

Late Cretaceous volcanism and climate change inferred from THg in marine invertebrate fossils

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Large-scale, semi-continuous volcanism in India produced the Deccan Traps and is coincident with the Chicxulub impactor and extensive end-Cretaceous extinction, including the demise of dinosaurs. Linking the timing of volcanism and impact events with local records of climate change and extinction has proven difficult with existing methods. We present total mercury concentrations (THg) derived from the biogenic carbonate of marine mollusks at intervals spanning active Deccan volcanism. The same shells were measured for their clumped isotopic composition (Ca ¹³C-¹⁸O¹⁶O₂ abundance), to determine ambient water temperature. We document a pattern of increased temperatures co-occurring with THg anomalies of 10 to 43 ng/g relative to a background of 0.5 to 4 ng/g in shells from numerous localities globally. The beginning of the warm interval (~100 to 250 ka prior to the end Cretaceous boundary) coincides with the onset of Deccan Traps volcanism and at one locality (Seymour Island, Antarctica) we find evidence for multiple THg anomalies (~10 to 17 ng/g), potentially corresponding to separate phases of Deccan Traps activity.

These data strongly suggest volcanic forcing caused significant end-Cretaceous climate change. The combined THg and paleotemperature records also provide new insight into long-standing questions regarding the role of volcanism as opposed to bolide impact on observed extinction patterns at the end of the Cretaceous.