Experimental studies on CO_2-water-shale and CO_2-water-olivine interactions related to geological CO_2 storage

CHEN JIAWEI[12*], GUO JILONG[12] AND LI ZIJING[2]

[1]State Key Laboratory of Biogeology and Environmental Geology, Beijing 100083, China. chenjiawei@cugb.edu.cn

[2]School of Earth Sciences and Resources, China University of Geosciences, Beijing 100083, China

CO_2-water-rock interaction is of great importance to geological CO_2 storage. Many recent experimental studies were focused on the change of minerals in the rock after water-rock interaction, while the organic matter in the rock were seldom discussed. Herein, shale, a kind of cap rock, was used to study the extraction efficiency of the organic carbon by CO_2. CO_2-water-shale interaction experiments with different gas/water ratios were conducted in the autoclave under 95°C and 15MPa. The dissolved organic carbon (DOC) in the water and morphology differences of the rock surface were determined after reaction. The DOC data showed that the extraction of DOC in the CO_2 system with no or a little of water was significantly higher than that of N2 control system, reaching to more than 3 times of DOC values. In the CO_2 systems with different amount of water, the maximum extraction of DOC was got in the system with a small amount of water and the extra 87% of DOC higher than that of the system without water. This may result from the enhancement of CO_2 solvation due to adding a little of polar H_2O. The SEM figures indicated different water-rock-gas contact form could change rock surface morphology. In addition, one way slowing progression of global warming is long-term CO_2 geologic storage in deep ultrabasic rocks. CO_2-water-olivine experiments were conducted at 15MPa and 150□ over the period of 250 ~ 1000h. The clay minerals found in olivine could affect the forms of the secondary minerals. The evolution of olivine surface includes dissolution step, secondary mineral forming step and the filling of the interval space step. Un-reacted olivine surface was etched by supercritical CO_2 mixture system and appeared to be diamond-shaped pores. Previous diamond-shaped pores turning into ellipse and generated magnesite chlorite and kaolinite with time. The additional pores were gradually filled. Our experimental results are helpful to well understand water-rock interaction under geological CO_2 storage and potential environmental risk.

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