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Research Article

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Analysis of some Heavy Metals in Soil samples collected from Elabedia Traditional Gold Mining area- Sudan

Sumia A. Nimir[1], Dr. Eljali Elobeid Elhassan[2], Nawal M. Suleman[3], Nada Omer Abdellah[4]

[1]Associate Professor, Chemistry Department, Faculty of Education, Nile Valley University, Sudan
e-mail: Corresponding author Sumiaa288@gmail.com
[2]Associate Professor, Chemistry Department, Faculty of Education, Khartoum University, P.O. Box 406 Omdurman-Sudan
e-mail: eljali2004@yahoo.com
[3]Assistant Professor, Chemistry Department, Faculty of Education, Khartoum University, P.O. Box 406 Omdurman-Sudan
Nawal.mahgoub@UofK.edu
[4]Chemistry Department, Faculty of Education, Nile Valley University, Sudan
e-mail:Omern6215@gmail.com

Abstract Heavy metal concentrations (Fe, Mn, Zn, Pb, Cr, Cu, and Ni) were investigated in soil from the traditional gold mining area at Elabdeia Berber city Nile State Sudan. Soil samples were collected from the site of the study, also soil samples were collected from the site expected to be free from industrial emission to serves as a control. *The heavy metals were* analyzed using X-Ray Fluoresce. Based on the obtained results, the average concentrations of 866960,17578, 1333.3, 900.00, 4427.8, 87.7778, 190.00 mg/kg. wet. were found respectively for Fe, Mn, Ni, Cr, Cu, pb, and Zn. The results indicated that the mean concentrations of the studied heavy metals in soil are higher than the mean concentration in the control site, this attributed to anthropogenic sources of these metals. The results of this study were compared with previous literature.

