GEO-STATISTICAL ANALYSIS OF DISTRIBUTION OF As, Fe, Mn, Cu, AND Zn IN ARTANA MINE TAILING FROM FLOATING PROCESS

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ABSTRACT

Tailings in Kosovo as in any other country in the world look like an asset and mineral resources, but despite this, these Tailings have a very large impact on the process of environmental pollution. In addition to the chemical and mineralogical research of the Artana Art-1 Tailings, we have conducted research on the geostatistical distribution of most pollutants and chemical elements of this tailing.

The flotation process of the Artana mine builds tailing Art-1 and the waste released from this process is dumped in this tailing (Trepça. JSC 2020). The Artana area includes the part of the territory of the Republic of Kosovo, between the coordinates 4716114, 4725406 of the northern latitude and 7530293, 7540539 of the eastern longitude. This part is mainly a mountainous area, with the Gollak Mountains in the north and the Strazha and Zhegoc Mountains in the south. Administratively the study area is part of the municipality of Prishtina.

Thanks to technological processes not very advanced in these tailing, we have a high concentration of various chemical elements, this has made many researchers take this work more seriously, but in addition to the high concentration of these elements, we also have high concentration elements of As, Fe, Mn, Cu and Zn which create very large pollution in the environment.

Keywords: Distribution, Heavy Metals, Geo-Statistics, Analysis, Tailings

INTRODUCTION

Kosovo as an area with very complex geology, with numerous mineral resources over the years and decades have used mineral resourses [1]. Mining practices and the absence of

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proper mine land reclamation has led to heavy metal contaminated sites with serious impact on the ecosystems and risk for human health. The origin of the contamination is often associated to mine tailing deposits because they are a source of the acid mine drainage (AMD). Heavy metal contamination is often the main problem in former mining areas and mine tailing deposits. The continuous release from the mine tailings of acid drainage loaded with metals contaminates water bodies, groundwater and soil. Most of heavy metals undergo transformations and eventually settle and accumulate in the bottom sediment of rivers and lakes [2].

A good understanding of urban soil contamination with metals and the location of pollution sources due to industrialization is important for addressing many environmental problems [3]. Tailings of old mines often contain metals, which were not of economic interest or could not be recovered with the existing technology at the time of active mining. A fundamental characterization of some tailings is presented in terms of their mineralogy and content of valuable metals which could be extracted to finance a possible remediation and improve the supply of the EU with critical metals [4]. Geostatistics, as a part of geomathematics began its development in the second half of the last century [5].

Advanced prediction modeling techniques include geospatial parameters sourced from Digital Elevation Models (DEM), developed and finally incorporated into the models of spatial distribution in the form of 2D or 3D maps. Innovative approaches to modeling assist us in the reconstruction of different processes that impact the entire study area, simultaneously. This holistic approach represents a novelty in contamination mapping and develops prediction models to help in the reconstruction of main distribution pathways, to assess the real size of the affected area as well as improving the data interpretation[6]. Flotation deposits in recent years are also seen as important mineral resources, in addition to the exploitation of various minerals, now even these tailings have aroused a great deal of interest worldwide. A good understanding of urban soils metal contamination and locating their pollution sources due to industrialization and urbanization is important for addressing environmental problems [3].

Complex sulphide ores typically containing lead, zinc, copper, precious metals and sulphur, represent considerable reserves and resources in the contained values. Flotation is the only process that enables the separation of the various major mineralogical constituents of a complex sulphide ores. The flotation process is particularly able to make a clean separation with respect to pyrite; however, attaining selectivity between valuable sulphides to obtain selective concentrates with desired purity and high metal recovery has presented difficulties as evidenced by a vast number of literature devoted to the subject concluded that hydrometallurgical processes could be combined with flotation for maximum efficiency in recovering values into concentrates [7].

GEOLOGICAL CHARACTERISTICS OF THE STUDY AREA

In recent years, a lot of studies have been realized on these tailings due to the concentration of various chemical elements. But in addition to the high concentration of chemical elements, also need for studies are more than necessary to study the environmental impact of these tailings, the concentration of chemical elements such as As, Fe, Mn, Cu, and Zn as elements that can have a negative impact in the soil and water around these tailings.

MATERIALS AND METHODS

To conduct such research we have done a very detailed study by sampling and analysis in a network of 10m x 10m, where a total was taken 68 samples were analyzed [8] and a high concentration of chemical elements was determined [9]. All samples were taken and dried at 105°C, after drying they were ground and prepared for chemical and mineralogical analysis.

In the picture below we will present the sampling and analyzing process up to the results which are presented in Fig. 1, based on methodology of sample prepairing [10].

