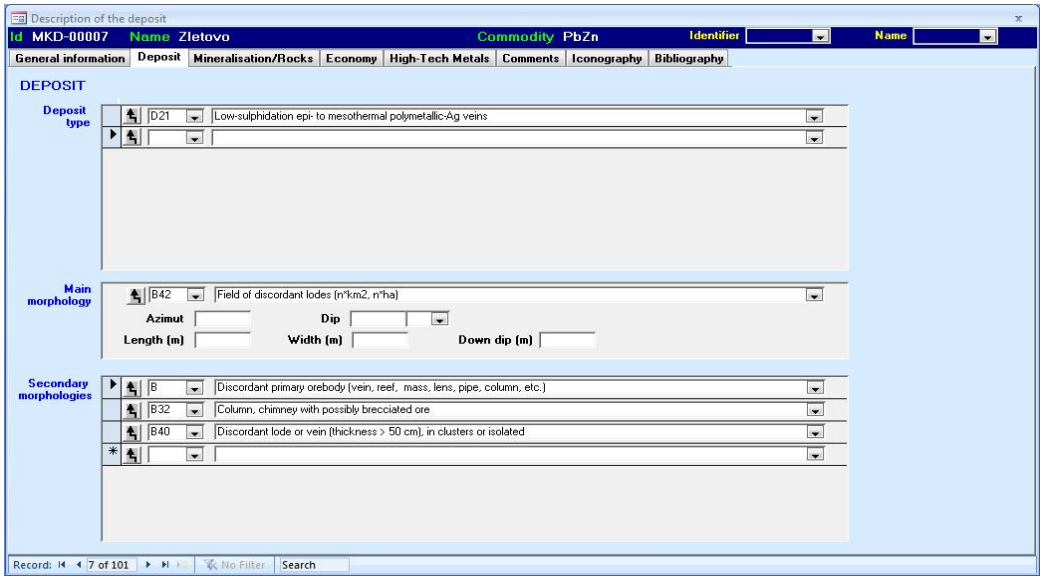

Fig. 2. Deposit features datasheet of the database

Mineralization/Rocks data sheet usually should contain data about age (supposed and absolute), ore mineralogy, gangue mineralogy, hydrothermal alteration, host rock (age supposed/absolute, host rock formation, name and lithology). All of them being grouped into separate main windows (Figure 3).

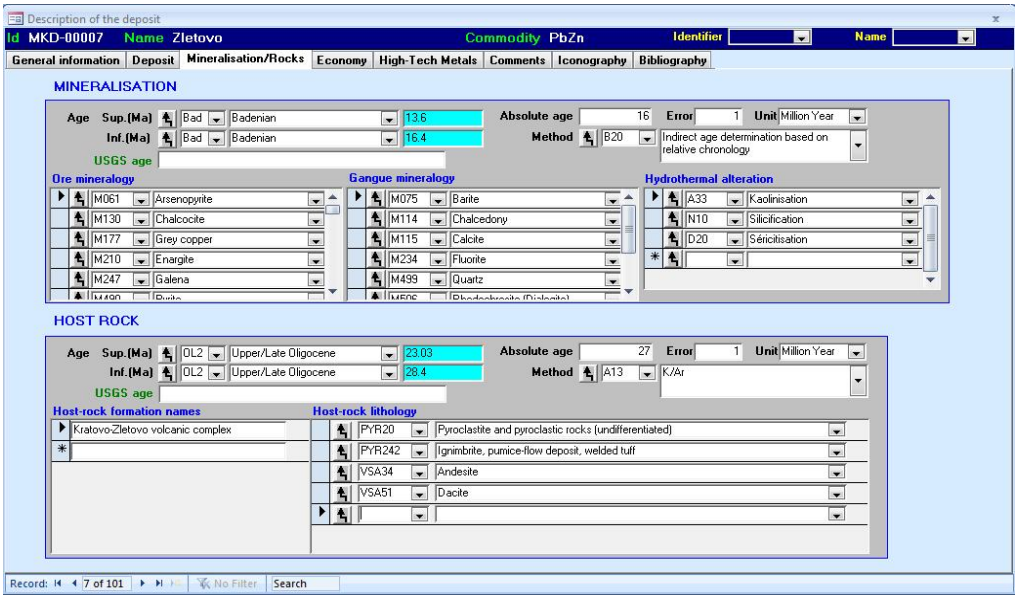

Fig. 3. Mineralization-rocks information datasheet of the database

Here we have entered a significant amount of data regarding the mineralization age (relative 16.4-13.6 Ma; absolute 16 Ma), ore mineralogy (arsenopyrite, chalcocite, galena, sphalerite, enargite, pyrite, chalcopyrite, marcasite, etc.), gangue mineralogy (barite,

chalcedony, fluorite, calcite, quartz etc.) and diverse hydrothermal alterations (silicification, sericitization, kaolinization etc.). After that followed an information about the host rock age (relative 28.4 - 23.03 Ma; absolute 27 Ma, K/Ar method) and host rock lithology (pyroclasts, ignimbrite, welded tuff, andesite, dacite etc.).

