Faculty of wamen for Art,
Science and Education,
Ain Shams University

"Assessment of natural radioactivity levels and radiation hazards of radionuclides released from granite and different sedimentary rock types"

By

Asma mohammed abdulrahman osman

Thesis
Submitted in Partial Fulfillment for the Ph.D.
Degree in Nuclear Physics

To
Physics Department
Faculty of women for Art, Science and
Education, Ain Shams University

M.Sc. Degree in Nuclear Physics, 2010

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To my lovely kids May God protects you

Asma

To the Spirit of my Father

To My Mother,

my Brothers and Sisters.

Asma

ABSTRACT

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Eighteen samples of sediments from Um Bogma, South western Sinai and twelve granite samples collected and from Gabal Gattar, North Eastern Desert in Egypt have been investigated. This work has stressed on the distribution of radionuclides and their ratios in the three phases; original sample, leachate and residual. The concentrations of trace and major elements were determined to compare with the radionuclide, distribution. These have been done throw three stages:

- First stage; radiometric analysis using Hyper Pure Germanium detector for different radionuclides and their isotopes and daughters.

- Second stage; chemical analyses of uranium after Leaching experiments for the choice samples to follow the behavior of radionuclides in different media (original, leachate and residual).

- Third stage; determination 0f trace elements using X-ray fluorescence.

In first stage: Concentrations of radionuclides in sediment and granite samples were determined by γ-ray spectrometer using HPGe detector with a specially designed shield. The value of uranium was high in sediments and granite samples where the value of ^{40}K in granite was higher than that in sediments where it depends on the chemical composition of rock types. The absorbed dose rate ranged from (419 to 3908) nGy/h for sediment samples and from (1002 to 1307) nGy/h for granite samples. The representative external hazard index values (Hex) for sediment and granite samples were estimated. In the present work, the state of radioactive disequilibrium in the U-series at Um Bogma and Gabal Gattar area were studied. The activity ratios between

$^{214}Pb/^{226}Ra$, $^{214}Pb/^{214}Bi$ and $^{226}Ra/^{238}U$ were calculated. The thorium to uranium concentration ratios (Clark value) was also estimated. The total excess life-time cancer risk (ELCR) was measured.

In second stage: The residual, produced from leaching processes, constitute most of the original rock materials and contain most of the radioactivity emitted from ^{226}Ra and its daughters ^{222}Rn, ^{214}Pb and ^{214}Bi. Six different rock samples (four sediments and two granites) were subjected to sulfuric acid leaching with the same parameters of solid-liquid fluid ratio (S / L), acid concentration and leaching time. After the leaching process, the solution was separated from the residue and the latter was dried. The two units, namely the solutions (leachate), and residues were measured by the germanium detector to determine the activity concentration (Bq / kg) of different radionuclides in the two units of the six samples. The results showed that the relationship between the total activities of solution and the residual have three categories. In the first one for sediment samples, the activity of solution + residual was 72.37% from the original of siltstone (3S), the activity of solution + residual was 90.02% from the original claystone sample (17S), the activity of solution + residual was 92.6% from original of shale (2S), the activity of solution + residual was 74.07% from original claystone (7S). In the second for granite samples, the activity of solution + residual was 130.39% from original (2G) and the activity of solution + residual was 142.3% from original (5G). These variations depend mainly on the grain surfaces in the different rock types. This phenomenon varied in magnitude within the different radionuclides in each sample. Also the leachability of U by the chemical analysis using several acidic leaching experiments for uranium have been performed by sulfuric acid. The measurements of leaching efficiency% of

uranium by using HPGe detector, we found the values of leachability are almost equality.

In third stage; Trace elements in the studied samples were determined, by using a Philips X-ray unit. These analyses have revealed the presence of interesting values of REEs and U; namely more than 500 and 250 ppm respectively. While the uranium chemically recorded about 240 ppm for (3S), the values of REEs and U which present in the sample (17S) are more than 1000 and 1020 ppm respectively, and the uranium chemically recorded about 420 ppm, for (2S) namely more than 500 and 1050 ppm respectively, while the uranium chemically recorded about 600 ppm, and finally (7S) more than 1000 and 300 ppm respectively, while the uranium chemically recorded about 300 ppm.

Contents

Chapter I
Introduction and Literature Review

Page

Chapter II
Geological setting and theoretical calculation