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The Uraniferous and Auriferous Allouga Quarry, Southwestern Sinai, Egypt;Geological Studies, RadioactivityandMineralogical Investigations

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Abstract: *Allouga area is located in the southwestern part of Sinai Peninsula. It represents one of the more significant economic and uranium mineralized area. It is located within low basin that has been formed from the normal faults of Wadi Nasib on the east and Wadi Baba on the west and most of the high radioactive anomalies recorded in the sediments of Um Bogma Formation within this basin.The Lower Carboniferous Um Bogma Formation is the main rock unitsconstituting the face wall of the Allouga quarry. The wall show very high radioactivity with eU-contents reach 3000 ppm. Sklodowskite and carnotiterepresents the main uranium minerals detected in the face wall of thequarry withanomalous contents of gold.The gold content reaches 1.78, 1.74, 2.02, 1.6, 1.78 and 1.8 ppm in the ferruginous sandstone, dolostone, black shale, marl, claystone and gibbsite, respectively.The structure (faulting), lithology (carbonaceous material and clay minerals in addition to iron oxides), topography (low basin) and biogenic effects (organic matter) are the main factors that controlled the localization and concentrating of the uranium and gold minerals within the Um Bogma Formation in the Allouga area especially in Allouga Quarry. In addition to the secondary ascending hydrothermal solutions carry out the radioactive and gold minerals to deposit mainly along fractures and faults.*

Keywords*: gold; uranium; Um Bogma; hydrothermal solutions*

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I. Introduction

Allouga is located about 60 km. to the east of Abu Zeneima town on the eastern coast of the Gulf of Suez, southwestern Sinai, Egypt. It is located at the intersection of Longitudes 33° 24' 11"E and Latitudes 29° 01' 15" N. Itrepresents oneofthemoresignificanteconomic and uraniummineralizedareawhereby, it wassubjectedtovariousdetailedgeological,geophysical,structural,geochemical, mineralogical and radiometric studies (Gindy, 1961, El- Agami, 1996 and Abdel-Monem,et al., 1997, etc.). Uranium mineralizationsare mainly associated with Um Bogma Formation that well exposed and developed in Allouga (Fig. 1A) where it attains a thickness ranging from 9 m to about 20m.

Allouga locality is covered mainly by Paleozoic rocks. Several authors divided the Paleozoic succession in Allouga area and its surrounding. The main subdivisions include three major lithostratigraphic units that comprise from base to top: a): Sarabit ElKhadim, Abu Hamata and Adedia Formations (Soliman and AbuEl Fetouh, 1969), b): Um Bogma Formation (Wiessbrod, 1969), which classified by Kora 1984 into: Lower, Middle and Upper members. C): El-Hashash, Magharet El-Maiah and Abu Zarab formations (Soliman and AbuEl Fetouh, 1969), Abu Thora Formation (Wiessbrod, 1980). The unconformity surfaces (Disconformity type) were recorded between Um Bogma Formation and other lower and upper formations.

Alshami (2019) concluded that the southwest Sinai considered an important target for some economic ores as copper, coal, kaolin, manganese, glass sand, REEs, uranium and recently thorium and gold. Sallam et al., (2014)recorded minerals bearing Ag and Au namely uytenbogaardtite and furutobeite in the lower member of Um Bogma Formation at El Sheikh Soliman Area. Alshami (2019) detected gold in Um Bogma Formation at Allouga locality.

The present study sheds the light on the geology and radioactivity of the Allouga quarry area. Also, the work aims to investigate the different mineralizations especially the radioactive minerals of the Allouga uraniferous quarryand their probable origin.

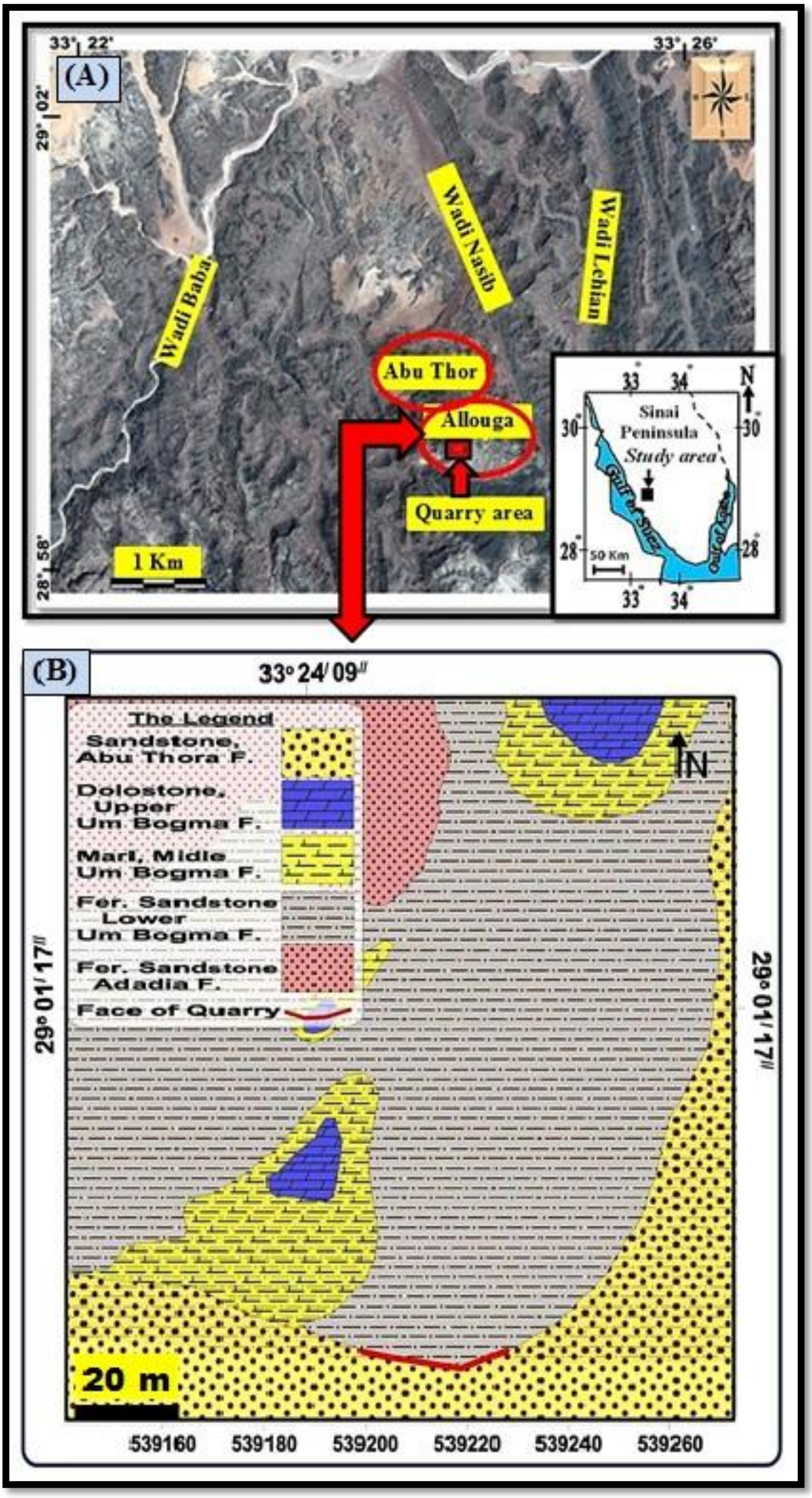

Fig. 1: Allouga quarry area; (A) Landsat image shows the location, (B) Geological map.

II. Materials and Methodology

The field radiometric survey measurements of eU (ppm), eTh (ppm) and K% were obtained using a portable differential gamma ray spectrometer model Rs-230 BGO Super-Spec, serial No. 4333, manufactured by Radiation Detection Systems AB, Backehagen 35, SE-79191 FALUN, Sweden and the reading were given directly each 30 second.

