01 - GEOMECHANICS FOR UNCONVENTIONAL DEVELOPMENTS

This is a very successful training course, one that OFG has been providing to the industry for many years. It has been updated with new aspects and issues that have emerged in the last years, like cube developments and frac hits. The course starts with a brief geomechanics fundamentals part and then the aspects relevant to Unconventionals are developed, especially the effect of fabric and heterogeneity. Within this course we challenge "common knowledge" and popular procedures in the light of geomechanics fundamentals and concepts. This is an in-depth but fun training course and one we enjoy teaching several times per year.

OUTLINE

PART I. GEOMECHANICS FUNDAMENTALS

Module 0. Introduction to Unconventional Geomechanics

- A few words about Oilfield Geomechanics.
- What is geomechanics? Definitions, history, relevance.

Modules 1 – 2. Principles of stress and strain with field stress measurements

- Basic of stress-strain and Mohr circles - applications to natural fractures.
- Effective stress concepts, role of pore pressure.
- Field stress variations, structural effects.
- Stresses around boreholes.
- Stress determination.

Module 3. Pore pressure evaluation

- Basic concepts and causes of overpressure.
- Pore pressure analyses – Eaton, Bowers', NCT, effective stress methods.
- Analysis workflow.
- Challenges in Unconventional, field examples.

Modules 4 – 5. Mechanical rock behavior

- Mechanical properties, elasticity, plasticity, poroelasticity, viscoelasticity.
- Failure in rocks, failure criteria.
- Influence of faults and fracture, anisotropy.
- Laboratory testing, measurements, interpretation.
- Use of logs for mechanical properties, calibration, correlations.

Module 6. Geomechanical modeling and workflows

- Concepts and tools.
- 1D, 2D and 3D models; when and where appropriate.
- Geomechanics workflows in Unconventionals

*OilField Geomechanics LLC * 503 FM 359, Suite 130 #166 * Richmond, Texas 77406*
*Tel: (832)327.9566 * msanchez-nagel@ofgeomech.com – www.ofgeomech.com*

PART II: GEOMECHANICS FOR UNCONVENTIONALS

Modules 7-8. Hydraulic fracturing fundamentals

- Basic, objectives, parameters.
- Frac containment, net pressure.
- Injection testing, DFITs.
- Horizontal wells and perforating.
- Proppants – 100 mesh and proppant transport,
- Fracturing fluids.
- Role of natural fractures.
- Injection zone selection effects.

Module 9. Stress Shadows for single frac, multi-stage and multi-well

- Mechanics of stress shadows.
- Effect on multi stages and clusters.
- Multi-well stress shadows.
- Tip shear stresses, Modeling examples.

Module 10. Rock fabric characterization

- Description and quantification of rock fabric attributes – cores.
- Mechanical behavior, hydraulic behavior, testing in Unconventionals.
- Stresses - critically stress fractures and hydraulic conductivity.
- Geometry and spatial occurrence, DFN models.
- Examples of evaluation in unconventional plays.

Module 11. Shale geomechanics

- Unconventional shale plays – shale types – challenges, critical issues.
- Geological scenarios for completions.
- Geomechanics of interfaces – HF interaction with interfaces, effect of fracture toughness.
- HF models: traditional and advanced models.
- Shale properties static and dynamics examples from different plays – elastic parameters, time dependency, frictional properties.
- Shale and shale-like behavior – mineralogic content, shale and flow.
- Myths to debunk – brittleness, complexity, SRV and microseismic, sand volume per lateral length.

Module 12. Hydraulic fractures (HFs) and natural fractures (NFs) with operational effects

- HFs propagation with NFs – effect of NF orientation.
- Dual HF propagating in a fractured media.
- Pressure Diffusion – coupled effects – stimulation benefits.
- Interaction HF – NF - crossing rules.
- Influence of NF characteristics – Dense vs sparse DFN, stress anisotropy, NF connectivity, parametric studies, with modeling examples.
- Influence of operational parameters, effects of fluid viscosity, injection rates – injection time.
- Influence of the stress field and in-situ pore pressure on HF behavior.
- Microseismicity response with anisotropic stresses – dry and wet MS events. Effect of initial aperture of the NFs.

Module 13. Depletion effects and refracs

- Depletion effects on HFs, depletion and in situ stresses.

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- Parent -child evaluations, cluster efficiency, drainage volumes.
- Frac hits – types.
- Microseismic depletion delineation, cube evaluations.
- Refracturing – candidates, case histories, lessons.
- Geomechanics of refracs.
- Refrac economics, refrac activity, examples.
- Refrac methods, engineered refracs.

Module 14. Multi-well completions

- Zipper fracs, stress perturbations, induced shear around zipper fracs.
- Interaction of HFs, overlapping HFs, models.
- Zipper fracs stress shadows.
- Effect of multiple well completions in fractured rock mass – sheared fabric – friction angle effect, geometry of zipper fracs. Effect on fabric stimulation.
- Sheared length, pressure diffusion.

Module 15. HF monitoring and models (extra session as time permits)

- Temperature logs, strengths and weaknesses, procedures. Effect of wellbore and completion.
- RA logging procedures, strength and weaknesses, tracer applications.
- Microseismic monitoring – MS as a geomechanics issue. Events, field data, MS imaging, passive seismology, triggered or induced seismicity, array design, surface vs downhole, source mechanisms, SRV from MS and drainage volume.
- Tiltmeters- direct fracture monitoring, measurements, patterns, cases.
- DAS/DTS basics, production estimations, cluster efficiency, integrated analysis.
- HF Models - advanced models fundamentals, input data, 2D models, pseudo (planar) 3D, Cell/Grid based models, lumped pseudo 3D, Fully 3D, HF reservoir simulators.

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