CRETACEOUS – TERTIARY STRATIGRAPHY OF THE LABRADOR SHELF

WELLS: FREYDIS B-87, HOPEDALE E-33, KARLSEFNI A-13, NORTH LEIF I-05 & SOUTH HOPEDALE L-39

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ENCLOSURES

EXECUTIVE SUMMARY

This report presents the results of a re-evaluation of the Cretaceous – Tertiary stratigraphy of two Labrador Shelf wells, Freydis B-87 and Karlsefni A-13; in association with the biostratigraphic analysis of a selected number of samples from the Hopedale E-33, North Leif I-05 and South Hopedale L-39 wells, carried out on behalf of Nalcor Energy.

This study is a continuation of the work carried out as part of a larger regional assessment of the slope and deepwater prospectivity of the Labrador margin, with the aim of improving shelf-slope-deepwater stratigraphic correlations.

Following discussions with Nalcor Energy – Oil & Gas, plus the recommendations as discussed in our primary report (Ainsworth *et al*., 2014a), this second phased study was initiated.

A number of objectives were assigned to this latest study of the stratigraphical analysis of the five newly examined wells.

Biostratigraphic and lithologic analyses have been carried out from the basal Saglek Formation through to the Bjarni Formation in Freydis B-87 and from the basal Saglek Formation through to the Pre-Cambrian Gneiss in Karlsefni A-13; in order to further improve our understanding of these Cretaceous and Tertiary sediments along the Labrador Shelf.

A selected number of biostratigraphical analyses have also been undertaken on another three wells (Hopedale E-33, North Leif I-05 and South Hopedale L-39) in order to ascertain the presence / absence of marked stratigraphic breaks at the Mokami / Kenamu formational boundary, plus the age of the of the lowermost Markland Formation, “Lower Markland Member” (as to whether there are any preserved Cenomanian / Turonian aged sediments).

The following conclusions have been drawn from this second phased study:

1. Bjarni Formation
   This non-marine / marginal marine formation is not envisaged to range no younger than the Late Albian.

2. Markland Formation
   The Markland Formation, Lower” Markland Member has now a maximum stratigraphic range of Cenomanian – Maastrichtian, while the “Upper Markland Member” is of lower Late Paleocene, Selandian, age. The base Tertiary unconformity is according indicated at the informal “Lower” / “Upper” Markland boundary. The sub-regional absence of Early Paleocene, Danian sediments (not recognised in the wells analysed to date) is particularly noted.

Cenomanian and Early – Middle Turonian aged sediments have been recognised in the South Hopedale L-39 well. The presence / absence of Campanian sediments does, however, remain uncertain due to an absence of short-ranging microfossil taxa. In a number of wells, the Maastrichtian is, however, envisaged to unconformably overlie the Santonian.

3. Cartwright Formation – Gudrid Member

   The Cartwright Formation, including the arenaceous Gudrid Member, is Late Paleocene, Thanetian, in age. Foraminiferid datasets indicate that the Gudrid Member sandstones were deposited in a deep-water marine setting, rather than as coastal marine sands and down-dip shelf fans as suggested by Balkwill & McMillan (1990).

4. Kenamu Formation

   The Kenamu Formation generally ranges in age from Early Eocene, Ypresian to Middle Eocene, Bartonian; extending into the Late Eocene, Priabonian in the Snorri J-90 well. Furthermore, the Kenamu – Mokami formational boundary is envisaged to be at least locally unconformable, with the Late Eocene, Priabonian, being absent.

5. Mokami Formation

   In many of the studied wells this formation is Late Eocene?, Priabonian? through to Early – Late Oligocene, Rupelian - Chattian in age.

1. INTRODUCTION

This report presents the results of a re-evaluation of the Cretaceous – Tertiary stratigraphy of two Labrador Shelf wells - Freydis B-87 and Karlsefni A-13; in association with a selected number of analyses from the Hopedale E-33, North Leif I-05 and South Hopedale L-39 wells, carried out on behalf of Nalcor Energy.

Riley Geoscience Ltd. personnel and associates involved in this study were:

N. R. Ainsworth: Tertiary - Cretaceous Micropalaeontology and Lithology
L. A. Riley: Cretaceous Palynology
H. W. Bailey: Tertiary – Late Cretaceous Micropalaeontology
K. J. Gueinn: Tertiary Palynology

Analyses:

All sample depths cited in this report are driller's depths.

Freydis B-87

Lithology: 83 ditch cuttings samples over the interval 1,510' – 7,560'
Micropalaeontology: 62 ditch cuttings samples over the interval 1,510' – 6,250'.
Palynology: 61ditch cuttings samples over the intervals 1,540' – 6,220'.

Hopedale E-33

Lithology: on all samples studied for biostratigraphy.
Micropalaeontology: 18 ditch cuttings samples over the interval 900m – 1,170m.
Palynology: 12 ditch cuttings samples over the interval 915m – 1,200m.

Karlsefni A-13

Lithology: on all samples studied for biostratigraphy.
Micropalaeontology: 199 ditch cuttings samples over the interval 1,780' – 13,590'.
Palynology: 200 ditch cuttings samples over the interval 1,810' – 13,550'.

North Leif I-05

Lithology: on all samples studied for biostratigraphy.
Micropalaeontology: 11 ditch cuttings samples over the interval 2,600m – 2,805m.
Palynology: 10 ditch cuttings samples over the interval 2,610m – 2,800m.

South Hopedale L-39

Lithology: 51 ditch cuttings samples over the intervals 1,000m – 1,180m and 1,430m – 2,120m.

Micropalaeontology: 45 ditch cuttings samples over the intervals 1,000m – 1,180m and 1,430m – 2,020m.

Palynology: 44 ditch cuttings samples over the intervals 1,010m – 1,170m and 1,420m – 2,110m.

Wireline logs and CanStrat lithlogs, as supplied by Nalcor Energy, have been used to interpret lithologies and lithostratigraphic boundaries.

2. OBJECTIVES

This study is a continuation of the work carried out as part of a larger regional assessment of the slope and deepwater prospectivity of the Labrador margin, with the goal of improving the interpretation of shelf-slope-deepwater stratigraphic correlation.

This second phased study was to continue the revised, consistent and regionally correlative Cretaceous to Tertiary (Alexis – Saglek Formations) biostratigraphic and lithostratigraphic framework used in the earlier study. Newly prepared ditch cuttings samples were again used throughout this latest study.

A number of objectives were assigned to this second study phase of.

1. Two wells to be fully analysed:

   Freydis B-87: Stratigraphic analyses from the basal Saglek Formation (1,510') through to Bjarni Formation (6,250'), plus lithological analyses between 6,250' – 7,560' over the Palaeozoic Shales and Limestones (Late Ordovician). The Freydis B-87 well was analysed in order to gain a near complete stratigraphic dataset from the most southerly Labrador Shelf well. It also possesses three important sandstone reservoir sequences (Gudrid, Freydis and Bjarni Formations / Members).

   Karlsefni A-13: Stratigraphic analyses from the intra-Saglek Formation (1,780') through to Pre-Cambrian Gneiss (13,590'). The Karlsefni A-13 well was analysed in order to gain a near complete stratigraphic dataset from a second southerly located Saglek Basin well. The Karlsefni A-13 well comprises a more complete section compared to the Pothurst P-19 well, possessing both a Cartwright Formation and a Markland Formation, "Upper Markland Member".

2. The biostratigraphic analysis of specific intervals from three well sections:

   Hopedale E-33: Stratigraphic analyses over the basal Mokami (900m) – upper Kenamu Formations (1,200m); to ascertain whether or not there is a marked stratigraphic break at the Mokami / Kenamu formational boundary.

   North Leif I-05: Stratigraphic analyses over the lower Markland Formation, "Lower Markland Member" (2,600m) – upper Bjarni Formation (2,805m); to ascertain if there are any Cenomanian and Turonian aged sediments within the lower Markland Formation.

   South Hopedale L-39: Three intervals were analysed:

a. Stratigraphic analyses over the basal Mokami (1,000m) – upper Kenamu Formations (1,180m); to ascertain whether there is a marked stratigraphic break at/near the Mokami / Kenamu formational boundary.

b. Stratigraphic analyses over the basal Kenamu Formation (1,420m) – base Bjarni Formation (2,010m); to ascertain the age of the thickened Markland Formation (whether there are any Turonian and Cenomanian aged sediments), plus the delineation of an attenuated Bjarni Formation.

c. Lithological analyses (2,020m – 2,120m) over the Palaeozoic Limestones (Late Ordovician) and intrusives.

The lithostratigraphic nomenclature follows Balkwill (1987), Balkwill & McMillan (1990), Jenkins (1984), McWhae & Michel (1975), McWhae *et al*. (1980), Umpleby (1979) and Ainsworth *et al*. (2014a, b).

The chronostratigraphic terminology broadly follows Gradstein *et al.* (2012).

