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An Eocene/Oligocene boundary geochemical proxy record from Ocean Drilling Program Site 1211 on the Shatsky Rise, Pacific Ocean.

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Evidence for significant global oceanographic and climatic change at the Eocene/Oligocene Boundary (EOB) is well documented, but records from the Pacific Ocean are limited to a single location, Site 1218 (Lear et al., 2004; Coxall et al., 2005). Here we present new data from the Shatsky Rise for cores collected during Ocean Drilling Program (ODP) Leg 198 that detail geochemical change across the boundary. During ODP Leg 198 an EOB section was recovered at Site 1211 (palaeodepth 2000-3000 m) on the southern high of the Shatsky Rise. This EOB section is a seemingly complete calcareous nannofossil ooze rich section, suggesting deposition above the carbonate compensation depth (CCD) throughout the EOB period. Deposition above the CCD should mean that changes in carbonate ion concentration, a potential control on foraminiferal Mg/Ca ratios, will be reduced in comparison to existing records from ODP Site 1218 (palaeodepth ∼3800 m; Lear et al., 2004). Based on data published in the ODP Leg 198 Initial and Scientific Reports, relevant Site 1211 cores were sampled across the EOB, as marked out by the last occurrence of Hantkenina spp. and a notable colour reflectance change. In the absence of a palaeomagnetic record, Sr-isotope chronostratigraphy has been used to supplement the existing biostratigraphy and facilitate the development of a more robust age model. Samples were picked for both benthonic and planktonic foraminifera, which subsequently were analysed for stable carbon- and oxygen-isotope and element/Ca (particularly Mg/Ca) ratios. These foraminiferal proxy data are supplemented by stable-isotope records from the <38 micron fine fraction, %CaCO3 and scanning X-ray florescence (Ca and Fe) data from across the EOB. The geochemical proxy data show the ubiquitous EOB positive shift in oxygen-isotope ratios synchronous with increases in %CaCO3, colour reflectance and % sand, suggesting enhanced carbonate preservation/sedimentation compared to the late Eocene. Benthonic Mg/Ca ratios increase across the EOB, while planktonic Mg/Ca ratios decrease. An increase in benthonic Mg/Ca ratios is similar to published Pacific Ocean records (Lear et al., 2004), previously explained by the likely control of carbonate ion concentration on uptake of Mg into the foraminiferal tests masking an expected temperature decrease. Using existing Mg/Ca temperature calibrations, foraminiferal Mg/Ca and oxygen-isotope ratios have been interpreted in terms of deconvolution of seawater temperature and oxygen-isotope composition, as well as potential carbonate ion effect. The Site 1211 geochemical proxy data also are considered in comparison to published records.
References: Coxall,H.K., Wilson, P.A., Palike, H., Lear, C.H. & Backman, J., (2005), Rapid stepwise onset of Antarctic glaciation and deeper calcite compensation in the Pacific Ocean, Nature, 433, 53-57; Lear, C.H., Rosenthal, Y., Coxall, H.K., & Wilson, P.A., (2004), Late Eocene to early Miocene ice sheet dynamic and the global carbon cycle, Paleoceanography, 19, PA4015, doi:10.1029/2004PA001039