Trace Element Geochemistry of Groundwater around Dump Site, a Case Study of Apete, South Western Nigeria

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Abstract- Assurance of drinking water safety is a foundation for the prevention and control of waterborne diseases. This research work was carried out to use geochemical methods: to determine percentage of the trace elements present in the water samples, the pH and temperature of the groundwater, and the effect of dumpsite on the groundwater quality in the study area. A total of five (5) water samples were collected in plastic bottles. Physical parameters like pH and Temperature of the water were measured at the point of collection. Hydro-chemical analysis using Atomic Absorption Spectrometry (AAS) to determine the concentration of trace elements Mn, Zn, Pb, Cu and Fe present in the water samples. The pH date of the water samples varies from 8 to 9 with an average of 8.2 indicating that the water is basic. The temperature of water in the study area is relatively constant ranging from 25^0C to 29^0C with an average temperature of 28.75^0C was recorded from the area. The results of this study showed that iron (Fe^{2+}) was the most abundant dissolved cation in the water sampled in the area. All the other dissolved cations such as Mn^{2+}, $Cu^{2,}$ Pb^2 and Zn^{2+} are generally conformed to the recommendation of W.H.O maximum limits. However, high percentage of iron than other trace elements present which source could be from dumpsite around the area gives a pointer to danger. The study recommended that waste disposal facilities should be sited in the outskirts of the towns. In this regard, the site of the well should be at least thirty meters away from any source of contamination.

Index terms: Atomic Absorption Spectrometry (AAS), Dumpsite, Groundwater, pH, Trace elements

1 Introduction

Water remains indispensable for survival of human, but the quality of groundwater of different places are influenced by impurities which causes pollution or reduction of the usability of the water. It has been observed over the years that the effects of these impurities are very hazardous to human. Also unsafe drinking water contributed to numerous health problems in developing countries such as the one billion or more incidents of diarrhea that occur annually (Mark et al., 2002). Due to inadequate supply of pipe – borne water in towns and cities in Nigeria, many people have been sourcing their daily water need from wells (Adedji and Ajibade, 2005). Water authorities all over the world, especially those concerned with drinking water supply and also many researchers have made efforts toward working out the safety limits of wholesome water constituents. For instance, Taylor (1958) defines the wholesome water as one not necessarily pure but should not endanger health. The quality of drinking water is a powerful environmental determinant of health. Assurance of drinking water safety is a foundation for the prevention and control of waterborne diseases. Thus, the

main objective of this research is to determine the suitability or otherwise the quality of groundwater within the area around dumpsite situated in Apete Area of southwestern Nigeria by comparing the chemistry of the water with WHO drinking water standards.

2 Location and accessibility of the study area

The study area under investigation is located within Apete, Ido-local government area of Ibadan, Oyo state, Southern Western Nigeria, between latitude 7^0 26'N and 7^0 28'N and longitude 3^0 50' E and 3^0 53'E. All the locations are accessible by various road networks and footpaths. The major rivers are the river Eleyele and its tributaries .This vegetation is largely grassland dotted with trees Fig.1

