Global seawater oxygenation during the Eocene: New constraints from molybdenum and uranium isotopes

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During the Eocene, the Earth's climate was tightly linked to perturbations and secular changes in the global carbon cycle. Climatic changes would have profoundly affected the distribution of O_2 in the oceans, but the timing and extent of any fluctuations in global ocean oxygenation during that period remain poorly constrained.

Here we investigate how Mo and U stable isotope compositions recorded in marine anoxic and euxinic sediments from the Arctic Ocean (IODP Expedition 302) may be used to reconstruct the extent of global marine anoxia during the Early to Middle Eocene (~56–46 Ma). Both isotope systems respond to changes in seawater redox, but they display different sensitivities to dissolved oxygen concentrations. Hence, by combining the information provided by these two proxies, we should be able to better constrain the timing and the severity of seawater anoxia episodes.

Our results suggest that anoxic and euxinic areas of marine sedimentation were more widespread at the onset of the Eocene than in the modern ocean, and that they further expanded during the long-term increase in global temperatures that culminated with the Early Eocene Climatic Optimum. Moreover, our analyses of the Arctic Ocean mudrocks highlight the importance of first understanding local sedimentary processes and their impact on isotope fractionation before any redox information can be inferred from Mo and U isotopic variations.