

This report is released as part of AER/AGS Open File Report 2017-08. It includes biostratigraphic charts updated on 16 January 2017. See Appendix 5 of AGS Open File Report 2017-08 for updated results and interpretations.

**PALYNOLOGICAL ANALYSIS OF
THE STEEPBANK 1-29-92-9W4 &
10-29-92-9W4 WELLS,
NORTHEASTERN ALBERTA**

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Project 98.28
February 1999

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Twenty one samples from the 10-29-92-9W4, ten from the 1-29-92-9W4 and one outcrop sample were prepared for palynological analysis. The objective of the study was to establish the palynological sequence in the pre-McMurray and McMurray formations and the Wabiscaw Member of the Clearwater Formation in 10-29, and correlate the pre-McMurray to lower Middle McMurray section in the 1-29 well with the longer section.

Recoveries in the 10-29 well were often excellent but those in 1-29 were much poorer. The proportions of various palynomorph groups were determined to help interpret the environments of deposition and these data are presented on four charts (pages 14, 15, 17 and 18). The semiquantitative distributions of individual species are plotted on charts at a scale of 1:500 in an appendix.

The succession of first stratigraphic appearances of spores and pollen in 10-29 suggests that a zonation scheme for local zonation of the Middle and Upper McMurray is feasible. Confirmation of this will have to wait until other sections are studied since the recoveries are poor in 1-29 and that core does not contain the entire McMurray sequence. In spite of the poor data in 1-29, a correlation line is tentatively suggested between the 213.28' sample in that well and the 69m level in 10-29.

For the present study, the published stratigraphic ranges of key palynomorph taxa were reassessed and only the most reliable records were used.

Burden (1984) published a spore-pollen zonation and age interpretation for the lower part of the Mannville Group. This was based in part on McMurray Formation sections including the outcrop on the Steepbank River located in the south-east quarter of 15-30-92-9W4.

In the Steepbank section, he described a spore assemblage in the Lower McMurray (CI Zone) which contained Neocomian spores and he assigned this a late Valangian or Hauterivian age.

He implied that the overlying TA assemblage is conformable but admitted that there was an unstudied interval between the two zones. The TA Zone was assigned an Early Barremian age which conflicts with his records of dinocysts which do not appear in stratigraphic record until the Aptian. The TA Zone was not delimited in the Steepbank section. The upper part of the Middle McMurray and the Upper McMurray were assigned to the CP Zone and given a Late Barremian to Late Aptian/earliest Albian age.

The dinocysts he recorded in the Lower McMurray clearly indicate that the Middle McMurray is not older than Aptian and the remaining age assignments need to be re-assessed.

In the present study, no early Neocomian species were recorded. In addition to this, the pre-McMurray sediments in both wells contained a dinocyst which does not range below the Middle Barremian. However, no species were recorded which become extinct in the Barremian. Dr. W.W. Brideaux, in his submission to the AEUB Hearing between Hillcrest Resources et al. and Truax Resources et al. (April 1995) stated that there is no evidence for an age older than Aptian for the base of the Mannville.

It is possible that there are isolated pockets of Neocomian sediments below the Mannville but in a recent extensive study of Basal Quartz channels, no early Neocomian markers were recorded.

The palynological succession can be divided into four parts:

Interval	Formation	Age
16m - 25m	Wabiskaw Mbr.	Early Albian
25m - 71.5m	Upper to Middle McMurray	Aptian
71.5m - 83m	Lower McMurray	Probably Aptian
83m - 85.6m	Pre-McMurray	Probably Aptian (-?Middle Barremian)

Interval:	83m - 85.6m
Samples:	83.5m, 85.6m
Formation:	Pre-McMurray
Age:	Probably Aptian (-?Middle Barremian)

Remarks

These two samples come from pre-McMurray strata and represent karst surface infilling by a Cretaceous marine incursion. They contain a small number of dinocysts including *Palaeoperidinium cretaceum*. This distinctive species usually makes its first appearance in the Late Barremian but has been recorded in the Middle Barremian of England. Also present are specimens of *Circulodinium* cf. *distinctum*, *Tanyosphaeridium variecalamum*, *Oligosphaeridium* spp., *Sentusidinium* spp. and *Canningia* spp., all of which have relatively long ranges. The terrestrial fraction consists of long-ranging pollen and spores but bisaccate pollen dominate. Rare specimens of *Lecaniella foveata* (*Zygnemataceae*) are also present. The lower range of this species is not known but it appears to have an Aptian - Cenomanian range.

