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Continuative foraminiferal research using the Enhanced Benthic Foraminifera Oxygen Index

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In 2022, Kranner et al. refined and enhanced the widely used tool of the Benthic Foraminifers Oxygen Index (BFOI) of Kaiho (1994) leading to the EBFOI. Additionally, a transfer function was introduced to directly calculate dissolved oxygen (DO) values for the first time ($DO_{[ml/l]} = 5.28475e^{0.00616x}–3.78475$). The authors adjusted the original formulas by combining calcareous and agglutinate foraminifer taxa, occupying the full range of infaunal and epifaunal habitats. Therefore, the EBFOI more fully considers both bottom water and pore water oxygenation, providing a clearer picture of oxygen levels prevailing within the total habitat space occupied by foraminifera. Through these adjustments, this new approach significantly improves the accuracy of quantitative reconstruction of marine (paleo-)oxygen and, thereby, also (paleo-)eutrophication. All formulas are calibrated with modern samples, demonstrating an accuracy increase of up to ~38% near OMZs compared to the original BFOI. Subsequently, we further tested the validity of the EBFOI as an oxygenation proxy by applying it to several hundred samples recovered from the east-coast of the US. These results further support its application on three Cenozoic fossil datasets, which were previously published. Thus, our new formulas provide a major improvement in reconstructing paleo-oxygen levels and enhancing the reliability of benthic foraminifers as an oxygen proxy. Henceforth, the formulas have been and are still being applied to the datasets of different geological timeframes and have been now also widely adopted in the benthic foraminifer community at large.
To further showcase the validity of the EBFOI we applied it to foraminiferal assemblages recovered during the Paleocene Eocene Thermal Maximum (PETM ~56 Ma). The PETM is one of the most prominent and closest analogues of modern climate change, providing tantalizing glimpses into potential analogues for near-future responses of bottom water oxygenation and productivity changes during major changes in pCO_2 concentration. Further studies are under way, targeting Plio-/Pleistocene (5 ma – 11ka) sapropelic samples from the Mediterranean Ocean Drilling Program (ODP) Leg 160. Finally, we aim to test and validate the EBFOI by integrating geochemical analyses. This validation is crucial and will not just provide more credibility for the proxy but also allow reliable results for problematic samples.
In the near future this research will be continued and intensified by being applied on samples of the Bavarian Molasse Basin. Since preservation and reworking of foraminiferal shells is a frequent issue in these sediments, geochemical analyses often show conflicting results. This will then highlight the usefulness of assemblage-based analyses over pure geochemical analyses which can be easily hampered by reworking.

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