CANADA

DEPARTMENT OF ENERGY, MINES AND RESOURCES

Geological Survey of Canada

BIOSTRATIGRAPHY AND DEPOSITIONAL HISTORY OF AMOCO IMP SKELLY B-1 EGRET K-36 GRAND BANKS, NEWFOUNDLAND

by

F.M. Gradstein, W.A.M. Jenkins, and G.L. Williams

OPEN FILE 396

OTTAWA
1976

BIOSTRATIGRAPHY AND DEPOSITIONAL HISTORY OF AMOCO IMP SKELLY B-1 EGRET K-36 GRAND BANKS, NEWFOUNDLAND

F.M. Gradstein, W.A.M. Jenkins and G.L. Williams

Abstract

Dinoflagellates, foraminifers, ostracods and spores in the Amoco Imp Skelly B-1 Egret K-36 well, Grand Banks, Newfoundland indicate the presence of over 10,000 feet of Upper Jurassic through Miocene rocks. Cenomanian and upper Maastrichtian to lower Eocene strata appear to be missing.

The depositional environment was mostly shallow marine. Kimmeridgian beds are brackish in part, and in Turonian time bathyal conditions may have occurred, becoming rapidly shallower during Senonian time. Sedimentation rates in Late Jurassic time exceeded 5 cm/1000 y, but after that varied from less than 0.5 to 2.8 cm/1000 y.

The Late Jurassic-Early Cretaceous foraminiferal fauna with prolific *Pseudocyclammina jaccardi* and also *Anchispirocyclina lusitanica* and *Choffatella decipiens*, and the rich Turonian plankton fauna is of Tethyan affinity. This is the northernmost occurrence to date of these Jurassic-Early Cretaceous species on the North American continent.

An appendix lists selected shelly and organic-walled microfossils for each stratigraphic interval.

Introduction

This report describes the biostratigraphy, chronostratigraphy and depositional history of the Amoco Imp Skelly Egret K-36 well located on the northeastern Grand Banks, 200 statute miles east-southeast of St. John's, Newfoundland at 46° 25' 37.88"N, 48° 50' 22.38"W (Fig. 1). The well is 27 statute miles northeast of Amoco IOE A-1 Murre G-67 and 43 statute miles south of Mobil Flying Foam I-13. It was spudded the 12 July 1973 in 223 feet of water and drilled to a total depth of 11,000 feet, with casing set at 486, 828, 2500 and 6503 feet. The well was drilled as a new field wildcat. No significant hydrocarbon shows were encountered. The well was abandoned the 10 September 1973. The above technical data are after Amoco Canada Petroleum Company Ltd. (1974).

The biostratigraphy, chronostratigraphy and depositional environment interpretations described below are based upon the vertical distribution in Egret K-36 of dinoflagellates, spores, foraminifers and ostracods in cuttings between total depth at 11,000 and 860 feet. The cuttings are composite samples taken over intervals of 30 feet. Dinoflagellate-spore assemblages have also been studied from 48 sidewall cores (SWC) between 10,995 and 3645 feet. All footages were measured from the rotary table standing 98 feet above sea level and 321 feet above the seafloor.

Stratigraphy

The well Egret K-36 is located in the Jeanne d'Arc sub-basin on the eastern margin of the Grand Banks. The well penetrates a more or less complete marine Upper Jurassic-Lower Cretaceous sequence, unlike most of the other wells drilled so far on the Banks, in which the top of the Jurassic and most or all of the Lower Cretaceous, are absent. It appears that the (angular) unconformity which developed in the Early Cretaceous time on the Grand Banks (Amoco 1974) is absent on both the southwestern (Jenkins *et al.* 1974) and northeastern parts.

The foraminiferal and palynological stratigraphy in the Egret K-36 well are treated together. The foraminiferal zonation is informal, except for the late Cretaceous *Globotruncana helvetica* and *Globotruncana carinata* Zones which follow Postuma's (1971) "General Zonation". The Jurassic foraminiferal biostratigraphy is dealt with in Gradstein (in press); the Tertiary foraminiferal zones are as defined in Gradstein and Williams (1976). The palynological zones are as defined by Williams (1975).

The lowermost 3700 feet (11,000-7300 feet) in Egret have been dated Late Jurassic. A sidewall core sample at 10,955 feet contains two dinoflagellate species, *Muderongia simplex* Alberti and *Parvocavatus tuberosus* Gitmez, which are not known from pre-Oxfordian sediments. No taxa characterising the *Valensiella vermiculata* Zone of Callovian age were observed in the cuttings sample from T. D. 11,000 to 10,970 feet, so that the well appears to bottom in the *Gonyaulacysta jurassica* Zone of Oxfordian-early Kimmeridgian age. The zone extends from 11,000 to 10,200 feet. The foraminiferal assemblage at this depth contains abundant *Pseudocyclammina jaccardi* (Schrodt) which indicates the bottom beds in Egret K-36 to be not older than late Oxfordian. The presence of *P. jaccardi* represents the northernmost occurrence of this "Tethyan" species on the North American continent (see also Dilley 1973, Gradstein in press).

The species of foraminifers present in this and subsequent stages are listed in Appendix A; the dinoflagellates and spores present throughout the well are given in Appendix B.

The (late) Kimmeridgian extends from 10,200-8237 feet and contains some of the dinoflagellate species which characterise the *Gonyaulacysta cladophora* Zone in other wells in this area (Gradstein *et al.* 1975). Abundant brackish water ostracods are present between 9400 and 9000 feet (see Appendix A).

The *Ctenidodinium panneum* Zone of Portlandian age is recognised between 8142 and 7300 feet. Spores and dinoflagellates are common and permit correlation with other Grand Banks-Scotian Shelf wells. The foraminifers include the Tethyan species *Anchispirocyclina lusitanica* (Egger), previously unrecorded so far north of this continent (Gradstein in press).

