P-ISSN: 2811-2512
E-ISSN: 2811-2520

THE NEXUS
A Publication of Al-Hikmah University, Ilorin, Nigeria
(Science Edition)

Available online at https://www.alhikmahuniversity.edu.ng

GEOCHEMISTRY OF ROCKS AND STREAM SEDIMENT FROM GARATU AREA OF BIDA SHEET184NE, IN RELATION TO GOLD MINERALIZATION

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ARTICLE INFO

Article history:
Received: December 8, 2021
Revised: December 30, 2021
Accepted: December 31, 2021
Published online: December 31, 2021

Citation:
Onoduku, U. S., Mahmud, M. S. and Jimoh, R. O. (2021). Geochemistry of Rocks and Stream Sediment from Garatu area of Bida Sheet 184NE, in Relation to Gold Mineralization. *The Nexus (Science Edition).* 1(1): 30 - 36

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ABSTRACT

Stream sediment and rocks were sampled and analysed for their gold and other elemental contents, the study area lies within longitude 006°24′30.00″E and 006°26′30.00″E and latitude 09°28′30.00″N and 09°29′45.00″N part of Bida Sheet 184NE. The aim of the study is to evaluating the gold and other mineralization potentials of the stream sediments and rocks. Ten stream sediments and five rock samples were analysed, using Instrumental Neutron Activation Analysis (INAA), Inductively Coupled Plasma (ICP) and Thermal Desorption Mass Spectrometry (TD-MS). The study area is underlain by schist and Granite. The result of the analyses shows gold enrichment of 140 timesand Al enrichment of12.36 and low enrichment factors for the rest elements in the sediment, while gold enrichment in rock sample is 69.8. From these results, only gold has shown potential mineralization within the study area.

Keywords: Geology, geochemistry, rock, stream sediment, gold, enrichment factor.

INTRODUCTION

Gold mineralization is present in primary rocks and alluvial (stream sediments) as primary and secondary concentration respectively in most parts of the schist belts in the north-western and south-western parts of Nigeria, especially within and around the Precambrian rocks of the Maru Schist belt. The most important geological occurrences are located within the Anka, Zuru Maru and Kushaka schist belt in the north-west and the Egbe-Isanlu and Ilesha schist belts in the south-west (Oyebanji *et al*., 2017; Ajibade, 1976, 1980, Turner, 1983; Rahaman, 1976; Truswell and Cope, 1963; Fitches *et al*., 1985, and McCurry 1976).

Stream sediment and rocks usually play suit for secondary and primary gold and other related minerals respectively. Hence, the geological and geochemical studies of the geological media (rocks and stream sediments) have proven to be effective method of ascertaining the presence or otherwise of gold and other related elements in these media. The result of the geological analysis of rocks and stream sediment can be interpreted to unravel the presence of these elements in term of quantity as well as the provenance of the host rocks and sediments. Rocks and stream sediments analysis for gold and it associated elements are usually achieved through multi elemental analysis using specialized geochemical methods which usually give the relative quantity and quality of these elements mineralized. The rocks and stream sediments hosting these gold occurrences are in association with metamorphosed rock such as schist.

This study is aimed at a critical characterization of the geochemical features of rocks and stream sediments of the study area in view to presenting new geochemical data in relation to gold mineralization on the study area. The objectives therefore include the geological mapping of the study area, rocks and stream sediment sampling, geochemical analysis of the rocks and stream sediments with the aim to ascertaining the gold potentials of the study area.

2. Location of the study Area

The study area is bounded by Latitude 06°24'30"E to 06°26'30"E and Longitude 006°09°28'30"N09°29'45"N. It is situated within the Bida Sheet 184NE

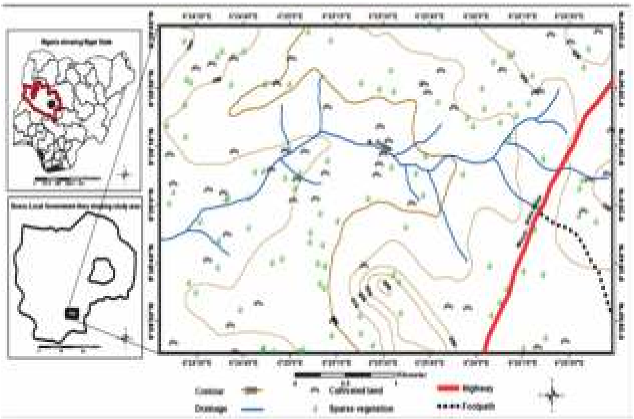


Figure 2: Topographical map of the study area

The mapped area covers only Garatu in Bosso Local Government Area of Niger State with no variety of settlements. The road from the east leads to Minna the state capital, and the road from the west leads to Sabon Daga. There is accessibility of footpaths to the area. The study area falls within Bida Sheet 184NE

2. Materials and Methods

Materials used in this study include rocks and stream sediments obtained from the study area (fig 3). The stream sediments were sourced from the river beds and their tributaries mostly at the meandering points where the flow velocities of the rivers are considered lowest and hence maximum depositions of sediments. The stream sediments were collected randomly along the drainage patterns with in the study area avoiding the collapsed river bank materials from the levees. A total number of ten stream sediments and five rock samples were sampled and analyzed for their gold and associated elemental contents.

