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LABORATOIRE DE GEOLOGIE DE BOUSSENS

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30/7-3 WELL (NORWAY)

BIOSTRATIGRAPHICAL REPORT ON THE
MESOZOIC SERIES BETWEEN 3608 AND 4040 m
CORRELATIONS WITH 30/10-5 WELL

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30/10 BLOCK (NORWAY)
SEDIMENTOLOGICAL INTERPRETATION OF BASAL
TERTIARY FORMATIONS.
- R. CUSSEY - J. LE FOURNIER : n° 7.1513 RP
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LITHOSTRATIGRAPHICAL STUDY OF THE BASAL TERTIARY.

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- 1 - Correlations of Upper Cretaceous (Cenomanian - Campanian) calcareous nannoplankton zonations of MANIVIT 1971 and CEPEK HAY 1969.
- 2 - 30/7-3 well. Palynological and micropaleontological results between 3608 and 4040 m.
- 3 - 30/10-5 well. Palynological and micropaleontological results between 3425 and 3793 m.

PLATES (out text) :

- 1 - 30/7-3 well. Distribution chart of microfossils, (interval 3675 - 4040 m).
- 2 - 30/7-3 well. Palynological range chart of dinoflagellates, spores, pollen grains and calcareous nannofossils (interval 3608 and 4040 m).
- 3 - 30/10-5 well. Distribution chart of microfossils (interval 3460 - 3800 m).
- 4 - 30/10-5 well. Palynological range-chart of dinoflagellates, spores and pollen grains, (interval 3425 - 3793 m).
- 5 - Biostratigraphic correlations between 30/7-3 and 30/10-5 wells.

1 - GENERAL REMARKS

The purpose of this report is to establish a biostratigraphic subdivision of the ALBIAN-TURONIAN interval in the 30/7-3 well by means of micropaleontological and palynological methods and to correlate this interval with probably equated sequence in the 30/10-5 well.

The report is based on the following studies :

- 1) Biostratigraphic study of the ALBIAN-TURONIAN series in the 30/7-3 well performed from 3608 to 3785 m.

The micropaleontological study deals with the interval 3675 - 4040 m.

The palynological study deals with the interval 3608 - 4040 m. In addition, calcareous nannoplankton analyses from the latest Cenomanian and Turonian (3608-3785) have been carried out.

- 2) Biostratigraphic study of the TURONIAN-SENONIAN series in 30/10-5 well performed from 3425 to 3800 m.

The palynological study has been carried out from 3425 to 3793 m.

2 - 30/7-3 WELL

2.1 - MICROPALEONTOLOGY

2.1.1 - INTRODUCTION

The micropaleontological study of 30/7-3 has been carried out on material examined from the interval 3675 m - 4040 m (T.D. = 4044 m) which covers a stratigraphical series ranging from Turonian to Albian.

SAMPLING

The examination of free microfauna has been performed on composite cutting samples collected at about 5 to 10m intervals. Only the lower depths of the samples have been located on the distribution chart enclosed. In addition, one sample has been examined from core n° 1 (3918 m - 3936 m).

SUMMARY OF RESULTS

The microfauna encountered down to about 3970 m is dominated by epipelagic foraminiferal assemblages (open marine conditions). On the basis of scarce planktonic and benthonic index Foraminifera species together with a few valuable Ostracodes, the Turonian, the Cenomanian and the Albian have been identified within this interval.

Below 3985 m, the lack of any diagnostic species and the presence of more or less abundant contaminations make precise stratigraphic determination impossible.

2.1.2 - ZONATION AND STRATIGRAPHICAL REMARKS

2.1.2.1 - Interval 3675 m - 3735 m = Turonian

The microfauna is dominated by epipelagic foraminiferal assemblages consisting of small Globigerinidae s.l. including Hedbergella spp., Globigerinelloides spp. and small Heterohelicidae, together with scarce Globotruncanidae :

- Globotruncana gr. lapparenti
- Globotruncana gr. marginata
- Globotruncana tricarinata
- Globotruncana cf. imbricata
- Praeglobotruncana cf. helvetica, at 3685 m.

The subordinate benthonic forms consist mainly of arenaceous and scarce calcareous Foraminifera such as small Buliminidae and Rotaliidae s.l.

The presence of one specimen belonging to Praeglobotruncana cf. helvetica at 3685 m and of scarce Globotruncana cf. imbricata at 3725 m and 3735 m enables us to assign a Turonian age to the interval.

2.1.2.2 - Interval 3745 m - 3905 m ? = Cenomanian

This age determination is supported by the progressive appearance, within the interval, of the following species :

- Tristix cf. acutangula
- Valvulineria gracillima
- Dorothis cf. gradata
- "Doloccytheridea" sp.
- Cythereis gr. bonnemaï

One specimen of the Turonian species, possibly derived from the series above, Praeglobotruncana ? paradubia has been observed at the top of the interval.

No Rotalipora gr. turonica has been recovered from the samples examined ; nevertheless, as this species is scarce in this area, there is no evidence to infer the absence of Uppermost Cenomanian/basal Turonian in the well section. The remainder of the microfauna consists of abundant small Hedbergella spp. together with arenaceous benthonic forms :

- Vernenilinidae
- Dorothis spp.
- Ammodiscus spp.
- Glomospira spp.

and calcareous ones :

- Lagenidae
- small Rotaliidae
- Pleurostomella spp.
- Gavelinopsis spp.
- Scarce Globorotalites sp.

Globigerinelloides spp. and Radiolaria are present in the lower part of the interval.

