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Physicochemical Characterization and Risk Environmental Trace Metals in Soils and Sediments Near the Abandoned Mine of "El Abed" Pb-Zn Deposit–Northwest Algeria

Mellah Farida[1,2*], Boutaleb Abdelhak[1], Henni Bachir[2] , Berdous Dalila[3] and Mellah. Abdelhamid[4]

[1] *Algerian Laboratory of Metallogeny and Magmatism - FSTGAT - USTHB – Algier, Algeria*
[2] *Department of Natural Sciences ENS Kouba - Algiers*
[3] *Faculty of Chemistry - USTHB - Algiers BP 32 El Alia - 16 111 Algeria*
[4] *Comena – Frantz Fanon Center – Algiers – Algeria*
*Correspondent author email: farida.mellah@g.ens-kouba.dz

ABSTRACT

This study examines the El Abed region, a major lead and zinc mine in northwestern Algeria. Despite being one of the largest mining operations in the area in the past 30 years, the mine has been abandoned since 2004, leaving behind a large backlog of mining waste. Fifty-six samples, including soil, sediment and tailings, were collected to verify physical properties. To measure concentrations and sources of heavy metals in surface samples, chemical analyzes were performed using an iCAP 7000 ICP Series Optical Emission Spectrometer.The physical and chemical properties of the surface samples showed that the pH ranged between 6.25 and 8.4, indicating alkalinity. Moderate to high electrical conductivity values were observed, ranging up to 5040 µS/cm. Eh values ranged from -78 to 53 mV, indicating appropriate reduction. The results showed that the average metal concentrations are: (As = 30.82), (Pb = 1219.27), (Zn = 2855.94), (Cu = 5.3) mg/kg. According to the results, all metals, except copper, meet the GBV standards for levels found in the Earth's crust. Pollution indicators revealed high values that exceed all usual classifications. Mining activity has increased concentrations of lead, zinc, copper and arsenic. The results of this study will assist in decision making and facilitate the development of effective remedial methods to reduce the environmental risks associated with the abandoned Al-Abd mine.

Keywords: Environmental quality; mining waste ; EL-Abed mine ; Algeria.

1 Introduction

The areas surrounding abandoned mines worldwide have been adversely impacted by mining waste generated by the mining industry. This waste is noted as the primary source of trace minerals. Trace metals are deemed as contaminants in agricultural soils, of which their origin is humanThis study was carried out at an abandoned mine in the El-Abed region of north-west Algeria, which has a history of lead (Pb) and zinc (Zn) production and is the largest mining area in North Africa. The mine operations ceased in 2004 and, as a result, the leftover mining waste was left unattended, exposed to the atmosphere. This research marks the first exploration of the affected area.Thus, the study was conducted for the following objectives (1) to evaluate the status and origin of heavy metals in surface soil and sediment around the former El-Abed Pb/Zn mine (North-West Algeria), (2)to determine the physical and chemical characteristics of soil and sediments in the Abed region.

2 Experimental

Fifty-six surface samples were collected and placed in sealed plastic bags, containing soil, sediments and waste, to study the physical properties. CE was measured at 25 °C using a standard experimental conductivity meter (X 31-113). The pH and Eh were determined at 20 °C using a pH meter (Norm X 31-103). To measure concentrations and sources of heavy metals in surface samples, chemical analyzes were performed using an iCAP 7000 ICP series optical emission spectrometer.[2]

3 Results and Discussion

The results obtained showed that the pH values varied from neutral to alkaline, and the values for the sum of all samples ranged between (6.25 - 8.4). This indicates the presence of carbonates. The presence of carbonates in soil is an important reservoir of heavy metals. [3] The results obtained showed that the

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electrical conductivity values for all samples varied between 58.6 and 5040 (µS/cm). This indicates saline conditions.The Eh values gave the following results: The values of all surface samples for the El-Abed region ranged between -78 and 53 (mV), the mean Eh values for all samples are -10.85 (mV).The percentage of calcium carbonate for all surface samples from the El-Abed area varies between 3 and 53%, whereas soil samples vary from 3 to 48%, this indicates the abundance of calcium carbonate in all samples, so the average calcium carbonate values are 25.27%. This indicates a dolomitic limestone substrate.

Table1: Statistical data of physical and chemical properties of surface samples of soil, sediment and mining tailings

Variability	pH	Eh (mv)	CE (µS/cm)	CaCO3%
Min	6,25	-78,00	58,60	3,00
Max	8,40	53,00	5040,00	53,00
Mean	7,34	-10,85	332,29	25,27

The results of the chemical and quantitative analysis of trace metals in surface soil samples from the El-Abed region are that zinc concentrations are present in large quantities in the waste and soil compared to the concentrations of lead, arsenic, and copper.The mean trace mineral contents are shown in this order: Zn >> Pb> As > Cu. The results showed that the average metal concentrations were: (As = 30.82), (Pb = 1219.27), (Zn = 2855.94), and (Cu = 5.3) mg/kg. According to the results, all metals, with the exception of copper, meet the GBV criteria for levels found in the Earth's crust.[5].

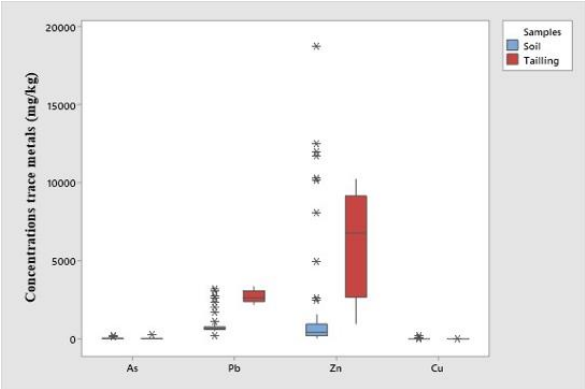

Figure 1: Concentrations of trace metals in surface samples of soil and mining waste from El- Abed region

4 Conclusions

We conclude that the evaluation of trace metal concentrations in soils and sediments near mining wastes and high valleys and the results of the study of physical and chemical properties. These results can help develop future treatment strategies for disposal of materials found in mining waste.

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