The stream sediment samples were wet washed at the Geology Departmental Laboratory, Federal University of Technology Minna. The coarse sediments were separated from the suitable one and the panning of the samples were done to which yielded some pan concentrate of gold grains, the pan was washed thoroughly after each sample preparation. The homogenized material was carefully poured on paper and was left for 30-35 minutes for it to dry under the sun. The rocks and stream sediments samples were poured on field container for laboratory analysis (plate 1).

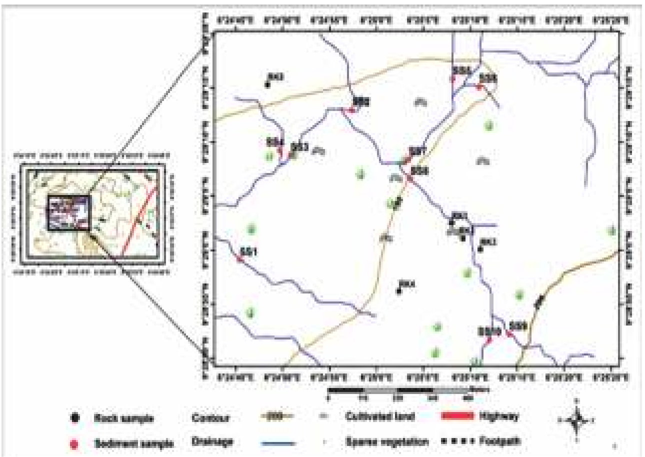


Figure 3 Stream Sediment and rock sampling points within the study area

Plate 1: (a) collection of sample on the field (b) recording of field observation (c) panning of stream sediment sample to separate coarse sediment from the suitable one (d) pan concentrate of gold grains

The laboratory analysis involved drying and homogenization of stream sediment samples, digestion and analysis. The various methods employed in the geochemical analyses of the stream sediments and rocks have been previously discussed in detail by several authors e.g. Activation Laboratory Manual of 2021, Garba, 1987, Haruna *et al*., 2008, Kankara and Darma, 2016, Robert *et al*., 2003, Adepoju and Adekoya, 2008, Caleb, 2010).

4.0 Results and Discussion

4.1 Geology and field observations

The area of study is underlain by granite and schists with the schist covering 80% of the study area while the granite covers the rest 20%.

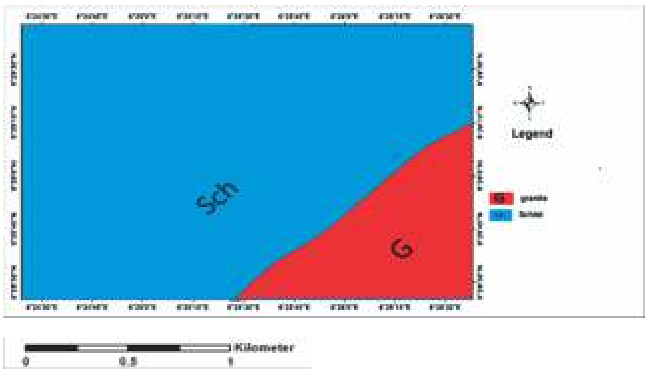


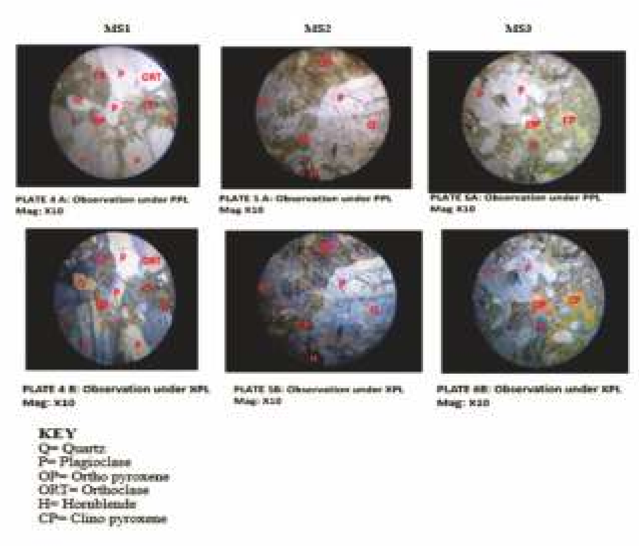
Fig 4: Geological Map of the study Area

The granites range in colour from dark to light grey. The minerals observed are quartz (25%), feldspar (45%) and biotite (10%). Other minor minerals observed include pyroxenes, hornblende and amphiboles. The rocks are mostly flat lying and ranges in size from few meters square to hundreds of meters square. The schist outcrops have undergone moderate to high grade of weathering and their textures range from fine to medium grained.