Figure 1. Sample processing and analyzing

RESULTS AND DISCUSSION

The main focus of this study has been to investigate the distribution of As, Fe, Mn, Cu, and Zn, as chemical elements that may have an impact on environmental pollution, as the main preview of their distribution are geostatistical methods to pressent their distribuion in studies area [11]. Firstly, we will present the descriptive statistics of the selected parameters which are presented in Table 1 (Processed in Microsoft Excel).

Descriptive Statistics

Table 1. Descriptive statistics for the selected elements

	As	**Fe**	**Mn**	**Cu**	**Zn**
Mean	3761,67	176341,99	835,92	313,13	2388,21
Standard Error	340,85	8282,06	308,43	63,60	684,54
Median	3280,71	188978,58	162,54	116,62	596,90

Mode	#N/A	#N/A	#N/A	#N/A	#N/A
Standard Deviation	2101,11	51054,06	1901,26	392,06	4219,81
Sample Variance	4414676,97	2606517509,79	3614795,03	153711,80	17806804,27
Kurtosis	-0,69	1,42	20,31	2,61	8,85
Skewness	0,57	-0,33	4,23	1,85	2,94
Range	7413,02	260953,97	10654,42	1427,72	18752,15
Minimum	768,72	58054,24	33,22	41,88	164,21
Maximum	8181,73	319008,20	10687,64	1469,60	18916,37
Sum	142943,50	6700995,53	31764,96	11898,99	90752,12
Count	38	38	38	38	38

Graphical Distribution - Histograms

We will present the graphical distribution of each element taken for statistical analysis in the following.

Vargu	*Frequency*
1500	5
3000	12
4500	9
6000	6
7500	4
More	2

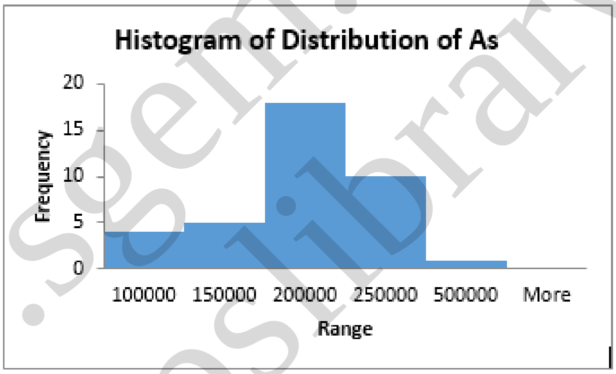

Figure. 2. Histogram of As

In the figure presented above, we have presented the distribution of As, where we see that we have the highest concentration from 1500 - 3000, with a fairly high concentration of As.

Vargu	*Frequency*
100000	4
150000	5
200000	18
250000	10
500000	1
More	0

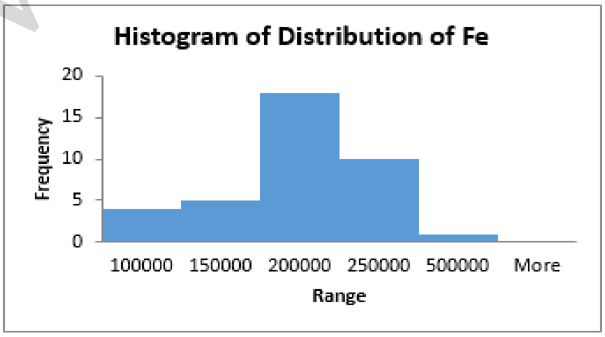

Figure. 3. Histogram of Fe

In the figure presented above, we have presented the distribution of Fe, where we see that the highest concentration is from 150000 - 250000, with a very high concentration of it which includes 28 samples of their total of 38.

Range	Frequency
50	1
100	8
150	8
200	5
250	2
More	14

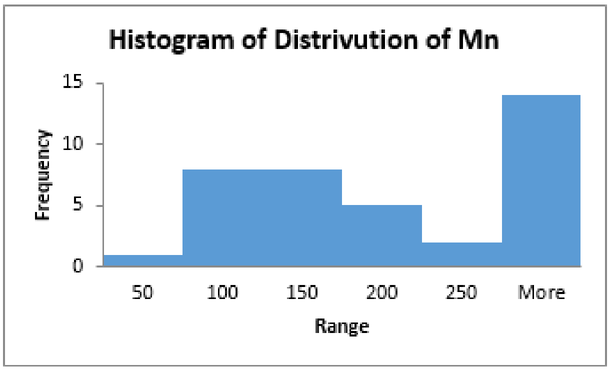

Figure 4. Histogram of Mn

In the figure presented above, we have presented the distribution of Mn, where we see that we have the highest concentration from 100-200, with an average concentration, but that we have a non-uniform distribution of it throughout the tailing samples.