Although a Barremian age cannot be ruled out, an Aptian age is more likely and an Aptian (-?Middle Barremian) age is tentatively assigned.

Interval: 71.5m - 83m
Samples: 73.3m, 73.85m, 79.75m, 81.7m
Formation: Lower McMurray
Age: Probably Aptian

Remarks

The lowest sample (81.7m) is dominated by reworked Devonian acritarchs, scolecodonts and spores which together comprise over 96% of the assemblage. The other samples contain a long-ranging spore-pollen association similar to those in the pre-McMurray. Dinocysts are rare and have little or no stratigraphic value. None of the Neocomian spores recorded by Burden (1984) in the Lower McMurray in the Steepbank outcrop were present.

An Aptian age is tentatively assigned.

Interval: 25m - 71.5m
Samples: 27.75m, 30m, 34.75m, 42.3m, 46.15m, 52.15m, 53.5m, 59m, 61.88m, 69m
Formation: Middle to Upper McMurray
Age: Aptian

Remarks

There is a major increase in richness and diversity in the spore-pollen assemblage at the base of the Middle McMurray. Bisaccate pollen continue to dominate but the spore fraction is much more diverse than in the underlying intervals. Important species which appear in the basal sample include:

Appendicisporites bilateralis
Concavissimisporites tribotrys
Dictyotriletes granulatus
Microreticulatisporites uniformis

Cicatricosisporites augustus
Couperisporites tabulatus
Foraminisporis asymmetricus
Triporoletes simplex

These are considered to be Aptian and younger species and *M. uniformis* probably first appears in the Early but not earliest Aptian. In the overlying samples, other species appear which are considered to appear in the Aptian including:

Crybelosporites brenneri
Parvisaccites rugulatus

Ischyosporites areolatus
Podosporites granulatus

Angiosperm pollen are extremely rare and the important species *Clavatipollenites minutus* is present at 53.5m. This is an index form for the CP Zone (mid to upper Middle McMurray) of Burden (1984).

Dinocysts are also extremely rare and consist of thin, hyaline forms typical of fresh to slightly brackish environments.

The presence of *Concavissimisporites* cf. *informis* at 30m implies that the section is still Aptian at this level. No samples were processed from the Upper McMurray.

Interval:	16m - 25m
Samples:	18.4m, 19.95m, 21.55m, 24.48m
Formation:	Wabiscaw Member of the Clearwater Formation
Age:	Early Albian

Remarks

These samples yielded abundant dinocysts with a concomitant drop in the richness and diversity of the terrestrial fraction. The assemblages are dominated by specimens of *Palaeoperidinium cretaceum*, *Canninginopsis colliveri* and *Oligosphaeridium* spp. and the diversity of the microplankton assemblages increases upsection.

The age is based on the presence of *Odontochitina costata*, *Leptodinium cancellatum* and *L. delicatum*, which first appear in the Albian, and the essentially Albian and younger forms *Ellipsoidictyum imperfectum* and *Cyclonephelium paucispinum*.

L. cancellata and *L. delicata* were first described from Middle Albian rocks (Brideaux & McIntyre, 1975) and these occurrences extend their ranges downwards since there is ample macrofossil evidence for an Early Albian age for the Clearwater.

Recoveries from this well were generally much poorer than in the 10-29 core. Furthermore, the Lower McMurray is thicker here and only the lower part of the Middle McMurray is represented.

