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STUDY OF CALCAREOUS NANNOFOSSILS
AND SOME NANNOFACIES FROM 2608m to 3164.5m

EP/S/EXP/RAG/Lab.Pau n°84/201 RP

DIRECTION EXPLORATION

—
division
recherches et applications
en géologie

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AND SOME NANNOFACIES FROM 2608m to 3164.5m

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INTRODUCTION

For this work 62 samples were studied, most of them being clab samples, and five from core number one.

A photo microscope was used to propose a stratigraphic scheme, whilst a scanning electron microscope made it possible to determine some relation between the fossils and the other elements present in the chalk.

After the optical analysis of the nannofossils present, some selected samples were viewed with the Scanning Electron Microscope (SEM) in order to define the nannofacies, which might improve further stratigraphic correlations.

Moreover, as it seems that there is a relation between porosity and the number and preservation of nannofossils this first investigation was undertaken with the aim of completing other studies already carried out in this way, by physical techniques.

12 pages
2 photo. plates
2 tables

I - STRATIGRAPHY

I.1 - Stratigraphic summary

- . 2698m to 2670.5m
No stratigraphic result
- . 2679m to 2738m
Upper Danian, NP 3 zone
- . 2756m to 2780.35m
Danian, NP 2 to NP 3 zone
- . 2781.10m to 2794.5m
Lower Danian, NP 1 zone
- . 2810m to 2984m
Upper Maastrichtian
- . 2995m to 3119m
Probably Lower Maastrichtian
- . 3154m
Probably Lower Maastrichtian

I.2 - Stratigraphic analysis

For details of the distribution of the species, see plates 1 and 2.
The zonal scheme used here is from MARTINI's (1971) zonation.

- . From 2608m to 2670m

11 clabs samples were studied and found to be non fossiliferous.
There are no stratigraphic results for this interval.

. Samples from 2679m and 2687.5m

Yielded rich taphocoenosis mostly composed of reworked species from Upper Cretaceous strata.

These species are

Eiffelithus tumiseiffelii
Eiffelithus eximius
Watznaueria barnesae
Arkhangelskiella cymbiformis
Broinsonia parca
Reinhardtites antophorus
Lucianorhabdus maletormis
Kamptnerius magnificus
Gartnerago obliquum
Micula decussata
Cribrosphaera ehrenbergi
Prediscosphaera cretacea
Chiastozygus litterarius

Tertiary species were also encountered, these species being :

Neochiastozygus junctus
Cruciplacolithus tenuis
Russelia multiplus
Placozygus sigmoides
Chiasmolithus consuetus
Chiasmolithus bidens
Prinsius dimorphosus
Ericsonia subpertusa
Ericsonia eopelagica
Thoracosphaera operculata, T. deflandrei

Zonation : this assemblage allowed us to assign this interval to the NP3 zone of MARTINI's standard zonation.

Proposed age : Upper Danian

. Samples from 2714m and 2724m were non fossiliferous hence no proposed age could be put forward.

. Samples from 2730.5m and 2738m

Yielded poor and very rich assemblages, very similar to those observed in samples from 2679m and 2687,5m.

The sample from 2738m yielded many nannofossil species :

Markalius inversus
Markalius apertus
Neocrepidolithus necrassus
Neocrepidolithus dirimosus
Fasciculithus sp. (cf. bitectus ?)
Braarudosphaera bigelowii

For the last time one can observe :

Neochiastozygus junctus
Neochiastozygus sp.
Ericsonia subpertusa

which were encountered in this sample.

Zonation : NP 3

Proposed age : Lower Danian

So the 2679m-2738m interval may be assigned to the NP 3 zone of MARTINI's zonation.

. Samples from 2746.5m and 2753m

No calcareous nannofossils. No stratigraphic results.

. From 2756m to 2779m

The appearance of the following species

Prinsius bisulcus
Thoracosphaera saxea
Ericsonia cava
Chiasmolithus danicus

Biscutum parvulum
Cyclagelosphaera reinhardtii
Prinsius rosenkrantzii
Cruciplacolithus edwardsii

Zonation : NP 2 to NP 3

Proposed age : Danian

. First core : (see plate 2)

From 2780.35m to 2788.55M

- sample 2780.35m

Neocrepidolithus neocrassus
Cruciplacolithus edwardsii
Cruciplacolithus cf. tenuis

Zonation : NP 2 (C. tenuis zone)

