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# Benthic foraminiferal response to the Middle Eocene Climatic Optimum in the South Atlantic (ODP Site 1263) and central-western Tethys (Alano section, NE Italy): a comparison.

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During the Middle Eocene Climatic Optimum (MECO; ∼40 Ma), one of the major short-term Cenozoic climatic perturbations, the cooling trend of the middle Eocene was interrupted by transient (∼500 Kyr) global warming of upper and deep ocean waters (Bohaty et al., 2009). MECO represents a large climatic disruption, but its paleoenvironmental changes and effects on biota are poorly constrained.
To provide insight into the effects of MECO and their regional variability on deep-sea biota, we present benthic foraminiferal data from lower-bathyal ODP Site 1263 (SE Atlantic), and compare these with the record from the middle-bathyal Alano section, located closer to the continental margin in the central-western Tethys (NE Italy; Boscolo Galazzo et al., 2013). The record of MECO at Site 1263 is continuous and not affected by $CaCO_3$ dissolution, allowing study of the nature and causes of benthic foraminiferal change in a pelagic setting remote from the continents.
The MECO did not induce a severe species turnover of benthic foraminiferal assemblages at Site 1263, but warming was paralleled by a marked decrease in benthic foraminiferal accumulation rates (BFAR). The decrease in BFAR combined with benthic assemblage changes indicates a decrease in supply of food to the sea floor, thus increased oligotrophy. Comparison of benthic foraminiferal data and surface-to-bottom $\delta$13C gradients at Site 1263, indicates that increased stratification and declining surface primary productivity were not the principal cause of the decrease in food flux to the sea floor. We argue that warming may have been mainly responsible for the reduction of the flux of organic matter to the sea floor, increasing the metabolic rates of pelagic consumers more than those of primary producers and leading to increased remineralization of organic matter in the water column. In addition, sea-floor warming would increase metabolic rates of benthic foraminifera and their food requirements, reducing the effective food supply. Our benthic foraminiferal records show that at Site 1263 the MECO did not induce large paleoceanographic (e.g., circulation, productivity) changes, and the changes in the benthic community may have been caused by the warming itself, rather than by its indirect environmental effects.
This scenario strongly differs from that for the Alano section, where delivery of food to the sea floor increased during the gradual warming of MECO, causing a significant but transient restructuring of benthic foraminiferal fauna. Deposition of organic-rich sediments and multiple peaks in abundance of bi-triserial opportunistic benthic foraminiferal taxa indicate that peak warming during MECO was immediately followed by severe eutrophication. The enhanced hydrological cycle during MECO may have led to increase in the delivery of nutrients into this marginal basin, thus increased primary productivity, enhanced delivery of organic matter to the seafloor, and consequent development of dysoxic sea-floor conditions. The comparison of benthic foraminifera at Site 1263 and the Alano section shows that the effects of MECO warming greatly varied geographically and bathymetrically, with different environmental stressors affecting benthic foraminiferal assemblages.