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## INFRA-CAMBRIAN PLACER GOLD-URANIFEROUS PALEOZOIC SEDIMENTS, SOUTHWESTERN SINAI, EGYPT

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### ABSTRACT

The present paper studied the stratigraphic succession of Infra-Cambrian Taba Formation overlain by Sarbit El Khadim, Abu Hamata, Adedia and Um Bogma formations. The distribution of Taba Formation at the study area comprises, Khaboba, Gabal Adedia, El Ferah, El Marahil, Gabal Hemeiyir and Ma'ein localities. Gold is recoded mineralogically and geochemically at Khaboba locality. Also the gold is recorded at the sandstone of Sarabit El khadim (4.5ppm) and the dolostone of Um Bogma Formation (9.7ppm). The radiometric survey recorded thorium in Taba Formation up to 700 ppm. Also, thorium is predominant in sandstone of Adedia Formation at Ras El Homara and Syniea. The chemical analyses recorded uranium up to 1000 ppm in sandstone of Adedia Formation at Sarbit El Khadim locality (Temple) for the first time.

### INTRODUCTION

The study area is located between lat. 28° 50'-29° 05' N and long. 33° 15'-33° 45' E. The Taba Formation nonconformably overlies the basement rocks and occupied by several laminae of conglomerate and coarse grained sandstone with kaolinite cement. Ammar et al., (2007) reported thorianite, uranothorite, cassiterite and zircon of basal conglomerate at Khaboba locality. Hassan et al. (2013) gives Infra-Cambrian to basal conglomerate of Taba Formation at Ghazalani area. The present study is assign to El Kelani and Said (1986-1990).

The lithology, structure and topography played an important role in localization of uranium and associated element. Salter (1868) was the first in identification and description of the Paleozoic sedimentary rocks in Sinai. The SW Sinai considered an important target for some economic ores as copper, coal,

kaolin, manganese, glass sand and recently REEs, uranium, thorium and gold. Thorium is associated with basal conglomerate of Taba Formation, also sometimes with sandstone of Adedia Formation and shale of Abu Hamata Formation. Uranium is associated with upper most part of sandstone of Adedia Formation and Um Bogma Formation. REEs are associated with Taba, Adedia, Um Bogma and Magharet El Maiah formations. Copper is dominant in green sandy shale (Abu Hamata Fm.) and marl, dolostone and claystone (Um Bogma Fm.). Kaolin and coal are associated with Magharet El Maiah Formation. Glass sand is represented in Abu Zarab Formation. Mn-Fe ore are associated with Um Bogma Formation especially within lower member and was discovered by Baurman (1869). The first radioactive anomalies were discovered by Abdel Monem et al. (1958).

For achieve the aim of the present study, four localities: El Sahu, Sarabit El Khadim,

Sidri and Abu Hamata are mapped radiometrically to follow up the uraniferous facies and delineate the high uranium content. On the other hand, five samples were analyzed for gold concentration representing basal conglomerate, sandstone, shale, ferruginous sandstone and dolostone. Eight samples were analyzed for major oxides and trace element, from Cambro-Ordovician and Lower Carboniferous sediments. The description of eighteen (18) uraniferous localities will be surveyed radiometrically and discussed (Fig.1).

## GEOLOGIC SETTING

### The Infra-Cambrian Sediments

Taba Formation overlies nonconformably the basement rocks and underlies the Sarabit El Khadim Formation which in some localities, the Sarabit El Khadim is direct rests on basement rocks. The present work assigned an Infra-Cambrian age to the Taba Formation. The Taba Formation consists of conglomerates intercalated with siltstone beds and gritty

sandstone Figs.(2&3) with kaolinitic matrix. The thickness of Taba Formation decreased toward the West to reach about 1.5m at Khaboba locality. It increased toward the East to reach about (17m) at Wadi Ma'ain. east of the study area.

The present work confirms the stratigraphic assignment of Infra-Cambrian to the Taba Formation (El Kelani and Said, 1986-1990). Infra-Cambrian base on the occurrence of Skolithus at south of Gabal Haithiat (through Saint Kathrine-Nuwieba high way).

### The Cambro-Ordovician Sediments

The Cambro-Ordovician sediments are represented by clastic sequence underlying the carboniferous rocks of Um Bogma Formation. Issawi and Jux (1982) used traced fossils and give these sediments Cambro-Ordovician age. Soliman and Fetouh (1969) subdivided these sediments into three formations: Sarabit El Khadim (3-27m), which comprises fine grained sandstones alternate with very coarse grained sandstones indicate braided stream

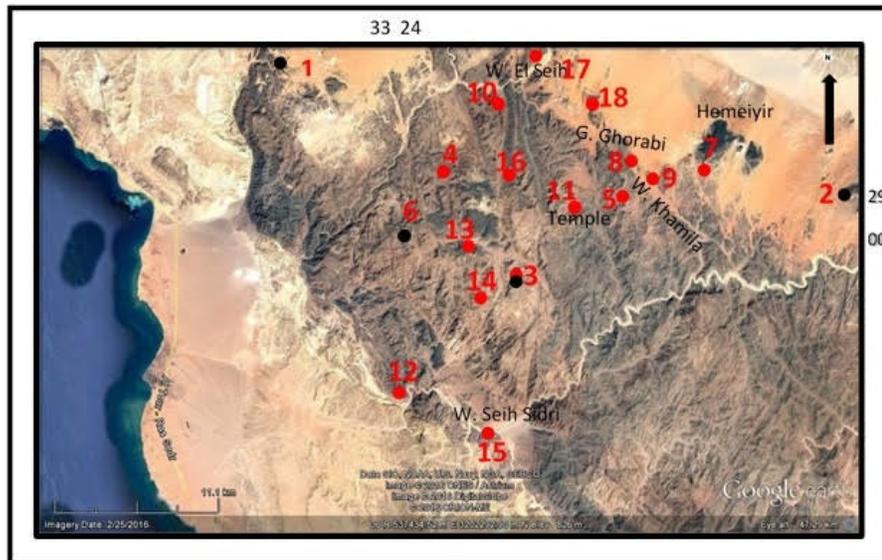


Fig.1:Google earth image shows the distribution of the studied localities



Fig.2:Trilobite mold at Abu Hamata Formation at Wadi El Seih locality



Fig.4:Basal conglomerate of Taba Formation at Ma'ain locality



Fig.3:Gritty sandstone of Taba Formation at Ma'ain locality.

depositional environment. It is conformable by Abu Hamata Formation (9.5-55m) which represented by three different units, two reddish sandy shale in between of them greenish sandy shale with copper mineralization. The present study recorded Trilobite mold (Fig.4) at Wadi El Seih north of the study area. The Adedia Formation (32-85m) overlies conformably by Abu Hamata Formation which consists of cross bedded sandstones, thickened, massive, jointed with very thin siltstone interbedded the sandstone.