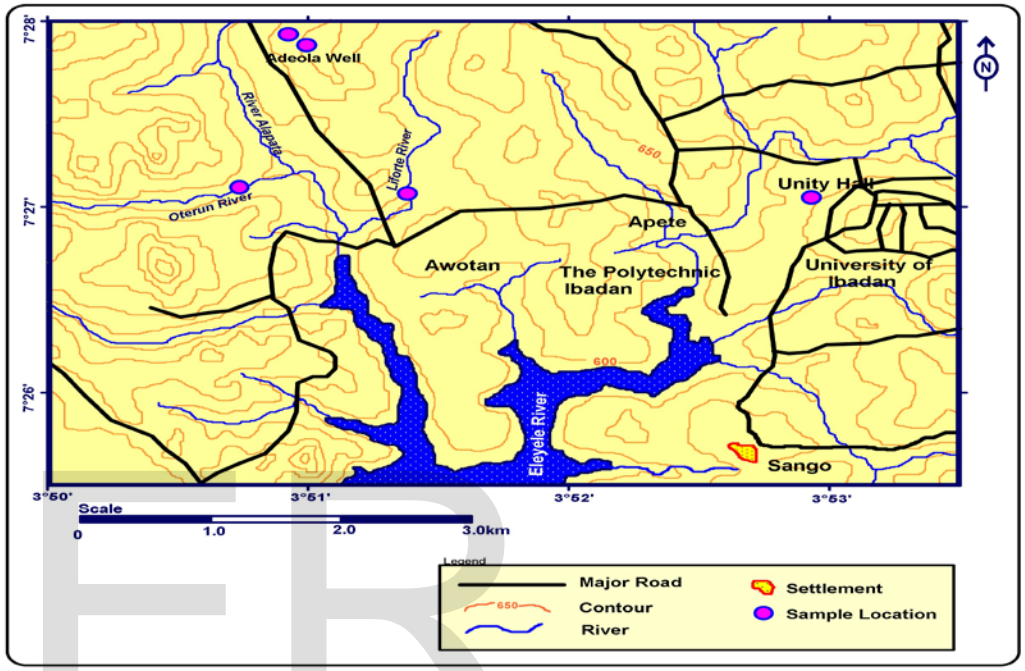

Fig.**1: showing the map of the study area (Nigerian geological Survey Agency, 1979)**

3 Geology of the Study Area

The study area is predominantly underlain by banded gneiss characterized by a layering appearance resulting from the segregation of light and dark mineral assemblages. The rock type is observed to be coarse grained and the banding in this rock is distinctly foliated Akintola et al (1980). Also present is quartzite which is metamorphosed arenaceous rocks that occurs in form of ridges in the study area. It is characterized by many

cracks and joints. The outcrops encountered within the study area have elevation that range from 209m to 212m. This outcrop comprises of linear structures with pervasive fractures. The rocks are intruded by quartz veins. Fig. 2 shows the location of the study area in the generalized geological map of Ibadan.

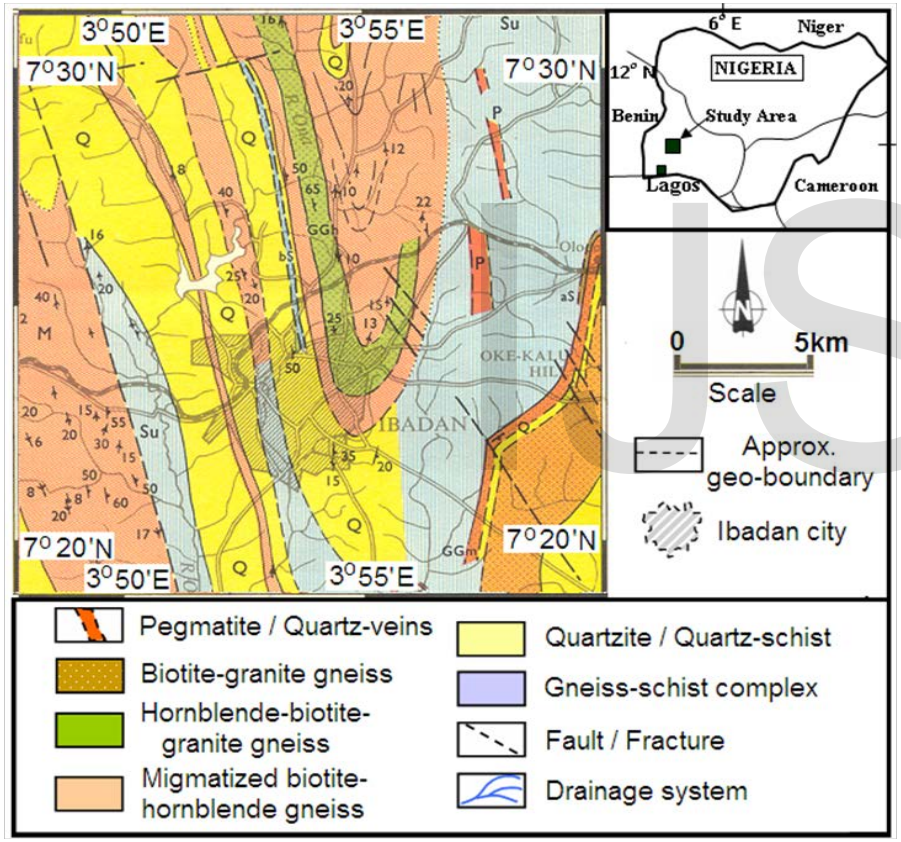

FIG 2: Geological Map of Ibadan showing the study area (Nigerian geological Survey Agency, 1979)

