

## **Corrigendum to: 'Basin-scale controls on the molybdenum-isotope composition of seawater during Oceanic Anoxic Event 2 (Late Cretaceous).'**

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### **Abstract**

A recent molybdenum-isotope estimate of the extent of anoxic and euxinic conditions in the world ocean during Oceanic Anoxic Event 2 (~94 Ma) concluded by discussing a contrast between the new results with existing estimates of marine euxinia based on sulphur isotopes. This suggested contrast was erroneous; when areal extents of marine anoxia and euxinia are calculated for both isotopic proxies, the agreement is actually striking, and highlights the fact that large areas of the global ocean probably remained well ventilated during this event.

### **Text**

Our recent study of the molybdenum-isotope composition (expressed as  $\delta^{98/95}\text{Mo}$  relative to NIST 3134) of marine sediments deposited during Oceanic Anoxic Event 2 (~94 Ma) concluded that the global seawater composition during this event was ~1.2‰ (Dickson et al., 2016), in agreement with a previous estimate (Westermann et al., 2014). This composition is significantly lower than the present-day seawater  $\delta^{98/95}\text{Mo}$  of ~2.1‰ (Nakagawa et al., 2012), which can be explained by a comparatively higher removal flux of Mo into sulphide-rich sediments deposited in anoxic and euxinic settings during OAE-2.

In our concluding paragraph, it was stated that the removal flux of Mo into anoxic and euxinic environments during OAE-2 was 60–125% greater than at present, which was highlighted as being significantly different from the 15–30 fold increase in euxinic seafloor area estimated using the isotope composition of sulphur bound within carbonates ( $\delta^{34}\text{S}$ ) deposited during the same event (Owens et al.,

2013). In fact, the Owens et al. estimate equates to ~2–5% of the OAE-2 seafloor being covered by euxinic waters, which is a maximum estimate given that  $\delta^{34}\text{S}$  is unable to differentiate between pyrite formed within a sulphidic water column and pyrite formed within sulphidic sediment pore-waters. The increase in Mo-removal fluxes into anoxic and euxinic sediments for OAE-2 calculated by Dickson et al. (2016) can be converted to approximate seafloor area by calculating a scaling constant from the proportional Mo flux into these environments (covering ~0.15% of the global seafloor) in the modern ocean; and then applying this scaling to the range of proportional fluxes into anoxic and euxinic environments estimated by Dickson et al. (2016) for OAE-2 (c.f. Ling et al., 2005). These calculations limit the extent of anoxic and euxinic water masses to < ~2% of the global seafloor during OAE-2, a value that is extremely close to the lower bound of the estimates (2–5%) based on  $\delta^{34}\text{S}$  (Owens et al., 2013). Note that the value of < ~10% quoted by Dickson et al. (2016) was a conservative estimate. Estimates of seafloor euxinia using both Mo- and S-isotopes contain a number of uncertainties, but can provide order-of-magnitudes assessments of the extent of deoxygenated water masses in the world oceans. The similar range of estimates using both methods is therefore an important observation.

The statement in the concluding paragraph of Dickson et al. (2016) that assessments of the extent of seafloor redox using the Mo- and S-isotope proxies were in disagreement for OAE-2 is not correct; in fact, the agreement between them is striking, and establishes that seafloor anoxia and euxinia, albeit expanded compared with the present day, did not affect the global ocean in as dramatic a manner as envisaged by some numerical models (e.g. Monteiro et al., 2012). The similarity in the results from the two proxies highlights the value of multi-isotopic approaches for reconciling the impact of oxygen depletion in the world ocean and, in turn, for assessing the likely impact of future deoxygenation on marine ecosystems and geochemical cycling of bio-essential nutrients and trace metals.

## **Acknowledgements**

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## **References**

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