2.1.2.3 - Interval 3915 m ? - 3970 ? = Albian

The microfauna recovered from this interval consists mainly of Hedbergellids together with scarce arenaceous benthonic forms including :

- Rhizamminidae
- Ammodiscus spp.
- Glomospira spp.
- Textularia spp.
- Haplophramoides spp.
- small Ammobaculites spp.
- Spiroplectinata sp.
- Dorothis filiformis

and the Ostracode "Platycythereis" sp.

This association is indicative of the Albian, chiefly in the upper part of the interval.

2.1.2.4 - Interval 3985 m ? - 4040 m = No age determination

The microfauna is composed mainly of the arenaceous Foraminifera and Hedbergellids observed in the series above, from which they are possibly derived.

In addition, scarce Sponge spicules, pyritic "tubulures" and "globules" together with abundant granules of no definite origin are to be noted within the interval.

On account of the lack of any valuable index species and the presence of possibly caved microfaunas, an age determination proved to be impossible.

2.2 - PALYNOLOGY

2.2.1 - DINOFLAGELLATES - SPORES - POLLEN GRAINS

2.2.1.1 - Introduction

24 samples have been processed between 3608 and 4040 m : 12 sidewall core samples, 11 cutting samples, 1 core sample (core n° 1). The microplanktonic dominating assemblages are generally rich. All the samples contain great amounts of black ligneous particles and coals. The thermal alteration index is 3,5 in the core n° 1.

The Palynological range chart of the microplankton is presented in Plate 2.

2.2.1.2 - Palynological Zonation

Three zones (NC V a-b-c) ranging from ALBIAN to CENOMANIAN and three zones (NC VI a-b- NC VII a) within the LOWER SENONIAN s.l. are described. The zonal system proposed here will be compared with the nannofossil zonation to provide additional stratigraphic data.

2.2.1.2.1 - 3608 - 3636 NC VII a Zone - Dinopterygium cladoides Zone

4 sidewall core samples.

. Rich microplanktonic assemblage with the diagnostic species :

- Dinopterygium cladoides
- Palaeohystrichophora infusorioides
- Xenascus ceratioides

very frequent :

- Palaeoperidinium pyrophorum
- Odontochitina striatoperforata
- Heliodinium voighti

. The continental microflora essentially contains bisacate pollen grains of Gymnosperms.

. Palynofacies : Coaly organic facies.

.../...

2.2.1.2.2 - 3648 - 3720 NC VI b Zone - Surculosphaeridium longifurcatum zone

3 sidewall core samples
3 cutting samples

- . Rich microplanktonic assemblage with the new important species,

S. longifurcatum
Hystrichosphaeridium cf. difficile

Presence of

P. infusorioides

Occasional specimens of Xiphophoridium alatum and Endoscri-nium campanula at 3648/54 m.

- . The bisaccate pollen grains are predominant in the terre-trial microflora.
- . All the samples contain coaly ligneous particules.

2.2.1.2.3 - 3734/37 - NC VI a Zone - Cyclonephelium membraniphorum zone

1 sidewall core sample

- . Several new species are recorded in this sample. These are :

C. membraniphorum
Stephodium coronatum
Hexagonifera chlamydata
Exochosphaeridium cf. bifidum

Rare

S. longifurcatum

Absence of

P. pyrophorum

- . The continental microflora and the palynofacies remain the same.

2.2.1.2.4 - 3738/39 - 3870 NC V c Zone - Lithosphaeridium siphoniphorum zone

4 sidewall core samples

2 cutting samples

- . Microplankton : The 3738/39 and 3740/41 are very poor. The main occurrence to note is the appearance of :

L. siphoniphorum at 3738/39.

The marine assemblage becomes richer at 3748/54 m and the interval 3748 - 3910 (sidewall core and cutting samples) shows a real, characteristic marine assemblage with abundant representatives of the species :

L. siphoniphorum
X. alatum
S. coronatum
Chlamydroporella nyei

- . The continental microflora and the coaly organic facies remain the same.
- . Age : CENOMANIAN.

2.2.1.2.5 - 3910 - 3936.80 (core 1) NC V b Zone - Ovoidinium scabrosum zone

1 core sample

1 cutting sample

- . Change in the composition of the microplanktonic assemblage at 3910 (cutting). This change becomes really conspicuous in the core 1.

Appearance of : Ovoidinium scabrosum
Batioladinium jaegeri
Pseudoceratium cf. dettmannae
Exochosphaeridium phragmites

Persistence of : L. siphoniphorum
St. coronatum

.../...

- . The bisaccate pollen grains of Gymnosperm are scarcely represented.
- . The palynofacies contain black ligneous particles and coals.
- . Age : UPPER ALBIAN.

2.2.1.2.6 - 3990 - 4040 NC V a Zone - Ascodinium D. 594 zone

3950 (Barren).

- . Rich although little diversified microplanktonic assemblage. The index fossil of this assemblage is :

"Ascodinium" sp. D. 594

Presence of :

Oligosphaeridium complex (abt)

Canninginopsis denticulata.

- . The terrestrial microflora is dominated by saccata pollen grains of Gymnosperms.
- . Coaly organic facies.
- . Age : ALBIAN.

2.2.2 - CALCAREOUS NANNOPLANKTON

2.2.2.1 - Introduction

13 sidewall core samples have been analysed between 3608 and 3785 m. All the samples (except one : 3658/61) provide extremely rich diverse assemblages of calcareous nannofossils.

Cretaceous nannofossils have been described in a number of papers and their stratigraphical importance has been amply demonstrated. Many of the species characteristic of the Upper Cretaceous evolved during the Cenomanian. The increase in diversity is a marked feature of Cenomanian and Turonian assemblages.

