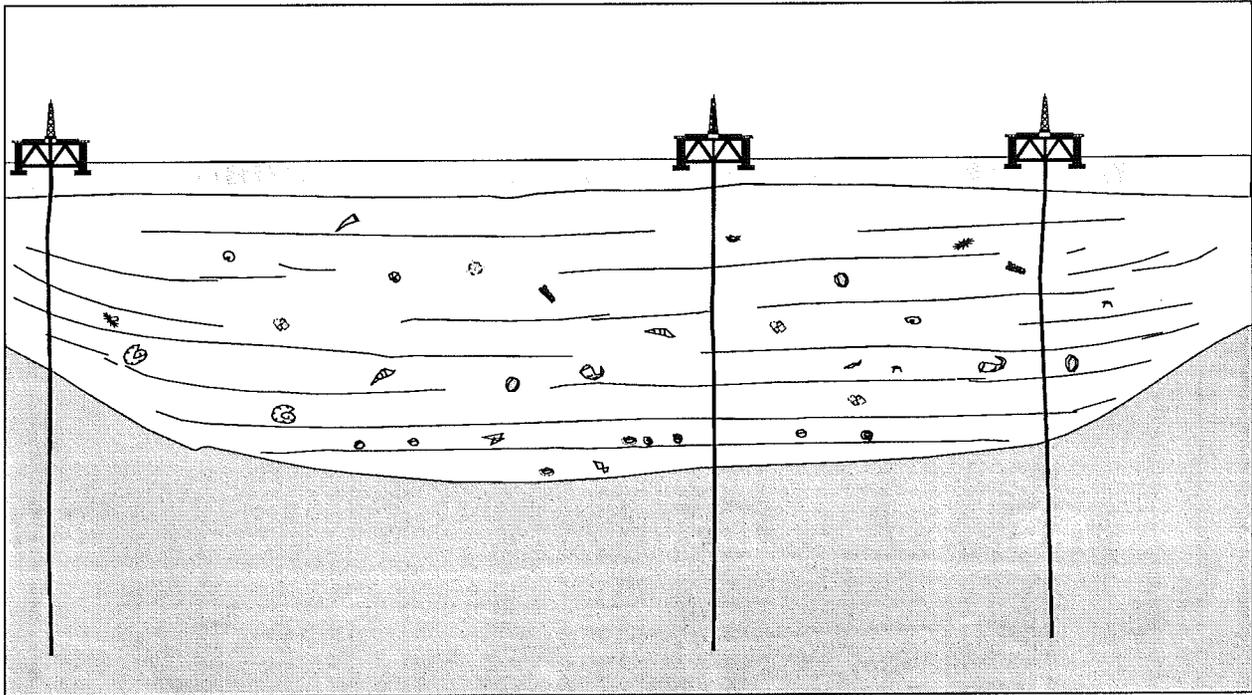


**PRELIMINARY CENOZOIC MICROPALAEONTOLOGICAL BIOSTRATIGRAPHY OF 16  
WELLS, JEANNE D'ARC BASIN, GRAND BANKS OF NEWFOUNDLAND**

Geological Survey of Canada / Commission géologique du Canada

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## **ABSTRACT**

The preliminary Cenozoic micropaleontological biostratigraphy of 16 exploratory wells in the Jeanne d'Arc Basin is presented. Analysis is based on ditch cuttings, and the Cenozoic is divided into Paleocene, Lower Eocene, lower Middle Eocene, upper Middle/Upper Eocene, Oligocene, Lower/Middle and Upper Miocene, based on benthic and planktic foraminifera. Paleoenvironments of these sites follow a general pattern of middle to upper bathyal conditions in Paleogene levels, shallowing to neritic in the Neogene.



## INTRODUCTION

The Jeanne d'Arc Basin in the northeastern Grand Banks of Newfoundland has its origins as a failed-rift basin during the early Mesozoic. It contains over 20 km of sedimentary fill and has demonstrably large economic hydrocarbon potential (McAlpine, 1990). Of the dozens of exploratory wells drilled in this area in the past two decades comparatively few have been analysed for Cenozoic micropaleontology, although the Mesozoic of many sites has been described (e.g. Ascoli, 1983, 1984, 1985, 1988). Sixteen of the Cenozoic sections (Figure 1) have recently been studied by the author and this report summarizes their preliminary Cenozoic biostratigraphy and paleoenvironments. Well-to-well correlations and a Cenozoic biostratigraphical synthesis of the Basin are not within the scope of this report, but will appear in later works.

Technical data and names of these wells are listed in Table 1. For each well a generalized biostratigraphic and paleoenvironmental scheme is provided followed by a listing of all recognizable microfossil tops in each subdivision of the Cenozoic section. These data all come from previously unpublished manuscripts.

Since all samples are ditch cuttings, only these tops of species can be regarded as more or less reliable: caving of younger material down into older is a common occurrence. In most cases these cuttings samples are composite, derived over a ten-metre interval, and with gaps of twenty to thirty metres between adjacent samples. Mobil Gulf Flying Foam I-13 was drilled previous to Canada's conversion to the metric system and originally all data and samples were based on footages. These have been converted to metres.

The principal zonation scheme used is that devised by Gradstein and Agterberg (1982) for the Northwestern Atlantic Margin which incorporates benthic foraminifera and a few non-foraminiferal taxa along with the more traditional planktic forms. This is essential in this basin because of the relatively low numbers of planktics encountered in some levels of many wells. Also useful in some cases are the treatises of Bolli and Saunders (1985) and Toumarkine and Luterbacher (1985) for planktics and van Morkhoven *et al.* (1986) and Tjalsma and Lohmann (1983) for benthic species.

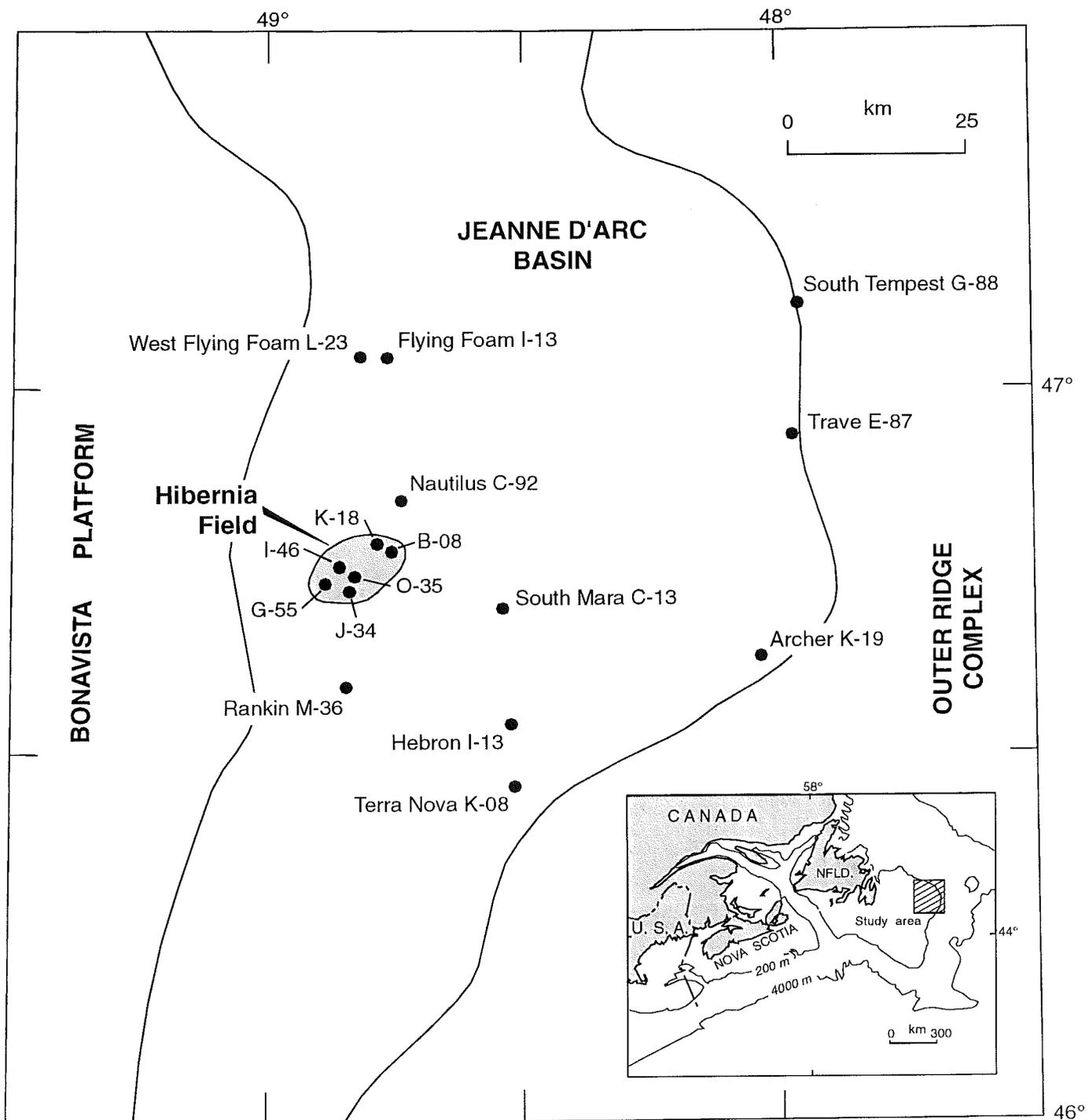


Figure 1. Location map showing Jeanne d'Arc Basin, 16 wells, tectonic highs and location of Hibernia Field.

## BIOSTRATIGRAPHIC SUMMARIES AND SPECIES LISTS

Husky-Bow Valley *et al.* Archer K-19 (from Thomas, 1993b)

Table 2. Stratigraphic succession and paleoenvironments.

<u>Depth</u> (m)	<u>Age</u> (Zone) - probable environment
900-960	Early Miocene to Oligocene ( <i>Spiroplectammia carinata</i> Zone) - upper bathyal
970-980	Oligocene ( <i>Turrilina alsatica</i> Zone) - upper bathyal
1000-1520	Late/Middle Eocene ( <i>Reticulophragmium amplectens</i> - <i>Limacina canadensis</i> Zone*) - bathyal
1540-1790	early Middle Eocene ( <i>Spiroplectammia spectabilis</i> Zone) - bathyal
1810-1850	Early Eocene (Megaspore sp.1 Zone) - (middle) bathyal
1870-1910	Paleocene ( <i>Gavelinella beccariiiformis</i> - <i>Rzehakina epigona</i> Zone) - middle bathyal

\* This is referred to as the *Cyclammia amplectens* - Pteropod sp.1 Zone in Gradstein and Agterberg (1982).

### Faunal List

Lower Miocene (?) to Oligocene 900-960 m

*Biloculina* sp.  
Bryozoa  
*Ceratobulimina contraria*  
*Cibicidoides pachyderma*  
*Coscinodiscus* sp.3  
?Eggerella sp.  
*Epistominella* cf. *umbonifera*  
*Eponides umbonatus*  
Gastropod sp.  
*Globobulimina* sp.  
*Globocassidulina subglobosa*  
*Guttulina problema*  
*Gyroidina girardana*  
*Gyroidina soldanii*  
*Haplophragmoides retroseptus*  
*Haplophragmoides* sp.  
*Karreriella* cf. *chapapotensis*  
*Labrospira pacifica*  
*Lenticulina alatolimbata*  
*Lenticulina* spp.  
*Limacina planispiralis*  
*Marginulina* aff. *bachei* var.  
*Melonis barleanum*  
*Melonis* sp. "fat form"  
*Nodosaria* sp.  
*Nodosaria* sp.4  
*Nodosaria* sp.14  
*Oridorsalis umbonatus*  
*Plectofrondicularia budensis*

*Pullenia bulloides*  
*Pullenia quinqueloba*  
*Quinqueloculina* cf. *stalker*  
*Reophax* sp.  
*Spirophthalmidium* sp.  
*Spiroplectammina carinata*  
*Vaginulinopsis* aff. *decorata*  
*Valvulineria petrolei*  
*Uvigerina* cf. *havanensis*  
*Uvigerina* cf. *miozea-nuttalli*

Oligocene 970-980 m

*Ammomarginulina aubertae*\*  
*Bolivina* sp.  
*Cibicidoides* cf. *incrassatus*  
*Epistomina eocaenica*  
*Gyroidina soldanii* aff. *mamilligera*  
*Hoeglundina elegans*  
*Lenticulina* aff. *totomiensis*  
Ostracodes  
*Turrilina alsatica*  
*Uvigerina* spp.

\* If in place, this is an unusually young occurrence for this recently-described species (Gradstein and Kaminski, 1989).

