Changes in the extent of marine anoxia during the Early Jurassic: Evidence from molybdenum isotopes

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Relatively brief periods of expanded marine anoxia (Oceanic Anoxic Events, OAEs) occurred during the Mesozoic. The Toarcian OAE (Early Jurassic, ~183 Ma ago) was associated with a crisis in marine phytoplankton, with the extinction of marine macrofossils, and with pronounced excursions in $\delta^{13}C$ and in seawater $^{187}Os/^{188}Os$ and $^{87}Sr/^{86}Sr$ ratios. However, as with other OAEs, the causes underlying the onset and recovery of oceanic anoxia during the Toarcian remain poorly understood. Because Mo isotopes are fractionated between oxic and anoxic sediments, the Mo isotope composition of appropriate marine samples can be used as a proxy for the redox state of ancient seawater [1,2], and thus this system may offer new insights into seawater redox changes that occurred during the Toarcian.

Our new data show that the $\delta^{98/95}Mo$ ratio of seawater increased by ~2.0‰ near the start of the Toarcian OAE, reflecting an initial shift from an oxic to anoxic environment. The presence of at least three rapid $\delta^{98/95}Mo$ excursions of ~ -0.6‰ after this initial shift suggests that the areal extent of marine anoxia was significantly expanded for short intervals. Furthermore, these three $\delta^{98/95}Mo$ excursions coincided with negative $\delta^{13}C_{org}$ excursions of 2-3‰ [3], which implies that the expansion of ocean anoxia was connected directly to the major perturbations to the global C-cycle. Isotopically heavy $\delta^{98/95}Mo$ values from sediments deposited after the OAE suggest that anoxic conditions continued locally, whereas there was a return to oxic marine conditions elsewhere.

Variations in Mo abundance and in the Mo/Re ratios of our samples are in line with the $\delta^{98/95}Mo$ evidence suggesting that the area of marine anoxia increased substantially for brief periods of the early Toarcian. In addition, a notable change in the relationship between $\delta^{98/95}Mo$ and Mo abundance during and after the major C-isotope excursions indicates that the combination of the two redox proxies may help determine whether seawater anoxia was global or regional in extent.

References

[1] Barling J., Arnold G.L. and Anbar A.D. (2001) *E.P.S.L.*. 193**,** 447-457.

[2] Siebert C., Nägler T.F., von Blanckenburg F. and Kramers J.D. (2003) *E.P.S.L.* 211**,** 159-171.

[3] Kemp D.B., Coe A.L., Cohen A.S. and Schwark L. (2005) *Nature* 437**,** 396-399.