Interval	Formation	Age
213.28' - 266'	Middle McMurray	Aptian
266' - 290'	?Lower McMurray	Probably Aptian
290' - 340'	Lower McMurray	Probably Aptian
340' - 402'	Pre-McMurray	Probably Aptian (-?Middle Barremian)

Interval:	340' - 402'
Samples:	350.5', 383'
Formation:	Pre-McMurray
Age:	Probably Aptian (-?Barremian)

Remarks

The assemblages from these two samples are similar to those from the pre-McMurray in the 10-29 core. The upper sample contains *Palaeoperidinium cretaceum*, which does not range below the Middle Barremian, and the longer ranging forms *Batioladinium jaegeri* and *Oligosphaeridium complex*.

As in 10-29, although a Barremian age cannot be ruled out an Aptian age is more likely and an Aptian (- ?Middle Barremian) is tentatively assigned.

Interval: 290' - 340'
Samples: 293.51', 338'
Formation: Lower McMurray
Age: Probably Aptian

Remarks

These two samples yielded extremely poor assemblages of long-ranging spores and pollen. There are insufficient data to interpret the age and the assignment is based on the underlying and overlying sections.

Interval: 266' - 290'
Samples: 267.08', 268.45', 287.8'
Formation: ?Lower McMurray
Age: Probably Aptian

Remarks

These assemblages are richer and more diverse than those in the Lower and Pre-McMurray but are comparable with the Lower and Pre-McMurray in 10-29. *Pristinuspollenites sulcatus*, present at 268.45' probably first appears in the Aptian.

Interval: 213.28' - 266'
Samples: 213.28', 218.19', 227.36'
Formation: Middle McMurray
Age: Aptian

Remarks

There is a slight increase in diversity here but the samples are poor when compared with those from the equivalent part of the 10-29 core.

The appearance of *Microreticulatisporites uniformis* at 213.28' is significant. This species, which first appears in the Early but not earliest Aptian, occurs down to 69m in the 19-29 core. A correlation line could tentatively be drawn between these two points.

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 and in 10-29 at 59m and 61.88m counts of 300 were made. The palynomorphs were assigned to biological groups to aid in the interpretation of the environments of deposition. The groups used are:

Group	Environment
Pteridophyte spores misc.	Swamp
Bisaccate pollen	Hinterland contribution
Taxodiaceae	Lowland floodplain swamps
Other gymnosperms	
Classopollis	Arid/semi-arid hinterland
Schizaceae	Stressed environment, flooding/drying cycles
Angiosperm pollen	
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.

The proportions and degree of sorting of the organic macerals was also determined where possible to help with the environmental interpretation. Unfortunately, many 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 both numeric and percentage abundance formats (pages 14, 15, 17 and 18). It is evident from the charts that recoveries were much better in 10-29. Samples in this well often yielded five times more palynomorphs than the best samples in 1-29.

10-29-92-9W4

Pre-McMurray

The assemblages from these karst infill deposits are dominated by bisaccate pollen with rare dinocysts which suggest a brackish, estuarine equivalent environment establish during a marine incursion.

Lower McMurray

The basal sample (81.7m) is overwhelmingly dominated by reworked Devonian taxa, but a fragment of *Oligosphaeridium pulcherrimum* indicates some marine influence. The recovery from 79.95m is small and dominated by bisaccate pollen. Rare ceratioid dinocysts similar to those in the Pre-McMurray indicate some faint marine influence. Bisaccates dominate the 73.85 sample but spores predominate at 73.3m where rare ceratioid cysts indicate a faint saline influence.

The overall impression is of a fluvial setting with occasional, weak, saline conditions.

Middle McMurray

The lower five samples (69m - 52.15m) are dominated by bisaccate pollen indicating a high hinterland contribution which is further emphasized at 61.88m and 53.5m by larger than usual numbers of the arid/semi-arid hinterland pollen *Classopollis*. Sorting is extremely poor which indicates low energy and the kerogens are dominated by sapropels and vitrinite. The 59m sample has rare hyaline dinocysts typical of freshwater deposits. Lacustrine/abandoned channel deposits might be expected to yield similar assemblages.

