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Prospecting and Exploration for Gold and Associated Elements in Wadi Arab, Red Sea State, Eastern Sudan

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1. Abstract:

The study area, South Wadi Arab is located in eastern Sudan, Red Sea State and River Nile State. The lithostratigraphic units of the target area are composed of high-grade Amphibolites Schist, Low-grade Volcano Sedimentary Green schist Assemblages, Metavolcanic, Metasediments rocks, Igneous activity, Undifferentiated syn-late orogenic intrusions, Awat Series, Post- orogenic igneous activities, Dykes and Quartz Veins, Cretaceous-Tertiary Sediments, Nubain Sandstone, Umm Ruwaba Formation, Quaternary Deposits.The area is characterized by open flat sand and planes with fairly gravels cover soil extensive sand dunes trend N-S. Remarkable the area with some isolated scattered outcrops such as J. Siehteab that mark the boundary between Adarama Sheet from Musmar Sheet to the north, Ogrein, which includes some isolated outcrops of quartzites found to the west of the elongated sand dunes.

Drainage system is dominated by the River Atbara into which numerous seasonal streams (Khors and Wadis) flow such as Wadi Arab, Wadi Gura, Khor Abu Slam, K., K. Geniyota and K. Tendera.

A regional geological and semi detailed geochemical survey (stream sediment samples and chip samples) investigations have been carried out on the target area.

The stream sediments samples containing gold values above the detection limit is low, about 41.5 % (N=200). Gold content of stream sediments vary from <2 ppb (detection limit) to 30 ppb, with mean Au content of 2.22 ppb. It is has been detective four zones of anomalies in the area at the first time in this study.

Key words: Wadi Arab, Volcano Sedimentary, geochemical and Gold

2. Introduction

2.1: location and accessible of study area:

The target area (South Wadi Arab) is located in eastern Sudan, Red Sea State and River Nile State. It is bounded by latitudes17˚ 30‘ - 18˚ 00‘ N and longitudes 34˚ 40‘- 35˚ 25‘E.from Khartoum via

Atbara to Port Sudan. The study area is started from Zahatiabstation.

The area is accessible from Khartoum by asphaltic highway road via Atbara and Haiya to Port Sudan, asphaltic highway road from Khartoum via Kassala to Port Sudan or by railway line

2.2: Topography

Regional surveying covers an area of South Wadi Arababout 4436 km2 (Fig. I.).

The target area lies within the physiographic province of the Red Sea Hills, and it can be classified into two topographic sub regions. Topographically the southwestern portion of area is crossed by Atbara River. The western part of the area is characterized by open flat sand and planes with fairly gravels cover soil extensive sand dunes trend N-S. Remarkable the area with some isolated scattered outcrops such as J.Siehteab (Fig. I) that mark the boundary between Adarama Sheet from Musmar Sheet to the north, Ogrein, which includes some isolated outcrops of quartzites found to the west of the elongated sand dunes.

The eastern portion is dominated by rigged features represented by mountain ridges, inselbrage outcrops, and sand dunes to the southeastern part. Wide flat seasonal streams (Wadis& Khors) crossed the study area, and drain to the southwest towards River Atbara.

2.3: Drainage system

The drainage system is dominated by the River Atbara into which numerous seasonal streams (Khors and Wadis) flow such as Wadi Arab, Wadi Gura, Khor Abu Slam, K., K. Geniyota and K. Tendera (Fig. 2). The drainage system is due southwest towards the River Atbara and the central part of the study area shows subdendcritic, radial and rectangular drainage patterns, controlled by regional structural features such as fractures and joints. Some water channels flow from the Kassala State ill the southeast to the River Atbara, the largest of which is Khor Arab (Artisanal gold mining area), which is supposed to be a prolongation of River Gash, which is a major seasonal stream flowing from the Ethiopian plateau.

All of the streams are seasonal and filled by thick clays, sands and gravels with some rock fragments.

Streams almost are undeveloped in flat area. The drainage system direction of main Wadis and Khors is NE to N and NW almost.

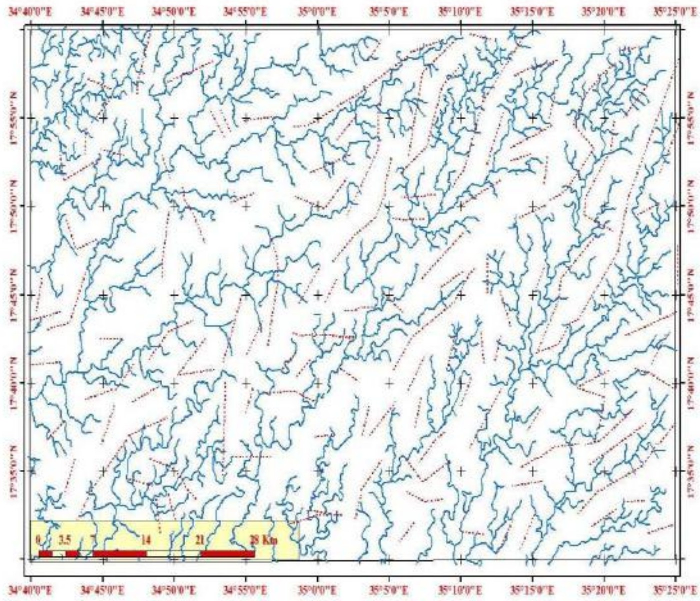

Fig. 1: Drainage system of target area.

Fig. 2: Location map of the study area.

2.4: Climate and vegetation:

The area lies in the arid to semi-arid climatic zone for most of the year. Summer season is very hot and dry with daily mean temperature up to 45"C with sandstorms.

The winter is cold with temperature varying between 20°-25°C, but these can drop to 10°C at

night. Strong winds blow throughout the year reaching its maximum in winter. The Rainy season in this is from July to September with few scattered rainfall during the period between July to September.

