

This report is released as part of AER/AGS Open File Report 2017-08. It includes biostratigraphic charts updated on 21 April 2009. See Appendix 5 of AGS Open File Report 2017-08 for updated results and interpretations.

**PALYNOLOGICAL ANALYSIS OF  
CORE AND OUTCROP SAMPLES  
FROM THE MCMURRAY FORMATION**

**AGS Tarsands Report #2**

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Project: 9933  
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Twenty-six outcrop samples from Daphne Island and 51 core samples from seven coreholes in the Fort McMurray area were processed for palynological analysis. The coreholes are as follows:

SOBC Fee Lot 2-4-90-9W4	7
Pex Daphne 6-36-95-11W4	8
Pex Daphne 5-1-96-11W4	10
AB/16-2-96-11W4	10
Pex Daphne 9-11-96-11W4	6
AD/9-12-96-11W4	8
16-11-96-10W4	2

The objective of the study was to determine the palynological successions and environments of deposition in order to sub-divide the McMurray Formation in this area.

Four of the coreholes contains spore associations not seen in the previous study (9828). One of these assemblages, present in 6-36-95-11W4 and 16-2-96-11W4, is considered to be of Barremian age.

Recoveries varied but were generally good but in some samples, oily or waxy residue obscured the kerogen. Charts showing palynomorph group abundances and kerogen abundances are included with the text. Charts showing species distributions in the coreholes and at Horse River are placed in an appendix.

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**SECTION 2****SUMMARY OF RESULTS**

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**COREHOLES**

Depth	Age	Salinity	Environment
<b>SOBC 2-4-90-9W4</b>			
251'	Aptian	1 - 1 <sup>+</sup>	Fluvial
269'	Aptian	1	Fluvial
350'	Aptian	1 - 1 <sup>+</sup>	Fluvio-lacustrine
364'	Aptian	1 - 1 <sup>+</sup>	Fluvio-lacustrine
378'	Aptian	1 - 1 <sup>+</sup>	Fluvio-lacustrine
397'	Aptian	1 - 1 <sup>+</sup>	Fluvio-lacustrine
398.1'	Aptian	1 - 1 <sup>+</sup>	Fluvio-lacustrine
<b>Pex Daphne 6-36-95-11W4</b>			
7.7m	Aptian	1 <sup>+</sup>	Flood, overbank
26.65m	Aptian	1	Fluvio-lacustrine
27.32m	Aptian	1	Fluvio-lacustrine
33.2m	Aptian	1	Fluvio-lacustrine
36.9m	Aptian	1	Fluvio-lacustrine
46.3m	Aptian	1	Fluvio-lacustrine
49-59m	Barremian	1	Fluvio-lacustrine
67.69m	Devonian		
<b>Pex Daphne 5-1-96-11W4</b>			
4.7m	Aptian		
6.8m	Aptian	1 - ?1 <sup>+</sup>	Fluvio-lacustrine
17.1m	Aptian	1 - ?1 <sup>+</sup>	Fluvio-lacustrine
26.1m	Aptian	1 - ?1 <sup>+</sup>	Fluvio-lacustrine
35.45m	Aptian	1	Oxidizing, overbank
39.1m	Aptian	1	Oxidizing, overbank
41.6m	Aptian	1	Oxidizing, overbank
54.7m	Aptian	1	Oxidizing, overbank
59.6m	Aptian	2	Upper estuarine
60.4m	Aptian	2	Upper estuarine

Depth	Age	Salinity	Environment
<b>AB/16-2-96-11W4</b>			
5m	Aptian	3	Nearshore, restricted marine
8.75m	Aptian	1 <sup>+</sup> - 2 <sup>-</sup>	Upper estuarine
20m	Aptian	1 - 1 <sup>+</sup>	Fluvio-lacustrine
35.7m	Aptian	1	Oxidizing, overbank
59.4m	Aptian	1	Fluvio-lacustrine
72.8m	Aptian	1	Oxidizing, overbank
76m	Barremian	1	Oxidizing, overbank
79.8m	Barremian	1	Oxidizing, overbank
96.9m	Barremian	1	Fluvio-lacustrine
98.5m	Devonian		
<b>Pex Daphne 9-11-96-11W4</b>			
40.9m	Aptian	1 <sup>+</sup> - 2 <sup>-</sup>	Very high estuarine
77.2m	Aptian	1	Channel
90m	Aptian	1	Abandoned channel
92m	Aptian	1	Low energy channel
101.4m	Aptian	1 - ? 1 <sup>+</sup>	Fluvio-lacustrine
111.2m	Aptian	1 - ? 1 <sup>+</sup>	Fluvio-lacustrine
<b>AD/9-12-96-11W4</b>			
33.1m	Aptian	1	Fluvio-lacustrine
39.6m	Aptian	2 <sup>-</sup>	Very high estuarine
70.75m	Aptian	2 <sup>-</sup>	Very high estuarine
92.3m	Aptian	1	Oxidizing, overbank
93.7m	Aptian	1	Oxidizing, overbank
96.9m	Aptian		Indeterminable
97.23m	Aptian	? 1	? Flood
109m	Aptian	? 1	? Flood
<b>16-11-96-10W4</b>			
86.35m	Aptian	1	Fluvio-lacustrine
101.09m	Aptian	1	Fluvio-lacustrine
<b>OUTCROPS</b>			
<b>Horse River</b>			
1	Latest Aptian -basal Albian	3 <sup>-</sup> - 3	Lower estuarine
2	Latest Aptian -basal Albian	3 <sup>-</sup> - 3	Lower estuarine
3	Latest Aptian -basal Albian	3 <sup>-</sup> - 3	Lower estuarine
4	Latest Aptian -basal Albian	3 <sup>-</sup> - 3	Lower estuarine

Depth	Age	Salinity	Environment
<b>Daphne Island East #1</b>			
1	Aptian	?1	Fluvio-lacustrine
1A	Indeterminable		
1B	Aptian	?1	Fluvio-lacustrine
2	Aptian	1	Fluvio-lacustrine
2A	Aptian	1	Fluvio-lacustrine
3	Aptian	1	Fluvial
4	Aptian	1	Fluvial
4A	Aptian	? 1	Fluvial
<b>Daphne Island East #2</b>			
5	Aptian	1	Fluvial
5A	Aptian	1	Fluvio-lacustrine
<b>Daphne Island East #3</b>			
7A	?Lake Aptian	1 (3)	Estuarine flood into overbank
8	Aptian	? 1	? Fluvial
8A	Aptian	1	Fluvio-lacustrine
<b>Daphne Island West #1</b>			
9	Aptian	1	Fluvio-lacustrine
10	Aptian	1	Fluvio-lacustrine
11	Aptian	1	Fluvio-lacustrine
<b>Daphne Island West #2</b>			
12	Aptian	1	Fluvio-lacustrine
<b>Daphne Island West #3</b>			
6	Aptian	1	Fluvio-lacustrine
7	Aptian	1	Fluvio-lacustrine
16	?Latest Aptian	3	Estuarine bay or lagoon
17	Aptian	1	Fluvio-lacustrine

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**SECTION 3****METHODS**

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To determine the proportions of the palynomorph taxa, a count of 200 specimens was made where possible. In some poor samples there were less than 200 specimens on the entire slide. The palynomorphs were assigned to biological groups to aid in the interpretation of the environments of deposition. The groups used are:

<b>Group</b>	<b>Environment</b>
Pteridophyte spores misc.	Swamp
Bisaccate pollen	Hinterland contribution
Taxodiaceae	Lowland floodplain swamps
Other gymnosperms	
Algae (Freshwater)	
Botryococcus	Lacustrine
Zygnemataceous spores	
Algae (Marine)	
Dinocysts Ceratioid	Abundance of some forms indicates reduced salinity
Peridinioid	Abundance of some forms indicates reduced salinity
Chorate	More abundant in open marine
Proximate	
Simple (indet.)	Unassignable. Usually fragments.
Hyaline	Essentially freshwater

The proportions and degree of sorting of the organic macerals was also determined where possible to help with the environmental interpretation. Unfortunately, some of the residues were unavoidably contaminated with an oily or waxy substance from the heavy oil in the core, which obscured the macerals.

The data are presented in percentage abundance histogram formats for the measured sections (coreholes and Horse River) and in spreadsheet format for the Daphne Island outcrops.

Table 1: General palynological indicators of degree of marine influence  
(Leckie et al. 1990)

ENVIRONMENT		DESCRIPTION
1	CONTINENTAL	Palynoflora composed of land derived microspores, megaspores and pollen.
2	SLIGHTLY BRACKISH	Introduction of saline water into an essentially fresh water environment, e.g., coastal lakes with outlets to the sea, inlets, upper estuaries and interdistributary channels. Littoral.  Contains rare specimens of ceratioid dinocysts (e.g., <i>Nyktericysta</i> , <i>Vesperopsis</i> and <i>Balmula</i> ) and a few acritarchs. Land derived spores and pollen abundant.
3	BRACKISH	Marginal marine conditions found in bays, estuaries, lagoons and barrier-associated backwaters. Increase in salinity.  Dinocyst species diversity low. Certain species of ceratioid and peridinioid dinocysts (e.g., <i>Luxadinium primulum</i> , <i>Palaeoperidinium cretaceum</i> ) appear in abundance. Assemblages often monospecific. Land - derived spores and pollen abundant.
4	NEARSHORE MARINE	Inner neritic environment. Shallow marine. Dinocyst diversity higher due to increased salinity but assemblages still dominated by land derived spores and pollen.
5	OPEN MARINE	Outer neritic environment. Close to the shelf margin. Fully saline. Dinocyst diversity high. Land derived spores and pollen reduced in quantity. Assemblages dominated by dinocysts.



## SECTION 4

## COREHOLES: ENVIRONMENTS

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### 2-4-90-9W4

Seven samples were processed and all yielded good assemblages. The 269' sample contained abundant ?waxy residue which prevented an assessment of the kerogen proportions and size distribution.

**Depths:** 398.1', 397', 378', 364', 350'  
**Environment:** Fluvio-lacustrine  
**Salinities:** 1 to 1<sup>+</sup>

#### Remarks

These samples contain modest numbers of dinocysts of fresh to barely brackish water origin including *Hurlandsia rugarum*, *Nykericysta arachnion*, *Holmwoodinium notatum* and sundry hyaline cysts. A specimen of *Circulodinium brevispinosum* occurs at 397'. Judging by the remainder of the assemblage, this species was either introduced during a minor flooding event or reworked, although the species first appears in the Aptian.

The kerogens are dominated by vitrinites and sapropels and there is evidence of very minor current activity at 398.1'.

The hinterland fraction (bisaccates) is very high (72-85%) and swamp-derived spores form a relatively minor proportion.

A low energy, fluvio-lacustrine setting is proposed with fresh to occasionally barely brackish salinities.

**Depth:** 269'  
**Environment:** Fluvial  
**Salinity:** 1

#### Remarks

This assemblage is essentially similar to the others in this well except that there are no dinocysts and the kerogen is partly obscured by a ?waxy residue.

A freshwater, fluvial environment is indicated.

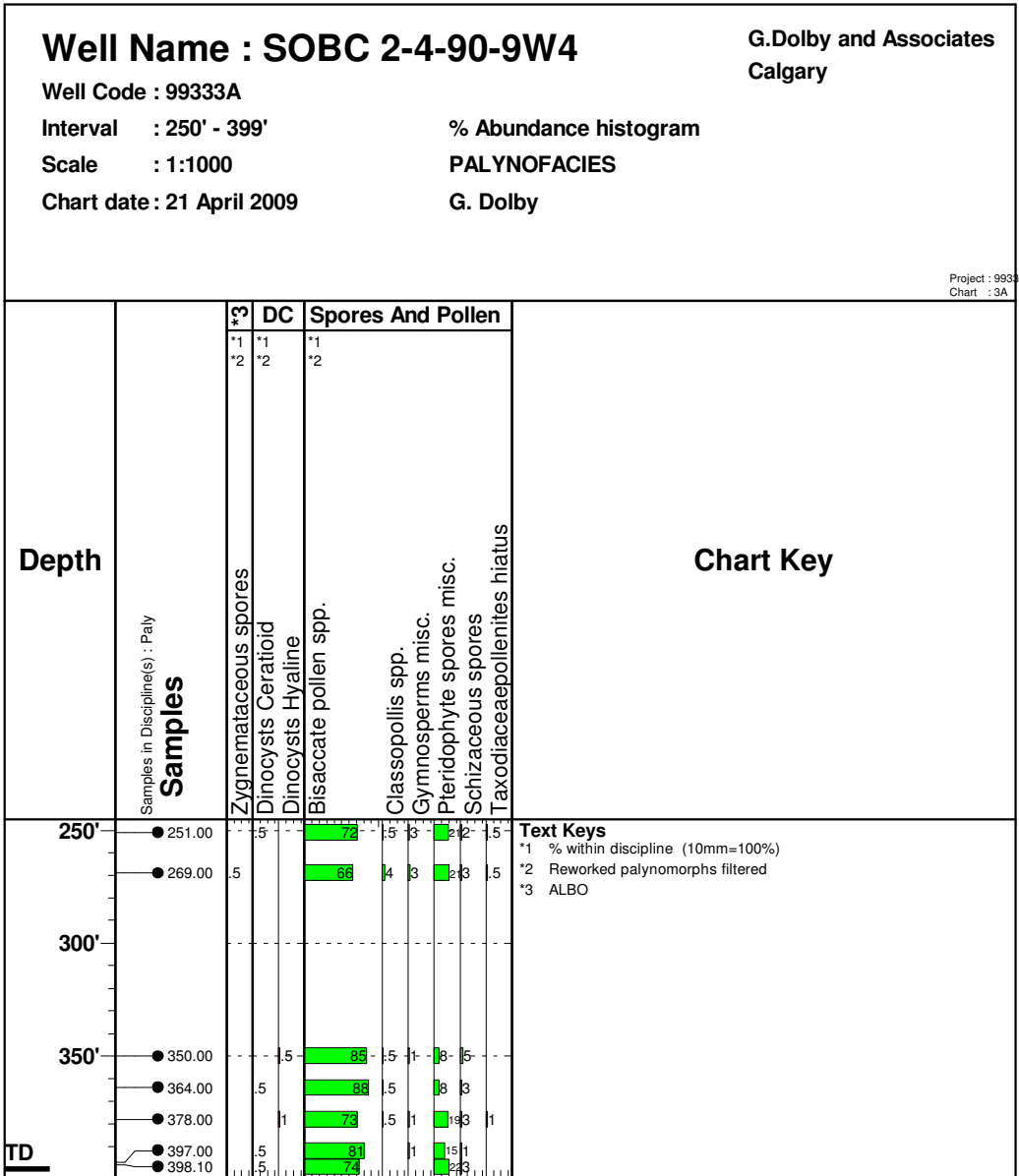
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**Depth:** 251'  
**Environment:** Fluvial  
**Salinity:** 1 to 1<sup>+</sup>

**Remarks:**

This sample is little different to the lower five in that it contains a small number of fresh to possibly faintly brackish dinocysts. There is evidence of very slight winnowing in the kerogen and a low energy, essentially freshwater, fluvial environment is suggested.





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## 6-36-95-11W4

Eight samples were processed and the assemblages are generally good except for 27.32 where the yield was low. The deepest sample at 67.69m is from the Devonian.

**Depths:** 49.59m, 46.3m, 36.9m, 33.2m, 27.32m, 26.65m  
**Environment:** Fluvio-lacustrine  
**Salinity:** 1

### Remarks:

There are no signs of saline influence in these samples. The lowest sample, from the *Trilobosporites Zone*, contains 5% *Classopollis* spp. which indicates an arid to semi-arid climate. The kerogen and the spore-pollen assemblage favor a fluvio-lacustrine environment (see 16-2-96-11W4, 96.9m).

