Goldschmidt 2021 Abstract
https://doi.org/10.7185/gold2021.5781

Geochemical equilibrium and reactive transport modeling of CO_2 sequestration at the Ebeity oil reservoir, Kazakhstan

NURLAN SEISENBAYEV, MIRIAM ABSALYAMOVA AND WOOJIN LEE

Nazarbayev University

Presenting Author: nurlan.seisenbayev@nu.edu.kz

Understanding the geochemical interactions among injected CO_2, rock, and brine water is one of the essential factors for the safe and proper operation of CO_2 storage in depleted oil reservoirs. The interactions can alter their original geochemical and physical environmental factors and therefore significantly affect the safety and efficiency of the sequestration process. We sampled the formation rock (sandstone) and fluid (pH 6) at an in-situ reservoir condition from an oil reservoir of Kazakhstan, Ebeity (863 - 894 m) for this research. The CO_2 injection to the depleted oil well and its storage were numerically simulated using geochemical software. PHREEQC was used to estimate the interaction among rock-water-CO_2 phases and the dissolution and precipitation of rock minerals, porosity change, and water composition alteration were investigated. 1-D radial model was developed and implemented via TOUGHREACT to investigate the fate of injected CO_2 and its influence on surrounding minerals and water over a distance, and to check potential for permanent sequestration at a constant rate of 100 kt/year for 50 and 10000 years. Albite, anorthite, k-feldspar, kaolinite, calcite, and smectite minerals were dissolved during the injection and storage, while secondary mineral such as dolomite, muscovite, ankerite, quartz, and dawsonite were precipitated. Porosity change was also estimated, i.e. ~4% of porosity decrease was observed during the carbon sequestration operation. Reactive transport modeling showed the decrease of surrounding storage pH by CO_2 injection over a radial distance and remarkable change of original minerals to secondary minerals. As 50 years passed after the injection, only ~10% of CO_2 mass was able to be dissolved at the storage site, whereas after 10,000 years, the total dissolution of CO_2 can be estimated by the simulation model. The results can provide a detailed understanding on the behaviors of injected CO_2 and variations of surrounding geochemical environments during the operation of carbon sequestration.

This study was supported by the Research Grant of Nazarbayev University (091019CRP2106 and 021220FD1051).