Detailed Structural Analysis For The Mineralized Shear Zones Of G-Ii Uranium Occurrence At Gabal Gattar Younger Granite Northern Eastern Desert Egypt.

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Abstract-, Gabal Gattar alkali feldspar granite, at the northern eastern desert of Egypt, is subjected to intense structural deformation which is responsible for the localization of uranium minerals in the investigated area (G-II occurrence). This structure is represented by two brittle shear zones, the NNE-SSW to NE-SW and NW-SE shear zones. The determination of the direction and sense of resolved shear stress for these shear zones indicated that it is directed NE-SW related to the youngest Red Sea- Gulf of Suez rifting extensional force which affected Egypt since the Tertiary time.

The extension force start at ENE-WSW direction at the beginning of the Red Sea rift and then turned to NE-SW direction. So that, we can mention that the Red Sea rifting has a great effect on Gabal Gattar area and so; it could be responsible for the localization of uranium minerals at the investigated area.

Key words- Shear Zones, Structural Analysis, Resolved Shear Stress, Uranium Minerals

I. INTRODUCTION

The investigated area is located at the intersection of latitude 27^0 5' 30"N and longitude 33^0 17' 5" E (G-II occurrence) (Figs. 1and 2) at the northern periphery of Gabal (G.) [The Arabic word for mountain] Gattar younger granite. The nearest town is Hurghada city; which lies on the Red Sea coast.

Figure 1. Land Sat Image For G-II Uranium Occurrence.

G. Gattar pluton is one of the post-orogenic younger granite of Egypt, which represents the last stage in the cratonization process of the Pan-African orogeney. It defines a mass of elongated shape and extends N-S for about 30 Km and its width is about 20 Km .The Gattar area comprises three principal granitoids rock suites namely: 1- calc-alkaline older granitoids, 2- mildly alkaline subsolvus younger granitoids and 3- alkaline hypersolvus younger granitoids suites [1]. G II occurrence is of alkaline hypersolvus granite and it is considered as one of the main occurrence of high potentiality for uranium mineralization at the northern eastern desert [2-16].

The investigated area was dissected by two main fault systems, one of them trending NW-SE, parallel to the Gulf of Suez and the Red sea graben and the other one is trending NNE-SSW to NE-SW, parallel to the Gulf of Aqaba. The uranium is hosted by the younger alkali feldspar Gattarian granite, the associated alteration features are silicification, kaolinitization, fluoritization and episyenitization, along shear zones mostly directed NW-SE and NNE-SSW to NE-SW.

The rifting of the Red Sea and Gulf of Suez was initiated at a most probably Oligocene [17]. It was initiated as a result of the continued northwesterly horizontal pressure, but with an interchange between the intermediate and least stress axes. This is a common phenomenon in mountain building movements: as more doming and uplift takes place due to continued horizontal pressure. The vertical direction is no longer the direction of least stress, or that regional horizontal extension became an ENE-WSW direction. Thus northern Africa may be regarded as having been under a regional ENE-WSW extension from mid- Tertiary to present times. This new regional extension resulted in the formation of the two complementary, conjugate primary shear fractures along the NW-SE (Gulf of Suez) and NNE-SSW (Gulf of Aqaba) trends. This regional extension starts as ENE-WSW and become in NE-SW direction [18].

Determining the direction and sense of the resolved shear stress on a certain planar surface such as a fault plays a fundamental role in examining the onset of slip along these planes for a given stress state, and it has been vigorously addressed by many structural geologists [19-25].

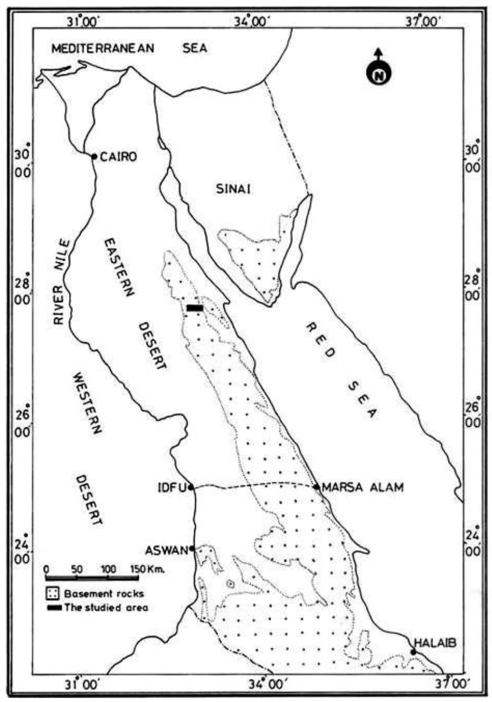


Figure 2. Location Map Of G. Gattar Area, Northern Eastern Desert, Egypt.