The Tertiary micropalaeontology is based on Charnock & Jones (1990), D'Iorio (1986, 1987), D'Iorio & Agterberg (1989), Gradstein & Berggren (1981), Gradstein & Srivastava (1980), Gradstein *et al*. (1994), Kaminski et al (1989a, b), King (1989), Miller et al. (1982, 1988), Setoyama *et al.* (2011b), van den Akker *et al.* (2000) and Williams *et al*. (1990) and unpublished personal observations.

The Late Cretaceous micropalaeontology follows King *et al*. (1989), Miller *et al*. (1982, 1988), Moullade *et al.* (1988), Setoyama *et al.* (2011a, b), van den Akker *et al.* (2000), Williams *et al*. (1990) and unpublished personal observations.

The Cretaceous – Tertiary palynology is largely based on Barss *et al.* (1979), Domassa *et al.* (1990), Head *et al.* (1989a, b, c), Ioannides (1986), Manum *et al.* (1989), Nøhr-Hansen (1996, 2003, 2012), Piel (1977), Rouse (1977), Williams (1974, 2007), Williams & Brideaux (1975), Williams & Bujak (1977), Williams (1986) and unpublished personal observations.

3. STRATIGRAPHIC SUCCESSIONS

3.1a FREYDIS B-87
(BASED ON PALAEONTOLOGICAL / SAMPLE CRITERIA)

Sample / Sample Interval	Age
1,510’	Age Indeterminate
1,540’	Early Miocene / Late Oligocene, Burdigalian / Chattian
1,600’ – 1,950’	Late – Early Oligocene, Chattian – Rupelian
2,040’ – 3,160’	Early Oligocene, Rupelian
3,410’ – 4,020’	Middle Eocene, Bartonian – Lutetian
4,060’ – 4,420’	Early Eocene, Ypresian
4,450’ – 4,870’	Late Paleocene, Thanetian
4,900’ – 5,050’	Late Paleocene, Selandian
----------Unconformity (?5,025’, log)----------	
5,080’ – 5,580’	Maastrichtian
5,590’ – 5,670’	?Campanian – Santonian
5,680’ – 5,830’	Early Santonian – Coniacian
----------Unconformity (5,864.5’, log)----------	
5,860’ – 5,950’	Late Albian
5,980’ – 6,220’	Middle? Albian
----------Unconformity (6,250’, log)----------	
	Late Ordovician

3.1b FREYDIS B-87 LITHOSTRATIGRAPHIC SUCCESSION (BASED ON WIRELINE LOG CRITERIA)

Interval Top	Lithological Unit	
756' (log)	**Saglek Formation**	
1,547' (log)	**Mokami Formation**	
2,821.5' (log)	**Kenamu Formation**	
4,501.5' (log)	**Cartwright Formation**	
4,550.5' (log) – 4,660.5' (log)		**"Upper Gudrid Member"**
4,790' (log) – 4,895' (log)		**"Lower Gudrid Member"**
4,895' (log)	**Markland Formation**	**"Upper Markland Member"**
-----Unconformity-----		
5,025' (log)		**"Lower Markland Member"**
5,677.5' (log)		**"Upper Freydis Member"**
-----Unconformity-----		
5,864.5' (log)	**Bjarni Formation**	
-----Unconformity-----		
6,250' (log)	**Late Ordovician Shales and Limestones**	
7,344.5' (log) – 7,592.5' (T.D.)	**Late Ordovician Limestones**	

3.2a HOPEDALE E-33
(BASED ON PALAEONTOLOGICAL / SAMPLE CRITERIA)

Sample / Sample Interval	Age
900m	**Age Indeterminate**
910m – 1,030m	**Early Oligocene – Middle Eocene, Rupelian – Lutetian**
1,040m – 1,200m	**Middle Eocene, Bartonian - Lutetian**

3.2b HOPEDALE E-33 LITHOSTRATIGRAPHIC SUCCESSION (BASED ON WIRELINE LOG CRITERIA)

Interval Top	Lithological Unit	
613m (log)	**Saglek Formation**	
-----Unconformity-----		
840m (log)	**Mokami Formation**	
-----Unconformity-----		
?983m (log)	**Kenamu Formation**	
?983 (log) – 1,197.5m (log)		**Leif – "Roberval" Members**
1,592.5m (log)	**Cartwright Formation**	
1,592.5m (log) – 1,645m (log)		**Gudrid Member Equivalent**
1,696m (log)	**Markland Formation**	**"Upper – Lower Markland Members"**
-----Unconformity-----		
1,948.5m (log)	**Bjarni Formation**	
-----Unconformity-----		
1,980m (log)	**Late Ordovician Dolomite**	
-----Unconformity-----		
2,000m (log) – 2,069.6m (T.D.)	**Precambrian Granite**	

3.3a KARLSEFNI A-13
(BASED ON PALAEONTOLOGICAL / SAMPLE CRITERIA)

Sample / Sample Interval	Age
1,780' – 2,080' (top not seen)	**Pleistocene – Pliocene**
2,110' – 2,420'	**Pliocene? – Late Miocene, Piacenzian – Tortonian**
2,440'	**Early Miocene / Late Oligocene, Burdigalian / Chattian**
2,500' – 5,650'	**Late – Early Oligocene, Chattian - Rupelian**
5,670' – 7,140'	**Early Oligocene, intra-Rupelian**
7,240' – 8,130'	**Middle Eocene, Bartonian - Lutetian**
8,160' – 9,140'	**Middle Eocene, Lutetian**
9,170' – 9,950'	**Early Eocene, Ypresian**
10,010' – 12,422'	**Late Paleocene, Thanetian**
12,450' – 13,550'	**Late Paleocene, Selandian**

---Unconformity (13,547', log)---

	Pre-Cambrian

3.3b KARLSEFNI A-13 LITHOSTRATIGRAPHIC SUCCESSION (BASED ON WIRELINE LOG CRITERIA)

Interval Top	Lithological Unit	
940' (log)	**Saglek Formation**	
2,385' (log)	**Mokami Formation**	
7,188.5' (log)	**Kenamu Formation**	
7,188.5' (log) – 7,364' (log)		**Leif Member**
9,967.5' (log)	**Cartwright Formation**	
12,371.5' (log)	**Markland Formation**	**"Upper Markland Member"**

--Unconformity--

13,547 (log) – 13,613' (T.D.)	**Pre-Cambrian Gneiss**

3.4a NORTH LEIF I-05
(BASED ON PALAEONTOLOGICAL / SAMPLE CRITERIA)

Sample / Sample Interval	**Age**
2,600m – 2,680m (top not seen)	**Early Maastrichtian**
2,690m – 2,725m	**Santonian**

---Unconformity (2,721.5m, log)--

2,730m – 2,805m	**Early Cenomanian – Late Albian**

3.4b NORTH LEIF I-05 LITHOSTRATIGRAPHIC SUCCESSION (BASED ON WIRELINE LOG CRITERIA)

Interval Top	Lithological Unit	
361.5m (log)	**Saglek Formation**	
547m (log)	**Mokami Formation**	
1,475.5m (log)	**Kenamu Formation**	
1,475.5m (log) – 1,697.5m (log)		**Leif Member**
1,765m (log) – 1,815.5m (log)		**"Roberval Member"**
2,109m (log)	**Cartwright Formation**	
2,141.5m (log) – 2,227.5m (log)		**"Upper" Gudrid Member**
2,311m (log) – 2,340m (log)		**"Lower" Gudrid Member**
2,350m (log)	**Markland Formation**	**"Upper – Lower Markland Members"**
-----Unconformity-----		
2,721.5m (log)	**Bjarni Formation**	
3,357.5m (log)		**Snorri Member**
-----Unconformity-----		
3,393m (log) – 3,513m (T.D.)	**Alexis Formation**	

3.5a SOUTH HOPEDALE L-39
(BASED ON PALAEONTOLOGICAL / SAMPLE CRITERIA)

Sample / Sample Interval	Age
1,000m	**Age Indeterminate**
1,010m – 1,160m	**Middle Eocene, Bartonian – Lutetian**
1,170m – 1,180m	**Middle Eocene, Lutetian**
No samples analysed between 1,190m – 1,410m	
1,420m – 1,430m (top not seen)	**Early Eocene, Ypresian**
1,440m – 1,550m	**Late Paleocene, Thanetian**
1,560m – 1,670m	**Late Paleocene, Selandian**
------Unconformity (1,648m, log)------	
1,680m – 1,810m	**Early Maastrichtian**
------Unconformity------	
1,820m – 1,860m	**Early Campanian – Santonian**
1,870m – 1,890m	**Santonian**
------Unconformity (?1,894m, log)------	
1,910m – 1,940m	**Middle – Early Turonian**
1,950m – 1,980m	**Cenomanian**
------Unconformity (?1,975m, log)------	
1,990m – 2,010m	**Late – Middle Albian**

3.5b SOUTH HOPEDALE L-39 LITHOSTRATIGRAPHIC SUCCESSION (BASED ON WIRELINE LOG CRITERIA)

Interval Top	Lithological Unit	
630m (log)	**Saglek Formation**	
812m (log)	**Mokami Formation**	
?1,074.5m (log)	**Kenamu Formation**	
1,462m (log)	**Cartwright Formation**	
1,462m (log) – 1,472.5m (log)		**"Upper Gudrid Member Equivalent"**
1,548m (log)	**Markland Formation**	**"Upper Markland Member"**
------Unconformity------		
1,648m (log)		**"Lower Markland Member"**
------Unconformity------		
?1,975m (log)	**Bjarni Formation**	
------Unconformity------		
2,008m (log)	**Palaeozoic Dolomite**	
------Unconformity------		
2,030m (log)	**Intrusives**	
------Unconformity------		
2,081.5m (log)	**Palaeozoic Dolomite**	
------Unconformity------		
2,221m (log) – 2,364m (T.D.)	**Pre-Cambrian Granite**	

5. CONCLUSIONS

The following conclusions are noted:

1. Bjarni Formation

   This formation is envisaged to range no younger than Late Albian on the Labrador Shelf.

