BENSON IDHOSA UNIVERSITY

21th INAUGURAL LECTURE

T O P I C :

HUMANITY IS THE SALT OF THE PHYSICAL UNIVERSE FROM SUBATOMIC PARTICLES TO UNIVERSAL SPACE. THE TESTAMENT OF A PHYSICIST.

D E L I V E R E D B Y

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DEDICATION

This Inaugural Lecture is dedicated to Almighty God for his grace upon my life, my husband, Prof. R. Ehigiator and my children.

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Gentle men of the press
Distinguished Ladies and Gentlemen

1.0. Introduction

Mr. Vice Chancellor sir, today marks a new beginning in the era of the girl child, just for the fact that history is about to be made. Permit me to say that this is the first inaugural lecture to be delivered by the first female Professor of Physics, in the history of Edo state by an Edo born citizen. There is a usual assumption that, the female gender in Edo state is usually perceived not to be interested in Education. May I respectfully say at this juncture that, the story has changed. This is the Lord's doing and it is marvelous in our sight.

Mr. Vice Chancellor sir, words are not enough to appreciate you for this privilege given me, to stand before these highly esteemed personalities here present to deliver this inaugural lecture, which is first of its kind on this day, 9th of May, 2023.

The topic of my Inaugural lecture is titled: **The salt of the Physical Universe, "From Subatomic Particles to the Universal Space" The Testament of a Physicist.**

I am going to take you through a journey of how humanity as the salt of earth, has added value from subatomic particle to the universe space at large.

Matthew 5:13 strictly states: 'You are the salt of the earth. As a Physicist, Prof (Mrs.) Mabel Oyenmwen Ehigiator, has become the salt of the earth by the series of researches she has carried out, by virtue of her career as a Professor in Benson Idahosa university.

My distinguished guests, ladies and gentlemen please lend me your ears, as I take you through this walk of my life from cradle of being an Assistant Lecturer to this present day of being a full blown adult of Professor of Physics (Geophysics).

1.1. Academic journey of a female Physicist

Prof. (Mr.) Mabel Ehigiator was born into a family of Chief P.N. Aiguobasinmwin, the Okaeben of Akenzua II of Benin kingdom. Her way of life as a growing child was to excel in her educational pursuit to make her parents happy. She was always pampered by her parents with money and love, after examination results were turned in. At the end of examination, the class teacher would write on the report card then: 'keep riding high clear, the sky is your spring board' I also thank my parents for believing in the girl child and giving me the maximum support needed for excellence in academics. I could remember then, going to the next class was predicated on us excelling in Mathematics and English language.

On completion of my primary education, I was admitted into one of the Federal Government Colleges in the North. My parents did not allow me go to the north but rather sent me to St. Maria Goretti Girls Grammar School, which was the best female secondary school then in my time. On admission into the school, a general examination was conducted and the best forty students were compulsorily selected into a special class. The students in that special class were mandated to take pure science subjects.

Science is one of the greatest collective endaevours of humanity. It significantly contributes to our understanding of the world and offers answers to the questions as well as solutions that benefit millions across the globe (Carl Sagan)

Permit me to reiterate that it is very difficult to have parents that can fit into the shoes of my parents in all ways round (Academically, morally and socially). I will forever be grateful.

May the soul of my father continually rest in peace. Daddy, you were the best gift, the world has ever offered to me. There can never be a replacement for you in my life. Your love for me was deep, deeper than the deep blue sea!

1.1.1. My career into Physics

On admission to study Pure and Applied Physics into the University of Benin, in 1990, my late uncle, Professor David Awanbor told me that he knew it was impossible for girls to graduate from Physics Department. He then promised me that as the usual practice in the Department, only a few would eventually graduate due to the nature of the course. His promise was, on withdrawal from the Department he would help me switch to other Departments. That statement did not go down well with me because I knew that, that was impossible .

Permit me to say that of about thirty students that were admitted to study physics at my, only seven of us graduated at final year, thereby, making me the **third female Physics student** in the history of university of Benin to have graduated from the Physics Department. Furthermore, I am delighted to inform you that this is the first inaugural lecture to be delivered by a female Professor of Physics in Edo state. This of course, is the Lords doing and it is indeed marvelous in our sight. This is also an inaugural lecture to be delivered by the first female professor of Physics in Benson Idahosa University.

1.2. Statements of truths in Physics

Below are some valid statements about physics:
Physics is essential but less exciting than other sciences
In physics you do not have to go around making trouble for yourself but nature does it.

Physics is pleasurable
The whole word is governed by the laws of physics
Physics is elegant but still messy as a subject
Physics is a complicated and difficult subject for physicists
Physics is like love because they both need time and space
The physicist is majorly concerned about energy
The physicist is precise and logical
The physicist believes more in action and not words
Though physics is the father of all sciences, it is usually not seen but felt in every aspect of life. The scriptures below brings about the reality of physics in creation and thus physics is the first discipline in creation.

Genesis 1:1-31;9 (KJV)
In the beginning, God created the ***Heavens and the Earth****. The Earth was without form and void, and darkness was over the face of the deep. And the spirit of God was hovering over the face of the waters. And God said "let there be light", and there was light. And God saw that the light was good. And God separated the light from the darkness. God called the light Day, and the darkness he called Night. And there was evening and there was morning, the first day.*

'*LET THERE BE LIGHT'. LIGHT BRINGS HEAT AND HEAT IS ENERGY AND THE STUDY OF PHYSICS DEALS MAJORLY ON ENERGY WHICH IS EXPRESSED IN JOULES, THE PHYSICIST, WHO WORKED ON ENERGY.*
Physics is needed in our daily activities. Physics takes us out of any confusion state to a state of clear understanding. The physicist is very humble but logical, precise, and comes out with predictive and reliable transformation which is empowering and emotional.

1.3. The Topic and Analysis

Topic: The salt of the Physical Universe, "From Subatomic Particles to the Universal Space" The Testament of a Physicist.

ANALYSIS

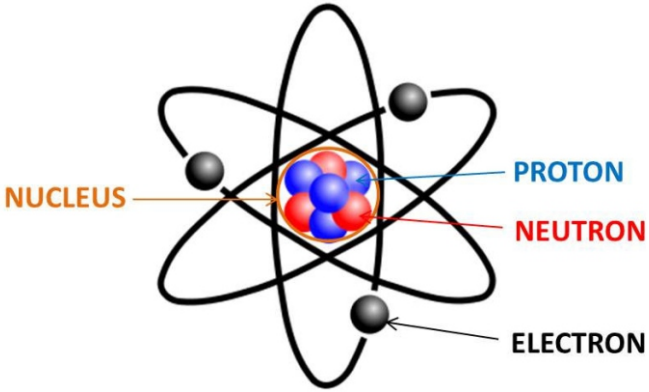
Physics is that science that deals with the interaction of matter and energy

Physics is the study of any physical thing on earth and the universe. The universe is concerned with space and time and their components. Such components are made up of the total energy in in their diverse forms, which include electromagnetic radiation and matter. Other components of the universe are planets, moons, stars, galaxies and the contents of intergalactic space.

Smaller particles like Protons, Neutrons and Electrons which are smaller than an atomic size which make up the atom are referred to as Subatomic particles.

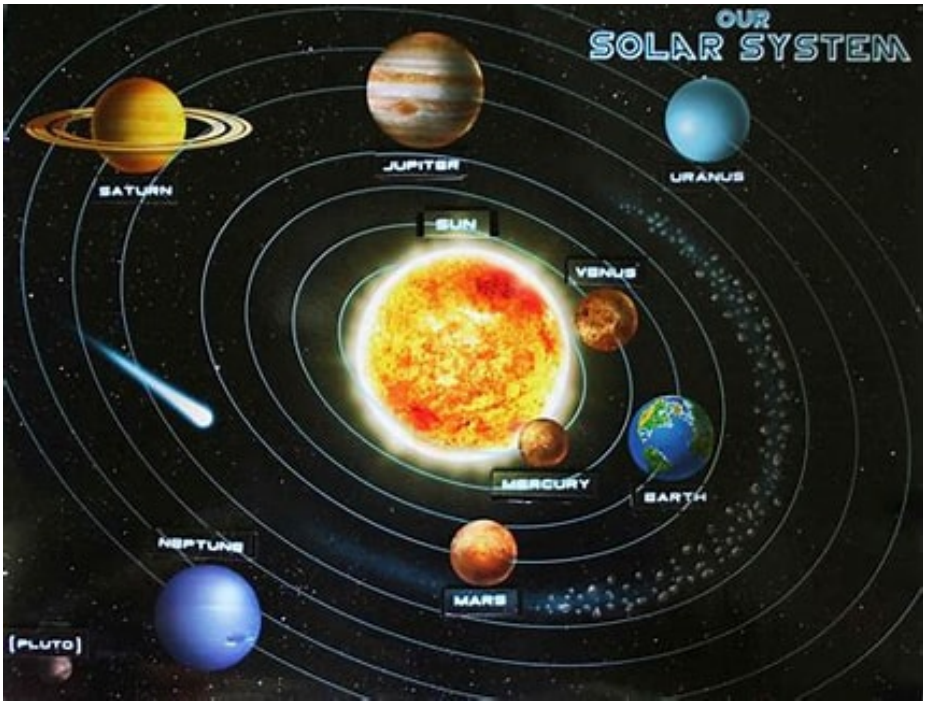
They are responsible for the basic structure of the universe and also for the binding of the universal blocks together.

Humans are made up of same basic pieces of matter, known as atoms that are made up the subatomic partcles.



Picture showing the subatomic particles.(Photo Credit: Pixabay)

The protons and neutrons also referred to as the Nucleons are at the centre of the atom. Earnest Rutherford proposed that the electrons rotate round the nucleus like minute planets orbiting on their own little sun. {. This movement can be likened to that of the solar system in which the nucleus is the sun.



