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THE EXPLOITATION OF THE TULGHEŞ-GRINŢIEŞ URANIUM DEPOSIT. BETWEEN BENEFITS AND CONTROVERSY

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ABSTRACT. – The Exploitation of the Tulgheș-Grințieș Uranium Deposit. Between Benefits and Controversy. Romania is one of the few European states (alongside the Czech Republic, France, Germany, Ukraine) and one of the few in the world with uranium deposits (Canada, Australia, Niger, Namibia are others), mainly used in the energy sector. According to recent studies, the only currently exploited deposit (Crucea-Botușana, Suceava County) is nearly depleted (by 2019) and will be eventually shut down. For this reason, there are plans to open a new uranium mining facility in the Tulgheș-Grințieș area, where geological surveys have proven that the area holds the largest uranium deposit in the country. It will provide the necessary fuel for Cernavodă Nuclear Power Plant, for the two functional reactors, which have a total capacity of 706 MW each (producing roughly 18% of the country's electricity needs), as well as for units 3 and 4, not operational yet. The study at hand intends to emphasize several aspects regarding the exploitation possibilities for the uranium deposit from the two mineralized structures located in the fracture areas of the central Carpathian line, through which the crystalline overflows the Cretaceous Flysch. Furthermore, the environmental impact analysis as well as the long term safety and security of the population inhabiting the area will be of utmost importance.

Keywords: *uranium, radioactivity, Cernavodă Nuclear Power Plant, Tulgheș, Grințieș.*

1. INTRODUCTION

The exploitation perimeter of the uranium deposit is located in the Central Group of the Eastern Carpathians, in Bistricioara Mountains (Bistriței Mts.), Preluca Ursului-Pietrele Roșii subunit, on the Prisecani, Bradu, Primatar and Grințieș

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streams, left side tributaries of Bistricioara, between Harghita and Neamț counties, at approximately equal distance (20 km) from Durău and Borsec mountain resorts (fig. 1).

Since 2013, the Energy Department has been pushing for the approval of the technical-economic indicators for the exploitation of the Primatar 1, Primatar 2, Bradu, Prisecani and Zone III uranium deposits, with funds from the National Uranium Company Bucharest (S.C. Compania Națională a Uraniului S.A. București) and from the state budget, more precisely the Ministry of Economy - Energy Department. The investment is planned for 2020.

The preserved mining tunnels cover a surface area of 10 hectares and are currently owned by the heirs of Prince Sturdza, a result of the enforcement of Law nr. 247/2005. The land is administered by the Forestry Administration, Hangu Domain LLC.

The current owner showed interest in a partnership that would reopen the mines, claiming his right, also soliciting shares, which will certainly insure large profits.

The negotiations were held at government level, as this represents a mining area of national importance.

2. METHODOLOGY

The first phase of the study involved reviewing the geological maps of Romania, which encompass the Tulgheș-Grințieș area, maps created in 1968 by the State Geological Committee, the Institute of Geology, Bucharest (Geological map of Romania, 1: 200000, Topliţa area), and the one from 1978, scale 1: 1000000, authored by Săndulescu et al., 1978; the geological map of Bilbor-Tulgheș (Eastern Carpathians), created by geologist Ionescu (1999), addendum after Kräutner et al., 1988; Gheucă et al., 1988; Bindea et al., 1990, 1991.

We additionally consulted a series of articles and papers which directly studied the area at hand (Atanasiu, 1929; Băncilă, 1958; Rădulescu, 1967, 1970; Mureșan, 1967, 1970, 1980; Gurău, 1969; Ionescu, 1999; Deák, Petrescu, 2002; Petrescu & Bilal, 2006, 2007; Săndulache, 2007; Dumitrescu, 2010).

Furthermore, we researched the general studies written by Mutihac & Ionesi, 1974; Čejka, 1990; Burns & Finch, 1999; Raboca, et al., 2001; Neguț, 2003; Murariu, 2005; Păcurar, 2006; Jefferson, Delaney, 2007; Ramasamy, Rajkumar, Suresh, Meenakshisundaram, Ponnusamy, 2011; Tofan, 2013, as well as the technical-economic documents necessary for the capitalisation of the investment objectives for the Tulgheș-Grințieș uranium deposit, the abstracts of the reports regarding the environmental impact study, feasibility studies, and several other reports by the County Health Administration and Neamț Environmental Protection Agency.

