Molybdenum isotopes record past instabilities of the Arabian Sea oxygen minimum zone (OMZ)

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Molybdenum is a redox-sensitive trace metal and Mo enrichments and isotopic compositions in marine sediments can be used to reconstruct paleo-redox conditions. Fractionation values reflect the partial or complete scavenging of pore water Mo and the precipitation of different Mo-bearing species including sulfur. The Arabian Sea OMZ is maintained by high oxygen consumption due to organic matter oxidation and low oxygenated intermediate water inflow. During the last 50 kyr, the stability of the OMZ is related to millennial climate variability. During massive ice-sheets collapse in the North Atlantic (Heinrich events HE), the inflow of oxygen-rich Antarctic Intermediate Water (AAIW) was stronger causing a transient weakening or disappearance of the Arabian Sea OMZ. We present Mo isotopes ($\delta^{98/95}$Mo) and authigenic Mo concentrations [Mo] measured by MC-ICP-MS in a sediment core collected within the OMZ offshore Pakistan. The transition from HE5 to warm interstadial Dansgaard/Oeschger event 12 (DO12; 48 to 46 kyr) is characterized by an important increase of total organic matter (TOC). [Mo] and $\delta^{98/95}$Mo mirror this pattern, with low [Mo] and low $\delta^{98/95}$Mo pointing to oxic to suboxic conditions during HE5. By contrast, during DO12, TOC and [Mo] increase and the $\delta^{98/95}$Mo isotopic composition is higher. This points to an anoxic water column due to a well-developed OMZ (but without free H_2S in the water column). During DO interstadials 12, 11 & 10 and stadials 12-11 & 11-10, $\delta^{98/95}$Mo values stay relatively high indicating that anoxia persisted throughout this period. Interestingly, the $\delta^{98/95}$Mo signature allows distinguishing between ventilation conditions during 'cold' DO stadials and HEs. This is probably linked to isotopic fractionation thresholds, highlighting the advantage of Mo isotopes in comparison with other redox-sensitive geochemical proxies (TOC, $^{15}N/^{14}N$, lycopane…).

Anthropogenic aerosols and Southern Hemisphere climate change: A modelling perspective

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Climate modelling suggests that because the distribution of aerosols is highly variable in space and time, anthropogenic aerosol forcing can actively drive changes in atmospheric circulation. Possible impacts of anthropogenic aerosols in the Northern Hemisphere (NH) include summertime floods and droughts in China [1], droughts in the Sahel [2], and a weakening of the South Asian Monsoon [3].

Anthropogenic aerosol concentrations are much lower in the Southern Hemisphere (SH) than in the NH. However, several climate modelling studies show a southward shift of tropical rainfall in response to an aerosol-induced cooling of the Northern Hemisphere [2,4,5], which also implies the possibility of effects on circulation and rainfall in the SH.

We performed 20th Century transient simulations with a low-resolution version of the CSIRO global climate model (GCM), designed to isolate the effects of anthropogenic aerosols on recent climate change [6]. The results suggest that anthropogenic aerosols (principally from the NH) are important for understanding late 20th-Century trends in the climate of the SH, including rainfall changes over Australia [6], the structure of temperature changes in the Indian Ocean [7] and changes in the Southern Annular Mode [8]. Changes in oceanic heat transport are important in modulating these responses in our GCM; this emphasises the importance of using coupled ocean-atmosphere GCMs in future studies of aerosol effects on climate.

[1] Menon *et al.* (2002) *Science* **297**, 2250-2253. [2] Rotstayn & Lohmann (2002) *J. Clim.* **15**, 2103-2116. [3] Ramanathan *et al.* (2005) *Proc. Natl. Acad. Sci.* **102**, 5326-5333. [4] Kristjansson *et al.* (2005) *J. Geophys. Res.*, **110**, doi: 10.1029/2005JD006299. [5] Takemura *et al.* (2005) *J. Geophys. Res.*, **110**, doi: 10.1029/2004JD005029. [6] Rotstayn *et al.* (2007) *J. Geophys. Res.*, **112**, doi: 10.1029/2006JD007712. [7] Cai *et al.* (2007) *Geophys. Res. Lett.*, **112**, doi: 10.1029/2007GL030380. [8] Cai & Cowan (2007) *Geophys. Res. Lett.*, **112**, doi: 10.1029/2007GL031706.