Keywords Gold mining, heavy metals, X-Ray Fluoresce, pollution, Elabedia, Sudan

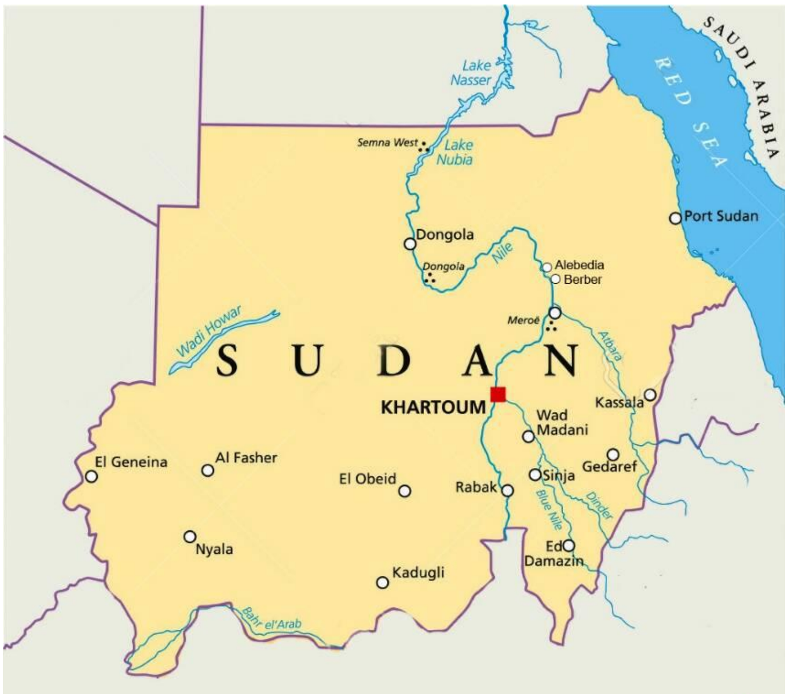
1. Introduction

Today environmental pollution problem due to heavy metals has taken global dimensions and it still on increase. Contaminated soil with heavy toxic metals can potentially lead to the uptake and accumulation of these metals in the edible plant's parts causing risk to human and animal health [1]. Heavy metals are any metallic chemical element that has a relatively high density (superior to 5 g/cm^3); most of them are toxic or carcinogenic even at low concentrations, such as mercury, cadmium, arsenic and chromium [2]. The toxic elements enter the human body mostly through food and water and to a lesser extent through inhalation of polluted air, the use of cosmetics, drugs, poor quality herbal formulations particularly [3]. Although heavy metals may occur naturally in soil based on the origin of soil its additional contribution comes from various source, including urbanization and industrialization, with poor planning in waste disposal and management. Sources of contamination include: accidental spills, leaks of chemicals and human activities such as (vehicular emission, power enervation plant, oil burring, waste incineration and construction) and mine activates. Among this mine, activity is considered as one of the most influential anthropogenic activities which result in changes in the landscape, destruction of habituates contamination of soil, water and degradation of land resource. Its impacts on public health may be found at greater distances from the source and for a long period. Mining activities also influence strongly the economic wealth of the area and act on its social life. Both the environmental and socio-economic impacts of mining are well documented in numerous areas worldwide [2,3,4]. The extent and degree of heavy metals contaminations around the mines vary depending on the capacity of mining activities and geochemical characterization of the area [5]. Hazardous elements in the tails of mining and metallurgical operations are often dispersed, included in particulates material or aqueous solution by wind and \ or water after disposal due to transport process [6]. In recent years several studies have been made by the number of researchers for determining heavy metals levels in contaminated soil. Kamunda et at [7] evaluated the health risk caused by some heavy metals inhabitants of gold mining area .their results, indicating that the contaminations of heavy metals were higher than permissible levels. The investigation of [8] indicated that the concentration of heavy metals in the soil around the oil filed area decreases with distances from metallurgical works. The study by [9] indicated should that the concentration of heavy metals was higher than the earth's crust value. Guan et al [10] analyzed soil from Tianjin chana and assessed the effected of industrial and mining on the concentration of heavy metals. The investigation of [11] showed that the soil samples from inside the mining area have a high enrichment factor for most heavy metals particularly Pb. The present study aimed to evaluate the pollution level by some heavy metals in the work environment at Elabedia Traditional gold mining area -River Nile, state, Sudan

2. Materials and Methods

2.1. The Study Site

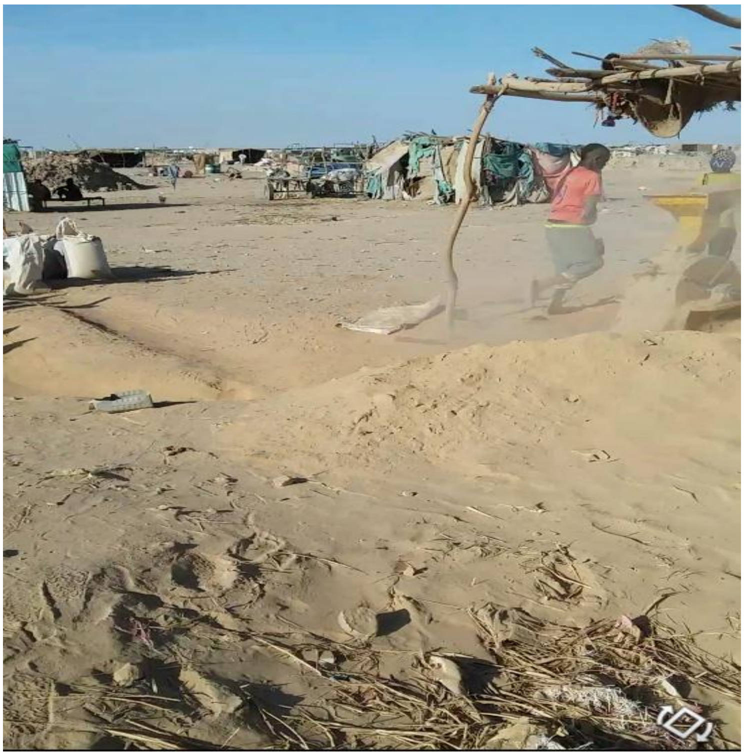
The site of the study is the traditional gold mining inside Elebedia which located in the River Nile State south Berber 15 Kilometers bounded by the Nile River from the west, AL sherik from the north, and the Red Sea State from the east scheme (1) the main profession of its inhabitants is agriculture, where is characterized by its fertile lands. Trade is considered of other professions in addition to the mining of gold. This site was surveyed during January 2017.



