Some stable isotope stories about magmas, melting and minerals

JULIE PRYTULAK

Department of Earth Science and Engineering, Imperial College London, UK (j.prytulak@imperial.ac.uk)

What is the Earth's mantle made of? How and why does it melt? How do melts fractionate? The answers to these questions underpin the understanding and evolution of our (mostly) pleasant, land-bearing planet. Over 50 years of radiogenic isotope study on mantle-derived melts has yielded fundamental insight to the secular evolution of the Earth. We increasingly complement this knowledge with stable isotopic studies of essentially every element possessing more than one isotope. Some systems promise to deduce mantle oxidation state, some to decipher fluid compositions and volatile budgets, and some to disentangle specific contributions from the subduction factory.

Here I recount advances in high temperature stable isotope geochemistry, focussing on the contrasting systems of vanadium and thallium. Vanadium's multiple oxidation states have long suggested its potential as a redox tracer. However, vexing technical challenges limited its accurate measurement and application until recently [1, 2]. Thallium represents a different extreme, with minute abundances leading to a hypersensitivity to sediments, it presents a potentially near-perfect tracer of surface materials [e.g., 3]. I aim to showcase what we may learn about melting and crystal fractionation from combining disparate stable isotope systems on the same samples. I argue that non-CHONS isotope systems are transforming our understanding of the mantle and magmatic processes in a similar fashion to the way combining radiogenic isotopes systems did decades ago.

[1] Nielsen, Prytulak, Halliday, GGR, (2011)
[2] Prytulak, Nielsen, Halliday, GGR, (2011)
[3] Nielsen, Rehkamper, Prytulak, RiMG, (2017)