Economy data sheet was planned to provide an information about ore type, grade unit, former production, average grade of production, years of exploitation, reserves, average grade, type of reserves, resources, average grade of resources, type of resources organized in windows named exploitation type, main commodity and commodity (Figure 4).

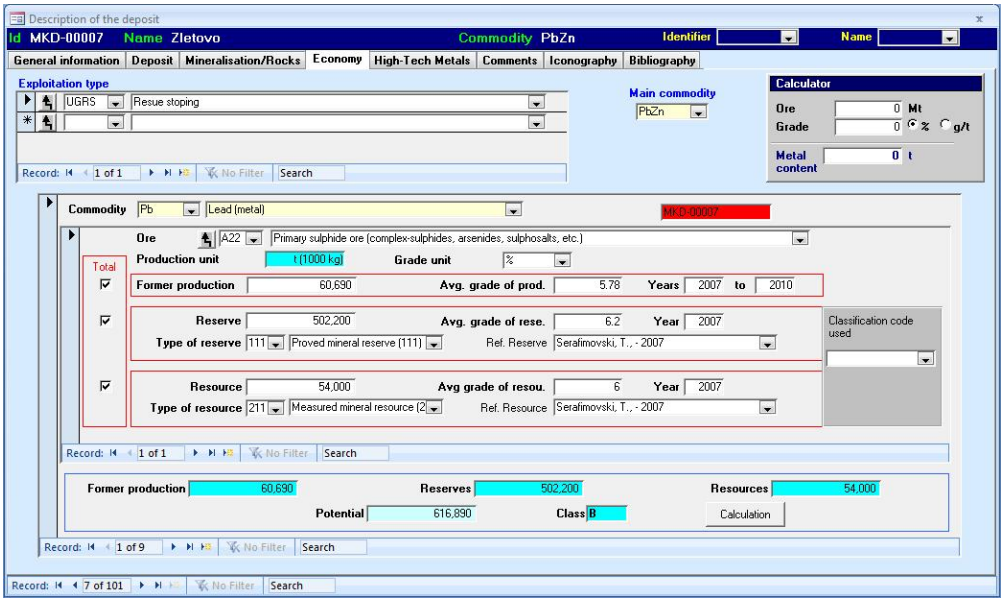

Fig. 4. Economy information datasheet of the database

So, here for the Zletovo deposit, was given information about the exploitation type of mining (underground) where the main commodities, Pb-Zn, are represented by primary sulfide ore (complex sulfides, sulphosalts etc.). Also, reserves has been quoted as former production in amount of 60 690 t (period 2007-2010 and lead concentration of 5.78% Pb), proved mineral reserves of 502 200 t (as of 2007 and lead concentration of 6.2% Pb) as well as measured mineral reserves of 54 000 t (as of 2007 and lead concentration of 6 % Pb) followed by data about four additional commodities (Zn, Cd, Ag, In) given as separate records within this datasheet (metal production, not the raw ore).

High-Tech Metals data sheet was divided into two different windows, which have been established in order to characterize (i) Potential of specific commodities or capacities (ii) where the anthropogenic products are processed. To characterize High-Tech metals, user has to enter a commodity (ex. Re, Se, Ga…) and then he will be able to give information about host minerals (e.g. molybdenite), grades (i.e. minimum, maximum and average grade) and abundance of host minerals in the ore. The right window provides information about processing site(s) (e.g. concentrator, mill, smelter…). Due to relatively strong unworked nature of the deposit, we haven't entered any additional data regarding this information sheet of the database.

Comments sheet, which is composed of two windows where it is possible to write free texts describing details about geology and/or details about economy of a particular deposit gives a fine opportunity to describe particular deposit in more details (Figure 5). Here we have entered

extensive free text data about the detailed geological and mineralization features of the deposit, not mentioned elsewhere in the database (Figure 5).

