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# Nannostratigraphic Study of K/Pg Limit Formations of Cote d'Ivoire Offshore Sedimentary Basin of (West Africa)

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**Abstract:** Study of calcareous nanofossils in the interval 1044 -1445 m of ZNB-1X well located off Abidjan in the offshore part of Cote d'Ivoire sedimentary basin revealed a low diversity of nanoflora. The material used consists mainly of drill cuttings that undergone a three step classic treatment nanofloral study allowed to identify three intervals: Selandien (Middle Paleocene) characterized by species *Toweius selandianus*, *Toweius crassus*, *Toweius rotundus* Danian (Lower Paleocene) based on assemblage composed of *Neochiastozygus modestus*, *Cruciplacolithus primus*, and *Thoracosphaera sp.* and Maastrichtian recognized by the assemblage of species *Micula murus*, *Cribrosphaera ehrenbergii*, *Retecapsa crenulata*, *Archangelskiella maastrichtiana*, *Quadrum sissinghi* and *Micula concava*. This nanoflora study that also highlights the K/Pg boundary associated with both lithological and calcimetric data indicates an inner shelf depositional environment.

**Keywords:** Nannostratigraphy, K/Pg Boundary, Offshore Basin, Côte d'Ivoire

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## 1. Introduction

In recent years PETROCI has developed new techniques to better characterize the boundaries of the stages and to establish a biostratigraphic model typical of the Ivorian basin. Some research works were carried out in palynology and micropaleontology; in particular, those reported by the recent work [1, 2] even gave details on lamellibranchs, gastropods fauna as well as Cretaceous and Tertiary series. The present work is the few ones conducted in nanostratigraphy on the Côte d'Ivoire sedimentary basin after those of [3] realized on Ghana Côte d'Ivoire Rive. This work aims to answer to a number of scientific questions mainly (i) In what consist different lithologies crossed by wells and the characteristic nanofossils described with in different deposits. (ii) How evolved the depositional environments? The main objective is to establish the evolution of depositional environments based on analysis of calcareous nanofossils identified in the cuttings analyzed. More specifically, it will be necessary to: (i) compile the lithological and calcimetric

assessment of the deposits; (ii) inventory all the nanofossils encountered and described in order to establish a local nanostratigraphic scale for this part of the Côte d'Ivoire offshore sedimentary basin and especially in the area located in figure 1.

## 2. Material and Methods

The material used consists exclusively of drill cuttings on which nanofossils extraction standard techniques were carried out using main conventional steps. 1 to 2 g were sampled, dried in an oven at 80°C and then ground in an agate mortar and stored in a pulp. A pinch of the sample is spread on the lamella by adding a water drop using a peak until the wavelets are homogeneously distributed on the lamella. The slide is dried using a hardened adhesive (loctite 835) by depositing blade and slide under a UV lamp. The blades thus obtained were studied using a Nikon petrographic microscope (Ellipse LV100 POL). Nannostratigraphic interpretations were based on the first and last appearances of the chronostratigraphic biozonal species used according [4,

11 and 14] modified by [5] for Cretaceous and that of [6] for Tertiary.

