

FORAMINIFERAL AND TEXTURAL CHARACTERISTICS OF WELL X, EASTERN NIGER DELTA: IMPLICATIONS FOR PALEOENVIRONMENTAL RECONSTRUCTION

¹Adenike Adeyokun, ^{*2}Olutayo Ayeniyo, ³Saka Opeloye, ³Temitayo Ale

¹Department of Applied Geology, Federal University of Technology, Akure, Ondo State, Nigeria.

²School of Earth, Environment, and Sustainability, University of Iowa, Iowa City, USA.

³Department of Earth Sciences, Adekunle Ajasin University, Akungba-Akoko, Nigeria.

*Corresponding Auhtor’s Email: olutayo-ayeniyo@uiowa.edu

ABSTRACT

Foraminiferal and textural analyses were conducted on sediments from 1320–4230 m in Well X, offshore eastern Niger Delta, to refine paleoenvironmental interpretation within a stratigraphic framework. The assemblages range from barren to moderately rich, with the identification of the NNDf 05 benthic foraminiferal zone supporting a Miocene age. The dominance of environmentally diagnostic benthic forms indicates deposition under reduced oxygen, relatively quiet marine conditions. Textural observations of interbedded shale, silty shale, and sandstone, combined with foraminiferal assemblages, indicate a middle to outer neritic setting. Vertical variations in lithofacies and faunal composition reveal a gradual upward shift toward more proximal, higher-energy shelf conditions. This approach shows how combining foraminiferal and sediment data improves depositional and stratigraphic interpretation in the Niger Delta.

Keywords: Foraminifera, Biostratigraphy, Eastern Niger Delta, Miocene, Paleoenvironment

INTRODUCTION

The Niger Delta Basin in southern Nigeria is one of the most important hydrocarbon provinces in Africa, consisting of thick clastic sediments deposited in deltaic to shallow marine environments Short & Stauble, 1967; Doust & Omatsola, 1990). Its stratigraphy, including the Akata, Agbada, and Benin Formations (Figure 1), reflects long-term interactions between sediment supply and tectonic processes (Evamy et al., 1978). Because of its economic importance, understanding how depositional environments vary within the basin remains a key focus of research. Although many studies have described the stratigraphy and petroleum systems of the Niger Delta (Short and Stauble, 1967; Doust and Omatsola, 1990; Evamy et al., 1978), several works have focused primarily on lithostratigraphic or biostratigraphic approaches in isolation (Reijers, 2011; Peters, 1982), which can limit the resolution of paleoenvironmental interpretations at the well scale. This

creates a need for integrated approaches that better capture both biological and physical signals of deposition. Foraminifera are widely used in paleoenvironmental studies because their distribution is strongly controlled by environmental factors such as water depth, oxygen levels, and substrate conditions (Murray 2006; Phleger, 1960). However, when used alone, they may not fully reflect changes in depositional energy or sediment supply. Textural data, such as grain size and sorting, provide complementary information on sediment transport and depositional conditions (Folk, 1974). Combining both datasets allows for a more complete interpretation of depositional environments, especially in complex deltaic systems like the Niger Delta. This study focuses on Well X, located offshore in the eastern Niger Delta within OML 70 and OML 99. The aim is to interpret the depositional environment of sediments between 1320 and 4230 m using an integrated analysis of foraminiferal assemblages and sediment texture.

