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Paleoceanographic reconstructions from planktonic foraminifera across the Cenomanian/Turonian boundary and OAE 2 at southern high latitudes (IODP Site U1516, Mentelle Basin, Indian Ocean, SW Australia)

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Planktonic foraminiferal population dynamics and stable isotope data are presented to interpret environmental changes across the Cenomanian-Turonian boundary interval at Integrated Ocean Discovery Program (IODP) Expedition 369 Site U1516 in the Mentelle Basin (Indian Ocean, SW Australia). Site U1516 was located at 60°-62°S paleolatitude and it is the first high latitude locality in the Southern Hemisphere where planktonic foraminifera are consistently recorded across the Oceanic Anoxic Event 2 (OAE 2) interval and its associated positive $\delta^{13}\text{C}$ excursion. Planktonic foraminifera and calcareous nannofossil biostratigraphy and stable isotopic results indicate the presence of a hiatus in the upper Cenomanian that spans the base of the $\delta^{13}\text{C}$ excursion, thus the record of the onset of OAE 2 is not preserved. Nevertheless, correlation between the $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ profiles at Site U1516 and the European reference section at Eastbourne (England) allow identification of the Carbon Isotopic Excursion and, tentatively, of correlative local cooling consistent with the expression of the Plenus Cold Event at low latitudes.

Absolute abundances of planktonic and benthic foraminifera, and radiolaria combined with $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ measurements of both bulk carbonate and planktonic and benthic foraminifera provide clues concerning the paleoceanographic changes across OAE 2. In the lower part of OAE 2 and coinciding with the trough in the $\delta^{13}\text{C}$ profile, the planktonic foraminiferal assemblages are dominated by small-sized (125-38 μm) opportunistic species and radiolaria indicating a dominantly eutrophic regime. An increase in benthic foraminiferal abundance may indicate a local increase of oxygenation during the interval of the Plenus Cold Event associated with high $\delta^{18}\text{O}$ values, as observed at low latitudes. At Site U1516, the middle part of OAE 2 corresponding to the plateau

phase of the $\delta^{13}\text{C}$ profile is masked by absence of carbonate, highest TOC values, and high biogenic silica indicating this interval corresponded to a time of highly stressed eutrophic conditions with possible shoaling of the Carbonate Compensation Depth. Above this interval, bulk isotopic results are characterized by a decrease in $\delta^{13}\text{C}$ values, CaCO_3 increases associated with the abundance of opportunist planktonic species and apparently cyclic fluctuations in the absolute abundance of benthic foraminifera. These observations point to dominantly eutrophic conditions likely affected by upwelling of nutrient-rich and $\delta^{13}\text{C}$ -depleted intermediate water masses.

Toward the top of OAE 2 across the C-T boundary interval, the planktonic foraminiferal assemblages show changes in composition with an overall increase in species diversity and continued cyclic fluctuations in absolute abundances. These features coupled with the foraminiferal species-specific $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ patterns reveal that Site U1516 occupied a paleoceanographic setting still affected by eutrophy likely related to enhanced input of nutrients. However, the occurrence of species that occupied relatively deep ecological niches indicates there were also episodes of stability with ecological/thermal stratification in the surface waters. This interval also records the highest sea surface water paleotemperatures values estimated as 20°-23°C based on $\delta^{18}\text{O}$ values of foraminiferal shell and assuming seawater $\delta^{18}\text{O}$ values of $-1\text{‰}_{\text{V-SMOW}}$. Following the OAE 2 event and associated $\delta^{13}\text{C}$ excursion, stable conditions in the water column were established.