

COMPOSITION OF OREBODIES AS A GUIDE TO THE STUDY OF SECONDARY MINERAL DEPOSITS IN NORTH EASTERN ZONE OF NIGERIA.

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Abstract

A study involving ore samples collected from the mineralized zones of Bauchi, Borno and Gombe States in North Eastern Zone of Nigeria was carried out. The elements analysed are Mg, Ca, Zn, Cu, Fe, Ag, Pb, Ni, P and As. Analysis and calculations of dissolved solids indicate the amounts of metals is up to 200,000mg/l. The geochemical significance of these results is discussed.

Introduction

As Sindeyeva [1] pointed out, iron-rich ore resulting from the leaching of Fe minerals precipitated massive limonite near the surface. Vestigial features resulting from simple weathering in place of metal rich parent materials provide a guide to burned ores. Thus weathering tends to obscure the original chemistry, mineralogy and texture. Elemental studies are therefore carried out in this present work to help to distinguish between the weathered from similar materials.

In order to investigate the mineralogy of some formations in different parts of Northern Eastern zone in Nigeria, a systematic collection from orebodies has been implemented. Many materials from these ore deposits have escaped detection because there is no readily visible indication in the residual overburden. Where the bedrock is exposed weathering and leaching may still obscure evidence of the primary metals.

Material and Methods

Sample Collection/Preparation:

The samples used in this study were collected from the formations in Bauchi, Borno and Gombe States. These samples from the seventeen orebodies areas were freed of silica and other contaminating materials. Clean fragments were hand picked under the microscope.

Extraction of the Samples:

Finely powdered materials (5.00g) was admitted into a volumetric flask (250ml) containing a solution of NH₄OAl (1M, 100ml) to which a tetfoh covered magnetic follower had been added. The flask was sealed and thermostated for 1hr at 25.20°C in a water bath and stirring was effected by a magnetic stirrer. The content of the flask was filtered using filter paper (0.45umilipore) and the volume was made up to 250ml with distilled water. This solution was labeled stock solution and were used for the various measurements.

Determination of pH:

The pH of the stock solution was determined using a pH TW 521 fitted with E56 combination.

Determination of the oxides:

Magnesium as its oxides:

The stock solution (10ml) was pipetted into conical flask (250ml) followed by addition of water (100ml), NH₃ solution (1M, 15ml), KCN, K₄Fe(CN)₆ (1:1, 50ml) and EDTA (0.1M, 10 drops) in that order. This mixture was allowed to stand for about 10minutes and titrated to a permanent blue colour with EDTA (0.01M) using Erochrome black T indicator (EBT).

The magnesium oxide of the final solution was determined by Direct Reading

A.I. Inegbenebor

Spectrophotometer (DR200). The results are given in Table 1.

Calcium as its oxides:

The stock solution (10ml) was pipetted into conical flask (250ml) then distilled water (100ml) was added, NH₃ solution (1N, 15ml) KCN, K₄Fe(CN)₆ (1:1, 50ml) and EDTA (0.1M, 10 drops) were added in that order. Sodium hydroxide (10%) was then added until the pH became 12. The mixture was then titrated against EDTA to a reddish violet colour using murexide powder as indicator. The ensuing solution was analysed for calcium oxide using Direct Reading Spectrophotometer (DR200).

Phosphorus and Arsenic:

Determination of total arsenate and phosphate in solution were carried out colorimetrically by molybdate blue method, according to the procedure recommended by Harwood [2]. The results are given in Table 1.

Results and Discussion

Table 1 represents the results of the analysis of the orebodies from seventeen different localities (see Figure 1a and b). The most abundant elements are Ca, Fe, Ag, and Pb whereas the minor ones include As, P, Mg and Zn. Despite the high amounts of the metals generally being recorded from these orebodies in Table 1, the knowledge and the full extent of species and their compositional ranges is very limited particularly of the secondary minerals. According to Langmuir and Whittemore (1971), most metals in well developed ores occur predominantly as secondary minerals or as firmly bonded components of clay (or silica) materials and hydrous Fe and Mn oxides. Semi-mobile trace metals such as P, As and Ni tend to be concentrated in silt and clay size fraction of the soil.

These results (Table 1) show three patterns: (A) those with total solids above 165,000mg/l but below 220000mg/l. (B) those with total solids above 100000mg/l below 165000mg/l. (C) those with total solids above 40000mg/l but below 100000mg/l.

Group A belongs to the assemblage which are characterized by high concentration of P, Al, Fe capable of precipitating species such as hematite and magnetite in arid-zone environments [3] (Langmuir and Whittemore, 1971).

