Effect of coexisting elements on the formation of dawsonite under weakly alkaline condition

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The question of "whether dawsonite ($NaAl(CO_3)(OH)_2$) will form in CO_2 reservoirs and contribute to mineral trapping" is a major concern for predicting the security of geological carbon storage and has been discussed for decades [1-2]. Although many numerical simulation studies suggest the formation of dawsonite in CO_2 reservoir and contributtion to the security of geological carbon storage (mineral trapping of CO_2), dawsonite formation is rarely observed in the experimental studies [3]. In addition, the natural occurrence of dawsonite is scarce despite its simple chemical formula (composed of only five commom elements).

In this presentation, we show the results of dawsonite synthesis experiments with co-existence elements (K, Ca, and Mg), and discuss the forming condition of dawsonite. Our experiments clearly demonstrated that co-existence magnesium ($MgCl_2$) inhibits dawsonite formation to form hydrotalcite ($Mg_6Al_2(CO_3)(OH)_{16}\cdot 4(H_2O)$) and/or manasseite instead of dawsonite under alkaline condition (pH=10.0±0.1). On the other hand, calcium ($CaCl_2$) and pottasium (KCl) did not affect the dawsonite formation in our experiments. Because magnesium universally exists in earth's crust, dawsonite could be formed only under extremely Mg-poor condition and is unlikely to form in CO_2 reservoir. However, Mg-bearing metastable carbonate minerals such as hydrotalcite and manasseite would form in CO_2 reservoirs and might contribute to the security of CO_2 storage, instead of dawsonite.

References: [1] Hellevang, H. et al. *Oil Gas Sci. Technol.* **66**, 119-135 (2011). [2] Hellevang, H. et al. *Greenhouse Gases: Sci. Technol.* **4**, 191-199 (2014). [3] Wolff-Boenisch, D. et al. *Int. J. Greenhouse Gas Control,* **68**, 176-190 (2018).