2. Markland Formation

   The results from this second phase study suggests that the Markland Formation, Lower" Markland Member" has a maximum stratigraphic range of Cenomanian to Maastrichtian; with the "Upper Markland Member" dated as early Late Paleocene, Selandian.

   Cenomanian and Early / Middle Turonian aged sediments are recognised in the South Hopedale L-39 well. The presence / absence of Campanian sediment remains uncertain, due to an absence of short-ranging microfossil taxa. In a number of wells, the Maastrichtian appears to unconformably overlie Santonian sediments.

   No Early Paleocene, Danian, sediments have been recognised in any of the wells studied to date; suggesting a marked stratigraphic break (base Tertiary unconformity) at the "Lower" / "Upper" Markland member boundary.

3. Cartwright Formation – Gudrid Member

   The Cartwright Formation, including the arenaceous Gudrid Member, are Late Paleocene, Thanetian, in age. The Gudrid Member sandstones are interpreted here as deep-water marine deposits, rather than coastal marine sands and down-dip shelf fans as favoured by Balkwill & McMillan (1990).

4. Kenamu Formation

   The Kenamu Formation generally ranges in age from Early Eocene, Ypresian to Middle Eocene, Bartonian; locally extending into the Late Eocene, Priabonian (Snorri J- 90). The Kenamu – Mokami formational boundary is considered to be locally unconformable, with the Late Eocene, Priabonian, absent.

5. Mokami Formation

   This formation is generally of Early – Late Oligocene, Rupelian - Chattian in age; locally extending down into the Late Eocene, Priabonian.

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Well Name : FREYDIS B-87

RILEY GEOSCIENCE LTD

Operator : EASTCAN et al.
Interval : 1510' - 7592'
Scale : 1:4000
Chart date: 17 May 2016

STRATIGRAPHIC SUMMARY LOG
ENCLOSURE 1

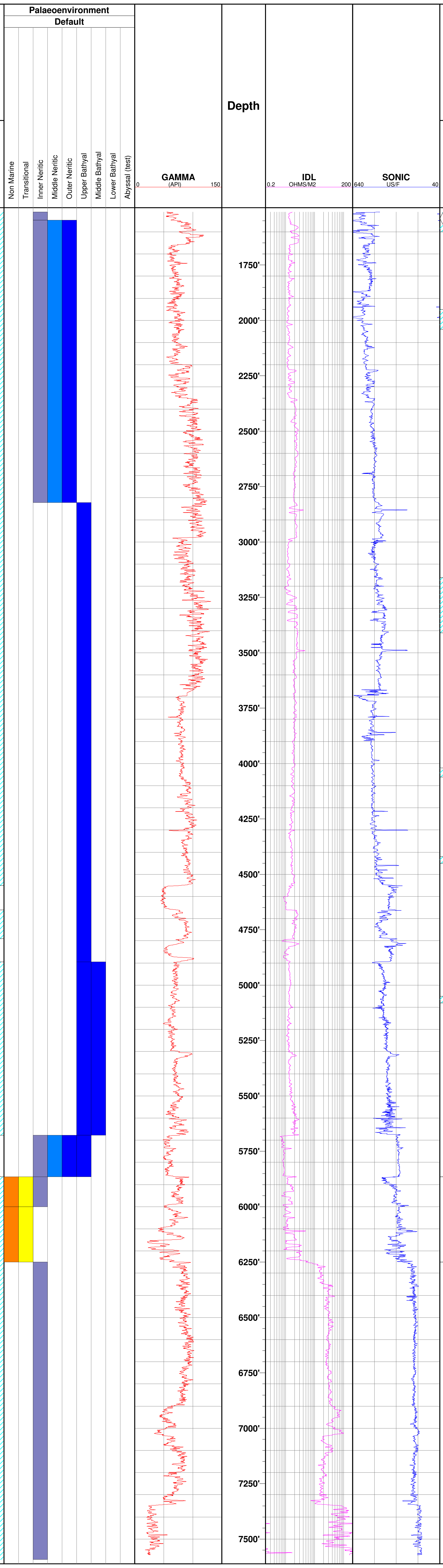
CLIENT: NALCOR ENERGY

IGD Boundary Key
- Possible
- Probable
- Confident
- Unconformable
- ?Unconformable
- Fault
- ?Fault

Text Keys
*1 LATE OLIGOCENE / EARLY MIOCENE

Lithostratigraphy

Formation	Top	Member
SAGLEK		
MOKAMI	1546.9	
KENAMU	2821.5	
CARTWRIGHT	4501.3	"UPPER" GUDRID (4550.5 – 4660.4); "LOWER" GUDRID (4790.0 – 4895.0)
MARKLAND	4895.0	FREYDIS (5677.5 – 5864.5)
BJARNI	5864.5	
PALAEOZOIC SHALE & LIMESTONE	6250.0	
PALAEOZOIC LIMESTONE	7344.2 – 7592.2	



Chronostratigraphy

Period/Epoch	Age
*1	CHATIAN / BURDIGALIAN
EARLY - LATE OLIGOCENE (1600 – 1950)	RUPELIAN - CHATTIAN (1600 – 1950)
EARLY OLIGOCENE (2040 – 3160)	RUPELIAN (2040 – 3160)
MIDDLE EOCENE (3410 – 4020)	LUTETIAN - BARTONIAN (3410 – 4020)
EARLY EOCENE (4060 – 4420)	YPRESIAN (4060 – 4420)
LATE PALEOCENE (4450 – 5050)	THANETIAN (4450 – 4870)
	SELANDIAN (4900 – 5050)
LATE CRETACEOUS (5080 – 5864.5)	MAASTRICHTIAN (5080 – 5580)
	? CAMPANIAN - SANTONIAN
	EARLY SANTONIAN - CONIACIAN (5670 – 5830)
	LATE ALBIAN (5860 – 5950)
EARLY CRETACEOUS (5864.5 – 6250.0)	MIDDLE? ALBIAN (5980 – 6220)
LATE ORDOVICIAN (6250.0 – 7592.2)	

Palynology Comments

Depth	Comment
1540 CU :	Miospore dominated. at & below 1540` Rare Tsugaepollenites
1820 CU :	Diverse miospore assemblage
2320 CU :	Miospore dominated. Rare, but persistent dinocysts 2320` - 3160`. FDO persistent Phthanoperidinium spp. D. phoshoritica, Jusseia sp.
2480 CU :	FDO R. draco, W. symmetrica/gochtii, M. aspinatum
2530 CU :	FDO common Phthanoperidinium spp.
2780 CU :	FDO persistent P. indentata
3010 CU :	Abundant P. indentata
3160 CU :	Localised dinocyst influx. Dominant A. araneosa. Rare Chiropteridium sp.
3410 CU :	FDO persistent Wetzeliella spp.
3630 CU :	FDO D. colligerum
3970 CU :	FDO abundant Impletosphaeridium / Cleistosphaeridium spp.
4090 CU :	FDO ?W. cf. lineidentatum
4200 CU :	Major downsection dinocyst influx. FDO common C. columna
4270 CU :	FDO common D. brevispinosum
4390 CU :	FDO Palaeostomocystis sp. A & common D. condylosum
4450 CU :	Abundant A. homomorphum. Common A. senonensis & A. robustum
4510 CU :	Abundant A. senonensis
4600 CU :	Dominant A. senonensis
4710 CU :	FDO common C. speciosum / D. oebisfeldensis
4900 CU :	S. deleitense, C. diebelii, P. pryrophorum. Poor preservation
4930 CU :	Common S. delitiense. FDO A. nucula
5020 CU :	FDO A. denticulata. Abundant A. nucula
5080 CU :	O. operculata, I. cooksoniae, S. delitiense, C. deibelii
5140 CU :	Significant S. delitiense, I. cooksoniae, C. deibelii
5200 CU :	C. niiga, C. deibelii
5260 CU :	Significant C. deibelii. L. biconiculum, O. operculata, S. delitiense
5320 CU :	Significant C. deibelii. D. cladoides, S. delitiense. LDO prominent Ipagiodinium spp.
5380 CU :	Downsection Cyclonephelium influx. C. deibelii, S. delitiense, O. operculata, O. costata, Cribroperidinium sp.
5440 CU :	Abundant Cyclonephelium spp. S. delitiense, Cribroperidinium sp.
5500 CU :	Common Cyclonephelium spp. C. deibelii
5580 CU :	Common Cyclonephelium spp. ?H. difficile, ?S. longifurcatum
5620 CU :	Common Cyclonephelium spp. O. operculata
5670 CU :	?H. difficile, S. longifurcatum, ?P. truncatum. Common Cyclonephelium spp.
5750 CU :	X. ceraoides, Cribroperidinium sp. Common Cyclonephelium spp.
5810 CU :	Prolixosphaeridium sp. LDO common Cyclonephelium spp.
5860 CU :	?H. difficile, ?X. ceratoides, O. costata. Influx bisaccate pollen
5920 CU :	C. colloveri, X. ceratoides, ?C. dampieri
5980 CU :	FDO Chlamydophorella sp. X. ceratoides, O. costata, C. exilicristatum. Increased Milliododinium / Cribroperidinium spp.
6040 CU :	X. alatum, ?C. segmentatus
6100 CU :	Chamydophorella sp., ?Ovoidinium sp, C. exilicristatum, ?H. diifficile
6170 CU :	?X. ceratoides, ?Ovoidinium sp., Cribroperidinium spp.
6220 CU :	C. exilicristatum, ?C. dampieri. Influx vitrinite / plant tissue

