Global versus regional anoxia during the OAE-2 and the T-OAE

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Oceanic anoxic events (OAE) are characterized by extensive black shale formation, indicating enhanced regional or even global ocean anoxia. Here, we present an approach to determining the extent of ocean anoxia during such OAEs compared to modern conditions, by combining U and Mo isotopes with redox sensitive trace metal concentrations in black shales. We focused on the early Jurassic T-OAE (ca. 183 Ma) and Mid-Cretaceous (C/T) OAE-2 (ca. 93 Ma) due to their possible global extension and impact on marine biogeochemistry.

We observed a shift of U and Mo isotope compositions for both OAEs towards lighter isotopic compositions, compared to their modern equivalents (Black Sea [1]). U isotope compositions of OAE-2 display the same shift relative to above- and below OAE-2 black shales, while respective Mo-isotope signatures are likely affected by local redox shifts [2]. The observed U isotope signatures indicates enhanced U removal into anoxic sinks to about 60 $^{+30}/_{-20}$% during both OAEs, compared to 10% at present day, if applying mass balance constraints . Furthermore, a positive correlation of U isotopes and U/Al for T-OAE black shales (rather than a negative one, as observed for Black Sea and OAE-2 black shales) may be interpreted as U-removal from the water column in a long term isolated basin [3]. Accordingly, we interpret the enhancement of anoxic environments during the OAE-2 to represent a global-, while that during the T-OAE more likely as a regional signal.

[1] Weyer *et al.* (2008) *GCA* **72**, 345-359. [2] Hetzel *et al.* (2009) *Palaeogeography, Palaeoclimatology*, *Palaeoecology* (in press). [3] McArthur *et al.* (2009) *Paleoceanography* (in press).

Sediment-rich Antarctic basal ice as a habitat for microorganisms

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Geochemical and biological analysis of sediment-rich ice from a basal ice sequence at Taylor Glacier, Antarctica, imply that *in situ* microbial respiration at -15°C is an important process that contributes to the high concentrations of CO_2 measured in the ice (up to 30% of the total gases). Gas volume and composition measurements made on ice samples collected from the basal ice sequence revealed concurrent trends in the microbiological and geochemical (dissolved and gas) data. We suggest that increases in CO_2 concentration, commensurate with decreased O_2 concentration, within zones of sediment-rich ice are the result of heterotrophic microbial respiration with O_2 as the terminal electron acceptor. Sediment-rich basal ice contains higher concentrations of dissolved nutrients and dissolved and particulate organic carbon compared with clean ice of meteoric origin, consistent with the idea that the former regions contain sufficient substrates (i.e., macro- and micronutrients) to support heterotrophic production. These data support the notion that microorganisms are capable of remaining metabolically active under the low water activity conditions in the ice, biotic processes continue within the ice for extended timeframes, and ice masses are active biomes. Our results provide new information on the specific physical, chemical, and/or biological processes responsible for gas production in basal ice and may provide the first direct evidence for *in situ* microbial activity at -15°C in the Antarctic cryosphere.