Scheme 1: Sketch map of Study Location

2.2. Samples Collection a pretreatment

Nine surface soil samples were collected from the site of the study (Scheme 2) with a stainless steel trowel into plastic bags and three surface soil samples were collected from an area that is exacted to be free from industrial emission to a server as control (Atbara). All soil samples were labeled before shipment to the laboratory. The samples were repeatedly crushed with clean mortar and pestle and sieved through a 2-mm sieve to fineness and saved for analysis.



Scheme 2: The area of study

2.3.Heavy Metals Measurement:

The XRF system used in this study was the X-MET5000 system (oxford instrument). X-MET5000: Dry, clean and homogenous us soil or sediment sample was placed into a plastic sample bag. This bag was placed on a background plate to minimize radiation scatter and to provide a constant background signal. The standards were prepared similarly. The concentrations of metals were measured directly by the holed analyzer at the right angles to the sample. The time of collection was 5 seconds. The X-MET model 5000 is a handheld elemental analyzer intended for various applications, include metal alloy analysis, soil and mining analysis, and electronic industry application. The X- MET 5000 series analyzers are based on energy dispersive X-Ray fluorescence technology and use X-Ray tube as the source of excitation. The standard material is Rhodium. The analyzer contains a high-resolution Penta.pin diode detector with palter cooling the X-MET provides a method for chemical analysis or samples identification (sorting) directly from samples in various forms. The instrument is a fully portable analyzer with an integrated PDA (Personal Digital Assistant Computer) within the X-MET analysis program the user may select analytical modes to view spectra and saved data.

Scheme 3: Shape of X -MT 5000

3. Results and Discussions

The results of total concentrations for heavy metals in the soil samples, determined by using (XRF) technique from the study area, and control area were shown blew.

Table 1: Summary of Statistical results for total elements concentrations in ppm from soil and control samples by XRF

No.	Types samples	Element	Mean	Std. Deviation	Minimum	Maximu
1	Soil	Fe	866960	20139.39616	827000	890000
	Control		821770	11927.41939	8.08000	8.29000
2	Soil	Mn	17578	4752.83541	10500.00	23900.00
	control		1553.3	613.29710	980.00	2200.00
3	Soil	Ni	1333.3	421.30749	900.00	2300.00
	control		190.00	115.32563	100.00	320.00
4	Soil	Cr	900.00	632.45553	200.00	1900.00
	control		120.00	43.58899	90.00	170.00
5	Soil	Cu	4427.8	2874.57726	1350.00	10100.00
	Control		943.33	404.51617	630.00	1400.00
6	Soil	Pb	87.7778	59.95369	10.00	200.00
	Control		16.6667	12.58306	5.00	30.00
7	Soil	Zn	190.00	81.39410	100.00	310.00
	Control		0.0000	0.00000	0.00	0.00

The analytical results for soil and control sites are summarized in the above tables. The differences between the arithmetic means and the medians in tables indicate that the results are positively skewed. High standard deviation(STD), results from a wide variation of the elemental content in soil from the study area. The mean concentrations of all elements in soil higher than the control site (Figures 1 to 7). This attributed to anthropogenic sources of these elements.

