GEOLOGICAL SURVEY OF CANADA

DEPARTMENT OF ENERGY, MINES AND RESOURCES, OTTAWA

PAPER 74-50

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G. L. WILLIAMS
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Price: $2.50 Catalogue No. M44-74-50

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Information Canada
Ottawa
1974

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ABSTRACT

The Shell Naskapi N-30 well, drilled to a depth of 7325 feet, penetrated approximately 6000 feet of Mesozoic sediments before encountering metamorphic basement at 6992 feet. Deposition was more or less continuous from the Middle Jurassic (resting on basement) to the Early Maastrichtian, with possible periods of nondeposition in the Late Aptian and Late Campanian. Limestones and terrigenous sediments characterize the Middle and Late Jurassic. Maximum sand accumulation occurs in the Neocomian. Throughout the remainder of the Cretaceous the sandstone content progressively declines with a consequent increase of mudstones and chalks. Late Jurassic and Early Cretaceous sedimentation was predominantly inner neritic, giving way to outer neritic, deeper shelf deposition in the Late Cretaceous. In the vicinity of Naskapi N-30, the Scotian Shelf appears to have been relatively stable throughout the Mesozoic.

RÉSUMÉ

Le puits Shell Naskapi N-30, foré a une profondeur de 7325 pieds, pénètre au travers d'environ 6000 pieds de sédiments mésozoïques avant de toucher la base métamorphique à 6992 pieds. Les dépôts sont plus ou moins continus du Jurassique moyen (à la base) au début du Maestrichtien, avec probablement des périodes où il n'y a pas eu de dépôts à la fin de l'Aptien et à la fin du Campanien. Des calcaires et des sédiments terrigènes caractérisent le milieu et la fin du Jurassique. L'accumulation maximale de sable se trouve dans le Néocomien. À travers le reste du Crétacé le contenu en grès diminue et les pélites et les craies augmentent en conséquence. À la fin du Jurassique et au début du Crétacé la sédimentation est néritique de façon prédominante et elle est replacée par une sédimentation bathyale qui a laissé sur la plate-forme des dépôts plus épais à la fin du Crétacé. Aux environs du Naskapi N-30, le plateau continental de la Nouvelle-Écosse semble être demeuré relativement stable pendant le Mésozoique.

INTRODUCTION

The Shell Naskapi N-30 well (Fig. 1) is located on the Scotian Shelf, a portion of the continental shelf lying southeast of Nova Scotia. The Scotian Shelf is a glaciated platform bounded on the west by Georges Basin and the Northeast Channel and on the east by the Laurentian Channel. The length of the Shelf is about 450 miles, while the width varies from 80 miles in the west to 140 miles in the east. Its surface area is approximately 60,000 square miles. Recent exploration for oil on the Scotian Shelf has resulted in the drilling of 43 wells as of July, 1973. These have revealed a wedge of Mesozoic-Cenozoic sediments up to 30,000 feet thick, which increases in thickness southeastwards towards the continental rise. Structurally, the wedge is part of the East Coast Miogeocline and comprises the La Have Platform to the west and the Scotian Basin to the east. The sedimentary cover on the La Have Platform rarely exceeds 7000 feet, whereas in the Scotian Basin it is in excess of 30,000 feet.

This report, compiled by the late D.F. Clark, is based on geological studies by all four authors.

Most of the wells on the Scotian Shelf have been drilled in the Scotian Basin because of the greater thickness of sediments. Three wells have however been drilled on the La Have Platform. One of these is the Shell Naskapi (Fig. 1) located approximately 80 miles east of Halifax at latitude 43°29'46.29"N and longitude 62°34'00.63"W. This well was completed at a T.D. of 7235 feet with the interval 6992'-7235' being metamorphic rocks of Cambro-Ordovician age. The sedimentary sequence encountered ranges in age from Middle Jurassic to Maastrichtian and has been examined for foraminifers and ostracods (P. Ascoli), dinoflagellates and spores (G.L. Williams) and nannofossils (D.F. Clark). The lithostratigraphy has been undertaken by L.F. Jansa, utilizing the lithostratigraphic subdivisions established by McIver (1972) for the Mesozoic-Cenozoic sediments of the Scotian Shelf.

McIver recognized three groups and twelve formations ranging in age from Early Jurassic to Pliocene. Unfortunately he lacked detailed biostratigraphic control and the degree to which each of his formations transgresses time is not apparent. In the present paper every attempt is made to assign ages to the formations. The biostratigraphic framework is outlined in the text. Species lists are presented in the Appendix.

Original manuscript submitted 28 May, 1974
Approved for publication 17 June, 1974

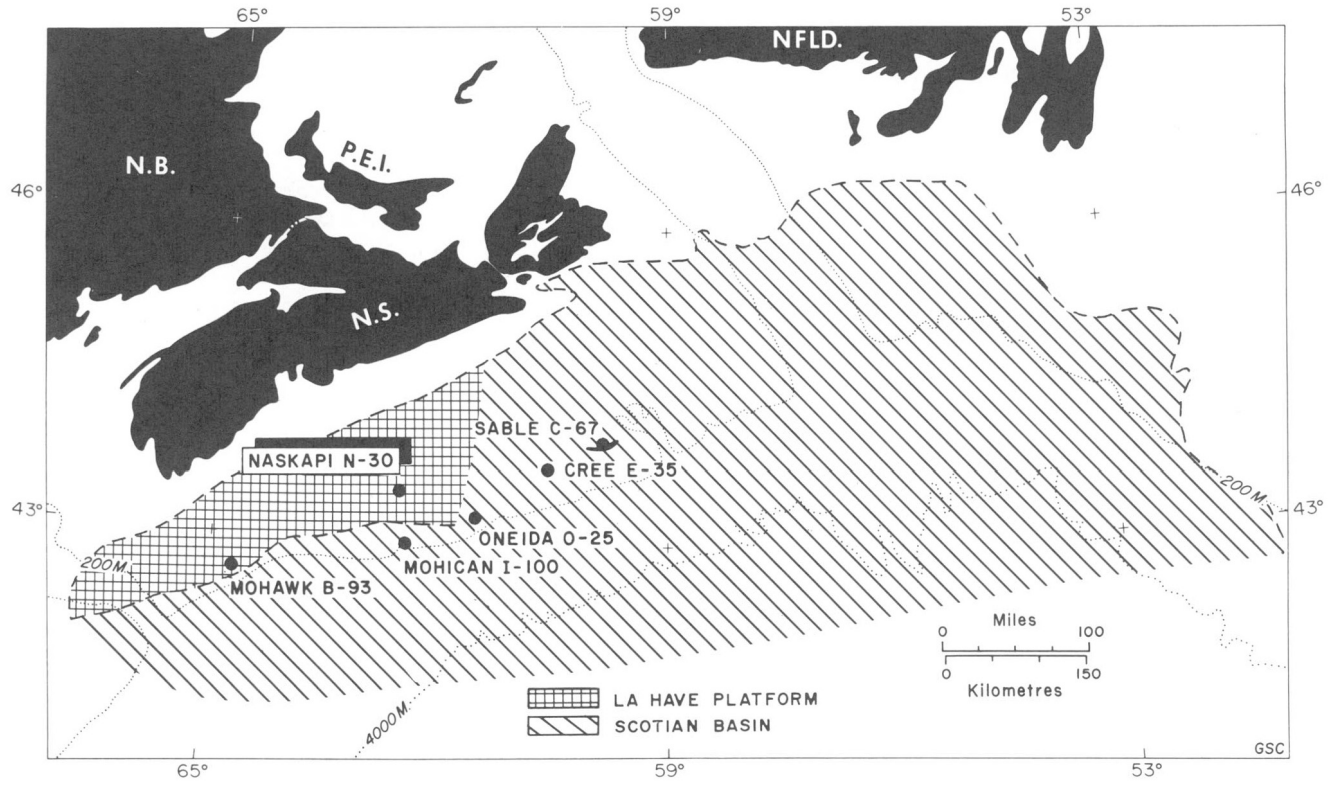

FIGURE 1. Location of Shell Naskapi N-30 on the Scotian Shelf.