The microfossil assemblages recovered in 30/7-3 well have been compared and correlated with the nannofossil zonations proposed by CEPEK and HAY 1969 in U.S.A. and MANIVIT 1971 in France. The nannofossil zonations of CEPEK and HAY 1969 and MANIVIT 1971 are compared, and their relationships to the Upper Cretaceous stages are presented in Fig. 3.

The distribution of the main Calcareous Nannofossils species encountered in 30/7-3 well is shown on Plate 2.

2.2.2.2 - Zonation

- 3608 - 3643 - Micula staurophora Zone TURONIAN to CONIACIAN

5 sidewall core samples

Laffittius obliquus (abundant zone)

Micula staurophora

Lithastrinus floralis

Tranolithus exiguus - orionatus

Tetralithus pyramidus ...

.../...

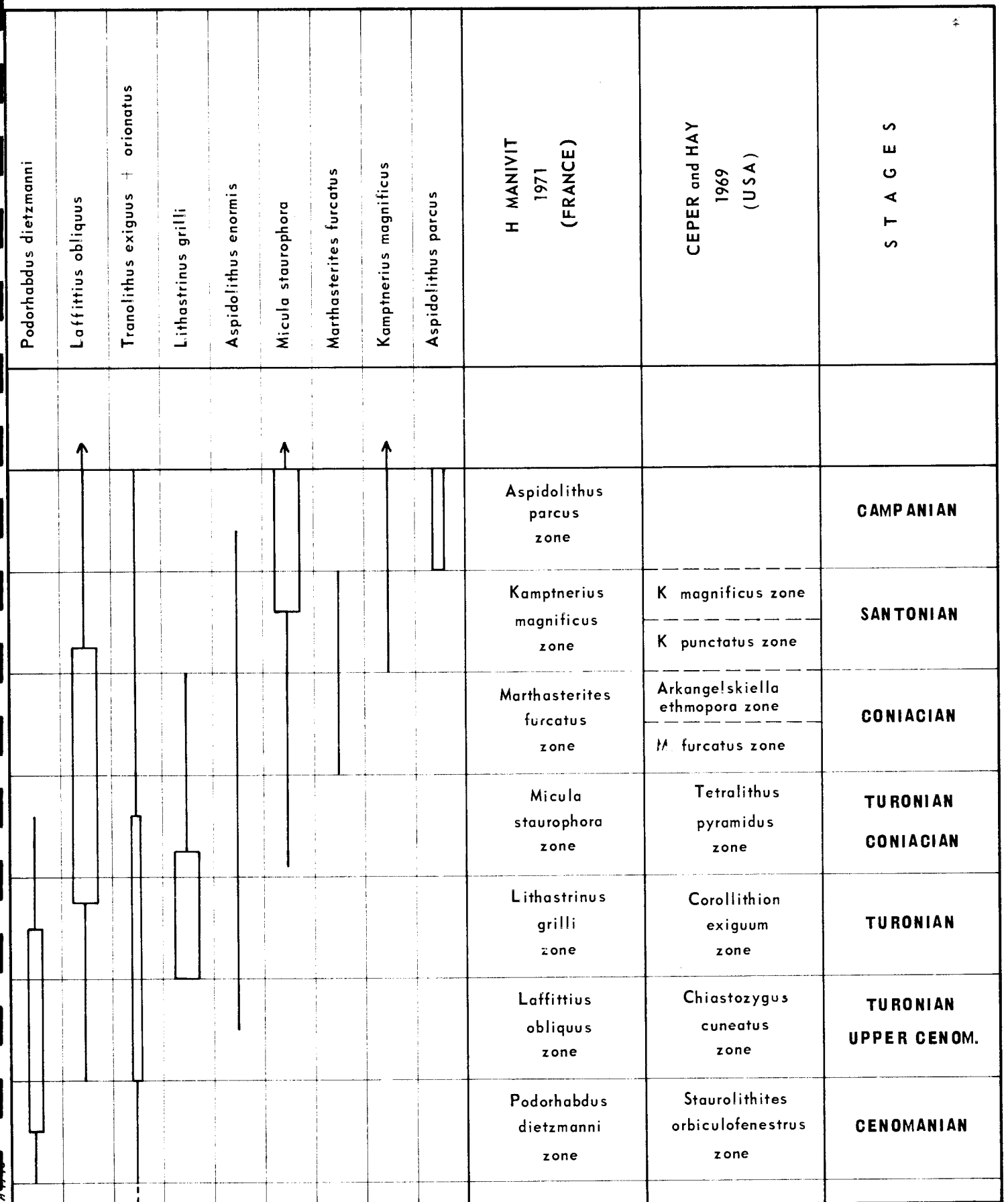


Fig 1 : CORRELATIONS OF UPPER CRETACEOUS (CENOMANIAN - CAMPANIAN)
CALCAREOUS NANNOPLANKTON ZONATIONS
OF MANIVIT 1971 AND CEPER & HAY 1969

- 3648 - 3736 - Lithastrinus Grilli Zone - TURONIAN

3 sidewall core samples

Lithastrinus grilli (abundance zone)

Laffittius obliquus

Ahmnerella octoradiata

Tranolithus exiguus - orionatus ...

- 3738 - 3785 - Laffittius obliquus Zone -
UPPER CENOMANIAN to TURONIAN

4 sidewall core samples

Laffittius obliquus

Aspidolithus enormis (abundance zone)

Lithastrinus floralis

Tranolithus exiguus - orionatus ...

