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Effect of co-injection of acidic impurity gas and seawater on geological sequestration of CO2 in basalt

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Carbon Capture and Storage (CCS) can be realized efficiently and safely by collecting atmospheric carbon dioxide (CO2) and injecting it into basalt formations in a dissolved state by co-injection of CO2 and water. In the actual storage, the collected CO2 may also contain a variety of soluble acidic impurity gases, and co-injection of acidic impurity gases with CO2 can significantly reduce the economic cost of gas collection, but the acidic impurity gases will be reacted before CO2, and there is a possibility of inhibiting the carbonation process of the minerals. In addition, the co-injection of CO2 and water is highly efficient, but it requires high freshwater resources. For coastal areas, seawater can be used instead of freshwater to reduce the dependence on freshwater resources, but at the same time, seawater injection is also more likely to affect the process of mineral sequestration. We used transparent quartz capillary tubes to simulate the reaction process between CO2 and basalt under geological reservoir conditions, and quantitatively observed the mineral reaction process after the addition of sulfur dioxide (SO2) and sodium carbonate (Na2CO3) solutions with the help of in-situ Raman spectroscopy, so as to reveal the influence of SO2 acidic gas and carbonate solution on the sequestration process of CO2 basalt. The results show:
(1) In the system consisting of only CO2 and pure water, CO2 is dissolved into water first, and then carbonate will gradually appear on the surface of basalt particles.
(2) When SO2 is added, SO2 and CO2 are dissolved into water at the same time, but sulfate and sulfite minerals appear first on the surface of basalt particles, and carbonate rocks appear on the surface of basalt particles only after SO2 is consumed by the reaction and the process of CO2 mineral sequestration occurs.
(3) The addition of Na2CO3 significantly limits the dissolution of CO2 into the water, but does not affect the dissolution of SO2. This allows SO2 to still react with basalt, while CO2 has difficulty reacting with basalt to produce carbonate minerals. This suggests that the presence of carbonate in solution further inhibits CO2 mineralization from occurring.

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