#### Lower Carboniferous sediments

The Lower Carboniferous sediments are dominated by carbonates and conformably overlying clastic rocks. Weissbrod (1969)

gives Um Bogma Formation (8.5-66m) to the carbonate rocks. Alshami (2017) reported that Um Bogma Formation comprises seven facies, these facies are Fe-Mn ore, gibbsite bearing sediments, claystone, marl, dolostone, shale and ferruginous siltstone. Soliman and Fetouh (1969) subdivided the clastic sediments into El Hashash, Magharet El Maiah and Abu Zarab formations. El Hashash (17-51m) characterized by brown medium grained sandstone massive moderately hard and jointed, it is rest on Um Bogma Formation and characterized by the ripple marks at the surface of bed. Magharet El Maiah Formation (8-26.5m), is characterized by two or three horizon of sandy shale with sandstone intercalated. These shale is laterally change to kaolin at some localities as Um Temeiyim, Hazbar and Abu Hamata. The Abu Zarab Formation (12-110m) which conformable overlying the Magharet El Maiah Formation and characterized by presence of glass sand with some intercalated siltstone thin beds. The basaltic sheet and or sill is covered the succession, the thickness of basalt reach up to (40m) at Farsh El Azraq locality, and it found as two horizons from basalt at Wadi Abu Natash at the west of the study area. Some elements have high contents as in Tables 1&2.

#### Placer gold at Sw Sinai

Anomalous contents of gold are recorded in the studied lithofacies bulk samples

Table 1: Chemical composition of Lower Carboniferous sediments at Allouga and Moreid localities of the study area

<b>Oxides</b>	<b>Mo-2</b>	<b>Ag-1</b>	<b>Ag-2</b>	<b>M0-1</b>
<b>SiO<sub>2</sub></b>	<b>46.14</b>	<b>58.85</b>	<b>23.70</b>	<b>45.89</b>
<b>Ti O<sub>2</sub></b>	<b>0.07</b>	<b>0.95</b>	<b>0.41</b>	<b>0.84</b>
<b>Al<sub>2</sub>O<sub>3</sub></b>	<b>46.04</b>	<b>19.32</b>	<b>7.85</b>	<b>23.50</b>
<b>FeO</b>	<b>.66</b>	<b>7.64</b>	<b>6.41</b>	<b>15.59</b>
<b>MnO</b>	<b>0.13</b>	<b>0.09</b>	<b>1.22</b>	<b>3.83</b>
<b>MgO</b>	<b>0.54</b>	<b>2.71</b>	<b>18.14</b>	<b>2.54</b>
<b>CaO</b>	<b>0.10</b>	<b>0.09</b>	<b>39.08</b>	<b>0.49</b>
<b>Na<sub>2</sub>O</b>	<b>1.19</b>	<b>0.08</b>	<b>0.26</b>	<b>1.26</b>
<b>K<sub>2</sub>O</b>	<b>1.02</b>	<b>2.20</b>	<b>0.71</b>	<b>2.54</b>
<b>P<sub>2</sub>O<sub>5</sub></b>	<b>0.05</b>	<b>0.06</b>	<b>0.06</b>	<b>0.11</b>
<b>H<sub>2</sub>O</b>	<b>0.36</b>	<b>0.54</b>	<b>0.05</b>	<b>0.47</b>
<b>S</b>	<b>2.1765</b>	<b>6.7800</b>	<b>1.0783</b>	<b>0.2078</b>
<b>Cl</b>	<b>3534</b>	<b>160</b>	<b>603</b>	<b>3409</b>
<b>V</b>	<b>98</b>	<b>424</b>	<b>243</b>	<b>534</b>
<b>Cr</b>	<b>56</b>	<b>787</b>	<b>377</b>	<b>842</b>
<b>Co</b>	<b>183</b>	<b>354</b>	<b>133</b>	<b>2234</b>
<b>Ni</b>	<b>1278</b>	<b>237</b>	<b>112</b>	<b>1523</b>
<b>Cu</b>	<b>290</b>	<b>2031</b>	<b>2646</b>	<b>1408</b>
<b>Zn</b>	<b>7453</b>	<b>194</b>	<b>905</b>	<b>14519</b>
<b>Pb</b>	<b>1156</b>	<b>0</b>	<b>0</b>	<b>780</b>
<b>Ag</b>	<b>1</b>	<b>23</b>	<b>18</b>	<b>32</b>
<b>As</b>	<b>35</b>	<b>538</b>	<b>222</b>	<b>159</b>
<b>Sb</b>	<b>12</b>	<b>11</b>	<b>6</b>	<b>8</b>
<b>Sn</b>	<b>15</b>	<b>9</b>	<b>0</b>	<b>0</b>
<b>W</b>	<b>49</b>	<b>8</b>	<b>7</b>	<b>33</b>
<b>Sr</b>	<b>685</b>	<b>0</b>	<b>51</b>	<b>302</b>
<b>Ba</b>	<b>63</b>	<b>155</b>	<b>0</b>	<b>744</b>
<b>Y</b>	<b>12</b>	<b>73</b>	<b>53</b>	<b>110</b>
<b>Zr</b>	<b>59</b>	<b>684</b>	<b>140</b>	<b>360</b>
<b>Nb</b>	<b>6</b>	<b>53</b>	<b>18</b>	<b>45</b>
<b>Th</b>	<b>0</b>	<b>19</b>	<b>5</b>	<b>12</b>
<b>U</b>	<b>39</b>	<b>1110</b>	<b>314</b>	<b>78</b>
<b>Rb</b>	<b>7</b>	<b>0</b>	<b>0</b>	<b>91</b>
<b>Mo</b>	<b>14</b>	<b>16</b>	<b>28</b>	<b>79</b>

