BIOSTRATIGRAPHY AND MATURATION OF 17 LABRADOR AND BAFFIN SHELF WELLS

Volume 8:
Roberval K-92 & Rut H-11

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EXPLANATION OF CONTENTS

This volume contains the following results of analyses on Roberval K-92 and Rut H-11.

1. **General drilling information**

2. **Consensus Age**

   The consensus age based on micropaleontology (M) and palynology (P).

3. **Palynological Results**

   The palynological zones and assigned ages in order of increasing depth within each well. The more important taxa are listed alphabetically, with miospores and fungal spores being denoted by an asterisk (*). Marker species are highlighted in bold type. The degree of confidence is given for each zonal assignment as follows:

   "4" The highest degree of confidence regarding both the zonal assignment and the sample level to which the top of the zone is assigned.

   "3" A high degree of confidence regarding the zonal assignment, but including the possibility that the zonal assignment may be slightly too low.

   "2" Indicates that the zonal asignment is probably correct but that the sample level indicated for the top of the zone is probably too low due to a scarcity of marker species.

   "1" A highly tentative zonal assignment due to extreme scarcity of marker species.

4. Micropaleontological Results

The micropaleontological zones and assigned ages in order of increasing depth. Within each zone the more important taxa are listed alphabetically with planktonic foraminiferal species being denoted by an asterisk (*) and diatom species by a cross (+). Marker species are highlighted in bold type. The degree of confidence is given for each zonal assignment as follows:

"4" The highest degree of confidence regarding both the zonal assignment and the sample level to which the top of the zone is assigned. This degree of confidence indicates the presence of planktonic foraminifera together with the main benthonic foraminiferal markers.

"3" A high degree of confidence regarding the zonal assignment. Indicates the presence of the main benthonic foraminiferal markers.

"2" Indicates that the zonal assignment is most probably correct. The assignment is based only on taxa occurring commonly within the zone, due to the scarcity of marker species.

"1" A tentative zonal assignment. Based solely on stratigraphic position due to extreme scarcity of marker species.

5. Paleobathymetric Interpretations

The interpreted paleobathymetries are in order of increasing depth, together with the criteria upon which they are based. The interpreted environments and corresponding paleobathymetries reported are: Non-marine (above sea level), Transitional (approx. 0m), Inner Neritic (approx. 0-20m), Middle Neritic (approx. 20-100m), Outer Neritic (approx. 100-200m), Upper Bathyal (approx. 200-1000m), and Lower Bathyal (>1000m).

6. Kerogen, TAI and Vitrinite Reflectance

Data on kerogen types and TAI are listed in a table, and are then discussed relative to petroleum source rock potential and the consensus ages assigned in this report. Data on vitrinite reflectance are listed and are discussed relative to their degree of reliability and indicated maturation level.

All references are given in Volume 1 of the report.

The following charts are included for each well:

1. A Palynological Summary Chart showing the assigned palynological zones, inferred ages, lithology, formational assignments provided by P.N. Moir, studies in progress, important palynological events (mostly species tops).

2. Sawtooth diagrams showing the relative abundances of the following palynological categories: Apectodinium homomorphum, Areoligera senonensis, marine dinoflagellates, Azolla, Pediastrum, gymnosperm pollen, angiosperm pollen, miospores, Late Cretaceous reworking, Early Cretaceous reworking.

3. A Micropaleontological Summary Chart showing the assigned micropaleontological zones, inferred ages, lithology, important micropaleontological events (mostly species tops), paleobathymetry.

4. A Kerogen Summary Chart showing the consensus ages, levels of Thermal Alteration (TAI), relative abundances of kerogen types.

5. A Vitrinite Summary Chart showing the consensus ages, histograms of the vitrinite reflectance measurements which are divided into three categories: caved (blue), in situ (green) and reworked (red). The in situ category is further subdivided into poor readings (horizontal lines) and good to excellent reading (solid colour). The means of the three main categories are indicated by correspondingly coloured triangles.

Roberval K-92:

BIOSTRATIGRAPHY AND MATURATION OF

ROBERVAL K-92

TOTAL EASTCAN et al. ROBERVAL K-92

GSC locality: 54° 51' 35.528"N, 55° 44' 35.762"W
KB elevation: 12.5m Water depth: 268.5m
Casing set at: 318.9m, 615.7m, 1665.4m, 2770.3m, 3201m
Total depth: 3874m
Interval studied for palynology: 635-3870m
Interval studied for micropaleontology: 635-3430m

CONSENSUS AGE

635- 645m	late Oligocene or older (P)
665- 735m	early Oligocene (P)
755-1890m	late Eocene (M)
1910-2190m	middle Eocene (P)
2210-2670m	early Eocene (M,P)
2690-2790m	early Paleocene (P)
2810-2950m	Maastrichtian (P)
2970-3040m	Campanian (P)
3060-3070m	Santonian (P)
3090-3130m	early Cenomanian to late Albian (P)
3150-3160m	middle Albian (P)
3180-3188m	early to middle Albian (P)
3188-3870m	no age assignment

ROBERVAL K-92

PALYNOLOGICAL ZONATION

635- 645m Chiropteridium mespilanum Zone or older (late Oligocene or older)

665-1455m Areosphaeridium arcuatum Zone (early Oligocene)

1475-1605m Deflandrea #LR Zone (late Eocene to early Oligocene)

1625-1890m Areosphaeridium fenestratum Zone (middle to late Eocene)

1910-2190m Eocladopyxis #LA Zone (middle Eocene)

2210-2310m Trinovantedinium #LA Zone (early Eocene)

2330-2670m Dracodinium condylos Zone (early Eocene)

Not observed Ceratiopsis speciosa Zone (late Paleocene)

Not observed Alisocysta circumtabulata Zone (late Paleocene)

Not observed Palaeoperidinium pyrophorum Zone (early Paleocene)

2690-2790m Spongodinium #LA Zone (early Paleocene)

2810-2860m Spongodinium delitiense Zone (Maastrichtian)

2880-2890m Impagidinium #LL Zone (Maastrichtian)

2910-2950m *Isabelidinium cooksoniae* Zone (Maastrichtian)

2970-3040m *Chatangiella tripartita* Zone to possible *Palaeohystrichophora infusorioides* Zone (?early to late Campanian)

3060-3070m *Surculosphaeridium longifurcatum* Zone (Santonian)

Not observed *Cometodinium obscurum* Zone (Turonian to Coniacian)

Not observed *Kiokansium polypes* Zone (Cenomanian)

3090-3130m *Epelidosphaeridia spinosa* Zone (early Cenomanian to late Albian)

3150-3160m *Trilobosporites humilis* Zone (middle Albian)

Not observed *Parvisaccites amplus* Zone (early to middle Albian)

3180-3188m *Muderongia asymmetrica* Zone (early to middle Albian)

Not observed *Oligosphaeridium asterigerum/Pilosisporites trichopapillosus* Zone (late Aptian)

Not observed *Pseudoceratium pelliferum* Zone (Berremian to early Aptian)

Not observed *Cicatricosisporites* #EAL Zone (Barremian to early Aptian)

3188-3870m No zonal assignment (no age assignment)

SELECTED PALYNOMORPHS

635-645m: Chiropteridium mespilanum Zone or older (late Oligocene or older)

635m
- Ceratiacean #LA
- **Chiropteridium mespilanum**
- Cribroperidinium giuseppei
- Lingulodinium machaerophorum
- **Membranophoridium aspinatum**
- Osmundacidites claytonites *
- Tsugaepollenites igniculus *

Degree of Confidence: 3

Remarks: The occurrences of C. mespilanum and M. aspinatum at 635-645m provide strong evidence for the presence of Oligocene strata. However, it is possible that this sample is early Oligocene and that markers for the A. arcuatum Zone were not observed.

665-1455m: Areosphaeridium arcuatum Zone (early Oligocene)

665m
- **Areosphaeridium arcuatum**
- Caryapollenites simplex *
- Lycopodiumsporites annotinioides *
- **Tiliaepollenite crassipites** *

695m
- Deflandrea phosphoritica
- **Glaphyrocysta texta**
- **Cyclonephelium** sp. E, Williams & Brideaux 1975

725m	**Lentinia serrata** Selenopemphix nephroides
815m	**Cyclonephlium sp. B, Williams & Brideaux 1975** **Rouseisporites #LA ***
965m	Pterocaryapollenites stellatus *
1175m	**Quercoidites #LA ***
1445m	**Phthanoperidinium comatum**

Degree of Confidence: 3

1475-1605m: Deflandrea #LR Zone (late Eocene to early Oligocene)

1475m	**Paralecaniella indentata (common)**
1505m	Cicatricosisporites paradorogensis * **Phthanoperidinium alectrolophum**
1535m	Diervillapollenites echinatus *
1565m	Alnipollenites verus * Hystrichokolpoma rigaudiae
1595m	**Glaphyrocysta spineta**

Degree of Confidence: 2

Remarks: Although the palynomorph P. indentata appears to range into the early Miocene on the Labrador Shelf, its common occurrence suggests penetration of the Deflandrea #LR zone. This is supported by the dinoflagellate P. alectrolophum at 1505-1525m.

1625-1890m: Areosphaeridium fenestratum Zone (middle to late Eocene)

1625m	**Micrhystridium fragile (abundant)**
1700m	Corylus #LA *
	Carpinipites #LA *
	Chiropteridium #LS *
	Faguspollenites #LA *
	Quercoidites #LG *
	Quercoidites #LA * (common)
1820m	Systematophora placacantha

Degree of Confidence: 3

Remarks: The occurrence of abundant specimens of M. fragile at 1625-1645m provides good evidence for the penetration of the A. fenestratum Zone, even though the marker Chiropteridium #LS which usually characterizes this zone was not observed in the well.

1910-2190m: Eocladopyxis #LA Zone (middle Eocene)

1910m	Cordosphaeridium inodes
	Dinopterygium cladoides

Lentinia wetzelii
Wetzeliella articulata

1940m Gochtodinium simplex
Hystrichokolpoma salacium
Hystrichokolpoma unispinum
Kisselovia crassiramosa
Wetzeliella ovalis

1970m Kisselovia tenuivirgula

2180m **Systematophora #LE**

Degree of Confidence: 2

Remarks: The occurrence of L. wetzelii at 1910-1930m tentatively indicates penetration of the Eocladopyxis #LA Zone. Most of the palynomorphs observed in this interval range into younger strata.

2210-2310m: Trinovantedinium #LA Zone (early Eocene)

2210m **Horologinella #LA**
Systematophora #LC
Trinovantedinium #LL

2240m Ceratiopsis pannucea
Dapsilidinium pastielsii
Homotryblium tenuispinosum
Homotryblium pallidum
Kisselovia edwardsii

Kisselovia coleothrypta
Trinovantedinium #LA
Wetzeliella meckelfeldensis

2270m **Trinovantedinium #LS**
Momipites coryloides *

2300m Cordosphaeridium fibrospinosum

Degree of Confidence: 4

2330-2670m: Dracodinium condylos Zone (early Eocene)

2330m **Dracodinium condylos**
Heteraulacacysta leptalea

2360m Homotryblium oceanicum
Punctodiporites sp. A, Rouse 1977 *

2450m Apectodinium homomorphum
Areoligera senonensis
Diphyes colligerum
Deflandrea oebisfeldensis
Polysphaeridium subtile

2480m Ceratiopsis speciosa glabra (?reworked)
Hystrichokolpoma #LP

2510m Apectodinium homomorphum (common)
Apectodinium hyperacanthum
Alisocysta circumtabulata (?reworked)

2540m **Isabelidinium #LP**

2630m Hystrichosphaeridium tubiferum brevispinum

Degree of Confidence: 3

Remarks: The occurrence of D. condylos at 2330-2350m indicates penetration of the D. condylos Zone, but the sporadic occurrence of this dinoflagellate suggests that the zonal boundary may be slightly too low at 2330-2350m. Isabelidinium #LP which is also a marker for the D. condylos Zone was not observed in the well above 3540-3560m. The Paleocene palynomorphs C. speciosa glabra and A. circumtabulata were observed in the middle part of this intervaland one interpreted as being reworked. If they are in place they would indicate the presence of upper Paleocene strata of the C. speciosa Zone at 2480-2500m and of upper Paleocene strata of the A. circumtabulata Zone at 2510-2530m.

2690-2790m: Spongodinium #LA Zone (early Paleocene)

2690m Chatangiella cf. biapertura (?reworked)
Palaeoperidinium pyrophorum
Spongodinium #LA

2720m Ceratiopsis striata
Hystrichosphaeridium tubiferum

2750m Eisenackia crassitabulata

2780m Palaeocystodinium lidiae
Prolixosphaeridium xanthiopyxides

Degree of Confidence: 3

Remarks: Penetration of the Spongodinium #LA Zone is indicated at 2690-2710m by the occurrence of Spongodinium #LA. Species of Trithyrodinium which are also markers for this zone were not observed in this interval, but do occur abundantly in the underlying section at 2810-2830m where they are considered to have depressed tops. A tentatively identified specimen of C. biapertura at 2690-2710m is interpreted to be reworked from the Maastrichtian.

