

## **Abstract**

The present study deals with the geology, petrography, geochemistry and radioactivity of Gabal Milaha area, North Eastern Desert, Egypt. Gabal Milaha area covers about 620 km<sup>2</sup> of crystalline basement rocks. It is bounded by latitudes 27° 27' and 27° 39' N and longitudes 32° 55' and 33° 12' E. Geo-chronologically, the Basement rocks cropping out in the investigated area are classified into:- (1) metavolcanics (oldest), (2) metagabbros, (3) older granitoids, (4) Dokhan volcanics, (5) Hammamat sedimentary rocks, (6) younger granites, (7) ring complex , and (8) Dykes and veins (youngest).

The metavolcanics (basic, intermediate and acidic rocks) and related metapyroclastics represent the oldest rock types in the study area. The basic metavolcanics mainly consist of metabasalts and related metapyroclastics. The intermediate metavolcanics are mainly composed of meta-andesites and related metapyroclastics. The acidic metavolcanics are very rare and mainly represented by metadacites. The metagabbros are exposed as small isolated and scattered hills at W. Ladid al Ji'dan and W. Milaha ath-Thimilah. Along the shear zones, the various rocks are subjected to hydrothermal solutions that are manifested by silicification, carbonitization, and hematitization. The older granitoids in the study area are ranging from tonalite to granodiorite. In some parts, these rocks are carbonitized and hematitized, especially in the highly fractured zones due to the effect of hydrothermal solutions passing through them. The Dokhan volcanics are extruded in the metavolcanics, metagabbros and older granitoids. They are represented by successive sequences of lava flows ranging in composition from intermediate to acidic varieties with their related pyroclastics. The Hammamat sedimentary rocks of the study area are exposed as scattered masses of low to moderate topography. They have different colours of light grey, greenish grey, deep green and black.

The younger granites are medium to coarse grained, greyish pink to red in colour and form numbers of moderate to relatively elevated outcrops. These rocks are altered in some parts due to secondary processes especially along the fault zones and contacts; the most common alteration features are chloritization, kaolinitization and epidotization. The ring complex is made up of three rock types arranged as an outer rim, an inner core and capped volcanic rocks. The outer rim is formed of feldspathoid-bearing syenite. It is undeformed, massive, white and shows heterogeneity in grain size and texture. The inner core lies in the central mass of the main ring complex and built up of quartz syenite of pink colour. Numerous acidic, intermediate and basic dykes of variable mineralogical composition, length and thickness are recorded traversing the area.

The studied area displays primary and secondary structures. Primary structures comprise layering, volcanic flows, vesicular tops of lavas, volcanic bombs, bedding, lamination and graded bedding. The secondary structures are represented by folds, foliations, joints and faults. In the

studied area, the majority of joints are tension joints. The most predominant fault sets are trending in N-S, NE-SW, NNE-SSW, ENE-WSW and NNW-SSE directions.

Petrographically, metavolcanics could be subdivided into basic (metabasalts), intermediate (meta-andesites) and acidic (metadacites) varieties as well as their metapyroclastics. Geochemically, the metavolcanics of the studied area were originated from a low to medium-K calc alkaline to mild tholeiitic magma in an immature island arc. On the other hand, metagabbros are subalkaline (slightly tholeiitic) of island arc tectonic setting (environment).

Dokhan volcanics could be subdivided into intermediate (andesites) and acidic volcanics (dacite and rhyolite) as well as their pyroclastics. Generally, the Dokhan volcanics originated from calc-alkaline magma in island arc to active continental margin environment.

The Hammamat sedimentary rocks are mainly represented by conglomerates, greywackes and siltstones. The sources of the studied Hammamat rocks are felsic and intermediate igneous rocks (volcanic and plutonic) of continental arc tectonic environment.

The studied older granitoids are classified as tonalites and granodiorites, but the younger granites are classified as syenogranites and alkali feldspar granites. The geochemical studies revealed that the studied older granitoids are considered as I-type granitoids, originated from metaluminous calc-alkaline magma and emplaced at a moderate depth in the earth crust at water pressure more than 3.5 kb. They were derived from the mantle (M-type) and crystallized at temperature ranging from 950 to 1100° C. On the other hand, the younger granites are considered as I-type granites, originated from peraluminous calc-alkaline magma and intruded at shallow depth in the earth crust at water pressure between 1 and 3 kb. They were derived from crust (C-type) and crystallized at a temperature ranging from 800 to 850°C. The studied younger granites are considered as uraniferous granites.

The studied ring complex is originated from alkaline magma in within plate environment.

The pegmatites recorded in the studied area can be grouped into two types:-

- (1) Normal pegmatites: the uranium average is 35.7 ppm, while the thorium average is 36.3 ppm.
- (2) Anomalous pegmatites: the uranium average is 90.7 ppm, while the thorium average is 71.7 ppm.

It could be concluded that the high uranium content in younger granites is related to its presence in some accessory minerals such as zircon, sphene and apatite but in pegmatites the high uranium content is related to columbite, pyrochlore and zircon as well as iron oxy hydroxides.

It is important to mention that the relatively high uranium content in both younger granites and pegmatites could be considered as source rock for uranium. So, this fact is rather important in planning for more detailed uranium exploration in this area or similar one.