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Title

In-situ mid/far micro-FTIR spectroscopy to trace pressure-induced phase transitions in strontium feldspar and wadsleyite

Source

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Abstract

As representatives of nominally anhydrous minerals (NAMs) in the crust and mantle the pressure-dependent behavior of strontium feldspar and wadsleyite, containing different amounts of water, was studied in a diamond-anvil cell via mid and far IR spectroscopy up to 24 GPa. The samples were synthesized in a piston-cylinder press at 2 GPa/700 degrees C (strontium feldspar) and in a multi-anvil apparatus at 13.8 GPa/1000 degrees C (dry wadsleyite) and 13.2 GPa/1150 degrees C (hydrous wadsleyite). The water content of the samples was determined by polarized FTIR and Raman spectroscopy. The strontium feldspar crystals (up to 300 mu m) contained about 1100(100) wt ppm water. The hydrous wadsleyite crystals (up to 240 pm) contained 12500(900) wt ppm water. The synthesis of dry wadsleyite yielded a fine-grained powder. A new THz/FIR-microscope for the synchrotron source BESSY was developed to conduct the diamond-anvil cell measurements in the far IR region. Conventional in-situ mid IR spectroscopy was also performed on all samples. The measurements on strontium feldspar showed a phase transformation at 6.5(5) GPa (space group I2/c to P2(1)/c). The wadsleyite analyses revealed a phase transition at approximately 8.4(7) GPa in the hydrous and approximately 10.0(7) GPa in the dry sample. It probably represents a transition from an orthorhombic to a monoclinic structure. The high amount of water incorporated in the hydrous wadsleyite shifts the transformation toward lower pressures compared to the dry one. By comparison, the relatively low amount of water in strontium feldspar does not change the stability relations compared to the dry one. Therefore, water incorporation in nominally anhydrous minerals may have an effect on the pressure of phase transitions, whereas the extent of that influence strongly depends on the structure of the phase and the amount of water carried within the mineral.