2810-2860m: Spongodinium delitiense Zone (Maastrichtian)

2810m	Apectodinium senonensis (abundant)
	Ceratiopsis diebelii
	Spongodinium delitiense
	Trithyrodinium evittii (abundant)
2840m	Gonyaulacysta wetzelii

Degree of Confidence: 3

2880-2890m: Impagidinium #LL Zone (Maastrichtian)

2880m	Ceratiopsis diebelii sensu McIntyre 1975
	Impagidinium #LL
	Manumiella cretacea
	Phelodinium tricuspe
	Trithyrodinium #LS

Degree of Confidence: 3

2910-2950m: Isabelidinium cooksoniae Zone (Maastrichtian)

2910m **Amphidiadema nucula**
Cyclonephelium distinctum
Palaeocystodinium australinum
Palaeoperidinium basilium
Phelodinium magnificum

Degree of Confidence: 2

Remarks: The occurrence of A. nucula suggests penetration of the I. cooksoniae Zone, although this species may range into the overlying Impagidinium #LL Zone on the Labrador Shelf.

2970-3040m: Chatangiella tripartita Zone to possible Palaeohystrichophora infusorioides Zone (?early to late Campanian)

2970m Isabelidinium korojonense
Palambages

3030m Palynodinium grallator

Degree of Confidence: 1

Remarks: Penetration of the Campanian strata is highly tentative, being based on the genus Palambages whose stratigraphic range is uncertain on the Labrador Shelf.

3060-3070m: Senoniasphaera rotundata Zone (Santonian)

3060m Surculosphaeridium longifurcatum
Spinidinium sverdrupianum

Degree of Confidence: 2

Remarks: Penetration of the Santonian S rotundata Zone is tentatively indicated by the occurrence by the dinoflagellate S. sverdrupianum, whose stratigraphic range is uncertain on the Labrador Shelf.

3090-3130m: Epelidosphaeridia spinosa Zone (early Cenomanian to late Albian)

3090m	**Aptea eisenackii**
	Epelidosphaeridia spinosa
	Plicatella problematica *
3120m	Asteropollis #LA *
	Densoisporites microrugulatus *

Degree of Confidence: 3

Remarks: A marked hiatus occurs between 3070m and 3090m, indicating the removal or non-deposition of the greater part of the Cenomanian to Coniacian section. Penetration of the Epelidosphaeridia spinosa Zone is indicated at 3090-3110m by the presence of E. spinosa.

3150-3160m: Trilobosporites humilis Zone (middle Albian)

3150m	**Cicatricosisporites hughesii** *
	Clavatipollenites hughesii *
	Platysaccus megasaccus *
	Tigrisporites scurrundus *
	Rugubivesiculites rugosus *

Degree of Confidence: 4

Remarks: Penetration of the Trilobosporites humilis Zone is indicated by the highest occurrence of T. scurrundus at 3150-3170m.

3180-3188m: Muderongia asymmetrica Zone (early to middle Albian)

3180m Cedripites canadensis
Muderongia asymmetrica
Parvisaccites amplus

Degree of Confidence: 4

Remarks: Penetration of the Muderongia asymmetrica Zone is indicated by the highest occurrence of M. asymmetrica in the sample at 3180-3200m. A condensed section or hiatus is suggested between 3160m and 3180m. This interval may represent the P. amplus Zone which is not recognized in this well. The marker species P. amplus occurs concurrently with M. asymmetrica.

3188-3870m: No zonal assignment (no age assignment)

3240m **Oligosphaeridium asterigerum**
Distaltriangulisporites maximus *

3270m **Aptea anaphrissa**
Nummus monoculosus

3550m *Podocarpidites epistriatus* * (caved)

Remarks: No zonal assignment is made for the section below 3188m due to the high probability of cavings from above the basalt. The marker species *O. asterigerum* occurs at 3240-3260m which suggests the presence of the *O. asterigerum/P. trichopapillosus* Zone (late Aptian), may have been caved from sediments immediately above the basalt or alternatively present in intercalated shales within the basalt flows.

MICROPALEONTOLOGICAL ZONATION

Not observed	Cassidulina teretis Zone (late Miocene or younger)
635- 675m.	Asterigerina guerichi Zone (early Miocene or older)
695- 735m	Asterigerina bartoniana Zone (late Oligocene)
755-1710m	Spiroplectammina adamsi Zone (late Eocene)
1730-2040m	Cyclammina amplectens Zone (late Eocene)
2060-2290m	Haplophragmoides acutidorsatum Zone (middle Eocene)
2210-2220m	Bulimina ovata Zone (early Eocene)
2240-2460m	Karreriella apicularis Zone (early Eocene)
2480-2670m	Spiroplectammina grzybowski Zone (early Eocene)
2690-2760m	Glomospira charoides Zone (late Paleocene)
2780-2950m	Glomospira corona Zone (early Paleocene)
Not observed	Praecystammina globigerinaeformis Zone (early Paleocene)
2970-3010m	Rzehakina epigona Zone (Maastrichtian)
3030-3100m	Arenobulimina dorbigny Zone (?Campanian)

3120-3160m possible Arenobulimina dorbigny Zone (possible upper Cretaceous)

3180-3430 No zonal assignment (No age assignment)

SELECTED FORAMINIFERA

635-675m: Asterigerina guerichi Zone (early Miocene or older)

635m **Asterigerina guerichi**
Elphidium antoninum

665m Globigerina bulloides * (caved)
Trifarina abbreviata
Melonis affinis
Neogloboquadrina pachyderma * (caved)
Cassidulina subglobosa

Degree of Confidence: 3

695-735m: Asterigerina bartoniana Zone (late Oligocene)

695m **Turrilina alsatica**
Buliminella elongata
Coscinodiscus #H 1 +

Degree of Confidence: 2

755-1710m: Spiroplectammina adamsi (late Eocene)

755m **Spiroplectammina adamsi**
Globigerina angustimbilicata *
Ceratobulimina contraria
Eponides plummerae

785m Guttulina problema

815m	Pullenia quinqueloba
845m	**Coscinodiscus** #H 2 +
875m	**Heterolepa dutemplei**
1055m	Baggina subconica
1175m	Cibicides proprius Globulina gibba
1355m	Alveolophragmium sp. **Haplophragmoides walteri** Gyroidinoides girardana
1415m	Bathysiphon discreta Cyclammina placenta **Cribrostomoides subglobosus** **Recurvoides walteri** Trochammina irregularis
1535m	**Haplophragmoides eggeri** Trochammina deformis
1595m	**Globigerina linaperta** * Ammodiscus cretaceus **Trochammina globigeriniformis**
1625m	Cyclammina cancellata
1665m	CASING

1700m **Nodosaria latejugata**
Dentalina inornata

Degree of Confidence: 3

1730-2040m: Cyclammina amplectens Zone (late Eocene)

1730m **Cyclammina amplectens**
Cribrostomoides scitulus

1790m **Stilostomella midwayensis**

1880m Karreriella siphonella

Degree of Confidence: 3

2060-2290m: Haplophragmoides acutidorsatum Zone (middle Eocene)

2060m **Haplophragmoides acutidorsatum**

2120m Saccammina sphaerica

2150m Ammodiscus peruvianus
Reophax pilulifer

2180m **Budashevaella multicamerata**

Degree of Confidence: 3

2210-2220m: Bulimina ovata Zone (early Eocene)

2210m **Bulimina ovata**
Bulimina trigonalis
Nodosaria minor

Degree of Confidence: 3

2240-2460m: Karreriella apicularis Zone (early Eocene)

2240m **Ammodiscus glabratus**
Karreriella apicularis

2270m **Chilostomella cylindroides**
Lenticulina midwayensis

2300m Spiroplectammina cf. eocenica

2390m Spiroplectammina navarroana

2420m **Ammobaculites expansus**

Degree of Confidence: 3

2480-2670m: Spiroplectammina grzybowski Zone (early Eocene)

2480m **Spiroplectammina grzybowski**
Planorotalites planoconicus
Alabamina wolterstorfi

2600m Siphogenerinoides plummerae

2660m **Ammobaculites polythalamus**

Degree of Confidence: 3

2690-2760m: Glomospira charoides Zone (late Paleocene)

2690m **Glomospira charoides**
Plectofrondicularia lirata

2720m Dorothia sp.
Rhizammina indivisa
Ammodiscus glabratus

2750m **Spirosigmoilinella compressa**

2770m CASING

Degree of Confidence: 3

2780-2950m: Glomospira corona Zone (late Paleocene)

2780m **Glomospira corona**
Dentalina colei
Textularia agglutinans

2880m Lagena globosa

2940m **Hormosina ovulum**

Degree of Confidence: 3

2970-3010m: Rzehakina epigona Zone (Maastrichtian)

2970m	**Rzehakina epigona** **Glomospira irregularis** Cibicidoides mirificus
3000m	Acarinina cf. densa * **Dorothia oxycona** Pleurostomella paleocenica **Haplophragmoides cf. suborbicularis**

Degree of Confidence: 3

3030-3100m: Arenobulimina dorbigny Zone (Campanian)

3030m	**Arenobulimina dorbigny** Uvigerinammina jankoi S. compressa Glomospirella sp.
3090m	Trochamminoides subtrullisatus

Degree of Confidence: 3

3120-3160m: possible Arenobulimina dorbigny Zone (possible upper Cretaceous)

3120m	Gavelinella micra

Degree of Confidence: 1

3180-3430m: No zonal assignment (No age assignment)

3201m CASING

PALEOBATHYMETRY

635- 645m Inner Neritic
Criteria: Asterigerina guerichi, Elphidium antonium

665-1395m Middle Neritic
Criteria: Melonis affinis, Coscinodiscus spp., Gyroidinoides spp.

1415-1575m Outer Neritic
Criteria: Bathysiphon discreta, Cribrostomoides subglobosus, Recurvoides walteri, Trochammina deformis

1595-1710m Outer Neritic to Upper Bathyal
Criteria: Trochammina globigeriniformis, Globigerina linaperta, Cyclammina cancellata

1730-2670m Upper Bathyal
Criteria: Cyclammina amplectens, Reophax pilulifer, Karreriella apicularis, Ammobaculites polythalamus, Chilostomella cylindroides, Budashevaella multicamerata, Ammodiscus glabratus

2690-3010m Lower Bathyal
Criteria: Glomospira spp., Plectofrondicularia lirata, Rhizammina indivisa, common Ammodiscus glabratus,

3030-3070m Outer Neritic to Upper Bathyal
Criteria: Decrease in diversity and abundance, Arenobulimina dorbigny, Spirosigmoidinella compressa

3090-3190m Inner Neritic to Middle Neritic
Criteria: Increase in abundance and diversity of spores and pollen, caved foramininifera?

KEROGEN & TAI

Depth	AM	AT	AG	SA	M	BT	ST	I	R	TAI
1730.0	40	20	0	5	5	10	15	5	0	2-
1850.0	40	25	0	0	5	10	15	5	0	2-
1970.0	45	30	0	0	5	5	10	5	0	2-
2060.0	40	35	0	0	5	5	10	5	0	2-2
2180.0	35	30	0	5	10	5	10	5	0	2-2
2300.0	35	35	0	0	5	10	10	5	0	2-2
2390.0	35	35	0	0	10	10	10	5	0	2-2
2510.0	35	30	0	5	10	5	10	5	0	2-2
2630.0	35	30	0	5	10	5	10	5	0	2-2
2720.0	40	25	0	0	10	5	10	10	0	2-2
2840.0	0	0	0	5	10	10	50	25	0	2+
2940.0	5	0	0	0	10	10	50	25	0	2+
3000.0	0	0	0	0	5	20	50	25	0	2+
3120.0	0	0	0	0	5	15	60	20	0	2+
3210.0	5	0	0	5	5	15	50	20	0	2+
3325.0	5	10	0	0	5	20	40	20	0	2+
3450.0	5	5	0	5	5	20	35	25	0	2+
3550.0	0	0	0	0	5	20	40	35	0	2+3-
3670.0	0	0	0	0	5	20	40	35	0	2+3-
3760.0	0	0	0	0	10	20	35	25	0	2+3-
3825.0	0	0	0	0	5	25	45	20	0	3-
3860.0	0	0	0	0	5	25	40	30	0	3-
3870.0	0	0	0	0	5	25	40	30	0	

KEROGEN, TAI AND VITRINITE REFLECTANCE

No slides were available for kerogen analysis in this well from 635-1730m. The interval from 1730-2720m of Maastrichtian to late Eocene age contains 60% to 75% amorphous kerogen including from 35% to 45% marine amorphous material. Herbaceous kerogen comprises from 10% to 20% and woody kerogen comprises from 10% to 15% of the total kerogen. Inertinitic coaly kerogen generally comprises 5% of the total kerogen content. The interval from 2840-3000m of Campanian to Maastrichtian age contains no amorphous kerogen, woody kerogen comprising 50%, coaly inertinitic kerogen comprising 25%, and herbaceous kerogen comprising approximately 25% of the total kerogen. The Lower Cretaceous section below 3090m comprises 5% to 15% amorphous kerogen between 3210-3450m, including 5% marine amorphous material. Coaly inertinitic kerogen is relatively common, reaching a peak of 35% between 3550-3670m. Woody kerogen comprises 35% to 60% and herbaceous kerogen comprises 20% to 30%.

