Dihedral angle of forsterite-H2O system up to mantle transition zone

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Pore morphology in liquid-bearing texturally equilibrated rocks strongly controls many physical properties of the Earth's deep materials. Dihedral angle characterizing the wetting properties for liquid phase in olivine-rich matrix is a key factor for understanding the physical behavior of the upper mantle. It has been reported that the dihedral angles between olivine and H2O, which is the dominant volatile species in the Earth's interior, decrease with increasing pressure. However, the degree to which the dihedral angle changes with pressure has not been determined under higher-pressure conditions. Here we report the new experimental results of the variation of dihedral angle and microstructures of the forsterite-H2O system at 1473K and various range of pressure (1 to 13GPa). We found that the dihedral angle of the system above the mantle transition zone (approximately 400km depth) is approximately 0 degree, corresponding to the complete wetted grain boundary. We interpret that this is caused by the decrease in the solid-liquid interfacial energy with pressure due to the increase of solubility in the fluid. These results suggest that even if melt fraction is very low, a presence of water-rich liquid would have drastic influences on physical properties of upper mantle around the transition zone.