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D. EXPLOR.
DEPARTEMENT GEOLOGIQUE CENTRAL
LABORATOIRES

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WELL 16/3-2 (NORWAY)

MICROPALAEONTOLOGICAL REPORT
(CRETACEOUS AND JURASSIC)

GEOLOGISK ARKIV

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ENCLOSURES

Plate n° 1 - Distribution chart of microfossils in the Upper Cretaceous

Plate n° 2 -- Distribution chart of microfossils in the Lower Cretaceous and the Jurassic.

1 - INTRODUCTION

The micropaleontological study of 16/3-2 well has been carried out on material examined from the interval 1470-2017 m (T.D.: 2019 m) which covers a stratigraphical series ranging from Maestrichtian to Jurassic.

Sampling :

The examination of free microfaunas has been made on cutting samples, collected at intervals of about 10 to 5 metres.

Summary of results (*) :

The Upper Cretaceous series penetrated by this well has been encountered at about 1480 m and ranges from the Maestrichtian to the Cenomanian. The foraminiferal assemblages are dominated by planktonic species consisting mainly of Globigerinidae, "Rugoglobigerina" and small Heterohelicidae in the Upper Senonian, of Globotruncanids in the Lower Senonian, and of Hedbergellids in the Lower Turonian and the Cenomanian. The stratigraphical subdivisions are substantiated by the presence of a few characteristic benthonic species. Ostracodes are present throughout the whole interval, but the assemblages consist mainly of juvenile forms that suggests conditions unfavourable to benthonic species. Both Foraminifera and Ostracode microfaunas are indicative of an open marine environment, fluctuating from outer neritic to upper bathyal conditions.

The Lower Cretaceous series has been encountered at about 1810 m. The stages identified range from Albian to Lower Hauterivian. The lower part of the Aptian and the Uppermost Barremian are not characterized here, but there is no evidence of a gap at this level. The thinness of the Hauterivian sequence is to be noted in this well. Both benthonic Foraminifera and Ostracode microfaunas, together with the persistence of more or less abundant small Hedbergellids, are indicative of open marine conditions during the Albian, Aptian and Barremian times.

The Upper Jurassic is characterized between 1960 m and 2078 m by the occurrence of numerous specimens of the species *Haplophragmoides infracallovienensis* (marine environment). The sandy sequence penetrated below, down to 2017 m, is probably poorly fossiliferous or even devoid of microfossils (Jurassic?).

More or less abundant contaminations are to be noted in places.

2 - ZONATION AND STRATIGRAPHICAL REMARKS

2.1 - Interval 1480-1560 m : Maestrichtian - Upper Campanian

The microfauna is dominated by planktonic foraminiferal assemblages consisting of :

* These micropaleontological results will be synthesized with the results of the palynological study now in progress.

Rugoglobigerina spp.
Globigerinidae
small Heterohelicidae
Globigerinelloides spp.

together with scarce Praeglobotruncana citae, Globotruncana cf. gr. lapparenti and questionable "Oligosteginas" at the top of the interval.

Among the subordinate benthonic forms, the following are the most representative :

Stensioina pommerana
Bolivinooides gr. draco
Bolivina incrassata gigantea
Bolivinooides gr. decoratus

Inoceramus debris and Echinoid spines are also present.

2.2 - Interval 1570-1590 m : Lower Campanian

This interval is characterized by the progressive appearance of the following species :

Stensioina pommerana juvenilis
Stensioina exculpta, abundant near the base
Globotruncana angusticarinata, rare

The planktonic foraminiferal assemblage consists essentially of Globigerinidae and "Rugoglobigerina" spp.

2.3 - Interval 1600-1685 m : Santonian - Coniacian (to Upper Turonian ?)

The microfauna is composed mainly of planktonic Foraminifera including various species of Globotruncanidae :

Globotruncana cf. arca
Globotruncana gr. marginata/bulloides, abundant
Globotruncana gr. lapparenti
Globotruncana coronata
Globotruncana globigerinoides
Globotruncana cf. imbricata ?, rare

together with Globigerinidae and Hedbergella spp., sporadic small Heterohelicidae and Globigerinelloides spp.; more or less abundant Radiolaria are present in the upper part and near the base of this zone. The occurrence of Praeglobotruncana ? gr. paradubia is to be noted in relatively large numbers at 1675 m (Upper Turonian ?).