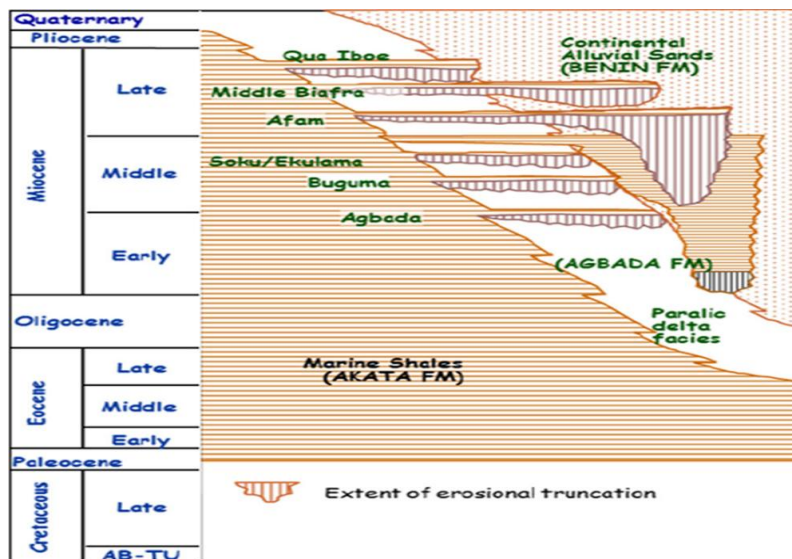


Figure 1: Regional Stratigraphy of the Niger Delta showing Different Formations (after Ozumba, 2013)

MATERIALS AND METHODS

Ditch cutting samples from Well X were used for this study. The well is located approximately 30 km offshore in the eastern Niger Delta within OML 70 and OML 99. A total of 15 samples were analyzed over a depth interval of 1320–4230 m. Sampling was carried out at selected depth intervals to capture lithological and faunal changes within the well section. Initial lithological description was carried out using visual inspection and a hand lens. Observations included rock type, color, grain size, sorting, and the presence of sedimentary structures or organic matter.

Foraminiferal extraction followed standard procedures (Brasier, 1980; Armstrong & Brasier, 2005). Approximately 20 g of each sample was treated with sodium carbonate and soaked in water to aid disaggregation. Samples were washed through a 53 µm sieve, dried, and separated into size fractions. Foraminifera were picked under a binocular microscope and identified using standard taxonomic references (Loeblich and Tappan, 1964, 1988; Cushman, 1933, 1939; Petters, 1983). For each sample, recovered specimens were counted and grouped into benthic and planktic forms to estimate relative abundance. Assemblage composition and species distribution were used to support paleoenvironmental interpretation. Given that ditch cutting samples may be affected by caving and mixing of materials from different depths, interpretations were based on consistent downhole trends rather than isolated occurrences.

Textural analysis was carried out on separate portions of the samples. Samples were dried, sieved using standard mesh

sizes (2 mm, 500 µm, 125 µm, 63 µm), and each fraction was weighed to estimate grain-size distribution. Grain characteristics such as sorting and roundness were examined under a microscope and described using standard sedimentological classification schemes (Folk, 1974). Depositional environments were interpreted by integrating foraminiferal assemblages with textural characteristics. Foraminiferal data provided information on water depth and oxygen conditions, while grain-size data helped infer depositional energy and sediment transport processes. Interpretations were guided by uniformitarian principles (Ellison, 1951) and established relationships between foraminiferal morphology and environment (Bandy, 1964).

RESULTS AND DISCUSSION

Overall Lithologic and Faunal Trends

The studied interval (1320–4230 m) is dominated by shale (>70%), with subordinate silty shale (15–20%) and minor sandstone units (10–15%) (Figure 2). Foraminiferal assemblages are largely composed of agglutinated forms (65–75%), with calcareous benthic species making up 25–30% and planktic forms occurring in very low proportions (<5%) (Figure 3). This overall pattern indicates deposition under predominantly low-energy marine conditions, with limited open-marine influence (Murray, 2006; Reijers, 2011). The strong dominance of agglutinated taxa, together with fine-grained lithology, suggests generally dysoxic bottom conditions throughout much of the section (Jorissen et al., 2007; Murray, 2006).

