

Spatial-temporal evolution of the Deccan Traps volcanic system

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Ongoing high-precision ⁴⁰Ar/³⁹Ar dating of lavas in the Deccan Volcanic Province (DVP) reveals regional trends in the temporal evolution of erupted lavas. Magmatism represented by small isolated intrusions initiated in the northwestern DVP at ca. 69 Ma and generally propagated southeastward at approximately plate velocity, consistent with passage of the Indian Plate over a fixed melting region. Though dominantly tholeiitic, alkaline lavas are present and are most abundant in the NW sectors of the DVP where they mainly pre-date the Cretaceous-Paleogene boundary (KPB, 66.052 ± 0.008 Ma). The classic geochemical stratigraphy, established in the well-studied Western Ghats (WG) sector, is only broadly applicable in more distal DVP sectors, e.g., Saurashtra, Malwa Plateau, Mandla lobe. However, geochemical characteristics (e.g., highly evolved tholeiites to quartz tholeiites derived from high mantle melt fractions) of the Wai subgroup defined in the WG are common to post-KPB lavas in all sectors, although trace element and limited isotopic data suggest distinct eruptive centers. These Wai-like, post-KPB lavas are the most widespread, occurring as far as ~800 km from the central WG, near Rajahmundry on the Indian Ocean coast. Their apparently sparse occurrence in the northwest (e.g., Gujarat) may be an artifact of post-DVP erosion, as this region is dominated by low elevation and relief. The most precise age control on DVP lavas is being obtained from plagioclase megacrysts in so-called "Giant Phenocryst Basalts" (GPBs), which occur in all sectors except Rajahmundry. GPBs are most abundant in pre-KPB sections, and appear to represent end-stages of cyclic magma evolution in mid-crustal magma chambers in which extreme Fe-enrichment promoted buoyancy of liquidus or near-liquidus plagioclase.

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