European Mineralogical Conference
Vol. 1, EMC2012-668, 2012
European Mineralogical Conference 2012

Tracing mantle evolution with novel isotopic systems

T. Elliott (1), M. Willbold (1), M. Andersen (1), Y.-J. Lai (1), P. Pogge von Strandmann (1,2), C. Archer (1), and K. Hibbert (1)

(1) Bristol Isotope Group, University of Bristol, School of Earth Sciences, Bristol, United Kingdom (tim.elliott@bris.ac.uk), (2) Department of Earth Sciences, University of Oxford, United Kingdom

The notion of mantle heterogeneity and its interrogation to reconstruct the evolution of the mantle was built on observed variability in radiogenic isotope systems in mantle derived melts. These measurements have been most popularly explained by recycling of crustal material, either oceanic or continental. These deductions are, perhaps inevitably, equivocal. It has therefore been as long standing goal to verify these inferences from independent lines of evidence. Most notably, the surface environment should impart distinctive stable isotopic fractionations on the crust before its return to the mantle. In order to provide a good tracer of recycled material, however, a number of important criteria need to be satisfied: 1) the distinctive stable isotopic signature needs to be associated with a large elemental flux to be discernible after remixing into the mantle 2) the surface cycling of the element of interest needs to have remained the same as present day, or at least predictably different, in order to be able to extrapolate back the effects of recycling over geological time 3) the isotopic systems should be sensitive to the recycling process alone and not to subsequent perturbation during magmatic transport to the surface. In the last decade we have explored the potential of several stable isotope systems, with a range of masses, to these ends including Li, Mo and U. We will discuss the strengths and weaknesses of these systems in helping to identify the presence of recycled material in shaping the composition of the current mantle. Recently the opportunity to look at the evolution of the mantle in the opposite direction has also become possible. Rather than try to work back from present via the plate tectonic cycle it is possible to observe how some of the most ancient isotopic signatures on Earth, as preserved in anomalous compositions of extinct nuclides (e.g. 182W), have been lost. Reconstructing the history of these changes offers the potential to examine the convective behaviour of the mantle, potentially before plate tectonics. We will preview what might be attempted in this burgeoning field.