

Monitoring the level of radioactive pollution of the dumps and ponds in the Jiu Valley

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Abstract. Radioactive pollution is an important environmental problem. With the mining of coal in the Mining Units in the Jiu Valley, a number of radioactive elements are brought to the surface. These radioactive elements are found in both coal and tailings resulting from coal extraction and processing. Due to the fact that the radioactive elements are not reduced by burning the coal, increased radioactivity is present in the resulting slag and ash. In this paper we aim to present the results of monitoring the level of radioactive pollution of the tailing dumps and the slag and ash ponds in the Jiu Valley.

Key Words: pollutant, environment, ponds, radioactivity.

Introduction. Jiu Valley is an intramontane depression located on the Jiu River. It is known for its natural riches, exploited for coal. The mountains that belong to it are in the Retezat-Godeanu group of the Southern Carpathians. The main cities in this area are Petrosani, Vulcan, Petrila, Aninoasa, Lupeni, Uricani.

Among the strongest pollutants of the environment are the energy and mining industries. They are responsible for air, water and soil pollution.

With the exploitation of the coal deposits, a series of radioactive elements are brought to the surface. These radioactive elements are found both in the tailings resulting from the exploitation and preparation, as well as in the slag and ash resulting from its burning. The radioactive elements do not burn and they are accumulated in the resulting slag and ash.

Theoretical considerations. The coal contains natural radioactive isotopes in natural concentrations which by combustion result in their concentration in the combustion products. Radioactive isotopes in the combustion products, which escape into the atmosphere, diffuse under the influence of atmospheric currents and are gradually deposited on the soil, water and vegetation. These can cause their radioactive contamination (Tataru et al 2015).

Radioactive pollution produced must not be neglected as a continuous pollution. The population living in the areas affected by the radioactive pollution produced by the thermoelectric power plants receives additional dose of 300-500 $\mu\text{Sv}/\text{year}$ (Stanci & Stanci 2013).

The radioactive 40K isotope of potassium and radioactive elements in the uranium and thorium series are the main elements that give the natural radioactivity of the rocks. The gamma radiation energies emitted by these radioactive elements are distinct for each element. Potassium radiates energy gamma radiation of 1.46 MeV, while the uranium and thorium series emit gamma radiation with different values (Stanci & Stanci 2013; Tataru et al 2015).

Research has been carried out in Romania on the radioactivity of coal in some carboniferous basins. Researches were also made for the coal exploited in the Jiu Valley and the slag and ashes from the combustion of coal in the Thermal Power plants (Inişconi 2015) (Table 1).

Table 1

Content in radioelements in coal and ash in Romania

Types of coal		Average content in radioelements	
		Ra [Bq/g]	U _{nat} [ppm]
Pit coal	Petroșani (Oligocen)	0.038	4
Slag and ashes from Thermal Power plants			
Thermal Power plant	Slag and ashes ponds	0.14	13
Paroseni			

In this paper we aim to study the radioactive pollution produced by the storage of tailings from the exploitation and preparation of coal, and from the coal-burning.

Material and Method. In order to determine the radioactive pollution of the atmosphere on the tailings dumps and the slag and ash ponds in the Jiu Valley, measurements of the dose rate of the radiation emitted were made.

The radiation levels α , β , and γ were analyzed both at the surface of the slag and ash ponds and the surface of the tailings dumps in the Jiu Valley.

Measurements were made using the Geiger Gamma Scout Radiation Detector. The Gamma-Scout is equipped with a Geiger-Muller counter that detects alpha, beta and gamma radiation.

The measurements were carried out on slag and ash pond Caprisoara Valley at Paroseni Thermal Power Plant between March and October 2019.

Results and Discussions. The average cosmic stock level recorded in the area unaffected by slag and ash ponds at the dose measurement for the tailings ponds of the Paroseni Thermal Power Plant is 0.08 μ Sv/h.

Table 2 presents the average value of the dose level recorded near the Valley Caprisoara pond of the Paroseni Thermal Power Plant. The average heat recorded between March and October 2019 is 0.38 μ Sv/h (Figure 1).

