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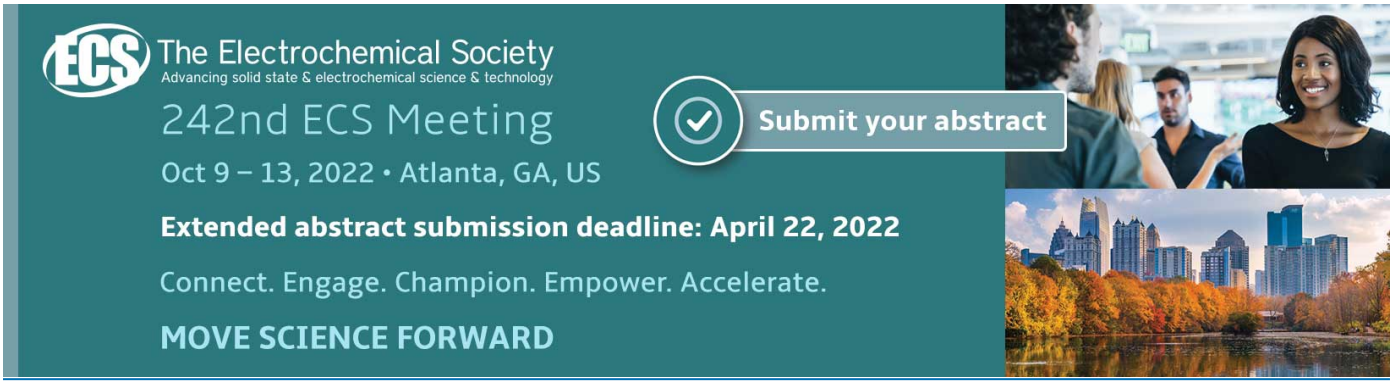

Measurements of Physiochemical Parameters and Trace Element Concentration of Rock Samples in Ogun State

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Abstract. Trace elements occur in tiny quantities but detectatble, in minerals and rocks. They are always less than 1% of the all the minerals. When trace elements' concentration is low, they become beneficial and aids growth an metabolism but when present at high concentrations begin to pose health risks. This paper aimed at investigating and analyzing the pH, electrical conductivity,and trace element concentrations in the rocks samples collected from twenty local government headquarters of Ogun state, using a pH meter, an atomic absorption spectrometer and an electrical conductivity meter,respectively.The measured pH ranged between 6.63 to7.34, which suggests that the rocks in these areas are neutral. The electrical conductivity estimated varied between 46.3 and 598$\mu Scm^{-1,}$ with Ewekoro having the highest conductivity, which may be due to the accumulation of limestone in this area. It was noticed that all the elements were present in minute quantities except iron (Fe), which was present in high concentration that exceeded the recommended value. It was thenconcluded that the rocks in the study area are neutral and contain a high concentration of iron.

Keywords: Physico-chemical, Rocks, Dose, Trace element, Atomic Absorption Spectrometer, pH.

1. Introduction

Rocks are solid materials that exists naturally, and consist of one or more minerals. Minerals are solid, occurs naturally and are chemiccaly homogenous. Rocks can be found inside an ocean, in the ground and on mountains. Rocks form the most part of the earth's crust. [1].Trace elements are chemical elements present in miunute but measurable quantities in minerals and rocksTrace elements that are beneficialare very essential to growth and help with hormonal and enzymatic's activity regulationsMolybdenum, Calcium, Cobalt, Copper, Iron, Manganese, Zinc and Magnesium, (Ca, Mg, Fe, Mn, Co, Cu, Zn, and Mo respectively) are all needed for good health. Examples of toxic trace elements are Arsenic, Mecury, etc..However, Flourine and Selenium are advantageous in very tiny quantities but harmful ifexist in high concentrations. Loco weed plants take up Selenium, and when eaten by animals inject poisons into to them. [2]. Therefore trace elements have both negative and positive effects. Most of the adverse effects might be iodine deficiency disorders (IDD), dental fluorosis when both adults and children consume excess fluoride, lung cancer, etc. [3]. Trace elements

are vitalprompts for many biological mechanisms in the circulatory, cerebral,muscular and digestivesystems. Although, if the body wants to function properly and to maintain healthy balance, trace elements must be present in tiny quantities. Trace elements present in the rocks which go through the weathering process and find their way in the soil are absorbed by the plants and crops consumed by man and other animals, which can cause serious health challenges. It has been reported that human activities such as industrialization, mineral processing, farming, mining, urbanization, etc. can influence the concentration of the element in our environment [4 – 7]. The masure of hydrogen ion concentrationin a solution is defined as the pH of thatsolution. A small variation in pH value corresponds to asignificantvariation in hydrogen ion. pH of a solutionmerely a degree of the acidity or the basicity of that solution.Rock electrical conductivity is simply an indirect measurement that connects well with different rock chemical properties and physical properties. This paper is aimed at investigating and analyzing the pH, electrical conductivity, and trace element concentration in the rocks samples obtained from twenty local government headquarters of Ogun state.

