HOT SPOT OF REHOVA IN ALBANIA THROUGH SUSTAINABLE DEVELOPMENT

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ABSTRACT

Rehova is one of the sixteen priority hotspots identified in Albania with a total area of approximately 100 ha out of 255.5 ha scattered over the entire territory of the country. The copper mine of Rehova is located 20 kilometers from Korça city in the southern direction, Korça-Erseka national road. The facilities were established near the Rehova village, 1.5 Km in the northern direction and today they do not operate. The mine is situated on the hill slope of a small valley and on the east hill there are the ruined premises of the former enrichment factory. A few hundred meters from the factory there is a waste dump, which can be described as a dike of approximately 15 meters high, filled with the tailing materials from the enrichment factory. Several sites of dumped mineral are situated in the surroundings near the water stream that passes by the foot of the valley flowing towards Rehova village. Another site of tailings is situated in the surroundings near the water stream that passes by the foot of the valley flowing towards Osumi river.

The Rehova mining terrain represents a hilly-mountain area with soft shapes, which are followed by higher mountain peaks in western and eastern directions. The altitude of the enrichment factory is 1040 meters above sea level, and the average altitude of the study area is 910 meters. The soil texture in the valley is classified as meadow soil in brown color.

Although the copper enrichment factory is destroyed, the Albanian government has occasionally taken measures to rehabilitate the area or use industrial waste for the enrichment of copper, which has been unsuccessful. The surrounding area, although has wonderful nature, it is not being used for agritourism, the number of inhabitants is decreasing day by day and the inhabitants collect aromatic plants. The adequate protection and restoration of soil ecosystems contaminated by heavy metals require their characterization and remediation (Wuana, R. A. and Okieimen, F. E. 2011).

Keywords: Hot-Spot, copper mining, Albania, Rehova village.

INTRODUCTION

The Korca region is rich in underground, as well as, ground resources who is well known for coal (13 sources), iron, nickel (2 sources), copper (2 sources), powder talc (2 sources), clay (4 sources) asbestos, quartz sands (2 sources), chromium (2 sources), construction materials and decorative stones (AKBN). As a natural soil component, heavy metals are as a rule, present in a small amounts but a high contents occur in some cases as a result of environmental pollution (Elsokkary, H. and Lag, J. 1978). A large number of state industries have been closed, but the consequences of the development of these activities have left their footprint in the region.

The region of Korça has a Mediterranean climate with an attractive nature and landscape of mountainous and hilly nature, three lakes such as Ohrid, Prespa e Madhe & Prespa e Vogel, National Parks and Protected Areas, tourist views with characteristic houses, museum sites, natural landscapes, rare species, etc. Fresh and healthy climate, mineral waters "Dardha & Vithkuq", places of historical and cultural interest such as prehistoric dwellings, archaeological objects, cult objects, potential for sports activities (skiing, fishing, mountaineering), traditional cultural and religious holidays (fairs, carnivals, serenades, etc.), create more favorable conditions for the development of agrotourism than industry.

The Albanian government explored the copper mine and enrichment plant from 1980 to 1990. After the 2000s, the Albanian government tried to put into operation a concession contract for the rehabilitation of the former enrichment plant as well as the reprocessing of the old waste from the landfill for further beneficiation of copper and other minerals. These efforts were unsuccessful, leaving a degraded and problematic environment. Within the site area abandoned premises of the former enrichment factory are located and with a dumpsite of mineral heaps and waste rock, and a tailings dam located few hundred meters from these buildings. Some of these dumpsites consist of piles of minerals, mainly of Cu, Fe and CuFeS2, resulting from the enrichment process.

Shallari et al (1997) highlight that large parts of the Albanian land are covered by soil developed on serpentine rocks. This soil is naturally rich in iron nickel chromium and copper determining the high density of mines that supply raw materials to Albanian metal smelters. Critical load of trace metals in soils is a function of biological uptake, leaching by percolating water, input of the trace metals due to bedrock weathering, and the norms set to protect soils from metal pollution (Paces T. 1998).

As for the anthropogenic background concentration, a large part of it appears to be due to a number of mining activities and smelters. Apart from impacting on soil at the mining/smelter sites themselves, these activities appear to have affected soil concentrations in the larger site areas, where generally high metal concentrations can be identified. Literature on the subject mainly analyze concentrations of heavy metals in agricultural soil next to mining or industrial sites. A reference search on the metal concentration in agricultural land next to the mineral enrichment plants in Guri i Kuq and Bilisht, for example, shows high concentrations of Ni, Cr, Pb Co and Mn, Shallari et al. (1998).

In the area of Progradec and in the area next to Perrenjas, Shallari et al. (1996) report the following heavy metal concentrations in the soil affected by the mining activities widely spread in the area.

In addition, Lushaj et al. (2005), in a study on the concentration of heavy metals in agricultural land show that heavy metals' concentrations in the topsoil around Korce (less than 10 km from Rehove) are very high for nickel and chromium.

In addition, Shallari et al. (1997) report a fairly comprehensive summary of soil concentration of heavy metals measured next to industrial sites throughout Albania. These concentrations, highlight that anthropogenic background concentration can actually achieve very high values which exceed both the DIVs 2009 and the Italian Regulatory threshold values.