The yield at 46.15m is lower and the kerogen is dominated by coaly material and amorphous vitrinite typical of coal swamps. The three assemblages from 42.3m - 30m are similar to those in the lower part of the Middle McMurray. The swamp influence returns at 27.75m but the hinterland contribution is still high.

The palynological data suggest a fluvio-lacustrine environment for the Middle McMurray at this location. The formation is usually considered to have been deposited in a tidal, estuarine setting but in this study no evidence of marine influence was encountered. Samples in 1-29 also contain freshwater algae.

Wabiskaw

There is a marked change in these very rich assemblages. Spores become predominant and dinocysts are abundant. Reduced salinities are indicated in the lowermost sample (24.48m) where there are high numbers of peridinioid and ceratioid cysts. An increase in diversity of the dinocyst assemblages upsection points to the establishment of normal marine salinities. The relatively low pollen to spore ratio indicates that the swamp influence is high and a lower estuarine to nearshore marine setting is indicated.

Well Name: 10-29-92-9W4 FACIES

Operator:

Interval : 16.00m - 85.60m

Scale : 1:500

Date : 24-January-1999

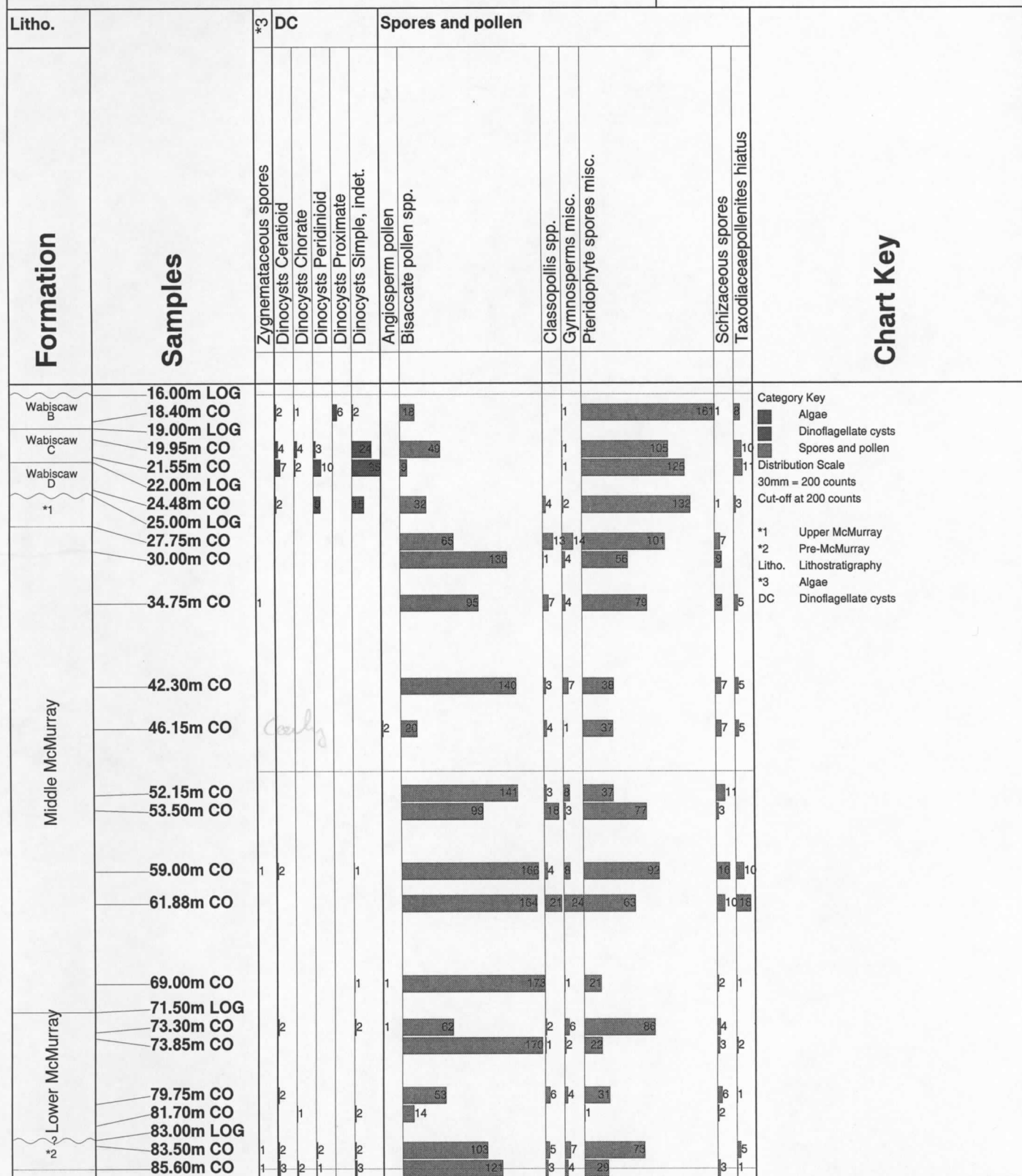
PALYNOMORPH GROUPS

Style : Numeric Abundance Histogram

Author: G. Dolby

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Well Name: 10-29-92-9W4 FACIES

Operator:

