



## Preliminary Interpretation of the Ground Magnetic Survey around Oguta Lake in Imo State, South Eastern Nigeria

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**ABSTRACT:** Ground magnetic profiling was carried out around Oguta Lake in Imo State, Southeastern Nigeria. Seventy-Six stations in three profiles were established at five hundred meters intervals on major roads in the study area. A total distance of thirty five kilometers was covered. The result indicates that the highest field reading was 32835gamma while the lowest field was 28118gamma. Five anomalies were observed. The anomaly at the lake, was most prominent with magnetic readings of 28118 -29235 gamma and elevations of 17 -37 feet, all trending in the NE -SW direction. These anomalies, suggest that the lake has a tectonic origin. @JASEM

*Keywords:* Ground magnetic profiling, interpretation, Oguta Lake, Anomaly, Tectonic Origin

Lakes are basins formed by many geological processes such as buckling of stratified rock into large folds, displacement of large masses of rock by fault, and blocking of valleys by landslides. Lakes are also formed by glaciations, which weakens and removes the bedrock thereby forming depression. Huron superior lake in Canada and Finger Lake of New York are formed through this process (Monroe and Wicander, 2005). Lake water is gotten through atmospheric precipitation that reaches the lake directly and by means of springs, brooks, and rivers. Lakes form and disappear over the course of varying lengths of geological time. Lakes may evaporate as the climate become arid, or they may be filled up with sediments, leaving a bog or swamp in the place. In arid regions, where precipitation is slight, lakes sometimes dry up for long period of time. In situations where evaporation prevents the lake water from overflowing the basin rims, substances dissolved in water becomes concentrated. The dissolved matter, brought by tributary streams varies in composition with the nature of the rocks in the local drainage system. The primary mineral constituent of salt lakes is common salt. Bitter lakes contain sulphates, borax lakes contain borates, alkali lakes contain carbonates, and some lakes contain combination of these substances. Lakes form at all attitudes and are distributed throughout the world, almost one half being in Canada. They are abundant in high attitudes, particularly in mountains ranges subjected to glacial action. Many lakes are important commercially as sources of fish and minerals, shipping, holiday resort etc. The Caspian sea, Lakes superior and Victoria are the largest lakes in the world. The Dead sea is the lowest lake, 40 m below sea level. The Caspian sea is the world's largest lake, covering an area of 370,998 sqkm. Lake Baikal is the deepest fresh water lake in the world, with a maximum depth of 1,637m.

Oguta Lake is one of the inland drainage basins of non-marine habitat, located on a low-lying continental plat form in southeastern Nigeria. It is the largest lake in southeastern Nigeria (Lozan, 1976).

The objective of this study therefore is to use ground magnetic profiling to map for geologic structures like faults, fractures, ground Oguta Lake, as well as to find out if the lake has a tectonic origin.

*The Study Area:* The study area lies between latitudes  $5^{\circ} 04^1$  and  $5^{\circ} 44^1$  N of the Equator and longitude  $6^{\circ} 41^1$  and  $6^{\circ} 60^1$  East of the Greenwich meridian. The lake is linear in shape and fed by main rivers namely: Njaba River and Awbana River. It has a surface and bottom current with velocities in the range of  $20-140\text{cms}^{-1}$  and  $10 - 19\text{cms}^{-1}$  respectively (Lozan, 1979). It has a total surface area of  $2.8\text{km}^2$  and maximum depth in the dry/flood season ranges from 7.0m to 9.0m with depth of 5.50m (Nwadiaro and Umeham, 1985). Oguta Lake is located in the northern tip of the lower Niger Delta. There are two major climatic seasons in the area, the wet season from April to October and dry one from November to March. Average annual rainfall is over 19.30mm (Akintola, 1986). The dry season is characterized by high temperature and low humidity while the rainy season has lower temperature and high relative humidity. In average, temperature for the year in the area is  $25^{\circ}\text{C}$ .

