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Groundwater Quality in Funtua North East, Northwestern Nigeria

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Abstract

Chemical reactions only take place under certain conditions of Temperature, Ph, Eh, and alkalinity. It can be inferred that trace element concentration in the area of Funtua north east such as Cd, Cu, U and As are likely to increase in concentration in the aquifer while Zr, Sr and Cr are not likely to increase and Zr, Pb, Ni and Co also show indications of increasing over time in the aquifer material. The increase may likely be as a result of their being released from geological materials in the area. The mobility of elements depends on the solubility of the various compounds, the tendency its ions to take part in ionic exchange and the extent to which organisms can extract the element from the hydrosphere. The solubility is controlled by several factors like temperature, pressure, pH and Eh. Under lower temperature more gases are taken into solution, of these gases Carbon dioxide is the most important. The geochemical process, though complicated result in dissolution or deposition of materials extracted from the host rock.

1. Introduction

The pH values affect the mobility of most elements. Only Na, K, No_3 and Cl^- ions remain in solution through the entire range of pH values found in normal groundwater. Water of very low pH carries high concentrations of ferric and ferrous ions (Fe^{2+} and Fe^{3+}). Ferrous ions remain stable under this condition and will oxidize to ferric ion at high pH. Magnesium ions are mostly precipitated above pH of 10.5. The mobility of most trace elements like Manganese, Arsenic, Copper, Vanadium, Cadmium and Uranium is affected by the pH of the groundwater of the area.

A rapid determination of total dissolved solids (TDS) can be made by measuring the Electrical Conductance of a groundwater sample. Specific electrical conductance of a cubic centimeter of water at a standard temperature of 25°C, an increase of 1°C increases conductance by about 2% (Todd, 1959). Electrical conductivity of water is easily measured and give results that are convenient as a general indication of dissolved solids. An approximate relation for most natural waters in the range of 100-5000 μS/cm leads to the equivalencies l meq/l of cations 100 μS/cm and 1mg/1 = 1.56 μScm (Todd, 1959).

Temperature ranges between 29 to 32°C with a mean of 31°C, pH ranges between 5.16 to 8.46 with a mean of 6, while electrical conductivity ranges between 105 and 550 μS/cm with a mean of 211 μS/cm. Mean temperature is 31.25°C, while pH is 7.9, conductivity 270.76p S/cm and salinity (as NaC1) 274.50 μS/cm. The pH is neutral, while conductivity and salinity indicates fresh water with low total Dissolved solids (TDS) The lower values of conductivity obtained may be attributed to freshening of the water as a result of local recharge or depletion of some ions from solution.

1.1 Location of the study area

The investigated study area is part of the Upper Proterozoic to Lower Palaeozoic terrane of NW Nigeria. Geographically the area cuts across Kankara, Bakori, Malumfashi and Faskari Local Government areas in Katsina State, covering a total land area of approximately 745.29km^2 (Fig.1.1).The study area falls within longitudes 7^0 15' to 7^0 30' and latitudes 11^0 45' and 12^0 00'. The area falls within the Funtua Sheet 78 NE, scale 1:50,000, Two well tarred roads of trunk 'A' link the area from Maimashekari village on Sheme-Kankara road and the other one passes through Danmarke to Burdugau in the south east of the project area.

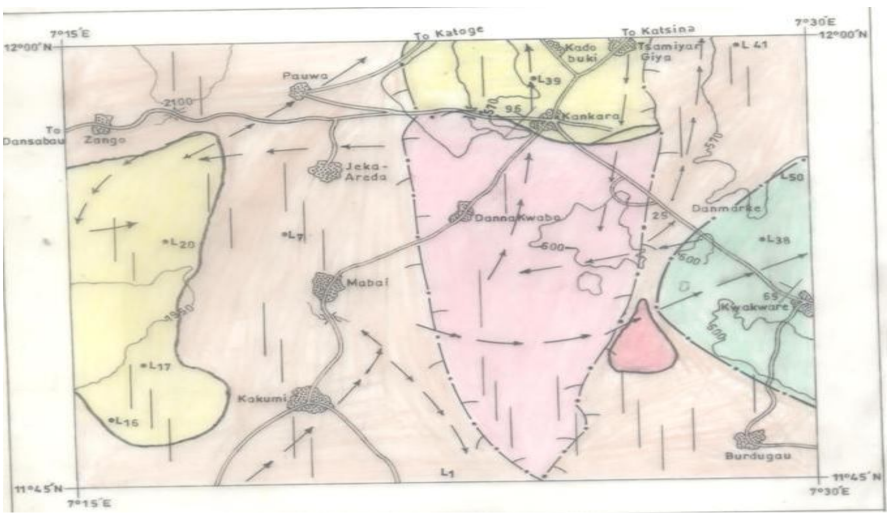

Figure 1.1: The study area.

