unine
Université de Neuchâtel
Centre d'hydrogéologie et géothermie

MSc in Hydrogeology and Geothermics

Thesis topic proposal 2023

Modelling and Understanding Aftershock Sequences

Context and objectives

A recently proposed and testable hypothesis is that all rich aftershock sequences are fluid-driven (Miller, 2020). This was tested by comparing a 2D model that included a fluid source from thermal decomposition with data from 50,000 aftershocks recorded in the Apennines (Gunatilake and Miller, JGR, 2022), subsequently extended to 3D using the same dataset (Gunatilake and Miller, in review, Geology, 2023). The recent (18.03.2023) M=6.8 earthquake in Ecuador produced no aftershocks, consistent with the fluid-absent tectonic environment, further supporting the hypothesis. Revisiting aftershock sequences as completely fluid-driven opens up new avenues for understanding human induced seismicity because natural and anthropogenic seismicity are both driven by the same physics.

Methodology

Accurate locations from many aftershock sequences provide rich datasets for comparison with numerical modelling. The numerical models solve a non-linear diffusion model with a source term, and includes co-seismic permeability enhancement and post-seismic permeability healing. Model development continues with collaborator Gaëlle Toussaint, and the student will assist in further model development and exploration of interesting aftershock sequences for comparisons. There are many avenues for this direction, so more than one student can be accommodated.

Supervision and collaboration

Prof. Steve Miller will supervise the work in collaboration with Gaëlle Toussaint

Contact : Stephen.miller@unine.ch, bureau E214

Figure. Model setup with faults for comparison with data (dots). From Gunatilake and Miller, in review, Geology, 2023).