Upper/Middle Eocene 1000-1520 m

*Ammodiscus latus*  
*Ammodiscus planus*  
*Ammosphaeroidina pseudoloculata*  
*Ammovertellina* sp.  
*Bathysiphon* ex. gr. *discreta*  
*Bolivina* cf. *dilatata*  
*Catapsydrax* aff. *dissimilis*  
*Cibicidoides* sp.  
*Cibicidoides truncana*  
*Chilostomella oolina*  
*Cribrostomoides scitulus*  
*Cribrostomoides* sp.  
*Cribrostomoides subglobosus*  
*Cyclammina cancellata*  
*Cyclammina placenta*  
? *Cymbalopora* sp.  
*Eggerella* sp.  
Fish teeth  
*Globigerina eocaena*  
*Globigerina linaperta*  
? *Globigerina* sp.  
*Globoquadrina venezuelana*  
? *Glomospirella* sp.  
*Gyroidina octocamerata*  
*Haplophragmoides kirki*  
*Haplophragmoides* sp.

*Haplophragmoides* sp.2  
*Haplophragmoides* ex. gr. *suborbicularia*  
*Hyperammina* sp.  
*Karreriella* sp.  
*Karreriella* cf. *subglabra*  
*Lenticulina* spp.  
*Limacina canadensis*  
*Lituotuba* sp.  
Mollusc fragments  
*Nodosaria* cf. *elegantissima*  
*Plectofrondicularia* ?*vaughani*  
*Pseudoglandulina humilis*  
Pyrite tubes  
*Quinqueloculina* sp.  
*Recurvoides* sp.  
*Reophax* sp.  
*Reticulophragmium amplectens*  
Scaphopod - "fluted" sp.  
*Spirillina* sp.  
*Spiroplectammina dentata*  
*Textularia* sp.  
*Trochammina* sp.  
*Trochamminoides* cf. *irregularis*  
*Turborotalia pomeroli*  
*Uvigerina* sp.

lower Middle Eocene 1540-1790 m

*Acarinina densa*  
*Adercotryma* cf. *glomerata*  
*Ammobaculites* aff. *agglutinans*  
*Ammolagena clavata*  
*Anomalinoides acuta*  
*Cibicidoides eocaena*  
*Cibicidoides tuxpamensis*  
*Coscinodiscus* aff. sp.1  
Fish teeth  
*Globigerina* aff. *yeguaensis*  
*Globigerinatheka* ex. gr. *subconglobata*  
*Globigerinatheka* sp.  
*Lenticulina* aff. *whitei*  
*Nodosaria* cf. *pozoensis*  
*Osangularia expansa*  
*Reophax duplex*  
*Reophax* sp.  
*Saccammina* sp.  
*Spiroplectammina spectabilis*  
*Subbotina frontosa*  
*Trochammina globigeriniformis*

Lower Eocene 1810-1850 m

*Acarinina broedermanni*  
*Acarinina soldadoensis*  
*Acarinina wilcoxensis intermedia*

*Anomalina cf. spissiformis*  
*Bulimina cooperensis*  
*Cibicidoides subspiratus*  
*Gavelinella sp.17*  
*Globigerina ?inequispira*  
*Karreriella conversa*  
*Marginulina sp.*  
*Morozovella aequa*  
*Pseudohastigerina wilcoxensis*  
*Reticulophragmoides cf. jarvisi*  
 Scaphopod - "corrugated"  
*Subbotina sp.*  
*Tolypammina sp.*

Paleocene 1870-1910 m

?*Ammoscalaria sp.*  
*Ammodiscus cretaceus*  
 "Balls" - 2 types; sphaeroid and lenticular  
*Bulimina bradburyi*  
*Gaudryina pyramidata*  
*Globigerina triloculinooides*  
*Glomospira corona*  
*Heterohelix sp.\**  
*Neoponides hillebrandti*  
 Ostracode  
*Reophax sp.*  
 ?*Rhizammina sp.*  
*Spiroplectammina navarroana*  
 Sponge spicules  
*Uvigerina sp.*

\* Reworked Late Cretaceous planktic species.

Mobil Gulf Flying Foam I-13 (from Thomas, 1993a)

Table 3. Summary of stratigraphic succession and paleoenvironments.

<u>Depth (m)</u>	<u>Age (Zone) - probable environment</u>
302-558	Late Miocene ( <i>Asterigerina gurichi</i> Zone) - neritic
576-942	Middle/Early Miocene ( <i>Spiroplectammina carinata</i> Zone) - neritic
960-1134	Oligocene ( <i>Turrilina alsatica</i> Zone) - outer neritic to upper bathyal
1180-1573	Late/Middle Eocene ( <i>Reticulophragmium amplectens</i> - <i>Limacina canadensis</i> Zone) - upper bathyal
1618-1929	early Middle Eocene ( <i>Spiroplectammina spectabilis</i> Zone) - upper bathyal
1948-2121	Early Eocene (Megaspore sp.1 Zone) - upper bathyal

Faunal List

Late Miocene 302-558 m

*Asterigerina gurichi*  
*Bulimina gracilis*  
*Cassidulina sp.*

*Caucasina elongata*  
*Ceratobulimina contraria*  
*Cibicidoides pachyderma*  
*Coscinodiscus* sp.1  
*Coscinodiscus* sp.2  
*Coscinodiscus* sp.4  
*Coscinodiscus* spp.  
*Dentalina* cf. *communis*  
Echinoid spines  
*Epistomina* sp.  
Fish teeth  
*Florilus* sp.  
*Gyroidina* cf. *octocamerata*  
*Hoeglundina elegans*  
*Laticarinina* sp.  
*Lenticulina* sp.  
*Melonis barleeaanum*  
Mollusc fragments  
*Nodosaria* sp.  
*Oolina* sp.  
*Planulina wuellerstorffi*  
*Pullenia quinqueloba*  
*Pullenia bulloides*  
*Sphaeroidina bulloides*  
Sponge spicules  
*Trifarina fluens*  
*Uvigerina canariensis*  
*Uvigerina* sp.

Early/Middle Miocene 576-942 m

*Astacolus* sp.  
*Cibicidoides tenellus*  
*Coscinodiscus* sp.3  
*Coscinodiscus* spp.  
*Globigerina* cf. *bulloides*  
*Globigerina* cf. *praebulloides*  
*Globoquadrina* aff. *venezuelana*  
*Guttulina problema*  
*Gyroidina soldanii*  
*Lenticulina* spp.  
Mollusc fragments  
*Pararotalia* sp.1  
*Pyrgo* sp.  
*Pyrulina* sp.  
*Quinqueloculina* sp.  
*Spiroplectammina carinata*  
Sponge spicules  
*Uvigerina miozea-nuttalli*  
*Valvulineria* sp.

Oligocene 960-1134 m

*Bathysiphon* aff. *eocaena*  
*Bolivina* sp.

Bryozoans  
*Cyclammia placenta*  
*Cyclammia rotundidorsata*  
*Eponides umbonatus*  
*Fissurina* cf. *marginata*  
*Globocassidulina subglobosa*  
*Gyroidina girardana*  
*Haplophragmoides* sp.  
Mollusc fragments  
Ostracode  
Pyrite tubes  
*Quinqueloculina* sp.  
Scaphopod sp. - "corrugated"  
Selachian denticles  
*Spirophthalmidium* sp.  
*Turrilina alsatica*  
*Uvigerina* spp.

Late/Middle Eocene 1180-1573 m

*Ammodiscus latus*  
*Ammomarginulina aubertae*  
*Ammosphaeroidina* sp.1  
*Bolboforma* sp.  
*Bathysiphon eocaena*  
*Chilostomella oolina*  
*Cribrostomoides* sp.  
*Globigerina* sp.  
*Gyroidina soldanii mamilligera*  
*Haplophragmoides kirki*  
*Haplophragmoides walteri*  
*Heterolepa mexicana*  
*Karriella apicularis*  
*Karriella conversa*  
*Lenticulina* sp.  
*Limacina canadensis*  
*Plectofrondicularia* sp.  
Pyrite tubes  
Radiolarians  
*Recurvoides* cf. *walteri*  
*Reticulophragmium amplectens*  
*Trochammina globigeriniformis*  
*Trochammina* sp.  
*Vaginulinopsis decorata*

early Middle Eocene 1618-1929 m

*Alabamina scitula*  
*Cibicidoides* cf. *eocaenus*  
*Coscinodiscus* sp.3  
*Coscinodiscus* spp.  
*Dorothia trochoides*  
Fish tooth  
*Globigerina senni*  
*Glomospira* sp.

Megaspore sp.1  
 Mollusc fragments  
*Pseudohastigerina wilcoxensis*  
*Spiroplectammina spectabilis*  
*Subbotina frontosa*

Early Eocene 1948-2121 m

*Ammobaculites* sp.  
*Bulimina midwayensis*  
*Bulimina ovata*  
 Fish teeth  
*Globigerina* sp.  
*Karreriella chapapotensis*  
*Lenticulina* sp.  
 Megaspore sp.1  
*Nodosaria* sp.  
 Ostracodes  
*Reophax* sp.  
*Rhizammina* sp.  
 Selachian denticles  
*Spirillina* sp.  
*Spiroplectammina navarroana*

Mobil *et al.* Hebron I-13 (from Thomas, 1993g)

Table 4. Stratigraphic succession and paleoenvironments.

<u>Depth</u> (m)	<u>Age</u> (Zone) - probable environment
390-430	Late Miocene ( <i>Asterigerina gurichi</i> Zone) - neritic
450-580	Early/Middle Miocene ( <i>Spiroplectammina carinata</i> Zone) - neritic
600-850	Oligocene ( <i>Turrilina alsatica</i> Zone) - neritic
870-1150	Middle/Late Eocene ( <i>Reticulophragmium amplectens</i> - <i>Limacina canadensis</i> Zone) - upper bathyal shallowing to neritic
1170-1515	(?Early/) Middle Eocene ( <i>Spiroplectammina spectabilis</i> Zone) - upper bathyal
1535-1545	Paleocene ( <i>Gavelinella beccariiiformis</i> - <i>Rzehakina epigona</i> Zone) - upper bathyal

Faunal List

Upper Miocene 390-430 m

*Asterigerina gurichi*  
*Coscinodiscus* sp.4  
*Gyroidina girardana*  
*Lenticulina* sp.  
*Nonion barleeaanum*  
 Ostracodes  
*Pullenia bulloides*  
*Pullenia quinqueloba*  
 Scaphopods

Lower/Middle Miocene 450-580 m

*Ceratobulimina contraria*  
*Chilostomella* sp.  
*Cibicides* cf. *lobatulus*  
*Cibicidoides* sp.  
*Coscinodiscus* sp.1  
Echinoid spines  
Fish teeth  
*Guttulina problema*  
*Hoeglundina elegans*  
*Lenticulina* aff. *alatolimbata*  
*Lenticulina* spp.  
*Marginulina bachei*  
Mollusc fragments  
*Nodosaria* sp.  
*Quinqueloculina* sp.  
*Parafrondicularia miocenica*  
*Pyrulina* sp.  
Scaphopods  
*Spiroplectammina carinata*  
*Stilostomella* sp.  
*Uvigerina miozea-nuttalli*

Oligocene 600-850 m

*Ammobaculites* sp.  
*Astacolus* sp.  
*Bathysiphon* cf. *eocaena*  
*Bolivina dilatata*  
Bryozoans  
*Bulimina* aff. *alazanensis*  
*Cibicides* sp.  
*Cibicidoides eocaenus*  
*Cibicidoides grimsdalei*  
*Cibicidoides praemundulus*  
*Cibicidoides* sp.  
Coarse agglutinated spp.  
*Cornuspira* sp.  
*Cyclogyra decorata*  
*Dentalina* sp.  
*Eggerella* cf. *bradyi*  
*Epistomina eocaena*  
*Eponides umbonatus*  
Fish teeth  
*Globigerina praebulloides*  
*Globocassidulina subglobosa*  
*Gyroidina soldanii mamilligera*  
*Karreriella bradyi*  
*Lagenella* sp.  
*Lenticulina* cf. *calcarata*  
*Lenticulina iota*  
*Lenticulina* spp.  
*Lenticulina* aff. *totomiensis*  
*Limacina canadensis*

*Marginulina bachei* var.  
Mollusc fragments  
*Nodosaria* cf. *elegantissima*  
*Nodosaria* sp.  
*Nodosaria* sp.5  
*Nodosaria* sp.12  
Ostracodes  
? *Palmula* sp.  
*Pseudonodosaria humilis*  
*Quinqueloculina* spp.  
Scaphopod "corrugated"  
*Sigmomorphina* sp.  
*Stilostomella* cf. *aculeata*  
*Turrilina alsatica*  
*Uvigerina* spp.  
*Vaginulinopsis* aff. *decorata*

Middle/Upper Eocene 870-1150 m

*Ammodiscus latus*  
*Bathysiphon eocaena*  
Bryozoans  
*Bulimina midwayensis*  
*Bulimina ovata*  
*Ceratocanceris* sp.1  
*Cibicides* sp.  
*Cibicidoides westii*  
*Cyclammia placenta*  
Echinoid fragments  
*Gaudryina laevigata*  
*Guttulina* sp.  
*Haplophragmoides* sp.  
*Karriella* sp.  
*Lenticulina* cf. *whitei*  
*Limacina canadensis*  
Megaspore sp.  
Mollusc fragments  
*Nodosaria* sp.  
Ostracodes  
? *Plectina* sp.  
*Quinqueloculina* sp.  
*Recurvoides* cf. *walteri*  
*Reticulophragmium amplexans*  
*Reticulophragmium rotundidorsata*  
Scaphopods  
*Subbotina linaperta*

(?Lower/) Middle Eocene 1170-1515 m

*Acarinina densa*  
*Ammosphaeroidina pseudopauciloculata*  
*Anomalinoidea acuta*  
*Catapsydrax* aff. *dissimilis*  
*Cibicidoides truncanus*  
Concretions

*Dendrophyra* sp.  
*Globigerina eocaena*  
*Globigerina* spp.  
*Haplophragmoides kirki*  
*Haplophragmoides walteri*  
Mollusc fragments  
*Nodosaria* sp.  
*Nodosaria* sp.11  
*Nodosaria* sp.20  
Ostracodes  
*Pleurostomella* sp.  
*Pseudohastigerina micra-wilcoxensis* gr.  
?Pyrgo sp.  
?Radiolarians  
Scaphopods  
*Spirillina* sp.  
*Spiroplectammina spectabilis*  
Sponge spicules  
*Stilostomella* cf. *subspinosa*

Paleocene 1535-1545 m

*Ammolagena* sp.  
*Gavelinella beccariformis*  
?Radiolarians

Mobil *et al.* Hibernia B-08 (from Thomas, 1992d)

Table 5. Stratigraphic succession and paleoenvironments.