2. Materials and Method

Ogun State is located in the south-western part of Nigeria. It borders Oyo and Osun to the north, Lagos State, Ondo State and the Republic of Benin to the south, the east, and to the west. The State capital is Abeokuta, and it is the largest city in the State. The study sites comprise of the 20 local government of Ogun State (Figure 1). The State's latitudeand longitude are 7.00^{o}N and 3.35^{o}E, respectively. Two rock types exist within the State. They are the basement complex rocks of the Pre-Cambrian and the younger and older sedimentary rock. The basement complex rocks of the Pre-Cambrian age are made up of the older and younger granites in the northern parts of the state, while the southern part is made up of the younger and older sedimentary rocks of both the tertiary and secondary ages [8 – 10]. The geology of Ogun State comprises of sedimentary rocks which underlie approximately three- quarters of the whole surface area of the state stretching from the northwest to the southeast and Basement complex rocks which underlie the remaining one-quarter of the surface of the state[10]. Soils in the State is different from one place to another due to different geological history and soil formation processes [11, 12].

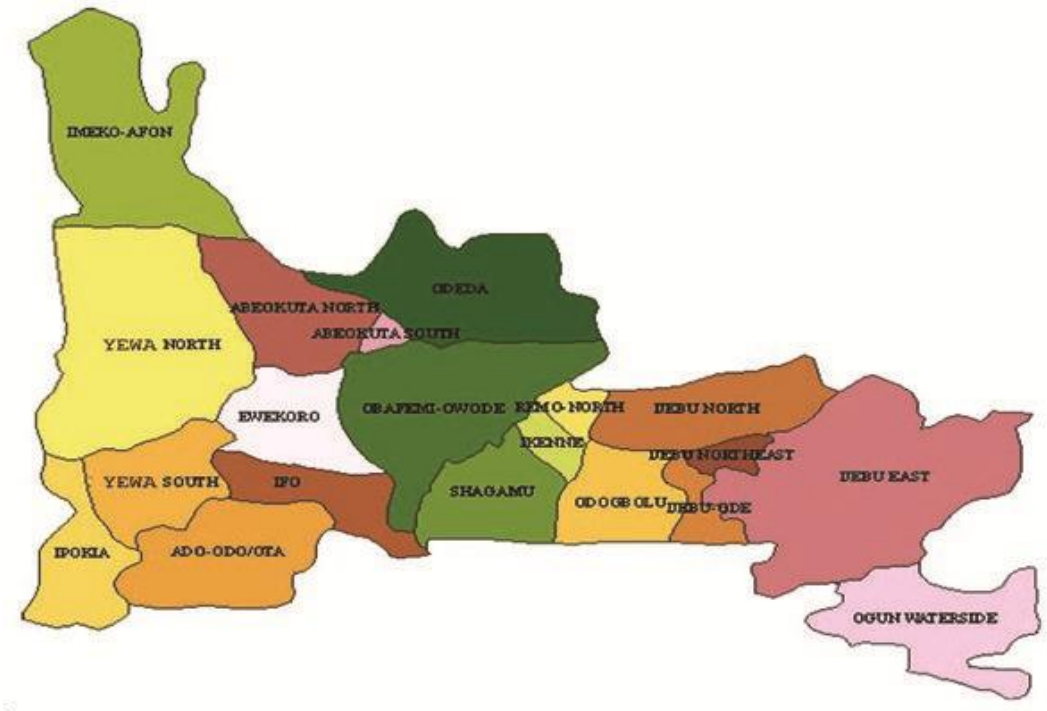

Figure 1: Map of the sampling points across the Ogun state

Five (5) rock samples were collected from each local government. The rock samples were dug from the ground, while some samples were handpicked from rivers (only areas with rivers, e.g., Ogun Waterside). The samples were then put in a Ziploc bag and labelled with a waterproof marker. The samples were dried and pulverized.The electronic balance was used to measure ten (10) grams of the pulverized rock sample collectedfrom each locationand thenfiltered through a 2*mm* mesh. 10ml of distilled water was added to the 10*g* rock sample. The pH of all samples was measured by the pH meter. After the calibration step has been performed, the pH meter probe was placed into the sample collected. Then, readings were recordedwhen stable reading was obtained from the meter.There is a direct linkage between the conductivity and both the mobility and ion's concentration. The ions in water act as electrolytes and allows movement of electron. Calibration of the meter was done with 0.1N Potassium Chloride. The electrode was thoroughly rinsed with de-ionized water and cautiously wipe with a clean paper. Part of the sample was transferred into different 20 cm^3 beakers. Then the electrode was dipped into the sample solution taken in a beaker, and reading was recorded when steady reading was displayed on the meter. Lastly, trace elements were determined. The following elementswhich are: