

## The Relationship between Radiation Backgrounds and Concentration of Elements in Ore (in Northern Sudan)

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**Abstract:** The main objective of this study is to find the relationship between radioactivity (radiation background) and the concentration percentage of the chemical element found in the soil. This study included some plant and soil samples taken from the study area in north Sudan and some other samples from another area, chosen as a reference area, and this area is Tuti Island (in central of Khartoum) during summer times of the year 2007. These samples were analyzed using XRF in order to determinate the elements and the concentration of these elements in the samples. A radioactivity survey was also made for the two areas (i.e. the study & reference area) using GM counter, where the readings taken from the study area were found to be higher than the other area. A comparison of the elements and their concentration were also made in the two areas. The results concerning most of the soil samples used in this work showed that (Ti) is the element of the highest concentration with percentage ranging between 575820.65 ppm and 2430189.58 ppm. In the other hand, the elements of the lowest concentration were Br, Y and Pb; with concentrations of 37.27 ppm, 125 ppm and 149.45 ppm respectively. The results that concerns the plant samples showed that the element found as a common, and its concentration was the same in the two areas. The only difference was in the lowest concentration elements such as Ca, Fe, and K with concentrations of 132685.71 ppm, 303417.72 ppm and 25696.20 ppm respectively. The results of the present study were subsequently compared with international and national recommended values.

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### 1. Introduction

Natural radiation is largely caused by the presence of primordial radionuclides and their decay products. Previous investigations reveal that the sources of radiation could vary from place to place but the dose rate generally falls between 80 and 150 nGy hr<sup>-1</sup> world over (UNSCEAR,2000), (UNSCEAR, 1993). However, there are areas in some part of the world wherein the background radiation levels have been found to be abnormally high. Such areas are referred to as High Background Radiation Areas (HBRAs). Accordingly, the coastal regions of Espirito Santo and the Morro Do Forro in Brazil (Paschoa, 2000), Bennett,1997), Yangjiang in China (Wei and Sugahara,2000), Wei et al,1993) Southwest coast of India Paul et al,1998), Mishra, 1993), Sunta, 1993), Sunta et al,1982) Ramsar and Mahallat in Iran (Sohrabi. 1998) are identified as HBRAs. Monazite sands were found to be the source of such high background radiation levels in certain parts of Brazil, China, Egypt and India (Ghiassi-nejad et al, 2002). While in parts of Southwest France, uranium

minerals form the source of natural radiation, and in Ramsar, the very high amounts of <sup>226</sup>Ra and its decay products brought to the surface by hot springs (Ghiassi-nejad et al, 2002) have been found to be the source.

### 2. Material and Methods

The radiation background was measured by using GM counter in Tuti, Mora, El-Hogeir, Tengasi and El-Burkul, during the summer times of the year 2007.

The concentration of natural elements in soil and plants was determined using XRF instrument. The concentration of elements in water was taken from AFRO ARABIA GROUND WATER COMPANY Ltd.

#### Sampling and sample preparation:

Soil and plant samples were taken from the same points. Soil samples were taken from 30 cm depth from surface. Both samples were dried, grinded and sifted before measured.

### 3. Results

Table below shows that the concentration of elements in water for some places in and around the study areas.

Element	Conc. ppm			
	Mora	El-Hogeir	Tengasi	El-Burkul
Ca	45	30	45	15
Mg	30	20	30	40
Cl	10	30	250	40
SO <sub>4</sub>	30	40	105	Nil
NO <sub>3</sub>	30	Nil	Nil	Nil
NO <sub>2</sub>	Nil	Nil	Nil	0.6
F	Nil	0.5	0.4	Nil
N	0.8	Nil	Nil	Nil
O	-	-	180	-
As	Nil	Nil	-	Nil
Pb	0.2	Nil	Nil	Nil
Na	Nil	Nil	Nil	Nil
K	Nil	Nil	-	Nil
Fe	-	-	5	-

Analysis results revealed that the highest concentration element in Jew's mallow soil is Fe (154284.56 ppm) and the lowest concentration element is Br (75 ppm). In Gumbo's soil, the highest concentration element is Ti (2430189.58 ppm) and the lowest concentration element is Y (163.31 ppm). But in Berseem's soil the highest concentration element is Ti (1912390.23 ppm) and the lowest concentration element is Pb (149.45 ppm). Also in Watercress's soil the highest concentration element is Ti (1857374.04 ppm) and the lowest concentration element is Br (37.27 ppm). In Tuti Island soil the highest concentration element is Ti (1087147.51 ppm) and the lowest concentration element is Y (125 ppm). But in El-Burkul mountain soil the highest concentration element is Ti (575820.65 ppm) and the lowest concentration element is Br (133.86 ppm).