At 46.3m and 36.9m *Classopollis* spp. are rare but the vitrinitic debris is predominately oxidized suggesting shallow water or a periodically exposed setting. The proportion of schizaceous spores favors the former. The upper sample contains hyaline cysts of probable freshwater origin and acritarchs which may have been reworked.

The kerogen in 33.2m is dominated by an amorphous, vitrinitic residue, possibly from a small lake.

The yield from 27.32m was low and the kerogen is oxidized which suggests a shallow, possibly fluvial environment.

There are no signs of oxidation in 26.65 and the high bisaccate content and two hyaline cysts indicate a freshwater fluvio-lacustrine setting.

**Depth:** 7.7m  
**Environment:** Flood deposit, overbank  
**Salinity:** 1<sup>+</sup>

### Remarks

This is a rich assemblage in which schizaceae comprise 13% of the assemblage. This group favored situations subject to flooding - drying out cycles. The presence of a small number of dinocysts including *Balmula tripenta* indicates a minor influx of brackish water associated with a flooding event.

# Well Name : Pex Daphne 6-36-95-11W4

Well Code : 99334A

Interval : 7.50m - 68.00m

% Abundance histogram

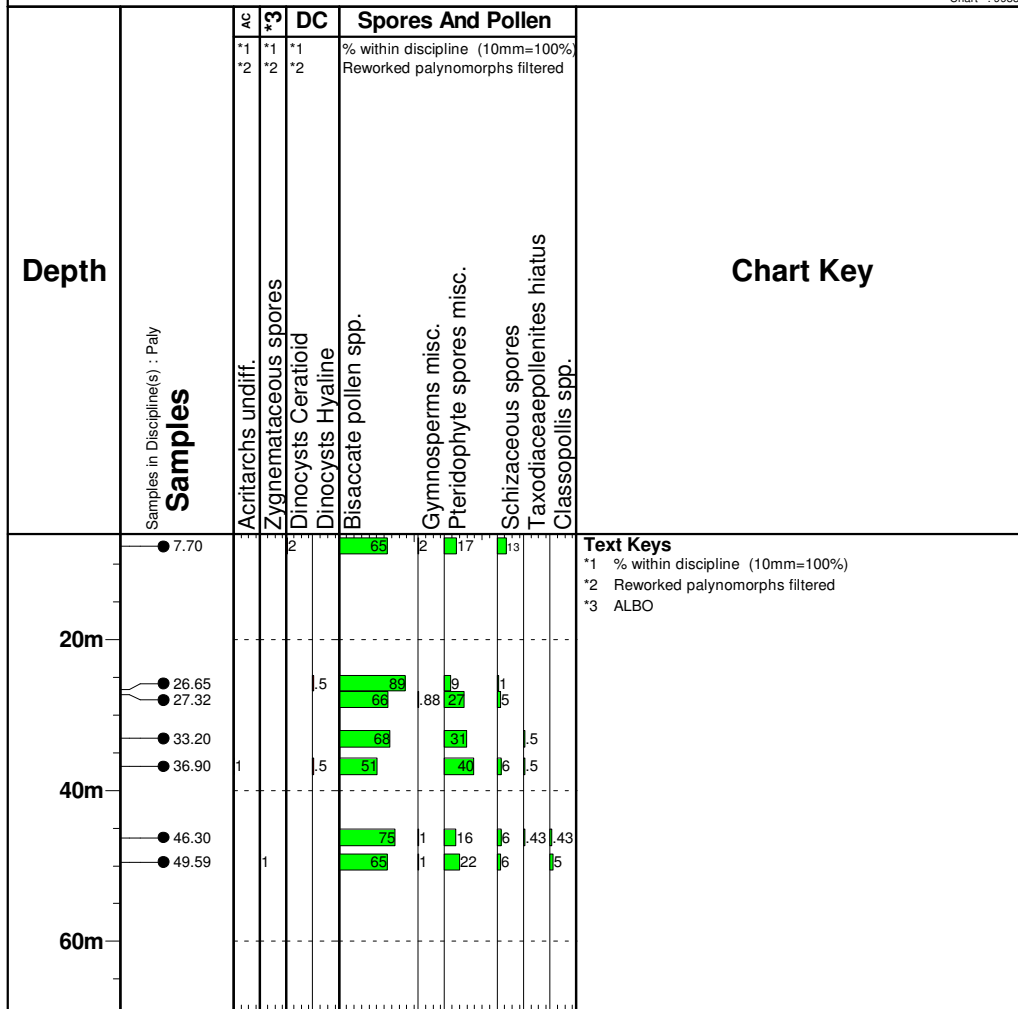
Scale : 1:1000

PALYNOFACIES

Chart date : 21 April 2009

G. Dolby

Project : 9933  
Chart : 99334A



# Well Name : Pex Daphne 6-36-95-11W4

Well Code : 99334B

Interval : 7.50m - 68.00m

% Abundance histogram

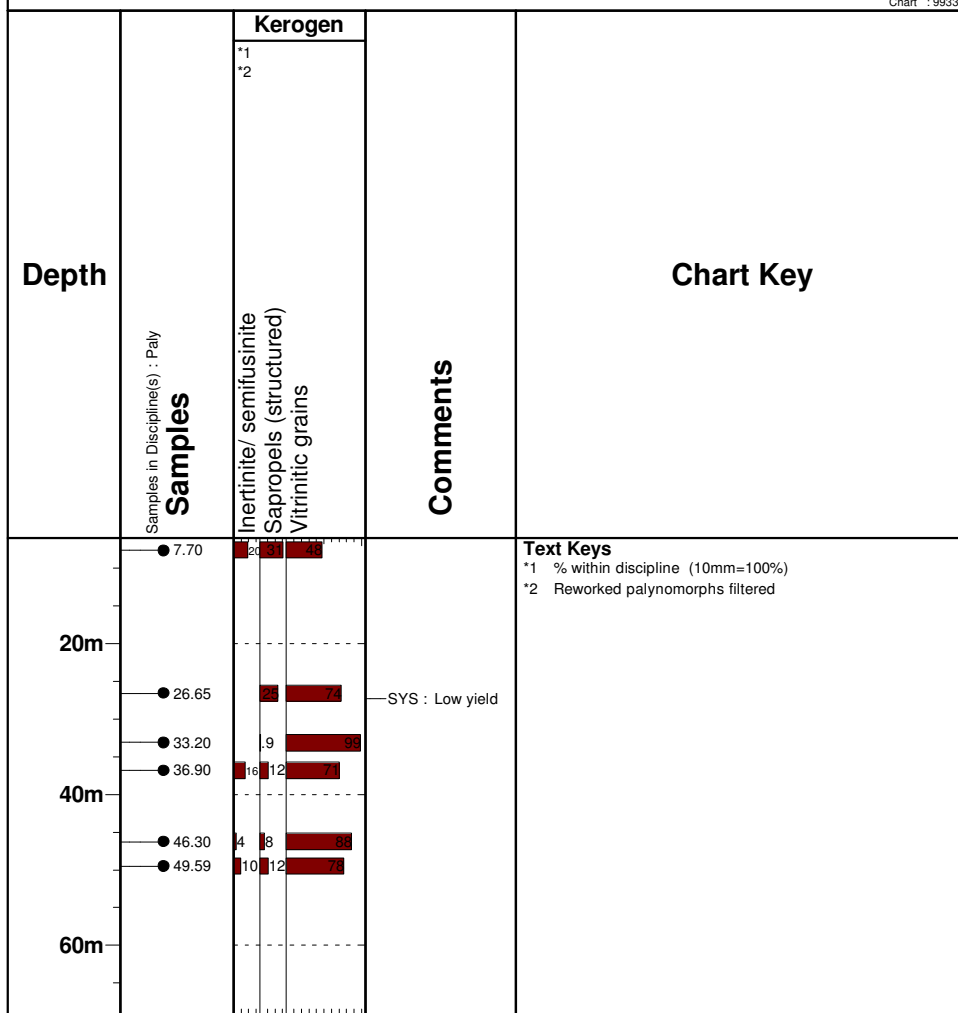
Scale : 1:1000

KEROGEN

Chart date : 21 April 2009

G. Dolby

Project: 9933  
Chart : 99334B



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## 5-1-96-11W4

Ten samples from this well were processed and most yielded good assemblages. Those from 4.7m and 39.1m contained some oil and ?waxy residues.

**Depths:** 60.4m, 59.6m  
**Environment:** Upper estuarine  
**Salinities:** 2

### Remarks:

These samples come from the "*grandis*" Zone. they both contain large numbers of dinocysts, most of which have yet to be described in the literature. The lower sample contains *Balmula* cf. *tripenta* and abundant *Nyktericysta* sp. which characterize Salinity Zone 2 environments. Also present are numerous *Atopodinium* spp. and *Mendicodinium* sp. B.

The upper sample does not contain *Balmula* spp. or *Nyktericysta* spp. but *Atopodinium* spp. and *Mendicodinium* sp. B are numerous as are hyaline cysts. The latter are almost certainly of freshwater origin and point to a possibly lower salinity level.

Both samples are considered to represent upper estuarine environments not unlike the Ostracod Formation.

**Depths:** 54.7m, 41.6m, 39.1m, 35.45m  
**Environment:** Oxidizing, overbank  
**Salinity:** 1

### Remarks:

The 39.1m sample is too poor to interpret with confidence. However, the kerogen consists predominantly of inertinite and oxidized vitrinite pointing to an at least periodically exposed position.

The other three contain high proportions of schizaceous spores which, with the predominately oxidized kerogen, suggest flood-prone, overbank settings.



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**Depths:** 26.1m, 17.1m, 6.8m, 4.7m  
**Environment:** Fluvio-lacustrine  
**Salinities:** 1 - ?1<sup>+</sup>

**Remarks:**

There is a distinct change here from the overbank assemblages below to bisaccate dominated assemblages. There is also an increase in vitrinite and sapropels with a concomitant decrease in inertinite. Small numbers of essentially freshwater dinocysts are also present. The sorting in the upper two samples indicates some current activity.

A fluvio-lacustrine environment is indicated.

# Well Name : Pex Daphne 5-1-96-11W4

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Calgary

Well Code : 99335A

Interval : 4.00m - 61.00m

% Abundance histogram

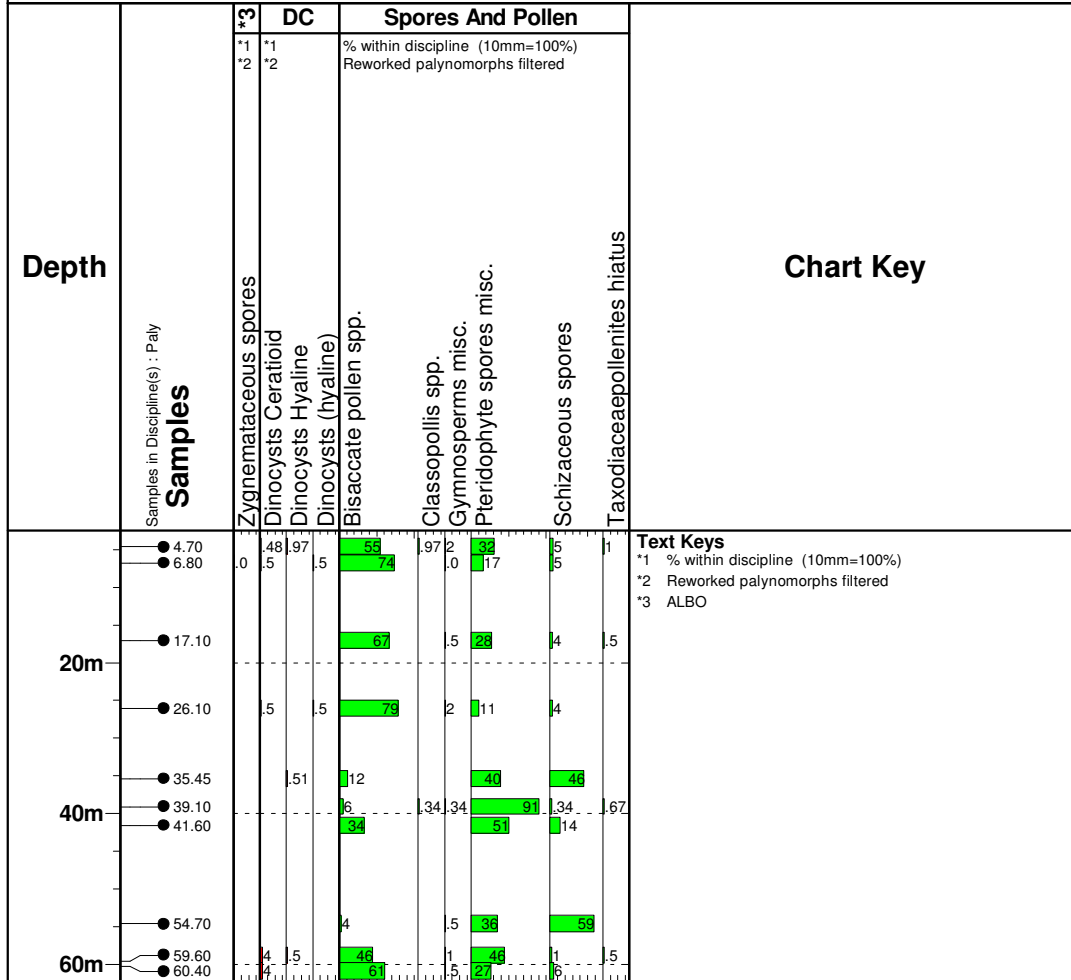
Scale : 1:1000

PALYNOFACIES

Chart date : 21 April 2009

G. Dolby

Project : 9933  
Chart : 99335A



# Well Name : Pex Daphne 5-1-96-11W4

Well Code : 99335B

Interval : 4.00m - 61.00m

% Abundance histogram

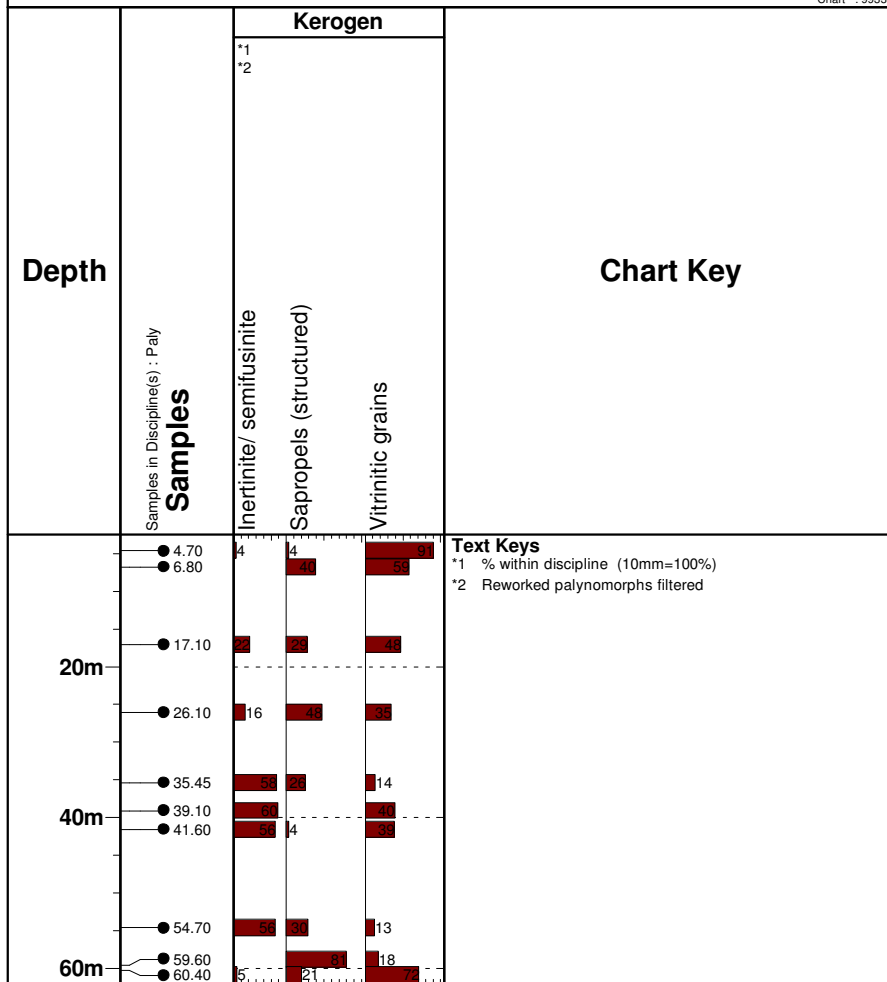
Scale : 1:1000

KEROGEN

Chart date : 21 April 2009

G. Dolby

Project : 9933  
Chart : 99335B



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## 16-2-96-11W4

Ten samples were processed from this well and the lowermost one (98.5m) is of Devonian age. Recoveries were good and in contrast to the other wells in this study, the uppermost sample yielded a restricted marine assemblage.