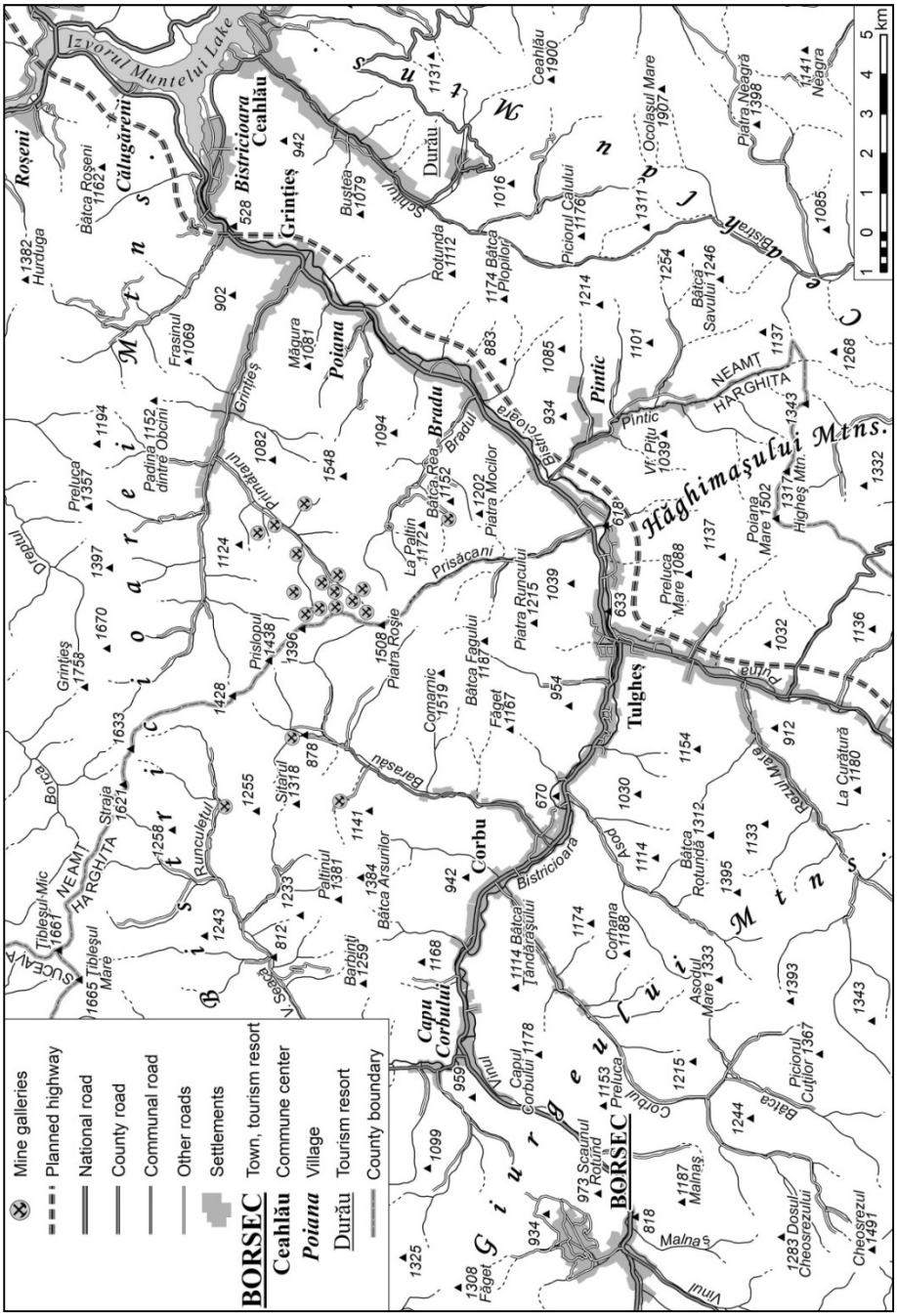

Fig. 1. Location of the study area.

