EVALUATIONOF THE CONCENTRATION OF THETRACEELEMENTSINSOIL SAMPLESFROM RIVERS INTHE KHARTOUM STATEIN SUDAN

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Abstract: This study aims at a systematic measurement of the trace elements concentration in the soil samples for the three rivers in Khartoum (the capital of the Sudan country) state: the Blue Nile , White Nile , Nile river and Tuti island river sides. XRF technique was used to analyze these samples. The Results showed that the Blue Nile has the most highest elements concentration than the White Nile, Nile river and Tuti island. These elements were K, Ca, Mn, Fe, Cu, Sr, and Pb with concentrations (17085,31491, 2252, 99759, 17, 406, 50) / ppm, respectively. And the concentration of the elements at east side of the Nile river was higher than the west side, which indicated that Blue Nile deposited most of the elements, confirming that the source of these elements belong to the origin of the Blue Nile at Lake Tana in Ethiopia country.

Keywords: Trace element concentration · XRF · River Nile

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1 Introduction

Pollution is defined as any physical, chemical, biological / biological change in the air, water or soil, resulting in adverse effects on human health. This is in addition to its qualitative or quantitative influence on the components of environment, which leads to imbalance in the ecological balance. Environmental pollution by trace elements has become a great concern in recent decades, which explains the increasing research involving control and clean-up operations of polluted sites (e.g of recent works are [1–3]). In order extend such kind of investigation to regions where systematic report about the trace elementsare lacking, this work has focused on the investigation of the trace elements in important rivers in the capital Khartoum (Sudan country). These are the Blue Nile and White Nile that are merged in Toti Island to create the Nile river. The Blue Nile originate from Tana Lake in the Ethiopia, while White Nile comes from Lake Victoria - in Kenya. In fall season the water level of the three rivers is increasing due to rainfall in the Ethiopian and southern of the Sudan, leading to the speed of movement of water which carries a mud that spreads outside the course of the rivers and deposits over large areas away from the rivers edges. The nature of the soil in Ethiopia and Kenya which Blue Nile and White Nile come from are different from the nature of soil in the state of Khartoum. This study was conducted to evaluate the difference in the soil components of the elements, because these areas are used in agriculture. X-ray has widespread application in the analysis of geological materials, steels, cements, archaeological samples, forensics samples and environmental samples. X-ray Fluorescence (XRF) a

common technique used in this area too, which can be used to analyze almost any element from Na to U, including non-metal ([4,5]). Background concentration of trace elements in soil are important due to recent interest in potential contamination and toxic effect of these elements on humans and the environment ([6,7]). Soils vary across the landscape, therefore each soil contains unique trace elements concentration based on its parent material and other soil forming factors that may have added or removed these elements from the soil ([8–12]).

2 Sampling and samples preparation

Soil samples were taken from the edge of the three rivers in Khartoum state as shown by the bold red line in Fig. 1 at both sides (East and West sides) as well as from the soil that was under the rivers water. Additionally, samples far from the rivers (3-5) Km (Fig 1(b)) were also collected. These samples were homogeneously dried by heating at 100°C for two hours, and then ground to powder form. Then they were pressed into pellet form of one inch diameter and about 1gr mass, using a pressing machine at 15 ton. The samples were then weighed and measured by XRF.

3 Results and discussions

The Results are discussed with reference to the concentration data for the soil elements listed in Table 1. The highest elements concentration found in Nile river are: Cr for soil at east side, Ni and Zn under the river water with concentration (720, 54 and 136) ppm respectively, as also shown in Fig. 2(d), 2(i) and 2(k). For Blue Nile the highest elements concentration are K, Cu, Sr and Pb for soil at east side with concentration (17085, 17, 406, 50) ppm respectively. While Ca ,Mn and Fe recide in the soil under the river water with concentrations (31491, 2252 and 99759) ppm, respectively. All these arealso indicated in Fig. 2 for the respective elements. In

White Nile the highest elements concentration are Co and Zr under the river water, in addition to Br and Rb at the west side with concentrations (48, 9, 68 and 564) ppm respectively (see Fig. 2, for the respective elements). For Toti Island the highest elements concentration measured was Ti with the concentrations 20848 ppm as shown in Fig. 2(c) for the south direction. Therefore, Blue Nile and Nile River at east side has more elements with the highest concentrations than White Nile. Our results are consistent with previous studies ([13–15]), however, our work are more systematic and quantitative.

4 Conclusion

Systematic measurement of the trace elements concentration in the soil samples for the three important rivers in Khartoum (the capital of the Sudan country) state: the Blue Nile , White Nile , Nile river and Tuti island river sides. XRF technique was used to analyze these samples. The Results showed that the Blue Nile has the most highest elements concentration than the White Nile, Nile river and Tuti island. These elements were K, Ca, Mn, Fe, Cu, Sr, and Pb with concentrations (17085,31491, 2252, 99759, 17, 406, 50) / ppm, respectively. And the concentration of the elements at east side of the Nile river was higher than the west side, which indicated that Blue Nile deposited most of the elements, confirming that the

source of these elements belong to the origin of the Blue Nile at Lake Tana in Ethiopia country.

