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Exploring Earth's Deep Water Cycle using Sublithospheric Diamonds

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Sublithospheric diamonds, which may form within the transition zone and lower mantle, are the very deepest direct samples of the Earth's interior. [e.g., 1, 2, 3]. Diamond can protect mineral inclusions from reactions during ascent to the surface. Therefore, the study of inclusions in diamond often provides invaluable insight into the geochemical and physical conditions of their formation and more broadly planetary volatile cycling [4].

Combining synchrotron X-ray computed microtomography and X-ray diffraction at the GSECARS sector of the Advanced Photon Source, we are analyzing mineral inclusions in-situ within a suite of about fifty diamonds from a known super-deep diamond locality in Juina, Brazil. Pink beam microtomography first enables high resolution mapping (1.24 microns/pixel) of mineral inclusions within host diamonds. The tomography data also reveal microcracks within the diamonds that may lead to secondary alteration of their inclusions. After locating pristine inclusions of interest, we employ single-crystal and powder X-ray diffraction to identify individual inclusions. The primary objective of this research is to identify and characterize silicate inclusions within these diamonds and determine their degree of hydration to understand Earth's deep water cycle.

We will present the results of our mineral inclusion work to date, including the range of mineral phases identified, their likely origin, and their implications for deep Earth composition and dynamics.

References

[1] Nestola, F. (2017) Inclusions in super-deep diamonds: windows on the very deep Earth. Rendiconti Lincei, 28(4), 595-604.

[2] Pearson, D.G., Brenker, F.E., Nestola, F., McNeill, J., Nasdala, L., Hutchison, M.T., Matveev, S., Mather, K., Silversmit, G., Schmitz, S., Vekemans, B., and Vincze, L. (2014) Hydrous mantle transition zone indicated by ringwoodite included within diamond. Nature, 507(7491), 221-224.

[3] Stachel, T. (2001) Diamonds from the asthenosphere and the transition zone. European Journal of Mineralogy, 13(5), 883-892.

[4] Palot, M., Jacobsen, S.D., Townsend, J.P., Nestola, F., Marquardt, K., Miyajima, N., Harris, J.W., Stachel, T., McCammon, C.A., and Pearson, D.G. (2016) Evidence for H2O-bearing fluids in the lower mantle from diamond inclusion.