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Paleoenvironmental Changes linked to Deccan Volcanism and the K-T Mass Extinction across India and their Correlations with more distant Areas

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Recent studies indicate that the bulk (80%) of the Deccan Trap eruptions occurred over a relatively short time period coinciding with the KT mass extinction. Here we present results based on multiproxy data from intertrappean sediments located at Anjar, Kutch, western India, Jhilmili, Madhya Pradesh, central India, and Rajahmundry, SE India. We compare these results with a KT sequence in Meghalya, NE India, about 800 km from the Deccan volcanic province and more distant areas (e.g. South Atlantic, Tunisia, Kazakhstan) .

Intertrappean sediments at Anjar consist mainly of lacustrine sediments and paleosoils, which exhibit at least three PGE anomalies with high Pd contents but only one with a significant Ir enrichment. The presence of dinosaur eggshells and bone fragments above the Ir anomaly implies an upper Maastrichtian age for these sediments. Thus, the PGE anomalies do not coincide with the KT boundary, nor are they of cosmic origin because normalized PGE values suggest a flood basalt origin. Clay minerals consist mainly of smectite and palygorskite and reflect arid conditions, probably linked to higher surface temperatures on a young volcanic landscape subjected to effusive volcanic activity.

In the Rajhamundry area, two Deccan basalt flows, known as the Rajahmundry traps, mark the most extensive lava flows extending 1000 km across the Indian continent. The sediments directly overlying the lower trap contain the earliest Danian planktic foraminifera of zones P0-P1a and mark the initial evolution in the aftermath of the KT mass extinction. The upper trap was deposited during zone P1b corresponding to the lower part of magnetic polarity C29n. Sedimentological, mineralogical data reveal that deposition occurred in a shallow estuarine to inner neritic environment with periods of subaerial deposition marked by paleosoils. Clay minerals consist exclusively of smectite, typical of vertisol developed under semi-arid conditions. Outcrop correlation reveals an incised valley estuarine system.

At Jhilmili, multidisciplinary analyses reveal the KT boundary at or close to the lower trap basalt in C29R and the upper trap near the C29R/C29N transition. Intertrappean deposition occurred in predominantly terrestrial environments. But a short aquatic interval of fresh water ponds and lakes followed by shallow estuarine marine conditions with brackish ostracods and early Danian zone P1a planktic foraminifera mark this interval close to the K-T boundary. Clays from paleosoils and sediments consist of smectite and palygorskyte and indicate sub-humid to semi-arid conditions.

In Meghalaya to the northeast, the KT transition consists of Upper Cretaceous sediments dominated by sandstone, shale, sandy shale and rare coal layers, which indicate deposition in a shallow marine environment with high detrital influx from nearby continental areas. The KTB is characterized by major PGE anomalies in Ir (11.8 ppb), Ru (108 ppb), Rh (93 ppb) and Pd (75 pbb). Contrary to the sections located in the Deccan traps, dominant kaolinite in clay mineral assemblages indicates high humidity and high runoff, which is likely linked with increased warming (greenhouse effect) due to Deccan activity on the mainland. Such climatic conditions have been observed worldwide (e.g. Tunisia, Kazakhstan, South Atlantic). The contemporaneous semi-arid climate conditions that are observed in the Deccan Traps province are not observed elsewhere and therefore appear to be restricted to areas of volcanic activity.