The growth of the southern Andean chain: a source-to-sink approach

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The topographic evolution of a mountain belt has been debated since decades in the Earth Science community. This is true also for the Andean chain, where the complex feedback between climate, tectonic and magmatic evolution causes significant variations along the chain and through time. The project is focused on the Patagonian sector, where an abrupt and major increase of both summit elevations and local relief along the orogenic crest occurs immediately inland of the Chile Triple Junction, where the Chile Rise collides with the South American continent. Recent studies have proposed a dynamic support of high topography above an extensive slab window created after collision (Guillaume et al., 2013). An alternative model interprets the increase of topography as due to local tectonics, in the case of Patagonia related to margin-parallel right-lateral strike-slip deformation by closely spaced oblique collision of successive oceanic ridge segments during the past 6 Ma (Georgieva et al, 2016). Finally, Thomson et al. (2010) linked increased summit elevations with latitudinal climate gradients and changes in the efficiency of glacial erosion. Despite these very different models, an along strike variability is evident and it is very clear that the building of Southern Andes was active in several different pulses since the Late Cretaceous (Folguera and Ramos, 2011). The internal tectonic segmentation is marked by the variable position of the magmatic arc and of the deformation front in the retroarc area.

The Argentinian side of the orogen corresponds to the foreland and is dominated by a landscape of faulted basement blocks and intramontane depressions of Neogene-Quaternary age. Their filling is the product of erosion of hinterland areas whose uplift is controlled by the before mentioned tectonic and climate-related factors. Therefore, these deposits yield precious information on the topographic growth of the chain. More in details, as the exposed continental-to-marine sediments span from Oligocene to Recent, we have the chance to investigate the evolution of the chain in the the last 30 m.y. This project is focused on detrital thermochronology as this tool is able to provide a fingerprint of the different sources of sediments and, through the lag-time approach (i.e. the time difference between the cooling age and the depositional age of a detrital mineral grain), is often used to infer the evolutionary stage of an orogen (growing, steady state or decaying). We plan to use a double-dating technique (fission-track and U-Pb dating) on a single mineral (apatite) to combine information on the crystallization of the rock and its cooling to surface. First, apatites will be dated through fission-track technique (at the Department of Geosciences of the University of Padova) and, then, they will be investigated by a La-ICPMS for U-Pb dating and geochemistry (at the Department of Physics and Geology of the University of Perugia). Single grain age data will be thus integrated by geochemical analyses that could provide an adding signature of the source rock.

Analysis on detrital apatites will be performed on a large number of grains and samples that will be collected from different sedimentary successions that deposited in the central Patagonian basin, at latitudes comprised between 44°S and 47°S, i.e. at the same latitude of the present-day Chile Triple Junction. Data obtained from detrital grains will be compared first with exhumation ages on the possible source rocks now exposed along the Cordillera and pre-Cordillera ranges. Although some data are already existing, we plan to collect new samples that will be dated with fission-track and U-Th/He techniques. The latter will be performed at the laboratories of the University of Paris Sud.

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