**Depth:** 96.9m  
**Environment:** Fluvio-lacustrine  
**Salinity:** 1

**Remarks:**

The arid/semi-arid climate in 6-36-95-11W4 at 49.59m is much in evidence here. *Classopollis* spp. are very numerous and the abundance of tetrads points to a nearby source. The hinterland gymnosperm pollen *Araucariacites australis* is also unusually abundant as is *Cerebropollenites mesozoicus*. Despite the climate, inertinitic debris forms a minor portion of the kerogen indicating a low level of oxidation. A fluvio-lacustrine environment is proposed.

**Depths:** 79.8m, 76m, 72.8m  
**Environment:** Oxidizing, overbank  
**Salinity:** 1

**Remarks:**

These samples are dominated by inertinitic debris and there is evidence of sorting (bimodal in 79.8m and 72.8m) which, with the high number of schizaceous spores, point to a flood-prone, overbank environment. Although the proportion is low, the number of *Classopollis* spp. at 76m is high, indicating a persistent arid to semi-arid climate.

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**Depth:** 59.4m  
**Environment:** Fluvio-lacustrine  
**Salinity:** 1

**Remarks:**

As in 5-1-96-11W4 at 26.1m, there is a distinct change from the oxidizing, overbank flood deposits beneath to a wetter, bisaccate dominated assemblage. The proportion of inertinite is relatively low and there appears to be some biodegradation although there are no signs of saline influences.

**Depth:** 35.7m  
**Environment:** Oxidizing, overbank  
**Salinity:** 1

**Remarks:**

The kerogen is oxidized and fairly well sorted which, with the higher than usual number of schizaceous spores, indicates a shallow, oxidized, overbank flood deposit. A single marine dinocyst may have washed in during the flood or it may be a contaminant.

**Depth:** 20m  
**Environment:** Fluvio-lacustrine  
**Salinities:** 1 - 1<sup>+</sup>

**Remarks:**

The environment reverts to a fluvial or fluvio-lacustrine one with a high level of biodegradation. There is a very faint saline influence in the form of a specimen of *Nyktericysta* sp. along with rare simple dinocysts and hyaline species which are probably of freshwater origin.

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**Depth:** 8.75  
**Environment:** Upper estuarine  
**Salinities:** 1<sup>+</sup> - 2<sup>-</sup>

**Remarks:**

The kerogen is oxidized and broken spore/pollen specimens are common but the sorting is extremely poor. Dinocysts are numerous but essentially freshwater forms outnumber the brackish species. A shallow, upper estuarine setting is suggested.

**Depth:** 5m  
**Environment:** Nearshore, restricted marine  
**Salinity:** 3

**Remarks:**

Dinocysts predominate in this sample but the poor preservation, due possibly to biodegradation, made it difficult to determine the abundances of all the taxa.

*Circulodinium brevispinosum* is the most abundant dinocyst (25%) followed by *Palaeoperidinium cretaceum* (15%). Open marine forms are relatively rare and the dominance of the above forms points to the brackish salinities found in the lower parts of estuaries or behind barrier bars. the rarity of bisaccate pollen (hinterland contribution) suggests some degree of restriction. An estuarine bay is also another possibility.

# Well Name : AB/16-2-96-11W4

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Well Code : 99331A

Interval : 4.00m - 100.00m

% Abundance histogram

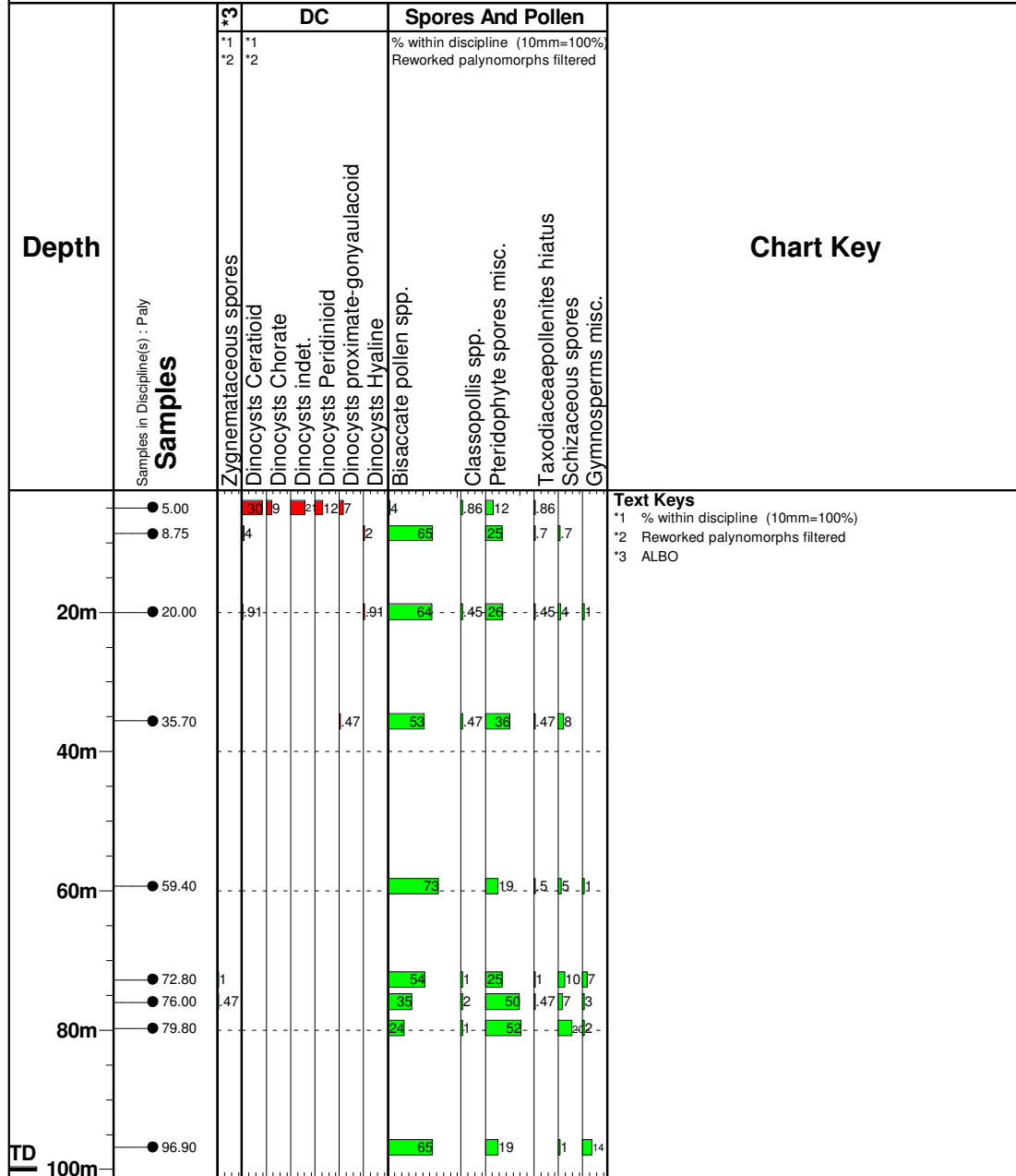
Scale : 1:1000

PALYNOFACIES

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Project : 9933  
Chart : 99331A



# Well Name : AB/16-2-96-11W4

Well Code : 99331B

Interval : 4.00m - 100.00m

% Abundance histogram

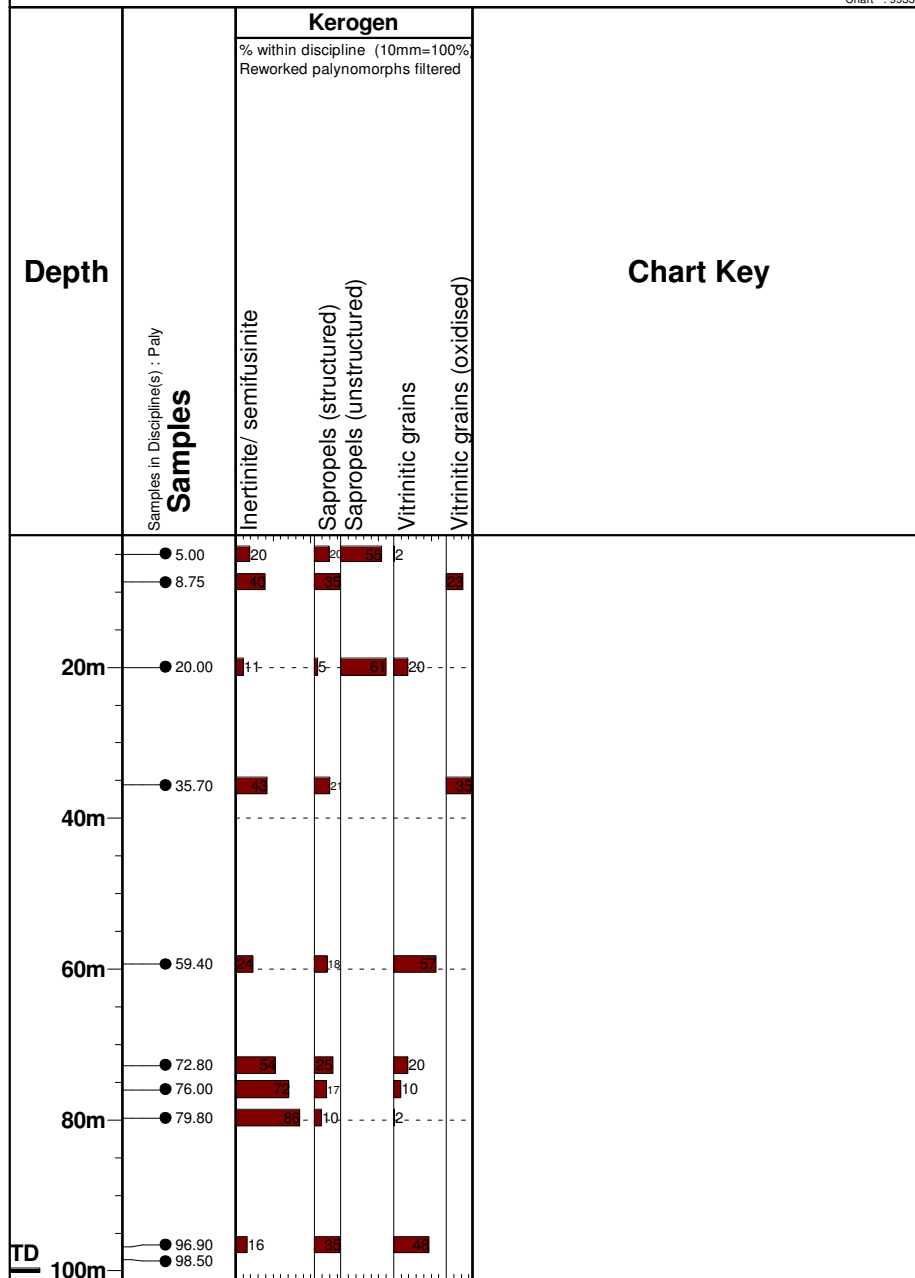
Scale : 1:1000

KEROGEN

Chart date : 21 April 2009

G. Dolby

Project : 9933  
Chart : 99331B





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## 9-11-96-11W4

Six samples were processed and recoveries varied considerably. The 77.2m sample yielded very little identifiable material and the 90m, 92m, and 111.2m sample yields were below average. The lowermost sample (111.2m) correlates with the "Grandis" Zone.

**Depths:** 111.2m, 101.4m  
**Environment:** Fluvio-lacustrine  
**Salinities:** 1 - ?1<sup>+</sup>

### Remarks:

The palynomorph yield from the 111.2m sample was low but abundant waxy residue prevented determination of the kerogen proportions. *Classopollis* spp. are numerous and indicate an arid/semi-arid climate. This group is also prominent as tetrads at 101.4m indicating a nearby source. In both cases, bisaccate pollen are abundant and swamp derived spores comprise a minor portion. Simple, ceratioid dinocysts are extremely rare and a specimen of *Hurlandsia rugarum* is present at 101.4m. An essentially freshwater environment is indicated although barely brackish salinities cannot be ruled out.

**Depth:** 92m  
**Environment:** Low energy channel  
**Salinity:** 1

### Remarks:

The spore-pollen yield was low and the kerogen consists of inertinite and oxidized vitrinite which indicates a shallow, oxidizing environment. There is some indication of sorting and small spores are more abundant than in most of the samples this study. A low energy channel (?abandoned) is suggested.

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**Depth:** 90m  
**Environment:** Abandoned channel  
**Salinity:** 1

**Remarks:**

Vitrinite and small spores predominate in this sample. There is some degree of sorting in the kerogen and this, with the kerogen composition suggests an abandoned channel.

**Depth:** 77.2m  
**Environment:** Channel  
**Salinity:** 1

**Remarks:**

The palynomorph yield is very low and consists predominantly of indeterminate spores. The kerogen is well sorted and mainly inertinitic. A channel environment is suggested.

**Depth:** 40.9m  
**Environment:** Very high estuarine  
**Salinities:** 1<sup>+</sup> - 2<sup>-</sup>

**Remarks:**

This sample resembles many of the high estuarine and fluvio-lacustrine assemblages in this study. Small numbers of *Hurlandsia rugarum* and *Nyktericysta* spp. and a specimen of *Balmula tripenta* indicate very low salinities.

