Hydrated clinopyroxene and garnet in ultrahigh-pressure metamorphic rock

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Input of water into the earths interior is restricted to subduction zones. However, the subducted oceanic crusts are dehydrated in shallow depth, and then transformed to dry eclogite containing no hydrous minerals at temperatures over 700 C and pressures over 30 kbar. It is therefore believed that subducted crusts cannot carry significant water into deeper mantle. Recent studies reported that trace amounts of hydroxyl can be contained in nominally anhydrous minerals (e.g., Bell and Rossman, 1992). Trace water in these minerals is capable of recycling into the earths interior at subduction zones. In order to evaluate how much water is transported into the upper mantle at deep subduction zones, we investigated the hydroxyl contents of clinopyroxenes and garnets in ultrahigh-pressure (UHP) metamorphic rocks in Kokchetav massif, which has been subducted to more than 150 km depth. As a result of infrared spectroscopic study, clinopyroxene and garnet in the eclogites contain hydroxyl up to 3020 ppm and 290 ppm, respectively. The hydroxyl absorbances increase with recrystallized pressure in both clinopyroxene and garnet. In clinopyroxene, the hydroxyl content correlates with increase of the CaEskola component, which contain vacancy on the M2 site. Same relation was reported from mantle xenoliths in Roverts Victor kimberlite pipe (Smyth et al., 1991). Because clinopyroxene and garnet represent about 40-50 volume% and 35-50 volume%, respectively, of eclogites, the bulk eclogites can contain approximately 1400 ppm hydroxyl, whereas these rocks do not contain any nominally hydrous minerals. Thus, subducted oceanic crust can carry H2O into the upper mantle, even in the absence of nominally hydrous minerals, and has an important bearing on physico-chemical properties of mantle dynamics.