High-resolution $\delta^{13}C_{org}$ and TOC records for the palaeo-Pacific Ocean during 'OAE-2': Insights into the global extent of ocean anoxia

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In contrast to the generally oxygenated conditions in the oceans today, the Oceanic Anoxic Events (OAEs) of the Mesozoic Era caused extreme perturbations to ocean chemistry and are commonly associated with biological turnover. OAE-2 (~94 Ma) represents the most severe and spatially extended of the OAEs. In particular, a number of studies indicate oceans deficient in oxygen in the Northern Hemisphere, although very few investigations address the extent of anoxia in the palaeo-Pacific Ocean. Here, we present the first high-resolution $\delta^{13}C_{org}$ and total organic carbon (TOC) datasets for part of the palaeo-Pacific Ocean during OAE-2, sampled at two sites in New Zealand.

The $\delta^{13}C$ record reveals a broad positive carbon-isotope excursion through OAE-2, allowing detailed correlation with sections from the Northern Hemisphere. The new records provide clear evidence of the onset of OAE-2 as well as the first documentation from the Southern Hemisphere of the carbon isotope expression of the 'Plenus Cold Event' (PCE), widely inferred to represent a short-term return to globally oxygenated conditions during OAE-2. Moreover, the occurrence of black-shale facies, typical for the Tethyan, proto-North Atlantic and equatorial palaeo-Pacific Oceans, are absent in New Zealand where, instead, marine Fe-oxide-rich 'red beds' were locally deposited. The generally low TOC values in the New Zealand sections is indicative, for this sector of the proto-Pacific Rim, of watermasses whose degree of oxygenation intensified into the PCE, coincident with a stepwise decrease in TOC. Relatively oxygeneated conditions at the sea floor were maintained throughout the OAE, suggesting an early recovery to pre-event conditions. Despite these findings, the New Zealand sections also reveal partial collapse of benthic ecosystems during OAE-2, an observation that remains unexplained.