Subsidence Management and Mitigation

PetroGem INC.
REDEFINING QUALITY

Geomechanics Training Series

About the Course

In addition to providing essential technical knowledge, this course introduces a comprehensive and integrated dynamic workflow for subsidence prediction and control. Along with presenting a detailed understanding of the mechanisms behind depletion-induced stress change and ground deformation, it will review the rock mechanical fundamentals and deformation/compaction constitutive models required for reservoir compaction and subsidence analysis. The processes of data collection, laboratory and field testing to acquire rock properties and in-situ stresses for geomechanical characterization, and building Mechanical Earth Models (MEMs) will be discussed in detail with a special emphasis on the issues of data uncertainty and geostatistical analysis. The course will discuss different modeling approaches, from simpler closed-form solutions to complex coupled numerical models and their applications for predicting subsidence and its associated geomechanical risks in oil and gas fields. As a major undesired consequence of reservoir compaction, the mechanisms leading to casing shear and their modeling approaches will be discussed in detail. Also, as essential components of subsidence control, different monitoring methods and safety regulations and policies will be reviewed. Finally, real-time updating of the predictive models and different mitigation strategies and planning approaches as the major steps of the provided dynamic workflow will be discussed. Several exercises and case studies will help the participants to gain a profound understanding of the presented materials. An online blog dedicated to the course will ensure that the participants will take their learning experience beyond the classroom doors.

Designed for

Engineers in the fields of reservoir management, completion and drilling as well as geoscientists in the fields of geology, geophysics and petrophysics. The participants are assumed to have limited background in petroleum geomechanics.

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Course Outline

Day 1

- Introduction to depletion-induced subsidence and its consequences
- Basic concepts of rock mechanics: stress and strain tensors and constitutive models
- Roles of in-situ stresses and pore pressure and their inter-coupling effects
- Mechanisms of depletion-induced stress change and ground deformation
- Review of different data sources for geomechanical modeling of subsidence

Day 2

- Rock property acquisition from lab tests, wireline logs and seismic data
- Designing laboratory tests for compressibility measurement for compaction analysis
- In-situ stress estimation using field tests, wireline logs, image logs and seismic data
- Construction of 3D Mechanical Earth Models and their key characteristics
- Different approaches for management of data uncertainty in subsidence analysis

Day 3

- Analytical and semi-analytical modeling of ground deformation and subsidence
- Numerical modeling approaches for geomechanical analysis
- Methods for coupling of fluid flow and geomechanical models for subsidence analysis
- Mechanisms of casing shear induced by reservoir compaction
- Numerical modeling of casing shear induced by ground deformation

Day 4

- Monitoring and surveillance of subsidence and ground deformation
- Controls on subsidence and planning and strategies for mitigation
- Casing shear controls and risk mitigation
- An integrated dynamic workflow for predicting and controlling compaction and subsidence
- Real-time data updating and reverse-analysis for model calibration and improvement

You Will Learn About

- Basics of rock mechanics required for subsidence analysis
- Mechanisms of depletion-induced deformation and stress change
- Designing laboratory tests for rock compressibility measurement
- Data acquisition for geomechanical and stress characterization
- Construction of Mechanical Earth Models (MEMs) for subsidence analysis
- Coupled fluid flow and geomechanical modeling for subsidence prediction
- Casing shear failure mechanisms and its modeling
- Monitoring of reservoir compaction, ground deformation and surface subsidence
- Strategies and planning for subsidence and casing shear control and mitigation

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