Isotopic constraints on the molybdenum cycle in the Late Cretaceous

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There are few Mo-isotope data from pre-Oceanic Anoxic Event 2 (OAE-2, ~94 Ma) strata that constrain the magnitude of the predicted Late Cretaceous shift in global euxinia at the onset of the event. New Mo-isotope data are presented from two drill cores that sample the Eagle Ford Shale, which spans a 2-million year interval of the Cenomanian leading up to OAE-2. The lower Eagle Ford succession was deposited on a detrital-sediment poor, distal carbonate shelf, underneath locally euxinic water masses. The lower Eagle Ford samples have stable Mo-isotope values with high and fluctuating Mo concentrations, consistent with non-quantitative removal of dissolved Mo to sediments with a constant isotopic offset from seawater. These data indicate a Cenomanian seawater Mo-isotope composition within uncertainty of published Mo-isotope data from within the acme of OAE-2. The data imply that there was no significant difference between the seawater Mo-isotope composition during OAE-2 and the preceeding Late Cretaceous background. In contrast, data from the upper Eagle Ford samples imply a multi-million year increase in the seawater Mo-isotope composition after OAE-2.

Current understanding of the molybdenum cycle predicts that the seawater concentration and isotope composition should both decrease with an increase in marine (Mo)-sulfide burial, as otherwise indicated for OAE-2 by published sulfur-isotope and Mo concentration data. The broad-scale lack of change in the seawater Mo-isotope composition therefore implies 'buffering' of the global Mo cycle to enhanced sulfide burial across the OAE. Two possibilities include: (i) A balanced switch in the locus of Mo-sulfide burial in the global oceans across the onset of OAE-2; (ii) A balanced increase in the burial of 'heavy' Mo associated with sulfides and 'light' Mo bound to Fe and Mn oxyhydroxides. The latter could have been remobilised from continental shelves during the advancement of widespread shelf anoxia at the start of OAE-2.