Mining activities in the superior basin of Crişul Negru river

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Abstract. The underground of this region provided along the years: gold, silver, iron, copper, lead, zinc, molybdenum, bismuth, tungsten, nickel, cobalt, pyrite, wollastonite, limestone, uranium, marble, building stone, and so on. In the literature, the subsoil of the region is known as “The Baita-Bihor metalo-genetic District”. It was for many centuries considered the greatness of mining in the country and in Central Europe. The Baita Bihor uranium deposit was located along the Cris Baita Valley, at the springs of the Valea Plaiului brook and was fully extracted by the Romano-Soviet Society „Sovrom-Kvartit” between 1952 and 1965. The ore’s high quality, the geological reservoir, the shape and shallow depth where it could be found have made this uranium mining to become, between 1957 and 1958, the biggest in the world. The Avram Iancu deposit, located in the interfluve between Crişul Negru, Ariesul Mic and Leucii Valley was exploited almost completely through underground mining during 1962-1998. Besides the useful mineral substances which were transported to processing plants, from the extracting process resulted also millions of tones of sterile rocks or slightly radioactive materials, those were deposited as waste, sometimes hastily on the water banks of Crisul Baita branches. A small fraction of these were driven by rainfall into the bed of these streams from where locals have gathered and used them as building material for household. After 1995 the mining production dropped considerably. Some areas have been restored naturally through afforestation and grassing. The intense work within this perimeter has modified the landscape aspect of the area and also partially the quality of some environmental factors on a distance up to 3 to 5 km from the mine. Their supervision was done by the specialised laboratories of the mining unit. Rehabilitation, however, was neglected until the Environmental Law foundation, this rising particular issues among specialists in this field. In 1998 were initiated the works to preserve and close some of the mining sectors and the environmental reconstruction was started in 1999 in Poiana-Izvorul Bihorului, Avram Iancu Mine and Baita pit. It is imperative to continue and complete them in all affected areas.

Key Words: underground, mine, rehabilitation, river.

Short history of mining activities in the area. From the subsoil of this region man has exploited many mineral resources such as: gold, silver, iron, copper, lead, zinc, molybdenum, bismuth, wolfram, nickel, cobalt, pyrite, limestone, marble, building face stones and uranium since the Middle Ages. In the beginning, gold and silver has been extracted by the local population. Around 1600, iron compounds have been also extracted, and after 1700, mining activities have increased including the exploitation of lead and zinc. In 1880, 7000 kg of copper, 1567 kg of silver, 5300 kg of lead have been extracted from Baita-Bihor area. Around 1890, important molybdenum and bismuth ores have been identified. During the First World War, the extraction of molybdenum has been taken over by a German company as this compound was used in for making cannons. Since 1935, the molybdenum mine was exploited by different Romanian companies. The most intense mining activities concerning non-ferrous mineral resources extraction have been carried out from 1960 until around the early 1990s (Dumitrescu 2010).

Uranium ore mining (1949-1999). Uranium ore geological prospection has been carried out independently in three phases by Romanian geologists (in 1930s), German teams (1943-1944) and by the Soviets (1945-1960), the last two phases being determined by the geopolitical situation of our country at that time. From the Romanian scholars who brought their contribution to the identification of the presence of uranium ores in this region, we can mention professor of geology Popescu-Voinesti, and geologist
Dan Giusca who identified and collected uranium bearing minerals from this region, but were not successful in delimiting the exact location of the ore.

In 1945 the Romanian territory was under Soviet occupation following the Second World War and the so called “SOVROM” treaties have been signed between Romania and the USSR. These commercial treaties implied import-export activities between the two countries on different fields of activities such as agriculture, oil industry, cattle growth or mining.