Cruciplacolithus tenuis zone from ROMEIN 1979

Proposed age : Danian

- samples from 2781.10m, 2783.57m, 2785.80m

Very few nannofossils occur such as

Prinsius cf. petalorus
Placozygus sigmoides
Cruciplacolithus primus

Zonation NP 1 MARTINI 1971 (Markalius inversus
zone)

Cruciplacolithus primus zone to Prinsius
dimorphosus zone from ROMEIN 1979

Proposed age : Lower Danian

- Sample from 2788.55m

Reworked species from Upper Cretaceous strata could be recognised

Lucianorhabdus cayeuxii
Micula decussata
Chiastozygus litterarius
Arkhangelskiella cymbiformis

and Danian species

Cyclagelosphaera reinhardtii
Markalius inversus
Thoracosphaera sp.
Biscutum cf. castrorum

In the lowest Danian, very few new species occur. Among them are :

B. castrorum
M. inversus is more abundant with
C. reinhardtii

Zonation : NP 1 MARTINI

Biantholithus sparsus zone from (ROMEIN 1979)

Proposed age : Lowest Danian

So the first core is mostly of Early Danian age.

The sample from 2794.5m yielded the last Danian species and is taken as the last Danian sample studied.

. From 2810m to 2984m

Very rare calcareous nannofossils were encountered in this interval.

Sample from 2810m yielded

Arkhangelskiella cymbiformis (very rare)
micula decussata (very abundant)

This taphocoenosis seems to illustrate the diagenetic effects of the nannofossil assemblage where the smallest species have disappeared whilst the more strongly ornamented have been preserved.

This sample is taken as the latest Maastrichtien sample studied.

Classical taphocoenosis of Upper Maastrichtian age were encountered in the other samples from this interval. Lithraphidites quadratus was observed at 2859m and as Nephrolithus frequens was also reworked in the Danian, it is thus possible to propose zonation and age.

Zonation : Lithraphidites quadratus zone to
Nephrolithus frequens zone

Proposed age : Upper Maastrichtian

. From 2995m to 3119m

Calcareous nannofossils are more abundant. This interval yielded Upper Cretaceous taphocoenosis similar to those from upper levels. The following species appeared :

Reinhardtites levis
Zygodiscus minimus
Prediscosphaera intercisa
Lithraphidites praequadratus
Biscutum constans

Zonation : Probably Reinhardtites levis zone

Proposed age : probably Lower Maastrichtian

Remark : In fact, R. Levis has a stratigraphic range from the Upper Campanian to the Lower Maastrichtian.

As Campanian species are absent, it seems possible to assign this interval to the Lower Maastrichtian (Upper Campanian to Lower Maastrichtian age is almost certain for this interval).

. From 3130.5m to 3151.5m

No calcareous nannofossils
No stratigraphic results.

. Sample from 3154m

The same Taphocoenosis was encountered. R. Levis is present with the first Phanulithus obscurus.

Zonation : Probably R. Levis zone

Proposed age : probably Lower Maastrichtian

Remark : the same remark as for the interval from 1995m to 3119m can also be applied to this sample.

II - NANNOFACIES STUDY

The Scanning Electron Microscope study of the rock samples was carried out to try to understand the great variations in nannofossil frequency.

II.1 - Nannofacies correlations

Danian stratas in particular were studied, especially because of the presence of the smallest species (Prinsius rasenkrantzii). (Cf. photographic plate n°2, Fig. 1-3).

Similar SEM analyses of the EAN 3/7-2 well yielded the same nannofacies with a great number of P.rosenkrantzii, the dominant species of the taphocoenosis.

Thus the acme zone of P. rosekrantzii should allow us to propose long range correlations between well 1/3-4 (samples from 2756 to 2779m) and well 3/7-2 (samples from 2583m and 2587.4m).

Similar correlations should be proposed for the other wells, already drilled, in further studies.

II.2 - Diagenetic evolution

In addition to these nannofacies correlations, the study of the preservation aspect of nannofossils, their frequency, and their relation to other rock components might give us some information about diagenesis.

If photos from plates 1 and 2, are compared, it can be seen that, at the same magnification, the number of calcareous nannofossils is rather different at 2779m than at 2756m and 2761m.

The crystals of calcite are larger in these last levels, while at 2779m small and homogeneous calcite fragments are encountered.

Numerous coccospheres were also observed at 2779m (photographic plate 2, Fig.1) but they are absent at 2756m and 2761m. Thus the diagenetic evolution of these samples should have been quite different. The less evolved level is probably represented by the P. rasenkrantzii acme zone.