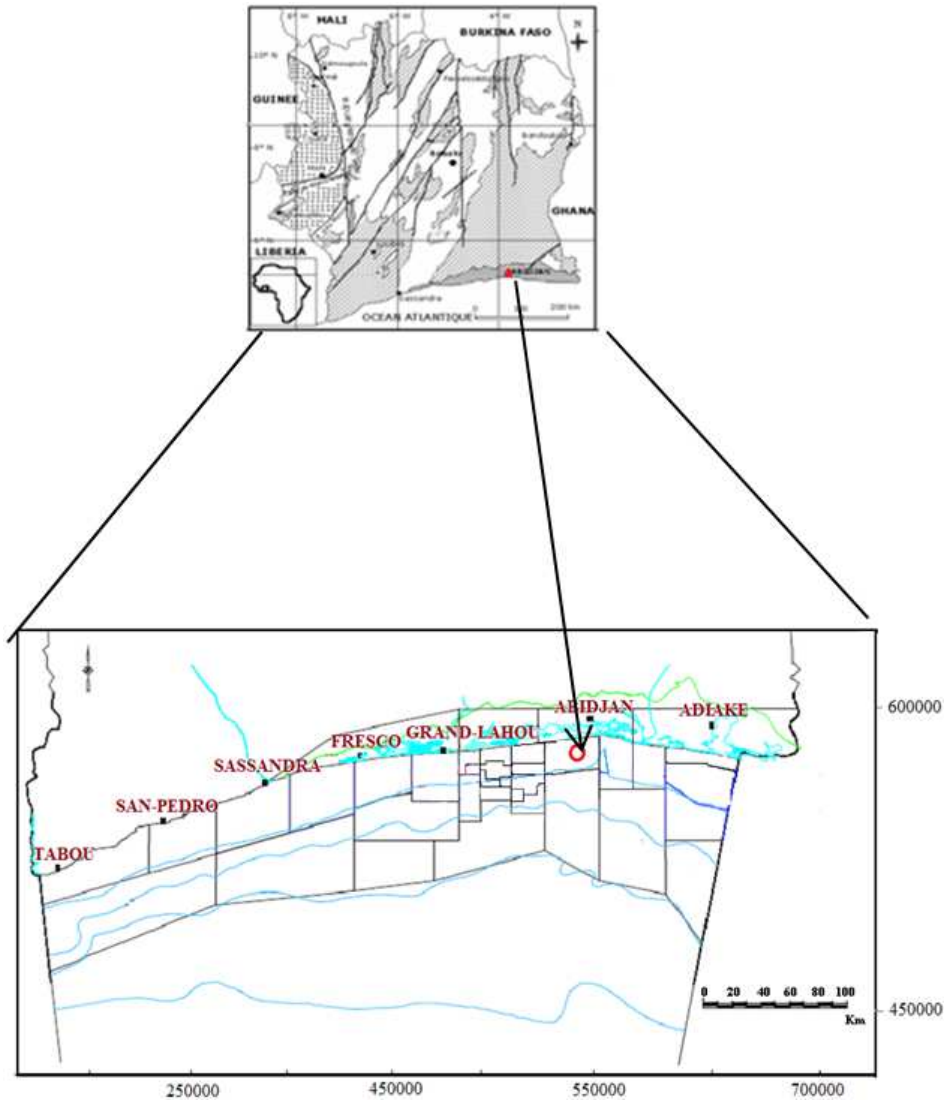


Figure 1. Location of well studied.

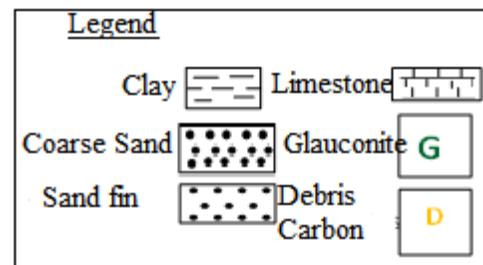
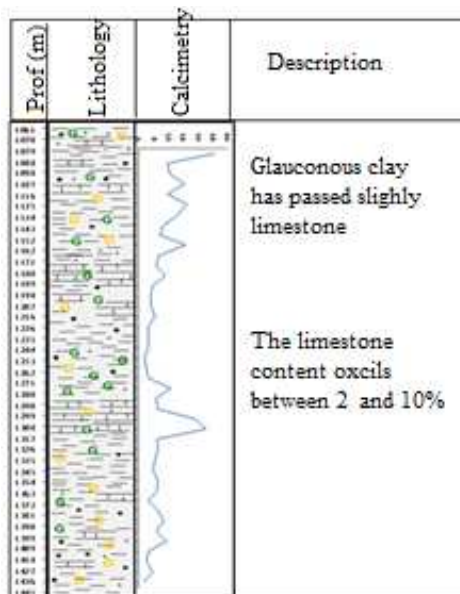


Figure 2. Synthetic lithological log of well studied.

