Practical Geomechanics for Unconventional Resources

24 - 26 October 2012, Calgary, Canada
Nowadays, unconventional resources have been brought into the forefront of the energy future due to the increase in demand of hydrocarbon and decline of production from conventional reservoirs. These energy sources are a fast-growing market and are recognized as having huge future potential for production worldwide. Due to low permeability of unconventional resources, production at commercial level requires conducting effective hydraulic fracturing and applying horizontal drilling technologies. Therefore, successful production from such complex reservoirs, with a typical poorly-defined gas-water contact, natural fractures, and very low matrix permeability, is heavily dependent on the stress regime requiring sufficient geomechanical analyses.

Geomechanics is an essential component of production from both conventional and unconventional reservoirs. It is because of changes in rock deformation and stress caused by drilling and/or production is very likely to affect permeability and porosity during the whole life of a reservoir. The extraction of hydrocarbons from a reservoir changes the in-situ stresses, which potentially leads to compaction and subsidence impacting well and completion integrity, cap-rock and fault-seal integrity and fractures behavior. However, geomechanics for unconventional resources is to some extend different from conventional reservoirs due to intricacy imposed by inelastic matrix behavior, stress sensitivity, existence of cleats and natural fractures, rock rheology, and different pressure-temperature environments. In addition to the complex geology, petrophysics, and reservoir heterogeneities, unconventional reservoirs provide unique challenges related to hydrocarbon storage and flow in complex rock systems, thus requiring an improved fundamental understanding for effective production. This course discusses the geomechanical aspects of unconventional resources and how it adds value to the development of this type of reservoirs.
What You Will Learn

Module I: Geomechanical Modeling and the Applications

In this module, the importance of geomechanics in oil and gas industry will be discussed and its different applications in petroleum engineering will be explained. In addition, you will learn how to use geology and drilling information, well logs and core data from off-set wells to construct geomechanical models. You will also learn to calibrate your model with regional stress and rock strength data. Special considerations for unconventional formations will be discussed.

Module II: Wellbore Stability Analysis

This module gives you the ability to analyze wellbore stability for generic and optimum well trajectories using an existing calibrated geomechanical model. After the course, you will be able to define a safe operating mud weight window for a specific well trajectory. Special cases related to unconventional resources, such as chemically reactive rocks, weak bedding planes, natural fractures and faults, salt domes and underbalanced drilling will also be addressed.

Module III: Hydraulic Fracturing Aspects

This module discusses geomechanical aspects of hydraulic fracturing. You will learn how hydraulic fracturing improves production from tight formations, what parameters control the success of fracturing operation and the geometry of fractures. It includes discussions on how to select wells and the best intervals for stimulation, how to control fracture propagation and width, how stress regime influence fracture orientation, and how to develop data sets for hydraulic fracturing analysis. Practical examples from worldwide unconventional projects will be presented.

Who Should Attend

Drilling, completion, exploitation and production engineers, geoscientists & petrophysicists with interest in unconventional resources.

What You Will Receive

- A detailed course manual including all presented material
- EXCEL programs for performing geomechanical analysis
- Up-to-date reference lists on all topics covered in the course
- Relevant case histories from different regions

Who Will Teach

Dr Hamed Soroush is serving as Independent Geomechanics Consultant and SPE Distinguished Lecturer for 2012-2013 (Topic: Non-conventional Geomechanics for Unconventional Resources). Prior to that, he was the Global Geomechanics Advisor for Weatherford Oil Tool based in Dubai providing project coordination, support and training for geomechanics and petroleum engineering applications. He has conducted or managed more than 100 consulting and research projects worldwide. Hamed has more than 15 years of experience in different applications of rock mechanics in mining, civil and oil industries. He has also worked with companies such as Technical and Soil Laboratories, CSIRO, GeoMechanics International, Senergy, and PDVSA in the Middle East, Asia Pacific, North Sea, and South America areas, in addition to 3 years of serving as a member of faculty in the Petroleum Engineering Department at the Amirkabir University of Technology in Tehran.