Interval : 16.00m - 85.60m

Scale : 1:500

Date : 24-January-1999

PALYNOMORPH GROUPS

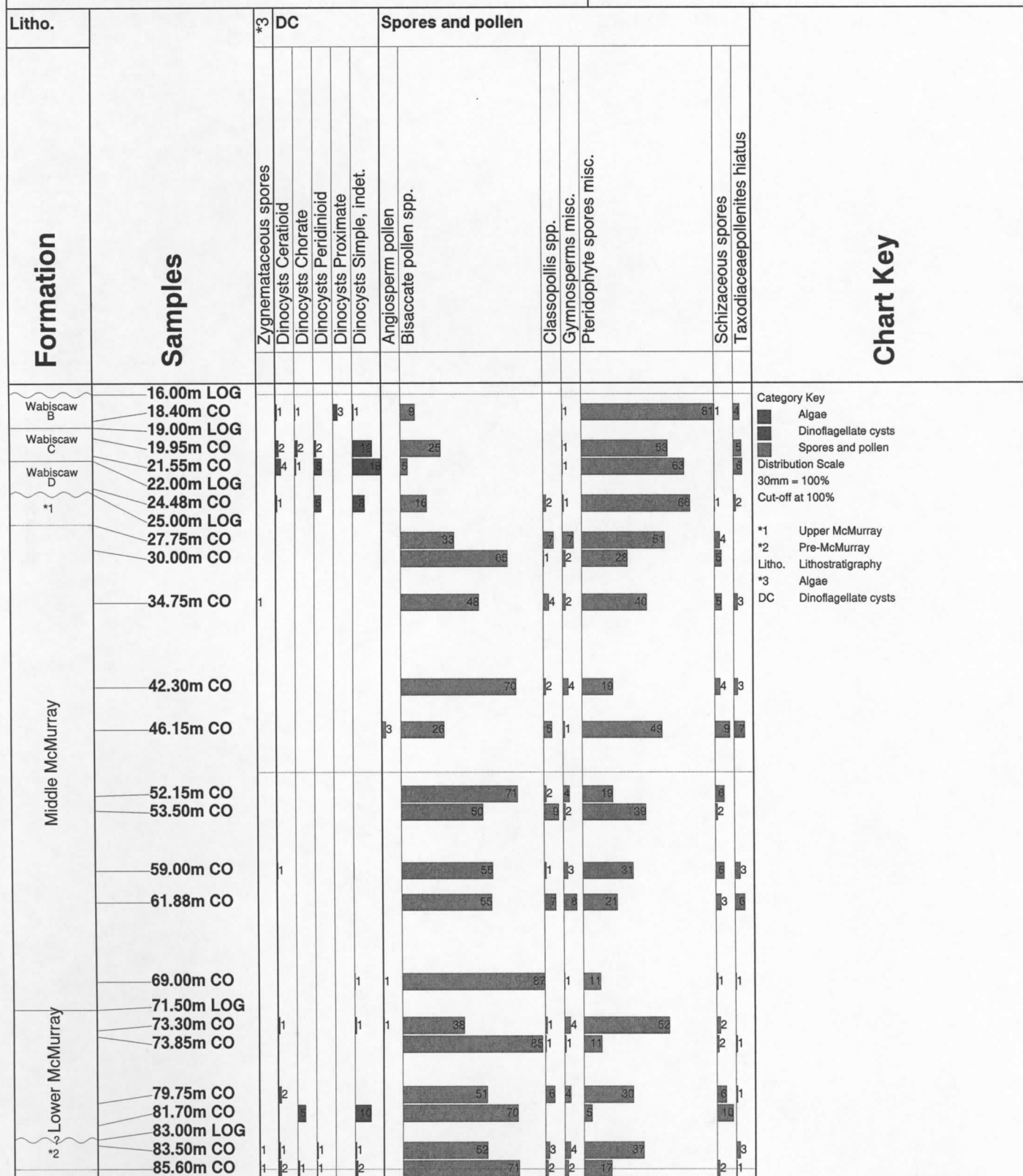
PERCENTAGES

Style : % Abundance Histogram

Author: G. Dolby

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1-29-92-9W4

Pre-McMurray

The lower sample yielded a non-marine assemblage with a high hinterland component. The kerogen is dominated by coaly debris. The upper assemblage at 350.5' is dominated by the hinterland component and also contains rare dinocysts which indicate a brackish, estuarine equivalent environment.

Lower McMurray

The yields here are too low to determine the environment with any confidence.

?Lower McMurray

The hinterland component (bisaccates and *Classopollis*) is high in all three samples. The kerogen from 287.8' is dominated by coaly material suggesting a strong swamp influence. The 268.45m residue is similar but also contains numerous *Botryococcus* colonies indicative of freshwater, possibly lacustrine conditions.

The 267.08' sample yielded few spores and pollen and the kerogen is not only dominated by inertinite/semi-fusinite, but there is a tendency towards bimodal sorting. This could represent a flood deposit.

Middle McMurray

The kerogen in these samples, from near the top of the core, is dominated by coaly debris. In addition, *Botryococcus* colonies are prominent at 218.19' and 213.28'. This part of the section appears to represent freshwater, possibly lacustrine conditions.

Well Name: 1-29-92-9W4 FACIES

Operator:

Interval : 213.28' - 402.00'

