Neogene Dinoflagellate Cysts from A Deep Water Well, Offshore Sabah, Northern Borneo

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Abstract

A research project is carried out with the objective to establish a dinoflagellate cyst biozonation for deep water wells drilled offshore Sabah and Brunei, envisaged to complement the biozonations based on nannoplankton, foraminifera and pollen. Ditch cutting samples from a pilot well have been analyzed for dinoflagellate cysts only, resulting in a list of FDO's, which could contain stratigraphic value: *Hystrichokolpoma rigaudiae* and *Hystrichokolpoma okinawainum* at 3150', Operculodinium sp. A at 3840', *Dapsilidinium pastielsii* at 4140' and *Lingulodinium pycnospinosum* at 4950' within the Pliocene section; Selenopemphix *brevispinosa* Head et al. 1989 subsp. *brevispinosa* at 5760', consistent occurrence of *Achomosphaera sp. B* at 5760' and *Systematophora placacantha* at 6495' within the Upper Miocene section. The correlation potential should be checked in a follow-up well.

Introduction

The palynological analysis results of a one well pilot study are presented; the first part of a research project with the objective to establish a dinoflagellate cyst biozonation for the deep-water wells drilled offshore Sabah and Brunei in Northern Borneo. These wells penetrate sediments deposited in prodeltaic deep-water (bathyal) environment. The dinoflagellate cyst biozonation, to be developed, is envisaged to complement the biozonations based on nannoplankton, foraminifera and pollen.

Palynological Analyses

Thirty-three ditch cutting samples from one well have been have been provided by Sarawak Shell Berhad. Palynological analyses of dinoflagellate cysts only have been carried out. Dinoflagellate cysts are restricted to the interval from 2610' to 6495'. A set of slides prepared from the oxidized fraction of the samples has been fully analyzed, resulting in real counts of dinoflagellate cysts, complemented with a screening of the unoxidized fraction for thin walled Protoperidiniacean dinoflagellates; *Selenopemhix spp, Brigantidium spp.* and *Lejeunecysta spp*, the bulk of which has been removed by oxidation. The palynological assemblages are overwhelmingly dominated by landplant material; pollen, spores, fungi and macerals. Marine elements (dinoflagellate cysts, acritarchs and algae) overall contribute to just 2 to 5 % of the microflora in the interval from 2610' to 6495'. From 6705' to 7905' the ditch cutting samples are virtually barren of marine palynomorphs. They still contain some (caved?) pollen and spores, but are dominated by dark brown debris.

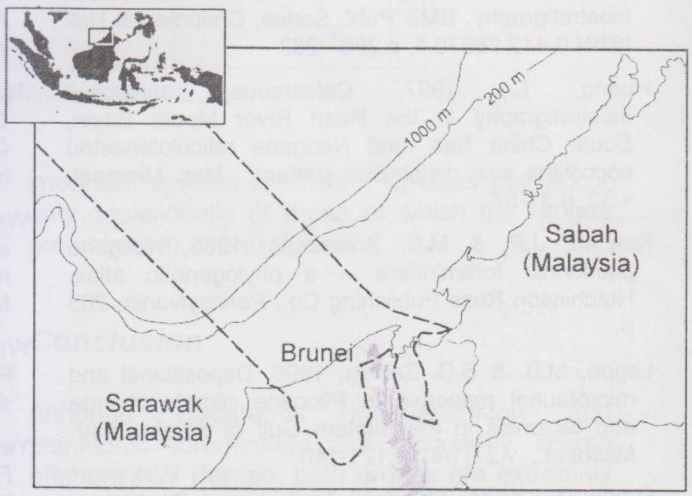


Figure 1: Location map of the study area

Biostratigraphy

The interval from 2610' to 4140' has been assigned to the Upper Pliocene, the interval from 4290' to 5430' to the Lower Pliocene and the interval from 5640' to 6495' to the Upper Miocene, based on the distribution of nannoplankton, foraminifera and pollen. A suite of FDO's of dinoflagellate cysts in descending order is presented over the full interval.

Overall, the dinoflagellate cyst assemblage is rather similar to the open oceanic assemblages of Neogene age from the Eastern Indian Ocean and Northeastern Australian Margin (McMinn, 1992 and 1993). The only difference is the rare presence only of open oceanic genera like *Impagidinium spp.* and *Nematosphaeropsis spp.* The dinoflagellate cyst assemblage is dominated by *Brigantidinium spp.*, *Spiniferites spp.* and *Operculodinium spp.* Large size varieties of *Operculodinium israelianum* and *Operculodinium walli* are commonly present, similar to those described in tropical Neogene environment in the Bahamas (Head and Westphal, 1999). *Selenopemphix nephroides, Tuberculodinium vancampoae, Lingulodinium machaerophorum* and *Polyshaeridium zoharyi* are consistently present over the full interval.

