Stabilization of the Bundelkhand craton of central India: Insights from apatite and zircon U-Pb age data

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The longevity of Archean cratons is in part a result of their resistance to recycling into the mantle, which is enhanced by distinct physical characteristics such as thick and chemically depleted mantle roots. The geologic processes involved in lithospheric strengthening remain debated despite their importance for craton preservation and stabilization. In central India, stabilization of the Bundelkhand craton has been attributed to the youngest magmatic event impacting the craton at ~2.5 Ga. However, new apatite U-Pb ages—obtained via LA-ICP-MS analysis—from the Bundelkhand craton provide important insight into post-amalgamation processes that may have promoted stabilization. Apatite from ~2.5-3.4 Ga granitoids and gneisses collected across the craton yielded near uniform U-Pb ages between ~2.3–2.4 Ga. We interpret these ages to record exhumation through mid-crustal temperatures across the ~250 km wide craton. Broad-scale exhumational unroofing at this time is corroborated by new detrital zircon U-Pb ages from the Paleoproterozoic Bijawar and Gwalior groups, which lie in direct nonconformable contact with the Bundelkhand craton along both its southeastern and northwestern margins, respectively. Detrital zircon ages from these rocks provide a maximum depositional age for this nonconformity at ~2.2 Ga and exhibit an abundance of ~2.5–2.7 Ga grains, indicating that the sediment infill of these basins was directly sourced from the Bundelkhand craton. Accordingly, this denotes that the craton was exposed and denuded by at least 2.2 Ga. While the mechanisms driving immediate post-assembly exhumation remain uncertain, we speculate that rapid exhumation may have been necessary to enhance cooling and strengthening of the lower crust in order to stabilize the craton.