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THE ECOLOGICAL RECONSTRUCTION OF JOLOTCA MINING (GIURGEU BASIN)

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Abstract. The ecological reconstruction of technological landscape of mining is an assumed priority for our country as well, by signing the documents of the acquis communautaire on the environment. Case study on measures for greening of the tailing heaps from Jolotca, Sărmaş commune, Harghita county is a measure of the effectiveness of the adopted method for the protection of radioactive tailings that may have devastating effects on the health of residents on long terms.

Introduction

The last stage of evolution of the Eastern Carpathians represents the collapse of some of its sectors, resulting posttectonic intramontane depressions as well as the putting in place of Neogene volcanic rocks. The emergence, evolution and expression of metalogenetic phenomena are closely linked to this geological evolution. Starting probably in the Paleogene and till early Quaternary, but with maximum manifestation in Neogene, in Carpathians at the contact with the Transylvanian Depression, there was an intense magmatic activity (volcanic and intrusive). It is deemed to have been the result of subduction to west of some fragments of oceanic crust as well as continental crust (Airinei Constantinescu, 1944) highlighted by the crystalline foliation considered of prealpine age (Balintoni, 2007 apud Hârtopeanu, Udubaşa, 2006).

Basically, over the foundation formations (crystalline and Mesozoic deposits of the Flysch in Carpathians, Mio-Pliocene formations of the Transylvanian Depression) the products of volcanism manifested in two stages were filed. The first stage, with an explosive character, has caused the appearance of a volcanic – sedimentation formation. The second stage has generated the

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volcanic superstructures consisting of lave flows and their pyroclastite. There were put in place intermediate rocks, mainly andesites, of calc - alkaline composition, and locally, acidic rocks, evolving ultimately to basic rocks.

In the crystalline shales of " Tulghes series "there are also included the alkaline sienits from Ditrau considered of Hercinic age. The sienitic masssif of Ditrau with a very complex geological structure, especially in terms of mineralogical and hydrogeological point of view preserve the prealpine lines precisely because of its resistance during the Alpine period, being in fact a compact intrusive body. It extends south and east till Belcinei (Bekeny / Belchia) Valley, fact revealed by the presence of metalogenetic structures typical to the sienitic massif on the right bank of the river (Rare metals, ferrous, etc.).

The only resource of aluminum of the metalogenetic Province in the Eastern Carpathians is that of nepheline syenite from Ditrau. The identified resources exceed 130 million tons and represent almost 24% of the mineral resources defined at the level of metalogenetic province in the Oriental Carpathians.

Another hypothesis to this wide metalogenetic variety of the Ditrau massive is due to the fact that in this area there are different types of rocks resulted from the process of magmatic differentiation. It is assumed that initially there was an invasion of normal basaltic magma, which dissolved the limestone and dolomite, passing so to an alcalo-gabroid melt. Through the process of magmatic differentiation, the melanocrate parties were separated by gravity, at the bottom of the tank and thus, from the remained alkaline and ultra alkaline magma arose by consolidation hornblends with peridot. At Jolotca there are found important massive of basic rocks (hornblends), black or brown with green tints, with a content of 12% iron and 2-4% titanium. Recent laboratory tests have shown that iron can be extracted magnetically, resulting in an apatite concentrate, as well. Since 1853, in the valley of Jolotca river there was reported a deposit of silver and tin. In the valley of Tászok river there is mineralization of pyrite, galena, calcopyrite as well as other sulfide of hydrothermal origin. The geological variety of this area is extremely rare, the range of ore found here extends from rare metals as zirconium, to rare varieties of eleonit crystals and amphibole. The titanium ore (ultra basic rock of titanium) is identified and quantified only at Jolotca. Besides titanium, the ore also contains iron and pentoxid of phosphorus. The quantified resource exceeds 35 million tones of ore. The sands of heavy minerals are found in one of Ditrau's perimeters, in the hydrographical basins of Belchiei and Jolotca. This deposit contains: ilmenite, zircon, titanite and magnetite. The quantified existing resources do not reach 50 million tons of sand. Molybdenum in amounts of about 8 million tones is reported and investigated in Jolotca. In addition to molybdenum the ore contains rare earth as well.