For measuring gold concentrations, fire assay analyses were carried out at the Egyptian Mineral Resources Authority (EMRA), Central Laboratory Sector.Weigh 50 gm. of sample, addition of flux (litharge-Borax –Sodium carbonate –Flour –Silica – silver) mix sample with flux in ceramic crucible, melting of (sample + flux) at 1000^0 C for 1.5 hours, cupellation of (lead + gold +silver) alloy at 900° C for 1 hour, parting of resulting (gold –silver) alloy in Nitric acid and aqua regain heating to get gold solution and finally analysis of gold solution by GBCAvanta atomic absorption instrument to get gold concentration with ppm.

The representative samples (each sample weight approximately 3 kg) were collected from the selected stations depending on the variation in composition and field radiometric measurements. The collected samples were crushed, grinded and quartered. The sample was sieved into three fractions; >800µm, 800µm-63µm and<63µm. The size fraction ranging between 800µm-63µm for each sample was subjected to the heavy liquid separation using bromoform solution (sp. gr. 2.81 g/cm^3) to separate the heavy minerals. The heavy fractions resulted from the bromoform separation were subjected to separate its magnetite content using hand magnet. The residue fractions were subjected to the magnetic fractionation using Frantz Isodynamic Magnetic Separator (Model LB 1) under the following conditions: transverse slope 5°, longitudinal slope 20° and step of current = 0.2, 0.5, 1.0, and 1.5 amps.The obtained heavy mineral fractions were studied under the Binocular stereo-microscope. Some of the picked mineral grains were analyzed byEnvironmental Scanning Electron Microscope(ESEM)(XL30-ESEM, Philips) attached with EDAX microanalysis unit developments in high-pressure (low-vacuum) and byX-ray diffraction(XRD) technique for mineral identification. These analyses were carried out in the laboratories of the Nuclear Materials Authority (NMA), Cairo, Egypt.

III. Geological Studies

3. A. Allouga quarry area

The Paleozoic sequence exposed in Allouga quarry area is beginning with Adedia Formation at the base followed by Um Bogma and Abu Thora formations (Fig.1B).

Adedia Formation

It is made up of coarse to fine grained, hard ferruginous sandstone, siltstone, pink to brown color. The copper mineralization is recorded in the upper part of the Formation. Also, Mn-Fe veinlet in addition to some radioactive anomalous recorded in the Adedia Formation.

Um Bogma Formation

Due to the importance of the U-bearingdeposits in Um Bogma Formation of Lower Carboniferous age, it is selected for detailed geologic and radiometric studies.Um Bogma Formation isunconformably overlies Adedia Formation and unconformably underlies Abu Thora Formation (Fig.2A). It is subdivided into the following three lithological members; 1) The Lower dolostone member, 2) The Middle fossiliferous marl, dolostone and shale member and 3). The Upper sandy dolostone member

Lower dolostone member

This member is referred asLower dolomitic member (Omara and Conil, 1965), sandy dolomitic member (Weissbrod, 1969) and Lower dolostone-ore member (Kora, 1984). Generally, this member exhibits three different lithilogic facies in an occasional unconformable arrangement from base to top; a) Mn-Fe ore, ferromanganese siltstone and silty shale facies, b) black carbonaceous and varicolored shale, siltstone facies and c) sandy dolomite facies.

The lower ferromanganese facies is mainly composed of ferruginous clasticrocks(ferruginous siltstone,ferruginous sandstoneandshale)andferromanganeseorebodieswithfewsandy dolomite.TheMn-Feoreoccursasbedsorlenses (Fig.2B) immediateoverlyingtheAdedia Formation.

The middle black carbonaceous shale, varicolored shale and siltstone facies is widelydistributedwithinearlythesameextensionastheunderlyingferromanganese facies. The colors of variegated, black (carbonaceous) shale horizon are changed frompurpletopink,brown,brownishyellow,gray,grayish white,grayish green,to yellowish green and black. This facies has variable thickness that ranging from tens centimeters to 5 meters.

The upper sandy dolomite facies is mainly composed of medium crystalline thicklybeddeddolomitewithpinkcolor.Itisranging from tens centimeters to severalmeters. Thesandydolomitefacieisabsentorcompletelyeroded.

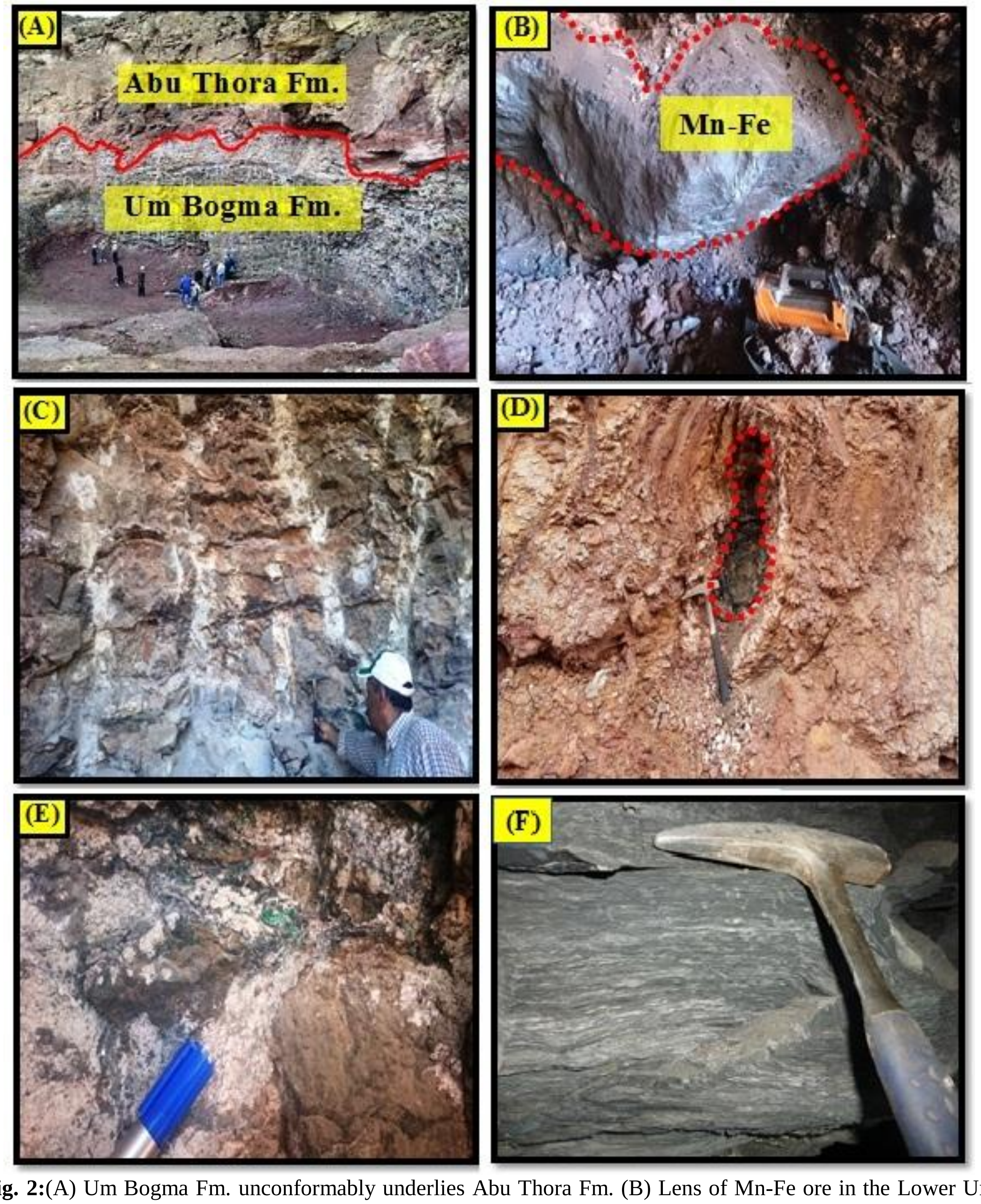

Fig. 2:(A) Um Bogma Fm. unconformably underlies Abu Thora Fm. (B) Lens of Mn-Fe ore in the Lower Um Bogma Fm.**,** (C)Dolostone intercalated with black shale in the Lower Um Bogma Fm., (D) Black gibbsite pocket in claystone in the Middle Um Bogma Fm., (E) Staining of copper mineralization on the dolostone surface, (F) Black shale.