PLATE 2: Granite outcrop at the study area (09°29'02.50''N 06°25'08E)

PLATE 3: Schist outcrop at the study area (09°28'56.20''N 06°25'02.40E)

The photomicrographs of the rocks that underly the study area are as shown in plates 4 to 8 while Tables 1a and b show the descriptive optical characteristics of the rocks in their thin sections.



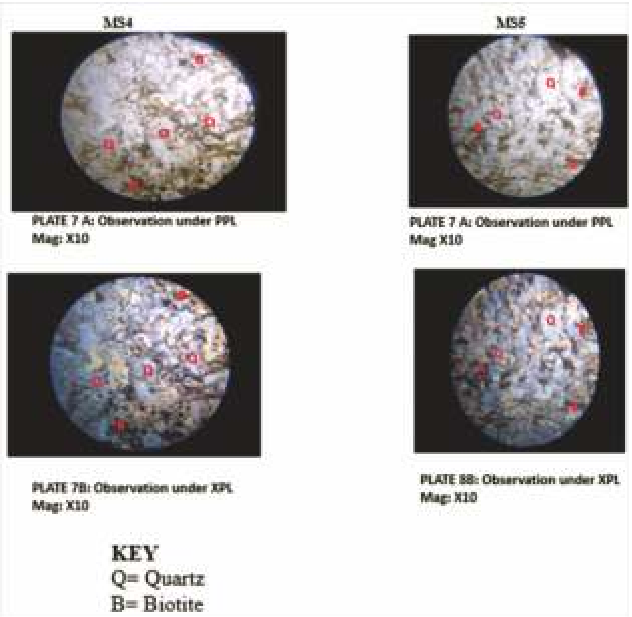


Table 1a: Optical properties of the rocks (Granites)

Mineral	Colour in PPL	Colour in XPL	Extinction angle	Diagnostic feature	Crystal form	Twining	% in Thin Section
Quartz	colourless	Blue to milky	[illegible]	Moderate to low relief, low pleochroism and no cleavage presence	Anhedral crystals	None	22
Orthoclase	Colourless	Blue to milky color	15°	Perfect interference but low relief and pleochroism	Anhedral crystals	Carlsbad	15
Plagioclase	Colourless	Blue	54°	Moderate relief, no cleavage and high pleochroism	Anhedral crystal	Albite	30
Hornblende	Brown	Green to brownish	30°	Moderate relief unlike biotite, it shows scattered cleavage directions and interference presence	Anhedral crystal	None	20
Orthopyroxene	Green	Green to red	30°	Moderate relief and high pleochroism	Elongated, tabular, anhedral to euhedral crystal form	None	5
Clinopyroxene	Green	Green to brown	23°	Moderate relief and high interference and pleochroism	Anhedral to euhedral crystal form	None	5

Table 1b: Optical properties of the schists

Mineral	Color in PPL	Color in XPL	Extinction angle	Diagnostic feature	Crystal form	Twining	% in thin section
Quartz	colourless	Blue	57°	Moderate to Low relief, low pleochroism and no cleavage presence	Anhedral crystal form	None	40
Biotite	Dark	Dark brown	20°	Low relief, observed two cleavage direction and pleochroism	Euhedral crystal	None	25

4.2 Geochemistry

4.2.1 Geochemistry of the analyzed Stream Sediment concentrates

4.2.1.1 Major Oxides

The result of the mean values of the major oxides shows that the highest major oxide is Al_2O_3(90.66) follow by SiO_2(66.4) and CaO, (8.089) Fe_2O_3,(6.163) Na_2O,(4.501) MgO, (3.75) and k_2O,(1.273) followed successfully in decreasing order, while Cr_2O_3,(0.003) MnO, (0.039) P_2O_5,(0.033)TiO_2 ,(0.742) are below 1 wt %.(Table 2 and Figure 4)

Table2: Concentration of Major Oxides (%) In Sediment Samples

S/N	Al_2O_3	CaO	Cr_2O_3	Fe_2O_3	k_2O	MgO	MnO	Na_2O	P_2O_5	SiO_2	TiO_2
MS1	20.4	0.028	0	6.29	1.193	0.547	0.028	5.931	0.007	63.3	0.133
MS2	24.37	0.616	0.003	8.58	1.446	1.26	0.015	5.257	0.007	66.2	0.701
MS3	132.9	75.55	0.001	10.29	0.409	3.863	0.029	2.386	0.005	66.46	2.218
MS4	230.5	0.308	0.003	5.72	0.928	3.498	0.053	2.089	0.011	67.75	1.651
MS5	190.5	0.937	0.001	4.433	0.783	5.803	0.086	3.896	0.011	62.68	0.1
MS6	85	0.434	0.001	3.432	2.543	1.442	0.007	3.909	0.018	63.02	0.116
MS7	105.4	0.112	0.001	8.866	2.555	0.814	0.017	1.186	0.007	67.65	0.684
MS8	17.01	0.602	0.004	7.15	0.398	10.28	0.015	4.206	0.056	72.03	0.367
MS9	43.26	0.502	0.006	2.86	2.422	3.084	0.077	7.913	0.16	67	0.534
MS10	57.24	1.707	0.007	6.006	0.048	0.912	0.059	8.236	0.092	68.15	0.917
MAX	**230.5**	**75.55**	**0.007**	**10.29**	**2.555**	**10.28**	**0.086**	**8.236**	**0.16**	**72.03**	**2.218**
MIN	**17.01**	**0.026**	**0**	**2.86**	**0.048**	**0.547**	**0.007**	**1.186**	**0.005**	**62.68**	**0.1**
MEAN	**90.66**	**8.089**	**0.003**	**6.163**	**1.273**	**3.75**	**0.039**	**4.501**	**0.033**	**66.42**	**0.742**

