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EVALUATION OF SOME ELEMENTS OF SOIL USING X-RAY FLUORESCENCE TECHNIQUE, BLUE NILE STATE, SUDAN

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ABSTRACT

In this work, X-ray fluorescence technique was used to evaluate the soil concentration with some elements for 30 soil samples (0 - 10 cm in depth) from various locations to cover the Blue Nile State, Sudan. Concentrations of elements: Ferrous (Fe), Cobalt (Co), Nickel (Ni), Chrome (Cr), Titanium (Ti), vanadium (V), Tungsten (W) and Aluminum (Al). The results revealed that the high levels of Fe, Cr, W, Ni, V, Co, Ti and Al concentrations were 91.47, 72.8, 11.45, 4.62, 1.31,0.80 and 0.28 mg/kg from Agadi, Manza, Arkwet, Dareng, Elnsr East, Agadi and Dareng, respectively, while the lower levels were 1.05, 0,55, 0.25, 0.11, 0.06, 0.01 and 0.01 gm/kg from El Shaheed and some locations - Manza, Elgri, Elgri and Elgri respectively, and Aluminum Al ND in all soil samples. The average concentration of Fe, Cr, W, Ni, V, Co and Ti were 576.18, 103.400, 40.976, 4.440, 4.310, 0.07 and 0.01 gm/kg, respectively. The elements' concentrations were compared with the normal values and other studies in different locations from the world.

KEYWORDS: *X-Ray Fluorescence Technique, Industrial Plants, Concentration of Heavy Metals*

Article History

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INTRODUCTION

Soil contamination by heavy metals resulting from emission of fumes and smokes from transportation and industrial plants is recognized as a major problem in different countries. Studying the levels of radionuclide distribution in the environment provides essential radiological information (Censi et al. 2006, Aktaruzzaman et al., 2013, Aktaruzzaman et al., 2012, Dolan et al., 2006). As a result of rapid urbanization and industrial development, the environmental contaminants are widely distributed in air, water, soil and sediment. among environmental pollutants. Heavy metals are of particular concern due to their potential toxic effect and ability to bio-accumulate in assessment becomes very complex when different sources of contamination are present and their products are variably distributed in these cases. The spatial variability of heavy metal concentrations in soils is a basic information for identifying the possible sources of contamination and to delineate the strategies of site remediation. (Ene et al., 2010). The most frequently reported heavy metals with regard to potential hazards and occurrence in soils are: AL, Co, Cu, Fe, pb, Mn, Ni and Zn (Tumuklu et al., 2007, Al-kashman and Shawabkeh 2009).heavy metal concentrations, such as Cd, Cu, As, Zn and pb in surface soils have been a focus of investigation over the past decades (Adriano, 1986). Kung and Ying determined some heavy metal concentrations. Their results revealed that soil pollution occurred predominantly around industrial complex (Kung and Ying, 1990). The content of pb, Cr, Cd, Hg and As from different industrial areas was investigated. Results show that the concentration of heavy metals was so high that the concentration of heavy metals was so high that these soils need immediate decontamination or at least remediation measures (Elbagermi et al., 2013). Metals content in Irish soils from an area with modern industrial development was generally indicative of low pollution input (Megrath, 1995). Assessment of heavy metals in soil and roadside dust around that the heavy metals concentration in industrial area was higher as compared to the non-industrial area (Elbagermi et al. 2013). (Ezekiel et al., 2013) reported that the concentration of the metals decreased with distance from the site of the industrial area. Heavy metals in effluents of pharmaceutical industries were determined (Ramola and Singn, 2013). Results show that the concentrations of some heavy metals are above the permissible limit recommended by WHO Standards. X-ray fluorescence (XRF) technology was used to evaluate the soil pollution with heavy metals in soil in Ado Ekiti, Nigeria. The experimental results indicate that the concentrations of heavy elements are greater than the level detected in a controlled soil. Anthropogenic releases give rise to highest concentrations of the metals relative to the normal background values and in some locations their levels exceed the alert level admitted by the Nigeria guideline (Ogunmodede and Ajayi, 2014). At present, very little is known about the heavy metals concentrations, distribution and the extent of environmental pollution in the soils of Omdurman. Therefore, the main goal of the present research was to assess the heavy metals concentrations in the industrial area, Omdurman City, Sudan. (Ali,I. H., 2014).

