

WU Yao, 2013. Hydroxyl Incorporation in Diopside and Sodic Clinopyroxenes up to 10 GPa and Implications for Water Transportation in Subduction Zones. *Acta Geologica Sinica* (English Edition), 87(supp.): 510.

Hydroxyl Incorporation in Diopside and Sodic Clinopyroxenes up to 10 GPa and Implications for Water Transportation in Subduction Zones

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Hydroxyl solubility in minerals has important implications for a series of geodynamical problems in the upper mantle. In order to understand the OH incorporation in sodic clinopyroxenes and their roles in water transportation in subduction zones, we conducted a systematic experimental investigation of OH incorporation in diopside and sodic clinopyroxenes covering a diverse chemical composition determined by secondary ions mass spectrometry (SIMS) analysis up to 10 GPa. We found that hydroxyl concentrations in jadeite and Al-free diopside show decreasing trend with increasing pressure consistent with the power-law solubility equation with $n=0.5$ for H₂O fugacity. By comparison, the OH concentration of cpx with significant amount of Ca-Eskola component demonstrate a strong bulk composition dependence rather than pressure and temperature. The presence of Ca-Eskola component drastically increases the OH content. The

dissolved OH concentration reaches its maximum at 7 GPa where up to 2000 ppm OH could incorporated into cpx structures, and decreases at 10 GPa as majorite component in garnet becomes progressively important. Our results also indicate that cpx without significant amount of Ca-Esk would dissolve c.5 times more OH with respect to olivine at 4-7 GPa. This partitioning coefficient would be reversed at still higher pressures as olivine could absorb more OH. The decreasing trend of OH incorporation of jadeite and diopside with pressure together with the strong dependence of hydroxyl solubility in sodic cpx on bulk composition have important implications for water transportation in subduction zones. Dehydration might be expected for sodic clinopyroxenes when subducting slabs proceed to a depth of c.300 km where majoritic garnet and stishovite is present.

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