



Contribution ID: 66

Type: Oral Presentation

The phase equilibria of aqueous electrolytes in confinement under Martian condition

Thursday, 25 May 2023 14:45 (15 minutes)

The discovery of chlorides and perchlorates has profoundly influenced our view of liquid water on Mars [1,2]. These salts attract much attention, because their hygroscopic nature and low eutectic temperature allow for the possibility of liquid water on the surface of Mars today. Recent studies showed the confined space exert significant effect on the phase boundary on salt solution, particular in the freezing and deliquescent process [3,4].

In this work, we perform experiments to investigate the eutectic temperature and deliquescence humidity of Mars-relevant salts (CaCl_2 , MgCl_2 , $\text{Ca}(\text{ClO}_4)_2$, and $\text{Mg}(\text{ClO}_4)_2$) in bulk and various size pores (3–20 nm). The results indicate that, compared with water, the confinement effect on melting temperature of salt solutions is more significant. It was found that freezing of concentrated solutions in narrow pores can even be suppressed completely. The deliquescence humidity of salts in pores is much lower than bulk particle, and the hydration dynamic process may be influenced for the deliquescence humidity shift. In order to understand the salt and confinement effects on the stability field of a liquid water phase, we develop an ion interaction model (based on Pitzer theory) to calculate the phase diagram of cryogenic aqueous solutions.

Participation

In-Person

References

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Session Classification: MS13

Track Classification: (MS13) Fluids in Nanoporous Media