LITHOSTRATIGRAPHY

The metamorphic basement encountered in Shell Naskapi (6992'-7235') is a heterogeneous rock suite composed of weathered sericite-biotite schist, biotite-chlorite schist, sericite-graphitic schist and biotite-chlorite metaquartzite, interbedded with a garnet schist. This metamorphic rock suite represents a low grade, regionally metamorphosed sedimentary sequence originally consisting of interbedded sandstone and shale.

Nine of the twelve formations described by McIver (1972) were recognized in the Shell Naskapi N-30 well. The contact of the oldest, the Mohawk Formation (6595'-6992'), with the underlying basement is sharp. The Mohawk Formation is a terrigenous sequence composed of 73 per cent variegated red, green and medium dark grey shale interbedded with sandstone and siltstone. The fine- to coarse-grained sandstone is composed of angular to subangular quartz grains, with a few beds of conglomeratic sandstone. The sandstone in the lower part of the Mohawk Formation is poorly sorted, slightly argillaceous, feldspathic and has a kaolinitic matrix. Cementation by silica is common. There is a progressive increase in the degree of sorting from older to younger sediments with 10 feet of well-sorted sandstone at 6600 feet. The contact with the overlying Abenaki Formation is conformable and sharp.

The Abenaki Formation is 575 feet thick, extending from 6020'-6595'. It is predominantly a carbonate sequence with interbedded clastic sediments near the middle. At its base a superficial oolite and oolite packstone is interbedded with peloid-skeletal wackestone and beds of calcareous siltstone and shale. The wackestone micritic matrix is partially dolomitized. The skeletal grains, which consist primarily of foraminiferal tests and molluscan fragments, are frequently blackened by iron monosulphide, and/or coated by fine rims of pyrite. The lower, predominantly carbonate sequence grades into fine-grained terrigenous sediments (6170'-6317'), composed of light to medium grey and reddish mottled shales, siltstones and fine-grained sandstones. These contain occasional coalified plant fragments. A thin bed of intraclastrudite occurs at 6188 feet. The upper part of the Abenaki Formation (6020'-6170'), is a foraminifer-pelecypod skeletal wackestone and mudstone which is rarely bioturbated. Several beds of oolite and superficial oolite packstone are present with calcareous shales interbedded near the top of the interval. The top of the formation is delineated by a thin bed of brownish coloured microcrystalline dolomite. Contact with the overlying Micmac Formation is abrupt but conformable.

The rock sequence between 5496'-6020' is assigned to the Micmac Formation and is composed of shales (62 per cent), interbedded limestone (15 per cent) and sandstone (10 per cent) beds. The shale is hard, blocky, well indurated, medium grey, with fine coalified plant fragments and pyrite. The limestone beds are generally less than 10 feet thick and are composed of a sandy oolitic packstone. The oolites have a fibrous radial fabric. In one bed rare algal oncolites are found. The light to medium grey sandstone is fine grained, moderately sorted, cemented by calcite and less fre-

quently by silica. In places it is argillaceous with thin laminations of coalified plant debris. The Micmac Formation has a conformable, sharp contact with the succeeding Mississauga Formation.

The Mississauga Formation (4746'-5496') consists of 68 per cent sandstone in units 30 to 100 feet thick, separated by thin siltstone and silty shale layers. Below 5250 feet the sandstone is generally slightly to moderately sorted, fine grained, silty, argillaceous, and is usually cemented by calcite. Quartz grains are subrounded or rarely rounded. The shale is medium to dark grey, changing to reddish near the base and at the top of the formation. It is bioturbated in places. An argillaceous skeletal wackestone bed, with rare superficial oolites formed around quartz nuclei is present near the base of the Mississauga Formation. Above 5250 feet occurs a poorly sorted, friable, coarse to very coarse sandstone composed of subangular quartz grains. This sandstone is in parts argillaceous. Porosity may be as high as 34 per cent (Shell Naskapi N-30 well history report, 1972). A gastropod coquina bed with a micritic matrix is present at 5230 feet. Thin coal beds occur between 5090'-5165'. Contact with the overlying Naskapi Shale is conformable and sharp.

The Naskapi Shale (4248'-4746') is predominantly shale with minor sandstone and carbonate interbeds. The shale is yellowish brown to brownish grey, carbonaceous, with coal fragments. Silty and dolomitic horizons may occur throughout. Two beds of skeletal packstone contain superficial oolites formed around quartz nuclei. The overlying Logan Canyon Formation rests conformably on the Naskapi Shale with a gradational contact.

The Logan Canyon Formation (3214'-4248') is an alternating sequence of sandstone, siltstone and shale. The Sable Shale Member, which occurs towards the middle of the formation permits the differentiation of a lower and an upper unit. Sandstones constitute 35 per cent of the formation and occur in 30- to 90-foot beds, the thickest of which lies immediately beneath the Sable Shale. The sandstones are light grey to olive grey, fine to coarse grained and composed predominantly of quartz, which tends to be subangular and moderately sorted in the lower unit and subrounded and well sorted in the upper unit. A few thin conglomeratic sandstones occur in the upper part of the formation. Minor constituents are feldspar, glauconite, muscovite and chlorite. In some sandstone beds coal and mollusc fragments occur. The sandstone is slightly to moderately argillaceous and in the lower unit is frequently cemented by clacite. Sandstones in the lower unit are tight, whereas porosity in the upper unit is poor to fair.

Siltstones of the Logan Canyon Formation are argillaceous, light to greenish grey, glauconitic and contain rare skeletal grains. The mudstone is usually silty, medium light grey to olive grey and contains mollusc, echinoderm and annelid fragments and foraminifer tests. Fissile shale occurs in the lower unit of the Logan Canyon Formation. The Sable Shale Member and the mudstone in the upper unit are poorly consolidated. The Sable Shale Member (3450'-3775') is predominantly a pale yellowish brown mudstone with a few siltstones and fine-grained sandstone beds. The contact between the Logan Canyon Formation and the overlying Dawson Canyon Formation is conformable and gradational.

