

The Placer Feldspars Of G. UM Tenassib Area, North Eastern Desert Of Egypt, As A Ceramic Industry Raw Material.

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ABSTRACT

The geological setting of G.Um Tenassib area was studied to construct its geological map. A detailed radiometric survey was conducted for the area. Placer feldspar of G.Um Tenassib area was subjected to the technical tests to investigate its suitability as a raw material in ceramic industry. The tests showed that, this feldspar can be used for wall and floor ceramic industry.

Introduction

Ceramic industry depends primarily on the good knowledge of the raw materials involved in this industry (**Konta, 1979**). Ceramic raw materials are usually classified according to their functions in ceramic manufacture as well as their basic properties. It generally divides the ceramic raw materials in two basic groups: the plastic and non-plastic raw materials.

Plastic ceramic raw materials involve any clay material that when mixed with water reveals the property called plasticity. Plasticity may be defined as a property which allows the deformation of the clay when an external force is removed. The large group of non-plastic ceramic raw materials includes minerals, rocks and artificial chemicals that when mixed with water becomes non-plastic. A part of the non-plastic ceramic raw materials acts as a filler, reducing high plasticity or shrinkage of the body when drying or firing. On the other hand, other non-plastic raw materials are used for sintering, fluxing and melting or to increase the refractoriness (**Lawrence, 1972**).

Plastic raw materials include kaolin, clay and bentonite while non-plastic raw materials are feldspar, quartz, limestone, dolomite, magnesite, calcium phosphate and talc. Feldspar is an important and common fluxing material for ceramic bodies as well as glazes and one of the three essential raw materials for the triaxial body. Feldspar provides the glassy phase for the ceramic bodies and added to decrease the firing temperature and thus to reduce cost. Feldspars are found in pegmatite rocks usually of the granite type or in placer deposits. Placer feldspar is naturally occurring as a blend of feldspar and quartz resulting from the erosion of the granitic rocks that are characterized by low quartz to feldspar ratio (± 1 free quartz to 1- 4 free feldspar).

There are three types of feldspar minerals namely Na-Feldspar or albite, the K-Feldspar or orthoclase and Ca-feldspar or anorthite. Pure feldspar does not occur in nature but are intermediate in composition. Therefore sodium feldspar also contains orthoclase and anorthite. Accessory minerals are present as well such as quartz, iron compound and magnesia. In the ceramic tile body, especially the porcelain tile; feldspars play an important role in achieving the vitreous nature of the body and the high mechanical resistance of the product at the end of the firing stage. Besides acting as a flux, feldspars also facilitate drying and release of gas during firing like other non-plastics.

Geology of W.Um Tenassib area

G. Um Tenassib area is located at the extreme North Eastern Desert of Egypt, between latitudes 28° 28' and 28° 35' N and longitudes 32° 25' and 32° 40'E covering about 123 km². The area under consideration is covered mainly by Precambrian rocks unconformably overlain along its western side by sedimentary rocks of the Late Cenomanian and Early Turonian age. The Precambrian crystalline basement rocks include different varieties of granites and metamorphic rocks (**Fig.1**). Gneisses are well exposed to the south of Gabal Um Tenassib in the form of small outcrops of low to medium relief. Such gneissose rocks are also somewhat widespread, particularly in association with granodiorite-dioritic rocks, along wadis in the surrounding areas; Wadi Hawashiya (**Eliwa et al., 2000**). Um Tenassib gneisses are distinguished into two types of gneisses namely; biotite-hornblende gneiss and most abundant biotite gneiss.

Biotite hornblende gneisses are mainly mesocratic to rarely melanocratic foliated and coarse-grained rocks consisting of quartz + plagioclase + biotite + hornblende ± K-feldspar. It commonly occurs close to the contact with the Older Granitoids and is also intercalated with the biotite gneiss.

Biotite gneisses are hard rocks forming relatively moderate to high topography. They are mainly medium to coarse grained rocks showing a well developed foliation. Biotite gneisses are mostly leucocratic to mesocratic rocks having a simple mineral assemblage, comprising quartz + plagioclase + biotite ± hornblende ± alkali feldspar. The both types of gneisses are cut and intruded by swarms of aplitic granite dykes striking (ENE). The gneisses are also intruded by acidic dykes comprising quartz porphyry and rhyolite. Amphibolites occur as relatively thick layers about (5m) that are concordant with the foliation plane of host gneisses. They are also present as pockets and boats enclosed within biotite gneisses.