Vegetation in the area is districted to banks of the River Atbara and the floors of the major seasonal water recourses such as W. Arab, W. Gura, W. Shemi, K. Amap, K. Deruded and other tributaries crossing the area (Fig. 2). In these streambeds sparse grasses are scattered bushes and Acacia trees (especially Acacia Salam and Acacia Seyal), but further to the east around Derudeb town the channels arc covered by Dom palms and short-lived grass during the rainy season.

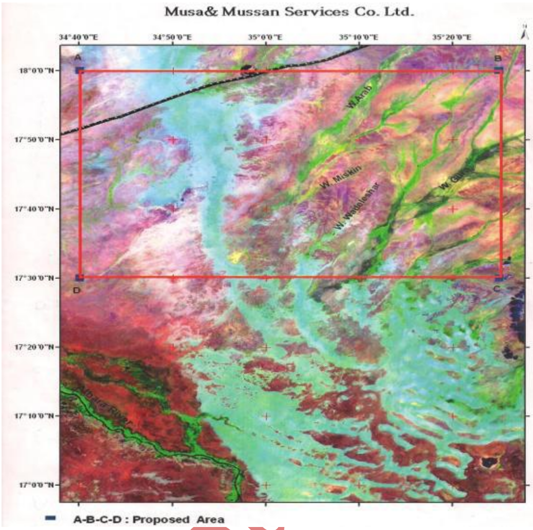

Fig 3. Land Sat Image of the South Wadi Arab

3- Geology of target area, South Wadi Arab

3.1 Introduction

The basement in north east Africa and western Arabia is referred to as the Arabian Nubian shield (ANS). This represents predominantly juvenile continental crust in that it was formed by differentiation of mantle melts largely without reworking of pre-existing continental crust. The ANS represents the northern part of the cast African Orogeny, which formed by collision between cast and west Gondwana at the end of a Wilson cycle that encompassed most of the Neoproterozoic and defined the pan- African orogeny (Abdelsalarn, 1996). Generally the ANS was accreted between 1000 Ma, and 500 Ma. (Late Proterozoic to early Cambrian).By the accretion of several intra-oceanic micro plates, most of them island arcs (Almond ct al, 1989). The ANS from about the Nile valley in the west to the phanerozoic cover in the cast consists of late Proterozoic - early Paleozoiccratonised intra-oceanic island arc to continental Andean marginal volcanism, during which extrusive and pyroclastic eruptives accumulated with associated sedimentary rocks. Numerous mafic and ultra mafic masses of serpentinites and gabbros are closely related, they are referred to here as the volcano-sedimentary and ophiolite green schist assemblages. These layered sequences subsequently become intruded by batholithic and plutonic syn- to post - orogenic mass dominantly dioritic, granodioritic. And granitic composition, but including gabbros and syenite, the whole evolving in chemistry from calc-alkali to alkali affinity (Vail, 1983) target area ,South Wadi Araboccurred in western part of the ANS.

These lithostratigraphic units of the target area (South Wadi Arab) will be as the following from older to younger (Map. 4).

2.2: High-grade Amphibolites Schist.
2.3: Low-grade Volcano Sedimentary Green schist Assemblages.
2.3.1: Metavolcanic.
2.3.2: Metasediments rocks.
2.3: Igneous activity.
2.3.1: Undifferentiated syn-late orogenic intrusions.
2.3.2: Awat Series.
2.3.3: Post- orogenic igneous activities.
2.3.4: Dykes and Quartz Veins.
2.4: Cretaceous-Tertiary Sediments.
2.4.1: Nubain Sandstone.
2.4.2: Umm Ruwaba Formation.
2.4.3: Quaternary Deposits.

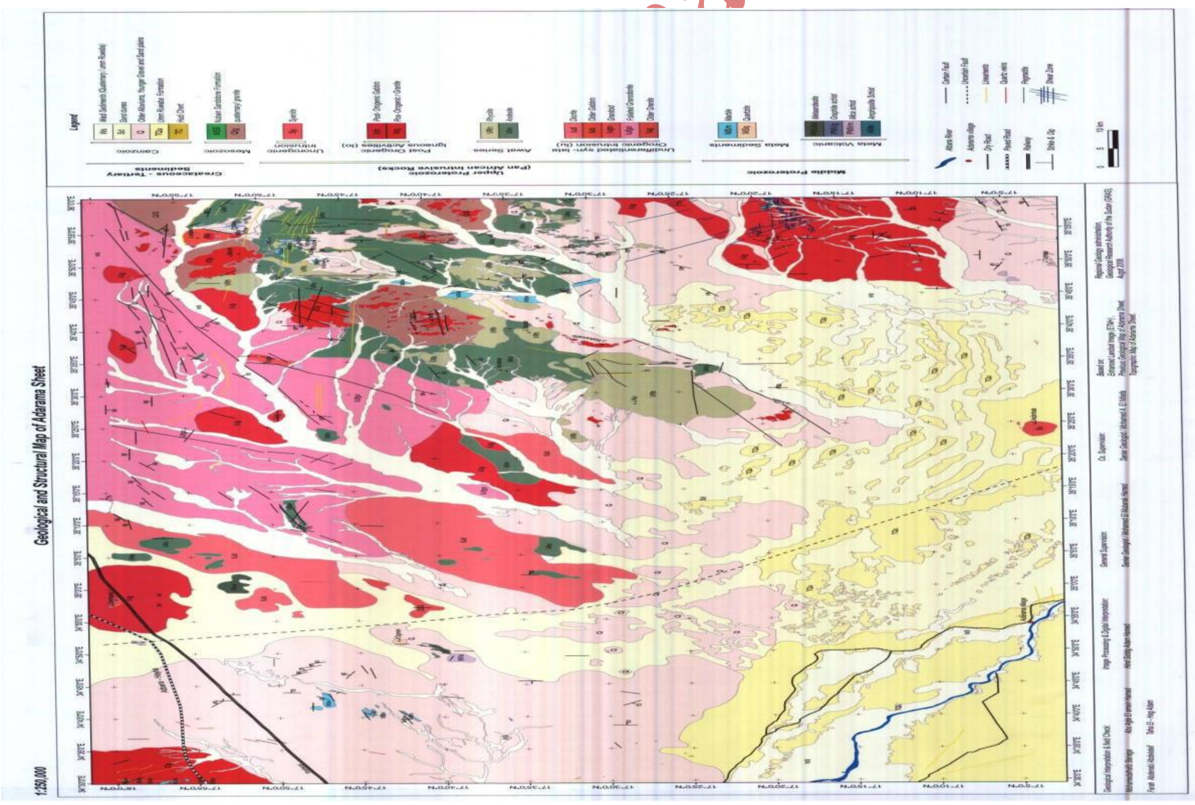

Fig.4: Geological and Structural Map of Target Area (South Wadi Arab).

