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Crustal growth and reworking in the early Archean Narryer Terrane: new evidence from strontium isotopes in apatite inclusions

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The limited preservation of ancient crustal material poses a challenge for understanding the composition of Earth's early crust. As a result of poor preservation and near-ubiquitous overprinting by later geological events, deciphering the early evolution of our planet often relies on the isotopic composition of resistive minerals, such as zircon. Although the isotopic information recorded by zircon grains has proved an invaluable asset to workers seeking to understand the geological evolution of the Earth, it is limited by the range of elements easily incorporated into the structure of the mineral.

One way to overcome these limitations is by analysing inclusions of other minerals that were trapped within the zircon during crystallisation. Apatite has great potential in this respect, as it is commonly found as inclusions in magmatic zircon and records a variety of useful isotopic information. Here I present an approach for investigating igneous petrogenesis and crustal evolution by combining $^{87}Sr/^{86}Sr$ measurements of apatite inclusions with U–Pb and Hf isotope analysis of their host zircon crystal. The Sr isotope information contained in the apatite can be accessed by applying a novel SIMS technique we developed for this purpose.

A case study applying this new approach to Eoarchean igneous rocks of the Narryer Terrane in the northern Yilgarn Craton of Western Australia demonstrates how this can be used to understand the evolution of this key locality, with implications for both regional geology and the growth of the continental crust.