Abstract Title: Mysterious blue olivine inclusion in diamond

Authors: Michelle Wenz, Steve Jacobsen, Dongzhou Zhang, Tiziana Boffa Ballaran, William A. Bassett, Elise Skalwold, and John Koivula

Diamonds act as protective vessels, bringing mantle minerals trapped as inclusions to the surface. The unique properties of diamond, including its chemical inertness and hardness, protects these inclusions from alteration. Thus, diamond inclusions offer a direct snapshot into the Earth's mantle where diamond formation takes place and fluids are likely abundant. Advances in analytical techniques make it possible to study these inclusions in-situ, while they remain trapped in the diamond. These studies provide information such as inclusion pressure along with chemical composition, oxidation states and water content, which can shed light on the conditions of the mantle and diamond formation processes.

We will present a detailed study on a blue-olivine inclusion (~260x100x80 μm^3) contained within a macle-twin diamond. A multitude of techniques were utilized to extract information from the inclusion using both in-house and synchrotron-based methods, yet the origin of its unique blue color remains speculative. Single-crystal X-ray diffraction with a conventional source was used to determine lattice parameters (volume 291.34 $Å^3$) as well as the forsterite number (Fe/(Fe+Mg)=0.08, which is not unusual for olivine inclusions in diamond (Meyer and Boyd, 1972; Meyer and Svisero, 1975). The internal pressure of the inclusion was found to be 0.2 GPa, which is consistent with other olivine inclusions in diamond at 0.2-0.4 GPa (Nestola et al., 2011). FTIR spectra revealed the olivine inclusion is anhydrous. XRF spectra show the olivine is rich in chromium, manganese and zinc, and UV-VIS absorption measurements reveal a broad band 15,000 cm^{-1}, which is consistent with Cr^{2+} spectra in Cr_2SiO_4, however, without a reliable Cr^{2+} olivine standard there is not enough proof that the blue color is in fact caused by a reduced form of chromium. Cr-XANES spectra are representative of chromite, suggesting that the blue color may originate as an optical phenomenon associated with nano-precipitates of chromite. Transects of X-ray diffraction data across the inclusion in search of evidence of chromite precipitates are currently underway at GSECARS.