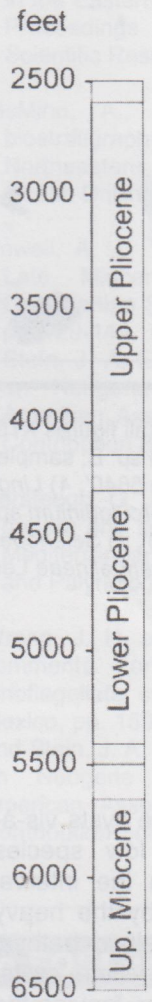
2610'-4140': Upper Pliocene interval

The FDO's of *Hystrichokolpoma rigaudiae* and *Hystrichokolpoma okinawainum* (Matsuoka, 1983) at 3150' could be of stratigraphic value. However, highest occurrences have been reported within the Pleistocene in the Western and Northern Pacific (Bujak and Matsuoka, 1986), and Gulf of Mexico (Wrenn and Kokinos, 1986). The informal species *Operculodinium sp. A* (covered with very distinctive fibrous processes) could be of considerable stratigraphic importance with a consistent range underneath a FDO at 3840'. Also *Dapsilidinium pastielsii* with a FDO at 4140' is considered to be of stratigraphic value within the Upper Pliocene section. Its highest occurrence has been reported in the Late Pliocene in Eastern Indian Ocean and Northeastern Australian Margin (McMinn, 1992 and 1993).

4290'-5430': Lower Pliocene interval

The FDO of *Lingulodinium pycnospinosum* at 4950' is considered to be of stratigraphic value. A questionable highest occurrence has been reported in the Late Oligocene in Germany (Benedek and Sarjeant, 1981). Several rare occurrences have been detected in this interval which could have stratigraphic potential; *Homotryblium tenuispinosum* with FDO at 4290' (possibly reworked), *Lejeunecysta cf. sp. 2* (Biffi and Grignani, 1983) at 4950'(also possibly reworked), *Spiniferites sp. A* (Duffield and Stein, 1986) with FDO at 5115', *Trinovantidinium ferugnomatum* at 5115' and *Selenopemphix dionaeacysta* (De Verteuil and Norris, 1992) at 5640'.

Analysis of ditch cutting samples invalidates the use of LDO's. However, it should be noted that the presence (in ditch cutting samples) of *Barssidinium cf. graminosum, Barssidinium evangelineae* (Head, 1993, and Lentin, Fensome and Williams, 1994) and *Achomosphaera granulata* is restricted to the Pliocene interval.



5640'-6495': Upper Miocene interval

Age assignment is supported by the FDO at 5760' of *Selenopemphix brevispinosa* Head et al. 1989 subsp. *brevispinosa* with a reported highest occurrence in the Latest Miocene in the eastern United States (De Verteuil and Norris, 1992 and 1996). A further support could be the top of the consistent occurrence of informal species *Achomosphaera* sp. B at 5760'.
Of stratigraphic importance is also the presence of *Systematophora placacantha* at 6495'. Its highest occurrence has been reported in the Late Miocene in Italy (Powell, 1986). The presence of *Edwardsiella sexipsinosum* at 5995', informal species *Cordosphaeridium* sp. A at 6270' and *Lejeunecysta fallax* at 6435' could also be of significance. However, the highest occurrence of *Edwardsiella sexipsinosum* has been reported in the Late Pliocene in Italy (Versteegh and Zevenboom, 1995). The highest occurrence of *Lejeunecysta fallax* has been reported in the Mid Miocene in the Pacific (Bujak and Matsuoka, 1986). The analyzed specimen could be reworked.