The older granitoids are exposed in the south part of the mapped area. They exhibit moderate to high relief with respect to the surrounding rocks, rising up to 759 m. They are medium to coarse grained granodiorite and tonalite and they are grey to whitish-pink in colour on their fresh surface due to presence of pink feldspars, while on their weathered surfaces they

are dark grey. Pinkish feldspar crystals do not show any preferred orientation but, locally, the quartz and plagioclase are slightly oriented and wrapped with mafic minerals giving the appearance of slightly foliated rocks.

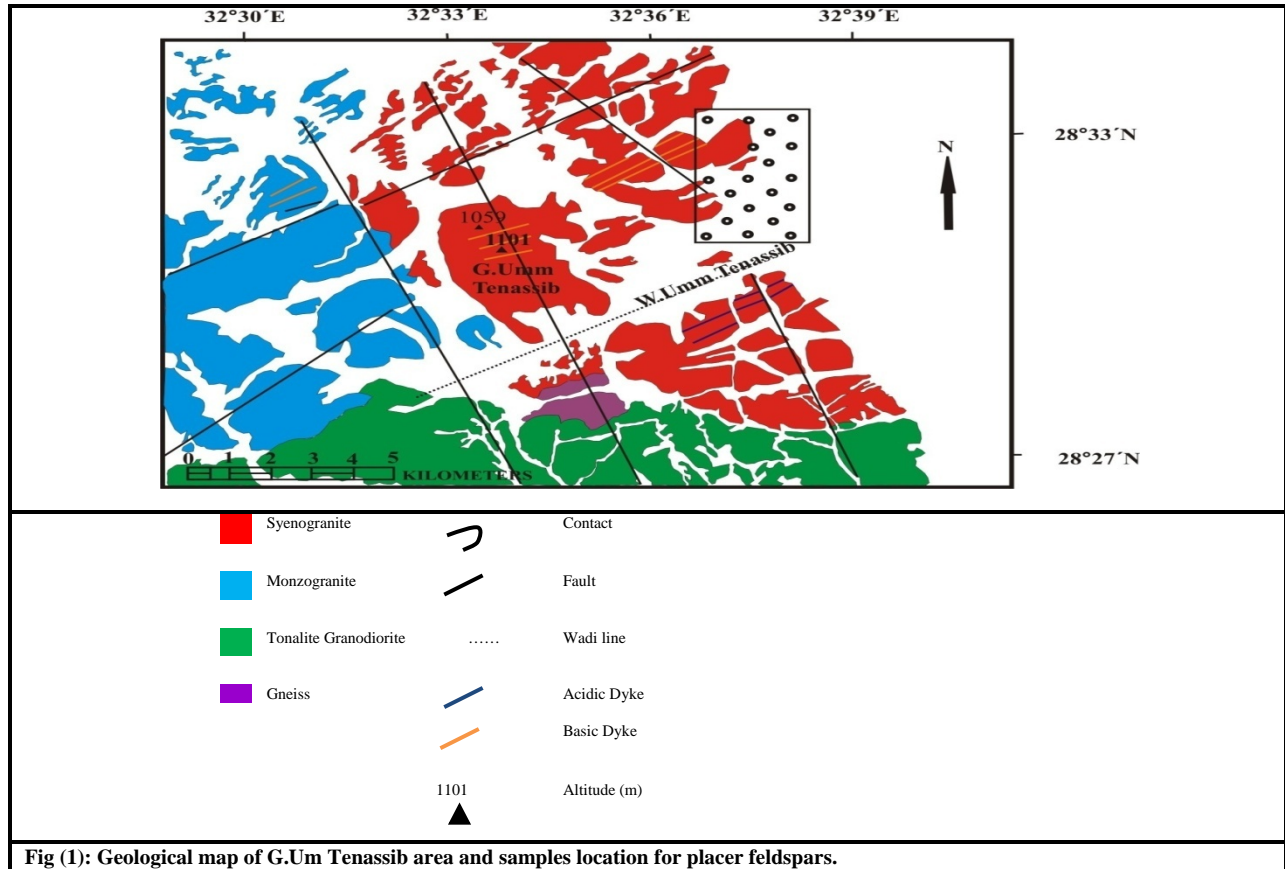
The older granitoids are necessarily stained within iron oxides along joints or cracks that affected the rock colour. They are intruded by the younger granites in the south western and south eastern parts of the mapped area and the contact between them are sharp. They are usually intruded by acidic dykes and intermediate dykes.