The implications of these remarks in relation to the porosity aspect are not yet clearly understood, but further study might help us in this respect.

Remark : the EAN 3/7-2 analysis was realized during a P.T.A. project (Assistance Technique Improvement project) in 1982-83, the report of which will be published this year.

Conclusion

- . The study of the calcareous nannofossils from the 1/3-4 well has allowed us to propose a biostratigraphic framework for the Danian and Maastrichtian (Campanian Maastrichtian ?) stratas.

. The SEM study of some selected samples has shown that the P. rosenkrantzi level might be of great interest in further biostratigraphic correlations.

PLATE 1

NANNOFACIES OF THE DANIAN CHALK

Figure 1 : 2756m ; x 3600

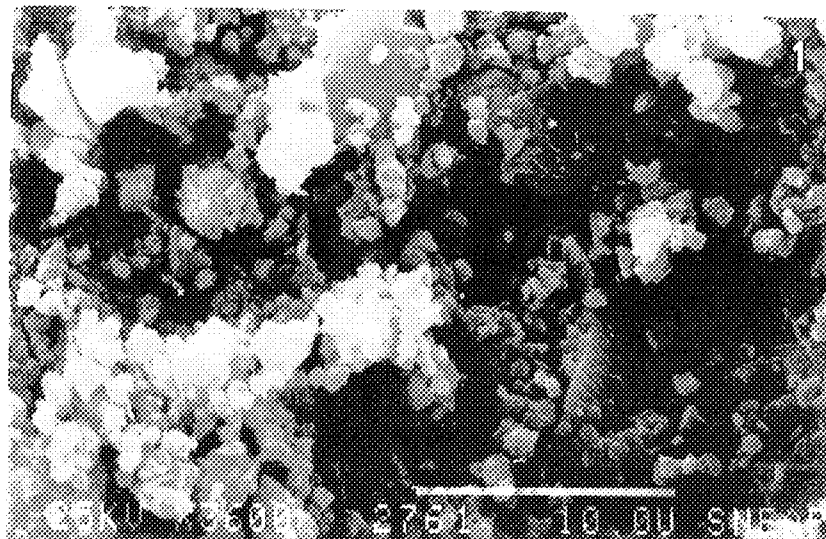
One can see the scarcity of calcareous nannofossils, their poor state of preservation, and their large size.

Figures 2 and 3 : 2761m ; x 3600

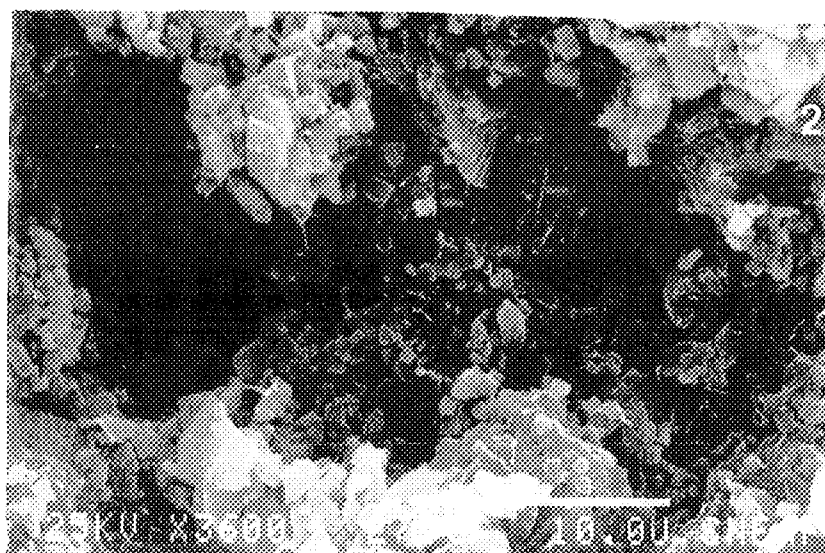
The calcite debris are rather irregular in size.