K, Na, Ca, Mg, Cr, Cu, Pb, Mn, Fe, and Zn were analyzed by determining the trace metal concentration of each rock sample using atomic absorption spectrometer. The samples were first digested by taken 1.0g of the pulverized rock sample, dispensed it, and poured into the Teflon tube. This was placed in the digestion tube block in a fume cupboard, and 20*ml* of Nitric acid (Conc. HNO_3) and 20*ml* of HCl (Conc. HCl) was added. The digestion block was switched on to heat the sample to dryness. The tube was then brought out and rinse with distilled water.The samples were then diluted as necessary and analyzed for trace metals using AAS. Atomic absorption spectroscopy relies on the Beer-Lambert law as shown in equation 1

$$A = \left[I_o \big/ I \right] \tag{1}$$

A is the absorbance, I_0 is the incident intensity, and I is transmitted intensity

3. Result and Discussion

The pH values measured varied between6.65 and 7.4, as shown in Figure 2, and has an average value of 7.08.The maximum pH (7.4) was obtained from samples collected from Itori (Ewekoro). This agrees with the study reported on the soil of the study area by [6].It was observed that the pH value in Ewekoro is slightly alkaline; this may be because of the limestone deposit in the area.The value of pH is an important index that determines the acidity or alkalinity and the concentration of hydrogen ion in a medium [12]. The pH values greater than 8.5 are considered to be too alkaline,and those lower than 6.5 are considered too acidic,which can cause health problems such as acidosis [13]. The ideal pH for soil and bedrock is from 6.0 – 6.5 if it is below 6.5, the usual recommendation is the application of ground limestone this is because Limestone pH range is from 7.0 – 14 [14].

The electrical conductivity measured was presented in a bar chart, as shown in Figure 3, and it ranged from 46.3 to 598μScm^{-1}. Electrical conductivity represents the total concentration of soluble salt in the rock. It was observed that only six locations have electrical conductivity within the permissible limit,while fourteen locations had elevated electrical conductivity, which is above the permissible recommended limit of 300 μScm^{-1}[15]. The high electrical conductivity in these areas might have emanated from industrial activities, i.e., Mg^{2+} and Ca^{2+} ions from the factory activities. This could also be as a result of accumulated limestone in the area.An electrical conductivity measurement above 1200 µS/cm may indicate a salinity problem from lack of drainage. Electrical conductivity measurements can vary greatly and are affected by several environmental factors, including climate, local biota, bedrock and surficial geology, as well as human impact on the land [16].

