

Gold Mineralization Discovery in Umm Sagata- Qala En Nahal areas, Gadarif State - Eastern Sudan.

By

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SUBJECTS OF SEMINAR

- 1. ABSTRACT**
- 2. INTRODUCTION.**
- 3. GEOLOGY.**
- 4. GEOCHEMISTRY.**
- 5. CONCLUSIONS AND.
RECOMMENDATION.**



1- Abstract:

- * A low density stream sediments survey has been conducted in Umm Saqata- Qala En Nahal area, Gadarif State – Eastern Sudan.
- The aim of the study is to explore for **gold** and associated elements using a cost and time effective exploration method, in a low grade non explored Pan- African volcanosedimentary -greenstone belt.
- An orientational study has been conducted to determine the optimum fraction (grain size) for sampling in a rich Savanna zone.
- About 12 samples have been collected from a mineralized locality and sieved for $-125\ \mu\text{m}$ and $-63\ \mu\text{m}$.
- Both of the fractions have been analyzed for gold using wet chemical technique with detection limit 2 ppb.
- Trace elements have been determined using Aqua- regia - ICP technique.
- concentrations of gold mineralization and a associated elements are typically found in the finest grain size fraction (silt and clay, $-63\ \mu\text{m}$).
- As it is the first time to conduct such survey in the study area a number of **gold anomalies** have been recorded.
- After selecting the right fraction the Umm Saqata – Qala En Nahal area has been fully geochemical surveyed at a density of 1 sample per 7 to 10 Km².

2. INTRODUCTION:

- The study area covers most of Umm Saqata - Qala En Nahal area in the southwestern part of El- Gadarif State, Eastern Sudan.
- The area investigated is about **2450 Km²** largely bounded by Longitudes 34° 35` and 35° 13` E, and Latitudes 13° 18` and 13° 43` N (Fig. 1) adjacent to the border line between the Sudan and Ethiopia.
- The region is generally a flat plain with a thick cotton soil cover.
- The maximum elevation is about 300 m above the surrounding plain recorded in Jebel Ganam.
- The area lies within the rich Savanna climate zone, with rainy season from end of April to October.
- The rainfall ranges between (900 to 500) mm, the average rainfall is about 550 mm.
- The dry season extends from November to April.
- The average of minimum temperature 17°C in January and the maximum average are 47°C in April.



- The drainage pattern is dendritic to sub dendritic and characterized by first, second and third order streams and some drainage shows a rectangular pattern which may explain certain second structures such as shears, faults and foliations, or primary structures such as cooling joints (Fig. 2).
- The area is drained to the River Rahad. A local watershed trends NE – SW following the oriental of the Mafic – Ultramafic and volcano-sedimentary units which form remarkable topographic features surrounded by extensive semi flat cotton soil plains in the water courses are meandering.
- Climate conditions, topographic features and geomorphologic characteristics of terrain are very important for geochemical survey.