Group B may belong to the copper and zinc rich associations made of thin crusts and coatings of minerals of cavernous granular quartz which could modify these minerals. Under moderate temperature conditions (35-45°C) and acidic pH, it has been suggested that orebodied minerals should have low values for metals such as Cu, Mg and Ag [4]. The values for these elements as shown in Table 1 are low for samples BOT1, BOT2, BOT4 and BOT9 which represent Borno Southeast, these belong to the same horizon of mean annual temperature of between 37-45°C in which semi trace elements tend to be concentrated in the silt, clay and clay size fraction and accompanied with shallow chemical leaching poor drainage and active erosion.

Table 2 represents the values for unorebodied ores which are considerably lower for the orebodied areas found in the area under study shown in the same figure. This observation indicates a high activity values which could be a useful guide in predicting the minerals in orebodied areas under study. When this criteria is applied to all the localities GM1, BOT3, BOT1, BAT5, BOT7, BOT4, BOT6, BOT5, BAT7, BOT10, BOT8, BAT6, BOT2, BOT9, BOT3, BAT1 and BAT2; these are associated with pH values 5-7,

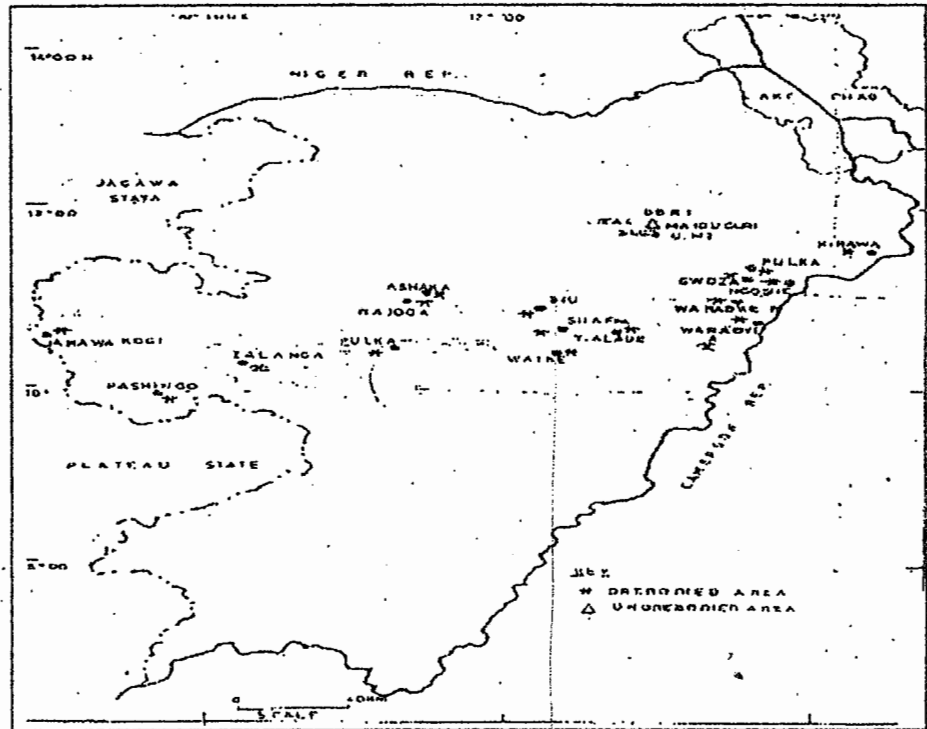


Fig. 1b. Locations of samples collected

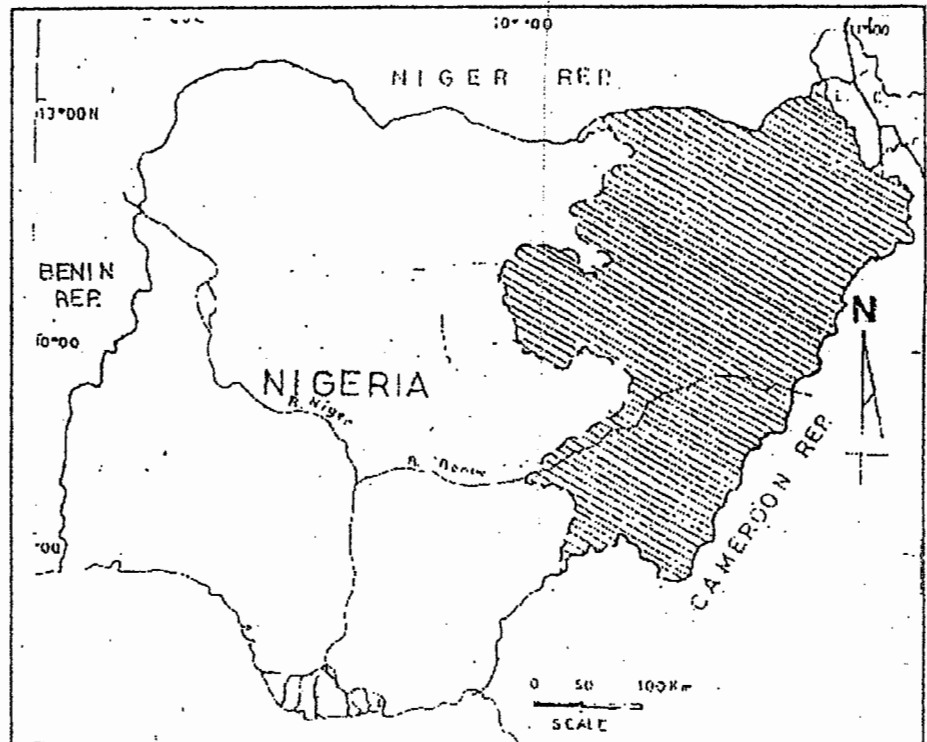


Fig. 1c. Nigeria showing the North East Region

Table 1: Average elemental composition of orebodies in Northeast of Nigeria (mg/l). TS=Total solids

Sample No	Formation	pH	Mg	Ca	Zn	Cu	Fe	Ag	Pb	Ni	P	As	Ts
GM1	ASHAKA	5.11	1640	34500	250	70	158200	1000	20000	1000	1200	780	218640
BOT3	BOJOGA	5.82	970	36300	205	230	125500	20000	15000	3000	1380	490	203075
BOT1	WAIKE	6.31	145	8300	450	100	160500	1000	20500	500	1450	300	193245
BAT5	FULKA	6.19	1130	10320	860	50	130000	1000	20000	500	1450	550	165860
BOT7	NGOSHE	5.81	690	27500	695	165	110000	5500	10000	1500	750	420	157220
BOT4	SHAFFA	5.50	1550	6750	1300	380	100500	3000	30500	500	1650	380	146510
BOT6	KIRAWA	6.10	1480	2330	1300	180	63500	40100	5200	7000	1030	380	122500
BOT5	GWOZA	5.91	4050	5600	1850	160	60000	30240	1000	5000	1540	450	118890
BAT7	ZALANGA	6.60	700	2338	230	10	64000	23400	10600	3000	1330	450	106058
BOT10	WARABVE B	5.80	900	1600	345	25	72370	13000	6500	2000	1000	450	98190
BOT8	PULKA	5.83	1640	10530	400	100	39000	20000	10000	5000	1500	650	88820
