The Geological and Geochemical Characteristics of Soil on Ore Deposits, Itagunmodi Gold Deposits as a Case Study

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Abstract-- **This work examines the geological and geochemical characteristics of soil on Ore deposits on the formation and maturity of (SHDG) deposits in Itagunmodi, Osun State, Nigeria. Although, some investigations have been carried out on their geological and geochemical characteristics in general, most of the studies are based on limited database. The source and the nature of the gold in the deposits are still not clear. The major objective of this study is to determine the geochemical characteristics of host soil. The plots of major elements collected from five different locations in the mining areas named A-E and three locations outside the mining areas F-H shows that the concentrations of the element is higher within the mining site than area outside the mining site.**

Index Term-- **Geochemistry, geology, host soil.**

1. INTRODUCTION

Sediment-hosted disseminated gold deposits, also referred to as vein type deposits, are distinct type of ore mineralization. High grade portions of these deposits, such as those at the Mercur deposit, Utah, U.S.A., have been mined since the last century (Jewell and Parry, 1987), they were not recognized as a distinct class until the discovery of disseminated gold mineralization in carbonate rocks in 1961, and the development of bulk-tonnage mining carlin deposits between 1962 and 1965 (Hausen and Kerr, 1968).

The sediment-hosted disseminated gold deposits (SHDGD) in Itagunmodi, Osun State, Nigeria is located in the clayey soil types derived from variably migmatised gneiss, biotite-and-biotite-hornblende-gneiss and weathered amphibolites respectively.

The geology of the area is Precambrian basement complex gneisses, migmatites and Schist associated with amphibolites.

2. LOCATION

Itagunmodi is located on latitude (DMS) $7^0 31'60''$ longitude (DMS) $4^0 39'0''$ and altitude (meters) 347 the time zone is east (est). The approximate population for 7km radius from this point is 12655

Fig. 1. showing some of the mining sites

Fig. 2. showing mining site

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Fig. 3. showing mining site

Fig. 4. showing mining site

3.   METHODOLOGY

Geochemistry analysis was carried out on soil samples collected within the mining sites and outside the mining sites to investigate the major elements and trace elements that are likely present.

3.1 PROCEDURE FOR THE AAS METHOD

A representative rock sample was first pulverized and digested using wet method of digestion in Nitric acid. About 0.5g of each sample was measured into the dry digesting tube, 3-4 drops of distilled water was added to wet the sample. 5ml of Hydrochloric acid (HCl) was added to the wet sample and the solution was stirred. 5ml of Nitric/Perchloric acid was added in the ratio 3:2 and stirred. The digesting tube was left overnight without heating. The samples were leached out with 5ml of 6M HCl into a measured test tube and made up tos 20ml mark with distilled water. To avoid caking, the content was shaken vigorously and the resulting solution is referred to as solution. The stock was used directly to determine the elements.

3.2   PRINCIPLE   OF   ATOMIC   ABSORPTION SPECTROPHOTOMETRY   (AAS)   FOR   TRACE ELEMENT ANALYSIS

The principle of Atomic Absorption Spectrophotometer (AAS) is based upon the concept that atoms of an element can absorb electromagnetic radiation. This occurs when the element is atomized and the wavelength of light absorbed is specific to each element. Thus the atomic absorption spectrophotometer comprises an atomizing device, a light source and a detector. A lowering of response in the detector during the atomization of the sample in a beam of light, as a consequence of atomic absorption, can be calibrated and is sensitive at the ppm level. The sample was prepared in a solution and aspirated via a nebulizer and atomized in an acetylene-air or acetylene- nitrous oxide flame.

The mass and volume of the sample was used in calculating the density of the sample. The density of solids (mean particle density) is determined by the relation;

$$\rho_s = M_s \big/ V_s$$

------------------ (1.1)

The value calculated was 2.632g/cm^3. In most mineral soils the mean mass per unit volume of solids is about 2600-2700 kg/m^3.This is close to the density of quartz, which is generally the most prevalent mineral in the coarsest fraction of the soil.