The solar system. (source: https://www.shutterstock.com)

A human body that weighs 176 pounds (80killograms) is made up of of 8 billion, billion, billion atoms, which is a 8.0×10^{27}
Three major elements present in the human body according to their percentages are stated below:
Hydrogen 65%
Oxygen 25%
Carbon 10%

The remaining 1% are made up of the trace elements (Zirconium, radium, boron, copper and lead){Freitas and Kross, 2007}
Please note that the human body is still full of empty space irrespective of these irrespective of these large quantities of atoms. The human body can compressed to the dimension of the size of the cube of a sugar if all the empty spaces are squeezed out.
Scientist assume that 96% of the universe is caters for the dark matter and dark energy while the other components of the universe including man, cellstial bodies and the planets caters for the remaining 4%. (Chown, 2022)
Universal space; refers to an open space that can be used for different purposes.

Vice Chancellor sir, "if the universe is an artificial simulation, then the mathematics is its code and Physicist is a programmer.
May I at this juncture emphatically say that the study of any physical thing on earth and universe is physics. God created everything on the planet Earth except Humanity in five days. he then made man in his image and likeness on the sixth day so man could survive, interact, replenish and have dominion over all that he created in five days. Consequently, man was the initial focus of God in the creation process.

Vice chancellor sir, my inaugural lecture is focused on how humanity has harnessed a few of God's creation (sun, moon, planets, resources and every other thing in space, surface and subsurface) to the betterment of humanity.
This inaugural lecture has been split into two sections: the first part being what Prof. (Mrs) Mabel Oyenmwen Ehigiator has done from her academic cradle as an Assistant Lecturer in 2004

till date from her researches and also the role Physics has played to make the universe at large better place for humanity.

1.3.1. The Three Laws of Physics (Newton's laws of motion)

When we speak of bodies, we are not speaking of actual human bodies (although human bodies can be included in this definition), but of any piece of matter upon which a force may act. Newton's three laws are outlined below.

Newton's Laws of Motion (The Three Laws of Physics)

1. **Law of Inertia:** A body remains at rest or in its state of uniform motion unless acted upon by an external force.
2. **Force = Mass x Acceleration:** change of momentum of a body is proportional to the Applied force.
3. **Action = Reaction:** To every Action, there is always an equal and opposite Reaction.

1.4. Branches of physics and their definitions

1.4.1. Acoustics

This is the branch of classical physics that **studies sound** as an air disturbance, its way of propagating, the phenomena that produce it, how it is heard and how it is absorbed.

Tools : pressure diagram, microphones, ultrasound.

Applications : soundproofing, sound insulation, design of

musical instruments and concert halls, navigation systems and sound location.

1.4.2. Astrophysics

The branch of physics that studies larger material bodies is astrophysics. Describe the motion of bodies and systems in space, such as stars, quasars, galaxies, and interstellar matter.

Tools : astronomical observatories, telescopes, radio telescopes, space probes.

Applications : Geo positioning, knowledge of other planets.

1.4.3. Biophysics

Biophysicists combine biology and physics to study the **physical laws of biological processes** , the functioning of the cell membrane, the way nerve impulses operate, and muscle contraction.

Tools : molecular biology, X-ray diffraction, fluorescence microscopy based on fluorescence resonance energy transfer, electrophysiology.

Applications : thermodynamic stability of proteins, cellular energy, cellular transport.

1.4.4. Cryogenics physics

Low-temperature physics or cryogenics studies the behavior of **matter at extremely low temperatures** . Absolute zero (0K) indicates the lowest temperature that a body can reach, where the molecules are practically immobile.

Tools : Gas compression and expansion, cryostat.

Applications : superconductivity and superfluidity, construction of super powerful magnets, power transmission lines with high efficiency.

1.4.5. Kinematics physics

Kinematics is the branch of mechanics that studies **objects in motion**. To describe the movement, kinematics studies the trajectory of points, lines and other geometric objects, speed, acceleration, displacement are calculated.

Tools : video cameras, observation, mathematics.

Applications: calculation of the speed and trajectory of objects, ballistics.

1.4.6. Dynamics physics

This deals with the relationships between the **movement of bodies and their causes** . It studies the forces that cause objects and systems to move.

Tools : Newton's laws, force diagrams.

Applications : Calculations of friction, deformation, resistance, aerodynamics, propulsion.

1.4.7. Static physics

Statics is the branch of mechanics that studies the balance of bodies. It deals with the analysis of the **forces acting on a system at rest**. In construction, static physics has an

outstanding application

Tools : Newton's laws, simple machines.

Applications : construction of buildings and bridges.

1.4.8. Electromagnetism

Electromagnetism is the study of phenomena of electricity and magnetism.

Tools : magnets, electrical charges, voltmeters, ammeters.

Applications : electricity distribution network systems, global communication networks, electronic equipment.

1.4.9. Atomic physics

Atomic physics is responsible for the **study of the atom** : its structure, electronic configuration and the mechanisms of emission and absorption of energy.

Tools: radioactivity, spectroscopy, lasers.

Applications : quantum mechanics, nanotechnology.

1.4.10. Physics of fluids

Fluid physics studies the behaviour of liquids, gases, or other fluids at rest and in motion.

Tools : Archimedes principle, surface tension, capillarity.

Applications: control of compressed air and fuel flow in aircraft, industrial hydraulic process control systems and high temperature processes. Functioning of the circulatory system.

1.4.11. Solid state physics

Solid state physics studies and explores matter and the

interaction between atoms in dimensions on a macroscopic scale. Try to explain chemical properties based on the physical properties of each atom.

Tools: Electron microscope, X-ray diffraction crystallography.

Application: laser materials, photoresistors, photocells, fluorescent or phosphorescent materials, new magnetic materials, superconductors, new magnetic materials.

1.4.12. Plasma physics

Plasma physics studies the **state of matter of charged particles**. Plasma is naturally found in stars and space. In laboratories, plasma is created by heating gases until electrons detach from their atom or molecule.

Tool: High power laser, microwave.

Applications: Treatment of paper for recycling.

1.4.13. Physics of condensed matter

Condensed matter physics deals with the thermal, electromagnetic and optical properties of solid and liquid substances

Tools: Crystallography, spectrometry.

Applications:Thermal conductivity, semiconductors and insulators, superfluidity, ferromagnetism.

1.4.15. Medical physics

Medical physics deals with methods, and techniques of physics to prevent, diagnose, and treat human diseases.

Tools : Imaging, radiological equipment, magnetic resonance.
Applications: Clinical service, radiotherapy, dosimetry.

1.4.16. Nuclear physics

Nuclear physics examines the **nucleus of the atom** , made up of protons, neutrons, and other particles. The nuclear Physicist studies the arrangement of these particles in the nucleus, the forces that hold them together, the way in which nuclei release energy in the form of natural radioactivity or due to fusion or fission reactions.

Tools: Beams of protons or electrons such as projectiles, nuclear reactors, Geiger counters.

Applications: Radioactivity, medicine, power plants.

1.4.17. Classical mechanics

Classical mechanics comprises the entire study of the motion of bodies. Includes kinematics, dynamics, and statics.

Tools: Newton's laws of motion.

Applications: rocket and spacecraft launch.

1.4.18. Quantum mechanics

Quantum mechanics studies the laws that govern the behaviour of subatomic particles. In the field of extremely small dimensions, bodies follow completely different laws of behaviour from those of the macroscopic world.

Tool : blackbody radiation.

Applications: predicting the behaviour of the particles and internal phenomena of the atom, allows to delve into the properties and structure of solid materials, such as semiconductors.

1.4.19. Meteorology

Meteorology is the **study of the atmosphere and its components**. Meteorologists apply physics to examine the flows and movement of air and water on the Earth's surface.

Tools: Satellite images, radars, weather stations.

Applications: Air flow investigation, weather forecasting, monitoring of weather conditions.

1.4.20. Optics

Optics studies **light** and has many applications in the field of optoelectronics and fibre optics.

Tools: lenses, mirrors, telescopes and binoculars.

Applications: study of the behaviour of light and other electromagnetic waves, optical fibre.

1.4.21. Thermodynamics

Thermodynamics is the branch of Physics that studies the different **forms of energy**, as well as the conditions under which one can be transformed into the other.

Tools: laws of thermodynamics, calorimeters.

Applications: Cooling systems, internal combustion engines,

space vehicle propulsion engines.

1.4.22. Theoretical and experimental physics

This deals with matter that constitutes the Universe and the laws that govern it. The work in physics can be approached in two main strategies:

theoretical physics: They use the laws of physics to refine theories and suggest experiments, as Albert Einstein, Richard Feynman, and Stephen Hawking did.

1.4.23. GEOPHYSICS

Geophysics is the use of Physics to study the Earth. 'GEO' means Earth, therefore Geopysics means 'Earth physics'. plp One emphasis is the exploration of the Earth's interior (Formation and the wealth of the Nation).This is the application of Physics, Mathematical models and computer simulations to study the earth to predict the activities and all the resources in the subsurface, surface as well as the universe. Presently, there are many methods applied for exploration in Geophysics. The method depends on what is sourced for.

2.0. Definition of Formation Evaluation.

Formation Evaluation is the application of different methods like mathematical, computer, well logs, coring, mud logs, drilling and other geophysical equipment to ascertain what is in the subsurface. (Ehigiator M.O. 2010). Other authors have their definitions but this is the definition of Mabel Ehigiator in her Ph.D. dissertation in 2010, titled: Formation Evaluation of five wells in the Niger Delta, Using Geophysical well logs and Core

Data. This work was supervised by Prof. Isaac Aigbedion, one of the pillars of Geophysics in Nigeria.

2.1. My Journey to Formation evaluation

On completion of my degree in Physics, I did my NYSC in the Nigerian National Petroleum Corporation Lagos state, in the Department of Frontier Exploration Services (FES) In NAPIMS. During the course of my service, I was sent to represent my unit at Western Atlas in Port Harcourt due to my competence. I was also sent to represent my unit at core LAB and Schlumberger oil servicing company, all in Port Harcourt. All these companies mentioned above, were into Formation evaluation. On completion of my NYSC, I digressed into Petroleum Engineering, where I obtained a Post graduate Diploma in Petroleum Engineering from the university of Benin, after which I was employed as an Assistant Petroleum engineer in an oil company. Thereafter, I obtained an admission for Masters programme in petroleum engineering at University of Ibadan. I was almost done with the first semester and due to some issues in my first pregnancy, I had to come back to Benin city, to commence my masters degree in exploration Geophysics in Physics department, in UNIBEN. This combination of these two professions and my industrial experience At NPDC Benin, spurred up my interest in *Formation Evaluation*, in which most of my researches were carried out.