# Well Name : Pex Daphne 9-11-96-11W4

Well Code : 99332A

Interval : 40.00m - 112.00m

% Abundance histogram

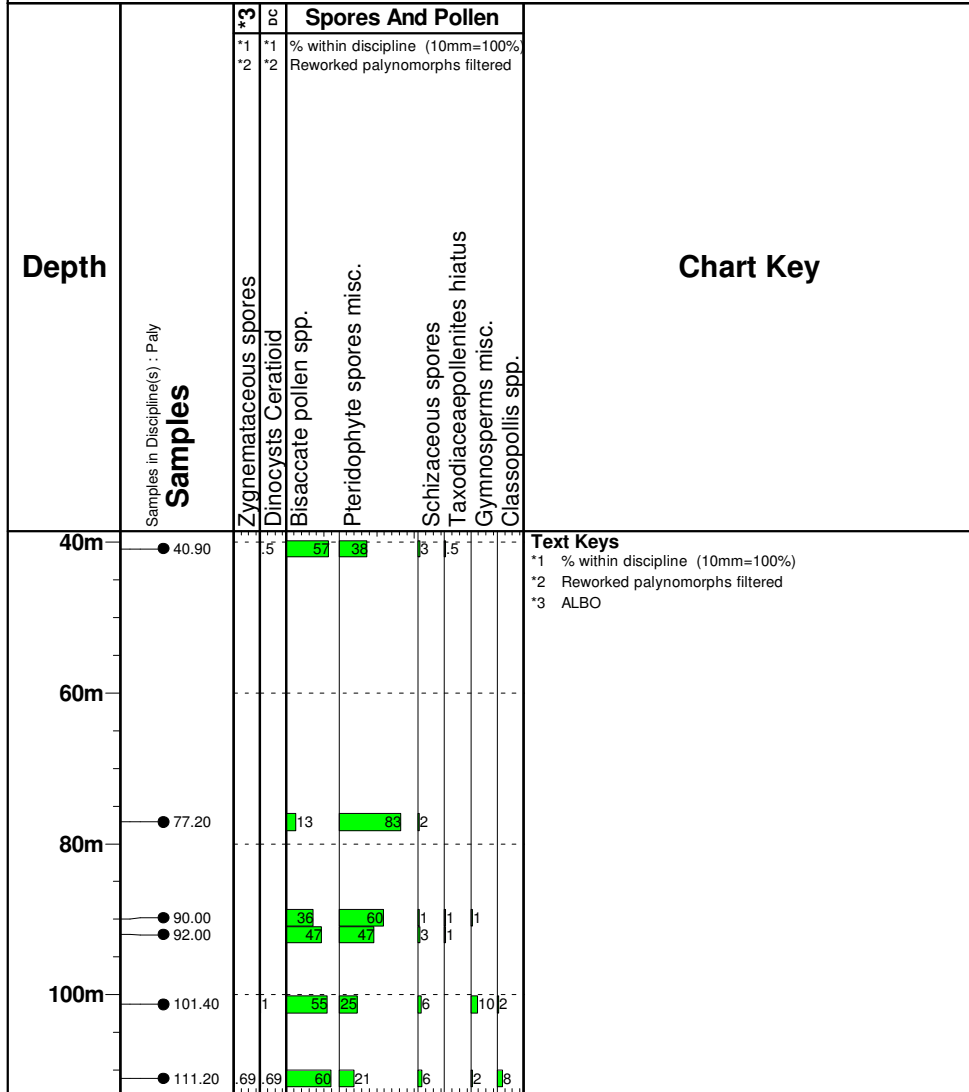
Scale : 1:1000

PALYNOFACIES

Chart date : 21 April 2009

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Project : 9933  
Chart : 99332A



# Well Name : Pex Daphne 9-11-96-11W4

Well Code : 99332B

Interval : 40.00m - 112.00m

% Abundance histogram

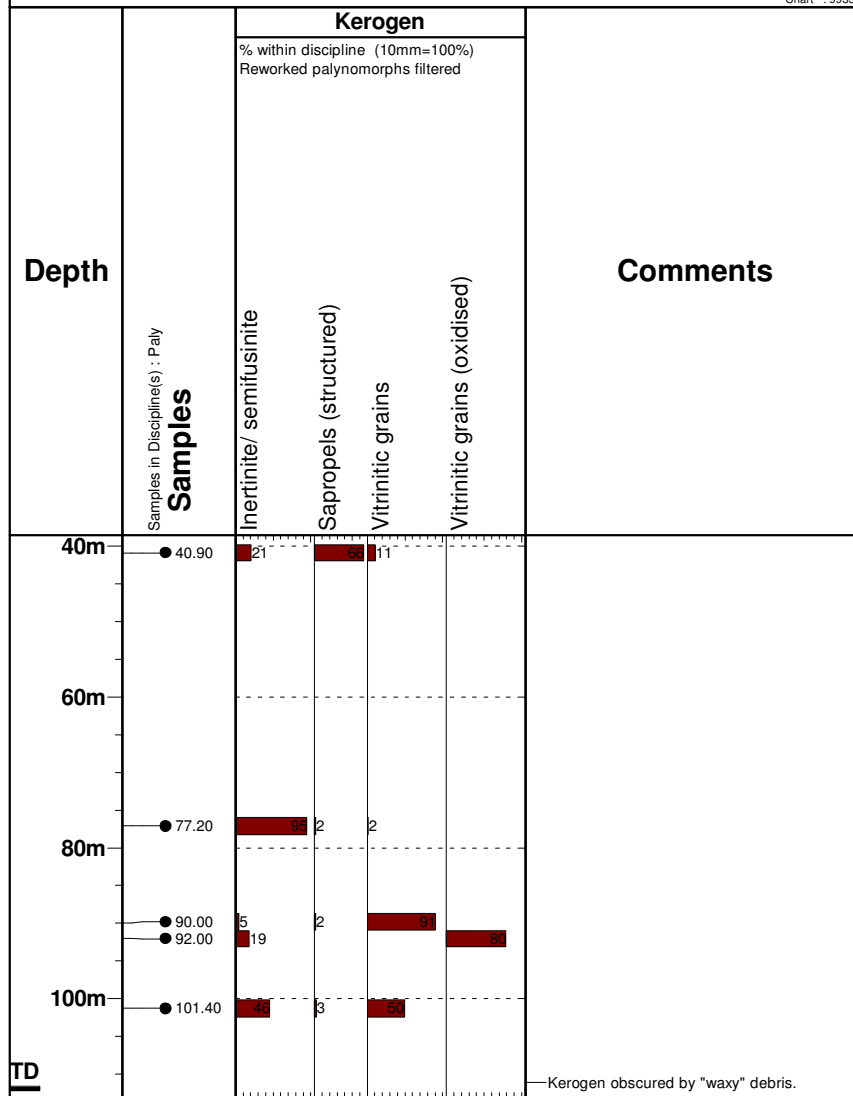
Scale : 1:1000

KEROGEN

Chart date : 21 April 2009

G. Dolby

Project : 9933  
Chart : 99332B



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**9-12-96-11W4**

Eight samples were processed and the yields were generally good except for the lower three where palynomorphs are extremely rare.

**Depths** 109m, 97.25m  
**Environment:** ?Flood deposits  
**Salinity:** ?1

**Remarks:**

Both samples yielded abundant vitrinitic debris of fairly uniform size. There are no palynomorphs in the upper sample and the lower contains only 15 spore/pollen specimens. It is possible that these are from mid-splay deposits where the heavier inertinites have been deposited in the proximal part of the unit and the lighter palynomorphs have been carried, in suspension, to the distal parts.

Five of the 15 palynomorphs at 109m are *Classopollis* spp. which suggests an arid/semi-arid climate.

**Depth:** 96.6m  
**Environment:** Indeterminable  
**Salinity:** Indeterminable

**Remarks:**

The residue consists of ?waxy and oil residue with only 3 palynomorphs.

**Depths** 93.7m, 92.3m  
**Environment:** Oxidizing, overbank  
**Salinity:** 1

**Remarks:**

Schizaceous spores and inertinitic debris are prominent in both samples indicating an oxidizing, flood-prone, overbank deposit. The kerogen in 92.3m is fairly well sorted presumably as a result of a flooding event. It also contains some hyaline dinocysts of probable fresh water origin.

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**Depths** 70.75m, 39.6m  
**Environment:** Very high estuarine  
**Salinity:** 2

**Remarks:**

These very rich assemblages resemble others from similar environments in this study. Both contain a mix of probable freshwater dinocysts, including *Hurlandsia rugarum*, with rare brackish dinocysts such as *Nyktericysta spp.* and *Balmula tripenta*.

**Depth:** 33.1m  
**Environment:** Fluvio-lacustrine  
**Salinity:** 1

**Remarks:**

This is a poor sample dominated by waxy and oil residues. It is dominated by bisaccate pollen and there are no dinocysts present.

# Well Name : AD/9-12-96-11W4

Well Code : 99336A

Interval : 33.00m - 112.00m

% Abundance histogram

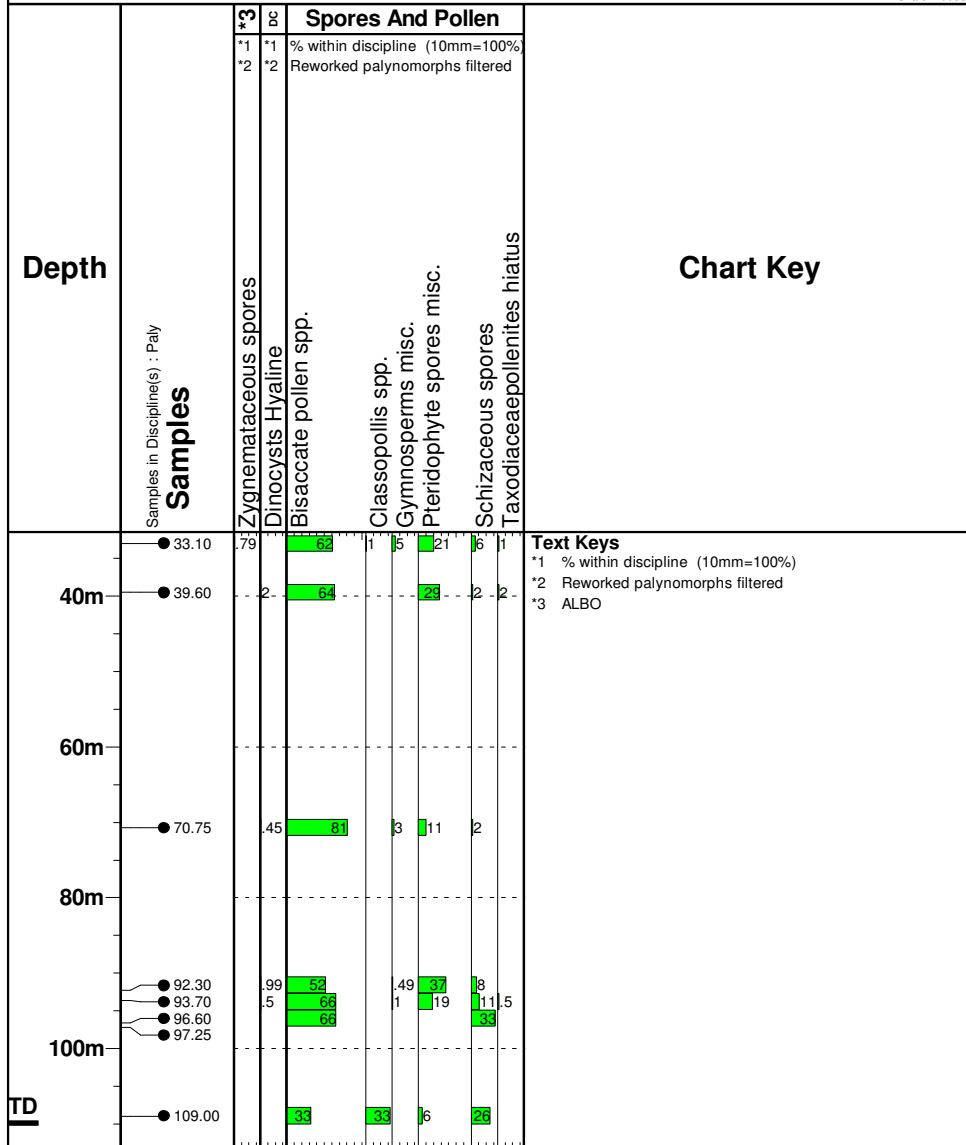
Scale : 1:1000

PALYNOFACIES

Chart date : 21 April 2009

G. Dolby

Project : 9933  
Chart : 99336A



# Well Name : AD/9-12-96-11W4

G.Dolby and Associates  
Calgary

Well Code : 99336B

Interval : 33.00m - 112.00m

% Abundance histogram

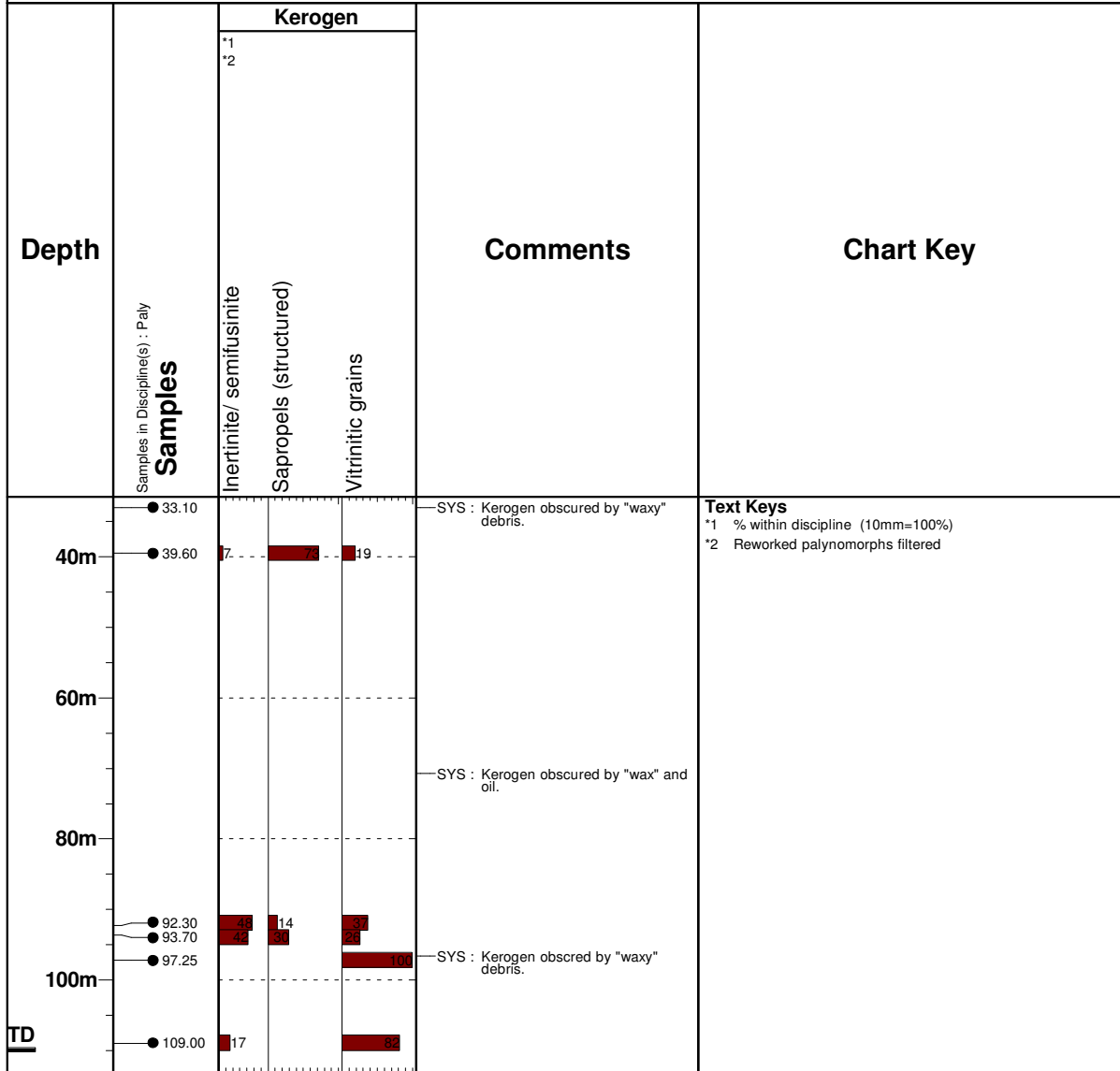
Scale : 1:1000

KEROGEN

Chart date : 21 April 2009

G. Dolby

Project : 9933  
Chart : 99336B





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**16-11-96-10W4**

Only two samples were prepared from this well and both yielded good assemblages of spores and pollen.