### 3. Results

The intervals 1061-1070 m and 1417-1445 m contain calcareous nannofossils.

#### 3.1. Lithostratigraphy

The interval 1061 to 1445 m of ZNB-1X well is composed of a single lithological unit with very glauconitic clays with

carbon debris and with intercalation of limestone (figure 2). The limestone (CaCO<sub>3</sub>) content in the samples is relatively low with a peak at 1308m.

**3.2. Nannostratigraphy**

The interval 1061-1445m revealed three stages namely Maastrichtian, Danian and Selandian (Figure 3).

The Selandian: (1079-1116 m) was attributed by the presence of *Toweius selandianus*, a characteristic species (Martini Top NP4-NP5, 1971) and associated here with two other *Toweius rotundus* and *T. crassus*. The Danian: (1134-1262m) is revealed by the first appearance of *Neochiastozygus modestus* that indicates the top of the Danian at the 1116m depth. This Danian age is confirmed by the first appearance according to the biozonation of [6 and

11], other species *Cruciplacolithus intermedius* encountered at 1134m *Cruciplacolithus primus* and *Neocripidolithus neocrassus* (Pl.3 /24) at the 1207m. The K / Pg. boundary (1280): The first appearance at 1280m of both *Ceratolithoides aculeus* and *Watznaueria barnesae* mark the Paleocene / Maastrichtian (limit K / Pg). The Maastrichtian (1280-1408 m) is revealed by the first simultaneous appearances of *Arkangelskiella maastrichtiana* and *Micula murus* (Pl.2 /11) and associated with the same 1298 m to *Quadrum trifidus* *Cribrosphaerella ehrenbergii* (Pl1 / 4), *Micula concava*, *Retecapsa crenulata* and *Quadrum sissinghii*. But the presence of *Quadrum trifidus* in this association suggests a Lower Maastrichtian age. We thus note the absence of the Upper Maastrichtian in the interval of study.