Lower Cretaceous sediments extend from 7286 to 4425 feet. The interval 7286-6500 feet is assigned to the *Phoberocysta neocomica* palynomorph Zone, tentatively dated Berriasian-Valanginian. Dinoflagellates present include *Imbatodinium kondratjevi* Vozzhennikova and *Lanterna sportula* Dodekova. The spore *Classopollis echinatus* Burger is common in the lowermost 300 feet. Foraminifers are absent. The succeeding *Ctenidodinium elegantulum* Zone extends from 6420 to 5600 feet. The palynomorph assemblages are dominated by spores, with a few rare dinoflagellates including *Muderongia simplex*. This interval is tentatively dated as Hauterivian. The presence of the foraminifer *Buccicrenata italica* between 5630-5500 feet suggests a Neocomian age for this interval.

The interval 5550-4900 feet is included in the *Tenua anaphrissa* palynomorph Zone of Barremian age. Spores are abundant, with *Cerebropollenites mesozoicus* (Couper) Nilsson being common in some samples. The single dinoflagellate species is *Pseudoceratium pelliferum* Gocht. The succeeding *Subtilisphaera perlucida-Systematophora schindewolfi* palynomorph Zone of probable Aptian age extends from 4830 to 4750 feet. The palynomorph assemblages are dominated by spores. According to the foraminiferal-ostracod data, the interval 5430-4700 feet is included in the *Choffatella decipiens* assemblage of Barremian-early Aptian age. This shows reasonably good correlation with the palynological age assignments.

The *Spinidinium* cf. *vestitum-Eucommiidites minor* palynomorph Zone of Albian age extends from 4730 to 4425 feet. Spores predominate, although there are a few dinoflagellates - including *Cleistosphaeridium polypes* (Cookson and Eisenack) Davey and *Cribroperidinium orthoceras* (Eisenack) Davey. Foraminifers are absent. According to the well logs there is an unconformity between 4600 and 4400 feet, probably at 4418 feet. This would agree with the paleontological data, since the Albian appears to be immediately overlain by Turonian sediments (there being no evidence for Cenomanian rocks.

Sediments assigned to the *Globotruncana helvetica* foraminifer Zone of Turonian age are present in the interval 4430-3860 feet. Planktonics are abundant in the carbonate sequence, with *Globotruncana helvetica* Bolli and other species of this genus, and also *Gavelinella* and *Praeglobotruncana*. The affinities are distinctly Tethyan (Douglas 1972). The equivalent palynomorph zone, the *Surculosphaeridium longifurcatum* Zone, extends from 4335-3950 feet. Dinoflagellates are dominant, spores few or absent. The assemblages are similar to those described from coeval sediments on the western Grand Banks and Scotian Shelf (Williams 1975).

The foraminiferal data recognise Turonian to Santonian age sediments from 3800 to 3660 feet, the *Globorotruncana carinata* Zone of Santonian age at 3030-3000 feet and the *Globotruncana arca* assemblage of Campanian-early Maastrichtian age at 2630-2600 feet. Foraminifers are sparse throughout most of this coarse clastic sequence. The palynomorphs in the same interval are occasionally abundant. The *Oligosphaeridium pulcherrimum* Zone of Coniacian age

extends from 3890-3745 feet. Species not ranging into younger sediments include *Hystrichosphaeridium stellatum* Maier and *Oligosphaeridium pulcherrimum* (Deflandre and Cookson) Davey and Williams. The *Hystrichosphaeridium truncigerum* Zone, dated Santonian, is recognised between 3645 and 2690 feet. The sidewall core from 3645 feet contains reworked Early Cretaceous species including *Muderongia perforata* Alberti, *Callialasporites dampieri* (Balme) Dev and *Corollina torosus* (Reissinger) Klaus.

The succeeding *Odontochitina operculata* Zone, of probable Campanian age, is recognised in the cuttings sample from 2630-2600 feet. Within this interval, specimens of caved Maastrichtian-Danian species indicate sediments of this age between 2600 feet and questionable middle Eocene at 2540 feet. The well logs indicate a possible unconformity at 2525 feet. We assume a hiatus with part, or all, of the (upper) Maastrichtian to lower Eocene missing.

The interval 2540-2510 feet contains abundant radiolarians and diatoms. This deposit may correlate with pre-late Eocene pelagic sediments in other Grand Banks wells (e.g. in Puffin B-90) and is tentatively dated middle Eocene (Appendix A). Palynologically, the interval from 2540 to 2330 feet is Eocene, further subdivision being impossible. The Pteropod sp. 1 zone, of late Eocene age is recognised between 2360 and 1850 feet, and is overlain by sediments assigned to the Oligocene *Turrilina alsatica* zone from 1810-1580 feet. The upper Eocene-Oligocene is rich in benthonic foraminifers (see Appendix A) common on the Labrador Shelf and well known from the North Sea Basin (e.g. Batjes 1958). The foraminiferal data show a slight disagreement with the palynological data. The dinoflagellate *Deflandrea heterophlycta* Zone is recognised between 2180 and 1240 feet. The age of this zone is early Oligocene. The base of the Oligocene palynologically is therefore approximately 300 feet lower than that indicated by the foraminifers. This may be due to the Eocene dinoflagellates having depressed "tops" in Egret K-36.

The interval in Egret K-36 from 1550 to 1040 feet corresponds to the foraminiferal *Spiroplectammina carinata* Zone of Oligocene-(Middle) Miocene age. The presence of the dinoflagellate *Deflandrea spinulosa* at 1040-1070 feet indicates Oligocene strata.

The uppermost samples of the well at 980-950 and 890-860 feet are of Miocene age with the spore zone of *Bombacacidites* sp. A and the foraminiferal zone of *Asterigerina gurichi*.

There appears to be a more or less unbroken depositional history of the well Egret K-36 from the Oxfordian to the Albian, although part of the Aptian may be absent. The Cenomanian has not been recognized, the Albian apparently being overlain by Turonian sediments. The succeeding Late Cretaceous stages are all present, with the possible exception of the Maastrichtian. The Paleocene, if present, must be condensed, since the Campanian extends to within 60 feet of Eocene sediments. The youngest dated sediments are of Miocene age.