Middle fossiliferous marl, dolostone and shale member

It is mainly composed of marl, dolostone, shale and ferruginous siltstone intercalations with characteristic distinctive yellow color and rhythmic alternating beds of carbonates and clastics. In the lower part of this member, the marl forms continuous bed slightly wavy and uniform in thickness with yellowish brown color.

On the other hand, shale and ferruginous siltstone are less compact, thinner than marl inthickness,friableinmostplaceswithbuff,reddishtograyishbrownandlightbrown in color. Copper staining is frequent, silt-shale association ranges in thickness from 30 cm to about 8m.This member is also characterized by the presence of evaporates; e.g. gypsum, anhydriteandhalitethathavefibrousandplatyforms.Theseevaporatesexhibiteither parallel veinlets or intersecting with the beddingplanes.

Upper dolostone member

This member exhibits the least variability in lithology with thickness ranging from2to3mwithamarketthinningtosoutheast.It ispink and grayish crystalline dolomite, yellowish to brownish white claystone anddark brown ferruginous sandstone conformably overlying the Middle member. The crystalline dolostone is hard, compact and displayingthickbedswithlateraluniforminthickness.

Abu Thora Formation

Abu Thora Formation in the light of uranium mineralization considered less important than the lower part of the Paleozoic section in the area. It has thickness range between 5m up to 30m. It is unconformably overlies Um Bogma Formation. In the study area, Abu Thora Formation is subdivided into three formations comprise from base to top, El-Hashash, Magharet El-Maiah and Abu Zarab formations.

Structurally, the study area are located in low basin that has been formed from the normal faults of Wadi Nasib on the east and Wadi Baba on the west (Fig. 1A) whichconstituting a part from the malty mineralized Um Bogma basin that surrounded from all directions by younger granite rocks. Most of the high radioactive anomalies recorded in the sediments of Um Bogma Formation within this basin. The NW-trending faults controlled the high uranium concentration at Wadi Nasib and TaletSelim, whereas the NE- trending faults controlled the U-concentrations at Baba.Alshami (2018)recorded that Allouga and Abu Thor area located within a low basinal shaped area that was affected by several fault setscomprisingstrike-slip and step faults, which to some degree helped the localization of the U and Au minerals.

Allouga area is located within the zone of Wadi Nasib normalfault trending nearly N-S (Fig. 1A) and the effects of the hydrothermal solutions are recorded filling the fractures of the different rock units of the area of study and farming many mineralizations especially the Mn-Fe ore deposits in the area.The southwestern Sinai district was affected by two volcanic episodes. The early one belongs to the Permo-Triassic age and was manifested by the basaltic sheet or / and sill at the top of the Post-Miocene age and resulted in abundant dolerite and basaltic dikes (El Shazly and Saleeb, 1969).

3. B. The face of the Allouga quarry

The excavated face wall of the Allouga uraniferous quarry extends about 30 m with about 10 m height.Um Bogma Formation is the main rock unitof Allouga quarry face. Grey to dark grey dolostone with intercalation of black shale (middle member) (Fig. 2C) are the main rock units constituting the wall (Fig. 3), ferruginous sandstone (lower member), black shale (middle), marl (middle) and claystone (upper) are also observed. Pockets of black gibbsite were recorded within the claystone (Fig. 2D). Also, staining of copper mineralizations recorded on the dolostone surface (Fig. 2E) and between the black shale flakes.The black shale (Fig 2A) and gibbsite characterized by enrichment of organic matter which responsible for the grayish black colure of the face wall.

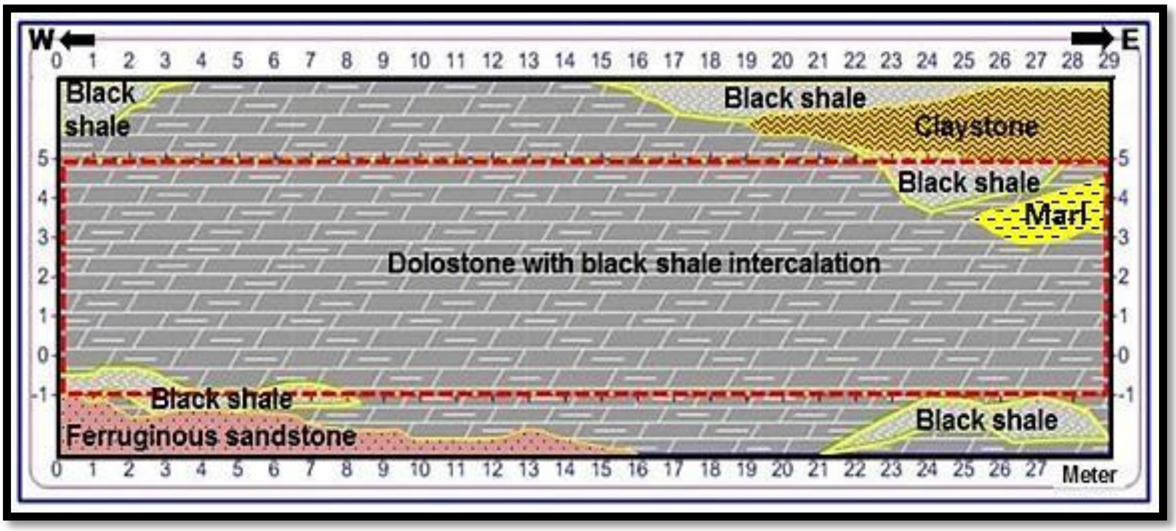

Fig. 3: Detailed geologic map of the uraniferous face wall of Allouga quarry.

Radiometric survey area

IV. Radiometric Survey

4. A. Radiometric survey of the area of Allouga quarry

A detailed systematic ground spectrometric survey has been taken on a grid pattern that consists of a set of parallel profiles trending in the NE. The line spacing is 1 m, while the observations have been taken at 1 m intervals along the survey lines. The eU contour map (Fig. 4) can be separated into three relative zones ranging in intensity from less than 12 ppm eU up to more than 2600 ppm eU. This division helped much in the interpretation of the eU radiospectrometric survey data. These relative and distinct three zones can be described in the following:

Low eU zone

The low eU zone is representing small scattered parts of the study area. This level is varies in eU intensity from less 12up to 50 ppm this ismainly related to the dolostone of the upper member of UmBogma Formation.

Intermediate eU zone

The intermediate eU zone is occupying a large part of the Allouga quarry area. This zone varies in eU intensity from 50 ppm up to 500 ppm. This isrelated mostly to the ferruginous sandstone of the lower member of Um Bogma Formation and in some parts to the marl of the middle member of Um Bogma Formation.

High eU zone

The high eU zone is mainly located at the south part of the study area. It varies in eU intensity from 500 ppm up to more than2600 ppmwhich is associated with black shale and dark gray dolostone of the lower member of Um Bogma Formation.

