

Biostratigraphy Studies Of Tuma-1 Well Chad Basin, Nigeria

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Abstract: These The upper cretaceous sediments of the Chad, basins have been studied from ditch cuttings and core samples from Tuma- well. The sedimentary sequences penetrated and sampled in Tuma-1 well include the Pliocene – pleistocene lacustrine sediments comprising mostly clays, sandy and silty clays, and sand belonging to the Chad formation and the highly distinctive upper cretaceous dark-gray, silty carbonaceous shale unit which underlies it. The foraminiferal assemblages of the upper cretaceous dark gray shale unit underlying the Chad Formation is dominated by arenaceous benthonic foraminifera comprising mostly Haplophragmoides species such as *H. sahariensis* *H. Hausa*, *H. Rugosa*, *H. baucnensis*, *H. benuensis* and *H. pindigensis* and *Ammobacultes* species which include *Ammobaculties Numanhinsis*, *A. benuensis*, *A. irregularity formis* and *A. numanninsis*. *A. benuensis*, *A. irregulariformis* and *A. bauchensis*.s few specimens of calcareous benthonic spesces such as *lenticulina* sp and *Reophax* sp are also associated with the assemblages. The calcareous benthonics constitute less than 1% of the entire assemblages recovered while the arenaceous assemblages makeup over 99% the sequences above the upper cretaceous unit yielded very few specimens. The generic composition of the assemblages characterized by a low diversity, coupled with the presence of carbonaceous and micaceous material suggests a probable marshy estuarine lacustrine environment of deposition for the upper cretaceous shale unit. The phosphatic and gypsiferous nature of the samples and their associated foraminiferal assemblages are indicative of a shallow marshy hypersaline marine depositional environment fo the st study section.

Index Terms: Biostrigraphy, Tuma-1 Well, Chad Basin, Nigeria, Foraminifera.

1 INTRODUCTION

Tuma -1 well is among the series of petroleum exploration wells currently being drilled by N.N.P.C in the Chad basin. The Tuma. 1 well was drilled to a depth greater than 1280m but the interval sampled and analysed in this study covers an interval of 55-1280m. a total of 17% ditch cuttings were sampled and analysed.

1.1 Location of the study Area

Tuma-1 well is located South east of Maiduguri in Tuma near Gajigana. It lies between latitude 12^oN and 11^oS and longitude 14^oE and 13^oW of Maiduguri.

1.2 Geology of the Chad basin

Several workers have come up with different stratigraphic schemes for the Chad basin, with the earlier workers basing their stratigraphic interpretations on extrapolation from adjoining basins, others on seismic sections and the more recent once on the combination of seismic and well cuttings, which gave a more accurate lithostratigraphic description.

(a) Bima formation This unit forms the basal sequence of sediments in the Chad Basin. It is of late Albian to early Turonian age, with thickness of between 100m to over 3000m of poorly sorted and thickly bedded feldsparitic sandstone, unconformably overlying the Precambrian crystalline basement (Barber, 1965). Outcrops of the formation have been found in both Chad and Benue Basins. However, the thickness of the formation is reduced along the Zambuk ridge separating both basins.

(c) Gongila formation This formation is a transition between the continental Bima Sandstone that underlies it and the marine Fika Shale, which overlies it (Matheis, 1976). It is of Turonian age and shows a maximum thickness of 500m (Matheis, 1976). The formation is mainly composed of intercalation of sand, shale and limestone. The base of the sequence is defined by the first appearance of marine limestone above the Bima Sandstone (Carter et al., 1963). The basal limestone is about 3m thick and consists of non-fossiliferous and shelly variety as well as Ammonites of Lower

Turonian age (Reyment; 1956, 1965, Carter, 1963).

(d) Fika shale Overlying the Gongila Formation is the marine Fika Shale. The Fika Shale is late Turonian to Senonian in age and it is composed of blue-black shale, occasionally gypsiferous with thin limestone intercalations (Carter et al., 1963). The unit outcrops in a narrow belt-trending north from Tilde and Tongo villages in the south until it disappears beneath the Chad Formation to the north east of Fika (Carter et al., 1963).

