



Deccan volcanism, acidification and ocean carbonate saturation overshoot

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During the Cretaceous-Paleogene (KPg) transition about 66 million years ago, eruptions of the Deccan Traps magmatic province released massive amounts of carbon dioxide and acid aerosols into the atmosphere, leading to global warming, environmental acidification and biological crisis. However, how this acidification affected the biosphere and was recorded in marine sediments is still poorly constrained. Here we investigated the unusual occurrence of a low magnetic susceptibility interval overlying the KPg boundary at Galanderud, Iran, and constituted by clays alternating with three limestone beds. On a global scale, the base of the Danian (biozone P0) represent a period of low biological productivity at the aftermath of the KPg mass extinction, and thus the occurrence of these three carbonate beds is unusual. Our results show that the basal Danian clays are characterized by anomalously low content of magnetite compared to Maastrichtian and upper Danian marls, as well as by a relative higher abundance of mercury (20-30 ppb) than the interbedded carbonates. Absence of significant correlation between mercury and total organic content comforts the contribution of the Deccan volcanism. Carbonates are constituted by microcrystalline calcite, with no or very few nannofossils, suggesting a diagenetic or early calcite precipitation origin. We hypothesized that these clay/carbonate alternations represent periods of acidification induced by the Deccan volcanism, where acid rains led to the dissolution of iron oxides inland and in surficial seawater and resulted in the deposition of magnetite-depleted clays. To test this hypothesis we conducted a set of simulations using a biogeochemical model coupled to a General Circulation Model (GCM). Results shows that dissolution of continental and shallow water carbonates would have led to the rapid injection of Ca^{2+} and CO_3^{2-} into the ocean, triggering ocean carbonate saturation overshoot, resulting in the precipitation of the abiotic carbonates. The occurrence of three successive and rapid pulses of Deccan eruptions may further explains the enigmatic clay/carbonates alternations in the basal Danian. These findings represent an unprecedented piece of evidence of the climate perturbation of the Deccan volcanism in the Tethys realm.

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