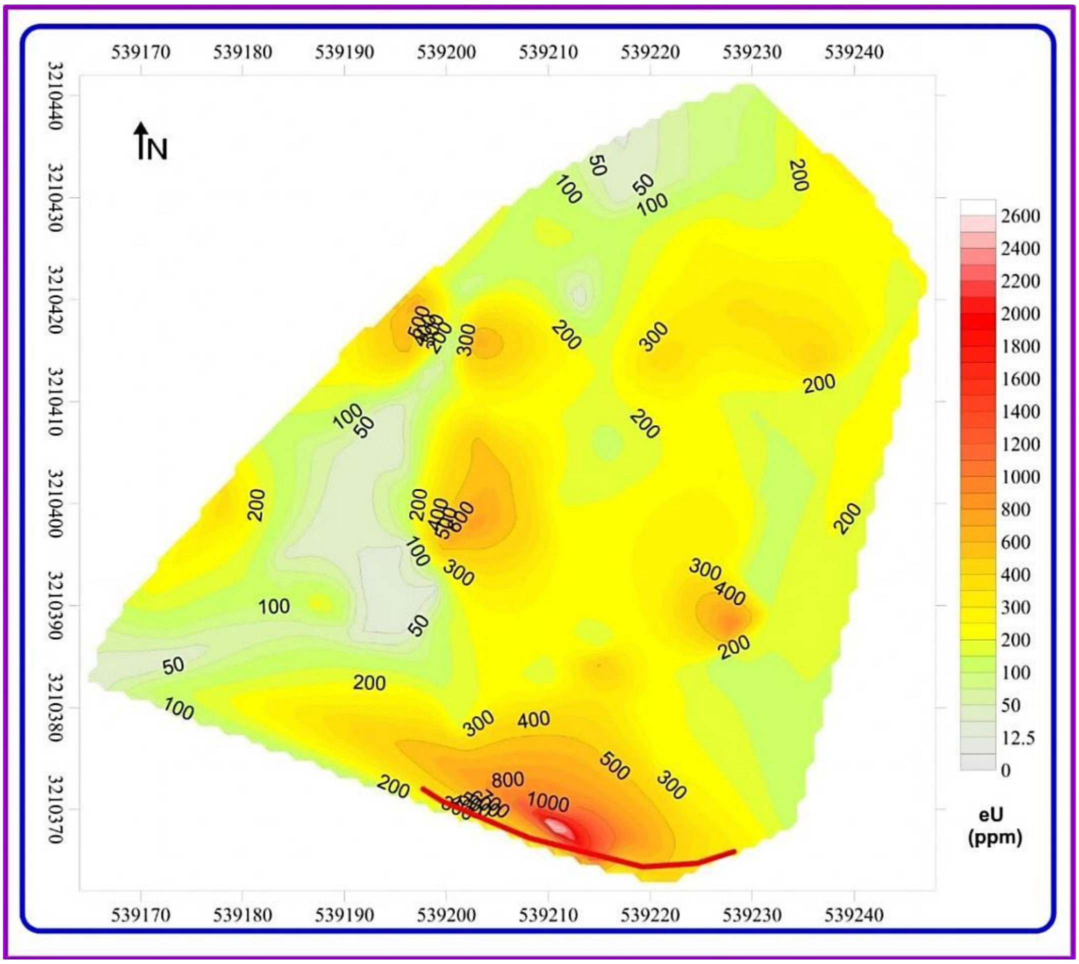

Fig.4: Radiometric contour maps of the area of Allouga quarry showing the distribution of eU-content (ppm), Face wall of quarry.

4. B. Radiometric survey of the face of Allouga quarry

The selected quarry face, for radiometric survey, trendsnearly E-Wdirectionwith length about 29 m and average height about 6m(Fig. 3). It is radiometrically measured to delineate the surface exposure of theuranium ore-body. For accurate surface determination of the U-ore body, a grid pattern is constructed along the face wall of the quarry with 0.5m intervals along the horizontal and vertical lines.The equivalent of uranium (eU) and thorium (eTh) contents in ppm and potassium content in % in every station are recorded (Figs. 5A, B&C).The radiometric measurements were carried out for every station in the grid. The obtained data are processed, radiometrically contoured and computed to create the radiometric contour maps.

The radiometric contour mapsfor the quarry wall reveals that the uranium contents ranges from less than 100 ppm to more than 3000 ppm (Fig. 5A), eTh from less than 20 ppm to more than 190 ppm (Fig. 5B) and K% from less than 4 to more than 35% (Fig. 5C).

The radiometric measurements of the quarry wall can be classified into three grades: for eU (less than, 200, 200: 500 and more than 500 ppm), for eTh (less than 50, 50: 100 and more than 100 ppm), for K% (less than 4, 4: 10 and more than 10 K%).Most of the high radioactivities are concentrated in the black shale, dolostone and gibbsite.

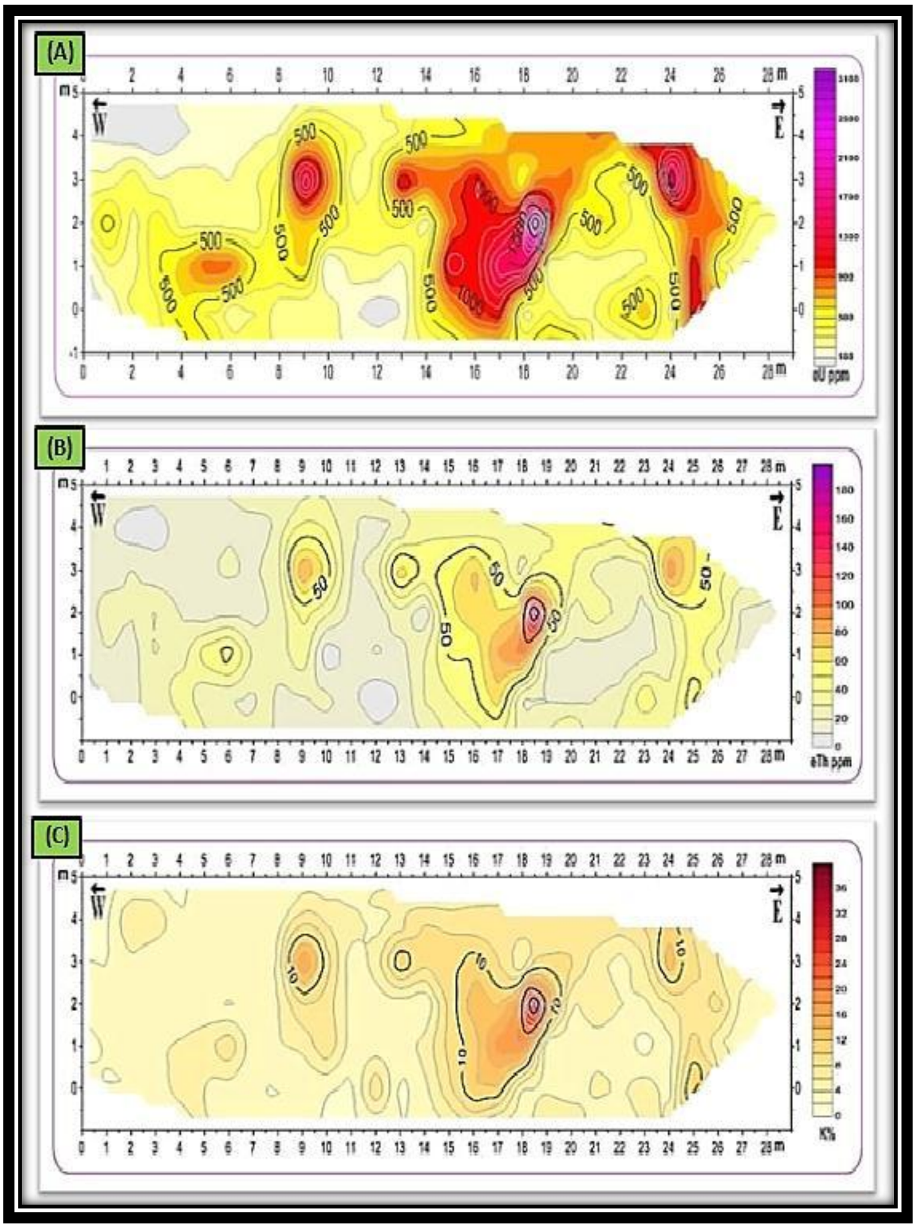

Fig.5: Radiometric contour map of the face wall of Allouga quarry showing the distribution of; (A) eU-content (ppm) (B) eTh-content (ppm) (C) K %.