<u>Depth</u> (m)	<u>Age</u> (Zone) - probable environment
540-670	Late or late Middle Miocene ( <i>Asterigerina gurichi</i> Zone) - neritic
690-730	Early-Middle Miocene ( <i>Spiroplectammina carinata</i> Zone) - neritic
750-850	indeterminate - ?neritic
870-880	Oligocene ( <i>Turrilina alsatica</i> Zone) - neritic
900-1030	indeterminate - ?neritic
1045-1355	?Late Eocene ( <i>Reticulophragmium amplexens</i> - <i>Limacina canadensis</i> Zone) - neritic
1375-1630	Middle Eocene ( <i>Spiroplectammina spectabilis</i> Zone) neritic to upper bathyal
1630-1710	Early Eocene (Megaspore sp.1 Zone) - indeterminate
1710-1740	Early or Middle Paleocene ( <i>Gavelinella beccariformis</i> - <i>Rzehakina epigona</i> Zone) - indeterminate
1745	Cretaceous

Faunal List

Upper or upper Middle Miocene 540-670 m

*Asterigerina gurichi*  
*Ceratobulimina contraria*  
*Cibicides lobatulus*  
*Coscinodiscus* sp.3  
*Coscinodiscus* sp.4  
*Eponides* sp.

Fish otoliths  
*Gyroidina* sp.  
*Hoeglundina elegans*  
*Lenticulina* spp.  
*Marginulina* cf. *bachei*  
*Melonis* sp.  
Mollusc fragments  
*Pullenia bulloides*  
Pyritized tubes  
*Quinqueloculina* sp.  
*Textularia agglutinans*  
*Uvigerina miozea-nuttalli*

Lower/Middle Miocene 690-730 m

*Coscinodiscus* sp.1  
*Dentalina* sp.  
*Eponides umbonatus*  
Fish teeth  
*Fissurina* sp.  
*Globulina* sp.  
*Guttulina problema*  
*Gyroidina girardana*  
*Nodosaria* sp.  
*Nonion* sp.  
*Pullenia* cf. *quinqueloba*  
*Spiroplectammina carinata*

Oligocene 870-880 m

?*Abyssammina* sp.  
*Cibicidoides* sp.  
*Nodosaria* cf. *elegantissima*  
*Pullenia* sp.  
*Stilostomella* sp.  
*Turrilina alsatica*  
*Uvigerina proboscidea*

?Upper Eocene 1045-1355 m

*Adercotryma* cf. *glomerata*  
*Ammodiscus latus*  
*Astacolus* sp.  
*Bathysiphon discreta* gr.  
*Biloculina* sp.  
Bryozoans  
*Bulimina* sp.  
*Coscinodiscus* sp.3  
*Cyclammina cancellata*  
*Cyclogyra involvens*  
*Dorothia* sp.2  
Echinoderm fragments  
*Eggerella* sp.  
Gastropods  
*Globigerina* sp.

*Gyroidina soldanii mamillata*  
*Haplophragmoides kirki*  
*Haplophragmoides rotundidorsata*  
*Lagena* sp.  
*Lenticulina calcar*  
*Lenticulina* spp.  
*Limacina canadensis*  
*Marginulina* sp.10  
Mollusc fragments  
Ostracodes  
*Pseudonodosaria* sp.  
*Pyrgo* sp.  
Scaphopod sp.  
*Spirophthalmidium* sp.  
*Vaginulinopsis* cf. *decorata*

Middle Eocene 1375-1630 m

*Alabamina scitula*  
*Ammomarginulina aubertae*  
*Bulimina* cf. *alazanensis*  
*Bulimina* aff. *pupoides*  
*Bulimina trigonalis*  
*Cibicidoides* sp.  
*Cibicidoides tuxpamensis*  
*Gaudryina* sp.2  
*Globigerina eocaena*  
*Globigerina senni*  
*Haplophragmoides walteri*  
*Hormosina* sp.  
*Kalamopsis* sp.  
*Karriella conversa*  
*Nodosaria latejugata*  
*Pseudohastigerina micra*  
*Pseudohastigerina wilcoxensis*  
*Reticulophragmium amplectens*  
*Rhizammina* sp.  
*Spiroplectammina dentata*  
*Spiroplectammina spectabilis*  
*Subbotina* aff. *linaperta*  
*Trochammina* sp.  
*Turrilina robertsi*

?Lower Eocene 1630-1700 m

*Ammodiscus* sp.2  
*Ammosphaereoidina* sp.  
"Balls"  
*Bulimina bradburyi*  
*Dorothia* cf. *oxycona*  
Echinoderm fragments  
*Gavelinella berthelini*  
*Gavelinella danica*  
*Gavelinella* sp.  
*Gavelinella* sp.3

*Lenticulina* spp.  
*Nodosaria* spp.  
*Osangularia* sp.4  
*Spiroplectammina navarroana*  
*Uvigerinammina* sp.

Lower or Middle Paleocene 1710-1740 m

"Balls"  
*Gavelinella beccariiformis*  
*Morozovella pseudobulloides*  
*Morozovella?* sp.  
*Pseudonodosaria* sp.

Mobil *et al.* Hibernia G-55 (from Thomas, 1992e)

Table 6. Stratigraphic succession and paleoenvironments.

<u>Depth</u> (m)	<u>Age</u> (Zone) - probable environment
540-610	Early to Middle Miocene ( <i>Spiroplectammina carinata</i> Zone) - upper bathyal
650-870	Oligocene ( <i>Turrilina alsatica</i> Zone) - upper bathyal
890-1060	Middle to Late Eocene ( <i>Reticulophragmium amplexens</i> - <i>Limacina canadensis</i> Zone) - upper bathyal
1085-1180	(Early) Middle Eocene ( <i>Spiroplectammina spectabilis</i> Zone) - upper bathyal
1220-1230	Early Eocene (Megaspore sp.1 Zone) - upper bathyal
1250	?Late Cretaceous

Faunal List

Lower to Middle Miocene 540-610 m

Algal balls  
 Bryozoans  
*Buliminella elegantissima*  
*Cassidulina subglobosa*  
*Ceratobulimina contraria*  
*Cibicides pachyderma*  
*Cibicides* sp.  
*Dentalina* sp.  
 Echinoid fragments  
 Fish teeth  
 Gastropod fragments  
*Globigerina bulloides*  
*Globorotalia fohsi peripheroronda* (caved at 650 m)  
*Guttulina problema*  
*Guttulina* sp.  
*Gyroidina* sp.  
*Hoeglundina elegans*  
*Lenticulina alato-limbata*  
*Lenticulina depressa*  
*Lenticulina* spp.  
 Mollusc fragments  
*Nodosaria* sp.  
*Nonion ?barleeianum*

Ostracodes  
*Plectofrondicularia vaughni*  
Pteropod sp.  
*Pullenia bulloides*  
*Pyrgo* sp.  
*Quinqueloculina* sp.  
Scaphopod sp.1  
*Spiroplectammina carinata*  
*Trifarina* sp.  
*Uvigerina miozea-nuttalli*  
*Vaginulinopsis* aff. *decorata*

Oligocene 650-870 m

*Bathysiphon eocaena*  
*Bolivina* sp.  
Bryozoans  
*Cibicides lobatulus*  
*Cibicidoides* sp.  
*Cornuspira decorata*  
*Cornuspira* sp.  
*Coscinodiscus* sp.3  
*Dentalina* sp.  
*Eggerella bradyi*  
Fish bones  
*Fissurina* sp.  
Gastropod fragments  
*Gyroidina girardana*  
*Gyroidina* sp.  
*Haplophragmoides* sp.  
*Karreriella bradyi*  
*Lagena* sp.  
*Lenticulina calcarata*  
*Lenticulina iota*  
*Lenticulina* spp.  
*Limacina canadensis*  
*Melonis pompilioides*  
*Nodosaria* cf. *elegantissima*  
Ostracodes  
*Plectofrondicularia budensis*  
*Pseudonodosaria* sp.  
*Quinqueloculina* aff. *triloculiniforma*  
Scaphopod sp. - "corrugated"  
*Spirophthalmidium* sp.  
*Turrilina alsatica*  
*Uvigerina* spp.

Middle to Upper Eocene 890-1060 m

*Ammodiscus latus* (caved at 1085 m)  
*Anomalina grosserugosa*  
*Astacolus* sp.  
*Bulimina midwayensis*  
*Cibicidoides* sp.  
*Cibicidoides truncanus*

*Cibicidoides tuxpamensis*  
*Coscinodiscus* sp.3  
*Cyclammina* sp.  
*Eponides plummerae*  
*Eponides umbonatus*  
Fish teeth  
Gastropods  
?Gaudryina sp.  
*Globigerina eocaena*  
*Globoquadrina venezuelana*  
*Haplophragmoides kirki*  
*Lenticulina* spp.  
Mollusc fragments  
Ostracodes  
*Polymorphina* sp.  
*Pullenia quinqueloba*  
Pyritized tubes  
*Recurvoides* sp.  
*Reticulophragmium amplexens* (caved at 1085 m)  
*Sphaeroidina bulloides*  
*Spiroplectammina dentata*  
*Stilostomella* sp.14  
*Subbotina linaperta* (caved at 1115 m)  
*Trifarina angulosa*

(Lower) Middle Eocene 1085-1180 m

*Bulimina midwayensis*  
*Ceratocancriis* sp.  
*Cibicidoides ungerianus*  
*Cyclammina placenta*  
*Eponides* sp.  
*Haplophragmoides walteri*  
*Lenticulina* sp.  
Ostracode sp.  
*Plectofrondicularia paucicostata*  
*Siphonina tenuicarinata*  
*Spiroplectammina spectabilis*  
*Trochammina* sp.

Lower Eocene 1220-1230 m

?*Ammobaculites* sp.  
*Ammosphaeroidina* aff. *pauciloculata*  
Balls (lenticular, rough)  
*Bulimina tuxpamensis* (caved at 1250 m)  
*Cibicicoides* sp. (possibly *C. perlucida*)  
*Gaudryina* sp. (caved at 1250 m)  
*Gavelinella* cf. *micra*  
*Glomospira corona* (caved at 1250 m)  
*Gyroidinoides* aff. *globosus*  
*Nodosaria* sp.11  
*Pseudohastigerina wilcoxensis* (caved at 1250 m)  
?*Spiroplectammina navarroana*

Table 7. Stratigraphic succession and paleoenvironments.

