

**Српско геолошко друштво  
Serbian Geological Society**

**Зборник радова  
XVI Конгреса геолога Србије**



**Proceedings  
of the XVI Serbian Geological Congress**

**Donji Milanovac, 22-25.05.2014.**

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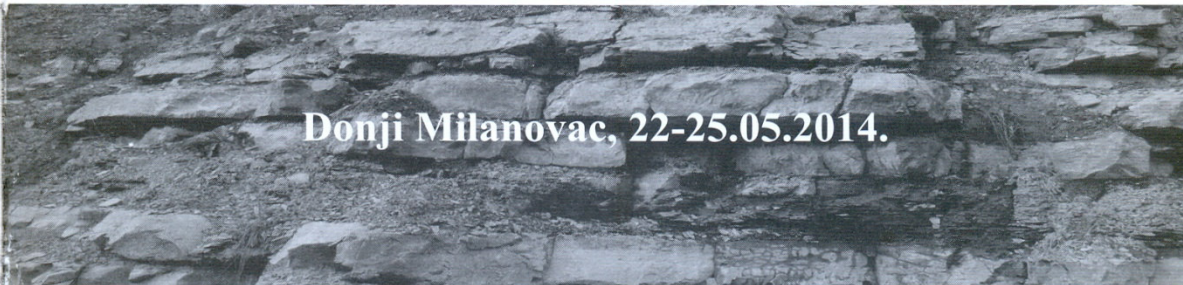


**Proceedings  
of the XVI Serbian Geological Congress**

**ОПТИМАЛНО ИСТРАЖИВАЊЕ И ОДРЖИВО  
КОРИШЋЕЊЕ ГЕОЛОШКИХ РЕСУРСА**

**OPTIMAL RESEARCH AND SUSTAINABLE USAGE OF  
THE GEOLOGICAL RESOURCES**

**Donji Milanovac, 22-25.05.2014.**





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# RESULTS OF GEOCHEMICAL EXPLORATION OF THE KAZANDOL AREA (R. MACEDONIA)

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**Key words:** copper, deposit, gold, geochemical characteristics, geochemical anomalous, Kazandol, stream sediments,.

*Abstract : To determine the geochemical characteristics of the deposit Kazandol, a technique of taking samples from the river sediments evenly distributed in the whole area of the deposit is used. With shortening, samples and the duplicates were formed with a weight from 250 gr which are sent to the laboratory for pulverization and analysis on multi-elementary analysis of ICP and for gold on AAS. The gained results from the testing of the river sediments - Stream sediments confirmed and supplemented the results of the lithogeochemical and metallometry testing. The gained results from the lithogeochemical association of elements with anomalous values, indicate the presence of copper mineralization. From the gained results it can be concluded that even in the stream sediments there is a complex geochemical association of the elements, which more significant are Cu, Mo, As, Sb, Pb, Zn, Co, Ni, Ba, Ga and others.*

## INTRODUCTION

The deposit Kazandol is located in the southeastern part of the Republic of Macedonia to the south of Valandovo and to the north of Bogdanci (Fig. 1). Specifically, it is located south of Brajkovci and west of Furka, and its centerpiece is the village Kazandol.

Researches of this locality are dating back to before the World War II , where there was a pit investigative work for the emergence of Cu. This research is conducted mainly by foreign companies and their documentation is not preserved . After the war ended, the tests were recovered , but did not obtain favorable results .



Figure 1. Map of the R. Macedonia with position the Kazandol locality

Significant research on the site Kazandol was carried out in the period between 1963 to 1972 (Rakicevic and Pendzerkovski., 1963a, 1963b; Stojanovic , 1968; Ivanovski and Rakicevic, 1970a, 1970b; Radovic



and Chulev, 1970, 1972), with specific attention to the study of the geological structure and mineralogical - petrographic characteristics of rocks . Recent research on this site was carried out in the period between 2010 and 2012 by the "Freeport-McMoran Exploration Corporation" - FMEC (former "Phelps Dodge Exploration Corporation").

## GEOLOGICAL CHARACTERISTICS

The geological structure of this site includes metamorphic rocks of precambrian age ( porphyroblastic gneisses and twomica - cordierite gneisses) and metamorphic rocks of Paleozoic age ( sericite chlorite - shale ) , and Mesozoic granites ( such Furka ) and quartz and quartzless porphyres , quartz – keratophyre and keratophyre ( Fig. 2).

