FRICTION - Fluid-Rock InteraCTION at hydrothermal conditions during the seismic cycle

Earthquakes, sometimes human-induced, cause about 50,000 casualties per year and billions of euros in damage. However, the probabilistic forecasting of earthquakes is challenged by our poor knowledge of earthquake physics and chemistry. In fact, the most damaging earthquakes are the result of ruptures nucleating and propagating in the Earth's crust along faults often impregnated by water-rich hot fluids ('hydrothermal fluids'). The poorly understood chemical and physical interaction between these fluids and the fault rock materials controls the early stages of earthquake nucleation. The EU-funded FRICTION project focuses on the dynamic interaction between hydrothermal fluids and fault zones in the continental crust. The study of ancient seismic faults, now exposed at the surface, and dedicated experiments reproducing these particular hydrothermal conditions will help to quantify the mechanical behaviour of faults in the presence of fluids at seismogenic depths, also for the safe exploitation of deep-seated reservoirs for energy purposes (geothermal fields, etc.).

With ca. 50.000 casualties per year and 330 billion USD of damage in this century, earthquakes are among the biggest geohazards on Earth. Earthquakes are natural, often human-induced, phenomena in which a vast amount of elastic strain energy stored in rocks is suddenly released. A large amount of research has been performed to investigate fault mechanisms during earthquakes whereas much less has been done to constrain the chemical-physical processes of fluid-rock interaction during the seismic cycle and how these processes enhance the healing of fault zones, the storage of elastic strain energy in the crust and the nucleation of new earthquakes.
The project FRICTION, building on the exciting results from a previous ERC project aimed to understand earthquakes mechanics from rupture nucleation and propagation to arrest, aims at investigating the feedback between seismic faulting, fluid-rock interaction, and tectonic loading in the processes of healing of fault zones and nucleation of earthquakes in the continental crust. FRICTION is innovative since it tackles a scientific topic which was so far overlooked with a multiscale interdisciplinary approach combining: high-detailed field structural characterization of exhumed ancient seismogenic fault zones, unprecedented rock deformation and fluid-rock interaction experiments under realistic hydrothermal and seismic conditions, both coupled with microstructural-petrophysical and chemical characterization of natural and experimental fault rocks.
This integrated approach will lead to building a wealth of novel datasets to quantify the strength, friction constitutive properties, and sliding behavior of faults at hydrothermal conditions in the continental crust. The research will be conducted at Università degli Studi di Padova, where the joint assets of an experienced supervisor and unique, ground-breaking equipment will guarantee the successful progress of the research and my professional growth as an independent researcher.

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