Depositional Environment

The depositional environment of the sediments in the Amoco Imp Skelly Egret K-36 well is illustrated in Figure 2. The width of the paleo waterdepth curve reflects the "confidence interval" of the interpretation.

The Upper Jurassic and Lower Cretaceous interval, from 11,000 to 4418 feet is of nonmarine to marginal marine and shallow marine character.

From 11,000 to 10,000 feet (Oxfordian-Kimmeridgian) a rich, "larger foraminifera" fauna occurs with *Pseudocyclammina jaccardii* and a few smaller benthonic forms, indicating a shallow marine environment.

From 9500-9000 feet (Kimmeridgian) there is a rich ostracod fauna including *"Metacypris" forbesi, Bisulcocypris, Darwinula, Paracypris,* many charophyte sporangia and the foraminifer *Eoguttulina*. The fauna may be of brackish origin.

From 9000-7800 feet (Kimmeridgian-Tithonian) samples are virtually devoid of fauna taken as reflecting marginal marine conditions. The larger foraminifer occurrence at 7830-7590 feet of *Anchispirocyclina lusitanica* with *Buccicrenata, Eoguttulina* and *Trocholina* in a biomicritic peloid to oolithic packstone (L. F. Jansa personal communication) indicates very shallow marine conditions.

From about 7500 to 5800 feet (Tithonian-Hauterivian) the microfossils, include only spores and a few ostracods; sideritic concretions are abundant. The environment is taken as nonmarine to marginal marine.

The Lower Cretaceous interval from 5800 to 4750 feet (Hauterivian to Aptian) contains gastropods, bryozoans, some foraminifers, including *Choffatella* and *Buccicrenata,* ostracods and a varied dinoflagellate/spore assemblage. The environment is interpreted as shallow marine. The ?Albian sediments at 4730-4425 feet with spores, some dinoflagellates, coal fragments and sideritic concretions may be of nonmarine to marginal marine origin.

Above the unconformity at 4418 feet there are over 500 feet of Turonian carbonatic sediments with a rich, diversified planktonic foraminifer fauna of globotruncanids with several single keeled taxa. Environment was relatively open marine, possibly deep shelf to slope (bathyal).

The younger Upper Cretaceous rocks up to 2600 feet are of a clastic nature; foraminifers and dinoflagellates are few. Following the Turonian, the open marine realm environment may have shallowed rapidly; an inadequate number of samples makes this interpretation tentative.

At 2540-2510 feet there is an Eocene radiolarian bed which suggests starved terrigenous sediment, shelf edge conditions. From 2500-1240 feet (Eocene-Oligocene) a diversified benthonic foraminifer, dinoflagellate and mollusc assemblage occurs which has a neritic, probably "middle" neritic aspect. Foraminifera are *Alabamina, Marginulina, Nodosaria, Turrilina, Eponides, Cyclogyra, Spiroplectammina, Gyroidina,* a partially costate *Uvigerina, Ceratobulimina* and *Epistomina*. It is interesting to note that in southern Labrador and southern Grand Banks wells (e.g. Jenkins *et al.* 1974, Gradstein and Williams 1976) taxa of this assemblage occur with a few specimens in a rich, coarse arenaceous *"Cyclammina"* fauna, interpretated as of deeper water, slope origin. Such an Eocene-Oligocene environment on the southern Grand Banks is also substantiated by the occurrence of many pelagic taxa, hispic *Uvigerina* and *Melonis soldanii-pompilioides*.

In the Miocene of Egret K-36, at 980-860 feet, foraminiferal taxa are few and specimens rare; *Asterigerina* is relatively common. The Miocene sea at the Egret K-36 site may have been shallow neritic.

7

Footage	Age	Depositional Environment
980-860'	Miocene	shallow neritic
1180-1040'	Oligocene-Miocene	"middle" neritic
1810-1240'	Oligocene	"middle" neritic
2270-1850'	late Eocene	"middle" neritic
2540-2360'	Eocene (?middle)	shallow-deep neritic
approx. 2525'	hiatus (footage derived from well logs)	
2600'	Campanian-early Maastrichtian	shallow neritic
3860-2690'*	Coniacian-Santonian	shallow neritic
4430-3860'	Turonian	bathyal
approx. 4418'	unconformity (footage derived from well logs)	
4730-4425'	?Albian	marginal marine
4830-4700'	Aptian	shallow neritic
5550-4900'	Barremian	shallow neritic
6420-5600'	Hauterivian	shallow neritic
7286-6500'	Berriasian-Valanginian	shallow neritic-marginal marine
8142-7300'	Portlandian	shallow neritic-marginal marine
10,200-8237'	(late) Kimmeridgian	brackish-shallow neritic
11,000 (T.D)-10,200'	(late) Oxfordian-early Kimmeridgian	shallow neritic

Table 1. Summary of Chronostratigraphy and Depositional Environments (see also Figure 2).

* Between 2720 and 3860 feet sample control is inadequate.

Sedimentation Rates

The rates of sedimentation in the Amoco Imp Skelly Egret K-36 well are based on the consensus of the chronostratigraphic interpretations as listed in the summary of chronostratigraphy (Table 1).

In Egret K-36 there is no data on the total thickness of late Oxfordian and Miocene strata, but it is assumed that the Oxfordian thickness in the well is close to total thickness. The ?middle Eocene beds are taken as middle Eocene. The Oligocene-Miocene beds at 1180-1040 feet are incorporated in the Oligocene.

The radiometric time scales used are those of Berggren (1972) for the Cenozoic, van Hinte (1972) for most of the Cretaceous, and Harland *et al.* (1964, p. 199, 204, 208) for the earliest Cretaceous and Jurassic.