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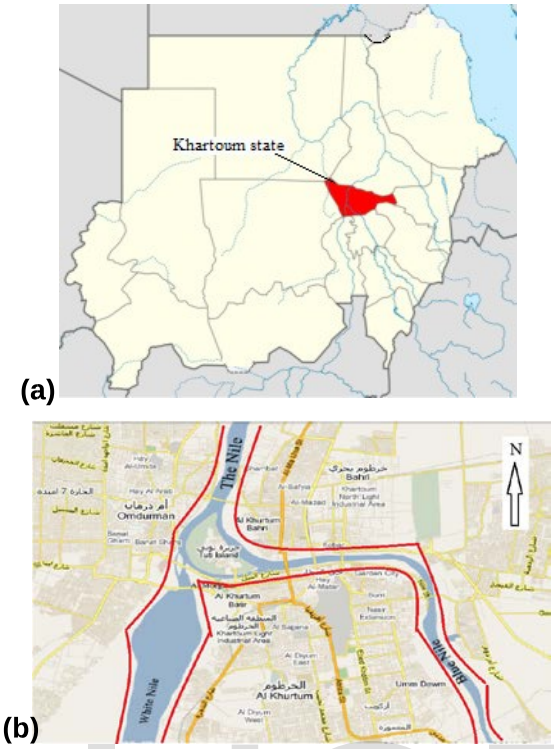

Fig. 1 (a)Sudan map, and Khartoum state with red color (b) The Khartoum state where the sample locations are indicated with red color

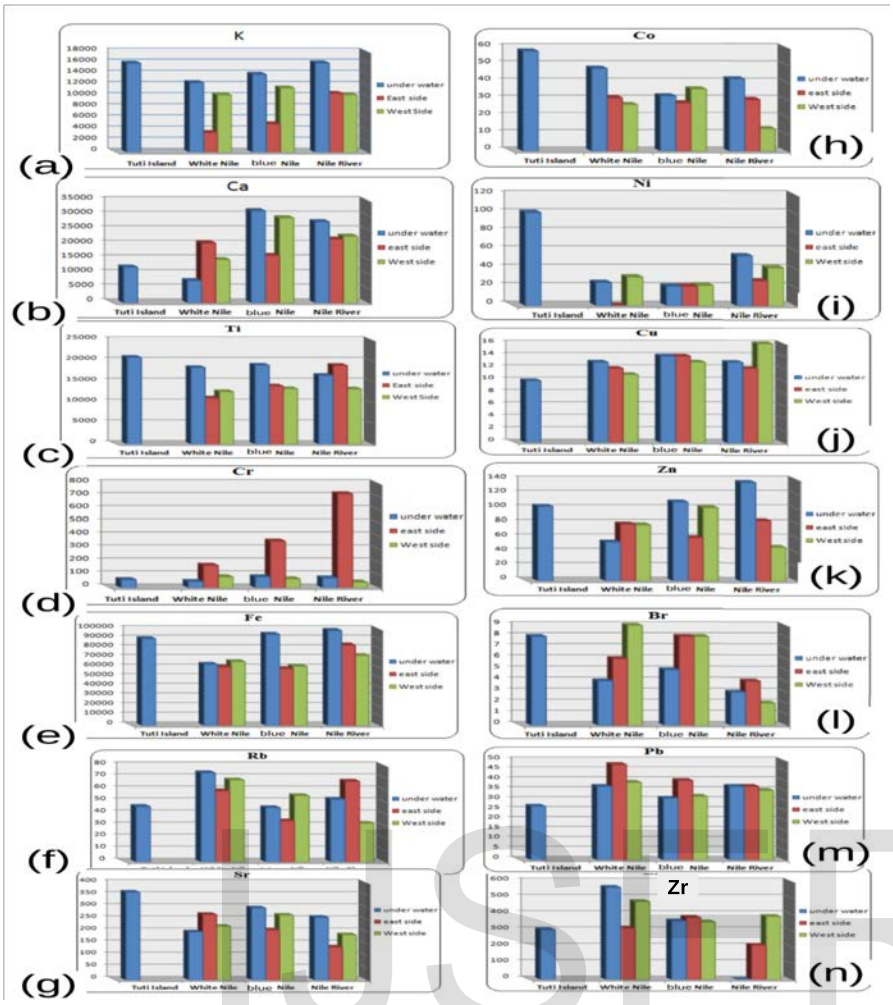

Fig. 2 Bar plots of the elements concentrations in soil samples in ppm corresponding to Table 1

Table 1 The concentration of Elements in soil samples /ppm

Element	Tuti Island	White Nile	Blue Nile	Nile River	Location
		Concentration / ppm			
K	15966	12490	13953	16008	Under the river water
		3528	17085	10532	East Side
		10263	11529	10285	West Side
Ca	12211	7581	31491	27778	Under the river water
		20478	16203	21781	East Side
		14774	29084	22804	West Side
Ti	20848	18404	18964	16488	Under the river water
		11050	13959	18891	East Side
		12588	13300	13231	West Side
Cr	63	48	84	75	Under the river water
		173	360	720	East Side
		84	68	43	West Side
Mn	1019	1262	2252	2084	Under the river water
		679	918	1923	East Side
		1156	942	1332	West Side
Fe	90215	63564	99759	98678	Under the river water
		60763	59030	83615	East Side
		66347	61478	72624	West Side
Co	58	48	32	42	Under the river water
		31	28	30	East Side
		27	36	13	West Side
Ni	101	25	21	54	Under the river water
		0	21	27	East Side
		31	22	41	West Side
Cu	10	13	14	13	Under the river water
		12	17	12	East Side
		11	13	16	West Side
Zn	103	54	109	136	Under the river water
		79	60	84	East Side
		78	101	47	West Side
Br	8	4	5	3	Under the river water
		6	8	4	East Side
		9	8	2	West Side
Rb	46	74	45	52	Under the river water
		59	34	67	East Side
		68	55	32	West Side
Sr	362	198	497	258	Under the river water
		270	206	135	East Side
		221	267	186	West Side
Zr	305	564	359	1	Under the river water
		315	380	210	East Side
		477	353	386	West Side
Pb	27	37	31	37	Under the river water
		48	50	37	East Side

39	32	35	West Side