**Depths:** 101.09m, 86.35m  
**Environment:** Fluvio-lacustrine  
**Salinity:** 1

**Remarks:**

The palynomorph and kerogen assemblages are virtually identical in overall composition but the lower one is richer in spores and pollen. Both are dominated by bisaccate pollen and resemble other fluvio-lacustrine samples in this study. Questionable specimens of hyaline cysts are present in both but there are no signs of saline influences.

# Well Name : 16-11-96-10W4

Well Code : 99338A

Interval : 86.00m - 102.00m

% Abundance histogram

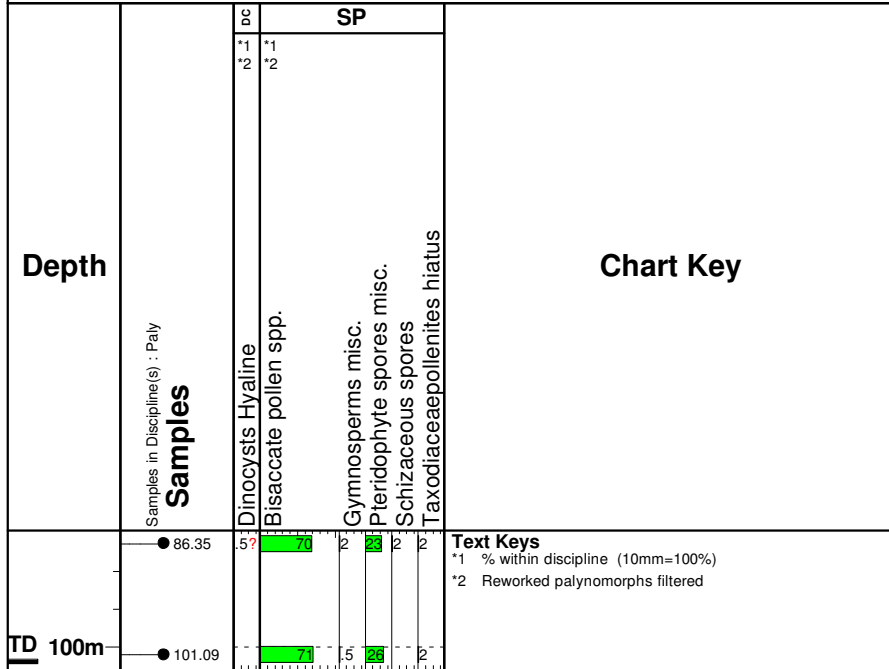
Scale : 1:1000

PALYNOFACIES

Chart date : 21 April 2009

G. Dolby

Project : 9933  
Chart : 99338a





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**SECTION 5**

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**COREHOLES: AGE & CORRELATIONS**

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Four of the seven coreholes studied contained spore assemblages not seen in the previous study of the Lower McMurray (Report 9828). The basal 18m or so in 6-36-95-11W4 and in 16-2-96-11W4 contained a distinctive association of *Trilobosporites* spp. and a new spore, *Aequitriradites* "grandis". The range of the latter extends above the extinction points for the *Trilobosporites* flora and is also found at the base of 5-1-96-11W4 and of 9-11-96-11W4. These events appear to be correlatable.

Several spore species appear above the *Trilobosporites* spp. extinction but the sequences of appearances vary from well to well presumably as a result of environments of deposition and sampling density.

The range bases and tops are summarised below. The bases of other potentially important species which appear only sporadically are also summarised on the chart.

<b>BASES</b>	2-4-90-9W4	6-36-95-11W4	5-1-96-11W4	16-2-96-11W4	9-11-96-11W4	9-12-96-11W4
Foraminisporis asymmetricus	397ft	7.7m	26.1m	59.4m	40.9m	70.75m
Dictyotriletes granulatus	378ft	36.9m	26.1m	59.4m	90m	70.75m
Concavissimisporites tribotrys	378ft		26.1m	35.7m		70.75m
C. trioreticulosus	269ft	46.3m	26.1m	79.8m	40.9m	70.75m
C. purverulentus	397ft	26.65m	54.7m	76m	40.9m	92.3m
Microreticulatisporites uniformis	398.1ft	49.59m	54.7m	35.7m	90m	93.7m
<b>TOPS</b>						
Aequitriradites "grandis"		46.3m	59.6m	76m	111.2m	
Triporoletes incertus		49.59m		96.9m		
Trilobosporites spp.		49.59m		79.8m		
<b>OTHER BASES</b>						
Cicatricosisporites augustus	398.1ft	49.59m	60.4m	96.9m	111.2m	109m
C. subrotundatus	269ft		60.4m		101.4m	93.7m
Appendicisporites bilateralis			39.1m			
A. potomacensis	398.1ft	49.59m	26.1m	35.7m		92.3m
A. erdtmannii	378ft			59.4m	101.4m	93.7m
Plicatella jansonii	251ft		6.8m		101.4m	92.3m
Triporoletes simplex		7.7m				
T. triangularis			6.8m			
T. radiatus				59.4m		70.75m
Kuylisporites lunaris	251ft		26.1m	96.9m	101.4m	92.3m

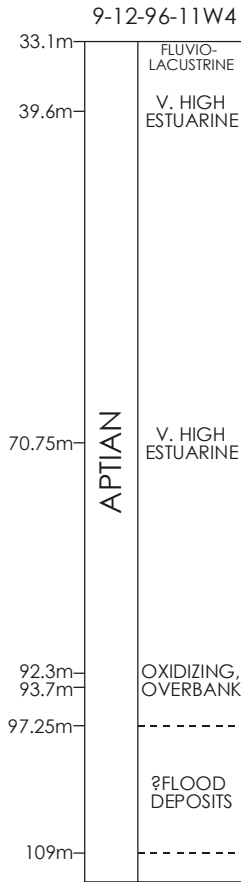
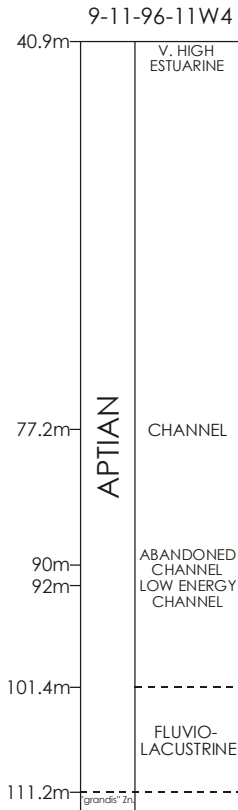
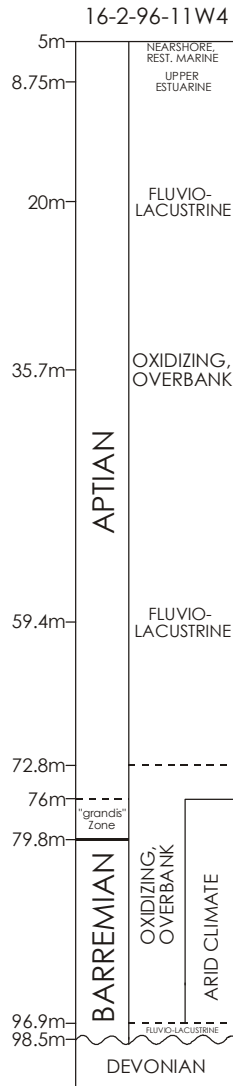
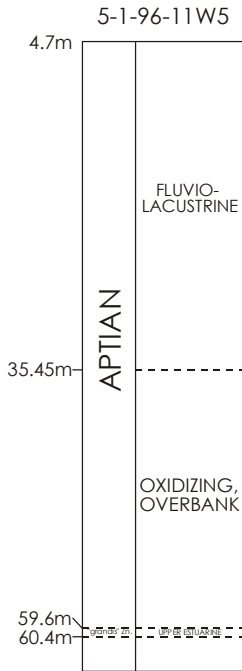
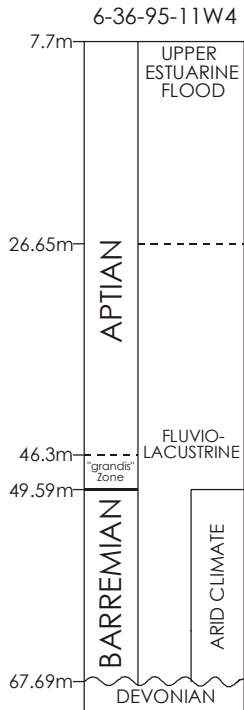
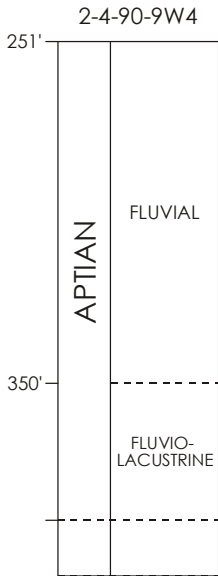
Burden (1984) describes a zone characterised by *Trilobosporites* spp. and *Triporoletes incertus* (CI Zone) which he assigned to the Valanginian-Hauterivian. The overlying TA Zone, which is characterised by *Concavissimisporites trioreticulosus*, *Foraminisporis asymmetricus*, *C. triotrys*, *C. purverulentus*, *Dictyotriletes granulatus*, *Plicatella jansonii*, *Kuylisporites lunaris*, *Microreticulatisporites uniformis*, *Triporoletes radiatus* and *Appendicisporites erdtmanii*, was given a Hauterivian - early Barremian age despite the fact that Aptian and younger dinocysts were also recorded. The contact between the two zones was not observed.

The contact is present in two of these coreholes and the ranges of some of Burden's TA Zone species occur with CI Zone markers. The age of the post "*grandis*" samples is almost certainly Aptian although the full stratigraphic range of many of the spore species is imprecisely known. The samples containing *A. "grandis"* in 5-1-96-11W4 contain numerous brackish water dinocysts, including *Nyktericysta* spp. and *Balmula* cf. *tripenta*, which have strong Aptian affinities.

There is little doubt that the *Trilobosporites* spp. assemblage is of Neocomian age but from the presence of the TA Zone species, it is most likely to be of Barremian, possibly Late Barremian age.

The two samples from 16-11-96-10W4 contain *F. asymmetricus*, *M. uniformis* and *K. lunaris* and are of Aptian age.

398.1'



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STRATIGRAPHY AND ENVIRONMENTS OF DEPOSITION	
PROJECT 9933	MAY 2000

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**SECTION 6****OUTCROPS: ENVIRONMENTS**

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Twenty-six outcrop samples from the Horse River-Daphne Island area were processed. Only the four from Horse River came from a measured section and the data from these are plotted to scale. The data from the remainder are presented on a series of spread sheets.

**Horse River**

**Samples:** 1C, 2C, 3C, 4C  
**Environment:** Lower estuarine  
**Salinities:** 3<sup>-</sup> - 3

**Remarks**

Although the dinocysts assemblages are moderately diverse, ceratioid species tend to predominate indicating some environmental stress associated with reduced salinities. In addition, the two upper samples contain numerous hyaline cysts which were probably the result of an influx of freshwater.

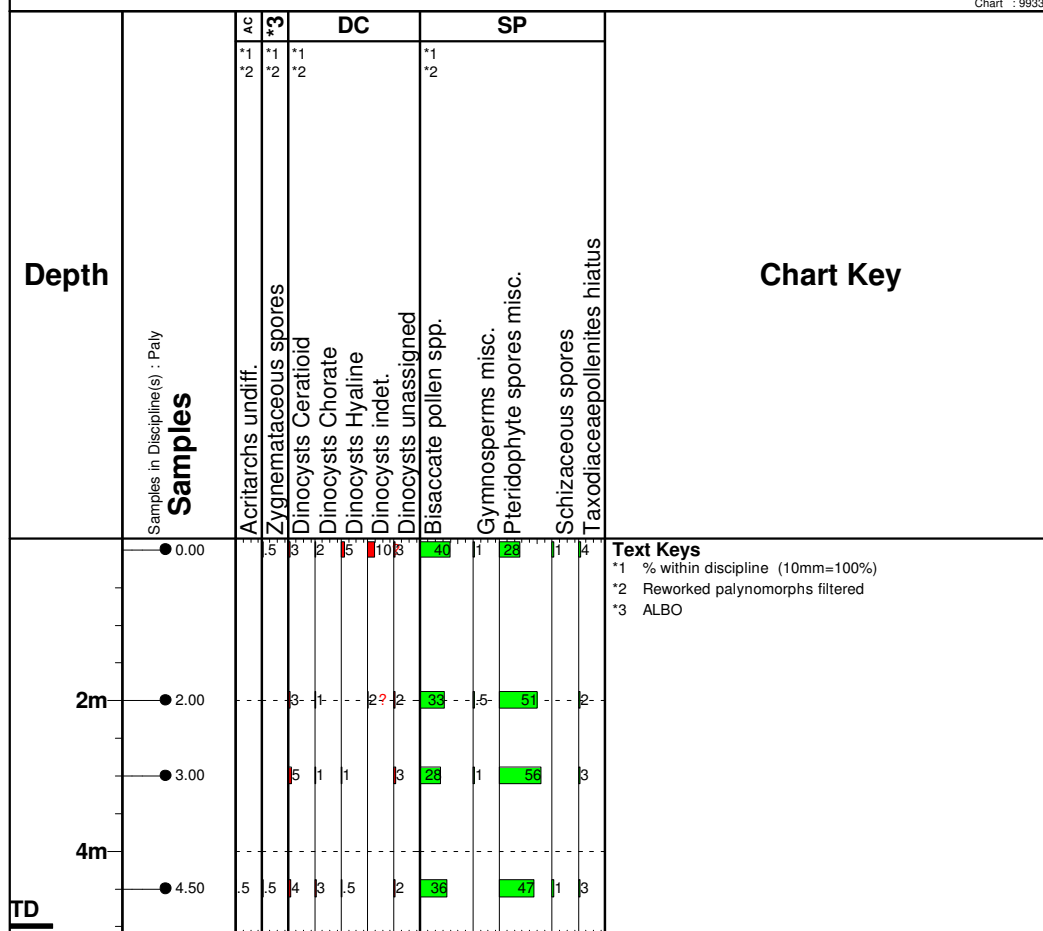
Pteridophyte spores are abundant and represent input from local, marginal swamps.

The kerogen is bimodally sorted in 2C and 3C and shows a tendency to bimodal sorting in 4C. This may be the result of tidal movements or storm activity.

A lower estuarine setting is indicated.

**G.Dolby and Associates  
Calgary**

Project : 9933  
Chart : 9933hrs





# Well Name : HORSE RIVER

Well Code : 9933HRK

Interval : 0.00m - 5.00m

% Abundance histogram

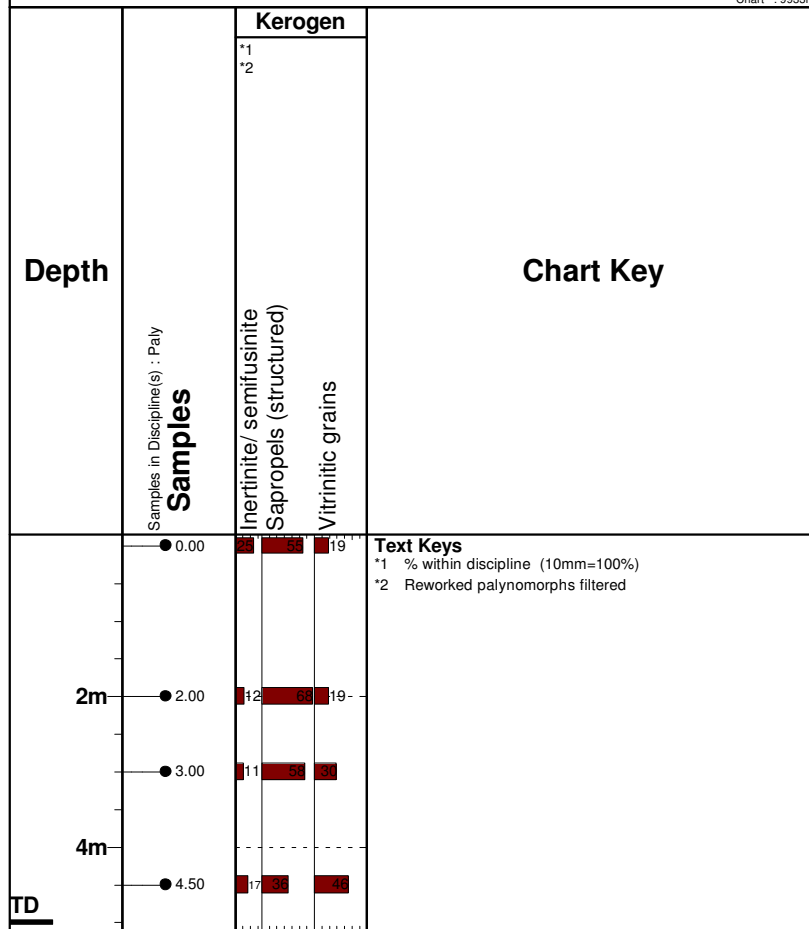
Scale : 1:100

KEROGEN

Chart date : 21 April 2009

G. Dolby

Project : 9933  
Chart : 9933hrk



## Daphne Island East #1

The recoveries in 6 of the 9 samples processed were poor and in two instances, oily residue is abundant.