3. HISTORY OF GEOLOGICAL SURVEYS

The geological survey of the area started in 1963, when the first gamma anomalies and ore deposits were found. After a short prospecting period, the perimeter began to be excavated. During 1994-1997, the mining activity involved an experimental face cut, later followed by proper mining procedures, single geological block only, and single gallery (between the second semester of 1997 and the first semester of 2001).

In the first trimester of 1998, due to lack of funding, the operation was halted. The following year, after a series of talks regarding the exploitation licence, with the National Agency for Mineral Resources, a feasibility study was performed for the opening of the northern part of the deposit. In the second semester of 2001, the mining operation in the only active gallery was halted due to lack of permits for the feasibility study, which stopped the investment in its tracks.

Later, in 2005, the National Uranium Company made a project aiming to reopen the mining operations for the existing uranium deposits found in Tulgheș and Grințieș area. The area currently holds several mining galleries, in different conservation stages.

Geological surveys were performed by *S.C. Radioactiv Mineral Măgurele S.A*, a company formed from the reorganization of the National Uranium Company, whose main objectives are to survey and exploit radioactive mineral deposits, as well to preserve and close mines, clean and restore the environment. Its main work station is the *Tulgheș-Bicazu Ardelean sector*, where a series of neighbouring perimeters have been surveyed (prospecting, preliminary, general, detailed, and experimental exploitation), such as: Grințieșului Valley-Bicazu Ardelean – Dămuc - Chicera-Pârâul Danci-Păltiniș (Neamț County); Bilbor-Corbu (Barasău)-Tulgheș (Putna Valley – Hagota-Șumuleu Valley -Prisecani - Pintic-Pârâul cu Peşti-Putna Întunecoasă Valley (Harghita County) etc.

Likewise, *Foradrill Baia Mare Company* was involved as partner in prospecting endeavours, geological and physical-chemical research, in Preluca Ursului perimeter.

4. RESULTS AND DISCUSSIONS

Information regarding the volume of uranium reserves from the analysed area, as well as the other operations from the nuclear cycle remains unknown, being highly classified. However, sources show that, between 2000 and 2007, there was a special monitoring programme of environmental radioactivity, meaning taking samples, preparing and measuring specific global beta activities five days after collecting surface and underground water, soil and vegetation samples, prepared by *Piatra Neamț Environmental Radioactivity Surveillance Station*, which

were then sent for spectrometric and radiochemical gamma measurements to the *National Reference Laboratory for Radioactivity*, part of *Iaşi National Environmental Protection Agency* (ANPM-LR).

The evolution of the environmental radioactivity in Tulgheş-Grinţieş perimeter was also influenced by several logging operations in the area, which led to soil and vegetation degradation and pollution.

The spectrometric gamma analysis showed that the natural gamma radioactivity of the samples comprises radionuclides from the natural series of uranium, radium and thorium, as well as the K-40 series, with traces of Be-7, a cosmogenic radionuclide, Cs-137 and Cs-134, due to fallout from the 1986 Chernobyl accident, plus some heavy metals characteristic for mineralization.

The above mentioned radioactive elements can pollute the atmosphere as powders carried by winds from ore or mining waste dumps, thus leading to air, soil, water, and vegetation contamination in the area. Moreover, there is the pollution of mine and rain water that flows on waste dumps, with negative effects on surface and underground water, soil and plant life.

The samples taken prove that the highest radioactivity levels of ground water are registered in spring, when the snow melts, in conjunction with heavy rainfall, when water turbidity and flow are high.

The increase of radioactivity in these areas is further exacerbated by the phenomenon of dispersion of waste from ore dumps (for instance, at the confluence area of Prisecani with Uluci, Primătar Valley, downstream of its confluence with Afiniş), leading to obstructions at the base of the dumps.

From the analysis of data presented in table 1, we conclude that several activities in the area led to an increase in radioactivity, with high levels especially close to certain waste dumps where we believe that the external radiation exceeds safe values. However, at distances of 200-300 meters from these dumps (including within the existing settlements), the radioactivity of the monitored environmental elements is within normal limits. During 2001-2004, no plant samples have been taken, while prior to 2000, another work methodology was employed, which is why the data obtained are not comparable.