Micropalaeo. Comments

Depth	Comment
1510 CU :	Abundant shell debris
1540 CU :	FDO A. guerichi guerichi
1570 CU :	.
1600 CU :	FDO C. sulzensis
1650 CU :	FDO N. affinis
1800 CU :	FDO S. carinata
1950 CU :	FDO G. problema, P. quinqueloba
2040 CU :	FDO influx Ditrupa spp. LDO superabundant shell debris. Reworked? Lenticulina spp.
2380 CU :	FDO? F. antiqua (broken)
2440 CU :	FDO superabundant pyritised burrow infill
2500 CU :	.
2550 CU :	FDO G. soldani
2560 CU :	FDO S. microtrias, influx pyritised burrow infill
2620 CU :	Reworked S. midwayensis
2680 CU :	FDO A. hirtus
2740 CU :	.
2800 CU :	.
2840 CU :	FDO S. adamsi, F. antiqua
2920 CU :	.
2960 CU :	.
3320 CU :	.
3460 CU :	.
3560 CU :	.
3610 CU :	FDO Coscinodiscus sp. 34
3670 CU :	.
3730 CU :	.
3820 CU :	FDO Lenticulina spp., M. affinis, Triloculina spp., C. ?placenta, F. antiqua, abundant S. microtrias
3880 CU :	FDO C. cf. ungerianus, G. girardana, H. elegans, M. affinis, T. brevispira, superabundant pyritised Cenosphaera spp. & S. microtrias, T. cf. wittiana, echinoderm debris
3940 CU :	FDO influx S. microtrias
4060 CU :	FDO B. cf. trigonalis, C. subconicus, N. konincki, C. morsianus morsianus, Diatom sp. 34, very common F. antiqua
4120 CU :	FDO C. contraria, C. cf. lobatulus
4180 CU :	FDO C. cf. tenellus, Plectofrondicularia sp. A, R. ex. gr. walteri, R. gr. discreta
4240 CU :	FDO common C. amplectens & C. placenta, H. walteri, abundant C. morsianus morsianus, C. morsianus var. moelleri, Diatom sp. 34, superabundant F. antiqua
4300 CU :	.
4360 CU :	.
4420 CU :	.
4490 CU :	FDO K. coniformis
4550 CU :	.
4630 CU :	.
4690 CU :	FDO glauconitic faecal pellets
4740 CU :	FDO common R. ex. gr. walteri
4810 CU :	FDO G. charoides, R. robusta
4870 CU :	.
4940 CU :	FDO K. conversa
4990 CU :	FDO common A. cretaceus, A. aubertae, B. nodosariaformis, common H. walteri, K. coniformis & P. elegans, superabundant R. ex. gr. walteri, common R. gr. discreta, S. navarroana
5050 CU :	FDO very common G. charoides & K. conversa, influx R. ex. gr. walteri, abundant R. gr. discreta, common S. navarroana & sponge spicules (monoaxon, siliceous)
5110 CU :	FDO S. sphaerica
5170 CU :	FDO G. voltziana, O. cordieriana, H. kirki, S. placenta, S. dentata, superabundant Geodia spp. & sponge spicules (monoaxon, siliceous)
5230 CU :	FDO B. crassa, A. tenuissimus, abundant B. nodosariaformis, C. trinitatensis, G. irregularis, abundant K. conversa, R. epigona, influx sponge spicules (monoaxon, siliceous)
5290 CU :	FDO very common A. cretaceus, abundant G. charoides, superabundant R. gr. discreta, common R. fissistomata, S. grzybowskii & S. compressa, T. chapmani
5350 CU :	FDO A. agglutinans, H. ovulum
5410 CU :	FDO R. minima. Re-appearance influx sponge spicules (monoaxon, siliceous)
5470 CU :	.
5530 CU :	FDO G. rugosa
5590 CU :	FDO G. pertusa, Lenticulina spp., A. obliqua, common G. rugosa, P. olszewskii, V. muensteri, very common Inoceramus debris
5660 CU :	FDO G. michelinianus, L. rotulata
5730 CU :	.
5770 CU :	.
5830 CU :	.
5900 CU :	FDO superabundant orange-brown stained Haplophragmoides spp.
5950 CU :	LDO superabundant Haplophragmoides spp., common Dorothia spp.
6000 CU :	FDO A. subcretaceus, common ?Haplophragmium spp.
6070 CU :	.
6130 CU :	.
6190 CU :	.
6250 CU :	.

Well Name : HOPEDALE E-33

RILEY GEOSCIENCE LTD

Operator : CHEVRON et al.

Interval : 900m - 1205m

Scale : 1:4000

Chart date: 17 May 2016

STRATIGRAPHIC SUMMARY LOG

ENCLOSURE 2

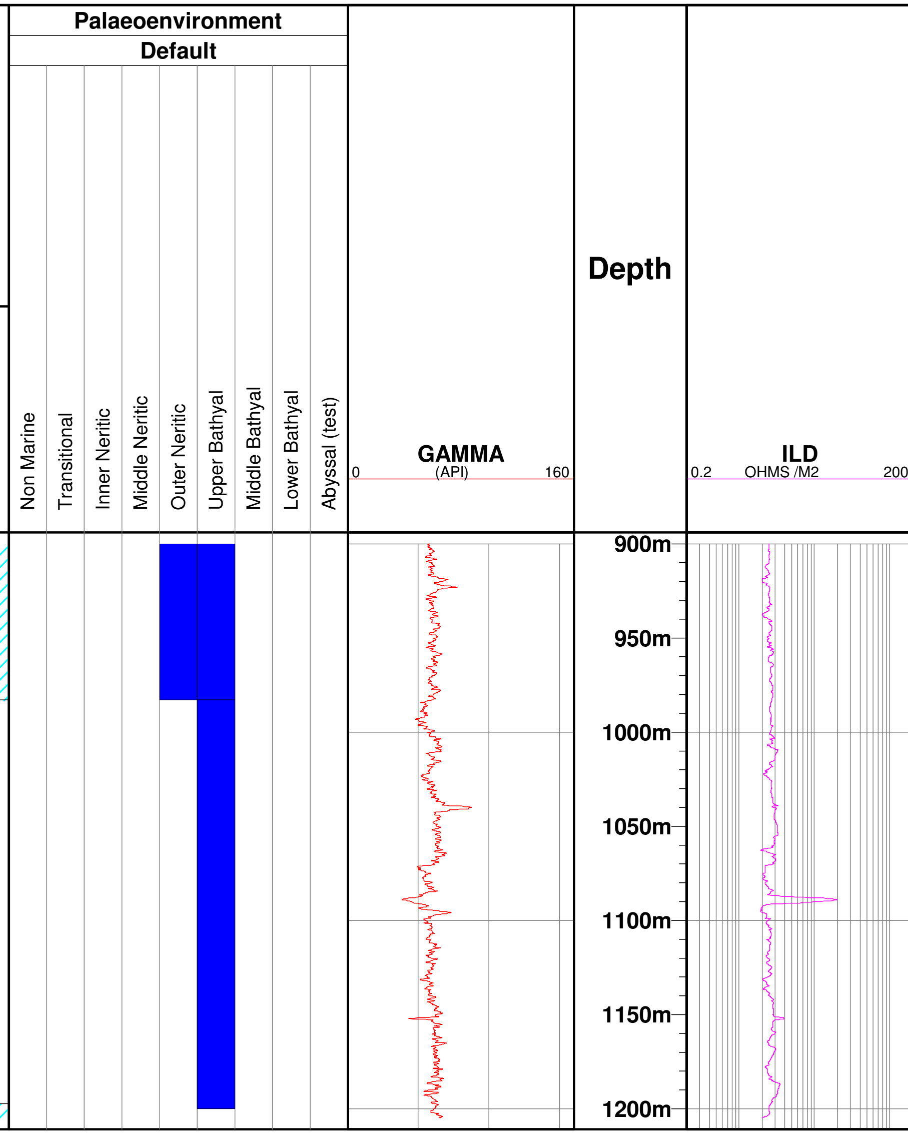
CLIENT: NALCOR ENERGY

IGD Boundary Key

- Possible
- Probable
- Confident
- Unconformable
- ?Unconformable
- Fault
- ?Fault