The level of Thermal Alteration increases from a value of 2^- at 1730m, to 2^- to 2 below 2060m in strata of middle Eocene age. A value of 2+ is reached at 2840m in the Maastrichtian, and a value of 2+ to 3^- or greater below 3550m in the lowest part of the well which was not assigned an age due to lack of fossils. The level of Thermal Alteration and kerogen types indicate some source rock potential for thermogenic liquid hydrocarbons from the marine amorphous material below 2060m, and some source rock potential for predominantly gaseous thermogenic hydrocarbons below 2840m from the herbaceous and woody kerogen types.

The following levels of thermal maturity are indicated by vitrinite reflectance analysis.

655-1230m: Onset of maturation or 100% reworking (Ro% = 0.395% to 0.594%)
1430-2210m: Immature (Ro% = 0.301% to 0.354%)
2410-3000m: Onset of maturation (Ro% = 0.420% to 0.596%)
3200-3870m: Mature (Ro% = 0.617% to 0.836%)

The upper portion of the well between 655m and 1230m contains abundant reworking. The lowest values of vitrinite are high relative to those deeper in the well and may also represent reworking. High populations of reworked material occur throughout the well obscuring the in situ populations.

VITRINITE REFLECTANCE

Key to Measurement Qualifying Labels

E = Excellent
= Good
P = Poor
C = Caved
R = Reworked

Sample Depth : 655.0

0.343		0.347		0.348		0.369	P	0.374	P	0.399		0.419	
0.446		0.448		0.462		0.482		0.501		0.508	E	0.517	E
0.535	E	0.536	E	0.556	E	0.610	R	0.612	R	0.662	R	0.665	R
0.848	R	1.100	R										

Actual Mean = 0.526 Actual Standard Deviation = 0.176

Edited Mean = 0.446 Edited Standard Deviation = 0.073

Sample Depth : 840.0

0.429		0.435		0.469	P	0.470	P	0.498	P	0.498		0.500	
0.532		0.534		0.543		0.607	R	0.665	R	0.728	R	0.736	R
0.813	R	0.839	R	1.340	R	1.352	R	1.360	R	1.470	R	1.474	R
1.771	R	1.772	R										

Actual Mean = 0.862 Actual Standard Deviation = 0.460

Edited Mean = 0.491 Edited Standard Deviation = 0.040

Sample Depth : 1040.0

0.298	C	0.402	C	0.475	P	0.506		0.533		0.536	P	0.540	
0.543	E	0.565		0.610	E	0.622		0.653		0.663		0.675	
0.690	P	0.699		0.733	R	0.776	R	0.805	R	0.820	R	0.830	R
0.850	R	0.921	R	1.267	R	1.504	R						

Actual Mean = 0.701 Actual Standard Deviation = 0.256

Edited Mean = 0.594 Edited Standard Deviation = 0.074

Sample Depth : 1230.0

0.189	C	0.248	P	0.257	E	0.278		0.340	P	0.377	E	0.420	P
0.452	P	0.485	P	0.486		0.495	P	0.505		0.519	R	0.533	R
0.533	R	0.549	R	0.557	R	0.560	R	0.595	R	0.596	R	0.647	R
0.650	R	0.668	R	0.673	R	0.679	R	0.683	R	0.730	R	0.750	R
0.758	R	0.760	R	0.777	R	0.840	R	0.840	R	0.850	R	0.914	R
0.934	R	0.966	R										

Actual Mean = 0.597 Actual Standard Deviation = 0.199

Edited Mean = 0.395 Edited Standard Deviation = 0.100

Sample Depth : 1430.0

0.245		0.265		0.265		0.287	E	0.300		0.313		0.330	
0.340		0.363	P	0.496	R	0.512	R	0.522	R	0.532	R	0.543	R
0.546	R	0.568	R	0.596	R	0.613	R	0.617	R	0.630	R	0.741	R
0.850	R	0.894	R	1.020	R	1.213	R						

Actual Mean = 0.544 Actual Standard Deviation = 0.250

Edited Mean = 0.301 Edited Standard Deviation = 0.039

Sample Depth : 1620.0

0.314	P	0.375		0.410		0.473		0.491		0.506		0.513	
0.537	R	0.552	R	0.577	R	0.600	R	0.624	R	0.646	R	0.673	R
0.691	R	0.707	R	0.739	R	0.744	R	0.804	R	0.818	R	0.850	R
0.955	R	0.967	R										

Actual Mean = 0.633 Actual Standard Deviation = 0.175

Edited Mean = 0.440 Edited Standard Deviation = 0.076

Sample Depth : 1820.0

0.147	C	0.210	C	0.216	C	0.221	C	0.228	C	0.255	E	0.262	P
0.263	E	0.266	E	0.268	E	0.272	E	0.274	E	0.277	E	0.291	
0.296	E	0.307	E	0.320	E	0.327	E	0.332		0.339	E	0.355	
0.363	E	0.365		0.376	E	0.377		0.378	E	0.390	E	0.417	
0.423		0.436	E	0.441	E	0.444	E	0.450	E	0.479	R	0.640	R
0.740	R	0.810	R	1.352	R	1.378	R	1.386	R	1.519	R	1.562	R
1.729	R												

Actual Mean = 0.516 Actual Standard Deviation = 0.419

Edited Mean = 0.342 Edited Standard Deviation = 0.064

Sample Depth : 2020.0

0.153	C	0.174	C	0.199	C	0.222	C	0.267	C	0.305	C	0.345	
0.357		0.373	E	0.390		0.422	E	0.455		0.458		0.478	E
0.503	E	0.618	R	0.793	R	1.103	R	1.292	R	1.380	R		

Actual Mean = 0.514 Actual Standard Deviation = 0.358

Edited Mean = 0.420 Edited Standard Deviation = 0.057

Sample Depth : 2210.0

0.214	C	0.235	C	0.243	C	0.246	C	0.260	C	0.272	C	0.286	C
0.317	E	0.318	E	0.322		0.330	E	0.360	E	0.373	P	0.377	E
0.381	E	0.410	E	0.502	R	0.536	R	0.548	R	0.565	R	0.792	R
1.010	R	1.048	R	1.613	R								

Actual Mean = 0.482 Actual Standard Deviation = 0.331

Edited Mean = 0.354 Edited Standard Deviation = 0.034

Sample Depth : 2410.0

0.247	C	0.264	C	0.274	C	0.275	C	0.278	C	0.278	C	0.288	C
0.298	C	0.298	C	0.316	C	0.316	C	0.331	P	0.336		0.342	
0.359		0.360	E	0.374		0.376	E	0.376		0.380	E	0.380	
0.382	E	0.399		0.403		0.404	E	0.405		0.416		0.431	
0.438		0.440		0.444		0.457	E	0.459		0.474	E	0.478	E
0.483	E	0.493		0.511	E	0.525	E	0.529	E	0.550	R	0.617	R
0.648	R	0.670	R	0.726	R	0.760	R	0.762	R	0.770	R	0.804	R
1.842	R												

Actual Mean = 0.469 Actual Standard Deviation = 0.246

Edited Mean = 0.420 Edited Standard Deviation = 0.057

Sample Depth : 2600.0

0.284	C	0.303	C	0.324	P	0.446	P	0.517		0.528		0.528	P
0.560	P	1.087	R										

Actual Mean = 0.509 Actual Standard Deviation = 0.242

Edited Mean = 0.484 Edited Standard Deviation = 0.087

Sample Depth : 2800.0

0.207	C	0.296	C	0.302	C	0.332	E	0.340		0.356		0.384	
0.387		0.437		0.490	E	0.495		0.496	E	0.497	E	0.523	E
0.533	E	0.542	E	0.562	E	0.852	R	0.986	R	1.302	R	1.638	R

Actual Mean = 0.569 Actual Standard Deviation = 0.352

Edited Mean = 0.455 Edited Standard Deviation = 0.080

Sample Depth : 3000.0

0.100	C	0.262	C	0.285	C	0.332	C	0.357	C	0.462	P	0.466	E
0.518		0.526	E	0.564		0.572	E	0.572	E	0.580	E	0.580	E
0.625		0.636	E	0.640	E	0.665	E	0.669		0.726	E	0.735	
0.790	R	0.800	R	0.825	R	0.841	R	0.848	R	0.861	R	0.870	R
0.893	R	0.893	R	0.920	R	0.936	R	0.946	R	0.957	R	0.976	R
0.996	R	1.010	R	1.015	R	1.056	R	1.112	R	1.126	R	1.310	R
1.336	R	1.357	R	1.417	R	1.420	R	1.471	R	1.577	R	1.587	R
1.717	R												

Actual Mean = 0.855 Actual Standard Deviation = 0.371

Edited Mean = 0.596 Edited Standard Deviation = 0.081

Sample Depth : 3200.0

0.350	C	0.427	C	0.433	C	0.451	C	0.535	E	0.536	E	0.552	
0.559		0.561		0.582		0.586	P	0.587	P	0.592	E	0.640	E
0.652	P	0.708	E	0.713		0.720		0.728		0.766	R	0.777	R
0.817	R	0.840	R	0.887	R	0.990	R	1.040	R	1.090	R	1.270	R
1.308	R	1.340	R	1.344	R								

Actual Mean = 0.754 Actual Standard Deviation = 0.281

Edited Mean = 0.617 Edited Standard Deviation = 0.071

Sample Depth : 3380.0

0.448	C	0.460	C	0.563		0.586	E	0.590	E	0.680	E	0.740	E
0.767		0.852		0.889		1.029	R	1.149	R	1.187	R	1.220	R
1.222	R	1.306	R	1.334	R	1.339	R	1.360	R	1.459	R	1.468	R
1.489	R	1.489	R	1.529	R	1.680	R	1.770	R	1.880	R	1.880	R

Actual Mean = 1.156 Actual Standard Deviation = 0.435

Edited Mean = 0.708 Edited Standard Deviation = 0.125

Sample Depth : 3550.0

0.142	C	0.273	C	0.415	C	0.422	C	0.428	C	0.430	C	0.454	C
0.482	E	0.526		0.566		0.575		0.586		0.588		0.592	
0.662		0.665		0.689		0.882	P	1.130	R	1.138	R	1.138	R
1.198	R	1.215	R	1.225	R	1.378	R	1.400	R	1.420	R	1.682	R
1.890	R												

Actual Mean = 0.834 Actual Standard Deviation = 0.452

Edited Mean = 0.619 Edited Standard Deviation = 0.106

Sample Depth : 3700.0

0.340	C	0.446	C	0.470	C	0.496	C	0.517	E	0.522	E	0.537	E
0.550	E	0.552		0.574	E	0.575	E	0.580	E	0.590	E	0.592	E
0.608	E	0.633	E	0.649	E	0.650	E	0.763		0.763		0.805	
0.892	R	1.412	R										

Actual Mean = 0.631 Actual Standard Deviation = 0.210

Edited Mean = 0.615 Edited Standard Deviation = 0.087

Sample Depth : 3870.0

0.516	E	0.651		0.678		0.810		0.869		0.911		0.950	P
0.959	P	1.004		1.008		1.109	C	1.200	C	1.205	C	1.260	C
1.285	C												

Actual Mean = 0.961 Actual Standard Deviation = 0.231

Edited Mean = 0.836 Edited Standard Deviation = 0.168

Rut H-11:

BIOSTRATIGRAPHY AND MATURATION OF

RUT H-11

PETRO-CANADA et al. RUT H-11

GSC locality: 59° 10' 16.47"N, 62° 16' 47.15"W
KB elevation: 11.6m Water depth: 124m
Casing set at: 154m, 648m, 2143m, 4056m
Total depth: 4474m
Interval studied for palynology: 675-4093m
Interval studied for micropaleontology: 675-4093m

CONSENSUS AGE

675-1135m	late Oligocene (M)
1155-1450m	early Oligocene (P)
1470-2250m	late Eocene (P)
2270-2570m	middle Eocene (M)
2590-3410m	early Eocene (M,P)
3430-3490m	late Paleocene (M)
3510-4010m	early Paleocene (M)
4030-4093m	no age assignment

RUT H-11

PALYNOLOGICAL ZONATION

675- 695m	Operculodinium centrocarpum Zone to Systematophora ancyrea Zone (middle to late Miocene)
715- 975m	Cordosphaeridium cantharellum Zone (early Miocene)
995-1135m	Chiropteriidum mespilanum Zone (late Oligocene)
1155-1450m	Areosphaeridium arcuatum Zone (early Oligocene)
1470-2250m	Deflandrea #LR Zone (late Eocene to early Oligocene)
2270-2370m	Areosphaeridium fenestratum Zone (middle to late Eocene)
2390-2570m	Eocladopyxis #LA Zone (middle Eocene)
2590-3130m	Trinovantedinium #LA Zone (early Eocene)
3150-3930m	Dracodinium condylos Zone (early Eocene)
3950-4065m	Ceratiopsis speciosa Zone (late Paleocene)
4085-4093m	No zonal assignment (no age assignment)

SELECTED PALYNOMORPHS

675-695m: Operculodinium centrocarpum Zone to Systematophora ancyrea Zone (middle to late Miocene)

675m
- Caryapollenites simplex *
- **Lingulodinium machaerophorum**
- Lycopodiumsporite annotinioides *
- Operculodinium centrocarpum
- Spiniferities ramosus
- Tsugaepollenites igniculus *

Degree of Confidence: 2

Remarks: Penetration of Miocene strata is indicated by the occurrence of rare specimens of L. machaerophorum at 675-695m. The occurrence in the underlying section of early Miocene dinoflagellate markers indicates that the section at 675-695m is no older than Miocene.

