TETRA TECH RPS ENERGY | TRAINING

N445: The Subsurface Applications of Geomechanics

Instructor(s): Tim Wynn

Format and Duration
Classroom - 3 Days

Summary

This course will firstly introduce geomechanics concepts and processes to provide a level playing field including a description of how to measure in-situ stresses and rock mechanic properties. The key focus of the course will then be on how this geomechanics knowledge can be applied to improve the integrated understanding and management of reservoirs. Most emphasis will be given to the role of geomechanics in reservoir modelling and production/injection operations and how these processes relate to field exploration, appraisal and development. A brief overview is provided on geomechanics for wells and desigining completions and stimulations.

Learning Outcomes

Participants will learn to:

1. Build an understanding of geomechanical concepts and relationships.
2. Evaluate methods of measuring stress states in the subsurface.
3. Appraise which geomechanical issues can affect reservoir behaviour.
4. Analyse changes in rock properties from burial, uplift, pore pressure and deformation.
5. Integrate geological, geophysical and engineering data types as part of a system of geomechanical processes.
6. Charcterise different faults and fractures and their relationship to stress states.
7. Assess a range of 3D reservoir geomechanical models and how they can be used in evaluating geomechanical influence on reservoir behaviour.
8. Integrate geomechanical influences into reservoir management workflows and processes.

Training Method

A classroom course with lectures, worked examples, exercises and discussion.

Who Should Attend

This course is designed for geophysicists, geologists, petrophysicists petroleum engineers, reservoir engineers, drilling engineers and production engineers who require an understanding of geomechanical processes to optimise their subsurface analysis.

Course Content

Reservoir geomechanics (or rock mechanics) can mean many things to many people and these different perceptions can lead to gaps in knowledge and misunderstanding between different disciplines. Accurate geomechanical models are being proven to have an impact throughout the value chain incluidng exploration, injection and in EOR processes. The course will focus on using the key principles to imporove reservoir management and reservoir modelling.

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Theory

- Stress-Strain relationships
- Material Properties
- Mohr circles
- Intact rock failure vs discontinuity reactivation
- Structural geology – natural geomechanics
- Elasticity theory
- Rock physics (acoustic wave propagation)
- Wellbore stress system

Measurement

- Stress tensor
- Pore pressure
- Elastic moduli (from well data and seismic)
- Rock strength (compressive and tensile)
- Friction angle
- Biot factor

Drilling and Productivity

- Wellbore stresses and wellbore stability models (e.g. Mohr Coulomb, Modified Lade)
- Wellbore design examples (anisotropic failure, open natural fractures)
- Sand production prediction (empirical and numerical)
- Introduction to hydraulic fracture design (2D and pseudo 3D models, proppant schedules)

Reservoir Performance

- 3D reservoir geomechanical model construction (well data, seismic inversion data)
- 3D Wellbore stability (trajectory screening & optimization)
- Production effects (compaction, subsidence, fault reactivation, poroelasticity)
- Injection effects and trap integrity (caprock tensile failure, fault reactivation, poroelasticity)
- Naturally fractured reservoirs (fracture compressibility, permeability changes)