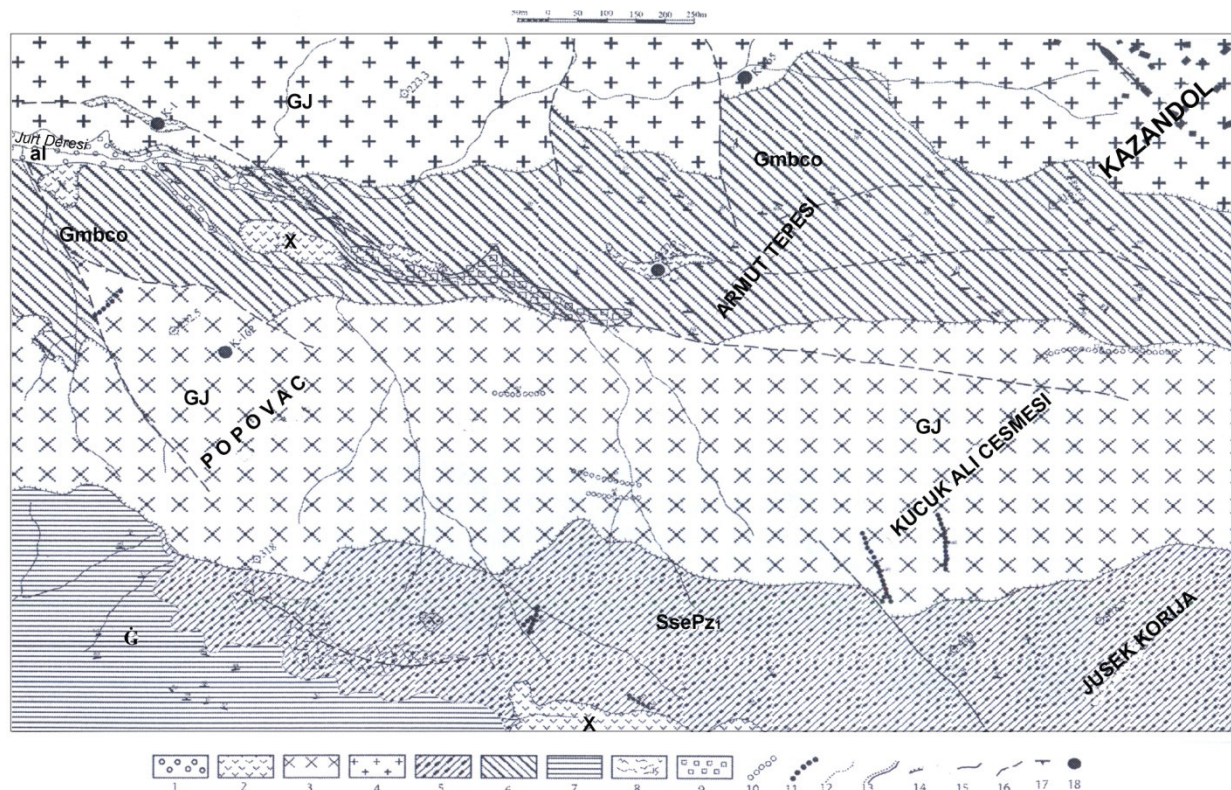


Fig.1 . Geological map of the Kazandol area

1. Alluvium, 2. Quartz and quartzless porphyres, 3. Fine – grained granites, 4. Porphyroid – and medium – grained granites, 5. Sericitic – chlorite schists, 6. Binary gneisses – cordierite gneisses, 7. Porphyroblastic gneisses, 8. Silification with Cu – mineral traces, 9. Silification and pyritization, 10. Quartz – veins, 11. Quartz veins mineralized with Cu – minerals, 12. Gradual transition boundaries, 13. Erosion boundary, 14. Magmatic body piercings, 15. Established boundary, 16. Supposed fault, 17. Foliation elements, 18. Specimens got for chemical analysis.

