

**TRAPPED HIGH DENSITY FLUIDS AND MELTS IN SUPERDEEP DIAMONDS. F. E. Brenker<sup>1</sup>, S.****Schmitz<sup>1</sup>, L. Vincze<sup>2</sup>, B. Vekemans<sup>2</sup>, M. Krebs<sup>1</sup>, W. De Nolf<sup>3</sup>, K. Janssens<sup>3</sup>, T. Stachel<sup>4</sup>, J. Harris<sup>1,5</sup>**

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**Introduction:** Diamonds from the transition zone and the lower mantle have attracted considerable attention in recent years [1-6]. Compared to the majority of diamonds worldwide derived from lithospheric and sub-lithospheric sources, these rare samples provide exceptional insights into the chemistry and dynamics of the deepest accessible parts of the Earth. Several occurrences of such “ultra-deep” diamonds have been reported and studied intensively in terms of their chemical characteristics and mineral paragenesis [1-7]. Several aspects, e.g. the C-isotopic composition of the diamond host or Eu-anomalies of pyroxene (former perovskite) inclusions, link to a subduction related origin for several of these ultra-deep inclusions [1-2,6].

Although diamonds and their inclusions may probe the deep Earth only locally they are the only direct source of information available and any finding provides information on the physical conditions (pressure, temperature, composition, oxygen fugacity) of their source region. In addition a minimum size of each chemical heterogeneity is expected because temperature is reasonable high in the deep mantle and the time-scales of subduction, storage, capture and exhumation exceed tens to hundreds of millions years. Homogenisation is even faster within the transition zone, where the resistance time (time before complete assimilation) of a ~1m sized object is calculated to be limited to ~1 million years [8].

The diamonds investigated in this study were mined from alluvial deposits in the Juina area of south western Brazil. It is shown that these diamonds contain abundant inclusions derived from sources extending from the deep asthenosphere into the lower mantle [4,5].

**Methods:** In the present work, the inclusions were studied in situ (inside the unbroken diamond) by the means of confocal Raman spectroscopy, confocal micro x-ray fluorescence [9-11] and micro x-ray diffraction. These techniques allow the investigation of the structure and chemical composition of even very tiny inclusions (< 5µm) with the only sample preparation being the polishing of a window close to the inclusions in the diamond in order to reduce light and x-ray absorption/scattering effects. Keeping a (reduced) diamond layer covering the inclusions prevents the trapped phases from any contamination and allows better distinction between their syn- and epigenetic origin, which was essential for the present study.

**Results:** Of special interest was a large Kankan diamond containing many Ca-Si-O rich inclusions (KK200). Investigations applying Raman spectroscopy yield CaSiO<sub>3</sub> walstromite, CaSi<sub>2</sub>O<sub>5</sub> titanite and larnite (beta-Ca<sub>2</sub>SiO<sub>4</sub>) as inclusion paragenesis. The varying proportions of the respected phases indicate a depth of origin within the two phase field of larnite + CaSi<sub>2</sub>O<sub>5</sub> titanite between 300 and 360km [3].

Detailed trace element tomography of several cubo-octahedral inclusions indicate a Ca,Si-rich source, in the absence of several common mantle minerals, like olivine, garnet and Ca-poor pyroxene. This reservoir may represent metasomatized oceanic lithosphere (rodingites, ophicarbonates), meta-morphosed carbonaceous sediments or a trapped carbonatitic melt. In addition investigations on the surrounding narrow fractures around the inclusions show that contrary to our expectation the fractures are actually filled with material. The fracture filling shows close similarities in trace element composition to the mineral inclusions, in addition to being generally enriched in REE. The former existence of a fluid or melt is required to transport material into these elongated fractures. This interpretation is further confirmed by X-ray diffraction measurements which indicate the presence of florencite and La-cerite crystals within the fracture fills.

The most likely interpretation is the entrapment of a volatile component during diamond growth, probably dissolved at high pressure within the solid inclusion phases. During uplift of the diamonds and associated pressure release this volatile content is expelled from the solid inclusion as a fluid and penetrates into the newly forming fractures.

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