

phase. Therefore, one part of the taxonomic confusion in calcareous dinoflagellates seems to result from comparing non-homologous calcareous structures, i.e. diploid resting cysts and vegetative coccoid cells.

Reinvestigating the ultrastructure of the calcareous walls in calcdinos is therefore urgently needed for a better understanding of unifying molecular, morphological and fossil phylogenies. First results show that the three major clades in calcareous dinoflagellates may be represented also by three different biomineralization modes. Unfortunately, the underlying biogeochemical processes are largely unknown. There are now first studies on the isotope chemistry of the calcareous wall of dinoflagellates representing different proposed biomineralization modes, and all of them show a characteristic strong depletion in  $\delta^{13}\text{C}$  against equilibrium conditions in modern and fossil species, indicating highly specialized biomineralization pathways in calcareous dinoflagellates that are maintained despite the evolution of different modes of biomineralization.

#### ***Lingulodinium machaerophorum* process length variations in the surface sediment: a salinity proxy?**

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Process length variation of *Lingulodinium machaerophorum* has formerly been related to salinity variations in the Black Sea by Wall *et al.* (1973). This observation was confirmed by other micropaleontological studies (e.g. Turon (1984); Ellegaard (1998); Mudie *et al.* (2001); Leroy *et al.* (2006), Sorrel *et al.* 2006), and by culture experiments (Hallett 1999). The establishment of *Lingulodinium machaerophorum* process length as a salinity proxy represents a large potential for paleoenvironmental studies, since this species can be traced back to the Eocene (Stover *et al.*, 1996). The aim of the study was to evaluate whether the average process length shows a linear relationship with salinity, and to assess its validity as a salinity proxy. *Lingulodinium machaerophorum* cysts from surface sediments from the following areas were studied:

Baltic, Norwegian Sea, Celtic Sea, Brittany, Portugese coast, Mediterranean, Marmara Sea, Black Sea, Caspian Sea, NW African coast, Canary Islands, Dakar coast, Gulf of Guinea, Caribbean, Monterrey Bay (California), Todos Santos Bay (Mexico) and Isahaya Bay (Japan). The 3 longest process lengths together with the body diameter of 50 cysts from every sample were measured for each sample. Process lengths of *Operculodinium centrocarpum* sensu Wall & Dale were used as a crosscheck. Results for the different geographic areas were compared to both SST and SSS (both seasonal and annual) at different depths at the locations, from the gridded  $\frac{1}{4}$  degree Ocean Data Atlas (2005). The data suggests a basis for developing a SSS proxy based on process length of *Lingulodinium machaerophorum*, and indicates that depth and seasonality surely are also important factors in process formation. The use of this proxy is demonstrated using process length variation over time in different late Quaternary cores (GeoB7625-2 and BC53 (Black Sea), Limfjord (Denmark), GeoB5546 (Canary Islands), GeoB9064 (Cadiz), ODP976 (Alboran Sea), ODP1002C (Cariaco Basin) and M35003-4 (Grenada). The use of confocal microscopy to measure all processes on the cyst is explained, and opens new ways of methodological refinement. Surprisingly, distances between the processes are strongly related to process length, and this suggests very early predetermination of process formation. The study suggests a conceptual model of process formation.

#### **The absolute abundance calibration project: the *Lycopodium* marker-grain method put to the test**

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Traditionally, dinoflagellate cyst concentrations are calculated by adding an exotic marker or “spike” (such as *Lycopodium clavatum*) to each sample following the method of Stockmarr

(1971). According to Maher (1981), the total error is controlled mainly by the error on the count of *Lycopodium clavatum* spores. In general, the more *L. clavatum* spores counted, the lower the error. A dinocyst / *L. clavatum* spore ratio of ~2 will give optimal results in terms of precision and time spent on a sample. It has also been proven that the use of the aliquot method yields comparable results to the marker-grain method (de Vernal et al., 1987).

Critical evaluation of the effect of different laboratory procedures on the marker grain concentration in each sample has never been executed. Although, it has been reported that different processing methods (e.g. ultrasonication, oxidizing, etc.) are to a certain extent damaging to microfossils (e.g. Hodgkinson, 1991), it is not clear how this is translated into concentration calculations. It is well-known from the literature that concentration calculations of dinoflagellate cysts from different laboratories are hard to resolve into a consistent picture. The aim of this study is to remove these inconsistencies and to make recommendations for the use of a standardized methodology.