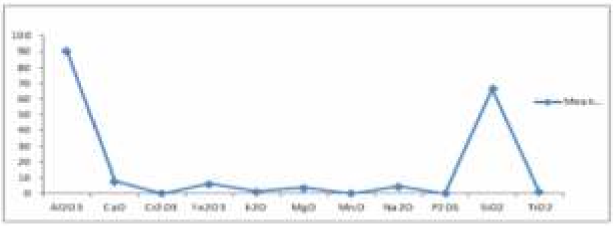


Fig 4: Mean concentration of major oxides in Sediments

4.2.1.2 Trace elements

The result of the mean values of trace elements followed successfully Fin decreasing order Ba,(206.3) V,(5.41) Zn,(64.8) Sr,(52.8) Ni,(36.6) Rb,(21.88)Co,(16) Ga,(12.98) Cu,(12) Pb,(9.8) As,(6.61)Th,(5.41) and Au,(0.697) ppm (Table 3 and figure 5)

Table 3: Concentration of Trace Elements (ppm) In Sediment Samples

S/N	As	Au	Ba	Cu	Co	Ga	Ni	Pb	Rb	Sr	Th	V	Zn
MS1	8.7	1.05	180	13	8	10	22	7	< 15	44	6.1	38	55
MS2	6.3	0.1	220	8	9	7	20	12	17	32	4.4	122	28
MS3	5.9	0.3	320	16	21	4	21	11	17	31	10.4	64	29
MS4	2.9	0.222	70	33	32	15	12	10	22	66	12.8	201	60
MS5	10.7	0.76	400	9	21	12	10	6	21	58	6.8	109	98
MS6	2.8	0.32	230	15	8	4	8	7	33	27	5.4	90	32
MS7	5.8	2.15	150	10	11	33	11	15	< 15	78	2.2	88	44
MS8	12.2	0.7	420	7	10	21	17	12	24	88	3.8	67	190
MS9	8.1	1.09	88	5	32	9.8	120	16	18	74	0.9	54	123
MS10	5.2	0.28	75	18	7	12	125	2	19	54	1.8	21	60
MAX	**12.2**	**2.15**	**420**	**33**	**32**	**33**	**125**	**16**	**33**	**88**	**12.8**	**201**	**190**
MIN	**2.8**	**0.1**	**70**	**5**	**7**	**4**	**8**	**2**	**17**	**27**	**0.9**	**21**	**28**
MEAN	**6.61**	**0.697**	**206.3**	**12**	**16**	**12.98**	**36.6**	**9.8**	**21.88**	**53.8**	**5.41**	**87.5**	**64.8**

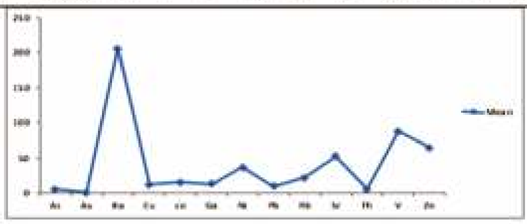


Fig.5: Mean concentration of Trace Elements in Sediment

4.2.1.3 Rare Earth Elements

The result of the analysis shows the mean concentrations of the REEs in decreasing order as Ce ,(70.8) Nd,(65.2) Y,(42.1) La,(38.1) Sc,(8.17) Sm,(6.61) Yb,(4.17) Eu,(3.62) Tb(3.31) and Lu (2.012) ppm. (Table 4 and Figure 6)

Table 4: Concentration of The Rare Earth Elements (ppm) In Sediment Samples

S/N	Ce	Eu	La	Lu	Nd	Sc	Sm	Tb	Y	Yb
MS1	109	0.3	50	1	92	10.2	4	2.6	40	2.3
MS2	82	6	59	2	66	10.4	5.8	6	43	6
MS3	76	7	41	4.22	108	2.9	6.9	0.6	78	6
MS4	88	2.1	32	4.6	80	2.3	3.1	<0.5	88	4.4
MS5	10	0.6	32	0.54	21	6.9	4.4	1.8	65	5.2
MS6	22	0.5	44	0.87	34	7.3	7	3.9	42	6.2
MS7	97	0.7	55	0.99	66	6.8	0.9	4.4	9	0.8
MS8	77	7	23	3.12	20	7.9	15	3.5	14	0.7
MS9	102	3	32	2.11	76	12	9	3	31	3.1
MS10	**48**	**9**	**13**	**0.67**	**89**	**18**	**10**	**4**	**11**	**7**
MAX	**109**	**9**	**69**	**4.6**	**108**	**18**	**18**	**6**	**88**	**7**
MIN	**10**	**0.3**	**13**	**0.54**	**20**	**2.3**	**0.9**	**0.6**	**9**	**0.7**
MEAN	**70.8**	**3.62**	**38.1**	**2.012**	**65.2**	**8.17**	**6.61**	**3.31**	**42.1**	**4.17**

