Dynamic Modeling Aspects of Carbon Dioxide Sequestration

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Geological storage of carbon dioxide, generally referred to as geo-sequestration, is considered to have the potential to be a major contributor to the reduction of greenhouse gas emission to the atmosphere. Possible sinks for carbon dioxide, a major greenhouse gas, are depleted petroleum reservoirs, deep saline aquifers, and coal-beds. In such a sequestration project, obviously preliminary site selection, through geological characterization, followed by detailed dynamic modelling are essential first steps in the workflow. Once a geological site is regarded as a candidate based on its size and containment potential, the dynamic modelling is used to estimate several important issues, such as injectivity, migration path, time-scale of the process, storage capacity, and structure integrity.

This work attempts to illustrate these concepts and workflow of sequestration using an ongoing carbon dioxide storage demonstration project in Australia as an example. The project plans to inject a significant amount of CO_2 into a depleted gas field. The bulk average permeability, the initial gas water contact and the aquifer strength are determined with a high degree of confidence through a methodical process of matching the production history. The dynamic modeling is then used to predict various scenarios and aspects of CO_2 injection, including injectivity, storage capacity, CO_2 plume shape and development, and the breakthrough time at an observation well. These predictions are highly relevant in helping to make quality decisions in the execution of the project.

The concept of CO_2 injection in saline aquifers and coal-beds is also briefly discussed and compared with the injection in depleted petroleum reservoirs.