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# Outline of arsenic dispersion in some piece of Biu Volcanic Province North-Eastern Nigeria

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**Abstract**— Overexposure to arsenic can cause different sicknesses, for example, malignant growth of (skin, lung, bladder, and kidney), male pattern baldness and nails disfigurement. These maladies are regular among grown-ups, youth and kids in some provincial networks in Biu Volcanic Province North-Eastern Nigeria. This is the thing that propelled the Authors to explore the convergence of arsenic in surface and ground waters of Biu volcanic condition, northern eastern Nigeria and to portray regions of high hazard to arsenic introduction. Thirty-seven water tests; thirteen surface water tests and twenty-four ground water tests were dissected utilizing Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES) at Geochemistry Laboratory, University of Jos, Nigeria. Arsenic fixations go from 0.03 to 0.477 mg/L in the surface water and 0.006 to 0.424 mg/L in the ground water. This investigation demonstrates that individuals in Yimirshika Village may be at a significant danger of arsenic harming.

**Keywords**— Arsenic Distribution, Volcanic Province, Health Hazard, Biu, Nigeria.

## 1. Introduction

The Biu volcanic territory comprises one of the biggest volcanic regions in Nigeria. It denotes the basic perfection between the Benue and the Chad sedimentary bowls (fig.1); it lies in the north eastern Nigeria. The territory covers a shallow zone of 5000Km2 with a thickness of 250m, made up of a few basic volcanoes with huge cavities (caldera) of more noteworthy than 1km, recommending that a serious huge volume of magma, volcanic powder and pyroclastic materials ejected. Through physical and concoction enduring procedures, rocks separate to frame the dirts on which the harvests that establish the sustenance supply are raised for people and creature’s utilization. Drinking water goes through rocks and soils as a major aspect of the hydrological cycle and in the process filtered components in arrangement (Lar, 2009). Volcanism and related molten exercises re convey a portion of the destructive components, for example, arsenic, beryllium, cadmium, mercury, lead, radon, and uranium. Practically all metals present in the earth have been biogeochemically cycled since the development of the Earth. Human movement has presented extra procedures that have expanded the rate of redistribution of metals between natural compartments.

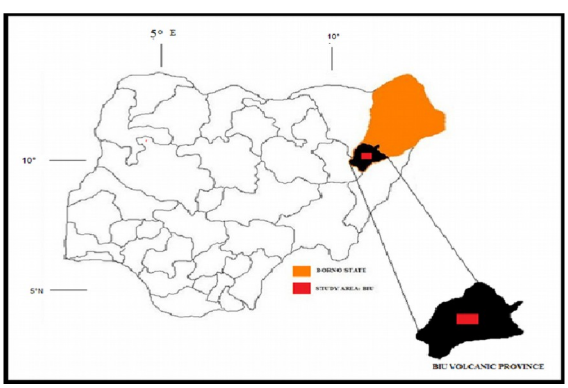

***Fig 1.** Map of Nigeria showing the location of the study area.*

In any case, over the vast majority of the Earth's property surface the essential control on the dispersion of metals is the geochemistry of the hidden and neighborhood rocks aside from in everything except the most pessimistic scenarios of modern tainting and some specific geographical circumstances.

The reason for this examination is to decide the appropriation of arsenic in the characteristic waters of Biu Volcanic Province Nigeria, and the conceivable wellbeing danger to the occupants.

## 2. Geological Setting

### *2. Geology and Hydrogeology of Biu Volcanic Province*

### *2.1. Geology*

Biu Plateau is arranged on the auxiliary and topographic separation between the Benue and Chad sedimentary bowls. The auxiliary separation is an expansive E-W edge or swell of storm cellar, which stretches out toward the western edge of the Biu Plateau. The two bowls are isolated by a sub-surface size, the Zambuk edge toward the west (Carter et al., 1963).

The basalt of the Biu Plateau for the most part overlies Basement rocks. They are generally happening as "flood basalts" in various streams and in actuality spread almost 85% of the region with its middle around Biu (Turner, 1978). The basalt at certain spots has developed huge number of streams. The element of the streams and the checked nonappearance of pyroclastics in and around Biu, Tum, Marama, and Shaffa territories, show that the emission of basaltic magma in these spots was not fierce. Nonetheless, the basaltic arrangement in the North-western piece of Biu is encompassed by a few young scoria, soot cones, tephra rings and so on., the pyroclastics are commonly confined to the region west of Biu-Damaturu street, recommending that the ejections in these spots are brutal in nature.