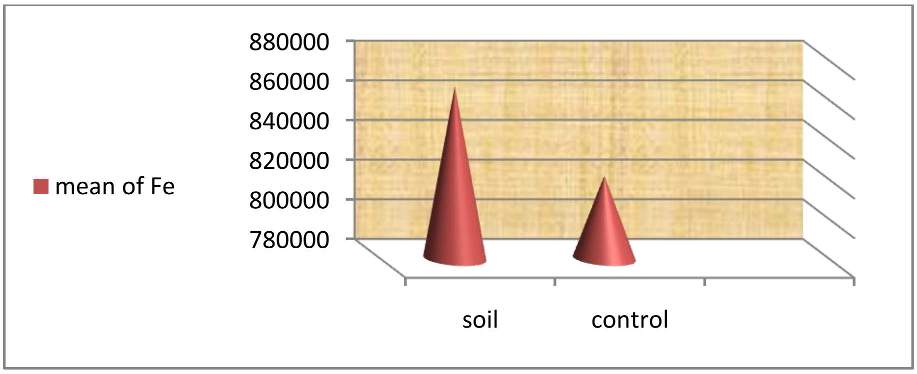


Figure 1: Mean concentration of Fe in soil and control samples

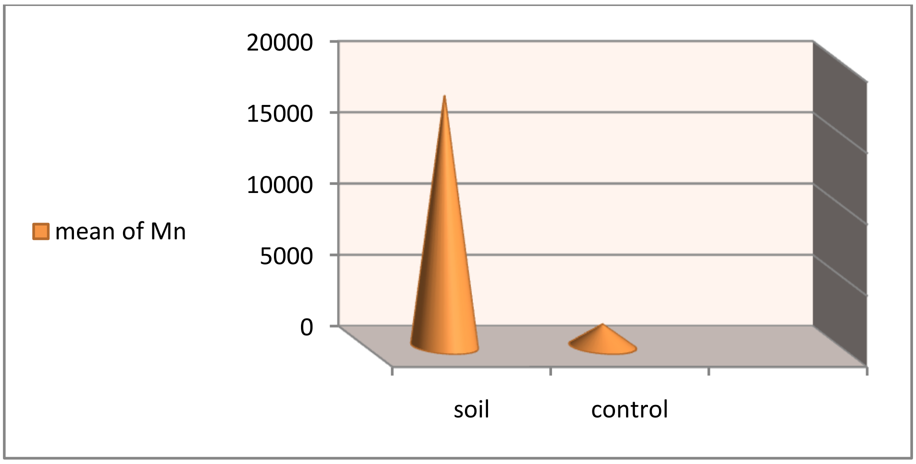


Figure 2: Mean concentration of Mn in soil and control samples

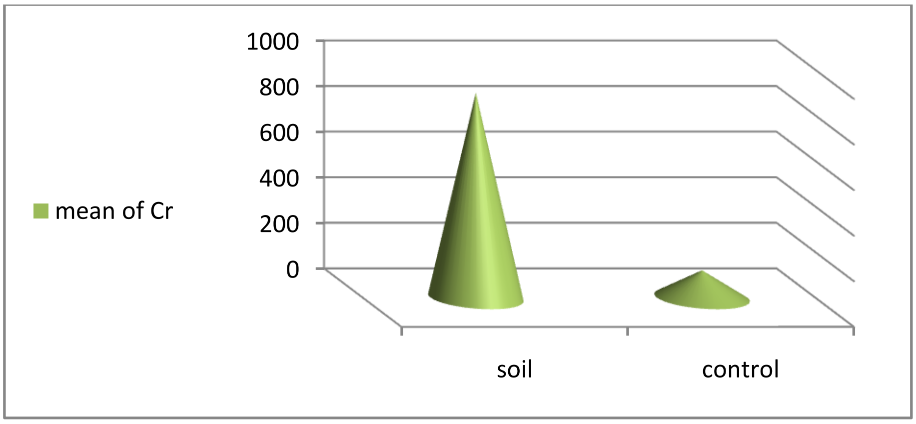


Figure 3: Mean concentration of Cr in soil and control samples

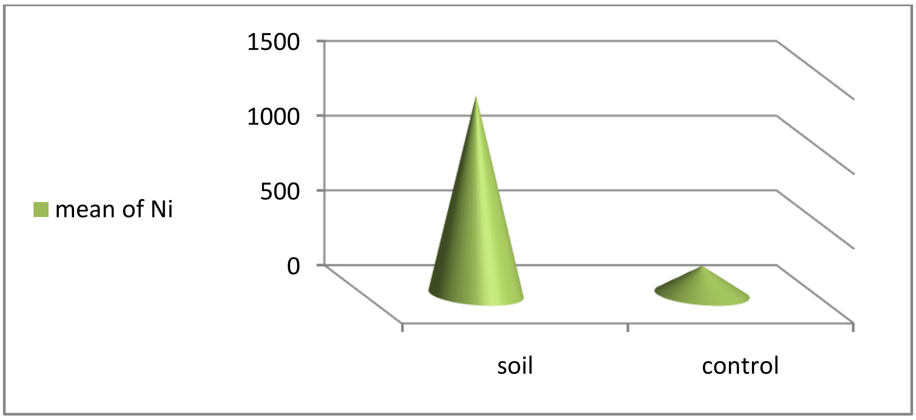


Figure 4: Mean concentration of Ni in soil and control samples

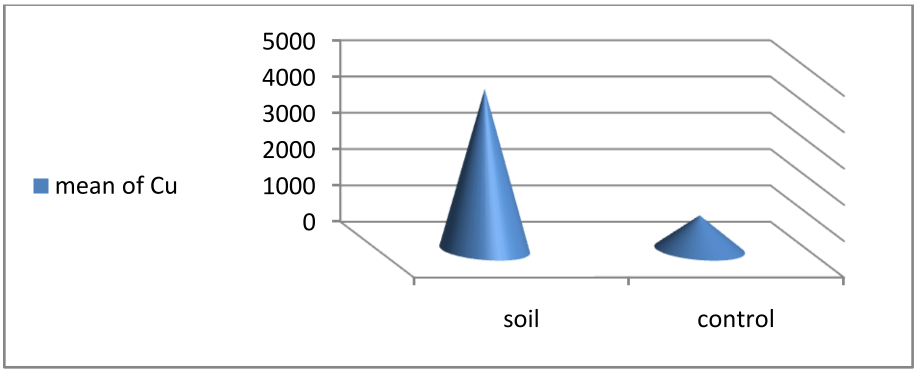


Figure 5: Mean concentration of Cu in soil and control samples

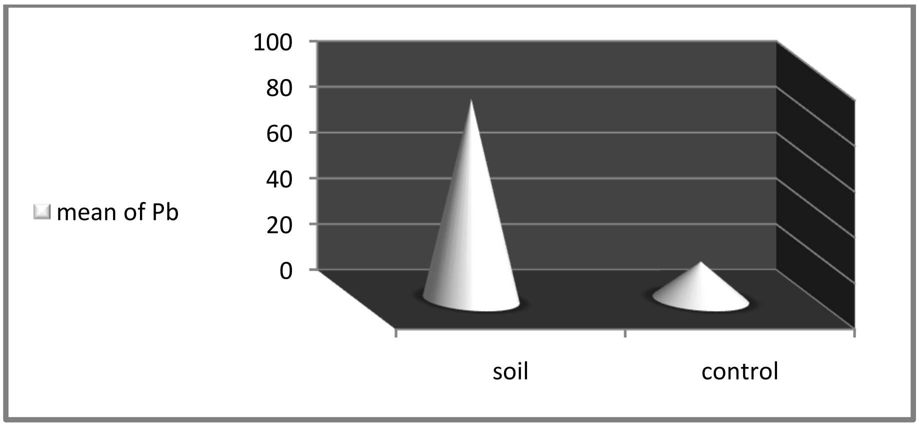


Figure 6: Mean concentration of Pb in soil and control samples

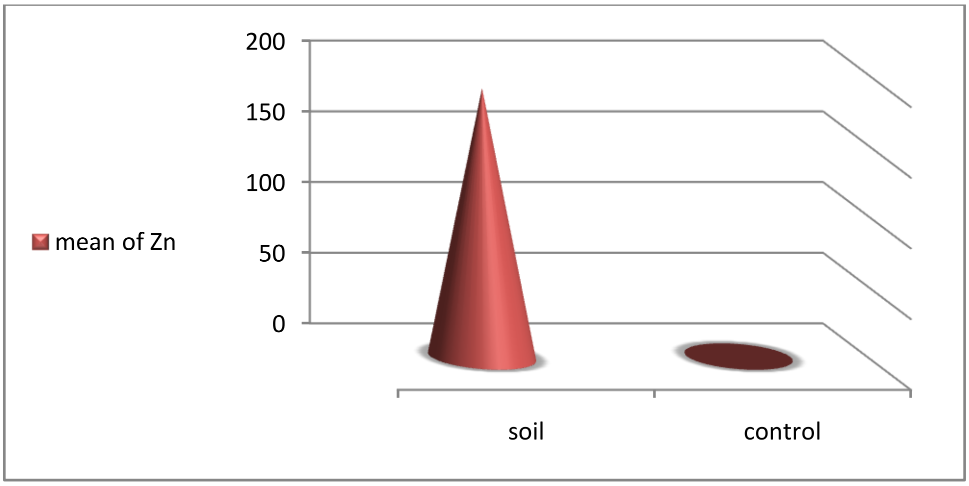


Figure 7: Mean concentration of Zn in soil and control samples

3.1. ANOVA One Way

Analysis of Variance (ANOVA) was used to test for significant differences in the heavy metal content of the (soil and control samples). One-way ANOVA was used in all cases for mean metal level comparisons at 125% level of significance. From the data set of the composite, the mean value in soil, sediment and control samples and its standard Error have been calculated for each elemental concentration.

Tables 2: Mean concentration(±S.E.) of heavy metals in the soil and control samples (ppm)