DATA AND METHODS

Sampling site

The copper mine of Rehova site is located at Korça District, direction Korça – Erseka national road, some 20 kilometers from Korça city in southern directions. The facilities were established near the Rehova village, a hilly-mountain area with soft slopes, which are followed by higher mountain peaks in western and eastern directions. The Rehove mine site covers an area of approx. 1 km^2, including mine area, the remaining of a former enrichment factory and dumpsites of mine waste near tributary of river Osumi.

Soil sampling, preparation and analyses:

In July 2023, 16 surface soil samples (0-30 cm) were collected from the different locations according to the distance (0m, 10m, 100m and 1km, 2km, 3km, 4km, 5km, 6km, 7km, 8km, 9km, 10km) from the first sample (Sallaku et al. 2009). Subsamples of each soil were air-dried and ground to pass through a 2-mm stainless-steel sieve and are analyzed with METHOD 3051A (https://www.epa.gov/sites/default/files/2015-12/documents/3051a.pdf).

The main characteristics of these soils are given in Table 1. The water content (w %), is calculated as the ratio of the weight of water to the weight of the solids in a given mass of soil and organic C by elementary analysis. Total contents of heavy metals were determined by the mineralization of soil samples in the solution of aqua regia (HCl and HNO3) in the ratio (3:1). The metal concentrations in the extracts were measured by Atomic Absorption Spectroscopy.

Table 1. Chemical-physicals characteristics of the studied samples

No. Soil Sample	W%	Organic C	N- tot	P-tot	K-tot	Ca	Mg
	%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	g/kg
1	2.91	0.28	213.87	241.33	171.63	0.566	145.987
2	3.34	1.77	829.06	271.14	357.74	0.580	127.855
3	5.45	2.12	498.81	241.33	445.46	4.139	37.942
4	5.77	1.30	350.36	271.14	394.27	7.454	38.632
5	4.07	1.24	283.55	666.11	206.87	1.475	101.443
6	3.14	11.49	768.09	801.04	329.41	2.362	71.718
7	4.22	1.91	551.85	498.66	703.65	6.184	33.312
8	3.20	1.60	855.34	579.44	509.14	2.814	116.401
9	6.29	1.58	668.60	2585.66	515.71	0.437	33.317
10	15.60	1.28	1435.97	369.10	446.38	2.892	117.084
11	6.81	4.61	2122.69	498.59	180.43	6.255	129.686
12	3.86	1.10	742.04	382.41	648.13	3.254	132.194
13	6.62	2.25	1355.95	426.00	1914.34	6.037	86.645
14	7.46	3.10	1783.93	740.78	2068.81	8.745	87.306
15	11.49	0.66	650.74	974.88	1434	5.759	103.446
16	4.92	1.66	1169.54	501.04	4960.33	4.475	573.308
Mean	**5.946805**	**2.3715432**	**892.5252**	**628.0406**	**955.3942**	**3.96425**	**121.0173**

RESULTS AND DISCUSSION

The chemical-physical characteristics of the studied samples varied greatly between them (table 1). The total contents of heavy metals of the studied samples are presented in Table 2. We compared the total content of heavy metals in the soil samples with international and German threshold values. The mean contents of Cd, Cr, Cu, and Ni were above the permissible limits of

the 86/278/EEC Directive (CEC 1986, BBodSchV (1999) and Average Earth Crust*. The mean contents of Pb were within values of international and German threshold values and the mean contents of Zn were above of permissible limits of Average Earth Crust*.

Table 2. Mean, international thresholds values, average earth crust (mg/kg) of heavy metals.

No. Soil Sample	Cd mg/kg	Cr mg/kg	Cu mg/kg	Ni mg/kg	Pb mg/kg	Zn mg/kg
1	7.545	120.415	947.73	84.02	7.502	99.593
2	6.876	91.439	1319.85	54.87	6.725	111.355
3	3.864	34.615	60.87	87.22	3.363	39.399
4	4.400	52.058	77.48	99.70	3.708	41.436
5	5.527	74.840	750.03	1.95	5.308	0.000
6	5.021	51.193	135.15	75.55	4.931	125.261
7	3.258	67.562	148.14	73.12	3.615	78.730
8	6.356	249.199	1571	492.80	10.957	336.407
9	4.774	329.547	75.7	388.27	9.426	69.074
10	6.425	1634.191	56.6	1732.54	4.390	76.981
11	5.160	932.096	47.05	1147.71	8.698	72.123
12	4.715	875.991	39.88	974.06	8.141	61.445
13	4.956	328.835	145.9	630.72	6.445	73.955
14	4.327	774.169	62.22	778.59	6.508	76.686
15	4.327	486.301	53.38	1252.56	2.961	71.823
16	3.048	82.468	76.98	111.03	5.073	77.297
Mean	**5.036204**	**386.55753**	**347.9975**	**499.0434**	**6.109406**	**88.22278**
86/278EECDirective[1]	3	150.000	140	75	300	300.000
BBodSchV[2]	1	60.000	40	50	70	150.000
Average Earth Crust*	0.98	85.000	25	44	17	71.000

[1]CEC (1986); [2]BBodSchV (1999); [*]Rudnick and Gao (2005) [7,8,9]

CONCLUSION

Although the industry has been inactive since 1990, the concentration of heavy metals is very high in the area for the four elements such as cadmium, copper, chromium and nickel.

It is necessary to make analyzes in surface waters or in deeper profiles to verify how the pollution has moved in the vertical direction.

The area should be rehabilitated as soon as possible to pave the way for the development of agricultural and cultural tourism, opening up jobs for the local population.

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