715-975m: Cordosphaeridium cantharellum Zone (early Miocene)

715m
- **Heteraulacacysta campanula**
- Systematophora ancyrea

755m
- Achomosphaera crassipellis
- Ceratiacean #LA
- Osmundacidites claytonites *
- Palaeocystodinium golzowense
- Quercoidites #LV* (?reworked)

795m
- Laevigatosporites ovatus *

955m Dapsilidinium pastielsii
Tsugaepollenites viridifluminipites *

Degree of Confidence: 2

Remarks: The occurrence of H. campanula at 715-735m tentatively indicates penetration of the C. cantharellum Zone.

995-1135m: Chiropteriidum mespilanum Zone (late Oligocene)

995m Membranophoridium aspinatum

Degree of Confidence: 3

Remarks: Although only a single specimen of the late Oligocene marker M. aspinatum occurs at 995-1015m, its presence in nearby wells at similar horizons, and the occurrence of early Oligocene markers in the underlying section indicates that its occurrence is in situ at 995-1015m in the Rut H-11 well.

1155-1450m: Areosphaeridium arcuatum Zone (early Oligocene)

1155m Achomosphaera ramulifera
Chiropteridium mespilanum
Deflandrea phosphoritica
Glaphrocysta intricata
Spiniferites pseudofurcatus

1235m **Cyclonephelium sp. B, Williams & Brideaux 1975**

1355m	Lejeunecysta hyalina
1395m	Luxadinium #LA (?reworked) Paralecaniella indentata

Degree of Confidence: 3

1470-2250m: Deflandrea #LR Zone (late Eocene to early Oligocene)

1470m	**Deflandrea #LR** Rouseisporites #LA *
1550m	Cordosphaeridium cantharellum
1870m	Jusseaia sp. Piel, 1971 *
2030m	Tiliaepollenites vescipites *
2070m	Rouseisporites #LA *
2150m	Alnipollenites verus * Azolla * Betulaceoipollenites betuloides * Corylus #LA * Lentinia serrata Quercoidites #LA * Quercoidites #LG * Quercoidites #LV * Retitricolites #LF *

2230m **Systematophora placacantha**

Degree of Confidence: 2

Remarks: Penetration of the Deflandrea #LR Zone is tentatively indicated at 1470-1490m by the occurrence of rare specimens of Deflandrea #LR. It is possible that these are reworked indicating a top for the zone which is too high, or alternatively that the zonal top is depressed due to the non-observation of Deflandrea #LR specimens higher in the well resulting from their scarcity. The precise position of the zonal boundary at 1470-1490m is therefore considered to be tentative.

2270-2370m: Areosphaeridium fenestratum Zone (middle to late Eocene)

2270m **Areoligera senonensis**
Fagus #LA *
Pterocaryapollenites stellatus *

2310m Azolla * (common)
Castanea #LA *
Chiropteridium #LS
Ericipites compactipolleniatus *
Glaphrocysta spineta
Micrhystridium fragile (common)

Degree of Confidence: 1

Remarks: Assignment of the sample at 2270-2290m to the A. fenestratum Zone is highly conjectural, being based on the occurrence of a single specimen of A. senonensis which may be reworked or is possibly in place. The stratigraphic range of this species is also imperfectly

known on the Labrador Shelf. A more confident assignment to the A. fenestratum Zone is at 2310-2330m based on the highest occurrence of Chiropteridium #LS.

2390-2570m: Eocladopyxis #LA Zone (middle Eocene)

2390m	**Glaphyrocysta vicina**
	Hystrichokolpoma salacium
	Hystrichokolpoma unispinum
	Thalassiphora patula
2430m	**Hystrichosphaeridium patulum**
2470m	Cicatricososporites auritus *
	Kisselovia crassiramosa
	Pesavis tagluensis *
2510m	Momipites coryloides *
	Lentinia wetzelii
2550m	Wetzeliella articulata

Degree of Confidence: 3

2590-3130m: Trinovantedinium #LA Zone (early Eocene)

2590m	Cicatricosisporites paradorogensis *
	Systematophora #LE
	Trinovantedinium #LA
	Wetzeliella meckelfeldensis

2630m	Carpinipites #LT *
	Diphyes colligerum
	Trinovantedinium #LL
	Wetzeliella ovalis
2670m	**Horologinella** #LA
	Trinovantedinium #LS
	Cordosphaeridium tiara
2710m	Glaphyrocysta exuberans
2750m	Ceratiopsis pannucea
	Thalassiphora pelagica
2790m	**Heteraulacacysta leptalea**
	Hystrichokolpoma #LP
2950m	Cordosphaeridium fibrospinosum
	Deflandrea oebisfeldensis
	Homotryblium pallidum
	Systematophora #LC
2990m	Areoligera senonensis
	Polysphaeridium subtile
3030m	Apectodinium homomorphum
	Hystrichokolpoma cinctum
3070m	Apectodinium hyperacanthum
	Homotryblium tenuispinosum
3110m	**Homotryblium oceanicum**
	Kisselovia coleothrypta

Degree of Confidence: 4

Remarks: The Trinovantedinium #LA Zone is well-developed in the Rut H-11 well, with many marker species for the zone being present in samples at and below that at 2590-2610m.

3150-3930m: Dracodinium condylos Zone (early Eocene)

3150m	**Isabelidinium #LP**
	Phthanoperidinium comatum
3190m	Areoligera senonensis (common)
	Apectodinium homomorphum (common)
3230m	**Areoligera senonensis (abundant)**
	Apectodinium augustum
	Ceratiopsis depressa
	Diphyes #LA
	Homotryblium abbreviatum
	Kisselovia edwardsii
3270m	Achilleodinium biformoides
	Areosphaeridium sp. A, Williams & Bujak 1977
3350m	Adnatosphaeridium robustum
3390m	Momipites rotundus *
3510m	Cribroperidinium giuseppei
3550m	Eatonicysta ursulae

3590m Aquilapollenite sp. indet. * (reworked)
Hamulatisporites amplus (reworked)

3630m Cordosphaeridium inodes longipes

3670m Oligosphaeridium complex (reworked)

3790m Oligosphaeridium complex (reworked)

Degree of Confidence: 3

Remarks: Penetration of the D. condylos Zone is indicated by the occurrence of the dinoflagellate Isabelidinium #LP at 3150-3170m. The markers Dracodinium condylos and D. solidum were not observed in the well, but the zonal assignment is supported by the presence of Apectodinium augustum and abundant specimens of Areoligera senonensis at 3230-3250m. The lower part of this zone contains several late Cretaceous or Late Cretaceous to Paleocene species such as Oligosphaeridium complex which are considered to be reworked.

3950-4065m: Ceratiopsis speciosa Zone (late Paleocene)

3950m **Ceratiopsis speciosa speciosa**
Deflandrea denticulata
Phelodinium magnificum

Degree of Confidence. 4

Remarks: This zone is well-defined by common and persistent specimens of several taxa indicated in bold at and below 3950-3970m. This

indicates that the Paleocene and older species occurring in the D. condylos Zone are reworked.

4085-4093m: No zonal assignment (No age assignment)

MICROPALEONTOLOGICAL ZONATION

Not observed	*Cassidulina teretis* Zone (late Miocene or younger)
Not observed	*Asterigerina guerich:* Zone (early Miocene or older)
675-1850m	*Asterigerina bartoniana* Zone (late Oligocene)
Not observed	*Ceratobulimina contraria* Zone (early Oligocene)
1870-2160m	*Spiroplectammina adamsi* Zone (late Eocene)
2230-2250m	*Cyclammina amplectens* Zone (late Eocene)
2270-2560m	*Haplophragmoides acutidorsatum* Zone (middle Eocene)
2590-2930m	*Bulimina ovata* Zone (early Eocene)
2950-2970m	*Karreriella apicularis* Zone (early Eocene)
2990-3410m	*Spiroplectammina grzybowski* Zone (early Eocene)
3430-3490m	*Glomospira charoides* Zone (late Paleocene)
3510-4010m	*Glomospira corona* Zone (early Paleocene)
4030-4093m	No zonal assignment (No age assignment)
Not observed	*Praecystammina globigerinaeformis* Zone (early Paleocene)

Not observed Rzehakina epigona Zone (Maastrichtian)

Not observed Arenobulimina dorbigny Zone (?Campanian)

SELECTED FORAMINIFERA

675-1850m: Asterigerina bartoniana Zone (late Oligocene)

675m	**Asterigerina bartoniana**
	Elphidium granosum
	Elphidium roemeri
	Globigerina angustiumbilicata *
715m	Bolivina parisiensis
	Trifarina abbreviata
995m	Melonis affinis
	Sigmoidella bornemmanni
1395m	**Coscinodiscus** #H 1 +

Degree of Confidence: 3

1870-2160m: Spiroplectammina adamsi Zone (late Eocene)

1870m	**Coscinodiscus** #H 2 +
1990m	**Haplophragmoides walteri**
2110m	Trochammina cf. inflata
	Haplophragmoides sp.
2150m	**Cyclammina cancellata**
	Cyclammina placenta
	Alabamina wilcoxensis
	Alveolophragmium #H 1

Degree of Confidence: 2

2230-2250m: Cyclammina amplectens Zone (late Eocene)

2230m	**Cribrostomoides** cf. scitulus
	Karreriella cf. siphonella

Degree of Confidence: 3

2270-2560m: Haplophragmoides acutidorsatum Zone (middle Eocene)

2270m	**Haplophragmoides acutidorsatum**
	Ammodiscus cretaceus
	Trochammina globigeriniformis
2310m	Globigerina linaperta *
	Budashevaella multicamerata
	Cyclammina amplectens
	Saccammina placenta
	Trochammina collyra
2350m	Ammodiscus peruvianus
	Haplophragmoides eggeri
2470m	Paratrochamminoides sp.
2550m	Spiroplectammina adamsi

Degree of Confidence: 3

2590-2930m: Bulimina ovata Zone (early Eocene)

2590m	**Spiroplectammina mexiaensis** **Spiroplectammina navarroana** Bathysiphon discreta Pseudonodosaria discreta
2670m	Bulimina kugleri
2710m	**Bulimina ovata**
2750m	**Haplophragmoides impensus**
2790m	Pullenia quinqueloba
2870m	Anomalinoides preacuta **Uvigerina batjesi**
2910m	**Vulvulina haeringensis**

Degree of Confidence: 3

2950-2970m: Karreriella apicularis Zone (early Eocene)

2950m	**Siphogenerinoides eleganta** Vaginulinopsis decorata

Degree of Confidence: 3

2990-3410m: Spiroplectammina grzybowski Zone (early Eocene)

2990m	**Bulimina quadrata**
	Textularia midwayensis
	Lenticulina midwayensis
	Dorothia cf. retusa
	Cibicidoides blanpiedi
3030m	Cibicides westi
	Cibicidoides cf. proprius
	Epistominella oveyi
	Nodosaria latejugata
	Vaginulinopsis echinata
3070m	Eponides elevatus
3110m	Marginulina bullata
	Cibicidoides praecursorius
	Nodosaria minor
3150m	**Allomorphina paleocenica**
	Lenticulina arkansana
	Karreriella apicularis
	Chilostomella cylindroides
3190m	Eponides toulmini
3230m	Dorothia trochoidea (reworked)
	Saccammina sphaerica
3310m	Chilostomelloides eocenica

3390m Stilostomella paleocenica

Degree of Confidence 3

3430-3490m: Glomospira charoides Zone (late Paleocene)

3430m **Rhizammina indivisa**

3470m **Gavelinella micra**

Degree of Confidence: 2

3510-4010m: Glomospira corona Zone (early Paleocene)

3510m **Gavelinella becariiformis**
Globigerina triloculinoides *
Saccammina complanata
Trochamminoides subtrullisatus
Saracenaria triangularis

3550m Cibicidoides alleni

3630m Spiroplectammina carinata

3670m Gavelinella danica

3710m Ammobaculites polythalamus

3950m Anomalinoides cf. madrugaensis

Degree of Confidence: 3

4030-4093m: No zonal assignment (No age assignment)

PALEOBATHYMETRY

675- 975m Transitional to Inner Neritic
Criteria: Asterigerina bartoniana, Elphidium granosum, Trifarina abbreviata

995-1055m Inner Neritic
Criteria: Melonis affinis, Sigmoidella bornemanni

1075-1375m Transitional to Inner Neritic
Criteria: No foraminifera, marine dinoflagellates

1395-1415m Inner Neritic to Middle Neritic
Criteria: Coscinodiscus sp.