Younger granites are the most dominant rock in the area. They form huge outcrops represented by monzogranites in the west and syenogranites belts in the east. Monzogranites crop out as moderately high topographic hills which are mainly concentrated in the western part of the studied area. Some scattered monzogranitic masses are exposed in both the southern and northern parts of the studied area.

On the western side of G. Um Tenassib, a narrow belt of highly weathered monzogranites was intruded by the syenogranites. These rocks intrude both the older granitoids and metamorphic rocks with sharp contacts and take several xenoliths of different shapes and sizes from them. Syenogranites are hard, massive and coarser grained relative to the monzogranites. They are also poor in biotite and rich in alkali feldspars. The alkali feldspar crystals reach 7cm in length giving the rock the porphyritic appearance and the pink to red colour.

The intrusion of Um Tenassib syenogranites is elongated mapped area, about 5.8 km long trending NW-SE direction and its width about 2km (Gabal Um Tenassib). The syenogranites are generally fractured and characterized by boulder, exfoliation and cavernous type of weathering. In the outer zone around G.Um Tenassib, syenogranites are occasionally characterized by porphyritic nature and whitish red colour. The joint systems are well developed in different directions but NW-SE trend predominates. The joints are gently to steeply incline and many of them are filling with the alteration products. These rocks are cut by various types of dykes and quartz veins.

The Precambrian rocks of the area under consideration are traversed by several types of dykes ranging from acid to basic dykes. The acid dykes include aplite, quartz porphyry, rhyolite and rhyodacite. The intermediate dykes are represented by andesite. Basic dykes are mainly doleritic basalt. The dykes vary in thickness from 0.5 to 10 m while their length varies from 0.5 Km to 5 Km. They vary in attitude from steeply incline to vertical.



The Radiometric Survey

A radiometric survey for G. Um Tenassib area was carried out by a multi channel radiometric survey instrument (RS-230) on a systematic grid with lines interval about 500m. The obtained data (eU, eTh) are expressed in ppm and their ratios, besides K %) were treated, tabulated (**Table.1**) & (**Fig.2**) and represented as contour maps (**Figs.3,4,5&6**). From the constructed radiometric maps, the contour lines more or less coincide with the rock contacts. The radioactivity values reflect a systematic increase from the older granitoids to the younger granites. The younger granites show the same systematic increase from the monzogranites to the syenogranites. Also, relatively high values were detected and confined to certain fractures and felsic dykes within these granitic masses.

Regarding to eU, eTh and K distribution maps, it is observed that the rock unites are easily separated. Wadis show intermediate contents of eU, eTh, and K, which range between the corresponding values of the rock types.

The contour lines of eU distribution map are slightly displaced relative to those of eTh. This could be attributed to the secondary processes causing mobilization of uranium rather than

thorium, which is considered as relatively immobile element. This phenomenon is clearly exhibited by the eU/eTh ratio distribution map (Fig.5) where the highest ratios restricted to the Wadis near syenogranites.

Table (1): eU, eTh and K% content in the rock unites of G.Um Tenassib area, north Eastern Desert, Egypt.

Rock Unit Contents		Older Granitoids	Younger Granites	
			Monzogranite	Syenogranite
eU ppm	Range	1.5-4.3	3.2-5.9	4.8-15.4
	Average	2.5	4.2	10.3
eTh ppm	Range	3.6-9.3	8.3-24.1	10.4-31.9
	Average	8.7	15.3	21.2
K%	Range	1.2-3.7	1.6-4.1	3.8-6.7
	Average	1.4	2.6	5.75