Comparison of these photographs with those of plate 2 illustrates the characteristics of the Prinsius rosenkrantzii zone (or the P. rosenkrantzii level as this zone seems to be very thin)

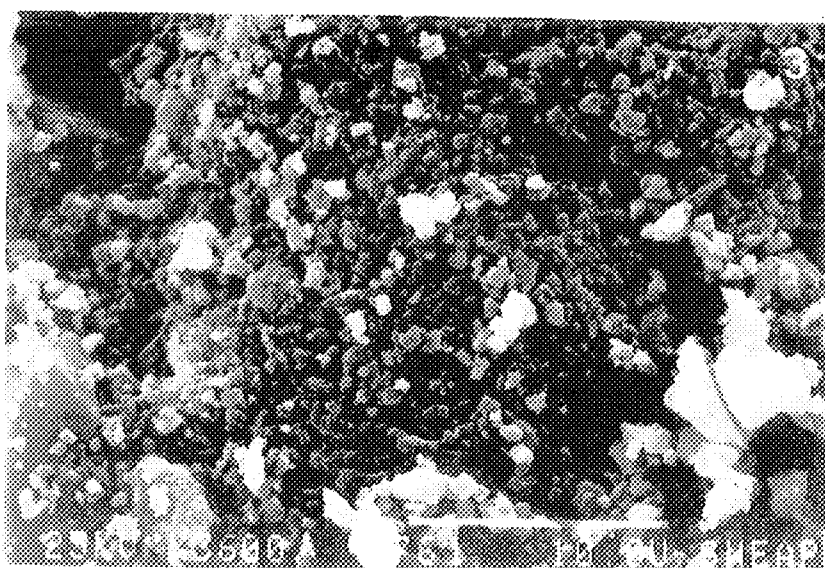
- great number of coccoliths
- very small coccoliths (2-4 μ)
- regularity of calcite debris
- monospecificity of the fossil assemblage
- homogeneity of the nannofacies



2756 m



2761 m



2761 m

PLATE 2

NANNOFACIES OF THE DANIAN CHALK

Prinsius rosenkrantzii levels

(2779m)

Figure 1 x 3600

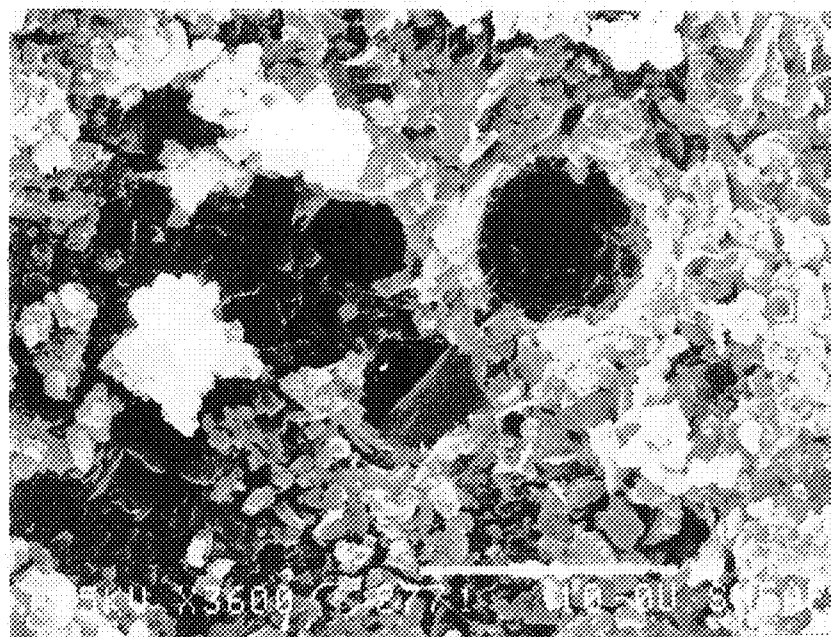
Well-preserved nannofacies with coccospheres

Figure 2 x 3600

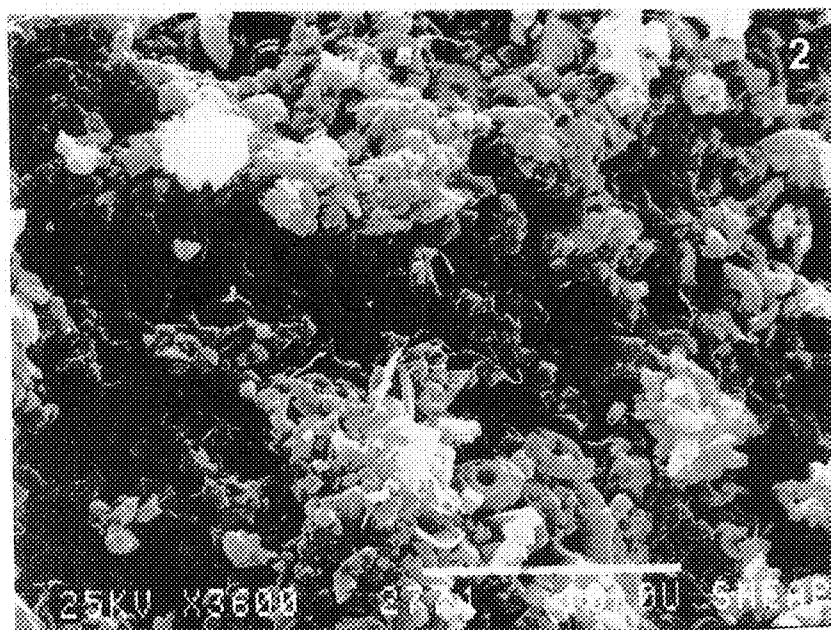
Nannofacies with numerous coccoliths of the P. rosenkrantzii species, which is dominant in the taphocoenosis of these levels.