I. Mineralogical Investigations

5. A. Gold (Au)

Six samples from the different anomalous radioactive facies of the Um Bogma Formation at the face of Allouga quarry were analyzed for measuring their gold contents. Anomalous contents of gold at Allouga quarry are recorded in the studied lithofacies bulk samples. The gold contents reach 1.78, 1.74, 2.02, 1.78 and 1.8 ppm in the ferruginous sandstone, dolostone, black shale, claystone and in gibbsite, respectively (Tab. 1).

Table 1: Gold concentrations in different lithofacies of the faceof Allouga quarry.

Age	Formation	Member	Lithofacies	Gold content (ppm)
Lower Carboniferous	**Um Bogma**	**Upper**	**Claystone**	**1.78**
			Gibbsite	**1.8**
		Middle	**Marl**	**1.6**
		Lower	**Black shale**	**2.02**
			Dolostone	**1.74**
			Ferruginous sandstone	**1.78**

5. B. Radioactive minerals

Sklodowskite [$Mg (UO_2)_2 Si_2O_7 . 6H_2O$]

This mineral occurs as granular grains ranging in color from yellow to pale orange with waxy luster and sometimes presents as prismatic acicular crystals or radial-fibrous aggregates ranging in color from yellow to greenish yellow with vitreous luster (Fig. 6). The X-ray diffraction diffractogram (XRD) shows that the separated sklodowskite grains are matching with the ASTM card No. (70-497). TheEDX data indicate the presence of U (22.19%), Si (34.17%), Mg (10.55%), Al (23.85%), K (5.58%), Fe (2.06%) and Ca (1.59%).

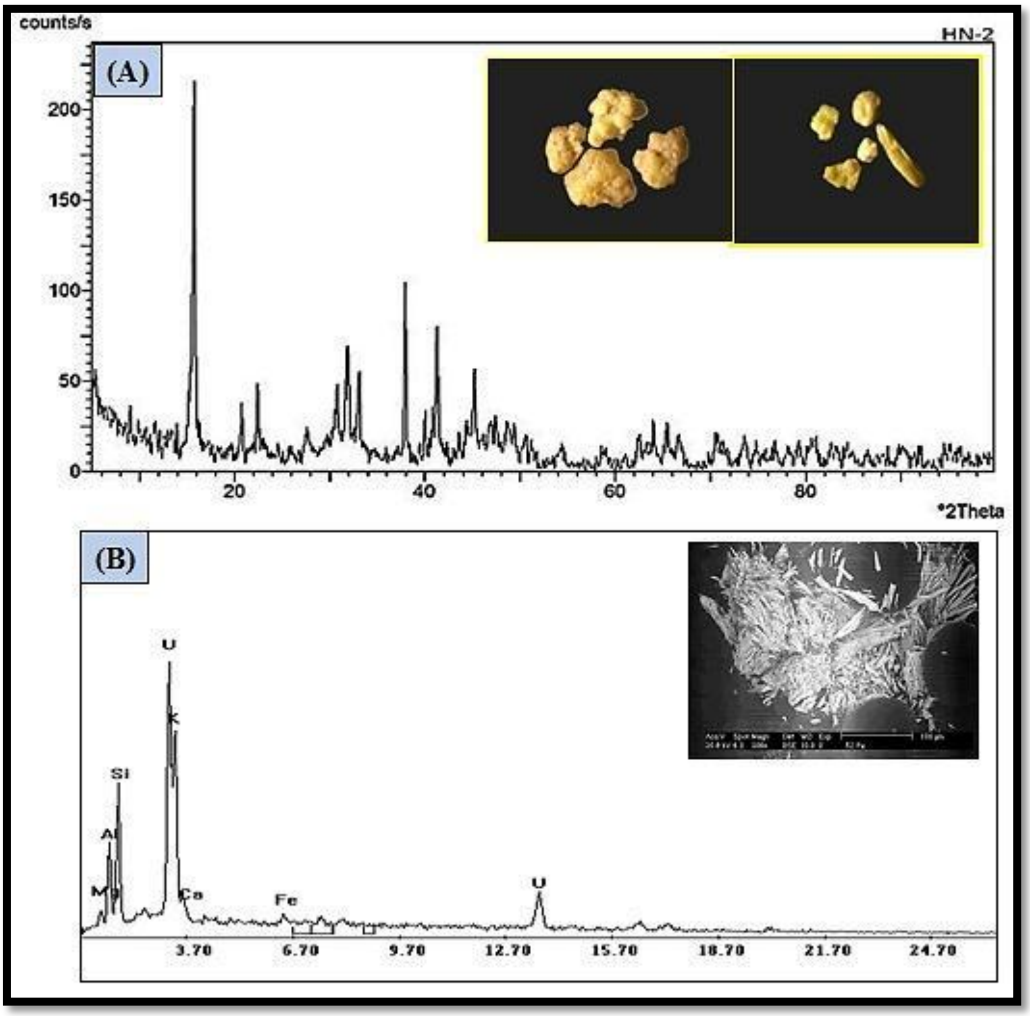

Fig. 6: Photomicrographs of sklodowskite, XRDpattern (A) and ESEM analyses (B).

Carnotite [$K_2(UO_2)_2 V_2O_8. 3H_2O$]

It occurs as crusts and flakes grains ranging in color from yellow to canarian yellow with dull and earthy luster (Fig. 7). The XRDshows that the separated carnotite grains are matching with the ASTM card No. (8-317) associating quartz and sklodowskite. The EDX data indicate the presence of U (15.55%), V (14.98%), K (15.47%), Si (10.62%), Mg (21.74%), Al (7.41%), Ca (12.22%) and Fe (2%).