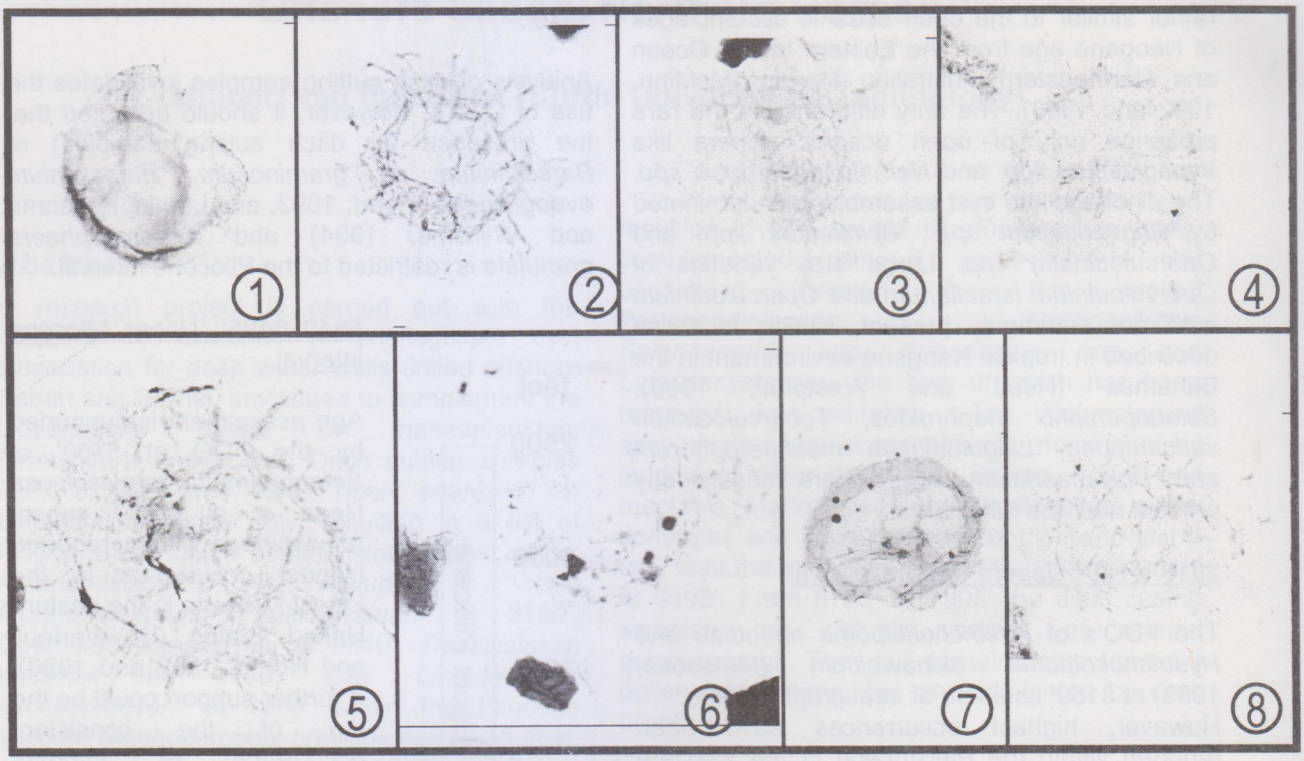


Plate 1: Key dinoflagellate cysts (all figures X750). 1) *Achomosphaera granulata* Mao Shaozhi, 1989; sample 2610'; 2) *Achomosphaera* sp. B; sample 5760'; 3) *Dapsilidinium pastielsii* (Davey and Williams, 1966b) Bujak et al., 1980; sample 5640'; 4) *Lingulodinium pycnospinosum* (Benedek, 1972) Stover and Evitt, 1978; sample 5640'; 5) *Operculodinium* sp. A; sample 4290'; 6) *Hystrichokolpoma rigaudiae* Deflandre and Cookson, 1955; sample 5640'; 7) *Selenopemphix brevispinosa* Head et al., 1989c, subsp. *Brevispinosa*; sample 5760'; 8) *Barssidinium evangelineae* Lentin et al., 1994; sample 4020'.

Discussion

The low percentage of dinoflagellate cysts vis-à-vis landplant material and the low species diversity of dinoflagellate cysts in the interval from 2610' to 6495' is explained by the heavy influx of fresh water in the prodeltaic bathyal environment, expelling the dinoflagellate cysts, which prefer to live in pure salt water, leaving the fresh water resistant forms behind. The interval from 6705' to 7905' represents the turbidite reservoir section of the well, the sands being devoid of palynomorphs.

Operculodinium sp. A, *Achomosphaera sp. B* and *Cordosphaeridium sp. A.* have been introduced with a potential stratigraphic value. Species are awaiting further taxonomic study.

At this stage a dinoflagellate zonation is not yet proposed based on palynological analyses of one well only. The correlation potential of the FDO's reported for this well has to be confirmed in a follow-up well.

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