Figure 3 x 7800

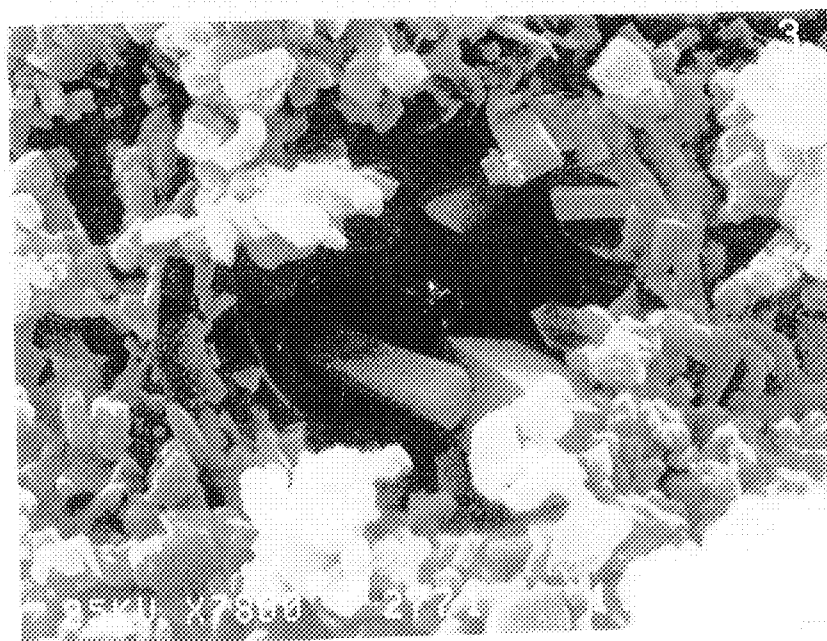
Example of crystals growing inside a coccosphere. The ultrastructural morphology of the coccoliths has been progressively modified. The average diameter of the coccoliths which constitute the main part of the chalk is 3-4 microns.



2779 m



2779 m



2779 m

LIST OF PHOTOGRAPHIC PLATES AND TABLES

Photographic plate 1 : Nannofacies of the Danian chalk

Photographic plate 2 : Nannofacies of the Danian chalk (Prinsius
rosenkrantzi levels)

