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ESPI–2023

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Москва, 21 апреля 2023 г.

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POPULATION AND COMMUNITY ECOLOGY

ECOLOGY OF SOILS

USING WELL LOG DATA AND SEISMIC DATA FOR THE PREDICTION OF CO2 EVOLUTION IN SOILS, NIGER DELTA AREA, SOUTHERN NIGERIA

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Abstract: The nature of hydrocarbon production activties in Niger Delta have been charactrized by gas flaring which have induced higher concentration of atmospheric CO2 in the study area. knowing the region of hydrocarn accumulation is a precusor to determination of CO2 migration. Therefore this study was carried out to predict the evolution of carbon dioxide in the Niger Delta, Southern, Nigeria using integrated well log and seismic data. Reserviors with hydrocarbon accumulation was delinated using well log and was mapped across the field in the petrel interface to generate reservior surfaces, follwed by faults mapping which are migration pathways for Hydrocarbon migration or seal. The depth surface maps of the mapped horizons(R1–R3) with the R1-reservoir as the deepest (29116ft) and the R3-reservoir as the shallowest (2316ft), this indicated that area of structural highs marked with yellow-red coloration are the prospective zones while the area of structural low with purple-blue coloration as the source area of the hydrocarbon. The Root Mean Sqaure Surface attributes maps revealed that the area of structural high are the are of hydrocarbon dominance which act as the major carrier of carbon dioxide. The reservoir with the highest Root Mean Square bright amplitude were ranked as follows, R1> R2>R3 and it was observed that the hydrocarbon have migrated up dip through the faults zones

Keywords: Fault, Reservoirs, Source, Seal, Migration, maps

1. INTRODUCTION

Niger Delta basin is one of the largest delta systems in the world, situated at the Gulf of Guinea, southern Nigeria (Figure 1A). From the

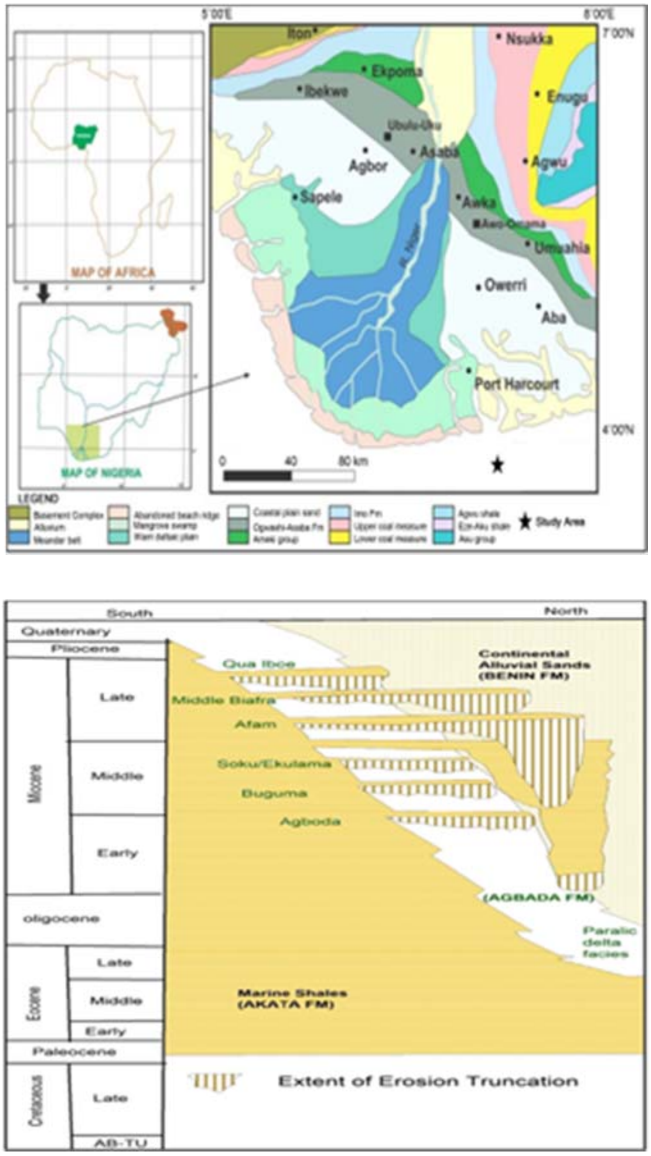

Fig. 1. (*A*) Map of the Niger Delta basin (*B*) shows the Niger Delta's stratigraphic column (After Doust and Omatsola, 1990;Nwajide, 2013)

Paleocene to the present, the basin's sediment progrades southwest over an area of around 75,000 km^2 (Nwajide, 2013). Its stratigraphic fill is made up of three major lithostratigraphic units(Obafemi et al. 2020) that comprise of the uppermost continental delta plain Benin Formation, the underlying Eocene shallow-marine Agbada Formation, (source and reservoir rocks), and the lowermost marine pro-delta Akata Formation (source rock) (Doust and Omatsola 1990; Adojoh et al. 2020) (Figure 1B). The entire delta is covered by these three formations but the identified formations in this study are Benin Formation and Akata Formation.