### *2.2. Hydrogeology of the Study Area*

#### *2.2.1. Introduction*

The water assets of the examination zone can be isolated into surface and groundwater assets. The surface water of this zone happens as streams and lakes. They fill in as water supply hotspots for both drinking and local employments. A large portion of the streams are regular. The streams and lakes are revived by direct precipitation during the blustery season.

#### *2.2.2. Surface Water*

##### *2.2.2.1. Lake Tila*

The main lasting waterway is Lake Tila arranged at Kwaya Bura town around thirteen kilometers toward the south-west of Biu. The lake possesses a pit a short separation west of Mount Tila.

The lake-level in the stature of the dry season is just one-meter underneath what has all the earmarks of being the pinnacle level seat mark. The high-water level every year is subject to the precipitation and it tends to be expected that it runs inside one meter, (Du Preez, 1965).

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The lake gets almost no spillover during the downpours and the ascent of the lake level is expected for the most part to coordinate precipitation. There is little leakage zone around the shore which streams constantly into the lake. Shallow permeation wells dove into the zone comprise the primary residential water supply for a few towns in the region.

Investigations of water tests from Lake Tila and from the shallow leakage wells along the shoreline did by the (Du Preez, 1965) are yielded. The investigation of the lake water demonstrates a high centralization of sodium carbonate, and nearly low sodium chloride content. In the water

from the drainage wells, sodium carbonate likely additionally prevails, while sodium chloride is irrelevant. Owing of the high carbonate content the lake water is unsatisfactory for water system. It is evaluated that the measure of soft drink in the lake is in the request of around 2,000 tons, yet it is far-fetched whether it is of any financial worth, (Du Preez, 1965).

#### *2.2.2.2. Perennial Stream Water*

The majority of the waterways in Biu evaporate for a piece of the year, however a significant number of streams ascending on the basalt Plateau are feebly enduring a portion of the streams are encouraged by leakage springs which issues from the basalts.

These releases are little and are caught up in the alluvium on achieving the low-lying nation underneath the basalt Plateau. Changeless pools are much of the time present in these streams, and they give water supplies to neighboring towns.

### *2.2.3. Groundwater in the Basalts*

The basalts are generally unequivocally jointed and fissured. The previous streams, ordinarily comprise of thick minimal basalt, while the early streams are unpredictable jointed. The joints fill in as loci of enduring and as channels for the dissemination and capacity of groundwater (Du Preez, 1965). The minimized basalts are unequipped for putting away water, the groundwater held in the joints offers ascend to various little springs on the higher pieces of the Plateau.

The basalts structure the most significant spring in Biu Plateau. The measure of water got in them relies upon the level of decay, jointing and the idea of the stone. The basalts demonstrate a shallow endured zone comprising of dark dim and darker earth with leftover stones of mostly deteriorated shake.

The scoriaceous and amygdaloidal basalts generally climate to darker and blue dirts which will in general break down on introduction to the environment. Moderate measures of water might be available in the basalt alluvium yet when all is said in done the amount of water accessible is little and the water table is liable to significant variety. Numerous locals get their water mostly or completely from this source during the dry season. The water from this source can be gotten through hand burrowed wells which were seen everywhere throughout the region and few boreholes.

### *2.2.4. Data Collection*

Information of the water table was acquired by field estimation of static water levels in wells inside the examination zone, just as the land positions and heights at different areas.

#### *2.2.4.1. Data Processing*

Directions of the watched wells and well rises were controlled utilizing a PC program (sufer 8).The X, Y, Z arranges in the surfer 8 is entered as longitude, scope and height separately, from which the PC program plots a water table form map (figure 2).

