Extraterrestrial diamonds

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Diamond is one of the most studied minerals in Earth and Planetary Sciences thanks to its capacity to provide crucial information on the evolution of carbon and carbon-bearing compounds through the entire time evolution of our Planet, the Solar System and even beyond.

The geological origin of terrestrial diamonds is deeply investigated over a large number of diamond mines all over the Earth. Classifying diamonds in terms of depth of origin in lithospheric (formed at about 120-200 km depth) or sublithospheric (formed between about 300 and 800 km depth) and in terms of their petrology in peridotitic, eclogitic and websteritic diamonds (see reviews by Stachel and Harris 2008; Harte 2010) is common practice. The same cannot be stated for extraterrestrial diamonds. Although, an increasing number of scientific works, mainly focused on meteorites, reported the presence of different types of diamonds, their actual origin is still strongly controversial. Especially in ureilites which are the second largest group of achondrites and well known for their frequent diamond appearance. In detail, some authors report the discovery of unusually large extraterrestrial diamond monocrystals up to tens of μm (Miyahara et al. 2015; Nabiei et al. 2018) stating that such large diamonds cannot originate simply by impact shock events, but they could be formed within a deep mantle of a huge parent body. On the other hand, other authors suggest that diamonds in meteorites can only be formed by impact events from a carbon-bearing precursor phase (i.e. Hezel et al. 2008; Ross et al. 2011).

This Ph.D. research project aims to investigate a significant number of diamond-bearing meteorites (mainly ureilites) adopting a series of analytical techniques (e.g. micro-X-ray diffraction and sub-micro X-ray fluorescence, in house and at large scale facilities, high-resolution confocal micro-Raman spectroscopy, analytical transmission electron microscopy, SEM-FEG-EDS-WDS-FIB) in order to provide a new base of evidences for the actual origin of this kind of extraterrestrial diamonds. The Ph.D. student will be based in Padova but for a significant number of months will be necessary to work in close collaboration with the Goethe University Frankfurt, where all experiments by transmission electron microscopy will be carried out.

References

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