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Elevated productivity during Oceanic Anoxic Event 2 in the Mentelle Basin, Western Australia (IODP Expedition 369), indicated by benthic foraminifera and geochemical proxies

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Oceanic Anoxic Event 2 (OAE2) was a period of geologically abrupt greenhouse gas release ~94 Ma, associated with Large Igneous Province (LIP) volcanism and severe ocean anoxia. However, relatively little is known of palaeoceanographic changes in the Southern Hemisphere. We refined the stratigraphy of International Ocean Discovery Program (IODP) Site U1516 by measuring high resolution carbon and oxygen stable isotopes from bulk rock carbonate ($\delta^{13}C_{CARB}$, $\delta^{18}O_{CARB}$) and total organic carbon ($\delta^{13}C_{TOC}$), and benthic foraminiferal isotopes. Published records of bulk rock $\delta^{13}C_{CARB}$ show a clear positive excursion, which is traditionally used to correlate OAE2 globally, but biostratigraphic age control at Sites U1513 and U1516 suggests that OAE2 was stratigraphically more extensive than $\delta^{13}C_{CARB}$ suggests. We resolve this discrepancy by compiling a composite benthic foraminiferal stable isotope record ($\delta^{13}C_{FORAM}$, $\delta^{18}O_{FORAM}$) from several species at Site U1516, after defining species-specific isotope offsets. Our composite $\delta^{13}C_{FORAM}$ record agrees with biostratigraphic age control that OAE2 in the Mentelle Basin was stratigraphically more extensive than suggested by bulk $\delta^{13}C_{CARB}$ alone.

We reconstruct palaeoceanographic change through OAE2 in the Mentelle Basin by comparing published records of biogenic silica and Nd isotopes with our new records of benthic foraminiferal assemblages and stable isotopes for Site U1516. Benthic foraminifera are moderately well preserved in most samples – outside of a prominent carbonate dissolution horizon – with 69 taxa identified, an average diversity of 14 taxa per sample, and species indicative of outer neritic to upper bathyal environments. Correspondence analysis indicates two clear assemblages in the record, with the assemblage change occurring over the dissolution horizon during the main phase of OAE2. Species characterised as high organic carbon flux/low oxygen indicators proportionally increase within OAE2, indicating a likely change to elevated primary productivity. Productivity appears to have increased substantially during the dissolution horizon in the early main phase of OAE2, occurring with increased biogenic silica, occasional pulses of high TOC, and more negative εNd values, indicative of enhanced terrigenous runoff and eutrophication. Within the later part of the main phase of OAE2, terrigenous runoff and productivity fell, carbonate reappeared, but benthic foraminifera indicate productivity was likely higher than before OAE2, and $\delta^{18}O_{FORAM}$ indicates warmer bottom waters, indicative of possible upwelling from less thermal stratification.