The Dawson Canyon Formation (2180'-3214') is a mudstone with several interbedded sandstones up to 20 feet thick, particularly in the upper part. The fine-grained, light grey, glauconitic sandstone contains a variable amount of argillaceous matrix; frequently it is well sorted and poorly consolidated. Glauconite content ranges from 10 to 15 per cent. Sandstone porosities of 16 to 37 per cent were obtained by measuring sidewall cores from the interval 2564'-2722' (Shell Naskapi N-30 well history report). The main part of the formation is a light brownish grey, poorly consolidated mudstone. It contains pelecypod, *Inoceramus* and annelid fragments, foraminiferal tests and glauconite. The "P" marker, a pelecypod coquina, is present between 2960'-2970'. Contact with the overlying Wyandot Formation is conformable and gradational.

The Wyandot Formation (1840'-2180') is a chalky limestone interbedded with poorly consolidated, light grey, calcareous mudstones and argillaceous, light grey, carbonates. The main chalky bed is 100 feet thick, very light grey and composed mainly of coccoliths, scattered foraminiferal tests, *Inoceramus* prisms, rare gastropods and pelecypod fragments. The Wyandot Formation is overlain conformably by the Banquereau Formation, the youngest of the formations recognized by McIver (1972). The contact is gradational and conformable.

The Banquereau Formation has been logged between 1090'-1840'. There are no mechanical logs for the interval above 1088 feet, the depth at which surface casing was set in the well. Consequently, the top of the Banquereau Formation, and hence the total thickness, is unknown. The Banquereau Formation is a mudstone with some siltstone and sandstone. The sandstone constitutes 19 per cent of the sequence and is concentrated mainly in the upper part of the formation. This permits division of the Banquereau Formation into a lower argillaceous unit and an upper arenaceous unit. Dividing these is a 70-foot-thick, coarse-grained sandstone between 1540' and 1610'.

The mudstone of the Banquereau Formation is noncalcareous, poorly consolidated and disintegrates in water. Mica, glauconite, foraminifer and molluscan fragments are common and pyrite is rare. The mudstone is medium grey to yellowish brown. The siltstone is argillaceous, glauconitic, medium grey, poorly consolidated and occurs less frequently than the other two rock types.

The 70-foot sandstone contains moderately sorted, well-rounded, polished quartz grains which indicate deposition in a moderate to high energy environment and has a porosity of 27.2 per cent. Other sandstones in the Banquereau Formation are fine to medium grained, moderately sorted with variable amounts of argillaceous matrix and commonly are cemented by calcite. The glauconite content of the sandstone in the upper unit varies between 10 and 35 per cent.

In summary, the following lithostratigraphic units are recognized in the Shell Naskapi N-30; 243 feet of

metamorphic basement (6992'-7235'), 397 feet of the Mohawk Formation (6595'-6992'), 575 feet of the Abenaki Formation (6020'-6595'), 524 feet of the Micmac Formation (5496'-6020'), 750 feet of the Mississauga Formation (4746'-5496'), 498 feet of the Naskapi Shale (4248'-4746'), 1034 feet of the Logan Canyon Formation (3214'-4248'), 1034 feet of the Dawson Canyon Formation (2180'-3214'), 340 feet of the Wyandot Formation (1840'-2180') and at least 750 feet of the Banquereau Formation (1090'-1840').

BIOSTRATIGRAPHY

Paleontology shows that the Shell Naskapi N-30 succession from 1175'-6992' ranges in age from Middle Jurassic to Maastrichtian, with nondeposition in the Late Aptian and Late Campanian. Stratigraphic control is based on dinoflagellates, spores, foraminifers and ostracods between 1175'-6995' and nannofossils between 1175'-3500'. The age determinations may represent agreement in all groups of microfossils, compromise, or occasionally and especially in the Jurassic-Early Cretaceous, are based solely on palynology. Evidence from the various fossil groups generally agreed, but where it did not alternative interpretations are presented in full.

Samples studied have included cuttings samples, sidewall cores and one conventional core at 4814'-4845' (for details see Appendix). The cuttings, washed and picked for the contained foraminifers and ostracods and processed for palynomorphs, (dinoflagellates and spores) and nannofossils, are composite samples taken over 30-foot intervals. Foraminifers and ostracods were studied at 30-foot intervals from 1240' to 6995'; dinoflagellates and spores were examined at 100-foot intervals from 1180' to 6995'. In addition 84 sidewall cores were examined for dinoflagellates and spores.

Comparison of ranges of species for Naskapi N-30 with those of Shell Mohawk B-93, Shell Oneida O-25 and Mobil Sable Island C-67 has permitted the recognition of zones. The dinoflagellate zones are strictly local zones and approximate peak or assemblage zones (see American Commission on Stratigraphic Nomenclature, Articles 20g, 23). In a study of well cuttings it is necessary to use "fossil tops" (i.e. the latest and highest occurrence of a species). Each assemblage zone takes its name from a fossil not found in sediments above that zone. Although the "base" or oldest occurrence of a species is frequently useful in the recognition of an assemblage zone, no zone is named after such a species.

The foraminiferal zonation is based on calcareous and arenaceous benthonics in the Middle and Upper Jurassic, benthonics and planktonics in the Neocomian-Aptian and on planktonics in the Albian and Upper Cretaceous. The Jurassic benthonic and Upper Cretaceous planktonic zones are cosmopolitan, having been originally established in Europe or the Caribbean. The ostracod zones of the Jurassic and Lower Cretaceous are also recognized in coeval European sediments whereas those in the Upper Cretaceous equate with the ostracod zones set up for rocks of similar age in the eastern United States. The nannoplankton zones are in part local, in part cosmopolitan.

The preliminary zonation set up for the Mesozoic rocks of the Scotian Shelf permits comparison of the Shell Naskapi N-30 section with the European stages (Fig. 2). We have assumed that species common to the Canadian Atlantic continental margin and Europe have similar vertical ranges in the two areas.

Jurassic

The oldest foraminiferal assemblage in Shell Naskapi N-30 constitutes the *Epistomina uhligi* Zone and extends from 6590'-6995'. Foraminifers are rare throughout this interval and specific identification is difficult. Occasional molluscan and echinoid fragments are present throughout. The dinoflagellate *Valensiella ovulum* Zone has been recognized in sidewall core 6572 feet and in cuttings from 6790' to 6820'. *Valensiella ovulum* has a known range of Bajocian to Lower Oxfordian. Seventy-five per cent of the organic fraction, as visually determined from a palynology slide, is totally carbonized. The palynological and foraminiferal data indicate that the interval 6600'-6995' is Middle Jurassic.

The overlying sediments are referred to the dinoflagellate *Gonyaulacysta jurassica* Zone which extends from 6390'-6590'. Other diagnostic fossils include *Systematophora areolata, Ctenidodinium ornatum* and *Leptodinium egemenii. G. Jurassica,* frequently recorded from the Oxfordian of Europe, has also been observed in the Early Kimmeridgian of Dorset. The zone, and therefore the interval 6390'-6620', are tentatively dated Oxfordian.

The succeeding dinoflagellate Zone of *Gonyaulacysta cladophora* extends from 5790'-6320' and includes, besides the zonal marker, *Hexagonifera jurassica* and *Polystephanephorus sarjeantii.* Since none of these species is known from post-Kimmeridgian sediments (Riley and Sarjeant, 1972) it seems reasonable to postulate a Kimmeridgian age for the zone.