*The Geology:* The geology of the area is well documented (Reyment, 1965, Short and stanble, 1967). Oguta and its adjacent environments fall within the Northern of the Niger Delta. The surface geology in the study area is essentially the coastal plain sands – the Benin Formation (Mid – Eocene and Recent), the Sombreiro- Warri Deltaic plain and the Recent alluvial deposits. Benin Formation consists of thick bodies of yellow (ferruginous) and white sands which are friable, poorly sorted and intercalated with shale, clay tenses and lignite. Formation thickness may be up to 200metres in some areas. Onyeagocha, (1980) reports that the Formation is overlain in many places by reddish lateritic material formed by in – situ weathering and ferruginization of the rock.

## MATERIALS AND METHODS

A proton – precession magnetometer (G 816/ 826A model) was used for the data acquisition in which a leap frog method was used. Seventy six stations were established in three profiles. The spacing interval between stations was 500metres and the total distance covered was 35kilometres. For the first profile (P<sub>1</sub>), twenty five stations were established and a total distance of 11.7km was covered. Twenty six stations

were established for the second profile (P<sub>2</sub>) and the total distance of 11.8km was covered. For the third profile (P<sub>3</sub>), twenty five stations were established and a total distance of 11.5km was covered. The times as well as the elevation (height above sea level) readings were taken along side with the magnetometer readings at each station as showed in tables 1, 2 and 3. At an hour interval looping was carried out in order to check for drift.

Table 1: Field data from Profile 1(P<sub>1</sub>): Izombe Sec.

STATION	READING IN GAMMA	MEAN
P <sub>1</sub> A <sub>0</sub>	31549 31553 31554	31552
P <sub>1</sub> A <sub>1</sub>	30691 29253 29019	29654
P <sub>1</sub> A <sub>2</sub>	28042 29090 29393	28842
P <sub>1</sub> A <sub>3</sub>	31653 31655 31653	31654
P <sub>1</sub> A <sub>4</sub>	31659 31654 31654	31656
P <sub>1</sub> A <sub>5</sub>	31135 31601 31600	31445
P <sub>1</sub> A <sub>6</sub>	30667 30663 30661	31445
P <sub>1</sub> A <sub>7</sub>	30683 30684 30680	30682
P <sub>1</sub> A <sub>8</sub>	30683 30683 30683	30682
P <sub>1</sub> A <sub>9</sub>	30697 30697 30697	31697
P <sub>1</sub> A <sub>10</sub>	31175 31187 31177	31180
P <sub>1</sub> A <sub>11</sub>	31685 31669 31657	31671
P <sub>1</sub> A <sub>12</sub>	31675 31675 31679	31673
P <sub>1</sub> A <sub>13</sub>	31551 31603 31605	31586
P <sub>1</sub> A <sub>14</sub>	31527 31527 31527	31527
P <sub>1</sub> A <sub>15</sub>	31343 31327 31323	31331
P <sub>1</sub> A <sub>16</sub>	31454 31461 31463	31459
P <sub>1</sub> A <sub>0</sub> Loop	31345 31345 31357	31349

Table 2: Field data from Profile 2 (P<sub>2</sub>): (Oguta Lake – Awo-

STATION	READING IN GAMMA	MEAN
P <sub>1</sub> B <sub>0</sub> (BASE)	31697 31697 31685	31693
P <sub>1</sub> B <sub>1</sub>	31479 31495 31577	31517
P <sub>1</sub> B <sub>2</sub>	31445 31467 31655	31522
P <sub>1</sub> B <sub>3</sub>	31947 31946 31875	31929
P <sub>1</sub> B <sub>4</sub>	32185 32947 32465	32532
P <sub>1</sub> B <sub>5</sub>	30447 30443 30485	30458
P <sub>1</sub> B <sub>6</sub>	31487 31487 31467	31480
P <sub>1</sub> B <sub>7</sub> (200m)	28113 28121 28119	28118
P <sub>1</sub> B <sub>0</sub> (LOOP)	31177 31119 31189	31162
P <sub>1</sub> A <sub>9</sub>	30697 30697 30697	31697
P <sub>1</sub> A <sub>10</sub>	31175 31187 31177	31180
P <sub>1</sub> A <sub>11</sub>	31685 31669 31657	31671
P <sub>1</sub> A <sub>12</sub>	31675 31675 31679	31673
P <sub>1</sub> A <sub>13</sub>	31551 31603 31605	31586
P <sub>1</sub> A <sub>14</sub>	31527 31527 31527	31527
P <sub>1</sub> A <sub>15</sub>	31343 31327 31323	31331
P <sub>1</sub> A <sub>16</sub>	31454 31461 31463	31459
P <sub>1</sub> A <sub>0</sub> Loop	31345 31345 31357	31349

