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Anoxic bottom water condition during the Deccan volcanism: Multi-proxy evidences from a shallow marine sequence in Rajahmundry, SE India

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Major events like global anoxic episodes and mass extinctions are often associated with the eruption of Large Igneous Provinces (LIPs) in the geological past. The Deccan Trap eruption in the end-Cretaceous period in India forms the second-largest LIP and has often been causally linked to the Cretaceous-Paleogene Boundary (K/PgB) mass extinction event. To date, however, environmental reconstructions from pre- and post-volcanic sequences (infra- and inter-trappean, respectively) have mostly been qualitative and fragmentary and as a result, the effects of volcanism on the adjacent environmental conditions are still not well understood. Here, we present evidence of bottom water anoxia as a direct consequence of the Deccan volcanism. For this work, we analyzed major and trace element abundance, total organic carbon (TOC), bulk carbon isotope composition ($\delta^{13}\text{C}_{\text{org}}$), and molecular characterization of organic matter (OM) from shallow marine trappean sediments in Rajahmundry, SE India, where the main volcanic episodes separating the infra- and inter-trappean sediments also encompass the K/PgB. The infra-trappean shows overall low TOC (<0.1%) and $\delta^{13}\text{C}_{\text{org}}$ ($-26.3\pm 0.4\text{‰}$) values, with relatively higher concentrations of longer-chained n-alkane homologues and detrital elements (Al, Ti, Th, K) suggesting a larger contribution from terrestrial derived OM. Across volcanism, however, there is considerable decrease in terrigenous influx, as well as lowering in Pristane/Phytane ratios (<0.6) and enrichment in redox-sensitive elements like Mo, U, V and Co. This is also accompanied by contemporaneous increases in TOC ($\sim 0.6\%$) and $\delta^{13}\text{C}_{\text{org}}$ values ($\sim 3.9\text{‰}$), suggesting that the change from oxic to sub-oxic or anoxic condition after the main volcanic episode led to increased OM burial and perturbations in the shallow marine carbon reservoir. Higher supply of micro-nutrient during this interval, as evidenced from enrichment in Ba, Fe, Ni and Zn possibly suggest that hydrothermal recycling and initial phases of eutrophication led to depletion in the bottom-water oxygen levels. Temperature increases due to CO_2 degassing from volcanism may have further decreased the solubility of oxygen in the sea-waters; however, further studies from the volcanic province are required to ascertain the underlying causes and extent of perturbations and ultimately, to better constrain the complex environmental feedbacks associated with the Deccan volcanism.