**Sample:** 1  
**Environment:** Fluvio-lacustrine  
**Salinity:** ?1

### Remarks

The assemblage is small, bisaccate dominated and there are no signs of marine influence. The kerogen appears to be all vitrinitic and may reflect a coaly origin.

**Sample:** 1A  
**Environment:** Indeterminable

### Remarks

The assemblage is too small to interpret but the kerogen appears to be all vitrinitic similar to sample 1.

**Sample:** 1B  
**Environment:** Fluvio-lacustrine  
**Salinity:** ?1

### Remarks

The assemblage is similar to #1 but the residue is dominated by bitumen.

**Sample:** 2, 2A  
**Environment:** Fluvio-lacustrine  
**Salinity:** 1

### Remarks

These are rich, bisaccate dominated terrestrial assemblages similar to many others in this study. There is a stronger swamp influence in 2A where spores are abundant and the kerogen is essentially vitrinitic, possibly reflecting a coaly origin.

**Sample:** 3  
**Environment:** Fluvial  
**Salinity:** 1

#### Remarks

The kerogen is quite well sorted indicating current activity although the spore-pollen assemblage is little different from 2 and 2A.

**Sample:** 4, 4A  
**Environment:** Fluvial  
**Salinities:** 1, ?1

#### Remarks

The assemblages are small in these samples and the residues are dominated by bitumen. The kerogen sorting is fairly good, indicating some current activity. A single dinocyst in 4A may have washed in or may be a contaminant. There are no other signs of marine influence.

DAPHNE ISLAND E #1	1	1A	1B	2	2A	3	4	4A	4B
<b>Spores &amp; Pollen</b>	*	*	*				*	*	*
Bisaccate pollen	55	15	55	66.5	50	78	23	124	1
Gymnosperms misc.				1	1	1		2	
Pteridophyte spores	2	1	9	30	44	17.5	38	11	
Schizaceae	1		3	1.5	4	2	5	4	1
Taxodiaceae				1	1	1			
<b>Algae</b>						0.5			
<b>Dinocysts</b>									
Ceratioid	1							1	
Peridinioid	1								
* Total counts									
<b>Kerogens</b>									
Inertinite			oil						oil
Vitrinite				3			27	60	
Sapropel (structured)	100	100		85	100	85	50	35	
				12		15	23	5	
<b>Sorting</b>									
<b>Salinity</b>	EP			EP	?	F-G	F	F	
	?1			1	1	1	1	?1	

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## Daphne Island East #2

**Sample:** 5  
**Environment:** Fluvial  
**Salinity:** 1

### Remarks

This is a rich assemblage and there are signs of sorting in the kerogen which indicate current activity. There is no evidence of marine influence.

**Sample:** 5A  
**Environment:** Fluvio-lacustrine  
**Salinity:** 1

### Remarks

This is a small assemblage within a vitrinitic (?coaly) kerogen residue. There is no sign of marine influence.

DAHPNE ISLAND E #2	5	5A
<b>Spores &amp; Pollen</b>		*
Bisaccate pollen	85.5	92
Classopollis spp.		2
Gymnosperms misc.	1.5	3
Pteridophyte spores	12.5	61
Schizaceae	0.5	1
* Total counts		
<b>Kerogens</b>		
Inertinite	7.5	
Vitrinite	85	100
Sapropel (structured)	7.5	
<b>Sorting</b>	Sl.win.	V. poor
<b>Salinity</b>	1	1

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### Daphne Island East #3

**Sample:** 7A  
**Environment:** Estuarine flood into an overbank setting  
**Salinity:** 1 (3)

#### Remarks

The terrestrial fraction is typical of a flood prone, overbank deposit in that it contains 12% schizaceous spores. There is also a small marine component typical of estuarine or marginal marine environments. The latter were probably introduced during a flooding event from a nearby estuary.

**Sample:** 8  
**Environment:** ?Fluvial  
**Salinity:** ?1

#### Remarks

The spore-pollen assemblage is very small but the kerogen is fairly well sorted indicating current activity. There are no marine indicators but only 30 palynomorphs were recorded.

**Sample:** 8A  
**Environment:** Fluvio-lacustrine  
**Salinity:** 1

#### Remarks

This is a rich, bisaccate dominated assemblage with no sign of marine influence.

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<b>DAPHNE ISLAND E #3</b>	7A	8	8A
<b>Spores &amp; Pollen</b>		*	
Bisaccate pollen	46.5	27	83.5
Gymnosperms misc.	0.5		1
Pteridophyte spores	36	3	12
Schizaceae	12		3.5
Taxodiaceae	3		
<b>Dinocysts</b>			
Ceratioid	1		
Chorate	1		
* Total counts			
<b>Kerogens</b>			
Inertinite		10	25
Vitrinite	75	90	22
Sapropel (structured)	25		53
<b>Sorting</b>	EP	F	EP
<b>Salinity</b>	?	?1	1

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## Daphne Island West #1

**Samples:** 9, 10, 11  
**Environment:** Fluvio-lacustrine  
**Salinity:** 1

### Remarks

These are rich assemblages dominated by bisaccate pollen. Swamp influence is slightly higher in 10 and 11 and the latter also contains a questionable dinocyst. However, there are no signs of marine influence.

<b>DAPHNE ISLAND W #1</b>	9	10	11
<b>Spores &amp; Pollen</b>			
Bisaccate pollen	73.5	56.5	57.5
Classopollis spp.			0.5
Gymnosperms misc.	1	1	3
Pteridophyte spores	23	40.5	36
Schizaceae	1	2	1.5
Taxodiaceae	1.5		1
<b>Dinocysts</b>			
Ceratioid			?0.5
* Total counts			
<b>Kerogens</b>			
Inertinite	17	8	25
Vitrinite	18	12	15
Sapropel (structured)	63	80	60
<b>Sorting</b>	EP	EP	EP
<b>Salinity</b>	1	1	1

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## Daphne Island West #2

**Sample:** 12  
**Environment:** Fluvio-lacustrine  
**Salinity:** 1

### Remarks

The assemblage is small but bisaccate dominated and resembles other fluvio-lacustrine samples in this study. Oil and ?wax obscures much of the kerogen.

<b>DAPHNE ISLAND W #2</b>	12
<b>Spores &amp; Pollen</b>	*
Bisaccate pollen	55
Gymnosperms misc.	3
Pteridophyte spores	13
Schizaceae	1
* Total counts	
<b>Kerogens</b>	oil/wax
<b>Sorting</b>	
<b>Salinity</b>	1



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### **Daphne Island West #3**

**Samples:** 6, 7  
**Environment:** Fluvio-lacustrine  
**Salinity:** 1

#### **Remarks**

Yields from both samples were low, especially for #7. As with many of the other samples, they are dominated by bisaccate pollen and there are no signs of marine influence. The kerogen, which appears to be vitrinitic, reacts strangely to oxidation in the lab. It may be some form of bituminous residue.

**Samples:** 16  
**Environment:** Estuarine bay or lagoon  
**Salinity:** 3

#### **Remarks:**

This sample contained a rich spore--pollen assemblage and numerous dinocysts. The latter show a tendency to single group dominance which indicates reduced salinities. The high pteridophyte spore content and modest number of bisaccates points to some restriction in the environment. An estuarine bay or lagoonal setting is suggested.

**Sample:** 17  
**Environment:** Fluvio-lacustrine  
**Salinity:** 1

#### **Remarks:**

This sample is rich, bisaccate dominated and non-marine. It resembles many of the other freshwater assemblages in this study.

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<b>DAPHNE ISLAND W #3</b>	6	7	16	17
<b>Spores &amp; Pollen</b>		*		
Bisaccate pollen	95.5	44	13.5	69.5
Gymnosperms misc.			0.5	
Pteridophyte spores	4.5	4	77	26.5
Schizaceae		2		2
Taxodiaceae			2	0.5
Angiosperm pollen	?	?		
<b>Dinocysts</b>				
Ceratioid			4.5	
Chorate			1	
Hyaline			1	
Indeterminate			0.5	1.5
* Total counts				
<b>Kerogens</b>	?wax	?wax		
Inertinite			40	40
Vitrinite			20	25
Sapropel (structured)			40	35
<b>Sorting</b>	?F	EP	EP	EP
<b>Salinity</b>	1	1	3	1

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**SECTION 7****OUTCROPS: AGES**

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Of the 26 outcrop samples processed, only 6 yielded assemblages containing marine dinocysts and these are described below. The remainder are of non-marine origin containing spore-pollen assemblages with no evidence of an age older than Aptian. They are generally comparable to the Aptian sections in the coreholes.

**Horse River**

**Samples:** 1-4  
**Environment:** Latest Aptian - basal Albian

**Remarks:**

The four samples from this section are rich in dinocysts, especially *Circulodinium brevispinosum*, and the occurrences are plotted on a chart (Appendix).

The age is based on the presence of *Cribroperidinium conopium* which appears in the latest Aptian, *Lithodinia stoverii*, which dies out at or near the Aptian-Albian boundary, and *Leptodinium delicatum*, which is usually considered to be an Albian species.

**Daphne Island East #3**

**Sample:** 7A  
**Environment:** ? Late Aptian

**Remarks:**

This sample yielded a small number of dinocysts which are interpreted here as being the result of a flooding event. Most of the species have long ranges which encompass the Aptian and Albian. However, there are two specimens present of *Senoniasphaera microreticulata* which first appears in the Late Aptian of Arctic Canada. It may have a later first occurrence in Alberta but there are no Albian species in the assemblages.

**Significant species:**

*Senoniasphaera microreticulata*  
*Circulodinium brevispinosum*  
*Oligosphaeridium* spp.

*Odontochitina operculata*  
*Pseudoceratium pelliferum*  
*Palaeoperidinium cretaceum*

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### Daphne Island West #3

**Sample:** 16  
**Environment:** ? Late Aptian

#### Remarks:

Dinocysts comprise 7% of this assemblage and *Circulosphaeridium* is the most abundant. The age is based on the presence of *Senoniasphaera microreticulata* and poor specimens of a cyst which resembles *Cribroperidinium conopium*. There are no obvious signs of Albian influence and a latest Aptian age is tentatively assigned.

#### Significant species:

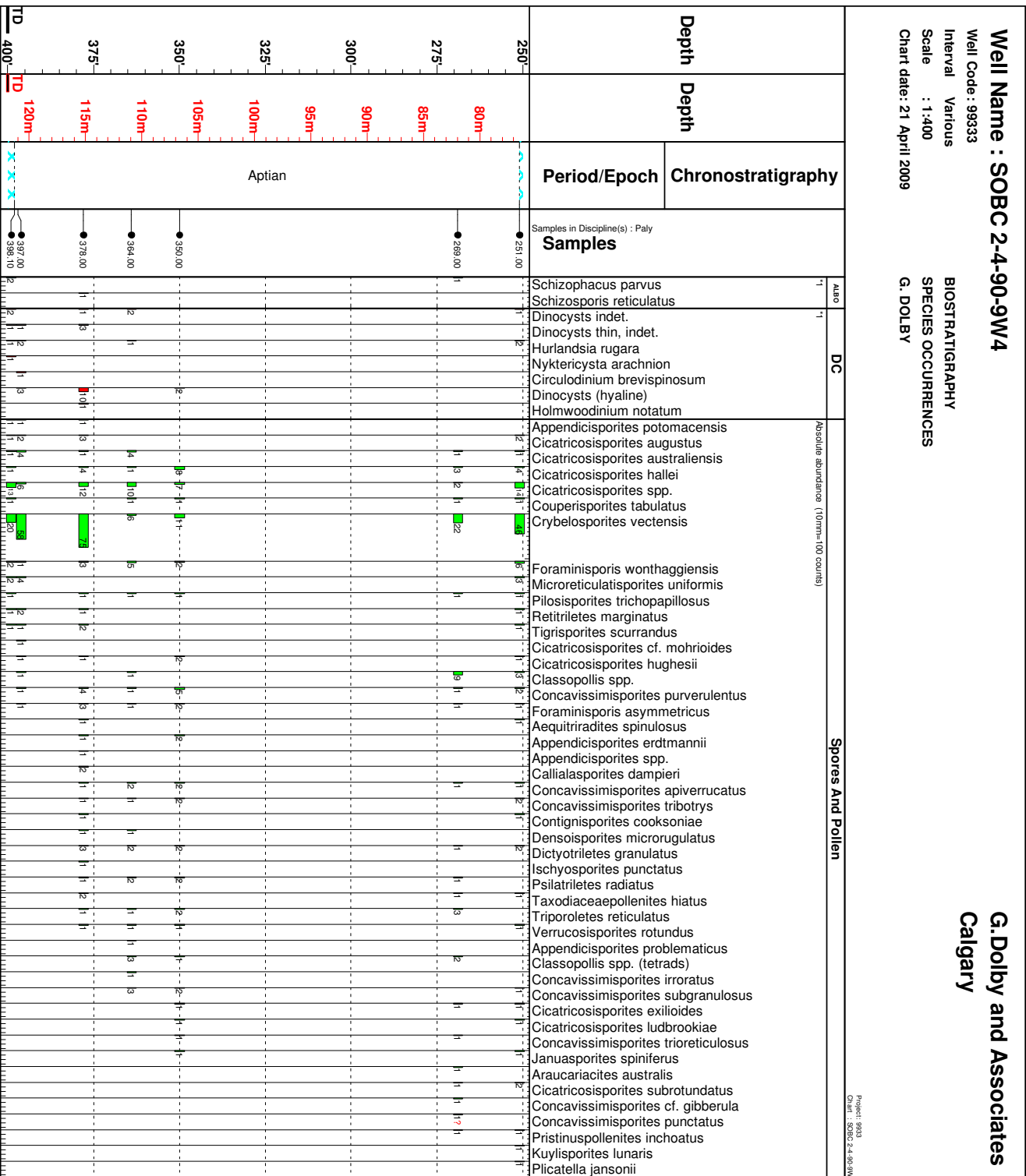
*Senoniasphaera microreticulata*  
*Circulodinium brevispinosum*  
*Pseudoceratium* cf. *eisenackii*  
*P. pelliferum*  
*Leptodinium hyalodermopse*

*Cribroperidinium* aff. *conopium*  
*C. cf. attadalicum*  
*P. cf. interiorensense*  
*Pterodinium* cf. *aliferum*  
*L. cancellatum*

