
Contribution ID: **725** Type: **Poster Presentation**

# Comparative verification of hydro-mechanical fracture behavior: Task G of international research project DECOVALEX–2023

*Tuesday, 14 May 2024 16:05 (1h 30m)*

Numerical simulations become necessary when experimental approaches cannot cover the required physical and time scale of interest. One such area is a simulation of long-term host rock behaviors for nuclear waste disposal and simulation tools involved in the assessment must go through rigorous validation tests. The DECOVALEX project (Development of COupled models and their VAlidation against EXperiments) is dedicated to this purpose by international participants\footnote{www.decovalex.org}.
This work is part of the ongoing phase DECOVALEX–2023 (D–2023, Task G) particularly aiming to simulate fracture behaviors under various conditions. Here, we cross-verified a variety of numerical methods including continuous and discontinuous approaches against four benchmark exercises with emphasis on numerical accuracy and parameterization of the various numerical approaches. The systematic inter-comparisons of test cases highlight the advantages and disadvantages of the different numerical models. Numerical details on discretization effects (e.g. mesh density and orientation) and domain size were investigated in detail for practical applications. It became evident that meticulous attention to mesh resolution and domain size is imperative for achieving accurate numerical simulations, even for static cracks. Moreover, when comparing numerical methods to closed-form solutions for static cracks, all models successfully reproduced the maximum crack opening but encountered challenges near the crack tips. Finally, the paper discusses how to convert between and therefore compare parameters of various numerical approaches. Our benchmark studies reveal that each model necessitates a distinct number of parameters, even in simple scenarios like static crack aperture benchmarks. It is generally more practical to employ fewer parameters to mitigate model over-parameterization and enhance experimental feasibility.

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## References

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**Session Classification:** Poster

**Track Classification:** (MS03) Flow, transport and mechanics in fractured porous media