Modeling Geomechanical Response to Commercial-Scale Carbon Storage in the Mt. Simon Storage Complex, Central Illinois

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Abstract

The development of large-scale commercial (>50 million tonnes) CO2 storage sites requires efforts in data acquisition, geologic characterization, identification of relevant contractual and regulatory requirements, subsurface modeling, risk assessments (groundwater contamination, surface deformation, induced seismicity), monitoring, and public outreach. Reservoir characterization and subsurface modeling including describing geomechanical behavior is essential for providing information necessary to determine important parameters for site development including injection strategies and managing pressure response The CarbonSAFE Illinois–Macon county Project drilled and logged a well near Mt. Auburn in central Illinois to evaluate the feasibility and suitability of the regional geologic setting for developing commercial-scale CO2 storage projects. The well penetrated the Cambrian Mt. Simon Sandstone into the Precambrian basement and data acquisition included a full suite of borehole geophysical logs and full-diameter and sidewall cores. The focus of this presentation is to address geomechanical characterization and modeling aspects of the site evaluation process for potentially large-scale CO2 injection and storage greater than 50 million tonnes. Borehole geophysical logs from the CarbonSAFE well were interpreted and analyzed to estimate fracture distribution, elastic properties, stress states, and facilitate development of 1-D and 3-D geomechanical models across the area of interest. These data were further supplemented by extensive downhole information from the nearby Illinois Basin – Decatur Project (IBDP) that is situated about

25 miles northeast and uses the Mt. Simon Sandstone as storage unit. To optimize injectivity and manage reservoir pressure while simultaneously managing in situ stress conditions, site characterization outcomes (static 3-D reservoir models) were used as input into reservoir simulations that explored injection strategies by performing sensitivity on number of wells and perforation interval. Coupled reservoir-geomechanics simulations were also performed to evaluate the geomechanical response of the storage system to pressure responses resulting from these injection strategies targeting storage of over 50 million tonnes of CO2.

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