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India's fast Mesozoic drift linked to continental mantle lithosphere delamination: New insights from (U-Th)/He thermochronology of Dharwar craton kimberlites

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Periods of significant continental uplift and erosion are linked to processes that operate within Earth's mantle [1], such as thermochemical upwelling (i.e., mantle plumes) and convective erosion of mantle lithosphere. Peninsular India is comprised of a collage of Archean cratonic blocks bounded by Proterozoic mobile belts. The basement blocks are overlain by remnants of thick sedimentary successions of Proterozoic basins ranging from 1.9 to possibly 0.7 Ga [2]. Basin formation was accompanied by pronounced kimberlite and lamproite magmatic activity across Peninsular India between 1.4-1.0 Ga [3]. However, the tectonic setting of the Proterozoic basins and associated kimberlites and lamproites remains poorly understood. In particular, the relationship of the intracratonic basins and the deeply derived alkaline magmas to the coeval mobile belts, for which subduction processes have been invoked, is enigmatic [4].

We are studying the (U-Th)/He systematics of a variety of kimberlite-derived minerals from across the Dharwar craton in an attempt to understand the burial and unroofing history of these small diamond-bearing magmatic bodies. Whereas previous studies suggested that basin inversion occurred during the Late Proterozoic, our novel perovskite (U-Th)/He thermochronology results suggest that the Dharwar craton crust was affected by nearby tectonothermal events during the Early Paleozoic assembly of Gondwana. Our apatite (U-Th)/He results indicate that diatreme root-zones of the once-buried 1.1 Ga Dharwar craton kimberlites were unroofed to within ~1 km of Earth's surface during the Mesozoic, most likely during the Early Cretaceous. This timing corresponds to the break-up of Gondwana after which the Indian plate drifted for several hundred kilometers with record speed toward its current position. India's fast drift during the Mesozoic has been explained by significant plume-related delamination of its cratonic mantle lithosphere [5], which also appears to be the underlying cause for km-scale uplift and erosion across Peninsular India during the Mesozoic. Our new model for the evolution of dynamic topography on the Indian plate since 1 Ga has important implications for diamond exploration on the subcontinent, which has produced iconic placer stones in the past (e.g., Hope and Koh-i-Noor diamonds), but no significant primary diamond deposit has been discovered to date.

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