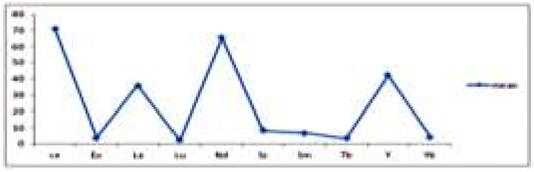


Fig.6: Mean concentration of Rare Earth Elements (REEs) in Sediments

4.3 Geochemistry of the analyzed Rock samples

4.3.1 Major Oxides

The result of the mean values of the major oxides shows that the highest value of major oxide is SiO_2 (80.23) and Fe_2O_3,(6.635) Al_2O_3,(3.268) k_2O,(2.079) Na,(2.235) and CaO (1.651) followed successfully in decreasing order, While MgO, (0.915) TiO_2 (0.427) MnO, P_2O_5,(0.076) and $Cr_2O_{3,}$(0)are below 1 wt %. (Table 5 and figure 7)

S/N	Al_2O_3	CaO	Cr_2O_3	Fe_2O_3	k_2O	MgO	MnO	Na_2O	P_2O_5	SiO_2	TiO_2
R1	0.17	1.259	0.016	7.15	0.771	1.658	0.068	0.445	0.206	80.11	0.117
R2	3.908	0.839	0.013	5.849	1.193	0.531	0.05	1.335	0.137	85.44	0.367
R3	8.101	4.197	0.007	4.447	1.205	1.277	0.037	2.696	0.009	73.82	0.384
R4	1.662	1.399	0.003	5.72	2.41	0.928	0.035	2.696	0.016	74.44	0.534
R5	4.42	0.559	0.001	10.01	4.82	0.182	0.012	4.004	0.011	87.33	0.734
MAX	**8.101**	**4.197**	**0.016**	**10.01**	**4.82**	**1.658**	**0.068**	**4.004**	**0.206**	**87.33**	**0.734**
MIN	**0.17**	**0.559**	**0.001**	**4.447**	**0.771**	**0.182**	**0.012**	**0.445**	**0.009**	**73.82**	**0.117**
MEAN	**3.268**	**1.651**	**0**	**6.635**	**2.079**	**0.915**	**0.040**	**2.236**	**0.076**	**80.23**	**0.427**

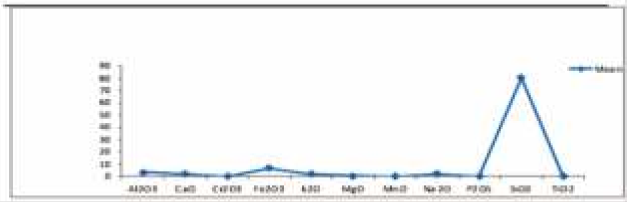


Fig.7: Mean concentration of major oxides in Rocks

4.3.2 Trace elements

The result of the mean values of trace elements followed successfully in decreasing order, Ba,(242.4)Sr, V,(35.2) Co,(26.2)Ga,(24.6) Zn,(22.8) Rb,(21) Ni,(16.4) Cu,(16)Pb,(11) As,(6.6)Th,(3.22) and Au(0.349) ppm (Table 4.4 and figure 4.5)

Table 6: Concentration of Trace Elements (ppm) in Rock Samples

S/N	As	Au	Ba	Cu	Co	Ga	Ni	Pb	Rb	Sr	Th	V	Zn
R1	5	0.7	300	11	22	26	15	7	<15	55	4.3	30	40
R2	5	0.345	210	7	43	33	12	8	18	16	7.2	56	32
R3	8	0.246	200	23	33	30	20	11	25	46	0.9	34	12
R4	3	0.055	102	21	23	12	22	23	21	88	2.3	44	22
R5	12	0.401	400	18	10	22	13	6	20	23	1.4	12	8
MAX	**12**	**0.7**	**400**	**23**	**43**	**33**	**22**	**23**	**25**	**88**	**7.2**	**56**	**40**
MIN	**3**	**0.066**	**102**	**7**	**10**	**12**	**12**	**6**	**18**	**16**	**0.9**	**12**	**8**
MEAN	**6.6**	**0.349**	**242.4**	**16**	**26.2**	**24.6**	**16.4**	**11**	**21**	**45.6**	**3.22**	**35.2**	**22.8**

Fig.8: Mean concentration of Trace Elements in Rock

4.3.3 Rare Earth Elements

The result of the mean values of Rare Earth Elements (REEs) in (Table 4.6and in Figure 4.7), the result of the analysis shows the mean concentrations of the REEs in decreasing order as Ce, (41.4) La, (18.46)Nd,(14.6) Y,(13.4)Sc,(10.4)Sm,(5.16)Yb,(2.58)Eu (2.26), Tb,(0.63) and Lu (0.506) ppm