1435-1610m Inner Neritic
Criteria: Marine Dinoflagellates

1630-1650m Inner Neritic to Middle Neritic
Criteria: Coscinodiscus #H1

1670-1770m Transitional to Inner Neritic
Criteria: Barren

1790-1810m Inner Neritic to Middle Neritic
Criteria: Coscinodiscus sp.

1830-1850m Transitional to Inner Neritic
Criteria: Barren

1870-1950m Inner Neritic to Middle Neritic
Criteria: Coscinodiscus #H2

1950-1970m Transitional to Inner Neritic
Criteria: Barren

1990-2010m Inner Neritic to Middle Neritic
Criteria: Haplophragmoides walteri

2030-2050m Non Marine to Transitional
Criteria: No foraminifera, pollen, wood?

2070-2090m Transitional to Inner Neritic
Criteria: Pteropod

2110-2130m Inner Neritic to Middle Neritic
Criteria: Trochammina cf. inflata, Haplophragmoides sp., scaphopods

2150-2160m Middle Neritic to Outer Neritic
Criteria: Cyclammina placenta, Cyclammina cancellata

2180-2210m Inner Neritic to Middle Neritic
Criteria: No foraminifera, scaphopod, pteropod

2230-2250m Middle Neritic to Outer Neritic
Criteria: Cribrostomoides cf. scitulus, Karreriella cf. siphonella

2270-2290m Outer Neritic
Criteria: Trochammina globigeriniformis, Haplophragmoides acutidorsatum

2310-3610m Upper Bathyal

Criteria: Cyclammina amplectens, Budashevaella multicamerata, Bathysiphon discreta, Spiroplectammina mexiaensis, Vulvulina haeringensis, Allomorphina paleocenica, Chilostomella cylindroides, Rhizammina indivisa, Trochamminoides subtrullisatus

3630-3650m Outer Neritic to Upper Bathyal

Criteria: Decrease in diversity, Spiroplectammina carinata

3670-4010m Middle Neritic to Outer Neritic

Criteria: Poor fossil recovery to T.D.

4030-4093m Inner Neritic to Middle Neritic

Criteria: Pelecypod, coral

KEROGEN & TAI

Depth	AM	AT	AG	SA	M	BT	ST	I	R	TAI
675.0	0	0	0	0	10	20	50	20	0	2-
755.0	0	0	0	0	10	25	50	15	0	2-
955.0	0	0	0	0	10	25	50	15	0	2-2
1035.0	0	0	0	5	15	25	25	10	0	2-2
1155.0	0	0	0	0	10	25	25	15	0	2-2
1235.0	0	0	0	0	10	30	30	15	0	2-2
1355.0	0	0	0	0	15	35	45	5	0	2-2
1470.0	0	0	0	0	10	35	50	5	0	2-2
1670.0	0	0	0	0	15	30	45	10	0	2-2
1790.0	0	5	0	0	10	30	45	10	0	2-2
1910.0	0	5	0	0	5	35	45	10	0	2-2
2030.0	0	10	0	0	5	35	45	5	0	2-2
2150.0	0	10	0	0	5	25	40	20	0	2-2
2270.0	0	0	0	0	5	30	35	20	0	2-2
2390.0	0	0	0	0	0	30	40	20	0	2-2
2510.0	0	0	0	0	0	35	40	20	0	2-2
2630.0	0	0	0	0	5	35	30	20	0	2-2
2750.0	0	0	0	0	5	35	30	20	0	2-2
2830.0	0	10	0	0	5	45	30	10	0	2-2
2950.0	0	10	0	0	0	45	35	10	0	2-2
3030.0	0	5	0	0	5	40	35	15	0	2-2
3150.0	0	0	0	0	5	35	40	15	0	2
3270.0	0	0	0	0	5	35	45	15	0	2
3350.0	0	0	0	0	5	40	45	10	0	2
3470.0	0	0	0	0	10	35	45	10	0	2
3590.0	0	0	0	0	5	40	40	15	0	2
3710.0	0	0	0	0	10	40	30	20	0	2
3830.0	0	0	0	0	5	40	40	15	0	2
3950.0	0	0	0	0	10	40	35	15	0	2
4070.0	0	0	0	0	5	45	40	10	0	2
4085.0	0	0	0	0	10	35	40	15	0	2
4093.0	0	0	0	0	10	35	40	15	0	

KEROGEN, TAI AND VITRINITE REFLECTANCE

The section examined from this well contains generally uniform kerogen types, with minor fluctuations in the relative abundances of amorphous kerogen and coaly inertinitic kerogen. Amorphous kerogen is absent throughout, except for small (5% to 10%) quantities of degraded terrestrial material between 1790-2170m in strata of middle to late Eocene age, and between 2830-2970m in strata of early Eocene age. Marine amorphous kerogen is absent throughout. Woody kerogen mostly comprises 30% to 45% of the total, and herbaceous kerogen comprises approximately 35% to 50%. Coaly inertinitic kerogen is always present, reaching a peak of 20% in the interval from 2150-2770m of early Eocene to early Oligocene age.

The level of Thermal Alteration increases from a value of 2^- at 675m, to a value of 2^- to 2 below 955m in strata of late Oligocene age. It reaches a value of 2 below 3150m in strata of early Paleocene to early Eocene age. This indicates that all kerogen types in the well are immature.

The following levels of thermal maturity ae indicated by vitrinite reflectance analysis.

1920-2680m: Immature (Ro% = 0.340% to 0.435%)
2760-3320m: Onset of maturation (Ro% = 0.50% to 0.55%)
3480-3920m: Mature (Ro% = 0.609% to 0.971%)
4093m: Indeterminate

The vitrinite reflectance value are considered to be generally reliable throughout this well. The basal sample contains no in situ vitrinite particles.

VITRINITE REFLECTANCE

Key to Measurement Qualifying Labels

E = Excellent
= Good
P = Poor
C = Caved
R = Reworked

Sample Depth : 1920.0

0.216	C	0.230	C	0.246	C	0.251	C	0.258	P	0.258	P	0.259	P
0.265	P	0.268	P	0.277	P	0.281	P	0.294		0.313	P	0.315	P
0.316		0.317		0.319		0.321		0.322		0.325		0.329	
0.329		0.331		0.333		0.334		0.334		0.337		0.340	
0.340		0.342		0.344		0.349		0.353		0.357		0.358	
0.358		0.358		0.359		0.359		0.367		0.371		0.373	
0.375		0.376		0.378		0.378		0.379		0.382		0.382	
0.383		0.384		0.391		0.393		0.394		0.397		0.403	R
0.407	R	0.415	R	0.428	R	0.496	R	0.893	R	0.996	R	1.069	R
1.451	R												

Actual Mean = 0.388 Actual Standard Deviation = 0.200

Edited Mean = 0.340 Edited Standard Deviation = 0.039

Sample Depth : 2120.0

0.232	C	0.239	C	0.249	C	0.265	C	0.271	C	0.283	C	0.287	C
0.293	C	0.314	C	0.316	R	0.320	P	0.320		0.323		0.329	P
0.329		0.330		0.335		0.336	P	0.336		0.346	E	0.350	
0.351		0.352		0.353	E	0.354	P	0.358		0.363		0.366	
0.367		0.367	P	0.368	P	0.371		0.374		0.377		0.378	
0.380		0.384		0.389	P	0.390		0.391		0.391		0.394	
0.394		0.409	P	0.413		0.415		0.418		0.423	R	0.427	
0.428		0.433		0.443	R	0.454	R	0.478	R	0.479	R	0.483	R
0.519	R	0.616	R	0.626	R	0.704	R	0.705	R	0.787	R	1.075	R
1.175	R												

Actual Mean = 0.414 Actual Standard Deviation = 0.167

Edited Mean = 0.370 Edited Standard Deviation = 0.032

Sample Depth : 2280.0

0.247	P	0.322		0.342		0.357		0.360		0.636	R	0.704	R
1.500	R	1.807	R										

Actual Mean = 0.697 Actual Standard Deviation = 0.568

Edited Mean = 0.326 Edited Standard Deviation = 0.046

Sample Depth : 2400.0

0.268	C	0.277	C	0.327		0.330	P	0.341		0.348		0.352	
0.359	P	0.377		0.379		0.399		0.403		0.409	P	0.410	
0.413		0.421		0.429		0.447		0.453	P	0.516	R	0.519	R
0.574	R	0.848	R	0.880	R	1.060	R						

Actual Mean = 0.462 Actual Standard Deviation = 0.193

Edited Mean = 0.388 Edited Standard Deviation = 0.040

Sample Depth : 2520.0

0.303	C	0.322	C	0.350		0.351	P	0.362		0.371		0.375	
0.387		0.394		0.396		0.411		0.412		0.415		0.420	
0.438	P	0.450	P	0.496	R	0.562	R	0.802	R	1.156	R	1.411	R
1.724	R												

Actual Mean = 0.559 Actual Standard Deviation = 0.379

Edited Mean = 0.395 Edited Standard Deviation = 0.031

Sample Depth : 2680.0

0.373	P	0.384		0.390		0.393		0.412		0.422		0.427	
0.438		0.439		0.441	P	0.461		0.493		0.507	P	0.509	P
0.534	R	0.624	R	1.426	R								

Actual Mean = 0.510 Actual Standard Deviation = 0.245

Edited Mean = 0.435 Edited Standard Deviation = 0.045

Sample Depth : 2760.0

0.216	C	0.306	C	0.387	C	0.402	C	0.425		0.430		0.437	
0.438		0.448		0.463		0.482		0.507		0.516		0.521	R
0.537	R	0.541	P	0.545	R	0.550	R	0.591	R	0.598	R	0.610	R
0.627	R	0.639	R	1.172	R								

Actual Mean = 0.516 Actual Standard Deviation = 0.172

Edited Mean = 0.469 Edited Standard Deviation = 0.041

Sample Depth : 2880.0

0.409	P	0.430		0.475		0.555		0.623	R	0.634	R		

Actual Mean = 0.521 Actual Standard Deviation = 0.097

Edited Mean = 0.467 Edited Standard Deviation = 0.065

Sample Depth : 3040.0

0.349	C	0.368	C	0.370	C	0.386	C	0.390	C	0.430	P	0.470	
0.514	R	0.603	R	0.653	R								

Actual Mean = 0.453 Actual Standard Deviation = 0.106

Edited Mean = 0.450 Edited Standard Deviation = 0.028

Sample Depth : 3200.0

0.306	C	0.325	C	0.352	C	0.384	C	0.387	C	0.398	C	0.403	C
0.420	C	0.424	C	0.453	C	0.482	P	0.484	P	0.499		0.511	C
0.525		0.529		0.530		0.544	P	0.545	P	0.552		0.553	
0.576	R	0.611	P	0.613		0.649	R	0.914	R	1.020	R	1.025	R
1.311	R												

Actual Mean = 0.563 Actual Standard Deviation = 0.230

Edited Mean = 0.539 Edited Standard Deviation = 0.042

Sample Depth : 3320.0

0.311	C	0.356	C	0.361	C	0.383	C	0.418	C	0.435	C	0.435	C
0.455	C	0.457	C	0.460	C	0.474	C	0.479	C	0.484	C	0.492	E
0.510		0.512	E	0.517	P	0.520		0.521		0.521		0.524	
0.529		0.530		0.533	E	0.540		0.542	P	0.542		0.543	
0.546		0.550		0.553		0.573		0.576		0.582		0.583	
0.584		0.585	E	0.594		0.603		0.607		0.611	P	0.611	P
0.615	P	0.625		0.651	R	0.894	R	1.000	R	1.200	R		

