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H-D isotopic fractionation between nominally anhydrous minerals

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In order to explore how polymorphism influences hydrogen isotopic fractionation between olivine polymorphs we have equilibrated olivine, enstatite and wadsleyite at high pressures (12-14 GPa) as a function of temperature between 600 and 1000°C. The minerals were equilibrated in a D_2O-doped fluid in a multi-anvil press and the distribution of OH between the nominally anhydrous minerals was measured with Raman spectroscopy and secondary ion measurements (SIMS). Because olivine and wadsleyite coexist over a very narrow interval of (P,T) conditions we used enstatite as a relay phase to calculate the fractionation between olivine and wadsleyite. We find the D-H fractionation between enstatite and wadsleyite to be very negative but that between enstatite and olivine to be even more negative. The ratio between these two fractionation factors results in a negative fractionation factor between wadsleyite and olivine, implying that deuterium preferentially partitions into olivine compared to wadsleyite.