Stacked SIMS Spectra: Unravelling ion production in geological materials

TREVOR R. IRELAND, PETER HOLDEN AND PETER LANC

Research School of Earth Sciences, The Australian National University (*correspondence: trevor.ireland@anu.edu.au)

Ion microprobe analyses rely on the production of secondary ions from solid target materials. In the material science community, complexity in ion production is noted for even simple targets comprised of only a few elements. In geological materials, complex mass spectra result from the large number of elements present and their propensity to form molecular ions. The analyses of molecular species is a cornerstone of zircon age determinations but resolution of unwanted interferences is also required.

We have developed a protocol to measure SIMS spectra under varying analytical conditions (mass resolution, energy filtering). These spectra can be stacked to allow identification of relevant species and custom built software allows individual peaks to be scrutinised. A reference lookup list means that isobars can be readily identified.

The spectra have been obtained on SHRIMP-RG, an instrument that allows mass resolution up to 20,000. A combined faraday – ion counter detection system is rapidly switched depending on count rates. Energy filtering can be changed to establish the nature of the molecular interferences based on the progressive exclusion of polyatomic intereferences with energy offset.

Thus far we have applied this technique to NIST glasses as well as minerals used for geochronology – zircon, monazite, and xenotime. For monazite, unresolved interferences in the Pb spectrum could potentially affect some analyses.

Having spectra from different matrices will also allow examination of ion production and speciation models, which will lead to a better understanding of zircon geochronology by SHRIMP.

Trans-lithospheric variations in highly siderophile elements beneath the Ontong Java Plateau

A. ISHIKAWA[1,2*], T. MARUOKA[3], C. W. DALE[4] AND D. G. PEARSON[5]

[1]The University of Tokyo, Tokyo, 153-8902, Japan (*correspondence: akr@ea.c.u-tokyo.ac.jp)
[2]IFREE, JAMSTEC, Yokosuka, 237-0061, Japan
[3]University of Tsukuba, Tsukuba, 305-8572, Japan
[4]Durham University, Durham, DH1 3LE, UK
[5]University of Alberta, Edmonton AB, T6G 2E3, Canada

We determined highly siderophile element (HSE) concentrations and sulfur contents for 70 peridotite xenoliths from Malaita, Solomon Islands, which represent virtually the entire thickness (~120 km) of oceanic lithosphere beneath the Ontong Java Plateau. The major aim is to assess whether the fertile part of the suboceanic mantle yields suprachondritic Ru/Ir and Pd/Ir ratios and hence investigate the extent of non-chondritic HSE systematics in the Earth's mantle. To date, most constraints on PUM HSE characteristics come from subcontinental mantle due to the rarity of fertile samples from ophiolites and abyssal peridotites. In contrast, our Malaita sample set includes MORB source-like spinel lherzolites representing shallow lithosphere (<85 km) and garnet lherzolites from basal lithosphere (95-120 km), likely representing a deep-plume source [1]. A further aim is to examine the formation of an intralithospheric harzburgite layer (85-95 km). A previous Re-Os study revealed that the varying degree of Os-depletion uniquely recorded in this melt-depleted layer is intimately related to the ~122 Ma plateau magma production [2].

The new HSE data demonstrate that lherzolite and harzburgite, the two principal lithologies, display contrasting HSE patterns. Regardless of *P-T,* mineralogy and alteration indices, almost all lherzolites show coherent patterns with suprachondritic Ru/Ir and Pd/Ir, but chondritic Os/Ir and Pt/Ir. This supports the widespread occurrence of PUM-like compositions in Earth's mantle. In contrast, harzburgites display HSE depletion with decreasing sulfur content, coupled with highly fractionated patterns relative to PUM and systematically decreasing HSE/Ru, most likely resulting from progressive extraction of HSE residing in sulfide. We establish an order of HSE compatibility that may place key constraints on the mechanism and condition of formation of harzburgites and their extracted magma.

[1] Ishikawa *et al*. (2004) *J. Petrol*. **45**, 2011-2044. [2] Ishikawa *et al*. (2011) *EPSL* **301**,159-170.