<u>Depth (m)</u>	<u>Age (Zone) - probable environment</u>
490-540	Middle/Early Miocene ( <i>Spiroplectammia carinata</i> Zone) - upper bathyal
570-860	indeterminate - ?
890-1100	Late/Middle Eocene ( <i>Reticulophragmium amplexens</i> - <i>Limacina canadensis</i> Zone) - middle to upper bathyal
1130-1210	early Middle Eocene ( <i>Spiroplectammia spectabilis</i> Zone) - ?middle bathyal
1240-1290	Early Eocene (Megaspore sp.1 Zone) - ?middle bathyal
1320-1410	indeterminate - ?
1440	Late Cretaceous

### Faunal List

Middle/Lower Miocene 490-540 m

*Asterigerina gurichi* (probably caved from above)  
*Cibicidoides pachyderma*  
*Cibicidoides* sp.  
*Cibicidoides* sp.14  
Fish otoliths  
*Globigerinoides* cf. *trilobus*  
*Guttulina problema*  
*Hoeglundina elegans*  
*Lenticulina* aff. *alatolimbata*  
*Lenticulina* spp.  
*Marginulina* aff. *bachei* var.  
*Melonis barleeaanum*  
Mollusc fragments  
*Pullenia bulloides*  
*Pyrgo bulloides*  
*Quinqueloculina* sp.  
*Quinqueloculina* aff. *triloculiniformis*  
*Spiroplectammia carinata*  
*Stilostomella* sp.  
*Uvigerina miozea-nuttalli*

Indeterminate 570-860 m

*Anomalina* cf. *spissiformis*  
Bryozoans  
*Ceratobulimina contraria*  
*Cibicidoides pachyderma*  
*Coscinodiscus* sp.1  
*Coscinodiscus* sp.3  
Echinoid fragments  
*Limacina canadensis*  
Mollusc fragments  
*Morozovella pseudobulloides* - reworked Paleocene species  
*Polymorphina* cf. *novangliae*  
Pyrite tubes  
Scaphopod sp.1

Selachian denticles

*Valvulineria petrolei* - probably reworked from Eocene

Upper/Middle Eocene 890-1100 m

*Ammodiscus latus*

*Bathysiphon discreta* gr.

*Biloculina* sp.

Bryozoans

*Bulimina cooperensis*

*Cibicidoides eocaenus*

*Cibicidoides* cf. *havanensis*

*Cibicidoides praemundulus*

*Cibicidoides truncanus*

*Cornuspira involvens*

*Cyclammia placenta*

Echinoid fragments

Fish otoliths

Fish teeth

*Gyroidina girardana*

*Haplophragmoides* sp.

*Haplophragmoides walteri*

*Hoeglundina elegans*

*Lenticulina alatolimbata*

*Lenticulina* spp.

*Limacina canadensis*

Mollusc fragments

*Nodosaria* cf. *elegantissima*

Ostracodes

*Plectofrondicularia* cf. *budensis*

*Pseudoglandulina humilis*

*Quinqueloculina* spp.

*Sigmomorphina* cf. *vaughani*

*Spiroloculina* cf. *canalicula*

*Stilostomella aculeata*

*Stilostomella* sp.

*Vaginulinopsis decorata*

lower Middle Eocene 1130-1210 m

*Cibicidoides* spp.

*Coscinodiscus* sp.4

*Cribrostomoides* sp.

*Eponides plummerae*

*Haplophragmoides kirki*

*Nodosaria* aff. sp.5

*Recurvoides* sp.

*Reticulophragmium* cf. *amplectens*

*Saccamina* sp.

*Spiroplectammia spectabilis*

*Stilostomella* cf. *midwayensis*

*Trochammia globigeriniformis*

Lower Eocene 1240-1290 m

*Alabamina* sp.  
*Ammodiscus planus*  
*Ammosphaeroidina pseudopauciloculata*  
"Balls" - whitish, rough-surfaced, discoidal to spherical  
*Bathysiphon* aff. *brosgei*  
*Bathysiphon discreta* gr.  
*Karriella* *conversa*  
*Limacina planispiralis*  
*Osangularia expansa*  
*Spiroplectammina navarroana*

Indeterminate 1320-1410 m

"Balls" - as above, possibly caved  
?*Bathysiphon* sp.  
Pyrite tube

Upper Cretaceous 1440 m

Mobil *et al.* Hibernia J-34 (from Thomas, 1993i)

Table 8. Stratigraphic succession and paleoenvironments.

<u>Depth</u> (m)	<u>Age</u> (Zone) - probable environment
430-440	Late Miocene ( <i>Asterigerina gurichi</i> Zone) - outer neritic
470-640	Middle/Early Miocene ( <i>Spiroplectammina carinata</i> Zone) - outer neritic/upper bathyal
670-680	Oligocene ( <i>Turrilina alsatica</i> Zone) - upper bathyal
710-760	indeterminate - ?upper bathyal
790-1085	Late/Middle Eocene ( <i>Reticulophragmium amplexens</i> - <i>Limacina canadensis</i> Zone) - upper bathyal
1115-1240	early Middle Eocene ( <i>Spiroplectammina spectabilis</i> Zone) - upper to middle bathyal
1270-1440	Early Eocene (Megaspore sp.1 Zone) - ?middle bathyal
1470	Cretaceous

#### Faunal List

Upper Miocene 430-440 m

*Asterigerina gurichi*  
*Cibicidoides* cf. *pachyderma*  
*Globobulimina* sp.  
*Gyroidina* sp.  
*Lenticulina* spp.  
Megaspore sp. (trilete)  
*Melonis barleeaanum*  
Ostracodes  
*Quinqueloculina* sp.  
Scaphopod sp.1  
*Trifarina* cf. *angulosa*

Middle/Lower Miocene 470-640 m

*Cibicidoides pachyderma*  
*Coscinodiscus* sp.4  
*Dentalina* sp.  
*Globulina gibba*  
*Guttulina problema*  
*Hoeglundina elegans*  
*Lenticulina alatolimbata*  
*Lenticulina* spp.  
*Marginulina* aff. *bachei* var.  
Mollusc fragments  
*Nodosaria* sp.  
Ostracodes  
? *Polymorphina* cf. *novangliae*  
*Sigmomorphina* cf. *vaughani*  
*Spiroplectammina carinata*  
*Uvigerina* ex. gr. *miozea-nuttalli*

Oligocene 670-680 m

*Ceratobulimina contraria*  
*Cibicidoides* cf. *laurisae*  
*Cibicidoides* cf. *perlucidus*  
*Coscinodiscus* sp.  
Echinoid fragments  
*Hoeglundina elegans*  
*Lenticulina* sp.  
Mollusc fragments  
Ostracodes  
*Pullenia bulloides*  
Pyrite tubes  
*Quinqueloculina* cf. *stalker*  
*Spiroloculina* cf. *canalicula*  
*Turrilina alsatica*  
*Uvigerina* sp.

Indeterminate 710-760 m

*Biloculina* sp.  
*Cibicidoides eocaenus*  
*Gaudryina laevigata* (reworked)  
*Glomospira corona* (reworked)  
*Lagena* sp.  
Ostracodes  
*Sigmoilina* sp.  
*Trifarina fluens*

Upper/Middle Eocene 790-1085 m

*Ammodiscus latus*  
"Balls" - smooth, orange variety  
*Bathysiphon discreta* gr.  
*Biloculina* sp.  
Bryozoans

*Ceratolamarckina* sp.1  
*Chilostomella oolina*  
*Cibicidoides praemundulus*  
*Cornuspira decorata*  
*Cornuspira involvens*  
*Coscinodiscus* sp.1  
*Coscinodiscus* sp.3  
*Coscinodiscus* spp.  
*Cyclammia placenta*  
Echinoid fragments  
*Eponides* cf. *umbonatus*  
Fish otoliths  
Fish teeth  
*Globigerina ouachitaensis* (caved to 1230 m)  
*Gyroidina primitiva*  
*Haplophragmoides kirki*  
*Lenticulina* spp.  
*Lenticulina* cf. *whitei*  
*Limacina canadensis*  
*Limacina planispiralis*  
Megaspore sp. - smooth  
Mollusc fragments  
*Nodosaria* cf. *elegantissima*  
*Nodosaria* sp.20  
*Orthomorphina* sp.  
Ostracodes  
*Quinqueloculina triloculiniformis*  
*Recurvoides* spp.  
*Reticulophragmium amplexens* (caved to 1155 m)  
*Trochammia globigeriniformis*  
*Vaginulinopsis* aff. *decorata*

lower Middle Eocene 1115-1240 m

*Ammosphaeroidina pseudopauciloculata*  
*Bathysiphon* aff. *brosgei*  
Bryozoans  
*Cibicidoides* aff. *subspiratus*  
*Eggerella* sp.  
*Epistomina eocaena*  
Fish otoliths  
Fish teeth  
*Haplophragmoides excavatum*  
*Haplophragmoides retroseptus*  
*Haplophragmoides walteri*  
*Karriella conversa*  
Mollusc fragments  
*Nodosaria* aff. sp.5  
*Pseudoglandulina humilis*  
*Spirillina* sp.  
*Spiroplectammina dentata*  
*Spiroplectammina spectabilis*  
*Stilostomella* cf. *aculeata*  
*Stilostomella* cf. *midwayensis*

Lower Eocene 1270-1440 m

*Anomalinoides acuta*  
"Balls" - rough, spheroid, whitish  
*Bathysiphon discreta* gr.  
*Bulimina* cf. *ovata*  
*Bulimina* sp.  
Fish otoliths  
*Gaudryina* cf. *laevigata*  
*Lenticulina* sp.  
*Nodosaria* cf. *pozoensis*  
Selachian denticles

Mobil *et al.* Hibernia K-18 (from Thomas, 1993k)

Table 9. Stratigraphic succession and paleoenvironments.

<u>Depth (m)</u>	<u>Age (Zone) - probable environment</u>
920-930	Middle/Early Miocene ( <i>Spiroplectammina carinata</i> Zone) - mid- to upper bathyal
950-1015	Oligocene ( <i>Turrilina alsatica</i> Zone) - mid- to upper bathyal
1035-1255	Late Eocene ( <i>Reticulophragmium amplectens</i> - <i>Limacina canadensis</i> Zone) - ?middle bathyal
1275-1495	early Middle Eocene ( <i>Spiroplectammina spectabilis</i> Zone) - ?middle bathyal
1515-1525	Early Eocene (Megaspore sp.1 Zone) - middle bathyal
1545-1615	?Paleocene ( <i>Gavelinella beccariiformis</i> - <i>Rzehakina epigona</i> Zone) - middle bathyal (?)

Faunal List

Middle/Lower Miocene 920-930 m

Bryozoans  
*Ceratobulimina contraria*  
*Cibicidoides pachyderma*  
*Cyclogyra decorata*  
*Dentalina* sp.  
*Fissurina* sp.  
*Gyroidina octocamerata*  
*Gyroidina soldanii*  
*Hoeglundina elegans*  
*Lagena* sp.  
*Lenticulina* spp.  
*Pullenia quinqueloba*  
*Spiroplectammina carinata*

Oligocene 950-1015 m

*Bathysiphon discreta* gr.  
*Biloculina* sp.  
Bryozoans  
*Bulimina* sp.  
*Cassigerinella* aff. *chipolensis*  
*Ceratobulimina contraria*

*Cibicidoides eocaenus*  
*Cibicidoides cf. laurissae*  
*Cibicidoides pachyderma*  
*Cibicidoides sp.*  
*Cyclammia placenta*  
*Cyclammia rotundidorsata*  
*Cyclogyra decorata*  
Echinoid fragments  
*Eggerella sp.*  
?Elphidium sp.  
Fish teeth  
*Globocassidulina subglobosa*  
*Guttulina problema*  
*Gyroidina girardana*  
*Hoeglundina elegans*  
*Lenticulina aff. alatolimbata*  
*Lenticulina calcarata*  
*Lenticulina iota*  
*Lenticulina spp.*  
*Melonis barleeaanum*  
Mollusc fragments  
*Nodosaria cf. elegantissima*  
*Oridorsalis umbonatus*  
Ostracodes  
*Pyrulina sp.*  
*Quinqueloculina triloculiniforma*  
*Recurvoides sp.*  
Scaphopod - "corrugated"  
Selachian denticles  
*Stilostomella sp.*  
*Tosaia cf. hanzawai*  
*Turrilina alsatica*  
*Uvigerina sp.*  
*Vaginulinopsis aff. decorata*

Upper Eocene 1035-1255 m

*Alabamina cf. scitula*  
*Ammodiscus latus*  
*Anomalinoidea cf. capitatus*  
*Bathysiphon discreta gr.*  
*Biloculina sp.*  
Bryozoans  
*Bulimina cooperensis*  
*Catapsydrax aff. dissimilis*  
*Ceratocancris sp.1*  
*Cibicidoides eocaenus*  
*Cibicidoides cf. laurissae*  
*Cibicidoides praemundulus*  
*Cibicidoides ungerianus*  
*Coscinodiscus aff. sp.1*  
*Coscinodiscus sp.3*  
*Cyclammia placenta*  
*Cyclammia spp.*  
*Dentalina sp.*

*Epistomina eocaena*  
 Fish otoliths  
*Fissurina* aff. *marginata*  
*Globigerina eocaena*  
*Globigerina ouachitaensis*  
*Globobulimina ovata*  
*Globoquadrina venezuelana*  
*Guttulina* sp.  
*Haplophragmoides kirki*  
*Haplophragmoides latidorsata*  
*Haplophragmoides retroseptus*  
*Karreriella subglabra*  
*Lenticulina* spp.  
*Lenticulina* cf. *whitei*  
*Limacina canadensis*  
 Mollusc fragments  
*Nodosaria* sp.12  
*Nodosaria* sp.14  
*Nodosaria* sp.16  
*Oridorsalis tenera*  
 Ostracodes  
*Pseudoglandulina humilis*  
*Pullenia* cf. *eocaena*  
*Quinqueloculina* cf. *stalkerii*  
*Reticulophragmium amplectens*  
*Saccamina* sp.  
 Scaphopod - "fluted"  
 Selachian denticles  
*Trochammina globigeriniformis*  
*Uvigerina* cf. *havanensis*

lower Middle Eocene 1275-1495 m

*Ammobaculites* sp.  
*Ammodiscus planus*  
*Ammosphaeroidina pseudopauciloculata*  
*Anomalinoides spissiformis*  
 Bryozoans  
 "Balls" - small, orange, smooth  
*Bolivina* sp.  
*Bulimina midwayensis*  
*Bulimina* sp.  
*Cassidulinoides* sp.1  
*Cornuspira* sp. - large, robust form  
*Coscinodiscus* sp.4  
*Cribrostomoides subglobosus*  
*Dorothia* cf. *trochus*  
*Eponides* cf. *plummerae*  
 Fish teeth  
 ?*Gaudryina* sp.  
*Globigerina* sp.  
*Haplophragmoides* spp.  
*Haplophragmoides walteri*  
*Karreriella* cf. *conversa*  
*Lagena* sp.

