Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.29081

Morphological preservation and porosity development during a pseudomorphic double mineral transformation

PABLO FORJANES[1], JEFFREY PAULO PEREZ[1], CAITLIN BERRYMAN[1], MARCIN DANIEL SYCZEWSKI[2] AND LIANE G. BENNING[1]

[1]GFZ Helmholtz Centre for Geosciences
[2]University of Warsaw

Mineral pseudomorphism frequently occurs in fluid-driven mineral transformation reactions when dissolution and precipitation take place simultaneously and in close proximity. Pseudomorphs serve as key geological proxies which can host details of the original mineral's microstructure and composition, while also providing insights into the chemical characteristics of the fluid responsible for the transformation. Considerable progress has been made in recent years in elucidating the physico-chemical conditions governing pseudomorph formation. However, knowledge gaps remain in understanding what happens when freshly-formed pseudomorphs interact with new fluids that may trigger further mineralogical changes.

To investigate this, we examined the pseudomorphic replacement of single crystals of gypsum ($CaSO_4 \cdot 2H_2O$) into celestine ($SrSO_4$) by interacting them with Sr-rich solutions. Following this 1st replacement, the conversion of the so formed celestine pseudomorphs into a second phase – this time strontianite ($SrCO_3$) was evaluated upon exposure of the celestine pseudomorphs to carbonate-rich fluids. The 1st transformation (gypsum to celestine) produced highly porous celestine pseudomorphs, consistent with an interface-coupled dissolution-precipitation mechanism. In the 2nd transformation (celestine to strontianite), the replacement morphologies developed in the 1st transformation were retained, but a secondary microporosity also arose. As a result, the final strontianite pseudomorphs contained two distinct generations of pores, each corresponding to a separate transformation, while the original external shape of the gypsum parent crystals remained preserved. These results emphasize the link between pseudomorph microstructures and their replacement history, reinforcing their significance as geological proxies.