Subject offered for a contract starting October 2018

FLUID TRANSPORT IN METAMORPHIC ROCKS: from field observations to the petro-physical properties of the subduction interface

Advisor: **ANGIBOUST Samuel, MCF, angiboust@ipgp.fr**

Host lab/ Team: **IPGP- Team Tectonics and mechanics of the Lithosphere – UMR7154**

Financing: Doctoral contract with or without teaching assignment

For more information go to http://ed560.ipgp.fr, section: Offres de these (PhD offer), You must apply on the Doctoral School website

Presentation of the subject:

Fluids released by metamorphic devolatilization reactions (e.g. H_2O, CO_2) between 20 and 60 km depth in subduction zones are generally invoked to explain a wide range of petrological and mechanical processes documented by both experimental and geophysical observations such as mantle wedge hydration, seismic instabilities and episodic slow slip events at the base of the seismogenic zone. In order to understand the origin of fluid "pulses" documented by geophysicists in active subduction zones (e.g. Frank et al., 2015; Fig.1A) it is crucial to study natural field examples exposing ancient subduction channels where such events may have formed. We herein focus on very well-preserved exposures of blueschists from Central Chile and Southern Iran characterized by pervasively hydrofractured blueschist-facies metabasalts wrapped in subduction channel matrix rocks (sediments and serpentinites). Preliminary observations have shown that these hydrofractures formed during burial of the oceanic lithosphere between 30 and 50km depth (Fig.1B,C). Understanding the origin of vein-filling material as well as the spatial distribution of these veins and their structural link with the matrix around is therefore critical for imaging subduction zone petro-physical processes poorly resolved until now.

The project will comprise two field missions (fall 2018-spring 2019) devoted to extensive mapping of structures from the vein scale to the outcrop scale and the collection of vein and matrix samples. The samples will be investigated by petrological and geochemical means (including chemical trace element mapping and LA-ICPMS; 2019-2020).

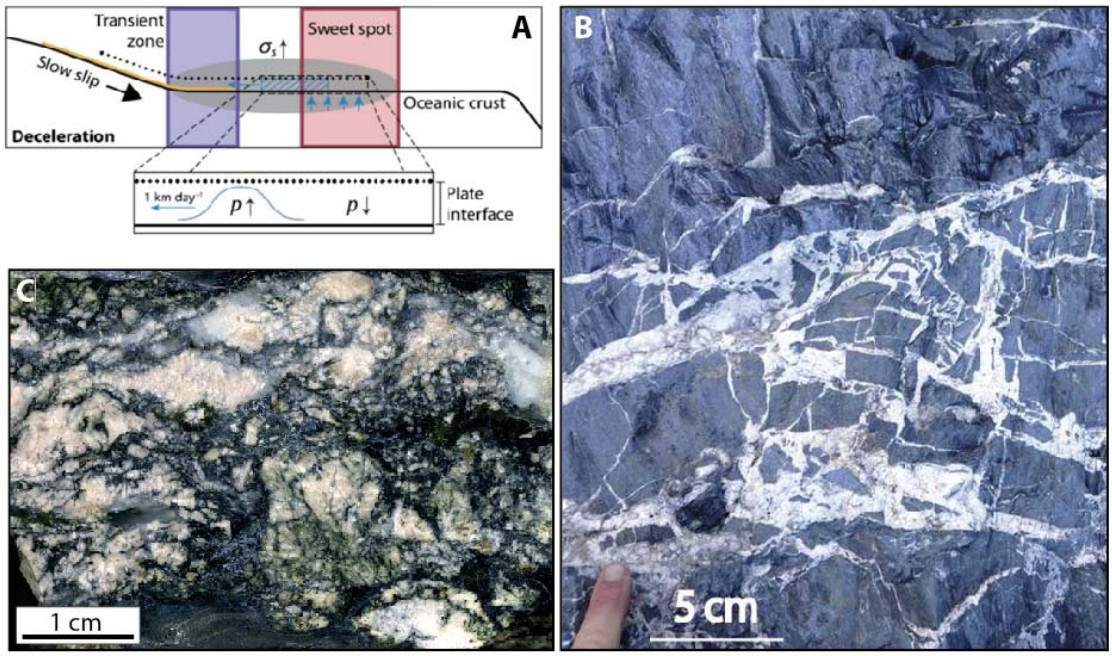

Fig.1. A. Geophysical model documenting fluid pulses travelling parallel to the interface at 40km depth in the Mexican subduction zone (Frank et al., 2015). B. Field view of a glaucophane-rich mafic block transected by prograde hydrofractures. C. Close up view a deformed vein sample showing a deformed micro-breccia texture formed at high-pressure/low-temperature conditions.

Stable isotopes studies (namely carbon, oxygen and strontium; autumn 2019) will be performed on carbonates and silicates to evaluate the degree of isotopic mixing between the matrix and the veins. Microstructures inside deformed rock regions will also be studied using EBSD mapping to understand and quantify the intensity of dynamic recrystallization (yr 2020). Last, a procedure linking thermodynamic modeling results, field observations and petro-geochemical data will be established in order to develop a volatile production model (yrs 2020-2021). These results will also provide quantitative estimates of petrophysical parameters of interface material (including pore fluid pressure variations, seismic velocities and densities) and be discussed with seismologists in the light of the recent finding of "fluid pulses", slow earthquakes and low frequency tremors.

The selected candidate will mostly work in the group of Tectonics at IPGP and in collaboration with the group of Geochemistry (P. Cartigny) and Seismology (N. Shapiro). Further data acquisition will be performed at the GFZ Potsdam (J. Glodny), at Lehigh University (G. Bebout) and at UPMC (P. Agard). This ambitious multi-disciplinary project requires a brilliant candidate interested by subduction zone processes, ready for remote field expedition and with a good knowledge of petrology and/or geochemistry and/or rock mechanics. A good command of English as well as computing skills (Illustrator, Matlab or equivalent) is required.