STABILIZING ATMOSPHERIC CO_2 CONCENTRATIONS: CAN GEOLOGIC STORAGE HELP?

Franklin M. Orr, Jr.

Stanford University

One option for reducing emissions of CO_2 to the atmosphere as a result of combustion of fossil fuels is to capture CO_2 and inject it into porous subsurface geologic formations. High pressure CO_2 has been used for the last three decades as an agent for enhanced oil recovery, and hence considerable experience in the technical issues associated with predicting the movement of CO_2 in the subsurface has been accumulated. Significant additional quantities of CO_2 could be stored in depleted oil and gas reservoirs if CO_2 were available at low cost. These formations are appealing as storage sites because the subsurface is known to have a trap and seal that contains the buoyant oil or gas.

Large-scale geologic storage of CO_2 will require use of geologic formations other than those associated with oil and gas recovery. Deep formations that containing salt water and deep, unmineable coal beds are two options that are being considered. Such formations may or may not have a trap, but other mechanisms can immobilize the CO_2. In deep saline aquifers, trapping of a residual CO_2 phase by capillary forces happens on relatively short time scales, and dissolution of the CO_2 in the brine then takes place. Because brine containing dissolved CO_2 is more dense than brine without CO_2, the driving force for upward migration of CO_2 disappears when all the CO_2 is dissolved.

In coal beds, the storage mechanism is adsorption of CO_2 onto the surfaces of coal particles. Many coals contain adsorbed methane. Because CO_2 adsorbs more strongly than does methane, the possibility exists to replace adsorbed methane with CO_2. Recovery of methane from fractured coal beds can then offset some of the cost of storing the CO_2. Applying this approach will require managing complex flows in the fracture networks that exist in many (but not all) coal beds.

Considerable volume exists in subsurface porous systems, and hence it is likely that geologic storage can contribute significantly to reductions in CO_2 emissions. But the volumes of CO_2 associated with growing energy use are so large, that geologic storage is likely to be only one of many approaches to reducing greenhouse gas emissions.