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Environmental acidification triggered by Deccan volcanism at the KPg Galanderud section, Iran

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The Galanderud section from the Alborz Mountain region of northern Iran provides a complete record of the Cretaceous-Paleogene (KPg) transition from the Tethys realm. Its peculiarity resides in the uncommon and enigmatic occurrence of three chalk layers alternating with clays at the basal Danian, just above the KPg boundary (biozone P0). In order to unravel the origin of this uncommon succession and their possible link with bolide impact and/or Deccan Traps volcanism, we conducted a rock magnetic study, consisting in the acquisition and unmixing of isothermal remanent magnetization (IRM) curves, magnetic susceptibility and S-ratio. Magnetic data are complemented by mercury analysis and nannofossil assemblages. Chalk layers are constitute by microcrystalline calcite, with no or very few nannofossils, suggesting a diagenetic or early calcite dissolution/precipitation origin. Magnetic results indicated magnetite, hematite and goethite, as the main magnetic carriers. Magnetite is dominant in the Maastrichtian marls and Danian chalks, but is strongly depleted in the clays interbedded within the Danian chalks, resulting in much lower S-ratio values. Interestingly, chalk layers, that should normally have low values of remanent magnetization due to the large abundance of diamagnetic calcite, show higher values of magnetite content than the interbedded clay levels. Such uncommon features suggest that the interbedded clay may have undergone reductive magnetite dissolution processes during or soon after deposition. Mercury (Hg) abundance in the Maastrichtian is generally low but exhibits peaks of 30 ppb at around -50 cm below the KPg boundary. Hg content in the Danian chalk is around 10-15 ppb, but reaches values of 20-30 ppb in the interbedded clays. Hg content shows no significant correlation with total organic carbon, suggesting a volcanic origin. The alternation of mercury-rich, magnetite depleted clays with chalk is interpreted as the result of environmental changes, including environmental acidification, triggered by Deccan volcanism. Our hypothesis is that acidification may have led to carbonate and iron oxide dissolution inland and in surficial seawater during the deposition of the basal Danian clay layers. The rapid injection of Ca+2 and CO_3-2 into the ocean then increased the seawater alkalinity, resulting in the rapid precipitation of carbonate and deposition of the chalk layer. The occurrence of successive and rapid pulses of Deccan eruptions may further explains the enigmatic alternation of chalks and clays in the basal Danian.

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