
Early cratonization of continents suggested by igneous apatite trace element signatures

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Résumé

Our planet is unique in the solar system for at least three aspects: the development of aerial life, the presence of large and stable bodies of water at its surface and the fact that the conditions to produce stable, long-lived, continents were met during its history. The ways and means of the latter aspect, often referred to as *cratonization*, remain ongoing discussion. The chemical & isotopic evolution of rocks belonging to the Tonalite-Trondhjemite-Granodiorite (TTG) suite, i.e. forming the bulk of Archean continental crust, and related granitoids, such as sanukitoids, the typical marker of cratonization, have been intensively scrutinized through the prism of in situ zircon geochemistry. That said, the extensive use of zircon has also biased interpretations towards a single mineral perspective, hence not reflecting the whole geological history of these magmas. To extend our understanding of early continent stabilization, a pivotal aspect of Earth's evolution, a fresh perspective is necessary.

In this study, we present in-situ geochemical analyses of apatite, $\text{Ca}_5(\text{PO}_4)_3(\text{OH},\text{Cl},\text{F})$, extracted from TTGs exposed in the eastern Kaapvaal craton. While these apatite crystals are interpreted as igneous and show U–Pb isotope dates ranging between 3.2 Ga and 3.1 Ga, their trace element contents indicate the contribution of a mantle component to their source, a signature not discernible at the whole-rock scale.

We interpret our new results as indicating direct involvement of the sub-continental lithospheric mantle (SCLM) in the source of these magmas. This implies that the ongoing formation of large, long-lived and stable lithospheric keels, was an active process during the Paleo to Meso-Archean in the eastern Kaapvaal craton, i.e. more than 0.5 Ga before the emplacement of sanukitoid suites and more than 0.1 Ga before the emplacement of potassic granite suites known in the Kaapvaal craton. Our results indicate that the Earth, during the mid-Archean, may have been very close, except for its atmospheric composition, to the one we know today.

Mots-Clés: Archean, cratonization, apatite, Kaapvaal craton

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