TETRA TECH RPS ENERGY | TRAINING

N266: Mechanical Stratigraphy, Stress, and Geomechanics *(West Texas, USA)*

Instructor(s): Kevin Smart and Adam Cawood

Format and Duration

Field - 5 Days
Moderate Physical Demand

Summary

This course will appraise participants of key concepts in geomechanics, and explore the importance and application of stress and geomechanical analyses to energy exploration and production. It will examine applications such as stress estimation and hydraulic fracturing and will develop the skill sets necessary for planning and evaluating a geomechanics study. The area around Marathon, Texas provides examples of different structural styles and mechanical stratigraphy exposed in the region.

Business Impact: We will explore the importance and application of stress and geomechanical analyses to energy exploration and production in both conventional and unconventional reservoirs, with emphasis on the importance of mechanical stratigraphy and stress states on processes such as natural deformation and hydraulic fracturing.

Learning Outcomes

Participants will learn to:

1. Evaluate the basics of stress analysis and geomechanics, including the interrelationship between stress and strain in the context of geomechanical rock behavior.
2. Characterize mechanical stratigraphy based on lithostratigraphy and other information.
3. Assess the role of mechanical stratigraphy and stress conditions on rock deformation behavior, including fracture prediction in unconventional and conventional reservoirs.
4. Estimate an in situ stress field for an area of interest.
5. Predict the likely effects of pore fluid pressure changes on existing fractures.
6. Employ outcrop analogs to create geomechanical models of a reservoir.
7. Evaluate geomechanical issues for common petroleum and unconventional resource applications such as stress estimation, and hydraulic fracturing.
8. Plan and evaluate a geomechanics study.

Training Method

This field course combines two days of classroom lectures and exercises with 3 days in the field. Participants will be using stress analysis and tectonic modeling software to aid in the exercises.

Physical Demand

The physical demands for this class are MODERATE according to the RPS field course grading system. Basic fitness is required. Fieldwork is in west Texas, where the climate is warm-hot and dry. Participants will be taking short to moderate hikes (less than 3.2km / 2mi each) over flat to hilly terrain with a maximum elevation change on a hike of 200 m (660 ft). Transport is by SUVs on mostly black-top roads, with some outcrops reached by well-marked dirt roads.

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Who Should Attend

This course is relevant to geologists, geophysicists, petrophysicists, and engineers who want to develop a fundamental understanding of geomechanics and stress and their application to energy exploration and production.

Course Content

Extensional fault-related folding (e.g. Big Brushy Canyon monocline) and exposures of Cretaceous carbonate and fine-grained clastic rocks in the Marathon area will provide the opportunity to study mechanical stratigraphy and deformation behavior of both unconventional reservoirs (e.g. Eagle Ford Formation/Boquillas Formation) and conventional reservoirs (e.g. Edwards/Santa Elena Limestone and Caballos Novaculite).

Itinerary (subject to revision)

Day 0:
Travel to Midland, Texas and drive to Marathon, Texas.
Course introduction and safety briefing followed by group dinner.
Overnight in Marathon each night.

Day 1: Field, exposures in Black Gap Wildlife Management Area
Examination of field exposures and data collection for geomechanical modeling exercise. Emphasis will be placed on defining the problem, constraining geometry, characterizing mechanical stratigraphy, assessing likely boundary and initial conditions, and evaluating appropriate data for model validation.

Day 2: Classroom, Marathon
Overview of fundamental concepts, such as stress (including pore fluid pressure), strain and deformation, mechanical stratigraphy, and rock behavior. Introduction to fundamentals of geomechanical modeling, including understanding and defining the problem, alternative approaches (e.g., numerical, physical analog, finite element, boundary element, and discrete element modeling) and key steps to success (appropriate choices of geometry, boundary and initial conditions, material properties) will be provided.Day

Day 3: Field, exposures in Big Bend National Park
Examination of field exposures and data collection for geomechanical modeling exercise. Emphasis will be placed on defining the problem, constraining geometry, characterizing mechanical stratigraphy, assessing likely boundary and initial conditions, and evaluating appropriate data for model validation.

Day 4: Classroom, Marathon

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Detailed discussion of numerical geomechanical modeling using finite element methods. Using data from Days 1 and 3 fieldwork, participants will conduct a hands-on modeling exercise that includes building the model (define geometry, assign material models and properties, apply loading conditions, specify outputs) and running the numerical simulation.

Participants will analyze and interpret model results using the fieldwork of the previous days to provide real world context. There will also be discussion and exercises to perform stress analyses based on a variety of inputs including geological maps, field data, structural interpretations from seismic reflection, and well data. Applications of stress and geomechanical analysis to conventional and unconventional reservoir exploration and production (borehole scale, reservoir scale, field scale).

Day 5: Field, Boquillas / Eagle Ford exposures between Marathon and Del Rio, Texas

Examine outcrop deformation of reservoir analogs with emphasis on comparing and contrasting deformation behavior of different mechanical layers. Discussion on how observations affect geomechanical models and stress analyses.

Day 6:

Return to Midland, Texas, flights home