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Direct formation of the γ-$CaSO_4$ phase in dehydration process of gypsum: In situ FTIR study

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Abstract

The dehydration mechanism of natural single crystals of gypsum was investigated in the temperature range 300–430 K by in situ infrared (FTIR) spectroscopy. The thermal evolution of the second-order modes of H_2O and SO_4 groups in gypsum, in the wavenumber range 4850–5450 cm^{-1} and 2050–2300 cm^{-1} respectively, were used to probe the dehydration and rehydration sequence. A total disappearance of the combination modes of H_2O and the replacement of four SO_4^{-2} bands (2245, 2200, 2133, and 2117 cm^{-1}) observed at room temperature by three bands (2236, 2163, and 2131 cm^{-1}) observed at 390 K indicates the direct formation of γ-$CaSO_4$ upon heating. Upon cooling water re-enters into the γ-$CaSO_4$ structure at around 363 K to form bassanite. This observation, that the dehydration of gypsum directly yields γ-$CaSO_4$ (anhydrite) without the intermediate formation of hemi-hydrate (bassanite), is further corroborated by the dehydration behavior of bassanite. The second-order SO_4 modes of bassanite observed around 2218, 2136, and 2096 cm^{-1} were replaced with the bands of γ-$CaSO_4$ at about 378 K upon heating.