Strontium isotope compositions of apatite inclusions in Archaean zircon

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The isotope composition of strontium has been investigated in Archaean minerals to trace the evolution of the inner Earth [1, 2]. We have developed an analytical method to measure strontium isotopes in biogenic calcite or apatite using a NanoSIMS [3, 4]. We applied this method on micro-size apatite inclusions found in Archaean zircons from ca. 3.6 Ga tonalite of Nuvvuagittuq Supracrustal Belt Northern Quebec [5]. Zircon is known to be a metamorphic-resistant igneous mineral which can be dated precisely by uranium-lead method. Thus, apatite inclusions encapsulated in zircons should enable us to get some pristine information of the Earth's primitive interior.

In this study, we measured $^{87}Sr/^{86}Sr$ ratio using the NanoSIMS50 at the University of Tokyo, targeting apatite inclusions, which diameters are approximately 10 μm. A primary $^{16}O^-$ ion beam of about 0.5nA was focused to less than 10um in diameter onto the apatite surface. The multi-collector system was adjusted to detect $^{26}Mg^+$, $^{43}Ca^+$, $^{40}Ca_2{}^+$, $^{86}Sr^+$, $^{87}Sr^+$, and $^{138}Ba^+$ simultaneously. The magnetic field was scanned to detect $^{86}Sr^+$ $^{87}Sr^+$ $^{88}Sr^+$, and $^{85}Rb^+$ $^{86}Sr^+$ $^{87}Sr^+$, by single collectors, respectively [4].

Eight apatite inclusions from Nuvvuagittuq were selected and analyzed. Isobaric effect of ^{87}Rb on ^{87}Sr, and calcium dimers on each strontium isotopes, were subtracted according to the amount of measured $^{85}Rb^+$ and $^{43}Ca^+$, $^{40}Ca_2{}^{2+}$. Corrected $^{87}Sr/^{86}Sr$ values range from 0.70877 to 0.72034 +- 0.0031, with the Sr amount varying between 26 and 398 ppm. Obtained values are heavier compared with the Archaean mantle at 3.6 Ga (~0.703 calculated from primitive $^{87}Sr/^{86}Sr$ and additional ^{87}Sr from radiogenic decay of ^{87}Rb), suggesting possibility: (1) an additional source of strontium from the subducting slab; or (2) metamorphic-induced isotopic fractionation.

[1]Veizer & Compston, (1976) *GCA* **40** 905, , [2]Richardson et al., (1984) *Nature* **310** 198, [3]Sano et al., (2008) *App. Geochem.* **23** 2406, [4]Sano et al., (2014) *JAES* **92** 10, [5]David et al., (2009) *GSA Bulletin* **121** 150.