The trace element concentration level obtained ispresented in Table 1, and Figure 4 shows the variations of iron in various samples across the study area.It was observed that the elements were present in all the samples. The trace elements analyzed wereMn, Fe Cu, Ca, Zn, Cr, and Ni. The elements tested for in this report are essential trace elements with the exception of Ni. The highest concentration of manganese was obtained from Odeda ($9.68mgl^{-1}$), while the lowest value obtained from Ota ($0.6mgl^{-1}$). Manganese is an essential trace element, the essentiality of manganese for various animal species is not well established. Thus it is surprising that an unequivocal case of manganese deficiency in humans has not been described. Manganese may be another trace element whose importance is manifested under special situations. The highest concentration of iron is highest in Abeokuta South ($1234.22mgl^{-1}$) and lowest in Ota ($35.58\ mgl^{-1}$). Copper (Cu) highest concentration was obtained from samples from Abeokuta north ($4.31mgl^{-1}$) and lowest in Shagamu ($0.3mgl^{-1}$). Epidemiological studies and observations on experimental animalsshowed that a low presence of the dietary copper in the body has adverse affect on cardiovascular health and have a toll on predictors metabolism of heart disease metabolism;as well as plasma cholesterol. Apparently, less than 25% of diets contain $2mg$ of copper thought to be required daily [17]. The highest concentration of Calcium (Ca) was found in a sample from Itori (Ewekoro) ($288.02\ mgl^{-1}$) while the lowest value obtained from Ota ($0.5\ mgl^{-1}$) The high concentration obtained from Ewekoro is not surprising because the raw material used in Ewekoro cement company contains mainly calcium [7]. Zinc highest concentration was obtained in Odeda ($8.56mgl^{-1}$) and lowest in Ota ($0.3mgl^{-1}$). Zinc is an essential element. It helps in the formation of enzymes, zinc improves immune function, helps clot blood, maintains a sense of taste and smell, keeps skin healthy, and enables normal growth and development. Chromium (Cr) highest concentration was obtained in Odogbolu ($1.66mgl^{-1}$) and the lowest from samples from Ota ($0.16mgl^{-1}$). Chromium is necessary forthe reduction of the stress of a low-protein diet, acute blood loss, or infection aggravated the sign of depressed growth and survival caused by chromium-deficient diets. In humans, severe trauma and exercise elevated the excretion of chromium in urine [15]. Nickel (Ni) highest concentration is obtainedfromOdeda($0.73mgl^{-1}$) and lowest obtained fromIfo ($0.14mgl^{-1}$). Nickel is said to be essential when it interacts with vitamin B-12 [16]. The elements were present in all the samples in trace quantity,except for iron that was found to be present in high quantity in the samples. This corroborates the report of [5] in which iron concentration was high on the soil samples from the study area. This may be becauseof the existence of iron inmany forms in the rocks, and only small amount is soluble and can be took in by plants, out of the high value[19].