Actual Mean = 0.553 Actual Standard Deviation = 0.149

Edited Mean = 0.557 Edited Standard Deviation = 0.037

Sample Depth : 3480.0

0.341	C	0.425	C	0.442	C	0.477	C	0.478	C	0.485	C	0.511	
0.514		0.526	P	0.529	E	0.532		0.581		0.582		0.592	
0.598		0.600		0.618		0.620		0.635		0.651		0.652	
0.687		0.692	R	0.696		0.699	P	0.718		0.747		0.774	R
0.774	R	0.786	R	0.806	R	0.837	R	0.898	R	1.012	R	1.104	R
1.145	R	1.184	R	1.286	R	1.653	P						

Actual Mean = 0.715 Actual Standard Deviation = 0.266

Edited Mean = 0.664 Edited Standard Deviation = 0.237

Sample Depth : 3640.0

0.324	C	0.325	C	0.350	C	0.351	C	0.377	C	0.382	C	0.384	C
0.409	C	0.429	C	0.448	C	0.453	C	0.467	C	0.475	C	0.476	C
0.487	C	0.504	C	0.520	P	0.534		0.540	P	0.544	E	0.569	
0.600		0.609		0.613		0.623		0.703		0.719		0.732	
0.777	R	0.800	R	0.805	R	0.826	R	0.874	R	0.880	R	0.884	R
1.001	R	1.170	R	1.322	R								

Actual Mean = 0.613 Actual Standard Deviation = 0.236

Edited Mean = 0.609 Edited Standard Deviation = 0.074

Sample Depth : 3890.0

0.306	C	0.326	C	0.364	C	0.383	C	0.405	C	0.408	C	0.413	C
0.414	C	0.431	C	0.431	C	0.435	C	0.458	C	0.460	C	0.483	C
0.520	C	0.544	C	0.683		0.721	P	0.760	E	0.762		0.769	
0.796		0.824	R	0.855	R	0.875	R	0.990	R	1.050	R	1.067	R
1.079	R	1.093	R	1.128	R	1.164	R	1.165	R	1.226	R	1.259	R
1.418	R	1.432	R	1.470	R	1.841	R						

Actual Mean = 0.800 Actual Standard Deviation = 0.390

Edited Mean = 0.749 Edited Standard Deviation = 0.040

Sample Depth : 3920.0

0.637	C	0.643	C	0.721	C	0.777	C	0.812	P	0.820		0.830	
0.852	P	0.854		0.858		0.859		0.870		0.900		0.939	E
0.955		0.966		0.982		0.984		0.998		1.000		1.005	
1.010		1.018		1.023		1.024		1.024		1.027		1.031	
1.033		1.037		1.038		1.050	R	1.059		1.065		1.086	R
1.090	R	1.093	R	1.113	R	1.117	R	1.131	R	1.137	R	1.140	R
1.181	R	1.184	R	1.189	R	1.219	R	1.242	R	1.244	R	1.248	P
1.265	R	1.289	R	1.312	R	1.321	R	1.328	R	1.336	R	1.392	R
1.470	R	1.660	R	1.726	R	1.890	R	1.963	R				

Actual Mean = 1.099 Actual Standard Deviation = 0.261

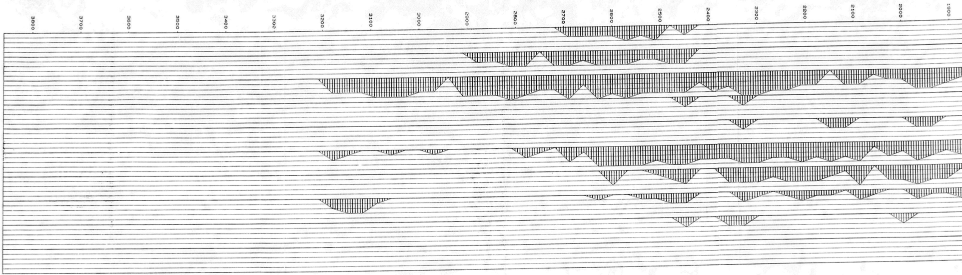
Edited Mean = 0.971 Edited Standard Deviation = 0.096

Sample Depth : 4093.0

0.380	C	0.473	C	0.500	C	0.523	C	1.338	R	1.754	R

Actual Mean = 0.828 Actual Standard Deviation = 0.574

Charts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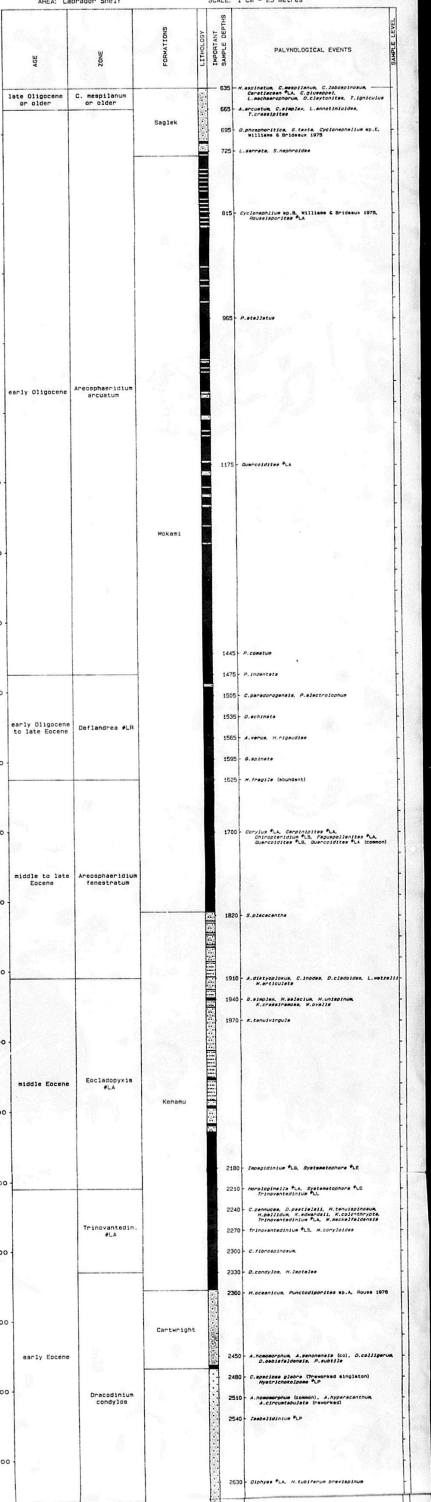
2100
2000
1900

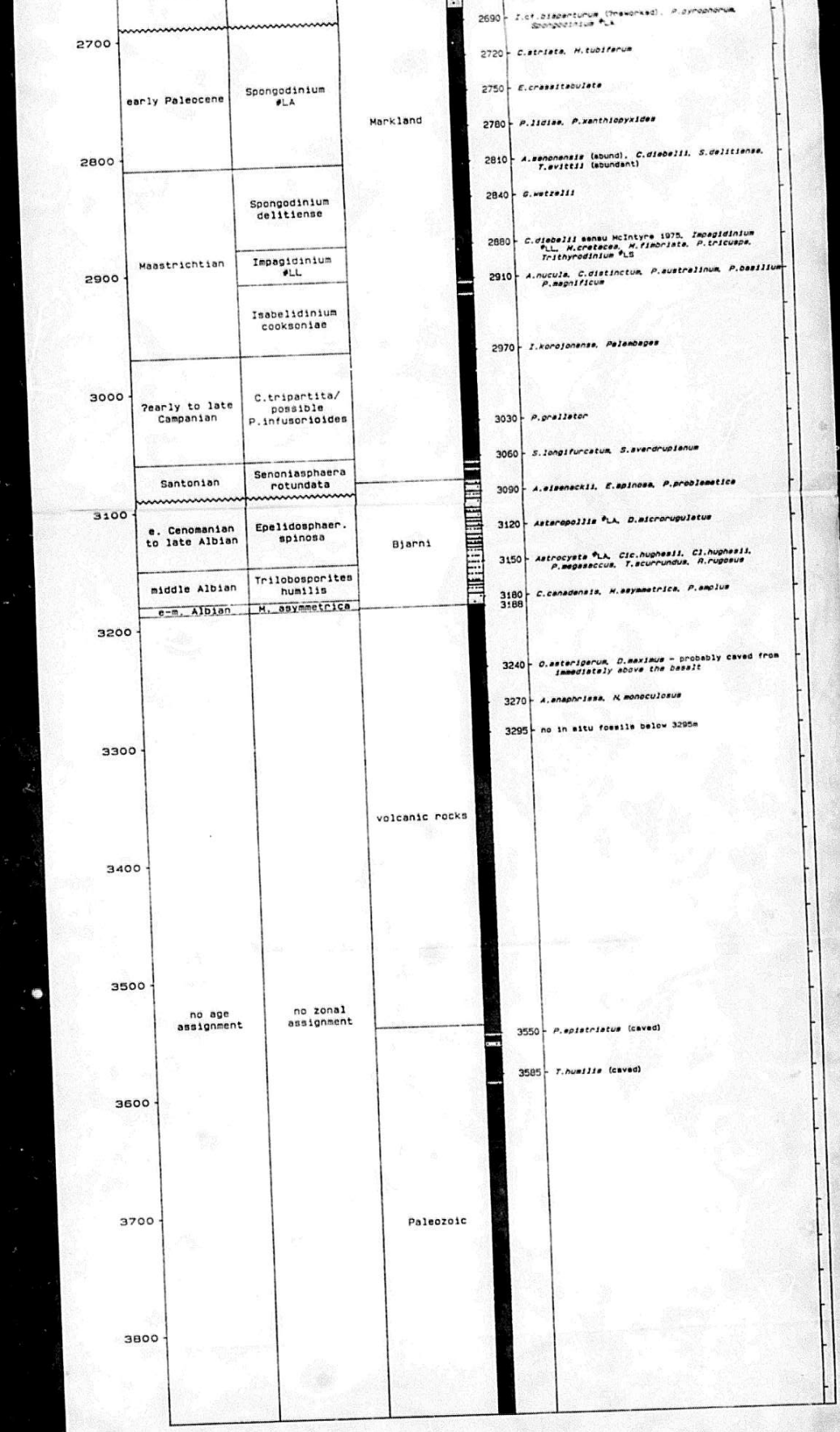
1800
1700
1600
1500
1400
1300
1200
1100
1000
800
700
P R C A D
Apectodinium homomorphum
Areoligera senonensis
Marine Dinoflagellate
Azolla
Pediastrum
Gymnosperm Pollen
Angiosperm Pollen
Spores
Upper Cretaceous Reworking
Lower Cretaceous Reworking