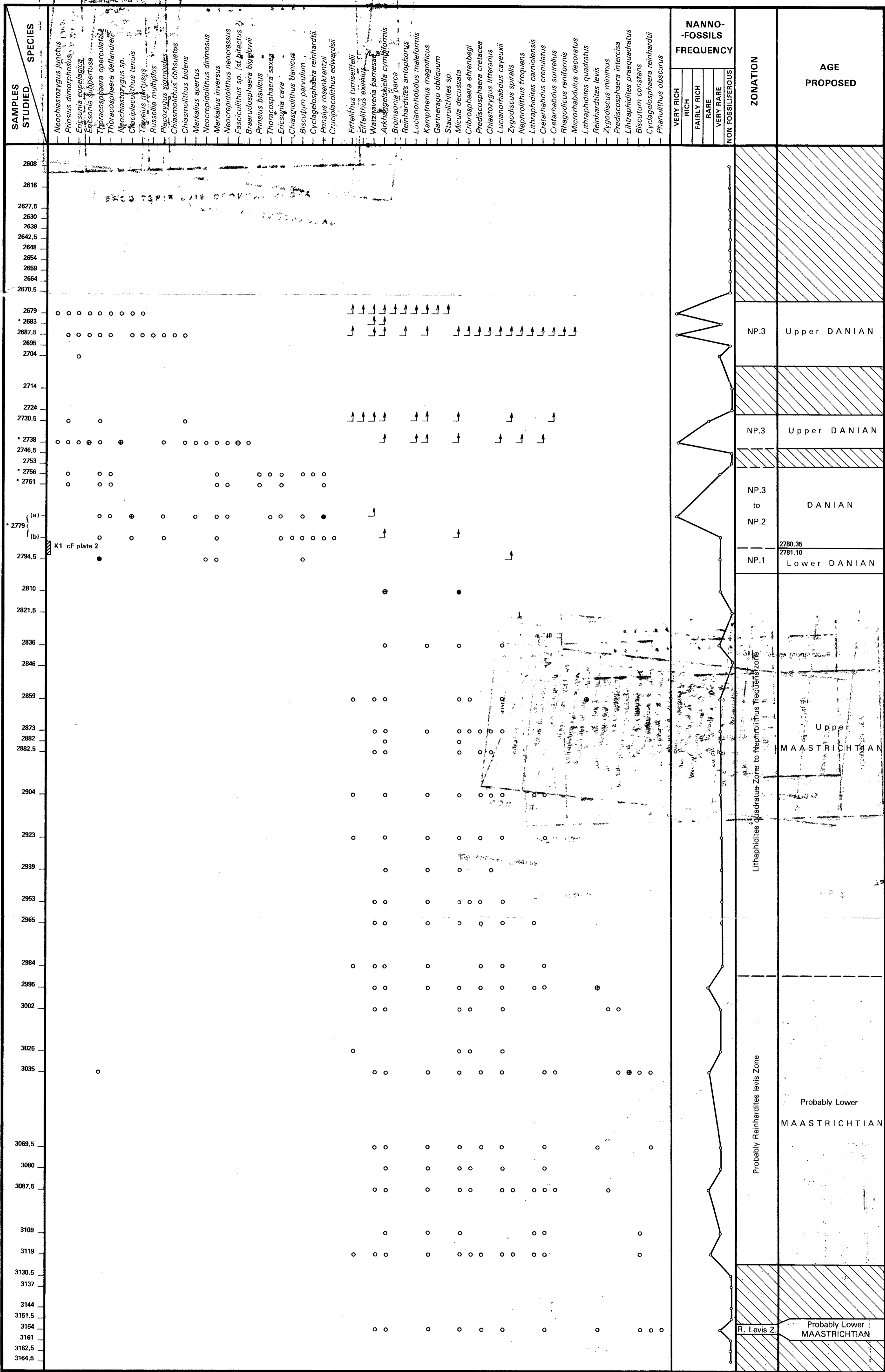
Table 1 : Range chart of calcareous nannofossils from EAN 1/3-4 well

Table 2 : Calcareous nannofossils - First core

NOR 1/34

DEPTH (meters)	SPECIES	ZONATIONS		AGE PROPOSED
		MARTINI 1971	ROMÉIN 1979	
2780.35	<i>Lucianorhabdus cayeuxii</i> <i>Micula decussata</i> <i>Chiastozygus literarius</i> <i>Arhangelskiella cymbiformis</i> <i>Cyclagelosphaera reinhardtii</i> <i>Mackalius inversus</i> <i>Biscutum cf. castrorum</i> <i>Theracosphaera sp.</i> <i>Theracosphaera operculata</i> <i>Theracosphaera deflandrei</i> <i>Prinsius sp. cf. petaloides</i> <i>Braarudosphaera bigelowi</i> <i>Placozygus sigmoides</i> <i>Cruciplacolithus primus</i> <i>Neotrepidolithus neocrassus</i> <i>Cruciplacolithus edwardsii</i> <i>Cruciplacolithus cf. tenuis</i>	NP.2	C. tenuis zone	DANIAN
2781.10			P. dimorphus zone to C. primus zone	
2783.57		NP.1		
2785.80				
2788.55			B. sparsus zone	

CALCAREOUS NANNOFOSSILS FIRST CORE



LEGEND

- Index specie ○
- Dominant specie ●
- Reworked specimen ↑
- Nannofossil in situ ○
- Sample studied with the scanning Electron Microscope (S.E.M.) *
- Interval with no stratigraphic results ▨

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Tab. 1

**RANGE CHART
OF CALCAREOUS
NANNOFOSSILS
FROM EAN 1/3-4 WELL
(From 2608 to 3164,5 m)**