The Northern Andes orogeny: causes and consequences

(Proposer: Prof. Massimiliano Zattin)

Understanding the construction and destruction of mountain chains needs the application of several fields in Earth sciences and may, in turn, provide first-order constrains on geodynamics and climate evolution. Mountain formation also appears as one of the most important geological processes linked with biological aspects such as speciation, migration and diversification. Orogenic systems often involve magmatism that results from variable contributions from mantle, crustal and subducted reservoirs. Episodic magmatism in cordilleran arcs are believed to be the result of: 1) external forcing (mostly slab dynamics) and 2) internal crustal forces mostly those leading to variation of crustal thickness.

The southernmost Northern Andes (SNA; i.e. the transition between the northern Andes and the central Andes) are located between the Ecuadorian and Peruvian Andes and correspond to one of the less studied parts of the subduction-orogeny Andean system. The SNA are coincident with: 1) the northern border of the magmatic gap related to the Peruvian flat slab, most-likely associated with the end of the magmatic activity during the latest Miocene and 2) the onset of the foreland fold-and-thrust belt coincident with the significant increase of the width of the Andean chain. The evolution of the topography of the SNA is poorly known with only few and sporadic rock uplift constrains and null surface uplift estimates.

The Ph.D. project is based on different lines of research: 1) the study of the magmatic evolution of the SNA by analyzing magmatic tempos and modes by radiometric dating and whole rock and mineral geochemistry (zircon and eventually apatite); 2) the study of rock uplift processes in both the west and east flanks of the SNA by thermochronometric techniques (mostly apatite fission tracks).

To address the project tasks, apatite fission track and (U-Th)/He dating will be performed on land outcrops (several fieldwork campaigns are expected). Fission track and (U-Th)/He analyses will help to estimate the denudation history of the Cordilleras. These data will be combined with the study of the magmatic evolution of the arc by analyzing magmatic tempos and modes by radiometric dating (mostly U-Pb on zircon) and stable and radiogenic isotopic analysis (mostly $\delta 18O$ and εHf).

The present study will attempt to establish a robust regional analysis of the SNA in terms of their eventual relationships with the internal and external forcing that are believed to shape cordilleran systems. In this context, our study will contribute to a better understanding of the interactions between tectonics and magmatic reservoirs operating in subducting systems. In particular, we will consider potential changes in the slope of the slab possibly associated with the subduction of oceanic plateaus, slab breakoff events and/or mantle convective processes. All these aspects are currently unexplored in this part of the Andes.

The joint research group (made by researchers from the Universities of Lille and Padova) has been working in the Andes for five years. The PhD. project will be supervised by Massimiliano Zattin from University and Cesar Witt from Lille University through a co-tutelle agreement. The project will also benefit from the collaboration with other units such as Geosciences Montpellier, CRPG, IRD.