BAT6	PASHIGO	5.81	2460	13270	300	25	48700	500	20000	100	970	560	86885
BOT2	BIU	6.50	370	44000	260	16	30850	5025	2000	700	950	450	84621
BOT9	WARABVE A	6.81	600	1855	200	20	27000	20000	10000	4000	1300	530	65505
BOT3	TACHAN ALADE B	6.25	880	10320	645	230	30240	4000	7000	100	1850	750	56315
BAT1	JARAWA- KOGI	6.00	5340	2500	190	160	40200	1450	3000	1000	850	450	47300
BAT2	BOYO	5.22	670	3895	200	180	30650	2340	2000	1000	950	330	42215S

Table 2: Elemental composition of samples from unorebodied areas in Northeast of Nigeria (mg/l)

Sample No.	pH	Constituents					
		Mg	Ca	Zn	Cu	Fe	Ag
SLC3	5.80	203	1220	100	80	1510	98
BCA4	6.10	150	98	93	75	1820	180
DBR1	6.50	138	1050	78	105	1750	550
UM2	6.60	240	1145	130	90	1800	550

most heavy metals are expected to be retained and therefore in general elements such as Pb, Cu and Ag will be strongly absorbed by ores.

The characteristics elements in secondary assemblage precipitation will depend on subtle variation in concentration based on the predomination of physicochemical parameters (i.e. pH of fluid, the amount of pyrite, the presence of carbonic feldspatic minerals [5, 6]. Table 1 shows that metals in the well developed ores could have occurred predominantly as secondary minerals or as firmly bonded clay minerals, anhydrous Fe and Mn.

The alkali and the alkali earth elements are the major constituent of the common silicate minerals and occur in most soils and rocks [1]. The dissolution of silicate minerals in water is extremely slow and therefore the accumulation of Mg, Na and K may not be true chemical precipitation. It has been suggested that the post depositional solution of carbonated may be responsible for high level of Ca, Mg and Zn or irregularities in pore water concentrations [1]. This phenomenon could be responsible for similar observations in the areas under study.

It is interesting to note the presence of arsenic in all the orebodies studied.

Conclusion

The elements when used as supplement to visual observation of the orebodies to identify the secondary minerals in this study areas, it can be said that the following minerals are likely to be abundant; hematite, Fe_2O_3 , magnetite, Fe_3O_4 , goetite, HFeO_2 , plumboferrite, PbFe_4O_7 , plattnerite, PbO_2 etc.

References

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