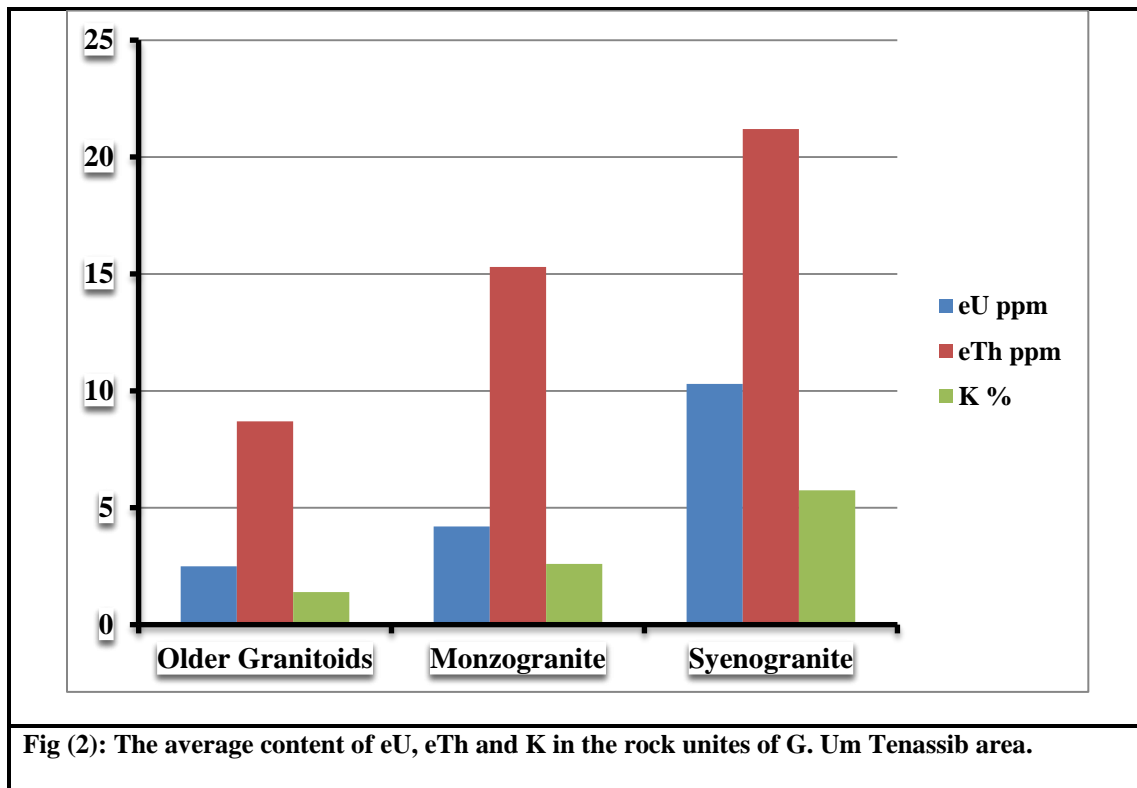


Fig (2): The average content of eU, eTh and K in the rock unites of G. Um Tenassib area.

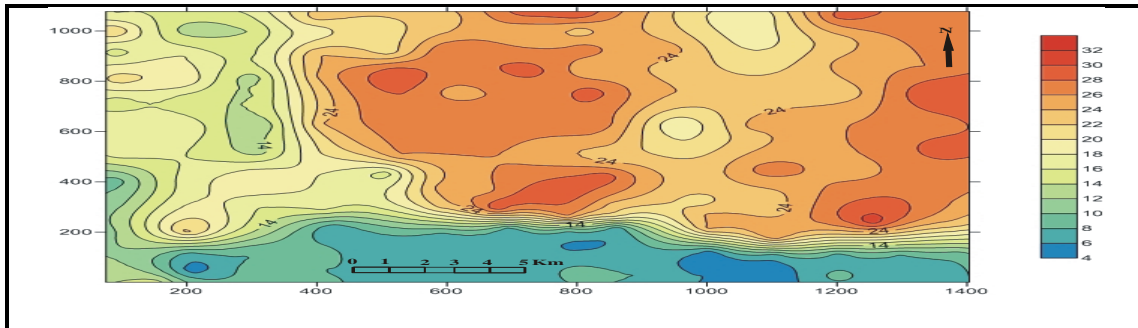


Fig (3.a): Contour map of eTh (ppm) distribution in G. Um Tenassib area.