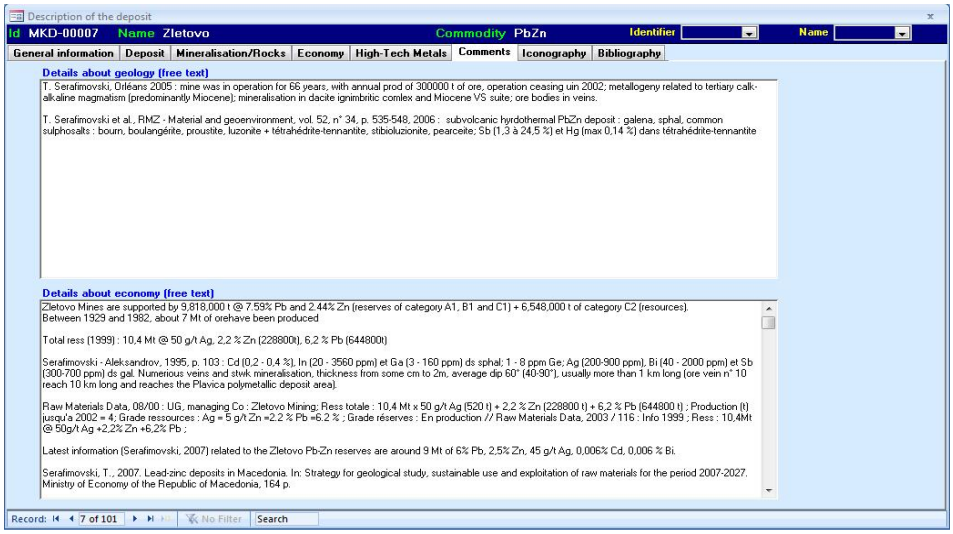

Fig. 5. Comments information datasheet of the database

Here in the upper window we accented that the mine has been in production for more than 66 years, with annual prod of 300000 t of ore. Also, here we stressed out that it's metallogeny is related to tertiary calk-alkaline magmatism (predominantly Miocene) where mineralisation is in dacite ignimbritic complex and Miocene VS suite while ore bodies are mainly veins. In the lower window were given some details on the economical aspect of the mine such were total reserves, excavated and remaining ones.

Iconography sheet has been elaborated in order to attach images with a deposit. The first step being definition of paths of the image directory and the image viewer (e.g. Photo Editor, Windows picture viewer, Picasa…) by clicking on "Configuration" button.

Bibliography data sheet for a particular deposits was intended to give an overview of geological bibliography (references relating to the geology of the deposit) and economical bibliography (references relating to economic data of the deposit) as can be seen at Figure 6.

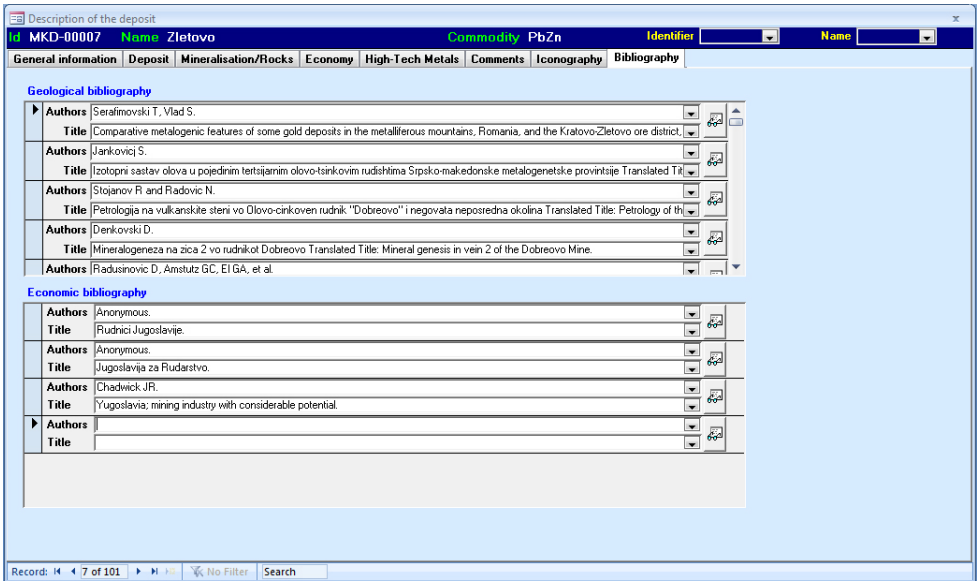

Fig. 6. Bibliography information datasheet of the database

For the Zletovo deposit, we made significant input in regards to both types of bibliography, geological and economical ones. All the known and commonly used references to this particular deposit have been covered in this data sheet.