The sienitic rocks of the Ditrău Massif, with blue and yellow spots of wax, due to the presence of sodalite and cancrinit felspatoits. As raw materials there are used as ornamental rocks, for statues and buildings, due to various colors of minerals and the shape of rocks after grinding and polishing. The dark and black copies are often used in funeral constructions. Due to the presence of feldspar (alumosilicaţs) there are used as raw material in ceramics and glass industry. The careers in the Ditrău area were closed by the local council's decision and the whole area became a natural reserve with geological landscape protection purpose. The sienits are more easily altered than granites, because of large concentrations of feldspar, which last less than quartz, at the influence of exogenous factors. At global level the sienits are rarely found than granitic rocks, although their genesis is common. In terms of chemistry, their composition contains silicon oxides, aluminum, iron, magnesium, calcium, sodium and potassium.

Ditrău is one of the few settlements in Romania that gave its name to an ore, in 1866, a rare mineral in the world, a variety of eleolit-syenite which can be found here and is called ditroit. The sienitic rocks of the Ditrău Massif with blue and yellow spots of wax, because of the presence of sodalite and cancrinit felspatoits were first described in the world by F. Zirkel in 1866 and named ditroits (Irina Ungureanu, 2004 apud Paraschiv, 2009).

Jolotca is situated on the valley Jolotca / Orotva brook, a tributary of second order to Ditrău brook, in the upper hydrographical basin of the Mures river. The Jolotca / Orotva brook draws its springs near Tartars Mount, part of Giurgeu Mountains. From administrative point of view, the village is split into two distinct parts, the plateau and the interfluves belong to Ditrau Commune from a territorial point of view and the new part, on the valley, with linear development on the brook's terraces, is a component village of Sărmaş commune.

On Orotva valley, at Jolotca, at about 1000 m altitude there have been preserved lake sediments with Dacian fauna and intercalations of coal, directly bedded over the crystalline. These Dacian fossil layers are folded, showing that we are dealing with positive tectonic movements that led to different further developments of the relief in the north of Giurgeu basin. Z. Török (1928-1929) and L. Somes (1948) consider this northern section of Giurgeu basin as a tectonic and geomorphologic unit apart, Topliţa Depression/ basin, possible but, as a subunit of the entire basin of lithologic contact.

A particular problem for Giurgeu basin, on the frame of lithologic contact of Neogene volcanic-crystalline is the presence of the depression's "bay" known as the "basin of Jolotca", briefly described from a geological and geomorphological point of view (Somes, 1948, Pişota et al., 1972, apud Paraschiv, 2002, 2009). It is located south of Jolotca / Orotva brook, being bounded to the north, northeast and southeast by the crystalline massif of Giurgeu, with crystalline rocks of igneous

origin (metasomatite - nepheline syenite), and to the south and southwest , there are pyroclastic rocks and andesites with piroxens on Hedieş Hill. Through a crystal spur, this basin is separated into two distinct basins, drained by several valleys with torrential origin (Török, Tászok), which due to the lower base levels of the collector (Jolotca Creek), have triggered a surface erosion extremely active, which makes even more obvious the feature of depression in its area of contact with the crystalline-Mesozoic unit, in comparison with the plateau consisting of volcanic - sedimentary formations and the central plain of Giurgeu extended to west and southwest.

The stratigraphic interval Upper Pliocene - Lower Pleistocene is represented here by sediments that are presented into two distinct facies, some with a typical character of lake, but with relatively small extension (especially in the valley of Jolotca / Orotva basin) and others get a mixed facies , lake - river with episodes of external deposition , which formed the volcanic –sedimentary formations . In Jolotca / Orotva basin, the drillings conducted on the western-south-west area met the following stratigraphic column: on the superior part 7m thick, there are sands with gravels, with intercalations of yellow clay for 1.5 - 2 m. The petrographic structure of these gravels contains elements of crystalline, new and old eruptive, and apparently, that seems to be recent proluvial-deluvial warehouses. Under gravel, there is a thin seam of coal, continued with alternating gray and blackish clays and sands to a depth of 19.8 to 21.1 m. After these depths, the drilling has submitted another two meters in coal (which was partially exploited).

