Melting behavior of H_2O at high pressures and temperatures

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Water plays an important role in the physics and chemistry of planetary interiors. In situ high pressure-temperature Raman spectroscopy and synchrotron x-ray diffraction have been used to examine the phase diagram of H_2O. A discontinuous change in the melting curve of H_2O is observed at approximately 35 GPa and 1040 K, indicating a triple point on the melting line. The melting curve of H_2O increases significantly above the triple point and may intersect the isentropes of Neptune and Uranus. Solid ice could therefore form in stratified layers at depth within these icy planets. The extrapolated melting curve may also intersect with the geotherm of Earth's lower mantle above 60 GPa. The presence of solid H_2O would result in a jump in the viscosity of the mid-lower mantle and provides an additional explanation for the observed higher viscosity of the mid-lower mantle.