4. RESULTS
Analysis- Geochemical Composition of Rocks (Soil samples)

TABLE I
MAJOR ELEMENT (%)

	A	B	C	D	E	F	G	H
SiO_2	59.86	65.87	61.89	56.84	57.68	65.82	59.80	61.20
TiO_2	2.06	1.19	3.19	1.04	0.01	1.18	1.08	3.10
Al_2O_3	24.68	10.82	20.60	21.22	24.21	10.56	24.70	20.54
Fe_2O_3	3.33	6.52	5.21	7.65	3.24	6.43	3.31	5.32
MnO	0.01	0.02	0.01	0.02	0.01	0.02	0.01	0.01
MgO	0.29	2.67	0.70	1.45	0.32	2.54	0.23	0.70
CaO	0.48	1.64	0.02	3.44	0.72	1.55	0.50	0.02
Na_2O	1.87	4.07	0.16	1.29	0.21	4.06	1.82	0.12
K_2O	0.50	0.89	0.65	0.97	0.50	0.77	0.48	0.67
H_2O+	10.98	16.10	8.20	8.43	10.55	15.20	10.88	8.24

TABLE II
TRACE ELEMENT (%) X10-3

	A	B	C	D	E	F	G	H
Ba	67.22	47.62	64.22	65.72	64.42	57.21	66.11	54.23
Rb	8.02	8.46	8.42	6.63	17.44	1.86	1.39	1.79
Ce	3.40	4.02	11.28	1.90	21.42	4.52	3.92	3.84
Zr	1.52	26.11	40.82	12.02	6.46	8.69	7.39	8.64
Cr	11.22	11.01	11.04	11.24	9.83	10.02	101.00	11.02
V	1.76	1.76	2.27	2.25	1.72	2.38	1.72	1.22
Zn	21.02	30.82	31.04	22.04	23.17	23.04	22.11	22.01
Cu	2.16	3.42	3.46	3.28	2.87	2.33	2.43	2.16

NOTE: Samples A-E were collected within the mining sites
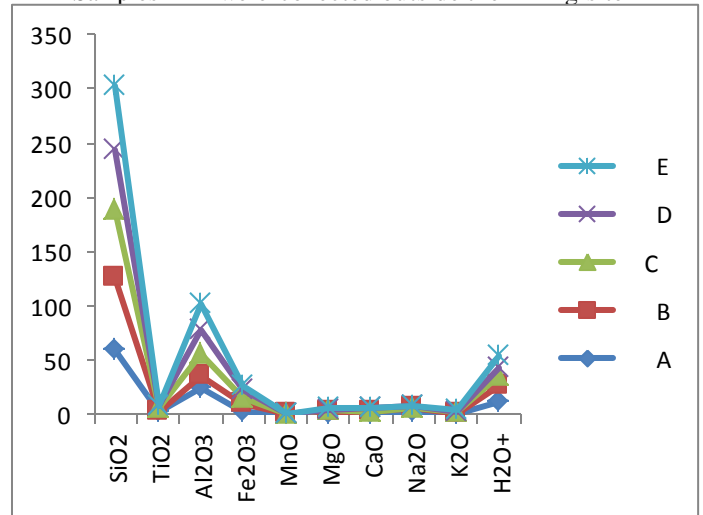Samples F-H were collected outside the mining site