The approximate thicknesses and sedimentation rates are:

late Eocene-Oligocene	1330'	1.5 cm/1000 y
?middle Eocene	210'	0.9 cm/1000 y
late Maastrichtian-early Eocene	0'	0 cm/1000 y
Coniacian-early Maastrichtian	1260'	1.9 cm/1000 y
Turonian	560'	2.8 cm/1000 y
Cenomanian	0'	0 cm/1000 y
Early Cretaceous (Berriasian-Albian)	2800'	2.3 cm/1000 y
Late Jurassic (late Oxfordian-Portlandian)	3700'	5.2 cm/1000 y

The moderate Late Jurassic rate is of the same order as the 4-7 cm/1000 y for the Jurassic as a whole in the Grand Banks wells Amoco IOE Eider M-75 and Murre G-67 (see locations in Figure 1).

The post-Jurassic rates are relatively low when compared to southwestern Grand Banks wells, e.g. Amoco Imp Puffin B-90, (for location see Figure 1), (Gradstein *et al.* 1975).

References

Amoco Canada Petroleum Company Ltd.
1974: Well history report Amoco Imp Skelly B-1 Egret K-36, latitude 46° 25' 37.88"N, longitude 48° 50' 22.38"W, offshore Grand Banks, Newfoundland; Open File, Dept. Energy, Mines and Resources, Ottawa.

Batjes, D. A. J.
1958: Foraminifera of the Oligocene of Belgium; Verh. Kon. Belgisch Inst. Natuurw., no. 143, p. 1-186, pls. 1-3.

Berggren, W. A.
1972: A Cenozoic time-scale - Some implications for regional geology and paleobiogeography; Lethaia, v. 5, p. 195-215.

Dilley, F. C.
1973: Larger Foraminifera and seas through time; Paleontology, Spec. Paper no. 12, p. 155-168, figs. 1-4.

Douglas, R. G.
1972: Paleozoogeography of Late Cretaceous planktonic Foraminifera in North America; J. Foram. Res, v. 2, no. 1, p. 14-34, figs. 1-14.

Gradstein, F. M.
in press: Biostratigraphy and biogeography of Jurassic Grand Banks Foraminifera; Proc. 'Benthonics '75', Halifax, (NS), Canada.

Gradstein, F. M. and Williams, G. L.
1976: Biostratigraphy of the Labrador Shelf, part I; Open File Report, Dept. of Energy, Mines and Resources, Ottawa.

Gradstein, F. M., Williams, G. L., Jenkins, W. A. M. and Ascoli, P.
1975: Mesozoic and Cenozoic stratigraphy of the Atlantic continental margin, Eastern Canada; Can. Soc. Petrol. Geol., Memoir 4, p. 103-133, figs. 1-7.

Jenkins, W. A. M., Ascoli, P., Gradstein, F. M., Jansa, L. F. and Williams, G. L.
1974: Stratigraphy of the Amoco IOE A-1 Puffin B-90 well, Grand Banks of Newfoundland; Geol. Surv. Can., Paper 74-61, p. 1-9, figs. 1-2.

Postuma, J. A.
1971: Manual of planktonic Foraminifera; Elsevier Publ. Comp., Amsterdam.

Williams, G. L.
1975: Dinoflagellate and spore stratigraphy of the Mesozoic-Cenozoic, offshore Eastern Canada; Geol. Surv. Can., Paper 74-30, v. 2, p. 107-145.

Williams, G. L. and Brideaux, W. W.
1975: Palynological analyses of Late Mesozoic-Cenozoic rocks of the Grand Banks of Newfoundland; Geol. Surv. Can., Bull, 236, p. 1-162.

Appendix A

Stratigraphic succession of selected shelly microfossils (mainly foraminifers and ostracods) in Egret K-36. I am grateful to P. Ascoli for assistance with ostracod determinations. The biostratigraphic subdivisions are informal except for two Late Cretaceous planktonic zones which follow Postuma's (1971) "General Zonation". The Jurassic biostratigraphy follows Gradstein (in press); the Tertiary biostratigraphy is dealt with in more detail by Gradstein and Williams (1976). Footages are listed from top to bottom.

860/90-950/80' *Asterigerina gurichi* zone - Miocene

Asterigerina gurichi (Franke) s. l
Nonion affine (Reuss)
Guttulina problema d'Orbigny ?reworked
Spiroplectammina carinata d'Orbigny ?reworked
Gyroidina girardana (Reuss) ?reworked

Only *Asterigerina gurichi* is common, the other species are rare.

1040/70-1520/50' *Spiroplectammina carinata* zone - Oligocene-Miocene

Ceratobulimina contraria (Reuss)
Uvigerina dumblei Cushman & Applin
Spiroplectammina carinata (d'Orbigny)
Valvulineria petrolei (Andrea)
Gyroidina girardana (Reuss)
Epistomina elegans (d'Orbigny)
Marginulina decorata (Reuss) ?reworked

From 1040 to 1460 feet the fossil record is poor; *Ceratobulimina contraria* occurs with common specimens at and below 1340 feet.

1580/1640-1790/1810' *Turrilina alsatica* zone - Oligocene

Cassidulina subglobosa Brady
Cyclogyra involvens (Reuss)
Epinodes umbonatus (Reuss)
Turrilina alsatica Andreae

1850/1910-2300/60' Pteropod sp. 1 zone - late Eocene

Alabamina wolterstorffi (Franke)
Globigerina linaperta Finlay
Nodosaria sp. 8
Pteropod sp. 1

2510/40' Abundant radiolarians, diatoms - ?middle Eocene

2600/30' *Globotruncana arca* assemblage - Campanian-early Maastrichtian

Globotruncana arca (Cushman)
Hedbergella sp.
Pseudotextularia sp.