## RESULTS AND DISCUSSION

For evaluation of the site potentials of concession " Kazandol " among other methods, the method of research of river sediments - stream sediments is applied. The used technique of taking samples of river sediments is modified and perfected by the company . Total of 93 trials were taken by the method of stream sediments evenly distributed in the researched area (Fig. 3). In a condition of a dry river sediment, the material is sieved on site to screen the -80 mix and in a condition of a wet river sediments , samples are taken with a weight of 5-10 kgs. This sample is

dried at room temperature and sieved with sieves of – 80 mix . From all samples sieved with sieve – 80 mix ,by shortening samples and duplicates are formed with weights from 250gr which are sent to a laboratory for pulverization and multi elementary analysis of ICP and gold AADZ . The results of sampling river sediments - Stream sediments confirmed and supplemented the results of litho geochemical and metallometric ( soil ) methods . The results of litho geochemical association of elements with anomalous values indicate the presence of copper mineralization .

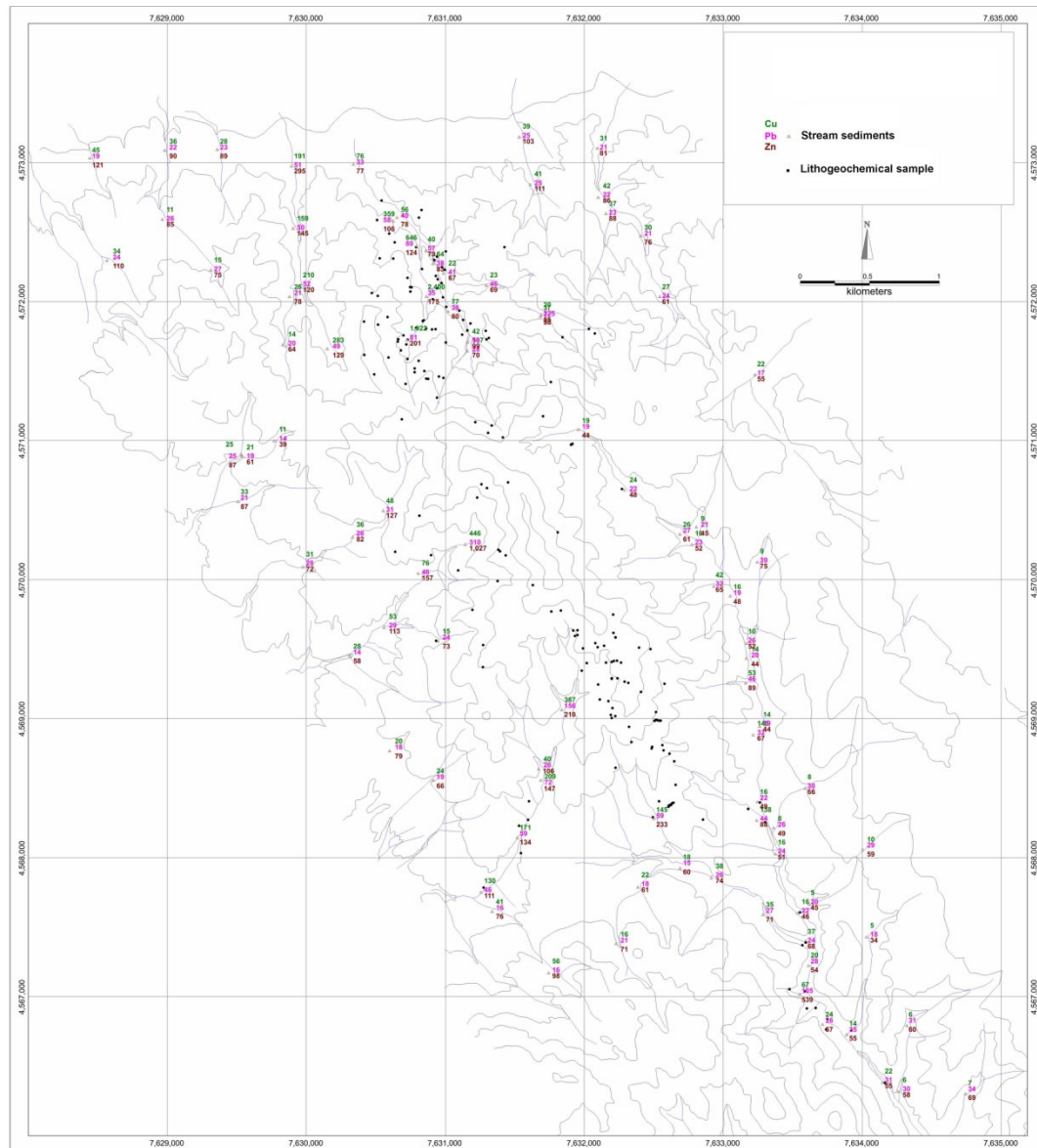


Figure 3. Map of the site Kazandol the position of samples of stream sediments (Alexandrov and Bombol, 2011)

From the results it can be concluded that the stream sediments have complex geochemical association of elements of which significant are Cu, Mo, As, Sb, Pb, Zn, Co, Ni, Ba, and Ga and others shown in the table 1 . Here we will describe some geochemical characteristics of several elements .