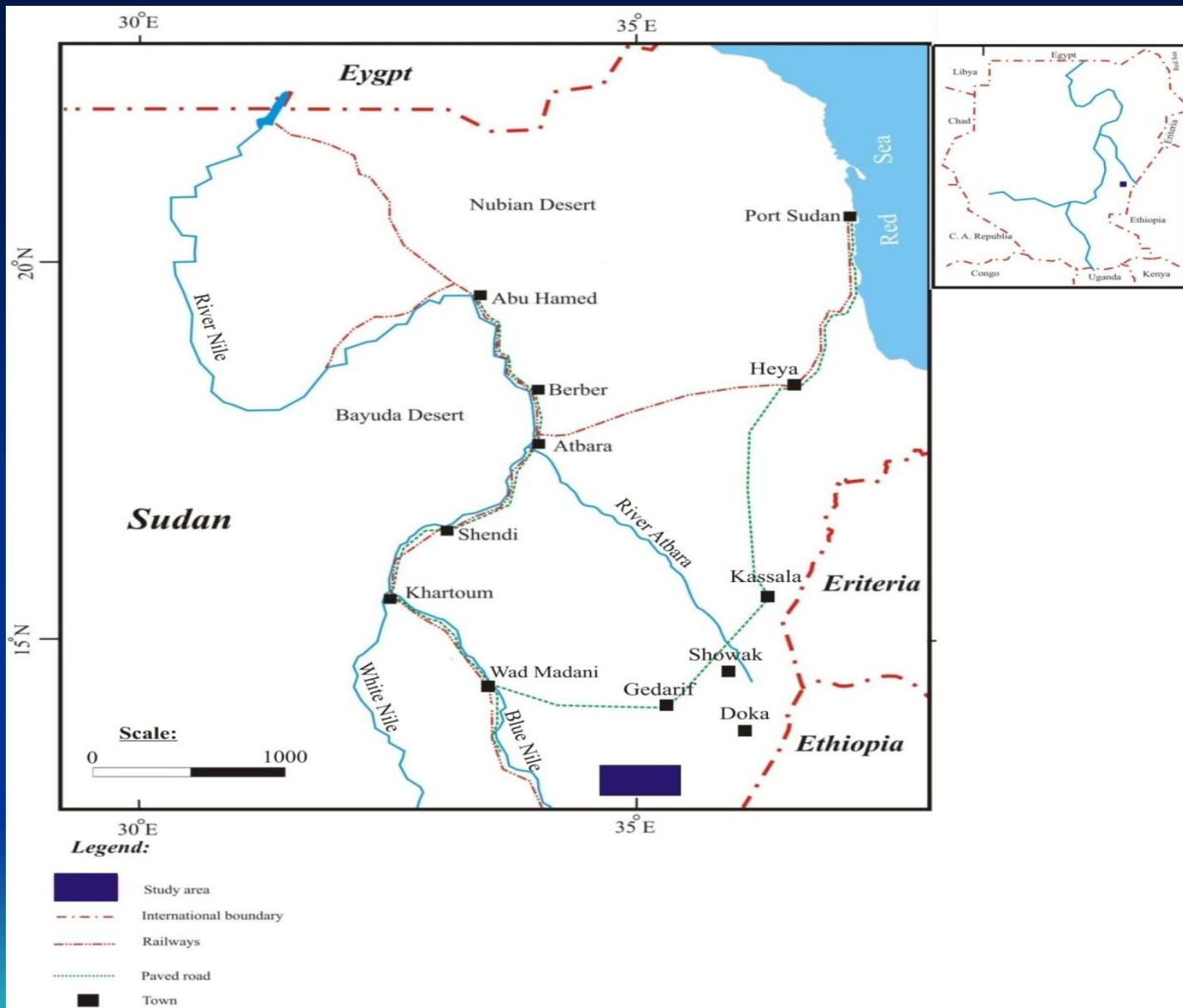




Fig. (1): location map of the study area.

3. GEOLOGY

The study area is an important link between the northern and southern terrains of the late Proterozoic Pan- African Arabian Nubian Shield.

