Deep Time, Deep Earth: Revealing Earth's early history

VICKIE C. BENNETT[1]

[1]Research School of Earth Sciences, The Australian National University, Canberra, ACT 2601, Australia
[*correspondance: vickie.bennett@anu.edu.au]

The last 20 years has produced a revolution in our understanding of the first billion years of Earth history, moving from the exciting field discoveries of surviving rock and mineral relicts to increasingly sophisticated reconstructions of the timing and processes that shaped the young planet. The most direct information comes from chemical information contained in the ancient rock and mineral record such that identification of new localities of >3,600 Ma rocks and minerals combined with advances in analytical approaches continues to illuminate the formerly “dark ages” of Earth history. At least ten Eoarchean to Hadean terranes are now known worldwide. In all cases however, these terranes have undergone a range of thermal and tectonic processes since they formed, requiring integrated field, petrologic and geochemical studies to accurately recover and interpret an increasingly rich and diverse suite of geochemical signatures.

Ultra-precise measurement of subtle isotopic differences produced from now extinct nuclides provides undisputed evidence of Hadean geological events. These small isotopic anomalies, as compared with signatures in modern rocks, not only constrain the timing of differentiation events in the first 500 million years of Earth history and enable direct comparisons with lunar and meteorite events, but also serve as tracers of mantle dynamics through time.

The types of tectonic processes operative on the early Earth are debated, with some emerging observations used to argue that plate tectonic processes were producing new crust by at least 3.8 Ga, but that only limited amounts of Hadean continental crust were preserved into the Archean. Increased recognition and understanding of potential life habitats strengthens the case for ancient life. Key outstanding questions increasingly focus on how early life might have interacted with the geodynamic regime on the evolving Earth and what feedbacks were necessary to maintain habitability.

In this talk we will take a modern look at the ancient rock record and highlight emerging work in this rapidly developing field.

.