Dr Soroush 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 3 technical books, 8 technical papers in ISI journals and more than 15 conference papers. Hamed has given different short courses for SPE and EAGE and serves as steering committee on several SPE conferences and workshops.
Course Outline

Module I (2 days):
Geomechanical Modeling and Applications

Introduction to Geomechanics
- Overview & history of geomechanics
- Overview & history of unconventionals
- Importance of geomechanics
- Geomechanical Earth Model (GEM)
- Anderson faulting theory and stress regimes
- Comparison of conventional vs. non-conventional geomechanics

Overview of Petroleum Applications
- Wellbore stability and lost circulation
- Sand production prediction
- Hydraulic fracturing
- Fault seal analysis
- Fractures permeability analysis
- Fractured reservoir modeling
- Compaction and subsidence
- Casing collapse and shear
- Salt bodies modeling
- Multi lateral junctions
- Unconventional resources

Theories and Background
- Principles of stress and strain
- Effective stress concepts
- Stress around a borehole
- Stress in shaly formations
- Rock deformation models
- Inelastic behavior of shale gas and CBM
- Rock failure mechanisms and criteria

Geomechanical Modeling
- Concepts
- 2D and 3D models
- Rock mechanical properties modeling
  - Laboratory measurements
  - Log-based models
  - Model calibration
  - Develop customized models
  - Properties of anisotropic rocks
- Pore pressure prediction
  - Concepts and definitions
  - Generation mechanisms
  - Measurements in permeable formations
  - Prediction methods for shale
  - Pore pressure and wellbore stability
  - Real time pore pressure prediction
  - Field examples
- Stress modeling
  - Overburden stress
  - Minimum horizontal stress magnitude
  - Maximum horizontal stress magnitude
  - Stress orientation
  - Considerations for anisotropic formations
  - Effect of pore pressure on stresses
  - Effect of depletion on stresses
  - Field examples

Module II (half day):
Wellbore Stability Analysis

Introduction and definitions
- What is wellbore instability
- Wellbore instability cost for industry
- Factors affecting wellbore stability
- General modes of instability
- Yielded zone & borehole breakouts
- Consequences of instability

Analysis and Outcomes of
Wellbore stability analysis
- Stability models
  - 2D linear elastic models
  - 3D linear elastic models
  - Poroelastic models
  - Elastoplastic models
- Prediction of yield zone dimensions around the borehole
- Calculation of collapse & fracture gradients
- Well trajectory optimization
- Safe operating mud weight window
- Casing and mud design
- Deviated & horizontal wells
- Identifying wellbore instability on the rig
- Wellbore stability for UBD

Special Cases for Unconventional Reservoirs
- Accounting for weak bedding planes
- Time-dependent wellbore instability
- Chemical wellbore instability
- Wellbore stability in fractured formations
- Accounting for hydraulic communication effects

Module III (half day):
Hydraulic Fracturing
Introduction and definitions
- What is hydraulic fracturing
- History of hydraulic fracturing
- Importance to unconventional reservoirs
- Fracture mechanics
  - Formation response to fracturing
  - Stress Intensity Factor
- Fracturing fluid mechanics
  - Hydrodynamic forces
  - Pressure requirements
  - Fracture conductivity
- Rock mechanics of fracturing
- Rock brittleness/ductility effect
- Permeability effect and fluid loss
- Rock strength effects
- Selection of the best candidates for fracturing in shale gas
- Existing methods to determine brittleness
- Limitations
- Requirements for new developments
- Stress aspects of fracturing
  - Fracture morphology
  - Fracture orientation in different stress regimes
- Hydraulic fracturing design
  - Fracture design variables
  - Design input data
  - Fracture orientation optimization by designing well trajectory
  - Fracture length & width prediction & optimization
  - Multiple zone fracturing
- Hydraulic fracturing modeling
  - PKN Fracture Model
  - Perkins & Kern Model
  - GDK Fracture Model
- Review of existing fracture modeling software
- Perforating for fracturing
- Fracture monitoring
- Field examples

Course code: PGU1012-2
Course fee: $2000/Person
venue: to be advised

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

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