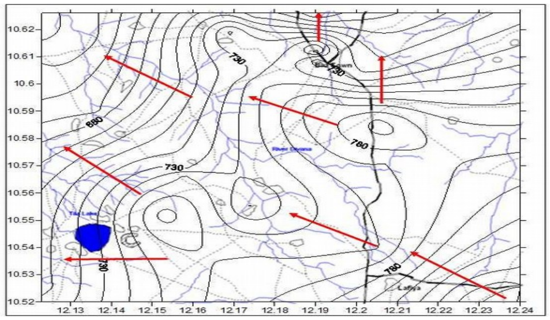


***Fig 2.*** *Groundwater Contour Map of the study area indicating direction of Water Flow (resent study)*

### *2.2.4.2. Interpretation of Groundwater Map*

A water table shape guide demonstrates the rise and the setup of the water table at a specific information. The guide is set up by plotting the outright water levels of all perception purposes of equivalent water table rise. This water table form map (figure 2) is a significant device in groundwater examinations as one can get from it the inclination of the water table and the course of the groundwater stream.

For the most part, the example of groundwater stream pursues the surface geology with regular varieties in water levels described by rising water levels during the wet months and declining water levels during the dry months.

## *3. Methodologies*

### *3.1. Field Sampling*

Testing was practiced during the dry season (March 28-April 25). An aggregate of thirty-seven (37) water tests and thirteen (13) soils tests were gathered over a territory of 150 km2 for investigation to decide their basic fixations.

The testing areas of the investigation territory are displayed in (fig. 3).

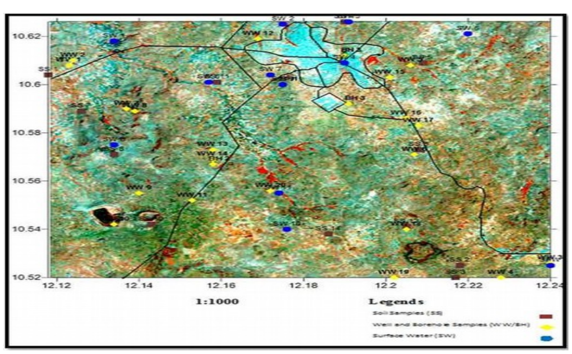


***Fig 3.*** *sampling locations of the study area (This study)*

In perspective on the typical low follow component focuses in water, different measures were taken to counteract the smallest tainting in the gathered examples. 250ml polyethylene bottle limit holders were

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utilized for the accumulation of tests. Containers were first washed with a blend of corrosive and refined water (1% HNO3). The containers were at long last flushed with refined water and kept to dry in a broiler at 25$^0$C. One significant advance taken was the quick wrapping of the jug with disinfected slender film with the highest point of the jug collapsing over a non-debasing hardened material joined to the curved end. With these techniques the containers were ensured and prepared for test gathering.

After the example was gathered, the old slender film was evacuated and another one re-wrap. All examples gathered were marked by area, nature of test, date of accumulation and number. Tests gathered were kept in the icebox at room temperature (23$^0$C).

### *3.2. Laboratory Analysis*

Examination of the water tests was done utilizing Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES) at Geochemistry Laboratory, University of Jos, Nigeria, to decide the major and follow components fixations.

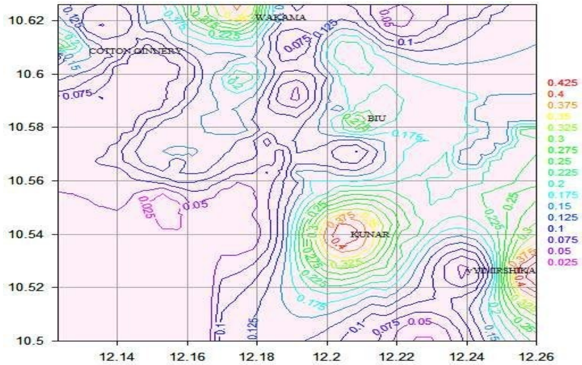
### *3.3. Results and Discussion*

The scope of arsenic esteems from various water sources is shown in Table 1.

