Geophysical Research Abstracts
Vol. 21, EGU2019-12108, 2019
EGU General Assembly 2019

Low-temperature thermochronometric insight into the long-term burial and erosional evolution of the Bundelkhand craton of central India

Cody L. Colleps (1), N. Ryan McKenzie (1), William R. Guenthner (2), Mukund Sharma (3), and Daniel F. Stockli (4)

(1) Department of Earth Sciences, University of Hong Kong, Pokfulam, Hong Kong, (2) Department of Geology, University of Illinois at Urbana-Champaign, Urbana, Illinois, USA, (3) Birbal Sahni Institute of Palaeosciences, Lucknow, India, (4) Department of Geological Sciences, Jackson School of Geosciences, University of Texas at Austin, TX, USA

Whereas the mechanisms controlling relative vertical motions of stable interior cratons remain uncertain, recent advancements in the (U-Th)/He system for apatite (AHe) and zircon (ZHe) can now provide temporal insight into ancient burial and erosional evolutions that may elucidate these uncertainties. We utilize the radiation damage accumulation and annealing model for apatite (RDAAM) and zircon (ZRDAAM), coupled with known geologic constraints, to track the long-term low-temperature thermal evolution of the ∼2.5–3.3 Ga Bundelkhand craton and the surrounding relatively flat lying strata of the ∼0.9–1.7 Ga Vindhyan basin in central India. Magmatic ZHe ages from the eastern craton margin range from ∼10 to ∼994 Ma with variable effective uranium concentrations (eU), revealing a steep negative date-eU trend within ∼150–300 ppm eU and a ZHe date-eU pediment at ∼70 Ma between ∼250 and ∼1415 ppm eU. In stark contrast, AHe ages range from ∼5 to ∼480 Ma with a steep positive date-eU trend between ∼5 and ∼50 ppm eU and an AHe date-eU age pediment at ∼360 Ma—significantly older than the ZHe pediment. Interestingly, detrital ZHe ages from ∼1.1 Ga and ∼1.7 Ga sandstones unconformably above the craton yielded significantly older ZHe ages between ∼576 Ma and ∼1475 Ma with low eU ranging from ∼18–210 ppm. Inverse modelling using current RDAAM and ZRDAAM parameters cannot produce models that agree with the large inversion observed in the magmatic ZHe and AHe age pediments. However, inverse models utilizing only AHe ages and RDAAM produce good-fit thermal histories and require a distinct heat pulse at ∼66 Ma, equivalent to emplacement of the proximal Deccan large igneous province. This Deccan heat pulse significantly influences the ZHe date-eU curve within moderate to high eU (∼250–>1500 ppm), whereas the ZHe date-eU curve for low eU (<250 ppm) is generally influenced by the robust Paleozoic thermal evolution. For these reasons, detrital ZHe ages from the Vindhyan basin and ZHe date-eU inheritance envelopes may be used to further constrain good-fit thermal models produced from AHe ages and RDAAM. Inverse and forward model results indicate that the Bundelkhand craton experienced maximum burial temperatures of 145–165°C between 600–950 Ma, followed by slow and gradual exhumation until the Deccan heat pulse. We speculate that the onset of slow exhumation between 500 and 800 Ma may be reflective of passive emergence of the continental interior due to increased continental buoyancy as mantle temperatures decreases with time. Rapid pulse heating from Deccan magmatism likely partially reset zircon with moderate eU while having only a minor effect on apatite with moderate to high eU—a result which cannot be explained by current helium diffusion kinetic models or by effects of zonation alone. Inverted ZHe and AHe ages may be explained by (1) annealing independent diffusion kinetics for moderately damaged grains and/or (2) the result of kinetic crossovers controlled by the duration and temperature of deccan trap reheating. Further investigation is needed to refine these models.