2.3 - STRATIGRAPHIC DISCUSSION - COMPARISON BETWEEN
DINOFLAGELLATES, CALCAREOUS NANNOFOSSILS AND FORAMINIFERAL ASSEMBLAGES (see Fig. 2)

. 4040 - 3910 m :

Two marine microplanktonic assemblages (NC Va and NC Vb) are observed :

. 4040 to 3970 (NC Va) :

It shows strong ALBIAN affinities. The index of this interval is "Ascodinium" D.594 which is a well known marker of the EARLY ALBIAN in Norway. It cannot be ascertained on the basis of the palynological investigations of cutting samples whether their range is slightly disturbed by caving or not. No interesting foraminifera have been recovered.

. 3936,80 - 3910 m (NC Vb) :

It contains some restricted Albian dinoflagellates (*O. scabcosum* - *B. jaegeri* *P. dettmannae*) together with several species which are considered to first appear probably in the latest Albian (*L. siphoniphorum*) or in the Middle Albian (*S. coronatum*). The occurrence of these species indicate here a LATE ALBIAN age. This age assignment is in agreement with the Hedbergellids assemblage.

Therefore the interval 4040 - 3910 m is to be considered as ALBIAN.

. 3870 to 3738 m :

The microflora recovered between 3970 and 3738 m is homogeneous and assigned to CENOMANIAN (NC Vc zone). This microflora is rich, varied and well preserved, with numerous *L. siphoniphorum*, *X. alatum*, *S. coronatum*, *C. nyei*. It corresponds to a Cenomanian foraminifera assemblage up to 3745 m.

The nannofossils recovered between 3785 and 3738 m (*laffittius* zone) characterize rather an uppermost Cenomanian to lower Turonian age. This means that there is no gap between the Cenomanian and Turonian.

In spite of the age assignment by means of nannofossils, the interval 3910 - 3738 m is to be considered on the whole as CENOMANIAN based on the top of a regional palynological marker.

. 3737 to 3648 m :

The two zones NC VIa and NC VIb characterized by *C. membraniphorum*, *S. longifurcatum*, *X. alatum* and *E. campanula* (top = Turonian according to documentation) correspond to the *Lithastrinus grilli* zone (Turonian) and partly to the *P. cf. helvetica* - *G. cf. imbricata* interval.

Therefore the interval 3737 to 3648 m is of TURONIAN age.

. 3643 to 3608 m :

The well defined NC VIIa zone (*P. infusioroides* *X. ceratioides*, *D. cladoides*) corresponds to the *Micula staurophora* zone of CONIACIAN TO TURONIAN age.

3 - 30/10 - 5 WELL

3.1 - MICROPALEONTOLOGY

3.1.1 - INTRODUCTION

The micropaleontological study of 30/10-5, previously carried out on the series penetrated below 3800 m, has been extended upwards to the interval 3800 m - 3460 m.

The examination of the microfaunas has been performed on composite cutting-samples collected at about 5 to 10 m. intervals between 3600 m and 3800 m, at larger intervals above 3600 m. In addition, a few thin sections have been prepared from marly and calcareous samples collected between 3630 m and 3660 m.

3.1.2 - ZONATION AND STRATIGRAPHICAL REMARKS

The microfauna recovered from the whole interval consists mainly of epipelagic foraminiferal assemblages including abundant *Hedbergella* spp., *Globigerinelloides* spp., small *Heterohelicidae*, scarce *Clavihedbergella* spp. (in the lower part), together with scarce *Globotruncanidae* :

Praeglobotruncana gr. *petaloidea*
Praeglobotruncana *citae*
Globotruncana gr. *marginata*
Globotruncana gr. *lapparenti*
Globotruncana globigerinoides (= *G. cretacea*)
Globotruncana cf. *imbricata*, at 3792 m.

The subordinate benthonic species are represented by arenaceous forms such as :

Rhizamminidae
Hormosinidae
Saccamminidae
Valvulinidae/Verneuilinidae
Ammodiscus spp.
Glomospira spp.
Lituotuba spp.
Pelosina spp.
Acruliammina spp.
Spiroplectammina spp.

.../...

and calcareous ones :

Osangularia spp.
Rotaliidae s.l.
Reussella pseudospinulosa
Pullenia quaternaria
Pullenia cretacea
Gyroidinoides spp.
Eponides spp.
Stensioina praexculpta-granulata
small Buliminidae

The association includes Senonian index species and Upper Cretaceous long-ranging forms. The Ostracodes recovered from the interval belong to Senonian species.

However, it is worth noticing that the base of the section studied here contains a few foraminiferal species which may extend downwards to the Turonian :

Stensioina prae-exculpta-granulata, at 3755 m
Globotruncana cf. imbricata, at 3792 m.

The latter species has been encountered in the Turonian of 30/7-3.

The small Buliminidae observed locally at 30/10-5 below 3720 m, are present in the Turonian of 30/7-3.

Besides, scarce specimens of Clavhedbergella spp., and Hedbergella planispira occur in places below 3720 m.

These data would suggest a Turonian age for the strata penetrated by 30/10-5 between 3720/3750 m and 3800 m, and overlying the Cenomanian to Lower Turonian ? series previously identified.

3.2 - PALYNOLOGY

3.2.1 - INTRODUCTION

The palynological study of 30/10-5 well previously carried out on the series penetrated between 3790 and 3180 m 1), has been extended upwards to the interval 3793 - 3425.

18 samples have been processed : 13 sidewall core samples and 5 cutting samples. Marine microfossils are frequent from 3425 to 3605, and rather poor below this depth.

No Calcareous Nannoplankton study was carried out on these samples.

The palynological range chart of the microfossils is shown on Plate 4.