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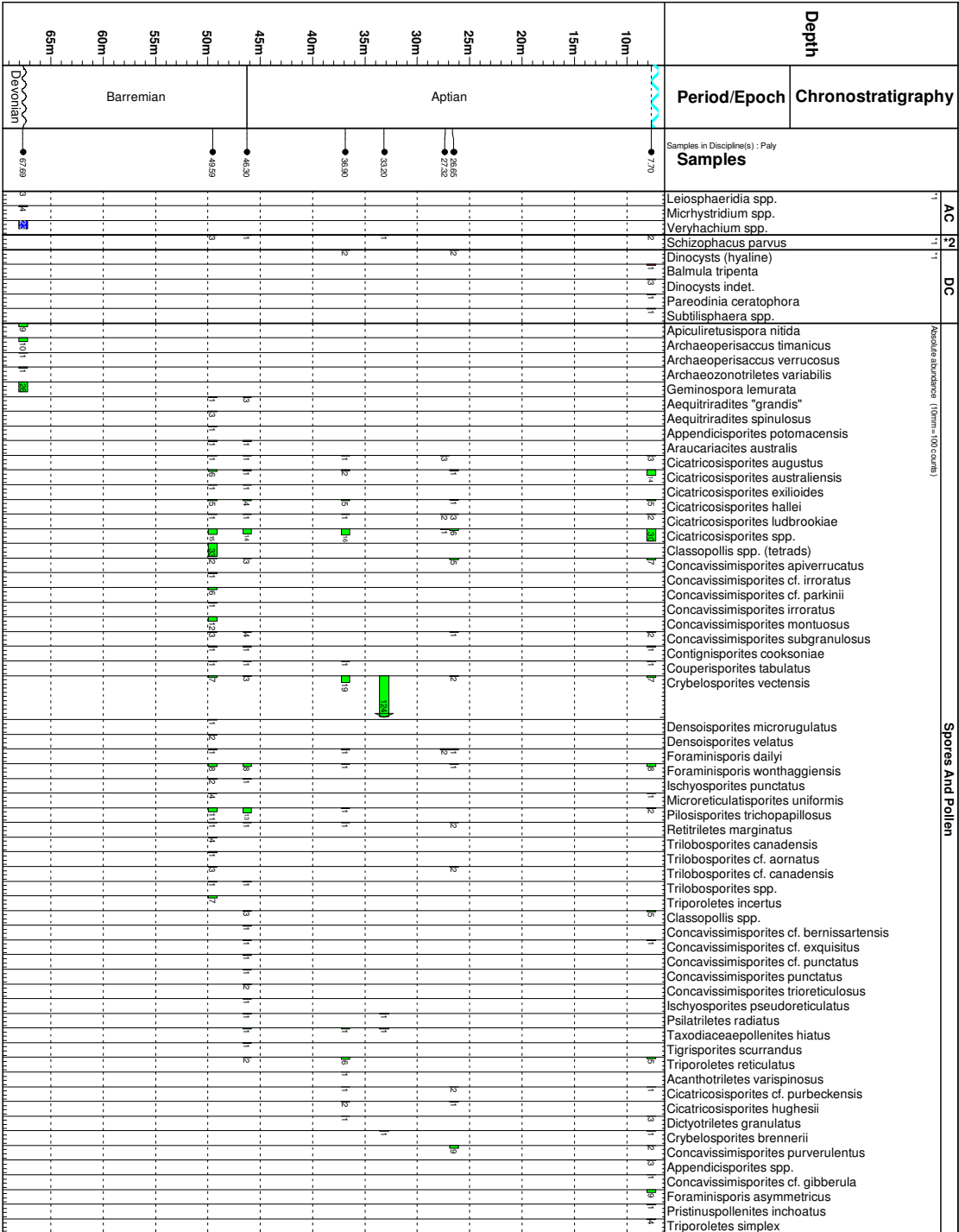
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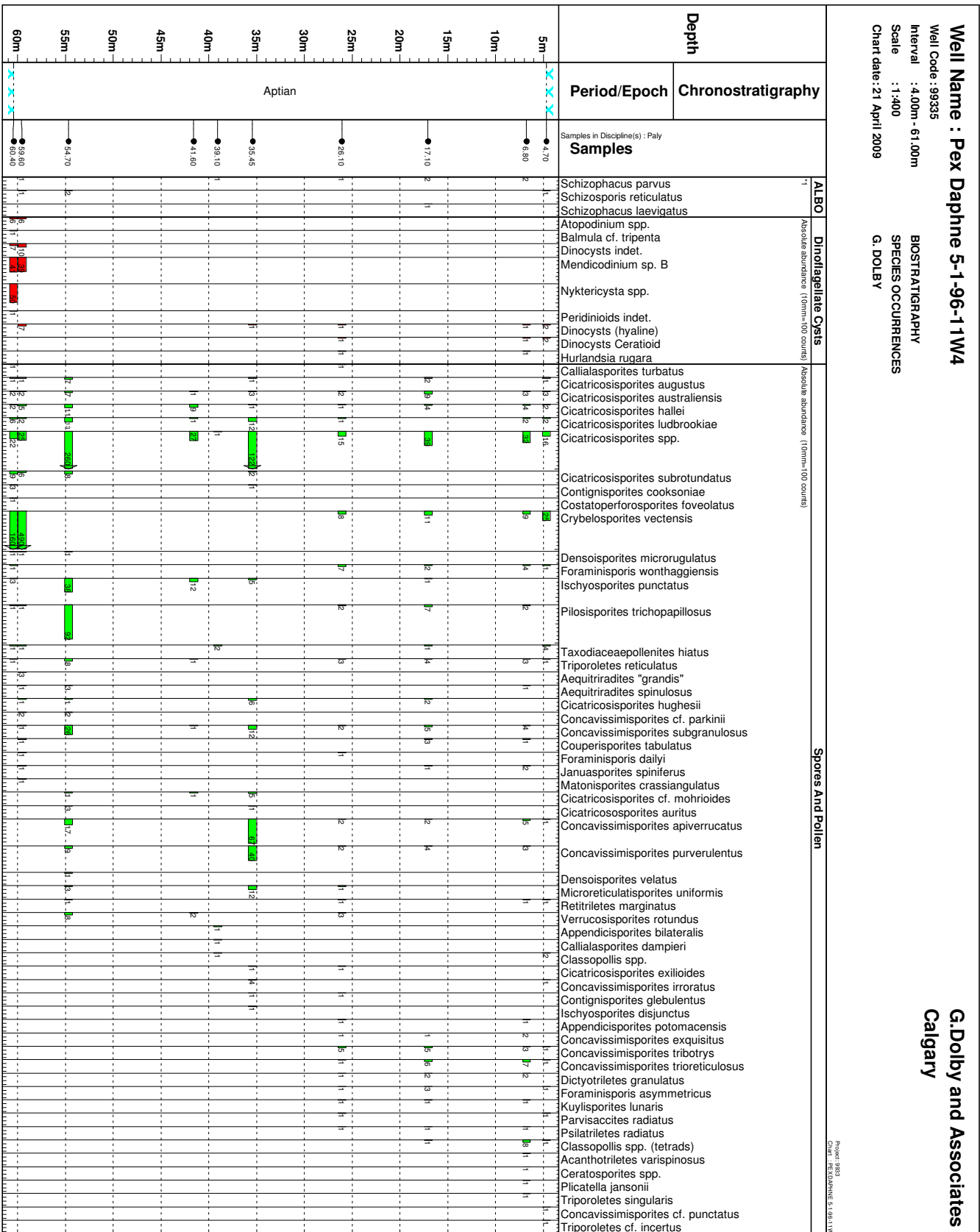
## **BIOSTRATIGRAPHIC CHARTS**



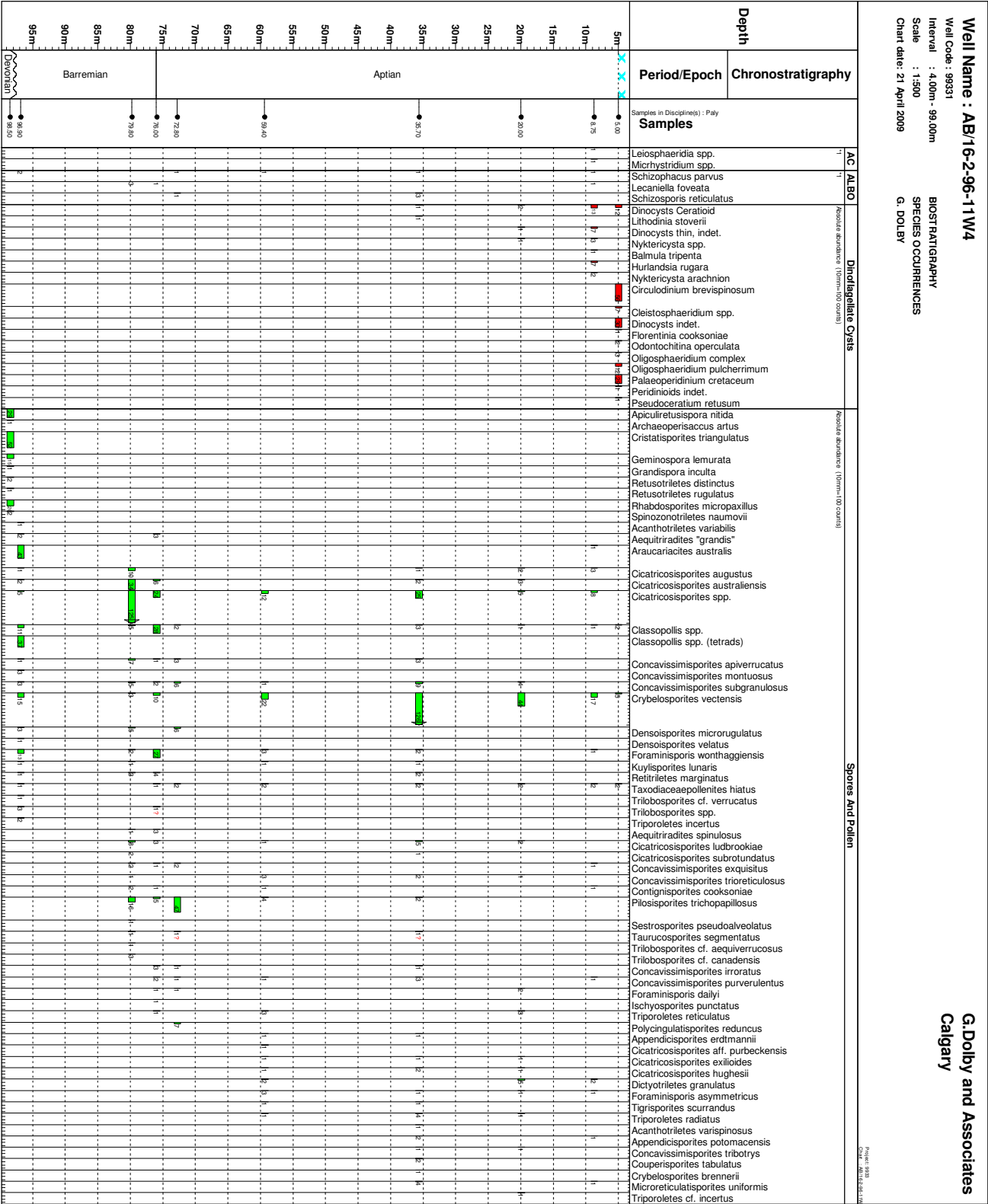
Well Name : Pex Daphne 6-36-95-1TW4  
Well Code : 99334  
Interval : 7.00m - 69.00m  
Scale : 1:400  
Chart date: 21 April 2009

BIOSTRATIGRAPHY  
SPECIES OCCURRENCES  
G. DOLBY









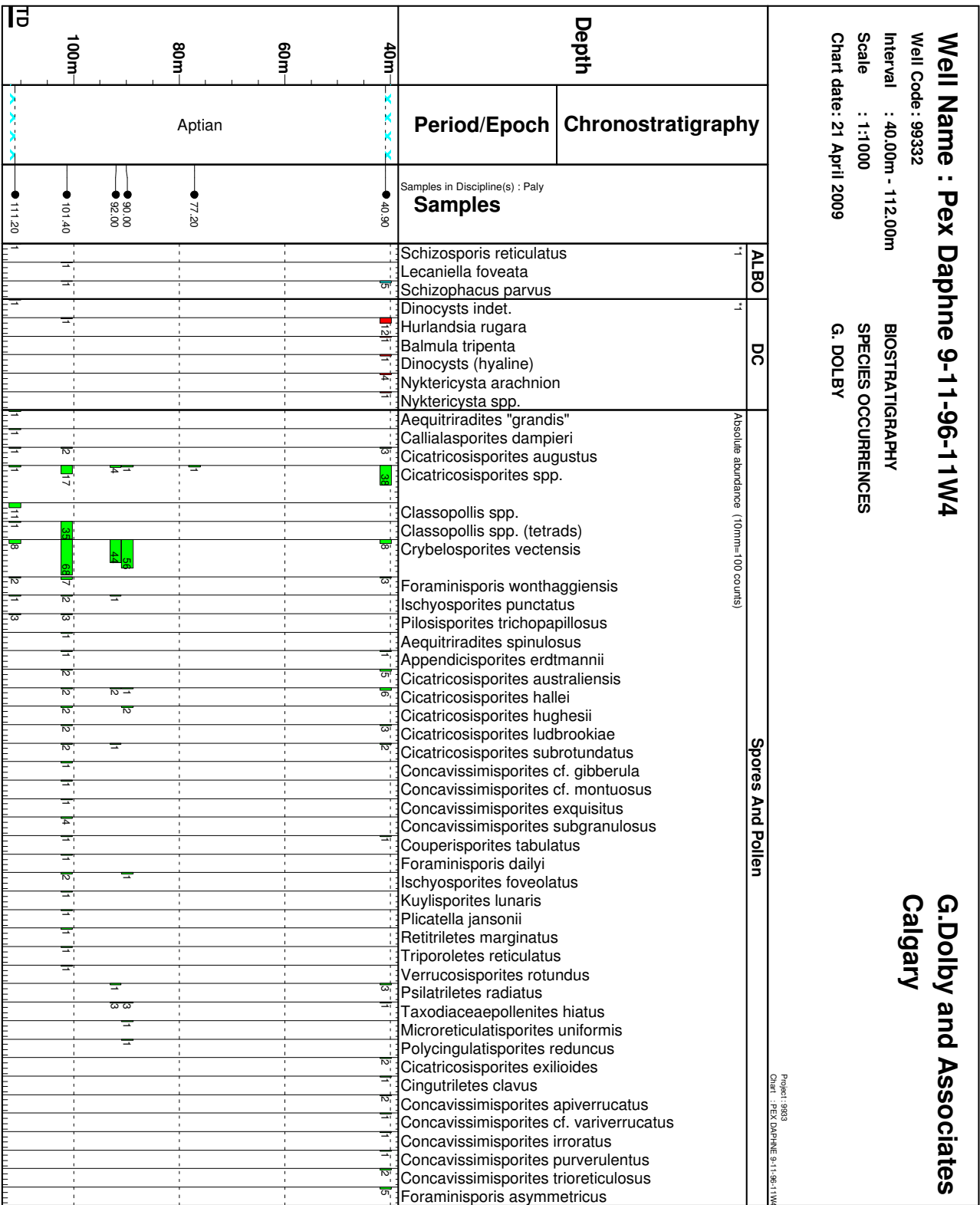
Leiosphaeridia spp.  
Micrhystridium spp.  
Schizophacus parvus  
Lecaniella foveata  
Schizosporis reticulatus  
Dinocysts Ceratoid  
Lithodinia stoverii  
Dinocysts thin, indet.  
Nyktericysta spp.  
Balmula tripenta  
Hurlandsia rugata  
Nyktericysta arachnion  
Circulodinium brevispinosum