- Geological information of Qala En Nahal – Umm Saqata area is very limited.
 - Hunting Geology and Geophysics Company (1969) mapped the area of Qala En Nahal.
 - The stratigraphy of the basement complex in Umm Saqata – Qala En Nahal area was correlated with the other part in Sudan by Whiteman (1971).
 - Babiker (1977) reported on aspects of the ore geology of Sudan with reference to the chromitiferous ultrabasic rocks of Ingessana Hills.
 - The Chromite Geological Technical Team (C.G.T.T., 1977) from peoples Republic of China and the Sudan Geological Survey set the first systematic geological maps for chromiteferous ultrabasic rocks on a 1:50,000 scale maps.
 - (Mustafa, 1994) reported on the economic potentialities of industrial minerals and rocks in Qala En Nahal and Umm Saqata areas.
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- The study area is comprises isolated hilly outcrops within intervening clay-covered plains.
 - **The main rock units** as classified and described by previous authors (Hunting Geology and Geophysics Company, 1969; Whiteman, 1971; Babiker, 1977; Mustafa, 1994) Include:
 - **Ophiolitic mafic-ultramafic masses known as Qala En Nahal - Umm Sagata Ophiolitic Complex, structurally overlying, a layered sequence of low-grade volcano-sedimentary units.**
 - **Syn- to late and post- orogenic granitoid complexes intruded the above- mentioned sequences.**
 - **Tow generation of quartz veins have been observed associated with syn and post orogenic magmatic events as show in (Fig. 3).**
 - **The Mafic – Ultramafic rocks comprise a dismembered ophiolite complex which represents the oldest units in the study area.**
 - **The ophiolite has been thrust over a low grade metavolcanosedimentary sequence.**
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- The Mafic- Ultramafic rocks are mainly **serpentinites** and can easily be picked and identified in ETM+ Landsat images by fine texture occurring as hilly liner outcrops trending NE-SW (**Fig. 4**).
- In this study the mafic-ultramafic masses have been found to include from bottom to top:
- A basal chromiteferours ultramafic tectonite of highly serpentized facies; overlain by mafic-ultrmafaic cumulate rocks comprising peridotite and pyroxenite grading upward into layered gabbro often containing plagiogranite differentiates at the top.