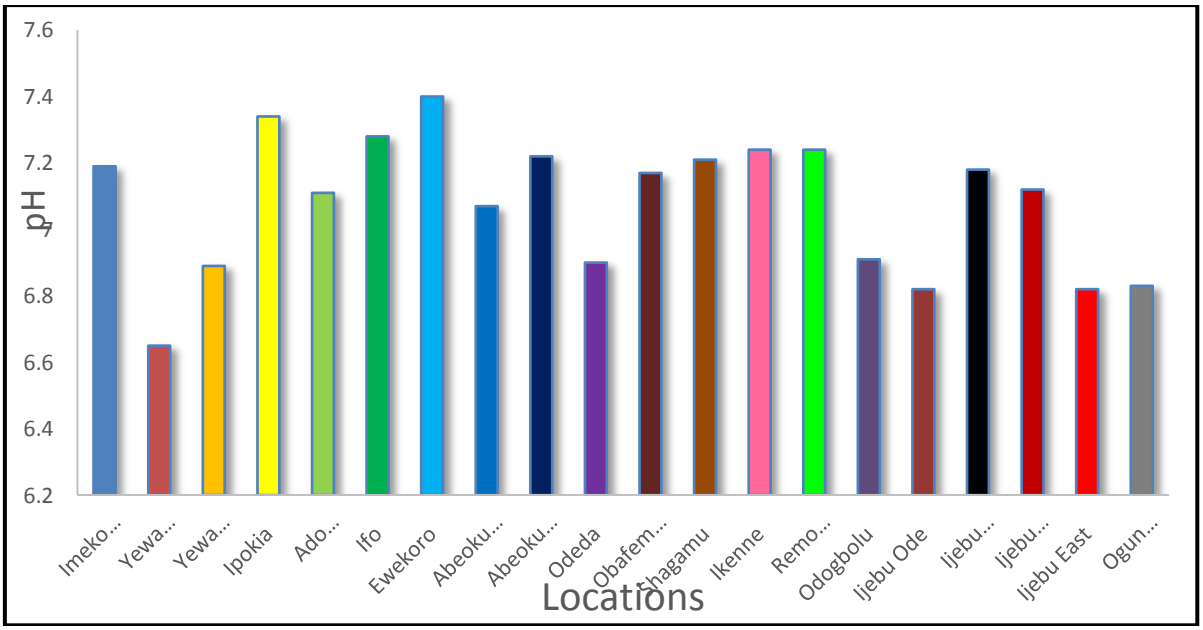

Figure 2: Variation of pH with locations

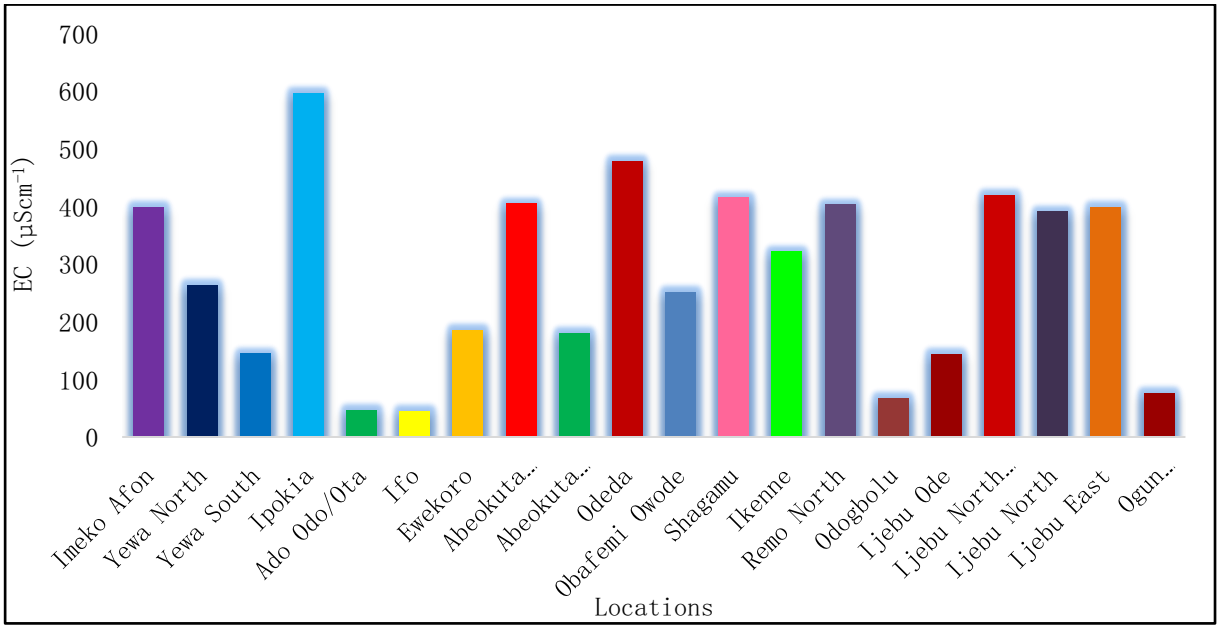

Figure 3: Variation of electrical conductivity with locations

Table 1 Trace elements measured in the study location

Location	ID No	Mn	Cu	Zn	Cr	Ni	Ca	Fe
Atan	1R	5.42	3.21	6.62	0.97	0.38	4.74	1024.05
Odogbolu	2R	2.77	0.48	1.72	1.66	0.17	0.52	1213.08
Ogbere	3R	2.87	0.38	0.87	0.42	0.15	0.94	613.24
Ota	4R	0.6	0.08	0.3	0.16	0.05	0.5	35.58
Itori	5R	2.33	0.3	1.81	0.33	0.12	288.02	160.58
Ijebu Igbo	6R	6.02	3.94	8.06	1.25	0.47	4.06	1120.06
Shagamu	7R	2.55	0.3	0.98	0.36	0.15	1.11	550.17
Akomoje	8R	6.98	4.13	7.86	1.37	0.56	3.76	1247.29
Odeda	9R	9.68	3.21	8.56	1.01	0.73	3.21	1356.09
Ipokia	10R	6.03	3.64	7.13	1.21	0.46	4.34	1096.25
Isara	11R	5.11	3.31	6.42	1.01	0.4	4.33	942.36
Owode	12R	4.76	1.81	4.46	0.86	0.31	1.94	806.32
Aiyetoro	13R	3.62	0.7	1.4	0.46	0.21	0.52	684.52
Ilaro	14R	5.06	1.37	2.85	1.41	0.27	1.23	1136.21
Ikenne	15R	5.77	2.75	5.82	1.24	0.44	3.31	1221.07
Abigi	16R	3.13	0.53	1.36	1.04	0.21	0.52	875.64
Ifo	17R	6.24	0.34	0.73	0.28	0.14	0.5	305.27
Ijebu Ode	18R	2.84	0.53	1.45	0.99	0.17	5.22	553.06
Ake Abeokuta	19R	4.32	0.84	1.82	0.95	0.26	1.01	1234.22
Imeko	20R	4.32	2.83	6.56	0.98	0.31	2.02	1011.08