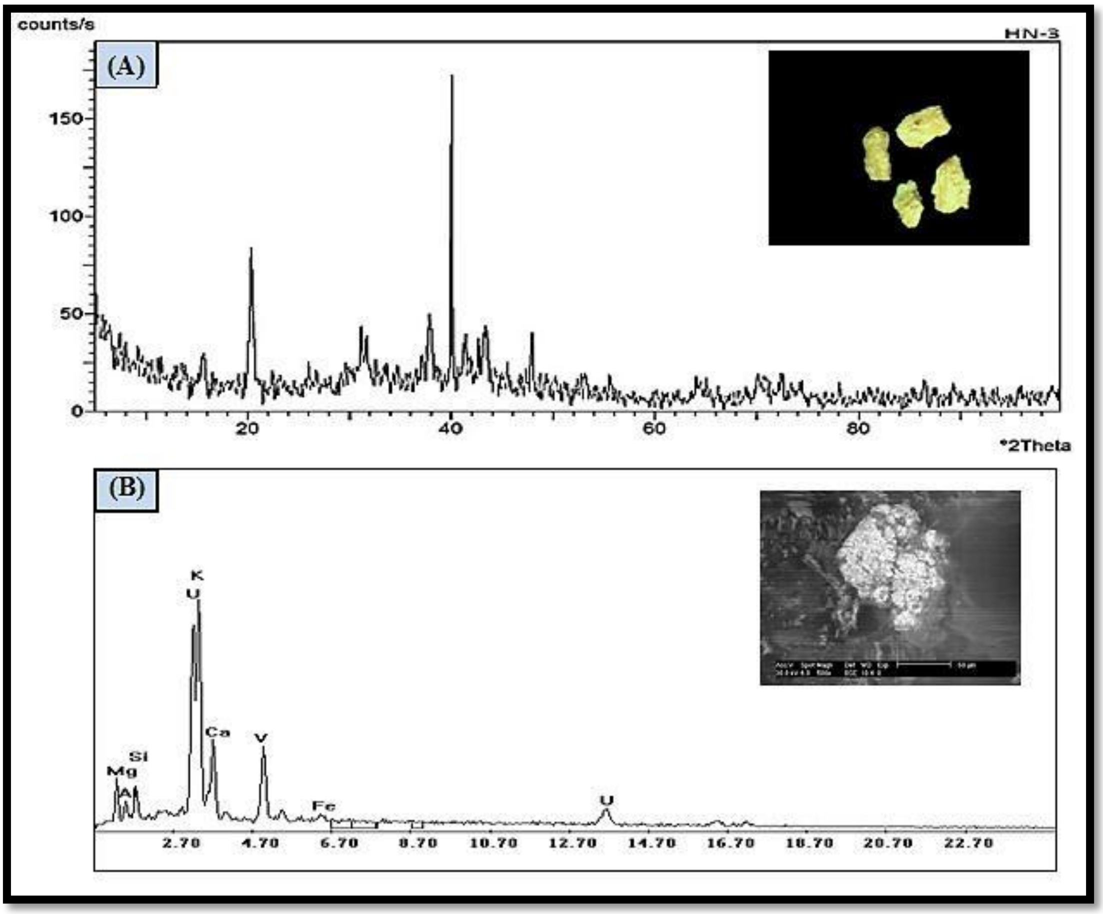

Fig. 7: Photomicrographs of carnotite, XRDpattern (A) and ESEM analyses (B).

5. C. Base metals minerals

Barite [$BaSO_4$]

Barite occurs as massive to granular grains ranging in color from yellowish honey to deep honey with vitreous luster (Fig. 8). The EDX data indicate the presence of Ba (47.82%) and S (52.18%).

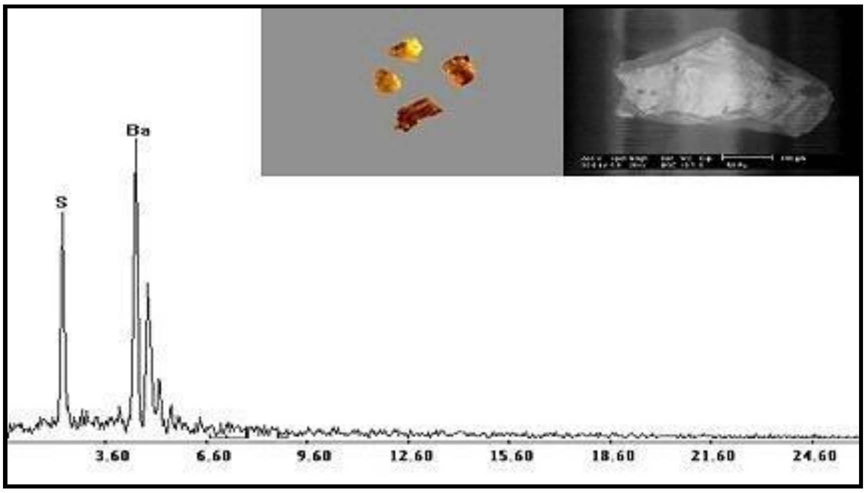

Fig. 8: Photomicrographs of barite and ESEM analyses.

Pyrite [FeS_2] and Chalcopyrite [$CuFeS_2$]

The separated grains of pyrite occur as cubic to massive crystals ranging in color from pale brass yellow to brass yellow with metallic luster (Fig. 9). The EDX data indicate the presence of Fe (34.81%) and S (65.19%). Chalcopyrite occurs associating pyrite crystals and disseminated in the wall rocks. It has a brass to golden yellow color with metallic luster (Fig. 6B).The EDX data indicate the presence ofCu (30.86%), Fe (31.57%) and S (37.57%).

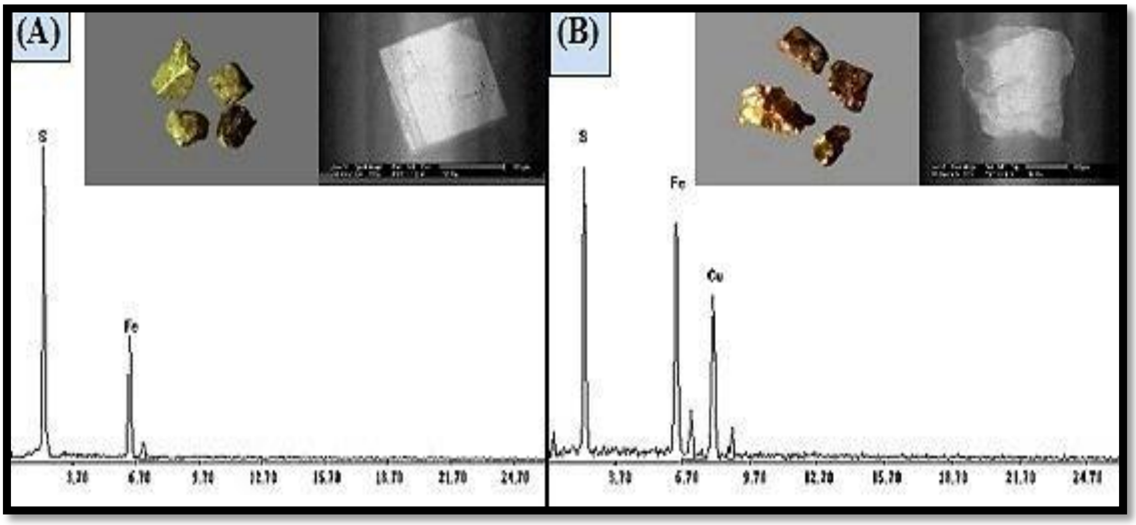

Fig. 9: Photomicrographs of pyrite and ESEM analyses (A) and chalcopyritewith its ESEM analyses (B).

Chalcocite [Cu_2S]

Chalcocite occurs as massive grains ranging in color from blue black to black with metallic luster (Fig. 10). The EDX data indicate the presence of Cu (51.07%) and S (48.93%).

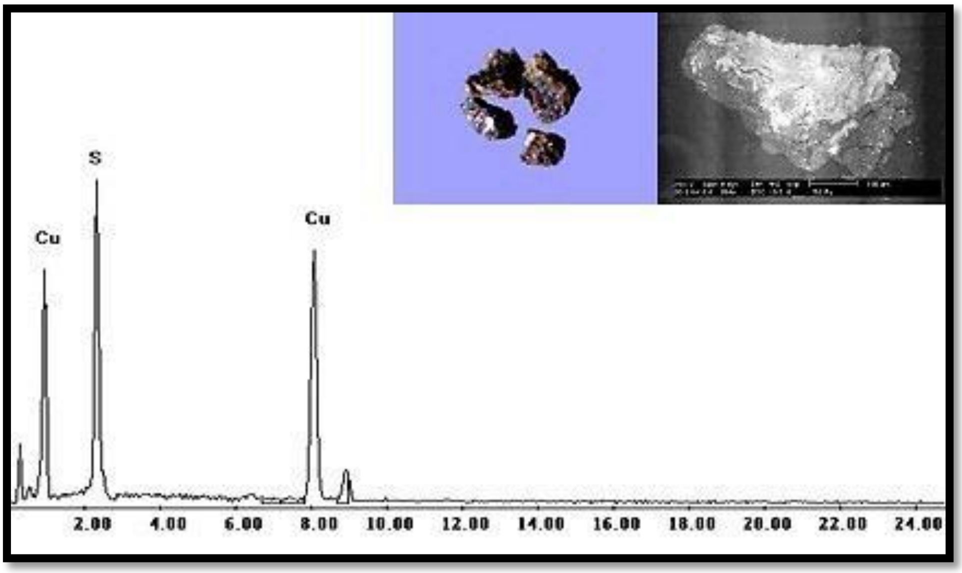

Fig. 10: Photomicrographs of chalcocite and ESEM analyses.