3.2.2 - PALYNOLOGICAL ZONATION

Three microplanktonic zones (NC VI a - NC VII a - NC VII b) are described and compared with the microplanktonic zones described in the 30/7-3 well.

3.2.2.1 - 3425 - 3473 m - NC VII b Zone - Xenascus ceratioides zone

3 sidewall core samples

. Rich microplanktonic assemblage with the diagnostic species

Xenascus ceratioides

Abundant

P. pyrophorum
O. striatoperforata
H. voigti ...

.../...

1) Biostratigraphical report on the Mesozoic series between 3790 and 5150 m.
P. DURIF - E. GROSDIDIER - J-F. RAYNAUD.

- . The continental microflora essentially contains bisaccate pollen grains of Gymnosperm and smooth trilete spores.
- . Palynofacies : Coaly organic facies (black ligneous debris and coals).
- . Age : CONIACIAN (SANTONIAN ?).

3.2.2.2 - 3495 - 3650 - NC VII a Zone - Dinopterygium cladoides zone :

6 sidewall core samples
2 cutting samples.

- . Rich dinoflagellate assemblage with appearance of
D. cladoides

Persistence of the main species mentioned above.

The two cutting samples (3550 - 3650) contain numerous upper Cretaceous caved dinoflagellates (Spongodinium delitiense, Deflandrea diebeli...).

- . The continental microflora, recovered on sidewall core samples, essentially contains bisaccate pollen grains and smooth spores. A representative of the Genus Aquilapollenites occurs at 3573 m.

The two cutting samples (3550 - 3650) contain some caved Angiosperm pollen grains referred to the genera Aquilapollenites, Integricorpus, Orbiculapollis, Expressipollis, Loranthacites...). These pollen grains are well known in the terrestrial assemblages from the Upper Cretaceous boreal provinces.

- . Palynofacies : Coaly organic facies with locally black powdery matter.
- . Age : TURONIAN to CONIACIAN.

3.2.2.3 - 3690 - 3793 - NC VI a Zone - Cyclonephelium membraniphorum - Stephodinium coronatum zone :

3 sidewall core samples
3 cutting samples.

- . Little change is to be noted in the microplanktonic assemblage with the appearance of some new species at 3690/95 (cutting sample).

This change becomes really conspicuous at 3730 m.

.../...

Appearance of :

S. coronatum

E. campanula

A. grande

C. membraniphorum

. The continental microflora and the organic facies remain the same.

. Age : TURONIAN.

3.3 - STRATIGRAPHIC DISCUSSION
COMPARISON BETWEEN DINOFLAGELLATES AND FORAMINIFERAL ASSEMBLAGES

. 4100 - 3808

Palynological assemblages described with the previous ① study are too poor to give an accurate stratigraphy for this interval.

Direct comparison with the zones described in 30/7-3 (NC V a-b-c) remains impossible.

The microfauna contains little of diagnostic value and suggests undifferentiated ALBIAN-CENOMANIAN up to 3842 m and CENOMANIAN between 3842 and 3808. The presence of *Rotalipora* gr. *turonica* at 3824 m would suggest that the top of the Cenomanian sequence is possibly passing to the Lower Turonian.

We conclude that the top of the Albian-Cenomanian interval occurs at 3808 m in 30/10-5.

. 3800 - 3690

The microflora is assigned to TURONIAN (NC VI a zone). It corresponds to a foraminiferal assemblage (*G1 imbricata*) of the TURONIAN age.

Therefore the interval 3800 - 3690 is to be considered as TURONIAN in age.

. 3650 - 3495

The NC VII a microflora recovered in this interval is assigned to TURONIAN-CONIACIAN. The microfauna in which the Globotruncanidae are the dominant elements suggest an undifferentiated SENONIAN.

Therefore, the interval 3600 - 3495 is to be considered as TURONIAN to CONIACIAN.

.../...

① Biostratigraphical report on the Mesozoic series between 3790 and 5150 m.

P. DURIF - E. GROSDIDIER - J.-F. RAYNAUD.

N° 6/1312 R - April 1976.

. 3473 - 3425

The NC VII b microflora is assigned to CONIACIAN and possibly to SANTONIAN. It corresponds partly, with the Globotruncanidae assemblage up to 3460.

The age of the NC VII b zone cannot be identified with certainty in section of 30/10-5 well. However, comparison with previously described NC VII assemblages shows that the upper part of the NC VII coincides with a nannofossil assemblage characterized by *Marthasterites furcatus*. The range of *M. furcatus* defines the CONIACIAN and SANTONIAN (see Fig. 3).

Thus, on nannoplankton evidence the NC VII b zone appears to be CONIACIAN and perhaps SANTONIAN

4 - CONCLUSIONS

4.1 - STRATIGRAPHICAL ZONATION IN 30/7-3 WELL

The following stratigraphical succession may be inferred from this study :

- 3608 - 3636 - CONIACIAN-TURONIAN
- 3648 - 3737 - TURONIAN
- 3738 - 3905 - CENOMANIAN
- 3910 - 4040 - ALBIAN

We feel that the sequence in 30/7-3 well starts with ALBIAN at 4040 m. No Jurassic elements have been observed in the cutting samples ; on the other hand, it may be assumed that the TURONIAN is evident in this well

4.2 - STRATIGRAPHIC CORRELATIONS WITH 30/10-5 well

4.2.1 - The top of the CENOMANIAN unit occurs at :

- 3738 m in 30/7-3 well
- 3808 m in 30/10-5 well

4.2.2 - The top of the TURONIAN unit occurs at :

- 3648 m in 30/7-3 well
- 3690 m in 30/10-5 well

.../...