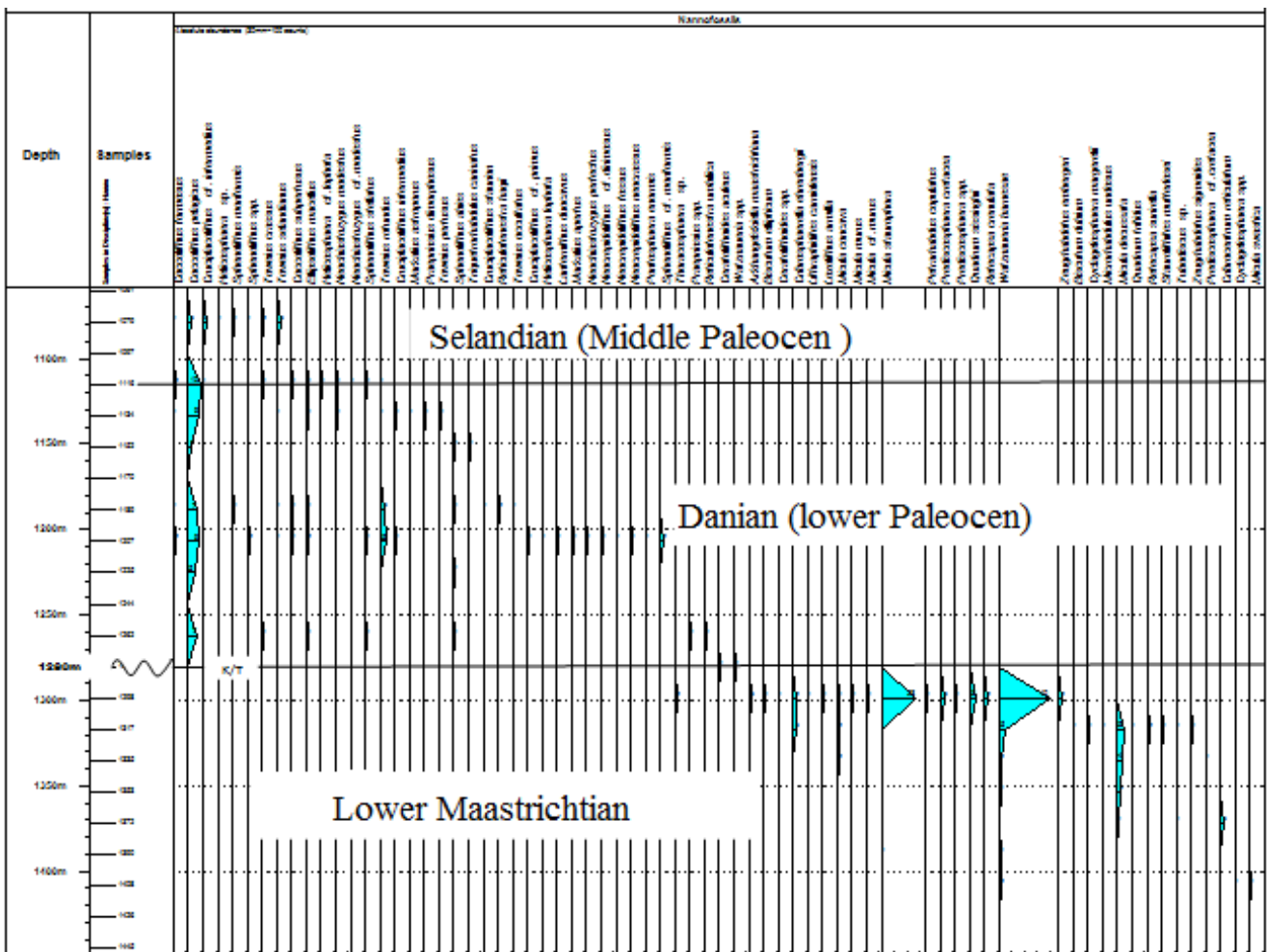


Figure 3. Vertical distribution of Calcareous in well ZNB-IX.

**4. Discussion**

In recent years, significant progresses were recorded in biostratigraphy, leading to the establishment of several scales, in particular those [4, 5, 6 and 13] of synchronous biozonations we have a global scale. Indeed, the discovery of the Cretaceous / Palaeogene (K/Pg) boundary with in the present studied area is supported by the work carried out by

[7] south-east of Petén basin (Guatemala). Generally, *Toweius selandianus*, *Toweius crassus*, *Toweius rotundus*, characteristic of the Paleocene (Selandian) encountered with in Cote d'Ivoire basin are markers of this interval in many other basins. The Paleocene was identified by the presence of *Cruciplacolithus intermedius* and *Neochiastozygus modestus* as described by [8] at the base of Danian. In the offshore basin in Norwegian Sea, works of [9] revealed the Danian

base through the assemblage of *Biantholithus sparsus*, *Thoracosphaera sp.* and *Prinsius dimorphosus*. Works carried out on Cote d'Ivoire offshore basin (unpublished internal report, Petroci) showed that *Neochiastozygus perfectus* and *Fasciculithus bitectus* species characterized lower Palaeocene. Maastrichtian was identified by [12] *Micula murus*, *Cribrosphaerella ehrenbergii*, *Retecapsa crenulata*, *Archangelskiella maastrichtiana* in Cote d'Ivoire basin, whereas in Tunisia this stage was revealed by the association composed of *Micula prinsii*, *Acuturris scotus*, *Tranolithus exiguus*, *Biscutum notaculum*, *Ceratholithodes aculeus*, *Microrhabdulus decoratus*. In addition, work in the Brazilian Basin also show that the species *Micula staurophora*, *Cribrosphaerella ehrenbergii*, *Prediscosphaera cretacea*, *Quadrum sissinghii* and *Watznauria barnesiae*, *Lithrathidites quadratus* and *Micula murus* indicate Maastrichtian as well as present results. Despite some differences in the assemblages composition of the nannoflora, the most important species described in this work are known and described in many peri-Atlantic basins. The Cretaceous / Paleocene boundary corresponds to periods of climatic and oceanographic changes and coincides with major biological crises. This idea is shared through works of