The basin is the best petroleum belt in Africa and ranks number 12 globally (Tuttle et al., 1999).With hydrocarbon reserves exceeding 34.5 billion STB of oil and 93.8 trillion TCF of recoverable gas, the Niger Delta makes up between 2% and 5% of the world's sedimentary basins today (Reijers, 1996) . The rapid increase in Africa's population from 257 million to 1.2 billion (Sankoh, 2016) in the last few decades, combined with technological advancement, has led to large-scale industrialization and an upscale in anthropogenic activities (such as power generation, transportation emissions, industrial processes), which invariably have an impact on the atmosphere of the continent in terms of its carbon dioxide levels (Herzog, 2001). In the oil-rich Niger Delta region of Nigeria, almost all of the gas produced during oil extraction is released into the atmosphere making Nigeria the second-highest gas-flaring country after Russia (Hansen, 2004).thus, this studies seeks to using well log and seismic data to predicts area of hydrocarbon accumulation which are area of carbon dioxide evolution in soils in Niger Delta, southern Nigeria.

2. METHODOLOGY

The approach used in this project was well log interpretation, in which various rock facies were categorized using gamma ray log signatures, and reservoirs were then mapped across the wells using gamma ray log and resistivity log. Due to the fact that the well only provides point information, it was connected to the seismic data by the checkshot data in order to obtain regional information about the study area and to build a strong association between the well log data's depth and the seismic data's timing. The next step was seismic interpretation, during which several geological structures were documented, including faults that act as channels for hydrocarbon migration and as seals to the discovered reservoirs. In order to find areas of bright amplitudes within the study area, surface Root Mean Square Amplitude characteristics analysis was conducted to the surfaces of the horizon surfaces for the mapped reservoirs, which were used to anticipate the evolution of the carbon dioxide evolution in the study area. To determine the mapped reservoir depths and the extent of the hydrocarbon migration throughout the reservoirs, the time depth map of the created reservoirs was transformed to depth maps using the Look-Up function.

3. RESULTS

3.1. Well log interpretation. Gamma ray log analysis was used to understand the lithology. The gamma ray log has counts calibrated in American Petroleum Institute, calculated on a horizontal scale from 0 to 150. (API). The Gamma ray log motifs were used to describe the study area's lithogic structure. The lithologies of sand and shale were distinguished as two separate groups. Whereas shale lithologies were linked to higher Gamma ray readings, sand lithologies were linked to lower Gamma ray presence of hydrocarbon while the shale bodies act as seal or source rock of the study area (Figure 2). With the help of resistivity log, density, and Neutron log, the hydrocarbon zones were identified as seen in ballon shape density — neutron log crossover. The cross-section shows the correlated wells (Well-1, Well-2, Well -5, and Well-6) in northwest — southeast direction

3.2. Well to seismic tie. With a very high degree of confidence, the synthetic seismogram produced from the research area's acoustic and density log tied the seismic data almost exactly (Figure 3). The reservoir tops were indicated by troughs with negative amplitudes (red colour).

3.4. Seismic Interpretation. The seismic portion that was used for this study was distinguished by low to high amplitudes, parallel to subparallel, and chaotic reflection patterns. There are also fault-terminating continuous and discontinuous reflectors in it, for example, inline 6200 (Figure 4A). The complete seismic volume's inline and cross lines were used to map these faults (seals and migration paths) and horizons (Formation top and reservoir tops)

3.6. Reservoir Depth Surface Maps. Three reservoirs R1, R2, and R3 were identified at depth at the depth of 3404ft, 3214ft, 29116ft respectively. The yellow to red coloration in the map shows area of higher