About the plants in northern the most concentration element to the Jew's mallow plant is Ca (134448.98 ppm), and the lowest concentration element is Mn (39.36 ppm). In Gumbo plant the highest concentration element is Fe (303417.72 ppm), and the lowest concentration element is Mn (15.86 ppm). With Beam plant the highest concentration element is K (273037.97 ppm), and the lowest concentration element is Mn (69.47 ppm). And about Watercress's plant the most concentration element found was K (435569.62 ppm), and the lowest concentration element is Mn (23.35 ppm).

Tuti's Island plants the most element concentration found in Berseem plant were Ca (132685.71 ppm), and the lowest concentration element in Mn (17.03 ppm). In watercress's plant the highest concentration element is K (25696.20 ppm)

and the lowest concentration element is Mn (19.53 ppm).

### 4. Discussions

The results thus obtained revealed a complete similarity of the compaction of the soil element of the Arable Land in Northern Province. In comparison with rates compactness of the plant element grown there in, the joint shared elements are:

Cr is highly correlated with Fe and Mn. Fe is highly correlated with Mn. Rb is highly correlated with Y.

The difference between the element of the Arable Land and the plants element grown in the Northern Province are:

Plant's soil	Plant
Ca-Br-Zr-Nb	-

A comparison of the Arable soil with soil of the Northern Province of Burkul Mountain, the joint common elements are:

Cr is highly correlated with Fe and Mn. Fe is highly correlated with Cr. Mn is highly correlated with Cr and Fe. Rb is highly correlated with Y.

The difference between the elements of the Arable soil and those of Burkul Mountain are:

Plant's soil	Burkul Mountain soil
-	Ca-Br-Zr-Nb

The difference shows that the existence of Ca in the soil of the Burkul Mountain soil.

Thus the compact elements of the Arable Land in Northern Province are the same compact element found at Tuti Island.

The compact shared elements between the soil of Tuti Island and Burkul Mountain are:

Cr is highly correlated with Fe and Mn. Fe is highly correlated with Cr. Mn is highly correlated with Cr and Fe. Rb is highly correlated with Y. Y is highly correlated with Sr.

But the difference between the element of the Tuti's Island soil and Burkul Mountain are:

Plant's soil	Burkul Mountain soil
Zn	Ca-Br-Zr-Nb

The common compact element between the Tuti's Island plants and Northern Province are:

Cr is highly correlated with Fe, Cr, Zn and Mn. Fe is highly correlated with Cr, Pb, Sr and Zn. Mn is highly correlated with Cr, Sr, Zn and Fe. Rb is highly correlated with Y and Sr. Y is highly correlated with

Sr. Pb is highly correlated with Fe. Sr is highly correlated with Pb, Zn and Y. Ti is highly correlated with Sr. Zn is highly correlated with Cr, Fe, Mn and Sr.

It is revealed that there are no separate elements in the plants of a region that are not found in the other.

All elements are found in the study area (Northern Sudan) are also found in the reference area (Tuti Island). The only difference that was found in the concentration of these elements in both areas and this is related to the nature of each area. And so, there is no danger for people.

The concentration percentage of the elements in the plantation for both areas is equal, and this can be true for the water found there.

The results obtained from the present work provide additional data on Radiation Backgrounds and Concentration of Elements in Ore (in Northern Sudan), For the radioactivity survey, the highest reading found in the study area (80 -100) CPM, when comparing it with reading taken from reference area (8 - 10) CPM. And this increases the conclusive that some elements have high degree of concentration in the study area, for example: Mn, Sr, Y, Zr, Ti, K, Co, and Ca, and which some of them have a relationship with radioactivity such as Sr, y, K, Co and Ca.

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