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An experimental study of water incorporation into peridotite minerals near the water saturated solidus

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The incorporation of water in minerals stable near the solidus of a fertile lherzolite compositions was explored experimentally at 2.5 and 4 GPa. The proportion and activity of water were varied to establish the partitioning of water between nominally anhydrous minerals (NAMs), the hydrous minerals pargasite and phlogopite, hydrous melt and water-rich vapour. We added a sensor-layer of olivine or pyroxenes to both sides of the lherzlite material and determined their water content by Fourier-transform infrared spectroscopy. The quantitative and qualitative aspects of 'water' incorporation in coexisting NAMs were determined under conditions in which the roles of hydrous mineral stability, partial melting or vapour-saturation could also be monitored. At 2.5 GPa in a fertile mantle lherzolite we observed pargasite even at very low bulk water contents of 100-250 ppm H_2O. Higher water contents result in increased pargasite abundance, up to 0.3-0.4% H_2O. When this limiting H_2O content is exceeded, melting begins at the vapour-saturated solidus. These observations indicate that pargasite is the major host phase for water storage in the uppermost mantle at depths to $\sim$100 km and T$\leq$1100°C and the "dehydration" solidus applies for water contents $<$0.3-0.4% H_2O. At higher pressures ($>$3 GPa) pargasite is not stable and in the absence of K_2O to stabilize the hydrous mineral phlogopite, the maximum water content in NAMs at the vapour-saturated solidus of fertile lherzolite (MORB-source) is $\sim$180 ppm at 4 GPa.