Fluvial bedrock gorges as markers for Late-Quaternary tectonic and climatic forcing in the French Southwestern Alps

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As one of the major erosive processes acting at Earth’s surface, fluvial incision is highly sensitive to tectonic, isostatic and climatic variations. In order to better understand what is the timing and driving mechanism(s) for Late-Quaternary incision in the Southwestern Alps, we focused on bedrock gorges and measured in situ-produced $^{36}$Cl concentrations along several river-polished gorge walls in the external Southwestern French Alps. Unlike previously dated river gorges in the study area, these newly dated catchments lie out of the previously glaciated domains during the last glacial periods, which makes them suitable to quantify fluvial incision dynamics in a non-glacial environment.

Cosmic-ray exposure dating results (ranging from 1 to 85 ka), compared to previous literature results in nearby catchments with glacial imprint and combined with a morphometric analysis, allow us to highlight three catchment groups related to different incision dynamics: (i) Group A with very high (=5 mm/yr) and recent (post-10 ka) incision rates that reflect recent topographic readjustment of glaciated catchments by fluvial and hillslope processes; (ii) Group B, including gorges that are directly or indirectly connected to the glacial processes, showing increased incision rates (1-3 mm/yr) during the paraglacial period after the Last Glacial Maximum (ca. 20 ka), possibly related to an increase in sediment yield and water runoff following glacier retreat; (iii) Group C with slow and steady incision rates (<1 mm/yr over the last ca. 30 kyr), which do not seem to reflect any impact of any climatic variations (except the humid Holocene phases) and that are comparable to previously estimated long-term denudation and rock-uplift rates in the area.

In catchments with glacial imprints, the climatic impact on fluvial incision is evidenced through high amplitudes changes that hinder the long-term (background) tectonic signal. Despite this, our results suggest the influence of long-term tectonic on geomorphic processes for sites disconnected from the glacial influence, showing that fluvial bedrock gorges can provide insightful constraints on both long-term tectonic and short-term climatic forcing.