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Reading the record of ocean anoxic events: Challenges and opportunities

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The dissolved oxygen content of seawater is set by a balance of physical, chemical, and biological processes. Changes to this balance can render seawater less oxygenated. During some climate perturbations in Earth's past, deep-water environments have become partially – or in the most extreme cases, entirely – oxygen-depleted. Looking to these past intervals as analogs for future ocean chemistry is of great interest to oceanographers, given that a loss of ocean oxygen content has already been observed over the past few decades of anthropogenic warming. However, sparse paleo-oxygen records and an incomplete mechanistic understanding of the drivers of past events inhibit straightforward comparison between these past climate intervals and the present day. Recent advances, especially in geochemical proxy development and model approaches, mean that it is an opportune moment to reevaluate the mechanisms of past deoxygenation events, especially through expanded data-model comparison during intervals of past ocean hypoxia. In this vein, this presentation aims to synthesize the findings of a workshop held by the Past Ocean Oxygen (PO2) working group of the Past Global Changes (PAGES) initiative. The goals of the workshop were to (i) identify mechanisms of past ocean deoxygenation, and (ii) extract lessons for the future. We find that while recent work has shed considerable light on the controls on past ocean oxygen levels, differences in both the magnitude and timescale of perturbation to the Earth system leave comparisons to the present inherently complex. In this presentation, we will expand on these findings, which will form the basis of forthcoming review articles.