Megaspore sp.  
*Nodosaria* spp.  
 Ostracodes  
*Pseudohastigerina wilcoxensis*  
*Reophax* sp.  
*Rhizammina* sp.  
*Spirillina* sp.  
*Spiroplectammina spectabilis*  
*Subbotina frontosa*  
*Verneuilina* sp.

Lower Eocene 1515-1525 m

*Anomalinoides acuta*  
*Anomalinoides rubiginosus*  
 "Balls" - white, rough  
*Bulimina bradburyi*  
*Cystammina* cf. *pauciloculata*  
*Lenticulina* spp.  
*Nodosaria* cf. *pozoensis*

?Paleocene 1545-1615 m

"Balls" - white, rough  
 Bryozoans  
 ?*Gavelinella beccariiiformis*  
*Spiroplectammina dentata*  
*Spiroplectammina navarroana*

Upper Cretaceous 1645 m

Mobil *et al.* Hibernia O-35 (from Thomas, 1993e)

Table 10. Stratigraphic succession and paleoenvironments.

<u>Depth (m)</u>	<u>Age (Zone) - probable environment</u>
520-530	Late Miocene ( <i>Asterigerina gurichi</i> Zone) - outer neritic
550-650	Middle/Early Miocene ( <i>Spiroplectammina carinata</i> Zone) - upper bathyal
670-740	Oligocene ( <i>Turrilina alsatica</i> Zone) - upper bathyal
760-920	indeterminate - upper bathyal
940-1130	Middle/Late Eocene ( <i>Reticulophragmium amplexans</i> - <i>Limacina canadensis</i> Zone) - upper bathyal
1150-1245	early Middle Eocene ( <i>Spiroplectammina spectabilis</i> Zone) - mid- to upper bathyal
1265-1335	Early Eocene (Megaspore sp.1) - mid- to upper bathyal
1355-1700	indeterminate - probably mid- to upper bathyal

Faunal List

Upper Miocene 520-530 m

*Asterigerina gurichi*  
 Gastropod fragments  
*Lenticulina* sp.

Lower/Middle Miocene 550-650 m

*Anomalinoides cf. spissiformis*  
*Buccella tenerrima*  
*Ceratobulimina contraria*  
*Cibicidoides pachyderma*  
*Coscinodiscus* sp.  
*Dentalina* sp.  
*Globocassidulina subglobosa*  
*Guttulina* sp.  
*Gyroidina soldanii*  
*Lagena* sp.  
*Lenticulina* aff. *alatolimbata*  
*Lenticulina* spp.  
*Marginulina* sp.  
*Melonis barleeaanum*  
Mollusc fragments  
*Oolina* sp.  
*Pararotalia* sp.2  
*Polymorphina* sp.  
*Quinqueloculina* sp.  
*Quinqueloculina* cf. *stalker*  
*Spiroplectammia carinata*  
*Stilostomella* sp.  
*Trifarina* cf. *fluens*  
*Uvigerina miozea-nuttalli*

Oligocene 670-740 m

*Bolivina dilatata*  
Bryozoans  
*Cibicides* cf. *lobatulus*  
*Cibicidoides eocaenus*  
*Cornuspira* sp.  
*Fissurina* cf. *marginata*  
Echinoid fragments  
*Eponides umbonatus*  
*Globorotalia opima* gr. (caved to 1210 m)  
*Guttulina problema*  
*Gyroidina girardana*  
*Gyroidina soldanii*  
*Hoeglundina elegans*  
*Karreriella* sp.  
Mollusc fragments  
*Oridorsalis* cf. *tenera*  
Ostracode spp.  
*Pullenia bulloides*  
*Pyrgo* sp.  
Scaphopod sp.1  
*Spirophthalmidium* sp.  
*Turrilina alsatica*  
*Valvulineria petrolei*  
*Uvigerina* spp.

Indeterminate 760-920 m

*Anomalina spissiformis*  
Bryozoans  
*Cibicidoides pachyderma*  
*Cibicidoides ungerianus*  
*Eggerella* sp.  
*Eponides umbonatus*  
Fish otoliths  
Fish teeth  
*Hoeglundina elegans*  
*Lagena* sp.  
*Lenticulina* spp.  
*Limacina planispiralis*  
?Microtektites  
*Nodosaria* cf. *elegantissima*  
Ostracode sp.  
*Pullenia eocaena*  
Pyrite tubes  
*Sigmoilina* sp.  
*Trifarina fluens*  
*Uvigerina* cf. *mexicana*

Middle/Upper Eocene 940-1130 m

*Ammodiscus latus*  
?Ammodiscus sp.  
*Bathysiphon discreta* gr.  
Bryozoans  
*Bulimina* spp.  
*Cibicidoides ungerianus*  
*Cornuspira decorata*  
*Cornuspira* sp.  
*Coscinodiscus* sp.1  
*Coscinodiscus* spp.  
*Cyclammina placenta*  
*Cyclammina* spp.  
?Cymbaloporella sp.  
Fish otoliths  
Fish teeth  
*Globigerina ouachitaensis* gr.  
*Haplophragmoides* sp.  
*Hoeglundina elegans*  
*Lenticulina* spp.  
*Limacina canadensis*  
*Limacina planispiralis*  
Mollusc fragments  
*Nodosaria* sp.  
Ostracode sp.  
Pyrite tubes  
*Quinqueloculina* sp.  
*Recurvoides* sp.  
*Reticulophragmium amplexans*  
Scaphopod sp.  
*Spiroplectammia dentata*

*Trochammina globigeriniformis*  
*Vaginulinopsis decorata*

lower Middle Eocene 1150-1245 m

*Acarinina densa*  
*Cibicidoides eocaenus*  
*Cibicidoides* spp.  
*Coscinodiscus* sp.3  
*Coscinodiscus* spp.  
*Dorothia* cf. *trochoides*  
*Epistomina eocaena*  
Fish tooth  
*Haplophragmoides kirki*  
*Haplophragmoides retroseptus*  
*Haplophragmoides walteri*  
*Lenticulina* sp.  
*Karriella conversa*  
Mollusc fragments  
*Nodosaria* sp.4  
Ostracode sp.  
Scaphopod sp. - "fluted"  
*Spiroplectammina spectabilis*  
*Stilostomella* cf. *aculeata*

Lower Eocene 1265-1335 m

*Ammosphaeroidina pseudopauciloculata*  
*Astacolus* sp.  
"Balls"  
*Bulimina midwayensis*  
*Bulimina* cf. *semicostata*  
*Cyclammina* spp.  
Fish teeth  
*Globigerina yeguaensis*  
*Gyroidinoides* sp. (?reworked)  
*Lenticulina calcar* (?caved)  
*Pseudohastigerina micra*  
*Subbotina linaperta*

Indeterminate 1355-1700 m

"Balls"  
*Bathysiphon discreta* gr.  
*Cyclammina* sp.  
Fish teeth  
*Gavelinella minima* (?reworked Late Cretaceous)  
*Gaudryina laevigata*  
*Gaudryina pyramidata*  
*Globigerina yeguaensis*  
*Gyroidina soldanii mamilligera*  
"?Inoceramus" crystals  
*Nodosaria* aff. *pozoensis*  
Ostracode spp.  
*Pseudohastigerina wilcoxensis*

Pyrite tubes  
*Spiroplectammina dentata*  
*Stilostomella aculeata*  
*Uvigerina cf. spinicostata*

Mobil *et al.* Nautilus C-92 (from Thomas, 1992b)

Table 11. Stratigraphic succession and paleoenvironments

<u>Depth</u> (m)	<u>Age</u> (Zone) - probable environment
880-1010	Early to Middle Miocene ( <i>Spiroplectammina carinata</i> Zone) - mid- to upper bathyal
1040-1205	Oligocene ( <i>Turrilina alsatica</i> Zone) - mid- to upper bathyal
1235-1405	Late(?) Eocene ( <i>Reticulophragmium amplectens</i> - <i>Limacina canadensis</i> Zone) - mid- to upper bathyal
1435-2005	Early to Middle Eocene ( <i>Spiroplectammina spectabilis</i> Zone) - mid- to upper bathyal
2035-2125	indeterminate - indeterminate
2155-2165	?Paleocene ( <i>Gavelinella beccariformis</i> - <i>Rzehakina epigona</i> Zone) - indeterminate
2195-2205	Late Cretaceous

Faunal List

Lower to Middle Miocene 880-1010 m

*Ammobaculoides* sp.  
*Asterigerina gurichi*  
 Bryozoans  
*Ceratobulimina contraria*  
*Cibicides cf. lobatulus*  
*Cibicidoides cf. pachyderma*  
*Cyclammina* sp.  
 Echinoderm fragments  
*Eggerella* sp.1  
*Eponides aff. umbonatus*  
*Globigerina* sp.  
*Guttulina problema*  
*Gyroidina girardana*  
*Hoeglundina elegans*  
*Karreriella bradyi*  
*Lagena* sp.  
*Lenticulina alatolimbata*  
*Lenticulina* spp.  
*Melonis sphaeroides*  
*Miliolinella* sp.  
 Mollusc fragments  
*Nodosaria* sp.14  
*Nodosaria* spp.  
 Ostracodes  
*Plectofrondicularia vaughani*  
*Pullenia bulloides*  
*Quinqueloculina* spp.  
 Selachian denticle

*Spiroplectammina carinata*  
*Trifarina fluens*  
*Uvigerina canariensis*

Oligocene 1040-1205 m

*Anomalina grosserugosa*  
*Bathysiphon* sp.  
*Bulimina midwayensis*  
*Bulimina pupoides*  
*Catapsydrax dissimilis*  
*Cibicidoides truncanus*  
*Cibicidoides tuxpamensis*  
*Coscinodiscus* sp.1  
*Cyclammina cancellata*  
*Cyclogyra decorata*  
*Eponides umbonatus*  
Fish teeth  
*Fissurina* cf. *marginata*  
*Gaudryina* sp.8  
*Globigerina eocaena* gr.  
*Globigerina praebulloides* gr.  
*Globigerina* sp.  
*Globigerina* aff. *venezuelana*  
*Globulina* sp.  
*Haplophragmoides rotundidorsata*  
*Lagena* sp.  
*Lenticulina calcarata*  
*Lenticulina depressa*  
*Lenticulina* spp.  
*Limacina canadensis*  
*Marginulina* sp.7  
*Martinotiella* sp.  
Megaspore sp.  
*Melonis* sp.  
*Nodosaria* sp.  
*Nodosaria* sp.5  
Ostracodes  
*Pullenia quinqueloba*  
*Quadriformina* aff. *allomorphinoides*  
*Recurvoides* sp.  
Scaphopod sp.  
*Sigmoilinopsis* sp.  
*Stilostomella* sp. (*Nodosaria* sp.14)  
*Trochammina globigeriniformis* gr.  
*Turrilina alsatica*  
*Vaginulinopsis decorata*

?Upper Eocene 1235-1405 m

*Adercotryma glomerata*  
*Amodiscus latus*  
"Balls"  
*Bathysiphon discreta* gr.  
*Chilostomella oolina*

*Cibicides tenellus*  
*Coscinodiscus* sp.3  
 Echinoderm fragments  
*Haplophragmoides kirki*  
*Nodosaria* cf. *elegantissima*  
*Nodosaria* sp.4  
 Ostracodes  
*Reophax* sp.  
*Reticulophragmium* aff. *amplectens*  
*Spiroplectammina dentata*  
*Trochammina* sp.