A new method for the graphical derivation of the direction of shear stress, which is probably the simplest is derived by [26], is here used for the uranium mineralized shear zones in the younger Gattarian granite.

This study includes detailed structural analysis for the uranium mineralized NW-SE and NNE-SSW to NE-SW shear zones in the younger Gattarian granite in order to. I. Detect the direction of resolved shear sense of movement II. Delineate the relation between the localization and distribution of the radioactive uranium minerals with the red sea rifting in the investigated area.

II. STRUCTURE

The NW-SE and NNE-SSW to NE-SW shear zones of G-II uranium occurrence are responsible for the localization of uranium minerals in the investigated area. The determination of direction of resolved shear direction in both of them will be discussed as follows:

2.1. Shear Zones and Resolved Shear Stress (τ)-

Commonly deformed rocks can be divided into areas of low deformation cut by planar zones of shear, which exhibit relatively high deformation. These are shear zones, which are found in all scales (Fig. 3).

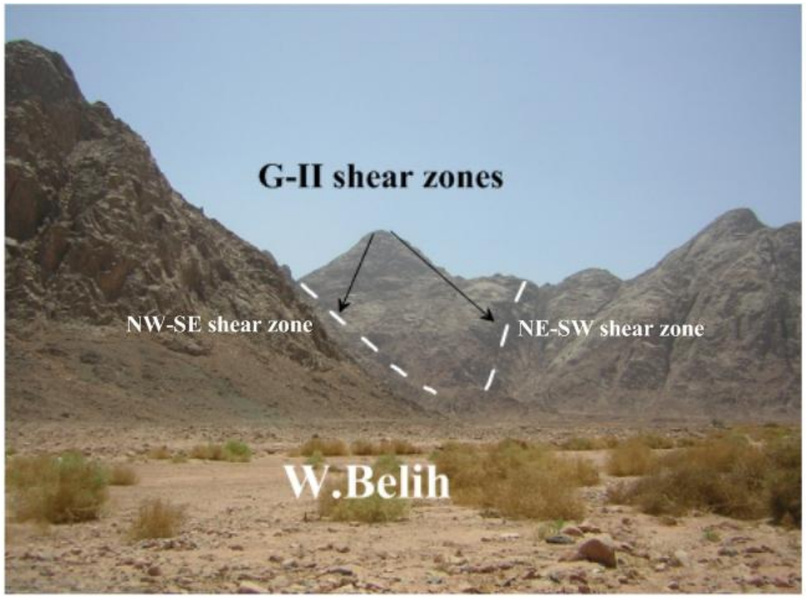


Figure 3. General View For Mineralized Shear Zones Of G-II Uranium Occurrence, Looking SW, G.Gattar Area.

In many naturally deformed rocks that have undergone strain approximating simple shear , the deformation is heterogeneous and is confined to relatively narrow, planar, and parallel sided shear zones (Fg.4) these may be ductile in nature (Fig.4 A), brittle (Fig.4B), or somewhere in between .

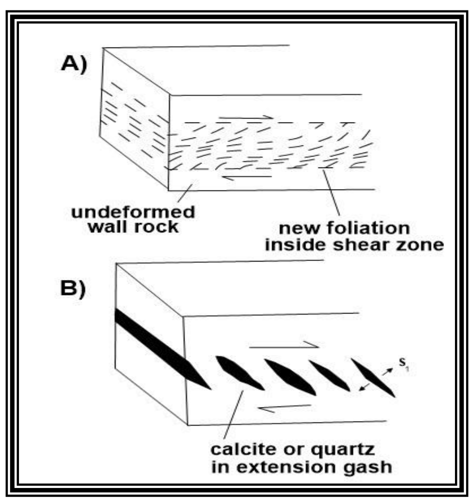


Figure 4. Three Dimensional Views Of Ideal Shear Zones In Which Deformation Is Heterogeneous Simple Shear. A) Ductile Shear Zone; B)”Brittle” Shear Zone. Modified After [27].