No.	Elements	Soil	Control	P-value
1	Fe	866960±(6713)	821.770±(757.72)	0.000
2	Mn	17578±(1584.2)	1553.3±(28.1997)	0.000
3	Ni	1333.3±(140. 43)	190.000±(7.54803)	0.000
4	Cr	900.0±(210.81)	120.00±(45.11512)	0.030
5	Cu	4427. 8±(958.19)	943.33±(53.85007)	0.002
6	Pb	87.778±(19.98456)	16.6667±(421. 69)	0.015
7	Zn	190.00±(27.13137)	0.000±(32.27223)	0.0414

Significant at; P-value < 0.05

The effects of major dominant activities on metallic contents in soil and control samples are indicated by one-way ANOVA for the obtained results table (2). ANOVA results showed that all the concentration elements were highly significant. The order of occurrence of the metals in the control and soil samples in the descending trend was as follows: Fe ≤ Mn ≤ Ni < Cu < Pb < Cr < Zn.

Comparison of Results of Soil Analysis with Literature Data

Table 3: Comparison of the mean concentration of heavy metals in soil in this work with literature data (ppm)

Elements Reported values	Fe	Mn	Ni	Cu	Cr	Zn	Pb
Albadawi [2]	4873. 0	238.11	15.33	19.000	-	20.85	12.6
Ali [3]	427000	600	21.78	12.95	-	107. 85	9.26
Ratnakar [11]	3276	327.44	0.84	1.37	72.44	-	32.05
Crabssi [12]	-	550	328	276	-	964	29
Tumuklu [13]	-	523.3	15.3	15.7	31.7	53.3	16.7
Our Study	866960	17578	1333.3	4427.8	900.0	190.00	87.78

When the result of this study was compared with results reported by Albadwi et al [2] and Ali et al [3] for the soil elemental content table 3, higher values concentration for all element in soil of this study were shown ,and this attributed to the extraction of gold mining in this study . Also, the results of this work were compared with the results reported by Ratnakar and Shikha [11], Tumuklu et al [13] and Crabssi et al [12] for the soil elemental content table (3) also a high concentration of all the elements in this study were observed and this also attributed to the anthropogenic sources.

4. Conclusion

The results of this study revealed compositions and distributions of heavy metal contaminants in soil samples collected from Traditional gold mining at El abedia barber city Sudan. Fe, Mn, Zn, Cu, Cr, Ni, and Pb analyzed in this study by using X-MET5000, X-Ray fluorescence. The results were treated statistically by ANOVA analysis. ANOVA results showed that all the heavy metals concentration was highly significant. The order of occurrence of the metals in the control and soil samples in the descending trend was as follows: Fe ≤ Mn ≤ Ni < Cu < Pb < Cr < Zn.

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