Copper - Cu Content of 5-100ppm in 76 rehearsals and rehearsals are not anomalous, but in stream sediments also they give a certain indication, 15 samples with content of 101-1000ppm, and 2 samples with content greater than 1000ppm. 2 sample containing 2400ppm Cu is with the highest value. These results obtained with the method of stream sediments indicate the presence of copper mineralization in the concession "Kazandol" and it is an evidence of the applicability of the method (Alexandrov and Bombol, 2011).

*Table 1. Results of performed chemical analysis of stream sediments*

Sample/ Elements(ppm)	1	2	3	4	5	6	7	8	9
Cu	9	2400	1922	646	76	56	359	446	191
Zn	75	175	201	124	77	78	106	1027	295
Pb	39	35	81	80	33	40	58	310	51
Mo	3	5	5	6	3	3	4	6	5
Co	9	23	16	15	11	11	13	17	23
Ni	13	22	25	20	18	17	23	52	49
As	6	14	16	12	10	10	12	34	22
Sb	<5	6	<5	<5	5	5	5	10	13
Ba	35	68	46	55	43	36	440	102	117

Molybdenum - content of Mo in 9 samples is below the sensitivity of the method (<3ppm). The contents in 84 samples is moving from 3 -6ppm, and it is not an anomalous samples , but they have indicative meaning and indicate of association Cu-Mo.

Arsenic - The contents of As is moving in the range of 6 -34ppm. Such contents of AS is not anomalous , but they suggest to correlation and association with Cu and Sb.

Antimony - Sb contents is moving in the range of < 5,5 -13ppm. The contents of 8 samples are > 10ppm, and in several samples are correlated with As . In these samples Sb has indicative meaning .

Lead - The contents of Pb is moving in the range of 33 -310ppm in rehearsal 8. In 78 samples the contents of Pb is from 33 -50ppm and they do not have geochemical significance , in 11 samples they are from 50 -100ppm ( low anomalous contents ) and only 4 trials with larger content of 100ppm, i.e to 310ppm in the sample 8 which is also the highest value ( anomalous content ) .

Zinc - the contents of Zn is moving in the range of 75 -1027ppm ( sample 8 ) and in association with Pb. In 8 samples they are within the 34 -50ppm ( not anomalous values ) , containing 59 samples of 50 -100ppm ( low content indicate anomalous geochemical character), in 21 samples they are 101 -500ppm, which for the stream sediments are anomalous contents , only 2 samples containing > 500ppm Zn ( sample ZS- 55 to 539ppm and sample 8 with 1027ppm), which are highly anomalous content .

Cobalt - The contents of Co are moving in the range of 9 -23ppm in rehearsal 9. In 27 samples they range from 5 -10ppm ( not anomalous values ) , and in 57 samples they are 10 -27ppm ( low anomalous values ) . It is important to note that the content in the 23 samples were <5ppm Co.

Barium - The contents of Ba is moving in the range of 35 - 440ppm ( in rehearsal 7 ) . In 74 samples they were in the range of 24 -100ppm ( not anomalous values ) , and in 19 samples they were 100 -440ppm ( low anomalous values ) and were not representing geochemical interest .

Nickel - contents of Ni in all samples are less than 100ppm and are not interesting in the geochemical aspect .

## CONCLUSION

The deposit Kazandol is located in the southeastern part of the Republic of Macedonia to the south of Valandovo and to the north of Bogdanci.

For evaluation of the site potentials of deposit " Kazandol " among other methods, the method of research of river sediments - stream sediments is applied.

The results of sampling river sediments - Stream sediments confirmed and supplemented the results of lithogeochemical and metallometric (soil) sampling.

From the results it can be concluded that the stream sediments have complex geochemical association of elements of which significant are Cu, Mo, As, Sb, Pb, Zn, Co, Ni, Ba, and Ga and others.

These results obtained with the method of stream sediments indicate the presence of copper mineralization in the concession "Kazandol" and it is an evidence of the applicability of the method.

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