Lower to Middle Eocene 1435-2005 m

*Acarinina densa*  
*Ammobaculites* sp.  
*Ammodiscus cretaceus*  
*Ammovertelina* sp.  
*Bulimina alazanensis*  
*Cibicides* sp.5  
*Cibicides* sp.15  
*Epistomina* cf. *eocaena*  
 Fish tooth  
*Haplophragmoides walteri*  
*Karrieriella conversa*  
*Morozovella aragonensis*  
*Osangularia expansa*  
*Pseudohastigerina wilcoxensis*  
*Recurvoides* sp.  
*Reophax* sp.  
*Spirillina* sp.  
*Spiroplectammina navarroana*  
*Spiroplectammina spectabilis*  
*Subbotina frontosa*  
*Subbotina linaperta*

Indeterminate 2035-2125 m

*Bulimina* spp.  
 Concretions  
*Lenticulina* spp.  
*Nodosaria* sp.19  
*Nodosaria* sp.20

?Paleocene 2155-2165 m

*Glomospira corona*

Mobil *et al.* Rankin M-36 (from Thomas, 1992a)

Table 12. Stratigraphic succession and paleoenvironments.

<u>Depth</u> (m)	<u>Age</u> (Zone) - probable environment
710-880	Oligocene ( <i>Turrilina alsatica</i> Zone) - neritic

910-960	(Late?) Eocene ( <i>Reticulophargmium amplexans</i> - <i>Limacina canadensis</i> Zone) - outer neritic
990-1000	Eocene (?) - outer neritic
1025-1205	indeterminate - indeterminate
1235	Late Cretaceous - indeterminate

### Faunal List

Oligocene 710-880 m

*Anomalina grosserugosa*  
*Bathysiphon* sp.  
*Bulimina* cf. *aculeata*  
*Catapsydrax dissimilis*  
*Ceratobulimina contraria*  
*Cibicides pachyderma*  
*Cibicidoides blanpiedi*  
*Cibicidoides truncanus*  
*Coscinodiscus* sp.1  
*Coscinodiscus* sp.3  
Echinoderm fragments  
*Eggerella* sp.1  
*Epistomina eocaenica*  
*Eponides* aff. *umbonatus*  
Fish teeth  
Gastropod fragments  
*Gaudryina* sp.  
*Globigerina angustiumbilitata* (caved at 990 m)  
*Globigerina praebulloides*  
*Globigerinoides* sp.  
*Globoquadrina venezuelana*  
*Guttulina* sp.  
*Gyroidina girardana*  
*Haplophragmoides kirki*  
*Hoeglundina elegans*  
*Karreriella bradyi*  
*Lenticulina* spp.  
*Limacina planispiralis*  
*Marginulina bachei*  
Mollusc fragments  
*Nodosaria* cf. *elegantissima*  
*Nodosaria* sp.4  
*Oridorsalis* sp.  
Ostracodes  
*Pullenia quinqueloba*  
*Quinqueloculina* aff. *triloculiniformis*  
Scaphopod sp.1  
*Spiroplectammina carinata*  
*Stilostomella* sp.14  
*Turrilina alsatica*

(Upper?) Eocene 910-960 m

*Adercotryma agterbergi*  
*Ammodiscus latus*

*Bolivina* sp.  
*Bulimina* sp.  
*Cibicidoides* sp.  
*Cibicidoides tenellus*  
*Cyclamina cancellata*  
 Gastropods  
*Guttulina problema*  
*Gyroidina* sp.  
*Haplophragmoides rotundidorsata*  
*Lagena* sp.  
*Lenticulina* cf. *pseudoiota*  
*Lenticulina* sp.  
*Nonion* aff. *affine*  
*Pyrgo* sp.  
*Recurvoides* sp.  
 Scaphopod sp. - "corrugated"

Eocene 990-1000 m

*Bulimina alazanensis*  
*Bulimina midwayensis*  
*Bulimina ovata*  
*Globigerina* sp.  
*Nodosaria* sp.8  
*Subbotina linaperta*

Indeterminate 1025-1205 m

"Balls"  
*Globotruncana* sp.  
 Pyritized tubes

Upper Cretaceous 1235 m

Mobil *et al.* South Mara C-13 (from Thomas, 1993c)

Table 13. Stratigraphic succession and paleoenvironments.

<u>Depth</u> (m)	<u>Age</u> (Zone) - probable environment
800-840	Early Miocene ( <i>Spiroplectamina carinata</i> Zone) - neritic
860-1050	Indeterminate - ?neritic
1070-1410	(Late/Middle) Eocene ( <i>Reticulophragmium amplectens</i> - <i>Limacina canadensis</i> Zone) - upper bathyal
1430-1920	(Middle/Early) Eocene ( <i>Spiroplectamina spectabilis</i> Zone) - upper bathyal
1940-2010	Early Paleocene ( <i>Gavelinella beccariiformis</i> - <i>Rzehakina epigona</i> Zone) - upper bathyal
2030	Late Cretaceous

Faunal List

Lower Miocene 800-840 m

Algal balls  
 Bryozoans

*Ceratobulimina contraria*  
*Cibicidoides cf. incrassatus*  
Echinoid fragments  
*Eponides umbonatus*  
*Globigerina bulloides*  
*Globocassidulina subglobosa*  
*Guttulina* spp.  
*Gyroidina girardana*  
*Lenticulina aff. alatolimbata*  
*Lenticulina iota*  
*Lenticulina* spp.  
Mollusc fragments  
*Nodosaria* sp.3  
*Nodosaria* sp.16  
Ostracode sp.  
*Pullenia bulloides*  
*Quinqueloculina* sp.  
*Spiroplectammina carinata*  
*Stilostomella cf. subspinosa*  
*Trifarina fluens*  
*Vaginulinopsis aff. decorata*

Indeterminate 860-1050 m

*Bathysiphon* sp.  
Bryozoans  
*Cibicidoides cf. incrassatus*  
Gastropods  
*Lenticulina aff. totomiensis*  
*Limacina planispira*  
Mollusc fragments  
*Nodosaria* sp.  
*Nodosaria* sp.14  
Pyrite tubes  
Selachian denticles  
*Vaginulinopsis aff. decorata*

Upper/Middle Eocene 1070-1410 m

*Ammobaculite cf. agglutinans*  
*Ammobaculites* sp.  
*Ammodiscus latus*  
*Ammomarginulina aubertae*  
*Ammomarginulina* sp.  
?Anomalina sp.  
*Bathysiphon eocaenica*  
Bryozoans  
*Bulimina cooperensis*  
*Bulimina macilenta*  
*Catapsydrax aff. dissimilis*  
*Chilostomella oolina*  
*Cibicidoides cf. eocaenus*  
*Cibicidoides truncanus*  
*Cibicidoides cf. tuxpamensis*  
Coarse agglutinated spp.

*Coscinodiscus* sp.1  
*Coscinodiscus* sp.3  
*Coscinodiscus* sp.4  
*Coscinodiscus* spp.  
*Cyclammina cancellata*  
*Cyclammina placenta*  
*Cyclogyra decorata*  
Fish otoliths  
Fish teeth  
*Fissurina* aff. *marginata*  
*Globigerina* sp.  
*Guttulina problema*  
*Gyroidina* sp.  
*Gyroidina subangulata*  
*Haplophragmoides kirki*  
*Haplophragmoides rotundidorsata*  
*Haplophragmoides walteri*  
*Hoeglundina elegans*  
*Karreriella conversa*  
*Lagena* sp.  
*Lenticulina calcarata*  
*Lenticulina* sp.  
*Limacina canadensis*  
Megaspores  
Mollusc fragments  
*Nodosaria* cf. *elegantissima*  
*Nodosaria* sp.4  
*Nodosaria* sp.20  
Ostracode spp.  
*Plectina elongata*  
*Pseudonodosaria* sp.  
Pyrite tubes  
*Quinqueloculina* sp.  
*Recurvoides* sp.  
*Reticulophragmium amplectens*  
*Rhizammina* sp.  
?Saccamina sp.  
Scaphopod - "corrugated"  
*Spiroplectammina* aff. *spectabilis*  
*Subbotina linaperta*  
*Trochammina globigeriniformis* gr.  
*Turrilina robertsi*

Middle/Lower Eocene 1430-1920 m

*Ammosphaeroidina pseudopauciloculata*  
*Bathysiphon broegei*  
Bryozoans  
*Bulimina midwayensis*  
*Cibicidoides alleni*  
*Cibicidoides blanpiedi*  
Concretions  
*Coscinodiscus* sp.2  
Fish teeth  
Gastropods

*Globigerina eocaena*  
*Gyroidina soldanii mamilligera*  
 Mollusc fragments  
*Spirillina* sp.  
*Spiroplectammina* aff. *navarroana*  
*Spiroplectammina spectabilis*  
*Trochammina* sp.11  
 ?*Trochammina* sp.  
*Trochamminoides* cf. *irregularis*  
 ?*Uvigerinammina* sp.

Lower Paleocene 1940-2010 m

*Ammodiscus planus*  
*Arenobulimina* sp.  
 Fish teeth  
*Gavelinella beccariiiformis*  
*Globoconusa* aff. *daubjergensis*  
*Glomospira corona*  
*Karrieriella* cf. *chapapotensis*  
*Rzehakina epigona*  
*Spiroplectammina navarroana*  
*Tritaxia* sp.  
*Trochamminoides* sp.

Mesozoic 2030 m and below

Mobil *et al.* South Tempest G-88 (from Thomas, 1993f)

Table 14. Stratigraphic succession and paleoenvironments.

<u>Depth</u> (m)	<u>Age</u> (Zone) - probable environment
710-1045	Middle and Early Miocene ( <i>Spiroplectammina carinata</i> Zone) - neritic
1065-1255	Oligocene ( <i>Turrilina alsatica</i> Zone) - deeper neritic
1275-1615	Late and late Middle Eocene ( <i>Reticulophragmium amplexens</i> - <i>Limacina canadensis</i> Zone) - upper bathyal
1635-2245	early Middle Eocene ( <i>Spiroplectammina spectabilis</i> Zone) - bathyal
2265-2665	Early Eocene (Megaspore sp.1 Zone) - bathyal

Faunal List

Late Miocene to Plio/Pleistocene cavings present in 710-1045 m

*Asterigerina gurichi*  
*Bucella frigida*  
*Criboelphidium clavatum* gr.  
*Globoquadrina* cf. *atlantica*

Middle and Lower Miocene 710-1045 m

*Buliminella elegantissima*  
*Cassidulina laevigata*  
*Ceratobulimina contraria*  
*Cibicidoides pachyderma*

*Cibicidoides cf. robertsonianus*  
*Cibicidoides* sp.  
 Coarse agglutinated species  
*Coscinodiscus* sp.1  
*Coscinodiscus* sp.3  
*Coscinodiscus* sp.4  
*Coscinodiscus* spp.  
*Cyclammia placenta*  
 Echinoid spines  
*Eggerella* sp.  
 Fish otoliths  
 Fish teeth  
*Globigerina bulloides*  
*Globocassidulina subglobosa*  
*Gyroidina girardana*  
*Hoeglundina elegans*  
*Islandiella islandica*  
*Lenticulina* spp.  
*Marginulina bachei* var.  
 Megaspore (trilete)  
*Melonis barleeaanum*  
 ?Microtektite  
*Nodosaria* sp.  
*Oolina* sp.  
 Pyrite tubes  
*Pyrulina* sp.  
*Quinqueloculina* sp.  
*Quinqueloculina cf. stalker*  
*Sphaeroidina bulloides*  
*Spiroplectammia carinata*  
*Stetsonia* sp.  
*Textularia* sp.  
*Trifarina fluens*

Oligocene 1065-1255 m

*Anomalina cf. spissiformis*  
*Bathysiphon* aff. *eocaenica*  
*Cibicides* aff. *tuxpamensis*  
*Cibicidoides* aff. *blanpiedi*  
*Cibicidoides* spp.  
*Cornuspira* sp.  
*Cyclammia* sp.  
*Dentalina* cf. *communis*  
*Eggerella bradyi*  
*Eponides umbonatus*  
 Fish otoliths  
*Fissurina marginata*  
*Fronicularia budensis*  
*Globigerina praebulloides*  
*Globigerina cf. tripartita*  
*Globorotalia opima opima*  
*Guttulina* sp.  
*Gyroidina soldanii mamilligera*  
*Haplophragmoides kirki*

*Heterolepa mexicana*  
*Lenticulina alatolimbata*  
*Lenticulina* spp.  
*Marginulina* sp.1  
Mollusc fragments  
*Plectofrondicularia miocenica* gr.  
*Plectofrondicularia vaughani*  
*Pullenia bulloides*  
*Quinqueloculina* cf. *trigonula*  
?*Recurvoides* sp.  
*Recurvoides* cf. *walteri*  
Scaphopod sp.1  
*Sigmomorphina vaughani*  
*Turrilina alsatica*  
*Uvigerina miozea-nuttalli* gr.  
*Vaginulinopsis* aff. *decorata*

Upper and upper Middle Eocene 1275-1615 m

*Alabamina* aff. *scitula*  
*Ammodiscus latus*  
*Ammomarginulina aubertae*  
*Ammosphaeroidina pseudopauciloculata*  
*Biloculina* sp.  
*Bolivina* sp.  
Bryozoans  
*Bulimina* aff. *cooperensis*  
*Bulimina* sp.  
*Cassigerinella* sp.  
*Catapsydrax* aff. *dissimilis*  
*Chilostomella oolina*  
*Cibicidoides eocaenus*  
*Coscinodiscus* sp.  
*Cribrostomoides* cf. *scitulus*  
*Cyclammina latidorsata*  
*Epistomina eocaena*  
*Epistominella* sp.  
Fecal pellets  
Fish otoliths  
Fish teeth  
*Globigerina eocaena* gr.  
*Globigerina* sp.  
*Glomospirella* sp.  
*Gyroidina octocamerata*  
*Haplophragmoides rotundidorsata*  
*Haplophragmoides walteri*  
*Karreriella conversa*  
*Karreriella* sp.  
*Karreriella subglabra*  
*Lagena* sp.  
*Lenticulina depressa*  
*Lenticulina* spp.  
*Lenticulina* cf. *whitei*  
*Limacina canadensis*  
*Martinotiella* sp.