2.1.1 What is a Formation

Formation, is a body of rock having a consistent set of physical characteristics (lithology) that distinguishes it from adjacent bodies of rock, and which occupies a particular position in the layers of rock exposed in a geographical region (the stratigraphic column). It is the fundamental unit of lithostratigraphy, the study of strata or rock layers. (Short, K.C. Stauble, A.J. (1967)).

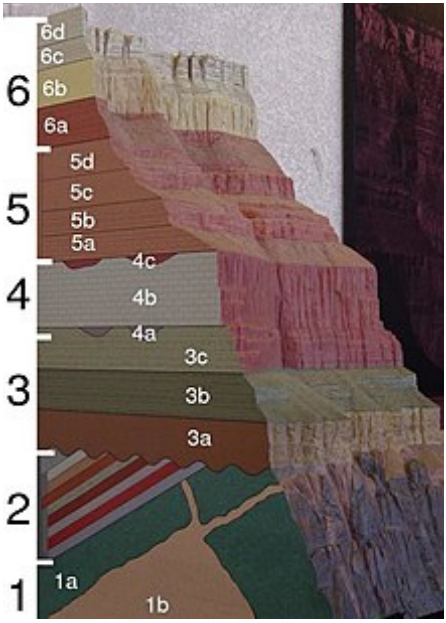


Diagramme showing a typical example of a Formation (Doverton, 1986; Peters, 1991)

Based on their lithologies, three major units have been identified in the Niger Delta (Efeotor,1997; Frost 1997). These are:

i. Benin Formation
ii. Agbada Formation
iii. Akata Formation

2.4. The Niger Delta

In Nigeria, nine states make up the Niger Delta region, these are: Cross River, Edo, Delta, Abia, Imo, Bayelsa, River, Akwa-Ibom and Ondo States.

2.4.1. Benin Formation (continental sands)

Mabel Oyenmwen Ehigiator in her Ph.D. stated clearly that the

Benin Formation is predominantly, that of fresh water, which is the topmost unit of the Niger Delta region.it was deposited in a continental fluvatile environment with a thickness of 0- 2134 meters. It averagely occupies an interval, within which is 90% and a few shaly intercalations. There is an increase in the shale content towards the base (Short and Stauble). In this Formation, there is absence of salt water and Marine Faunas. Non commerciable quantity of oil has been found in this Formation.

2.4.2. Agbada Formation (PARALIC CLASTICS)

This underlies the Benin Formation. It occupies an interval of (1756 - 2896)m below the derrick floor and it is made up of alternation of sands, sandstones and siltstones. The sands constitutes mainly hydrocarbon reservoir in the Niger Delta. The sands are not well sorted except in some cases where they grade into shales as a reservoir seal. This Formation occurs in the subsurface of the Delta area and maybe continuous with ogwashiuku – Asaba Formation. This is majorly the seat of hydrocarbon accumulations and found usually between the Eocene and Pliocene age (Ejedawe, 1981, Ekweozor and Dakouru,). There is however a controversy of whether the shales in this vicinity are source rocks due to the immaturity of the Agbada Formation. Others have however suggested that the source rocks are the marine shales of Akata Formation that are more matured(Doverton, 1986; Peters, 1991)

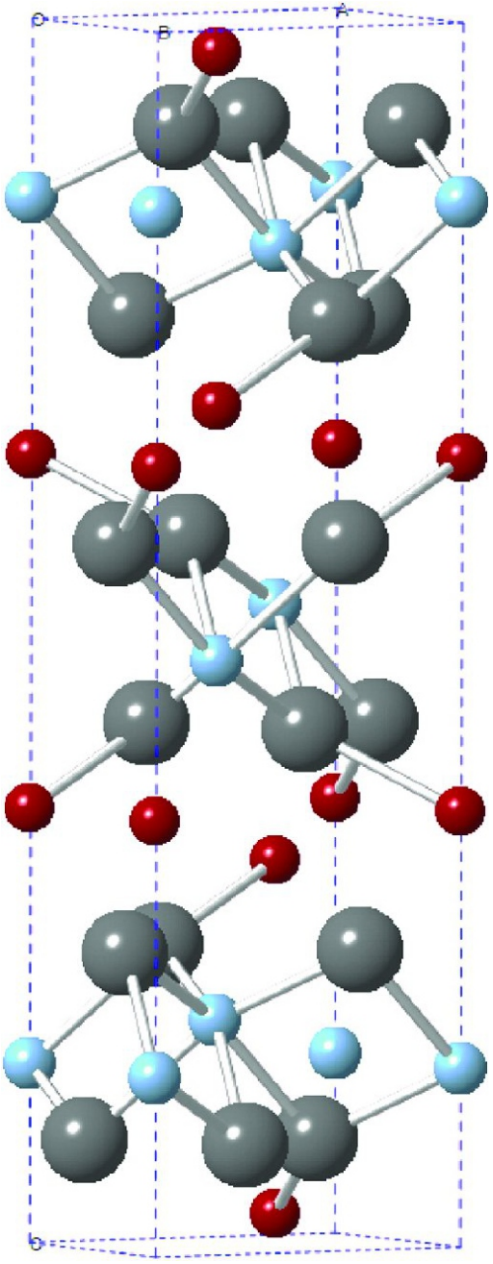
2.4.3. Akata Formation (Marine Shales)

The Lithofacies are predominantly shales, clays and silts which are at the base of the existing Delta sequence. The contain insignificant of quantity sands , possibly of turbidite deposited in the Holomarine (Delta front deeper marine) environment. The thickness of this sequence is about 7000m in the central part of the Delta. Marine shales form the base of the sequence of the range from Paleocene to Holocene age.

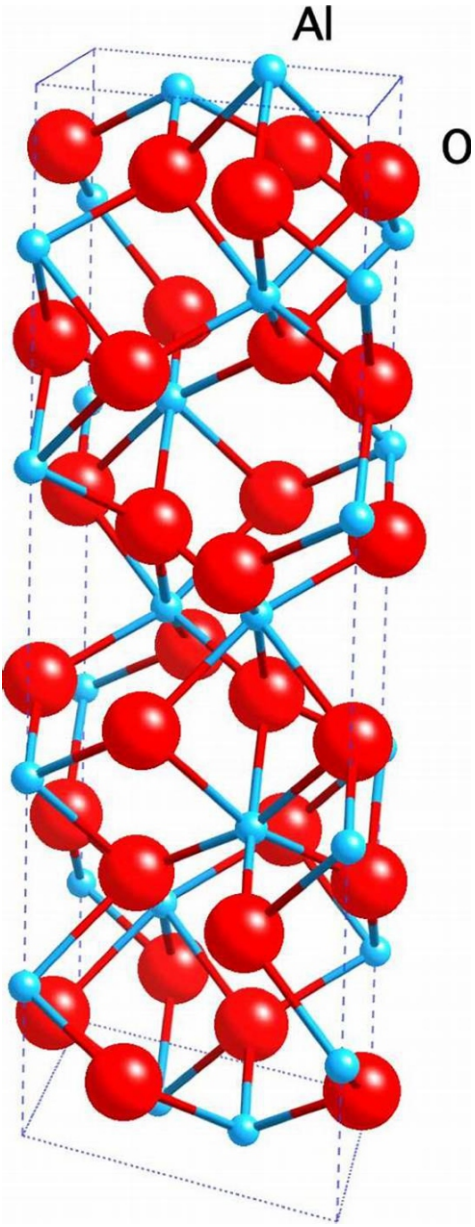
2.5. Why Formation Evaluation?

The wealth of any nation lies on 80% of how far, and how much the subsurface can be evaluated. Pause, and look around you, is there really anything around you that did not come from the subsurface? All the minerals: water, elements, cutleries, aircrafts, the component of the cars, batteries in the (cars, inverters,), sands, rocks (for building, bridges, road, dams, constructions,), metals for houses, electronic gadgets, gates for security purposes, lighting systems, tiles, e.t.c. These are just to mention abut a few. Before the end of this lecture, if there are things you have observed that did not emanate from the surface or subsurface, please let me know.

From my definition, it was observed that I did not mention 'Petroleum as Mineral'. to the physicist , petroleum is not a mineral because scientifically, Mineral is not an **organic** compound but **Inorganic.** Petroleum is an organic compound**.** Mineral is defined as a *solid , naturally occurring inorganic element or compound having an orderly internal structure and characteristic chemical composition, crystal form and physical properties. Minerals differ from* ***rocks*** *which are naturally occurring solids composed of one or two minerals while minerals are composed of elements.*



crystal structure of ilmenite mineral (o = grey,=blue , iron =red)



crystal structure of sapphire

2.6. Types of Minerals

There are majorly four types of minerals:

Carbonates – contain combinations of carbon and oxygen atoms ($C0_3$)

Halides - contain the group seven elements known as halogens.

Oxides - contain oxides of minerals in which the main element is oxygen.