3000/30' *Globotruncana carinata* Zone - Santonian

Globotruncana carinata Dalbiez

3660/90-3770/3800' - Turonian-Santonian

Gavelinella aff. *minima* (Vieaux)
Ostracod sp. 3

3860/90-4400/30' *Globotruncana helvetica* Zone - Turonian

Gavelinella minima (Vieaux)
Gavelinella tourainensis Butt
?Globotruncana concavata (Brotzen) (?caved)
Globotruncana helvetica Bolli - frequent
Globotruncana marianosi Douglas
Globotruncana primitiva Dalbiez
Globotruncana renzi Gandolfi
Globotruncana sigali Reichel
Lingogavelinella turonica (Butt)
Praeglobotruncana difformis (Gandolfi)
Praeglobotruncana aff. *hagni* Scheibnerova
Praeglobotruncana stephani Gandolfi

4700/30-5400/30' *Choffatella decipiens* assemblage - Barremian-early Aptian

Asciocythere ex gr. *brevis* (Cornuel)
Choffatella decipiens Schlumberger
Gavelinopsis cenomanica Brotzen (?caved)
Haplophragmoides aff. *globosus* Lozo
Lenticulina nodosa (Reuss)
Megaspore sp. 2
Neocythere vanveeni Mertens
?Protocythere aptensis

5500/30-5600/30' - Neocomian

Buccicrenata italica Dieni & Massari
Trocholina sp.

6100/30-6800/30' many sideritic concretions

7200/30' - Upper Jurassic

Dictyocythere sp.
Small pelecypods

7590/7600-7800/30' *Anchispirocyclina lusitanica* zone - Tithonian

Anchispirocyclina lusitanica (Egger)
Buccicrenata italica Dieni & Massari
Eoguttulina sp. 2
Trocholina sp. 2

8500/30' - Kimmeridgian-Tithonian

Schuleridea sp. 1 Ascoli

9000/30-9500/30' - "Kimmeridgian"

Bisulcocypris sp.
Charophyte sporangia
Darwinula sp.
Eoguttulina sp. 2
"Metacypris" forbesii Jones
Ostracod spp. (ref. coll. nos. 48-53)
Paracypris sp.

10,000/30'-10,970/11,000' T. D. *Pseudocyclammina jaccardi* zone - late Oxfordian-early Kimmeridgian

Ammobaculites subaequale (Mjatliuk)
Buccicrenata italica Dieni & Massari
Epistomina aff. *uhligi* Mjatliuk
Pseudocyclammina jaccardi (Schrodt) - abundant

Appendix B

Stratigraphic succession of organic microfossil assemblages (dinoflagellates and spores) in Egret K-36. The zones are as defined in Williams 1975.

860/90-950/80' *Bombacacidites* sp. A Zone - Early-Middle Miocene

Spores:

Bombacacidites sp. A Williams & Brideaux 1975
Caryapollenites simplex (Potonié) Raatz

1040/70' - Oligocene-Middle Miocene

Dinoflagellates:

Deflandrea spinulosa Alberti (?reworked specimen)

1240/70-2150/80' *Deflandrea heterophlycta* Zone - Early Oligocene

Spores:

Tiliaepollenites sp.
Tsugaepollenites igniculus (Potonié) Potonié & Venitz (base)

Dinoflagellates:

Areosphaeridium arcuatum Eaton
Chiropteridium aspinatum (Gerlach) Brosius
Chiropteridium dispersum Gocht
Cordosphaeridium cantharellum (Brosius) Gocht
Cordosphaeridium funiculatum Morgenroth
Cyclonephelium sp. B Williams & Brideaux 1975
Deflandrea heterophlycta Deflandre & Cookson
Deflandrea phosphoritica Eisenack
Gonyaulacysta cf. *granulata* (Klement) Sarjeant sensu Benedek 1972
Homotryblium plectilum Drugg & Loeblich
Hystrichokolpoma rigaudae Deflandre & Gocht
Thalassiphora pelagica (Eisenack) Eisenack & Gocht
Tubidermodinium sulcatum Morgenroth
Wetzeliella articulata Eisenack
Wetzeliella coleothrypta Williams & Downie

2330/60-2510/40' - Eocene

Dinoflagellates:

Cyclonephelium ordinatum Williams & Downie
Hystrichosphaeropsis ovum Deflandre
Systematophora ancyrea Cookson & Eisenack
reworked *Dinogymnium* sp.

2600/30' *Odontochitina operculata* Zone - Campanian

Dinoflagellates:

Australiella victoriensis (Cookson & Manum) Lentin & Williams
Ceratiopsis diebeli (Alberti) Vozzhennikova (interpreted as caved Maastrichtian-Early Paleocene)
Deflandrea cf. *magnifica* (interpreted as caved Maastrichtian-Paleocene)
Deflandrea rotunda Eisenack & Cookson (interpreted as caved Paleocene)

2690-2645' *Hystrichosphaeridium truncigerum* Zone - Santonian

Spores:

Rugubivesiculites convolutus Pierce

Dinoflagellates:

Oligosphaeridium complex (White) Davey & Williams
Palaeohystrichophora infusorioides Deflandre
Surculosphaeridium longifurcatum (Firtion) Davey *et al.*

Specimens of reworked Early Cretaceous species occur in the sidewall core at 3645 feet. Such species include the dinoflagellates *Astrocysta cretacea* (Pocock) Davey and *Muderongia perforata* Alberti and the spores *Alisporites grandis* (Cookson) Dettmann, *Callialasporites dampieri* (Balme) Dev, *C. trilobatus* (Balme) Dev, *Cerebropollenites mesozoicus* (Couper) Nilsson and *Corollina torosus* (Reissinger) Klaus.

Sample control in this interval is poor.

3745-3890' *Oligosphaeridium pulcherrimum* Zone - Coniacian

Dinoflagellates:

Chlamydophorella nyei Cookson & Eisenack
Cyclonephelium distinctum Deflandre & Cookson
Deflandrea echinoidea Cookson & Eisenack
Hystrichosphaeridium stellatum Maier
Oligosphaeridium pulcherrimum (Deflandre & Cookson) Davey & Williams
Trichodinium castanea (Deflandre) Clarke & Verdier
Xenascus ceratioides (Deflandre) Lentin & Williams

3950-4335' *Surculosphaeridium longifurcatum* Peak Zone - Turonian

Dinoflagellates:

Callaiosphaeridium asymmetricum (Deflandre & Courteville) Davey & Williams
Canningia reticulata Cookson & Eisenack
Hystrichokolpoma ferox (Deflandre) Davey
Odontochitina costata Alberti
Senoniasphaera rotundata Clarke & Verdier
Spiniferites cingulatus (O. Wetzel) Sarjeant
Surculosphaeridium longifurcatum (common)
Tenua sp.

