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# An experimental study of diopside- $CO_2$ -brine interaction

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Diopside is one of the main minerals that consist igneous rock. It is characterized by high content of divalent cations like Ca, Mg, and Fe and relatively fast dissolution rate. These features make it an expected mineral of releasing metal ions for mineral carbonation during the research of mineral trapping of $CO_2$. This study focus on the dissolution amount and micro-scale observing of diopside after the reaction with $CO_2$ and brine under 100, 150, and 200°C. Each of the three experiments are carried out with 2 pieces of diopside (10mm*10mm*4mm) and 500ml Nacl (1mol/L) for 72h, and the pressure inside is 7Mp after injecting of $CO_2$. SEM analysis of the surface of diopside before and after the experiments shows that the degree of corrosion increase with the rising of temperature. The slices of diopside lose 0.8% of its weight at the end of the experiments of 100°C, about 1.8% at 150°C, and about 3.92% at 200°C. Silicon concentrations after reaction are 14.55 mg/L (100°C), 47.02 mg/L (150°C), and 65.32 mg/L (200°C), which also prove the elevated temperature has a positive influence on dissolution of solid. Concentration of calcium and bicarbonate increase with temperature, while magnesium and iron are not. This may due to the heterogeneity of the composition in each piece of solid, or the precipitation of some compounds during the experiments. There are some amorphous compounds are found under SEM, which are mostly consisted of C, O, Na, Mg, Si, and Ca. A simple numerical simulation of $CO_2$-diopside-brine interaction is carried out by TOUGHREACT. The setting of parameters are based on the experiments. Diopside reacts with 1mol/L Nacl under the $CO_2$ partial pressure of 10Mp and the temperature keeps 100°C. The results present that the volume percent of precipitated carbonates (calcite and magnesite) reaches 1.23% after 100 years, which means 1m3 diopside could capture 16.76kg $CO_2$ after 100 years by the means of mineral carbonation. This study reveals the considerable capacity of the mineral trapping of $CO_2$ in diopside, and provide information to $CO_2$ sequestration projects. This work is supported by Key Development Plan of Science and Technology Project of Jilin Province in China (No. 20110426) and National Natural Science Foundation of China (No. 41172091).