

D/H and Sr isotopic ratios of apatite inclusions from Archaean zircons to study Earth's evolution

ISHIDA, Akizumi^{1*} ; TAKAHATA, Naoto¹ ; SANO, Yuji¹ ; DAVID, Jean² ; PINTI, Daniele²

¹AORI Univ. Tokyo, ²Universite du Quebec a Montreal

Isotopes of volatile elements H and S, and those of incompatible element Sr, presented in Archaean rocks can give unique information to understand the evolution of the Earth's interior and the state of its surface. Apatite or glass inclusions contain hydrogen, halogen, and strontium as major or minor element. When they are encapsulated in metamorphic-resistant zircon crystals, it is expected that the pristine isotopic information of these elements might be preserved. However, apatite inclusions are usually less than a hundred micrometers in diameter, which require the use of high-sensitive and high-resolution analytical methods for measuring isotopic abundances. Furthermore, discriminating between pristine compositions and later alteration is problematic. We are trying to approach these issues by using a NanoSIMS50 at University of Tokyo.

U-Pb dating using NanoSIMS50 has been carried out on zircon crystals separated from tonalitic gneisses of the Eoarchaean Nuvvuagittuq supracrustal belt, Superior province, Canada. The estimated age, 3638 ± 19 Ma, using NanoSIMS50 is consistent with previous reported age of 3661 ± 4 Ma, using LA-MC-ICP-MS. Some zircons show discordant ages suggesting that a certain amount of Pb was lost by a thermal alteration event at 980 ± 330 Ma. We excluded such discordant zircon crystals because the isotopic composition of H and Sr could have been also altered by this thermal event.

Measurements have been made by peak jumping analysis using single collector with Cs⁺ primary ion beam. H and D were collected for hydrogen isotopic analyses, and ⁸⁶Sr, ⁸⁷Sr, and ⁸⁸Sr were collected for strontium isotopic analyses.

Obtained D/H ratios from 7 apatites suggest that δD values range from -223 to +54 ‰ (vs. SMOW). Considering the correlation between measured D/H and O/H ratios, it turned out that these values were affected by contamination with a D-poor, H-rich component. As a result, $+17 \pm 40$ ‰ was estimated as the D/H true value for these apatite inclusions. This value is heavier than that of reported one by Pope et al (2012) which estimated the hydrogen isotopic ratio of Archaean sea water as -25 ‰ targeting hydrogen contained in serpentine from ca. 3700 Ma Isua supra crustal belt.

Keywords: apatite, U-Pb dating, hydrogen isotopic ratio, strontium isotopic ratio, Archaean