PetroSkills

Applied Rock Mechanics - ARM

COURSE

About the Course

Understanding the stress, strain, and failure mechanics of rocks and their response to earth stresses can lead to enormous economic benefits in all phases of petroleum reservoir development. Over the last ten years, rock mechanics has emerged as a critical technology capable of lowering financial risk in drilling and well completions, qualifying exploration and development opportunities, and improving hydrocarbon productivity. Rock mechanics is a vital decision-making tool for high-angle and horizontal drilling, unconventional reservoirs, deepwater drilling, massive hydraulic fracturing, and completing poorly cemented formations. Borehole instability, casing shear, subsidence, stuck pipe, and sand control issues cost the petroleum industry many billions of dollars annually. New theory and experimental methods as well as straightforward computer modeling techniques have provided insight into developing prospects in complex geological basins and harsh drilling environments. In Applied Rock Mechanics, students are provided with basic theory, laboratory demonstrations, hands-on exercises, and computer modeling demonstrations. In addition to a comprehensive manual, software is provided for the student to perform wellbore stability calculations. The practical application of rock mechanics is emphasized. Applied Rock Mechanics is designed to familiarize engineers and geoscientists with the necessary tools for immediate field application.

"The entire course was great." - Geologist II, United States

"I liked learning about failure/breakdown computation and fundamentals of stress and strain." - Geologist, Canada

Target Audience

Petrophysicists, drilling engineers, completion engineers, exploration and development geologists, reservoir engineers, core and log analysts, geophysicists, and oil company research and development staff.

You Will Learn

Participants will learn how to:

- Determine the stress, strain, and failure mechanics of rocks
- Apply rock mechanics concepts and generate economic benefits in all phases of reservoir development

Course Content

- Introduction to rock mechanics and geomechanical principals
- Basic mechanics: stress and strain, elasticity (linear and non-linear effects, brittle and ductile rock behavior, poroelasticity, time-dependent-effects), consolidation and creep, normal and shear forces, hoop stresses, the Kirsch solution, 2D and 3D stress components, tensors, the stress ellipsoid, and basic rock failure (Mohr-Coulomb theory)
- Rock mechanical properties: ability to bear stresses (compressive strength, tensile strength, deformation response to stresses), elastic moduli, Poisson's ratio
- Pressure, stresses, and loads: principal stresses, in-situ stress regime, total-stress and effective-stress, temperature effects, nature, and origin of pore pressure
- Geomechanics and structural geology: faulting and folding, tectonics, regional structural analysis, regional and localized stress
- Wellbore and field measurement of in-situ (earth) stresses: stresses around boreholes, overburden stress, horizontal stresses, leakoff tests, mini-frac tests, formation testers, other pressure transient techniques, and tool deployment
- Overview of common rock mechanics tests (lab demonstrations): unconfined compression, triaxial compression, hydrostatic compression, poly-axial, multi-stage triaxial, thick-walled cylinder, direct tensile strength, indirect (Brazilian) tensile strength, direct shear, uniaxial strain (compaction), and quick look (rock hardness) and scratch tests
- Stress orientation techniques: geological/mapping methods, wireline logging techniques, analastic strain recovery, differential strain curve analysis, acoustic anisotropy
- Elastic, plastic, and viscous models of rock behavior: deformation mechanisms and common models used in petroleum related rock mechanics
- Borehole stability: borehole stresses, wellbore placement, shale characterization, review of borehole stability models, high angle and horizontal drilling, pilot hole evaluation, multi-lateral wellbores, borehole breakouts, fluid-related instability, drilling through depleted zones and casing shoe decisions, stuck pipe, and case histories (software demonstration)
- Sand control: review of sand production mechanisms, completion techniques in unstable formations, gravel pack design, special liners and screens, and case histories
- Fracture mechanics: naturally fractured reservoirs, hydraulic fracturing, stimulation options, and case history
- Unconventional reservoir applications
- Reservoir engineering applications: compaction drive, reservoir compaction and compressibility, subsidence, casing shear, depletion and effective stress, and case history
- Wireline log predicted mechanical properties: density logging, acoustic logging, Biot theory, dipole and multi-pole (dynamic) acoustic logging, seismic data and Amplitude Versus Offset (AVO), and shear- and compressional-wave anistropy (lab demonstration)
- Data integration

Product Details

Categories: Upstream

Disciplines: Petrophysics Unconventional Resources

Levels: Specialized

Product Type: Course

Formats Available: In-Classroom

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