Mineralogy and geochemistry of the metamorphites and of the sulphide mineralization associated from the Mănăila area (crystalline mesosoic-zone, Eastern Carpathians)

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PhD thesis summary

In drawing abstract were kept the same notations for chapters figures, tables used in the text of the thesis.

Thesis "Mineralogy and Geochemistry of the metamorphites and the sulphide mineralization associated from the Mănăila area (crystalline-Mesozoic zone of the Eastern Carpathians)" is the result of a comprehensive study of bibliographic material which also involved both field work and laboratory during the first two years of doctoral studies. During this time, an national stage (North University of Baia Mare) and an international stage (University of Cologne, Germany) were performed inside of the doctoral program funded by POSDRU/88/1.5/S/47646 .

In this stages were performed chemical and mineralogical analyzes. The main objectives of this study was:

- Mineralogical characterization of the sulphide mineralization from the Mănăila ore deposit
- Geochemical characterization of the sulphide mineralization from the Mănăila ore deposit
- Petrographic description of the host rocks from the Mănăila ore deposit
- Geochemical characterization of the host rocks from the Mănăila ore deposit

The motivation for choosing this subject was the fact that the region has been relatively slightly studied so far, although the mineralization from Mănăila area are among the few currently exploited from the one associated to the Tulghes litogroup.

The thesis is organized into 6 chapters, conclusions, bibliography and appendix.

Chapters 1 and 2 include data exclusively from literature. The first chapter refers to historical research on Tulgheş litogroup which outcrop over large areas in Eastern Carpathians and is

known for its exploitation of Kuroko-type metal sulphides (Kräutner, 1965, 1989, Balintoni, 1997, Muresan 2002 a, b, Munteanu, 2010).

The rock cropping out in the Mănăila ore deposit belongs to the Tulgheş metamorphic unit, respectively Tg3 formation of Bucovina nappe, and it is located on the territory of Fundu Moldovey village, Suceava County.

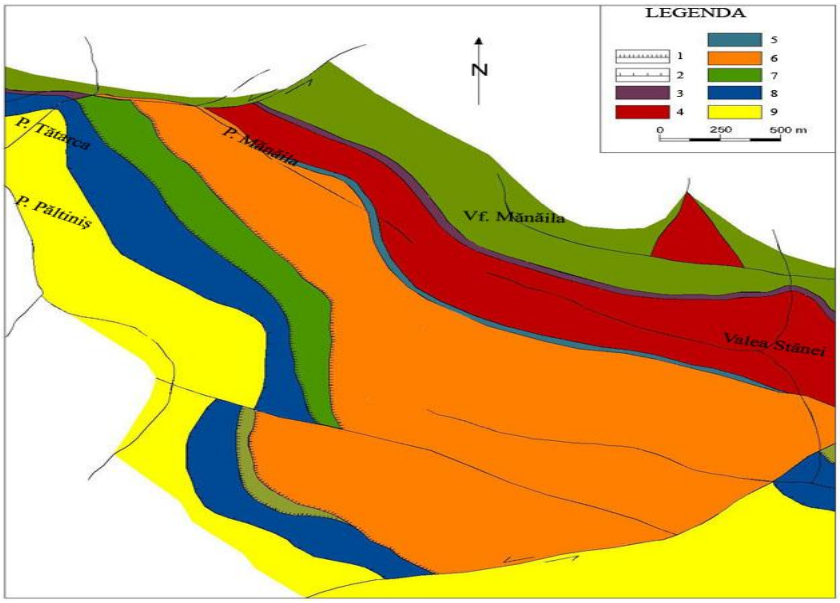


Fig. 3. Geological map of the Mănăila ore deposits (modified after Podaşcă, 2004)
1. Pre-Alpine thrust, 2. Alpine thrust, 3. Fundu Moldovei sulphide horizon, 4. Fundu Moldovei metavolcanics, 5. Mănăila sulphide horizon, 6. Moroşan Member, 7. Negrişoara Group, 8. Rebra Group , 9. Sub Bucovinian Nappe: Tulgheş Group.

Chapter 2 contains general data on geological characterization of Tulgheş litogroup, massive sulphide deposits in the Eastern Carpathians and the geology of Mănăila ore deposits. At the end of the chapter are summarized characteristics of other massive sulphide deposits in the Eastern Carpathians: Burloaia, Fundu Moldovei, Leşu Ursului, Bălan.

For this study were conducted the following analysis, detailed in the chapter 3 of the thesis.

- X-ray fluorescence spectrometry, (XRF)
- Inductively coupled plasma mass spectrometry, (ICP-MS)
- Electron microprobe,
- Optical microscopy,
- X-ray difractometry, (XRD)

Chapter 4 the most consistent of the thesis includes petrographic considerations on metamorphites of Tulgheş litogroup, general considerations over the polymetallic ores,

considerations over the mineralization from Mănăila ore deposit, the microscope determination of the opaque minerals from Mănăila ore deposit, the results of investigations by X-ray difractometry method and composition maps for the main metallic minerals from Mănăila ore deposit obtained by electron microprobe.

In Chapter 5 are treated aspects of geochemistry of the metamorphites and associated sulphide mineralization from the Mănăila ore deposit (major elements, minor elements and rare earth elements), distribution and character of major and minor elements in pyrite ores. Chapter 6 deals with the classification of VMS type deposits and a comparison between the mineralogy of the Mănăila ore deposit with those of Kuroko-type deposits.

