

BIOSTRATIGRAPHY AND PALEOENVIRONMENT OF THE EARLY - MIDDLE MIOCENE OF THE GULF OF SUEZ, EGYPT: A PALYNOFLORAL APPROACH

Ali S. SOLIMAN¹, Martin J. HEAD², Werner E. PILLER¹ & Salah Y. EL BEIALY³

¹Institut für Erdwissenschaften (Geologie und Paläontologie), Karl-Franzens Universität Graz, Heinrichstraße 26, A - 8010 Graz; e-mails: ali.soliman@uni-graz.at; werner.piller@uni-graz.at

²Department of Earth Sciences, Brock University, 500 Glenridge Avenue St. Catharines, Ontario L2S 3A1 (Canada); e-mail: mjhead@brocku.ca

³Department of Geology, Faculty of Science, El Mansoura University, El Mansoura 35516 (Egypt); e-mail:syelbeialy@mans.edu.eg

The present study deals with the palynological analysis of 273 cutting-samples taken at different depth intervals from five boreholes located at the southwestern shore of the Gulf of Suez. Lithostratigraphically, the studied interval is represented by the Nukhul, Rudeis and Kareem formations and the lower part of the Belayim Formation of Gharandal and Ras Malaab groups. The Miocene sediments unconformably overly Lower Eocene.

The dinoflagellate cysts are more diversified than previously known and many taxa are recorded for the first time in Egypt. *Hystrichosphaeropsis zevensantii*, *Selenopemphix denticulatum*, *Lejeunecysta sphaerica*, *Lejeunecysta asymmetricum* and *Trinovantedinium suezense* will be described as new species. Among acritarchs the marine taxa *Nannobarbophora gedlii* and *Cyclopesilla* spp. occur as well as *Quadrina condita*, which probably is, however, a dinoflagellate. Terrestrially derived palynomorphs (miospores), freshwater algae (*Pediastrum* spp.) and fungal spores are persistently recorded.

The dinoflagellate flora allows the establishment of four biozones covering the ?Late Aquitanian to Early Serravallian:

- *Exochosphaeridium insigne* Taxon-range Zone (GOZ1: middle Early Miocene; ?Late Aquitanian - Early Burdigalian; uppermost NN2 to lowermost NN4).
- *Distatodinium paradoxum* Interval Zone (GOZ2: late Early Miocene; Late Burdigalian; NN4).
- *Selenopemphix denticulatum* Interval Zone (GOZ3: early Middle Miocene; Langhian; upper part of NN4 to lower part of NN5).
- *Cleistosphaeridium placacanthum* Interval Zone (GOZ4: Middle Miocene; Late Langhian - ?Early Serravallian; NN5).

Comparisons with other Miocene biozonations from the Mediterranean, North Atlantic, eastern USA and central Paratethys indicate that the highest occurrences of *Tityrosphaeridium cantharellus*, *Exochosphaeridium insigne*, *Distatodinium paradoxum* and *Apteodinium spiridoides*, and the lowest occurrences of *Hystrichosphaeropsis obscura*, *Sumatradinium soucouyantiae*, *Sumatradinium druggii*, *Labyrinthodinium truncatum* are important markers. The current zonation is tied to a chronostratigraphic framework by applying correlation to calcareous Nannoplankton, using the same set of samples. This is the first study to demonstrate the applicability of Early and Middle Miocene dinoflagellate cyst markers for detailed stratigraphic correlation in the Gulf of Suez, Egypt.

The dinoflagellate cyst assemblage indicates an inner-neritic environment. The presence of the thermophilic dinoflagellates *P. zoharyi*, *T. vancampoae*, *M. choanophorum*, *Tectatodinium pellitum* and others in most samples indicates the dominance of tropical to subtropical climatic conditions. This is supported by the presence of calcareous nannoplankton discoasterids. The rare occurrence of protoperidiniacean (heterotrophic) genera such as *Lejeunecysta*, *Selenopemphix*, *Trinovantedinium* and *Brigantedinium* in the Kareem-30 samples may indicate a shortage in nutrient supply (oligotrophic). Such conditions are

supported by the high percentage of reticulofenestrads within the calcareous nannoplankton. On the contrary, proteridiniacean are common and fairly to well preserved in the Shukheir boreholes. Their abundance is directly related to that of the calcareous nannoplankton species *Coccolithus pelagicus* in some intervals. This may indicate high nutrient content, upwelling and/or fresh water input. The dominance of *Polysphaeridium zoharyi* and its inverse relation to *Lingulodinium machaerophorum* in the Kareem-30 borehole may indicate a hypersaline environment (unlike in Shukheir samples). Considering the dinoflagellate assemblages of the studied sequences they clearly indicate rapidly changing environmental conditions in space and time.

KARPATIAN – BADENIAN (MIDDLE MIOCENE) DINOFLAGELLATE CYSTS OF THE STYRIAN BASIN, AUSTRIA

Ali SOLIMAN & Werner E. PILLER

Institut für Erdwissenschaften, Bereich Geologie und Paläontologie, Universität Graz,
Heinrichstraße 26, A- 8010 Graz

From Lower/Middle Miocene strata of the Styrian Basin only one short report on dinoflagellate cysts was published so far (SOLIMAN & PILLER, 2004). Work on this material was continued including two surface outcrops along the Middle Styrian Swell - Wagna and Retznei - and two deep wells of exploratory drill holes of the RAG – Waltersdorf-1 and Blumau-1. In the section of Wagna, the Karpatian/Badenian boundary is included, all other sites deal with Badenian sediments only.

The dinoflagellate cysts are mostly well preserved and diversified. In addition, other palynomorphs as acritarchs (*Cymatiosphaera* spp., *Nannobarbophora gedlii*, *Cyclopesilla* spp.), foraminiferal test linings and miospores were recorded.

The presence of many biostratigraphic dinocyst markers such as *Cerebrocysta poulsenii*, *Cleistosphaeridium placacanthum*, *Habibacysta tectata*, *Hystrichosphaeropsis obscura*, *Labyrinthodinium truncatum* subsp. *truncatum/modicum*, *Operculodinium? borgerholtense*, *Palaeocystodinium miocaenicum*, *Tityrosphaeridium cantharellus*, and *Unipontidinium aquaeductum* strongly supports the Early-Middle Miocene (Karpatian-Badenian) age.

The dinoflagellate cyst assemblages indicate an inner to outer neritic environment. Sub-tropical climate conditions are suggested by the presence of *Tuberculodinium vancampoeae*, *Tectatodinium pellitum* and *Melitasphaeridium choanophorum*. For the investigated samples, the gonyaulacoid/proteridinioid - ratio is very high. The rare occurrence of proteridiniacean genera may be interpreted either as primary due to a shortage in nutrients or taphonomically due to a low sedimentation rate since they are very sensitive to oxidation. In Retznei, our preliminary data indicate that dinoflagellate diversity and water depth increase upsection. In Waltersdorf-1 and Blumau-1, which are in a basal position, the open marine conditions are indicated by the abundance of *Nematosphaeropsis* spp.

Reference:

SOLIMAN, A. & PILLER, W. E. 2004: Miocene Dinoflagellate cysts of the Styrian Basin, Austria. - Ber. Inst. Erdwiss., K.-F.-Univ. Graz, 9: 379, Graz.

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Autor(en)/Author(s): Soliman Ali, Head Martin J., Piller Werner E., El Beialy Salah Y.

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