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MS15 - Frontiers in Computational Geomechanics for Coupled Multi-Physical Processes

Keywords: Computational geomechanics; Multi-physical coupling; Fracture mechanisms; Viscoelasto-plastic behavior; Constitutive models; Regularization techniques; Gradient-based methods; Phase-field methods

Organizers:
Mehran Ghasabeh (1) – mehran.ghasabeh@ifgt.tu-freiberg.de (Corresponding author)
Mostafa Mollaali (1,2) – mostafa.mollaali@ufz.de (Corresponding author)

Affiliations:
(1) Institute of Geotechnics, TU Bergakademie Freiberg, Freiberg, Germany
(2) Helmholtz Center for Environmental Research, Leipzig, Germany

Abstract:
In geosciences and related engineering fields, computational geomechanics plays a critical role in understanding complex geological processes. These processes often include multi-physical couplings across different scales, therefore, a robust framework is required to address inherent nonlinearity and complexities of material behavior. When investigating the fracture mechanisms of materials under coupled multi-physical conditions, regularization techniques are essential to overcome numerical challenges and ensure robust simulations.

This mini-symposium will focus on cutting-edge computational methods and their applications in geomechanics, with an emphasis on multi-physical couplings such as thermo-hydro-mechanicalchemical (THMC) processes. It will highlight advancements that improve predictive accuracy, computational efficiency, and scalability in modeling coupled processes in critical energy and environmental systems. Furthermore, it addresses key challenges in computational geomechanics in relation to regularization techniques.
We invite contributions presenting innovative computational techniques, real-world case studies, or interdisciplinary approaches advancing geomechanics. Topics of interest include, but are not limited to:

- Material behavior and constitutive modeling for complex visco-elasto-plastic processes
- Fracture propagation and damage evolution in geomaterials under multi-physical couplings, using advanced regularization techniques, such as gradient-based and nonlocal approaches (e.g., phase-field methods)
- Energy and environmental applications in geothermal energy, CO2 sequestration, oil and gas recovery, and nuclear waste disposal

This mini-symposium aims to catalyze collaborations and drive innovations that address pressing challenges in geosciences and engineering, ensuring computational geomechanics remains at the forefront of sustainable solutions for energy and environmental systems.