Sulphides - contain sulphur and one or more metals or semimetals

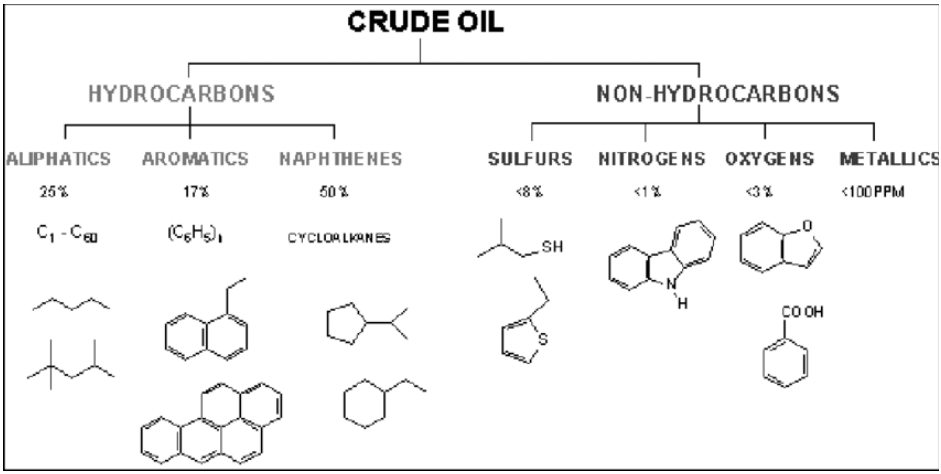


Diagramme of a petroleum

2.9. Types of Formation Evaluation

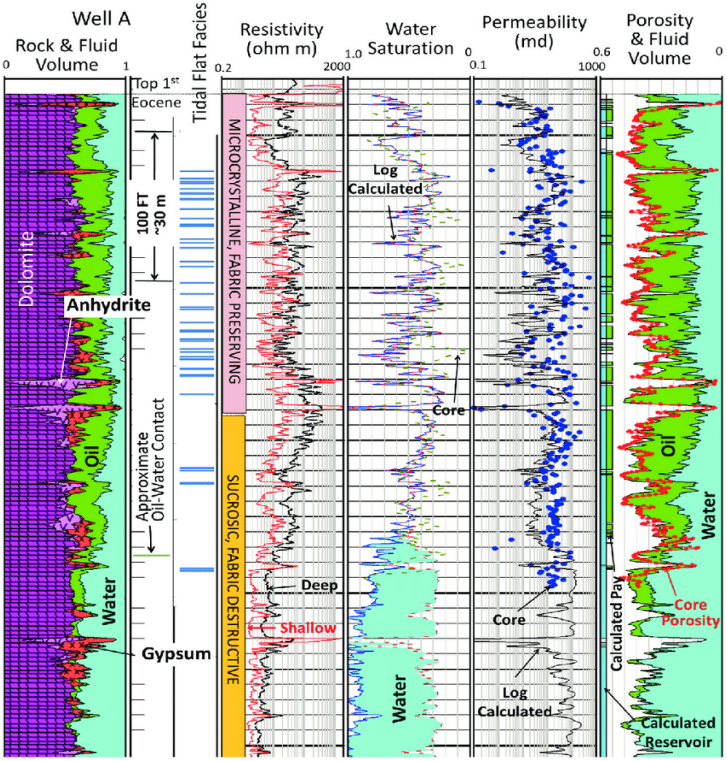
The various types of Formation Evaluation are stated below:

a. Well log
b. Core analysis
c. Mud log
d. Drill stem Test
e. Pressure Volume and Temperature (PVT Analysis)

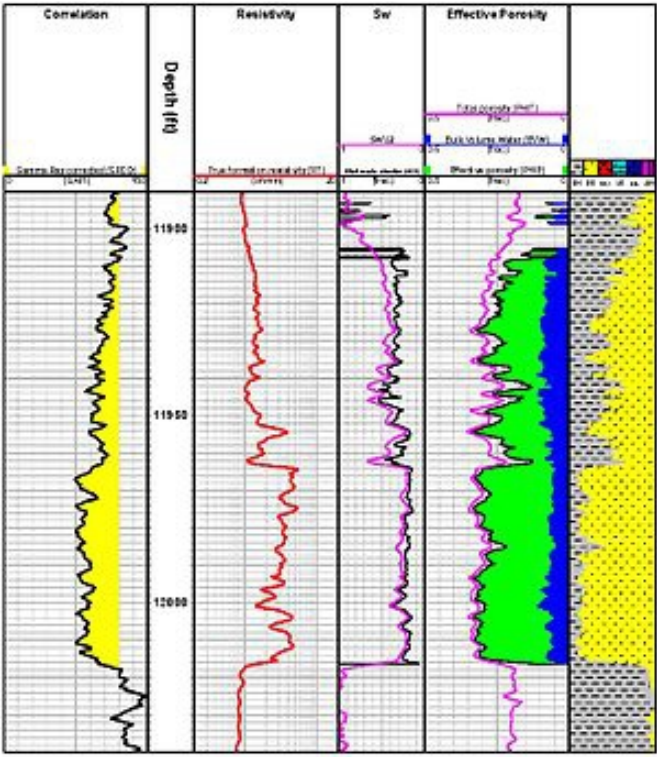
2.10. Petrophysics

Petrophysics is derived from the Greek word, πέτρα, *petra*, meaning 'rock' and φύσις, *physis*, "nature". This involves the physical and chemical properties of rocks with respect to the fluids within .

petrophysics is applied majorly to ascertain the components of the reservoir in the wellbore in Exploration and Exploitation industry. The role of the Petro physicists are to assist the professionals in the petroleum industry interprete the rock properties of the rocks in the reservoir. Major parameters analysed by petrophysicists are porosity, lithology, water saturation, permeability and formation density. The petrophysicists measure and evaluate the properties of the rocks, using well logs.



Typical example of well log (source: Schllumbeger 2009)



Typical example of well log (source: Schllumbeger 2009)

2.10.1. Conventional petrophysical properties

Lithology: This deals with the qualitative property characteristics, such as reservoir thickness, components and texture. Basically, the types of logs run in hole to determine the lithology are Spontaneous potential logs and Gamma Ray logs. Either of them could be used but however, the Gamma ray log is far better than the Spontaneous Potential log. Combination of both logs gives better results. The disadvantage of Spontaneous potential(SP) log is that, it can not be run in cased hole while the Gamma ray log can be run in cased well. the major advantage of SP log over the gamma ray log is that it is less expensive than the Gamma ray log. Deflection to the right of shale base line indicate shale while deflection to the left indicates a porous and

permeable zone.

Porosity: This is the ratio of the void space to the rock matrix. It is dimensionless because it is ratio. It can be multiplied by 100 and expressed in percentage. The higher the porosity, the higher the tendency of more fluid in the reservoir. This is typically calculated using the combination of the Neutron and the Density log.

Water saturation (Sw)*:* This is the portion of the reservoir rocks saturated with water and it is usually expressed in percentage. Water Saturation is usually estimated using the Resistivity logs. The oil resistivity R_o and true resistivity R_t are determined from the resistivity logs. The Archies equation is the applied substituting the values of the R_o and R_t. Sw can either be expressed in fraction or percentage

Oil saturation (S_o) The oil saturation is 1- Sw (expressed in fraction) or 100 – Sw (when expressed in %)

Permeability (K)*:* This is a measure of the interconnectivity of the rock. Permeability of a rock is its ability to allow the flow of fluid out of it as a result of inter connectivity of the pores of the rocks. Please note that a porous rock cannot transmit fluid if the pores are not interconnected. Please note that not all porous rocks are permeable but all permeable rocks are porous. PERMEABILITY IS expressed in mD (milli D'arcy). Where D'Arcy iss the French man that detered the concept of permeability. K is usually calculated using the Willy and Rose equation.

2.11. Ore quality

Bore holes can be drilled into ore bodies (for example coal seams or gold ore) and either rock samples taken to determine the ore or coal quality at each bore hole location or the wells can be wireline logged to make measurements that can be used to infer quality. Some petro physicists do this sort of analysis. The information is mapped and used to make mine development

plans.

2.12.1. Symbols and Definitions:

Stated below, are some definitions and symbols in petrophysics

1. Shale is composed of silt, clay and their bounded water which will not flow. This is the reason that during the lithologic well evaluation , a deflection of the Gamma ray or SP log to the right, indicates the presence of high radioactive content present in clay and these two logs are able to detect radioactive components in clay like potassium.

2. Hydrocarbon are stored only in pore space in sand matrix.

3. Total porosity (Φ_T) is the sum of the pore spaces in source and reservoir rocks

4. S_w (water saturation), is defined as the fraction of the pore space occupied by water.

5.Φ_e (Effective) porosity is defined the pore space in the reservoir rock. The pore space in shale due to lack of interconnectivity of the pore spaces is excluded.

Swe – (Effective shale corrected water saturation). The volumetric source rock portion of Φe which is occupied by water.

Vsh – Volumetric fraction of shale..

Φsh – Shale porosity. Volumetric fraction of pore space in shale. These pore space is filled with bounded water by definition.

Key equations:

$(1-\Phi e-Vsh) + Vsh + \Phi e*Swe + \Phi e*(1-Swe) = 1$

Sandstone matrix volume + shale volume + water volume in sand + hydrocarbon volume in sand = total rock volume

$\Phi e = \Phi T - Vsh * \Phi sh.$

2.13. Drill Stem Test (DST)

In Drill stem test, the suspected economically viable reservoirs are subjected to test before the well is completed. Some of the well parameters tested for are flow rate, basic sediments are water, (BSW), temperature , Reservoir pressure permeability of the well. These wells are carried out to determine how economically viable the sands are. This test will enable them determine the reservoirs to put on stream. The other sands that are not on stream will be temporally sealed. DST could be run in cased hole or open hole. The cased hole is when the well is cased before the test while the open hole DST is run before the well is cased. The equipment used to carry out this test are mounted on the Bottom Hole Assembly (BHA)