STATION	READING IN GAMMA	MEAN
P <sub>2</sub> A <sub>0</sub>	30535 30635 30643	30604
P <sub>2</sub> A <sub>1</sub>	32191 32194 32002	32129
P <sub>2</sub> A <sub>2</sub>	31377 31374 31374	31375
P <sub>2</sub> A <sub>3</sub>	31673 31674 31654	31667
P <sub>2</sub> A <sub>4</sub>	31011 31017 31005	31011
P <sub>2</sub> A <sub>5</sub>	30294 30221 30244	30253
P <sub>2</sub> A <sub>6</sub>	31144 31143 31147	31145
P <sub>2</sub> A <sub>7</sub>	31464 31467 31464	31465
P <sub>2</sub> A <sub>8</sub>	32084 32059 32065	32069
P <sub>2</sub> A <sub>9</sub>	31431 31434 31431	31432
P <sub>2</sub> A <sub>10</sub>	31597 31679 31629	31635
P <sub>2</sub> A <sub>11</sub>	31587 31575 31597	31586
P <sub>2</sub> A <sub>12</sub>	31185 31175 31174	31178
P <sub>2</sub> A <sub>0</sub> (Loop)	31003 31075 31077	31052

STATION	READING IN GAMMA	MEAN
P <sub>2</sub> B <sub>0</sub> (BASE)	31073 31067 31067	31069
P <sub>2</sub> B <sub>1</sub>	31857 31847 31847	31850
P <sub>2</sub> B <sub>2</sub>	31689 31685 31683	31686
P <sub>2</sub> B <sub>3</sub>	31817 31017 31017	31284
P <sub>2</sub> B <sub>4</sub>	31675 31117 31685	31492
P <sub>2</sub> B <sub>5</sub>	31067 31835 31847	31583
P <sub>2</sub> B <sub>6</sub>	32227 32227 32257	32237
P <sub>2</sub> B <sub>7</sub>	32117 32017 32015	32050
P <sub>2</sub> B <sub>8</sub>	31544 31405 31407	31452
P <sub>2</sub> B <sub>9</sub>	31403 31405 31407	31405
P <sub>2</sub> B <sub>10</sub>	31115 31127 31119	31120
P <sub>2</sub> B <sub>11</sub>	31997 31967 31951	31972
P <sub>2</sub> B <sub>12</sub> 300m	32441 32867 32059	32456
P <sub>2</sub> B <sub>0</sub> Loop	31003 31075 31077	31052

**PROFILE 1:** This profile runs in the NNE-SSW direction and cut across the area where the geology is characterized by the Sombreiro- Warri Deltaic plain and Alluvium. Settlements that falls in this profile includes: Nnebuku, Izombe and Ossu-Obodo (Fig. 1). Twenty five stations were covered at a total distance of 11.7km. Anomalies were observed at station 2 (Fig. 2) which is 1km from the base station (Izombe) as well as at stations 6, 7 and 8. There was a high uniform magnetization between stations 10 and 20. This area is mainly alluvium, which is characteristic of clay, shale, silt sand and gravels that have high adsorption capacity of heavy minerals. There was a sharp drop or plunge between stations 22 and 24 which are close to the lake. The last station having the lowest magnetic value of 28118gamma, which is 17ft above sea level can be said to be as a result of depression or tectonic activities.

**PROFILE 2:** The profile runs in the NNW – SSE direction and cuts across the area where the geology

is characterized by Alluvium and Benin Formation (Fig. 1). A total distance of 11.8km was covered and twenty six stations established. An anomaly was observed at stations 5 (Fig. 2) which is 2.3km from the lake. This corresponds with steep slope/depression in Oguta main town. An uneven magnetic value was observed as one moves away from the lake. This may be as a result of intercalation of sand and shale in the area.