The benthonic species are represented chiefly by :

Stensioina gracilis
Stensioina gr. praeexculpta
Bulimina reussi
Globorotalites subconica
Pseudovalvulineria spp.
Osangularia spp.

Gyroidinoides spp.
Lenticulina spp.

The Ostracode assemblages observed within this interval consist mainly of juvenile forms (unfavourable conditions in connection with "deeper" waters).

2.4 - Interval 1695-1805 m : Lower Turonian - Cenomanian

The uppermost part of this interval, down to about 1720 m, is marked by the occurrence of :

Clavhedbergella simplicissima
Praeglobotruncana turbinata
Praeglobotruncana cf. algeriana
Praeglobotruncana stephani, at 1720 m.

A Lower Turonian (to Upper Cenomanian ?) age may be assigned to this zone.

The lower part of this interval, between 1760 m and 1800 m, is characterized by the incoming of the following benthonic species :

Gavelinella gr. baltica/ammonoides
Gavelinella cf. intermedia
Gavelinella cf. rudis
Gavelinella umbilicitecta
Dorothia gradata

and the Ostracodes Cythereis gr. bonnemai (at 1770 m) and "Mandocythere harrisiana" (at 1790 m).

This association would be suggestive of a Lower Cenomanian age.

The remainder of the microfauna, encountered between 1695 m and 1805 m, consists of abundant epipelagic small Hedbergellids together with Lenticulina spp. and a few agglutinated forms : Arenobulimina spp., Eggerella spp., Ammodiscus spp....

The microfaunas observed within the whole interval are composed mainly of yellowish specimens, in contrast with the white-stained locally pinkish assemblages recovered from the series above.

2.5 - Interval 1810-1900 m : Albian (to Aptian ?)

The age determination is supported by the gradual appearance, within the interval, of the following species :

Spiroplectinata gr. complanata
Textularia foeda
Planulina schloenbachi
Gavelinella intermedia
Ammobaculites parvispira
Gaudryinella sherlocki

The remainder of the microfauna is represented chiefly by abundant arenaceous Foraminifera including :

H. (Trochammina ?) globosa
Haplophragmoides nonioninoides
Ammodiscus spp.
Glomospira spp.
Verneuulinoides spp.
Rhizamminidae

together with more or less abundant epipelagic small Hedbergellids, Lenticulina spp.... and scarce sporadic Ostracodes belonging to Lower Cenomanian - Middle Albian species.

The microfaunas are composed mainly of yellowish to light grey specimens. Between 1855 m and 1900 m, these microfaunas are locally reddish or greenish (at the base of the interval).

2.6 - Interval 1906-1918 m : Aptian

This interval contains reddish to light grey and whitish microfaunas including :

Gavelinella cf. barremiana
Verneuulinoides subfiliformis
Saracenaria spinosa
L. (Marginulinopsis) robusta
Cythereis cf. reticulata
Pontocyprrella HO A 46
Cytherura HO A 49
Eocytheropteron cf. lindamensis

together with more or less abundant Lenticulina, small Gyroidinoides, Glomospira, H. (Trochammina ?) globosa, Uvigerinammina, "Guttulina" and small Hedbergellids.

2.7 - Interval 1924-1936 m : Barremian

The microfauna is represented by reddish or whitish foraminiferal assemblages including :

Conorotalites gr. aptiensis/intercedens
Conorotalites intercedens
Conorotalites bartensteini
Gavelinella barremiana
Ammobaculites goodlandensis
L. (Marginulinopsis) sigali
Falsopalmula sp.
Lenticulina spp., abundant
Trochammina spp.
Hedbergella spp.

and the Ostracodes :

Protocythere inornata
Veeniacythereis blanda
Schuleridea gr. bilobata
Dolocythere longa
Pontocyprrella spp.

2.8 - Interval 1942-1954 m : Hauterivian

This interval is characterized by reddish or whitish, locally pyritic, foraminiferal assemblages consisting of :

Marssonella cf. oxycona (= Dorothis kummi)
Lenticulina gr. ouachensis
Meandrospira wachitensis
Gavelinella ? sigmoicosta
Lenticulina eichenbergi
Lagena hauteriviana hauteriviana
L. (Planularia) crepidularis
Marginulina pyramidalis
Lenticulina spp., abundant
"Guttulina" spp.
"Conicospirillina" spp.

