DETERMINATION OF URANIUM, THORIUM AND POTASSIUM CONTENTS IN SOME EGYPTIAN GRANITIC ROCKS APPLYING GAMMA RAY SPECTROMETRIC METHOD

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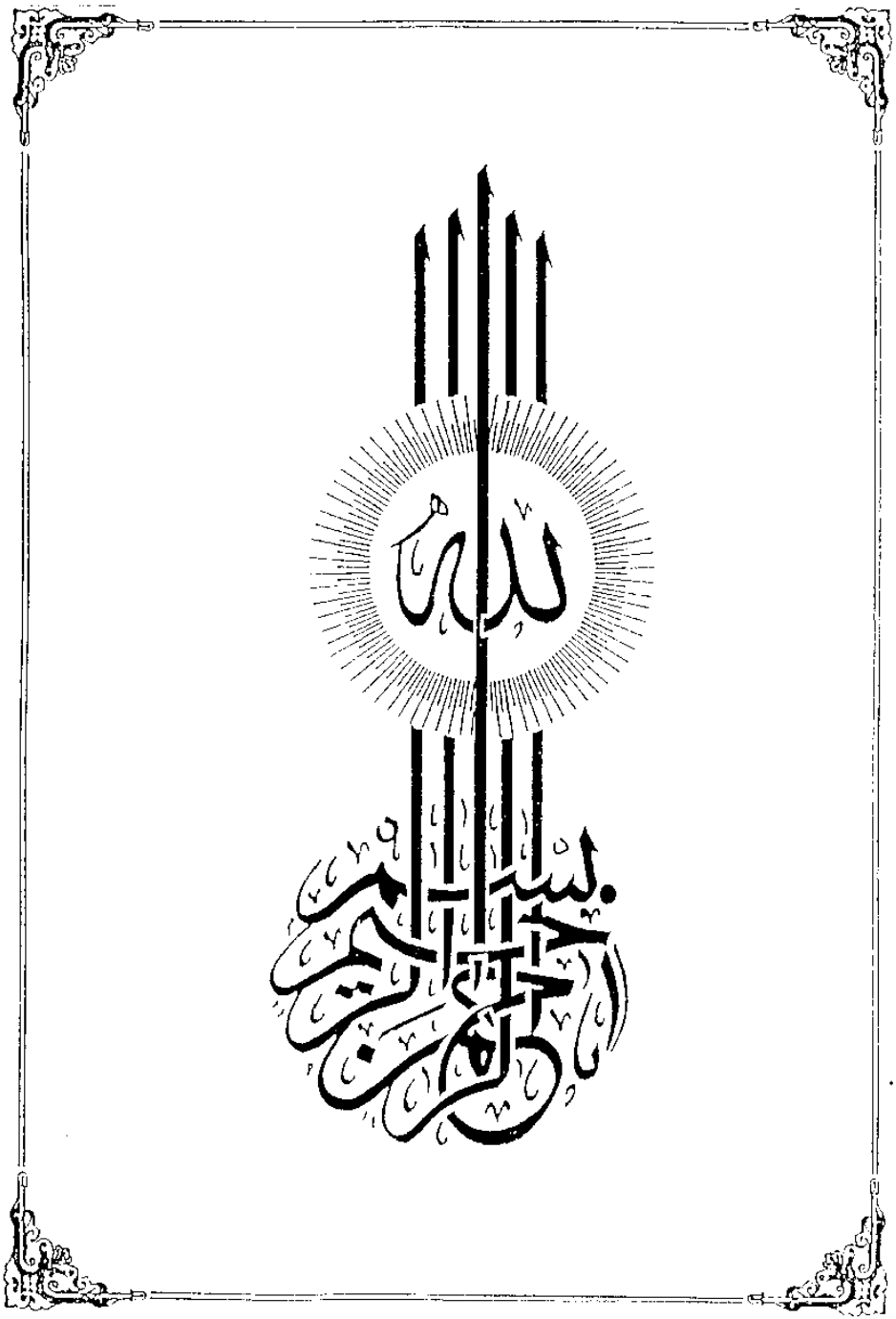


SUMMARY

Exploration for radioactive materials, is one of the main goals of gamma ray spectrometric techniques and so the principal objective of this work is to develop and apply a radiometric method in the search for radioactive resources, and to determine the U, Th and K contents in 200 Egyptian granitic rock samples collected from various localities in the Eastern and Western Deserts.

