Primordial and Recycled Noble Gases in the Deep Mantle

KATHRYN STREET[1], MARGARET HARTLEY[1], GREG HOLLAND[1], RAY BURGESS[1], EMMA WATERS[1], SÆMUNDUR A. HALDÓRSSON[2], OLIVER SHORTTLE[3]

[1]SEES, University of Manchester, Oxford Road, Manchester M13 9PL, U.K. kathryn.street@manchester.ac.uk
[2]Institute of Earth Sciences, University of Iceland, 101 Reykjavik, Iceland.
[3]Department of Earth Sciences, University of Cambridge, Downing Street, Cambridge, CB2 3EQ, U.K.

The Icelandic mantle source is chemically and lithologically heterogeneous on both long and short length scales. Previous determinations of noble gas isotopic compositions from Miðfell (SW Iceland), suggest that this primitive Icelandic basalt samples a relatively undegassed mantle source that has undergone very little modification since the first c.100 Ma of Earth's history (Mukhopadhyay, 2012). Quantification of lithological variability based on major and trace elements and lithophile isotopes, however, indicates that the Icelandic mantle must contain at least 4- 10%, and possibly up to 40%, of an enriched component derived from ancient recycled oceanic crust (Shorttle et al., 2014). Therefore, an unresolved dichotomy exists between interpretations of different geochemical proxies: why do primordial and recycled geochemical signatures coexist, even in the same samples? Our sample suite of subglacially erupted basalts maps a high-resolution transect across the Iceland mantle plume, and is thus expected to preserve geochemical signatures of melts from both ancient sources and the convecting mantle. By combining new and existing geochemical data, we aim to explore the spatial and temporal relationships between Iceland's primordial and recycled mantle components. Here we present noble gas data from our sample suite, obtained using the HELIX mass spectrometer at the University of Manchester. We discuss some of the successes and challenges in measuring heavy noble gases (Kr, Xe) in subglacial basalt samples. Preliminary results indicate that high precision analyses are possible and the technique is capable of resolving noble gas variability.

Mukhopadhyay, S. 2012. Nature. Shorttle, O. et al., 2014. EPSL