(e) Gombe Formation This unit forms an almost continuous and generally north trending belt some 250km long and 20km wide. It is a sequence of estuarine and deltaic sedimentation consisting of sandstones, shale, siltstone and ironstone (Carter et al., 1963). The sequence is best developed in the southwestern portion of the basin where it attains a thickness of about 350m (Matheis, 1976).

(f) Kerri-kerri Formation The Kerri-Kerri Formation is composed of continental sequence, which dips northeast beneath the Chad Formation and lies unconformably on the folded Cretaceous sedimentations. They contain alternating layers of clayey grit, grit and sandstone with well developed cross-bedding indicating lacustrine and deltaic environments respectively (Carter et al., 1963). The sequence is often capped by thin laterite, which may either be oolitic or vesicular in texture (Matheis, 1976). The Kerri-Kerri Formation is similar to Bima Sandstone in terms of depositional conditions, but Bima Sandstone differs from the Kerri-Kerri Formation by the feldspathic nature of the sediment (Matheis, 1976).

(g) Chad Formation this formation is a variable sequence that includes all quaternary sediments of lacustrine origin underlying the surface deposit over a vast area in the chad basin (matheis, 1976). the chad formation unconformably overlies the fika shale in some parts of the basin due to non-wide spread occurrence of both the gombe sandstone and kerri-kerri formation which are mainly restricted to the southwest part of the basin (matheis, 1976). towards the center of the basin, lacustrine clays are predominant in the

sequence, but near the margins, fluviatile sands, grits and gravels become more predominant. The Chad basin resulted from plate divergence along the west Africa continental margin (Petters, 1979d, 1981c). The basin is believed to be the vestige of the fragmentation and dispersal of Gondwanaland, like other Mesozoic - Cenozoic sedimentary basins of central West Africa.

1.3 Aim of the study

The object of this study is to describe the foraminiferal assemblages recovered from Tuma-1 well (Chad basin) with the aim of studying Biostratigraphy, paleoenvironments, and Paleogeology of the Area.

2.0 METHODOLOGY

2.1 Lithostratigraphic Description.

The lithologic description of the relevant sequence in this well is based on physical inspection of the ditch cuttings from top to base and it is compared favourably with the stratigraphic units outlined by Barber (1965) and modified by Matheis (1976) in their work on the Chad Basin. The lithologic sequence of the studied interval covered a depth range of 2520m – 3250m, having a total thickness of 730m.

2.2 Biostratigraphic Analysis

Samples for each depth were pulverized and 10g weighed into an enamel container. The samples were mixed with water and treated with 2g Sodium bicarbonate (Na_2CO_3) and brought to boil at about 200°C for some minutes. Samples were turned into plastic containers and allowed to cool. Cooled samples were washed using a set of sieves. Set of sieves 90, 75 & 53µm respectively in a jet of water. Residues from each sieve were collected and dried. The dried samples were examined using Zeiss paleontological microscope at varying magnifications and the fossils were picked and morphological examinations were then carried out on species with aid of nomenclature. Species were also counted and recorded.

3.0 PRESENTATION OF RESULT

3.1 Lithostratigraphic Units:

The stratigraphic units outlined by Barber (1965) and modified by Kogbe (1976) will be adopted in the discussion of the biostratigraphy of Tuma-1 Well. The lithologic sequences penetrated by Tuma-1 well at the interval sampled (55-1280m) shown in The basal unit of the section comprising carbonaceous silty shale extends from a depth of 1085m to 1280m, covering a thickness of 195m within the interval sampled, it contains micaceous and pyritized materials. This unit is homogenous and grades upwards into alternating sequences of silty clays, silty sands, sandy silt, and clays silt. The clays silt occupies a depth interval of 560 – 100m, have a thickness range of 5 – 70m. Some units are ferruginized, such as the unit occupying the interval 785- 835m. Clasts of granite material were recovered from sample at depths of 560 and 23 indicating the presence of igneous intrusives. The interval 560 – 55m is occupied by a similar sequence which are more arenaceous, containing pebbles, grading and minor traces of calcareous material especially the depth of 715m. The silty carbonaceous shale unit may be an equivalent of the marine estuarine and pure marine state belonging to the Gongila and Fika formation respectively and may include the carbonaceous silt, clay unit. These sequences may thus represent the