As U-238 and Th-232 are not gamma ray emitters, their determination could be indirectly achieved using the corresponding gamma ray emitting daughters Bi-214, Pb-212 respectively. The two energy peaks (609 Kev and 238 Kev) have been used for U and Th determination respectively, assuming that the two series exhibit secular equilibrium with their daughters in both standards and analysed samples. Measurement of uranium and thorium contents are carried out by using a computer scaler IDL-6000 single channel analyser and applying Hurely equations (1956).

In case of potassium a direct estimation has been achieved using the same gamma ray spectrometric technique after being adjusted for the 1.46 Mev gamma radiation following the K capture of potassium 40

Beside these studies, there are many other authors contributed to this field of research.

Gindy (1961) studied the radioactivity of some minerals using the nuclear emulsion technique. He determined the equivalent uranium content of some minerals such as garnet, microcline, oligoclase and muscovite from some pegmatites of Aswan area and found that it ranges between 1.04 and 7.01 ppm. In (1962) he determined the Th/U ratio in granitic rocks from Aswan by measuring the alpha radioactivity of the rocks using the same technique. Hassan (1964) studied the radioactivity of pegmatitic gneiss from Wadi Sikait using also the nuclear emulsion technique and found that the minerals responsible for the radioactivity are thorite, zircon and magnitite with radioactive inclusions. In 1963, El Sokkary found that pink-rosy granites and felsites have the highest radioactivity among basement rocks of west central sinai.

Abdel Gawad (1964a) studied the resinous uranium mineraloid at El Atshan locality and called it "Atshanite". The mineralogy, geochemistry and other aspects of the secondary uranium Atshan or material were discussed by Abdel Gawad (1964b).

Shehata (1964) carried out some field and laboratory studies on some granitic exposures and determined the equivalent U content on the basis of

total radioactivity measurement. He discussed the radioactivity related to different types of granitic and pegmatitic rocks and found that the pegmatite related to the pink granite can be considered as the most radioactive granitic rock. This higher radioactivity was attributed mainly to the oxyphilic character of uranium, to the tendency of both Th and U to concentrate in the residual magma and to the higher content of potash feldspar present in the pegmatite.

Hussein et al (1965 and 1966) studied the radioactivity of some granitic rocks in Egypt. In 1968 they published the results of some field radiometric investigations at Wadi El Kareim Wadi El Dabbah area. Among the host rocks for the radicactive minerals of uranium and thorium, the pink granites show high radioactivity (El Shazly et al, 1968) and their wide distribution in large bodies support their promising potential.

El Sokkary (1970) in his geochemical study of some Egyptian granites determined the U and Th contents of these rocks using gamma radiometric method . Gindy (1974) published some chemical analysis for the major and trace elements of some basement rocks including the coarse grained monumental granite of Aswan and correlated

these data with their alpha radioactivity.

Abdel Aziz (1975) studied the radioactive equilibrium in El Atshan locality, Eastern Dosert, Using a single channel analyzer and applying Hurley method (1956). Elshemi (1976) studied the radioactivity of Qatrani area using the same techrique .

Recently Nishimori et al (1977) in their report on the uranium deposits in granitic rocks reviewed the main characteristics and uranium potentialities of Egyptian granites which they considered as relatively enriched in uranium. El Kassas and El Amin (1980) considered that Aswan monumental granite shows uniform pattern of radioactivity distribution in the studied occurrences, ranging from 25 to 35 μR/h. However the radioactivity may be as low as 15 μR/h in some parts containing abundant xenoliths of older schists and gneisses. But in other parts the radioactivity may reach 60 UR/h, and this is mostly due to the presence of some dykes and veins and often pegmatite cutting the granitic masses. In 1981, El Sokkary and Abdel Aty determined the U and Th contents in Aswan granites by gamma radiation measurements. They found that the average thorium content is 35 ppm, the average uranium content is 16 ppm,

