

Integrated Development of Geologic Models and Field Test Results in Sequestration/EOR Pilots in the Illinois Basin

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Within the Illinois Basin, most of the oilfields are mature and have been extensively water-flooded. In order to maximize oil production from these fields, new recovery techniques need to be researched and applied. The Midwest Geologic Sequestration Consortium is performing two pilot tests examining the potential of Illinois oil reservoirs for CO₂ sequestration and EOR. The pilots will consist of an immiscible CO₂ flood and a miscible CO₂ pattern injection. After conducting an exhaustive search for site candidates, Sugar Creek Field in western Kentucky was chosen for the former and Mumford Hills in southern Indiana was chosen for the latter.

In order to prepare for the injection pilots, a detailed study of the geology of each site was conducted. The objective of these studies was to produce an experience-based, three-dimensional model of the reservoir architecture to be used for flow simulation models.

The geologic model development process combined traditional methods along with geostatistical methods. As a first step, electric log cross sections, isopach, and structure maps were created. One of the major challenges encountered in the course of the geologic assessment was that available permeability and porosity core data proved insufficient for modeling requirements while the more abundant log suites did not include porosity logs. As a solution, the spontaneous potential data were utilized by first normalizing all the logs and then determining a transform that would relate the normalized SP log values to core permeability and porosity values. Once an appropriate transform was created, the reservoir was characterized using geostatistics based on the synthetic log data. The geostatistical results were used to constrain a simulator employing the turning bands method to produce multiple, conditional realizations. The mean of the realizations was considered the most probable model and selected for injection simulation.

In addition to presenting the modeling process, specific aspects of the geologic models that are expected to affect pilot performance, e.g., the presence of a weak bottom drive aquifer, are discussed. Early injection, production and monitoring results of the pilots are presented in the context of the geologic models.