Brittle shear zone such as in figure (4B) is characterized by en-echelon “tension” gashes arrays. at G-II uranium occurrence the NNE-SSW to NE-SW shear zone are associated with ENE-WSW en echelon gashes and are filled with uranium minerals (Fig.5) , also mentioned by [16] ; so that, the NNE-SSW to NE-SW shear zone is of brittle nature.

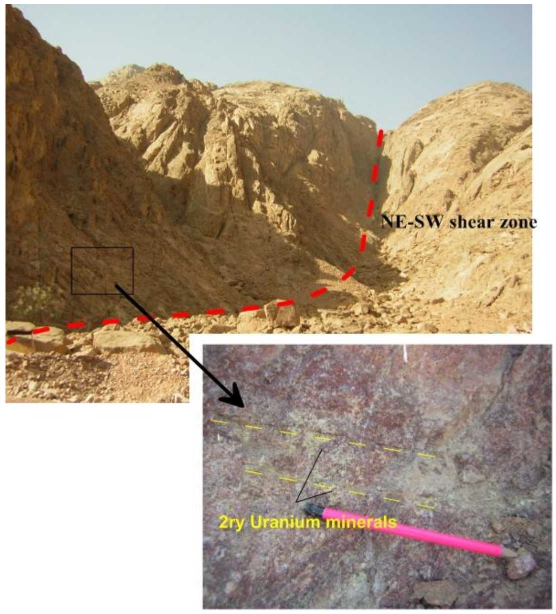


Figure 5. NE-SW Brittle Shear Zone Associated With ENE-WSW En Echelon Tension Gashes Filled With Uranium Minerals .

On the other hand, the NW-SE shear zone is characterized by normal displacement (Fig.6) due to pure extensional regime affected on the granitic rocks of the studied area as indicated from paleostress analysis (σ1 plunges 72º, fig 6). The above mentioned structure elements are the main fabric elements which affected on the northern periphery of G. Gattar and also hosted by uranium minerals.

Figure 6. Vertically Dipping Slickenlines Along The Wall Of NW-SE Brittle Shear Zone .

The resolved shear stress on a plane is the minimum stress required to initiate slip on that plane, or stress required to initiate slip on a given slip plane and in a given direction [most favorably oriented slip system].

III. GRAPHICAL CONSTRUCTION AND RESULT

The determination of the direction and sense of resolved shear stress on a plane is done on both the NE-SW and NW-SE shear zones which are considered as the most important zones responsible for the localization and distribution of uranium minerals in G. Gattar (G-II uranium occurrence) by using the lisle method [26]. This method use a simple graphical technique based on the geometry of the representation quadric of a reduced stress tensor. A construction for finding direction and sense of resolved shear stress on a plane requires knowledge of the orientations of the principal stress axes and the ratio of the principle stress differences and these data are obtained by the paleostress analysis for shear zone fault planes.

At (G-II) uranium occurrence, the derived direction of shear stress (τ) plunges 27º on bearing 50º (pitches 40ºE) for the N45ºE shear zone dipping 87º to SE (Fig.7). The known three principle stress axes are as follows:-

1- σ1 plunges 9 º on bearing 39º,

2- σ2 plunges 81º on bearing 219º

3- σ3 plunges 1º on bearing 130º and the stress ratio is 0.5.