**PROFILE 3:** The profile runs in NNW-SSE direction and cuts across Mgbidi and Awomamma settlements where the geology is characterized by alluvium. A total distance of 11.5km was covered and twenty five stations were established. This profile is characterized by magnetic values as high as 32838 gamma. Generally, there was variation in magnetization in this profile (Fig. 3). It was observed from the alignment of profiles 1 and 2 that there was a sharp plunge at the last station of profile 1 and the first station of profile 2, which are both on the Oguta lake

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axis. This is a clearer indication of a fault within that region.

**Table 3:** Field data from Profile 3 (P<sub>3</sub>): (Awo-Omama/Mgbidi Junction - Obumiri) Base Station (A): Awo-Omama/Mgbidi Junction Base Station (B)

A			B		
STATION	READING IN GAMMA	MEAN	STATION	READING IN GAMMA	MEAN
P <sub>3</sub> A <sub>0</sub> (BASE)	30447 29271 30054	29924	P <sub>3</sub> B <sub>0</sub> (BASE)	31137 31187 31824	31383
P <sub>3</sub> A <sub>1</sub>	32197 31674 31605	31825	P <sub>3</sub> B <sub>1</sub>	35491 36125 36415	32000
P <sub>3</sub> A <sub>2</sub>	30625 30509 29851	30328	P <sub>3</sub> B <sub>2</sub>	31837 31827 31817	31827
P <sub>3</sub> A <sub>3</sub>	31197 31179 31193	31190	P <sub>3</sub> B <sub>3</sub>	31191 31185 31199	31192
P <sub>3</sub> A <sub>4</sub>	31163 31817 31653	31544	P <sub>3</sub> B <sub>4</sub>	31825 31825 31847	31832
P <sub>3</sub> A <sub>5</sub>	31183 31119 31179	31160	P <sub>3</sub> B <sub>5</sub>	32312 32315 32281	32303
P <sub>3</sub> A <sub>6</sub>	32071 31885 32007	31988	P <sub>3</sub> B <sub>6</sub>	32133 32117 32167	32139
P <sub>3</sub> A <sub>7</sub>	32833 32843 32837	32838	P <sub>3</sub> B <sub>7</sub>	31887 31814 31887	31863
P <sub>3</sub> A <sub>8</sub>	31193 31154 31145	31164	P <sub>3</sub> B <sub>8</sub>	31203 31197 31224	31208
P <sub>3</sub> A <sub>9</sub>	31329 31379 31385	31364	P <sub>3</sub> B <sub>9</sub>	30163 30167 30117	30149
P <sub>3</sub> A <sub>10</sub>	32585 32483 32437	32502	P <sub>3</sub> B <sub>10</sub>	31007 31187 31195	31130
P <sub>3</sub> A <sub>11</sub>	30957 30973 30954	30961	P <sub>3</sub> B <sub>11</sub>	31997 31967 31951	31972
P <sub>3</sub> A <sub>12</sub>	31123 31125 31137	31128	P <sub>3</sub> B <sub>0</sub> Loop	31997 31475 31491	31654
P <sub>3</sub> A <sub>13</sub>	31864 31877 31837	31859			
P <sub>3</sub> A <sub>0</sub> (Loop)	31817 31874 31807	31833			

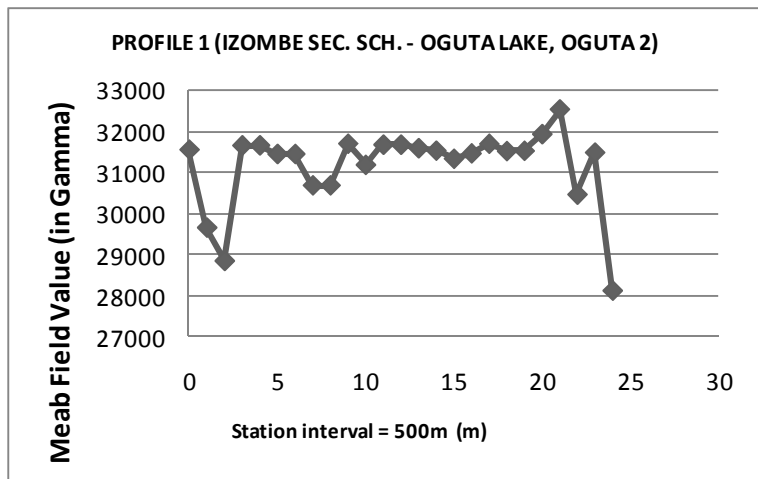


Fig. 1: Profile 1 (Izombe Sec. Sch. - Oguta Lake, Oguta 2)