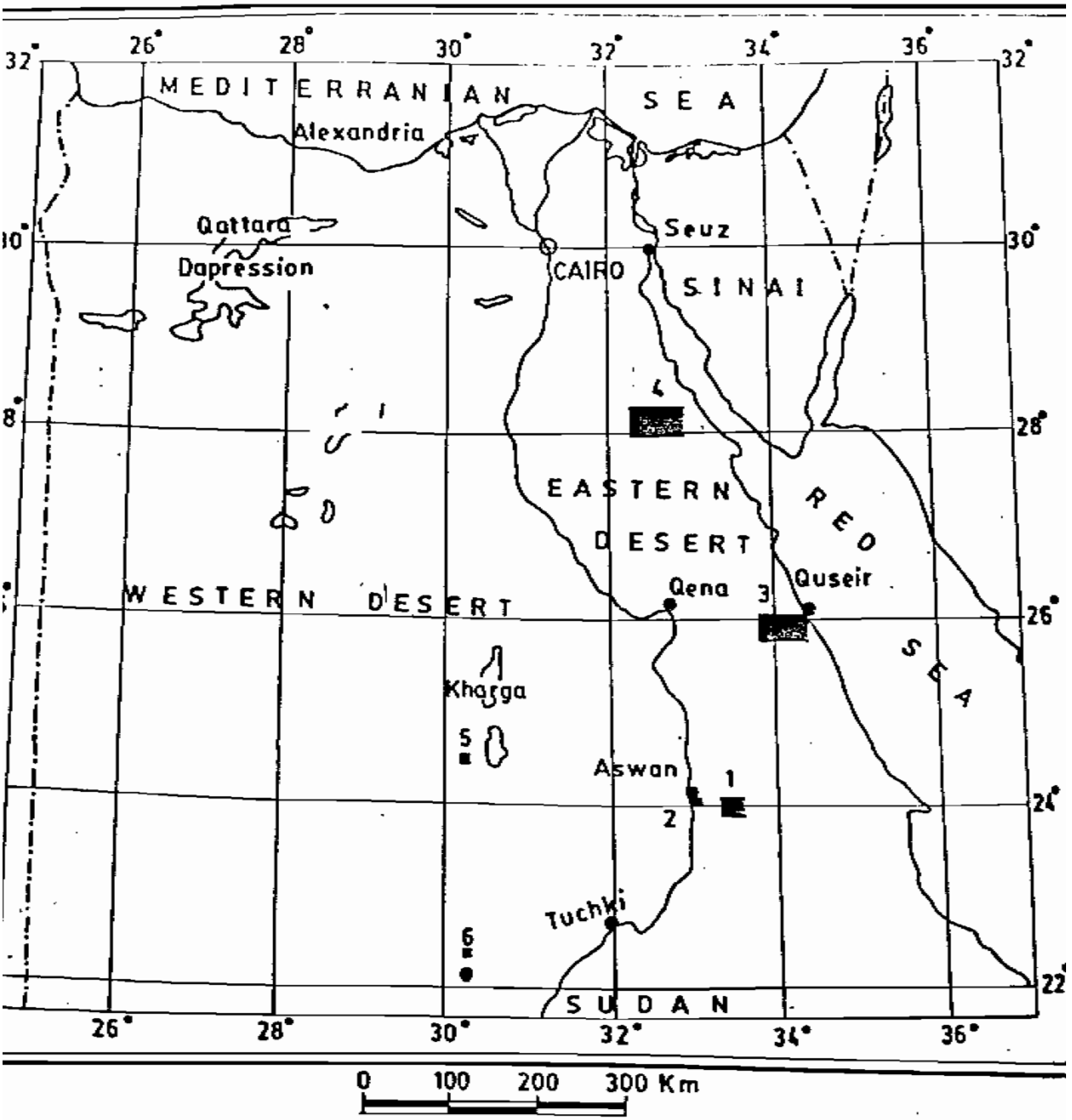
and the average Th/U ratio is 2.2. Also Abdel Meguid applied the same technique to determine the rock contents of uranium and thorium as a means of evaluating the radioactive anomalies in the field. Moreover, laboratory gamma spectrometric analyses were also carried out to control the field analyses and to ensure its suitability for evaluting the radioactive occurences. Finally Mansour (1981) investigated the relation between radioactivity and the geological features of Aswan type granite and associated rocks.

It is thus clear that among the studied rock units; the granites are found to be of interest since they are associated with some radioactive anomalies which are in general above normal radioactivity. Thus granitic rocks are given particular importance during this work.

Accordinly, the aim of the present work is to apply gamma- radiometric technique in the search for radioactive materials resources. Thus 200 samples representing various types of acidic igneous rocks have been collected from different localities in the Eastern and Western Deserts of Egypt, and U, Th and K contents were determined radiometrically. This was carried out by measuring the gamma activity at three selected gamma energies related to U,Th and K-40.

Data are statistically treated inorder to define normal and abnormal distributions of the different radio elesments in each rock type. Computation has been carried out for each group for the contents of U, Th and K. Comparison of these groups of rocks is intended to check whether there is a trend of radioactivity enrichment or not. Discussion of data on maps will eventually help in making some interpretation spatial distribution of radioelements. Sampling areas are shown on the key map Fig(1). From each a set of samples are collected, described and measured radiometrically in situ and sent for laboratory analysis for Th, U and K, applying gamma ray spectrometric method.

