Evolution of the Acasta Gneiss Complex constrained by Sr isotope analysis of apatite inclusions in zircon

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Earth's early crustal evolution can be studied through the geochemical analysis of Eoarchean and Hadean rocks. However, such rocks are often poorly preserved in the geological record. The Acasta Gneiss Complex (AGC), Northwest Territories, Canada, is one of the few locations where intact rocks of this age are found. Studies have suggested the involvement of a Hadean source in the formation of the AGC [1,2], yet the nature of this source remains enigmatic. Rb/Sr and Sr isotope analysis may reveal the composition of this ancient source as the Rb/Sr system provides a potentially powerful proxy for crustal evolution and composition [3]. Rb is enriched in felsic reservoirs relative to Sr, as it is a highly incompatible element, and these reservoirs subsequently develop higher $^{87}Sr/^{86}Sr$ with time. Whole rock open-system behaviour is prevalent during metamorphism and hydrothermal alteration, which is why the Rb-Sr system has thus far been underutilised in early crustal evolution studies. Recent advances in laser ablation multi-collector inductively coupled plasma mass spectrometry provide a way to avoid this issue. The method now allows for $^{87}Sr/^{86}Sr$ analysis of small apatite inclusions within zircon (30-50 μm), which can be combined with U-Pb dating to investigate the initial $^{87}Sr/^{86}Sr$ value of magmatic rocks. We applied this method for the first time in the AGC. The results constrain the Rb/Sr value of the Hadean source, and thus provide new insights into its composition and evolution.

[1] Reimink *et al*. (2016) Nat. Geosci. 9, 777-780. [2] Bauer *et al*. (2017) Earth Planet. Sci. Lett. 458, 37-48. [3] Dhuime *et al*. (2015) Nat. Geosci. 8, 552-555.