The benthonic foraminifer Zone of *Pseudocyclammina jaccardi-Epistomina soldanii* is recognized between 5660'-6595'. The zone contains numerous specimens of the arenaceous species *Pseudocyclammina jaccardi.* The ostracod *Cytherella index* Zone also extends from 5660' to 6595'. A few gastropods and the crinoid *Pentacrinus* have been observed in the cuttings samples. Both the *Pseudocyclammina jaccardi-Epistomina soldanii* Zone and the ostracod *Cytherella index* Zone are believed to be Oxfordian to Early Kimmeridgian.

According to the foraminiferal data, the top of the Jurassic is at 5560 feet. The succession from 5560 feet to 5560 feet falls within the arenaceous foraminifer *Bucci-crenata italica* Peak Zone and the ostracod *Schuleridea triebeli oblonga* Zone. It shows close agreement with assemblages from the Upper Malm (Kimmeridgian-Tithonian) of Europe. The palynomorphs suggest that the interval 5620'-5713', which is referred to the *Ctenidodinium panneum* Zone, is Tithonian. *C. panneum* has previously been described only from the Tithonian of England (Norris, 1965). Dinoflagellates are rare and the spores are undiagnostic in this part of the succession.

Cretaceous

The oldest Cretaceous sediments recognized occur between 5255' and 5550'. They are included in the dinoflagellate *Phoberocysta neocomica* Zone which also includes *Achomosphaera neptuni* and *Pareodinia ceratophora*. Data from other wells (Shell Oneida O-25, Shell Mohawk B-93 and Mobil Sable C-67) on the Scotian Shelf indicate that *Phoberocysta neocomica* is not present in post-Valanginian sediments. The interval 5255'-5550' is therefore assigned a Berriasian-Valanginian age, although these stages may not be totally represented.

The succeeding dinoflagellate *Ctenidodinium elegantulum* Zone extends from 4985' to 5126'. Species not extending below this zone are *Pseudoceratium pelliferum* and *Muderongia simplex*. *Ctenidodinium elegatulum* was described originally from the Hauterivian-Aptian of Switzerland and France (Millioud, 1969). *Pseudoceratium pelliferum* was described by Gocht (1957) from the Hauterivian of Germany. The *Ctenidodinium elegantulum* Zone is provisionally considered to be Hauterivian.

The dinoflagellates permit recognition of the *Doidyx anaphrissa* Peak Zone between 4774'-4925'. In this interval *Doidyx anaphrissa* and *Deflandrea perlucida* increase markedly in abundance and *Muderongia simplex* and *Meiourogonyaulax stoveri* occur for the last time. The zone is considered to be Barremian.

Foraminifers do not permit detailed subdivision of the Lower Cretaceous strata in Naskapi N-30 from 4770' to 5560'. Sparce assemblages between 4770'-5560' include the planktonic *Globigerina kufleri*, the benthonics *Epistomina reticulata* and *Lenticulina crepidularis* and the arenaceous genus *Pseudocyclammina*. The ostracod *Neocythere denticulata* and echinoids also occur.

The overlying sediments between 4403'-4710' are referred to the dinoflagellate *Cyclonephelium attadalicum* Zone. Several of the samples examined in this interval, including sidewall core 4403 feet, contain rich dinoflagellate assemblages in which the following taxa have been identified: *Cyclonephelium attadalicum, C.* cf *attadalicum, Doidyx anaphrissa* and *Deflandrea perlucida*, together with the spores *Pilosisporites trichopapillosus* and *Trilobosporites trioreticulosus*. *C. attadalicum* was described from the Aptian-Albian of Australia by Cookson and Eisenack (1962). *Deflandrea perlucida* is not known from post-Aptian sediments. The *Cyclonephelium attadalicum* Zone is therefore assigned an Aptian age. The presence of *Doidyx anaphrissa* may indicate that the zone is restricted to the Early Aptian.

The benthonic *Epistomina reticulata-Lenticulina gaultina* Zone and the ostracod *Schuleridea jonensiana* Zone extend from 4180'-4580' and are considered to be Albian. Throughout this interval, however, both foraminifers and ostracods are rare. Other fossils include echinoids and gastropods, and there are numerous coal fragments.

The interval 3908'-4345' falls within the dinoflagellate Zone of *Spinidinium* cf. *vestitum*. Strata from 3948' to 4345' is considered Early to Middle Albian in age. Species present include *Spinidinium* cf. *vestitum, Trilobosporites apiverrucatus, Vitreisporites pallidus* and numerous specimens of *Oligosphaeridium complex*. Sidewall core 4234 feet contains no dinoflagellates. At the top of this zone, beds at 3908 feet contain *Eucommiidites minor* and *Spinidinium* cf. *vestitum* and have been dated Late Albian because of the presence of the angiosperm pollen species *Tricolpites parvus*.

In the Upper Cretaceous sediments, cosmopolitan planktonic foraminifers species permit correlation with the European type sections. Paralleling this development is the influx of nannofossils, a marked increase in dinoflagellates relative to the spores and pollen, and the presence of ostracods in sufficient numbers to provide an independent means of biostratigraphic control.

The planktonic foraminifer *Rotalipora cushmani* Zone and the ostracod *Cythereis roanokensis* Zone occupy the interval from 3160' to 3740'. Species present include the planktonic *Praeglobotruncana stefani*, the arenaceous *Ammobaculites comprimatus* and the ostracods *Neocythere vanveeni* and *Eocytheropteron* sp. 1. Arenaceous foraminifers are abundant and echinoid, mollusc, gastropod, brachiopod and coal fragments occur in the cuttings. Ostracods are rare. The interval 3095'-3778' falls within the dinoflagellate *Cleistosphaeridium polypes* Zone. Species are *C. polypes, Cribroperidinium orthoceras, Cyclonephelium vannophorum, Classopollis classoides* and *Tricolpites parvus*. The assemblages closely compare with those described by Davey (1969, 1970) from the Cenomanian of England and France. *Schizeaceous* spores are common throughout. The nannofossil *Parahabdolithus bitraversus* Zone is recognized between 2995' and 3500'. Collation of the foraminiferal, ostracod and palynomorph data indicates that the interval 3095'-3778' is Cenomanian.

The sediments between 2925' and 3095' are referred to the planktonic foraminifer Zone *Globotruncana helvetica-Praeglobotruncana stephani* and the ostracod *Cythereis* sp. 2 Zone of Turonian age. These zones correspond closely to the dinoflagellate Zone of *Surculosphaeridium longifurcatum* recognized between 2860'-3060'. Dinoflagellates show a marked increase in relative abundance in the Turonian.

The nannofossil *Corolithion exiguum* Zone is recognized only between 2860' and 2890'. As mentioned previously, the underlying *Parahabdolithus bitraversus* Zone covers the interval 2995'-3500'. It therefore ranges through Cenomanian time into the Turonian.

The dinoflagellate *Oligosphaeridium pulcherrimum* Zone is found from 2695' to 2815' and is provisionally dated Coniacian. Its vertical extent compares closely with the nannofossil *Discolithus incohatus* Zone which includes the sediments between 2785' and 2815'. Foraminifers are sparse in this interval.

