Ain Shams University
Faculty of Science
Geology Department

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Uranium Potentiality of the Upper Carboniferous Sedimentary Rocks, Wadi Araba, West Gulf of Suez, Egypt

A Dissertation
Submitted for the Degree of Doctor of Philosophy in Geology

Presented By:
Mohamed Metwaly Hassan Ali

Assistant Researcher of Geology, Research Sector,
Nuclear Materials Authority (NMA)

Supervised by

Late Prof. Dr. Mohamed Ismail El Wakeel

Prof. of Geology
Faculty of Science
Ain Shams University

Dr. Ashraf Rushdi Baghdady

Assistant. Prof. of Geology
Faculty of Science
Ain Shams University

Prof. Dr. Ibrahim El Qattany El Sayed El Aassy

Professor of Geology
Nuclear Materials Authority

Prof. Dr. Abdu Abd El Razek El Sayed

Professor of Geology
Nuclear Materials Authority

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Approval Sheet

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By:

Mohamed Metwaly Hassan Ali

B. Sc in Geology, South Valley University (1997)
M. Sc. in Geology, Ain Shams University (2011)

To:

Ain shams University, Faculty of Science,
Geology Department

Advisors	***Approved***
Late Prof. Dr. Mohamed Ismail El Wakeel Prof. of Geology, Faculty of Science, Ain Shams University	…….
Dr. Ashraf Rushdi Baghdady Ass. Prof. of Geology, Faculty of Science, Ain Shams University	…….
Prof. Dr. Ibrahim El Qattany El Sayed El Aassy Professor of Geology, Nuclear Materials Authority	…….
Prof. Dr. Abdu Abd El Razeik El Sayed Professor of Geology, Nuclear Materials Authority	…….

Qualification

Name: Mohamed Metwaly Hassan Ali

Scientific Degree: B.Sc. (1997) M.Sc. (2011)

Department: Geology

Faculty: Science

University: Ain Shams

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DEDICATION

For my *loving family*

Memory of my *father*

My *mother*

My *wife* and *sons*

My *brother* and *sisters*

ABSTRACT

The main aim of the present thesis is studying the geology, petrography, mineralogy, geochemistry and radioactivity of Late Carboniferous rock units in Wadi Araba. The results were used to shed more light on the radioelements distribution in the studied area with special emphasizes on uranium potentiality. The results based on the integration of various surface and subsurface geologic data in order to define the anomalous radiospectrometric zones in the study area, their distributions and their relations to lithology and structure. In addition, processed and mapped radiometric data were measured in the different rock units of the study area to show the distributions and intensities of radioelement anomalies.

In the present study, the member "V" of Rod El Hamal Formation is subdivided into three units and the Qiseib Formation is subdivided into two members. The microfacies analysis of the studied rock units revealed the presence of six lithofacies types indicating that the rocks were deposited under environment ranging from alluvial to shallow marine. The study area is affected by faults, joints and minor folds. The main faults have NNE-SSW, E-W and ENE-WSW trends. A comparative study dealing with the main directional trends and intensity of fault sets, wadi lines and joint sets show good statistical matching in some trends and no obvious relations in other.

The petrographical analysis indicates that the plutonic and metamorphic rocks and preexisting sandstone are the main provenances of the studied rock units, these provinces were affected by extensive chemical weathering. X-ray diffraction technique (XRD) and Scanning Electron Microscope (SEM) detected many non-radioactive and radioactive minerals in the studied samples.

The chemically analyzed samples indicate that the studied rock units were mainly altered and suffered from many stages of diagenesis. They are characterized by the dominance of SiO_2 and kaolinite but rarity of illite, K-feldspars and micas. The geochemical classifications of most samples according to Herron (1988) are mostly plotted around wacke and some around quartz arenite and lithicarenite. The studied sandstone is mature enriched in Na_2O relative to K_2O. The recorded CIA and ICV values suggest that the source rocks were mainly dominantly by feldspars and/or mafic minerals and subjected to moderately chemical weathering. The relationship between elements revealed that most of the studied samples were plotted in both the arid and semiarid climate fields. The

studied samples indicated that these sediments were deposited under marine conditions followed by fresh water. The provenance of these samples mainly consists of felsic and intermediate igneous rocks, partially mixed with sedimentary rocks. The investigated samples seem to be related to oceanic island arc provenance and active continental margin.

Rod El Hamal Formation has total gamma ray activity and radioelements concentrations higher than Qiseib Formation. Several radiometric anomalies recorded in the study area for the first time especially in shale, siltstone, marl and sandstone of Rod El Hamal Formation. The radioactivity of shale, siltstone and marl are higher than sandstone and dolomitic limestone. The majority of mineralization confined to altered shale and siltstone. Thorium displays high values relation to the uranium values (reach up thirteen times) and that indicates that uranium was leached from these sediments. Therefore, the measured of the radioactivity (especially uranium) of subsurface was carried out along the Wadis between Blocks.

Siltstone, marl and shale in MRS are subjected to intense alterations due to uranium migration-in than sandstone. The correlation between radioelements indicates that individual results for any one of the radionuclide concentrations in each pair are a good predictor of individual values for the other. The relation between thorium with uranium indicates that thorium was not enriched from the same source of uranium in the studied samples and thorium is mainly responsible for the high radioactivity spots of the studied selected area because the enrichment of eTh is the highest among the other radioactive elements.

The comparison between surface spectrometric contour maps and concentration of radon map (predicted by α-track technique) refer to the presence of subsurface radioactive mineralization. The relation between radon concentration and the height for detector in cylindrical chamber in the expected sources of radium gives the expected depth at this location is 22.59 m and the flux density for soil and air are 467.8 $x10^{-6}$ and 46.78 x 10^{-6}, respectively. Several mechanisms work in combination to give strong radon surface anomalies over deep sources. Among these mechanisms are type of the bedrocks, prospect source minerals of radon, structural elements and radioelements distribution.

Key Words: Late Carboniferous - Rod El Hamal Formation - Qiseib Formation - Wadi Araba - radioactive minerals - uranium potentiality - radioelements - α-track technique.

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