4425-4730' *Spinidinium* cf. *vestitum* - *Eucommiidites minor* zone - Albian

Spores:

Appendicisporites potomacensis Brenner
Cicatricosisporites pseudotripartitus (Bolkhovitina) Dettmann
Corollina torosus (Reissinger) Klaus

Deltoidospora juncta (Kara Murza) Singh
Eucommiidites minor Groot & Penny
Eucommiidites troedssonii Erdtman
Rugubivesiculites rugosus Pierce (base at 4425')

Dinoflagellates:

Cleistosphaeridium polypes (Cookson & Eisenack) Davey
Cleistosphaeridium polypes subsp. A Williams 1975
Cribroperidinium orthoceras (Eisenack) Davey
Hystrichosphaeridium bowerbanki Davey & Williams

4750-4830' *Deflandrea perlucida* - *Systematophora schindewolfi* Zone - Aptian

Spores:

Appendicisporites bifurcatus Singh
Callialasporites dampieri (Balme) Dev
Cerebropollenites mesozoicus (Couper) Nilsson

Dinoflagellates:

Surculosphaeridium cf. *longigurcatum* Williams 1975

4900-5550' *Tenua anaphrissa* Peak Zone - Barremian

Spores:

Aequitriradites spinulosus (Cookson & Dettmann) Cookson & Dettmann
Appendicisporites bilateralis Singh
Cerebropollenites mesozoicus (common)
Cicatricosisporites australiensis (Cookson) Potonié
Cicatricosisporites subrotundus Brenner
Denzoisporites perinatus Couper
Execipollenites tumulus Balme
Klukisporites pseudoreticulatus Couper
Perinopollenites elatoides Couper

Dinoflagellates:

Pseudoceratium pelliferum Gocht

5600-6420' *Ctenidodinium elegantulum* Zone - Hauterivian

Spores:

Callialasporites trilobatus (Balme) Dev
Concavissimisporites variverrucatus (Couper) Brenner
Coronatispora valdensis (Couper) Dettmann
Dictyophyllidites equiexinus (Couper) Dettmann
Foraminisporis wonthaggiensis (Cookson & Dettmann) Dettmann
Osmundacidites wellmanii Couper
Plicatella abaca (Burger) Norris
Schizosporis parvus Cookson & Dettmann
Trilobosporites apiverrucatus Couper
Trilobosporites bernissartensis (Delcourt & Sprumont) Potonié

Dinoflagellates:

Muderongia perforata Alberti
Muderongia simplex Alberti

6500-7286' *Phoberocysta neocomica* Zone - Berriasian-Valanginian

Spores:

Classopollis echinatus Burger
Perinopollenites elatoides (common)
Pilosisporites trichopapillosus (Thiergart) Delcourt & Sprumont
Trilobosporites domitus Norris

Dinoflagellates:

Dingodinium cerviculum Cookson & Eisenack
Endoscrinium campanula (Gocht) Vozzhennikova
Gonyaulacysta ambigua (Deflandre) Sarjeant (two specimens, one at 6593', one at 6600-6630')
Gonyaulacysta granulata (Klement) Sarjeant (two specimens, one at 7000-7030', one at 7100-7130')
Hystrichodinium pulchrum Deflandre
Imbatodinium kondratjevi Vozzhennikova
Kalyptea monoceras Cookson & Eisenack
Lanterna sportula Dodekova
Leptodinium sp.
Occisucysta "distincta"
Pareodinia ceratophora Deflandre
Systematophora schindewolfi (Alberti) Downie & Sarjeant
Systematophora sp.

7300-8142' *Ctenidodinium panneum* Zone - Portlandian

Spores:

Contignisporites cooksonii (Balme) Dettmann
Corollina torosus (abundant)
Leptolepidites psarosus Norris

Dinoflagellates and others:

Amphorula metaelliptica Dodekova
Imbatodinium kondratjevi (common)
Imbatodinium villosum Vozzhennikova
Systematophora turonica (Alberti) Downie & Sarjeant
Tasmanites sp.

8237-10,200' *Gonyaulacysta cladophora* Zone -(late) Kimmeridgian

Spores:

Contignisporites cooksonii (common)
Ischyosporites crateris Balme (common)
Leptolepidites psarosus (base)

Dinoflagellates:

Gonyaulacysta granulata Klement
Hexagonifera jurassica Gitmez & Sarjeant
Systematophora orbifera Klement
Tenua sp.

10,200-11,000 *Gonyaulacysta jurassica* Zone - Oxfordian-early Kimmeridgian

Spores:

Cicatricosisporites australiensis (Cookson) Potonié (base)
Distalanulisporites sp.
Januasporites spinulosus Dettmann

Dinoflagellates:

Adnatosphaeridium caulleryi (Deflandre) Williams & Downie
Gonyaulacysta globota Gitmez & Sarjeant
Gonayulacysta jurassica (Deflandre) Norris & Sarjeant
Gonyaulacysta jurassica with large antapical pericoel
Kalyptea monoceras Cookson & Eisenack
Muderongia simplex Alberti (present in SWC at 10,955')
Parvocavatus tuberosus Gitmez (present in SWC at 10,955')