Malachite [$Cu_2 CO_3 (OH)_2$]

The separated grains of malachite occur as massive and granular forms ranging in color from bright green, with crystals deeper shades of green to dark green with vitreous luster. The X-ray diffraction diffractogram shows that the separated malachite grains are matching with the ASTM card No. (10-0399)(Fig. 11).

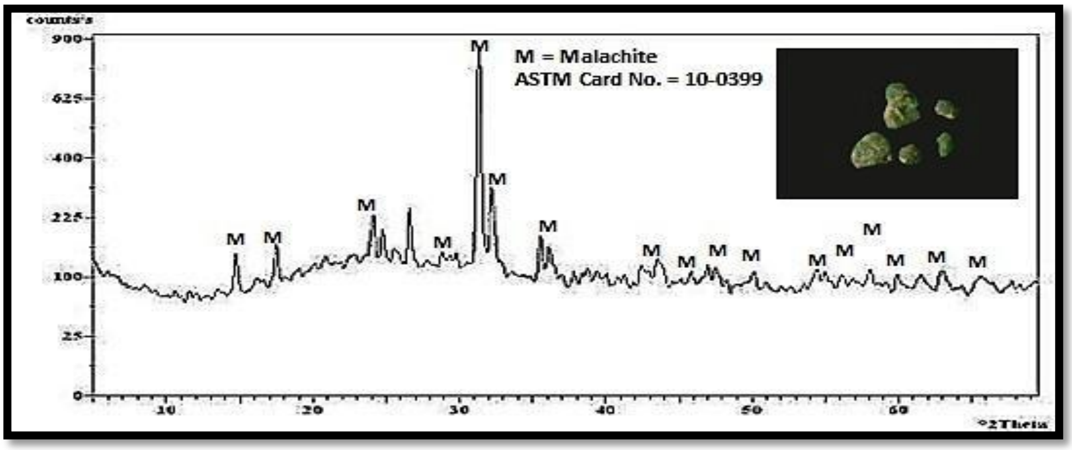

Fig. 11: Photomicrographs of malachite crystals and XRDpattern analyses.

Azurite [$Cu_3 (CO_3)_2 (OH)_2$]

It occurs as prismatic and tabular aggregates ranging in color from azure-blue to very dark blue with vitreous luster. The XRDshows that the separated azurite grains are matching with the ASTM card No. (72-1270) (Fig. 12).

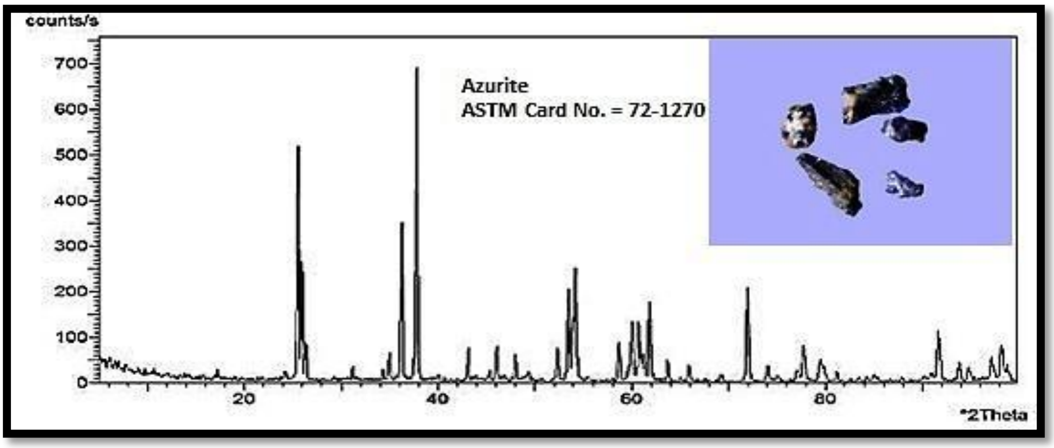

Fig. 12: Photomicrographs of azurite crystals and XRDpattern analyses.

5. D. Associated minerals

Zircon [$ZrSiO_4$]

It occurs as euhedral crystals and subrounded grains ranging in color from colorless to pale reddish brown with adamantine luster (Fig. 13). The EDX data indicate the presence of Zr (56.89%), Si (42.47%) and Hf (0.64%).similar data for zircon derived from the country alkaline younger granites have been given by Abdel-Karim (1999).

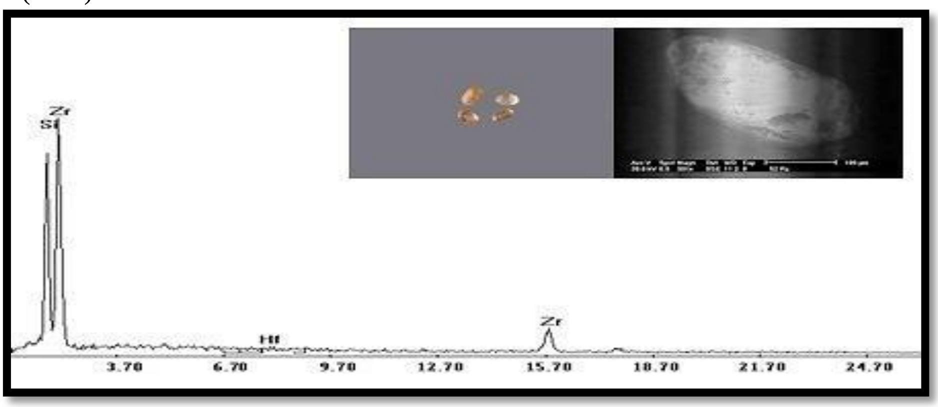

Fig. 13: Photomicrographs of zircon and ESEM analyses.

Jarosite [K Fe_3 $(SO_4)_2$ $(OH)_6$

It occurs as massive to granular form ranging in color from dark yellow to yellowish brown with vitreous to dull luster (Fig. 14). The EDX data indicate the presence of Fe (64.87%), S (22.85%), K (10.02%) and Al (2.26%).

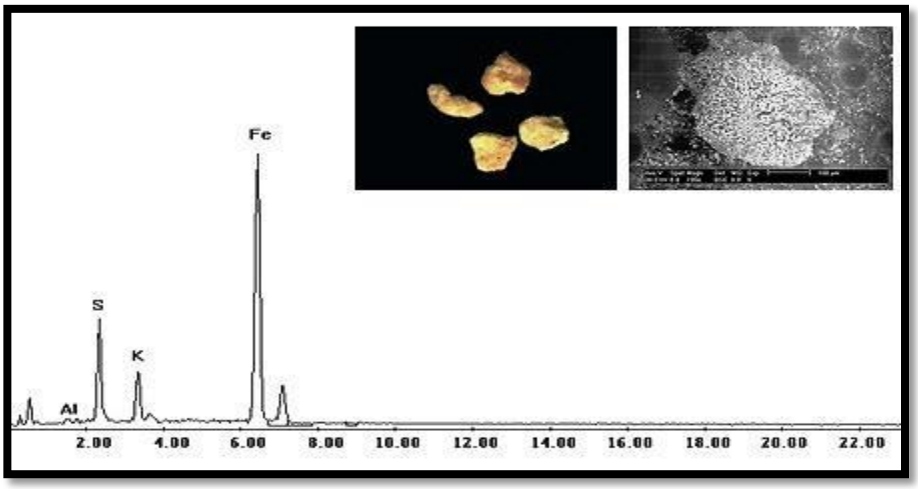

Fig. 14: Photomicrographs of jarosite and ESEM analyses.

