Depositional Environments and Seal Capacity of Fine-Grained Sediments for CO_2 Geological Storage

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The successful geological storage of carbon dioxide is dependent on many variables. One of the critical parameters for CO_2 storage is the capacity of the fine-grained sealing sediments to confine CO_2 in potential reservoir units and to baffle and slow its migration. The depositional environments of these fine-grained sediments can be a key factor in understanding the likely distribution and retention capacity of sealing units.

Seal studies of potential CO_2 storage sites from around Australia reveal that clastic lithologies with significant retention capacities vary from claystones to very fine-grained sandstones. These are usually deposited in outer shelf to marginal marine to fluvio-lacustrine depositional environments. This environmental transition also tends to reflect seals of decreasing areal extent.

Top seal depositional environments which have significant CO_2 seal capacity are mostly low energy marine in origin and vary on a regional basis from outer shelf to marginal marine; including muddy marine sediments from large deltaic systems. Lower seal capacities tend to be attributable to mixed facies, where sand-sized material becomes dominant over muddy matrix. CO_2 column heights from four potential storage sites analysed varied from 17-1300m (average 535m).

Intraformational seals are limited in thickness and areal extent, due to being deposited in such environments as overbanks. However, they can occasionally have higher seal capacities than top seals. CO_2 column heights from four potential storage sites analysed varied from 4-1630m (average 509m). Low energy fluvio-lacustrine depositional environments tend to form thin compact layers of clay, leading to these high seal capacity values.