2.14 CORE ANALYSIS

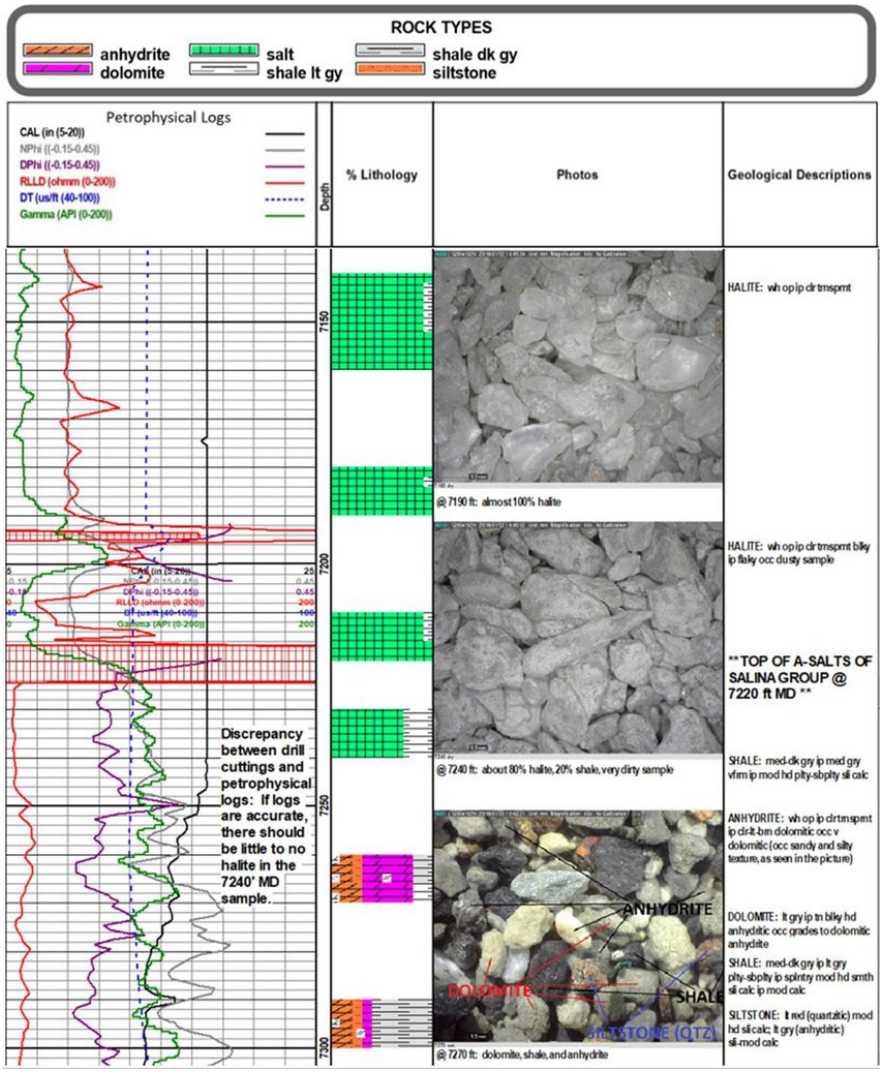
In core analysis, core samples are captured from the sands in the well bore and taken to the core laboratory, fore petrophysical analysis. The two major disadvantages are that the core samples must be preserved at the same while the samples were in the reservoirs before they get to the laboratory. The is to ensure the accuracy of the results.

Secondly, Core analysis is very expensive and takes a lot of time.. Please note that, this is one of the surest ways of carrying out formation evaluation

2.15. Mud Log Analysis

Mud log analysis is routine analysis of the drilling mud during the drilling process. This is also measurement while drilling. Rock samples from the mud are constantly analysed to detect the presence of hydrocarbon that will appear as show during the course of drilling. Also in a hydrocarbon zone, the presence of gas or oil could increase the rate of penetration. If there is gas or oil in the formation while drilling, it could reduce the viscosity

and density of the mud. When the density of the mud is lower than the density of the formation, it could lead to ' kick' or even blowout , if not probably managed managed.



Graphical representation of Mud log analysis

Gases monitored include hydrogen sulhydrogen sulphhydrogen sulphide (H_2S) and carbon IV (CO_2). H_2S is poisonous, very corrosive when dissolved in water, and flammable as a gas. When dissolved in water (of the mud) it lowers the mud pH increasing corrosion tendencies. As a gas it is transported to the surface when air is applied as the drilling fluid. Carbon dioxide is soluble in water and can form carbonic acid in the drilling fluid which reduces the mud pH and makes it more corrosive.

sudden increase in the Rate of Penetration (ROP) might help indicate fracture zones, which are of great interest in the geothermal drilling process.

2.16. Pressure Volume and Temperature (PVT Analysis)

PVT is a temperature analysis of the laboratory analysis of the study to determine results that are accurate so as to proffer quick solutions that will benefit the oil industry. This analysis is used to access the phase behaviour and fluid properties of oil and gas samples from the well bore. This analysis will give a clear perspective of the content of the reservoir for future planning of the well. This analysis can help to reveal some properties of the hydrocarbon behaviours. These fluid properties are further utilised for designing a reservoir simulation model to predict the future performance of the reservoir

The basic logs, which are required for the adequate Formation Evaluation, are:

1. Lithology logs or Permeable zone logs (SP, GR, Caliper) , are run in track 1
2. Resistivity logs (MFSL, Shallow and Deep resistivity logs) are run in track 2
3. Porosity logs (Density, Neutron and Sonic) are run in track 3

Using such a set of logs, a log interpreter has to solve the following problems,

First step: The first step in the log interpretation is to locate the

permeable zones. Scanning the log in track one and it has a base line on the right, which is called the shale base line. This baseline indicates shale i.e., impermeable zones and swings to the left indicate clean zones- e.g., sand, limestone etc. The interpreter focuses his attention immediately on these permeable zones.

Next step: To scan the resistivity logs in track 2 to see which of the zones of interest gives high resistivity readings. High resistivities reflect either hydrocarbons in the pores or low porosity.

Next step: Scan the porosity logs on the track 3 to see which of the zones have good porosity against the high resistivity zones. Discard the tight formations. Select the interesting zones for the formation evaluation.

2.17. Determining Geothermal Gradient

The first step involved in determining temperature at a particular depth is to determine the geothermal gradient (gG) of the region. Temperature increases with depth, and the temperature gradient of a particular region depends upon the geologic, or tectonic, activity within that region. The more activity, the higher the geothermal gradient. Geothermal gradients are commonly expressed in degrees Fahrenheit per 100 m (°F/100m).

If the geothermal gradient of an area is not known, then it can be determined by chart or by formula.

gG = (BHT- Tms /TD) x100

Where:

BHT = bottom hole temperature (from header)

TD = total depth (Depth-Logger from header)

Tms = mean surface temperature

Determining Formation Temperature (Tf)

Once the geothermal gradient (gG) has been established, it is possible to determine the temperature for a particular depth. This is often referred to as *formation temperature* (Tf).

Where:

Tms = mean surface temperature

gG = geothermal gradient
D = depth at which temperature is desired

2.18. Environmental Corrections

In actual logging conditions, porosity (Ø) and the "true" resistivity of the uninvaded zone (Rt) cannot be measured precisely for a variety of reasons. Factors affecting these responses may include hole size, mud weight, bed thickness, depth of invasion, and other properties of the logging environment and formation. Many of these effects have strong impacts on analysis and must be corrected prior to evaluating the Formation.

2.18.2. Density porosity

Formation bulk density (ρb) is the function of matrix density, porosity, and density of the fluid in the pores (salt mud, fresh mud, or hydrocarbons). To determine density porosity, either by chart or by calculation the matrix density and the type of fluid in the borehole must be known. Stated below is the formula for calculating the density porosity is:

$$\Phi = \frac{\rho_{ma} - \rho_b}{\rho_{ma} - \rho_f}$$

Where;

ρ_{ma} = matrix density of formation. [=2.87g/cm3 Dolomite]

[2.65g/cm3 sandstone]

[2.71g/cm3 limestone]

These constants have been given according to schllumerger,1972.

ρ_b = bulk density of the formation.

ρ_f = pore fluid density in the borehole.

Please note that, ρ_{ma} in the Niger Delta is usually 2.65g/cm3. This means that the sedimentary rock is predominantly, that of sandstone.

2.18.3. Cross-Plot Porosity

There are a variety of methods--visual, mathematical, and graphical--used to determine the cross-plot porosity of a formation. Porosity measurements taken from logs are rarely adequate for use in calculating water saturation. There are two methods for the determination of porosity:

1. Cross-Plot Porosity Equation

Consolidated and compacted sandstones: (This is however obsolete)

$$\Phi_{SONIC} = \frac{\Delta t_{log} - \Delta t_{ma}}{\Delta t_{fluid} - \Delta t_{ma}}$$

Unconsolidated sands:

$$\Phi_{SONIC} = \left\{ \frac{\Delta t_{log} - \Delta t_{ma}}{\Delta t_{fluid} - \Delta t_{ma}} \right\} X 1/Cp$$

Where:

Δtlog = travel time from the log.

Δtma = Formation matrix travel time.

Δtf = fluid travel time

Cp = compaction factor.

Determining Formation Water Resistivity (Rw) by the Inverse Archie Method: Determining a value for formation water resistivity (Rw) from logs may not always provide reliable results; however, in many cases logs provide the only means of determining Rw. Two of the most common methods of determining Rw from logs are the *inverse-Archie method* and the *SP method*. Another method of Rw determination is by means of *Hingle plot.*

2.19.3. INVERSE ARCHIE METHOD: Rwa

$$R_{wa} = \frac{\Phi^{m} \times R_{t}}{a}$$

Where:

Rt = resistivity of the uninvaded zone

Φ = porosity

2.19.4. *Sw Calculations:*

Water saturation may now be calculated for those zones that appear to be hydrocarbon bearing.

The water saturation equation for clean Formations is as follows:

Archie's Equation

$$S_w = \sqrt[n]{\frac{a}{\Phi^m} \times \frac{R_w}{R_t}}$$

Where:

Sw = water saturation

n = saturation exponent

a = tortuosity factor.

Φ = porosity of the rock

m = cementation exponent.

Rt = Resistivity of the formation

Rw = Resistivity of Formation water

Among the most difficult variables to determine, but one which has a tremendous impact upon calculated values of water saturation (Sw). Often best obtained from the customer, but can be obtained from logs under ideal conditions. Other sources include measured formation water samples (DST or SFT), produced water samples, or simply local reservoir history.

2.20. Moveable Hydrocarbon Index (MHI)

One way to investigate the moveability of hydrocarbons is to determine water saturation of the flushed zone (Sxo). This is accomplished by substituting into the Archie equation those parameters pertaining to the flushed zone.

$$S_{xo} = \sqrt[n]{\frac{a}{\Phi^{m}} \times \frac{R_{mf}}{R_{xo}}}$$

Where:

Rmf = resistivity of mud filtrate.

Rxo = resistivity of flushed zone.

Permeability estimation (k)

$$K = \frac{0.136\,\Phi^{4.4}}{(S_w)^2_{irr}}$$

Where S_w and Φ are in percentage and k is in mD

2.21. Formation factor estimation (F)

$$F = \frac{0.81}{\Phi^2}$$

Where Φ^2 is the square of the estimated porosity

The Volume of Hydrocarbon (VHC) in place is therefore estimated as:

$$VHC = V_B \sum (1-S_w)\,\Phi$$

Where, V_B is the = bulk volume which is Area x thickness

$1-S_w$ = Hydrocarbon saturation

Φ = porosity

Once flushed zone water saturation (S_{xo}) is calculated, it may be compared with the value for water saturation of the uninvaded zone (S_w) at the same depth to determine whether or not hydrocarbons were moved from the flushed zone during invasion. If the value for S_{xo} is much greater than the value for S_w, then hydrocarbons were likely moved during invasion, and the reservoir will produce.