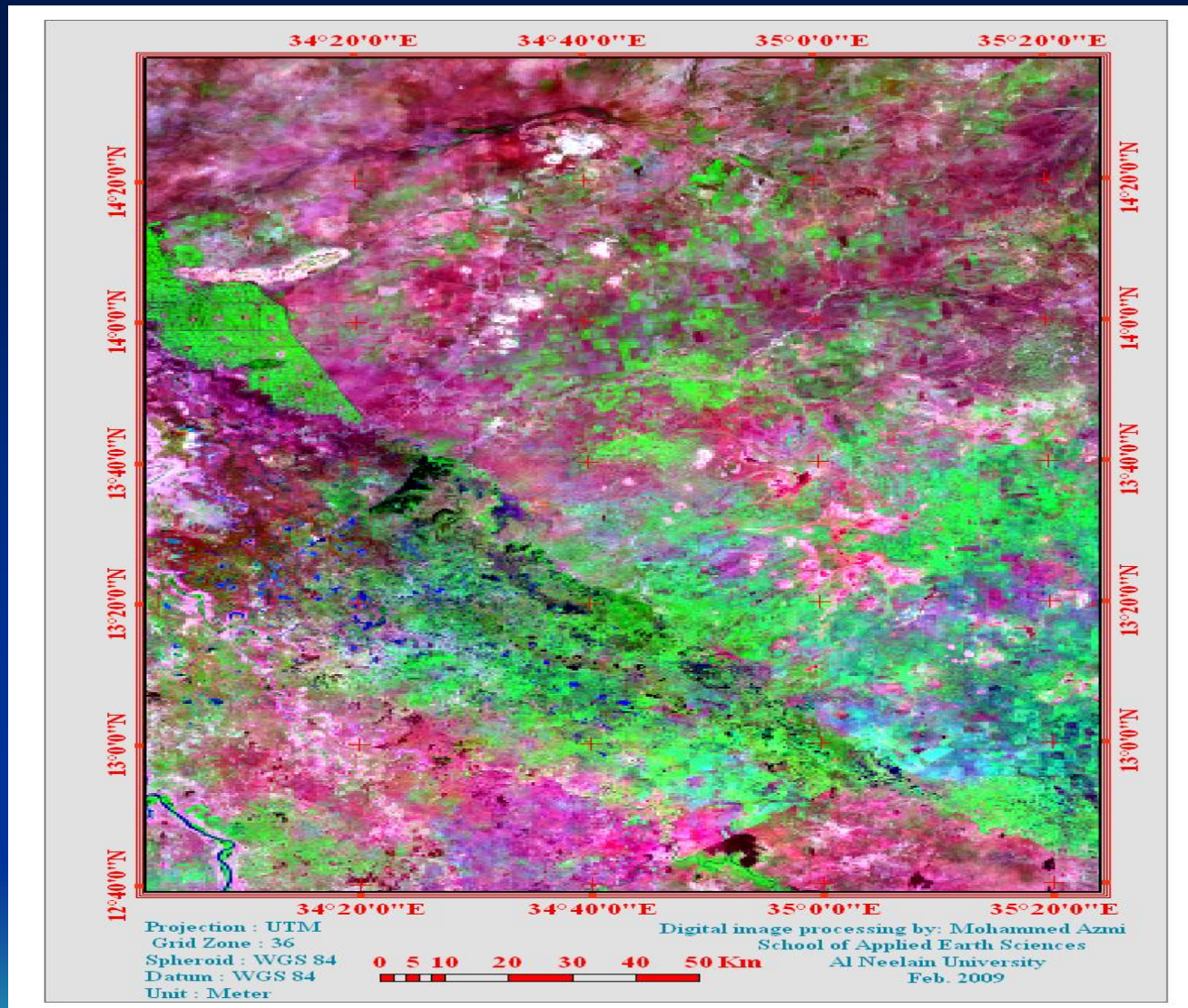


Fig. (4): Land Sat image of Umm Saqata – Qala En Nahal ETM+ (bands 7, 4 & 1 in R, G and B).

- The low grade volcano-sedimentary sequence is structurally the lower most units in the study area. It comprises different lithologies including quartz sericite schist, quartz biotite schist, pyritiferous quartz schist, chlorite schist all intercalated with metachert and thin lenses of layered marble.
- The syn-orogenic granites occur at the outer sides of the ophiolite complex, e.g. at Jebel Beila (**Fig. 3**). They are easily distinguished in Landsat ETM+ by their light-reddish brown colour and coarse texture.
- These rocks form hilly outcrops with three sets of cooling joints and onion skin weathering pattern.
- Beila granite shows well developed foliation and cut by pegmatite dykes.
- The younger granite intrusions occur as reddish rounded circular shaped in satellite imagery, and represented by J. Ban and J. Balos (**Fig. 3**). They are so named because they post-date the deformation.
- They occur as scattered hilly outcrops with three sets of cooling joints, and they show xenoliths from syn-orogenic granites. These rocks are leucocratic coarse-medium grained in texture, and are composed of feldspar, quartz and minor ferromagnesian minerals



- **Quartz veins** are mainly distributed where the metavolcanosedimentary rocks are exposed. They vary in size. Quartz ridges East of Qala En Nahal town reaches 100 m in height, 200 m in length and 30 m in width.
- Generally, the quartz veins and ridges trends coincide with the schistosity of the metavolcanosedimentary rocks (**NE - SW**).
- **They are two generation of quartz veins and ridges;**
- one of them is old and synchronized with the syn-orogenic granite, this one is ferriginated, brecciated, folded and faulted which indicate that these veins effected by the tectonic events.
- The other one emplaced as late stage magmatic products associated with younger granitic intrusion.



4- GEOCHMISTRY

METHODS OF INVESTIGATION

- Previous geological maps and information have been compiled on satellite imageries.
- 1:250,000 base maps have been prepared for Umm Sagata and Qala En Nahal areas.
- Remote sensing digital data have been processed to produce images for mapping, location purposes and roads for sample collection.
- A Color composite image of band 7, 4 & 1 in R, G and B respectively used as the best combination image for geological interpretation of the study area (**Fig. 3**), and
- Hydrographic and liniment maps have been prepared using Digital Elevation model (DEM) and satellite imageries using PCI GEOMATICA 9 and RIVER TOOLS (**Fig.2**).
- Remote-sensing data are especially useful for these studies because they can frequently reveal invisible hydrographic features and hidden spatial pattern (Bokhari, 1995).
- Drainage patterns conform to some degree to the regional slope of the terrain, and to its underlying geological structures.