The Ostracode fauna includes :

Macrocypris. gr. sp 2 GRUNDEL
Pontocyprrella mandelstami

Other Hauterivian Ostracode species were only observed below 1954 m. These caved specimens correspond more particularly to the species :

Schuleridea gr. thoerenensis
Cytherelloidea gr. ovata
Cytherelloidea gr. anomala

Most of the Ostracode species, especially those encountered at 1945/1954 m and below, are indicative of the Lower Hauterivian. The Hauterivian stage is represented by a relatively thin series in this well and seems to correspond in the main to the Lower Hauterivian.

Pyritic tubulures are to be noted within the interval.

2.9 - Interval 1960-2017 m : Jurassic

The upper part of the interval, down to about 1978 m, yielded a rich arenaceous microfauna consisting mainly of Haplophragmoides cf. infracallovienensis; this species is indicative of the Upper Jurassic.

Below 1978 m, the microfauna is represented by sporadic, probably caved Haplophragmoides cf. infracallovienensis and one specimen of the Jurassic Ostracode species Cytherella suprajurassica. Thus, only an inferred Jurassic age has been assigned to this zone.

3 - PALEOECOLOGY

The predominance of planktonic microfaunas is indicative of persistent open marine conditions in this area during the Upper Cretaceous. However, some fluctuations may be noted from the Cenomanian to the Maestrichtian.

The Cenomanian and the Lower Turonian are characterized by Hedbergellid assemblages, associated with scarce Praeglobotruncana towards the top; the ecology would correspond mainly to outer neritic conditions.

The abundant, keeled Globotruncanids observed in the Lower Senonian (to Upper Turonian ?) indicate deeper marine, probably upper bathyal environments; the Ostracodes recovered from this interval consist mostly of juvenile forms; this suggests conditions which are unfavourable to benthonic species, in connection with "deeper" waters. Moreover, the occurrence of keeled planktonic forms (Globotruncanids) suggests the probable inflow of warm waters.

The Campanian and the Maestrichtian are marked by the progressive disappearance of keeled planktonic species and the development of Globigerinidae, "Rugoglobigerina" and small Heterohelicidae. This would suggest a tendency to shallower, probably outer neritic conditions.

Open marine conditions were present during the Lower Cretaceous times, from the Albian to the Barremian. This is supported by the occurrence of more or less abundant small Hedbergellids which may be considered "in situ" on account of the staining of their tests.

The Albian microfauna is dominated by agglutinated Foraminifera; the Ostracodes are scarce and sporadic, probably as a result of too deep marine conditions. More abundant calcareous benthonic Foraminifera have been observed in the Aptian and Barremian series; they are predominantly Lagenids, together with Gavelinella and Conorotalites. The Ostracode fauna is dominated by several species of Pontocyprilla while shallow marine benthonic forms are very scarce and poorly preserved. The ecology would correspond mainly to outer neritic conditions.

The microfaunas recovered from the Upper Jurassic shales consist essentially of abundant Haplophragmoides cf. infracallovienensis, which are indicative of a marine environment. The underlying sandy sequence, penetrated down to 2017 m (top of basement strata) yielded only sporadic, possibly caved microfaunas.