Table 2: Chemical analyses of dolostone at Allouga locality

<b>Compound formula</b>	<b>%</b>	<b>Compound formula</b>	<b>%</b>
<b>Major elements</b>		<b>Trace element</b>	
<b>Na<sub>2</sub>O</b>	<b>0.104</b>	<b>Mo</b>	<b>30.90</b>
<b>MgO</b>	<b>6.829</b>	<b>Ag</b>	<b>5.53</b>
<b>Al<sub>2</sub>O<sub>3</sub></b>	<b>4.647</b>	<b>Sb</b>	<b>6.07</b>
<b>SiO<sub>2</sub></b>	<b>10.921</b>	<b>Te</b>	<b>2.57</b>
<b>P<sub>2</sub>O<sub>5</sub></b>	<b>0.057</b>	<b>I</b>	<b>15.32</b>
<b>SO<sub>3</sub></b>	<b>2.313</b>	<b>Ba</b>	<b>3.50</b>
<b>K<sub>2</sub>O</b>	<b>0.726</b>	<b>La</b>	<b>39.21</b>
<b>CaO</b>	<b>23.952</b>	<b>Ce</b>	<b>76.74</b>
<b>TiO<sub>2</sub></b>	<b>0.552</b>	<b>Nd</b>	<b>33.13</b>
<b>V<sub>2</sub>O<sub>5</sub></b>	<b>0.126</b>	<b>Sm</b>	<b>10.02</b>
<b>MnO</b>	<b>1.933</b>	<b>Hf</b>	<b>4.95</b>
<b>Fe<sub>2</sub>O<sub>3</sub><sup>Total</sup></b>	<b>7.951</b>	<b>Ta</b>	<b>9.38</b>
<b>Co<sub>3</sub>O<sub>4</sub></b>	<b>0.052</b>	<b>W</b>	<b>1.84</b>
<b>CuO</b>	<b>2.394</b>	<b>TI</b>	<b>2.640</b>
<b>Pr<sub>2</sub>O<sub>3</sub></b>	<b>0.019</b>	<b>Pb</b>	<b>59.42</b>
<b>SrO</b>	<b>0.155</b>	<b>Bi</b>	<b>0.866</b>
<b>U</b>	<b>0.370</b>	<b>Th</b>	<b>14.028</b>
<b>L.O.I</b>	<b>36.8</b>		
<b>Trace element</b>			
<b>Sc</b>	<b>22.346</b>		
<b>Cr</b>	<b>98.6</b>		
<b>Zn</b>	<b>23.00</b>		
<b>Ga</b>	<b>3.787</b>		
<b>As</b>	<b>76.496</b>		
<b>Se</b>	<b>7.08</b>		
<b>Br</b>	<b>4.42</b>		
<b>Rb</b>	<b>14.40</b>		
<b>Y</b>	<b>23.77</b>		
<b>Zr</b>	<b>82.72</b>		
<b>Nb</b>	<b>8.73</b>		

(Table3). The fire assay analyses were carried out in analytical laboratory of Geologic Survey of Egypt. The gold content recorded abrupt and sharp decrease from 49 ppm in the basal bed representing the Taba Formation to reach 4.5 ppm in sample (SK) in the contact bed with the overlying Sarabit El Khadim Formation. However, gold content shows monotonous decrease upward with time of deposition during the Cambro-Ordovician sediment. It reaches 0.4 ppm in sample (AH) from Abu Hamata Formation then reaches 0.3

ppm in the sandstones of Adedia Formation (sample; AD). Then gold content increased upward at sandy dolostone of Um Bogma Formation (sample; D) where it reaches 9.7 ppm.

From the distribution curve of gold (Fig.5), the samples B and SK from Khaboba locality but the samples AH, AD and UB from Abu Hamata, Sarabit El Khadim (temple) and Allouga localities, respectively.

Mitchell and Garson (1981) suggest that the sedimentary basins which contain paleo-

Table 3: Gold distribution in different lithofacies of a the study area

Era	Fm	Gold content in ppm
Lower Carboniferous	Um Bogma	9.7
Cambro-Ordovician	Adedia	0.3
	Abu Hamata	0.4
	Sarabit El Khadim	4.5
Infra- Cambrian	Taba	49

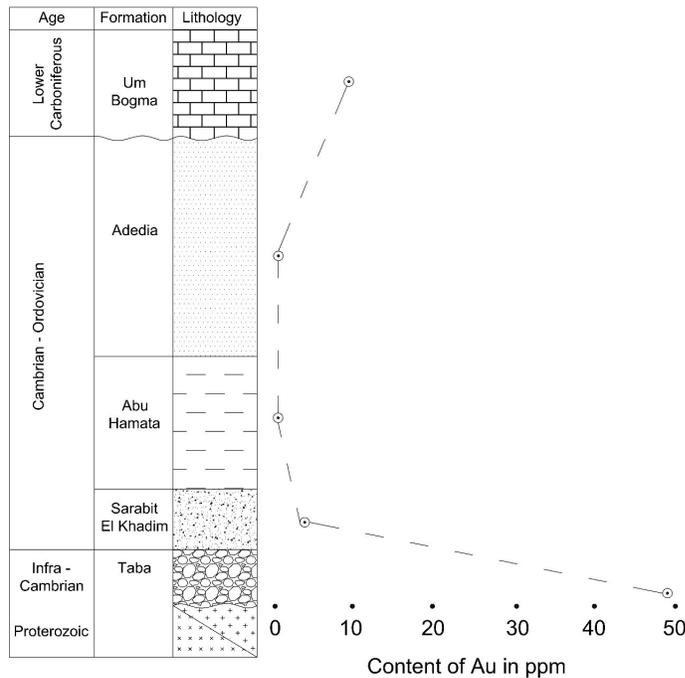


Fig.5: Vertical distribution curve of gold in SW Sinai Succession

placer may be formed in a tectonic regime which existed only in Proterozoic times. The characteristic features of these sedimentary basins are that they contain thick succession of dominantly shallow water terrigenous sediments and rest nonconformable on basement younger granite at Gabal Adedia, biotite schist at Khaboba area and older granit at Wadi Ma`ein.

