Zircon O isotope ($^{18}O/^{16}O$) single-grain mapping using LG-SIMS

HEEJIN JEON*, MATT R. KILBURN, LAURE MARTIN

ARC CoE Core to Crust Fluid Systems, Centre for Microscopy, Characterisation and Analysis, University of Western Australia, Perth, WA 6009, Australia (heejin.jeon@uwa.edu.au)

Measuring the oxygen isotopic composition of geolgical materials is one of the most powerful approaches in earth and environmental sciences, as the relative abundances of O isotopes can be determined by a wide range of geological processes. In particular, the O isotopic ratio of zircon is known to be barely affected by post-crystalline events, and thus provides insight into erstwhile geological processes. The techniques available to measure the O isotopes are, however, quite limited - especially in-situ measurement that are only possible with Secondary Ion Mass Spectrometry (SIMS).

The O isotopic ratio ($^{18}O/^{16}O$) of zircon can be precisely measured with ≤ 0.2‰ reproducibility (1 s.d.) using large-geometry SIMS (CAMECA IMS-1270/80, ASI SHRIMP II/V), typically with a ca. 2-3 nA Cs^+ primary beam. But it is not easy to anayse narrow and/or complex O isotope compositional zones/distributions within a grain with the typical beam/crater size of > 10 um. We here present O isotopes analyses using a 2 um-sized beam (ca. 100 pA), from grided-spots with ≤ 10 um distance, operated with CAMECA IMS-1280, to produce an O isotope compositional map for a single zircon grain. As zircon is an insulator, an electron flood is required to compensate charge build-up on the sample surface attributed to positive primary ions (Cs^+) and negative secondary ions (O^-). Thus, the electron-stimulated desorption (ESD) or electron induced secondary ion emission (EISIE; Ickert et al., 2008) could be a critical issue for side-by-side spots. To monitor the effect of ESD, which we can minimise with a small field aperture, $^{16}O^{1}H$ is also simultaneously measured. $^{16}O^{1}H/^{16}O$ also gives a good indication of later modification in composition (Pidgeon et al., 2013) mapped for unknown zircon. Three different zircon standards are measured during the zircon analyses, providing accurate results with a reproducibility of ≤ 0.4‰ (1 s.d.).

Ickert et al. (2008) Chemical Geology, 257, 114–128

Pidgeon et al (2013) Contributions to Mineralogy and Petrology, 166, 511–523