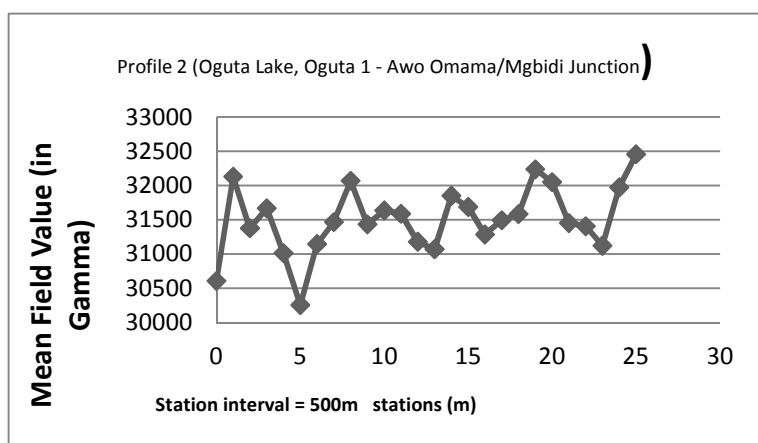


Fig. 2: Profile 2 (Oguta Lake, Oguta 1 – Awo-Omama/Mgbidi Junction)

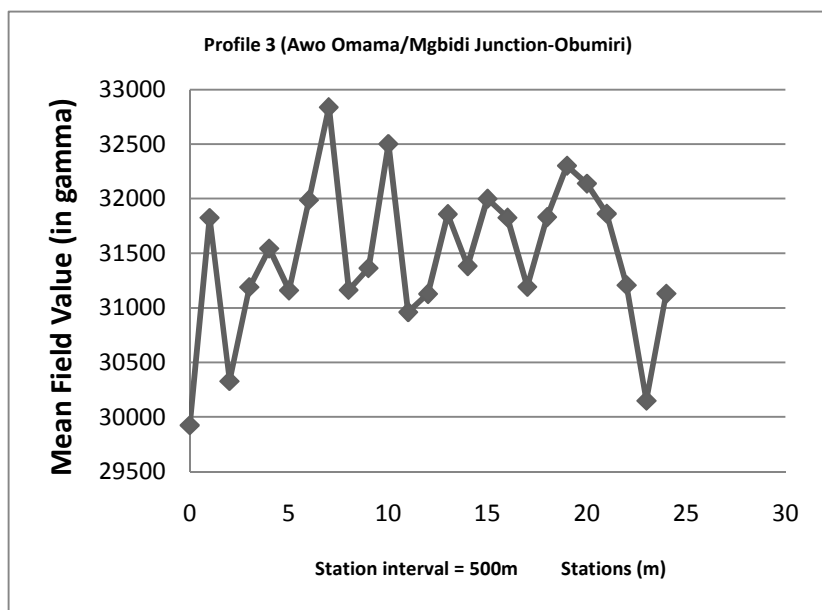


Fig. 3: Profile 3 (Awo-Omama/Mgbidi Junction - Obumiri)



*Conclusion:* This research work has achieved some level of success in the use of ground magnetic profiling to map for geologic structures like faults, fractures and lineaments around Oguta Lake as well as to find out if the lake has a tectonic origin. The ground magnetic profiling in the study area shows anomalies which are characterized by low amplitudes and low relief. These anomalies are predominantly due to basement lithology rather than topography. The signatures of the observed magnetic lineament trending in the NE – SW direction suggests that Oguta lake considering its co-ordination falls within the charcot fracture zone. It is therefore recommended that more ground magnetic profiling should be done in other directions that were not covered during the course of this work so as to authenticate this proof. It is equally recommended that an aeromagnetic survey of Oguta lake and its environs be done so as to confirm the presence of geologic structures as well as the depression at the lake.

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