

CHEMISTRY AND MINERALOGY OF EARTH'S MANTLE

Formation of SiH_4 and H_2O by the dissolution of quartz in H_2 fluid under high pressure and temperature‡

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ABSTRACT

Species dissolved in H_2 fluid were investigated in a SiO_2 – H_2 system. Raman and infrared (IR) spectra were measured at high pressure and room temperature after heating experiments were conducted at two pressure and temperature conditions: 2.0 GPa, 1700 K and 3.0 GPa, 1500 K. With the dissolution of quartz, a SiH vibration mode assignable to SiH_4 was detected from Raman spectra of the fluid phase. Furthermore, an OH vibration mode was observed at 3260 cm^{-1} from the IR spectra at 3.0 GPa. With decreasing pressure, the OH vibration frequencies observed between 3.0 and 2.1 GPa correspond to that of ice VII, and those observed at 1.4 and 1.1 GPa correspond to that of ice VI. These results indicate that the chemical reaction between dissolved SiO_2 components and H_2 fluid caused the formation of H_2O and SiH_4 , which was contrastive to that observed in SiO_2 – H_2O fluid. Results imply that a part of H_2 is oxidized to form H_2O when SiO_2 components of mantle minerals dissolve in H_2 fluid, even in an iron-free system.

Keywords: H_2 – H_2O fluid; dissolution; Raman; IR; laser-heated diamond-anvil cell