PALYNOLOGICAL ANALYSIS CHART
BUJAK DAVIES GROUP

CLIENT: G.S.C.
WELL: Roberval K-92
AREA: Labrador Shelf

SCIENTIST: Bujak Davies Group
DATE: April 1987
SCALE: 1 cm = 25 metres



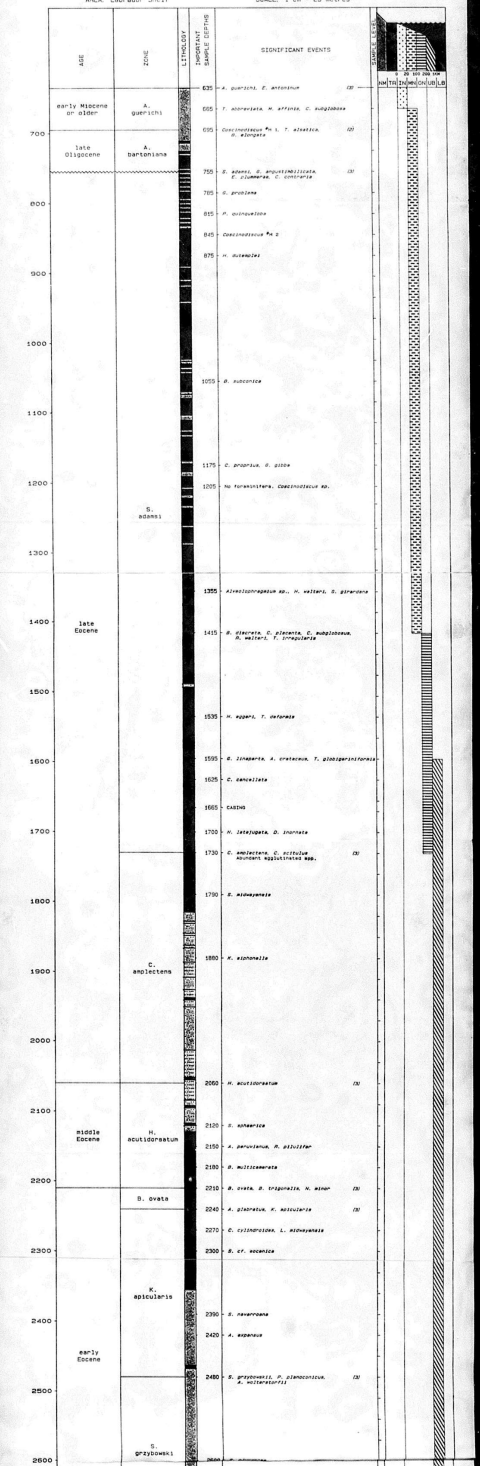

2700
2800
2900
3000
3100
3200
3300
3400
3500
3600
3700
3800
early Paleocene
Spongodinium #LA
Maastrichtian
Spongodinium delitiense
Impagidinium #LL
Isabelidinium cooksoniae
?early to late Campanian
C.tripartita/ possible P.infusorioides
Santonian
Senoniasphaera rotundata
e. Cenomanian to late Albian
Epelidosphaer. spinosa
middle Albian
Trilobosporites humilis
e-m. Albian
H. asymmetrica
no age assignment
no zonal assignment
Markland
Bjarni
volcanic rocks
Paleozoic
2690 I.cf.disparitumum (fragmented), P.pyrophorum, Spongodinium #LA
2720 C.striata, H.tubiferum
2750 E.crassitabulata
2780 P.licium, P.xanthiopyxides
2810 A.senonensis (abund), C.diebelii, S.delitiense, T.evittii (abundant)
2840 G.wetzelii
2880 C.diebelii sensu McIntyre 1975, Impagidinium #LL, H.cretacea, H.fimbriata, P.tricuspe, Trithyrodinium #LS
2910 A.nucula, C.distinctum, P.australinum, P.basillum, P.magnificum
2970 I.korojonense, Palambages
3030 P.grallator
3060 S.longifurcatum, S.averdrupienum
3090 A.eisenackii, E.spinosa, P.problematica
3120 Asteropollis #LA, D.microruguletus
3150 Astrocysta #LA, Cic.hughesii, Cl.hughesii, P.megasaccus, T.scurrundus, R.rugosus
3180 C.canadensis, H.asymmetrica, P.amplus
3188
3240 O.asterigerum, D.maximus - probably caved from immediately above the basalt
3270 A.anaphrissa, H.moneculosus
3295 no in situ fossils below 3295m
3550 P.epistriatus (caved)
3585 T.humilis (caved)

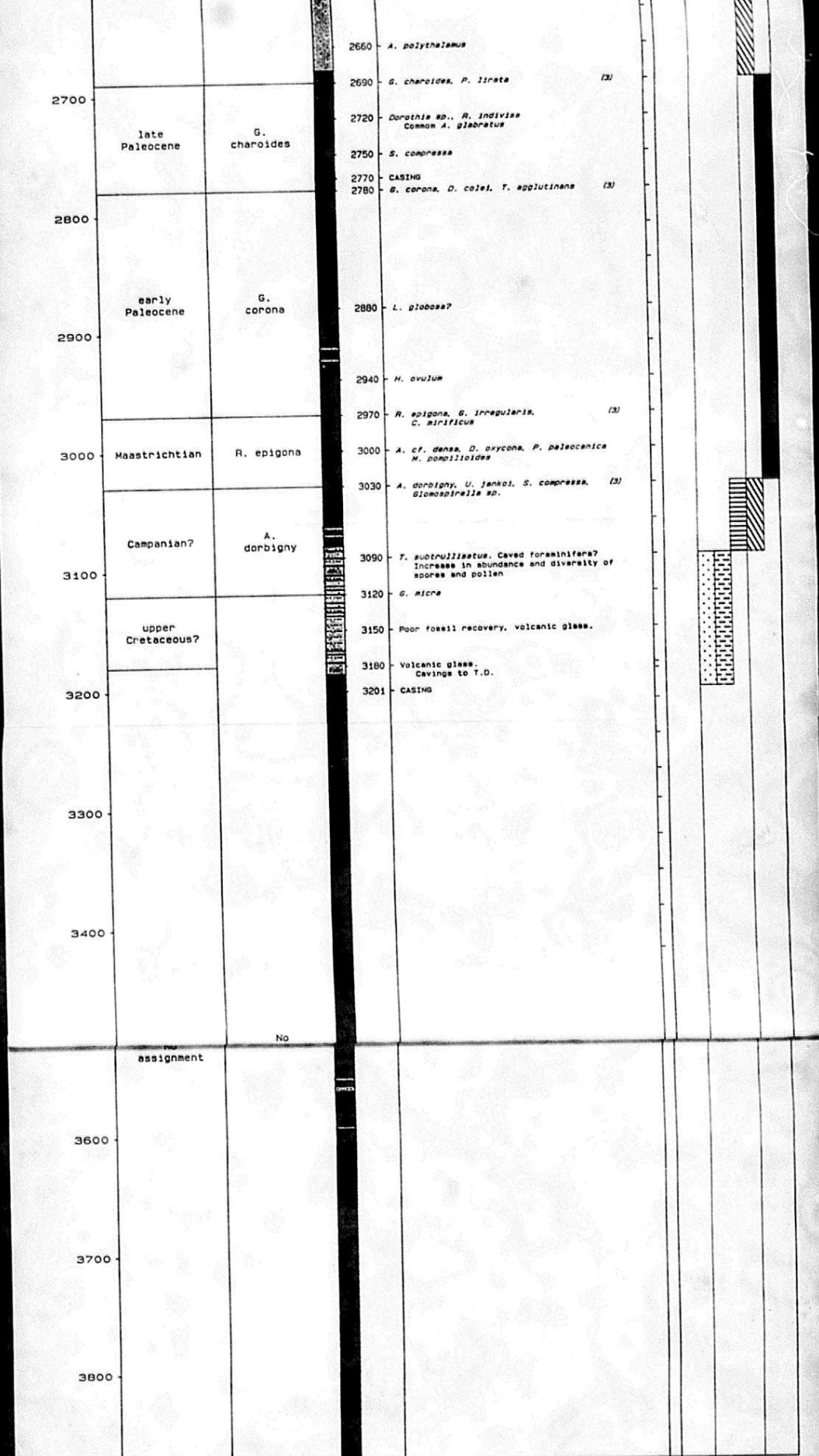
MICROPALEONTOLOGICAL ANALYSIS CHART

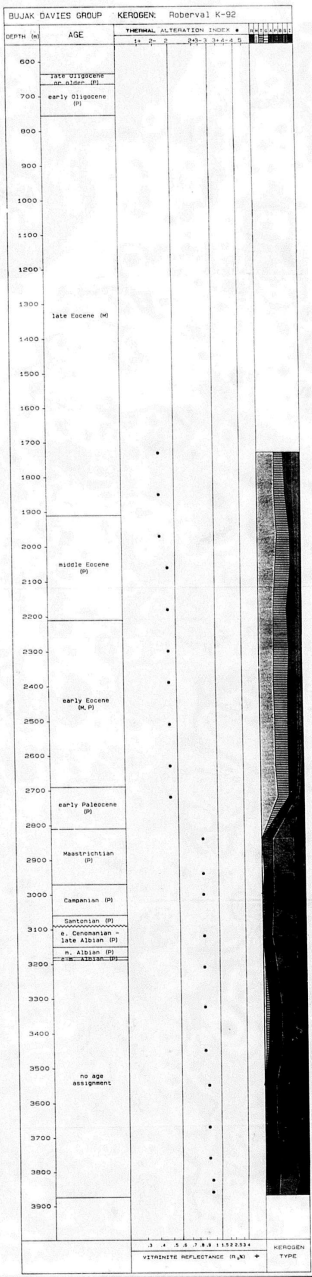
BUJAK DAVIES GROUP

CLIENT: G.S.C.
WELL: Roberval K-92
AREA: Labrador Shelf

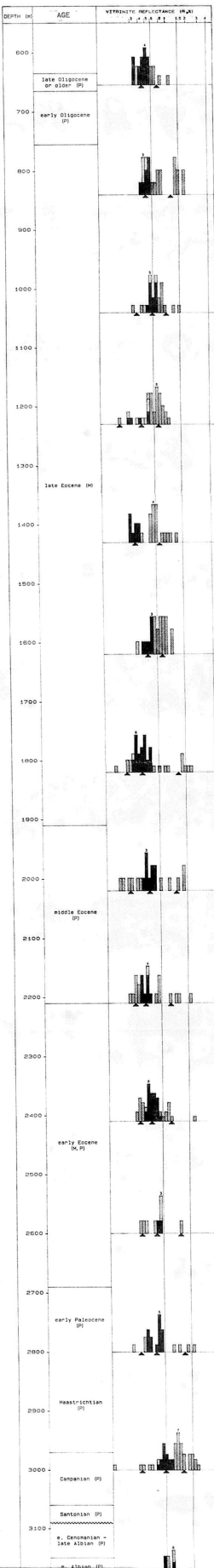
SCIENTIST: Bujak Davies Group
DATE: April 1987
SCALE: 1 cm = 25 metres

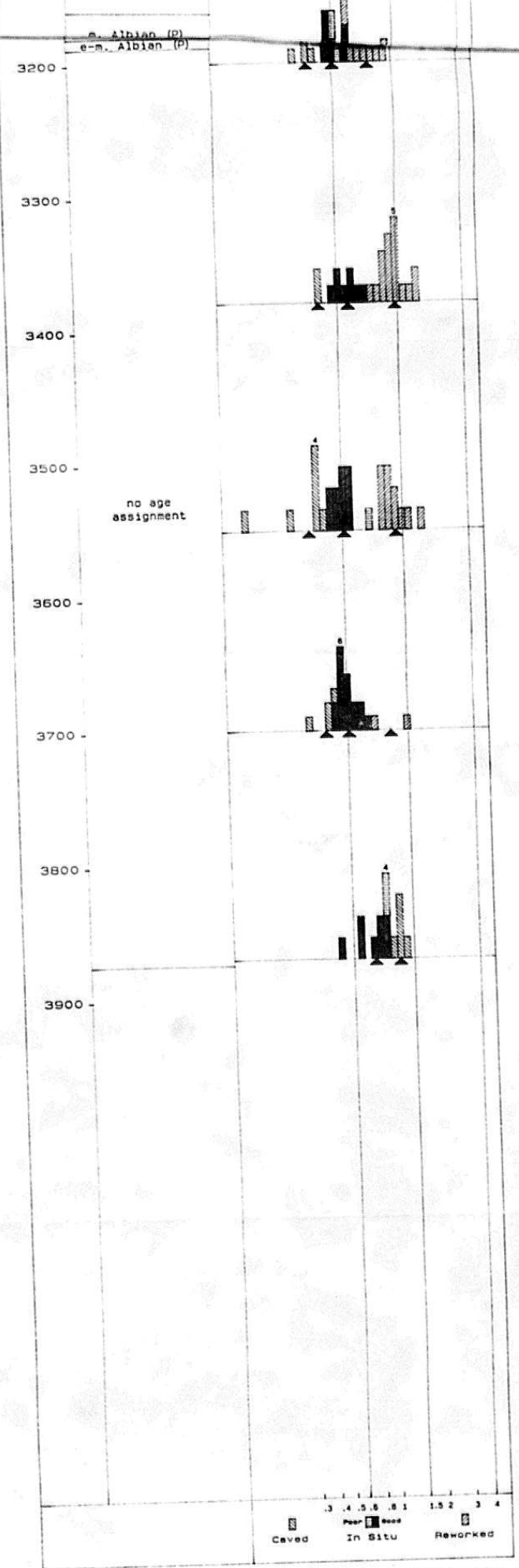


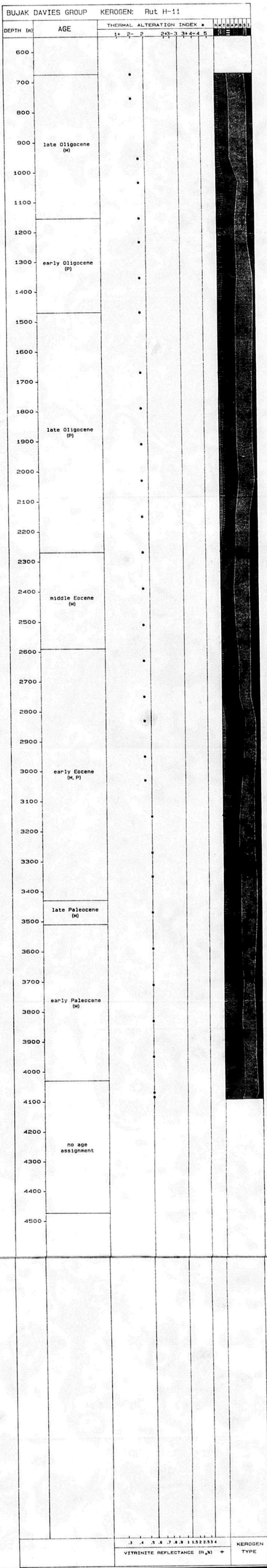

2660 A. polythalamus
2690 G. charoides, P. lirata (3)
2700
2720 Dorothia sp., R. indivisa
Common A. glabratus
late Paleocene
G. charoides
2750 S. compressa
2770 CASING
2780 G. corona, D. colei, T. agglutinans (3)
2800
early Paleocene
G. corona
2880 L. globosa?
2900
2940 H. ovulum
2970 R. epigona, G. irregularis, C. mirificus (3)
3000 Maastrichtian
R. epigona
3000 A. cf. densa, D. oxycona, P. paleocenica
M. pompilioides
3030 A. dorbigny, U. jankoi, S. compressa, Glomospirella sp. (3)
Campanian?
A. dorbigny
3090 T. subtrullisatus. Caved foraminifera? Increase in abundance and diversity of spores and pollen
3100
3120 G. micra
upper Cretaceous?
3150 Poor fossil recovery, volcanic glass.
3180 Volcanic glass. Cavings to T.D.
3200
3201 CASING
3300
3400
No assignment
3600
3700
3800


