The Northern Andes orogeny: causes and consequences

(*Proposer: Prof. Massimiliano Zattin*)

Understanding how mountain chains form needs the application of several tools and methodologies and may, in turn, provide first-order constrains on very different aspects including geodynamics and climate. Mountain formation also appears as one of the most important geological parameters linked with biological aspects such as speciation, migration and diversification. In the geodynamics' point of view, orogenesis may be intrinsically related with aspects taking place at very different levels from the deep lithosphere to the shallow surface. It has been demonstrated that mountain building is not entirely coupled to crust shortening. In fact, convergence rate, age and angle of the subducting slab, roll-back, subduction regime, partitioning and deeper mantle flow are believed to be some of the aspects responsible for deformation in the forearc–arc pair, thus controlling the interplay between uplift and subsidence in convergence margins.

The Andean mountains form the second largest mountain chain in the world, and at present most studies aiming at understanding the link between geodynamic processes and topography focus on the Southern and Central Andes disregarding the role of the Northern Andes in the overall long-term landscape evolution. The southernmost Northern Andes (SNA) are located between the Ecuadorian and Peruvian Andes and correspond to one of the most segmented zones of the subduction-orogeny system, including the presence of autochthonous versus allochthonous basements and normal versus flat subduction. The uplift history of the SNA is poorly known with only few and sporadic rock uplift constrains and null surface uplift estimates. Furthermore, the SNA host several middle Miocene intermountain basins of marine and continental origin making difficult the conception of a paleo-geographical model. The characterization of vertical movements and the formation of trench-parallel structural highs may help to elucidate temporal guidelines for sediment input to the trench and recycling of crustal material at the Peruvian subduction zone. In this frame, a proper analysis of tectonic forcing including its spatial and temporal distribution is susceptible to be combined in the future with numerical modelling, geochemistry and morphological studies that will offer valuable insights on the relationships between forearc deformation and the dynamics of subduction and the Andean orogeny, thus improving the current knowledge about how forearcs really form.

The research is aimed to three main objectives, summarized as follows:

- reconstruction of the thermal evolution with possible identification of discrete exhumation events along both the Coastal and main cordillera;
- characterization of the nature of the magmatic intrusions and evaluation of their role in uplift and exhumation;
- quantification of possible budgets between forearc sedimentation (rates and gaps) and the evolution of the magmatic arc.

This Ph.D project searches to follow different lines of research and implies a total participation of the student in: 1) the study of the magmatic evolution of the SNA by analyzing magmatic tempos and modes by radiometric dating and stable and radiogenic isotopic analysis (mostly $\delta 18O$ and εHf); 2) the study of rock uplift processes in both the west and east flanks of the SNA by thermochronometric techniques (mostly apatite fission tracks).

If the scholarship is obtained, the Ph.D. project will be based on a ***co-tutelle scheme between the Universities of Padova and Lille*** under the supervision of Professor Massimiliano Zattin and Dr.

Cesar Witt, respectively. The project will benefit also of the collaboration of Dr. Delphine Bosch of the University of Montpellier for ICP-MS analyses and of Dr. Pablo Samaniego (CNRS-IRD). At least two field campaigns will be hold in 2022 and 2023. The project will be supported by funds from both Padova and Lille Universities and is the subject of two proposals submitted to the calls Vinci 2021 and PRIN2020 (currently under evaluation).