4 Methodology

Five (5) water samples were collected in plastic bottles. They were collected for the sole aim of determining concentration of trace elements present in the water samples. To each of these water samples, two (2) drops of concentrated nitric (HNO_3) were added for homogenization and to prevent absorption/absorption of trace elements to the walls of the plastic container. The pH was measured by using pH meter; temperature measurement was done using the thermometer on the field. The collected samples were labeled correctly to ease identification. After the collection of water samples, they were taken to the laboratory where each of the water samples were filtered in order to prevent the blockage of the nabulizer of the A.A.S.(Atomic Absorption Spectrometry) machine and other equipment by suspended particles. The technique makes use of absorption spectrometry to assess concentration of an analyte in a sample. The water is then prepared for the analysis of the following trace elements; magnesium (Mn), zinc (Zn), lead (Pb), cupper (Cu), iron(Fe). All the hydrochemical analyses were carried out at the water laboratory of Petroc Laboratories, Shasha Ibadan.

5 Results and Discussion

pH which is the concentration of the hydrogen ion (H^+) and is mainly controlled by the amount of dissolved carbonate and carbon dioxide

gas in water. The pH date of the study area varies from 8 to 9 with an average of 8.2 indicating that the water is basic (Table1). The temperature of water in the study area is relatively constant ranging from 25^{0}C to 29^{0}C with an average temperature of 28.75^{0}C. The normal atmospheric temperature of the area is 27^{0}C; as a result increase in temperature will dissolve some of these elements (Table1).

TABLE 1: Result of Physical Parameters of Groundwater in the Study Area

SAMPLE	WATER SOURCE	TEMPERATURE (^{o}C)	PH
L1	S.W	25 ^{o}C	8
L2	G.W	29 ^{o}C	8
L3	G.W	27 ^{o}C	8
L4	S.W	27 ^{o}C	9
L5	G.W	27 ^{o}C	8

G.W – Ground water

S.W – Surface water

L – Location

Iron concentration in all the water samples varies from 0.10mg/l to 1.30mg/l with an average of 0.48mg/l. Zinc concentration varies from 0.01mg/l to 0.05mg/l with an average value of 0.03mg/l. The Manganese concentration ranges between 0.05mg/l and 0.10mg/l, with a mean value of 0.07mg/l. Copper concentration also varies between 0.05 to 0.10mg/l and a mean value of 0.07mg/l, while Lead concentration retains the same value for the whole water samples, having a value of 0.05mg/l and mean value of 0.05mg/l. It can then be deduced that the concentration of the five cations in order of their abundance is Fe^{2+}>Mn^{2+}>Cu^{2++}>Pb^{2+}>Zn^2 (Table 2 and 3)

TABLE 2: Summary of both Physical and Chemical Parameters of the Water Sample and WHO Standards for Drinking Water (1999)

Parameters Measured	Range		Average	Highest Desirable level (mg/l)	Maximum permissible Level (mg/l)
pH	8	9	8.2	6.5	8.5
Temperature E^{o}C	25	29	27		
Fe^{2+}(mg/l)	0.10	1.30	0.48	0.1	1.3
Mn^{2+} (mg/l)	0.05	0.10	0.07	0.4	0.5

Cu^{2+}(mg/l)	0.05	0.01	0.07	2.0	2.0
Zn^{2+}(mg/l)	0.01	0.05	0.03		3.0
Pb^{2+}(mg/l)	0.05	0.05	0.05	0.01	0.15

MAXIMUM PERMISSIBLE LEVEL: Values greater than those listed would impair the potability after WHO (1999).

HIGHEST DESIRABLE LIMIT: Applies to water generally accepted by consumers.

Table 3: result of chemical parameter of the study area (All parameters are in mg/l)

SAMPLE No	**WATER SOURCE**	**Fe^{2+}**	**Mn^{2+}**	**Cu^{2+}**	**Pb^{2+}**
L1	SW	1.30	0.10	0.10	0.05
L2	GW	0.20	0.06	0.05	0.05
L3	GW	0.10	0.06	0.05	0.05
L4	SW	0.70	0.08	0.10	0.05
L5	GW	0.10	0.05	0.05	0.05

G.W. – Ground water

S.W – Surface water

L – Location

6 Conclusion

Although chemical analysis results showed that almost all the physical and chemical parameters tested for corresponds with the standard laid down by WHO (1999), insinuating that the water is good to an extent, although cases of Iron which is above that standard laid down by WHO (1999) gives a pointer to danger. It source which may be from either corroded pipes or dumpsite, and it could be removed by using water softener, coated filters and a host of other methods. However to avoid pollution of groundwater, the study recommended that locations that are far from the household and dwelling areas should be designated for refuse dumping, to at least reduce if not eliminate the problem of water pollution and contamination.

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