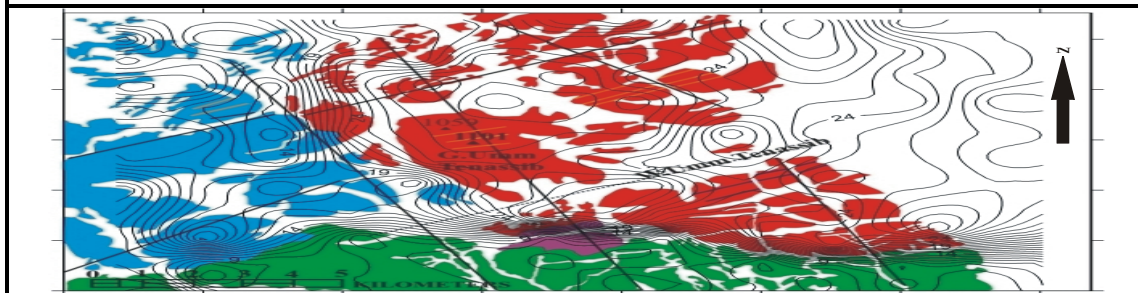


Fig (3.b): Geology and contour map of eTh (ppm) distribution in G. Um Tenassib area.

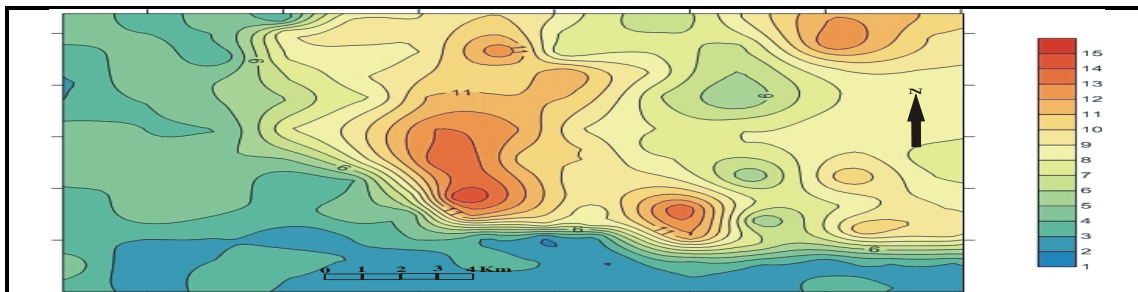


Fig (4.a): Contour map of eU (ppm) distribution in Um Tenassib area.

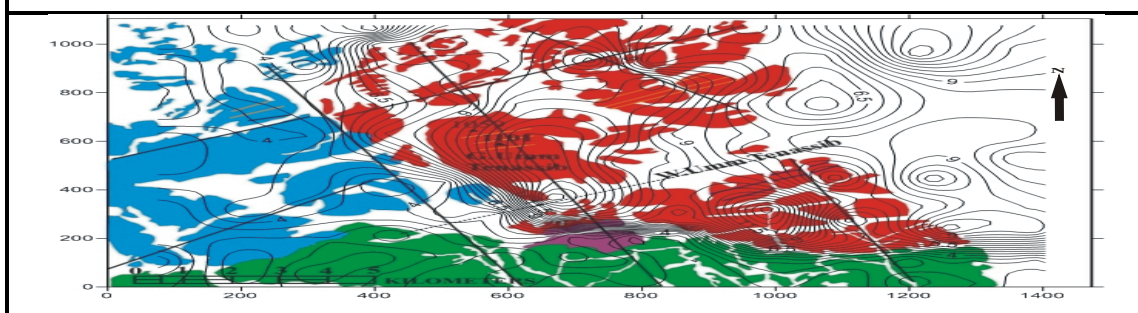


Fig (4.b): Geology and contour map of eU (ppm) distribution in Um Tenassib area.

