TETRA TECH RPS ENERGY | TRAINING

N923: Modelling of Reservoir Structure & Fractures - Applications to CCS, Gas Storage, Geothermal, Oil & Gas *(Somerset, UK)*

Instructor(s): Tim Wynn and Ed Stephens

Format and Duration
Field - 5 Days

Summary

This course provides a practical, integrated approach to characterising, classifying, analysing and modelling natural fractures. It uses lectures, modelling software and field examples to deliver an understanding of: fault and fracture system origins including geomechanics; the building and use of simple conceptual and more complex finite difference models; and the impact of fractures on well and reservoir productivity and recovery. The course combines field sessions in Somerset looking at world-class fault and joint systems along with classroom sessions assessing case studies relevant to CCS, Gas Storage, Geothermal and Oil & Gas, applications. Where applicable, these case studies contain different host lithologies and structures that require participants to perform data analysis, fracture model design and creation of a modelling plan.

Learning Outcomes

Participants will learn to:

1. Identify the material properties, stress states and fluid pressure conditions required to create tensile fractures and faults in various lithologies.
2. Assess the key parameters associated with fault and fracture systems that control stored volumes and flow behaviour.
3. Evaluate the benefits and issues with different types of static and dynamic data and analysis derived from fractured rocks.
4. Learn the basic physical processes that govern multiphase fluid flow in fractured systems.
5. Examine the fundamental interactions of fluids and stresses with existing faults and fractures during production or injection operations.
6. Define multiple reservoir concepts, reservoir modelling strategies (e.g. full field vs sector) and implement them as static models using standard O&G industry tools plus introduction to some specialised tools e.g. DFNs.
7. Learn how to setup and run dynamic finite difference fractured reservoir models with single porosity, dual porosity or dual permeability modes.
8. Explore the ways in which fractured reservoirs can be developed including key mitigation strategies for issues such as fracture connectivity or early water breakthrough.

Training Method

This course is a combination of

- classroom sessions comprising lectures, worked examples, hands-on exercises, and discussion
- visits to coastal field locations that provide illustration of fractures and opportunities for further exercises

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Physical Demand

This course has a LOW physical demand. The majority of sections consist of walks no more than 4 km along beach sections, which can be a little uneven in places.

Who Should Attend

This course is aimed at subsurface professionals working in Oil & Gas, CCS, Gas Storage and Geothermal to provide a basis for understanding and modelling fault and fracture systems and their influence on fluid flow in reservoirs and caprock systems.

Course Content

Fault systems exposed on the North Somerset foreshores deform Triassic to Lower Jurassic stratigraphy and are located on the southern margin of the Mesozoic to Tertiary, E-W and NW-SE trending East Bristol Channel and Central Somerset Basins. Excellent 3D examples of extensional fault systems are exposed in the cliffs and on the foreshore at Kilve and Lilstock in North Somerset. Extensional faults range from a few metres to several hundred metres in strike-lengths and occur in dark coloured shales and interbedded limestones. Extensional and inverted fault systems are also exposed in the cliffs and on the foreshore at Watchet in North Somerset. Inverted Upper Jurassic extensional faults juxtapose grey Lower Jurassic (Lower Lias) shales and interbedded limestones against red Upper Triassic Mercia mudstones.

Itinerary

Day 0

- Arrival and transfer to the Combe House Hotel.

Day 1

- Safety briefing, basic mechanics of fault and fracture formation and reactivation, fault and joint system habitats, fracture concept generation.
- Watchet fault systems, assessment of fault characteristics in shale systems, evaluation of mudrocks plus associated veins and possible fluid migration pathways.

Day 2

- Data gathering and interpretation in fractured reservoirs, fracture system parameters (poroperms,

connectivity).
- East Kilve cliffs and foreshore for faults and joint systems, assess faults in 3D and their interactions with bed delimited joints, revisit fracture concepts and modelling strategies.

Day 3

- Static model building approaches, simple static model build workflows. Dynamic model building approaches, dynamic model types single and dual porosity, dual permeability.
- West Kilve foreshore, open joint systems and minor folds, measurements of joints in 1D, 2D and 3D and associated issues.

Day 4

- Case studies of fracture analysis, modelling and development planning for CCUS, Oil & Gas and Geothermal.
- Lilstock joint pavements with minor faults. Assessment of large-scale joint patterns, relationships to faults vs bedding, usefulness of field analogues, possible geothermal briefing in evening at final meal.

Day 5

- Travel to Cheddar Gorge, review Carboniferous fractured limestones, discussion of the Mendips geothermal play and how it could be developed.
- Depart from the Field.