Using Stratigraphic Heterogeneity to Maximize the Efficiency of CO_2 Geological Storage

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Geological storage of carbon dioxide (CO_2) is influenced by many variables. Stratigraphic architecture and reservoir heterogeneity primarily affect the migration pathway of CO_2. An understanding of these aspects can assist with devising an injection strategy to maximise the efficiency of CO_2 geological storage. A conceptual example is presented from the Kingfish Field area in the offshore Gippsland Basin, southeastern Australia.

The potential injection targets are the interbedded sandstones, siltstones and shales of the Paleocene-Eocene upper Latrobe Group, regionally sealed by the Lakes Entrance Formation. The sequence stratigraphy suggests that there are several packages of sand separated by locally effective but regionally non-extensive intraformational seals. Seal capacity analyses indicate that the intraformational seals can retain an average CO_2 column height of around 500m. Thus, the interbedded siltstones and shales will behave as flow baffles and barriers that will hinder or slow vertical migration, encouraging the CO_2 to migrate laterally, and create localised traps throughout the stratigraphy, which reduces the reliance on the top seal.

Numerical simulations demonstrate how these baffles reduce the effective vertical permeability and create a more tortuous path, effectively increasing the length of the CO_2 migration pathway. This increases the volume of pore space moved through by the CO_2, resulting in greater residual gas trapping and dissolution along the migration pathway, and allowing more time for geochemical reactions to take place. These effects all increase the potential CO_2 storage capacity and containment security, and should be considered when devising injection scenarios to optimise the geological CO_2 storage process.