A developed method for the measurement of CO_2 solubility in NaCl solutions under geological conditions via fused silica capillary cell with in-situ Raman spectroscopy

Zhiyan Pan [1], Junliang Wang [2]

[1]*College of Environment, Zhejiang University of Technology, Hangzhou 310032, China, panzhiyan@zjut.edu.cn*

[2]*College of Environment, Zhejiang University of Technology, Hangzhou 310032, China, upupwang@zjut.edu.cn*

The measure of CO_2 solubility in geological fluids is important for carbon capture and storage (CCS). A method using a fused silica capillary cell (FSCC), combined with confocal Raman spectrometer, has been developed to determine the CO_2 solubility in NaCl solutions. The micro-scale FSCC was constructed to reduce the temperature gradient and reagent consumption. Raman spectroscopy was used to verify the system reached phase equilibrium based on the fact that the intensity of Raman scattering is proportional to the molecular concentration of CO_2 under given conditions. The CO_2 solubility data were calculated from the Raman peak intensity ratio ($\upsilon_{CO_2}/\upsilon_{H_2O}$) in CO_2 saturated solutions and the equation relating Raman peak intensity ratio and CO_2 concentration in NaCl solutions. The measured CO_2 solubilities ranged from 0.3036 to 1.2790 mol·kg^{-1} in 1.0 mol·kg^{-1} NaCl solution, from 0.2528 to 1.0348 mol·kg^{-1} in 2.0 mol·kg^{-1} NaCl solution, and from 0.2126 to 0.8931 mol·kg^{-1} in 3.0 mol·kg^{-1} NaCl solution at temperatures from 30°C to 80°C and pressures from 3.0 MPa to 30.0 MPa. Our results indicate that the method is feasible and that the solubility of CO_2 in NaCl solutions decreases with increasing temperature or salinity, increases with increasing pressure. On the basis of a comparison between our experimental data and the results of the previous model, our method provides satisfactory results.