

Calcareous nannoplankton and ϵNd as paleogeographic proxies: A case study from the Langhian junction of the Indian Ocean, the Mediterranean, and the Paratethys

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The location of marine seaways or gateways between the Mediterranean, the Paratethys, and the Indian Ocean from the late Burdigalian to the Serravallian is still a matter of scientific debate, although several paleogeographic reconstructions have attempted to assess this issue in recent decades (Popov et al., 2004; Bialik et al., 2019). Unfortunately, due to intensive tectonic activity and denudation of the Miocene sedimentary cover in the Eurasian area, only isolated relicts of the original marine basins, including those representing communication corridors, have been preserved. As a result, the only original record available is that of isolated relicts, which in some areas are completely absent. However, various paleobiological proxies (e.g., migration paths of indicative species and distribution of indicative assemblages) can be used to partially reconstruct the paleogeographic setting. In addition, Nd isotope systematics can be helpful, as $^{143}\text{Nd}/^{144}\text{Nd}$ is one of the most prominent paleoceanographic proxies for tracing water masses (von Blanckenburg, 1999; Bialik et al., 2019).

In this context, our study aims to evaluate the contribution of calcareous nannofossil assemblage analysis together with the $^{143}\text{Nd}/^{144}\text{Nd}$ proxy to reconstruct communication corridors in the Early–Middle Miocene interval in the European region and the Middle East. All analyzed samples were dated using integrated biostratigraphy and chemostratigraphy (strontium isotope stratigraphy) to ensure maximum robustness of the stratigraphic correlations. In general, the variability in calcareous nannofossil assemblages reflects the quality of the surficial water masses. We focused on characteristics such as warm-water taxa ratios, diversity, dominance, and distribution of different assemblage types, all of which were subjected to multivariate statistical methods. These results were then compared with high precision ϵNd data. Although the distribution of calcareous nannoplankton in marginal areas is thought to be primarily related to the variance of surface water temperatures, which correspond to climatic zones and the presence of stress factors, when these data are combined with high precision $^{143}\text{Nd}/^{144}\text{Nd}$ data, they can significantly contribute to refining paleogeographic reconstructions of complex marine regions.

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