

EVOLUTION OF THE DISSOLVED OXYGEN CONTENT OF WATER DURING THE CONIACIAN-SANTONIAN INTERVAL FROM THE KM WELL OF CÔTE D'IVOIRE

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Abstract— The study of foraminifera recovered from 38 cuttings samples from KM well (Côte d'Ivoire sedimentary basin) allowed to describe the paleoenvironment of the interval 2074 m to 1687 m. the samples yielded 258 foraminifera specimens with 32 planktonics (12,4%), 92 agglutinated foraminifera (35,66%) and 134 calcareous benthic (51,94%). Coniacian-Santonian interval was dated by the first occurrences or last occurrences of planktonic foraminifera. The base of this interval is characterized by shallow water and oxygen-poor habitat. The top is marked by deep marine conditions with an increase in dissolved oxygen causing microfossils proliferation both on the bottom and in the water column.

Index Terms— Coniacian-Santonian, Foraminiferous, Ivory Coast, occurrences, oxygen, paleoenvironment, shallow water,

1 INTRODUCTION

Since several decades, oil indices have been found in onshore sedimentary basin of Côte d'Ivoire. These are the oil sands discovered in Eboinda in 1896 in the Assinie region near the Ghana border. These indices have promoted important exploration campaigns for the development of the Ivorian oil industry. Today, oil research is becoming more and more successful with oil discoveries in the offshore part thanks to the combined efforts of oil companies and researchers. The results of numerous published research exist ([1], [2] [3], [4], [5], [6], [7], [8], [9], [10]. They allowed to understand the local petroleum system and facilitated the exploration of the entire ivorian sedimentary basin. However, it is clear that many blocks of this basin remain little known. In this work, the reflection is focused on the paleoenvironment of the coniacian-santonian interval of the KM well. The aim of this study is to improve the knowledges of ivorian basin and to make a

contribution for local biostratigraphic diagnosis criteria. The geology of Côte d'Ivoire presents two majors entities: the basement, le largest with 97,5 % of the total surface and the meso-cenozoic sedimentary basin located in the south part, with 2,5% of the territory. This basin is the result of the opening of the Atlantic between the African and South American continents [11]. The general evolution of the marine regression observed in Late Cretaceous highlights an emerging, less extensive basin with lagoons. The important part of the ivorian sedimentary basin which is the offshore basin extends to the continental shelf to the mid-Atlantic ridge. The KM well which is the aim of this study is implanted on the continental shelf, south of Grand-Basam city (Figure 1).

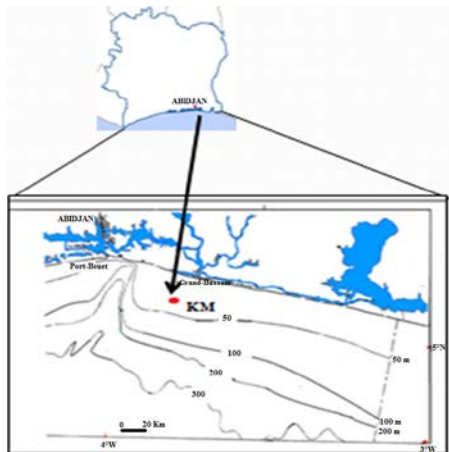


Figure 1: Location of KM well (KESSE *et al.*, 2013)

2. Material and method

A total of thirty-eight (38) ditch cuttings d from KM well between 2074 m and 1687 m, were analyzed. The samples were soaked in hydrogen peroxide solution (10% H₂O₂), wet-sieved and the residue was dried. The foraminifera picked from the remaining residue are identified. Marker species are described using the bibliography ([12], [14], [15], [16], [17]).

The study of the paleoenvironment concerns an estimate of the depth in relation to the oxygenation of the seabed. Indeed, variations in depths can have an effect on the fauna by the harmful influence of the decrease of the oxygen content on foraminifera population (benthic, planktonic). The presence or absence of benthic foraminifera as well as the proportions of some genera are excellent indicators in the reconstitution of the oxygenation conditions of the bottom sea. Planktonic morphotypes can give information on the evolution of the oxygenation conditions on the bottom sea although living in the water column.

3. Results

3.1. Microfauna distribution

The microfauna encountered consists essentially of foraminifera (258) associated with rare ostracods (8). The benthic foraminiferal population is predominant (226 specimens, 87.60% of total population). These benthic foraminifera are represented by agglutinated forms (92 individuals, 35.66%, divided into 8 genera and 11 species) and calcareous forms (134 individuals or 51.94%) divided into 10 genera and 16 species). Planktonic foraminifera are represented by 32 individuals, or 12.40% of the total population of foraminifera.

3.2. Biostratigraphy

The bar chart below (Figure 2), represents the foraminiferal distribution in this studied interval. This bar chart shows an abundance of specimens belonging to *Haplophragmoides* genera and species *Gavelinella pachysuturalis*.

