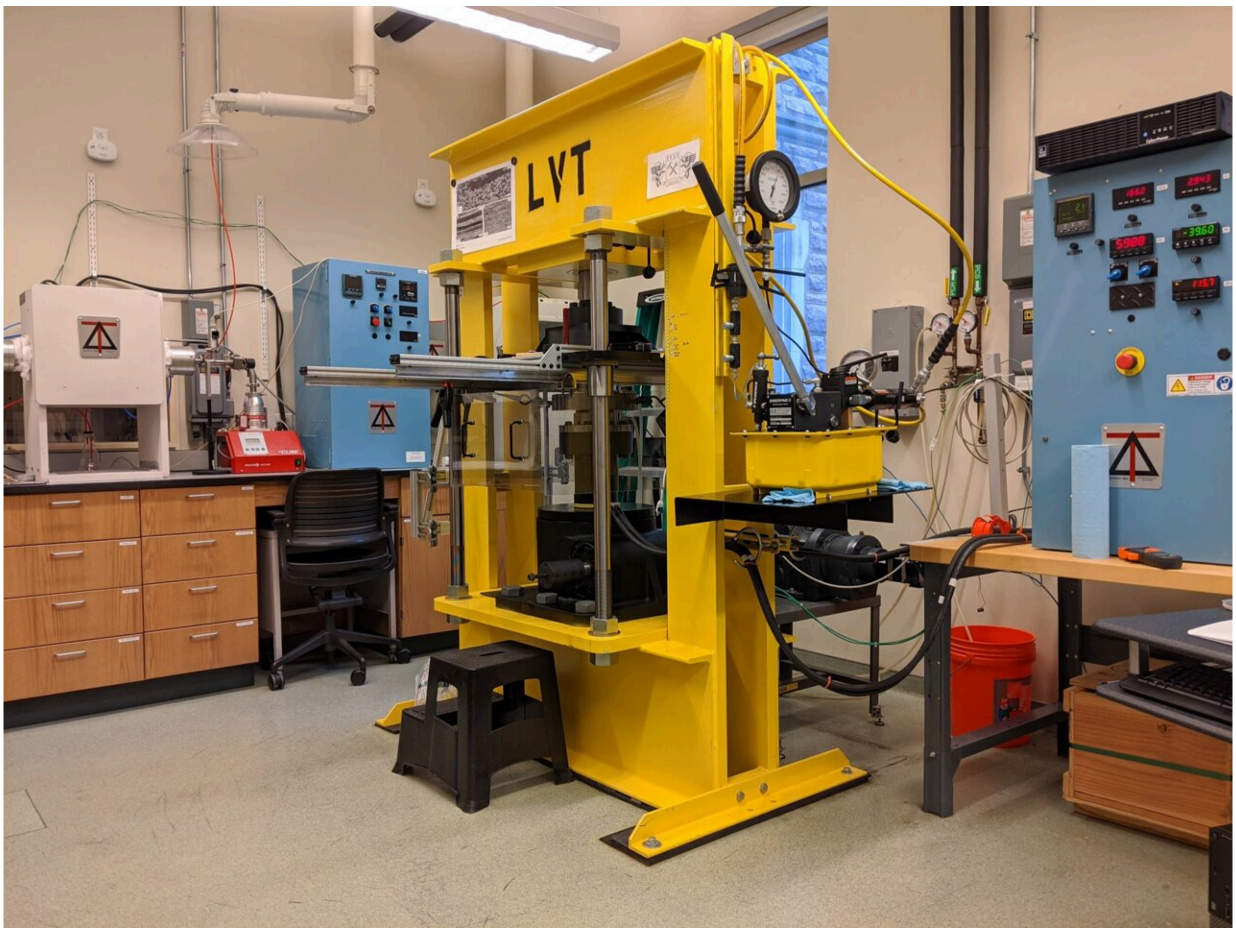
Squeezing rocks for science: The power and potential of the large volume torsion apparatus

May 9 2023, by Chris Woolston



A large volume torsion apparatus in Skemer's lab. Credit: Washington University in St. Louis