Sediment surface samples from four different localities (North Sea, Celtic Sea, NW Africa and Benguela) were macerated in different laboratories each using its own palynological maceration technique. A fixed amount of *Lycopodium clavatum* tablets was added to each sample.

The uses of different preparation methodologies (sieving, ultrasonication, oxidizing ...) are compared using both concentrations - calculated from *Lycopodium* tablets - and relative abundances (more destructive methods will increase the amount of resistant taxa).

Additionally, this study focuses on some important taxonomic issues, since obvious interlaboratorial differences in nomenclature are recorded.

### **Microplankton from the Cretaceous Mannville Group, Northeast Alberta, Canada.**

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The Early Cretaceous Mannville Group of western Canada corresponds to the oldest Cretaceous strata overlying the Paleozoic basement. It contains the main reservoirs of the northeastern Alberta heavy oil province. The basal oil-bearing sandstones of the McMurray Fm are overlain by Clearwater Fm, whose base consists of the glauconitic sandstones of the Wabiskaw Mb.

Previous work: The first accounts of the organic microplankton of the Mannville Group were

published in the 1960's by Pocock<sup>5</sup>, 1962, Singh<sup>6</sup>, 1964 and Vagvolgyi and Hills<sup>8</sup>, 1969. In 1971, Brideaux<sup>1</sup> and Singh<sup>7</sup> investigated its lateral equivalent in the Peace River area (Peace River Fm and Lower Shaftesbury Fm).

Present contribution: We illustrate here dinocyst assemblages recorded in the Mannville Group: McMurray Fm, Wabiskaw Mb and Clearwater Fm, based on boreholes from north-eastern Alberta. The distribution of organic microplankton is presented on a synthetic range chart, along with the percentage of marine microplankton and number of marine species. The main species are illustrated.

Palynostratigraphic calibration: The Clearwater Fm yielded species with well calibrated world-wide ranges: *Litosphaeridium siphoniphorum* has its stratigraphic inception in the Late Albian. *Ovoidinium verrucosum* has Middle to Late Albian stratigraphic base occurrence. *Stephodinium coronatum* is known from Albian or younger times. Several taxa whose geographic record seems restricted to high latitudes were recorded in the "upper" McMurray Fm and overlying units: *Ellipsoidictyum imperfectum*, *Gonyaulacysta hyalodermopsis*, *Leptodinium cancellatum*, *Pseudoceratium retusum*, *Pterodinium verrucosum*. Outside Alberta (Singh<sup>7</sup>), calibration points are provided by publications on the District of MacKenzie: Brideaux<sup>2</sup> Brideaux & McIntyre<sup>3</sup>, and the Canadian Arctic (Nohr-Hansen & McIntyre<sup>4</sup>). *Leptodinium cancellatum* and *Pterodinium verrucosum* were described in the Horton River Fm of the District of MacKenzie, assigned to the middle Albian. It was recorded in the early to late Albian of the Canadian Arctic. *Gonyaulacysta hyalodermopsis* was first described in the middle Albian of the District of MacKenzie and reported in the Aptian to early Albian of the Canadian Arctic. *Pseudoceratium retusum* was initially described by Pocock<sup>5</sup> as *Pseudoceratium pelliferum* in sediments from Alberta dated Aptian? and lower and Middle Albian. In the Peace River area, it ranges from the middle to the late Albian (Singh<sup>7</sup>).

Dinocyst assemblages: It is possible to informally subdivide the McMurray Fm into 2 units, based on their microplankton assemblages. Marine dinocysts are sporadic in the "lower" McMurray Fm (maximum of 8 species). The species present are *Oligosphaeridium complex*, *Palaeoepidinium cretaceum*, *Canningia cf. colliveri sensu* Brideaux 1977, *Circulodinium brevispinosum*. Abnormal salinity taxa (*Nyktericysta* sp., *Vesperopsis mayi*) may be abundant. The most prominent feature of the "upper" McMurray Fm is the combination of diverse marine dinocyst assemblages and a significant amount of abnormal salinity taxa. The former group