On the 6th August 2008, a sample was taken from an underground water source (spring) located on Mărului Hill, which supplies water for several households situated in Grinţieş commune, the specific value of the global beta activity five days after sampling being below 74.2 Bq/m^3.

The results regarding radioactivity evolution for the environmental factors from Neamţ County show that, in 2007, there was no spatial or temporal radioactive pollution that would lead to significant spikes in radiation levels or that would jeopardise human health, the activities in the area, or the ecosystems in the immediate vicinity. In May 2010, in Tulgheş-Grinţieş area, there was another special radioactivity monitoring programme.

Table 1.

Comparison of the specific global beta activity of the main environmental factors from the Tulgheș-Grințieș area, monitored during 2000-2007

Sample name	Location	Measurement unit	Specific value of global beta activity							
			2000	2001	2002	2003	2004	2005	2006	2007
Surface water	Primătar stream-downstream of confluence with Afiniș	Bq/m^3	160.0	960.0	160.0	113.0	157.3	181.2	426.9	168.2
	Bradu stream- upstream of Bistricioara		360.0	350.0	110.0	129.2	152.9	166.2	774.0	168.3
	Prisecani-downstream of confluence with Uluci stream		190.0	180.0	220.0	151.7	151.9	571.3	460.3	132.2
	Grințieșul Mare-upstream of confluence with Bistricioara		-	350.0	-	161.8	225.0	398.0	97.6	1412
	Bistr. at Tulgheș		-	-	-	-	-	-	<80.1	95.0
	Bistr. at Bistr., bridge over Durău		240.0	80.0	100.0	125.2	158.3	213.2	<80.1	884.7
Drinkable water	Fântână Grințieșul Mare-confluence area of Primătar with Grințieșul Mare	Bq/m^3	100.0	400.0	270.0	119.4	177.1	127.9	<83.7	313.3
Drinkable water	Fântână-Grințieș (Poiana) centre		320.0	1550	970.0	837.6	223.3	896.6	680.2	931.3
Uncultivated soil	Primătar area-left bank Primătar downstream of confluence with Afiniș	Bq/kg	5290	6050	1730	990.4	2364	1644	2040	1221
	Primătar area-plant nursery		870.0	810.0	910.0	-	-	782.7	1072	1045
	Prisecani-confluence area of Prisecani with Uluci stream		-	980.0	-	-	1759	1390	1275	1192
	Grințieș- School no. 2 area		-	-	1030	689.2	836.8	779	843.3	809.7

Sources: Neamț Environmental Protection Agency, Piatra Neamț Radioactivity Monitoring Station.

It basically involved taking samples, preparing and measuring the global beta specific activity, five days after sampling, of several surface and underground water, soil and plant samples. These were prepared for analysis by *Piatra Neamț Radioactivity Monitoring Station*, which later sent them to *Iași Radioactivity Monitoring Station*, for gamma spectrometry.

Table 2.

The results of the global beta specific activity of the samples from the second semester of 2010, Tulgheș-Grințieș area

Crt. no.	Sample name	Location	Date of sampling	Date of measure-ment	Measure-ment unit	Value of global β activity
1	Surface water	Stream Bradu, upstream of confluence with Bistricioara	17. 09. 2010	22.09.2010	Bq/m^3	224.3 ± 27.8
		Grințieșu Mare, upstream of confluence with Bistricioara	17. 09. 2010	22.09.2010		243.1 ± 28.3
		Bistricioara, bridge towards Durău	17. 09. 2010	22.09.2010		206.5 ± 27.2
2	Underground water	Well, central area of Grințieș	17. 09. 2010	22.09.2010		1136.0 ± 62.1
3	Unculti-vated soil	Primatar area, downstream of confluence Afiniș with Primatar	17. 09. 2010	22.09.2010	Bq/kg	2351.3 ± 100.2
4	Vegetation	Afiniș (tree nursery)	17. 09. 2010	22.09.2010		237.5 ± 18.0

Sources: Neamț Environmental Protection Agency, Piatra Neamț Radioactivity Monitoring Station.