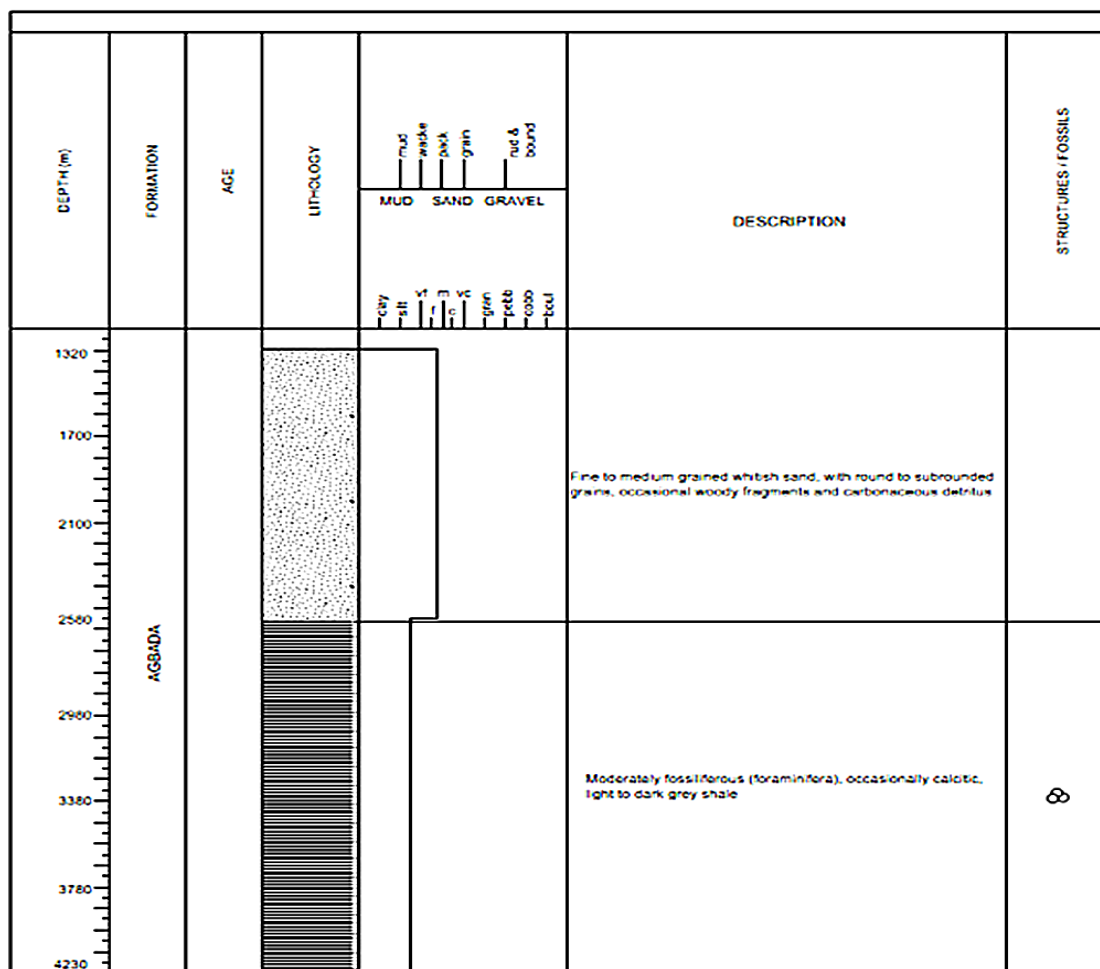


Figure 2: Lithologic Profile of Well X

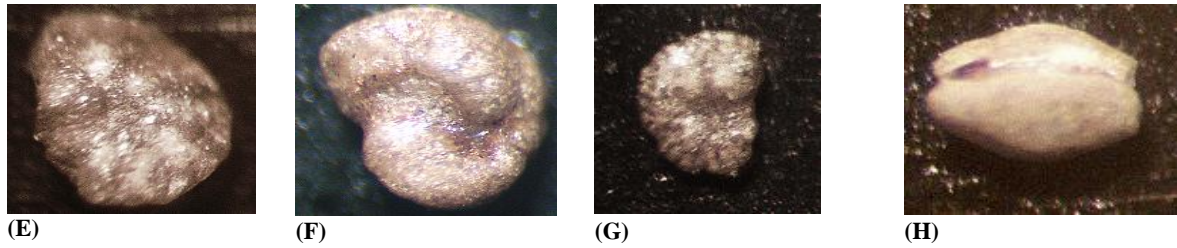


Figure 4: Photographs of Recovered Agglutinated Foraminifera (A–F)

Explanation of Figure 4

- (A) *Valvulina flexilis*
- (B) *Cyclammina cancellata*
- (C) *Cyclammina cf. minima*
- (D) *Alveolophragmium crassum*
- (E) *Haplophragmoides compressa*
- (F) *Cribostronites* spp.

