

Miocene dinoflagellate cysts as links between taxonomy and oil industry

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At about 11.6 Ma a glacioeustatic sea-level drop caused the final disintegration of the Paratethys Sea, and Lake Pannon arose in the Pannonian basin system. The benthic ecosystem collapsed at that point and marine life completely vanished. The lake was initially brackish, slowly freshening and slightly alkaline. Lake Pannon attained a maximum length of 860 km (from the Karlovac Basin close to Zagreb in the west to the Transylvanian Basin in Romania in the east) and a width of 550 km (from the Vienna Basin in the north to Belgrade in the south). It covered an area of c. 290,000 km². The lake was highly structured by numerous islands and mountain ranges. Its maximum water depth may have reached 800 m in its central part but less than 200 m elsewhere. The aberrant water chemistry and the decline of marine taxa gave rise to the evolution of an impressive assemblage of dinoflagellate cysts. Whilst the dinoflagellate cyst assemblages are fairly similar to assemblages recorded from adjacent areas during the Middle Miocene, the assemblage is nearly fully endemic thereafter in Lake Pannon. Simultaneously, the high diversity of 126 taxa declines strongly to about 40 taxa. The paleoecological interpretation of the dinoflagellate assemblages in Lake Pannon is complex. Most taxa have roots in marine ancestors, which became adapted to brackish water conditions of Lake Pannon with the onset of the Late Miocene. Therefore, a straightforward comparison with congeneric open marine taxa is difficult. A more promising source for comparison are the marine-derived assemblages from the Black Sea, the Marmara Sea, the Caspian Sea, the Aral Sea and some adjacent lakes.

This endemism is reflected by the absence of cosmopolitan taxa and the appearance and dominance of new morphotypes. Well studied examples are *Spiniferites bentorii* and *Impagidinium sphaericum* and their allies. Both taxa exhibit, an enormous morphological variability within Lake Pannon. This variability has been used to introduce several endemic species/subspecies. These taxa are probably mere eco-morphotypes and are difficult to define as systematic units. Nevertheless, they are valuable tools for Pannonian stratigraphy. A typical application is their use in biostratigraphic correlations of well cores in the Pannonian Basin by oil companies. Thus, despite the problematic taxonomic status of many of these morphotypes, their applicability in industry is obvious.

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