2. Results and Discussion

Information on the various chemical parameters of cations, anions and trace elements are presented. Analysis was obtained after the result of geochemical result of the major and trace elements analysis of different rock units were obtained, using AAS, XRF and Flame Photometry.

The major cations are Calcium (Ca^{2+}) and magnesium (Mg^{2+}), while anions are the carbonate. Minor cations are the alkali (K and Na), while the anions are Sulphate (So_4^{2-}), Chloride (Cl) and Nitrates (NO3). The most predominant Trace Elements in wells are manganese (Mn^{2+}), copper (Cu^{2+}) and Flouride (F^-). The dominant cation is Magnesium ($^{Mg2+}$) while the dominant anions are the carbonates; minor cations are Calcium, and Potassium and sodium, while phosphates and Nitrates are the minor anions. The dominant Trace Element is Copper, followed by Arsenic and Lead, while Manganese is considerably high in a well, it is very low in boreholes, Copper on the other hand is high in both wells and boreholes.

Calcium and magnesium are the dominant cations while the carbonates still remain the dominant anions is streams. The dominant Trace Element in stream is copper and Zinc, then Manganese and lead. Both the stream and well waters in the study area can be classified into (Langguth, 1967) freshly earth alkaline water (with high alkaline but mostly sulphate), and normal earth alkaline freshwater, (but mostly sulphate) in order of their predominance.

Major Constituents (10-1000 mg/1)	**Secondary Constituents (0.01-10.0 mg/1)**	**Minor Constituents (0.0001-0.01 mg/1)**	**Trace Constituents (<0.001 mg/1)**
Silica	Manganèse	Lanthanum	Thorium
Aluminum	Bromine	Cobalt	Silver
Potassium	Titanium	Vanadium	Gold
Sodium	Chlorine	Neodymium	Bismuth
Calcium	Zinc	Copper	Cadmium
Magnesium	Boron	Uranium	Europium
Barium	Chromium	Molybdenum	Germanium
Strontium	Lithium	Arsenic	Niobium
Iron	Nickel	Beryllium	Rubidium
-	Sulphur /Scandium	Lead	Tin/Tantalum

Figure 1: Relative Abundance of Dissolved Solids in the Aquifers of Funtua NE.

Sodium and potassium elements are univalent, since each of their atoms has only one valence electron (in the periodic table of elements they are familiar elements in group 1). They are univalent, since each of their atoms has only one valence electron. They ionize very readily to form positive ions by donating electrons and form electrovalent compounds. The ease with which they donate their outermost electrons also makes them good reducing agents. They are very good conductors of electricity and are electropositive. They react with cold water vigorously to liberate hydrogen gas and form alkalis; so they are known as e alkali metals. The oxides of alkali metals also dissolve in water to form very strong alkalis.

Calcium, Magnesium, Strontium and Barium belong to group 2. They have divalent elements since each of their atoms has two valence electrons. They are electron donors, form electrovalent compounds and are reducing in nature. Calcium reacts very slowly with cold water while magnesium reacts with steam only. They both liberate hydrogen from water, but while calcium forms a hydroxide magnesium forms an oxide. Calcium oxide dissolves sparingly in water to form calcium hydroxide solution, which is a very weak alkali, while magnesium oxide is practically insoluble in water.

The major element in group 3 is Aluminum. It is trivalent since each of its atoms has three electrons. Being a potential donor of three electrons, it is reducing in nature and forms electrovalent compounds. Aluminum oxide is insoluble in water (Ababio, 2003).

3. Discussion

Most of the natural radioactivity of groundwater is caused by ^{238}U, ^{232}Th, ^{232}U and to a lesser extent ^{40}K and ^{87}Rb. These nuclides have such a long half-lives (4.5 x 1 0 years for ^{238}U) that they could have been part of the original matter that formed the earth. Uranium concentrations usually range between 0.000 1 and 0.01 mg/I. Radioactive elements found in the water are U and Th. Uranium has a mean concentration of 0.0005 mg/l while Thorium has a mean concentration of 0.0004 mg/I. Mean concentration of uranium in the central part is 0.00 1 mg/I, while that of thorium is somewhat higher. The lowest concentration is found in the northern part while the south western part occupies a medium position. Uranium has a mean concentration of 4.550 ppm in the geological materials, especially in the south western part where it occurs mostly in the metasediments.

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