Turonian - Senonian interval (upper Cretaceous). Evidences from the columnar section of various boreholes in the basin Barber (1965), Kogbe (1975) suggests that the paleocene and Maastrichtian unit belonging to the Kerikeri formation, and Gombe salt are not present in the subsurface, in many areas, at the southern fringes of the basin where they also occur. In these sections therefore, the facies of the Chad formation dated Pliocene (Barner 1965) varies from the upper Cretaceous.

3.2 Biostratigraphy Analysis

Based on the foraminiferal biofacies composition of the basal carbonaceous silty shale unit of Tuma-1 well comprising *Haplophragmoides saharicensis*, *H. benuensis*, *H. bauchensis* and *Ammobaculites* sp. *A. Numanhensis*, *A. Tindigensis*, *A. benuensis*, and *A. bacuchensis*, other upper Cretaceous species described in this study (See plate 1 for the pictures of the forms of foraminifera). This can be assigned to the Turonian – Senonian interval.

4.0 DISCUSSION OF RESULT

As was observed from the study and discussion of the biostratigraphy of Tuma-1 well, the foraminiferal assemblages recovered from the basal silty carbonaceous shale samples comprises mostly arenaceous benthonic species such as *Ammobaculites* and *Haplophragmoides* species and few calcareous benthonics such as *Rheophax*, and *Lenticulina* species, which are poorly represented. Also, the species making up the assemblages are small, poorly preserved, and of low diversity, though some species show some degree of dominance over others within some assemblages. Using the morphogroup method of paleoenvironmental analysis, in accordance with the model outlined by Chamney (1976), those assemblages can be assigned to the stable morphogroup category because of the predominance of *Haplophragmoides*, and *Ammobaculites* species which are suggested to be adapted to stress, and marginal marine environments, such as lagoons, estuaries, and epeiric seas. The strong paleobathymetric dependence emphasized by Szczchura and Pozaryska (1974), for small benthic foraminiferal species places limits on their paleoecological distribution. The arenaceous benthonic assemblages of Tuma No 1. Well in this regard belongs to the shallow marine environment, that is, from the inner neritic to the littoral zone as suggested by their composition. These assemblages are therefore of low diversity also. The co-occurrence of the arenaceous benthonic species with calcareous benthonic species such as *Elphidiella Africana* is indicative of shallow marine environment (Peters 1979), such as lagoons, marshes, and estuaries for the assemblages. The gypsiferous and diphosphatic nature of the samples further suggests a shallow marine depositional environment.

5.0 CONCLUSION

The carbonaceous silty shale unit of Tuma-1. Well which contains and almost exclusively preserve of arenaceous benthonic assemblages of foraminifera, similar to the assemblages described from the upper Cretaceous sequences of the north eastern Benue trough, has been assigned to this unit. It has also been suggested that the carbonaceous silty shale unit may belong to the same depositional regime as the upper Cretaceous unit in the north eastern Benue trough. Sporadic occurrence of planktonic species were reported by Peters (1979), from the upper section of the Jessu formation

and non at all from other upper cretaceous sequences. The carbonaceous silty shale unit of Tuma No 1 well also yielded no Planktonics in these sequences constitutes one of the major problems in their stratigraphic correlation and establishing the possibility of faunal exchange between the two basins in upper cretaceous times. However, the presence of planktonic species is still not ruled out taking into account the fact that enough investigation has not been performed the sediments, the cosmopolitan character of the arenaceous benthonics already found, the possibility of diagenetic dissolution of the calcareous species to which most planktonics belong and laterization. These factors enumerated, may account for the barren zone above the carbonaceous silty shale unit of Tuma-1 well. Based on the biostratigraphic data obtained from Tuma-1 well, further supported by geochemical parameters which include the presence of carbonaceous matter pyritic and micaceous materials, a marshy lacustrine estuarine paleoenvironment of deposition is suggested for the sequences traversed in Tuma No 1 well. The gypsiferous and diphosphatic nature of the sequences together with their associated foraminiferal assemblages, suggests a shallow marshy hypersaline marine depositional environment.