Lithostratigraphy

Formation	Member
MOKAMI (840.0 – 983.0)	[hatched] (– 983.0)
KENAMU (983.0 – 1592.5)	"ROBERVAL" - LEIF (983.0 – 1197.5)



Chronostratigraphy

Period/Epoch	Age
(– 915)	(– 915)
MIDDLE EOCENE - EARLY OLIGOCENE (915 – 1035)	LUTETIAN - RUPELIAN (915 – 1035)
MIDDLE EOCENE (1040 – 1200)	LUTETIAN - BARTONIAN (1040 – 1200)

Palynology Comments

Depth	Comment
915 CU :	Miospore dominated. Rare dinocysts of Oligocene - Miocene aspect
930 CU :	.
950 CU :	Jussiaea sp.
975 CU :	.
990 CU :	Jussiae sp.
1010 CU :	.
1035 CU :	.
1050 CU :	Jurassiaea sp.
1090 CU :	Miospore dominated 1090m - 1200m. P. megregorii, ?Wetzeliella sp, C. bartonensis, Azolla sp.
1120 CU :	?Wetzeliella sp., Azolla sp.
1150 CU :	P. mcgregori, W. cf. compactum. Significant Wetzeliella spp.
1200 CU :	P. mcgregori, K. tenuivigula, Wetzeliella spp, Azolla sp.

Micropalaeo. Comments

Depth	Comment
900 CU :	Caved? C. stainforthi, G. praebulloides, G. obliquus, G. pseudopima, C. laevigata, F. boueanus, Triloculina spp., F. antiqua
920 CU :	FDO A. tangentialis, C. cf. lobatulus, G. girardana, H. elegans, A. cretaceus, A. hirtus, rare pyritised burrow infill
945 CU :	FDO common pyritised burrow infill
950 CU :	FDO common A. tangentialis, Stilostomella spp.
960 CU :	Influx shell debris
980 CU :	FDO superabundant pyritised burrow infill
1000 CU :	.
1020 CU :	.
1040 CU :	FDO S. adamsi
1065 CU :	.
1070 CU :	Caved G. triloba
1080 CU :	FDO F. antiqua. Sperabundant shell debris
1100 CU :	FDO common S. adamsi
1110 CU :	FDO common Ditrupa spp.
1140 CU :	FDO S. adamsi
1160 CU :	FDO C. placenta, R. gr. discreta
1170 CU :	FDO S. microtrias, superabundant Ditrupa spp.
1190 CU :	.

Well Name : KARLSEFNI A-13

RILEY GEOSCIENCE LTD

Operator : EASTCAN et al.
Interval : 1780' - 13612'
Scale : 1:4000
Chart date: 17 May 2016

STRATIGRAPHIC SUMMARY LOG
ENCLOSURE 3

CLIENT: NALCOR ENERGY

IGD Boundary Key
- Possible
- Probable
- Confident
- Unconformable
- ?Unconformable
- Fault
- ?Fault

Text Keys
*1 LATE OLIGOCENE - EARLY MIOCENE

Palynology Comments

Depth	Comment
1810 CU :	Miospore dominated assemblages 1810` - 2050`. Persistent Tsugaepollenites. Rare reworked dinocysts
1880 CU :	.
1930 CU :	.
1990 CU :	.
2050 CU :	.
2110 CU :	FDO H. tectata. Miospore dominated assemblages. Sporadic dinocysts
2170 CU :	H. tectata
2230 CU :	.
2280 CU :	.
2360 CU :	FDO R. actinocoronatum
2420 CU :	FDO B. cf. wrennii
2470 CU :	FDO I. / C. ancyreum
2530 CU :	FDO L. truncatum
2590 CU :	FDO S. pseudofurcatus
2650 CU :	.
2720 CU :	.
2770 CU :	.
2840 CU :	.
2900 CU :	.
2960 CU :	R. actinocoronata
3020 CU :	.
3080 CU :	.
3140 CU :	.
3200 CU :	FDO Chiropteridium sp. Miospore dominated assemblages 3200` - 5630`. Sporadic dinocysts
3250 CU :	Common Chiropteridium spp.
3300 CU :	.
3340 CU :	.
3380 CU :	.
3420 CU :	.
3500 CU :	FDO Deflandrea sp.
3540 CU :	.
3580 CU :	FDO Paleocystodinium sp. 1 & P. sp. 2 (Damassa et al.)
3620 CU :	Paleocystodinium sp. 2
3640 CU :	.
3660 CU :	.
3700 CU :	.
3740 CU :	FDO D. phosphoritica grp., M. aspinatum
3800 CU :	.
3840 CU :	.
3880 CU :	.
3920 CU :	.
3960 CU :	.
4000 CU :	FDO W. symmetrica
4040 CU :	.
4100 CU :	.
4160 CU :	.
4200 CU :	LDO persistent Chiropteridium spp.
4240 CU :	.
4280 CU :	.
4320 CU :	.
4360 CU :	.
4420 CU :	.
4500 CU :	.
4540 CU :	.
4620 CU :	.
4660 CU :	.
4700 CU :	.
4740 CU :	.
4780 CU :	.
4820 CU :	.
4860 CU :	.
4930 CU :	.
4970 CU :	.
5010 CU :	.
5050 CU :	.
5090 CU :	.
5110 CU :	.
5170 CU :	.
5230 CU :	.
5270 CU :	.
5330 CU :	.
5380 CU :	.
5430 CU :	.
5470 CU :	.
5510 CU :	.
5550 CU :	.
5590 CU :	.
5630 CU :	.
5670 CU :	FDO Phthanoperidinium spp. Miospore dominated assemblages 5670` - 8100`. Sporadic dinocysts
5710 CU :	.
5770 CU :	.
5850 CU :	.
5910 CU :	.
5950 CU :	.
6030 CU :	.
6070 CU :	.
6130 CU :	.
6240 CU :	.
6310 CU :	.
6350 CU :	.
6450 CU :	.
6530 CU :	.
6660 CU :	.
6730 CU :	.
6790 CU :	.
6860 CU :	.
6930 CU :	.
6980 CU :	.
7040 CU :	.
7110 CU :	.
7210 CU :	.
7300 CU :	FDO rare / sporadic Wetzeliella spp.
7340 CU :	.
7410 CU :	.
7460 CU :	.
7480 CU :	A. arraneosa
7540 CU :	.
7600 CU :	.
7650 CU :	.
7800 CU :	.
7930 CU :	.
7990 CU :	.
8050 CU :	.
8100 CU :	.
8160 CU :	Common C. diversispinosum, rare T. pelagica
8230 CU :	.
8290 CU :	.
8350 CU :	.
8410 CU :	.
8480 CU :	.
8530 CU :	.
8590 CU :	.
8630 CU :	.
8700 CU :	FDO persistent D. cladoides
8760 CU :	FDO W. cf. lineidentatum. Influx Cleistosphaeridium sp. A
8820 CU :	.
8870 CU :	.
8930 CU :	.
8990 CU :	.
9050 CU :	.
9110 CU :	.
9170 CU :	FDO C. columna
9230 CU :	.
9290 CU :	FDO D. brevispinosum
9350 CU :	.
9410 CU :	FDO persistent H. tenuispinosum
9470 CU :	.
9560 CU :	FDO persistent rare Azolla spp.
9620 CU :	.
9670 CU :	Increased A. homomorphum. Common H. tenuispinosum
9740 CU :	.
9800 CU :	.
9860 CU :	Localied influx A. senonensis / Glaphrocysta spp.
9930 CU :	.
9980 CU :	.
10040 CU :	FDO Palaeostomocystis. LDO common Wetzeliella spp.
10100 CU :	.
10160 CU :	.
10230 CU :	FDO D. condylosa
10290 CU :	.
10350 CU :	.
10410 CU :	.
10470 CU :	.
10530 CU :	.
10590 CU :	.
10650 CU :	.
10710 CU :	.
10843 CU :	Carboniferous & Tertairy palynomprhs derived from lignite additive 10843` - 13550`
10903 CU :	.
10930 CU :	FDO persistent A. senonensis
10972 CU :	.
11053 CU :	.
11103 CU :	.
11163 CU :	.
11233 CU :	.
11283 CU :	.
11343 CU :	.
11403 CU :	C. speciosum / D. oebisfeldensis
11463 CU :	.
11523 CU :	.
11583 CU :	.
11623 CU :	.
11683 CU :	.
11743 CU :	.
11801 CU :	.
11870 CU :	.
11940 CU :	.
12000 CU :	.
12072 CU :	.
12142 CU :	.
12200 CU :	.
12262 CU :	.
12322 CU :	.
12392 CU :	.
12450 CU :	FDO P. pyrophorum
12510 CU :	.
12560 CU :	.
12570 CU :	Downhole dinocyst influx. Abundant A. senonesis & C. seciosum/striatum. P. australinum, Alisocysta spp., H. tubiferum
12650 CU :	.
12710 CU :	.
12770 CU :	.
12830 CU :	.
12900 CU :	.
12960 CU :	.
13020 CU :	.
13080 CU :	.
13140 CU :	.
13200 CU :	.
13260 CU :	.
13320 CU :	.
13380 CU :	.
13440 CU :	.
13500 CU :	.
13550 CU :	.