Table 2

Monthly average of the dose level value recorded on the Valley Caprisoara pond of the Paroseni Thermal Power Plant

No.	Interval	Time: From	Time: To	Pulse count	Pulse rate	Dose rate	Medium
1	10	20.03.2019 15:54:42	20.03.2019 15:54:52	5	0.5	0.36	0.38
2	10	20.04.2019 16:35:22	20.04.2019 16:35:32	5	0.5	0.38	
3	10	20.05.2019 15:22:45	20.05.2019 15:22:55	6	0.6	0.39	
4	10	20.06.2019 13:13:20	20.06.2019 13:13:30	6	0.6	0.39	
5	10	20.07.2019 15:44:33	20.07.2019 15:44:43	6	0.6	0.38	
6	10	20.08.2019 15:11:09	20.08.2019 15:11:19	6	0.6	0.38	
7	10	20.09.2019 14:19:49	20.09.2019 15:19:59	5	0.5	0.38	
8	10	20.10.2019 16:36:21	20.10.2019 16:36:31	6	0.6	0.39	

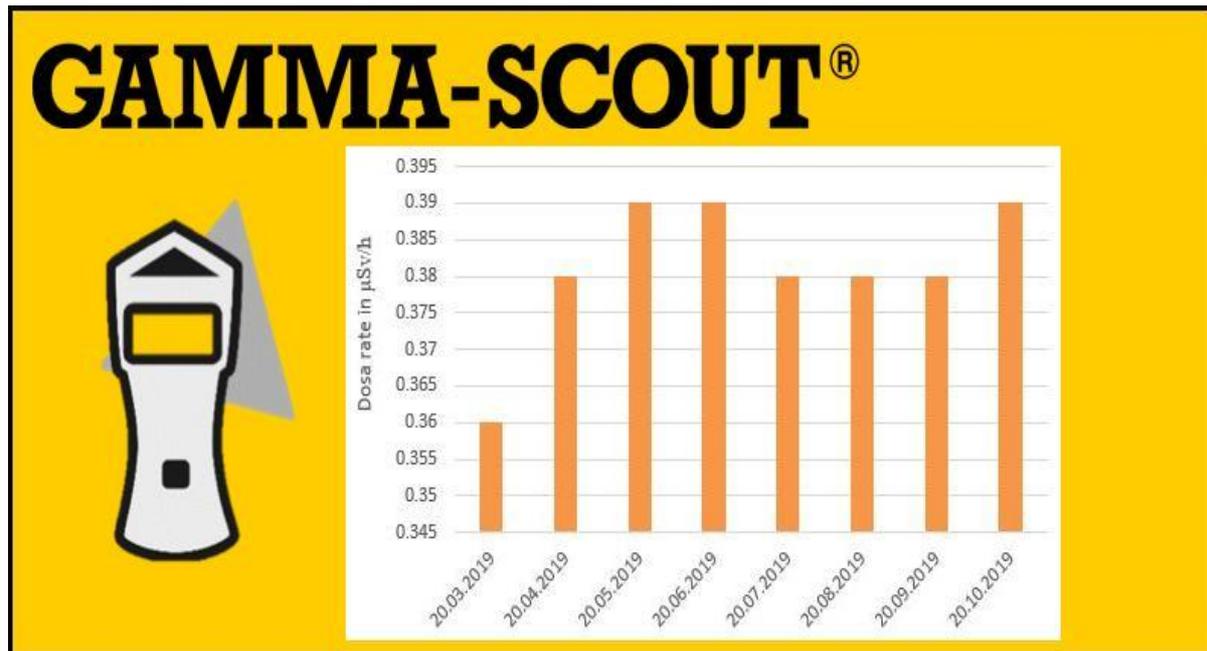


Figure 1. The average monthly value of the dose level recorded on the Caprisoara Valley of the Paroseni Thermal Power Plant.

The settling ponds Valley Caprisoara Valley of the Paroseni Thermal Power Plant have an average radiation dose of 0.3 µSv/h. These values represented the difference between the recorded value and the cosmic fund value.

The high value of the dose recorded on the slag and ash pond Valea Căprișoara is due to the fact that by burning the radioactive elements accumulate in the slag and ash.

The radiation level recorded can have negative effects on the fauna and flora of the affected areas.

Conclusions. Radioactive elements are brought to the surface with the exploitation of coal deposits in the Jiu Valley.

Radioactive elements are found both in extracted coal and in tailings from coal mining and preparation.

The radiation dose recorded for the Caprioara Valley pond of the Thermal Power Plant Paroseni is 4.5 times higher.

The higher radiation dose recorded on the slag and ash pond of Paroseni Thermal Power Plant. This value is higher due to the fact that the burning of the radioactive elements does not burn and accumulates in slag and ash.

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