Range	Frequency
250	26
500	4
750	2
1000	3
1250	1
More	2

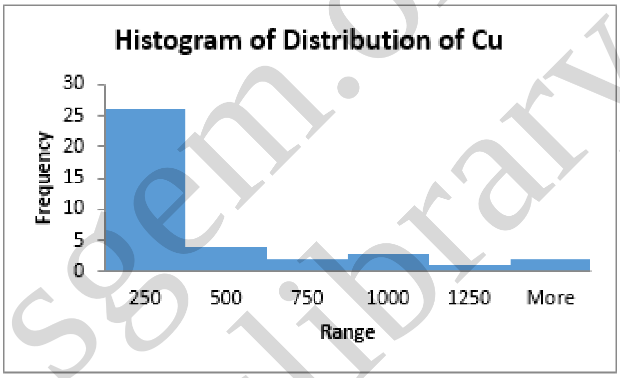

Fig. 5. Histogram of Cu

In the figure presented above, we have presented the distribution of Cu, where we see that we have the highest concentration up to 250ppm, with a fairly high concentration of it with a total of 26 samples.

Range	Frequency
200	2
400	13
600	4
800	4
1000	3
More	12

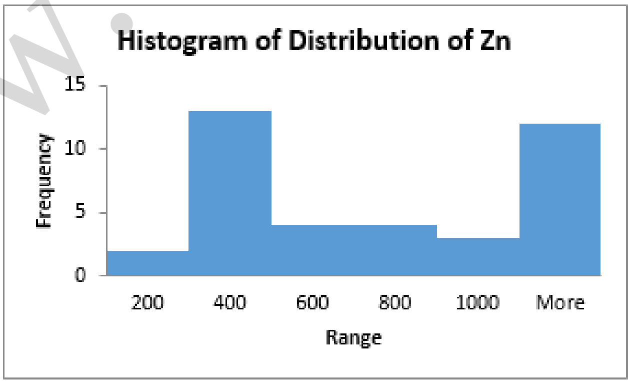

Figure 6. Histogram of Zn

In the figure presented above, we have presented the distribution of Zn, where we see that the highest concentration is from 400 - 80, with a very high concentration of it, but even here we have a large deviation of samples.

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Distribution of elements in tailing Art-1 Artana

In the following figures, we will present the distribution of map points where samples were taken and for which analyses were performed. To better imagine the distribution of these elements, we will present the results through spatial distribution (Sinani. B. 2021), of the samples taken and the results obtained.

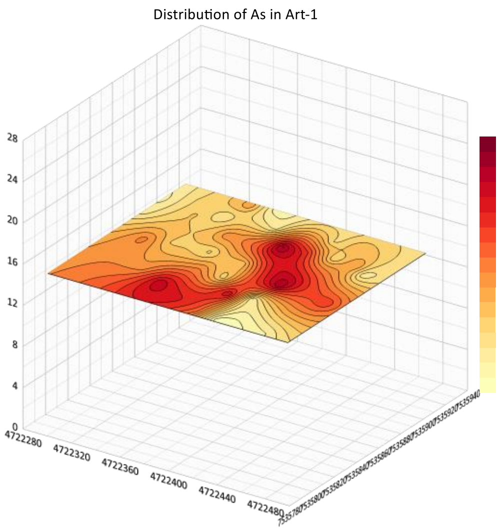

Figure 7. Spatial distribution of As in Art-1 tailing

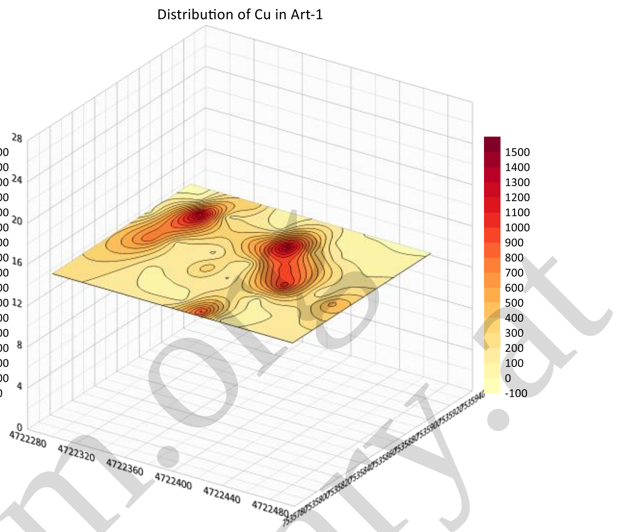

Fig. 8. Spatial distribution of Cu in Art-1 tailing

Based on the figure 7 shown above illustrated in Surfer 16, we see that we have a distribution almost throughout the tailing of As and this gives us a clear picture that As is spread everywhere in this landfill and its impact on the environment is in all directions.