The terrigenous sediments forming the bed containing (49ppm) gold representing the Infra-Cambrian Taba Formation of El Kelany and Said (1986-1990). So, the Taba Formation extended from Ras El Naqab at the Northeast Sinai where the thickness is 28.7m to 8m at Gabal Ghazalani near Sharm El Sheikh southeast Sinai and also, extended slightly to the west at Wadi Ma`ein, where the thickness is 17m, while it reaches 1.5m at Khaboba locality near the coast of the Gulf of Suez. Also, it is found at El Ferah, El Marahil and Gabal Hemeiyir area. The gold bearing Taba conglomerate could be considered paleo-placer gold which has been formed in tectonic regime existed in latest Proterozoic time

(Hassan et al., 2013). The sharp decrease in gold content in the younger formations at Abu Hamata Formation (0.4ppm) and Adedia Formation (0.3ppm) could be explained due to recycling of the gold bearing paleo-placers of Taba Formation (49ppm) during the younger ages of formations f the younger paleo-placer during Cambro-Ordovician and Lower Carboniferous.

The polished surface at basal conglomerate of Infra-Cambrian shows the specks of gold at both quartz (Fig.6) and cements of basal conglomerate. While the goethite is found as fine to medium grained and also found as aggregate, on the other hand the hematite is appear as fine to medium grained and some crystals is partially altered to goethite .

The ESEM patterns and backscatter image as well as the four analyzed EDX data carried out on the four chosen spots within the investigation mineral grain (Fig.7) shows (A) Au, (B) Zn mineral (C) Co, (D) Ba, and Fig. (8) Shows (A) Monazite, (B) Zr , (C) uranothorite, (D) wolframite. This mineralogical studies will be discussed in details later Figs. (6-9)

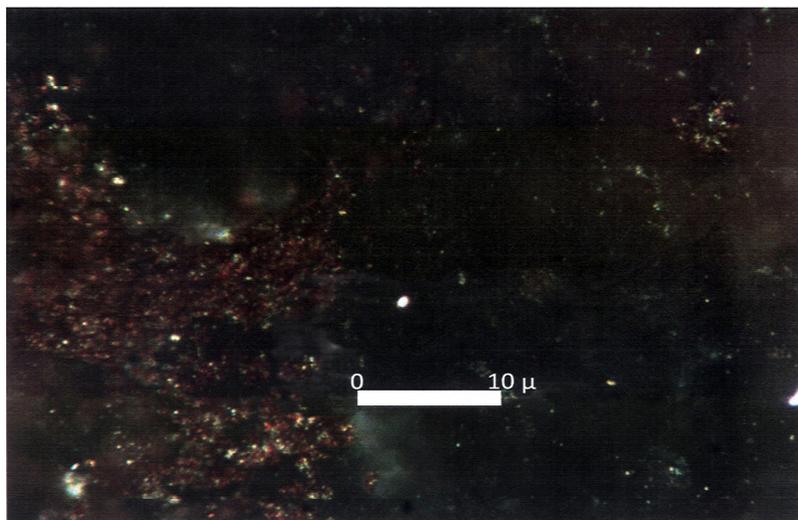
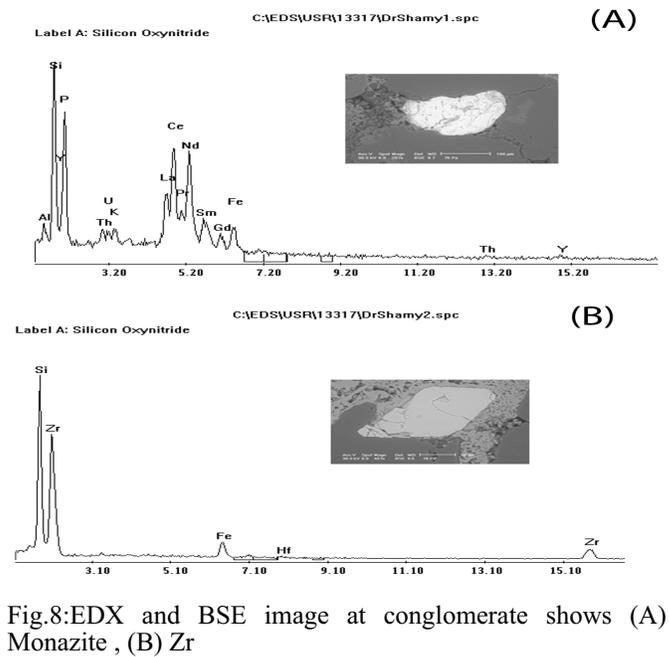
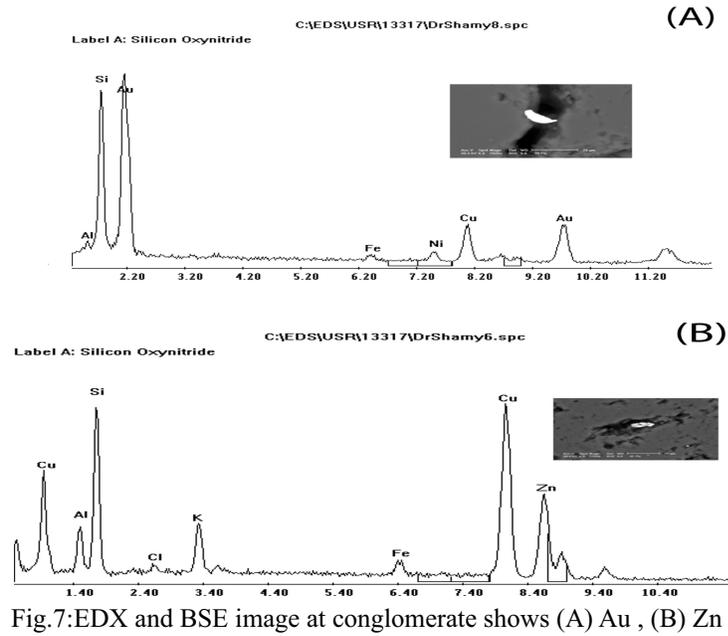


