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The role of sulphur during partial melting of the eclogitic cratonic mantle

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The activity of volatile elements in the mantle (e.g. Hydrogen, Carbon) are known to have profound effects on the position of the solidus (Green 2015). Additionally, the presence of certain key volatiles, such as C, can drastically change the character of the melts produced (Dasgupta et al. 2006). The presence of volatiles during low-degree melting of the upper mantle (cratonic mantle lithosphere, CML) at elevated pressures can lead to production of diamond-bearing magmas such as kimberlites, lamproites and lamprophyres (Foley 1990). However, while the effects of carbon and water on melting in ultramafic and mafic high-pressure lithologies, are to some extent understood, the effect of sulphur is relatively unconstrained. More recently, partial melting experiments in the presence of Sulphur (S) at upper mantle conditions (e.g. Li and Audétat, 2015) suggest that melting is likely a complex function of temperature, pressure and composition. Thus, in order to investigate activity of S as well as the behaviour of highly siderophile and chalcophile elements in mantle petrogenetic processes, we have conducted high temperature and pressure experiments on S bearing basalt/eclogite. The focus of our study is to delineate the effect of S on the melting behaviour of basalt/eclogite and the relationship between sulphide-melt formation relative to carbonate+silicate melt formation. Experiments in progress will aim to constrain the location of the different volatile-controlled solidi at upper cratonic mantle conditions; the composition of the S-bearing melts generated from basalt/eclogite within the cratonic lithospheric mantle; the formation of sulphide minerals in basalt/eclogite systems and the partitioning nature of various major and trace elements between silicate residuum and S-bearing melt(s), compared to volatile-free and C-bearing systems.

The results of the partial melting behaviour of sulphide-bearing cratonic mantle source compositions in both mafic and ultramafic systems will be applied to several geological problems. Firstly, the mechanisms by which anatectic processes in the mantle source may assist or facilitate the formation of magmatic ore complexes in the crust (Griffin et al. 2013) will be delineated by an investigation of natural cratonic mantle samples (e.g. xenoliths) derived from kimberlites in proximity to massive crustal ore complexes (e.g. the Bushveld complex of South Africa). Secondly, the links between generation of sulphur- and/or carbon- bearing melts and mantle metasomatism, including the presence of sulphides in mantle xenoliths and diamonds, will be investigated by comparing the chemical signatures of both the experiments and natural samples.

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