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Plate 1

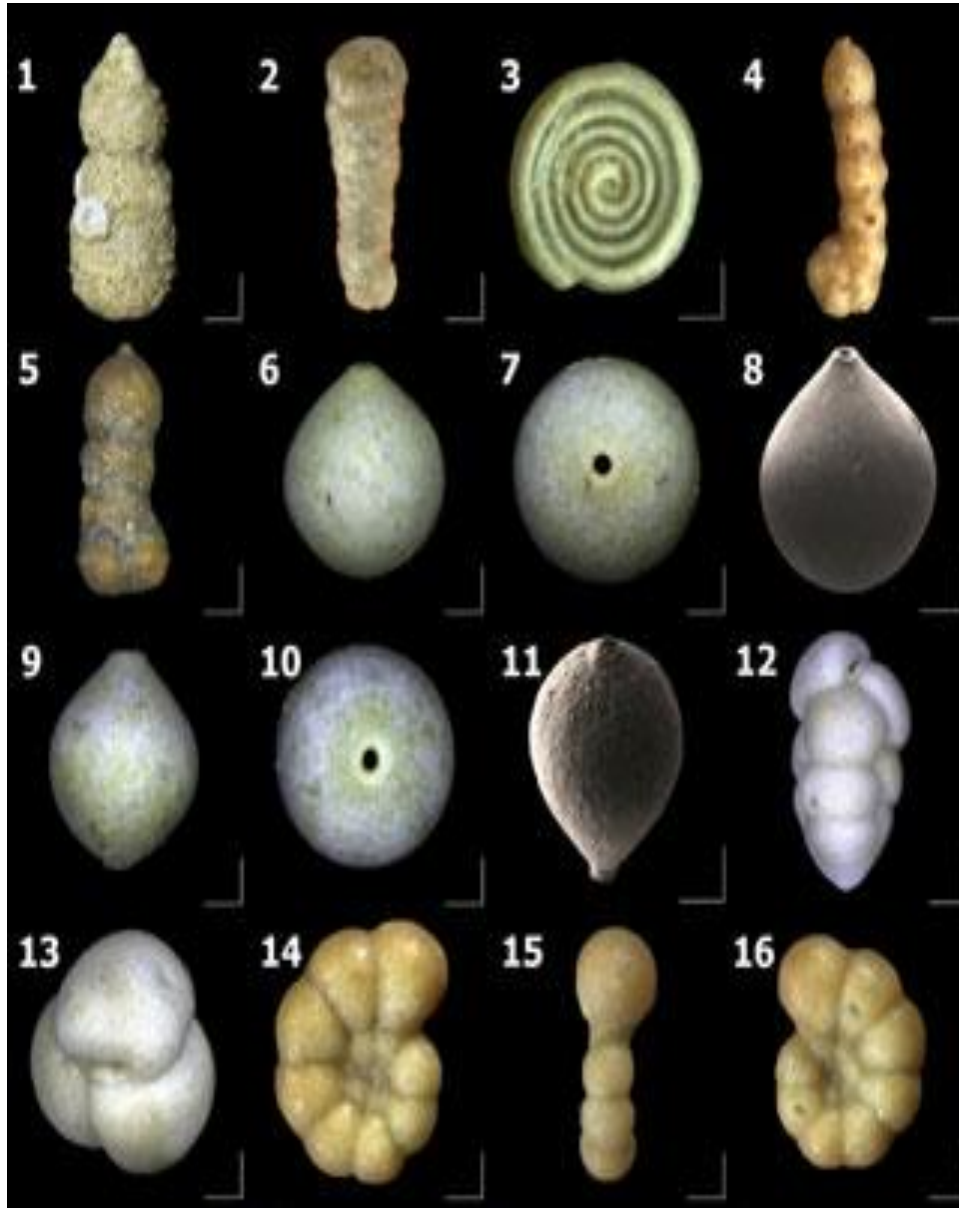


Plate 1: showing forms of foraminifera encountered in the Study