Fig 6:Basal conglomerate of the study area ,Photo showing specks of gold in gangue minerals, ,R.L



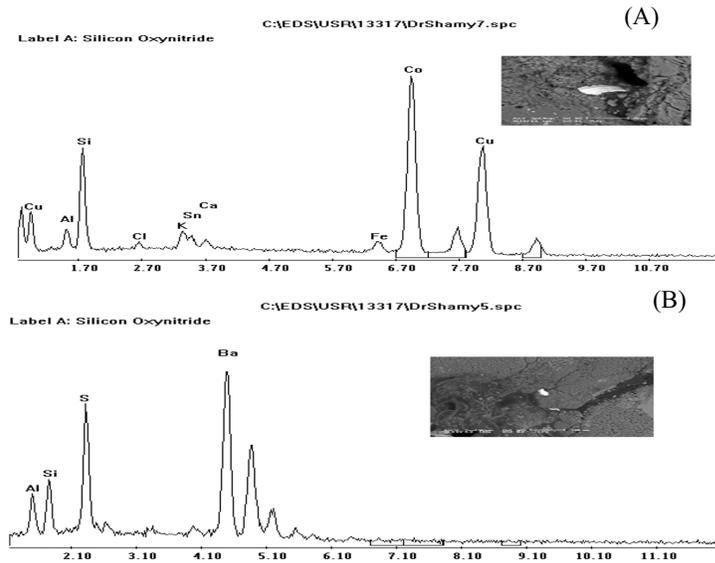


Fig.9:EDX and BSE image at conglomerate shows (A) Co , (B) Ba

#### Distribution of the uraniferous sediments at the study area

The uraniferous sediments are localized within variable facies as clastic and carbonate rocks. This study concerned with Cambro-Ordovician and Infra-Cambrian sediments.

The following paragraph shows the distribution of the uranium and its associated elements at some promising localities added the associated elements. The distribution of uraniferous sediments is differing from one locality to other in stratigraphic position, lithofacies and age.

#### Khaboba, Ma'ein and Gabal Adedia

The khaboba, Ma'ein and Gabal Adedia (site No. 1, 2, 3 on Fig. 1) are characterized by the Th which is predominant and comprises basal conglomerate of Infra-Cambrian of Taba Formation which ranging in thickness from 1.5-17m in the study area. eTh values are 2300, 695, 20 ppm at localities 1,2,3 in (Fig.1), respectively. But the high thorium

and gold contents concentrated at the bottom of basal beds.

#### Abu Hamata locality

Sometimes Th and U concentrate alternated their predominance, as in Abu Hamata Formation (site 4). At the green sandy shale facies the U is more concentrated and reaches to 101.9 (eU) ppm and eTh 19.6 ppm, while at reddish sandy shale facies eTh reach to 22.5 ppm and eU170 ppm.

#### Gabal Syniea and Ras Homara

Also, the Th is predominant at both Gabal Syniea and Ras El Homarah (site No. 5 and 6 on Fig.1) localities. These anomalies comprised in sandstones of Adedia Formation. The uraniferous sediments at Gabal Syniea appear as flat plateau near the floor of Wadi (Fig.10) and extended about (2km). eTh reaches to 582.6 ppm and the Th-bearing minerals exist as separate lenses, it is very easy to excavate and mined.

**Sarabit El Khadim (Temple)**

The Adedia Formation is considered a promising rock unit where the present study reported new uraniferous sediments extended tens meters with 3m thickness. The U content reaches up to 1000 ppm chemically. This uraniferous unit located at Sarabit El Khadim (temple) locality (site No.11, Figs.11&12) below the carbonate unit by 6m. This new records is very similar to the uraniferous sediments at Gabal Um Karasi in the south of the study area. Fawzy et al., (2015) found the U-bearing xenotime content reaches to 16.9%.



Fig.10:Gabal Syniea with flat uraniferous sediments.

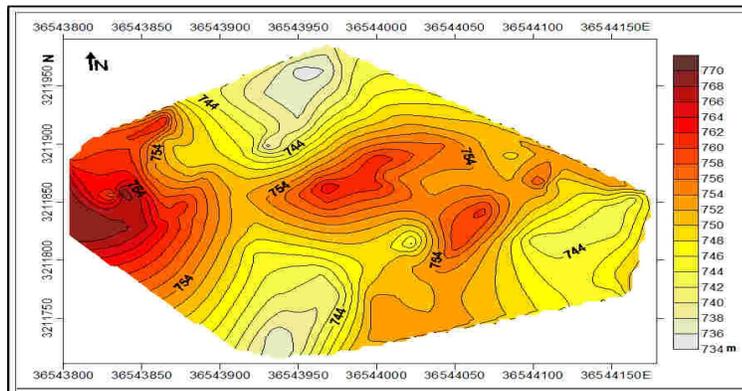


Fig.11:Topographic map of Sarabit El Khadim (Temple), Uraniferous sandstone of Adedia Fm., (first record)

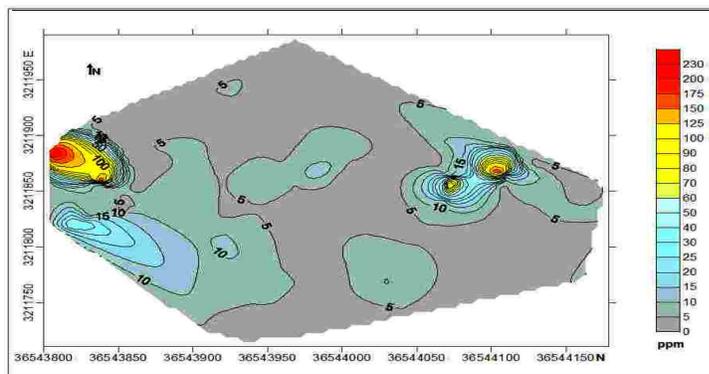


Fig.12:Radiometric map of Sarabit El Khadim (temple) Uraniferous sandstone of Adedia Fm., (first record)

The present study reported that this sandstone at Sarabit El khadim locality contains, Gd (252) Ppm, Dy (740) ppm, Ho (160) ppm, Er (540) ppm, Yb (400) ppm and Y (7000) ppm.