Trace elements in soil result from the weathering of rocks and minerals in the soil parent material. The concentration of trace elements in different parent rocks is especially important in soils of undeveloped arid and semi-arid zones (Haluschak et al. 1998; Fengxiang 2007). Trace elements can be mobilized from arid soils through plant uptake and erosion/leaching processes, but these soils usually contain higher contents of trace elements than other soils (Kabata-Pendias & Penzias 2001).

Heavy metals find their way to the soil from such anthropogenic activities, as mining and smelting, road retelling, application of sewage sludge and phosphate fertilizers and pesticides, manuring, burning of coal and gasoline, leaching from building materials and direct domestic or industrial discharges and disposals. Commonly, sewage sludge-based organic fertilizers contain variable quantities of heavy metals that contaminate soils.

OBJECTIVE

To evaluate some elements' concentrations like ferrous Fe, Cobalt CO, Nickel Ni, Chrome Cr, Titanium Ti,Vanadium V, Tungsten W and Aluminum Al, of soil using X-ray Fluorescence Technique, Blue Nile State, Sudan

MATERIAL AND METHODS

Thirty soil samples were collected at the surface level (0 – 10 cm in depth) from various locations to cover the Blue Nile state, Sudan during December 2016 to February 2017. The distance between each successive sample is about 30 kilometers. The soil samples were dried, homogenized and saved at 200 mesh grain size, determining the heavy metals' concentrations like ferrous Fe, Cobalt CO, Nickel Ni, Chrome Cr, Titanium Ti, Vanadium V, Tungsten W and Aluminum Al, of soil in Blue Nile State, Sudan and analyzed for their heavy metals using X-ray Fluorescence (XRF) technique (model X-MET5000).

RESULTS AND DISCUSSIONS

The concentrations of the Fe, Cr, Ni, Co, W, V, Ti and Al metals in the different soil samples were determined as shown in Table (1) and Figure (1)

XRF Results for collected surface soil samples from Blue Nile State, Sudan, show evidence to the existence of the following elements :Fe, Cr, Ni,Co,W,V, Ti, and Al. As shown in Tables (1), it can be seen that average Fe, Cr and W concentrations for almost all studied sites are greater than normal values 547.40, 103.40 and 40. 976 mg/kg-1, respectively, while most of the Average Ni, V, Ti, and Co concentrations are lower than the normal values 4.440, 4.310, 110 and 700 mg/kg, respectively, except Site 19 Elkrmuk, which recorded high concentrations of Cr. Table 2.2 gives the comparison of trace element concentrations in present work with other reference data (Elbagermi et al., 2013, Ezekiel et al., El-Bahi et al., 2013, Al-shayeb, 2002, Dingjian, 2012, Vandana Adriano, 2006). It can be seen that the present concentrations of Cr and Zr are lower than that of Wadi El Rayan in Eygpt (El-Bahi et al., 2013) and Hyderabad City in India (Vandana et al., 2011) and lower than threshold values as well (Adriano 2001). Table 2 shows also that the present concentrations of Ni, Cu and Zn exceed all reference data (Elbagermi et al., 2001). Existence of all these elements with different values causes many diseases in human bodies, e.g., Cr Causes carcinoma. Data of XRF sample were recorded to identify each element present in soil samples. Using the elemental analysis data obtained (Table 2.2). Table 4.31 and the plot of elemental concentrations (%) were sampled against locations are presented in Figure 4.31. The results of trace elementals, such as Fe, Ni, Cr, Co, V, W and Ti were found to be 54.74, 0.444, 10.34, 0.07, 0.431, 4.0976 and 0.011% respectively. When compared with literature K, Ca, Ti, Mn and Fe 0.95, 2.31, 0.84, 0.06 and 4.27 were observed, respectively. In this study, Fe was higher than the concentration of such elements in the soil sample. The present study observed that the results of Fe, Ni, Cr, Ti, Co, V and W concentrations were measured in soil samples, as expressed in (mg /kg) are summarized in Table 4.32, the concentrations of Ti and Ni in the soil samples were 110,4.440 mg /kg, which revealed that the examined soil samples contained relatively lower amount of Ti and Ni than that of soil sample.

