Earthquakes ! In the laboratory...

Because earthquakes are spectacular examples of uncontrollable catastrophes, the opportunity to study them under controlled conditions in the laboratory is unique and is, in fact, the only way to understand the details of the earthquake source physics. Following the pioneering work of Brace and Byerlee (1966), we propose a simple idea : to reproduce earthquakes, on real rocks, at in-situ conditions, in the laboratory. The advantage of this approach is that, at the very first order, if the experiment matches real in-situ conditions, physical processes at play during dynamic fracture propagation are expected to be the same as those during 'real' earthquakes. In other words to experimentally constrain the thermodynamic conditions driving dynamic shear crack propagation in rocks, while recording all the relevant parameters essential to quantify fully, the energy budget at play during an earthquake. Put together, our studies demonstrate that dynamic rupture propagation is self-similar, and thus, laboratory earthquakes are not mere earthquake analogs, but real -yet tiny- earthquakes. Doing so, our work particularly highlights the non-negligible role played by (mineral) phase transitions in the earthquake energy budget, both during earthquake triggering and dynamic rupture propagation.