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Hydogen occurence in mantle olivine nodules from kimberlites

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Mantle olivine samples represented by xenocrysts (single olivine grains of about 1 cm in size) and xenoliths (rock fragments of several cm in size) from kimberlite pipe Udachnaya have been investigated with the Transmission Electron Microscopy (TEM) and Infrared Spectroscopy (FTIR). FTIR data show that H2O (OH) content in olivine samples from megacrysts (116-392 wt.ppm) and xenolites (14-23 wt.ppm) is different. Both intrinsic and extrinsic OH- is present.

All the samples contain numerous nanoinclusions of high-pressure hydrous silicates (10 A-phase Mg3Si4O10(OH)2 nH2O, where 10 A = 10 Angstrem, and hydrous olivine Mg[2-õ]SiO[4]H[2x]) and low-pressure products of their alteration (serpentine and talk). TEM study revealed that 10 A-phase is the main high-pressure nanophase in olivine. 10 A-phase occurs as nanoinclusions (50 - 200 nm in size) in xenocrystic olivine samples while it is present as veins (50 - 350 nm in width) developed along healed microcracks in xenoliths. The origin of 10 A-phase in xenocrysts and xenoliths is suggested to be different. Nanoinclusions of 10 A-phase have formed due to deprotonization of olivine in mantle environment. Veins filled with 10 A-phase in xenoliths have developed by hydration of olivine in the mantle (mantle metasomatic reaction). 10 A-phase is proposed to be a typical nanomineral of kimberlites that marks a certain stage of the kimberlite process at pressures 3-4 GPa. The data indicate that: (i) 10 A-phase exists as a nanometer-sized crystals only; (ii) 10 A-phase is genetically associated with olivine in the mantle and (iii) the origin of 10 A-phase is not magmatic. 10 A-phase ocurrence in olivine gives the argument for the olivine hydration in mantle environment and the depths at which xenocrysts and xenoliths have been hydrated are estimated to be 150-165 km and 90-125 km respectively.