H_2 production and CO_2 storage during peridotite serpentinization under CO_2-rich hydrothermal conditions: Influence of pyroxene

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Serpentinization of peridotite (mainly includes olivine and pyroxene) usually produces molecular H_2, which may potentially contribute to today’s always-increasing energy demands. On the other hand, peridotite also appears to be a good candidate for CO_2 sequestration by mineralization. Based on this, our previous research has successfully combined the strategies of H_2 production and CO_2 mineralization by olivine alteration in CO_2-rich hydrothermal system. However, olivine may not necessarily act as a peridotite equivalent during alteration, and the pyroxene influence is still poorly understood.
In this study, we examined the reactions in H_2O-olivine/pyroxene-CO_2 systems by performing hydrothermal experiments in 0.5 mol/L $NaHCO_3$ solutions under conditions of 300 °C and 10 MPa. The results show that H_2 was produced when olivine and/or pyroxene reacted in $NaHCO_3$ solution, and the presence of pyroxene in starting material suppressed H_2 production from per kg of mineral. Pyroxene was converted solely to serpentine, rather than brucite and magnesite even in CO_2-contained solutions, which indicates CO_2 mineralization was only realized in olivine-contained systems. In addition, the pyroxene serpentinization process is quicker than olivine. In the experiment with olivine/pyroxene weight ratio of 3/2, all of the pyroxene was altered after 72 h reaction, whereas half of the olivine particles have remained. Based on experimental results, we propose that the presence of pyroxene in starting material will suppress the H_2 production and CO_2 storage during peridotite alteration; however, the inhibition effect will be decreased along the reaction time.

Keywords: Pyroxene, Olivine, Hydrothermal, H2 production, CO2 storage