The overlying *Australiella victoriensis* Zone between 2290' and 2620' contains, besides *A. victoriensis*, the diagnostic species *Hystrichosphaeridium truncigerum, Dinogymnium acuminatum* and *Deflandrea sverdrupiana*, none of which are known from the Coniacian. This, plus the fact that *Hystrichosphaeridium truncigerum* is restricted to the Santonian of the Grand Banks (Williams and Brideaux, in press), strongly supports a Santonian age for this zone. The equivalent nannoplankton Zone is that of *Marthasterites furcatus*. It extends from

2095'-2725'. The foraminifers do not permit separation of the Coniacian from the Santonian. The *Globotruncana coronata-Globotruncana renzi* Zone and the ostracod *Protocythere triebeli-Orthonotacythere hannai* Zone, which span the Coniacian and Santonian stages, are present in the interval 2368'-2925'.

The interval 1690'-2368' contains numerous planktonic foraminifers and nannofossils, and several species of dinoflagellates. The Zone of *Globotruncana elevata-G. ventricosa,* which covers this footage, is cosmopolitan and has been dated Campanian. Planktonics, particularly species of *Globotruncana* predominate. The coeval ostracod zone is the *Brachycythere rhomboidalis-Amphicythere distincta* Zone. Other fossils include the radiolaria *Dichtyomitra* spp. and gastropods. The dinoflagellate *Odontochitina costata* Zone (1582'-2215') is characterized by *Odontochitina costata, Deflandre echinoidea, Xenascus ceratioides* and *Palaeohystrichophora infusorioides.* The last named species which is present in the sample at 1582 feet does not range up into the Upper Campanian in other wells (Shell Mohawk B-93 and Shell Oneida O-25) on the Scotian Shelf. The interval 1582'-2215' is therefore assigned an Early Campanian age. If present, the Upper Campanian must be less than 41 feet thick since a sidewall core at 1540 feet is placed in the overlying *Dinogymnium euclaensis* Zone of probable Maastrichtian age. The nannofossil *Tetralithus nitidus* Zone also contains the diagnostic species *Kamptnerius magnificus* and *Arkhangelskiella specillata* and extends from 1690' to 2020'.

The youngest sediments examined in Shell Naskapi N-30 fall within the planktonic foraminifer Zone of *Globotruncana arca* and the ostracod Zone of *Veenia arachoides* which occur between 1175' and 1690'. In this zone foraminifers are abundant but ostracods are rare. The cosmopolitan assemblages indicate a Maastrichtian age. Mollusc fragments and coprolites are also present. The nannofossil *Chiastozygus initialis* Zone occurs above 1615 feet and is also dated Maastrichtian. The absence of the foraminifer *Globotruncana contusa* and the nannoplankton *Nephroithus frequens* suggests the Upper Maastrichtian may be missing. The interval 1175'-1540' is included in the dinoflagellate *Dinogymnium euclaensis* Zone. While species of dinoflagellates are common, a few specimens of the gymnosperm pollen *Rugubivesiculites* are the only spores encountered. The topmost cuttings sample from 1180'-1220' contains numerous caved Late Paleocene-Early Eocene species including the dinoflagellate *Wetzeliella echinosuturata* described by Wilson (1967) from the Lower Eocene of New Zealand.

Superimposing the biostratigraphic data on our lithological subdivisions permits assignment of ages to the formations. The Mohawk Formation is of Middle Jurassic, in part Bathonian, age and is overlain by the Abenaki Formation which must have been deposited during the Oxfordian-Kimmeridgian. The Micmac Formation is Late Jurassic, probably Kimmeridgian-Tithonian. Except for the bottom 150 feet, which may be Tithonian, the Mississauga Formation is Neocomian. One of us (L.F. Jansa) places the Naskapi Shale between 4248' and 4746' and the overlying Logan Canyon Formation between 3215' and 4248'. Consequently, the Naskapi Shale would be Aptian-Albian and the Logan Canyon Formation, Albian-Cenomanian. Since this sequence is lithologically somewhat monotonous, it is here proposed that the Naskapi Shale be restricted to the interval 4345'-4746' and the base of the Logan Canyon Formation be lowered to 4345 feet. This would confine the Naskapi Shale to the Aptian and the Logan Canyon Formation to the Albian-Cenomanian. The Dawson Canyon Formation is assigned a Late Cenomanian-Early Campanian age. The "P" marker, which is present in the Dawson Canyon Formation and is a useful seismic horizone, falls within the Turonian. The Wyandot Formation is Late Santonian-Early Campanian. The youngest formation, the Banquereau Formation, which is known to extend up to 1175 feet, is Early Campanian-Maastrichtian. Within this formation in Shell Naskapi N-30, a hiatus apparently represents Late Campanian time and probably marks the top of the regressive sandstone at 1540 feet. Cavings indicate that above 1175 feet must be in part Paleocene-Early Eocene.

The history of deposition is remarkably continuous in Naskapi N-30. Except for the hiatus between the Naskapi Shale and Logan Canyon Formation, the only obvious gap is the absence in the Banquereau Formation of Late Campanian. The biostratigraphic data support the belief that the La Have Platform in the vicinity of Naskapi was stable during most of Mesozoic time.

PALEOECOLOGY

Paleoecological conclusions determined from the fossil studies are based primarily on the character of the foraminiferal and ostracod faunas, supported by data from nannofossils and palynomorph assemblages. Utilizing these groups of microfossils, it is possible to distinguish continental, littoral, inner neritic and outer neritic environments in Shell Naskapi N-30. Sediments deposited in a continental environment contain freshwater ostracods with delicate shells, which are usually destroyed during diagenesis, chara seeds, abundant wood and sometimes coal fragments together with spores and pollen. Foraminifers and coccoliths are, of course, absent and dinoflagellates are rare.

Sediments deposited in a littoral environment contain heavily ornamented ostracods, which are often abundant, echinoids, bryozoans, molluscs, corals, chara seeds, coal and wood fragments and spores. Large foraminifers are rare, and generally assignable to *Elphidium Ammonias* or the miliolids. Dinoflagellates are rare, if the latter one or two species tend to dominate the assemblages. Nannofossils are absent.

The inner neritic environment is taken to be between low-tide level and a water depth of about 300 feet and generally corresponds to the inner shelf. Sediments deposited in the inner neritic environment contain rare to abundant foraminifers and assemblages consist of few to several benthonic species and rare planktonics. Abundant ostracods with thinner tests than littoral species, molluscs, echinoids, bryozoans and corals are also present. Spores occur throughout and the

dinoflagellates are predominantly peridinioid. Nannofossils are generally rare.

The outer neritic zone is taken to extend from about 300 feet to 600 feet water depth and corresponds to the outer continental shelf. Benthonic foraminifers here attain their maximum species diversity and greatest concentrations. Planktonic foraminifers and nannofossils are generally abundant. Ostracods are rare and usually have thin tests. Molluscs are present in lower numbers than in the inner neritic zone. Bryozoans are occasionally encountered. Spores, other than bivesiculates, are rare. Dinoflagellates, predominantly gonyaulacacean taxa, become rarer towards the continental slope and open oceanic waters.

The Mesozoic paleoecology of the La Have Platform has been extrapolated from Shell Naskapi N-30 by co-ordinating paleoecological data based on the microfossils with data from lithological studies.