Since 1946, having partial information on the existence of uranium resources in this region, teams from the Russian Geological Survey started prospecting from the Northern border and in 1949 they have reached the Bihor Mountains region. Allegedly, after a working day in the Biharia Massif, a team from “Complex Geological Expedition nr 3 of USSR Geological Survey” have descended from the mountain to Baita, stopping at around 500 m away from the confluence of Valea Plaiului and Crisul Baita rivers to have a meal. One of the workers observed when he wanted to drink water from the river that the value indicated by his radiation counter was much higher than the normal background values. After checking the rest of the radiation meters of his colleagues, they have identified pieces of uranium ore along the river bed. Following the river course upstream towards Baita Plai, they have identified the source of this ore. This ore deposit was surprisingly close to Baita (only 4 km away) and to the molybdenum exploitation that was in use for hundreds of years (only 2.5 km away), very accessible and extremely rich (Figure 1).

![Figure 1. Valea Plaiului, Baita Plai and Avram Iancu mines.](image)

The prospection of ore deposit has been performed soon after and declared a strategic objective by the USSR, having the code name “objective K”. On 30th of December 1951, a Romanian-Soviet economic enterprise “SOVROM” named KVARTIT has been established with the aim of exploiting this ore (Stoici 1983; Niţu 2000).

Baita Bihor ore, localized at the spring source of Valea Plaiului river, found at a depth of maximum 60 m has been integrally extracted by the Soviets between 1952 and 1965. 95% of this ore has been mined in open quarries.

The mining activities on Baita-Bihor ores performed by SOVROM-KUARTIT (1952-1960). Until 1952 mostly additional works for accessing the quarries have been performed. The resulted rocks, rich in uranium ore, have been carried in willow twig baskets by the workers and deposited in small waste dumps just outside the quarry area, that were under strict military surveillance.

The location of the ore (extending for 1.5-2.5 km) has been exactly delimited and organized into three “objectives”. Work was started in 1952 and the miners got a free meal when entering their shift, milk and sparkling water and smoking was prohibited in the area.
The village of Stei expanded greatly in this period and was later called the City of Doctor Petru Groza in 1953.

The road connecting the mine to the city has been modernized. At the beginning, the ore was firstly sent to Stei from Baita (approximately 200 transports daily), using soviet trucks and was covered only by a tarpaulin. These transports have always been accompanied by military armed forces. From Stei, the ore was subsequently sent by train or even by plain to the Soviet Union. The first transport to Novosibirsk has taken place in November 1952 (Savu 2011).

The intensive mining and related activities have determined the need for supplementary work force in the region. For this reason blocks of flats have been built in Baita Plai (near the entrance in the mine). The mining town of Nucet has been built in 1954, 2 km away from Baita. The payment for the workers was very good at that time and thus for that period the mining activities had a very benefic influence on the development of the region.

The high quality of the ore and its accessibility transformed this location into the most important uranium mining area in the world between 1957 and 1958, having 28,000 employees (Stoici 1983; Nitu 2000; Dumitrescu 2010; Savu 2011). Unfortunately however, the desire of the Soviet enterprise for intensive mining along with the eagerness of the workers for getting more individual profits led to an alert working rhythm that had as a consequence many working protection rules to be broken.

The workers have been informed about the risks related to working in a radioactive environment only in 1957, leading to protests. In 1958 a Laboratory of Research on Radioprotection, Working Conditions and Ecology has been established. Since 1960 however, the mining activities in the region decreased as the ore available in quarries was diminished.

**Avram Iancu ore.** Localized by the soviets in 1952 near the Spring of Ariesu Mic River has been subsequently mined by underground work in the period 1962-1998. The Avram Iancu Mine, located in the center of Bihor Mountain is connected to the surface through Noroc Bun Gallery (meaning Good Fortune), having a length of 7 km. From this ore copper, lead and zinc, copper pyrites, nickel and cobalt have been extracted along with uranium.

Uranium has been extracted from this mine from 1962 until 1997 (Stoici 1983; Dumitrescu 2010). Until 1978 the tailings have been deposited in the old quarry. From the mine the ore was sent to Stei and then to the processing mill at Feldioara.

**The pollution of the area.** Can be divided into physical pollution caused by the existence of tailing waste dumps and the effects of previous quarry works and the radioactive pollution caused my uranium mining specifically.

