INIDMEDEA - Inclusions in diamonds: messengers from the deep Earth

Diamonds and their inclusions are the deepest materials originating from the Earth□s interior reaching the surface of our planet. Their study plays a key role in understanding and interpreting the geodynamics, geophysics, petrology, geochemistry and mineralogy of the Earth□s mantle and those processes which governed trough the time the evolution of the Earth. The most abundant mineral inclusions in diamonds are olivines, orthopyroxenes, clinopyroxenes, garnets, spinels, and sulfides. All of these mineral phases have been identified by X-ray diffraction or electron microprobe analysis since the 1950s almost always after their extraction from the diamonds. However, a non-destructive in-situ investigation of an inclusion in diamond is useful and important because: (a) some mineral inclusions under pressure could have a different crystal structure, and thus different petrologic significance compared to that at ambient pressure; (b) the internal pressure on the inclusion can provide information about the formation pressure of the diamond; (c) the morphology and growth relationships of the inclusion with the host diamond can provide indications about its protogenetic vs. syngenetic and/or epigenetic nature.
In this project a new experimental approach, based on X-ray diffraction technique, will be used in order to determine, for the first time, the crystal structure of the inclusions still trapped in their host diamonds allowing to obtain chemical information capable to provide the inclusion remnant pressure and, from this, the pressure of formation of the diamond-inclusion pair. At the same time, our approach will allow to obtain any possible epitaxial relationship between diamond and its inclusions in order to provide strong constraints about the syngenetic or protogenetic nature of minerals included in diamond solving a 50 years old debate. Several geochemical and geodynamical models are based on the assumption of syngenesis but this has yet to be demonstrated.

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Department: Geosciences

Coordinator: Università degli Studi di Padova

Total EU Contribution: Euro 1.423.464

Call ID: ERC-2012-StG_20111012

Project Duration in months: 72

Start Date: 01/01/2013

End Date: 01/01/2019

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