Graduate Seminar

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Miscible mass transfer mechanism in porous media

Abstract:

Carbon dioxide (CO_2) is the primary greenhouse gas emitted through human activities, which is considered responsible for global warming and climate change. The main *sources* of CO_2 emissions include sectors, such as electricity (38%), transportation (31%), and other industrial activities (14%)[1]. As a potential *sink*, CO_2 is captured from the atmosphere and stored in a subsurface saline aquifer or injected into a oil reservoir so that CO_2 can be trapped after the oil has been recovered. This latter option is more useful because the miscibility of CO_2 with the residual oil in a reservoir enhances its mobility, and adds a substantial economic benefit since about 370 billion barrels of the residual oil in various oil reservoirs in United States cannot be recovered otherwise with primary and secondary techniques.

Such a subsurface migration of CO_2 is often studied through observations and models of miscible mass transfer in porous media. For example, in the Utsira Sand at Sleipner, offshore Norway, the flow of the stored CO_2 is being monitored, where a marked increase in CO_2 flux arriving at the reservoir top was observed although the rate of CO_2 input was approximately uniform. However, state-of-the-art computer models of fluid flow in porous media failed to explain this observed miscible mass transfer mechanism. Some researchers suggested that pathway transmissivities may be increasing in time, which was not resolved with contemporary computer models.

In order to study miscible mass transfer in porous media, my research group employs multiresolution approximation techniques, multilevel solvers, and statistical mechanical theory. In this brief talk, I plan to introduce the scientific challenges associated with the subsurface flow of CO_2, along with some of the basic modelling and simulation techniques on miscible mass transfer mechanism in porous media. Some numerical simulation results with idealized simulations may be presented.

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[1]Based on estimates from the Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2011.