***Table 1.*** *Arsenic Concentration in natural water*

| Samples | Locality | As (mg/L) |
|---|---|---|
| BH1 | Waka | 0.224 |
| BH2 | Hena | 0.089 |
| BH3 | Army Barrack | 0.039 |
| BH4 | Biu BCJ | 0.070 |
| W1 | BCJ | 0.040 |
| W2 | Wakama | 0.315 |
| W3 | Yimirshika | 0.037 |
| W4 | Waka | 0.023 |
| W5 | Biu | 0.227 |
| W6 | Biladega | 0.066 |
| W7 | Tabra Fulani | 0.083 |
| W8 | Malan | 0.039 |
| W9 | Tila | 0.059 |
| W10 | Tila | 0.043 |
| W11 | Tila | 0.006 |
| W13 | Hena | 0.123 |
| W14 | Hena | 0.229 |
| W16 | Yimirshika | 0.136 |
| W17 | Gwarta | 0.290 |
| W18 | Kunar | 0.424 |
| SW1 | Wakama | 0.067 |
| SW2 | Waka | 0.389 |
| SW3 | Waka | 0.087 |
| SW5 | Tabra Fulani | 0.041 |
| SW6 | Hena | 0.074 |
| SW7 | Hena | 0.116 |
| SW8 | Hena | 0.067 |
| SW9 | Army Barrack | 0.021 |
| SW10 | Army Barrack | 0.032 |
| SW11 | Kunar | 0.036 |
| SPW | Yimirshika | 0.477 |

It is noticed that arsenic is moved in all the water bodies above WHO permissible standard of 0.01 mg/L. Scope of arsenic fixation in surface water is from 0.02 to 0.0477 mg/L. The most reduced grouping of 0.02 mg/L was seen in Takwa town while the most noteworthy centralization of 0.477 mg/L was distinguished in surface spring water in Yimirshika town. Centralization of arsenic differed from 0.01-0.424 mg/L in well water tests gathered from different locales. The least convergence of 0.01 mg/L was identified at Tila while




the most astounding grouping of 0.424 mg/L was resolved from Kunar. The watched grouping of arsenic in borehole water tests gathered from different locales in Biu extended from 0.04-0.2 mg/L. The most noteworthy convergence of 0.2 mg/L was recorded in Waka Biu while the least centralization of 0.04 mg/L was seen in Biu Army Barrack. Centralization of arsenic and its spatial appropriation in surface and groundwater is appeared in Fig 4.

***Fig 4.*** *Shows concentration of arsenic and its spatial distribution in surface and groundwater*

### *4. Trace Element Exposures*

This examination finds the convergence of arsenic from 0.1 to 0.48 mg/L, the high focus will be dangerous to the occupants because of long time presentation through ingestion of sustenance and water. As per Maloney, 1996 and Smedley and Kinniburgh, 2002, the overexposure to this component can cause different ailments, for example, malignancy (skin, lung, bladder, and kidney), male pattern baldness and nails distortion. This is in congruity with the present investigation in which a portion of the occupant's shows indication of a portion of these illnesses which might be connected to arsenic poisonous quality.

### *4.1. Arsenic Concentrations in Waters and Effects on Health in Biu Volcanic Province North-Eastern Nigeria*

The World Health Organization 2008, stated that safe limit for arsenic in drinking water is 0.01, it is clear that excessive arsenic is being consumed in drinking water at; Waka (0.224 and 0.389 mg/L), Hena (0.116, 0.123 and 0.229 mg/L), Yimrshika (0.136 and 0.477 mg/L), Wakama (0.315 mg/L), Biu (0.227 mg/L) and Kunar (0.424 mg/L). These areas are delineated as high-risk zone to arsenic exposure. For example, the inhabitant of Yimirshika relies on their Spring Water which contains unsafe levels of dissolved arsenic for drinking, cooking and other domestic purposes. These findings indicate that they are over-exposed to this toxic metal through the ingestion of water and food. Due to long time exposure, few of the inhabitants show manifestations of nail deformity (nail thickening and brittleness), and hyper-pigmentation of the skin and hand palms. Others present various forms of skin diseases (especially skin growth) which all could be attributed to exposure to arsenic toxicity. Plate 1-3 shows nails deformation and skin problem.

### 5. Summary and Conclusions

Areas identified with high arsenic in surface and groundwater of the province shows that the inhabitants of these areas have symptoms of arsenic exposure, such as diabetes, loss of hearing, hair loss, deformed nails and various skin problems like: rashes, abnormal growth, skin lesion and roughness.

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