STRUCTURE CHARACTERIZATION OF IMPACT NATURAL DIAMOND FROM POPIGAI CRATER

Mara Murri[1], Adrian P. Jones[2], Paul F. McMillan[3], Christoph G. Salzmann[3], Matteo Alvaro[1], M. Chiara Domeneghetti[1], Fabrizio Nestola[4], Mauro Prencipe[5], David Dobson[2], Rachael Hazael[3], Moreton Moore[6], Sergei A. Vishnevsky[7], Alla M. Logvinova[7], Nikolay V. Sobolev[7]
[1] Earth and Environmental Science University of Pavia, Via Ferrata 1, Italy (mara.murri01@universitadipavia.it),
[2] Department of Earth Sciences, University College London, WC1E 6BT, UK (adrian.jones@ucl.ac.uk),
[3] Department of Chemistry, University College London, WC1E 6BT, UK, [4] Department of Geosciences, University of Padua, Italy [5] Earth Sciences Department, University of Torino, Italy, [6] Royal Holloway, University of London, TW20 0EX, UK, [7] Institute of Geology and Mineralogy, Siberian Branch of Russian Academy of Sciences, Koptyug Ave., 3, 630090, Novosibirsk, Russia

Introduction: Impact cratering is undoubtedly one of the most frequent high-energetic and potentially catastrophic event occurring at the earth surface and in the planetary system. For example, the energy released from an impact occurring on the Earth's surface as calculated even for a small impact crater appears to be 3 orders of magnitudes higher than the Hiroshima atomic bomb. These enormous energies and the very short duration can cause unique irreversible changes to rocks and minerals (eg. deformations, phase transformations, melting and vaporization) and are compatible with P and T conditions required to transform graphite into diamond (4.5GPa at 1000°C) and are also enough to induce deformation in the newly formed diamonds.

Samples: Popigai impact diamond represents a shock-metamorphosed mineral found in the large ~100 km diameter Popigai crater in Siberia, Russia, which formed in the Late Eocene at ~35.7 Ma. The impact smashed into the regional geological Precambrian-Phanerozoic boundary and it reached the basement rocks (e.g depth > 5Km) containing graphite-bearing gneisses, producing peak pressures ~ 600 GPa. It is estimated that shocked graphite was transformed throughout a large central region, within ~13.6 km of ground zero, into "lonsdaleite"-bearing "impact diamond" [1]. The Popigai impact diamond contains up to ~50% diamond and 50% diamond-related materials with significant hexagonal characteristics, interpreted as "lonsdaleite".

Results and Discussion: High-resolution synchrotron x-ray diffraction data of [2], collected for a laboratory-shocked (DC4) and a natural impact diamond from Popigai (POP20) showed that hexagonality can be achieved by shocking diamond as well as from graphite precursors. Their approach provides an "hexagonality index" that can be used to characterize and distinguish among samples that have experienced different degrees of shock or static high pressure-high temperature treatments. To the aim of better understanding the origin of Popigai diamond and if the stacking disorder could provide an entire record of the impact shock event, we have investigated by high-resolution x-ray diffraction the preserved traces of deformation (eg. stacking disorder [3]) in other natural impact diamonds from Popigai impact crater retrieved from two different thermal regimes in the impact melt, called tagamite hot and tagamite cold. Therefore, the new quantitative analyses, performed by analyzing X-ray diffraction data with the DIFFaX software package, enabled us to better characterize and constrain the high pressure and high temperature conditions experienced by diamonds from Popigai impact crater.

References: [1] Masaitis V. (1998) *Meteoritics and planetary Science* 33,349-359. [2] Jones A.P. et al. (2016) *Lithos* 265: 214-221. [3]Salzmann C.G. et al. (2015) *Diamond and Related Materials* 59**,** 69-72.

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