Coccolithophores and environmental changes during middle Miocene major events - responses and records at the marginal Paratethys

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This study deals with complex oceanographic systems that existed in the restricted Paratethys during the middle Miocene climate transition (MMCT) and the resulting regional and global events that influenced species diversity. The latest Badenian was characterized by stable marine conditions and diverse warm-water taxa (*Acanthoica* spp., *Calcidiscus leptoporus*, *Calciosolenia brasiliensis*, *Coronosphaera mediterranea*, *Helicosphaera carteri*, *Rhabdosphaera clavigera*, *Syracosphaera* spp., holococcoliths, and *Discosphaera tubifera*) that are typical for the subtropical gyre. Global cooling, regional regression, and local tectonic events, with a possible short-term closing of the Paratethys within the Badenian-Sarmatian transition (Zone NN6d), caused decreased species diversity and endemism. These changes are known as the Badenian-Sarmatian Extinction Event (BSEE) and saw the last appearances of *Cyclicargolithus floridanus*, *Acanthoica* spp., and *Syracosphaera* spp. Enhanced atmospheric CO_2 drawdown increased the productivity in temperate forms (*Coccolithus pelagicus*, *Calcidiscus pataecus*, and *Reticulofenestra pseudoumbilicus*), which supports the presence of the MMCT and a temperate climate. After the lowstand, sea level rose in Subzone NN7a with a maximum highstand in Subzone NN7b, which was the last period of relatively warm climate in the subtropical gyre. This is based on an increased abundance of *Helicosphaera carteri* and species of the diatom genus *Rhizosolenia* at the marginal part of the gyre, which balanced the eddy heat flux divergence that supplied the interior of the basin with warmer water. After this, the circum Mediterranean climate remained basically the same. Because of the warm marine current inflow from the Mediterranean and Indo-Pacific into the Paratethys, the North Croatian gyre system was restored, which brought a relatively warmer climate until the middle Sarmatian and extended the MMCT. Gradually this was replaced with a more temperate climate with seasonal changes and coastal upwelling. During the late Sarmatian, conditions oscillated, but warm-water coccoliths were still present in Zone NN8 (*Sphenolithus abies*, *Syracosphaera clathrata*, and *Reticulofenestra minuta*) that sporadically continued into the Pannonian.