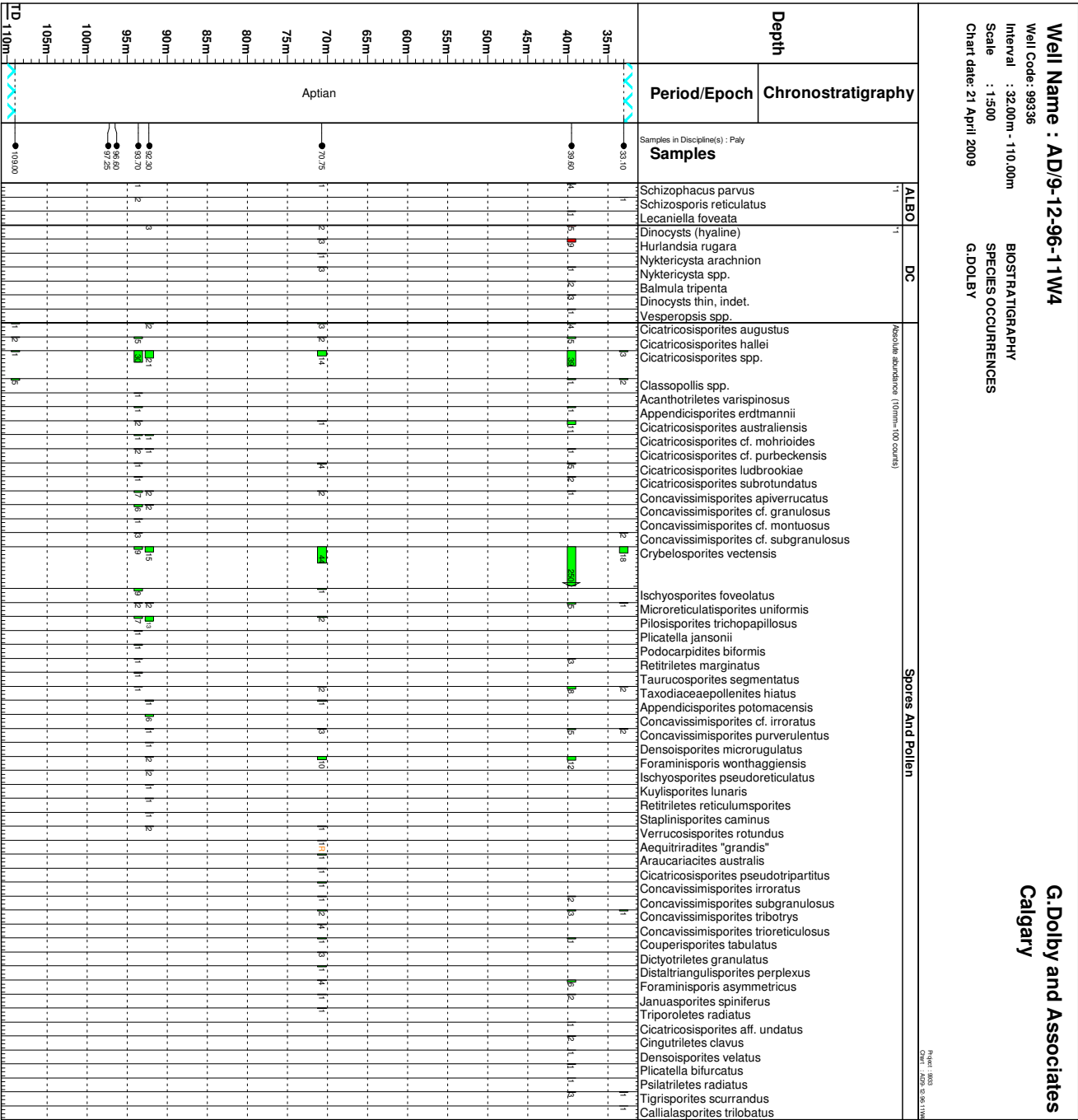
Cleistosphaeridium spp.  
Dinocysts indet.  
Florentinia cooksoniae  
Odontochitina operculata  
Oligosphaeridium complex  
Oligosphaeridium pulcherrimum  
Palaeoperidium cretaceum  
Peridinioides indet.  
Pseudoceratium retusum  
Apiculiretusispora nitida  
Archaeoperisaccus artus  
Cristatisporites triangulatus

Geminispora lemurata  
Grandispora inculta  
Retusotrilites distinctus  
Retusotrilites rugulatus  
Rhabdosporites micropaxillus  
Spinozonotrilites naumovii  
Acanthotrilites variabilis  
Aequitriradites "grandis"  
Araucariacites australis  
Cicatricosisporites augustus  
Cicatricosisporites australiensis  
Cicatricosisporites spp.  
Classopollis spp.  
Classopollis spp. (tetrads)  
Concavissimisporites apiverrucatus  
Concavissimisporites montuosus  
Concavissimisporites subgranulosus  
Crybelosporites vectensis

Densoisporites microrugulatus  
Densoisporites velatus  
Foraminisporis wonthaggiensis  
Kuylisporites lunaris  
Retitrlites marginatus  
Taxodiaceapollenites hiatus  
Trilobosporites cf. verrucatus  
Trilobosporites spp.  
Triporoletes incertus  
Aequitriradites spinulosus  
Cicatricosisporites ludbrookiae  
Cicatricosisporites subrotundatus  
Concavissimisporites exquisitus  
Concavissimisporites trioreticulosus  
Contignisporites cooksoniae  
Pilosporites trichopapillosus

Sestrosporites pseudoalveolatus  
Taurucosporites segmentatus  
Trilobosporites cf. aequiverrucosus  
Trilobosporites cf. canadensis  
Concavissimisporites irroratus  
Concavissimisporites purulentus  
Foraminisporis dailyi  
Ischyosporites punctatus  
Triporoletes reticulatus  
Polycingulatisporites reduncus  
Appendicisporites erdmanni  
Cicatricosisporites aff. purbeckensis  
Cicatricosisporites exilioides  
Cicatricosisporites hughesii  
Dictyotrilites granulosus  
Foraminisporis asymmetricus  
Tigrisporites scurandus  
Triporoletes radiatus  
Acanthotrilites varispinosus  
Appendicisporites potomacensis  
Concavissimisporites tributrys  
Couperisporites tabulatus  
Crybelosporites brennerii  
Microreticulatisporites uniformis  
Triporoletes cf. incertus





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Chart: AD/9-12-96-11W4

# Well Name : 16-11-96-10W4

G.Dolby and Associates  
Calgary

Well Code : 99338

Interval : 86.00m - 102.00m

BIOSTRATIGRAPHY

Scale : 1:400

SPECIES OCCURRENCES

Chart date : 21 April 2009

G. DOLBY

Project : 9933  
Chart : 16-11-96-10W4

Depth		Chronostratigraphy		Samples		DC		Spores And Pollen	
Period/Epoch		Chronostratigraphy		Samples		DC		Spores And Pollen	
Aptian		Aptian		Samples in Discipline(s) : Paly		DC		Spores And Pollen	
100m		100m		101.09		86.35		101.09	
95m		95m		95m		95m		95m	
90m		90m		90m		90m		90m	
86.35		86.35		86.35		86.35		86.35	
101.09		101.09		101.09		101.09		101.09	
TD		TD		TD		TD		TD	
100m		100m		100m		100m		100m	
95m		95m		95m		95m		95m	
90m		90m		90m		90m		90m	
86.35		86.35		86.35		86.35		86.35	
101.09		101.09		101.09		101.09		101.09	
TD		TD		TD		TD		TD	
100m		100m		100m		100m		100m	
95m		95m		95m		95m		95m	
90m		90m		90m		90m		90m	
86.35		86.35		86.35		86.35		86.35	
101.09		101.09		101.09		101.09		101.09	
TD		TD		TD		TD		TD	
100m		100m		100m		100m		100m	
95m		95m		95m		95m		95m	
90m		90m		90m		90m		90m	
86.35		86.35		86.35		86.35		86.35	
101.09		101.09		101.09		101.09		101.09	
TD		TD		TD		TD		TD	
100m		100m		100m		100m		100m	
95m		95m		95m		95m		95m	
90m		90m		90m		90m		90m	
86.35		86.35		86.35		86.35		86.35	
101.09		101.09		101.09		101.09		101.09	
TD		TD		TD		TD		TD	
100m		100m		100m		100m		100m	
95m		95m		95m		95m		95m	
90m		90m		90m		90m		90m	
86.35		86.35		86.35		86.35		86.35	
101.09		101.09		101.09		101.09		101.09	
TD		TD		TD		TD		TD	
100m		100m		100m		100m		100m	
95m		95m		95m		95m		95m	
90m		90m		90m		90m		90m	
86.35		86.35		86.35		86.35		86.35	
101.09		101.09		101.09		101.09		101.09	
TD		TD		TD		TD		TD	
100m		100m		100m		100m		100m	
95m		95m		95m		95m		95m	
90m		90m		90m		90m		90m	
86.35		86.35		86.35		86.35		86.35	
101.09		101.09		101.09		101.09		101.09	
TD		TD		TD		TD		TD	
100m		100m		100m		100m		100m	
95m		95m		95m		95m		95m	
90m		90m		90m		90m		90m	
86.35		86.35		86.35		86.35		86.35	
101.09		101.09		101.09		101.09		101.09	
TD		TD		TD		TD		TD	
100m		100m		100m		100m		100m	
95m		95m		95m		95m		95m	
90m		90m		90m		90m		90m	
86.35		86.35		86.35		86.35		86.35	
101.09		101.09		101.09		101.09		101.09	
TD		TD		TD		TD		TD	
100m		100m		100m		100m		100m	
95m		95m		95m		95m		95m	
90m		90m		90m		90m		90m	
86.35		86.35		86.35		86.35		86.35	
101.09		101.09		101.09		101.09		101.09	
TD		TD		TD		TD		TD	
100m		100m		100m		100m		100m	
95m		95m		95m		95m		95m	
90m		90m		90m		90m		90m	
86.35		86.35		86.35		86.35		86.35	
101.09		101.09		101.09		101.09		101.09	
TD		TD		TD		TD		TD	
100m		100m		100m		100m		100m	
95m		95m		95m		95m		95m	
90m		90m		90m		90m		90m	
86.35		86.35		86.35		86.35		86.35	
101.09		101.09		101.09		101.09		101.09	
TD		TD		TD		TD		TD	
100m		100m		100m		100m		100m	
95m		95m		95m		95m		95m	
90m		90m		90m		90m		90m	
86.35		86.35		86.35		86.35		86.35	
101.09		101.09		101.09		101.09		101.09	
TD		TD		TD		TD		TD	
100m		100m		100m		100m		100m	
95m		95m		95m		95m		95m	
90m		90m		90m		90m		90m	
86.35		86.35		86.35		86.35		86.35	
101.09		101.09		101.09		101.09		101.09	
TD		TD		TD		TD		TD	
100m		100m		100m		100m		100m	
95m		95m		95m		95m		95m	
90m		90m		90m		90m		90m	
86.35		86.35		86.35		86.35		86.35	
101.09		101.09		101.09		101.09		101.09	
TD		TD		TD		TD		TD	
100m		100m		100m		100m		100m	
95m		95m		95m		95m		95m	
90m		90m		90m		90m		90m	
86.35		86.35		86.35		86.35		86.35	
101.09		101.09		101.09		101.09		101.09	
TD		TD		TD		TD		TD	
100m		100m		100m		100m		100m	
95m		95m		95m		95m		95m	
90m		90m		90m		90m		90m	
86.35		86.35		86.35		86.35		86.35	
101.09		101.09		101.09		101.09		101.09	
TD		TD		TD		TD		TD	
100m		100m		100m		100m		100m	
95m		95m		95m		95m		95m	
90m		90m		90m		90m		90m	
86.35		86.35		86.35		86.35		86.35	
101.09		101.09		101.09		101.09		101.09	
TD		TD		TD		TD		TD	
100m		100m		100m		100m		100m	
95m		95m		95m		95m		95m	
90m		90m		90m		90m		90m	
86.35		86.35		86.35		86.35		86.35	
101.09		101.09		101.09		101.09		101.09	
TD		TD		TD		TD		TD	
100m		100m		100m		100m		100m	
95m		95m		95m		95m		95m	
90m		90m		90m		90m		90m	
86.35		86.35		86.35		86.35		86.35	
101.09		101.09		101.09		101.09		101.09	
TD		TD		TD		TD		TD	
100m		100m		100m		100m		100m	
95m		95m		95m		95m		95m	
90m		90m		90m		90m		90m	
86.35		86.35		86.35		86.35		86.35	
101.09		101.09		101.09		101.09		101.09	
TD		TD		TD		TD		TD	
100m		100m		100m		100m		100m	
95m		95m		95m		95m		95m	
90m		90m		90m		90m		90m	
86.35		86.35		86.35		86.35		86.35	
101.09		101.09		101.09		101.09		101.09	
TD		TD		TD		TD		TD	
100m		100m		100m		100m		100m	
95m		95m		95m		95m		95m	
90m		90m		90m		90m		90m	
86.35		86.35		86.35		86.35		86.35	
101.09		101.09		101.09		101.09		101.09	
TD		TD		TD		TD		TD	
100m		100m		100m		100m		100m	
95m		95m		95m		95m		95m	
90m		90m		90m		90m		90m	
86.35		86.35		86.35		86.35		86.35	
101.09		101.09		101.09		101.09		101.09	
TD		TD		TD		TD		TD	
100m		100m		100m		100m		100m	
95m		95m		95m		95m		95m	
90m		90m		90m		90m		90m	
86.35		86.35		86.35		86.35		86.35	
101.09		101.09		101.09		101.09		101.09	
TD		TD		TD		TD		TD	
100m		100m		100m		100m		100m	
95m		95m		95m		95m		95m	
90m		90m		90m		90m		90m	
86.35		86.35		86.35		86.35		86.35	
101.09		101.09		101.09		101.09		101.09	
TD		TD		TD		TD		TD	
100m		100m		100m		100m		100m	
95m		95m		95m		95m		95m	
90m		90m		90m		90m		90m	
86.35		86.35		86.35		86.35		86.35	
101.09		101.09		101.09		101.09		101.09	
TD		TD		TD		TD		TD	
100m		100m		100m		100m		100m	
95m		95m		95m		95m		95m	
90m		90m		90m		90m		90m	
86.35		86.35		86.35		86.35		86.35	
101.09		101.09		101.09		101.09		101.09	
TD		TD		TD		TD		TD	
100m		100m		100m		100m		100m	
95m		95m		95m		95m		95m	
90m		90m		90m		90m		90m	
86.35		86.35		86.35		86.35		86.35	
101.09		101.09		101.09		101.09		101.09	
TD		TD		TD		TD		TD	
100m		100m		100m		100m		100m	
95m		95m		95m		95m		95m	
90m		90m		90m		90m		90m	
86.35		86.35		86.35		86.35		86.35	
101.09		101.09		101.09		101.09		101.09	
TD		TD		TD		TD		TD	
100m		100m		100m		100m		100m	
95m		95m		95m		95m		95m	
90m		90m		90m		90m		90m	
86.35		86.35		86.35		86.35		86.35	
101.09		101.09		101.09		101.09		101.09	
TD		TD		TD		TD		TD	
100m		100m		100m		100m		100m	
95m		95m		95m		95m		95m	
90m		90m		90m		90m		90m	
86.35		86.35		86.35		86.			

**Well Name : HORSE RIVER**

**Well Code : 99337**

Interval : 0.00m - 5.00m

**Scale : 1:100**

**Chart date: 21 April 2009**

## BIOSTRATIGRAPHY

## SPECIES OCCURRENCES

**G. DOLBY**

**G. Dolby and Associates**  
**Calgary**

Project : 9933  
Chart : HORSE RIVER[illegible]