The oldest formation encountered in Shell Naskapi N-30, the Mohawk Formation, was terrigenous and deposited in a continental environment with a marginal marine influence appearing near the top of the formation. Sidewall core 6752 feet contains dinoflagellate species thought to be marine, and the pollen species *Classopollis classoides*, which is believed to be produced by plants favouring a dry coastal environment (Pocock and Jansonius, 1961).

The Abenaki Formation (6020'-6595') has been assigned an Oxfordian-Early Kimmeridgian age. The presence of oolitic grainstone and peloid packstone indicate deposition in a moderate to high energy, nearshore marine environment, probably with a marginal coastal plain episode in the middle represented by the fine-grained terrigenous sequence, red beds and coalified plant fragments. The foraminifers indicate an inner shelf, inner neritic environment. Spores and dinoflagellates are few or absent. The formation's depositional environment or diagenetic history seem not to have favoured the occurrence or preservation of dinoflagellates.

The interval 5496'-6020' has been identified as the Micmac Formation. Foraminiferal and lithologic evidence indicates these Upper Jurassic sediments were deposited in a marginal marine to inner shelf environment, mostly of a low to moderate energy, with several moderate to high energy episodes. Dinoflagellates are scarce and nannofossils are absent. Sixty to ninety per cent of the organic fraction, as visually determined from a palynology slide, is totally carbonized throughout the Mohawk, Abenaki and Micmac formations. The acritarch genus *Micrhystridium*, which frequently predominates in nearshore marine to brackish water environments, is present throughout this interval. A strong influx of dinoflagellates occurs between 5126' and 5550', possibly indicating a nearshore inner neritic environment.

The interval 4815'-5056' is interpreted as fluviatile to deltaic with a delta front facies present near the base. There are few spores and no dinoflagellates. The Schizeaceae, trilete spores from pteridophytic plants, are abundant at 4815' and 4820'. This indicates a non-marine close to shore environment with a humid, temperate to subtropical climatic zone. Dinoflagellates are common at 4774'-4785' and the relative percentage of totally carbonized organic matter drops sharply. The foraminifers indicate that the interval 4770'-5440' was deposited in an inner neritic environment.

The Naskapi Shale (4345'-4746') of Aptian age was deposited in an inner neritic environment with a diagnostic dinoflagellate association often dominated by a single species. The pollen *Classopollis classoides* is abundant in the sample from 4710 feet. Foraminifers are rare.

Shallow water conditions persist in the Logan Canyon Formation (3214'-4345') of Cenomanian-Albian age. The foraminifers suggest a nearshore inner neritic, occasionally littoral environment. The spores provide supporting data. Sidewall cores 4345' and 4266' contain very few dinoflagellates. Sidewall core 4234 feet contain only spores. Between 3474' and 4165', there is little difference between the relative abundances of the dinoflagellates and the spores and pollen. The Late Albian sample at 3908 feet contains numerous schizeaceous spores indicating a humid, temperate to subtropical climate. The abundance of the thick-walled dinoflagellate *Cribroperidinium intricatum* in the sample suggests a nearshore inner neritic environment. Only one dinoflagellate was recorded at 3386 feet while numerous specimens were present at 3330 feet. Interpretation of the dinoflagellate population in the Logan Canyon Formation suggests that 4234'-4345' is a very shallow nearshore marine to continental environment; 3474'-4202' was deposited under open marine inner neritic conditions; 3386 feet in a brackish nearshore environment, and 3330 feet is open marine, inner neritic.

The Dawson Canyon Formation (2376'-3214') marks the onset of deeper water conditions. This takes place between 3095' and 3060' and is marked by a significant increase in nannoplankton and planktonic foraminifers and a corresponding decrease in spores. The Wyandot Formation (1480'-2376') of Late Santonian-Early Campanian age was deposited in an outer shelf environment. Dinoflagellate cysts are scarce; spores occur only in the cuttings and may, therefore, be caved. Abundant planktonic foraminifers and nannoplankton and rare ostracods are indicative of an outer neritic environment.

Foraminiferal data indicate that the Banquereau Formation (1090'-1840') was deposited in Maastrichtian-Campanian time in an outer neritic environment with a period of shallowing during deposition of the regressive sandstone at 1540 feet. The suspected absence of the Late Campanian may denote periods of nondeposition or deposition followed by subsequent uplift and erosion. Throughout the Banquereau, the dinoflagellates predominate over the pollen and spores. Nannoplankton are abundant except in the regressive sandstone at 1540' where inner neritic conditions prevailed and excluded planktonic populations.

CONCLUSIONS

The Shell Naskapi N-30 well penetrated a remarkably complete sequence, almost six thousand feet thick, of Middle Jurassic to Upper Cretaceous strata. Two interruptions in deposition appear to have occurred in

the Upper Aptian and Upper Campanian respectively. The area had a history of inner neritic deposition from the Middle Jurassic to the Early Cretaceous. In the Late Cretaceous, outer neritic sedimentation predominated. The La Have Platform, at least in the vicinity of Naskapi N-30, must have been relatively stable in the Jurassic and Early Cretaceous with significant subsidence occurring in the Late Cretaceous.

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APPENDIX A

FORAMINIFERA

Zones and Species Present in Shell Naskapi N-30 Well

Only the diagnostic species are given for each zone.

1175'-1690': *Globotruncana arca Zone (Maastrichtian)*

Species: *Bolivina incrassata; Dorothia* sp. 1 (F); *Gavelinella dumblei; Globigerinelloides messinae; Globotruncana arca; Globotruncana bulloides; Globotruncana fornicata; Globotruncana lapparenti; Heterohelix* spp. (F): *Hoeglundina supracretacea; Pseudouvigerina plummerae; Rugoglobigerina rotundata; Rugoglobigerina rugosa.*

1690'-2368': *Globotruncana ventricosa-Globotruncana globigerinoides Zone (Campanian)*

Species: *Arenobulimina americana; Archeoglobigerina cretacea; Bolivinoides decoratus delicatulus; Gavelinella dumblei* (F); *Gavelinella* gr. *clementiana; Globotruncana bulloides; Globotruncana fornicata; Globotruncana lapparenti; Globotruncana marginata; Globotruncana ventricosa; Globorotalites* sp. 1; *Hedbergella delrioensis; Heterohelix* spp. (F); *Kyphopyxa christneri; Neoflabellina rugosa*; *Neoflabellina rugosa leptodisca; Pseudotextularia elegans.*

2368'-2925': *Globotruncana coronata-Globotruncana renzi Zone (Coniacian-Santonian)*

Species: *Archeoglobigerina blowi; Archeoglobigerina cretacea; Arenobulimina americana; Epistomina favosoides; Globotruncana concavata; Globotruncana coronata; Globotruncana primitiva; Globotruncana renzi; Haplophragmoides* sp.; *Hedbergella brittonensis; Hedbergella delrioensis; Kyphopyxa christneri; Marssonella trochus; Neoflabellina deltoidea; Neoflabellina* gr. *paerugosa; Vaginulina wadei.*

2925'-3095': *Globotruncana helvetica-Praeglobotruncana stephani Zone (Turonian)*

Species: *Ammobaculites comprimatus; Ammobaculites* spp.; *Dorothia gradata; Haplophragmoides* spp.; *Hedbergella brittonensis; Hedbergella delrioensis; Praeglobotruncana delrioensis; Praeglobotruncana stephani; Rotalipora* cf. *cushmani; Trochamminoides* spp.

