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Revisiting the relationship between the pore water carbon isotope gradient and bottom water oxygen concentrations

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Reconstructing the oxygen content at the base of the ocean provides insight into ocean circulation, carbon storage in the deep ocean and hence, the global carbon cycle. The microbial breakdown of organic carbon within marine sediment through aerobic respiration consumes oxygen in the pore fluid and releases dissolved inorganic carbon. The offset in the carbon isotopic composition of epifaunal and infaunal foraminifera is related to the respiration of the organic carbon and can be used to reconstruct the oxygen content of the bottom water. Previous work has provided a data-derived calibration which is valid for oxygen reconstructions between 55–235 micromolar. In this study, we apply a biogeochemical reactive transport model (RTM) to extend and update the calibration, which allows for the reconstruction of oxygen concentrations up to ~400 micromolar. Using the RTM and new data from the Iberian Margin, we also demonstrate that the calibration between the carbon isotope gradient and bottom water oxygen concentrations must account for the coupled changes in all aspects of the carbon system due to the respiration of organic carbon. We apply the improved calibration to reconstruct the changes in oxygen content in the North Atlantic over the past 1.4 Myr.