Mantle metasomatism and diamond-forming fluids

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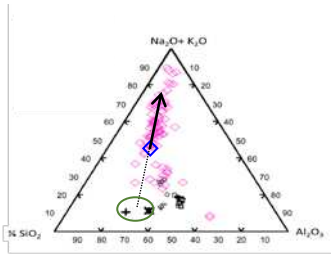
Diamonds and the fluids that form them are important players in the deep carbon cycle that transforms carbon between mantle and surface reservoirs. However, the role of the high-density fluids (HDFs) that are found in micro-inclusions in diamonds is not limited to diamond formation. Examination of literature data on metasomatized rocks suggests that some may have formed by interaction of peridotites and eclogites with HDF-like melts. For example, silicic HDFs can explain the evoltion of an orthopyroxene-rich vein in a garnet hartzburgite from Bulfontein,SA [1]. The composition that was added to the harzburgite and turned it into an orthopyroxene+olivine+phlogopite+garnet+carbonate +sulfide vein (green ellipse in the figure) lies at the extention of the array of silicic to low-Mg carbonatitic HDFs found in fibrous diamonds (pink diamonds). A silicic HDF (blue diamond) that contributed the added component would evolve into more carbonatitic compositions (arrow).



Saline melts found in diamonds carry chloride, carbonate and silicate components, similar to saline hydrous fluids found in harzburgites xenoliths from Pinatubo, Phillipeens [2]. The higher water content in Pinatubo is, most probably, the result of lower temperatures and shallower level, but it attests for the role of saline fluids in metasomatism at the arc environment.

In a companion abstract (Elazar et al., this volume) we report the finding of potassium-rich microinclusions in garnets in an eclogite xenolith from Robert Victor, SA. Their composition falls close to that of silicic to low-Mg carbonatitic HDFs in diamonds. Their lower potassium and higher aluminum content suggests derivation by higher degree of partial melting compared with the diamond forming fluids. All of the above observations support the important role of HDF-like melts and fluids in mantle processes.

[1] Bell et al. (2005) CMP, 150, 251–267. [2] Kawamoto et al. (2013) PNAS 110, 9663-9668.