3160'-3740': *Rotalipora cushmani Zone (Cenomanian)*

Species: *Ammobaculites comprimatus* (F); *Ammobaculites* spp.; *Dorothia gradata; Gavelinopsis tourainensis; Haplophragmoides* spp. (F); *Praeglobotruncana stephani; Rotalipora cushmani.*

4180'-4580': *Epistomina reticulata-Lenticulina gaultina Zone (Albian)*

Species: *Ammobaculites* spp.; *Gavelinella* sp.; *Epistomina reticulata; Lenticulina gaultina; Lenticulina* spp.; *Reophax* sp.; *Pseudocyclammina?* sp.; *Verneuilinoides* cf. *schizeus.*

4770'-5560': *(Early Cretaceous)*

Species: *Epistomina reticulata; Globigerina kugleri; Lenticulina crepidularis; Pseudocyclammina* sp.

5560'-5660': *Buccicrenata italica peak, Epistomina uhligi Zone (Kimmeridgian-Tithonian)*

Species: *Buccicrenata italica* (FF); *Trocholina* gr. *transversarii; Trocholina* spp.; *Cristellaria nodosa; Epistomina* spp.; *Eoguttulina* spp.; *Ammobaculites* spp.; *Haplophragmoides* spp.; *Trochamminoides* spp.

5660'-6595': *Pseudocyclammina jaccardi-Epistomina soldanii Zone (Oxfordian-Early Kimmeridgian)*

Species: *Ammobaculites* spp.; *Buccicrenata italica; Eoguttulina* spp.; *Epistomina uhligi* (F); *Epistomina porcellanea; Lenticulina nodosa; Pseudocyclammina jaccardi; Pseudocyclammina* spp.; *Trocholina* sp.

6595'-6995': *Epistomina uhligi peak-Epistomina regularis Zone (Middle Jurassic)*

Species: *Epistomina* cf. *uhligi; Epistomina* cf. *regularis; Pseudocyclammina* spp.

FF = Abundant F = Frequent

APPENDIX B

OSTRACODA

Zones and Species Present in Shell Naskapi N-30 Well

Only the diagnostic species are given for each zone.

1175'-1690': *Veenia arachoides Zone (Maastrichtian)*

Species: *Haplocytheridea plummeri; Protocythere* sp. 1; *Veenia arachoides.*

1690'-2368': *Brachycythere rhomboidalis-Amphicytherura distincta Zone (Campanian)*

Species: *Amphicytherura distincta; Brachycthere rhomboidalis; Cythereis* sp. 1; *Monoceratina montuosa; Protocythere derooi; Pterygocythere saratogana.*

2368'-2925': *Protocythere triebeli-Orthonotacythere hannai Zone (Coniacian-Santonian)*

Species: *Cythereis* sp. 2; *Cythereis* sp. 3; *Haplocytheridea councilli; Orthonotacythere hannai; Protocythere triebeli; Schuleridea* sp.

2925'-3095': *Cythereis* sp. 2 *Zone (Turonian)*

Species: *Paracyprideis* sp.

3160'-3740': *Cythereis roanokensis Zone (Cenomanian)*

Species: *Cythereis roanokensis; Cythereis* spp.; *Eocytheropteron* sp. 1; *Neocythere vanveeni; Schuleridea* sp.

4180'-4580': *(Albian)*

Species: *Neocythere* sp.; *Schuleridea jonesiana.*

4770'-5560': *(Early Cretaceous)*

Species: *Neocythere denticulata; Schuleridea* sp.

5560'-5660': *Schuleridea aff. triebeli oblonga Zone and the upper part of the Orthonotacythere sp. 1, Cytherella index zone (Kimmeridgian-Tithonian)*

Species: *Schuleridea* aff. *triebeli oblonga; Orthonotacythere?* sp. 1; *Galliaecytheridea* sp.; *Asciocythere* sp.; *Monoceratina* sp.

5660'-6595': *Cytherella index zone (Oxfordian?-Early Kimmeridgian)*

Species: *Galliaecytheridea* sp.; *Schuleridea* sp.; *Cytherella index.*

APPENDIX C

PALYNOMORPHS

Zones and Species Present in Shell Naskapi N-30 Well

Unless otherwise indicated, the species listed within each zone are not present in younger zones.

1175'-1540': *Dinogymnium euclaensis Zone (Maastrichtian)*

Species: *Deflandrea* cf. *cooksoni; Deflandrea granulifera* (with 3I archeopyle); *Deflandrea sverdrupiana; Deflandrea tripartita; Dinogymnium acuminatum; Dinogymnium digitus; Dinogymnium euclaensis; Dinogymnium microgranulosum; Dinogymnium undulosum; Rugubivesiculites reductus; Rugubivesiculites rugosus.*

1582'-2215': *Odontochitina costata Zone (Campanian)*

Species: *Canningia reticulata; Deflandrea echinoidea* (restricted to this horizon); *Dinogymnium undulosum* (base); *Horologinella apiculata; Hystrichosphaeridium recurvatum; Odontochitina costata; Oligosphaeridium anthophorum; Palaeohystrichophora infusorioides; Xenascus ceratioides; Senoniasphaera rotundata; Tanyosphaeridium variecalamum; Trichodinium castanea.*

2290'-2620': *Australiella victoriensis Zone (Santonian)*

Species: *Australiella victoriensis; Chlamydophorella* sp.; *Cycloephelium vannophorium; Deflandrea pirnaensis; Deflandrea* cf. *cooksoni* sensu Clarke and Verdier, 1967; *Deflandrea sverdrupiana* (base); *Dinogymnium acuminatum* (base); *Dinoterygium cladoides;* Forma P. Evitt, 1961 (base); *Hystrichosphaeridium cooksoni; Hystrichosphaeridium stellatum* var. A. Williams and Brideaux; *Hustrichosphaeridium truncigerum; Palaeohystrichophora infusorioides* (common); *Surculosphaeridium longifurcatum.*

2695'-2815': *Oligosphaeridium pulcherrimum Zone (Coniacian)*

Species: *Cycloephelium paucispinum; Oligosphaeridium pulcherrimum.*

2860'-3060': *Surculosphaeridium longifurcatum Zone (Turonian)*

Species: *Areoligera* sp.; *Coronifera oceanica; Polysphaeridium laminaspinosum; Surculosphaeridium longifurcatum* sensu Williams and Brideaux (common).

3095'-3778': *Cleistosphaeridium polypes Zone (Cenomanian)*

Species: *Callaiosphaeridium asymmetricum; Camarozonosporites insignis* (common); *Classopollis classoides; Cleistosphaeridium huguonioti; Cleistosphaeridium polypes* subsp A; *Converrucosisporites exquisitus; Cribroperidinium intricatum; Cyclonephelium vannophorum* subsp. A; *Deflandrea pontis-mariae; Epelidosphaeridia spinosum; Gleicheniidites senonicus* (common); *Retitricolpites virgeus; Tricolpites parvus.*

3908'-4345': *Spinidinium cf. vestitum Zone (Albian) Late Albian (3908'-3948')*

Species: *Cribroperidinium intricatum* (common); *Eucommiidites minor; Palaeostomocystis fragilis; Spinidinium vestitum; Spinidinium* cf. *vestitum; Tricolpites parvus* (base).