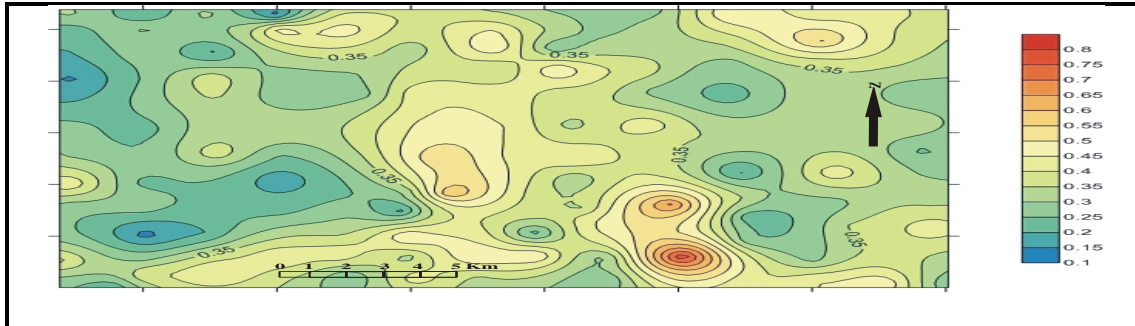


Fig (5.a): Contour map of eU/eTh distribution in G.Um Tenassib area.

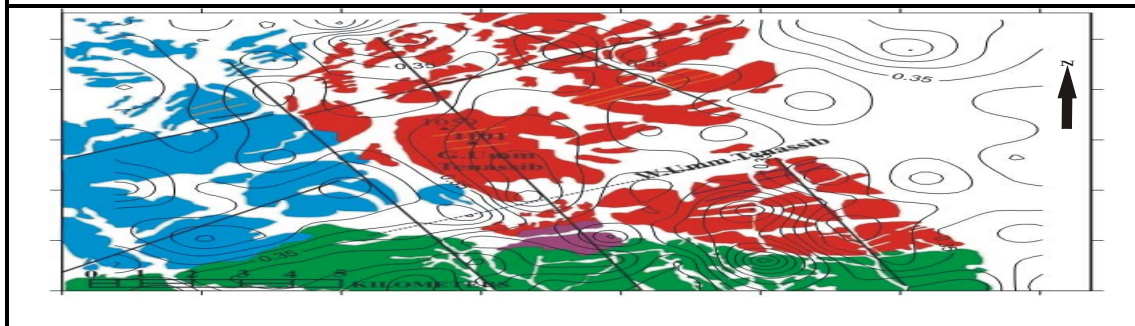


Fig (5.b): Geology and contour map of eU/eTh distribution in G.Um Tenassib area.

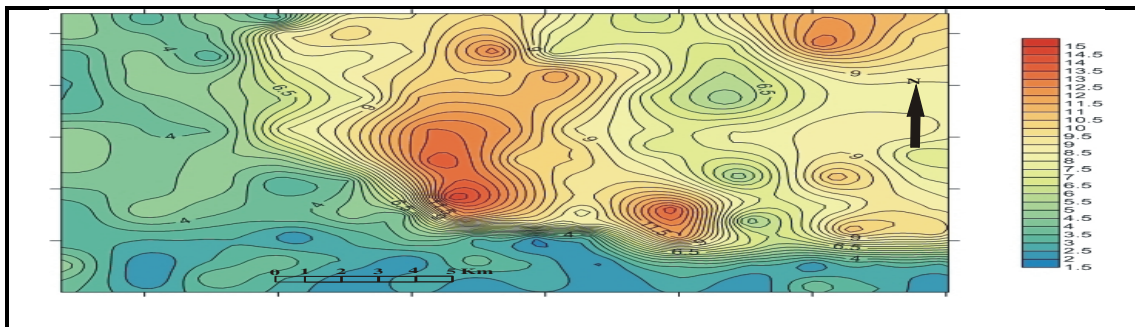


Fig (6.a): Contour map of K % distribution in G.Um Tenassib area.

