ENGLISH

Topic/Title

Unravelling the spatio-temporal distribution of surface uplift in active orogens: New data from the southern Apennines (Italy) and Chilean Andes – 30S

Proposer (Tutor)

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Research proposal

In the last decades, growing attention has been placed to the analysis of the morphometric features of rivers and the reconstruction of the evolution of fluvial systems in active mountain belts, which are both considered as valuable clues to the reconstruction of the time-space distribution of vertical motions. Indeed, river dynamics is very sensitive to any - climate or tectonic-driven - environmental change and rivers transmit any perturbation across hydrographic basins. Among the main perturbations that may affect the hydrographic net, those resulting from relative sea-level changes driven by coastal uplift strongly affect fluvial dynamics, making difficult the detection of vertical motions inside the mountain belts.

The research proposal herein aims at the investigation and comparison the spatial distribution of vertical motions in two active mountain belts through the geomorphological analysis of two transects spanning from the coast to the orogenic divide. The selected transects are located in the Chilean Andes – 30S latitude – and in the Calabrian-lucanian sector of the southern Apennines, respectively. The Andean transect includes the drainage basins of the Los Choros and Elqui rivers, while the southern Apennine transect spans from the Maratea/Scalea Tyrrhenian coastal belt to the Noce and Lao/Mercure river basins. Although being characterized by major differences in terms of both geological processes and large-scale morphometry features (e.g., elevation, relief), the

selected transects share a common feature, that is comparable coastal uplift rates (in the order of 0.2-0.25 mm/a, estimated by raised marine terraces) since the late Quaternary. Such a condition makes the river systems located in the transects comparable in terms of active and recent (late Quaternary) tendency to incision. Therfore, the comparison of the relief/hydrographic net features in the two transects, will allow highlighting the contribution provided by parameters, such as local relief or/and surface uplift inside the moutain belts on the dynamics and evolution of river systems.

The methodological approach will be bsed on the integration of morphometrical and morphostratigraphical analyses. A morphometrical analysis of topography and drainage net will be carried out in GIS and MATLAB environments using digital elevation models at different scales (SRTM 90m, ASTER GDEM, and GTOPO30). Various morphometric parameters will be derived, such as: i) swath profiles; ii) elevation maps and related indices (maps of maximum, mean, and minimum elevations; slope maps); iii) local relief; iv) hypsometric integral of drainage basins; v) longitudinal river profiles and related indices (concavity index, θ, and normalized steepness index, Ksn); vi) chi-plots and knickpoints. Combined analysis of these indices will allow the identification of areas characterized by anomalies (e.g., increases in mean elevation, local relief, Ksn index, or slope of chi-plots), which can be interpreted as the result of recent vertical movements. A classical morpho-stratigraphical analysis will be focussed to the identification, mapping and characterization, in the field, of fluvial terraces. Age constraints to the fluvial terraces will be obtained by OSL (Optically Stimulated Luminescence) measurements. The presence, in the investigated drainage basins, of lithologies rich in quartz and feldspars (volcanic units in the Principal Cordillera of the Andes and Lagonegrese units in the southern Apennines) makes the fluvial deposits ideal candidates for OSL dating. The dating will be performed at the School of Earth and Environmental Sciences, University of St Andrews (UK), with which a long-standing

scientific collaboration is in place. The results will allow the estimation of fluvial incision rates, that will contribute to assess the spatial distribution of uplift inside each transect, and to compare the style of uplift in the investigated mountain range sectors.

Research Plan

I° year

- Morphometricl analyses of topography and river network through GIS and Matlab
- Geomorphological analysis of the selected river basins and river terrace mapping;
- Traineeship on OSL sampling techniques at the School of Earth and Environmental Sciences, University of St Andrews, St Andrews (UK);
- Field work and sampling of river terraces in the southern Apennines;
- Field work and sampling campaign in Chile.

II° year

- Field work and sampling of river terraces in the southern Apennines;
- Field work and sampling of river terraces in Chile.
- Sample preparation and OSL dating (at the University of St Andrews);
- Synthesis of the study on the Apennines transect;
- Presentation of the results at conferences.

III° year

- Sample preparation and OSL dating (at the University of St Andrews);
- Synthesis of the study on the Chilean transect;
- Synthesis of the study;

- Presentation of the results at conferences;
- Writing of the dissertation.

Additional notes:

Financial support to the Chile field work and geochronological analyses will be supplied by the PRIN 2022 Project "Innovation in Thermochronology applied to the Andean natural laboratory", within which the study is framed.