In regards to the *anthropogenic concentrations* Access database we would like to display its several organizational entities:

General information address information about the location, status, latitude/longitude, ore district name, comments etc. (Figure 7).

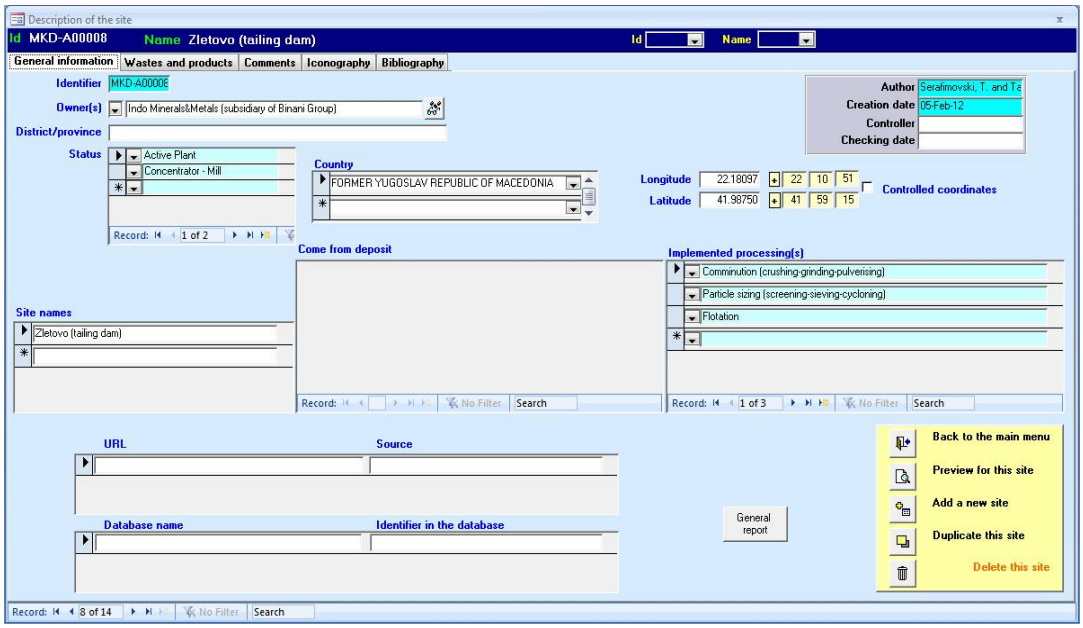

Fig. 7. General information datasheet of the anthropogenic database

For the Zletovo deposit related anthropogenic concentrations, we stressed out that is a an active plant/mine with concentrator-mill facility with description of implemented processing methods, followed by coordinates, familiar names used by locals for the mine and short general comments.

Wastes and products sheet is organized in a manner that should be given details about the parameters: type of storage (surface, underground,...), type of waste (mine waste dump, slag,...), volume and surface occupied as well as tonnage and density of a particular waste-product, waste mineralogy, particular commodity and affected water area (Figure 8). Here potential of specific commodities in the anthropogenic products (e.g. Pb, Zn, Mn, Fe, Cu, Bi, Ag, Ga, Ge, In, Cd and Ni) related to certain host minerals was given, as well as grades (i.e. minimum, maximum and average grade) and abundance of host minerals in anthropogenic products. For ours particular locality, Zletovo, we have entered data about all different kinds of minerals found in the waste (galena, sphalerite, pyrite, barite, kaolin, limonite etc.). There the accent was given to the significant quantities of lead, zinc, silver, gallium, germanium, indium and cadmium with potential of 87559 t, 133119 t, 477 t, 213 t, 8.5 t, 1331 t and 292 t, respectively.

