Mechanisms of the Wettability Alteration of CO_2/H_2O/Muscovite system by Increasing Pressure

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CO_2 Geological Storage (CGS) is one of the most promising technologies designed for reducing the amount of CO_2 emissions into the atmosphere. The trapping mechanisms are classified into four types; structural, residual, dissolution, and mineral trapping.

The sealing performance of the caprock is affected by wettability, which derives from the interfacial tensions related to CO_2, brine, and mineral phases. In the reservoir condition, the pressure and temperature are about 10MPa and 313K. Physical properties of CO_2 are likely to change drastically because it changes from gaseous phase to the supercritical phase. Therefore, the pressure dependence of the contact angle of CO_2/Brine/Mineral system has been investigated by a number of experimental measurements. Among them, the largest amount of experimental data has been obtained for muscovite (Iglauer et al. (2015)). Most data shows that the contact angle increases with increasing pressure. This indicates that the sealing performance is likely to decrease at the target PT conditions compared with the ambient condition. However, the mechanism of this trend has not been quantitatively revealed yet. This study calculated the effect of intermolecular forces by the augmented Young Laplace equation which is based on van der Waals forces, electrostatic forces, and hydration forces. Results shows that the increase in CO_2 density and the surface charge reversal are crucial factors for the wettability alteration.

Keywords: CO2 Geological Storage, Wettability, Contact Angle