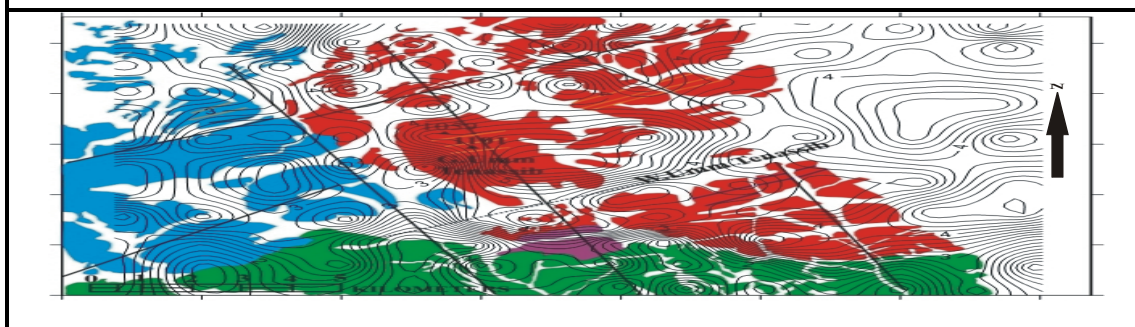


Fig (6.b): Geology and contour map of K % distribution in G.Um Tenassib area,

Placer feldspar of G.Um Tenassib area

Placer feldspars can be used as a new material for ceramics and sanitary wares. Mobile Petroleum Service Company shows to the occurrence of placer feldspars north of the study area and then followed by Ceramica Cleopatra Company, which used the placer feldspars as a new raw material for ceramics and sanitary wares. 16 representative placer deposits samples from G.Um Tenassib area (**Fig.1**) were collected at interval to test their suitability for using as an alternative source for the conventional feldspar. The mineralogical composition was investigated qualitatively and quantitatively (**Table.2**).

Table (2): The average of the mineralogical composition for 15 placer feldspar samples.

Mineral	Free feldspars	Free quartz	Mafics	Fine clays
Percentage	43.60	30.90	6.64	19.46

Technical Tests of placer feldspars

The flotation test was conducted to establish the mineralogical composition and assists on the economic feasibility of producing free high quality materials. No magnetic separation of impurities was applied in this floatation test.

Feldspar analysis differs due to the technical flotation methods. According to the chemical analysis for placer feldspar, average composition of the 19 placer feldspars samples, containing the total alkali about 8.29%, Al_2O_3 about 12.20% and $SiO_2 = 76.50\%$. Total Fe_2O_3 is about 0.84%, which indicates to a good new raw material in ceramic industry.

Inspection of biscuit (small tile) for placer feldspars

There many tests are done for feldspars to adapt its quality for ceramic industry. These tests include shrinkage, water absorption and bending strength. These tests are applied in bascuit sample that prepared as follow:-

- 1- Weight 250 g grind feldspars
- 2- Add 5% (12.5 g) Spanish kaolin to increasing the plasticity and not change of ceramic body.
- 3- Take the mixture for grinding 80 minutes and put the slap in the drier about 90 minutes at $100^{\circ}C$.
- 4- Make hand grinding with little amount of spray water.
- 5- Pressing the sample at 300 bar and passed to the glaze line.
- 6- Firing of sample at $1200-1220^{\circ}C$ for 47 minutes.

The results of water absorption %, shrinkage and bending strength are shown in (Table 3). Accordingly, from these results, the placer feldspars of the studied area can be used for wall and floor ceramic industry.

Table (3): Water absorption %, shrinkage and bending strength for placer feldspars of G.Um Tenassib area.

Sample No.	Water absorption %	Shrinkage	Bending strength
1	0	12.9	61.42
2	0	12.7	59.91
3	12.8	7.1	29.81
4	5.3	9.7	44.20
5	7.9	8.8	40.81
6	2.1	10.0	50.21
7	5.4	9.5	95.00
8	0	11.0	55.10
9	0	14	67.00
10	0	3.8	65.12
11	0	14.8	68.11
12	1	12.1	58.99
13	0	13.9	65.14
14	0	13.3	62.10
15	2	11.9	55.61
16	0	15.0	67.90

Conclusions

G. Um Tenassib area is located at the extreme North Eastern Desert of Egypt, between latitudes 28° 28' and 28° 35' N and longitudes 32° 25' and 32° 40'E covering about 123 km². The detailed field study of the exposed rock types in the area shows that it contains both metamorphic and igneous rocks.

A radiometric survey for G. Um Tenassib area was carried out. The constructed radiometric maps show that the contour lines more or less coincide with the rock contacts. The radioactivity values reflect a systematic increase from the older granitoids to the younger granites. The younger granites show the same systematic increase from the monzogranites to the syenogranites. Also, relatively high values were detected and confined to certain fractures and felsic dykes within these granitic masses.

Regarding to eU, eTh and K distribution maps, it is observed that the rock unites are easily separated. Wadis show intermediate contents of eU, eTh, and K, which range between the corresponding values of the rock types.

The inspection of biscuit (small tile) for the placer feldspar showed that the placer feldspars of the studied area can be used for wall and floor ceramic industry.

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