4. Geochemical survey

4.1. Introduction:

The purpose of geochemical measurements is to discover the abnormal chemical patterns or geochemical anomalies related to mineralization (Hawkes and Webb, 1962). The principle of geochemical prospecting is closely linked with mobility and geochemical association of elements. A hidden ore body can be easily detected by geochemical method, if its constituent elements are relatively mobile. Elements of similar relative mobility tend to occur together under a given set of environmental conditions and some retain characteristic association throughout a wide range of different geological conditions. The presence of one member of such an association can therefore be based as a probable presence of the other member that may be difficult to detect. Some elements like S, U and Mo are mobile while elements like Li, Zn, As, Cu, Ni, Co, Ag, Cr and Hg are semi mobile. Heavy minerals of Au, Sn, Ti and Fe are naturally concentrated and known as placer deposits (not mobile).

Since nearly every type of ore is represented by at least one of these elements and because of that greater mobility, they invariably from recognizable geochemical dispersion pattern, which could imply the existence of the particular ore being looked for.

Hawkes and Webb (1962) have recommended S, Se and Sb association as indicator (pathfinder) for base metal ores.

Pathfinder is a term indicates one or more elements (or minerals) can be closely associated and can constitute a halo, which assists in finding sought-after mineral deposits (Levinson, 1974). Pathfinder occurs in primary environment with the element being sought or otherwise be derived from it. There is a direct and interpretable relation between the geochemical distribution of the Pathfinder and the mineralization.

For every area in which geochemical exploration survey is intended to be carried out there is a need for preliminary investigations (orientation geochemical survey). Such survey is necessary to be carried out first in the study area, to determine the optimum size fraction for the mineralization. This orientational survey must be done in a known mineralized locality in the area.

4.2. Orientation study

The selection of an optimum size fraction is to reveal the best contrast between anomalous and background element contents and to remove components that have no geochemical relationship to mineralization and, hence, dilute anomalies. The selection of the optimum size fraction of stream sediment samples in geochemical exploration is a matter of controversy. Levinson (1980) stated that the minus -80mesh fraction is usually preferred, but an orientation survey is necessary to confirm this. Mayer et al, (1979) considered the use of trace elements analysis of fine fractions (normally minus -80mesh fraction) of active sediments increasely questioned. In their opinion, the variation of sampling and analytical methods must depend on regional climatic differences and different survey aims.

The optimization of size fraction for routine sampling in El zahatibe areas has been assessed based on artisanal mining in the area.

The separation of samples into different size fractions by sieving helps to identify the grain size distribution of gold. Hence, in the area the stream sediment samples from different lodes were sieved to yield the following size fractions:-63µm and -125µm.

For the orientational study 14 stream sediment samples have been collected from the target areas and sieved for tow fraction sizes and analyzed in OMAC laboratories. The results presented in (Table.1).

Table 1: Au concentrations in fraction -63 µm and -125 µm

Sample No.	Au in ppb (mesh size -63 µm)	Au in ppb (mesh size -125 µm)
Art 1	150	34
Art 2	141	52
Art 3	28	15
Art 4	13	5
Art 5	220	120
Art 6	189	80
Art 7	15	5
Art 8	1044	7338
Art 9	684	476
Art 10	303	107
Art 11	370	275
Art 12	1233	381
Art 13	141	149
Art 14	232	147

All results show high anomalous gold concentrations in the tow fraction sizes (Fig. 5.a and 5.b).

On the other hand, the -63 mesh fraction is sufficiently abundant in most stream sediment so that obtaining the quantity needed for analysis presents no difficulty. Therefore, all samples were sieved through -63 mesh fraction.

4. 3. Low density geochemical survey

The results of the orientational study have guided the main low density geochemical survey over the whole El Zahatibe region. The fraction -63 µm has been taken as an optimum size.

