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Tectonics and erosion patterns on long-term and short-term timescales: insights from detrital fission-track analysis in the Western Alps

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Erosion is a fundamental process for exhumation of rocks during the late stages of orogeny. Lithology, relief, climate and tectonics have been alternatively invoked as the most important controlling factors (Harrison, 1994; Vannay et al., 2004; Koppes & Montgomery, 2009).
Fission track analysis on detrital minerals allows to investigate both long- (10^6 yr) and short-term (10^3-10^5 yr) exhumation and erosion patterns in orogenic belts, the former being recorded by the age of fission-track populations, the latter by their relative size, provided that apatite fertility in the source rocks and the effects of hydraulic sorting are taken into account (Malusà et al., 2009).
Our analyses are focused on two transects across the Western Alps, in the Aosta and Arc Valleys, draining in opposite directions a comparable stack of tectonic units. Available fission-track data on bedrock apatite indicate increasing long-term exhumation rates from the axial sector of the belt towards the European foreland. Major age jumps across the main tectonic discontinuities detected in the field testify for a primary tectonic control on long-term erosion rates (Malusà et al., 2005). Spatial distribution of bedrock age data made it possible to infer provenance of detrital grains.
Our study shows that the focus of short-term erosion is located in the External Massifs, thus reproducing the long-term erosion pattern derived from bedrock fission-track data. Geomorphological analysis and distributions of pluviometric data show no clear correlation between local morphology, climate and erosion. Tectonics is instead invoked as the main driving force controlling both short-term and long-term erosion rates in the Western Alps.

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