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PROCEEDINGS

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HYDROGEOLOGICAL CHARACTERISTICS OF THE GOLEMA REKA LEAD-ZINC DEPOSIT, SASA ORE FIELD, MAKEDONSKA KAMENICA

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ABSTRACT

Boundary, fracture, karst types of aquifers and conditionally waterless terrain have been determined in the area of Golema Reka based on the structural type of porosity of rocks.
Key words: *Golema Reka, boundary type, fracture type, karst type of aquifers.*

INTRODUCTION

The Golema Reka lead-zinc deposit is part of the Sasa ore field, which occupies the central parts of Mt. Osogovo and the north-eastern part of the Republic of Macedonia. It is situated 12 km from Makedonska Kamenica.

In terms of its geotectonics, the Sasa ore field belongs to the Serbo-Macedonian Metallogenic province known for its Pb, Zn, Ag and Sn abundance.

The Golema Reka deposit is situated in the south-western part of the Sasa ore field in close proximity to its industrial section. The major elements occurring in the lead-zinc ore are Pb, Zn, Cd and Ag.

GEOMORPHOLOGIC, CLIMATIC AND HYDROGRAPHIC CHARACTERISTICS OF THE SURROUNDING

The wider surrounding of the Golema Reka deposit is characterised by mountainous relief of large vertical dismembering. The main valley is the riverbed of the River Golema and its canyons. There are lows in the terrain and dried out riverbeds or temporal streams that cause intensive gullies while transporting significant amounts of material.

The area is characterised by continental mountainous climate. Winters are rather cold and summers are cool with unexpected changes.

There are two rivers in the area - Svinja and Kozja that comprise the river basin. The hydrogeological characteristics of the Golema Reka deposit are largely affected by the Golema Reka basin since the ore horizon lies beneath the river. The tributaries to the Kozja, Svinja and Golema Rivers largely depend on precipitation and snow melting in the surrounding.

GEOLOGICAL COMPOSITION

The geology of the Golema Reka deposit is made up of Precambrian gneisses, Paleozoic quartz-graphite schist and cipolines, quartz-phyllite, sericite-chlorite schists and phyllite micaschists. Tertiary dacites (quartz-latites) and alluvial-deluvial and proluvial Quaternary sediments are less common.

Precambrian albitised gneisses

Precambrian gneisses predominate in the area. They occur as a monoclinal with a general dip to south-west and azimuth of slope of 200 - 280° and angle of dip of some 35°. Gneisses are characterised by augen striped texture to schistose texture, their structure being porphyroblastic. They are made up of potassium feldspars, plagioclase, (albite), quartz and biotite and muscovite.

Joints can be seen under right angle relative to textural elements. They are genetically related to tectonic movements. Joints developed by physical mechanical weathering are also present.

Gneisses occur as fairly fresh or completely changed affected by kaolinization and chloritization processes.

Paleozoic metamorphic rocks

The Paleozoic complex is present as quartz-graphyte schists, quartz-phyllite, sericite-chlorite schists, phyllite-micaschists and interbeds of cipolines and cipoline schists. More common lithological members alternate in an irregular series. The most common minerals in the schists are quartz, graphyte, chlorite, muscovite and sericite. Cipolines occur as interstratified members in the series as layers or lenses (Fig. 1).

Tertiary magmatic rocks

Tertiary magmatic rocks are present as dacites and quartz-latites occupying a small part of the area. They occur as intrusions in quartz-graphyte schists and gneisses (Fig. 2). These rocks are fairly hard, cracked and occasionally weathered so the feldspars are kaolinized and femic minerals are chloritized.

Quaternary sediments

Quaternary sediments are the least common in the area under investigation. They occur as present-day alluvial sediments, deluvial detritus material and proluvial sediments.

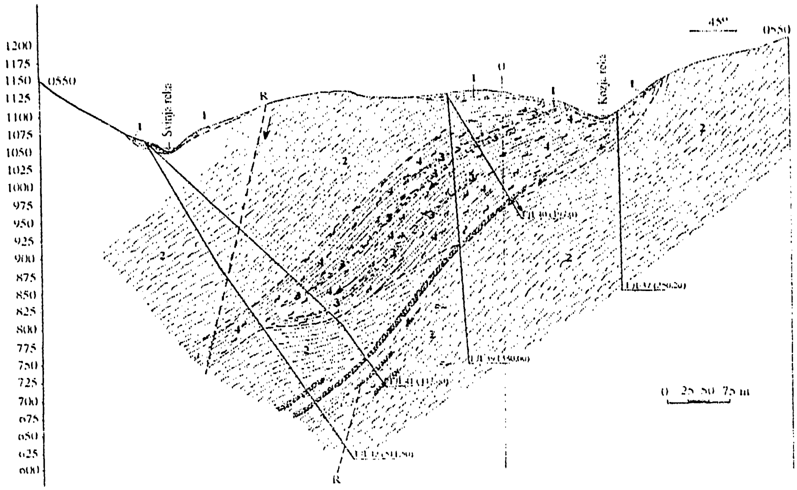
Alluvial sediments can be found along the Golema, Svinja and Kozja Rivers (Fig. 1). They are built up of gravel and poorly sorted and unevenly rimmed layers. They are made up of boulders and solitary gneisses, schists, cipolines, quartz-latites and dacites with gravel and sand.

Deluvial boulders have formed from surrounding weathered rocks and are not widespread.

Proluvial sediments are very heterogeneous and built up of clayey sandy detritus with pieces and blocks of schists, gneisses as awell as dacite of 0.5 to 30 m in size.