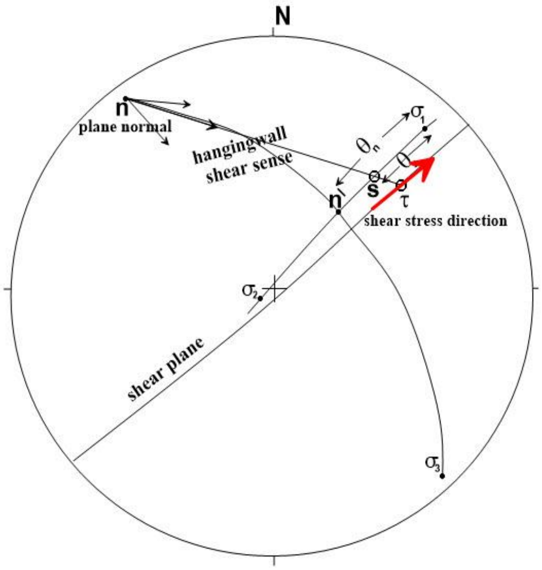


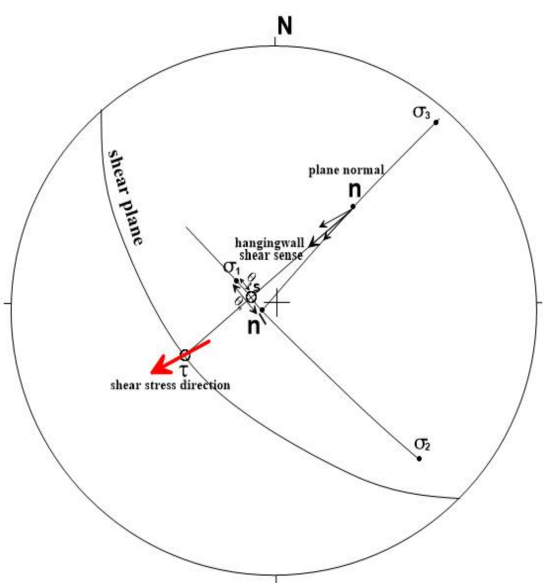
Figure 7. Stereographic Construction For The Direction Of Shear, T On A NE –SW Plane.

The derived direction of shear stress (τ) plunges 47 º on bearing 233º(pitches 37ºW) for the N 50º W shear zone dipping 49º to SW (Fig.8).; the known three principle stress axes are as follows:-

1- σ1 plunges 72º on bearing 292º

2- σ2 plunges 16 º on bearing 129 º

3- σ3 plunges 4 ºon bearing 38 º and the stress ratio is 0.5.



ISSN: 2319-1058

Figure 8. Stereographic Construction For The Direction Of Shear, T On A Nw – Se Plane.

The previously maintained data indicate that the direction of shear for both the NE-SW and NW-SE shear zones is the same where, it is directed NE-SW. The type of this shear stress is tensile due to the type of these uranium hosted brittle shear zones [28] ; the rock has been deformed by brittle deformation process(i.e. Generate a fault zone and contain fractures). It is indicated as mentioned before by the presence of en echelon tension uranium mineralized fracture in the NE-SW shear zone [16] and the normal displacement along the NW-SE shear zone (discrete fracture on which sliding has occurred).

IV. DISCUSSION

Concerning the tectonic setting of G. Gattar pluton, the trace element data demonstrate that its granitic magma evolved in a within-plate (anorogenic) environment [29] related to hot spots and incipient rifting [30-31]; it is emplaced at shallow crustal levels along an active continental margin[32-33]. The magma of the Gattarian granites of Egypt was emplaced within continental crust as a result of post – cratonization rifting [34] which have been emplaced along the major weak structural zones trending NNW-SSE to N-S [35] .G. Gattar younger granite affected by syn-Miocene NE-SW extension event [11].

The major faulting associated with the Gulf of Suez rifting began in the Latest Oligocene to Early Miocene [36-38] at the same time as initial Red Sea rifting [39-40]. The kinematic evolution of the eastern margin of the Gulf of Suez has been studied by [18] and mentioned that the extension force starts at ENE-WSW direction at the beginning of the rift and then become in NE-SW direction. In addition to, the hydrothermal activities associated with Tertiary vulcanicity and Oligo-Miocene phase volcanic eruptions have enriched the country rocks with different types of minerals such as uranium minerals. So, it can be concluded that the direction of tensile shear stress NE-SW is in the most important shear zones responsible for the localization and distribution of uranium minerals at (G-II) uranium occurrence and is related to the effect of the youngest phase of Red Sea rifting.

V.CONCLUSION

The detailed structural analysis for the mineralized shear zones of GII uranium occurrence at G. Gattar younger granite indicate that these shear zones contribute to the same deformation event or belong to one phase of deformation (monophase)which is NE-SW extensional phase. This is indicated from stress required to initiate slip on these shear planes (resolved shear stress).

the direction of tensile shear stress in the most important shear zones responsible for the localization and distribution of uranium minerals at (G-II) uranium occurrence could be initiated due to the effect of the youngest extensional phase of Red Sea- Gulf of Suez region rifting which is NE-SW direction and synchronous with it . So that, the relation between the localization and distribution of radioactive uranium minerals with Red Sea rifting could be very great or strong.

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