	Valid N	Arith. Mean M	Geometric Mean	Minimum	Maximum	Std.Dev. S	Coef.Var. C.V.	Skewness	Bc.Value M	Thresh. Value M+ 2S	AC %
Au ppb	200	2.215	1.595	1.0000	30.000	3.0800	139.0505	6.02795	2.215	8.375	2.000
Ag	200	0.073	0.067	0.0250	0.355	0.0362	49.4890	3.45054	0.073	0.146	
Al %	200	3.249	3.210	1.9835	4.436	0.4939	15.2013	-0.23677	3.249	4.237	
As	200	3.221	2.962	0.3007	13.633	1.3547	42.0640	2.71205	3.221	5.930	
Pa	200	142.441	140.015	66.0392	235.770	26.1848	18.3829	0.32072	142.441	194.811	
Be	200	1.012	0.999	0.5168	1.386	0.1557	15.3840	-0.45269	1.012	1.324	
Bi	200	0.051	0.050	0.0100	0.113	0.0119	23.1337	1.00244	0.051	0.075	
Ca %	200	1.578	1.418	0.6996	9.386	1.0059	63.7602	4.32315	1.578	3.590	
Cd	200	0.069	0.067	0.0237	0.118	0.0160	23.0414	-0.10802	0.069	0.101	
Ce	200	37.730	37.472	20.6587	60.778	4.3651	11.5694	0.23546	37.730	46.460	
Co	200	22.893	22.573	11.8870	37.059	3.7171	16.2363	-0.13755	22.893	30.328	
Cr	200	84.012	83.103	49.4717	165.527	13.1323	15.6315	1.92772	84.012	110.277	
Cu	200	44.135	43.508	20.2059	72.735	7.4277	16.8293	0.46693	44.135	58.991	
Fe %	200	4.431	4.401	2.9699	5.807	0.5049	11.3951	-0.41166	4.431	5.441	
Ga	200	11.182	11.068	6.2149	15.128	1.5655	14.0002	-0.21655	11.182	14.313	
Hg	200	0.061	0.015	0.0025	8.019	0.5658	934.4790	14.12115	0.061	1.192	
K %	200	0.276	0.259	0.0779	0.581	0.0927	33.6534	0.32139	0.276	0.461	
La	200	20.016	19.817	11.5382	40.928	3.0871	15.4228	2.84340	20.016	26.191	
Mg %	200	1.276	1.262	0.6705	1.776	0.1884	14.7610	-0.35829	1.276	1.653	
Mn	200	719.620	709.899	370.8557	1347.025	118.6160	16.4831	0.68181	719.620	956.852	
Mo	200	0.333	0.325	0.1296	0.874	0.0803	24.1072	2.09968	0.333	0.494	
Na %	200	0.074	0.064	0.0194	0.343	0.0476	64.0600	2.31996	0.074	0.170	
Nb	200	0.554	0.540	0.2717	0.972	0.1213	21.9141	0.32006	0.554	0.796	
Ni	200	50.402	49.726	25.5670	88.626	8.1493	16.1685	0.18636	50.402	66.701	
P %	200	0.073	0.070	0.0226	0.124	0.0214	29.1682	-0.26402	0.073	0.116	
Pb	200	5.651	5.576	3.0935	8.868	0.9202	16.2842	0.31823	5.651	7.491	
Rb	200	17.205	16.498	5.1777	28.967	4.6334	26.9312	-0.16402	17.205	26.472	

S %	200	0.006	0.005	0.0050	0.132	0.0111	173.8399	9.73027	0.006	0.029	
Sb	200	0.150	0.147	0.1045	0.611	0.0438	29.1055	6.70752	0.150	0.238	
Sc	200	11.609	11.473	5.7282	17.501	1.7538	15.1075	0.02284	11.609	15.117	
Sn	200	0.772	0.762	0.3645	2.462	0.1509	19.5498	6.95004	0.772	1.074	
Sr	200	114.782	112.142	67.5477	253.616	26.3789	22.9817	1.59800	114.782	167.540	
Te	200	0.045	0.042	0.0100	0.089	0.0147	32.6450	0.18027	0.045	0.075	
Th	200	3.615	3.562	1.8457	6.728	0.6506	18.0000	1.38748	3.615	4.916	
Ti	200	1947.013	1864.153	588.2192	3119.711	520.1454	26.7150	-0.45461	1947.013	2987.304	
Tl	200	0.079	0.076	0.0233	0.135	0.0209	26.6297	0.16786	0.079	0.120	
U	200	0.565	0.554	0.2891	1.488	0.1197	21.1941	2.94132	0.565	0.804	
V	200	116.189	115.018	52.8684	191.784	16.3449	14.0675	0.51849	116.189	148.879	
Y	200	16.662	16.587	11.7853	22.249	1.5766	9.4627	0.18236	16.662	19.815	
Zn	200	67.991	67.182	37.1674	98.145	10.2216	15.0339	-0.12172	67.991	88.434	
Zr	200	22.484	21.786	9.8700	33.420	5.3883	23.9649	-0.13100	22.484	33.261	

Table 2: Summary of basic statistics for trace elements with their parameters.

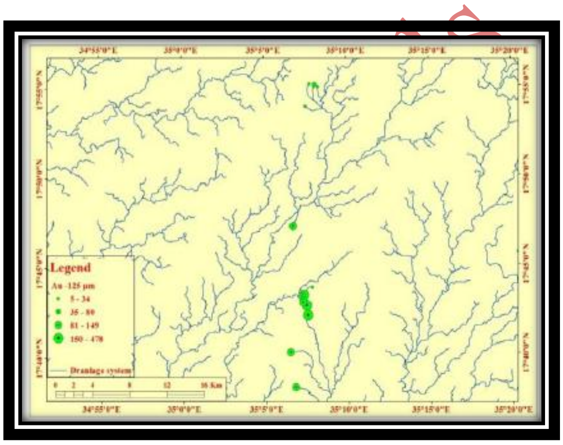

Fig. 1.a: Concentrations of gold analysis in fraction size -63 µm

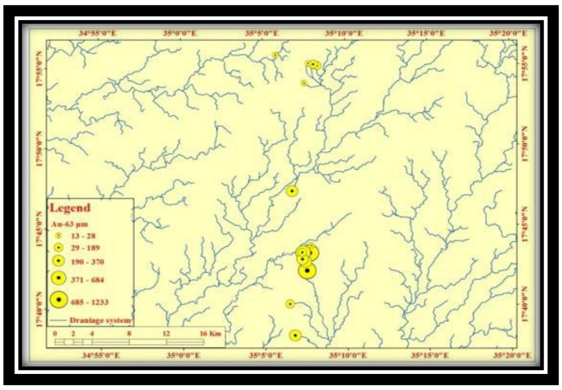

Fig. 1.b: Concentrations of gold analysis in fraction size -125 µm

A total of 232 samples have so far been collected from first, second and third order streams of the drainage system for geochemical survey at an average sample density of approximately one sample per ten squared Kilometers. All of the stream sediments samples were analyzed for gold and further 46 major and trace elements.

4.4. Evaluation of Geochemical Data

The results of geochemical analysis of stream sediments samples for gold and trace elements are presented in Appendix (Tables A1 and A2 respectively). Elements such as Au, Ag,Al, As, Ba, Bi, Be,Ca, Cd, Ce, Co, Cr, Cu, Fe, Ga, Hg, K, La, Mg, Mn, Mo, Na, Nb, Ni, P,Pb, Rb, S, Sb, Sc, Se, Sn, Sr, Te, Th, Ti, Tl , U, V, Y, Zn and Zrshow values below the detection limit in some samples. Trace elements such as Ge, B,Li, Se,Ta, Re, Re and W are below the detection limit in all samples. The other elements are above the detection limit in all samples.

