Unconventional hydrocarbons exploration:

Release of hydraulic fracturing/flowback or formation fluids from the shale production zone

SECURe employed the Bow Tie risk assessment approach, which identifies a series of barriers that prevent a principal hazard ("top event") from occurring. This factsheet outlines recommendations, which address a single top event that can occur if control of a hazard is lost: release of hydraulic fracturing/ flowback or formation fluids from the shale production zone . It should be read in conjunction with the Participatory Monitoring Factsheet, which provides overall guidance on project construction.

The issue

Although considered to be of lower risk than release via wells, the potential release of hydraulic fracturing, flowback or formation fluids from the hydrocarbon reservoir must be fully assessed. Such releases could result in emissions and/or impacts to ecosystems and people, including other subsurface users. Potential release mechanisms have been identified via existing or legacy wells, capillary leakage through the primary seal, or via fracture and fault networks or via lateral migration during or after hydraulic fracturing. Faults may be reactivated and new fractures induced from stresses during injection or natural seismicity.

A range of site engineering, operational strategies, corrective actions, monitoring site selection and operational strategies, and monitoring provide effective barriers to prevent releases. If release were to occur, then remediation options include monitoring, operational responses, well engineering interventions, and the use of natural geological properties to slow the release. These barriers, and preventive and remedial actions, are discussed in detail in SECURe report BGS-01-R-11.

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For more information about the project, contact info@securegeoenergy.eu

Risk mitigation recommendations

Monitoring approach

- **Thresholds should be set** for hydrochemical parameters, which could indicate contamination in the future (D3.6). Thresholds should be calculated using environmental baseline data to establish concentrations of parameters that would indicate excessive natural temporal variation.
- **Hydrochemical parameters to be used as indicators of contamination should be selected** based on the mineralogy of the aquifer, the characteristics of the potential contaminant (for example, hydraulic fracture fluid release), and the nature of any likely reaction between the two (for example, decreased pH) (D3.6).
- The sampling network for environmental baseline monitoring, ongoing monitoring throughout operation and post-operation monitoring should ensure that **sampling is undertaken in all major hydrogeological units at suitable depths** (D3.6). Existing relevant boreholes should be utilised and bespoke boreholes drilled, where necessary.
- Monitoring is required from baseline characterisation to operational and post-operational monitoring, to be able to detect any contamination events (D3.6).

Use of models

- A **multi-disciplinary approach to assessing fault leakage rates should be taken.** This requires suitable field and laboratory investigations (e.g. analogue studies using outcrop and core) and upscaled hydromechanical modelling (D2.6).
- Acquisition of extended data (including geochemical, temperature and pressure conditions) from dedicated monitoring wells and their subsequent usage will allow history match and validation of the simulation model (D2.6).
- Geomechanical models should be calibrated using detailed data of geomechanical rock properties of the structure and its surroundings (D2.6).
- Reliable datasets (e.g. seismic and wireline-logging datasets) of sufficient quality and quantity should contribute to fault-sealing models (D2.6).
- Fault juxtaposition results should be calibrated **by other data and methods**, since results solely from juxtaposition plots may lead to misinterpretation (D2.6).
- **The Shale Gouge Ratio (SGR) is an indicator of fault-sealing potential**, but, for reliable outcomes, calibration of accurate thresholds using available geological information is needed; application to rock types other than sedimentary clastic rocks can be unreliable (D2.6).

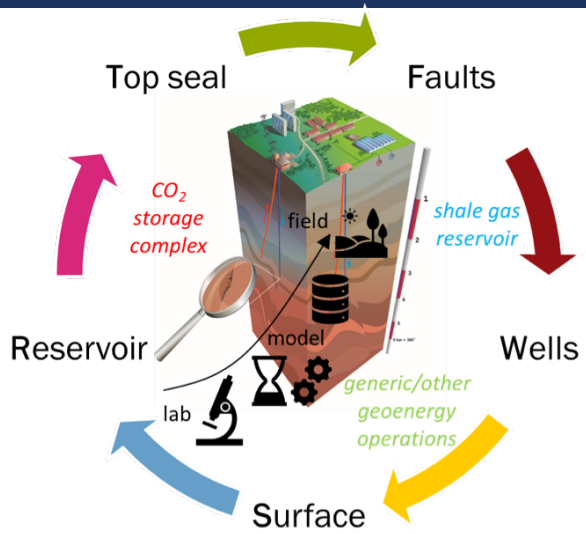

Figure 1: Application domains (CO_2 storage complex, shale gas reservoir and generic/other geo-energy operations), topics or impact areas/risk receptor (R-Reservoir, T-Top seal, F-Faults, W-Wells, S-Surface), and tools or methods (lab experiments, modelling, field cases - as indicated by symbols and text in figure) for research within WP2 of the SECURe project (from D2.6).