Micropalaeo. Comments

Depth	Comment
1780 CU :	.
1840 CU :	FDO common shell debris
1900 CU :	.
2020 CU :	.
2080 CU :	.
2140 CU :	FDO superabundant shell debris
2200 CU :	.
2250 CU :	FDO monoaxon, siliceous sponge spicule
2320 CU :	.
2380 CU :	FDO C. cf. lobatulus
2440 CU :	FDO A. guerichi
2500 CU :	FDO common B. elongata & T. alsatica, Triloculina spp., common monoaxon, siliceous sponge spicules
2560 CU :	.
2620 CU :	FDO superabundant B. elongata
2690 CU :	FDO abundant shell debris
2740 CU :	.
2810 CU :	FDO major influx shell debris
2870 CU :	.
2930 CU :	.
2990 CU :	.
3050 CU :	.
3110 CU :	.
3170 CU :	FDO M. barleeanum
3230 CU :	.
3270 CU :	Re-appearance common monoaxon, siliceous sponge spicules
3320 CU :	.
3400 CU :	.
3450 CU :	.
3520 CU :	.
3560 CU :	.
3610 CU :	.
3640 CU :	.
3680 CU :	.
3720 CU :	.
3780 CU :	.
3820 CU :	LDO influx shell debris
3860 CU :	.
3900 CU :	.
3940 CU :	.
3980 CU :	.
4020 CU :	.
4080 CU :	FDO C. dutemplei
4140 CU :	.
4180 CU :	.
4220 CU :	.
4260 CU :	FDO Geodia spp. LDO superabundant shell debris
4300 CU :	.
4340 CU :	.
4400 CU :	.
4440 CU :	.
4520 CU :	Re-appearance superabundant shell debris
4600 CU :	Reworked C. acutidorsata. Major decrease in shell debris
4640 CU :	.
4680 CU :	.
4720 CU :	.
4760 CU :	.
4800 CU :	.
4840 CU :	.
4900 CU :	.
4950 CU :	Re-appearance abundant shell debris
4990 CU :	FDO persistent A. hirtus
5030 CU :	.
5070 CU :	.
5110 CU :	.
5150 CU :	.
5210 CU :	.
5250 CU :	FDO Coscinodiscus spp.
5310 CU :	.
5350 CU :	.
5410 CU :	.
5450 CU :	.
5490 CU :	.
5530 CU :	FDO R. perforata. Re-appearance abundant shell debris
5570 CU :	.
5610 CU :	.
5650 CU :	.
5690 CU :	.
5750 CU :	.
5810 CU :	.
5870 CU :	.
5930 CU :	Re-appearance A. hirtus
5970 CU :	.
6050 CU :	.
6110 CU :	.
6170 CU :	.
6250 CU :	FDO abundant Ditrupa spp.
6330 CU :	FDO influx Ditrupa spp.
6430 CU :	FDO abundant F. antiqua, T. wittiana. Re-appearance superabundant shell debris
6500 CU :	Re-appearance influx shell debris
6560 CU :	.
6700 CU :	.
6760 CU :	.
6830 CU :	FDO A. latus, C. placenta, R. gr. discreta. Reworked C. amplectens fragment
6900 CU :	FDO C. actuidorsata, abundant C. placenta, common R. gr. discreta
6960 CU :	FDO C. morsianus var. morsianus, very common S. microtrias. Re-appearance A. hirtus, common F. antiqua
7010 CU :	FDO S. sphaerica
7070 CU :	FDO common H. walteri, R. ex gr. walteri, abundant S. microtrias
7140 CU :	FDO A. subexcavata, superabundant S. microtrias
7240 CU :	FDO C. sulzensis, C. amplectens
7320 CU :	FDO H. kirki, common echinoderm debris
7380 CU :	.
7440 CU :	FDO Plectofrondicularia sp. A, common C. amplectens & H. walteri
7520 CU :	Re-appearance influx Ditrupa spp.
7560 CU :	.
7620 CU :	FDO Lenticulina spp. Re-appearance F. antiqua
7750 CU :	FDO S. placenta
7910 CU :	FDO abundant C. amplectens
7960 CU :	Re-appearance C. morsianus var. morsianus
8020 CU :	FDO C. pauciloculata, H. porrectus
8060 CU :	FDO superabundant C. amplectens, P. irregularis
8130 CU :	.
8200 CU :	.
8260 CU :	.
8320 CU :	.
8380 CU :	.
8440 CU :	FDO common H. porrectus
8500 CU :	FDO A. peruvianus, influx C. amplectens, superbundant C. placenta, abundant H. porrectus, very common R. ex. gr. walteri, common S. sphaerica
8560 CU :	FDO A. cretaceus, abundant H. walteri & R. ex. gr. walteri, S. placenta, V. propinqua, common pyritised Cenosphaera spp.
8610 CU :	FDO E. foliaceus, abundant R. ex. gr. walteri, superabundant pyritised Cenosphaera spp. & S. microtrias
8670 CU :	FDO superabundant R. ex. gr. walteri, S. deperdita
8730 CU :	FDO Globigerina spp., D. cf. seiglei, superabundant H. walteri, Triceratium spp. Re-appearance echinoderm debris
8780 CU :	FDO N. konincki, S. spectabilis perplexa
8850 CU :	FDO C. rotundidorsata, common K. conversa, P. olszewskii, T. globigerinaeformis
8900 CU :	.
8960 CU :	FDO P. elegans
9020 CU :	FDO ?O. umbonatus, G. serpens
9080 CU :	FDO A. tangentialis, N. ewaldi, V. mexicana
9140 CU :	FDO A. subexcavata
9200 CU :	FDO common S. navarroana, superabundant C. morsianus var. morsianus, C. morsianus var. moelleri. Re-appearance superabundant S. microtrias
9260 CU :	FDO C. contraria, V. decoratus, common K. conversa, influx S. microtrias
9320 CU :	FDO common A. cretaceus, K. coniformis, abundant pyritised Cenosphaera spp.
9380 CU :	FDO common A. tangentialis, C. cf. dayi & Lenticulina spp., common C. pauciloculata, abundant S. sphaerica, V. subeocaenus
9440 CU :	FDO G. problema, G. irregularis, influx pyritised Cenosphaera spp., Hemiaulus spp.
9530 CU :	FDO G. soldanii, M. affinis, Quinqueloculina spp., Cytherella spp.
9600 CU :	FDO common G. soldanii, N. truempyi, A. pseudopaucilocula,
9650 CU :	.
9710 CU :	FDO Stilostomella spp., abundant F. antiqua
9770 CU :	FDO T. brevispira
9830 CU :	.
9900 CU :	.
9950 CU :	.
10010 CU :	FDO B. eocenicus, R. robusta, S. spectabilis trinitatensis
10060 CU :	FDO N. ewaldi, persistent B. nodosariaformis
10130 CU :	FDO common B. eocenicus
10200 CU :	.
10260 CU :	FDO common E. gerochi
10320 CU :	Re-appearance influx pyritised burrow infill. Caved S. gr. linaperta
10380 CU :	.
10440 CU :	Caved G. eocaena
10500 CU :	FDO abundant B. eocenicus, K. grzybowski
10560 CU :	FDO C. ovoidea, C. paupera
10620 CU :	FDO common S. spectabilis trinitatensis
10680 CU :	.
10740 CU :	FDO superabundant R. gr. discreta
10873 CU :	FDO V. pennatula, common echinoderm debris
10942 CU :	FDO Krithe spp.
11023 CU :	.
11083 CU :	FDO P. quinqueloba
11133 CU :	.
11193 CU :	.
11253 CU :	FDO common C. paupera
11303 CU :	FDO T. madrugensis
11373 CU :	.
11433 CU :	.
11493 CU :	.
11553 CU :	.
11603 CU :	FDO ?H. dilatata
11653 CU :	.
11713 CU :	.
11772 CU :	.
11831 CU :	.
11912 CU :	.
11972 CU :	.
12042 CU :	.
12102 CU :	.
12172 CU :	.
12232 CU :	.
12292 CU :	.
12362 CU :	.
12422 CU :	.
12480 CU :	.
12540 CU :	.
12610 CU :	FDO G. charoides
12680 CU :	.
12740 CU :	.
12800 CU :	.
12860 CU :	.
12930 CU :	FDO A. paleocenica, B. quadrata, G. gibba, N. cf. soldadoensis, S. midwayensis, common G. charoides
12990 CU :	.
13050 CU :	FDO common Geodia spp.
13130 CU :	.
13170 CU :	.
13230 CU :	.
13290 CU :	.
13340 CU :	.
13420 CU :	.
13470 CU :	LDO S. spectabilis trinitatensis
13520 CU :	.
13590 CU :	.

