

Subsurface Pressures for Injection of Fluids and Gases (G504)



Tutor(s)

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Overview

This course covers all aspects of subsurface pressures with particular emphasis on pre-drill estimates and the conditions for injection and storage of fluids and gas, including hydrogen and CO₂. Methods for estimating pressures from rock and fluid properties will be reviewed, as well as the processes that determine them in the subsurface prior to drilling. The impact of rock strength relative to fluid pressure at depth will also be discussed, in relation to injection rate limitations and storage volumes.

Duration and Logistics

Classroom version: A 3-day course comprising a mix of lectures, case studies and exercises. The manual will be provided in digital format and participants will be required to bring a laptop or tablet computer to follow the lectures and exercises.

Virtual version: Five 3.5-hour interactive online sessions presented over 5 days. A digital manual and exercise materials will be distributed to before the course. Some reading and are to be completed by participants off-line.

Level and Audience

Advanced. Intended for geoscientists and engineers who are involved in drilling into reservoirs for the purpose of injecting, storing and producing fluid. Some knowledge of subsurface geology and the basics of drilling wells would be an advantage.

Objectives

You will learn to:

1. Understand how subsurface pressures determine safe injection, storage and production from deep reservoirs.
2. Appreciate the processes that govern safe drilling, with particular emphasis on pore fluid and fracture pressures.
3. Describe how to analyze subsurface pressure data and calibrate to estimate pore pressures from a variety of drilling and logging data.
4. Relate regional and local rock stress magnitudes to failure of seals.
5. Evaluate how to assess volumes that can be safely sequestered in underground storage.
6. Interpret typical pressure profiles, in terms of subsurface fluid processes, such as lateral drainage (open aquifers) and lateral transfer (enhanced pressures and a drilling surprise).
7. Perform basic pressure prediction calculations and estimate storage volumes.
8. Review and critique relevant case study material.

Course Content

Session 1

- Introduction
- Components of evaluation for drilling, injection and storage of fluids
- Pressure plots: exercises
- Typical pressure profiles and their relationship to reservoir/storage and overburden
- Generating an overburden (Sv) curve: exercise

Session 2

- Overpressure generating mechanisms and recognition using velocity-density plots
- Basics of pore pressure prediction: exercise
- Relationship between shale and reservoir pressures

Session 3

- Fluid pressure compartments and rock seals
- Membrane leakage – relationship between fluid and rock properties
- Fracture pressure and its prediction
- Hydraulic seal failure and assessing seal breach risk: exercise
- Determination of volumes and safe storage below failure pressure

Session 4

- Open aquifers vs closed traps for underground storage
- Depleted reservoirs – advantages and disadvantages
- Hydrodynamics in open aquifers and influence on storage: exercise

Session 5

- Case studies
 - Drilling
 - Injection
 - Storage
 - Production and associated depletion