- For the orientation study, selection of streams to be sampled was based on mineralized areas, these mineralized localities discovered by heavy concentrated minerals samples, which collected from khors around Umm Saqata and Quala EN-Nhel area.
- Approximately 35-50 kg of gravel to sandy alluvial sediment has been collected from these khors and panning at River Rahad.

The Heavy concentrated minerals show **gold grains (panning test)**.

- Recently these localities have been artisanal mining as show in **(Plate 1)**.
- A total of 12 stream sediment samples were collected from Umm Sagata area during the sampling period (March 2009), mainly in the mineralized areas **(Fig.5)**.



- The distance between sample stations varied from 1 Km to 10 Km.
- At each site, where possible, 2 – 3 Kg samples were collected, comprising material for 3–1 pits at the sampling point (depending on the width of the active channel) in order to minimize within-site heterogeneity.
- Sample depth was usually 10–15 cm to minimize the possibility of surface contamination.
- Each sample was sieved using a number of stainless steel screens to obtain the $-125\ \mu\text{m}$ and $-63\ \mu\text{m}$ fractions in the field, then stored in bags and send to OMAC laboratories in Ireland to analyzed gold and trace elements.





Plate (1): Shownig artisanal mining in Umm Sagata area.

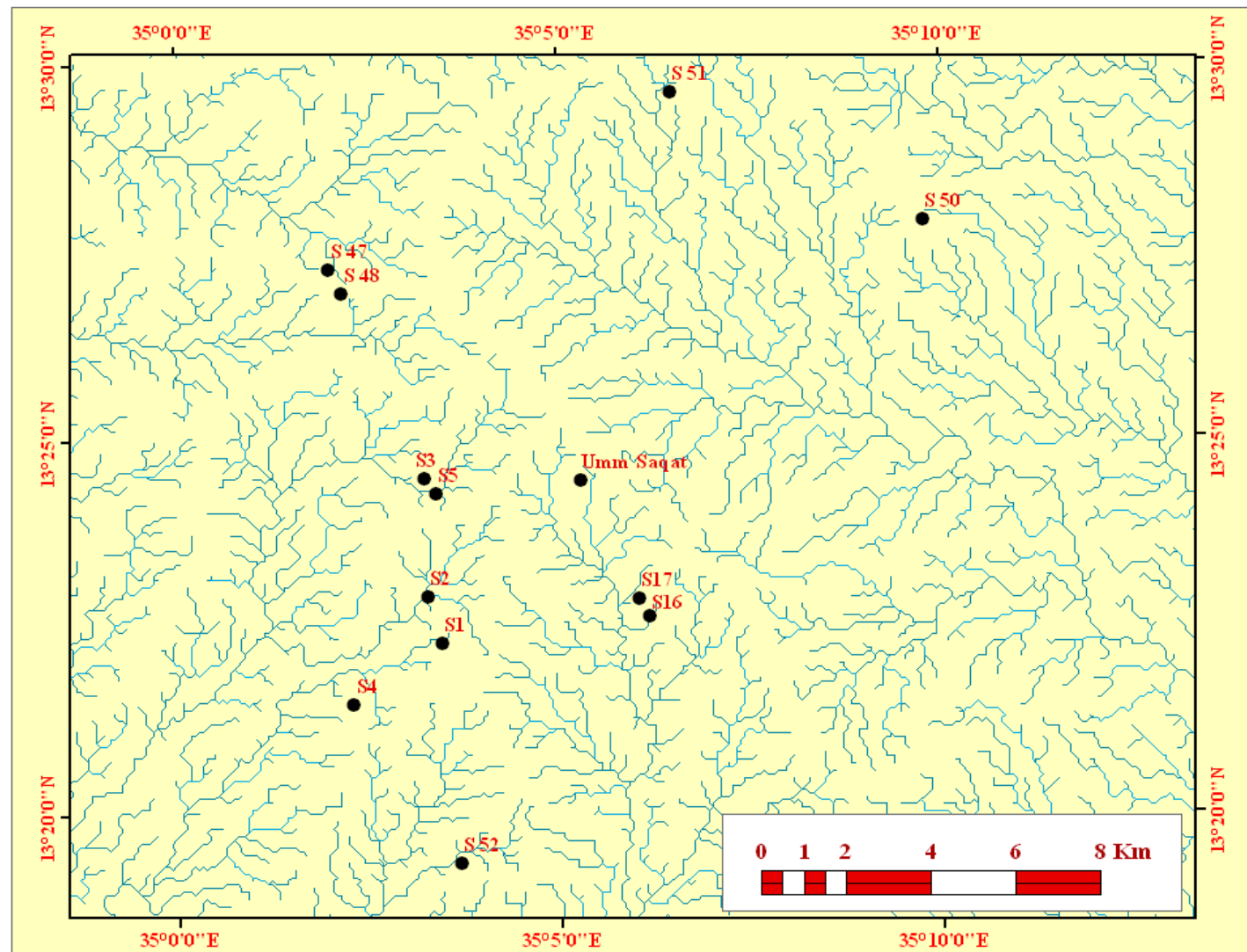


Fig. (5): Location of orientational samples (Mineralized areas) in Umm Saqata area.

MINERLIZATION

- Umm Sagata – Qala En Nahal areas is very important link between the northern and southern terrains of the late Proterozoic Pan- African Arabian Nubian Shield.
- As such the area is very potential for mineral deposits related to such Juvenile rock sequences. However, almost all of previous authors reported on minerals related to the ultramafic rocks such as chromite, asbestos, talc and magnesite which have already been mined in various scale.
- **Gold mineralization has been found in four types in this study:**