In Fig. 8. We have presented the distribution of Cu in the Artana tailing, where it can be observed that the central part as well as the North-Eastern part has a much higher concentration, while the southern and western part of the tailing has a much more limited distribution.

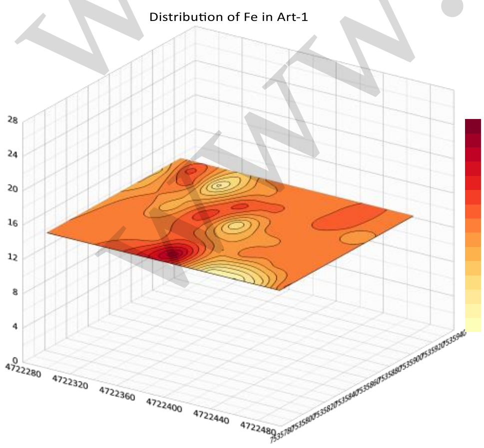

Figure 9. Spatial distribution of Fe in Art-1 tailings

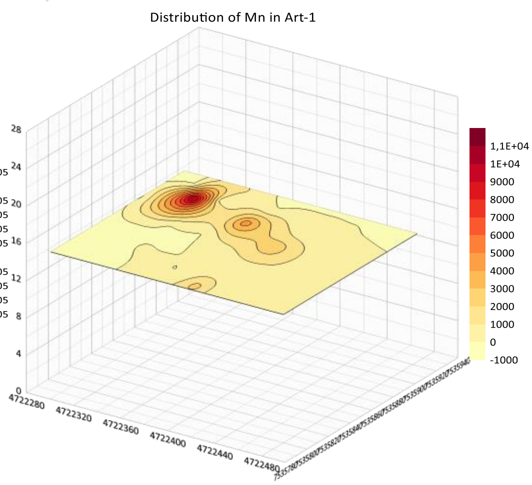

Figure 10. Spatial distribution of Mn in Art-1 tailings

In Figure 9. We have presented the distribution of Fe in the Art-1 tailing, iron as well as As has an almost uniform distribution throughout the tailing, based on the fact that the river passes there, this shows the high degree of influence it can have throughout that area the high presence of iron in this tailing. In Figure 10 we have presented the distribution of Mn, which is a little more limited, it has a distribution mainly in the north-eastern part of the tailing, while in the other parts it is almost evident in a very small amount.

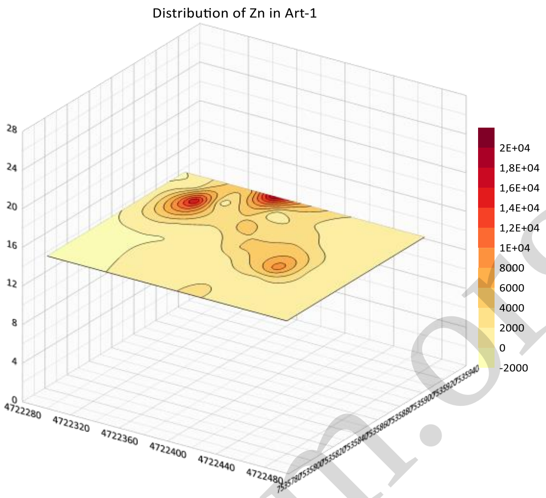

Figure 11. Spatial distribution of Zn in Art-1 tailings

In figure 11 we have presented the distribution of Zn in Artana Art-1 tailing. The presence of Zn in this tailing is mainly concentrated in the samples taken in the northern and eastern parts, but it is also emphasized in all other parts. What characterizes this dump the most is that it is a Pb-Zn flotation dump, the deeper the samples are taken, the higher the concentration of Zn is found, and this is the result of older technologies, and with With the advancement of technology, the profitability of Zn has risen to a great extent.

CONCLUSIONS

Based on the data presented by this research and their geostatistical interpretation we see that we have a very high degree of concentration of these elements, which in addition to their concentration in Artana Art-1 tailing have a very large impact on environmental pollution.

Copper, Manganese, and Zinc have been identified but to a lesser extent than Arsenic and Iron and are mainly concentrated in the North and East while the river flow is on the Southside and this indicates that the potential possibility of river pollution is smaller compared to these others.

Arsenic has a high concentration in any part of this tailing, it is also evidenced during the samples taken near the river flow in which case the effect of pollution is also present in the river as well as on agricultural lands and pastures near this tailing.

Iron, as well as arsenic, have a fairly large distribution throughout the tailing, can not be highlighted area in which no high concentration of arsenic and iron has been evidenced and these two elements have a fairly high distribution along the river and that the flowing river is always polluted with these chemical elements.

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