The stream sediments data have been evaluated using basic statistics, histrograms, correlation matrix, Multivariate Analyses (factor and cluster and regression analysis) and geochemical mapping, using SPSS statistics 17.0 and Statistica 8 soft wares.

Values below the detection limits are represented by criteria $X_i = 0.5\,X$ Lower limit before statistical analysis (Kelley and Kelley, 1992).

4.4.1 Univariate Analysis

A summary of basic statistics for trace elements with their parameters is shown in (Table. 2).

For all elements the arithmetic Mean (M) is chosen to represent the background value. The threshold value is chosen as (M+2S) (Lepeltier, 1969; Nichol et al, 1994).

To aid in the interpretationof the geochemical data and to compare it with geology, the anomalous value of gold and related trace elements have been utilized for producing symbol plot maps, which are then superimposed with the satellite image of the study area. The basic statistical parameters for some trace elements are discussed in the following paragraphs.

4.4.1.1 Gold (Au)

The stream sediments samples containing gold values above the detection limit is low, about 41.5 % (N=200). Gold content of stream sediments vary from <2 ppb (detection limit) to 30.000ppb, with mean Au content of 2.22 ppb. It is evident from histogram (Fig.5) and skewness (Table.2) the gold is normally distributed.

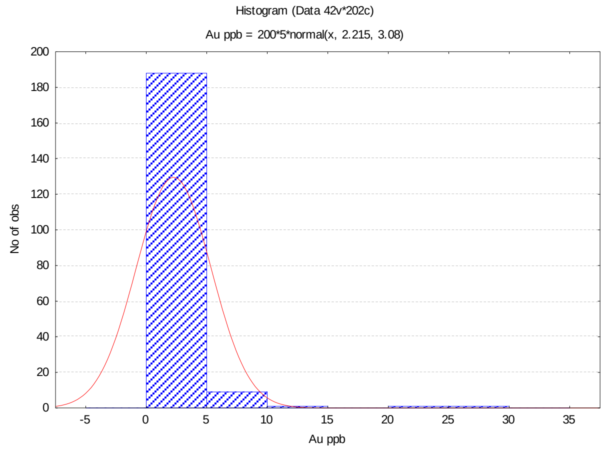

Fig. 2: Histogram of Au in stream sediments samples

The background value for Au is calculated to be 2.22 ppb and the threshold value is 8.38 ppb. The dispersion of gold in the stream sediments is erratic (inhomogeneous) as suggested by the very high coefficient of variation (C.V.) about 139.1%. The anomaly coefficient (AC) of Au in the stream sediments is very low about 2%. Fletcher and Day (1988; 1989), Day and Fletcher (1989) pointed out that the anomalous levels of gold in the drainage sediments are typically erratic and difficult to verify because samples normally collected are too small to be representative. They added that the hydraulic processes in the stream play an important role in the distribution of gold in the sediments.

The distribution of gold in stream sediments is shown in (Fig. 6). It is found that all the known gold occurrences in the investigated area are restricted in seven localities showing isoconcentration map of gold mineralization (Fig. 7). It is evident that most of the samples with high anomalous content may be structurally controlled by NW- SE shear zone (Fig. 7).

4.4.2. Multivariate Analysis

The application of stream sediments in gold prospecting and exploration involves problems and difficulties in obtaining representative samples (Hughes et al, 1995).

Therefore, the use of multi elements distribution pattern may help in solving these problems and locating auriferous mineralization (Rose et al, 1983; Plant et al, 1988). In this case the pathfinder elements are searched with the aids of multivariate analysis including correlation coefficient, factor analysis, cluster analysis and regression analysis.

4.4.3: Correlation Coefficient:

The correlation coefficient of the stream sediments data sets are shown in (Table. 3). For the number of analysis samples (N=184) coefficients of correlations Rs> 0.05 are significant. Weakly significant positive correlation exists between Au and Ag, As, Be, Bi, Co, Cr, Ni, Cu, Mn, Mo, Pb, Sb, Sc, Te, Th, U, V, Y and Zn. Au shows significant negative correlation with Pa, Cd, Hg, La, Nb, Rb, Sr, Ti and Zr. The weak correlation between Au and these elements are most probably due to the unrepresentative nature of the 300-gram samples or to clastic dispersion of gold in the stream sediments (Akcay et al, 1996). The correlation between Cr, Ni and Co is due to the presence of mafic minerals. Correlation between Cu, Zn and As may indicate presence of sulphide minerals in stream sediments.

4.4.4
Regression Analysis

Regression analysis is an estimation of the linear relationship between a dependent variable (gold) and other independent variables (46 elements) to determine the pathfinder elements which guide to the presence of gold. The regression analysis has been conducted on the row data and the results are shown in (Table.3). It has been found by regression analysis that Ni, Sb, Sc, Te, Th and Zn are reliable pathfinder elements for gold mineralization.Nevertheless, Ga, Hg and Zr are unreliable pathfinder elements since they have negative coefficient in explaining gold (Table. 3)

Table. 4: Correlation coefficient of the stream sediments data sets

	Coefficient	p-level		
Intercept		0.071004		Regression Summary for Dependent Variable: Au ppb (Data) R= .51891670 R^2= .26927455 Adjusted R^2= .08544424 F(40,159)=1.4648 p<.05179 Std.Error of estimate: 2.9454
Ag ppm	0.069283	0.403479		
Al %	0.444002	0.204872		
As ppm	0.059960	0.524910		
Pa ppm	-0.132907	0.470309		
Be ppm	0.179079	0.94030	0.348488	
i ppm	-0.052172	-0.50517	0.614140	
Ca %	0.028327	0.18920	0.850178	
Cd ppm	-0.051844	-0.43768	0.662211	
Ce ppm	-0.067607	-0.32131	0.748398	
Co ppm	0.228125	0.66882	0.504583	
Cr ppm	-0.049853	-0.20341	0.839072	
Cu ppm	-0.062760	-0.30893	0.757776	