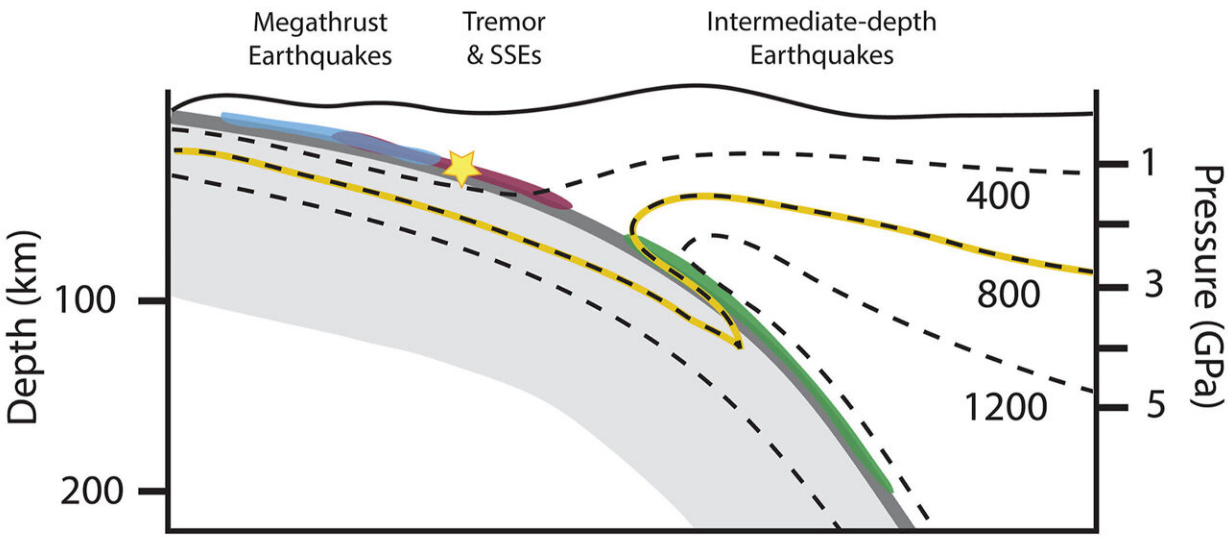
Philip Skemer, associate department chair and professor of Earth and planetary sciences, and graduate student Charis Horn, both in Arts & Sciences at Washington University in St. Louis, have published a study in *Geophysical Research Letters* that showcases the power and potential of the large volume torsion (LVT) apparatus.

This WashU-built device can squeeze and twist rocks with 100 tons of force and temperatures of 1,300 degrees Celsius (2,500 degrees Fahrenheit). "There are no other devices with the same capabilities anywhere else on the planet," Skemer said.

Skemer's lab now has two LVT devices, each standing 8 feet tall and weighing about 5,000 pounds. The LVTs were designed to experimentally reproduce how rocks deform in parts of the Earth that are subject to high pressure and temperature, including deep within faults where tectonic plates meet.

In the latest study, Horn and Skemer used the device to test talc, an extremely soft mineral that is commonly found in active, earthquake-prone faults.

Experiments with the LVTs showed an unexpected result: When pressed hard enough, the layers in the mineral form ripples, much like rumpled carpet. Those ripples create small pockets of empty space called ripplocations, features that were unknown to scientists a decade ago. "We're pushing on the talc from all sides with an enormous amount of force," Skemer said. "You would not expect that to create a void."



Schematic of a hot subduction zone. Temperature contours are from Currie et al. (2004). The pale gray region represents the downgoing slab, with depths dominated by different seismic regimes highlighted atop the slab. The yellow star indicates the pressure at which our experiments were conducted. The maximum depth of talc is assumed to follow the 800°C isotherm (highlighted in yellow), since in a hot subduction environment talc stability will be exceeded before it reaches its maximum pressure limit (Pawley & Wood, 1995). Earthquake depths are from Schwartz and Rokosky (2007) and Hyndman et al. (1997).

This is the first time researchers have seen these structures in talc, and their discovery could change geophysicists' understanding of how certain classes of mineral responds to stress deep underground. "It's important because the tiny spaces might give water a place to permeate the rocks, which could change the mechanical properties of the rocks," Skemer said.

Skemer and Horn suspect that talc may play a surprising role in the movements of faults. The new paper postulates that talc and its ripplocations might encourage "slow slip events," which are relatively slow movements that happen along the surfaces of faults, and that are detected using GPS and seismological techniques. At this time, however, it's not clear how they might affect the sudden movements closer to the surface that cause earthquakes.

Skemer cautions that his research doesn't make it any easier to pinpoint where and when earthquakes might occur. "Our goal is not to predict earthquakes," he said. "We study the physical properties of geologic materials to better understand processes that affect the evolution of planets."

More information: C. M. Horn et al, Semi-Brittle Deformation of Talc at the Base of the Seismogenic Zone, *Geophysical Research Letters* (2023). DOI: 10.1029/2022GL102385

Provided by Washington University in St. Louis