Table 7: Concentration of The Rare Earth Elements (Ppm) in Rock Samples

S/N	Ce	Eu	La	Lu	Nd	Sc	Sm	Tb	Y	Yb
R1	60	2.4	30.2	0.91	45	15	7.2	0.6	33	5.2
R2	70	3	16.3	0.77	6	9	4.1	<0.5	17	3.3
R3	43	5	15.7	0.34	9	6	2.9	0.7	3	3.4
R4	22	0.3	18.1	0.44	6	10	5.3	0.6	3	0.6
R5	12	0.6	12	0.07	7	12	6.3	<0.5	11	0.4
MAX	**70**	**6**	**30.2**	**0.91**	**46**	**16**	**7.2**	**0.7**	**33**	**6.2**
MIN	**12**	**0.3**	**12**	**0.07**	**6**	**6**	**2.9**	**0.6**	**3**	**0.4**
MEAN	**41.4**	**2.26**	**18.46**	**0.506**	**14.6**	**10.4**	**5.16**	**0.63**	**13.4**	**2.58**

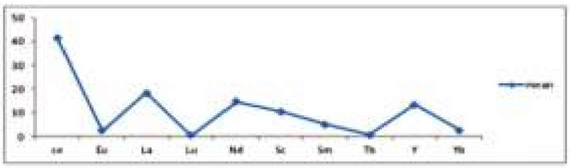
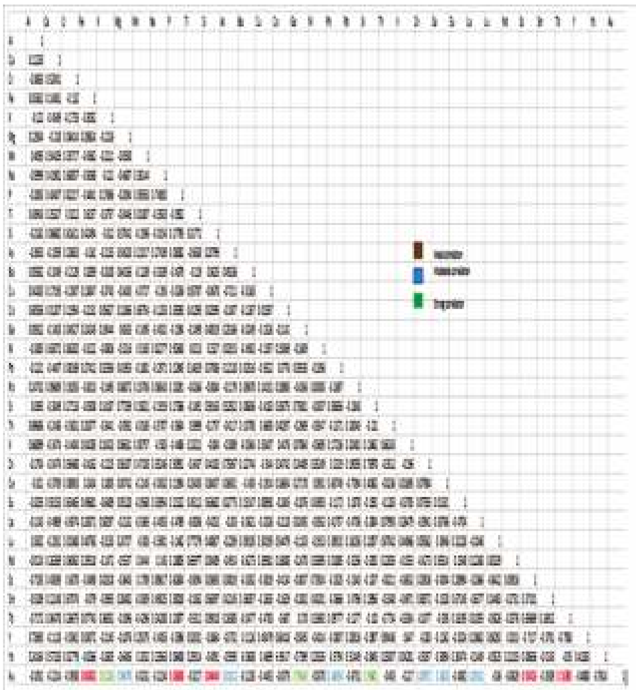


Fig.9: Mean concentration of Rare Earth Elements (REEs) in Rock

4.4 Correlation coefficients of Au with other elements in the stream sediment samples

Pearson correlation analysis of the Au with other elements in the stream sediment indicated that gold strongly positively correlates with K, (0.512161) Ga, (0.75645) and Sr, (0.59681). Moderately positively correlated with Mg, (0.39478) As, (0.31012) Pb,(0.46554) Zn, (0.20972) Ce, (0.3823) and La,(0.29131), and weakly positively correlated with Fe,(0.00602) P, (0.06838) Si (0.04644) Nd, (0.05426) Sm,(0.16385).

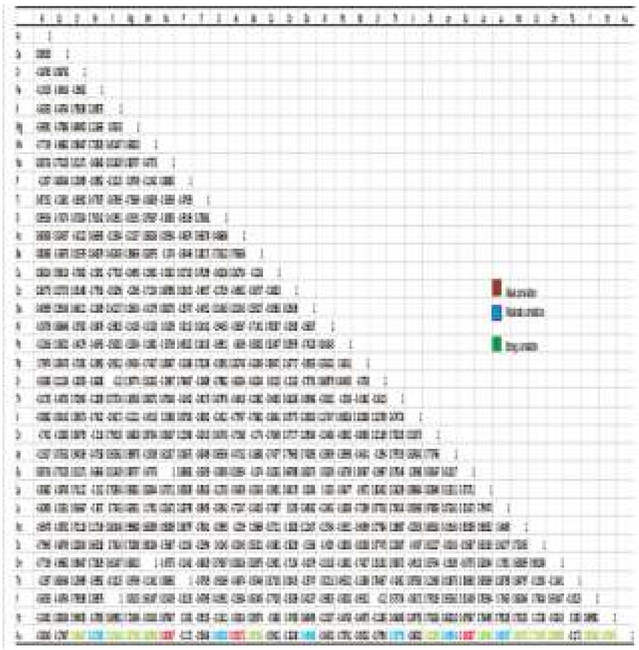
Table 8: Correlation coefficient of Au with other elements in sediments samples



4.5 Correlation coefficients of Au with other elements in the rock

Pearson correlation analysis of the Au with other elements in the rock samples indicated that gold strongly positively correlates with Cr, (0.684627) K, (0.925946) Mg, (0.827588) Mn, (0.600988) Ba, (0.697656) Zn (0.520359) La, (0.639456) Nd, (0.833705) Sc, (0.716376) Sm (0.600988) Y (0.925046) and Yb (0.673674). Moderately positively correlated with Fe, (0.427385) Si, (0.458038) Ga, (0.449669) Th, (0.319759) Ce, (0.449954) and Lu, (0.140367), and weakly positively correlated with Na, (0.140367) As, (0.1913172) and Eu, (0.140367).