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Fe %	-0.546291	-1.11649	0.265898	
Ga ppm	-0.572814	-1.35124	0.178540	
Hg ppm	-0.097000	-1.20490	0.230034	
K %	-0.103669	-0.43990	0.660607	
La ppm	0.075432	0.37345	0.709309	
Mg %	-0.166341	-0.62478	0.533010	
Mn ppm	0.032621	0.18279	0.855197	
Mo ppm	-0.015022	-0.11307	0.910121	
Na %	-0.030100	-0.32208	0.747812	
Nb ppm	0.015184	0.13050	0.896334	
Ni ppm	0.325872	1.13653	0.257444	
P %	0.181751	0.73389	0.464096	
Pb ppm	0.023033	0.23337	0.815773	
Rb ppm	-0.075947	-0.22537	0.821984	
S %	0.061907	0.59868	0.550236	
Sb ppm	0.194603	1.72736	0.086045	
Sc ppm	0.381537	1.16898	0.244160	
Sn ppm	0.059344	0.57834	0.563855	
Sr ppm	0.021642	0.15309	0.878518	
Te ppm	0.278237	3.24799	0.001418	
Th ppm	0.156068	1.41178	0.159968	
Ti ppm	0.264459	1.06464	0.288652	
Tl ppm	0.089886	0.47629	0.634519	
U ppm	-0.018300	-0.13192	0.895218	
V ppm	0.209446	0.98765	0.324823	
Y ppm	-0.072255	-0.57005	0.569447	
Zn ppm	0.377417	1.48151	0.140450	
Zr ppm	-0.659680	-2.45253	0.015267	

Previous results of Au values from different international laboratories , GRAS, Sudan. OMAC Ireland.

1. Results of 11 samples from the study area have been analyzed to gold in ppm in Gras lab (Table. 5). Show the distribution in (Fig.9),

Table. 5: Chemial analysis of Au values in Gras Lab.

S. N.	Au ppm
M001	1.84
M002	0.62
M003	0.98
M004	18.52
M005	11
M006	0.84
M007	50.16
M008	0.03
M009A	1.37
M009B	0.47
M007A	64.52

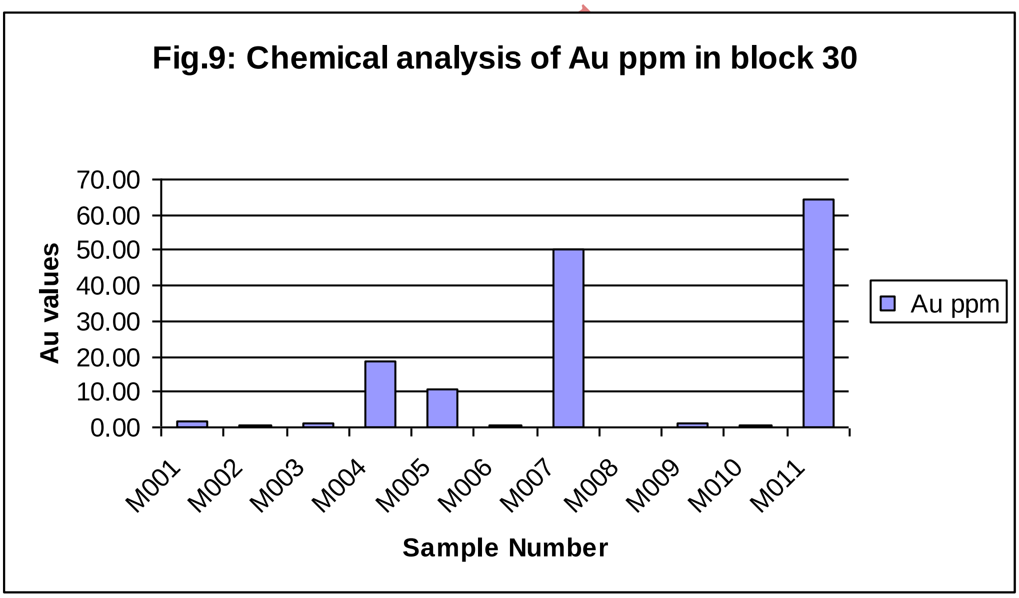
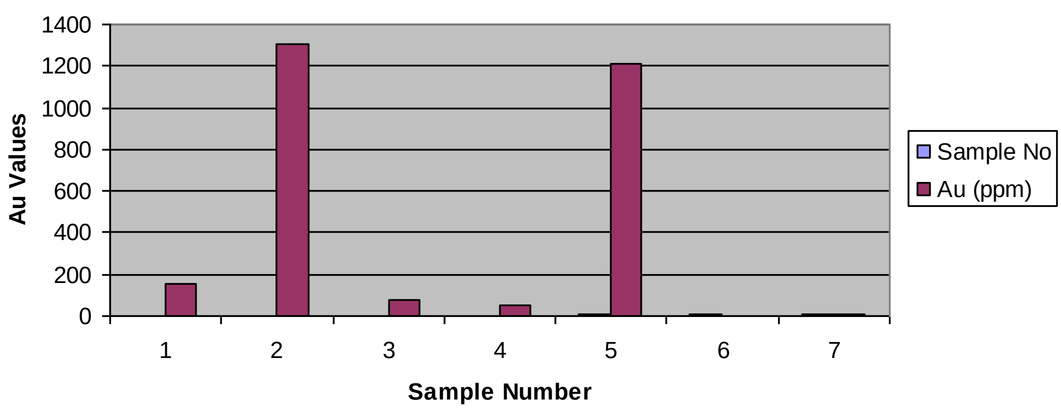


Table. 6: Chemical analysis of Au values in Russian Lab.

Sample No	Au (ppm)
1	154.2
2	1306
3	78.7
4	49.8
5	1215
6	0
7	8.4

Fig. 10 : Distribution of Au values in ppm of Block30



The Study Area

Table. 7: Chemical analysis of Au values in OMAC Lab.

