Contribution ID: **43** Type: **60s-Pitch + Scientific Poster**

Model calibration without calibration data

Geomechanical–numerical modeling aims to predict the 3-D in situ stress field for example to assess the distance to failure of larger rock volumes. However, model calibration typically relies only on few stress magnitude measurements that are expensive to acquire. In addition, these in-situ measurements represent meter-scale conditions and may not capture the stress state over larger rock volumes. Here I propose to overcome these limitations by using alternative data from borehole images that are routinely collected during site exploration as well as formation integrity tests (FITs). Even though image data provide only upper and lower limits of the stress state, their advantage is that they scan the rock volume along the entire borehole with high resolution.

In the Zürich Nord-Ost siting region for deep geological repository for radioactive waste in northern Switzerland, we have access to an exceptional calibration dataset of stress magnitude data. This dataset combines extensive laboratory measurements of Young's modulus and rock strength with borehole imaging and FITs. Using the stress magnitude data alone yields accurate stress predictions and therefore serves as a benchmark to evaluate models calibrated solely with indirect indicators of stress.

Our approach integrates from the borehole images the interpreted borehole breakouts (BOs), drilling-induced tensile fractures (DITFs), FITs, and the documented absence of BOs and DITFs at locations where stress magnitudes were measured. We developed a numerical framework that explores ~63,000 combinations of boundary conditions, estimates the local stress state at each observation point, and quantifies the agreement between predicted and observed stress indicators to identify the best-fitting boundary conditions.

Results show that stress predictions based only on indirect observations are as precise as those calibrated with direct stress magnitude measurements. This demonstrates that indirect datasets, readily available during routine site exploration, can provide reliable, uncertainty-quantified stress predictions for subsurface projects such as energy storage, CO_2 sequestration, and tunneling.

Author: LARUELLE, Louison

Co-authors: DEGEN, Denise (TU Darmstadt); COTTON, Fabrice (GFZ Helmholtz Centre Potsdam); DESROCHES, Jean (Rocks Expert SARL); VELAGALA, Lalit Sai Aditya Reddy (GFZ); Dr RAJABI, Mojtaba (University of Queensland); Dr ZIEGLER, Moritz (TU Munich); Prof. HEIDBACH, Oliver (GFZ Helmholtz Centre Potsdam); Dr GIGER, Silvio (NAGRA)

Presenter: LARUELLE, Louison