Well Name : NORTH LEIF I-05

RILEY GEOSCIENCE LTD

Operator : PETROCANADA et al.

Interval : 2600m - 2820m

Scale : 1:4000

Chart date: 17 May 2016

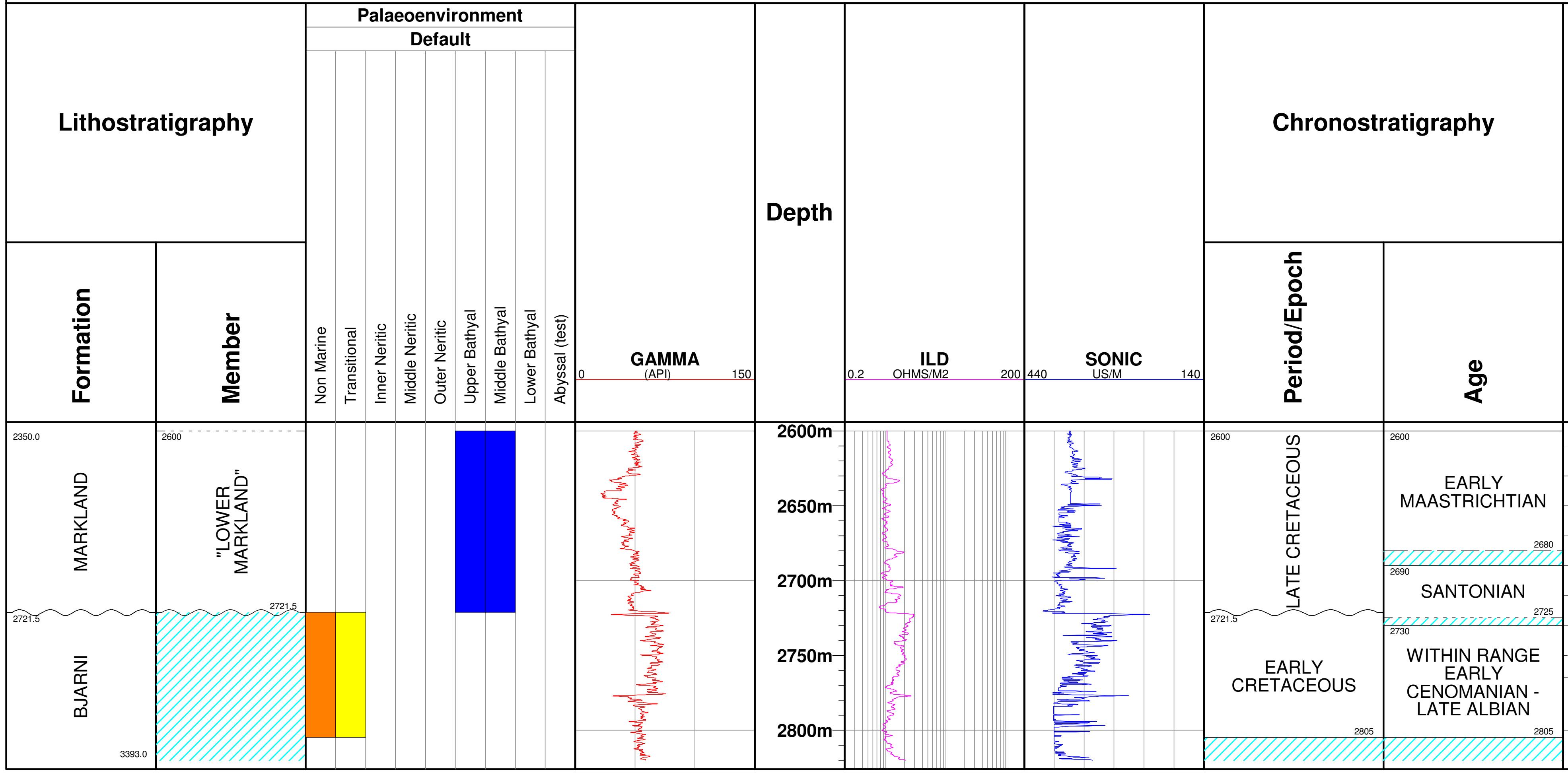
STRATIGRAPHIC SUMMARY LOG

ENCLOSURE 4

CLIENT: NALCOR ENERGY

IGD Boundary Key

- Possible
- Probable
- Confident
- Unconformable
- ?Unconformable
- Fault
- ?Fault



Palynology Comments

2610 CU :	O. operculata. Prominent Tertiary cavings
2630 CU :	C. diebelii, D. cladoides, Cass. cf. reticulata, Surculosphaeridium sp.
2650 CU :	C. diebelii, ?Odontochitina sp.
2670 CU :	C. tripartita, C. diebelii
2690 CU :	C. tripartita, C. diebelii
2710 CU :	Tanyosphaeridium sp., ?H. difficile. Downsection Cyclonephelium influx
2730 CU :	O. costata. Common Cylconephelium spp.
2750 CU :	S. longifurcatum. Abundant Cyclonephelium spp.
2765 CU :	Increased microforaminifera. S. longifurcatum, ?X. ceratoides., Florentinia sp. Common Cyclonephelium spp.
2800 CU :	Influx "flimsy" AOM. ?T. boletum

Micropalaeo. Comments

2600 CU :	Common G. messinae, R. rugosa, B. crassa, G. voltziana, L. rotulata, P. quaternaria, S. beccariiformis, S. pommerana, superabundant A. cretaceus & G. charoides, C. trinitatensis, common H. ovulum, H. trinitatensis, R. epigona
2625 CU :	FDO G. havanensis, A. cf. gracilis, B. incrassata, abundant L. rotulata, N. voorthuyseni, P. kickapooensis, P. reussi, V. lenticula, C. excelsa, D. pupa, influx G. charoides, S. jarvisi, S. navarroana
2640 CU :	FDO H. globulosa, G. pertusa, O. cordieriana, R. fissistomata, common S. dentata, T. cf. jongmansi, V. muensteri
2660 CU :	FDO common G. asperus, B. incrassata gigantea, B. draco, E. beisseli, A. obliqua, D. retusa, common Inoceramus debris
2680 CU :	Marked decrease in foraminiferid diversity
2700 CU :	FDO superabundant U. jankoi, very common sponge spicules (monoaxon, siliceous)
2725 CU :	FDO R. guttus, superabundant sponge spicules (monoaxon, siliceous)
2745 CU :	FDO R. minuta
2755 CU :	FDO Gavelinella spp., C. gigantea, T. bettenstaedti
2790 CU :	FDO major influx shell debris, rare calcitic gastropods
2805 CU :	.