Sample No	Au (ppm)
M001	240.64
M002	3.84
M003	6.96
M004	0.27
M005	445.44
M006	1.98
M007	3.76

Fig. 11: Distibution of Au (ppm) valu the Study Area

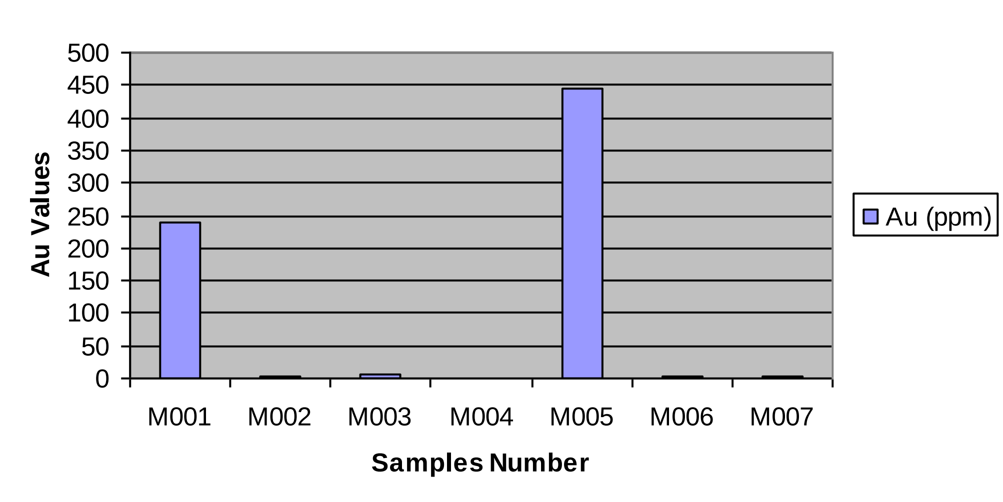


Table (8): previous chemical analysis of stream sediment samples (63- um) Analyzed to ppm.
(GRAS teams, in July 2008).

S. No	Long.			Lat.			Au	Ag	Cu	Ni	Pb	Zn	e
1	55.9	59	35	17	51	52.3	6.82	N.D	30.1	116	36	70.3	6.82
3	36.4	47	35	17	56	36.1	10.55	N.D	38.2	132.9	N.D	77.13	10.55
5	9.1	54	35	17	55	55.5	8.06	N.D	42.3	139.3	N.D	85.36	8.06
7	38.2	43	35	17	56	2.5	7.65	N.D	46	137.5	N.D	79.1	7.65
9	32.1	55	35	17	58	15.1	8.37	N.D	37.6	121.4	N.D	80.38	8.37
11	21.1	44	35	17	34	39.2	10.73	N.D	39.3	135.2	N.D	80.2	0.73
13	20.7	44	35	17	36	41	7.06	N.D	39.2	147.7	38	85.35	7.06
15	28.2	36	35	17	41	25.1	8.82	N.D	4.1	130.9	27	86.27	8.82
17	25.6	33	35	17	37	7.3	6.18	N.D	42.1	160.4	16	87.95	6.18
19	57.2	30	35	17	34	11.1	6.5	N.D	34.5	172.2	15	95.65	6.5
21	34.8	26	35	17	28	3.1	4.84	N.D	38.4	139.3	3	89.49	4.84
23	56.6	58	35	17	48	0.1	4.8	N.D	21.3	107	2	88.62	4.8
25	26.1	47	35	17	53	8.7	4.51	N.D	31.2	139.2	N.D	84.78~	4.51
27	51.4	54	35	17	44	50.8	4.85	N.D	31.6	141.5	N.D	112.4	4.85
29	49.8	55	35	17	45	27	5.67	N.D	35.5	216.3	N.D	10.231	5.67
31	26.6	53	35	17	47	15.1	4.93	N.D	41.1	184	7	97.56	4.93

Table (9): previous chemical analysis of Chip samples, analyzed to ppm.

S.N.	Name	Long.	Lat.	Au	Ag	Cu	Co	NI	Pb	Zn	Fe
1	<JQI	35.8857	17.3238	0.23	N.D	5.1	57.7	102.5	N.D	28.71	4.6
2	JR28	35.8389	17.9587	0.32	N.D	15	56.4	114.5	N.D	44.72	2.62
3	JQI6	35.8690	17.7743	0.15	N.D	2.4	64.8	112.5	N.D	110.9	0.176
4	9QI/\	35.8857	17.3238	0.18	N.D	7.3	75.2	121.6	N.D	4.94	1.272
5	109	35.6680	17.9258	0.11	N.D	5.9	83.7	159.2	N.D	31.12	4.592
6	7R7	35.0057	17.4521	0.24	N.D	7.3	91.7	123.5	N.D	9.95	7.172
7	51J	35.2429	17.6282	0.185	N.D	33.1	109.3	219.4	N.D	97.64	6.952
8	21'1I	35.7776	17.8492	0.1	N.D	9.8	176.8	121.1	N.D	77.09	0.868
9	21>12	35.7754	17.8497	0.06	N.D	4.6	160	1366	N.D	1.24	11.88
10	7N2	35.5911	17.4630	0.06	N.D	8	24.9	136.9	N.D	23.8	1.068
11	51'IJ	35.7841	17.6080	0.06	N.D	34.3	18.2	127.5	N.D	24.75	14.46
12	8Q4	35.9007	17.3383	N.D	N.D	6.1	53.6	184	N.D	152.7	5.74
13	JR25	35.9642	17.8269	N.D	N.D	7	28	185	N.D	23.94	1.052
14		35.8360	17.6640	N.D	N.D	7.6	24.4	144.3	N.D	13.69	0.64
15	4QI	35.8980	17.7286	N.D	N.D	6.5	31.8	152.3	N.D	10.85	2.864
16	JQ5	35.8912	17.7931	N.D	N.D	293.9	36.8	159.9	N.D	10.98	0.638
17	JRI6	35.9782	17.7992	N.D	N.D	8.5	41.9	82.5	N.D	15.17	0.54