 - Quartz vein, veinlets.
 - Alteration zones and bed or host rock.
 - Placer gold (streams of black cotton soil , lateritic soil)
 - Iron caps bodies (indicate gossans model, not study in detail).
- * A total of 12 stream sediment samples were collected from Qal.En Nhal and Umm Sagata area and sieved for tow fraction sizes and analyzed in OMAC laboratories. The results of the wet chemical technique analysis for the two fractions –125 μm and – 63 μm of stream sediments in study area represented in (table1).



Table 1: A comparison of gold in the two sieved fractions

The gold results from table 1 shows concentrations of gold mineralization are typically found in the finest grain size fraction (silt and clay, -63 μm).

Serial No	Sample No	Mesh Size in μm	Au In ppb
1	S 1	63	51
2	S 1	125	6
3	S 2	63	30
4	S 2	125	34
5	S 3	63	12
6	S 3	125	11
7	S 4	63	6
8	S 4	125	-2
9	S 5	63	32
10	S 5	125	6
11	S 16	63	178
12	S 16	125	86
13	S 17	63	26
14	S 17	125	9
15	S 47	63	106
16	S 47	125	6
17	S 48	63	328
18	S 48	125	549
19	S 50	63	32
20	S 50	125	4
21	S 51	63	2
22	S 51	125	-2
23	S 52	63	3
24	S 52	125	2

5- CONCLUSION AND RECOMMENDATION

- The maximum value of Gold minimization is 1350 ppb and the minimum is 0.01ppb (obtained from stream sediments samples)
- 38 grams have been explored in study area in one quartz vein.
- Positive results of chemical analysis for Au, Ag, Cu, Zn, Fe of chip samples of iron caps bodies in the study area.
- This geochemical survey is the first time study in the region discovered gold mineralization.
- Concluded that is concentrations of gold mineralization find in the finest grain size in fraction -63 μm (effective fraction).
- The area has been promised of various gold mineralization.
- The investigation area recently have been widespread artisanal mining.



A person wearing a white turban and a white face mask is holding a large, irregular, brownish-gold nugget. The background is a plain, light-colored wall.

Thank you

8 K. gm.



2 K. gm.

Native Gold

ARTISANAL MINING