Mollusc fragments  
Ostracodes  
*Pseudonodosaria humilis*  
*Pullenia quinqueloba*  
*Pyrgo* sp.  
*Quinqueloculina* spp.  
*Reophax* sp.  
*Reticulopohragmium amplectens*  
*Saccamina* sp.  
Scaphopod sp.  
*Spirophthalmidium* sp.  
Sponge spicules  
*Stilostomella* cf. *gracillima*  
*Subbotina linaperta* (caved at 1695 m)  
*Textularia agglutinans*  
*Trochammina globigeriniformis*  
*Trochammina* sp.  
*Turborotalia pomeroli* (caved at 2025 m)

lower Middle Eocene 1635-2245 m

*Acarinina densa*  
*Acarinina intermedia-wilcoxensis*  
*Acarinina* sp.  
*Ammodiscus planus*  
*Ammovertellina* sp.  
? *Anomalina* sp.  
*Arenobulimina* sp.  
*Astacolus* sp.  
Bryozoans  
? *Bulbobaculites* sp.  
*Bulimina alazanensis*  
*Bulimina bradburyi*  
*Bulimina midwayensis*  
*Bulimina ovata*  
*Cibicidoides truncanus*  
*Cyclogyra* sp.  
Echinoid spines  
Fish bones  
Fish otoliths  
*Fissurina* sp.  
*Globigerina* cf. *inequispira*  
*Globigerina* spp.  
*Globigerinatheka* cf. *index*  
*Kalamopsis* sp.1  
*Lagena* sp.  
*Lenticulina* cf. *totomiensis*  
*Limacina planispiralis*  
Megaspore sp.  
*Neoeponides* cf. *lunata*  
*Nodosaria* sp.12  
*Oolina* sp.  
Ostracodes  
*Quadriformina* aff. *allomorphinoides*  
*Reticulophragmium* cf. *garcilloi*

*Rhizammina* sp.  
*Rotaliatina buliminoides*  
 Scaphopod sp. - "corrugated"  
*Spiroplectammina dentata*  
*Spiroplectammina spectabilis*  
*Stilostomella* cf. *aculaeata*  
*Stilostomella* sp.  
*Subbotina frontosa*  
*Subbotina patagonica*  
*Subbotina* spp.  
*Turborotalia* cf. *praecentralis*

Lower Eocene 2265-2665 m

*Acarinina broedermanni*  
*Acarinina intermedia-wilcoxensis*  
*Acarinina pentacamerata*  
*Acarinina wilcoxensis*  
*Alabamina* sp.  
*Anomalinoides acuta*  
*Arenobulimina* sp.  
*Bulimina* cf. *callahani*  
*Bulimina* cf. *jacksonensis*  
*Cibicidoides subspiratus*  
*Dorothia trochoides*  
*Gavelinella* aff. *danica*  
*Gavelinella* sp.  
*Globigerina inequispira*  
*Globigerina senni*  
*Glomospira corona*  
 Megaspore sp.1  
*Morozovella aequa*  
*Morozovella* aff. *pseudobulloides*  
*Morozovella subbotinae*  
*Nodosaria* sp.20  
*Nuttalites truempyi*  
*Osangularia expansa*  
*Planorotalites planoconica*  
*Pseudohastigerina wilcoxensis*  
*Spiroplectammina navarroana*  
*Tristix* sp.  
*Truncorotalites rohri*  
*Turrilina robertsi*

Petro-Canada *et al.* Terra Nova K-08 (from Thomas, 1993d)

Table 15. Stratigraphic succession and paleoenvironments.

<u>Depth</u> (m)	<u>Age</u> (Zone) - probable environment
695-705	Early Miocene ( <i>Spiroplectammina carinata</i> Zone) - outer neritic
725-915	indeterminate - probably outer neritic
935-975	?Late Eocene - ( <i>Reticulophragmium amplexans</i> - <i>Limacina canadensis</i> Zone) - outer neritic or upper bathyal
1000-1280	Middle/Early Eocene - ( <i>Spiroplectammina spectabilis</i> and Megaspore sp.1

1290-1300                      Zones) - outer neritic or upper bathyal  
  ?Paleocene - indeterminate

Faunal List

(?Lower) Miocene 695-705 m

*Astacolus* sp.  
*Bathysiphon discreta* gr.  
*Biloculina* sp.  
*Ceratobulimina contraria*  
*Cibicides lobatulus*  
*Cibicidoides pachyderma*  
Echinoid fragments  
*Eponides* aff. *umbonatus*  
*Globobulimina* sp.  
*Gyroidina girardana*  
*Hoeglundina elegans*  
*Lenticulina* cf. *alatolimbata*  
*Lenticulina iota*  
*Limacina canadensis*  
Mollusc fragments  
*Nodosaria* sp.2  
*Nodosaria* sp.3  
*Nodosaria* sp.12  
*Nodosaria* sp.13  
*Nodosaria* spp.  
*Nonion barleeanum*  
*Oolina* cf. *borealis*  
*Oridorsalis* sp.  
Ostracodes  
*Ramulina* sp.  
Scaphopod sp.  
*Spiroplectammina carinata*  
*Vaginulinopsis decorata* gr.

Indeterminate 725-915 m

*Bathysiphon discreta* gr.  
Bryozoans  
*Cibicidoides pachyderma*  
*Cornuspira decorata*  
*Coscinodiscus* sp.1  
*Coscinodiscus* sp.2  
*Cyclammina* ?*placenta*  
Fish otoliths  
Fish teeth  
*Guttulina* sp.  
*Karriella* cf. *chapapotensis*  
*Lenticulina* cf. *calcarata*  
*Limacina planispiralis*  
*Marginulina bachei* var.  
Megaspore sp.  
?Microtektite  
*Nodosaria* sp.14

*Pullenia bulloides*  
*Quinqueloculina* cf. *?trigonula*  
Radiolarians  
*Uvigerina* sp.

?Upper Eocene 935-975 m

*Ammodiscus latus*  
*Ammosphaeroidina* sp.  
*Bathysiphon discreta* gr.  
*Cyclammina* sp.  
*Globoquadrina* aff. *venezuelana* (caved at 1000 m)  
*Haplophragmoides* sp.  
*Lenticulina* sp.  
*Limacina canadensis*  
*Nodosaria* spp.  
*Recurvoides* sp.  
*Reticulophragmium* cf. *amplectens* (fragment)

Middle/Lower Eocene 1000-1280 m

*Alabamina scitula*  
?Algal concretions  
*Anomalinoides acuta*  
*Astacolus* spp.  
"Balls"  
Bryozoans  
*Bulimina cooperensis*  
*Bulimina ovata*  
*Bulimina* sp.  
*Catapsydrax* aff. *dissimilis*  
*Cibicidoides* cf. *perlucida*  
*Cibicidoides* sp.  
*Coscinodiscus* sp.3  
*Cribrostomoides* cf. *scitulus*  
*Cyclammina placenta*  
*Epistomina eocaenica*  
*Eponides* aff. *megastoma*  
Gastropod fragments  
*Globigerina eocaena*  
*Globigerina linaperta*  
*Globocassidulina subglobosa*  
*Guttulina problema*  
*Gyroidina soldanii mamilligera*  
*Gyroidina* sp.  
*Haplophragmoides kirki*  
*Haplophragmoides rotundidorsata*  
*Haplophragmoides walteri*  
*Lenticulina* cf. *whitei*  
*Lenticulina* sp. "heavy-ribbed form"  
*Lenticulina* spp.  
Megaspore sp.  
Mollusc fragments  
*Nodosaria* cf. *elegantissima*  
*Nodosaria* cf. *pozoensis*

*Nodosaria* sp.20  
*Nodosaria* spp.  
 Ostracodes  
*Pararotalia* sp.2  
 ?*Planulina* sp.  
*Pseudohastigerina* sp. (caved at 1290 m)  
*Pullenia quinqueloba*  
*Quadrinorphina* aff. *allomorphinoides*  
 Radiolarians  
 Scaphopod sp. "corrugated"  
 Scaphopod sp. "fluted"  
 Selachian denticle  
*Spiroplectammina dentata*  
*Spiroplectammina spectabilis*  
*Trochammina globigeriniformis* gr.

?Paleocene 1290-1300 m

*Gaudryina* ?*pyramidata*

Husky Bow Valley *et al.* Trave E-87 (from Thomas, 1993j)

Table 16. Stratigraphic succession and paleoenvironments.

<u>Depth</u> (m)	<u>Age</u> (Zone) - probable environment
740-780	(Middle-Late) Miocene ( <i>Asterigerina gurichi</i> Zone) - outer neritic
800-960	(?Early) Miocene ( <i>Spiroplectammina carinata</i> Zone) - outer neritic/bathyal
980-1140	indeterminate - indeterminate
1160-1740	Middle-Late Eocene ( <i>Reticulophragmium amplexens</i> - <i>Limacina canadensis</i> Zone) - bathyal
1760-2100	Early-Middle Eocene ( <i>Spiroplectammina spectabilis</i> Zone) - bathyal
2120-2130	Early Eocene (Megaspore sp.1 Zone) - bathyal
2150-2160	?Cretaceous - indeterminate
2180-2190	Early Cretaceous - ?neritic

Faunal List

(?Middle-Upper) Miocene 740-780 m

*Asterigerina gurichi*  
*Caucasina elongata*  
*Ceratobulimina contraria*  
*Cibicidoides* cf. *incrassatus*  
*Coscinodiscus* sp.3  
*Coscinodiscus* sp.4  
*Dentalina* sp.  
*Globigerina bulloides*  
*Globigerina* sp.  
*Globulina* sp.  
*Gyroidina octocamerata*  
*Lenticulina* sp.  
*Melonis barleeaanum*  
 Mollusc fragments  
 Ostracode sp.

*Pullenia quinqueloba*

(?Lower) Miocene 800-960 m

*Bulimina* sp.  
*Cibicidoides pachyderma*  
*Dentalina* sp.  
*Coscinodiscus* spp.  
*Gyroidinoides* cf. *orbicularis*  
*?Karreriella* sp.  
*Lenticulina* spp.  
*Melonis sphaeroides*  
*Pullenia bulloides*  
Pyritized tubes  
*Spiroplectammina carinata*  
*Uvigerina* ex. gr. *miozea-nuttalli*  
*Uvigerina* sp.

Indeterminate 980-1140 m

*Bathysiphon* cf. *eocaena*  
*Cibicidoides* sp.  
*?Glomospirella* sp.  
*Haplophragmoides* sp.  
*Marginulina* sp.  
*Quinqueloculina* sp.  
*Recurvoides* sp.

