Deccan Traps thermal overprint on zircon and apatite (U-Th)/He dates from the Bundelkhand craton of central India

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The longevity of exposed cratonic rocks at relatively low temperatures increases the likeliness for low-temperature thermochronometers to be affected by short-term thermal events such as large igneous province magmatism. In central India, the Bundelkhand craton and Vindhyan basin are bound to the south by the onlapping ~66 Ma Deccan Traps flood basalts. Zircon and apatite (U-Th)/He (ZHe and AHe, respectively) cooling ages from across the craton reveal a significant ~250 Myrs age inversion within grains with moderate to high effective uranium (eU) concentrations. Whereas compiled ZHe ages range from ~10–994 Ma and yield a steep negative date-eU trend at low to moderate eU, AHe ages range from ~5–480 Ma and exhibit a steep positive date-eU trend at low to moderate eU. Inverse thermal models utilizing coupled ZHe and AHe age inputs with the radiation damage accumulation and annealing model for apatite (RDAAM) and zircon (ZRDAAM) are not capable of reproducing this age inversion. Inverse modelling with solely ZHe or AHe data inputs produce time-temperature models with statistically robust fits only in scenarios where these rocks were at or near the surface by 66 Ma followed by a simulated Deccan Traps heat pulse from 66-65 Ma. Based on current diffusion kinetics of RDAAM and ZRDAAM, the magnitude of this event must exceed ~100°C to satisfy ZHe ages, and less than ~100°C to satisfy AHe ages. We speculate that zircon with moderate to high eU are especially sensitive to short-lived heat pulses, particularly in scenarios when the pulse is late-phased relative to a prolonged low-temperature history. This likely demonstrates how Deccan Traps heating overprinted magmatic ZHe ages with a minimal effect on AHe ages, and further experimental work is necessary to define this kinetic crossover in helium diffusion between the AHe and ZHe system.