# Geologic Risk Characterization of a Carbon Storage Complex, an Illinois Basin Example

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## Abstract

The Ordovician and Cambrian stratigraphy has some of the most important carbon sinks available for the sequestration of carbon dioxide (CO2) in the midwestern United States. Reservoirs of the same age are also used for natural gas storage and there exists a 50-year history of sustained natural gas storage that enhances our understanding of containment and economic risk. In addition, new data acquired from U.S. Department of Energy funded projects have led to a significant improvement in understanding the risks, uncertainties, and potential of Carbon Capture and Storage (CCS). These data include 2D and 3D seismic reflection data, pressure and microseismic monitoring before/during/after CO2 injection, and new deep wells penetrating the basement rocks. Both gas storage and CCS operations have containment and economic risk. Containment risk revolves around the question of whether stored gas can escape and reach shallow aquifers and/or the ground surface and be a hazard. Economic risk may include problems with injectivity, deliverability, capacity, and efficiency. The Illinois gas storage reservoirs are a case study of the importance of understanding the seal, reservoir, and structural complexity associated with tectonic history. The Illinois Basin is an excellent area to better understand this risk since Illinois has the greatest amount of natural gas storage projects in saline reservoirs in the United States. These natural gas storage projects enable us to understand best practices for dealing with incidents of subsurface storage of fluids. Newly acquired seismic reflection data have enabled us to better identify faults and avoid those that could be conduits for movement of fluids. We also found contemporaneous (growth) faults in the Cambrian that may be loci for microseismic activity. The thickness of the reservoir rock is also

adversely affected by Precambrian paleotopography with over 200 ft (60m) of relief. To date, approximately 2.3 million tonnes of CO2 have been injected into the Cambrian Mt. Simon Sandstone in the Decatur, Illinois area. Continuous monitoring of this CCS area shows that 80% of induced microseismicity occurs in the Precambrian basement. Integration of all geologic data, especially seismic data, is absolutely necessary to understand the risk for both present and future CCS projects. One needs to study the reservoir, the seal, and the underlying strata in order to fully evaluate a proposed CCS site.

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