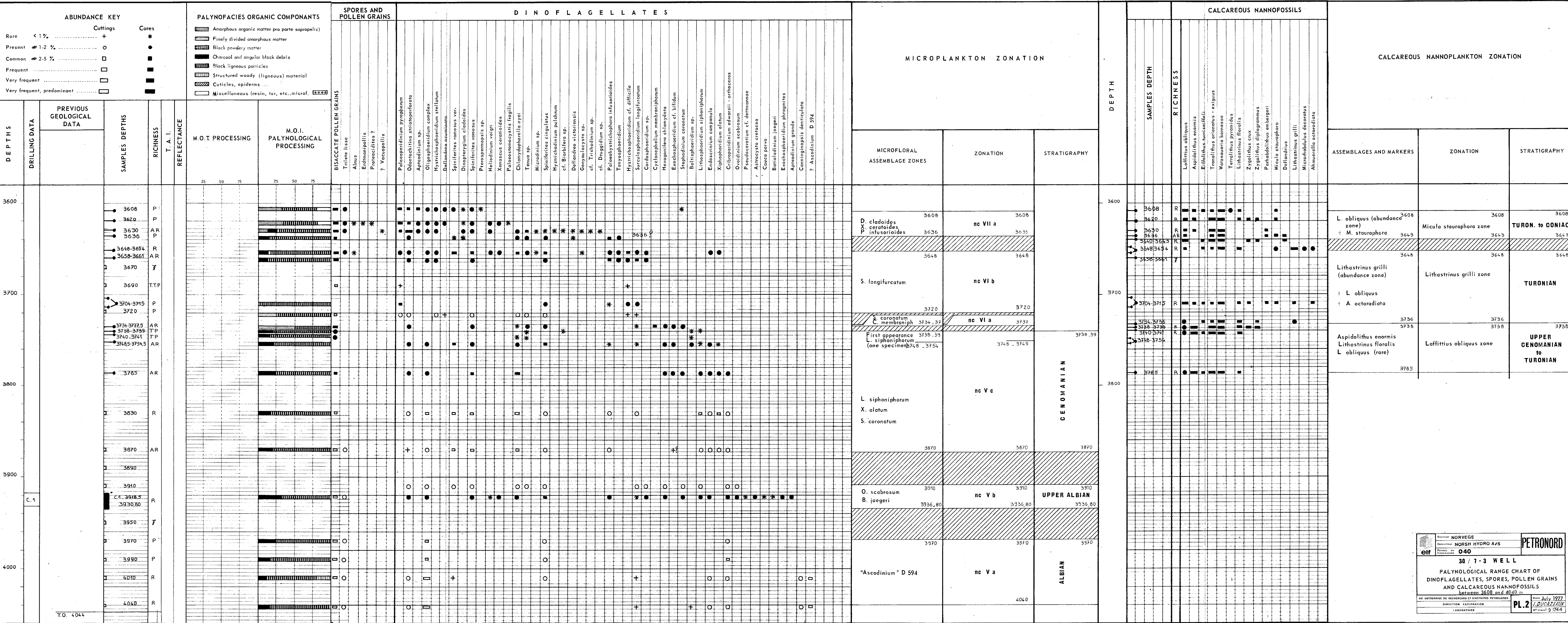
The palynological correlations show a NC VI a microflora, reduced in 30/7-3 (3734/37 m) and fairly thick in 30/10-5 (3793-3690 m). Inversely the NC VI b microflora is evident in 30/7-3 and has not been observed in 30/10-5. There is an interval of uncertainty between the base of the NC VII a and the top of the NC VI a.

It may be assumed that these NC VI zones are roughly equivalent, that is of TURONIAN age, but no conclusion may be drawn from the relationships between NC VI a and NC VII a.

4.3 - The base of the NC VII a occurs at :

3626 m in 30/7-3 well

3650 m in 30/10-5 well



ABUNDANCE KEY

Rare < 1%	Cuttings +	Cores *
Present # 1-2 %	○	●
Common # 2-5 %	□	■
Frequent	◻	◼
Very frequent	◻	◼
Very frequent, predominant	◻	◼

PALYNOFACIES ORGANIC COMPONENTS

- Amorphous organic matter pro parte sapropelic
- Finely divided amorphous matter
- Black powdery matter
- Charcoal and angular black debris
- Black ligneous particles
- Structured woody (ligneous) material
- Cuticles, epiderms
- Miscellaneous (resin, tar, etc..microf.)

SPORES AND POLLEN GRAINS

BISACCATE POLLEN GRAINS

- Trilete lisae
- Alnus
- Erdmannipollis
- Protocidites ?
- ? Vaccinipollis

DINOF LAGELLATES

- Palaeoperidinium pyrrophorum
- Odonochitina striatoperforata
- Aptedinium sp.
- Oligosphaeridium complex
- Hystriosphæroidium striatum
- Deflandrea acuminata
- Spiniferites ramosus var.
- Dinoptygium cladoides
- Spiniferites ramosus
- Parasponopsis sp.
- Heliodinium volgii
- Xenosus ceratoides
- Palaeostomocystis fragilis
- Chlamydompharella nyei
- Tenua sp.
- Microdinium sp.
- Spiniferites cingulatus
- Hystriochidium pulchrum
- cf. Blorbifera sp.
- Deflandrea victorinensis
- Gonyaulacysta sp.
- cf. Trichodinium sp.
- cf. Draggidium sp.
- Palaeohystrichophora infusorioides
- Tomyosphaeridium
- Hystriosphæroidium cf. difficile
- Sarcosphaeridium longifurcatum
- Cordosphaeridium sp.
- Cyclonephellium membraniphorum
- Hexagoniterra chamydata
- Exochosphaeridium cf. bifidum
- Stephodinium coronatum
- Baltisphaeridium sp.
- Lithosphaeridium siphoniphorum
- Endoscrinium campanula
- Xiphophoridium alatum
- Cribroperidinium edwardsii - orihoceras
- Ovoidinium scabrosum
- Pseudoceraurum cf. detmannae
- Astrocysta cretacea
- Cauca parva
- Berliodinium jaegeri
- Exochosphaeridium phragmites
- Aptedinium grande
- Canningtopsis denticulata
- ? Ascodinium D 594