An easy way of quantifying this relationship is through the *moveable hydrocarbon index (MHI)*.

$$MHI = \frac{S_w}{S_{xo}} = \left(\frac{R_{xo}/R_t}{R_{mf}/R_w} \right)^{0.5}$$

2.22. SHALYS AND INTERPRETATION

The presence of shale (i.e. clay minerals) in a reservoir can cause erroneous results for water saturation and porosity derived from logs. These erroneous results are not limited to sandstones, but also occur in limestones and dolomites.

Whenever shale is present in the Formation, porosity tools like, (sonic and neutron) will record too high porosity. The only exception to this is the density log. It will not record too high a porosity if density of shale is equal to or greater than the reservoir's matrix density. In addition, the presence of shale rmation will cause resistivity logs to record lower resistivity.

2.22.1. Calculation of V_{shale} :

The first step in the shaly sand analysis is the calculation of volume of shale from a gamma ray log. Volume of shale from

gamma ray log is determined by the chart or by the following formulas:

$$I_{GR} = \frac{GR_{log} - GR_{min}}{GR_{max} - GR_{min}}$$

Where:

IGR = gamma ray index

GRlog = actual borehole-corrected GR response in zone of interest

GRmin = minimum borehole-corrected GR response against clean zones

GRmax = maximum borehole-corrected GR response against shale zones

consolidated rocks	$V_{sh} = 0.33(2^{(2\times I_{GR})} - 1.0)$
unconsolidated rocks	$V_{sh} = 0.083(2^{(3.7\times I_{GR})} - 1.0)$

2.23. Determining Effective Porosity (Φe):

The second step of shaly sand analysis is to determine the effective porosity of the formation i.e. determining porosity of the formation if it did not contain clay minerals.

Effective Porosity from Neutron-Density Combinations:

Φn-corrected = Φn - (Vclx Φnsh) For Neutron

Φ d-corrected = Φd - (Vcl x Φdsh) For Density

These values of neutron and density porosity corrected for the presence of clays are then used in the equations below to determine the effective porosity (effective) of the formation of interest.

$$\Phi_{effective} = \frac{\left(\Phi_{n-corrected} + \Phi_{d-corrected}\right)}{2} \quad \text{for oil}$$

$$\Phi_{effective} = \left[\frac{\left(\Phi_{n-corrected}\right)^2 + \left(\Phi_{d-corrected}\right)^2}{2}\right]^{0.5} \quad \text{for gas}$$

2.24. Determining Water Saturation (Sw) :(Indonesian Equation)

There are many different equations by which water saturation (Sw) of a clay-bearing formation may be calculated. However, the most suitable equation is the Indonesian Equation, which is as follow

$$S_w = \sqrt{R_t}\left[\frac{V_{cl}^{(1-(Vcl/2)}}{\sqrt{R_{cl}}} + \frac{\sqrt{\Phi_e}^{m/2}}{\sqrt{a^* R_w}}\right]^{1}$$

Where:

Rt = resistivity of uninvaded zone

Vcl = volume of clay

Φe = effective porosity

Rcl = resistivity of clay

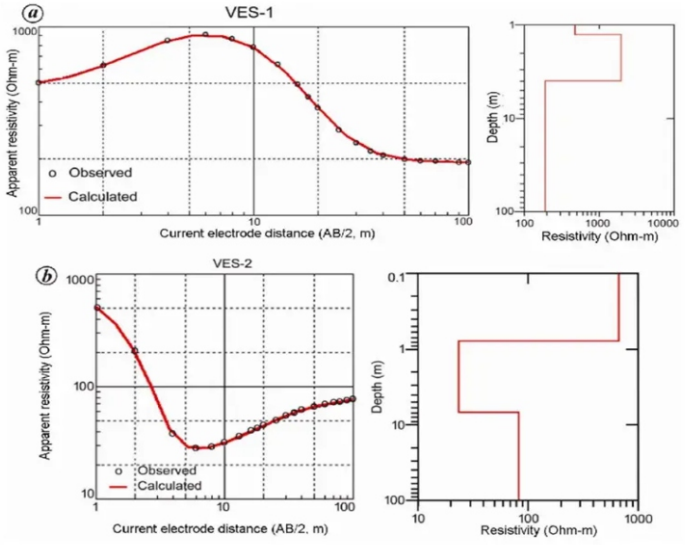
Rw = resistivity of formation water

3.0.Formation evaluation for water Exploration

3.1. The The Electrical Resistivity (ERT) The Electrical Resistivity (ERT) methods are used for locating and mapping groundwater sources, natural groundwater flow paths, groundwater contamination, and archeological remnants. These methods measure voltages associated with electric currents flowing in the ground. These currents may be currents introduced into the earth through electrodes or they may be

natural currents due to earth processes. This type of testing is useful in detecting changes in apparent resistivity or apparent conductivity both laterally and vertically. When the goal is to map an area for lateral changes in resistivity, then the profiling technique is used. When the goal is to create a pseudo-depth section in the earth, then the sounding technique is used. These two techniques are often used in conjunction to fully understand the problem.

Electrical Resistivity Tomography



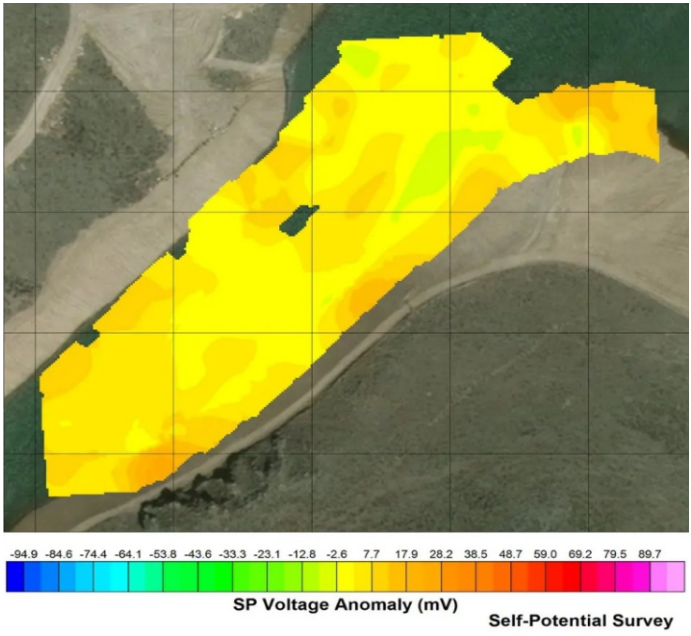


Diagramme showing [Vertical Electrical Sounding (VES)]

3.1.2. Self-Potential (SP)

MY Vice Chancellor sir, if the Government is able to employ the services of the geophysicist to provide water on a large scale to the community, there will be no hazards attached to it. However, if individuals are allowed to sink boreholes due to the failure of the government to provide water on a large scale, there are lots of hazards attached to the numerous boreholes sunk by individuals as stated below:

3.2. Too many boreholes can cause building collapse –

On the 2nd of January, a paper was delivered by a geophysicist.(Okechukwu Nnodim,) in a Surveyors Council of Nigeria (SURCON) conference at Abuja that the drilling of many boreholes in a particular location or on a street is capable of putting structures in that area at the risk of collapse, the Surveyors Council of Nigeria has warned.

According to SURCON, the increasing cases of building collapse across the country may not be mainly as a result of human errors or structural defects on the buildings, but may be due to weak soil on which such structures are erected.

The Registrar, SURCON, Mr. Suleiman Hassan, told journalists in Abuja that findings by the council had shown that the massive drilling of boreholes nowadays posed great risks to buildings constructed around locations where the boreholes were drilled.

He explained that the machines used to drill boreholes operate by sucking the ground water that hold the soil together, adding that when this continued for a prolonged period, the soil would

lose its compactness and might not be able to support heavy structures.

Hassan said, *"I had this problem with my neighbour in Gombe and I worked very hard to convince him that he should not do a borehole. As a result, I had to pipe water from my house to his own house because it is not that safe to have too many boreholes on one street. It is a problem or can create problems because it is risky.*

"This is because you are sucking the underground water, and when you do so for a long time, the soil will not have the strength to continue to support structures erected on it. Once it gets extreme, these structures may have no choice than to give way and will eventually collapse.

This is why we used to have waterworks all over the place in the past cross the country. What the government was doing then was that it would go very far to get water for the populace. For instance, in Zaria, as far back as the 1970s, they started the waterworks; and in Kaduna, they pumped treated water from the River Kaduna. The same thing was done in Gombe, Katsina and Kano by the various waterworks."

Hassan, however, noted that there were exemptions, as some areas might need boreholes, but explained that water from boreholes should be treated once in a while.

He said, "For some of the places where you can't help it,

definitely you can drill a borehole. However, another thing is that 80 per cent of those who dig boreholes in their houses do not take the water for test and this is also not healthy. This is why many people fall sick because if you check it, there is much proximity between their toilets and boreholes.

"Now, since the machine for boreholes suck water from the soil, there is every tendency for it to suck water from whatever source that is close, whether from the toilet water or any other water. So, these are issues that we don't really take into consideration many times."

4.0. Work carried out professor Mrs M.O. Ehigiator

In 2004, My very first publication, on a topic titled: *Net evaluation of crude oil production in the Niger Delta basin of Nigeria.* The paper was co published with Professor O.M. Alile, the results reflected a porosity of well 'A' of 0.34%, with a percentage error calculated to be 5%, which confirmed unconsolidated sands. The water saturation was 40%, oil saturation was 60%, with Formation factor of 0.76%. the 40% waster saturation indicates that the reservoir is water driven. Well 'B' water saturation of 29.2%, oil saturation of 70.8%. from these results, we concluded that the well was an oil prolific well.