[10] performed on basins of Cameroon, Gabon, Senegal and Nigeria indicating that the associations characterizing the Upper Cretaceous are totally different from the Palaeocene species. The complete disappearance of species at the end of Maastrichtian could be one of the consequences of this biological crisis.

## 5. Conclusion

The study of the Calcareous nannofossils from the interval 1061 to 1445 of the ZNB-1X well lead to record a nannoflora of low abundance and diversity. This study allowed to propose a nannostratigraphic scale and to determine the depositional environments. The lithology of the interval studied consists of a single unit composed of very glauconitic clay with carbonaceous debris and limestone intercalation clay. The nannoflora reveals the Cretaceous / Palaeogenic boundary and defines three stages: (i) Selandian (Middle Paleocene) (1079-1116 m) (ii) Danian (lower Paleocene) (1134-1262 m) and (iii) Lower Maastrichtian (1280-1408 m). The discordant Danian-Lower Maastrichtian contact suggests the lack of Upper part of the Maastrichtian. Lithological and nannoflora data indicate an inner continental shelf deposition environment.

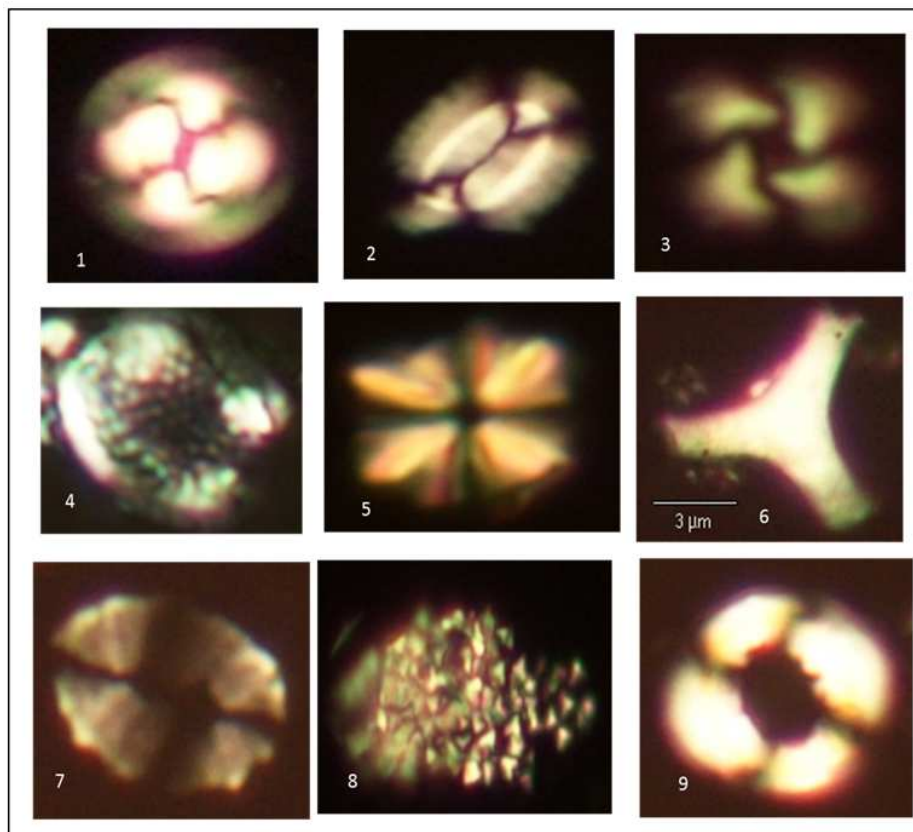


Plate 1

1-*Coccolithus pelagicus* 2-*Ellipsolithus macellus* 3-*Reticulofenestra haquii*

4- *Cribrosphaera ehrenbergii*, 5-*Sphenolithus abies* 6- *Tribrachiatus ortostylus*

7-*Neocrepidolithus neocrassus* 8-*Thoracosphaera sp* 9-*Reticulofenestra umblica*

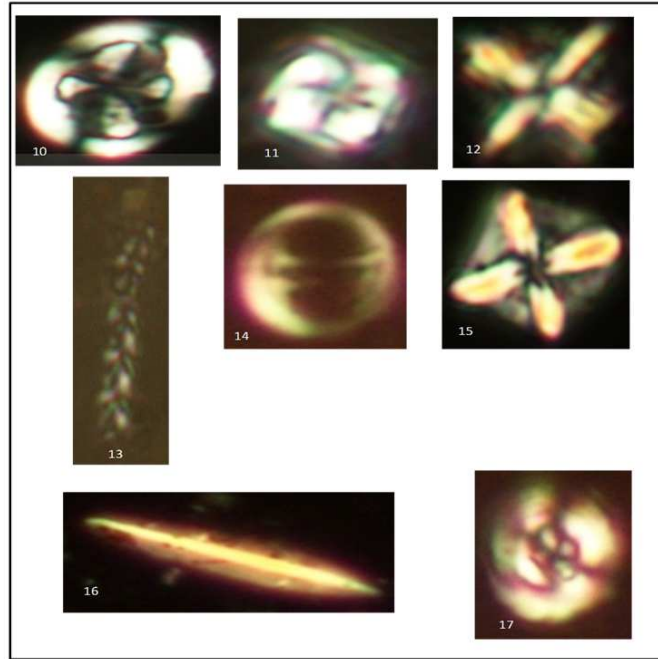


Plate 2

- 10-*Arckangelskiella maastrichtiana* 11- *Micula murus* 12-*Quadrum tissinghii*  
 13-*Microrhaddulus undosus* 14- *Zeughrabdodus diplogrammus* 15-*Micula staurophora*  
 16-*Lithraphidites carniolensis* 17 - *Cruciplacolithus primus*