According to these results, there were no cases of local pollution or radioactive contamination in the second semester of 2010, in Tulgheș-Grințieș area, that would lead to high degrees of radiation or that would jeopardise human health.

We strongly believe that, in the future, there will be a need for a rehaul of the entire environmental radioactivity monitoring system, one that would allow for real time access to data by the authorities, as well as for the measurement of other parameters, mainly in areas susceptible to a high radiological impact, like the mining sites of Tulgheș-Grințieș and Bicazu Ardelean, areas that must be surveyed continuously through special programmes adapted to local conditions.

5. URANIUM ORE PROCESSING UNIT

The National Uranium Company intends to build in Feldioara (Brașov County) a modular installation for uranium ore processing, as well as for refining uranium technical concentrates, using the latest technologies currently available in the European Union and the world and complying with the existing environmental standards.

The new plant will run for 19 years, having a surface area of 146 890 square meters and an annual processing capacity between 80 000 and 120 000 tonnes of uranium ore. Electricity for this installation will be supplied by the "S.C. F.F.E.E. Electrica Furnizare Transilvania Sud S.A. - A.F.E.E. Brașov", the current total electrical output of the Feldioara Substation being 10 MW, a capacity necessary for satisfying the newly installed 4 880 kW. Natural gas is supplied through the existing network in the area.

In terms of drinkable water needs (roughly 100-120 square meters/ day), there are five supply wells that are used, while the industrial water (for processing) (1 000 – 1 150 square meters/day) comes from the recirculation of the cleared water of the settling basin and the Cetățuia I reservoir. Initially, the ore processing plant was planned to be located close to the mining area, but due to high costs involving infrastructure construction and due to the scarcity of qualified personnel (lack of engineers, technicians, and high-skill workers in uranium processing), a more convenient location was chosen, the uranium ore being transported to Feldioara.

Likewise, many other important factors were taken into account in choosing the location of the plant, such as the relief, climate, hydrography, plant and wildlife, soils, as well as human factors (land usage and cover, distance to human settlements, utilities, access routes for personnel and industrial goods and so on).

6. BENEFITS AND CONTROVERSIES

The announcement published by the National Uranium Company (Energy Department), regarding the exploitation of Tulgheș-Grinţieș deposit, generated a series of controversies among local inhabitants. Debates went back and forth between advantages such as a new source of uranium for electricity production, new jobs (between 600-1000 jobs), money in local budgets from taxes, and disadvantages like potential health risks and the peril of obstructing the development of rural tourism in the area.

Consequently, many residents signed a series of petitions opposing these plans, as people were frightened by the risk of radiation exposure, contamination of animal products and thus the inability to sell them, as well as by the impact on future tourism development, the most affected areas from this point of view being Borsec and Durău local resorts, and the entire area of Bistrița Valley.

At the end of 2013, the presidents of Harghita and Neamț County Councils proposed to organize an awareness campaign to inform the population of the two communes about the pros and cons of this project. We would like to point out that such a campaign never came to fruition, the situation remaining uncertain to this day.

7. CONCLUSIONS

It is a known fact that mining uranium deposits implies a radiological risk. However, in the Tulgheş-Grinţieş exploitation perimeter, according to the measurements shown, there are no dangers for the environment or for the area's inhabitants, as the concentration of radioactive material is extremely low. From an economic point of view unfortunately, this makes the area less profitable, as it requires processing larger quantities of material.

There is also the issue of distance from railway transport. Regarding this problem, the closest route is through Tulgheş, on DJ 127 county road, over Ţengheler Pass (1 025 m), towards Ditrău train station (37 km), or on DN 15 national road, to Topliţa, which has a loading station.

The necessity to produce inexpensive electricity through nuclear fission will eventually lead, in the near future, to the mining of Tulgheş-Grinţieş deposit. At the same time, we believe that the impact on the local community will be rather insignificant, as a part of the qualified work force will be relocated from the two existing mining operations of Crucea and Botuşana.

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