This interval is marked by a considerable decrease of planktonic foraminifera. The scarcity of planktonic species *Hedbergella delrioensis*, *Hedbergella planispira*, *Whiteinella paradubia* and the presence of benthic foraminifera *Ammotium nkalagum*, *Bulliminella colonensis africana* are indicative of Coniacian-Santonian age.

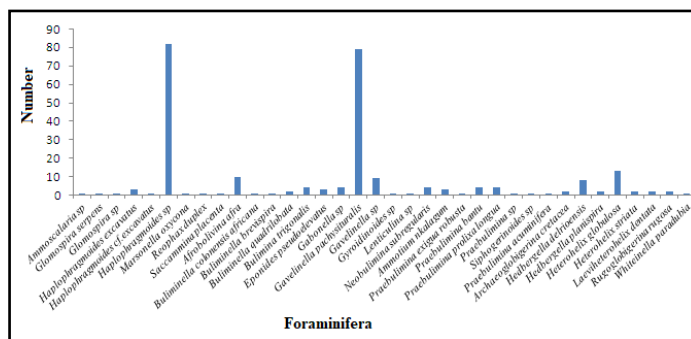


Figure 2: Foraminifera bar chart

3.3. Systematics

In this work, only diagnostic species have been described and illustrated in the Plate I.

Hedbergella planispira (Tappan, 1940)

(Plate I, Figure 1)

Test, smooth, slightly asymmetrical, small size with 6-8 spherical chambers in the last whorl and wide umbilicus. The trochospire is low and the sutures are radial and depressed in both sides. The primary aperture is extraumbilical – umbilical, extending and reaching the periphery bordered by a narrow lip.

Stratigraphic range: Aptian – Coniacian.

Bulliminella colonensis africana (Cushman, Hedberg, de Klasz, Magne and Rerat ,1963)

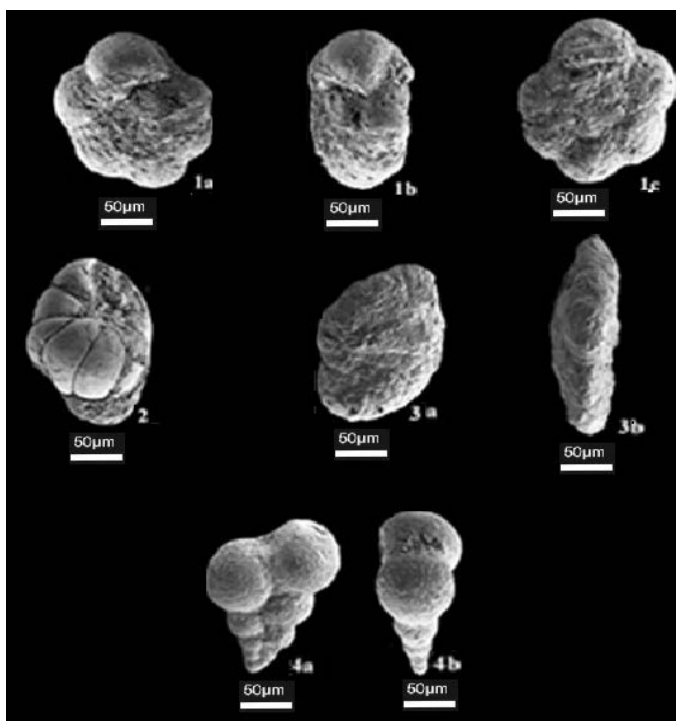
(Plate I, Figure 2)

Test elongated, 1.5-2 times longer than it is wide, composed of chambers disposed in a spiral. Two-three whorls are visible. Chambers are globulose in the initial stage, very elongated

and curved in the last whorl, occupies up to about four-fifths of the test. Sutures, Depressed, quite visible. Aperture is large, in the form of a spoon, extended to the last chamber.

Stratigraphic range: Coniacian to Maastrichtian.

PLANCHE I : *Hedbergella planispira* (Tappan, 1940), Cote : 2074 m (figure 1) ; *Buliminella colonensis africana*, (de Klasz, Magne et Rerat, 1963), Cote : 2055 m (figure 2) ; *Ammotium nkalagum* , (Petters, 1982), Cote : 1762 m (figure 3) ; *Heterohelix globulosa* (Ehrenberg, 1840), Cote : 2074 m (figure 4).



Ammotium nkalagum (Petters, 1982)

(Plate I, Figure 3)

The test is wide and flabelliform, coarsely agglutinated with an abundant cement. The aperture is narrow and slightly displaced towards the rectilinear peripheral edge.

Stratigraphic range: Turonian - Santonian.

Heterohelix globulosa (Ehrenberg, 1843)

(Plate I, Figure 4)

The test is biserial with 6 to 7 pairs of globular chambers increasing gradually in size, except for the late chambers, which

increase more rapidly. Faint costae are present on all chambers.

Stratigraphic range: Cenomanian – Maastrichtian

3.4. Reconstitution of bottom-water oxygenation

Considering the 2 parameters such as the diversity and the abundance of individuals, the ecosystem of the Coniacian – santonian interval in the KM well was estimated (Figure 3 and 4).