Rutile [TiO_2]

The separated grains of rutile occur as elongated and subrounded in form ranging in color from pale red to deep blood red with adamantine luster (Fig. 15). The EDX data indicate the presence of Ti (89.01%) and Fe (10.99%).

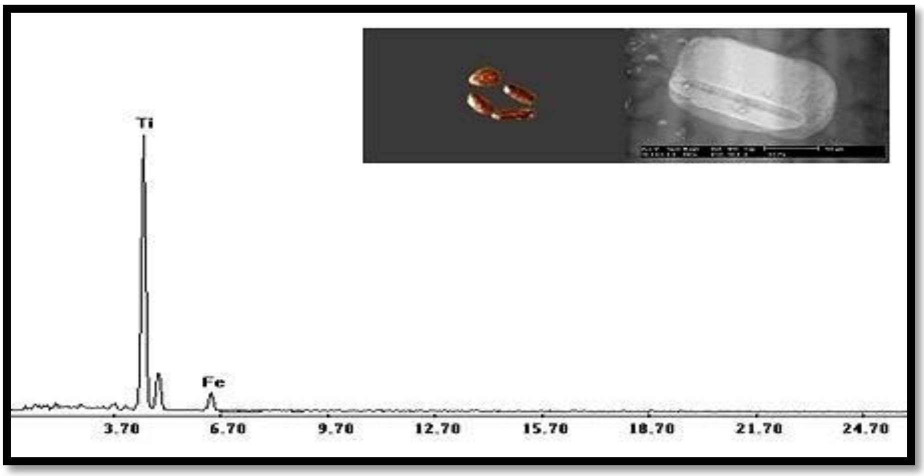

Fig. 15: Photomicrographs of rutile and its ESEM analyses.

II. Discussions

Allouga area located in low topographic area (basin) and affected by numerous faults, these important factors for accumulating the different minerals during the migration from the surrounding rock units (granitic and sedimentary) by the circulating water. The area of study constitutes a part from the Um Bogma basin which surrounded from all sides by granitic rocks.

Sallam, (2002) concluded that granitic rocks can be regard as the main feeder source for uranium anomalies and mineralization in Um Bogma Formation within Um Bogma basin and according to the migration out and in studies, all the formations and rock units except Um Bogma Formation are considered as U-source horizons (units) in the Um Bogma basin. The younger granite rocks have U migrated out 24.1 ppm with 180.2 % migration rate. So,the granitic rockscould be considered as the most important U-source units for anomalous horizon (Um Bogma Formation) in the study area.

The studied facies composed of; rich in iron oxides facies (ferruginous sandstone) carbonaceous material facies (dolostone, black shale andmarl), clay minerals facies (claystone) and rich in organic matter facies(black shale and gibbsite).

Carbonaceous material and/or organic matter is thought to be a key reductant contributing to the formation of large Au deposits (Aileen Mirasol-Robert et al. 2017). Au deposits are commonly associated with carbonaceous sediments suggesting carbon materials may be an important factor in Au concentration processes. Many gold deposits and indeed Au-bearing fluids occur in Proterozoic terrains with predominantly carbonaceous shale or sedimentary host rocks (Goldfarb et al., 2001).

Organic matter may potentially share a large number of intimate relationships with Au during its transportation, accumulation or deposition (e.g., redox or catalytic reactions, solubility changing complexations, co-transportation in hydrothermal fluids or co-accumulation in porous rocks; (Gize, 2000; Greenwood et al., 2013).Mira et al., (2006) concluded that the micro-organisms (organic matter) in gibbsiteof Um Bogma Formation play a major role in the absorption and precipitation of uranium and some metals at Um Bogma area.

So, the identified uraniumandgold in Um Bogma Formation at Allouga quarry may be leached and concentrated by the carbonaceous material, clay minerals and organic matter in addition to iron oxides presents in the different facies during transportation of U and Au from the surrounding rocks by means of circulating water.

The identified gold may be concentrated from the surrounding hydrothermal deposits as its high resistance to both chemical and physical weathering and its high specific gravity.The source of hydrothermal fluids probably derived from the Proterozoic basement rocks dominated in the studied area, which comprise younger and older granites. The younger granites are alkaline to peralkaline, Late- to Post tectonic granites (Abdel-Karim, 1992a, 1996). They are fluorite bearing (Abdel-Karim, 1992b), REEs-rich, and show affinity of A-type one (Abdel-Karim, 1999).

Also, Allouga area located within the zone of fault and the effect of the hydrothermal solution could be noticed in the formation of Mn-Fe ore deposits in the study area. Bishr and Gabr(2012) recorded some evidences of the hydrothermal solution effects in Abu Thor and TaletSeliem area (at the north of the study area) and they related the origin of the Mn-Fe ore deposits at these area to the hydrothermal solution. Sallam (2020) concluded that the origin of the Mn-Fe ore deposits at Allouga area is related to the hydrothermal solution.

The structure (faulting), lithology (carbonaceous material and clay minerals in addition to iron oxides), topography (low basin) and biogenic effects (organic matter) are the main factors that controlled the localization and concentrating of the uranium and gold minerals within the Um Bogma Formation in the Allouga area especially in Allouga Quarry. In addition to the secondary ascending hydrothermal solutions carry out the radioactive and gold minerals to deposit mainly along fractures and faults.

III. Conclusions

The Paleozoic sequence exposed in Allouga quarry area is beginning with Adedia Formation at the base followed by Um Bogma and Abu Thora formations.The lower member of Um Bogma Formation is the main rock units constituting the excavated face wall of the Allouga uraniferous quarry which extends about 30 m with about 10 m height.

The equivalent uranium content (ppm) of the study areareaches more than2600ppm in some spots located at the bottom of the face of quarry. The highest values are mainly located at the south part of the study area which is associated with black shale and dark gray dolostone of the lower member of Um Bogma Formation. Meanwhile, the lowest values areranging between 12 and 50 ppm representing small scattered areas. The intermediate eU zone is occupying a largest part of the Allouga quarry area. This zone varies in eU intensity from 50 ppm to 500 ppmrelated mostly to the ferruginous sandstone of the lower member of Um Bogma Formation and in some parts to the marl of the middle member of Um Bogma Formation.

The areaof the radiometric survey of the face of quarry trends nearly E-Wdirection with length about 29 m and average height about 6m.The contour maps for the wall of the quarry reveal that the uranium contents ranges from less than 100 ppm to more than 3000 ppm, eTh from less than 20 ppm to more than 190 ppm and K% from less than 4 to more than 35%.Sklodowskite and carnotiterepresents the main uranium minerals detected in the face wall of El Allouga quarry.

Anomalous contents of gold atAllouga quarry are recorded in the studied lithofacies bulk samples. The gold contents reach 1.78, 1.74, 2.02, 1.6, 1.78 and 1.8 ppm in the ferruginous sandstone, dolostone, black shale, marl, claystone and gibbsite, respectively.

The study proposed thatAllouga quarry not only uraniferous quarry but also could be considered as auriferous quarry. So, documentation and evaluation works of gold in the Allouga quarry should be done.So that, more samples must be collected and also moreboreholes must be drilled to evaluate the three diminutions of the gold body.

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