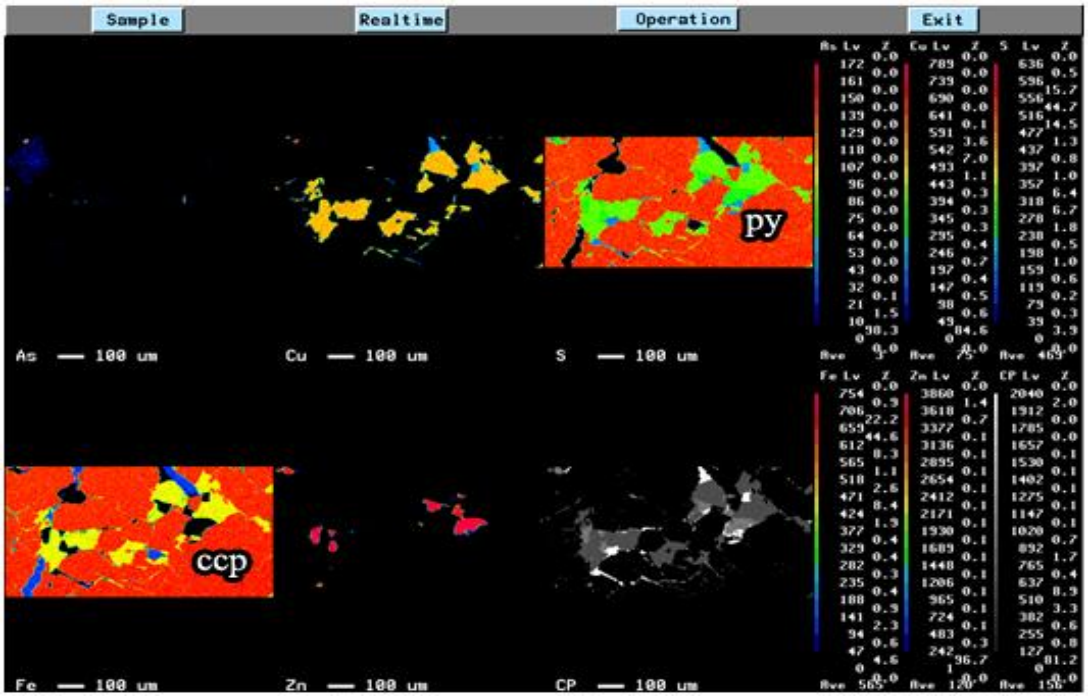
In the study area were separated following petrographic varieties: quartzitic schists, quartzitic schist with sulphide impregnation, quartzitic sericite chlorite schists, etc.

The mineralization from the Mănăila ore deposits have the form of lens layer, and are represented by disseminated pyrite, chalcopyrite, sphalerite and galena in the host rocks, with contents without significant economic value. Galena usually does not come into contact with gangue minerals and is surrounded by pyrite and sphalerite crystals.

The mineralogical composition in the Mănăila ore deposits is relatively simple: pyrite, chalcopyrite, sphalerite, galena and tetrahedrite, respectively in paragenesis with quartz, chlorite and muscovite, as pointed out in a previous paper (Moldoveanu et al., 2010).

The gangue is composed mainly of quartz in addition with feldspar, chlorite, sericite, carbonates minerals. Compact polymetallic ore consists predominantly of pyrite. Optical microscopy analyses and electron microprobe analyses showed that predominant sulphide is pyrite followed by chalcopyrite, sphalerite, galena, tetrahedrite.

Based on the electron microprobe analysis were highlighted an average of Fe content of 47.1% and 53.2% for S. For sphalerite were highlighted an average content of 62.6% Zn, 32.8% S and small amounts of Fe with an average of 1.5%. For chalcopyrite the average contents are: 34.8% S, 29.9% Fe, 33.2% Cu.



(A)

Fig .11. Maps for main metallic minerals resulting from electron microprobe analyzes : A, B , C D , E, F samples 18 and 25, G , H, I: samples 03, 05 .

After the geochemical analyzes of the rock samples, this were divided into samples hosting the mineralization and non-mineralized samples.

REE concentrations in rocks are usually normalized to a common reference standard, which most commonly comprises the values for chondritic meteorites. Chondritic normalization therefore, has two important functions. Firstly, it eliminates the abundance variation between odd and even atomic number elements and secondly, it allows any fractionation of the REEs group relative to chondritic meteorites to be identified (Rollinson, 1993). In this study the results was normalized both chondrite values and primitive mantle.

The set of results normalized, using the data after Boynton (1984) and McDonough et al., 1991 were plotted in diagrams. All the samples present negative Eu anomalies ranging in the limits:

- Eu/Eu^{*} = 0.08 – 0.80 for the rock samples;
- Eu/Eu^{*} = 0.23 – 0.65 for the mineralized samples.

Chondrite normalized REE patterns are moderately fractioned with La_N/Yb_N values between 2.02 $\mu g \cdot g^{-1}$ - 11.48 $\mu g \cdot g^{-1}$ for the rock samples and 2.02 $\mu g \cdot g^{-1}$ - 11.48 $\mu g \cdot g^{-1}$ for the

mineralized samples which are less fractioned. Both the rock samples and the mineralized samples show LREE enrichment and HREE depletion.

There are not significant differences between the LREE enrichment and HREE depletion in the rock samples and mineralized samples. Negative europium anomaly may be due either to a reducing environment or due to the fluctuations concentration in mineralized and non-mineralized samples .

Strong positive or negative correlations geochemical stand for both major elements and for the minor elements. We have high values and positive correlations between elements with high concentrations or between elements whose sulphides were precipitated simultaneously similar and stability. This correlations are sligtly or negative between elements with low concentrations. Hence we conclude that correlations between elements are dependent on their concentrations .

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