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*Porous materials
for a green future*



ABSTRACT BOOK

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1297 - THE ROLE OF TEMPERATURE IN P INDUCED CRYSTAL FLUID INTERACTION A STUDY ON LAU AND HEU TOPOLOGIES

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Natural zeolites can be found in soils, oceanic basalts as well as sediments and diagenetic environments. Their peculiar reversible hydration property (i.e., the ability to adsorb and release H₂O molecules) and the ability to overhydrate under pressure, make them suitable carriers of fluids in the upper Earth crust during the early stage of subduction. Despite the extensive study of high-pressure and high-temperature behavior of natural and synthetic zeolites over the last decades, few studies have yet combined the effects of both conditions. Experiments at combined high pressure and high temperature might provide valuable insights on the crystal-fluid interaction precesses occurring in nature at the geological conditions of stability of zeolites, especially when these microporous compounds can act as carriers and moderators of the circulating fluids.

In this study, the in situ combined high-pressure and high-temperature behavior of two commonly occurring natural zeolites, heulandite and laumontite, was investigated. The P-induced crystal-fluid interaction of these two zeolites was studied at ambient-T by Comboni et al. [1] for laumontite and Seryotkin [2] for heulandite. These results have been used as benchmarks to evaluate the role of temperature on the crystal-fluid interaction. In-situ, HTHP single-crystal synchrotron X-ray diffraction experiments were conducted using a diamond anvil cell (DAC) surrounded by a resistive heater at the ID15b beamline at the European Synchrotron Radiation Facility in Grenoble (France). The setup allowed to reach temperatures of about 150(2)°C. Pressure was measured using the ruby fluorescence technique while temperature was monitored using a thermocouple located very close to the P-chamber, allowing a precise determination of both these variables. The results obtained were consistent with those calculated using the Au-powder pattern.

The results showed that temperature significantly increased the kinetics of H₂O adsorption in laumontite, with respect to the compressional behavior at room conditions, leading to a volume expansion observable already at pressures < 5 kbar. It was previously found that laumontite hydrated at ambient conditions after 24 hours, while the presence of a temperature gradient reduced the time at about 15 minutes. Even for heulandite, the comparison with literature data suggests that a higher H₂O adsorption rate was observed when the thermal gradient was applied.

References

- [1] Comboni D., Gatta G.D., Lotti P., Merlini M. & Hanfland M. 2018. Crystal-fluid interactions in laumontite. *Microporous Mesoporous Mater.*, 263, 86-95.
- [2] Seryotkin, Y.V. 2015. Influence of content of pressure-transmitting medium on structural evolution of heulandite: Single-crystal X-ray diffraction study. *Microporous and Mesoporous Mater.*, 214, 127-135.