The structure controlling the localization of U at some sediments as following paragraphs:

**El Sahu**

the reverse fault at Wadi El Sahu (site No.13 on Figs.1,13-16), where the U is enriching and concentrated and reaches to 700 ppm chemically in ferruginous fine to medium grained sandstone of Adedia Formation.

**Wadi Khamila area**

The strike slip fault at the east of the study area is affecting on concentrate of U at Hemeiyir area. The area between Wadi Khamila and Gabal Hemeiyir is first record by the present study. Table (4) shows the chemical analyses for trace elements with high concentration of some elements as: Y, Cr, W, Sr and Ag which gives 6819,768,314,561 and 15 ppm respectively.

**Long Hill and Gabal Hemeiyir**

The basic dykes in the study area affecting on localization of U especially at the sandstone closed to the basic dyke as at Zobeir-Lehian (long hill), it reaches up to 140 ppm in sandstones of Adedia Formation while at Gabal Hemeiyir reaches to 180 ppm in sandstone of El Hashash Formation.

**Sidri basin**

The Sidri basin (site No.12, Fig.17-20) at south comprises sandstone of both Adedia and Um Bogma formations appear as uraniferous sediments. Alshami et.al, (2015), constructs the map for the part of this basin and found eU in the sandstone of Um Bogma Formation 1300 ppm. The present study recorded U at sandstones of Adedia Formation 330 ppm in the same locality. The Um Bogma

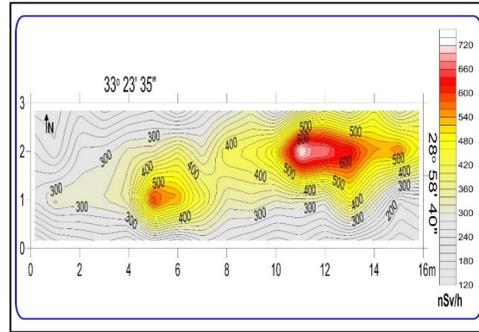


Fig.13:Radometric Th-map of El Sahu uraniferous sandstone of Adedia Formation

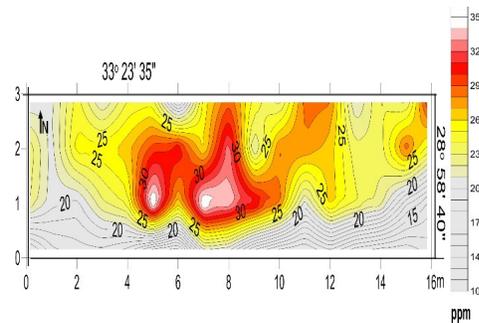


Fig.14:Radometric U-map of El Sahu uraniferous sandstone of Adedia Formation

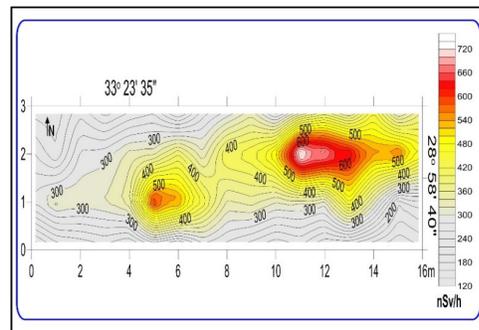


Fig.15:Topographic map of El Sahu uraniferous sandstone of Adedia Fm.

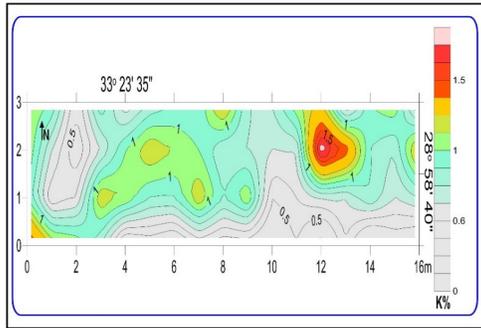


Fig.16:Radometric K-map of El Sahu uraniferous sandstone of Adedia Formation

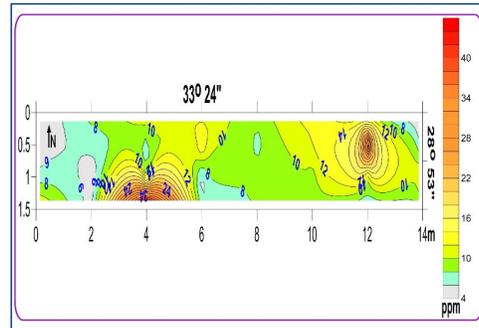


Fig.17:Radometric Th-map of Seih Sidri uraniferous sandstone of Adedia Fm

Table 4: Chemical composition of representative samples from Cambro-Ordovician sediments at Gabal Hemeiyir, Ghorabi, Khamila localities of the study area