Lower Senonian (Coniacian-Santonian) recorded a proliferation of benthic foraminifera dominated by the genera *Gavelinella*, *Haplophagmoides* and *Praebulimina* (Figure 4). Planktonic foraminifera are rare, excepted the species *Heterohelix globulosa*, *Hedbergella delrioensis* and *Whiteinella paradubia*.

The presence of *Gavelinella* indicates a shallow, eutrophic environment and severe dysoxia. This dysoxia is justified by the presence of *Heterohelix globulosa* and *Hedbergella delrioensis* and characterizes the slope. *Neobulimina subregularis* and *Praebulimina prolixa longa* suggest an eutrophic to mesotrophic intermediate environment with moderate dysoxia. Also *Eponides pseudoelevatus* indicates a shallow to deep marine environment. The *Buliminidae* group, *Buliminella quadrilobata*, *Buliminella gabonica*, characterizes a deep marine environment, mesotrophic to oligotrophic and oxic, such as the continental glacia. Thus, there is a stratification of the water column in the lower Senonian, with poor-oxygenated bottom-water to well-oxygenated surface water.

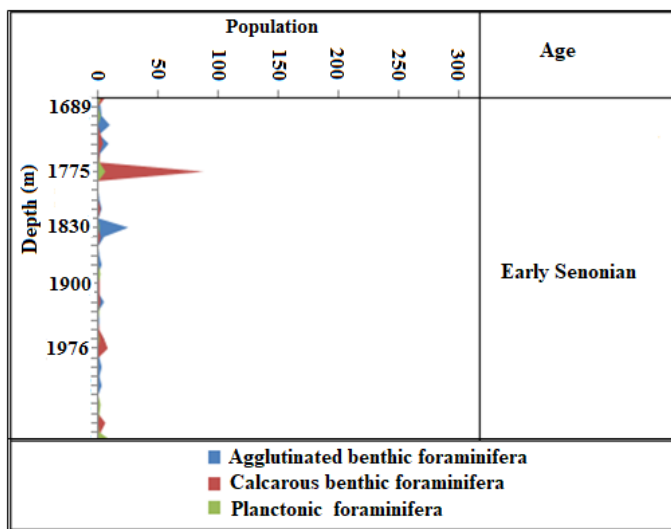


Figure 3: Evolution of the foraminifera in the KM well

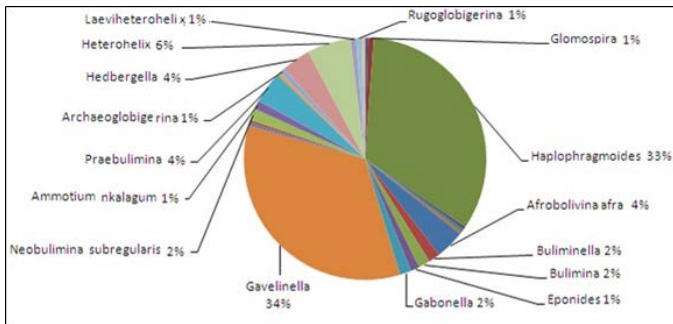


Figure 4: Distribution of foraminifera in the lower Senonian deposits of the KM well.

4. Discussion

The foraminifera identified in the KM well are known mostly in Southern Atlantic basins ([12], [13], [14], [15]). The proportions of planktonic foraminifera are low in the Lower Senonian. The last occurrence of *Hedbergella delrioensis* was recorded in Santonian. *Whiteinella paradubia* and *Hedbergella planispira* have their last occurrences in the Coniacian. These three species associated with benthic foraminifera, *Ammotium nkalagum* (Turonian-Santonian) and *Buliminella colonensis africana* (Coniacian – Maastrichtian), have been used to characterize the lower Senonian. The benthic foraminifera *Gavelinella* sp., *Buliminella* sp., *Siphogenerinoides* sp., *Praebulimina* sp., *Neobulimina* sp. and *Afrobolivina afra* were also found in the lower Senonian (Coniacian – Santonian) in most of the West African basins, from Angola to Senegal ([14], [15], [21]). *Gavelinella*, *Heterohelix*, *Hedbergella* and *Eponides* are characteristics of shallow environment, eutrophic to severe dysoxia conditions. According to studies realized in the Cote d'Ivoire-Ghana transform margin [17], the Middle Coniacian - Upper Santonian is marked by an increase in diversity and abundance of benthic foraminifera such as *Praebulimina* sp., *Buliminella* sp., *Neobulimina* sp., *Gyroidinoids* sp., *Gavelinella* sp. and *Lenticulina* sp.

5. Conclusion

The study of the KM well revealed the Coniacian-Santonian interval between 2074 and 1687 m. It is characterized by a microfauna comprising abundant benthic foraminifera, few planktonic foraminifera and rare ostracods. The distribution of the different species encountered as well as their abundance have made it possible to define two environments of deposits. At the base, a shallow and poor-oxygenated marine environment is distinguished. On the other hand, at the top (top) level, a relatively oxygenated deep domain is observed.

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