Estimation of the Sealing Properties of MTU-site (Michigan) for Geological Carbon Storage

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Abstract. Carbon Capture and Sequestration (CCS) is a feasible approach for the reduction of concentrations of carbon dioxide (CO_2) in the atmosphere. Depleted oil reservoirs, natural gas reservoirs, deep saline aquifers, and un-mineable coal seams are possible candidates for long-term CO_2 storage. The geological formation must be permeable enough to accept large amounts of injected CO_2, and must be overlain by a low permeability caprock to keep CO_2 from migrating upward. Supercritical CO_2 is less dense and less viscous than the existing brine of the aquifer, favoring gravity override, as well as possible viscous fingering. If the injected CO_2 finds a potential pathway that leads back to the surface, it may affect adversely shallow groundwater resource or even land surface. Characterization of the caprock is a decisive element for the effectiveness and safety of CCS systems. Unfortunately, unlike petroleum reservoirs, saline aquifers have never contained oil or gas; therefore they are less characterized than petroleum fields. In this study we assess the sealing properties of the caprock overlying the Gray Niagaran formation at the MTU-site (Michigan) for geological carbon storage. Seismic surveys will be used to define lithological facies of this real site. This information will be used to generate stochastically different distributions of facies over the caprock of the reservoir where no information is available. Two types of facies will be generated: 1) confining formation and 2) inclusions. The inclusions will represent randomly distributed zones of high permeability in the caprock where CO_2 could leak to overlying formations. These fields of generated facies will be used as an input for the multiphase flow simulations. A semi-analytical solution will be used to simulate the injection of CO_2. To accomplish this, a categorical indicator kriging technique will be used. In some relevant stochastic simulation scenarios, the influence of simplifying assumptions behind semi-analytical models will be analyzed through the use of a reservoir simulator: ECLIPSE (a commercial numerical multi-phase flow model based on a 3D finite-difference discretization and widely used in the gas and oil industry).

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