## The role of pore fluid phase transition during earthquake ruptures: insights from an idealised numerical model

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### Motivation

Earthquakes lead to large and fast changes in porosity along the fault and in the surrounding rock. Under water-saturated conditions, this rapid expansion of fluid-filled cavities and fractures could lead to transient phenomena such as vaporisation due to the resulting large pressure drop, impacting the propagating earthquake rupture. However, a proper quantification of the conditions leading to such events and their resulting stresses is needed.

### Project description

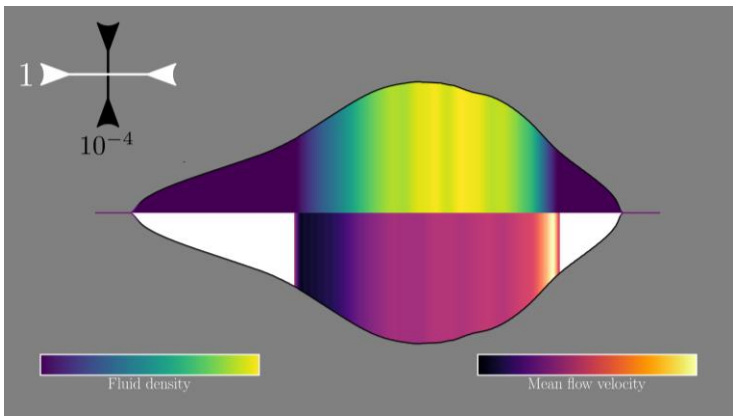
In this project we propose to investigate the physics of a rapidly expanding fluid-filled cavity. The student will employ and develop a numerical model that fully couples solid and fluid dynamics at the tip of a rapidly growing tensile fracture. We will initially consider a single fluid-filled crack propagating between two semi-infinite solid blocks (see Figure). The compressible fluid dynamics within the expanding cavity will be simulated using a finite element method formulated on a moving mesh. The implementation of the fluid dynamic model will be validated against theoretical predictions. Next, the model will be used to identify the conditions leading to phase transition of the pore fluid and its impact on the surrounding solid, i.e. the formation and eventual collapse of cavitation bubbles. Throughout the project, the candidate will benefit from direct comparison with ongoing experiments at PoreLab UiO investigating cavitation in an analogue setup.

### Resources

The candidate will learn how to use High-Performance Computing (HPC) infrastructure and will have access to the computing clusters of the Norwegian HPC infrastructure (Sigma2) as well as the local cluster of PoreLab UiO.

### Required background

Basic programming skills (C++, Python) and basic background in fluid mechanics. Some knowledge of solid mechanics and thermodynamics is an advantage.




*Snapshot of dynamic fluid flow simulation (i.e. density and mean fluid velocity) within a rapidly expanding crack cavity. The white area highlights the formation of a fluid-depleted cavity.*