Scale : 1:500

Date : 24-January-1999

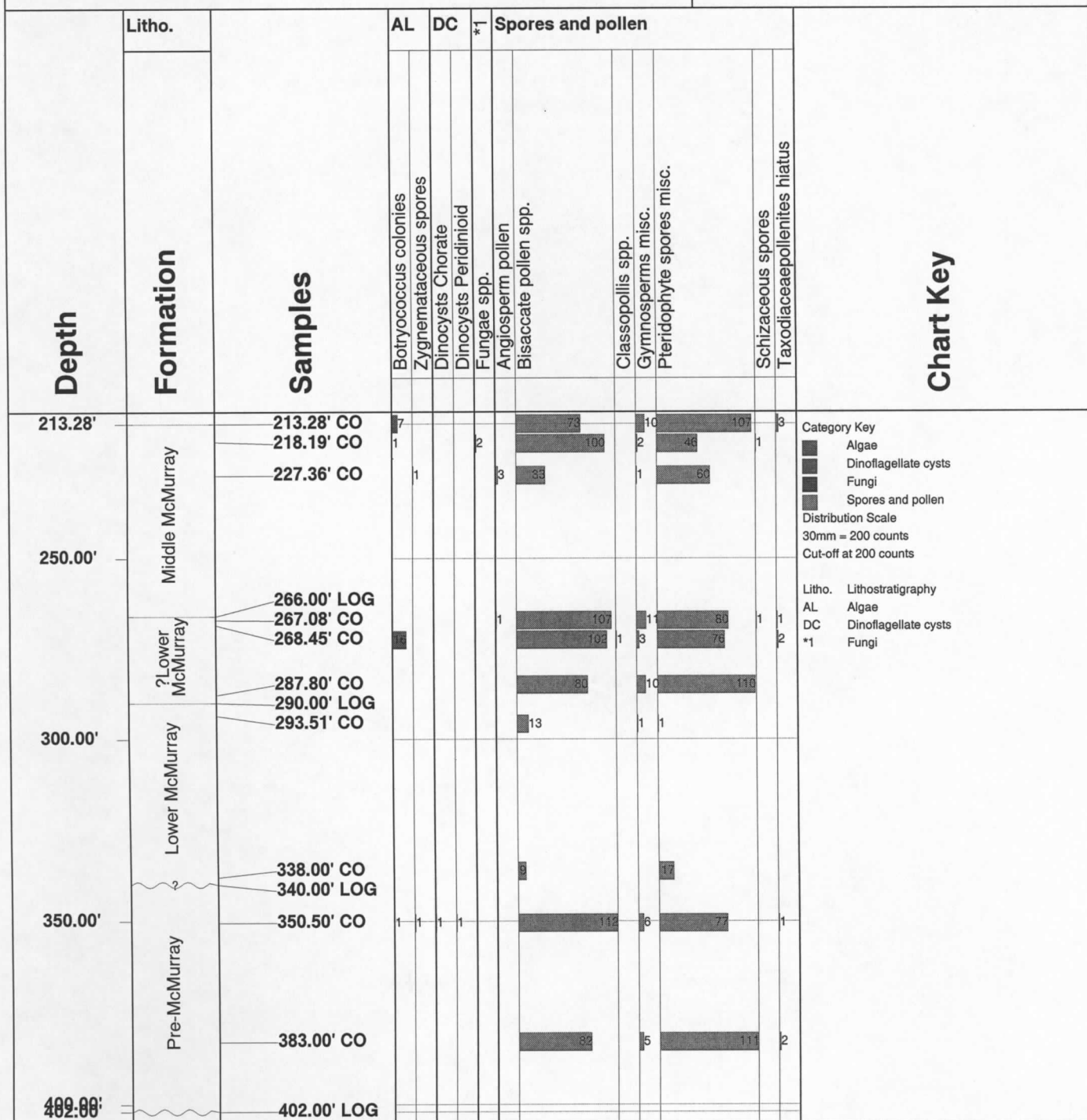
PALYNOMORPH GROUPS

Style : Numeric Abundance Histogram

Author: G. Dolby

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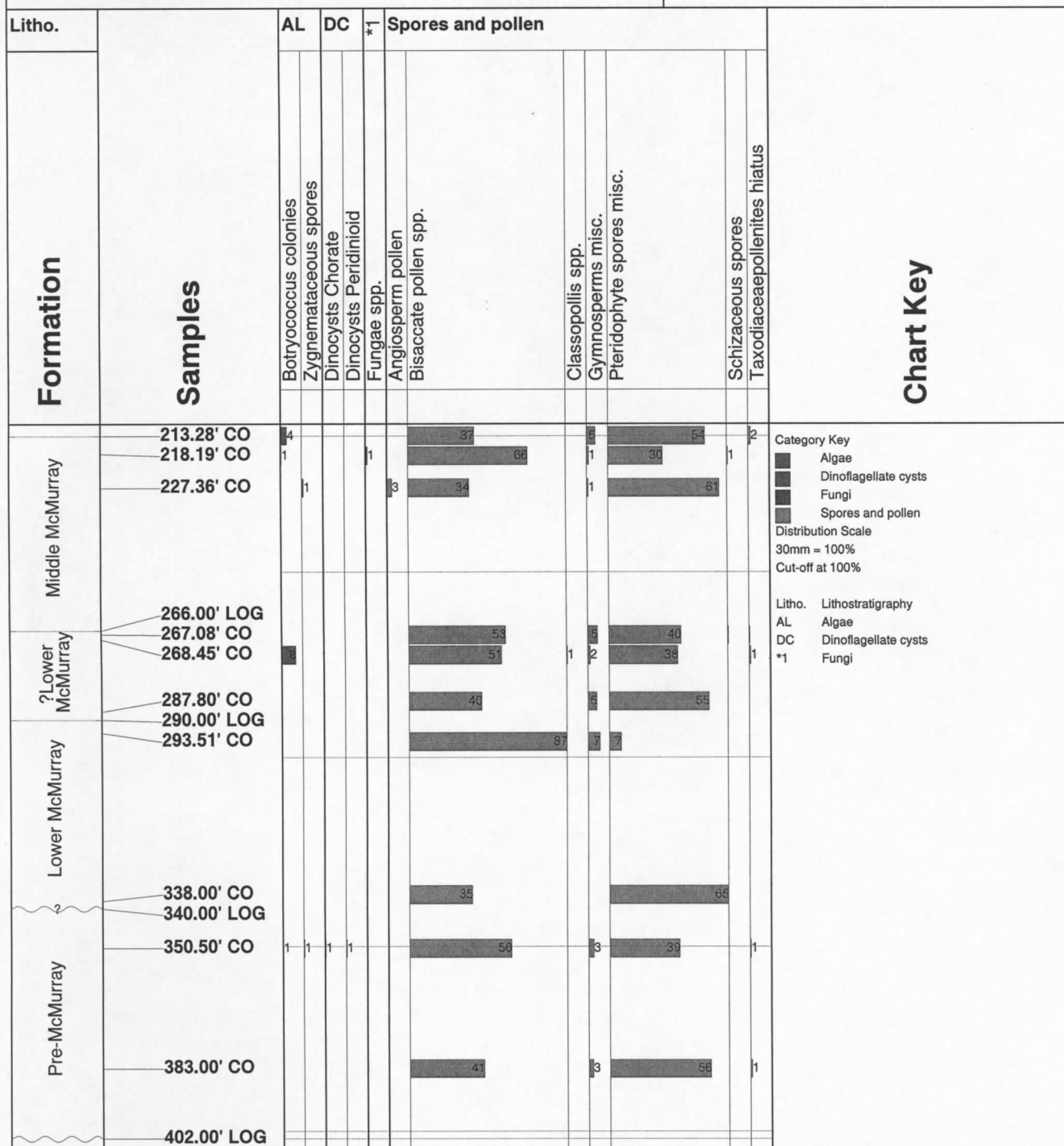


Well Name: 1-29-92-9W4 FACIES

Operator:
Interval : 213.28' - 402.00'
Scale : 1:500
Date : 24-January-1999
PALYNOMORPH GROUPS

Style : % Abundance Histogram
Author: G. Dolby

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A coaly fragment from an otherwise unpromising sandstone sample was processed and yielded a modest terrestrial assemblage of limited composition. Long-ranging bisaccate pollen predominate but specimens of *Lecaniella foveata* comprise 5% of the assemblage. The full range of this zygnemataceous spore is not known but it appears to be Aptian-Cenomanian.

Species recovered

Lecaniella foveata (A)

Cedripites canadensis
Alisporites bilateralis

C. cretaceus
A. grandis

Brideaux, W.W. & McIntyre, D.J. 1975. Miospores and microplankton from the Aptian-Albian rocks along the Horton River, District of Mackenzie. G.S.C. Bulletin 252.

Burden, E.T. 1984. Terrestrial palynomorph biostratigraphy of the lower part of the Mannville Group (Lower Cretaceous), Alberta and Montana.
C.S.P.G. Memoir 9, p.249-269.

The plotting program recognises the depths of core, sidewall core and cuttings samples as well as electric log depths. All depth information here is derived from cores. To distinguish between palynological samples and lithological boundary depths, sample depths are followed by the letters CO (core sample) and formation boundaries by LOG.

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Project : 9828
Chart : 10-29-92-9W4 BlOstrat on



