Trace Elements in Crystalline Rocks of Southern Benue Trough and the Effects to Health

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Abstract

The crystalline rocks in the igneous suite of some part of southern Benue trough, mainly the Anambra basin and the Afikpo basin were studied. The petrographic results show that the rocks are mostly intrusive rocks with few extrusive rocks. The mineral components of the extrusive rocks (basalt and pyroclastics) and some of the intrusive rocks (dolerite, gabbro) are feric, comprising pyroxene, olivine, amphibole, plagioclase feldspar and biotite. The intermediate intrusive rocks (syenite and diorite) are felsic comprising quartz, potassium feldspar and muscovite. These rocks are embodiments of elements (major and trace elements). Quarrying of these rocks into different aggregates create entrance of the elements especially the trace elements into the human system. Some of these trace elements are needed for human sustainability but when the tolerable limit is exceeded, the element becomes hazardous to human health. Most of the trace elements are causative factors to some terminal diseases such as cardiac problem, lungs cancer, skin cancer, kidney damage, stomach irritation, nervousness, weakness, high blood pressure, respiratory organs infection, suffocation, dizziness, unconsciousness, loss of concentration and confusion, tremor, rapid breathing, coma and death. Knowledge of the effects of some of these trace elements are crucial in order to avoid some terminal diseases associated with them.

Keywords

Crystalline Rocks, Southern Benue Trough, Trace Elements, Terminal Diseases

1. Introduction

The Southern Benue Trough Nigeria is a sedimentary terrain that hosts some igneous rocks which constitute some of the trace elements. The geochemistry of some of the igneous rocks in the southern Benue Trough has been studied and documented by many authors [1, 4 -10, 12]. From some of these authors, it is observed that the trace elements in the rocks are almost forty five in number and categorized into four, mainly the high field strength elements (HFSE, Be, u, Hf, Sn, Mo, Nb, Ta, and Zr), the large ion lithophile elements (LILE, Cs, Rb, Pb, Ba, Sr, HREE and Eu), the rare earth elements (REE, La, Ce, Pr, Nd, S., Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu) and the transition elements (Ni, Cr). The presence/occurrence of some of these elements in the environment and interaction with human has the tendency of causing disease like cancer, lungs disability, and impaired respiration [2, 13]. These elements enter the body through ingestion, inhalation and contacts.

In some part of the Southern Benue Trough (Afikpo, Ameta, Mgbom, Ozara; Ishiagu; Lokpaukwu, Uturu) most of the crystalline rocks are being quarried with mechanized instruments and as well-being quarried by local miners. The quarrying of these rocks releases some of the rock particulate into the environment. Elemental constituents of these particulates come in contact with the water vapor, they dissolved and percolate into the soil or they are being absorbed by plant and man feed on these plants. In some

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cases, the particulates are being washed into the water body in which human depend on and these may result to terminal diseases and death. Inhalation of dust and some of the rock particulate in the atmosphere can result to respiratory problems such as lung cancer, and so many other diseases. The map of the study areas are shown in figures 1, 2, and 3. Skin irritations and skin sicknesses are also problems encountered when some of these trace elements come in contact with human body. Nevertheless, few of the trace elements are needed in the body at a tolerable limit and once the tolerable limit is exceeded in the body, it becomes hazardous. Deficiency of some of the trace element in the body also results to problems. Elements like lead (Pb) are not tolerated in the body irrespective of how little the quantity appears. Lead-Zinc mineralization of Afikpo basin, and positive anomalous concentration of lead in igneous rocks of the southern Benue trough has been documented [3, 11]. The scope of this work is to highlight the effect of some of these trace elements to human health especially when they exceed the tolerable limits.

Figure 1. Generalized geologic map of Nigeria showing the Southern (Lower) Benue Trough. Modified from Google map: 09/01/2019.

Figure 2. Map of some parts of the study area in Anambra basin, Southern Benue Trough.
2. Geologic Setting

The study area is characterized by intrusive and extrusive igneous rocks. The rocks intruded the oldest sediment (Asu River Group) in the study area. The intrusive rocks range between syenite, diorite, dolerite and gabbro. Quarrying activities and erosion exposed the intrusive rocks. The extrusive rocks are basaltic in nature. The magma that form the rocks probably erupted during the Santonian times. The rocks are structurally controlled to the Abakaliki anticlinoria. The association of the intrusive rocks and extrusive rocks in some of the igneous suite could be that the Santonian tectonics generated satellite rift through which the magma erupted to the surface. The rocks are faulted and jointed in some areas.

