Water dissolved in silicate mineral inclusions in diamonds

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Measurements of the water concentrations in mantle derived materials, combined with experimental studies of water solubilities in mantle minerals have provided important insights into the role of water in the deep Earth. There have been many studies of the water concentrations of olivine, pyroxenes and other minerals in mantle xenoliths that originate from depths down to about 200 km, but there are still unresolved questions relating to the requilibration of xenoliths with their host magmas during ascent and emplacement at the surface.

Here, we will present FTIR measurements of the water concentration and speciation in silicate inclusions in lithospheric diamonds. Inclusions are exposed by polishing a thin diamond plate such that a window though the inclusions is generated for transmission FTIR measurements. These measurements provide very different information from measurements on xenoliths because (i) the water in the inclusion is trapped at the time of diamond crystallisation (or earlier) and is unaffected by subsequent metasomatism that would reset the water concentrations in the surrounding mantle; (ii) there is no possibility of partial or complete re-equilibration with melt during ascent and emplacement because diamond acts as a perfectly impermeable insulating capsule. Inclusions in diamonds thus have the potential to provide information on the composition of diamond-forming fluids far back in Earth history and at great depths.

Our preliminary data on olivine in diamonds from Murowa (Zimbabwe) and Bunder (India) give surprisingly low water concentrations, as low as 5 ppm for Murowa, implying that the fluid from which the diamonds grew was low in H_2O. Different dissolution mechansisms for water in olivine were observed for diamonds from different localities. In Bunder olivines, spectra with peaks in the 3300-3400 cm^{-1} range were observed. These peaks are associated with oxidising conditions[1] and imply higher CO_2/CH_4 ratio in the fluid than at Murowa.

The data will be discussed in terms of the known solubilities of pure H_2O fluids in mantle minerals and the less well known effects of mixed fluid composition and oxygen fugacity.

[1] Grant et al. (2007) *Earth Planet Sci Letters* **261** 217–229