TEM investigations of nano-inclusions in milky diamonds from Juina, a super deep source

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Defect microstructures, e.g. nano-inclusions, voidites and dislocations in a unique set of milky diamonds from alluvial deposits in Rio Soriso, Juina area, Brazil have been investigated in detail using Transmission Electron Microscopy (TEM). They may have an ultra deep origin as shown for many samples of the same location (e.g. [1-3]). The Focussed Ion Beam (FIB) technique (GFZ Potsdam) was applied to prepare 150 nm thick electron transparent TEM slices. TEM bright-field images reveal hundreds of nano-features which may represent inclusions or voidites with a size range between about 20 and 200 nm. For simplicity from here on we will call them nano-inclusions, regardless if they are empty or filled with a fluid or solid. Some nano-inclusions look very similar to voidites, which have been described and investigated in previous studies on type IaB specimens (e.g. [4]]5]). Electron Energy-Loss Spectroscopy (EELS) provides evidence for the presence of nitrogen in the nano-inclusions. The respective EELS measurements reveal the N K-edge at 401 eV. Suggestions for the nano-inclusion content can be either NH_3 [4] or non-equilibrium modification of N_2 [5]. However, the widespread occurrence of nano-inclusions in this specific type of diamonds indicates a new formation mechanism of milky diamonds. If the assumption of an ultra-deep origin is correct the nano-inclusions will help to get new information of the diamond forming fluids at these great depths.

[1] Brenker *et al* (2007) *Earth and Planetary Science Letters* **260**, 1-9. [2] Pearson *et al* (2014) *Nature* **507**, 221-224. [3] Kaminsky, Wirth (2011) *The Canadian Mineralogist* **49**, 2, 555-572. [4] Barry *et al* (1986) *Ultramicroscopy* **20**, 169-176. [5] Luyten *et al* (1994) *Philosophical Magazine A*, Vol. **69**, No. 4, 767 – 778.