

New insights into mineral storage of CO₂: comparison of flooded and not flooded sandstone from the same formation

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Mineral storage of carbon-dioxide is one of the most promising ways of storing CO₂ safely underground. This study sheds light on the mechanism and timeline of the precipitation of a carbon-dioxide fixing mineral dawsonite (NaAlCO₃(OH)₂). Petrographic, geochemical and stable isotopic analysis of a sandstone formation from two neighbouring CO₂ gas fields in NW Hungary (Central Europe) were carried out. Sandstones from the Mihályi-Répcelak field contains large amount of dawsonite that entirely, and siderite that partially originate from the result of natural CO₂ ‘injection’ since late Miocene (6-4 Ma) on the basis of their carbon isotopic composition¹. New petrographic analysis of the same sandstone from the nearby Ölbő field where CO₂ has been trapped under the sandstone lacks dawsonite. New isotope data of siderite (−10.9 - −6.5 ‰) from the Ölbő field suggests that the siderite is early diagenetic in origin. Above results provide an excellent opportunity to establish input parameters for geochemical modelling on dawsonite formation in the Mihályi-Répcelak field as a response to CO₂ flooding.

Kinetic modelling was carried out using PHREEQC. The model indicates the dissolution of albite, which drives dawsonite precipitation via cation supply. It also indicates low amount of kaolinite precipitation after albite dissolution and that siderite is mostly dissolving. The majority of the reactions in the kinetic-batch models, takes place in the first 30 years after CO₂ injection. Modelled final composition of sandstone after CO₂ ‘injection’ is validated by observed mineral composition of sandstones from the Mihályi-Répcelak CO₂ reservoir¹. Present research reinforces that dawsonite can be a significant sink of CO₂ that forms at the early stages of CO₂ injection, making it an ideal candidate for CCS projects seeking on achieving mineral storage of carbon on human timescales.

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References

[1] Cseresznyés et al. 2021, Chem.Geol.584(5).