In a paper, published in knowledge Review 2006, titled: *Open Hole Formation Evaluation of Log Interpretation of a reservoir*, 0.36% of porosity was observed, 40%, Formation factor of 0.623%, water saturation of 40%, oil saturation of 60% for well 'A'. Well 'B' indicated results of: 36% porosity, formation Factor or 0.76%,water saturation of 29% and oil saturation of 71%. The interpretation of the well drilled indicated a prolific well.

1n 2008, M.O. Alile, M.O. Ehigiator and S.I. Jegede, worked on a research titled: *Underground Water exploration, using Electrical Resistivity method in Edo state.* These VES data were obtained from two sites in Edo state. the interpretation of the data showed that the total depth of the aquifer layer are 241.48m(796.90ft) and 229.13m(756.13ft) respectively. These values correlated with the value of 206.1m (680.00ft) obtained from the geological section of a nearby borehole. The high correlation between the VES results and the borehole values showed that the method is suitable for underground exploration.

In 2010, I presented a paper in Siberia in Russia, on a research

titled: *Modelling of oil water Contact, using the Material balance equation.* this material balance equation is to verify mathematically, the results obtained from the well log analysis. The results obtained showed consistency with minimal error. The error can be caused by estimation of relevant computation data used and care must be taken in the estimation of these relevant data. However, the method of this M.B.E. is economical, faster and therefore affordable by small scale oil and gas industries.

parameters	STOIIP	N_p	R_p	R_{si}	B_{gi}	B_{oi}	GROSS RES.VOL
Reservoir	78.8Mstb	14.1MMstb	429svf/stb	20scf/stb	0.006146scf/stb	1.175bbl/stb	51.54mac-ft
parameters	Porosity	Net/gross(N/G)	S_{wc}(Avg)	B_w	W_e	W_p	Initial pressure
reservoir	0.13	0.97	0.23	1.02	21.53×10^6 stb	4.10MMstb	2540_{psi}
Parameters	Crest of structure	Avg gross sand thickness	Current temperature	O_{owc}	Current pressure	Initial Temperature	Bubble point Pressure
Reservoir	5700ftss	76ft	167˚f	582ft	2280_{psi}	167˚f	2085_{psi}

Table showing values of reservoir parameters using M.B.E.

Still in 2010, in Siberia in Russia, I presented another paper ,titled: ***Characterisation of reservoir, using petrophyical parameters and core data (Using Abura field as a case study).*** In this presentation , I was able to prove to the researchers that the use of core data was very important to ascertain the

correctnes of the interpreted data from the well logs as seen below

Well log interpretation for Hydrocarbon well

Well reservoir	Well interval	Thickness (m)	Porosity (%)	Core Porosity	Permeability (mD)	Water saturation (%)
A	2245 - 2258	13	22	21	80	37
B	2277 - 2412	35	20	21	53	37
C	2578 - 2583	5	23	22	41	57
D	2226 - 2627	5	25	26	34	75
E	2638 - 2641	3	27	26	48	75
F	2679 - 2683	5	22	24	22	71
G	2709 - 2713	4	23	20	45	54
H	2874 - 2880	6	21	21	37	60
I	2939 - 2943	4	23	24	33	52

Table 2- Hydrocarbon reserve for well B

Well reservoir	Well interval (m)	Thickness (m)	Porosity (%)	Core Porosity (%)	Permeability (mD)	Water saturation (%)
A	2510 – 2518	8	23	26	130	32
B	2532 - 2542	10	26	24	238	31
C	2649 - 2658	9	24	22	101	40

From the results , we could see that the sands are homogenous within the pay thickness implying communication within the two wells.

In 2011, A research ***Hydrocarbon investigation using petrophysical parameters and core analysis using Umoro field*** was carried out. Results showed that, though a total of 16860082bbls and 11490872bbls were in the two sands in the well drilled, the total recoverable oil calculated was 1136000bbls. The short fall was as result of many factors like drive mechanisms, inappropriate well completion e.t.c.

2011, O.M. Alile and I carried out a research on ***Water determination of the Aquifer layer by the application of Electrical method of Exploration at Ubiaja in Edo Central was carried out, using the Schlumberger automatic analysis*** This investigation was carried out to proffer solution to the acute water shortage that ravaged the area.

From our findings, it was observed that the total cumulative thicknesses of the aquifer layers were 435.70m and 467.56m were delineated. From the geological explanation of the subsurface material, these values indicate a deeper probing into the aquifer zone. The study gave a guide on the effective aquifer position in the study location in Ubiaja, Edo state Nigeria.

In 2015, I published two papers titled: ***Core Analysis data and well log interpretation; A case study in Ologbo field and Wireline log data: A variable tool for Formation Evaluation in the Niger Delta***. Results of the porosity values indicate the presence of sandstones as reservoir rocks in the area. Please note that there are many types of reservoir rocks available like dolomite, sandstone, e.t.c.

In **2017**, I presented paper in Miami in Florida, U.S.A., On a research titled: ***Geophysical and well correlation analysis of Ogo field, in Niger Delta basin of Nigeria***. The research was carried out with my student, Chigbata Chinenyen. In this research, three wells were correlated using their petrophysical parameters. Result obtained showed that there is interbedding

in the subsurface stratigraphy of Ogo 1, Ogo 2 and Ogo 3. See table below:

Summary of petrophysical parameters obtained from Ogo 1

wells	Top (m)	Btm (m)	Gr.thk (m)	Nt.thk (m)	N / G (%)	P o (%)	rsw_{irr}	sw	sh	Vsh	K(mD)	VOOIP (M^3)
sand1	1557	1574	17	10	0.59	0.24	0.093	0.43	0.57	0.008	1380	58140
sand 2	5145	5164	6	4	0.66	0.19	0.11	0.24	0.76	0.15	243	21660

Summary of petrophysical parameters from Ogo2

wells	Top (m)	Btm (m)	Gr.thk (m)	Nt.thk (m)	N / G (%)	P o (%)	rsw_{irr}	sw	sh	Vsh	K(mD)	VOOIP (M^3)
sand1	1641	1649	8	5	0.63	0.29	0.08	0.89	0.11	0.02	5808	4338
sand 2	1638	1644	6	4	0.66	0.09	0.24	0.14	0.86	0.17	3	7895
Sand 3	1647	1665	18	11	0.61	0.13	0.17	0.58	0.42	0.06	10.4	16708

Summary of petrophysical parameters from Ogo3

wells	Top (m)	Btm (m)	Gr.thk (m)	Nt.thk (m)	N / G (%)	P o (%)	rsw_{irr}	sw	sh	Vsh	K(mD)	VOOIP (M^3)
sand1	1563	1575	12	7	0.58	0.26	0.10	0.33	0.67	0.079	812	39900
sand 2	1642	1653	11	7	0.64	0.17	0.16	0.53	0.47	0.083	1940	9647

From this research, it was recommended that more well correlation should be carried out before embarking on drilling and well completion to save cost.

In **2017**, I carried out a research with professor R. Ehigiator and surveyor O.S. Oladosun on the topic titled: ***Determination of volume and direction of flow of Kainji reservoir using Hydrogeomatics techniques.***

From the results, it was obvious that the volume and direction of flow of the river could be determined.

It was also observed that, the reduction noticed in the reservoir volume could be attributed to sedimentation and slight increase in the area which resulted from the erosion of the bank by the river.

One major recommendation of the research was that, the information on the direction of flow of the reservoir can be of immense help to the downstream inhabitants.

Vice chancellor sir, I hope to carry out researches in this area, especially now that the country is being ravaged by erosion.

In 2018, I carried out a Hydro physical survey of ground water development in Okha community (along Sapele Road), Ikpoba Okha L.G.A. Edo state. The Schlumberger array was used. Results processed indicated that the area was underlain with substantive aquiferous Formation but at a depth not exceeding 93.4m(306.43ft). however, adequate borehole logging of the samples from well bore to enable the proper screening of the aquifer zones which are captured was recommended.

Another publication was also carried out in 2018 on the topic titled: Hydro-Geophysical survey of Ground water development at Erua Nokhua (near Ehor) in Uhunmwode L.G.A of Edo state.

Analysis indicated eight aquifer sub layers. The aquifer unit was found at a depth of 138.6m (454.72ft)

Vice chancellor sir, from the researches carried out on water investigation, it is obvious that the depth of aquifer layers varies from location to location. The Geophysicist is one of the best hands to be employed in water investigation.

In 2018 , I co authored a paper with Oladosu S.O. titled: Asaba metropolis for mapping Erosion ***Deployment of global Navigation satellites system [(GNSS) (Real Time Kinematics)] methodology for rapid 3D collection in parts of prone Areas.***

The paper focused on the importance of using GNSS (RTK) technique in acquiring Asaba metropolis and environs for the purpose of designing a well refined drainage system to combat the menace of Erosion and / or flooding. For this purpose, a Hi-Target V30 50 GPS receivers were deployed to acquire the 3D

spatial data. A maximum of 192.454m and minimum of 20.546m in elevation was recorded respectively from a total of 1,051sample points. ArcGIS 10.2 version was used to generate the tin model of the study area and presentation of the 3D stack maps was done using surfer golden software which showed 3D surface map, stream map, grid vector map, as well as contour map. This study is relevant in providing primary data needed by civil engineering for the design of culvert, drainage channel, storm sewer e.t.c.

Finally, I want to bring to your attention a paper presented in Fort Lauderdale, Florida in USA in a conference where I was the key note speaker. ***The paper was titled: determination of conversion constant between Lagos datum and Niger Delta mean lower low water Datum and their horizontal and vertical accuracy standards, using GNSS observations.***
In this research, with the use of Global Navigation Satellite System (GNSS) technology, it is now possible to determine the position of points in 3D coordinates system. Lagos datum is the most common mean sea lea level used in most parts in Nigeria.. in Niger Delta, for instance Warri and its environs, the most commonly used datum for height determination is the mean lower low water datum (Ehigiator – Irughe, R. and **Ehigiator M. O**. 2010) It then becomes necessary to determine a constant factor for conversion between the two data, when the need arises.as both are often encountered during geomatics Engineering field operations. In this research the constant to be applied I converting between both data was determined. The constant was found to be 17.79m. Th horizontal and vertical accuracy standard was also determined as well as the stack map.

