Practical Geomechanics for Oil & Gas Industry
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The integrity of the wellbore plays an important role in petroleum operations including drilling, completion and production. Borehole instability, lost circulation, sand production, hydraulic fracturing failure, casing collapse, compaction, subsidence, and permeability reduction issues cost the oil and gas industry several billions of dollars every year. Prediction and prevention of these issues requires understanding the interaction between formation, in-situ stresses, and drilling practice. This multi-disciplinary course provides a concise overview of basic rock mechanics and its application in many oil and gas industry practical problems encountered at well and field scales. This is an interactive course which will be presented in two modules: Principals of Rock Mechanics and Geomechanical Earth Modeling; and Geomechanics Applications in Field Development.

What You Will Learn

Module I: Principals of Rock Mechanics and Geomechanical Earth Modeling
This module provides an introduction to geomechanics importance for oil and gas industry, relevant rock mechanics theories and geomechanical modeling. You will learn how to integrate geological, petrophysical and drilling information, in conjunction with well logs and core data from off-set wells to construct geomechanical models. You will also learn how to verify and calibrate the model with drilling incidents and regional information.

Module II: Geomechanics Applications in Field Development
In this module, different applications of geomechanics in development of oil and gas fields will be discussed and several interesting case studies will be shared. This module gives you detailed information about wellbore stability, sand production prediction, hydraulic fracturing, production optimization from natural fractures, deep water drilling, compaction and subsidence analyses. You will learn how to analyze wellbore stability for generic & optimum well trajectories and define a safe operating mud weight window; to optimize well trajectory in order to maximize production from natural fractures; to predict & control the orientation and extension of hydraulic fractures; to evaluate the potential for sand production under drawdown, depletion and how to manage it using selective or/and oriented perforation strategies etc.

Who Should Attend
Drilling, reservoir, completion, exploitation, production engineers; geologists, geophysicists, geoscientists and petrophysicists.

What You Will Receive
- Detailed course manual including hard copy of all presented material.
- Course package including soft copy of course slides, relevant books and papers.
- EXCEL program for performing geomechanical modeling.
- Relevant case histories from different regions.
Dr. Hamed Sorosh is an internationally recognized geomechanics expert with more than 17 years of experience in different applications of rock mechanics in mining, civil and oil industries. He has conducted or managed more than 100 consulting & research projects worldwide. He is currently working for Shell as Geomechanics consultant in Houston. Prior to that, Dr. Sorosh was the Global Geomechanics Advisor for Weatherford based in Dubai, UAE, providing project coordination, support and training for geomechanics and petroleum engineering applications. He has also worked with companies such as Technical and Soil Laboratories, CSIRO, GMI, Senergy and PDVSA in the Middle East, Asia Pacific, North Sea, and South America, in addition to three years of serving as a member of faculty in the Petroleum Engineering Department at the Amirkabir University of Technology in Tehran.

Dr. Sorosh holds a BSc in Mining Engineering, a MSc in Rock Mechanics and a PhD in Petroleum Engineering from Curtin University of Technology in Australia. He has published three technical books and numerous journal and conference papers. Dr. Sorosh has given different short courses for PETROLERN, SPE and EAGE. He has also served as steering committee on several SPE conferences and workshops. He was selected as SPE Distinguished Lecturer for year 2012-2013.

**Course Outline**

**Module I:**

**Principals of Rock Mechanics and Geomechanical Earth Modeling (1 day)**

*Introduction to Geomechanics*
- Overview and history of geomechanics
- Importance & applications of geomechanics
- Geomechanical Earth Model (GEM)
- Anderson faulting theory and stress regimes

*Theories and Background*
- Principles of stress and strain
- Effective stress concept
- Effect of pore pressure on stresses
- Stress around a borehole
- Rock failure mechanisms and criteria
- Rock deformation and mechanical behavior models

*Geomechanical Modeling*
- Concepts
- 1D to 4D geomechanical models
- Rock property modeling
  - Core recovery and management
  - Core plug preparation
  - Laboratory measurements
  - Log-based models
  - Model calibration
  - Develop customized models
- Pore pressure prediction
  - Concepts and definitions
  - Generation mechanisms
  - Measurements
  - Prediction methods
  - 3D pore pressure prediction
  - Real time pore pressure prediction
  - Field examples
- Stress modeling
  - Overburden stress
  - Stress orientation
  - Min. horizontal stress magnitude
  - Max. horizontal stress magnitude
  - Stress perturbation
  - Field examples

**Module II:**

**Geomechanics Applications in Field Development (1 day)**

*Wellbore Stability & Lost Circulation*
- What is wellbore instability
- Effective parameters
- Instability consequences
- Modeling techniques
• Yielded zone and borehole breakouts
• How to control borehole breakouts
• 2D elastic/poroelastic models
• 3D elastic/poroelastic models
• Elastoplastic models
• Calculation of collapse & fracture gradients
• Safe operating mud weight window
• Casing and mud design
• Wellbore stability for deviated & horizontal wells
• Well trajectory optimization
• Accounting for hydraulic communication effects
• Accounting for weak bedding planes
• Time-dependent wellbore instability
• Chemical wellbore instability
• Wellbore stability in fractured formations
• Wellbore stability in salt bodies
• Wellbore stability for UBD
• Identifying wellbore instability on the rig
• Field examples

**Sand Production Prediction**

• What is sand production
• Sand production consequences
  - Effect on surface & downhole equipment
  - Effect on production
• Elements of sand production
  - Rock failure
  - Particle transport
• Sand production impact on completion and facilities designs
• Sand management versus control
• Borehole and perforation failure
• Sand production prediction models
  - Empirical models
  - Analytical models
  - Experimental models
  - Numerical models
• Effect of water breakthrough
• Geomechanical solutions
  - Selective perforating
  - Oriented perforating
• Real time sandstone strength evaluation
• Sand control methods
  - Open hole completion
  - Cased hole completion
• Field examples

**Hydraulic Fracturing**

• What is hydraulic fracturing
• History and importance
• Rock brittleness/ductileness
• Selection of the best candidates for fracturing shale plays
  - Existing methods to determine brittleness
  - Limitations - Requirements for new developments
• Stress effect on orientation and extension of hydraulic fractures
  - Fracture orientation in different stress regimes
  - Fracture length & width prediction & optimization
  - Fracture orientation optimization by designing well trajectory
  - Multiple zone fracturing

**Production Optimization from Natural Fractures**

• Fractures analysis and modeling
• Productive vs. non-productive fractures
  - Critically Stressed Fractures (CSF) concept
  - Mohr-coulomb analysis to identify CSFs
• Well trajectory design for maximum production

**Compaction and subsidence**

**Casing collapse and shear**

**Salt bodies modeling**

**Multi lateral junctions**
To register for this course please contact us at info@petrolern.com or visit WWW.PETROLERN.COM

To request customized in-house courses, please contact us.