According to the US Environmental Protection Agency (EPA) and NY Department of Environmental Conservation (NYSDEC) guidelines, natural threshold background of pb in agricultural soil is 200 mg /kg. The maximum Zn value in light soil used in cultivation in India was 100 mg /kg. The concentration of Zn was found at 107.85 mg /kg in the soil samples, which was higher than by different guidelines and nations. Similarly, the Cu content in soil samples was 12.95 mg/kg. which was also extremely higher than that of in India (< 35 mg/kg) and India (20–30 mg/kg). Some well documented studies disclosed that heavy metals such as zinc (Zn) and Copper (Cu) are the principal elements restricting the use of soil for agricultural purposes. Ni 21.78, Zr 374.86 and Rb 53.76 were higher concentration dependent on literature 16.6.51.2 and 7.37 mg/kg, respectively. Sr was found in study 263.35 but PMC:WHO 1996 is 200 mg/kg. The present study compares the results of Br (20.11) with Japan (122 mg/kg). This means that the Br was not higher. The results are representing an attempt to assess the influence of various pollution sources on the environment, such as industrial processes. The specific type of metal contamination found in a contaminated soil is directly related to the operation that occurred at the site. The range of contaminants will also depend on activities and disposal patterns for contaminated wastes on the site. The properties of soil resulting from urban sewage wastewater treatment differ from place to place and depend on the structure of the population and its food habits, season and diversity of industrial and agricultural units. The chemical composition demonstrates that sewage soil is an important source of organic matter for the soil and of nutritive elements for crops. Sewage soil contains various heavy metals. Finally, in this study, some elements such as Cu, Br and Pb were within the permissible levels given by different guidelines and nations, but Ni, Zn, Zr, Sr and Rb were higher than the allowable levels. (Khalda A. Albdawai, 2017).

CONCLUSIONS

The present study is a trial to compare the results of some elements with the world's standard, as the Department of Environment, Government of Sudan has not yet established any standard for heavy metal content in agricultural soil. It is very necessary to establish a safe or standard limit for the concentration of heavy metal in soil. The elemental analysis of soil samples, collected from different sites in Blue Nile State, Sudan, was carried out using XRF technique, which provided concentration levels of different elements. The results show that.Fe, Cr, and W are the major emitted elements in study samples. Samples (8, 28, 15, 14, 13) show high concentrations of Fe. 914.700, Ni.46.200, Cr.728.000, V.13, 100 and W. 114.500 mg/kg-1, respectively.

Table 1: Concentration (mg/kg-1) of Some Elements of Soil Samples from Different location, Blue Nile State, Sudan

No	Location	Metals Concentrations (mg/kg^{-1})							
		Fe	Ni	Cr	CO	V	W	Ti	Al
1	Village 8	890900	6400	1500	ND	4900	55600	ND	ND
2	Elbangded	18.800	100	700	ND	ND	ND	ND	ND
3	Rewina	11.900	100	100	ND	ND	ND	ND	ND
4	El Shaheed	10.500	100	100	ND	ND	ND	ND	ND
5	Elnhda	18.700	100	400	ND	ND	ND	ND	ND
6	Elgri	580.90	6.10	539.80	8.000	1.100	2.500	600	ND
7	Elsora	869.40	4.00	ND	ND	7.700	91.600	ND	ND
8	Agdi	914.70	11.40	ND	ND	5.000	49.600	ND	ND
9	Elseka	13.700	100	400	ND	ND	ND	ND	ND
10	Village 60	908.60	ND	500	ND	12.40	55.500	ND	ND
11	Ganes west	859.60	3.800	300	ND	11.70	88.600	ND	ND
12	Omjmina	11.800	100	1700	ND	ND	ND	ND	ND
13	Arkwet	863.60	2700	ND	ND	8.000	114.50	ND	ND
14	Elnsr east	888.90	6.100	100	ND	13.10	65.600	ND	ND
15	Menza	272.00	ND	728.00	ND	ND	ND	ND	ND
16	Elryad	11.500	100	400	ND	ND	ND	ND	ND
17	Magnza	514.80	14.60	591.20	5.500	1.600	3.200	ND	ND
18	Abuhshem	902.30	7.100	1.800	ND	8.900	60.000	ND	ND
19	Elkrmuk	326.00	ND	673.00	ND	ND	ND	ND	ND
20	Bant	888.70	3.200	400	ND	8.800	70.300	ND	ND
21	Elrusers W	853.80	7.100	300	ND	7.200	111.80	ND	ND
22	Babnosa	862.40	7.000	4.300	ND	5.700	91.600	ND	ND
23	Elgasm	900.20	4.000	300	ND	4.800	54.900	ND	ND
24	Ganes east	882.30	ND	260	ND	4.400	69.800	ND	ND
25	Elfrdos	840.70	ND	320	ND	8400	111.00	ND	ND
26	Elrosers E	896.90	2600	160	ND	6.500	57.700	ND	ND
27	Elsrawa	909.50	ND	ND	ND	6.500	62.300	ND	ND
28	Darang	474.80	46.20	555.10	8.000	2.700	132.00	2.80	ND
29	Elagager	8.200	100	400	ND	ND	ND	ND	ND
30	Alzihar	16.300	100	400	ND	ND	ND	ND	ND
Average		**547,40**	**4.440**	**103.40**	**70**	**4.310**	**40.976**	**11**	**ND**