Table 9: Correlation coefficient of Au with other elements in rocks.



4.5 Gold and other elements mineralization potentials in the study area

The gold comparatively is more enriched and consequently more mineralized in sediment (Table 10) than the rock (Table 11). This is because the mineralized gold in the rock are in primary form while those in stream sediment are in secondary form, meaning that the rock has been weathered; releasing the primary gold which were now moved by water and concentrated in an area within the stream sediment, hence given rise to higher concentration in the stream sediment.

Table 10: Gold and other Mineralization Potentials of Sediments in the Study Area

S/N	ELEMENTS	MEAN ANALYZED VALUE (PPM)	BACKGROUND CONCENTRATION/ CLARK'S VALUES (PPM) REEDMAN,1979	COMPUTED ENRICHMENT FACTORS (EFS) %	MINERALIZATION STATUS
1	Al	90.7	7.34	12.36	Moderately mineralized
2	Fe	6.2	4.11	1.509	Non-mineralized
3	Mg	3.8	2.28	1.666	Non-mineralized
4	Na	4.5	2.33	1.931	Non-mineralized
5	Ba	206.3	400	0.516	Non-mineralized
6	Co	16	23	0.696	Non-mineralized
7	Ni	36.6	80	0.458	Non-mineralized
8	Sr	52.8	450	0.117	Non-mineralized
9	V	87.5	135	0.648	Non-mineralized
10	Zn	64.8	65	0.997	Non-mineralized
11	Au	0.7	0.005	140	Mineralized

Table 11: Gold and other Mineralization Potentials of Rocks in the Study Area

S/N	ELEMENTS	MEAN ANALYZED VALUE (PPM)	BACKGROUND CONCENTRATION/ CLARK'S VALUES (PPM) REEDMAN,1979	COMPUTED ENRICHMENT FACTORS (EFS) %	MINERALIZATION STATUS
1	Fe	6.635	4.11	1.614	Non-mineralized
2	Ce	41.4	46	0.9	Non-mineralized
3	La	18.46	18	1.026	Non-mineralized
4	Nd	14.6	24	0.608	Non-mineralized
5	Sc	10.4	5	2.08	Non-mineralized
6	Sm	5.16	7	0,737	Non-mineralized
7	Y	13.4	40	0.335	Non-mineralized
8	Ba	242.4	400	0.606	Non-mineralized
9	Co	26.2	23	1.139	Non-mineralized
10	Sr	45.6	450	0.101	Non-mineralized
11	V	35.2	135	0.261	Non-mineralized
12	Zn	22.8	65	0.351	Non-mineralized
13	Au	0.349	0.005	69.8	Mineralized

4.6 Gold assessment in the study area

Tables 12 and 13 show the gold mineralization assessments. From the above gold assessment, gold is highest in stream sediment sample location 7 (06°25' 01.20" E 09° 29'06.60" N) and lowest at location 2 (06°24'53.80" E 09° 29'09.09"N). Similarly, gold is highest for rock in location 1(06° 25'08.00"E 09° 29'02.50" N) and least in location 4 (06° 25'02.40"E 09°28'17.70"N).

Table 12: Gold Assessment from the analyzed Sediment Samples

SAMPLE LOCATION	EASTING	NORTHING	GOLD ASSESSMENT (PPM)
MS 1	06°24'53.90"	09°29'10.40"	1.05
MS 2	06°24'53.80"	09° 29'09.09"	0.1
MS 3	06°24' 53.10"	09°29'08.40"	0.3
MS 4	06°24' 51.10"	09°29'11.20"	0.222
MS 5	06°24' 55.20"	09°29'10.30"	0.76
MS 6	06°24' 58.00"	09° 29' 09.10"	0.32
MS 7	06°25' 01.20"	09° 29'06.60"	2.15
MS 8	06°25' 03.70"	09°29' 04.80"	0.7
MS 9	06°25' 03.90"	09°29' 04.80"	1.09
MS 10	06°24' 58.60"	09°28'55.30"	0.28

Table 13: Gold assessment from the analyzed Rock Samples

SAMPLE LOCATION	EASTING	NORTHING	GOLD ASSESSMENT (PPM)
MS 1	06° 25'08.00"	09° 29'02.50"	0.7
MS 2	06° 25'09.20"	09° 29'01.10"	0.345
MS 3	06° 25'10.40"	09° 29'00.00"	0.246
MS 4	06° 25'02.40"	09° 28'56.20"	0.055
MS 5	06° 25'53.20"	09° 28'17.70"	0.401

5.0 CONCLUSIONS

The aim of the study is to evaluate the gold and other mineralization potentials of the stream sediments and rocks. The Geological mapping and thin section the geological mapping and thin section petrography of the rock samples of the study area has revealed that the area is underlain by granite and schist.