Oxides	Km	Gh-1	Gh-2
SiO <sub>2</sub>	79.25	84.37	84.69
TiO <sub>2</sub>	1.1	0.27	0.27
Al <sub>2</sub> O <sub>3</sub>	7.20	8.27	8.13
FeO	6.45	4.69	4.65
MnO	0.06	0.01	0.01
MgO	.49	.45	0.45
CaO	2.61	0.67	0.68
Na <sub>2</sub> O	0.06	0.10	0.08
K <sub>2</sub> O	0.01	0.03	0.01
P <sub>2</sub> O <sub>5</sub>	0.95	0.31	0.31
H <sub>2</sub> O	0.50	0.45	0.36
S	0.1593	0.0559	0.0465
Cl	171	487	464
V	151	60	48
Co	120	27	40
Ni	255	58	60
Cu	30	21	21
Zn	0	0	0
Pb	57	73	78
Ag	15	10	4
As	71	30	28
Sb	4	7	10
W	314	85	53
Sr	561	281	282
Ba	342	32	27
Y	6819	1402	1407
Zr	618	180	187
Nb	216	44	45
Th	10	4	4
U	147	58	52

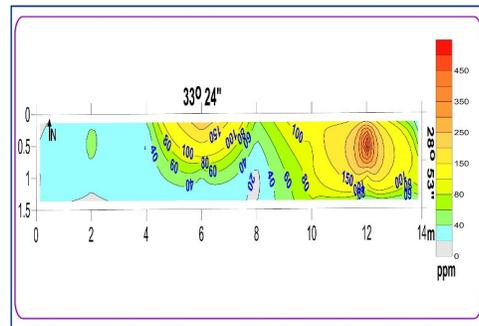


Fig.18:Radometric U-map of Seih Sidri uraniferous sandstone of Adedia Fm.

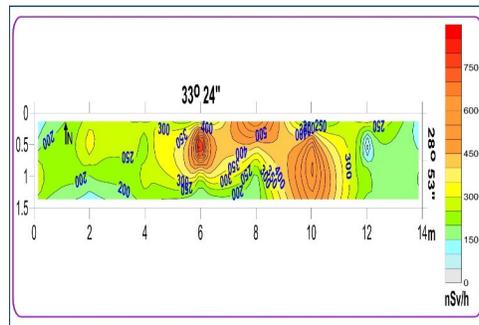


Fig.19: Topographic map of Seih Sidri uraniferous sandstone of Adedia Formation

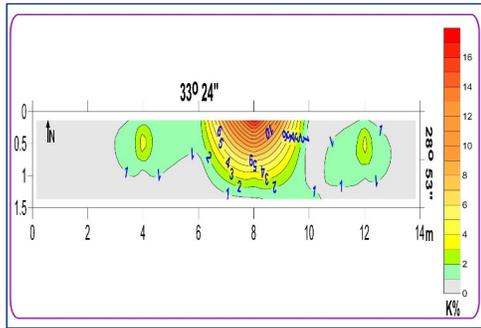


Fig.20:Radometric K-map of Seih Sidri uraniferous sandstone of Adedia Formation

The occurrences of U is found along NE-SW trend(Fig.1).

**MINERALOGY**

**Gold**

Gold almost has traces of silver, and may also contain traces of copper and iron. A Gold nugget is usually 70 to 95% gold. The mineral occurs as bright spots associated with copper and Ni. Au was measured by fire assay and contains about 49 ppm. Also it was confirmed by ESEM technique and associated with Ni and Cu. Au (56 wt. %), Cu (12.3wt.%).

**Titanomagnetite**

Titanomagnetite is present as accessory mineral and associated with magnetite and can help in fixation of uranium oxide from their uranyl solution as magnetite. Its color is black with metallic to submetallic luster. Titanomagnetite was confirmed by ESEM technique, and the EDX analyses give Fe (73 wt. %) and Ti (14wt. %).

**Thorite [(Th, U) SiO<sub>4</sub>]**

Thorite occurs as fine opaque grains. The ESEM analysis shows that it consists essentially of ThO<sub>2</sub>, which exceeds significantly UO<sub>2</sub>. According to Heinrich (1958), uranium content is usually present in amounts up to

Formation which represented the high uranium content with claystone (Fig.21). The radiometric maps were done to delineate the concentration of U, K and Th at four selected areas at Sarabit El Khadim, Abu Hamata, Seih Sidri and El Sahu (Figs.11-20).

Uranium minerals in the studied sediments exist in the form of oxides, oxyhydroxides, carbonates, silicates, phosphates, arsenates, vanadates, molybdates and sulphates, Alshami (2018a). These minerals encountered within the Paleozoic sediments of SW Sinai, especially at Mn-Fe ore, claystone, siltstone, gibbsite bearing sediments, dolostone, marl and shale of Um Bogma Formation.

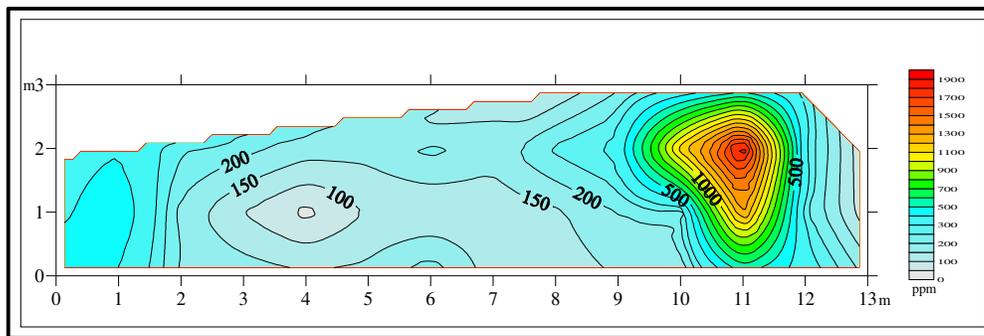


Fig.21:Radiometric map of Abu Hamata locality, claystone of Um Bogma Fm., uraniferous zone, (first record)

about 10% in this mineral. It is color black, to brown, with resinous to pitchy luster. Thorite was confirmed by ESEM technique and gave Th, (37.19 wt.%) U (6.8 wt.%), Si (17 wt.%) with traces of Zr (4 wt.%).

