Geophysical Research Abstracts
Vol. 20, EGU2018-19398, 2018
EGU General Assembly 2018

The mobility of metal in the mantle – implications for metallogenesis, prospectivity and the formation of sulphide ore deposits

Hannah S. R. Hughes

Camborne School of Mines, College of Engineering, Mathematics and Physical Sciences, University of Exeter, Penryn Campus, Penryn, Cornwall TR10 9FE, h.hughes@exeter.ac.uk

Some critical metals such as Co, Se, Te, Sb, and the platinum-group elements (PGE) are essential to the development of green- or high-technology, (e.g., fuel cells, batteries and solar energy). Collectively they have an affinity for sulphur (i.e., are chalcophile) and are largely hosted by base metal sulphide (BMS) minerals in the mantle. During partial melting of the mantle, BMS release a portion of their metal budget into the magma generated. Hence if a mantle source region has BMS strongly enriched in critical metals, any magma produced by significant partial melting of this region may also be enriched in these elements and thus translate to being 'fertile' – an idea fundamental to global 'metallogenesis' (the concept of a regional-to-global distribution of metals linked by magmatic and tectonic processes).

Estimations of the abundance of chalcophile elements in the 'Primitive Upper Mantle' are based on observations from mantle xenoliths and diamonds (e.g., Becker et al., 2006; Aulbach et al., 2012). Indeed, mantle xenoliths containing sulphide minerals and sulphide inclusions within diamonds are our only direct insights into the abundance of chalcophile elements at depth. BMS contained within these sample types are usually divided into two or more categories, E-type (eclogitic) and P-type (peridotitic) based on the associated silicate phase assemblage. Pilot and literature data (e.g., McDonald et al., 2017) indicate that metal budgets of these BMS populations are distinct. Further, added complexities must be considered as there may be fewer BMS in some regions of ancient peridotitic mantle and/or these may be more resistant to melting (e.g., Lorand & Luguet, 2016; Aulbach et al., 2009). Together these observations have significant implications for magma-derived ore deposit geology characteristics with economic consequences (Hughes et al., 2015, 2016).

Over the past few years, we have used mantle-derived material (xenoliths and diamonds) to begin to investigate the metallogeny of the mantle spatially and through time, with the aim of assessing what underlying factors influence critical metal abundance and thus their distribution in orthomagmatic mineralisation in the overlying crust. In essence we ask, can the Earth's upper mantle be mapped such that it may act as a time capsule for metals or highlight a region's 'prospectivity' for mineralisation?

REFERENCES:

Aulbach, S., Creaser, R.A., Pearson, N.J., Simonetti, S.S., Heaman, L.M., Griffin, W.L. and Stachel, T. 2009. EPSL, 283(1), pp.48-58.

Aulbach, S., Stachel, T., Seitz, H.M. and Brey, G.P. 2012. GCA, 93, pp.278-299.

Becker, H., Horan, M.F., Walker, R.J., Gao, S., Lorand, J.P. and Rudnick, R.L. 2006. GCA, 70(17), pp.4528-4550.

Hughes, H.S., McDonald, I. and Kerr, A.C. 2015. Lithos, 233, pp.89-110.

Hughes, H.S., McDonald, I., Faithfull, J.W., Upton, B.G. and Loocke, M. 2016. Lithos, 240, pp.202-227.

Lorand, J.P. and Luguet, A. 2016. RiMG, 81(1), pp.441-488.

McDonald, I., Hughes, H.S.R., Butler, I., Harris, J.W., Muir, D. 2017. GCA, 216, 335-357.