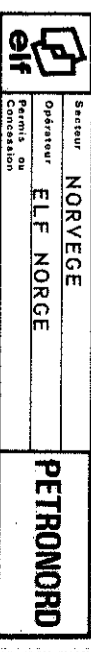
D E P T H S (in metres)		S A M P L I N G (cuttings)		T E C H N I C A L R E M A R K S	
		± abundant contaminations (cavings)			
				Inoceramus debris	
				Lenticulina spp	
				* Hedbergella spp	
				* Globigerinelloides spp	
				Arenobulimina spp	
				Ammodiscus spp	
				Glamospira spp	
				Gyroidinoides / Valvulinera spp	
				Lagenidae	
				Textularia foeda	
				Spiroplectinata gr. complanata	
				Planulina schloenbachi	
				H. (Trochammina?) globosa	
				Rhizamminidae	
				Ammobaculites parvispira	
				Vaginulina spp	
				Gavelinella spp	
				Gavelinella intermedia	
				Haplophragmoides nonioninoides	
				Verneulinoides spp	
				Gavelinella cf. barremiana	
				Lagenidae (costate)	
				Eggerella spp	
				Pseudosigmoilina antiqua	
				Ramulina aculeata	
				Marssonella cf. trochus	
				Uvigerinamina sp	
				Pelosina sp	
				Gaudryinella sherlocki	
				Dorothia filiformis	
				Tristix excavata	
				Marssonella oxycona	
				Reophax minuta	
				Foraminifera, indet-genus	
				Saracenaria spp	
				Verneulinoides subfiliformis	
				Lagena spp	
				Saracenaria spinosa	
				Gaudryina dividens	
				L. (Marginulinopsis) robusta	
				"Guttulina" sp	
				Gaudryina / Dorothia spp	
				L. / Vaginulinopsis cf. schreiteri	
				Gavelinella barremiana	
				Conorotalites gr. aptiensis / intercedens	
				Marssonella cf. oxycona (= Dorothia kummi)	
				? Verneulina / Eggerella sp	
				Lenticulina gr. ouachensis	
				Verneulinoides neocomiensis	
				Pseudoglandulina spp	
				Conorotalites intercedens (+ bartensteini)	
				Lingulina sp	
				Ammobaculites goodlandensis	
				Haplophragmoides sp (large size)	
				Trochammina spp	
				Saracenaria bronni	
				L. (Marginulinopsis) sigali	
				Falsopalmula sp	
				Meandrospira washitensis	
				Tubulures (pyritic)	
				Gavelinella ? sigmoicosta	
				Lagena hauteriviana hauteriviana	
				Lenticulina eichenbergi	
				Pseudoglandulina humilis	
				Pseudoglandulina mutabilis	
				L. (Planularia) crepidularis	
				"Conicospirillina" spp	
				Marginulina pyramidalis	
				Haplophragmoides infracalloviensis	
				Haplophragmoides (debris)	
				* Dictyomitra (pyritic)	
				Debris + indet.	
				Cytherella cf. ovata	
				"Mandocythere" HOB 51	
				Cytherella cf. parallela	
				Cythereis bonnemai	
				Pontocyprilla HO A 34	
				Cytherella sp sp	
				Cythereis cf. reticulata	
				Pontocyprilla sp sp	
				Pontocyprilla HO A 46	
				Cytherura HO A 49	
				Eocytheropteron cf. lindumensis	
				Protoargilloecia parva	
				Pontocyprilla sp (small size)	
				Pontocyprilla sp (plump)	
				"Protocythere" inornata	
				Schuleridea gr. hammi	
				Orthonatocythere inornata	
				Genus: sp A NEALE	
				Veiniacythereis blanda (broken)	
				Schuleridea gr. bilobata	
				Apatocythere ? sp	
				Dolococythere longa	
				Bairdia sp	
				Macrocypris gr. sp 2 GRUNDEL	
				Paracypris ? sp	
				Asciocythere sp	
				Pontocyprilla mandelstami	
				Schuleridea gr. thoerensis	
				Parexophthalmocythere (broken)	
				Cytherelloidea gr. ovata	
				Cytherelloidea gr. anomala	
				Schuleridea sp	
				Cytherella suprajurassica	
				CENOMANIAN S.L.	
				1805	
				1810	
				ALBIAN	
				(TO APTIAN ?)	
				1900	
				1906	
				1918	
				1924	
				1936	
				1942	
				1954 HAUTERIVIAN	
				1960	
				1972	
				UPPER JURASSIC	
				JURASSIC ?	
				Basement	
				M A R I N E	
				(with more or less open marine influences)	
				A G E	
				P A L E O C O L O G Y	

FORAMINIFERA (+ other microfossils)

OSTRACODA

FREQUENCY OF SPECIMENS

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


STATOIL NORVEGE
ELF NORVEGE
PETRONORD

W E L L 16 / 3 - 2
DISTRIBUTION CHART OF MICROFOSSILS
IN THE LOWER CRETACEOUS AND THE JURASSIC

MI ENTREPRISE DE RECHERCHES ET D'ACTIVITES PETROLIERES
 PETROLIUM EXPLORATION
 LABORATOIRE
 Date: JUNE 76
 No. 1018
 No. 1018
 No. 1018
PL.2
 No. 1018
 No. 1018
 No. 1018