3. Sampling Techniques and Laboratory Procedure

Forty-eight fresh samples of basaltic, syenitic-Dioritic rocks were collected randomly at different pockets of the igneous suite in the study areas. Contact relationship of the igneous rocks and the host rocks were studied in the field and it was discovered the igneous rocks occur as dykes in some areas of the southern Benue Trough while majority of the igneous rocks occur as sills. Thin sections were prepared and described using petrological microscope.

Samples for thin sectioning were trimmed using cutting machine. The trimmed samples and the slides were polished on a glass plate that contained mixture of carborundum and little water. The rock samples were polished to reduce the thickness to 0.03mm as to allow light to penetrate through during the optical interpretation of the component minerals while the slide was polished to create a rough surface which can hold the polished rock. The polished rock and the slides were placed on hot plate for twenty five to thirty minutes to dehydrate the water content. Araldite gums were then rubbed on the slide and the polished rock sample was place on it. The rock samples glued to the slide was placed back on the hot plate with increased temperature of about 250° C to dry the gum and avoid air bubbles from forming.

The prepared thin sections were then studied using petrological microscope (under plane polarized light and cross polarized light).

Thin section results show that the average modal compositions of minerals in the basaltic rocks are plagioclase...
(45% - 47%), olivine (10% -15%), biotite (10% -12%), pyroxene (25% -20%), iron ores (8% -5%), quartz (1%-2%) while the average modal compositions of the syenitic – Dioritic rocks are plagioclase (20%-22%), potassium feldspar (28% - 30%), pyroxene (20%-15%), hornblende (10%-15%), biotite (9%-10%), quartz (13%-10%).

4. Trace Element Geochemistry
The trace element geochemistry in the rocks of the study area areScandium (Sc), Beryllium (Be), Vanadium (V), Barium (Ba), Strontium (Sr), Yttrium (Y), Zirconium (Zr), Chromium (Cr), Cobalt (Co), Nickel (Ni), Copper (Cu), Zinc (Zn), Gallium (Ga), Germanium (Ge), Arsenic (As), Rubidium (Rb), Nobelium (Nb), Molybdenium (Mo), Argon (Ag), Wolfram (W), Lanthanum (La), Cerrium (Ce), Prasendymium (Pr), Neodymium (Nd), Samarium (Sm), Europium (Eu), Gadolinium (Gd), Terbium (Tb), Dysprosium (Dy), Holmium (Ho), Erbium (Er), Thullium (Tm), Ytterbium (Yb), Lutetium (Lu) as documented by previous authors [1, 4-6, 7-10, 12].

High concentration of barium can cause stomach irritation, nervousness, weakness, high blood pressure and cardiac problem [13]. Exposure to soluble beryllium salt can result to acute beryllium poisoning and long period exposure to beryllium oxide through inhalation can cause berylliosis. Chronic beryllium disease probably can be a cancer causing substance. Some of the trace element present in the rock are needed for sustainable life at a certain extent, not exceeding the tolerate limit in order to avoid being hazardous to health and result to death. Occurrence of some of the trace elements in the body result is brain damage, liver and kidney problems, lung cancer, respiratory problems, hearing loss, cardiovascular diseases, skin irritations, fibrosis and some developmental deformities in children.

Little quantity of zinc is required to sustain human health but when zinc becomes excess in the body it has the tendency to be hazardous. Copper (Cu) can as well be taken at a very little quantity by adult for sustainability but much quantity of Copper in the body can result to terminal sicknesses. Some of these trace elements react with oxygen in the atmosphere and become toxic to human health, some of them result to suffocation, dizziness, and unconsciousness, loss of concentration confusion, tremor, rapid breathing, coma and death.

5. Conclusion
The interaction of man with the elemental components in the rock probably will be more pronounce during the quarrying activities by contact or inhalation. Proper personal protective equipment should be worn in order to prevent the contact of the rock dust/particulate with the body. Humans are not expected to live very close to the quarry sites to avoid the effects of these particulates to health. The dissolution and reaction of some of these rock dusts with water is likely to have some level of effect to man when such is used for domestic purposes. The solubility of some of the elements in water probably makes it easy for plants to absorb them and man ingest them (elements) through food chain. Some of the elements are only toxic when they come in contact with oxygen or water.

References