#### **Barite (BaSO<sub>4</sub>)**

Barite is the main ore of barium. Barite is isomorphous with celestite and may partially replace it. Barite color is variable but is commonly found as blue, green, yellow and red shades of tabular crystals. Barite was confirmed by X-ray diffraction and by ESEM technique, the EDX analysis show Ba (65.04 wt. %) and S (17.57 wt.%).

#### **Wolframite [(Fe, Mn) WO<sub>4</sub>]**

Wolframite is a principal ore of tungsten. It is an iron and manganese tungstate mineral; wolframite is actually a series between two minerals; huebnerite and ferberite. Huebnerite is the manganese rich end member while ferberite is the iron rich end member. Wolframite was confirmed by ESEM technique, the EDX analysis show W (72.89 wt. %) and Fe (3 wt.%).

#### **Monazite [(Ce, La, Th, Nd, Y) PO<sub>4</sub>].**

Monazite is a primary ore of several light rare earth metals most notably thorium, cerium and lanthanum. Monazite is radioactive, sometimes highly radioactive, and specimens are often metamict. Uranium may occupy some of the REE sites in monazite (Hughes et al., 1991). Its color is yellow to brown or orange-brown. It has been identified by ESEM as separated mineral grain. The EDX analyses give P (15.4 wt. %), Th (4.52), U (1.11), Y (4) and REEs (51.28).

#### **Zircon (ZrSiO<sub>4</sub>)**

Zircon occurs in igneous rocks as primary crystallization product, in metamorphic rocks and sedimentary rocks as detrital grains.

Zircon occurs as euhedral six-sided or eight-sided prismatic crystals. It is mainly colorless, pale yellow and violet. Also, some of the studied zircon grains show lengthening where a high fluid content causes the period of zircon crystallization to lengthen (Pupin et al., 1979). Some crystals show preferential growth of the pyramidal faces at the expense of the prismatic ones.

Pupin and Turcon (1975) and Vavra (1990) proposed that zircon shape is a function of the conditions or environment of crystallization. In particular, formation of the bipyramidal faces is related to slow crystallization, a capacity ratio and substitution by U, Th, REE and P, while the formation of the prismatic faces is a function of temperature and degree of zirconium supersaturation in the liquid. However, Speer (1982) concluded that it is difficult to relate the morphology to any one condition. Zircon was confirmed by ESEM technique, the EDX analysis show Zr (62.81 wt.%) and Hf (1.54 wt.%)

### **CONCLUSIONS**

The Infra-Cambrian Taba stratigraphic horizon consists of alluvial paleo-placer containing considerable content of gold. The Cambro-Ordovician sediments at SW Sinai consists of three formations. From the base: Sarabit El Khadim Formation where the gold is 4.5 ppm at fine to medium grained sandstone. The Abu Hamata Formation where the Cu mineralization is predominant as well as limited Th and U content. The Adedia Formation where the U, REE, and some associated elements are predominant such as Y, Pb, Cr, W, Sr, Ni, Ba, As, Zr.

This study focused on some promising localities for Th, U and Au. The uranium is predominant at Gabal Hemeiyir, Gabal Ghorabi, Khamila, Long Hill, Temple, Seih Sidri, El Sahu, Um Karasi, Abu Alaqa, El Lehian, El Seih, Ramlet Hemeiyir. The thorium is predominant at Khoboba, Ma'ain, Syniea and Ras El Homarah localities. At Wadi Abu Ha-

mata sometimes the uranium is predominant and other the thorium is predominant within Abu Hamata Formation.

Thorium and gold are predominant in basal conglomerate of Taba Formation. While uranium is predominant in sandstones of Adedia Formation with depletion of Au at Gabal Adedia locality. A new occurrence is recorded for ferruginous sandstones of Adedia Formation at Gabal Sarabit El Khadim locality (Temple). This uraniferous zone extended tens meter and localized as small lenses. eU reaches up to 1000 ppm in some part of this uraniferous zone.

The ESEM patterns and backscatter image as well as the eight analyzed EDX data carried out on the eight chosen spots within the investigation mineral grain shows Au, Zn, Co, Ba, Monazite, Zr, Uranothorite and Wolframite.

The newly discovered uranium and gold ore deposits are considered additional economic values to the area of SW Sinai.

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## تسجيل مرافد ذهب وكذلك طبقات غنية باليورانيوم في البروتيروزوى المتأخر والباليزوى، جنوب غرب سيناء، مصر

عبد الله سليمان الشامي

تحتوى منطقة الدراسة على صخور عصور ما قبل الكامبرى والباليزوى. وقد اثبتت الدراسة وجود متكون طابا لأول مرة فى منطقة الدراسة وذلك بمقارنته بمثيلاته فى جبل غزلانى ورأس النقب. ومن خلال هذه الدراسة تم تسجيل ثلاث نطاقات جديدة تحتوى على الذهب وهى:

- متكون طابا والى يتكون من الكنجوميرات وتصل فيه نسبة الذهب إلى ٤٩ جزء فى المليون.
- متكون سراييط الخادم ونسبة الذهب فيه ٤,٥ جزء فى المليون.
- متكون ام بجمة ونسبة الذهب فى الدولوستون ٩,٧ جزء فى المليون.

ومن جهة اخرى فقد تم اكتشاف نطاق يحتوى على اليورانيوم بنسبة ١٠٠٠ جزء فى المليون فى منطة سراييط الخادم (المعبد) وتمتد عشرات الامتار بسمك حوالى 3متر.

وكذلك اكتشاف منطقة جديدة ما بين جبل حمير ووادى خميلة تحتوى على يورانيوم بنسبة ١٤٧ جزء فى المليون وتحتوى على عناصر مصاحبة مثل الإتريوم والكروم والتنجستن والاسترنشيوم والفضة بنسب ١٥,٥٦١,٣١٤,٧٦٨,٦٨١٩ جزء فى المليون على الترتيب.

وهذا العمل يمثل بداية ويحتاج الى دراسات استراتيجرافية حقلية ومعننية ورايوميتريية لتتبع هذه النطاقات المختلفة سواء مع روسب الذهب القديمة او اليورانيوم.