Early-Middle Albian (3948'-4345')

Species: *Cicatriocosisporites pseudotriparitus; Cleistosphaeridium polypes* (base); *Deflandrea pontis mariae* (base); *Lycopodiumsporites crassimacerius; Oligosphaeridium complex* (common); *Palaeohystrichophora infusorioides* (base); *Protoellisodinium* sp.; *Spinidinium* cf. *vestitum* (base); *Trilobosporites apiverrucatus; Vitreisporites pallidus.*

4403'-4710': *Cyclonephelium attadalicum Zone (Aptian-possibly Early Aptian)*

Species: *Aptea polymorpha; Callialasporites trilobatus; Canningia colliveri; Cyclonephelium attadalicum; Cyclonephelium* cf. *attadalicum; Deflandrea perlucida; Doidyx anaphrissa; Pilosisporites trichopapillosus; Polystephanephorus* sp.; *Pseudoceratium* sp.; *Trilobosporites trioreticulosus.*

4774'-4925': *Doidyx anaphrissa Zone (Barremian)*

Species: *Deflandrea perlucida* (common); *Doidyx anaphrissa* (common at 4774'); *Meiourogonyaulax stoveri; Muderongia simplex.*

4985'-5126': *Ctenidodinium elegantulum-Pseudoceratium pelliferum Zone (Hauterivian)*

Species: *Ctenidodinium elegantulum; Gonyaulacysta serrata; Muderongia simplex* (base); *Pseudoceratium pelliferum* (base).

5255'-5550': *Phoberocysta neocomica Zone (Berriasian-Valanginian)*

Species: *Achomosphaera neptuni; Dingodinium cerviculum; Pareodinia ceratophora; Systematophora complicata; Systematophora schindewolfi.*

5620'-5713': *Ctenidodinium panneum Zone (Tithonian)*

Species: *Ctenidodinium panneum; Ctenidodinium* sp.; *Prolixosphaeridium xanthiopyxides; Wanaea* sp.

5790'-6320': *Gonyaulacysta cladophora Zone (Kimmeridgian)*

Species: *Ctenidodinium culmulum; Dingodinium cerviculum* (base); *Gonyaulacysta cladophora; Gonyaulacysta granulata; Hexagonifera jurassica; Imbatodinium* sp.; *Micrhystridium stellatum; Polystephanephorus sarjeanti; Systematophora fascigulifera.*

6390'-6600': *Gonyaulacysta jurassica Zone (Oxfordian)*

Species: *Ctenidodinium ornatum; Dictyopyxis* sp.; *Gonyaulacysta jurassica* subsp. *longicornis; Leptodinium egemenii; Systematophora areolata.*

6600'-6820': *Valensiella ovulum Zone*

Species: *Meiourogonyaulax* sp.; *Valensiella ovulum.*

APPENDIX D

NANNOPLANKTON

Zones and Species Present in Shell Naskapi N-30 Well

Only the diagnostic species are given for each zone.

1175'-1615': *Chiastozygus initialis Zone (Maastrichtian)*

Species: *Arkhangelskiella cymbiformis; Arkhangelskiella specillata; Broinsonia parca; Chiastozygus initialis; Cretadiscus colatus; Cretarhabdus conicus; Cretarhabdus crenulatus; Cribrosphaerella ehrenbergi; Eiffellithus turriseiffeli; Kamptnerius magnificus; Microrhabdulus decoratus; Micula staurophora; Parhabdolithus bitraversus; Prediscosphaera cretacea; Prediscosphaera spinosa; Tetralithus nitidus; Tetralithus quadratus.*

1690'-2020': *Tetralithus nitidus-Kamptnerius magnificus-Arkhangelskiella specillata Zone (Campanian)*

Species: *Actinozygus splendens; Arkhangelskiella cymbiformis; Arkhangelskiella specillata; Coccolithus actinosus; Chiastozygus litterarius, Chiastozygus quadriperforatus; Cretarhabdus crenulatus; Cyclindralithus asymmetricus; Disolithus venatus; Dodekapodorhabdus noelae; Eiffellithus turriseiffeli; Eiffellithus octoradiatus. Kamptnerius magnificus; Lithastrinus grilli; Lucianorhabdus cayeuxi; Microrhabdulus decoratus; Micula staurophora; Percivallia porosa; Tetrialithus nitidus; Vekshinella imbricata; Watzhaueria barnesae, Zygodiscus diplogrammus; Zygodiscus theta.*

Table 1

Geological Age of Formations

in the Shell Naskapi N-30 Well

Formation	Footage	Age
Banquereau	1090-1840	Campanian-Maastrichtian
Wyandot	1840-2180	Campanian
Dawson Canyon	2180-3214	Turonian, Coniacian, Santonian
Logan Canyon	3214-4345	Albian-Cenomanian
Naskapi Shale	4345-4746	Aptian (Early?)
Mississauga	4746-5496	Neocomian-Barremian
Micmac	5496-6020	Kimmeridgian-Tithonian
Abenaki	6020-6595	Oxfordian-Early Kimmeridgian
Mohawk	6595-6992	Middle Jurassic

2095'-2725': *Marthasterites furcatus Zone (Santonian)*

Species: *Apertapetra gronasa; Braarudosphaera bigelowi; Broinsonia bevieri; Broinsonia parca; Chiastozygus disgregatus; Chiastozygus interruptus; Cretarhabdus crenulatus; Cribrosphaera ehrenbergi; Deflandrius cantabrigensis; Eiffellithus turriseiffeli; Kamptnerius punctatus; Lithastrinus grilli; Lithraphidites helicoideus, Marthasterites furcatus; Microrhabdulus decoratus; Micula stauophora; Parhabdolithus angustus; Percivalia porosa; Prediscosphaera cretacea; Stephanolithion laffittei; Tetralithus pyramidus; Vekshinella imbricata; Watznaueria barnesae.*

2785'-2815': *Discolithus incohatus Zone (Coniacian)*

Species: *Broinsonia parca; Cretadiscus colatus; Discolithus incohatus; Eiffellithus turriseiffeli; Prediscosphaera spinosa; Tranolithus exiguus; Vekshinella imbricata; Watznaueria barnesae.*

2860'-2890': *Corollithion exiguum Zone (Turonian)*

Species: *Coccolithus ficula; Cretarhabdus crenulatus hansmanii; Discolithus incohatus; Eiffellithus turriseiffeli; Prediscosphaera cretacea; Vekshinella imbricata; Watznaueria barnesae; Zygodiscus theta.*

2995'-3500': *Parahabdolithus bitraversus Zone (Cenomanian-Turonian)*

Species: *Arkhangelskiella scapha; Broinsonia dentata; Chiastozygus planus; Coccolithus matalosus; Corollithion signum; Costacentrum horticum; Cretarhabdus crenulatus hansmanii; Cylindralithus gallicus; Cyclolithus solidus; Deflandrius cantabrigensis; Diadorhombus minutus; Kamptnerius punctatus; Lithastrinus grilli; Micula staurophora; Parhabodolithus bitraversus; Prediscosphaera cretacea; Tranolithus exiguus; Vekshinella imbricata; Watznaueria barnesae; Zygodiscus sisyphus; Zygodiscus theta.*