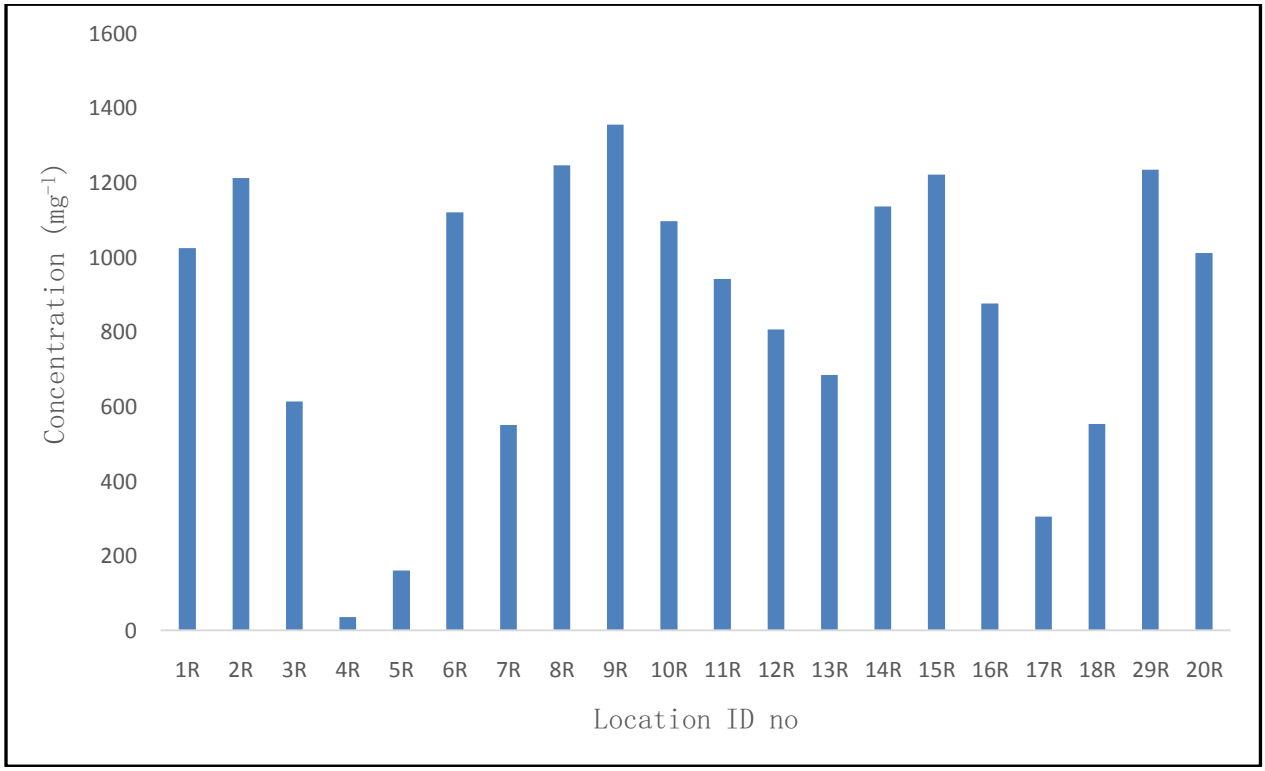

Figure 4: Variation of elemental Concentration (Fe) with location

4. Conclusion

The electrical conductivity, pH, and concentration of trace elements of rock samples obtained from all Local Government of Ogun State were measured using conductivity meter, pH meter, and atomic absorption spectrometer,correspondingly. The rock samples were found to be neutral, and the electrical conductivity of fourteen out of twenty locations exceeded the permissible recommended limit, which suggests that most of the samples were saline. It was observed that samples from Itori (Ewekoro) had the highest pH and concentration of calcium, which may be attributed to the accumulated of limestone in this area. The trace elements detected in this study are essential. It was noted that all the elements were present in minutequantities withthe exception of iron (Fe), which was present in high quantity. The study, therefore, recommended that the environmental assessment impact of all the manufacturing companies be carried out to assess their impact on the neigbourhood.

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