2019 Geomechanics for Unconventionals: "Reservoir Characterization and Completion Optimization"

Training Course Information

Geomechanics – in both completions and drilling operations – has become a critical technology in the development of Unconventional Plays. This course presents the basics of oil field geomechanics and its application to unconventional developments; specifically, the role of stress, pore pressure, mechanical properties, and natural fractures on hydraulic fracturing operations. The first portion of the course will focus on the fundamentals of oil field geomechanics including stress, pressure, mechanical properties and failure as, in our opinion, a necessary part of reservoir characterization for Unconventionals. The second part of the course will focus on the geomechanics of hydraulic fracturing for Unconventionals with an emphasis on proper characterization, modeling, interpretation and field aspects (i.e., hydraulic fracturing in heterogeneous rock masses with the presence of discontinuities and weakness planes).

At the end of the course, it is expected that attendees will understand the necessary basics of geomechanics, be able to specify and QC a geomechanics evaluation program for Unconventionals, and understand the key geomechanical issues and inputs for hydraulic fracture optimization in Unconventionals.

Who Should Attend

The course approaches geomechanics from an engineering aspect of completions optimization in Unconventionals. The course is intended for geoscientists, reservoir engineers, drilling engineers, and completions engineers with little or no background in geomechanics but who are engaged in the development of Unconventionals.

About The Instructors

The primary instructor is Dr. Neal Nagel. Neal has 30+ years of industry experience and has provided geomechanics consulting and training since 2009. Neal is the Chief Engineer and co-founder of OilField Geomechanics LLC. He previously worked for 20 years with ConocoPhillips as a world-wide geomechanics specialist. He has taught extensively over his career as well as given many invited presentations – including serving as an SPE Distinguished Lecturer in 2004 and 2016. Neal is chairman of the SPE Geomechanics Technical Section, and has written more than 50 peer-reviewed and conference papers, including more than 20 related to Unconventional Play geomechanics.

The second instructor will be Dr. Marisela Sanchez-Nagel. Marisela is president and principal engineer at OilField Geomechanics LLC. She has more than 25+ years of industry experience having worked for Intevep, the technology arm of PDVSA; as President of Global GeoSolutions; for GMI; and as General Manager and President of Itasca Houston from 2007 to 2014. Marisela was a 2012-2013 SPE Distinguished Lecturer and has presented at numerous geomechanics schools throughout North and South America.

Draft Course Outline

OilField Geomechanics Presents:

2019 "Geomechanics for Unconventionals" Training Course

Times		Tuesday	Wednesday	Thursday
0830	1015	*Principles of Stress & Strain*	*Geomechanical Applications, Models & Workflow*	*Shale Geomechanics Overview / Debunking Geomechanics Myths*
1015	1030	*Break*	*Break*	*Break*
1030	1200	*Principles of Stress & Strain*	*Geomechanics of Hydraulic Fracturing*	*Hyd. Frac / Fabric Interactions & Op Effects*
1200	1300	*Lunch*	*Lunch*	*Lunch*
1300	1415	*Pore Pressure Evaluations / Mechanical Rock Behavior*	*Geomechanics of Hydraulic Fracturing*	*Depletion Effects, Frac Hits & Refracturing*
1415	1430	*Break*	*Break*	*Break*
1430	1600	*Mechanical Rock Behavior*	*Hydraulic Fracturing: Stress Shadows*	*Unconventional Completions Geomechanics (Multi-Well Schemes / Zipper Fracs)*
1600	1615	*Break*	*Break*	*Break*
1615	1700	*Mechanical Rock Behavior / Laboratory Testing*	*Rock Fabric Characterization*	*Wrapup & Discussions*

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Course Outline Details

Part 1. FUNDAMENTALS OF GEOMECHANICS

I. Principles of Stress and Strain

A) Basics of stress/strain and Mohr circles; B) Effective stress concepts and the importance of pore pressure; C) Stress field variations and structural effects; D) Stress measurements and analysis; and E) Examples.

II. Pore Pressure Evaluation

A) Basic concepts and causes of over pressure; B) Analysis concepts: NCT, Bowers, Centroid-Effect; C) Analysis workflow; and D) Examples.

III. Mechanical Rock Behavior

A) Mechanical properties (elasticity, poroelasticity, plasticity, creep); B) Strength, failure and post failure behavior; C) Influence of faults and fractures; D) Laboratory vs. log vs. field data; correlations; E) Laboratory testing; F) SeIsmic and geological integration; and G) Examples.

IV. Geomechanical Modeling and Workflow

A) Concepts and tools; B) 1D/2D modeling and 3D modeling; and C) Example geomechanics workflow.

V. Review of Main Petroleum Geomechanics Applications

A) Wellbore stability; B) Sanding; C) Solids (cuttings) injection; and E) Monitoring/Field/lab testing.

Part 2. GEOMECHANICS FOR UNCONVENTIONALS

VI. **Introduction to Unconventional Developments and Unconventional Reservoir Quality Evaluations**

A) On the importance of Unconventionals world-wide; B) Common play characteristics; C) Challenges in general and challenges from a geomechanics point-of-view; and D) TOC, porosity/permeability, natural fractures, pressure, stresses and mechanical properties as quality indicators

VII. Geomechanics for Hydraulic Fracturing – Basics and HF for Unconventional Plays

A) Basics; B) Models and design; C) Frac QC; D) Conventional models in unconventional developments: and E) Workflow and examples.

VIII. Hydraulic Fracturing Stress Shadows

A) Basics; B) Impact on rock fabric; C) Shear stresses; and D) Interaction with formation pressure.

IX. Rock Fabric Characterization

A) Concepts, characterization, and modeling; B) Discrete Fracture Network (DFN) issues; C) Fabric mechanical behavior and testing; and D) Influences on drilling and stimulations.

X. Unconventional Completions: Critical Geomechanical Overview

A) Geomechanics of shale plays; modeling and shale completions; B) What is shale, shale properties, and shale types ('Brittle' vs. ductile behavior); C) Interactions with rock fabric and natural fractures and weakness planes; and D) Unconventionals myths and magic: "brittleness", complexity", sand-volume-per-length-of-lateral.

XI. Hydraulic Fracturing in Unconventionals – Fabric Interactions and Operations Effects

A) Interactions with rock fabric and natural fractures and weakness planes; B) Influence of operational effects (rate and volumes); and C) Influence of rock fabric mechanical properties.

XII. Depletion Effects, Frac Hits and Refracturing

A) Basics of influence of pressure changes on formation stresses; B) Parent-child geomechanics; C) Geomechanics of frac hits; and D) Refracturing Issues, candidates, and stress changes.

XIII. Multi-well Completions

A) Zipper fracs, SimulFracs; B) Impact of operational parameters: rate, volumes, clusters, and well spacing; C) Workflow and key issues from published work and numerical simulations.