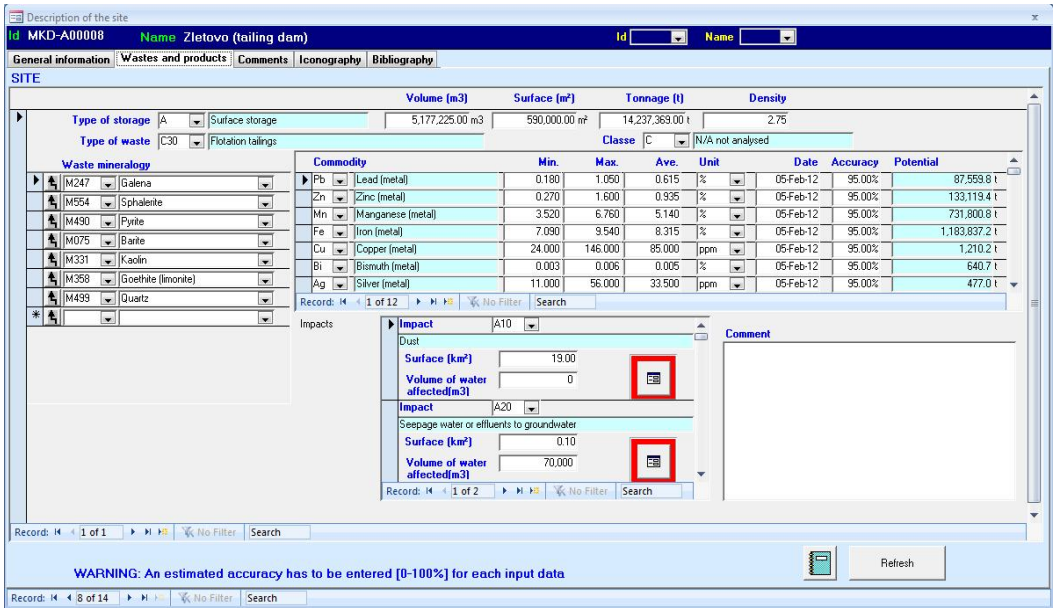

Fig. 8. Wastes and products datasheet of the anthropogenic database

Comments sheet, which is composed of space where it is possible to write free texts describing details about geology and/or details about economy of a particular deposit related to the anthropogenic concentrations gives a fine opportunity to describe particular concentrations in more details (Figure 9). However, due to low level of knowledge at the moment and ongoing research we were not able to make some significant input here especially in regards to eventual representative economic features.

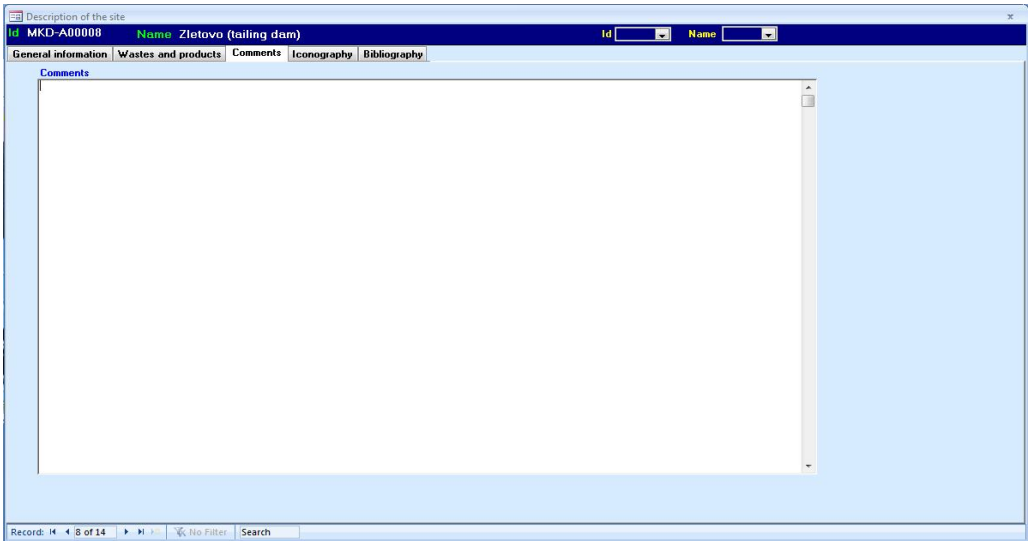

Fig. 9. Comments information datasheet of the anthropogenic database

Iconography sheet has been elaborated in order to attach images with an anthropogenic concentration. The first step being definition of paths of the image directory and the image viewer (e.g. Photo Editor, Windows picture viewer, Picasa…) by clicking on "Configuration" button quite similar to the mineral database above.

Bibliography data sheet for particular anthropogenic concentrations was intended to give an overview of available bibliography (references relating to the anthropogenic

concentrations) and economical bibliography (references relating to economic data of the anthropogenic concentrations) and was quite similar to the database seen at Figure 6.

CONCLUSION

The initial build of the Access database for the Zletovo Pb-Zn mineral deposit and its anthropogenic reflections, had their major accents in the qualitative-quantitative parameters and natural indicators in function to present and future valorization of metals that were subject to the establishment of the database, in accordance with professional mineral databases, as well as environmental and economic viability of the particular waste dump enclosed in form of an anthropogenic concentration Access database.

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