ÉCOLE DOCTORALE
SCIENCES DE LA TERRE ET DE L'ENVIRONNEMENT
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Titre du sujet : Experimental and numerical investigation of thermo-hydro-mechanical couplings during earthquake rupture

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Earthquakes result from weakening of faults (transient decrease in friction) during co-seismic slip. Dry faults weaken due to degradation of fault asperities by frictional heating (e.g. flash heating). In the presence of fluids, theoretical models predict faults to weaken by thermal pressurization of fault fluid. However, experimental evidence of rock/fluid interactions during dynamic rupture under realistic stress conditions remains poorly documented, while numerical models seldom take into account the Pressure-Temperature dependence of the fluid properties.

In this project we aim at demonstrating that the relative contribution of thermal pressurization and flash heating to fault weakening depends on fluid thermodynamic properties. Laboratory earthquakes will be generated, during which all the thermodynamic quantities (temperature, pressure, stresses and strains) will be measured, in order to understand what drives frictional weakening under dry, high and low fluid pressure conditions. Our results will be confronted to flash-heating theory modified for pressurized fluids and by numerical modelling of thermal pressurization, in order to later extrapolate our results crustal depths (~2–10 km), where most natural earthquakes nucleate.

References:

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3. Viesca, R. C., & Garagash, D. I. (2015). Ubiquitous weakening of faults due to thermal pressurization. *Nature Geoscience*, *8*(11), 875-879.