Risk Assessment of Long-Term Containment of CO_2 in Geological Storage Projects

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The main area of perceived risk for carbon dioxide (CO_2) capture and geological storage projects is storage; and the key risk relates to long-term containment of the stored CO_2. Risk is the product of the likelihood and impact of risk events, both of which are uncertain and change over time.

For CO_2 storage, the risk of leakage depends not only on the likelihood of existence of potential leakage pathways (such as wells, faults, permeable zones in the seal etc), but also the likelihood that these potential pathways will intersect CO_2 whilst it is in mobile phase, and finally the likelihood that the potential leakage pathway will leak. As many containment risk assessments are benchmarked against an impact of 1% leakage over 1000 years, the frequency, duration and volume of potential leakage events are assessed for this time frame.

Likelihood of existence of potential leakage pathways varies from well-known (ie wells), inferred (ie faults), to less well-known (ie permeable zones in the seal); the last two depend on the quantity and quality of geological and geophysical data. The likelihood of intersection of potential pathways with mobile CO_2 is predicted from geological, fluid flow and pressure modelling, using available data. The likelihood of the potential leakage pathways actually leaking CO_2 requires the temporal and spatial integration of this information. The loss of containment impact requires evidence from both man-made and natural analogs supporting assumptions for the frequency, duration and volume of leakage. Australian examples are used to illustrate this risk assessment approach.