

# Geomechanics for Heavy Oil Reservoirs and In-situ Thermal Operations



## About the Course

The course introduces an integrated workflow for reservoir containment evaluation and caprock integrity assessment in thermal operations such as Steam Assisted Gravity Drainage (SAGD) and Cyclic Steam Stimulation (CSS) in heavy oil reservoirs. The essential fundamentals of petroleum-related rock mechanics will be presented, and the processes of data collection, geomechanical characterization, and building Mechanical Earth Models (MEMs) will be discussed in details with an emphasis on data uncertainty. The course provides a comprehensive picture of the geomechanical behavior of heavy oil fields in response to thermal operations and shows how different modeling approaches, from simpler closed-form solutions to more cumbersome numerical models, may be implemented to predict this behavior and its associated geomechanical risks. It presents the application of modeling in mitigating the adverse effects of these risks and determining safe-operating criteria such as maximum operating pressure. Different aspects of field monitoring and real-time updating, as essential components of reservoir containment evaluation, are discussed. Several case histories and in-class exercises help participants grasp a practical perception of the course materials. An online blog dedicated to the course will ensure that the participants will take their learning experience beyond the classroom doors.

### Designed for

The course has been developed for geoscientists, reservoir engineers and project managers involved in heavy oil plays. Participants are expected to have a limited knowledge of petroleum geomechanics.

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## Course Outline

### Day 1

- Introduction to petroleum geomechanics and its application for heavy oil reserves
- Integrated reservoir containment assessment workflow and its elements
- Fundamentals of rock mechanics
- Constitutive models for rock mechanical behaviour
- Mechanisms of rock failure: failure and fracturing
- Mechanical behaviour of oil sand reservoirs and their caprocks

### Day 2

- Introducing Mechanical Earth Models (MEMs) and their different elements
- Workflow for MEM Construction for heavy oil fields
- Integrated in-situ stress data, acquisition and interpretation from multiple sources
- Acquisition and estimation of elastic and strength rock properties
- Data uncertainty and its importance
- Mechanisms of stress change in heavy oil In-situ operations
- Modeling of stress change using analytical and numerical models

### Day 3

- Workflow for building numerical models for geomechanical analysis
- Coupling between geomechanics and fluid flow/heat transfer models
- Different aspects of numerical analysis for heavy oil reservoirs
- Modeling of caprock integrity and reservoir containment
- Feasibility assessment and operational criteria for heavy oil operations
- Regulations and standards for safe operations
- Monitoring and real-time updating of geomechanical analysis
- Review of case studies and their different geomechanical aspects

## You Will Learn About

- Structuring integrated workflows for reservoir containment evaluation and caprock integrity assessment during the field's life.
- Applying principles of reservoir fluid flow and geomechanics for thermo-poro-mechanical modeling of SAGD and CSS operations.
- Identifying different factors affecting reservoir containment, using field and laboratory data for geomechanical characterization, and building Mechanical Earth Models (MEMs).
- Using analytical and semi-analytical models for qualitative and quantitative prediction of geomechanical response of the reservoir and its caprock in thermal operations.
- Predicting, validating and interpreting the results of coupled fluid flow-geomechanics numerical modeling of thermal operations and identifying the major causes of numerical imprecision.
- Implementing sensitivity and probabilistic analysis tools to account for data uncertainty in modeling.
- Performing feasibility assessment and determining operational criteria such as maximum safe injection pressure for thermal operations.
- Field monitoring and real-time updating for reservoir containment assessment