Determining transition metal isotope fractionation factors in mantle minerals
Supervisor: Dr. Julie Prytulak

BACKGROUND
Stable isotope fractionation is fundamentally driven by differences in bond strength between anions and cations in crystal structures (Urey, 1947). Bond strength is dominantly influenced by both elemental coordination and the oxidation state of the element in question. Iron and vanadium stable isotope fractionation have both been suggested to reflect oxidation state (e.g., Dauphas et al., 2014; Prytulak et al., 2013; Williams et al., 2009) and thus the intensive parameter: oxygen fugacity \( (f_{O_2}) \). Debate currently rages as to what the prevailing \( f_{O_2} \) conditions are in the interior of the Earth (e.g., Frost and McCammon, 2008). Before invoking a direct relationship between \( f_{O_2} \) and stable isotope fractionation, the competing effects of oxidation state and coordination environment must be carefully assessed. This project tackles the issue by using iron and vanadium isotopes, both of which should be sensitive to changing \( f_{O_2} \), combined with zinc isotopes, which should only respond to changing coordination environments, to disentangle the competing effects of oxidation state versus crystal co-ordination. The project uses well-characterized mantle xenoliths and peridotite massifs from a variety of tectonic settings.

AIMS
To determine the utility of emerging stable isotope systems for tracking mineralogy and/or oxygen fugacity, the project will:

1) Determine the magnitude and direction of Fe-V-Zn stable isotope fractionation factors in mantle minerals such as spinel, olivine, pyroxene and garnet.
2) Assess the relative importance and relationship of Fe-V-Zn isotopes with changing oxygen fugacity versus changing coordination environment.

METHODS
The student will perform Fe-V-Zn stable isotope analysis on mantle mineral separates to determine isotope fractionation factors. There is also opportunity for fieldwork to European peridotite massifs such as the Rhonda in Spain, Troodos in Cyprus, Lherz in France and Balmuccia in Italy to collect samples.

STUDENT PROFILE AND RESEARCH ENVIRONMENT
This project is lab-based and would suit a candidate with strong interest in cutting edge analytical isotope geochemistry and possessing excellent...
organizational and time management skills. Candidates should have a degree in Earth Science or Chemistry and a good background in both laboratory-based and field-based petrology. Previous chemical laboratory and/or isotope geochemistry experience is not required but is highly advantageous.

The successful candidate will join the vibrant MAGIC research group, which comprises PhD students, postdoctoral researchers, fellows and four academic members of staff working on a diverse range of applications in isotope geochemistry. The student will also benefit from interaction with the Geodynamics Group, and from collaborative links with the neighboring Natural History Museum. Do not hesitate to contact me for further information and informal enquiries: j.prytulak@imperial.ac.uk

REFERENCES