The ecological reconstruction of the tailings dump in the the former Jolotca mining. The geological research (especially in the advanced stages of exploration) and in particular mining have a negative impact on environment. The legislation (The Environmental Protection Law 137/1995, republished and supplemented, the Mining Law no. 85/2003) contains measures on the control, reduction of pollution and rehabilitation of the affected environment due to mining activities. Thus, by legislation, there are provided plans of rehabilitation / ecological reconstruction through measures of ecological restoration and rehabilitation within the perimeter of exploration / exploitation. The competent national authority endorses the closing of a mining objective (quarrying, mining) and implementation of environmental rehabilitation measures based on the following formalities: technical and economic documentation of the motivation of the cessation of activity, technical program of decommissioning or conservation of exploitation , the social welfare program of the staff, the authorization management on water and the environmental permit for closure of the objective, the procedure for decommissioning and releasing the land (GD 858/2008, on preventing and reducing the environmental impacts due to mining).

Fig. 1 - The tailings dump on the valley of Jolotca / Orotva brook. In the foreground there is the main dump at Mina 25 before greening (ortofotoplan scale 1:50000)

The Jolotca "Mine" located on the administrative territory of Sărmaş commune (south of Topliţa Photo 1) represents the main objective of closure and ecological works executed by SC Geolex S.A. in Miercurea Ciuc (*www.geolex.nextra.ro*). Geological investigations carried out here in almost the entire twentieth century followed a dike mineralization particularly interesting, with molybdenum and rare earths, stationed in alkaline magmatite and ultramafic rocks related to Ditrau Massif. The research works consisted of dozens of coastal galleries, dozens of climbing and aeration wells, two extraction wells and probably a hundred wells, which explains the large extent of closure operations and ecological rehabilitation. These involve, first, tilting, rectification and covering the heaps with vegetation, the partial filling and closing of the galleries with concrete walls, filling the extraction wells, the climbing (primarily with radioactive material from the heaps of course). The most spectacular work is the coverage and protection of huge heaps from gallery 25 from the old mine of Jolotca, through the three-dimensional cell system Geoweb GWS 100 76 PC with polymer tendons. It consists of a network of high density polyethylene, ultrasonic welding. The length of the dump is about 370 meters, and the slope's length is 30-60 m, with a large inclination, of 60-70 degrees. The difference between the base of the heap and its top is about 30 meters. The geocells "carpet" extending on the dump's slope, was secured by anchors and tendons, filled with soil and seeded with grass vegetation.

The heap's base arranged so is drained by a creek that drains even the waters from the coastal galleries and dug wellsthroughout the years (fig. 2 and 4).

Fig. 2 - The dump of Jolotca mining during the works of greening with poly cells (Source: *www.geolex.nextra.ro*)

Fig. 3 - Gallery 10, Pietraru enclosed by concrete walls provided with drainage pipe (Source: www.geolex.nextra.ro)

Other galleries of exploitation from the perimeter of Jolotca mining: Teasc, Pietraru (fig. 3) and Filip were greened by covering them with a wall of concrete which was provided at the entrance with leakage of excess water accumulated within the galleries. The only technical problem of ecology that arises upon this work is the chemistry of collected and then drained waters, knowing that the dikes in the area contain mineralization with radioactive and heavy metals.

Fig. 4 - The system of polymeric geocells protecting the dump and frost deposits (11/29/2009, photo by Anca Ghiurco)

Fig. 5 - Disaggregating of rocks on the bare slopes during the improvement of the mining land (photo by Anca Ghiurco, nov. 2009)

The impact on environment in the perimeter of Jolotca mining can not be reduced all. There are activities which led, on long-terms, to the development of current geomorphological processes, landslides and torrentiality affecting strongly the entire hydrological basin of Jolotca / Orotva. The disintegration of overburden rocks during the improvement of the mining land still affects the landscape and it imposes itself in the landscape as a residual anthropic relief. (fig. 5).

Conclusion

The assessment of the impact of mining activities by: investigations, data processing, multifactorial analysis of the risk and hazard (the role of rainfall

washing the landfill material, soil analysis in the area of preparation and degradation of its quality), impacts on human settlements and forest ecosystems (shown as a stress factor), evaluation of rivers' biocenosis that cross the area and the change of the quality of the final receiver due to washings from landfills or underground drainage, is a comprehensive research and requires monitoring and a long-term research.

From the data of the Environmental Protection Agency in Harghita on radioactivity analyzed for the years 2000-2009, the normal indicators do not exceed in the whole county. The tourist routes which capitalize the existing tourist infrastructure in the Giurgeu depression and the mountain massifs in the eastern part, may include as well this technological objective of real interest and which, by the generated anthropiclandscape, impresses and may be publicized as an example of good practice.

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