4.1. New researches in progress

vice Chancellor sir, presently, I am working on researches that have to do with land tremors, surface and subsurface deformations, road failures and erosional hazards ravaging the country as well as the globe as a whole. This is being done using some Geophysical, mathematical and computer models. The

Geophysicists have equipment that can be used to determine voids, fractures and other abnormalies in the subsurface and surface of the earth, hence they are very useful during road construction.

My researches are ongoing to determine the effect of sinking too many boreholes in our country today, which is one of the contributing factors of land subsidence that lead to collapse of buildings in Nigeria today.

This is as a result of the numerous disasters that are prevalent in the country and the world at large. I know that collaborations with other professionals, will go a long way to proffering solution or reduce the level of casualties.

Moreover, I am currently carrying out researches on Geothermal energy. This Geothermal energy is about the safest, easiest and the cheapest means of energy generation. Energy generation has become a major problem in the country today. This in turn will help reduce the production of green gasses. Production of green gas is a major contributor to the ozone layer depletion, which is a big problem ravaging the society at large.

5.0. Conclusion

Vice chancellor sir, from cradle of being an Assistant lecturer to this present day, my researches have been geared towards making the physicist, the salt of the earth in the area of preserving lives especially in provision of water in places where there was high level of impossibility for pottable water.

Secondly, in the aspect of environmental protection in preventing erosion from ravaging communities and also working on alternative means of viable energy generation, which is the geothermal means of energy generation. This will reduce the use of other sources that could lead to ozone layer depletion.

I am not an environmentalist I am an earth warrior. It is very sad

that, our modern industrial economy takes a mountain covered with trees, lakes, running streams and transforms it into a mountain of junk, garbage, slime, pits and debris.
Thirdly, evaluating the subsurface for minerals and petroleum for financial empowerment and man's comfort.
In the aspect of subsurface deformation using the gravity and Electromagnetic geophysical prospecting method.
Most importantly, empowering the girl child to be self actualized. Create the awareness in the girl child that Physics as a course is not only for the male gender alone in the society as evidenced from my story and the stories of other female physicists globally.

5.1. Recommendations

It is possible for the citizens of Nigeria to have access to pottable water. Thousands of people have lived without love but no one lives without water. Water is the only drink for the wise man. Water is the most neglected nutrient in your diet but one of the most vital, water is a basic necessity for both the rich and the poor. Therefore, the government should make it compulsory for every citizen of Nigeria to readily have access to it. Provision of water should solely be the responsibility of the government and not the individual.
This on the long run will help to reduce the perforation in the subsurface and also reduce the consistent tremors experienced in some parts of Nigeria.
Drilling of hydrocarbon reservoirs should still be extended to the Akata Formation of the Niger Delta basin of Nigeria. If proper care is taken during the course of drilling, the fear of kick and blow out would be overcome. Good Formation Evaluation can help increase productivity of the hidden treasures in the subsurface and hence more wealth for the nation and better standard of living for all.
Moreover, the use of coring should be widely encouraged to provide enough information for Formation evaluation.
One of the major causes of insecurity in Nigeria, is due to inadequate power supply. One of the major concerns of the

physicist is energy. The physicist understands the concerns of energy more than any other profession in the world. This spurred my interest in Geothermal energy. This is energy from the hot reservoir in the subsurface. Therefore, my recommendation is that physicists should be vitally involved with issues that have to do with energy generation in Nigeria.
The geophysicists are the only scientists that than send signals to the subsurface to detect anomalies in the subface like voids, cavities etc. the rate of road failure is in the increase. During the course of my masters degree, I carried out researches on causes of road failure using some geophysical equipment. I am therefore recommending that the services of the engineering geophysicist, should be employed during the course of road construction in Nigeria.

Mr. vice chancellor sir, distinguished guests, ladies and gentlemen, this is the conclusion of the matter. This mighty ocean evidenced before us today, started like little drops of water. I dared take a bold step to venture into physics years ago, here I am, the girl child that lacked self confidence, timid and shy now soaring higher, rendering consultancy services to individuals, students, companies, contributing to the wellbeing of my country and also delivering lectures both within and outside the country.
May I end this lecture by saying : do not feel lonely, the entire universe is inside of you. Stop acting so small. You are the universe in ecstatic motion. Set your life on fire. Isaiah 12: 4-5 clearly states "And on that day you will say, 'give thanks to the lord, call on his name, make known His deeds among the people, make them remember that his name is exalted'. Praise the Lord in songs for he has done glorious things; let this be known throughout the earth.
Thank you and God bless you.

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5.2 ACKNOWLEDGEMENT

Psalm 103: 1-2 says bless the lord oh my soul and all that is within me bless his holy name. I am indeed thankful to Almighty God for his special grace upon my life.
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My special thanks go to my darling husband, Professor, Surv., Eng, R. Ehigiator-Irughe, Dean, of a Faculty in UNIBEN. The best thing that has ever happened to me is being blessed with such an intelligent, kind and responsible man. A genius of the highest order. God bless you sir, infact, you are one in a million and the strength beneath my wings. Men like you are rare. I will forever be there for you and nothing compares to you in my life.

My wonderful children are not left out. they are very considerate and understanding. I thank God for being privileged to be your mother.
I want to also use this medium to appreciate the President of this noble university of ours, BIU, President FEB Idahosa II. His uncommon humility is unequalled and unparalled. God bless you sir. You are an uncommon gift to humanity. Thank you sir, for creating a friendly and enabling environment for us to work in. I will forever be grateful sir. I say a big thank you to the first lady of Benson Idahosa University, Rev. Mrs Laurie FEB Benson Idahosa II. Thank you for being a good support system to our President. The Lord himself will reward you
I will also like to appreciate the Vice Chancellor of BIU. The man of Professor, Sam Guobadia. He is a true representation of what Vice Chancellors should be. He is a man of few words but always a goal getter. So far, he is the best Vice Chancellor that

has ever served in this institution as evidenced from the high level of progress, he has brought to the institution. He is indeed, a seasoned and smart administrator. I will forever be grateful sir.

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I. Okungbowa, Mr. Ewaen Egharevba, Mr. Lucky Omorogiuwa , Mr. Oyeyemi Olaoluwa, Mr. Uyi, Mr. Esosa Uwadia, Osadolor, Mr. Prince Igbinigie, thank you for being there for me. Please to other Academic and non Academic staff members of BIU, whose names were not captured, please pardon and do remember that my sincere love is contagious.

To other Members of staff of Benson Idahosa university, I thank you all for making my dream come through. I will not fail to acknowledge the following: Mrs E. Aihie, Mr. J. Ogbeide, Dr. Mrs Eguasa, Mr. Kingsley Ekhator, Professor Mrs . N.Omoregie, Prof. Mrs Ruth Uroghide, Prof. Mrs. Theresa Akpoghomen, Mr. Smith Goodluck Irhibhogbe, Mrs H. Akhigbe, Mrs E. Enujeke, Mrs Victory Joel -Arimien, Mrs Faith Ehimuan, Mrs P. Egbagbe, Mrs. F. Igbnigie, the CBSU unit, Bursary unit,

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To my Great BIU students, Remember, I am one of you and I want to tell you that I sincerely love you all.

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PREVIOUS INAUGURAL LECTURES

S/N	NAME OF LECTURER	LECTURE TOPIC	DATE
1.	Professor Johnson Olajide Oyedeji	Bricks with Little Straws: How efficient are the meat and egg-type chickens?	27 July 2010
2.	Professor R. A. Masagbor	Language: A Complementarity of Being	17 April 2012
3.	Professor A. A. Borokini	Female Genital Mutilation: The Nexus between Anthropology, Law and Medicine	19 May 2015
4.	Professor Ernest B. Izevbigie	From Growth Biology to HIV associated Neuropathy to the Discovery of Anti-Cancer Agents: Economic Implications	8 December 2015
5.	Professor Andrew O. Oronsaye	The Anatomy of Nigeria Federalism and the Physiological Imperatives for Sustainable Development	22 March 2016
6.	Professor Rex O. Aruofor	Economic Systems Engineering- Poverty, Unemployment and Underdevelopment: A Quest for Solution and Imperatives for Developing the Nigerian Economy	6 March 2017
7.	Professor Sam Guobadia	It's the Environment	19 October 2017
8.	Professor (Mrs.) Clara Leyibo Igeleke	Microbes The Good and The Bad, and The Fascinating: Man the Effective Manager"	26 November 2019

9.	Professor (Mrs.) Nora Omoregie	Educational Administration and Quality of Products of the school system	2 April, 2021
10.	Professor Duze Chinelo Ogoamaka	Nigeria's Legacy in Education, Nigeria's Education System and Sustainable National Development: Thought for Food	13 July 2022
11.	Professor Theresa Uzoamaka Akpoghome	Taming the Beast: IHL in a Bleeding Environment	26 July 2022
12.	Professor Alexandra Esimaje	Because War is much too serious to be left to the Military, Corpus Linguistic is a thing and it is a very Useful Thing too	18 October 2022
13.	Professor Mark Osamagbe Ighile	The Poet Prophetic Voice in the Wilderness of our Time: an Oral, Literary and Biblical Prognosis	8 November 2022
14.	Professor Augustine E. Akhidime	Financial Gatekeepers, Watchdogs and Bloodhounds in the Eyes of the Storm of Public Trust; and the House that is Divided Against Itself	22 November 2022
15.	Professor Ehimen Pius Ebhomielen	Take Responsibility: Comprehensive accountability culture is mandatory for all and sundry	13 December 2022

16.	Professor Kingsley Osamianmionmwan Obahiagbon	From Medieval to Modernity: Odyssey of an Information Scientist (informatics)	17 January 2023
17.	Professor Frederick Omonkhegbe Joseph Oboh	Exploration and modification for better Utilization: Adding value to plant based resources for nutritional, medicinal, and industrial applications	21 February 2023
18.	Professor Taidi Ekrakene	The paradoxical life of insects: The testimonials of an entomologist.	28 March 2023.
19.	Professor Godwin O. Oboh	The Same Difference between the Media and Politicians has implication for Nigerian Elections.	18th April, 2023
20.	Professor John O. Ohiorenoya	Management Fads: The Human Factor	25th April, 2023