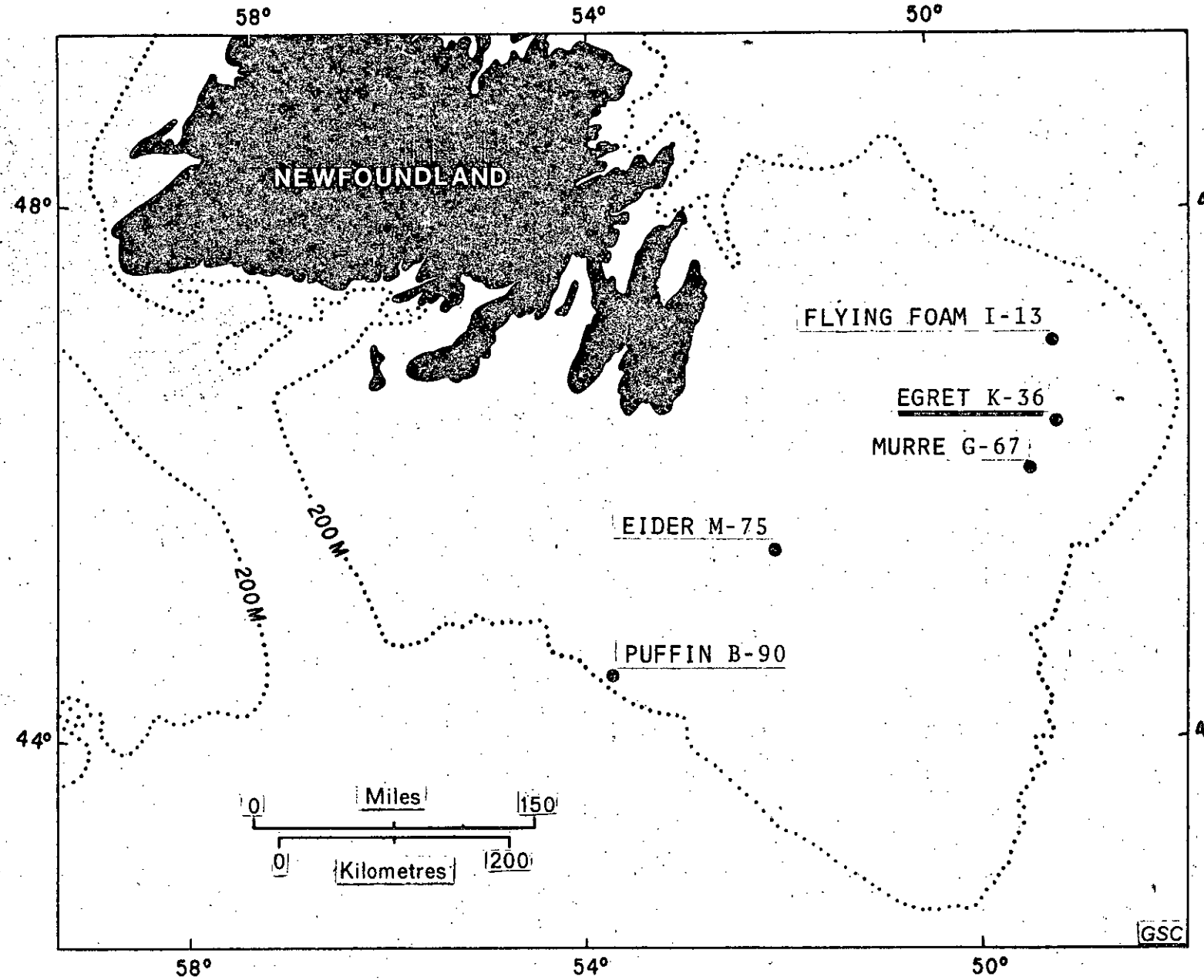


Figure 1. Location of Amoco Imp Skelly Egret K-36, Grand Banks and other wells mentioned in the text.

FIGURE 2. STRATIGRAPHY AND DEPOSITIONAL ENVIRONMENT, AMOCO IMP SKELLY EGRET K-36, GRAND BANKS.