Middle-Upper Eocene 1160-1740 m

*Ammobaculites* sp.  
*Ammodiscus* cf. *latus*  
*Ammodiscus* sp.  
*Ammomarginulina aubertae*  
*Arenobulimina* sp.2  
*Astacolus* sp.  
*Bathysiphon eocaenica*  
Bryozoans  
*Bulimina alazanensis*  
*Bulimina* cf. *?ovata*  
*Cassidulina* sp.  
*Catapsydrax dissimilis*  
*?Cibicides* sp.  
*Cibicides* cf. *tenellus*  
*Cibicides ungerianus*  
*Cibicidoides* sp.  
*Cibicidoides tuxpamensis*  
*Cribrostomoides rotundidorsata*  
*Cribrostomoides* cf. *scitulum*  
*Cyclammina ?placenta*  
*Dentalina* sp.  
*?Dorothia* sp.2  
*Eggerella* sp.  
*Epistomina* cf. *eocaena*  
*Epistomina* sp. (may be a reworked Cretaceous form)

*Eponides umbonatus*  
 Fish teeth  
*Frondicularia* cf. *budensis*  
 Gastropod  
*Gaudryina* cf. *laevigata*  
*Globigerina* cf. *eocaena*  
*Globocassidulina subglobosa*  
*Guttulina problema*  
*Gyroidina primitiva*  
*Gyroidina soldanii mamilligera*  
*Haplophragmoides kirki*  
*Haplophragmoides walteri*  
*Kalamopsis* sp.  
*Karrieriella conversa*  
*Lenticulina* spp.  
*Lenticulina* cf. *whitei*  
*Limacina canadensis*  
*Miliolinella* sp.  
 Mollusc fragments  
*Nodosaria* cf. *elegantissima*  
*Nuttalides truempyi*  
 Ostracodes  
*Pseudonodosaria* sp.15  
*Recurvoides* sp.2  
*Reticulophragmium amplectens*  
*Rhizammina* sp.  
*Rotaliatina buliminoides*  
 Selachian denticles  
*Spirillina* sp.  
*Spirophthalmidium* sp.  
*Spiroplectammina dentata*  
*Stilostomella* cf. *aculeata*  
*Subbotina* sp.  
*Textularia* cf. *agglutinans*  
*Tolypammina* sp. (encrusting on *Ammodiscus latus*)  
*Trochammina* sp.8  
*Turrilina robertsi*  
*Uvigerina* cf. *rippensis*  
*Vaginulinopsis* aff. *decorata*

Lower-Middle Eocene 1760-2100 m

*Acarinina* aff. *broedermanni*  
*Acarinina pentacamerata*  
*Ammovertellina* sp.  
*Anomalina* cf. *spissiformis*  
*Anomalinoides* aff. *acuta*  
*Cibicidoides* cf. *grimsdalei*  
*Cibicidoides* aff. *subspiratus*  
 Echinoid fragments  
*Eggerella bradyi*  
*Globigerina* sp.  
*Globigerinatheka index*  
*Martinotiella communis*  
 Megaspore sp.1

*Osangularia* aff. *expansa*  
*Pseudohastigerina wilcoxensis*  
*Quadromorphina* aff. *allomorphinoides*  
*Reophax* sp.  
 Scaphopod sp. - "corrugated"  
*Spiroplectammina* aff. *spectabilis*  
*Subbotina frontosa*  
*Subbotina patagonica*

Lower Eocene 2120-2130 m

*Ammodiscus cretaceus*  
 "Balls"  
*Spiroplectammina navarroana*

Probable Cretaceous 2150-2160 m

*Marssonella trochus*

Lower Cretaceous 2180-2190

Mobil *et al.* West Flying Foam L-23 (from Thomas, 1992c)

Table 17. Stratigraphic succession and paleoenvironments.

<u>Depth</u> (m)	<u>Age</u> (Zone) - probable environment
560-720	Late Miocene ( <i>Asterigerina gurichi</i> Zone) - neritic
740-990	Early to Middle Miocene ( <i>Spiroplectammina carinata</i> Zone) - neritic
1010-1200	indeterminate - neritic
1220-1440	Oligocene ( <i>Turrilina alsatica</i> Zone) - outer neritic
1460-1710	Middle to Late Eocene ( <i>Reticulophragmium amplexens</i> - <i>Limacina canadensis</i> Zone) - upper bathyal
1730-2190	early Middle Eocene ( <i>Spiroplectammina spectabilis</i> Zone) - upper bathyal
2210-2370	Early Eocene (Megaspore sp.1 Zone) - upper bathyal
2390-2430	(Late) Paleocene ( <i>Gavelinella beccariformis</i> - <i>Rzehakina epigona</i> Zone) - upper bathyal
2450-2460	indeterminate - indeterminate
2480-2490	?Cretaceous - indeterminate

Faunal List

Late Miocene 560-720 m

*Asterigerina gurichi*  
*Caucasina elongata*  
*Ceratobulimina contraria*  
*Cibicides* sp.  
*Cibicides* sp.15  
*Cibicides* cf. *tenellus*  
*Coscinodiscus* sp.3  
*Eggerella* sp.  
 Fish otoliths  
*Globulina* sp.  
*Guttulina problema*

*Guttulina* sp.  
*Gyroidina girardana*  
*Hoeglundina elegans*  
*Lagena substriata*  
*Lenticulina* aff. *alato-limbata*  
*Lenticulina* sp.  
Mollusc fragments  
*Nonion* cf. *affine*  
*Nonionella* sp.  
*Oridorsalis* aff. *tenera*  
*Quinqueloculina* sp.  
*Sphaeroidina bulloides*  
*Spiroplectammina carinata*  
*Textularia agglutinans*  
*Uvigerina* spp.

Early to Middle Miocene 740-990 m

*Anomalinoidea* cf. *spissiformis*  
*Biloculina* sp.  
*Bolivina* sp.  
*Cibicides pachyderma*  
*Coscinodiscus* sp.1  
*Coscinodiscus* sp.3  
*Dentalina intermedia*  
*Dentalina* sp.  
Fish otolith  
Fish tooth  
Gastropod  
*Guttulina* sp.  
*Lenticulina articulata*  
*Lenticulina depressa*  
*Lenticulina* cf. *pseudoiota*  
*Lenticulina* spp.  
*Melonis* sp.  
Mollusc fragments  
*Nodosaria* sp.13  
Ostracodes  
*Pseudonodosaria* sp.  
*Pullenia bulloides*  
*Pullenia quinqueloba*  
*Pyrgo* sp.  
*Pyrulina* sp.  
*Quinqueloculina* aff. *triloculiniiforma*  
*Spiroplectammina carinata*  
*Uvigerina miozea-nuttalli*

Indeterminate 1010-1200

*Ammobaculites* sp.9  
*Bathysiphon* cf. *eocaena*  
*Bathysiphon* sp.  
Bryozoans  
*Bulimina* sp.  
*Cassidulina subglobosa*

*Cribrostomoides* sp.  
*Cyclammina placenta*  
*Cyclammina* sp.  
*Eggerella bradyi*  
*Eponides umbonatus*  
Fish otolith  
*Fronicularia* cf. *budensis*  
*Globigerina praebulloides*  
*Globigerina* sp.  
*Lenticulina calcarata*  
*Lenticulina* sp.  
*Limacina canadensis*  
Mollusc fragments  
*Nodosaria* cf. *elegantissima*  
*Nodosaria* sp.3  
*Nodosaria* sp.5  
Pyrite tubes  
*Trifarina fluens*  
*Trochammina* sp.  
*Vaginulinopsis decorata*  
Worm tube

Oligocene 1220-1440 m

*Ammodiscus latus*  
*Anomalina grosserugosa*  
*Anomalinoides* sp.  
*Bathysiphon* aff. *eocaena*  
Bryozoans  
*Bulimina alazanensis*  
*Bulimina* sp.  
*Cibicidoides blanpiedi*  
*Cibicidoides pachyderma*  
*Cyclogyra decorata*  
Echinoderm fragments  
Fish otolith  
Fish tooth  
*Fronicularia* sp.  
*Globigerina* aff. *ampliapertura*  
*Globigerina praebulloides*  
*Globigerina* sp.  
*Haplophragmium* sp.  
*Haplophragmoides rotundidorsata*  
*Karriella bradyi*  
*Lagena* spp.  
*Limacina* cf. *planispirata*  
*Marginulina* aff. *bachei*  
Mollusc fragments  
*Nodosaria* sp.14  
*Nodosaria* sp.16  
Ostracode spp.  
*Recurvoides* sp.  
*Reticulophragmium* sp.  
?Scaphopod spp.  
*Sigmoilinopsis schlumbergeri*

*Spirillina* sp.  
*Textularia agglutinans*  
*Turrilina alsatica*

Middle to Late Eocene 1460-1710 m

*Ammomarginulina aubertae*  
*Chilostomella oolina*  
*Cibicidoides alleni*  
*Cibicidoides truncanus*  
*Dorothia* sp.  
*Epistomina eocaenica*  
*Eponides plummerae*  
Fish teeth  
*Gaudryina* cf. *laevigata*  
*Globigerina eocaena*  
*Globigerina* spp.  
*Globigerina yeguaensis*  
*Haplophragmoides kirki*  
*Haplophragmoides walteri*  
*Karreriella conversa*  
*Karreriella* sp.  
*Martinottiella* sp.  
Ostracode spp.  
*Quadriformina allomorphinoides*  
*Reticulophragmium amplectens*  
? *Spirillina* sp.  
*Spiroplectammina dentata*  
*Subbotina linaperta*

early Middle Eocene 1730-2190 m

*Alabamina scitula*  
*Ammobaculites* sp.  
*Ammodiscus* cf. *cretaceus*  
*Ammovertellina* sp.  
? *Anomalina* sp.  
*Astacolus* sp.  
*Coscinodiscus* sp.3  
*Gyroidina* sp.  
*Lagena* sp.  
*Marssonella trochus*  
*Nodosaria* sp.20  
*Osangularia expansa*  
*Pelosina* sp.  
*Plectofrondicularia paucicostata*  
*Pseudobolivina* sp.  
*Recurvoides* cf. *walteri*  
*Reticulophragmoides* cf. *jarvisi*  
*Rhizammina* sp.  
*Saccamina* sp.  
*Spiroplectammina* cf. *navarroana*  
*Spiroplectammina spectabilis*  
Tubes  
*Turrilina robertsi*

Early Eocene 2210-2370 m

*Acarinina* aff. *broedermanni*  
*Acarinina densa*  
*Ammodiscus cretaceus*  
*Anomalinoides acuta*  
*Bulimina midwayensis*  
*Gavelinella* aff. *beccariiformis*  
*Gavelinella* cf. *danica*  
*Globigerina* sp.  
*Glomospira corona*  
*Gyroidina* sp.  
Ostracode spp.  
*Spiroplectammina navarroana*  
*Vulvulina* cf. *mexicana*  
*Vulvulina spinosa*

(Late) Paleocene 2390-2430 m

*Morozovella conicotruncata*  
*Morozovella* sp.  
*Planorotalites pseudomenardii*  
*Rzehakina epigona*

Indeterminate 2450-2460 m

*Arenobulimina* sp.  
? *Pararotalia* sp.  
*Spiroplectammina* sp.

?Cretaceous 2480-2490 m

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Table 1.

WELL	GSC locality	Location Latitude Longitude	Elevation Sea level to Rotary Table (m)	Water Depth (m)	Total Depth (m)	Interval Studied (m)
Husky-Bow Valley <i>et al.</i> Archer K-19	D-254	46°38'43.17"N 48°02'18.42"W	22.0	118.9	4299.3	900-1940
Mobil-Gulf Flying Foam I-13	D-117	47°02'41.96"N 48°46'30.98"W	29.9	90.8	3683.2	302-3683
Mobil <i>et al.</i> Hebron I-13	D-196	46°32'33.95"N 48°31'45.47"W	27.4	93.9	4723.5	390-1570
Mobil <i>et al.</i> Hibernia B-08	D-191	46°47'06.36"N 48°45'29.87"W	25.9	82.9	4435.5	540-1755
Mobil <i>et al.</i> Hibernia G-55	D-194	46°44'17.07"N 48°53'10.75"W	29.7	76.5	3460.1	540-1600
Mobil <i>et al.</i> Hibernia I-46	D-221	46°45'40.74"N 48°51'17.20"W	33.2	78.7	3435.7	490-1480
Mobil <i>et al.</i> Hibernia J-34	D-206	46°43'33.84"N 48°50'13.00"W	29.0	78.3	3711.8	430-1480
Mobil <i>et al.</i> Hibernia K-18	D-200	46°47'34.69"N 48°47'17.05"W	29.7	78.3	5039.3	920-1645
Mobil <i>et al.</i> Hibernia O-35	D-186	46°44'54.92"N 48°49'53.74"W	24.4	79.6	4788.5	520-1730
Mobil <i>et al.</i> Nautilus C-92	D-204	46°51'03.55"N 48°44'20.64"W	27.4	84.4	4109	880-2205
Mobil <i>et al.</i> Rankin M-36	D-229	46°35'46.58"N 48°50'56.26"W	26.8	72.4	3967.3	710-1245
Mobil <i>et al.</i> South Mara C-13	D-247	46°42'01.07"N 48°32'19.63"W	25.6	97.2	5034.1	800-2040
Mobil <i>et al.</i> South Tempest G-88	D-199	47°07'19.92"N 47°57'30.48"W	26.8	158.2	4674.8	710-2695
Petro-Canada <i>et al.</i> Terra Nova K-08	D-236	46°27'31.60"N 48°30'59.60"W	24.7	94.2	4499.8	695-1320
Husky-Bow Valley <i>et al.</i> Trave E-87	D-238	46°56'17.56"N 47°58'09.74"W	25.3	137.8	3985.6	740-2190
Mobil <i>et al.</i> West Flying Foam L-23	D-205	47°02'43.81"N 48°49'17.02"W	26.8	92.0	4553.8	560-2520