Joint PhD in UNSW and ENPC on fault mechanics

The Universities of UNSW Australia and ENPC France open a joint PhD (cotutelle) position in the area of theoretical and experimental fault mechanics. The call is open until the position is fulfilled and the candidates will be assessed on a case-by-case basis. The interested candidates need to email their CV and expression of interest to Manolis Veveakis in UNSW (e.veveakis@unsw.edu.au) and Ioannis Stefanou in ENPC (ioannis.stefanou@enpc.fr).

Summary of the project

Shear zones in outcrops and core drillings on active faults commonly reveal two scales of localization, with centimeter to tens of meters thick deformation zones embedding much narrower zones of mm-scale to cm-scale. The narrow zones are often attributed to some form of fast instability such as earthquakes or slow slip events. Surprisingly, the double localisation phenomenon seems to be independent of the mode of failure, as it is observed in brittle cataclastic fault zones as well as ductile mylonitic shear zones. In both, a very thin layer of chemically altered, ultra fine grained ultracataclasite or ultramylonite is noted. Recent studies reveal that in both brittle and ductile shear zones, chemistry stops the localisation process caused by a multiphysics feedback loop leading to an unstable slip. The microstructural evolutionary processes govern the time-scale of the transition between slow background shear and fast, intermittent instabilities in the fault zone core. The fast cataclastic fragmentation processes are limiting the rates of forming the ultracataclasites in the brittle domain, while the slow dynamic recrystallisation prolongs the transition to ultramylonites into slow slip instability in the ductile realm. It is therefore of fundamental importance to understand the different physical mechanisms operating during the evolution of a shear zone, and measure the energy budget of each of them.

The suggested project proposes a thorough theoretical, numerical and experimental study of the mechanics of energy dissipation in rapidly deforming shear zones. It will combine thermo-poro- mechanical experiments with appropriate analytical and numerical tools aimed to tackle the description of the mechanical behaviour of shear bands from the rigorous angle of energetics.

Requirements

The candidate is expected to:

1. Be eligible for the commencement of a PhD in both countries (Australia and France) and be willing to spend his time shared between the two institutes (1.5 years in Sydney and 1.5 years in Paris)
2. Have a solid background in mechanics

Stipend

The successful candidate will receive the equivalent of a full Australian scholarship ($26,000 - $35,000 AUD per year), plus additional travel budget facilitating the interaction between the two institutes and the overall cotutelle experience.