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Cd isotopes in carbonates deposited during 'OAE 2': Assessment of a novel palaeo-productivity tracer

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Cadmium (Cd) displays nutrient-type patterns in the oceans and offers potential as a tracer of the efficiency of the ocean's 'biological pump' and its ability to transport CO_2 from the atmosphere to the deep ocean during intervals of major environmental change. Such geochemical behaviour arises because phytoplankton preferentially incorporate lighter Cd isotopes under many oceanic conditions, leaving surface waters relatively enriched in heavier isotopes. As a consequence of this fractionation, Cd-isotope ratios have been shown to track nutrient availability and the intensity of primary productivity in the modern ocean. However, the ability of the Cd stable-isotope system to serve as a robust palaeo-productivity tracer is not yet well established.

Oceanic Anoxic Event 2 (OAE 2; ~94 Ma) represents a period of widespread environmental degradation and oceanic de-oxygenation, likely the result of increased volcanism, intensified marine and continental silicate weathering, elevated nutrient input to the ocean and augmented primary productivity. However, direct evidence for the availability of bio-limiting nutrients in the oceans and the role of primary productivity as a feedback mechanism to eventually re-stabilize climate is limited. Here we present the first Cd-isotope record for OAE 2, from the biostratigraphically well-constrained and stratigraphically expanded organic-lean pelagic carbonate section through the English Chalk at Eastbourne (UK). A previous zinc (Zn)-isotope investigation of the Eastbourne section indicates that the availability of bio-limiting metals during OAE 2 probably controlled primary productivity[1]. However, Zn is also influenced by scavenging processes, and there is increasing evidence that Zn- and Cd-isotope systematics are controlled both by sulphide formation in addition to biological uptake. Our new Cd-isotope record for Eastbourne, in combination with the available Zn-isotope stratigraphy, allows the role of primary production in driving environmental change across OAE 2 to be de-convolved from other biogeochemical processes.

[1] Sweere et al. 2018. Geology 46, 463–466.