18	**IQ7**	**35.8702**	**17.9200**	**N.D**	**N.D**	**12.2**	**46.8**	**81.8**	**N. D**	**77.77**	**4.66**
19	**5PI O**	**35.7965**	**17.6632**	**N.D**	**N.D**	**6.9**	**44.2**	**66.7**	**N. D**	**14.75**	**0.83**
20	**IIR4**	**35.9349**	**17.1460**	**N.D**	**N.D**	**11.5**	**52**	**71.3**	**6**	**23.39**	**1.27**
21	**5Q7**	**35.8213**	**17.6394**	**N.D**	**N.D**	**5**	**37.8**	**74**	**3**	**15.3**	**0.84**
22	**6N4**	**35.6360**	**17.5568**	**N.D**	**N.D**	**8.7**	**41.6**	**105.4**	**13**	**41.94**	**1.41**
23	**JQI 6**	**35.8690**	**17.7743**	**N.D**	**N.D**	**43**	**37**	**80.2**	**90**	**248.9**	**1.47**
24	**5N8**	**35.6355**	**17.5935**	**N.D**	**N.D**	**42.4**	**86.25**	**203.9**	**11**	**55.67**	**.-- !J.L**
25	**2RlJ /**	**35.9981**	**17.8644**	**N.D**	**N.D**	**26.7**	**52.9**	**110.1**	**19**	**~25**	**10.57**
26	**2RI 4**	**35.9975**	**17.8711**	**N.D**	**N.D**	**10.9**	**36.5**	**73.5**	**N. D**	**3.45**	**0.908**
27	**2RI J**	**35.9981**	**17.8644**	**0.01**	**N.D**	**28.8**	**43.2**	**62.8**	**7**	**6.52**	**1.908**
28	**7Q5**	**35.8668**	**17.4411**	**N.D**	**N.D**	**50.1**	**51.7**	**83.4**	**19**	**43.9**	**9.63**
29	**4117**	**35.1516**	**17.6721**	**0.04**	**N.D**	**40.4**	**86.4**	**191.8**	**N O**	**132.7**	**5.22**
30	**zsu**	**35.8489**	**17.3112**	**N.D**	**N.D**	**11.1**	**84.7**	**157.1**	**N. D**	**127.4**	**9**
31	**8L6**	**35.4276**	**17.3423**	**0.04**	**N.D**	**348**	**90.3**	**215.4**	**N. D**	**120.4**	**8.91**
32	**1134**	**34.6525**	**17.9323**	**0.12**	**N.D**	**6.9**	**39.1**	**93.2**	**N. D**	**7.39**	**0.32**
33	**405**	**34.7511**	**17.7172**	**0.12**	**N.D**	**43**	**66.7**	**152.9**	**N. D**	**1296**	**6.25**
34	**5115**	**35.1085**	**17.6691**	**20.95**	**N.D**	**1.63**	**66.5**	**202.4**	**N. D**	**103.2**	**5.42**
35	**4E5**	**34.8563**	**17.7058**	**0.17**	**N.D**	**39**	**61.5**	**94.4**	**N. D**	**12.45**	**2.03**
36	**411 I1**	**35.1253**	**17.7132**	**79.8**	**N.D**	**19.7**	**51**	**38.1**	**N. D**	**7.2**	**0.396**
37	**203**	**35.0622**	**17.8964**	**0.25**	**N.D**	**42.3**	**91.5**	**122.1**	**N. D**	**131.7**	**4.776**
38	**4EJ**	**34.8413**	**17.6736**	**0.21**	**N.D**	**42.3**	**53.7**	**41.6**	**N. D**	**13.67**	**3.452**

39	**2B7**	**34.6613**	**17.9022**	**NO**	**N.D**	**58.2**	**68.9**	**129.2**	**4**	**87.71**	**1.612**
40	**J08**	**34.8088**	**17.7686**	**2.51**	**N.D**	**43.7**	**49.3**	**23.1**	**N.D**	**4.56**	**0.221**
41	**4E5/**	**34.8563**	**17.7058**	**0.38**	**N.D**	**194.8**	**115.4**	**220.8**	**11**	**4.073**	**6.48**
42	**404**	**35.0744**	**17.6734**	**0.16**	**N.D**	**7.4**	**58.5**	**99.8**	**NO**	**38.12**	**0.872**
43	**JRI2**	**35.9173**	**17.7766**	**0.18**	**N.D**	**6.4**	**42.3**	**45.5**	**N.D**	**10.39**	**0.387**
44	**J17**	**35.3281**	**17.7631**	**0.245**	**N.D**	**42.55**	**44.1**	**137.8**	**N.D**	**122.6**	**7.36**
45	**JRI6**	**35.9782**	**17.7992**	**0.16**	**N.D**	**6.3**	**N.D**	**34**	**N.D**	**13.27**	**0.206**
46	**4E5D**	**34.8563**	**17.7058**		**N.D**	**18.6**	**N.D**	**41.2**	**N.D**	**12.58**	**1.712**
47	**41110**	**35.1377**	**17.7186**	**0.13**	**N.D**	**4.7**	**N.D**	**96.9**	**N.D**	**23**	**0.804**
48	**507**	**34.8206**	**17.6578**	**0.19**	**N.D**	**8.7**	**N.D**	**106**	**N.D**	**89.65**	**0.899**
49	**507**	**34.5895**	**17.9645**	**0.17**	**N.D**		**6.8**	**232.6**		**36.49**	**0.798**

5.Conclusion and Recommendations

-The Study area is a considered located in the Arabian Nubian Shield, South of Ariab Mine company, the biggest Mining Company in Sudan.

-This systematic geochemical survey is carried out in the first time in this area.

- The orientaianal study results is conducted in the study area and concluded the best fraction is (-63 Micron).

-The background value for Au is calculated to be 2.22 ppb.

-The results of the chip samples had been obtained high concentrations in Au, Ag, Cu, Pb and Zn.

-Reommendation that target area of south of Wadi Arab has been occurred about 4 minerlization zones which obtained high concentrations in the isoconcentatation map.

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