

Evaluating and quantifying the potential for CO₂ leakage through the caprock during carbon sequestration using a Risk Matrix



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MUSTANG EC FP7, Collaborative Large Scale Integrating Project



The long term dependability of CO₂ sequestration is directly linked to the integrity of the caprock seals effectively trapping the CO₂. A **Risk Matrix** provides an evaluation of the possible CO₂ leakage risks through the caprock by quantifying the probability and severity of any CO₂ leakage throughout the carbon sequestration timescale. This provides a methodology to assess storage site quality. The risks were quantified by assigning a **severity** and **probability** to each identified risk.

Severity was ranked from 1 to 5; where:

- 1 - Intrusion of CO₂ into the first mm of the caprock.
- 2 - Intrusion of CO₂ into the first 10 cm of the caprock.
- 3 - Intrusion of CO₂ into the first meters of the caprock.
- 4 - Intrusion of CO₂ into the first tens of meters of the caprock.
- 5 - Intrusion of CO₂ above the top caprock.

Probability was also ranked from 1 to 5; where:

- 1 - Likelihood of CO₂ leakage after 10000 years.
- 2 - Likelihood of CO₂ leakage after 1000 years.
- 3 - Likelihood of CO₂ leakage after 100 years.
- 4 - Likelihood of CO₂ leakage after 10 years.
- 5 - Likelihood of CO₂ leakage during injection.

Methodology

A questionnaire was sent out to the MUSTANG partners asking for:

- Best guess value of severity and probability for each leakage risk.
- Maximum value for each leakage risk severity and probability.
- Minimum value for each leakage risk severity and probability.
- Personal expert level on each leakage risk factor.
- The more expert input the more reliable the CO₂ Leakage Risk Matrix.
- Currently there is only input from 3 experts and the Risk Matrix is **still under development**
- The data will facilitate a study of expert level on risk perception.

If you would like to receive the CO₂ leakage risk assessment questionnaire and contribute to the CO₂ leakage risk database, please e-mail: kedlmann@staffmail.ed.ac.uk.

This study aims to identify the CO₂ leakage risks during carbon sequestration using a Risk Matrix. The leakage risks are identified and the impact of each risk evaluated and quantified. What factors will cause CO₂ leakage? how will it leak? how much will it leak? and how far will it leak?

The risks were assessed for all factors that may lead to CO₂ leakage through the caprock including those associated with the rock properties and well environment and those associated with the reservoir and CO₂ fluid properties:

- **Migration through fracture and microfracture** network existing and induced, **caprock matrix permeability**, **geological discontinuities** and the **wellbore / drilling environment**.
- **CO₂ diffusion / aquifer flow, scCO₂ flow properties, capillary transport, effective and relative permeability** of the scCO₂ / brine / pore system and **mineral precipitation / dissolution**.

