Structural Geology: Key Concepts for Resource Distribution and Prediction (G555)

Tutor(s)

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Overview

Of central importance to all energy transition exploration and exploitation (geothermal, critical minerals, CCS, Radwaste, or hydrocarbon exploration) is an understanding of the subsurface in 3-D dimensions and how this geometry impacts the temporal and spatial delivery and retention of fluid. Two fundamental challenges exist: 1) datasets used in resource scale modelling require the application of conceptual models to aid the interpolation of often spatially limited or low-resolution data; 2) placing the resource scale concepts into a wider context to understand timing and controls on fluid delivery / retention. Addressing these challenges is the focus of this course, and being aware of the associated uncertainties is essential for resource exploration, appraisal and risking.

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 3 days. Digital course notes and exercise materials will be distributed to participants before the course. Some exercises may be completed by participants off-line.

Level and Audience

Fundamental. The course is largely aimed at geoscientists who are working on subsurface projects where a wide-ranging understanding of structural geology concepts is required. The course content is targeted at those with a broad geoscience background but can be tailored for specific backgrounds and interests. The course can also be adapted for those with no or limited geological background who require the key concepts to be covered.

Objectives

You will learn to:

1. Understand the fundamental importance of structural geology in modelling the subsurface within the context of the energy transition.
2. Appreciate the concept of structural styles and why it is essential to aid the interpretation of subsurface and outcrop data.
3. Assess input data required for resource modelling and appreciate its limitations.
4. Apply relevant and appropriate models to areas of limited data or zones of complexity and capture the implications of the inherent uncertainty.
5. Apply relevant techniques and understanding to enhance resource prediction in extensional,

compressional and multi-phase settings, including salt.

6. Appreciate the importance of developing a structural robust understanding for any energy transition resource model.

Course Content

Course Details

The workshop will be practically based, supplemented by a number of group thought experiments. It will cover an introduction to the fundamentals of structural geology and its impact on resource distribution and prediction. It will then outline, with examples, the essential geometric components expected in normal faults / rift basins, reverse faults / contractional environments, inversion / multi-phase settings, and salt and strike-slip influenced systems. Case studies from across the energy transition will be used to illustrate the application of the concepts. Examples will include geothermal, critical minerals, conventional hydrocarbons, CCS, hydrogen storage and radwaste. The course is appropriate for geoscientists either within these specific industries or who are interested in developing skills and knowledge that are transferable across the themes setting them up for the future.

Case studies from across the energy transition will be used to illustrate the application of the concepts – examples are highlighted in the course summary but can be tailored to participants' requirements.

1. Review of key components of structural geology, including the importance of differentiating syn and post kinematic systems, stress and strain, and critically stressed faults
2. Fault zone architecture and influence on retarding or inducing fluid migration; issues of scale and data representation
3. Extensional systems – from normal fault geometry to rift basin and lithospheric extension
4. Compressional systems – the challenges of reverse faults and how they interact to form larger scale contractional systems
5. The importance of understanding multi-phase deformation
6. Unravelling the complexity of strike-slip deformation
7. Role of salt across the energy transition