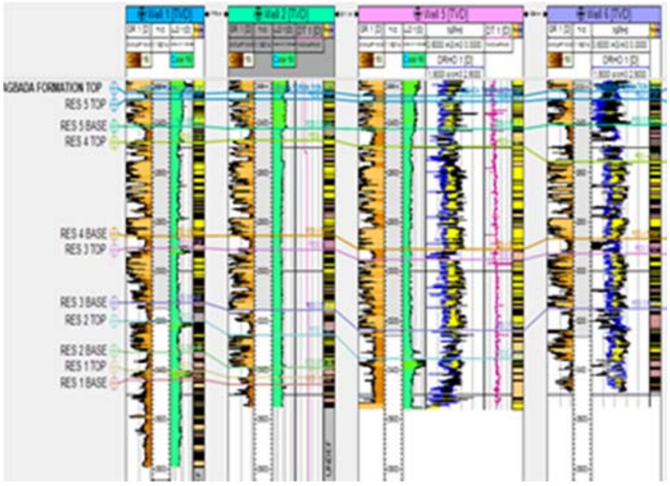

Fig. 2. Well log interpretation

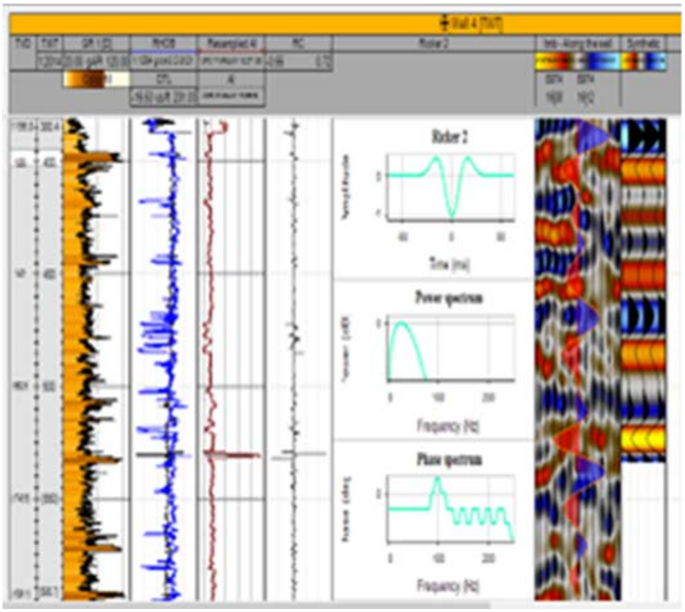

Fig. 3. Well to seismic tie using well 4

elevation while blue to purble coloration shows lower elavation. However, hydrocarbon migrates from the area of lower elevation to area of higer elevation. The thick black lines on the map shows faults which acts as migration pathways to hydrocarbon. The lower blue-purple coloration is the source to which the hydrocarbon is generated while the yellow-red coloration is the prospectives zones of hydrocarbon

