

4D X-ray imaging of laboratory earthquakes

François Renard, The Njord Centre, University of Oslo



Earthquakes occur in the Earth's crust and dissipate part of the elastic strain energy accumulated by tectonic plates.

They initiate at 5-15 kilometers depths and direct observation of rock fracturing processes at these depths is not possible. In the Oslo group, we have developed a rock deformation apparatus, the Hades rig, which allows reproducing the conditions of pressure and temperature at depths where earthquakes occur.

We have deformed a series of rock samples under in situ conditions to reproduce the fracturing and frictional processes responsible for earthquakes. We have imaged these samples using dynamic X-ray microtomography.

The Hades apparatus has been designed to be used on beamline ID19 at the European Synchrotron Radiation Facility. The full synchrotron white beam with energy up to 200 keV is used and the apparatus acts as a filter such that the sample receives an energy around 80 keV. For the first time, mechanisms that lead to frictional processes and system-size failure in rocks were imaged at micrometer spatial resolution.