DOCTORAL PROGRAM
Earth Surface Processes & Paleobiosphere

Short Course on Geomechanics for Sedimentary Reservoirs

The CUSO ESPB is organising in collaboration with the SLB Geomechanics Center of Excellence a 4-days workshop on 3D geomechanics and natural fracture prediction from **12th to 15th of February 2024** at the University of Geneva. SLB experts from the Global HQ Geomechanics Center of Excellence (Crawley, United Kingdom) will be delivering the workshop:

- Dr. Maximilian Haas (HQ Geomechanics Engineer)
- Dr. Assef Mohamad-Hussein (HQ Interpretation & Geomechanics Lead)

Workshop content & software:

- 3D Geomechanics, Stress Simulations, Property Modelling, Natural Fracture Prediction.
- Petrel Geomechanics, Geomechanics & Fluid Flow simulators.

Reservoir Geomechanics

Integrate Geomechanics across Disciplines

The effect of geomechanics is often neglected when considering hydrocarbon production, despite the fact that it may have significant impact on production rates and ultimate recovery. As reservoir pressure changes during the life of a field, so the stress state is modified, affecting the porosity and permeability of the reservoir, the integrity of well completions, and the behavior of fractures and faults. Temperature changes in and around the reservoir may also modify the stress state creating considerable deformation.

In recent years, integration of fluid flow and geomechanics has become crucial to success for both conventional and unconventional reservoirs. Not only is it important to understand the natural geomechanical behavior of the reservoir during production, but it is also important to know how to harness that behavior to enhance productivity. At the same time, it is essential that the geomechanics of the field is understood to avoid costly mistakes.

The talk aims to discuss how innovative approaches integrating different disciplines such as geology, petrophysics, fluid flow, and geomechanics are able to improve the knowledge and understanding of the reservoir for future success.

Seismic Geomechanics

Link Geophysical Applications to Rock Mechanics

The predictive capability of 3D geomechanical models relies heavily on the existence of calibration information (experiential and experimental), which only becomes available as the field's development progresses. Therefore, the ability to continuously gather, process and understand geomechanically relevant information is a fundamental requirement for the practical usage of 3D geomechanical models across the life of the field.

This presentation focuses on the use seismic interpretations and inversion data, log and core measurements for characterizing the field-scale 3D geomechanical properties. Starting with first-order controls on subsurface stress fields and their imprint on seismic velocities, we address the stress field simulation around complex geological structures, as well as applications in time-lapse reservoir monitoring.

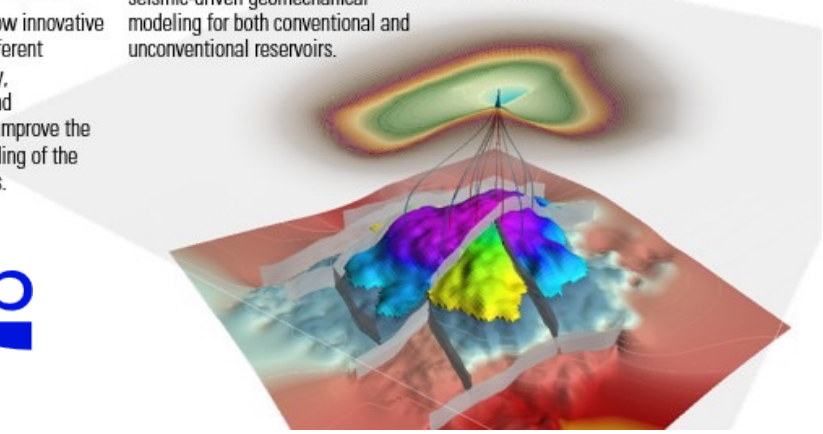
We illustrate different examples of seismic-driven geomechanical modeling for both conventional and unconventional reservoirs.

3D Geomechanics for Drilling

Interactive Well Design Analysis in 3D Geomechanical Space

We provide a description of the use seismic-driven 3D geomechanical models for updating well locations and configurations, aimed at maximizing wellbore stability conditions within a geological context.

Incorporating the effects of both structural features and rock property heterogeneity through geomechanical stress modelling, results allow for a comprehensive review of the wellbore stability issues and a direct mapping to their in-situ causes. It aims at improving current drilling engineering processes as we demonstrate the manner in which subsequent alterations to a preconceived well plan are provided with an immediate update of the pore pressure and fracture gradients, in addition to geomechanical stability indicators. Using an integrated workflow, we avoid multiple iterations of geomechanical studies. The findings are particularly relevant in faulted environments in which the hole stability is highly sensitive to the drilling direction.