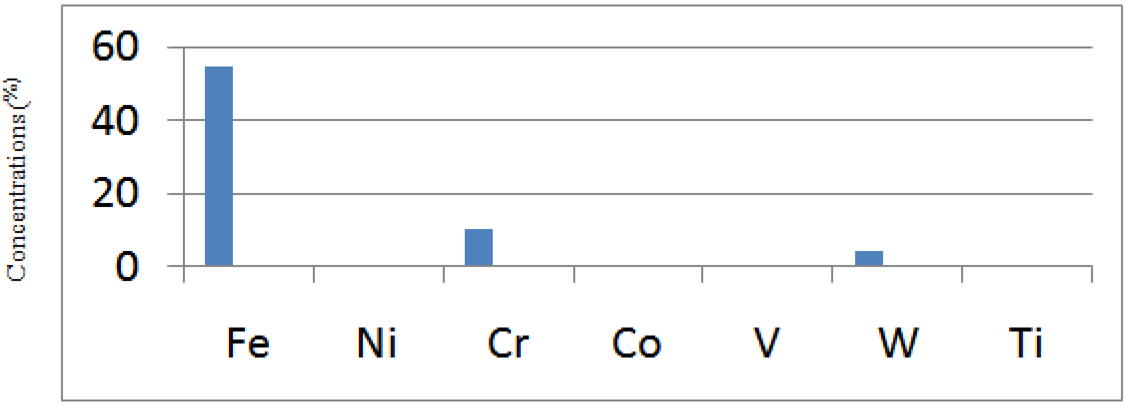

Figure 1: Concentration (mg/kg-1) of Some Elements of Soil Samples from Different Locations, Blue Nile State, Sudan.

Table 2: Comparison of the Trace Elements. Concentrations (in mg/kg) for Studied Samples with other Studies from Different Locations of the World

Element	Ali, A.H2014	ElBahi, *et al.*, 2013)	Ajayi, 2014)	(Alshayeb, 2012)	(Dingjian,2012)	(Elbagermi *et al.*, 2013)	(Vandana *et al.*, 2011)	(Adriano, 2001)
Cr	11-46	23-203	2.42	1.20	27.68	19.7	12.3-480.6	10-50
Ni	45-134	14-18	0.22	1.14	-	22.5	12.6-132.0	10-50
Cu	21-77	43-52	2.71	2.22	23.20	32.1	11.1-186.6	10-40
Zn	14-86	27-33	8.33	4.25	47.18	67.5	40.8-882.2	20-200
Zr	111-320	98-737	-	-	-	-	-	-
Rb	16-35	18-25	-	-	-	-	-	50
Pb	13-33	u.d-2	4.58	3.9	23.15	2.25	42.9-1832.5	10-30
Co	9-34	-	1.39	-	-	-	-	8
Cd	4-20	27-32	0.28	-	-	29.1	-	1.0
As	2-10	-	-	-	0.13	-	-	6

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