MICROPLANKTON ZONATION

MICROFLORAL ASSEMBLAGE ZONES	ZONATION	STRATIGRAPHY
D. cladoides X. ceratoides P. infusorioides	nc VII a	
S. longifurcatum	nc VI b	
S. coronatum C. membraniph	nc VI a	
L. siphoniphorum X. alatum S. coronatum	nc V c	CENOMANIAN
O. scabrosum B. jaegeri	nc V b	UPPER ALBIAN
"Ascodinium" D 594	nc V a	ALBIAN

CALCAREOUS NANNOFOSSILS

- Laffittius obliquus
- Aspidolithus enormis
- Elffittius buriseiffeli
- Tranolithus orionatus - exiguus
- Wernaueria barmesae
- Terralithus pyramibus
- Lithastrinus floralis
- Zygolithus caux
- Zygolithus diplogrammus
- Parhabdolithus embergeri
- Micula stauraphora
- Deflandria
- Lithastrinus grilli
- Microhabdulus decoratus
- Almuarella octoradiata

CALCAREOUS NANNOPLANKTON ZONATION

ASSEMBLAGES AND MARKERS	ZONATION	STRATIGRAPHY
L. obliquus (abundance zone) + M. stauraphora		TURON. to CONIAC.
Lithastrinus grilli (abundance zone) + L. obliquus + A. octoradiata	Lithastrinus grilli zone	TURONIAN
Aspidolithus enormis Lithastrinus floralis L. obliquus (rare)	Laffittius obliquus zone	UPPER CENOMANIAN to TURONIAN

T.O. 4044

Sector NORVEGE
Operateur NORSH HYDRO A/S
Primes de Concession 040
elf

PETRONORD

30 / T-3 WELL

PALYNOLOGICAL RANGE CHART OF
DINOF LAGELLATES, SPORES, POLLEN GRAINS
AND CALCAREOUS NANNOFOSSILS
between 3608 and 4040 m

DE ENTREPRISE DE RECHERCHES ET D'ACTIVITES PETROLIERES
DIRECTION EXPLORATION
LABORATOIRE

Date: July 1977
J. DUCAZEUX
N° chart D 1744
PL.2

DEPTH (in metres)	SAMPLING (cuttings)	TECHNICAL REMARKS	M	I	C	R	O	F	O	S	S	I	L	S	OSTRACODES	AGE	PALEOECOLOGY
3500		Inoceramus debris															
		Echinoid spines															
		Tubulures (pyritic)															
		Rhizamminidae															
		Small Haplophragmoides spp.															
		Eggerella sp.															
		Small Heterohelicidae	*														
		Small Globigerinidae (incl. Hedbergella)	*														
		Praglobotruncana gr. petaloidea	*														
		Globigerinelloides spp.	*														
		Haplophragmium sp.															
		Spiraplectamina spp.															
		Ossangularia spp.															
		Glomospira spp.															
		Hormesinidae															
		"Recurvoides" sp.															
		Ammodiscus spp.															
		Lituotuba spp.															
		Pseudoclavulina sp.															
		Praglobotruncana citae	*														
		Pelosina spp.															
		Valvulinidae															
		Globotruncana gr. marginata	*														
		Allomorpha sp.															
		Rugoglobigerina / Hedbergella spp.	*														
		Saccaminidae															
		Reussella pseudospinulosa															
		Pullenia quaternaria															
		Rotaliidae s.l.															
		Globotruncana spp.	*														
		Verneuilinidae															
		Lagenidae															
		Arenaceous Foram. (indet.)															
		Allomorpha minuta															
		Acutilamina spp.															
		Lenticulina spp.															
		Dictyonitra ? (Radiolaria)	*														
		Gaudryina / Dorothis															
		"Biglobigerinella" sp.	*														
		Pseudoglandulina sp.															
		Bolivinoidea gr. decoratus															
		Plectina spp.															
		Gyrogonoides spp.															
		Gaudryinella / Trifaraxia															
		Polymorphinidae															
		Pullenia cretacea															
		Globotruncana gr. lapparenti	*														
		Bolivina sp.															
		Ammonitella ? sp.	*														
		Heterohelix cf. moremani	*														
		Sponge spicules															
		Pullenia spp. (globular)															
		Globorotalites spp.															
		Eponides spp.															
		Clavohedbergella spp.	*														
		Small Bulimina spp.															
		Pseudovalvulineria spp.															
		Stensioina praesculpta - granulata															
		Hedbergella planispira	*														
		Globotruncana globigerinoides	*														
		Radiolaria	*														
		Pseudogumbelina cf. excolata	*														
		Globotruncana cf. imbricata	*														
		Globules (pyritic)															
		Gavelinopsis sp.															
		Arenobulimina spp.															
		Glomospirella spp.															
		Dorothis cf. gradata															
		Rotalipora gr. turonica	*														
		Pleurostomella spp.															
		Rotalipora ? sp.	*														
		Debris & indet.															
		Cytherella sp. sp.															
		Bairdia sp. sp.															
		"Argilloecia" sp.															
		Phacohabdotus ? sp.															
		Eucytherura sp.															

