Globally distinctive redox responses to Oceanic Anoxic Event 2

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Cenomanian-Turonian boundary is recognized by a large carbon isotope excursion due to widespread deposition of black shale. Basin-scale ocean oxygenation dynamics during the OAE 2 have been intensively studied using multiple geochemical proxies on various lithologies including I/Ca, Fe speciations, trace element concentrations, S isotopes, and Cr, Mo, U, Tl isotopes. Combined proxy data suggest gradual marine deoxygenation during OAE 2. However, geographical differences in oceanic redox responses are poorly constrained, especially for the southern hemisphere. Here we report Ce anomaly data from seven OAE 2 sections representing a more global record: Raia del Pedale (Italy), Eastbourne (UK), and Clot de Chevalier (France) from North Atlantic Ocean and Tethys Sea; ODP Hole 763B, 765C, 766A, 1138A from Indian Ocean. Ce anomaly is calculated as Ce/Ce*= Ce^2/(Pr*Nd), using the UCC (upper continental crust) noramlized concentrations. Ce anomaly data from sections in the northern hemisphere show positive shifts that initiate shortly prior to the $\delta^{13}C$ excursion, and this time lag is also recognized in Tl isotope record of OAE 2 sections (Ostrander et al., 2017). Among which, Ce anomaly data from Eastbourne and Clot de Chevalier are all below 1, indicating a local oxic to suboxic enverironment duing OAE 2. However, Ce anomaly in Raia del Pedale are over 1 during OAE 2 and return to the baseline level (~0.8) afterwards, suggesting suboxic to anoxic condition in upper water column. On the other hand, Ce anomalies in four ODP holes have low value close to 0.1 before OAE 2, gradually shift towards higher values during OAE 2 and slowly returned to baseline value after the end of $\delta^{13}C$ excursion, but all data remained lower than 1. Compiled Nd isotope data from these OAE-2 sections show distincted patterns between the proto-Indian Ocean and the Atlantic basins as well as Tethys Sea. Coupled evidence from Nd isotopes and Ce anomaly suggest oceanic redox heterogeneity is partially caused by different responses in ocean circulation and stratification. Lastly, local oceanic oxygen dynamics in each section are quantitatilvely reconstructed using Ce oxidation thermodynamic models.