Due to the fact that the mines are located far enough from the villages and towns in the area emanated radon gas is mixed with air and consequently the specific activities encountered outdoors in these inhabited areas is not significant. Environmental monitoring in this area has been constantly carried out since 1958 in the specialized laboratory from Stei. The investigated samples have been: water, air, soil, sediments, vegetation samples and other agro-alimentary products. The main interest was in monitoring the radionuclides with higher radiobiological significance: uranium, radium and radon. In the last 10 years the values for the specific activity for natural uranium and radium 226 obtained were:

- sediments-natural uranium (4-6g/t), radium 10-60 Bq/kg;
- soil-natural uranium (1-4g/t), radium 10-40 Bq/kg;
- vegetation samples-natural uranium (1-5g/t of ash), radium 20-150 Bq/kg of ash (Dumitrescu 2010).

Drinking water samples analyzed do not present specific activities for natural uranium (0.021 mg/l) and radium-226 that exceed the maximum admissible values (0.088 Bq/l).

In Figure 2 it can be seen recent analysis of radium content for surface waters from the mine uranium exploitation (Dumitrescu 2010).
However, the industrial water does display higher concentrations, the water draining from galleries having specific activities up to 0.238 Bq/l (Dumitrescu 2010). These mine waters have contact to the surface water sources. Surface waters upstream from the mines have specific activities that are lower than the maximum admissible limits for drinking water, but downstream these values can increase by three or four times.

![Figure 2. Radium content in surface water from Baita and Avram Iancu uranium mine (Dumitrescu 2010).](image)

Sediment samples analyzed upstream the mines in the industrial zones have average uranium concentrations of 15.8g/t and radium 226 concentrations up to 362 Bq/kg. These values are in concordance with the expected values considering the geological particularities of the region. However the specific activities of these radionuclides are much higher in sediments that are collected from the riverbeds downstream the mines. Soil samples display relatively high values of radioactivity, but in the inhabited areas do not generally exceed the reference values. Vegetation samples specific activities inside the mining parameters are high, the reference levels being exceeded by four to five times, but away from the mining perimeter they are normal (Dumitrescu 2010).

Until now, over 150 studies have been elaborated on environmental pollution issues in this region. After 1995 the mining activities in this region was severely reduced and almost ceased. In 1998 the closing up and conservation process of the mines started. This had a tremendous effect on the living conditions of the inhabitants of this region.

**Ecological reconstruction of the region.** Some projects on the ecological reconstruction of this region have started in 1999 at Avram Iancu Uranium Mine (Dumitrescu 2010).

**Local tourism.** The Apuseni Mountains National Park, the Bihor and Vladeasa Massifs in this region host many natural beauties that can help the development of the tourism sector in this area. However, the investors have been discouraged by the psychological effects that are caused by the proximity of the potential locations to an old uranium ore and the fear induced by the presence of the abandoned mining relics that can still be noticed.

Excluding radon exposure (Cosma et al 2009; Sainz et al 2009; Cucoş (Dinu) et al 2012; Cosma et al 2013), at the moment, based on the existing studies it cannot certainly be affirmed that there are measurable health effects on the local population.
However, the measurements of residential radon in Baita-Stei area (Cosma et al 2009; Sainz et al 2009; Cucos (Dinu) et al 2012; Cosma et al 2013) proved that this zone has a high radon risk exposure and special attention must be given for remediation of the houses with high radon content (3000-4000 Bq/m$^3$) as well as in the case of the new buildings construction. Using as building material stone, gravel or sand from Crisul Baita River, without radioactivity control, can lead to the inclusion of material with high uranium content, as found in the foundation of a remediated house in Baita village with occasion of remedial measures applied in last year in IRART project (Figure 3).

Figure 3. A stone from Crisul Baita river bed extracted from a house foundation from Baita.

The stone from this figure is not a fragment from Baita exploitation during the mining. It is a natural stone found in the river bed of Crisul Baita and used in building foundation. The main mineral constituent is pitchblende and the uranium content measured by gamma spectrometry is very high (35%). It may be that a similar stone was found by the team of geologists when the Baita Plai deposit was discovered.

Starting from 2010 in this area (Baita-Nucet-Fanate-Campani) an international program IRART was implemented. The aim of the project was to identify and to remediate the houses with the highest radon concentrations in the area Baita-Nucet-Campani-Fanate, the most inhabited proximity of the Baita uranium mine.

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