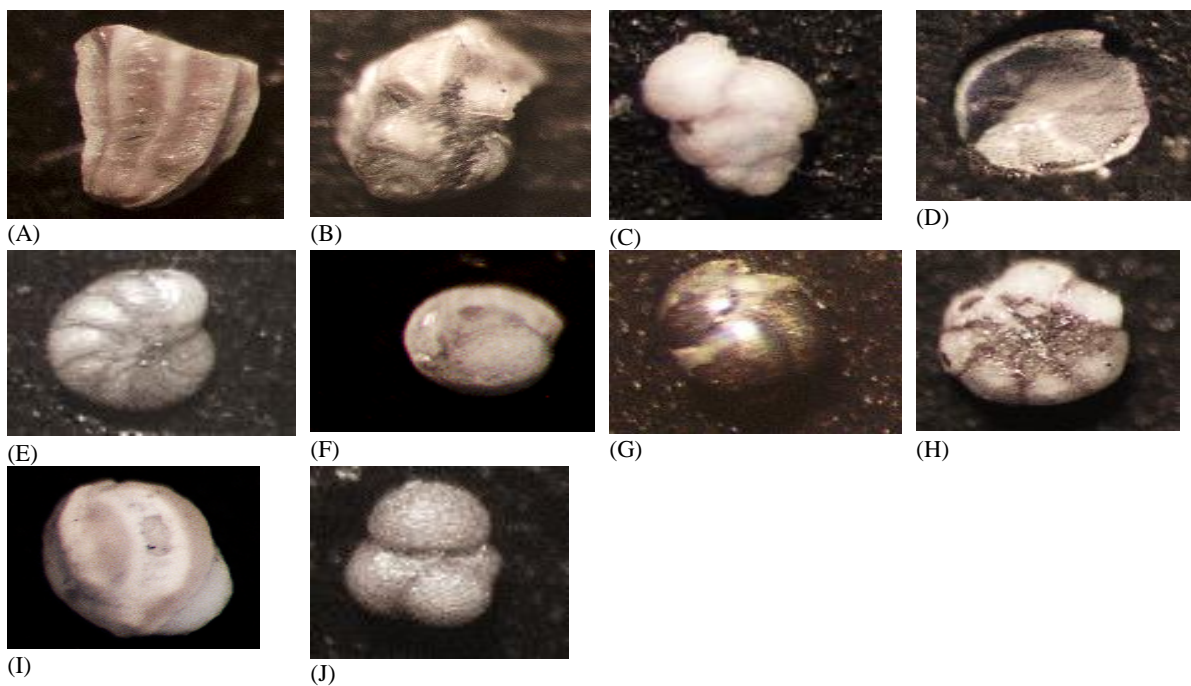


Figure 5: Photographs of Calcareous and Planktic* Foraminifera (A–J)

Explanation of Figure 5

- (A) *Marginulina raphanus*
- (B) *Trifarina angulosa*
- (C) *Uvigerina peregrina*
- (D) *Heterolepa pseudoungeriana*
- (E) *Anomalinoidea alazaensis*
- (F) *Pullenia bulloides*
- (G) *Globobulimina ovata*
- (H) *Ammonia beccarii*
- (I) *Quinqueloculina lamarckiana*
- (J) *Globigerina praebulloides**

shows that combining micropaleontological and sedimentological data improves the resolution of depositional trends and provides a more reliable basis for stratigraphic interpretation and reservoir evaluation in the Niger Delta.

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