Factors Affecting CO_2 Storage Potential in Unmineable Coal Beds

Kevin B. Jones[1] and Margo D. Corum[1]

[1] U.S. Geological Survey, 12201 Sunrise Valley Drive MS 956, Reston VA 20192, kevinjones@usgs.gov

The atmospheric CO_2 concentration has increased from about 280 ppm in pre-industrial time to more than 390 ppm today. This increase is expected to continue as energy demand continues to increase worldwide. Capture and geologic storage of CO_2 is one approach to reduce the atmospheric CO_2 concentration and its effects on global climate. The U.S. Geological Survey (USGS) is currently assessing the potential national geologic resources available for geologic CO_2 storage, as directed by the 2007 Energy Independence and Security Act (EISA, Public Law 110–140). Although the current assessment will not address potential CO_2 storage in unmineable coal beds, future assessments may. For this reason, the USGS is assembling a body of knowledge on factors affecting this storage, including aspects of coal-CO_2 interactions that are not yet well understood and are the subject of active research.

Because long-term storage of CO_2 in coal essentially precludes use of the coal as fuel, EISA specifies that only unmineable coal seams will be considered for CO_2 storage. The term “unmineable” is problematic, however, as its definition changes based on economics and technology. A consensus definition of unmineable coal is needed before its potential for CO_2 storage can be estimated.

Carbon dioxide can be stored in coal by adsorption to coal surfaces and trapping in pore spaces. Injection of CO_2 into a coal bed for storage requires permeability in the form of pores and fractures in the coal so that the CO_2 can infiltrate the bed. Several factors affect coal permeability. Adsorption of injected CO_2 gas causes coal to swell, reducing its permeability and making further injection of CO_2 more difficult. Coal permeability also decreases with depth. At pressure and temperature conditions that occur below about 1000 m depth, CO_2 is a supercritical fluid rather than a gas. Supercritical CO_2 is an organic solvent that can diffuse into and plasticize coal, reducing its permeability and porosity. Research into coal strength, sorption-induced strain, and effects on permeability and porosity is ongoing.

Many in-progress and completed field CO_2 injection tests and subsequent monitoring are allowing researchers to build on theoretical work and laboratory studies and better understand geologic and engineering factors affecting CO_2 storage in coal beds. This understanding will form the basis for a future USGS methodology for the assessment of CO_2 storage potential in unmineable coal beds.