The result of the analysis of stream sediment shows gold enrichment of 140%, and other elements with enrichment of Al 12.36%, Fe 1.509%, Mg 1.666%, Na 1.931% Ba 0.516%, Co 0.696% Ni 0.458%, Sr 0.117%, V 0.648% Zn 0.997% from these results only Gold and Aluminum have shown the potential enrichment within the study area.

The result of the analysis of rock samples shows gold enrichment of 69.8%, and other elements with enrichment of Fe 1.614%, Ce 0.9%, La 1.026%, Nd 0.608%, Sc 2.08%, Sm 0,737%, Y 0.335%, Ba 0.606%, Co 1.139%, Sr 0.101%, V 0.261%, Zn 0.351% from these results only gold have shown the potential enrichment within the study area.

Pearson correlation analysis of the Major, Trace and Rare Earth elements in sediment indicated that gold strongly positively correlates with K, (0.512161) Ga, (0.75645) and Sr, (0.59681). Moderately positively correlated with Mg, (0.39478) As, (0.31012) Pb,(0.46554) Zn, (0.20972) Ce, (0.3823) and La,(0.29131), and weakly positively correlated with Fe,(0.00602) P, (0.06838) Si (0.04644) Nd, (0.05426) Sm,(0.16385).

Pearson correlation analysis of the Major, Trace and Rare Earth elements in rocks indicated that gold strongly positively correlates with Cr, (0.684627) K, (0.925946) Mg, (0.827588) Mn, (0.600988) Ba, (0.697656) Zn (0.520359) La, (0.639456) Nd, (0.833705) Sc, (0.716376) Sm (0.600988) Y (0.925046) and Yb (0.673674). Moderately positively correlated with Fe, (0.427385) Si, (0.458038) Ga, (0.449669) Th, (0.319759) Ce, (0.449954) and Lu, (0.140367), and weakly positively correlated with Na, (0.140367) As, (0.1913172) and Eu, (0.140367).

REFERENCES

Adepoju, M. O and Adekoya, J. A (2008): Statistical Analysis of Reconnaissance Geochemical data from orle District, SW Nigeria. Global of geological science. 6(i): 65-73.

Ajibade, C. A. (1976). Provisional Classification and Correlation of the Schist Belts of the \North-western Nigeria. In: Kogbe, C. A. (Ed.), Geology of Nigeria (pp. 85-90). Lagos: Elizabethan Publishing Company.

Ajibade, C. A. (1980). Geotectonic Evolution of Zungeru Region, Nigeria. Unpublished Ph.D Thesis, University college of Wales, Aberyswyth, pp. 303.

Caleb, A. T, (2010). Trace element distribution patterns in the Middle Benue Trough: A Case study of Faya and Environs. And unpublished M. SC. Thesis, University of Jos, Nigeria, 165 p.

Fitches, W., Ajibade, A.C., Egbuniwe, I.G., Holt, R.W. and Wright, J.B. (1985). Late Proterozoic schist belt and plutonism in Northern Nigeria. J GeolSoc 142; 319-337.

Garba, I (1987).Geochemical Exploration of Gold in the area North of Isanlu, SW Nigeria. Journal of African Earth Science, 6 (3): 281-286.

Haruna, I. V, Dada, S.S, and Mamman, Y. D. (2008).Stream sediment Geochemical Survey of an area around Dass, NE Nigeria. Global journal of Geological science.

Kankara, I. A. and Darma, M. R. (2016). A Review of Gold Metallurgeny in Nigeria. In*: Int'l Journal of Research in Chemical, Metallurgical and Civil Engg.* (IJRCMCE) Vol. 3:295-296).

McCurry, O. (1976). The Geology of the Precambrian to lower Paleozoic Rocks of Northern Nigeria. In: C.A. kogbe (Ed.), Geology of Nigeria series, southern Camerron. Elizabethan Publishers.

Oyebanji, A., Falae, P., and Fadamoro, O. (2017).Geochemichal characterization of Naskogold deposit North-Western Nigeria: journal of Applied Geochemistry, 19(3) 277-288

Rahaman, M.A. (1976). Review of the Basement Geology of South-Western Nigeria. In: C.A. Kogbe (Ed.), Geology of Nigeria (pp 41-57) Lagos: Elizabethan Publisher.

Robert, F., Poulsen, K. H. and Dube, B. (2003). Gold Deposits and their Geological Classification, pp. 212-219.

Truswell, J.F. and Cope R.N. (1963). The geology of parts of Niger and Zaria Provinces, Northern Nigeria. GeolSuvey Nigeria Bull 29, 1–104.

Turner, D.C. (1983). Upper Proterozoic schist belts in the Nigerian sector of the Pan-African Province of West Africa. Precambrian Res 21, 55–79.