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Simulating Remediation of CO_2 Leakage from Geological Storage Sites

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One strategy to reduce net greenhouse gas emissions is to inject carbon dioxide (CO_2) deep into subsurface formations where presumably it would be stored indefinitely. Although geologic storage formations will be carefully selected, CO_2 injected into a target formation may unexpectedly migrate upwards and ultimately seep out at the ground surface, creating a potential hazard to human beings and ecosystems. In this case, CO_2 that has leaked from the geologic storage site is considered a contaminant, and remediation strategies such as passive venting and active pumping are needed. The purpose of this study is to investigate remediation strategies for CO_2 leakage from geologic storage sites. We use the integral finite-difference code TOUGH2 to simulate the remediation of CO_2 in subsurface systems. We consider the components of water, CO_2 and air, and model flow and transport in aqueous and gas phases subject to a variety of initial and boundary conditions including passive venting and active pumping. We have investigated the time it takes for a gas plume of CO_2 to be removed from the vadose zone both by natural attenuation processes and by active extraction wells. The time for removal is parameterized in terms of a CO_2 plume half-life, defined as the time required for one-half of the CO_2 mass to be removed. Initial simulations show that barometric pressure fluctuations enhance the removal of CO_2 from the vadose zone, but that CO_2 trapped near the water table is difficult to remove by either passive or active remediation approaches.

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