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Calibrating authigenic trace elements as proxies for past ocean oxygenation

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The ocean is a pivotal climate regulator due to its size and tight coupling to the atmosphere. Its interaction with climate is associated with physical processes on the one hand, such as ocean circulation redistributing heat, freshwater, and carbon around the globe. On the other hand, biogeochemical processes ultimately control the strength of the biological carbon pump, and by inference the sequestration of atmospheric carbon into the ocean interior.
Seawater oxygen concentrations are intimately linked to both types of processes and are thus a crucial parameter for assessing the state of the ocean today and in the past. While paleoceanography offers a unique opportunity to observe the state and behaviour of the ocean under different boundary conditions, the quantitative reconstruction of past bottom water oxygen concentrations (BWO) remains a major challenge.

Here we present the project OxyQuant, within which we aim to develop and calibrate an innovative proxy toolkit to reliably reconstruct past BWO. The proxies we focus on are based on the abundance of authigenic redox-sensitive metals and rare earth elements in sediments, on iodine associated with sedimentary organic matter, and on the stable isotope composition of the oxygen-sensitive rare earth element cerium. For their calibrations we rely on a global suite of sediment cores from diverse geochemical environments. We present a preliminary assessment of the usefulness of these trace elements as proxies for past bottom water oxygenation.
For cerium concentration and its stable isotopes, for example, we find consistent behaviour across different sediments, but their correlation with bottom water oxygen concentrations is weak.