Study of silicate melts and iron oxides by x-ray Raman scattering

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Knowledge of the Earth's composition, structure and dynamics is essential for the understanding of geological processes. Most physical properties of the Earth's interior have been extracted from seismological observations or structural laboratory studies of materials attendant in the Earth's body. Though, determination of the electronic properties of high pressure and temperature phases of geologically relevant materials is still a challenge. X-ray Raman scattering (XRS) is a powerful technique to probe the electronic states of an absorber atom, similar to conventional x-ray absorption spectroscopy. Using hard x-rays, studies of absorption edges at binding energies between 10 eV and 10 keV are possible in-situ even under high pressure and high temperature conditions.
For the study of hydrous silicate melts a resistive heated hydrothermal diamond anvil cell was used for pressures below 2 GPa and temperatures up to 800°C in order to achieve conditions of the deep Earth's crust. First results of in-situ XRS measurements of the sodium and oxygen K-edges as well as the aluminum and silicon L-edges of the melts are presented. Moreover changes in the Fe $L_{2/3}$ and Fe $M_{2/3}$ edges in differently coordinated iron (FeO, Fe_2O_3 and Fe_3O_4) are discussed using XRS measurements at ambient conditions.

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