The results are discussed on maps with symbolic definition of normal back ground and abnormal values for each radioelement in a trial to investigate trends within each rock unit. Moreover, pairs of radioelements are linearly correlated to check the elemental coherence and their significance.



(1): KEY MAP OF EGYPT SHOWING SAMPLING AREAS.

1 - EL HUDI AREA.
2 - SOUTH EAST OF ASWAN.
3 - SOUTH WEST OF QUSEIR.
4 - NORTH OF WADI QENA.
5 - ABU BAYAN EL BAHARI.
6 - GEBEL FANTAS.

CHAPTER I

OUTLINES ON GEOLOGICAL LOCALITIES

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OUTLINES ON GEOLOGICAL LOCALITIES AND SAMPLING

Granites and related dykes are among igneous rocks that exclusively contain appreciable amount of radio elements (U and Th). The choice of such types of rock, for radiometric counting is for more than one reason. Firstly, they can be considered as low grade, uranium and/or thorium resources of very wide distribution and actually they form potential host rocks in Egypt. Secondly, they furnish a wide variation in radio element content, a case which is suitable to prove the feasibility of the present measuring technique.

It is obvious that detailed geologic description of the host granitic rocks is out of scope of the present thesis. However, general geology when given in brief, will eventually help interpreting the variable contents of U, Th and K contents for the different studied groups of rocks in different localities. Statistics of U and Th contents in each rock type when discussed on maps will define anomalous measurements which may furtherly be developed as potential occurrences.

In brief, granites are intrusive acid rocks, the essential constituents of which are: quartz, alkali feldspar, acid plagioclases and some dark minerals as mica and/or amphiboles and/or pyroxenes. Some granitic plutons are frequently invaded by pegmatite, aplite and felsite dykes commonly named as post granite dykes formed from residual magmatic solution rich in radioelements.

Samples were collected from six localities: four of them in the Eastern Desert; namely: El Hudi, Aswan, Quseier-Safaga and North Wadi Qena, and two localities in the Western Desert namely: North Gebel Fantas and Abu Bayan El Bahari as shown on the Key map, Fig.(1).

I. THE EASTERN DESERT:

1. El Hudi area:

The area under consideration is located sowth east of Aswan.

According to El Sokkary et al (1980), the area is very complex in both the geology and structure. The basement rocks covering this area are uncomformable overlain by Nubian Sandstone. However, marle and

ferruginous sandstones are also shown covering some of the crystalline basement rocks. Granites and granitoid rocks are different varieties occuring in the area. Some of these granites are of synorogenic type as those of Abu Aggag. Muscovite granite lies north east of Gebel El Hudi, while other granites are of post orogenic type as those of Khur Um Buweirat which is located south to west of Gebel El Hudi, El Hudi granites are medium to coarse grained and rich in mica. The measured back ground ranges between 20-30 μ R/h while that from the granitic masses is from 120-160 μR/h i.e. about six times the background. By digging till 30 cm depth, the radiation reaches up to 300 μR/h.

To the north west of Gebel El Hudi, The Nubian sandstone forms small bodies with quartizitic nature overlying most of the crystalline basement rocks of this area. Many dykes of pegmatite varieties with different lengths and sizes but mainly with the same direction are cutting through these rocks while some times stock-like bodies with pegmatitic shape and character occur in the area. A major fault is observed with NW- SE direction extending trhough the schest, gneiss and the granite. Forty six granitic and pegmatitic samplea were collected from this area.

2. Aswan area:

According to El Shazly (1954) Aswan granites of monumental type form conspicuous hills regionally extending in a N-S direction. Most of its exposures are characteristic by a gentle plateau like relief, unconformable overlain by well stratified, nearly horizontal beds of Nubian Sandstone in many localities. A thin layer of weathered kaolinized rock is usually developed along the contact zone between the granite and the overlying sandstone. The basal beds of Nubian Sandstone, where conglomeratic, include some pebbles of this granite.

Oplisque, Shallal and Karkour are the three sampling locations in Aswan area from which 12, 4 and 5 granitic samples were collected respectively.

3. Quseir Safaga District:

According to Akkad and El Ramly (1961), the area south west of Quseir shows a marked difference from the coastal plane. It represents a topographically rugged country of crystalline basement rocks. The terrain has a gradual fall north east wards. Granodiorites have either low or moderate relief as they are