Ain Shams University
Faculty of Women for Arts,
Science and Education

"Behavior of radionuclides in uranium series and associated trace elements for some phosphate rocks"

By

Naima Almbrouk Salem Alkbashy

Thesis

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

To
Physics Department
Faculty of Women for Arts, Science and Education, Ain Shams University

M.Sc. in Physics, 2010

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Supervisors

Prof .Dr Ibrahim E. El Aassy
Prof. of Nuclear Ore Materials,
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Prof. Dr. Amany Taha Sroor
Prof. of Nuclear Physics, Faculty of Women for Art, Science and Education, Ain Shams University.

Prof. Dr. Nadia El_sayed Walley El-Dine Fouad
Prof. of Nuclear Physics, Faculty of Women for Art, Science and Education, Ain Shams University.

Prof. Dr. Enass M. El Sheikh
Prof. of Ores Processing Nuclear ,
Nuclear Materials Authority.

Dr. Eman Samir Abd-El Moaty Abd-El Halim
Lecture of Nuclear Physics, Faculty of Women for Art, Science and Education, Ain Shams University.

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Faculty of Women for Arts,
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Approval sheet

Student Name : **Naima Almbrouk Salem Alkbashy**

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- **Prof. Dr. Nadia El-sayed Walley El-Dine Fouad**
  Prof. of Nuclear Physics, Faculty of Women for Art, Science and Education, Ain Shams University.
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  Prof. of Ores Processing Nuclear , Nuclear Materials Authority.
- **Dr. Eman Samir Abd-El Moaty Abd-El Halim**
  Lecture of Nuclear Physics, Faculty of Women for Art, Science and Education, Ain Shams University.

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Post Graduate Studies Department
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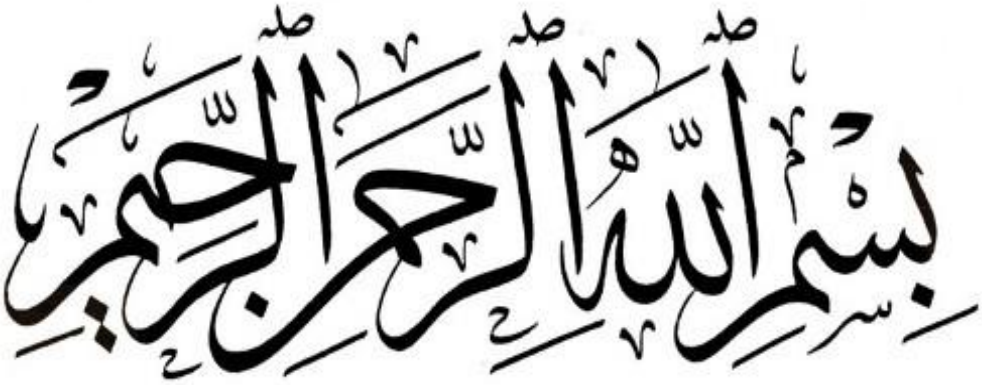
بسم الله الرحمن الرحيم

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

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Naima

I WOULD LIKE TO DEDICATE

THIS THESIS TO
THE SPIRIT OF MY PARENTS

AND
MY LOVELY DAUGHTERS

MY HUSBAND , MY BROTHERS AND SISTERS

MAY GOD PROTECTS THEM

Naima

Abstract:

The principal aim of this study is to examine the mobility of uranium and their isotopes and daughters during the acid leaching of phosphate samples, the distribution of radionuclides and their ratios (the daughter /parent) in the three phases ; original, leachate and residual of the samples. Ten samples were collected from El-Quseir- Hamrawein – Safaga , (in Red Sea Coast) Egypt. Locations as in figure (2 -3). A total of twelve samples, were collected from Sibaiya area is located (in Nile Valley) , Egypt .

In the first stage; measuring the natural radionuclides in the original samples by using Hyper Pure Germanium detector with high resolution. The work showed that the activity concentrations of ^{238}U,^{226}Ra , were higher than the permissible level , while the activity concentrations of all studied phosphate samples for thorium ^{232}Th and potassium ^{40}K are lower than the permissible level in the two localities (Red Sea Coast and Nile Valley).The thorium to uranium concentration ratios (Clark value) was also estimated. The activity ratios $^{234}U/^{238}U$, $^{230}Th/^{238}U$, $^{230}Th/^{234}U$, $^{226}Ra/^{238}U$, $^{238}U/^{235}U$ and $^{234}U/^{235}U$ were studied to estimate the radioactive equilibrium /disequilibrium in the two localities. In this work, the radium equivalent (Ra_{eq}) in Bq/Kg, radioactivity level index (I_{γ}) , external hazard index (H_{ex}), the absorbed dose rate (D) and the annual effective dose (AED) in an outdoor environment were estimated. The total excess life-time cancer risk (ELCR) was measured, it is found to be higher than the permissible level in the two localities. The radon mass exhalation rate and the radon emanation factor have been calculated for the two localities.

In second stage; Three different phosphate rock samples (two from El-Quseir - Safaga and one from Sibaiya area) were choiced and subjected to acid leaching by two Acids: Hydrochloric (HCl) and Nitric (HNO_3) **,** 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 by the filtration process and then the residue was dried. The activity concentration (Bq / kg) of different radionuclides for the pregnant solutions (leachate) and residues of the three choice samples by two acids (HCl and HNO_3) were measured by the Germanium detector. The activity ratios are also studied for both

solutions and residues. The behavior of radionuclides (uranium isotopes) during the acid leaching process, the ^{238}U and ^{235}U are leached to the same extent, but the similarity is not observed for ^{234}U. The behavior of radionuclide ^{40}K during the acid leaching process, concentrated in the residuals and pregnant solutions in very large quantities compared to the original. Radium equivalent Ra_{eq}, radioactivity level index I_{γ} , external hazard H_{ex} , the outdoor absorbed rate D , outdoor annual effective dose AED in the residuals and solutions have been calculated for the two localities.

In the third stage; From the chemical analysis by using (XRF) for determination of the distributions components major oxides and trace elements in the three choice samples, the samples have high level of CaO , P_2O_5 and L.O.I compare with the other major oxides .

Contents

Chapter 1
Introduction and Literature Review