# How fluid viscosity affects earthquake intensity

March 21 2019

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Fault zones play a key role in shaping the deformation of the Earth's crust. All of these zones contain fluids, which heavily influence how earthquakes propagate. In an article published today in *Nature Communications*, Chiara Cornelio, a Ph.D. student at EPFL's Laboratory of Experimental Rock Mechanics (LEMR), shows how the viscosity of these fluids directly affects an earthquake's intensity. After running a series of laboratory tests and simulations, Cornelio developed a physical model to accurately calculate variables such as how much energy an earthquake needs to propagate—and, therefore, its force—according to the viscosity of subsurface fluids.

The study formed part of wider research into geothermal energy projects, which, like other underground activities, can trigger earthquakes—a process known as induced seismicity, as opposed to natural seismicity, in which earthquakes occur without human intervention.

"Subsurface exploration projects such as geothermal power, injection wells and mining all involve injecting pressurized fluids into fractures in the rock," explains Cornelio. "Studies like this show how a better understanding of the properties and effects of fluids is vital to preventing or attenuating induced earthquakes. Companies should factor these properties into their thinking, rather than focusing solely on volume and pressure considerations."

## Like soap

Cornelio ran 36 experiments, simulating earthquakes of varying intensity, and propagating at different speeds, in granite or marble, with fluids of four different viscosities. Her findings demonstrated a clear correlation between fluid viscosity and earthquake intensity.

"Imagine these fluids working like soap, reducing the friction between your hands when you wash them, or like the oil you spray on mechanical parts to get them moving again," explains Marie Violay, an assistant professor and the head of the LEMR. "Moreover, naturally occurring earthquakes produce heat when the two plates rub together. That heat melts the rock, creating a lubricating film that causes the fault to slip even further. Our study also gives us a clearer picture of how that natural process works."

**More information:** C. Cornelio et al, Mechanical behaviour of fluid-lubricated faults, *Nature Communications* (2019). DOI: 10.1038/s41467-019-09293-9

Provided by Ecole Polytechnique Federale de Lausanne