Fig. 5. Plot of major elements concentrations in the mining site
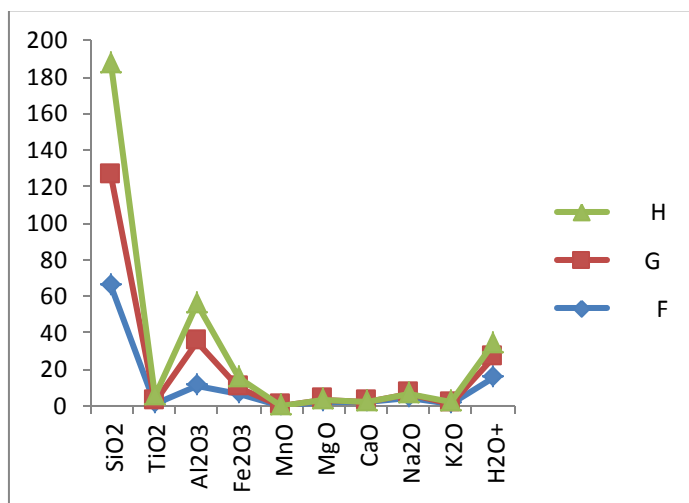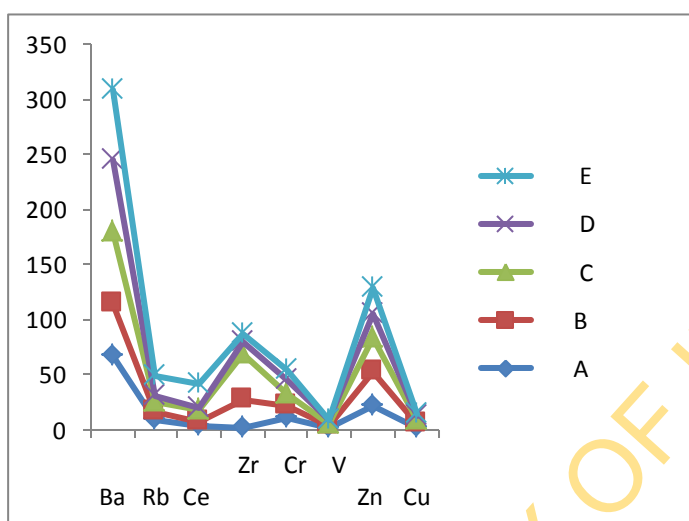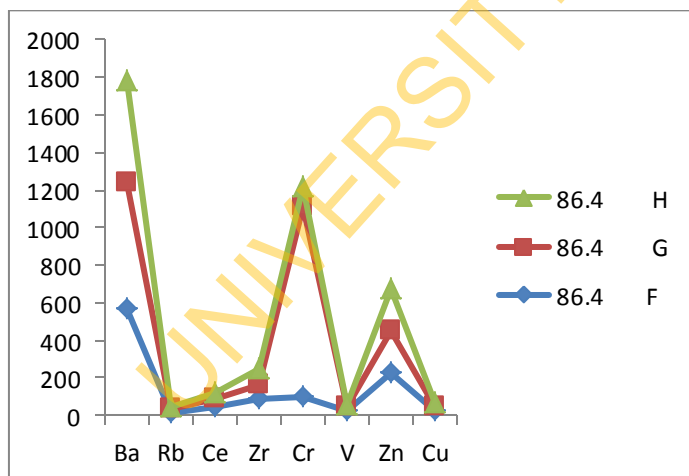
Fig. 6. Plot of major elements concentrations outside the mining site

Fig. 7. Plot of trace elements concentrations ($\times 10^{-3}\%$) in the mining site

Fig. 8. Plot of trace elements outside the mining site ($\times 10^{-3}\%$)

MnO, MgO, CaO, Na_2O, K_2O, and a further increase in concentrations of $H2O^+$ as seen in the plot of major and trace elements respectively.

The plot of trace elements shows higher concentrations in Ba, Cr and Zn, in F-H, and low concentrations in Rb, Ce, Zr, V, and Cu. For samples A-E, the concentrations were higher in Ba, Zr, and Zn, with decrease in Rb, Ce, Cr, v and Cu respectively.

Trace elements, especially rare earth elements (REE), are widely used to model the petro genesis and evolution of igneous, sedimentary and metamorphic rocks (e.g., Hauskin, 1984; Fleet, 1984). REE are generally regarded as insensitive to hydrothermal alteration. Recently, the potential of REE to provide information about ore forming processes through REE mobility or immobility during ore forming processes has widely been recognized, and detailed REE investigation have been performed on many metallic deposits (Tailor and Fryer, 1980, 1982; Campbell et. Al., 1984; Giere, 1986; Whitford et. al., 1988; Lottermoser, 1992; Perr, 1992; Wood and William-Jones, 1994; Bierlen, 1995; Bieriein et., 1999). The mobility of the trace elements in altered host-rocks, and their distribution in host rocks and ores may provide constraints regarding the physico-chemical characteristics of the ore-bearing fluids, and may contribute to understanding the ore-forming processes (Lottermoser, 1992).

REFERENCES

[1] Arehart, G. B. 1996. Characteristic and origin of sediment-hosted disseminated gold deposits: a review. Ore geology reviews, 11:383-403.

[2] Environmental Soil Physics by Daniel Hillel 1998 academic Press pg. 10-12

[3] 3. Geochemistry of the Sediment-Hosted Disseminated Gold Deposits in Southwestern Guizhou Province, China. By Zhiwei Bao. 2001.

[4] Hausen, D.F. and Kerr, P.F. 1968. Fine gold occurrence at Carlin, Nevada. In. J.D. Rigde (editor). Ore deposits of the United State, 1933-1967. Volume 1, New York, AIME, 908-940. 5. Jewell, P.W., and Parry, W.T. 1987. Geology and hydrothermal alteration of the mercur gold deposit, Utah. Economic Geology, 82(7); 1958-1966.

5. DISCUSSION AND CONCLUSION

The analysis of the soil shows more concentrations SiO_2, and Al2O3, with a decrease in the concentrations of TiO_2, Fe_2O_3,