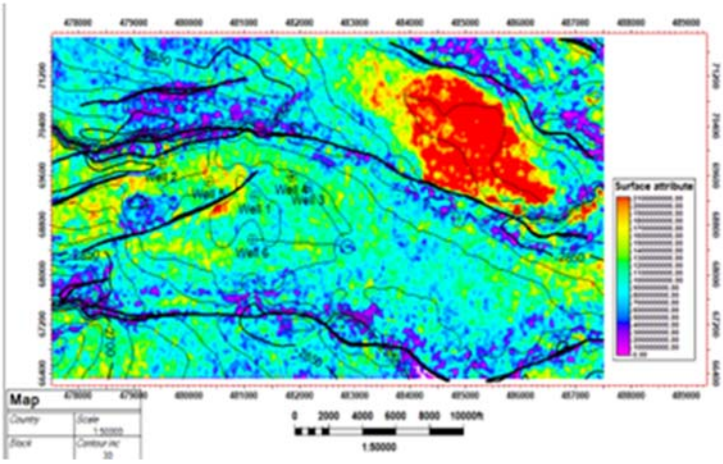

Fig. 4A. 3D Structural Interpretation at inline 6200

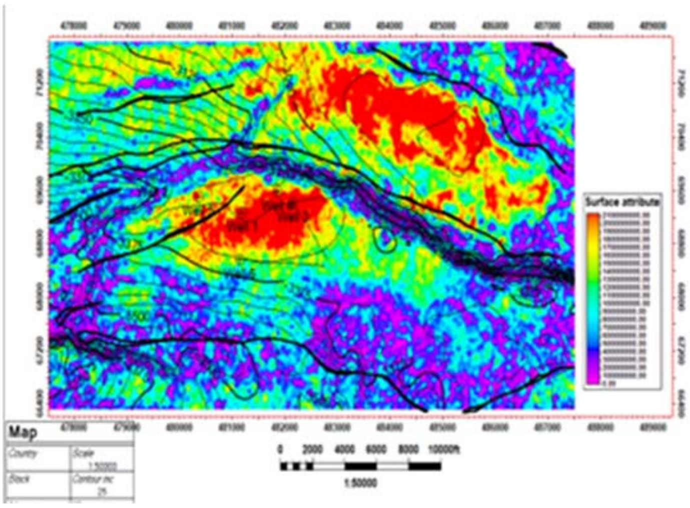

Fig. 4B. R1 RMS Amplitud

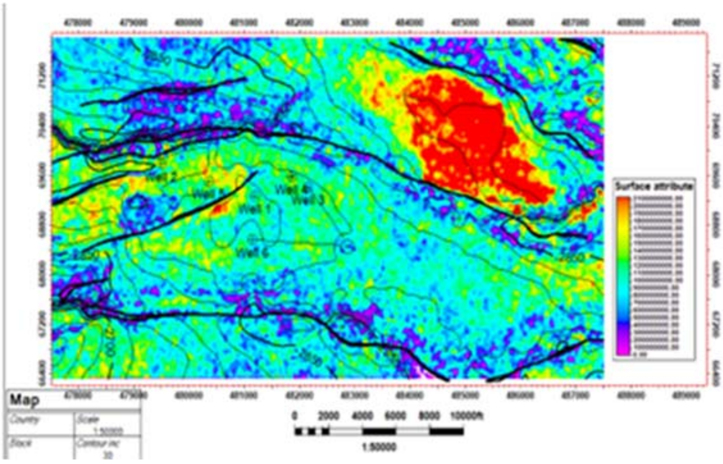

Fig. 4C. R2 RMS Amplitud

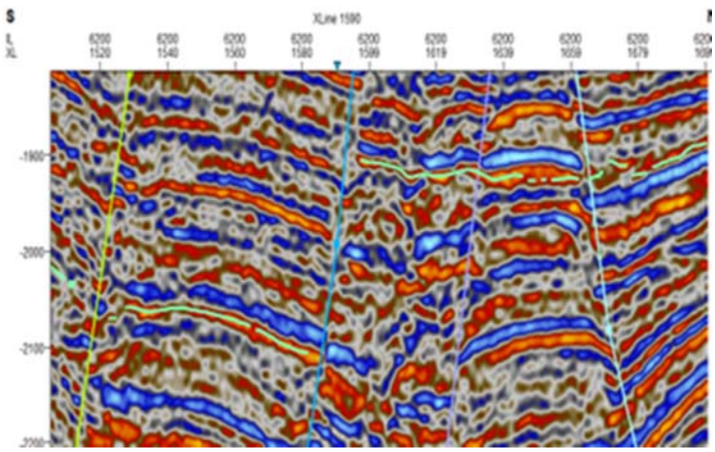

Fig. 4D. R3 RMS Amplitud

3.7. Root Mean Square (RMS) Surface Attribute Maps. Root Mean Square (RMS) Surface Attribute analysis was run on the five reservoirs (R1, R2, and R3) so as to know the area of hydrocarbon dominance. The area with bright amplitude (yellow to red colour zones) are the zone with high hydrocarbon shows. The result confirmed reservoir R1 as the reservoir with the highest volume of hydrocarbon followed by R2, and R3. Therefore, R1 has the largest area of carbon dioxide evolution in the study area while R3 is the least(Figure 4B–4D) respectively. The yellow to red coloration in the map shows area of higher elevation while blue to purble coloration shows lower elavation. However, hydrocarbon migrates from the area of lower elevation to area of higer elevation. The thick black lines on the map shows faults which acts as migration pathways to hydrocarbon. The lower blue-purple coloration is the source to which the hydrocarbon is generated while the yellow-red coloration is the prospectives zones of hydrocarbon

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CONCLUSIONS

The study revealed that most of the hydrocarbon flared in the Niger Delta Area are found within the underground fault assisted reservoirs and traps which when exploited, the gaseous part of it including carbon dioxide would be flared, thereby constituting environmental problems. The soil of Niger Delta includes shales and the sands are the source rocks and the reservoir rocks respectively. The depth surfaces map generated indicated area of high and low elevation while the Root Mean Square Attribute maps indicated the presence of hydrocarbon within the study area which act as the major carrier of carbon dioxide.

REFERENCE

1. *Nwajide C.S.* (2013) Geology of Nigeria's Sedimentary Basins. CSS Bookshops Limited, Lagos.
2. *Tuttle M.L., Charpentier R.R., Brownfield M.E.* (1999) The Niger Delta Petroleum System: Niger Delta Province, Nigeria, Cameroon, and Equatorial Guinea, Africa. US Department of the Interior, US Geological Survey. https://doi.org/10.3133/ofr9950H
3. *Reijers T.J.A.* (1996) Selected Chapters on Geology: Sedimentary Geology and Sequence Stratigraphy in Nigeria, Three Case Studies and a Field Guide.

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