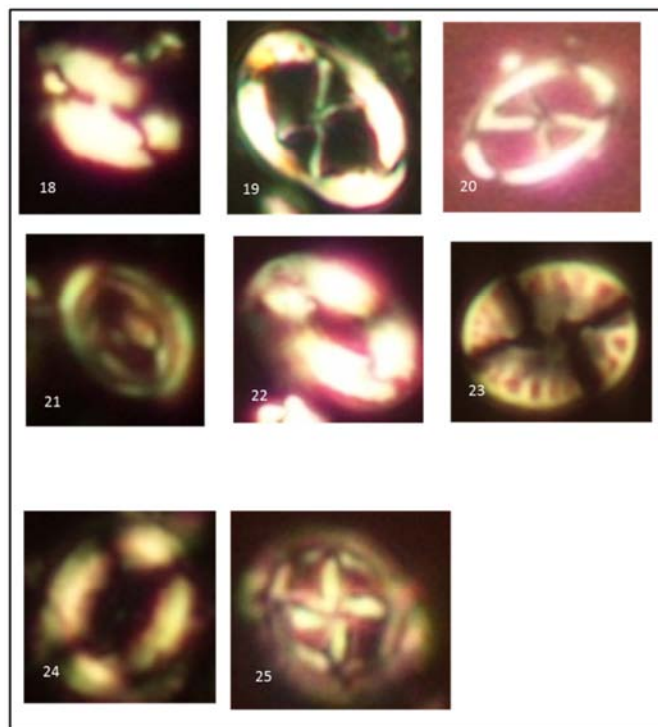


Plate 3

- 18-*Helicosphaera lophota* 19-*Neochiastozygus modestus* 20-*Neochiastozygus perfectus*  
 21-*Zeughrabduthus stgnotides* 22-*Neocrepidolithus* sp 23-*Pontosphaera enormis*  
 24-*Neocrepidolithus neocrassus* 25- *Prediscosphaera cretacea*

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## References

- [1] Goua Topka Emmanuel (1997) Biostratigraphy and Evolution Paleo environmental of Maastrichtian and Paleocen in Sedimentary Basin Côte Ivoire. doctoral, Univ. Bourgogne, Center of Earth sciences, pp 354.
- [2] Bie Goha René, Digbehi Zeli Bruno, Yao Konan Raphael, Tea –Yassi Juliette et Kangah Kouadio David, Tahy Ignace Palynological Stratigraphy of the Upper Maastrichtian-Upper Eocene of the Cote d'Ivoire Offshore Sedimentary Basin, West Africa, International Journal of African Studies Issue 6 (2012), pp 40-57.
- [3] Robertson. (1998): Biostratigraphy of survey Ocelot-1, Léopard-1.unpub 28p.
- [4] Sissing W. (1977): Biostratigraphy of cretaceous calcareous nannoplankton.
- [5] Perch-Nielsen, K (1985) Mesozoic Calcareous Nannofossils in: Bolli, H. M, Saunders, J. B and Perch-Nielsen K, eds plankton stratigraphy Cambridge University Press p 329-426.
- [6] Martini, E (1971) Standard Tertiary Calcerous Nannoplankton from the Western equatorial Pacific.
- [7] Gardin S., Marsure E., (1997) Cretaceous / Tertiary boundary in South western Péten (Guatemala) p58.
- [8] Stoykova k (2004): Calcareous Nannofossils and sequence stratigraphy of the Cretaceous /Tertiary transitionn in Bulgaria. Journal of Nannoplankton Research Vol. 26, N°1 pp. 47-61.
- [9] Lottaroli F. and Catrullo D. (1999): The Nannofossil biostratigraphic framework of the late Maastrichtian –Danian North Sea chalk p 253.
- [10] Elisabeth Sales (1967) Association of Calcerous Nannofossils of the west African Tertiary and Cretaceous Paleocology pp 291-314.
- [11] Alkali, Y. Baba, E. A. Okosun, Onoduku, U. Shehu (2014): Biostratigraphic Study of the Calcareous Nannofossils of Well 02, Shallow Offshore. Niger Delta, Nigeria, Universal Journal of Geoscience Vol. 2(3), pp. 104–108.
- [12] Boussaha, M, Thibault, NR & Stemmerik, L (2016): Integrated Stratigraphy of the late Campanian - Maastrichtian in the Danish Basin: Revision of the Boreal calcareous nannofossil zonation' Newsletters on Stratigraphy, vol 49, no. 2, pp. 337-360.
- [13] Nicolas Thibault, Kresten Anderskov, Morten Bjerager, Lars O. Boldreel Mads E. Jelby, Lars Stemmerik, (2015): Biometric analysis of the *Arkhangelskiella* group in the upper Campanian-Maastrichtian of the Stevns-1 borehole, Denmark: Taxonomic implications and evolutionary trends pp. 549-560.
- [14] Agnini, Claudia; Fornaciari, Eliana; Raffi, Isabella; Catanzariti, Rita; Pälike, Heiko; Backman, Jan; Rio, Domenico (2014): Biozonation and Biochronology of Paleogene calcareous nannofossils from low and middle latitudes Newsletters on Stratigraphy Volume 47 Number 2 , pp 131–181.