BUJAK DAVIES GROUP
KEROGEN: Roberval K-92
DEPTH (m)
AGE
THERMAL ALTERATION INDEX
1+ 2- 2 2+ 3- 3 3+ 4- 4 5
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
2100
2200
2300
2400
2500
2600
2700
2800
2900
3000
3100
3200
3300
3400
3500
3600
3700
3800
3900
late Oligocene
or older (P)
early Oligocene
(P)
late Eocene (M)
middle Eocene
(P)
early Eocene
(M,P)
early Paleocene
(P)
Maastrichtian
(P)
Campanian (P)
Santonian (P)
e. Cenomanian -
late Albian (P)
m. Albian (P)
e. - m. Albian (P)
no age
assignment
.3 .4 .5 .6 .7 .8 .9 1 1.5 2 2.5 3 4
VITRINITE REFLECTANCE (R,%)
KEROGEN
TYPE

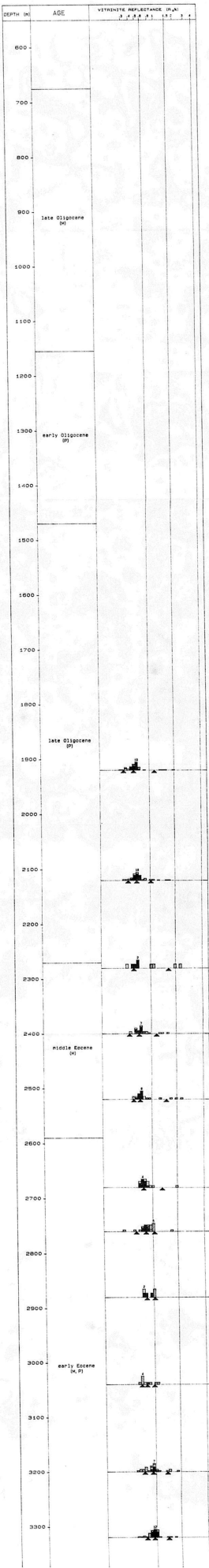
BUJAK DAVIES GROUP VITRINITE: Roberval K-92

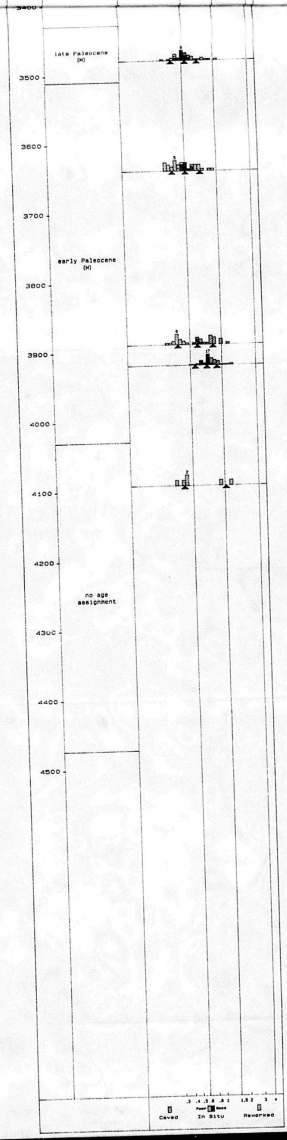



e. Albian (P)
e-m. Albian (P)
3200
3300
3400
3500
3600
3700
3800
3900
no age assignment
.3 .4 .5 .6 .8 1 1.5 2 3 4
Poor Good
Caved
In Situ
Reworked


BUJAK DAVIES GROUP KEROGEN: Rut H-11
DEPTH (m)
AGE
THERMAL ALTERATION INDEX •
1+ 2- 2 2+3- 3 3+ 4- 4 5
R H T G A P B S I
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
2100
2200
2300
2400
2500
2600
2700
2800
2900
3000
3100
3200
3300
3400
3500
3600
3700
3800
3900
4000
4100
4200
4300
4400
4500
late Oligocene (M)
early Oligocene (P)
late Oligocene (P)
middle Eocene (M)
early Eocene (M, P)
late Paleocene (M)
early Paleocene (M)
no age assignment
.3 .4 .5 .6 .7 .8 .9 1 1.5 2 2.5 3 4
VITRINITE REFLECTANCE (R₀%) +
KEROGEN TYPE

BUJAK DAVIES GROUP VITRINITE: Rut H-11



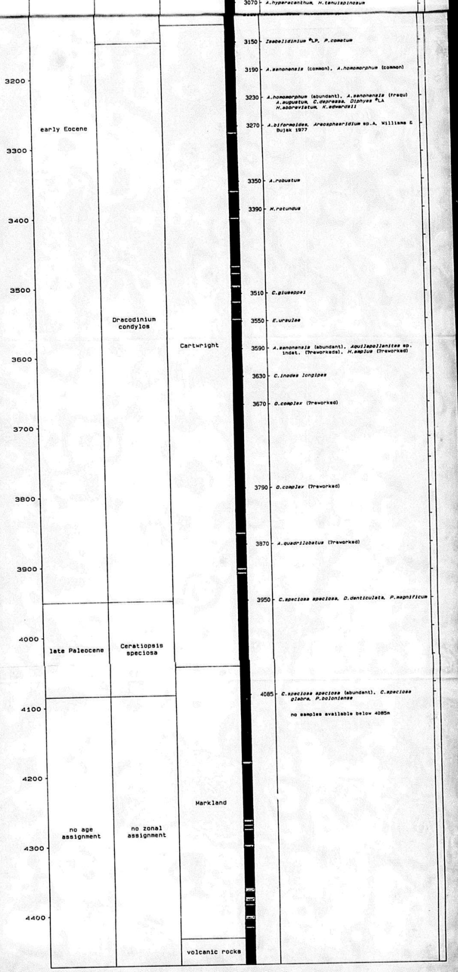

late Paleocene
(M)
early Paleocene
(M)
no age
assignment
3400
3500
3600
3700
3800
3900
4000
4100
4200
4300
4400
4500
Caved
In Situ
Reworked

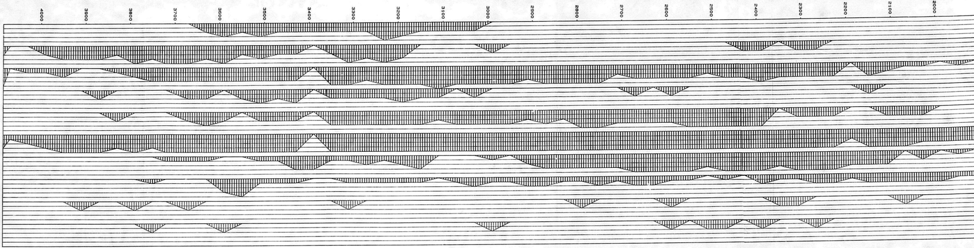
PALYNOLOGICAL ANALYSIS CHART
BUJAK DAVIES GROUP

CLIENT: G.S.C.
WELL: Rut H-11
AREA: Labrador Shelf

SCIENTIST: Bujak Davies Group
DATE: April 1987
SCALE: 1 cm = 25 metres

AGE	ZONE	FORMATIONS	LITHOLOGY	IMPORTANT SAMPLE DEPTHS	PALYNOLOGICAL EVENTS	SAMPLE LEVEL
				675	*C.similar, L.annetinoides, L.eocharaphorum, O.centrocarpum, S.rameus, T.igniculus*	
middle to late Miocene	O. centrocarpum /S. ancyrea			715	*H.camanula, S.enzyrea*	
early Miocene	Cordosphaeridium cantharellum			755	*A.cressipellis, Ceratiaceae ^{P}LA, D.eilytanteas, P.golzowense, Quercoidites ^{D}LV*	
				795	*L.evatus*	
				955	*D.pastielsii, T.viridiflumimpites*	
late Oligocene	Chiropteridium mespilanum	Saglek		995	*M.cf.camanula, M.explanatum*	
				1155	*A.remulifera, C.mespilanum, D.phosphoritica, G.intricata, S.pseudofurcatus*	
early Oligocene	Areosphaeridium arcuatum			1235	*Cyclonephelium* sp.B. Williams & Brideaux 1975	
				1305	*D.spinulosa, L.hyalina*	
				1395	*P.indentata*	
				1470	*Deflandrea ^{P}LR, Rouseisporites ^{P}LA*	
				1550	*D.cantharellum*	
				1870	*Jussasia* sp., Pell 1971	
early Oligocene to late Eocene	Deflandrea #LR	Hekami		2030	*T.vesiculosa*	
				2070	*Rouseisporites ^{P}LA*	
				2150	*A.verus, Azolla, B.betulaidea, C.funiculatum, Caryapa ^{P}LA, L.serrata, Quercoidites LA, LB & LC, Retitricolpites ^{P}LF*	
				2230	*B.blaeacantha*	
				2270	*A.senonensis, Fagus ^{P}LA, P.stellatus*	
middle to late Eocene	Areosphaeridium fenestratum			2310	*Azolla (common), Caesarea ^{P}LA, Chiropteridium ^{P}LA, E.cinnamomiidirectus, E.spinata, M.fragile (common)*	
				2390	*B.vicina, H.reticulum, H. undispinum, T.betula*	
middle Eocene	Eocladopyxis #LA			2430	*H.patulum*	
				2470	*C.auritus, V.crassiramosa, P.tagluenale*	
				2510	*H.corylioides, L.wetzelii*	
				2550	*H.articulata*	
				2590	*C.paradoxagenata, Systematophora ^{P}LE, Trinovantedinium ^{P}LA, H.macrofalcunata*	
				2630	*Canninitites ^{P}LT, D.colligerum, Trinovantedinium ^{P}LL, H.ovalis*	
				2670	*Homotryblium ^{P}LA, Trinovantedinium ^{P}LS, O.tiara*	
		Kenamu		2710	*D.suberana*	
				2750	*D.pannucea, T.pelagica*	
				2790	*H.tepidata, Hystrichosphaera ^{P}LP,*	
	Trinovantedin. #LA			2950	*C.fibrospinosum, D.pastielsiensis, H.pallidum, Systematophora ^{P}LC*	
				2990	*A.senonensis, P.subtile*	
				3030	*A.homomorphum, H.cinctum*	
				3070	*A.hyperacanthum, H.tenuispinosum*	


3070 A.hyperacanthum, H.tenuispinosum
3150 Isabelidinium *LP, P.cometum
3190 A.senonensis (common), A.homomorphum (common)
3230 A.homomorphum (abundant), A.senonensis (frequ)
A.augustum, C.depressa, Diphyes *LA
H.abbreviatum, K.edwardsii
3270 A.biformoides, Areosphaeridium sp.A, Williams &
Bujak 1977
3350 A.robustum
3390 H.rotundus
3510 C.giuseppei
3550 E.ursulae
3590 A.senonensis (abundant), Aquilapollenites sp.
indet. (?reworkeds), H.amplus (?reworked)
3630 C.inodes longipes
3670 O.complex (?reworked)
3790 O.complex (?reworked)
3870 A.quadrilobatus (?reworked)
3950 C.speciosa speciosa, D.denticulata, P.magnificum
4085 C.speciosa speciosa (abundant), C.speciosa
glabra, P.boloniense
no samples available below 4085m
early Eocene
late Paleocene
no age
assignment
Dracodinium
condylos
Ceratiopsis
speciosa
no zonal
assignment
Cartwright
Markland
volcanic rocks
3200
3300
3400
3500
3600
3700
3800
3900
4000
4100
4200
4300
4400


4000
3900
3800
3700
3600
3500
3400
3300
3200
3100
3000
2900
2800
2700
2600
2500
2400
2300
2200
2100
2000

1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
P R C A D
Apectodinium homomorphum
Areoligera senonensis
Marine Dinoflagellate
Azolla
Pediastrum
Gymnosperm Pollen
Angiosperm Pollen
Spores
Upper Cretaceous Reworking
Lower Cretaceous Reworking