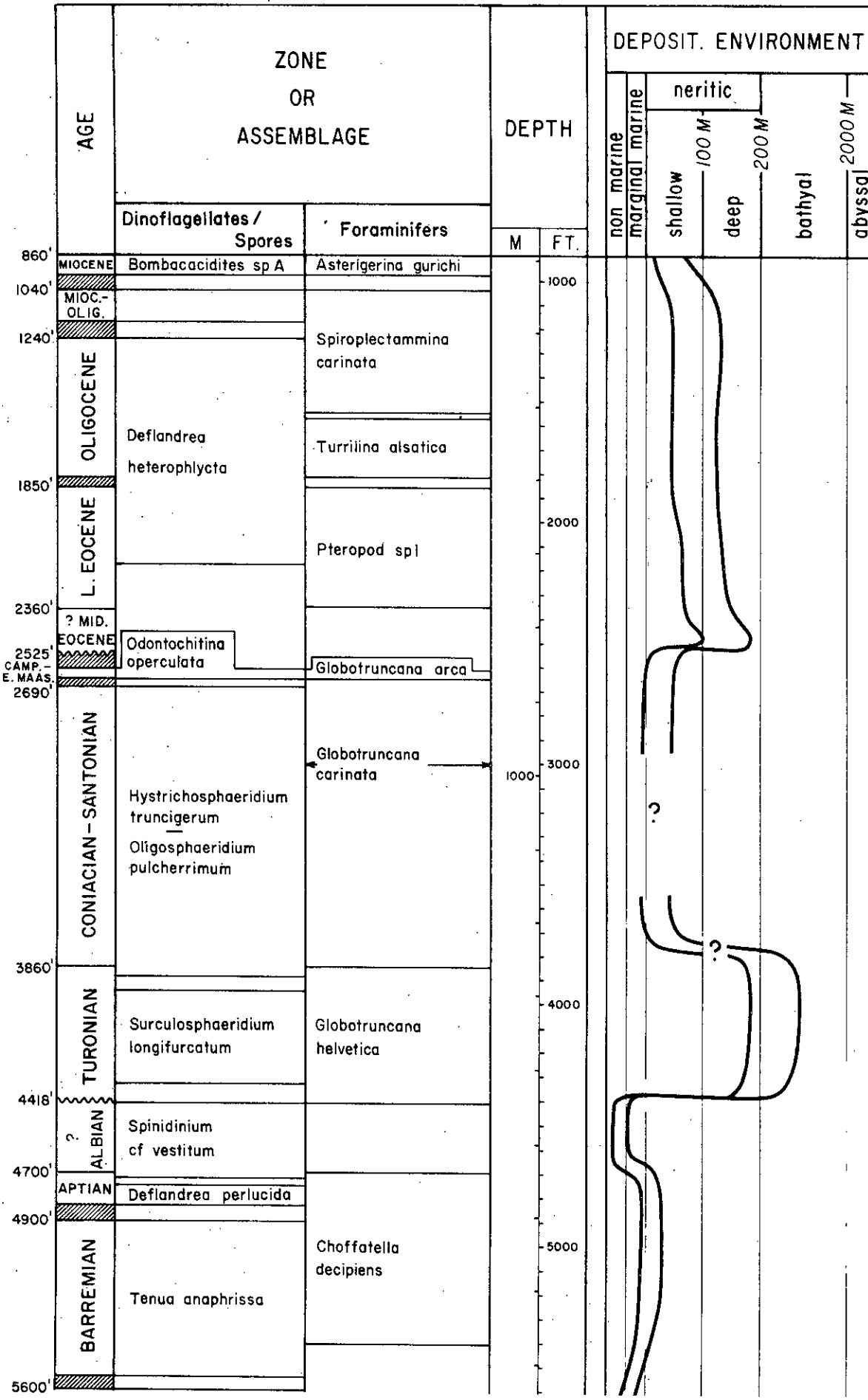
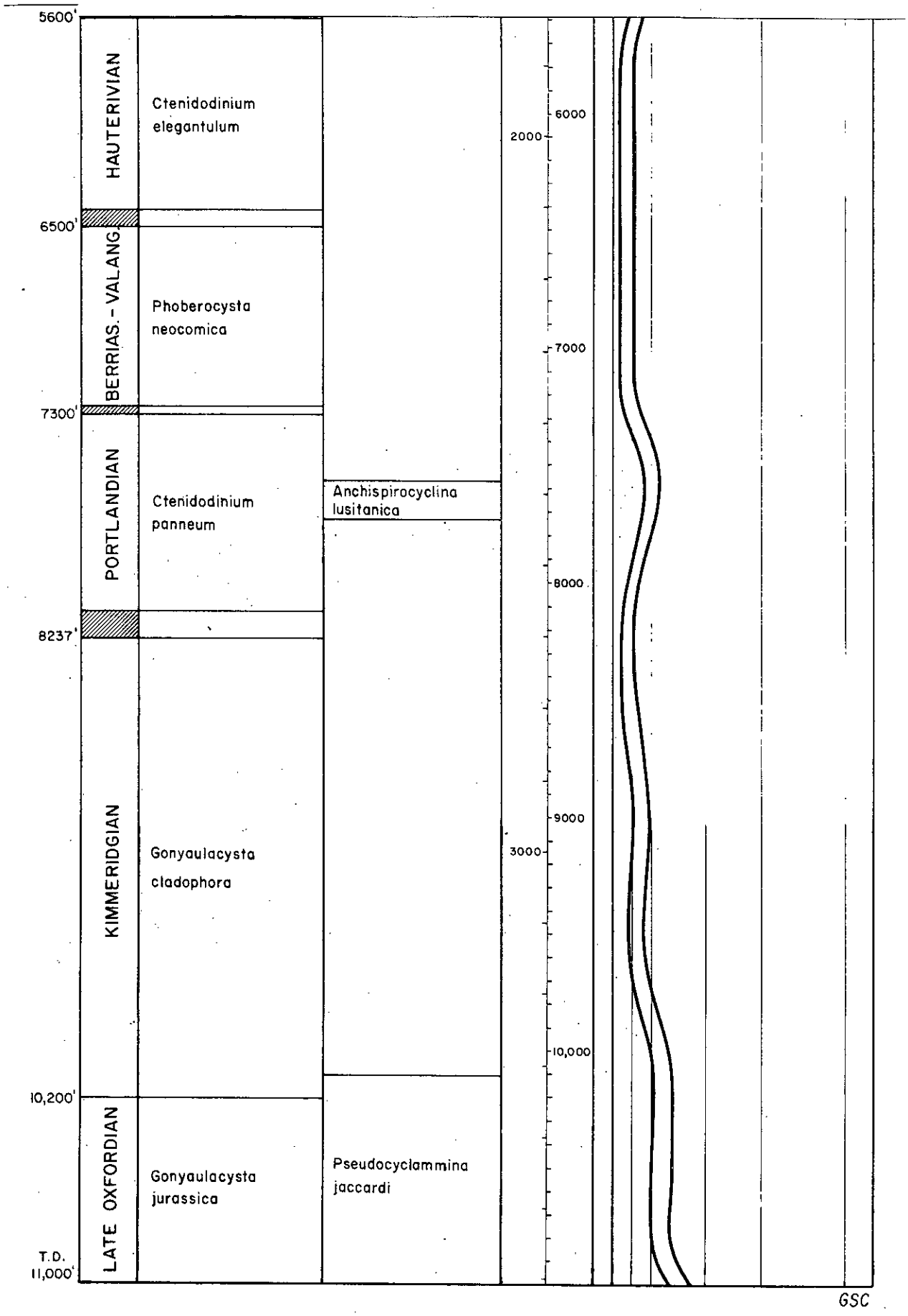


Figure 2 continued



396 BIOSTRATIGRAPHY AND DEPOSITIONAL HISTORY OF AMOCO IMP SKELLY B-1 EGRET K-36, GRAND BANKS, NEWFOUNDLAND

This unedited report (19 p., 2 figs.) by F.M. Gradstein, W.A.M. Jenkins, and G.L. Williams, includes lists of selected shelly and organic-walled microfossils for each stratigraphic interval.

A copy of this report is available free of charge from the Ottawa address only.