Fundamentals of Petroleum Geomechanics

Table of Contents:

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Introduction:

This course covers the necessary fundamentals of Geomechanics for wellbore applications; the origin of stresses in the subsurface and how in situ stresses can be understood from wellbore data; mechanical properties such as rock strength, and the origins of pore pressure and how it is measured and estimated.

The course then proceeds to show how these data are applied through the Mechanical Earth Model to critical problems in exploration and field development. There are detailed case studies on wellbore stability sand production and hydraulic fracturing. The course also includes an introduction to reservoir Geomechanics, showing the geomechanical influence of pressure changes in the reservoir.

Objectives:

By the end of this BTS training course, participants will be able to:

- Use routinely collected and specialized data to make basic geomechanical calculations for wellbore stability, sand production and hydraulic fracturing
- Select and design data acquisition for geomechanical studies
- Interpret image data to identify basic geomechanical behavior

Who should attend?

Drilling Engineers, Senior Drilling Engineers, Drilling Supervisors, Work over Engineers, Petroleum Engineers, Completion Engineers, Tool Pushers, Reservoir and Senior Reservoir Engineers, Geologists, Production Engineers, Well site Engineers, Foremen, and Industry Personnel

Course Outline:

Fundamentals and experimental rock mechanics:

- The stress tensor
- Principal stresses
- Strain, resolving stresses on a plane
- Construct Mohr's Circle and analyse stress
- Elasticity and elastic properties, effective stress, internal friction
- Cohesion, modes of rock deformation
- Unconfined compressive strength
- Mohr-Coulomb failure
- Experimental rock mechanics
- Uniaxial and triaxial testing
- Thick wall cylinder tests

- Scratch testing, true triaxial tests
- Tensile tests, analyze results

Stress, Pore pressure and the Mechanical Earth Model:

- Principal earth stresses, regional and local stresses
- World stress map
- Andersonian classification of faults
- Overburden stress
- Horizontal stress orientation
- Borehole breakouts
- Drilling-induced tensile fractures, image logs
- Horizontal stress magnitudes
- Leak-off tests, fracture gradients
- Origins of pore pressure, methods for measurement
- Methods for estimation, vertical and horizontal methods
- Eaton’s method, real-time approach
- Concept and construction of the mechanical earth model
- Data requirements and types of input data
- Wellbore Geomechanics and Wellbore Stability
- Wellbore Geomechanics

- State of stress in the wellbore
- Modes of rock deformation in the wellbore
- The effect of well azimuth and inclination, simple calculations
- Wellbore deformation in fractured rock masses and non-classical rock failures

Applications:

- An introduction to planning for wellbore stability and real time operations
- Sand production and management
- Causes of sand failure
- Experimental evidence
- An introduction to screen less completion design for sand prevention
- Hydraulic fracturing
- Process of hydraulic fracturing
- Geotechnical factors effecting fracture development and simple calculations
- Reservoir behavior
- An introduction to compaction and subsidence
- Well integrity
- Use of 4D seismic in Geomechanics and the effects of injection
- Pressure maintenance
- Waste disposal and gas storage