HYDROGEOLOGICAL CHARACTERISTICS

Boundary, fracture, karst types of aquifers and conditionally waterless terrain have been determined in the area of Golema Reka based on the structural type of porosity of rocks (Fig. 1 and 2).



L E G E N D
(for fig 1 and fig 2)

al Aluvium gravel nad sand with dust, boulders and blocks Waste dumps
d Deluvium clayes-sand, detritus
Dacites (quartz - latites)
Quartz - graphite schists
M Cipolines
Albitized gneisses
Ore
Pb and Zn mineralization
Assumed fault
Direction of undergruond water movement
Completed exploration adit
Designed exploration adit
Exploration drillholes

GEOLOGICAL SETTING OF THE TERAIN ACCORDING TO THE KIND OF AQUIFER

1 Boundary type of aquifer
2 Fracture type od aquifer
3 Karst type of aquifer
4 Waterless terrains

Fig. 1: Reprezentative hydrogeological cross-section

Boundary type of aquifers

Boundary type of aquifer is present in alluvial-deluvial boulders determined along the Golema Reka riverbed (Figs. 1 and 2). Layers in alluvial boulders are characterised by good filtration properties. There is good hydraulic connection between the aquifer and surface waters.

Of special importance is the equifer that forms in the waste dump located close to the Golema Reka deposit. The slope of the aquifer is made up of gneisses. The coefficient of filtration calculated based on granulometric analysis ranges from K = 5.15 h 10^{-4} sm./sec to K = 5.15 h 10^{-3} sm./sec. The values indicate that the layers in the deposit have filtration properties that allow fast water draining and its stability. A temporal aquifer zone forms in the deposit that does not retain significant amounts of water for a long time.

Fracture type of aquifer

This type of aquifer is the most widespread. They have formed in gneisses and magmatic rocks characterised by joint type porosity of various degree of fissure patterns (Figs. 1 and 2).

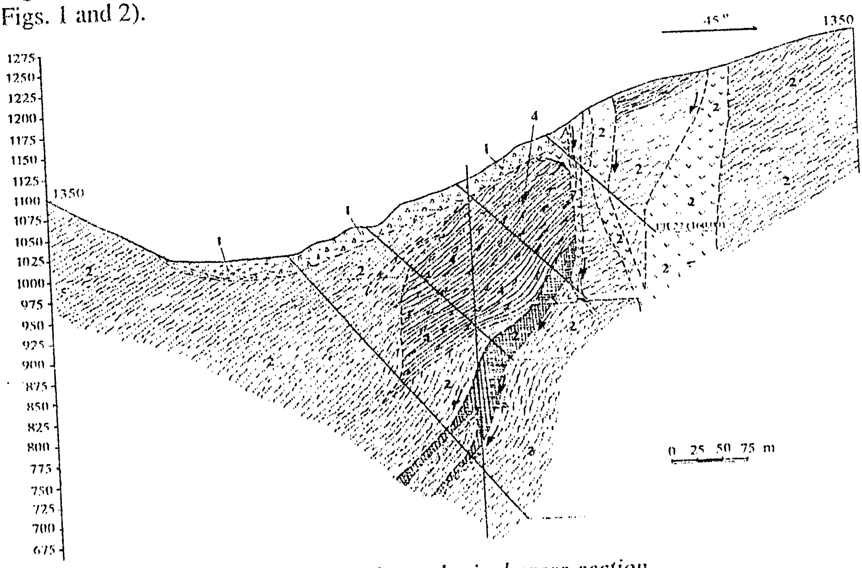


Fig. 2: Reprezentative hydrogeological cross-section.

Regional and local system of cracks can be distinguished in the rocks. Regional system of cracks can be found in the deeper parts. It is related to the regional fault structures, whereas the local system of cracks occurs in the surface parts of the terrain and is due to exogenous factors.

The system of cracks in gneisses in the surface parts is larger. Since gneisses in the surface parts are affected by weathering, a larger number of cracks both in the shallower and deeper parts are filled with weathering products which reduces the possibility for the development of aquifers and accumulation of various kinds of underground waters in the environment.

This conclusion is supported by the low yield of springs in the area as aell as in the adit 830 where the yield amounts to Q = 0.1 - 1 l/sec.

Karts type of aquifers

This type of aquifers has formed within cipolines and cipoline schists present in the Golema Reka deposit (Fig. 1).

Cipolines and cipoline schists occupy the smallest part of the area and reduce the possibility for accumulation of important amounts of underground waters. The increased amount of underground water can be found at the contacts of cipolines and cipoline schists with gneisses and quartz-graphyte schists.

Conditional waterless terrain

An area made up of quartz-graphyte schists has been distinguished as conditionally waterless terrain. Most of the cracks occurring in the rocks are filled with clayey material and one should not expect significant amounts of aquifer waters. Temporal aquifers develop in the surface parts where the system of cracks is larger and the deluvial cover preserves part of precipitin and infiltration to depth. As a result, there are occurrences of underground waters in some parts of the pits that intersect quartz-graphyte schists

CONCLUSION

The degree of system of cracks and filling of joints with a secondary material, the low yield of springs in fracture type of aquifers, the low widespread of karst and boundary type of aquifers indicate that one should not expect significant amounts of underground waters in pit premises.

Largest amounts of underground water in pit premises should be expected in fault zones and at the contact between cipolines and cipoline schists with gneisses as well as quartz-graphyte schists and ore.

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