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Solubility and dissolved storage capacity of CO_2 in brine From micro visual reactor to basin sealing in Zhejiang Province

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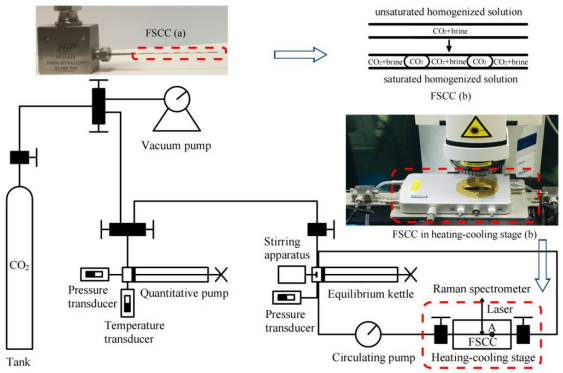
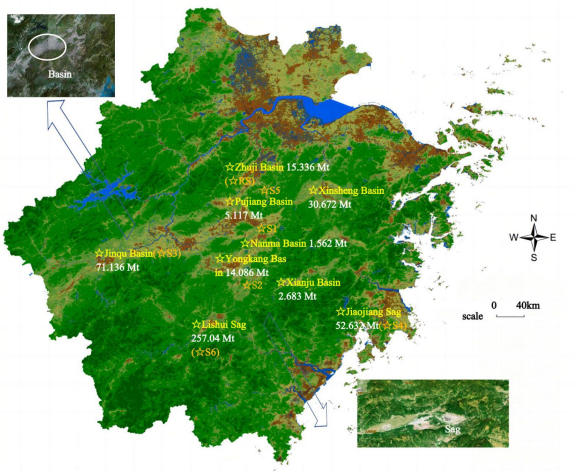
Carbon dioxide (CO_2) capture and sequestration is essential for reducing greenhouse gas emissions and requires understanding CO_2 dissolution and storage capacity in geological formations. This study measured CO_2 dissolution in deep brine from seven major basins and two sags in Zhejiang Province under various in-situ pressure and temperature conditions. We introduced a new model to simulate CO_2 dissolved storage capacity using a fused silica capillary cell (FSCC) coupled with in-situ Raman spectroscopy to study CO_2 solubility in a series of deep brine[1]. Similar studies were carried for investigating CO_2 solubility in n-dodecane at near-critical and supercritical conditions of CO_2[2]. The schematic diagram of in situ CO_2 + brine measurement system is presented in **Fig. 1**[3]. Results reveal that the hydro-chemical characteristics of deep brine were significantly different between surface water samples. Despite of similarities in the concentrations of several ions, such as Na^+ and K^+, those for Ca^{2+} and Mg^{2+} are different. In addition, The CO_2 solubilities in coastal basins (1.172 to 1.253 mol/kg) show minimal variations when compared to those in inland basins (0.8771 to 1.2279 mol/kg). CO_2 solubility in brine significantly correlates with pressure ranging from 7.38 to 28.38 MPa at depths of 800 to 2800 m. However, salinity negatively impacted CO_2 solubility. The detailed sampling sites and basin locations for the deep brine are presented in **Fig. 2.** An evaluation model for CO_2 storage capacity was proposed by means of the solubility calculation formula, indicating effective storage capacities at nine sites ranging from 1.562 to 257.04 Mt, with a total capacity of 454.264 Mt in Zhejiang Province, nearly six times the annual CO_2 emissions. This research enhances understanding of CO_2 solubility and establishes needed procedures for storage capacity evaluations.





References

[1] Pan Z. et al. (2009). Green Chemistry, 11(8):1105-1107.

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[3] Wang J . et al. (2019). Journal of Chemical & Engineering Data, 64:2484−2496.

Figure 1. Schematic diagram for in situ measurement of CO_2 solubility in brine.

Figure 2. Field sampling sites and basin locations of deep brine.