Well Name : SOUTH HOPEDALE L-39

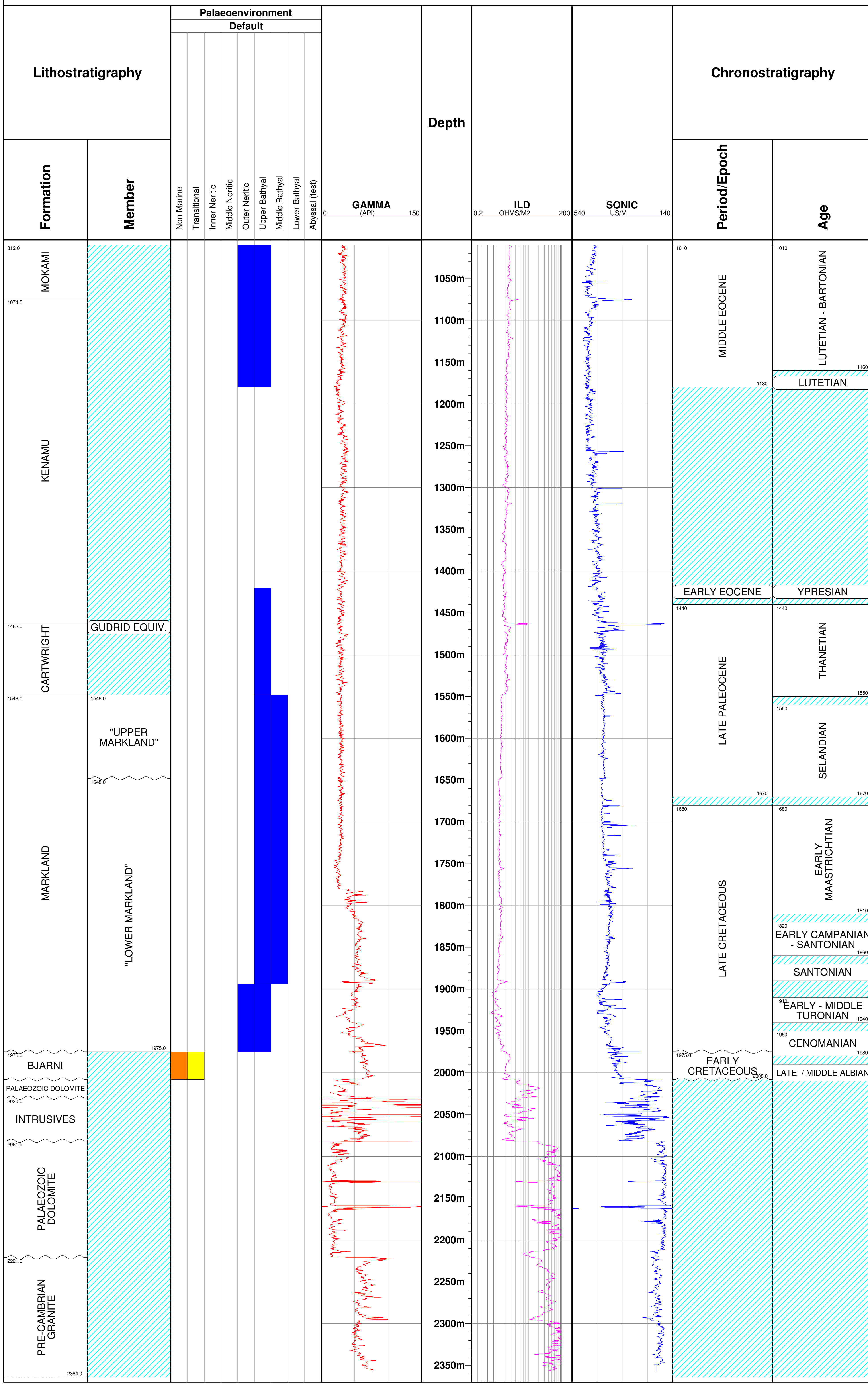
RILEY GEOSCIENCE LTD

Operator : CANTERRA et al.
Interval : 1010m - 2364m
Scale : 1:4000
Chart date: 17 May 2016

STRATIGRAPHIC SUMMARY LOG
ENCLOSURE 5

CLIENT: NALCOR ENERGY

IGD Boundary Key
- Possible
- Probable
- Confident
- Unconformable
- ?Unconformable
- Fault
- ?Fault



Palynology Comments

Depth	Comment
1010 CU :	Wetzeliella spp., C. tenuivirgula
1030 CU :	.
1050 CU :	.
1070 CU :	Common Wetzeliella spp.
1090 CU :	.
1110 CU :	Common C. tenuivirgula
1130 CU :	.
1150 CU :	.
1170 CU :	Increased C. ancyreum/placacanthum & C. diversispinosum
1420 CU :	FDO D. condylosa, C. columna. Common A. homomorphum & Palaeostomocystis sp. A
1440 CU :	Dominamt A. homomorphum
1460 CU :	Abundant A. senonensis
1480 CU :	FDO C. speciosum glabrum/D. oebisfeldensis grp.
1500 CU :	Dominant A. senonensis grp.
1520 CU :	FDO A. margarita. Abundant C. speciosum glabrum / D. oebisfeldensis grp
1540 CU :	Dominant A. margarita
1560 CU :	FDO P. pryrophorum
1580 CU :	FDO S. delitiense
1600 CU :	Common S. deltienses. P. grallator
1620 CU :	Common P. pyrophorum
1640 CU :	.
1660 CU :	Downsection reduced palynomorph recovery
1680 CU :	FDO O. operculata & ? X. ceratoides.. LDO common P. pryrophorum
1700 CU :	.
1720 CU :	FDO H. pulchrum
1740 CU :	.
1760 CU :	.
1780 CU :	.
1800 CU :	?H. difficle
1820 CU :	FDO X. alatum. C. excilicristatum
1840 CU :	.
1860 CU :	Influx Cyclonephelium spp.
1880 CU :	Abundant Cyclonephelium spp. ?O. porifera
1910 CU :	Common Cyclonephelium spp. C. dampieri
1930 CU :	Significant (reduced numbers) Cyclonephelium spp. O. porifera
1950 CU :	O. costata, F. amphora, C. dampieri, S. longicornutum
1970 CU :	O. costata, ?Ovoidinium sp.
1990 CU :	FDO V. mayi. Ovoidinium sp., O. costata
2010 CU :	V. mayi, ?O. costata
2030 CU :	Common / abundant caved Middle / Late Albian dinocysts 2030m - 2110m
2050 CU :	.
2070 CU :	,
2090 CU :	.
2110 CU :	.

Micropalaeo. Comments

Depth	Comment
1010 CU :	Wetzeliella spp., C. tenuivirgula
1020 CU :	FDO S. deperdita, common Ditrupa spp. & calcitic gastropods
1040 CU :	FDO G. soldanii, N. konincki, common Quinqueloculina spp., V. decoratus, abundant S. deperdita, superabundant Ditrupa spp.
1060 CU :	FDO A. tangentialis, C. cf. lobatulus, A. hirtus, F. antiqua, common S. microtrias
1080 CU :	FDO M. affinis
1100 CU :	FDO common M. affinis
1120 CU :	.
1140 CU :	.
1160 CU :	FDO common Lenticulina spp., N. ewaldi, N. konincki, V. cf. mexicana grammensis, common R. gr. discreta
1180 CU :	FDO B. dilatata NO SAMPLES AVAILABLE 1190m - 1410m
1430 CU :	C. amplectens, Haplophragmoides spp., S. spectabilis perplexa
1450 CU :	FDO H. kirki, R. ex. gr. walteri, S. spectabilis trinitatensis, common C. morsianus var. morsianus & S. microtrias
1470 CU :	.
1490 CU :	FDO common C. placenta
1510 CU :	.
1530 CU :	FDO A. cretaceus
1550 CU :	FDO common A. cretaceus & B. nodosariaformis, G. charoides, H. walteri, K. conversa, S. placenta, common S. spectabilis trinitatensis, T. bettenstaedti, common Cenodiscus spp., Geodia spp., sponge spicules (monoaxon, siliceous)
1570 CU :	FDO abundant H. walteri & R. gr. discreta, common S. placenta, superabundant S. spectabilis trinitatensis, abundant sponge spicules (monoaxon, siliceous)
1590 CU :	FDO C. pauciloculata, common G. charoides, G. irregularis, common H. kirki & T. bettenstaedti
1610 CU :	FDO common K. conversa, S. navarroana
1630 CU :	FDO increase A. cretaceus, Gravellina spp., superabundant H. walteri, abundant K. coniformis, common P. elegans, superabundant R. ex. gr. walteri, S. dentata
1650 CU :	FDO G. rugosa, superabundant R. gr. discreta
1670 CU :	FDO T. globigerinaeformis
1690 CU :	FDO C. ovula, R. parvula, R. epigona, R. fissistomata
1710 CU :	FDO H. ovulum, abundant K. conversa, M. varians
1730 CU :	FDO sponge spicule (monoaxon, siliceous)
1750 CU :	FDO H. excavatus, M. oxycona, influx Geodia spp., superabundant sponge spicules (monoaxon, siliceous), common sponge spicules (tri-radiate, siliceous)
1770 CU :	FDO common H. ovulum, major influx Geodia spp., influx sponge spicules (monoaxon, siliceous), superabundant sponge spicules (tri-radiate, siliceous)
1790 CU :	.
1810 CU :	FDO A. clavata, C. excelsa
1830 CU :	FDO abundant G. charoides, P. fusca, U. jankoi, abundant large sponge spicules (monoaxon, siliceous)
1850 CU :	.
1870 CU :	FDO A. problematicus, superabundant B. nodosariaformis, abundant G. stanislawi, common U. jankoi
1890 CU :	FDO superabundant G. charoides
1920 CU :	FDO common mustard brown-stained G. charoides, V. muensteri, common Innoceramus debris
1940 CU :	FDO H. brittonensis, abundant H. delrioensis & W. baltica, H. praehelvetica, common L. rotulata, superabundant Inoceramus debris
1960 CU :	.
1980 CU :	.
2000 CU :	.
2020 CU :	.