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Tempo of the Deccan Traps eruptions in relation to events at the Cretaceous-Paleogene boundary

Paul Renne (1,2), Courtney Sprain (1,2), Kanchan Pande (3), Mark Richards (2), Loyc Vanderkluysen (4), and Stephen Self (2)

(1) Berkeley Geochronology Center, Berkeley, CA, United States (prenne@bgc.org), (2) University of California, Berkeley, Department of Earth and Planetary Science, (3) Indian Institute of Technology, Bombay, Department of Earth Sciences, (4) Drexel University, Department of Biodiversity, Earth and Environmental Science

It has been known for decades that the Deccan Traps (DT) continental flood basalts were erupted over an interval spanning the Cretaceous-Paleogene boundary (KPB). Paleomagnetic data clearly show that the volumetric majority of preserved DT lavas were erupted during geomagnetic polarity chron 29r, hence over an interval <1 Ma. Until recently, radioisotope geochronology has failed to clarify the tempo of the eruptions or to delineate where the KPB age-equivalent horizon occurs within the eruptive sequence.
An ongoing high-precision 40Ar/39Ar geochronologic study is providing the first indications of variable time-averaged eruption rates in the important Western Ghats region, in addition to providing the first precise location of the KPB within the Deccan pile. One to three samples from each of the ten geochemically-defined Jawhar through Mahabaleshwar Formations [Beane et al., 1986], sampled in seven stratigraphic sections, have been analyzed. Replicate analyses of plagioclase separates were conducted in as many as five incremental-heating experiments for each sample, yielding weighted mean plateau ages as precise as ± 0.035 Ma with fully propagated systematic uncertainties as low as ± 0.055 Ma.
The accumulating data require abandoning several misconceptions about Deccan magmatism. Most importantly, the notion of several temporally discrete pulses of volcanism in the Western Ghats is unsupported by our data and should be abandoned. Despite changes in mean extrusion rates, volcanism was essentially continuous for 0.91 ± 0.1 Ma, from 66.38 ± 0.05 to 65.47 ± 0.1 Ma, with no regional hiatuses >100 ka.
A sharp increase in mean volumetric eruption rate commencing within the Poladpur or uppermost Bushe Fm., near the base of the laterally extensive Wai Subgroup, is now well-documented. Based on recent area-weighted volume estimates [Richards et al., 2015], the eruption rate tripled from 0.2 to 0.6 km̂3/year at this transition. The transition coincided with increased mantle relative to crustal melt contributions and much larger volume, albeit seemingly more episodic, individual eruptive events. Prior to the transition, lavas were erupted dominantly as compound flows, whereas afterwards fields of inflated sheet flows are more abundant. These changes in magma chemistry, eruptive style, and tempo imply a fundamental change in the DT magma plumbing system, which is consistent with enlargement and/or consolidation of magma chambers. The timing and abruptness of the transition occurred within $\sim$50 ka of the KPB, supporting a causal relationship to the Chicxulub impact whose synchrony with the KPB at 66.04 ± 0.01 Ma [Sprain et al., 2015] is unambiguous.
Further 40Ar/39Ar dating (in progress) will refine the tempo of DT eruptions and will test for synchrony of geochemically-defined formations on a regional scale. Improving volume estimates for each formation remains a significant challenge. Quantifying volatile release as a function of time is also challenging but critical to providing realistic constraints on the role of DT volcanism in ecosystem stress around the KPB. New high-precision geochronological and geochemical constraints on large “outlying” regions such as the Malwa Plateau, Mandla Lobe, and Kutch Peninsula will be crucial to a more complete understanding of the evolution of Deccan volcanism and its relation to the KPB.