USGS Studies Involving CO_2 Storage, Natural Resources, and Enhanced Oil Recovery in the Permian Basin

T. L. Roberts, P.D. Warwick,
C. Doolan, E.R. Slucher
U.S. Geological Survey

The Energy Independence and Security Act (EISA) of 2007 authorized the U.S. Geological Survey (USGS) to conduct a national assessment of geologic storage resources for anthropogenic carbon dioxide (CO_2). In June 2013, the USGS Carbon Sequestration Geologic Research and Assessments (CS-GRA) Project completed an evaluation of the technically accessible storage resources (TA_{SR}) for CO_2 in 36 sedimentary basins in the onshore areas and State-waters of the United States (see http://pubs.usgs.gov/circ/1386/). The TA_{SR} is based on current geologic and hydrologic knowledge of the subsurface and current engineering practices. By using a geology-based probabilistic assessment methodology, the USGS calculated a mean estimate of approximately 3,000 metric gigatons of subsurface CO_2 storage capacity that is technically accessible in onshore and State-water regions. Of this national CO_2 subsurface storage space, 59,000 metric megatons of CO_2 subsurface storage space was estimated for the Permian Basin, and is divided amongst three storage assessment units (SAUs): Lower Paleozoic Composite SAU, Lower Paleozoic Composite Deep SAU, and Permian Composite SAU. The Lower Paleozoic Composite SAUs are composed of reservoir rocks within the Ordovician Ellenburger Group, Simpson Group, and Montoya Group; the Ordovician-Silurian Fusselman Dolomite; the Silurian-Devonian Wristen Group; and the Devonian Thirtyone Formation. Reservoirs within the Wolfcampian, Leonardian, and Guadalupian Series make up the the Permian Composite SAU.

To assess the risks associated with anthropogenic CO_2 geosequestration, the USGS CS-GRA Project is conducting detailed studies

of natural CO_2 reservoirs located throughout the U.S. (those containing >10% CO_2) to determine the long-term geologic and geochemical effects of natural CO_2 storage. Such sites are considered analogues to sites that may undergo sequestration of anthropogenic CO_2. These natural-CO_2-reservoir studies include: 1) characterization of natural gas (including hydrocarbons, CO_2, and noble gases) and associated reservoir rocks by geochemical and isotopic analyses to help determine the origin (mantle, thermal carbonate alteration, or other), migration pathways, and ultimate fate of the natural CO_2; 2) characterization of associated formation water; and 3) geologic characterization of the CO_2 reservoir rocks to determine the long-term effects of natural CO_2 storage and the occurrence of CO_2 leaks from the reservoir. The USGS CS-GRA Project plans to sample CO_2-producing wells from fields located throughout the Permian Basin and natural CO_2 hot springs located within the southwestern region of the Basin as part of this national evaluation of natural CO_2 reservoirs.

In addition to conducting a national CO_2 storage resource assessment, the 2007 EISA also authorized the USGS to evaluate the national technically recoverable hydrocarbon resources resulting from CO_2 injection and storage through CO_2-enhanced oil recovery (CO_2-EOR). During the next several years, the USGS plans to develop an assessment methodology and conduct a national assessment of recoverable hydrocarbons associated with CO_2 injection, including those located within the Permian Basin. Additional oil recovery using CO_2-EOR is not a novel technology in the Permian Basin; however, the planned USGS assessment will help identify new areas where CO_2-EOR could potentially be implemented in the future.