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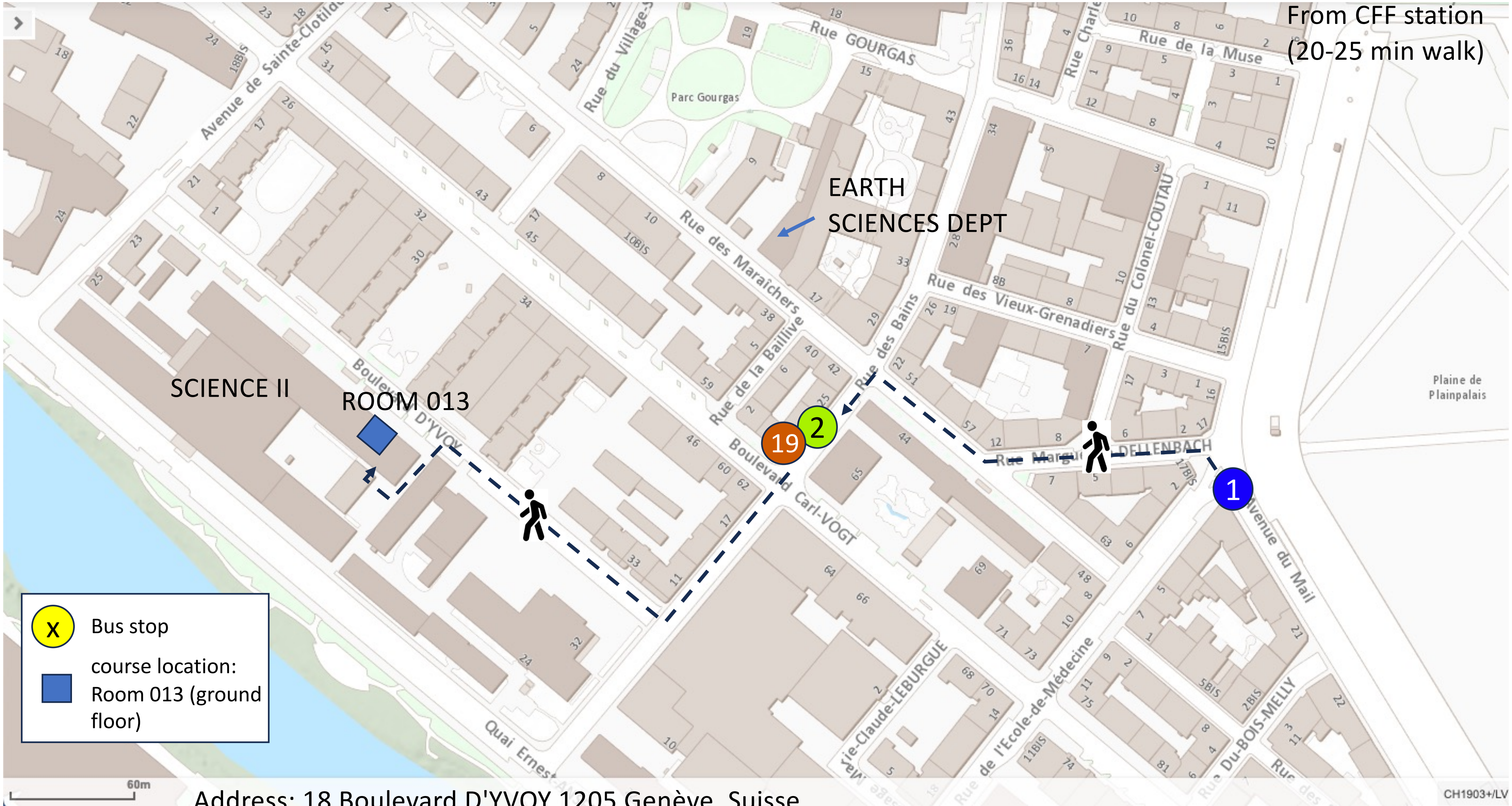
Schedule	Module	Presenter	Description	Duration (hours)
Day 1	START: 9:15 M1: General introduction: • The Centre of Excellence team (15 min) • Geomechanics & natural fracture prediction in SLB (45 min)	Assef Maximilian	The participants will be introduced to the basic applications of rock mechanics and fracture analysis for both the oil/gas and new energy industry. The session further dives into the theoretical principles needed for the consecutive tasks. This refers to the introduction of the most common failure criteria, stress analysis, rock fracturing as well as near- and far-field stress computations.	1
	M2: Advanced case studies: • Reservoir geomechanics • Near wellbore geomechanics • On field- and well-scale	Assef	This part showcases advanced reservoir geomechanics studies performed by SLB, focusing on the latest technology & workflow developments.	1.5
	M3: Software introduction & basic functionalities for workshop on: • Petrel • Visage • Techlog	Maximilian	The concept of a mechanical earth model (MEM) and basics of FEM are covered, substantiated by theoretical explanations and hands-on exercises in the Petrel software.	2
	Session day closure – Q/A	all		0.5
Day 2	START: 9:15 M4: Technical content: • Construction of a mechanical earth model (MEM) • Basics of the Finite Element Method (FEM) • Geostatistics & property modelling	Maximilian Assef	As a prerequisite for the geomechanical model, property modelling in Petrel will be explained.	3
	M5: Hands-on: • Construction of a MEM & property modelling in the software (step-by-step)	Maximilian Assef	Based on the theoretical explanations, the knowledge will be applied on CARBFIX or a training data set.	3
	Session day closure – Q/A	all		1
Day 3	START: 9:15 M6: Geomechanics-driven natural fracture prediction based on geological restoration	Assef	The prediction of natural fractures is explained in detail	2
			from a theoretical and practical point of view. In addition, a new concept currently in SLB R&D is introduced, which refers to geomechanics-driven natural fracture prediction based on geological (stratigraphic) restoration.	

	M7: Petrel Geomechanics workflow including natural fracture modelling applied to CARBFIX		Continuation of previous day. Working on the CARBFIX project (or training data set).	3
	Session day closure –	all		1
Day 4	START: 9:15 M8: Hands-on CARBFIX project	Maximilian Assef		2
	Questions & discussions	all		1
	Workshop closure	all		1



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