Geophysical Research Abstracts
Vol. 21, EGU2019-6916-1, 2019
EGU General Assembly 2019

Unravelling the lithospheric mantle redox state by inclusions still trapped within diamonds

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Lithospheric diamonds are interpreted to have formed beneath cratons, ancient and deep-reaching continental blocks, at depths between about 130 and 200 km. About 1% of these diamonds contain mineral inclusions that were trapped during diamond growth (Stachel and Harris, 2008). Thanks to the physical strength and chemically inert nature of their diamond hosts, these inclusions may remain pristine and represent key geological samples, protected from alteration or re-equilibration processes during exhumation. Thus, such inclusions could provide direct and unique information on mineralogy and geochemistry of the deep Earth.

Cr-bearing spinels $(Mg, Fe^{2+})(Cr, Al, Fe^{3+})_2O_4$ are widespread accessory phases in different upper mantle rocks as well as well-known inclusions found in lithospheric diamonds. Furthermore, they may serve as petrogenetic indicators and oxybarometers (e.g. Ballhaus, Berry and Green, 1991). Oxygen fugacity, fO_2, reflects Earth's mantle oxidation state or oxidising potential and controls the speciation of C-O-H bearing-fluids (Frost and McCammon, 2008 and references therein).

Two magnesiochromite-olivine touching pairs still trapped within two diamonds from the Udachnaya kimberlite (Siberia, Russia) were analysed by (i) Energy-Domain Synchrotron Mössbauer Spectroscopy (SMS) *in-situ* measurements, conducted at the Nuclear Resonance beamline ID18 at the European Synchrotron Radiation Facility (ESRF), Grenoble (Potapkin *et al.*, 2012) and by (ii) single-crystal X-ray diffraction (SXRD) *in-situ* measurements at Department of Geosciences, University of Padua, to obtain $Fe^{3+}/\sum Fe$ ratios and mineral chemical compositions. The $Fe^{3+}/\sum Fe$ ratios for the two magnesiochromites are 0.15 and 0.17, i.e., identical within errors. These two values suggest similar redox conditions for both inclusion pairs. Thermobarometric analyses are being performed in order to convert these $Fe^{3+}/\sum Fe$ ratios into fO_2 data. The results will be discussed.

References

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