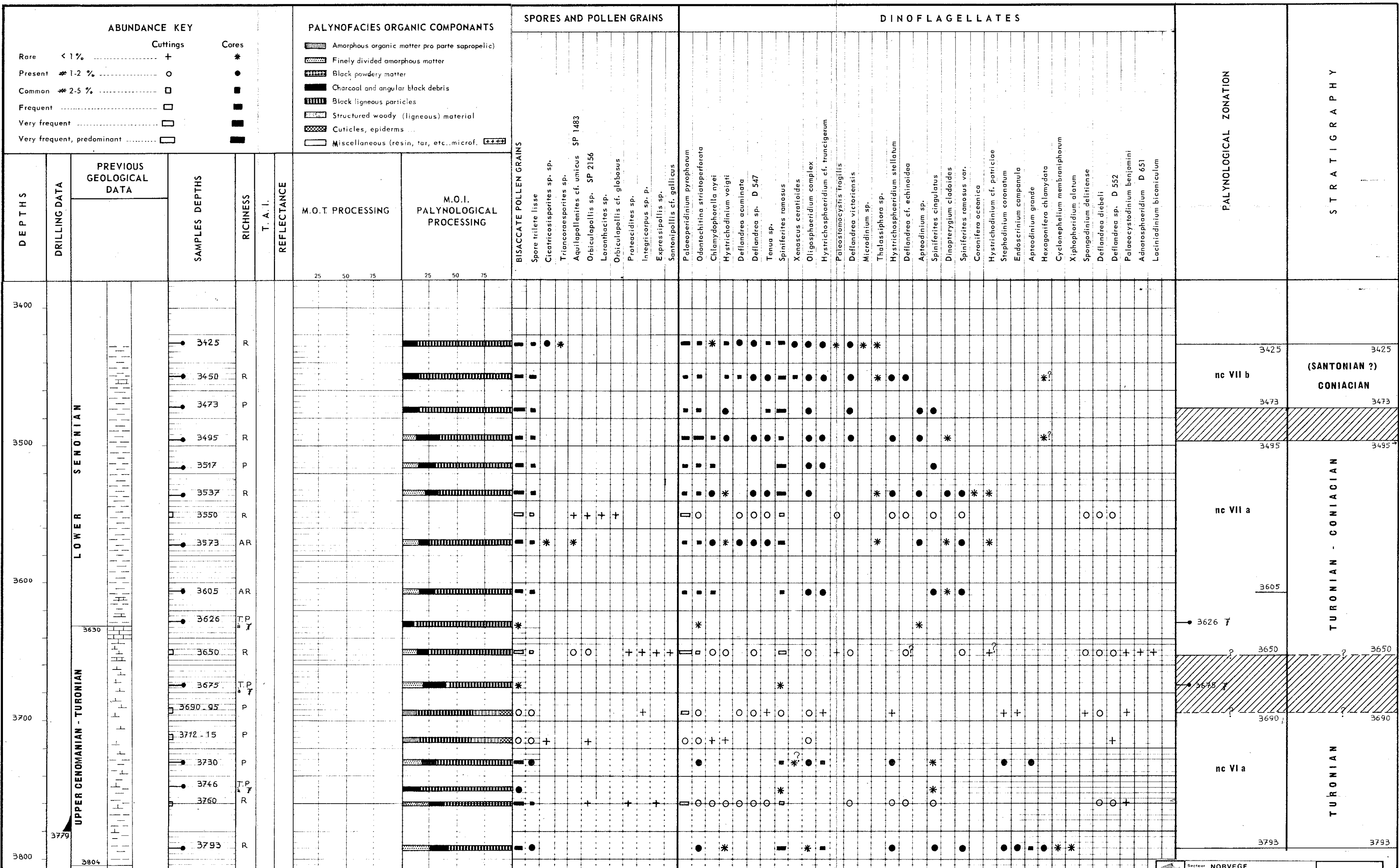
FREQUENCY OF SPECIMENS

- 1 specimen
- 2 - 5 specimens
- 6 - 10 specimens
- 11 - 20 specimens
- > 20 specimens
- * Pelagic forms

(TURONIAN ?)
3808 ?
L. TURON. ?
GENOMAN.

S E N O N I A N
O P E N M A R I N E
(± abundant epipelagic microfauna)

elf	Secteur NORVEGE	PETRONORD
	Opérateur NORSH HYDRO A/S	
	Permis ou Concession 040	
30 / 10 - 5 W E L L		
DISTRIBUTION CHART OF MICROFOSSILS		
(Interval 3460 - 3800 m)		
Echelle: 1/2000		
OP ENTREPRISE DE RECHERCHES ET D'ACTIVITES PETROLIERES		Date July 1977
DIRECTION EXPLORATION		PL.3
LABORATOIRE		N° de dossier C 1745



Secteur NORVEGE
 Operateur NORSH HYDRO A/S
 Permis ou Concession 040
elf

PETRONORD

30 / 10 - 5 WELL (NORWAY)
 PALYNOLOGICAL RANGE CHART OF
 DINOFLAGELLATES, SPORES AND POLLEN GRAINS
 BETWEEN 3425 AND 3793 m

OR ENTREPRISE DE RECHERCHES ET D'ACTIVITES PETROLIERES
 DIRECTION EXPLORATION
 LABORATOIRE

Date July 1977
 J. DUCAZEUX
 No. chart C 1746
PL.4

