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Differential post-orogenic topography along the Romanian Carpathians.

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The growth or decay of a mountain range through time depends on the interactions and feedbacks between tectonic (e.g nappe stacking) and surface (e.g fluvial incision) processes. The syn-orogenic system is controlled by the balance between thickening and erosion, where the uplifting range is the source of sediment and the subsiding (foreland) basin the sink. However, during post-orogenesis, surface elevations can vary significantly along the system, driven by differential deep processes (e.g. isostatic rebound, gravitational collapse, asthenospheric flow), differential lithologies (e.g. plutonic/metamorphic rocks in the inner range vs sandstones and mudstones in the fold-and-thrust belt) and changing base levels. It results in a spatial reorganization of source-to-sink systems and the associated sediment fluxes (e.g. basins inversions, gateway opening, relief decay) driven by the differential control on the topography along the post-orogenic range.

We are investigating the different controls on topography in the Romanian Carpathians (Eastern Europe). Its present-day topographic expression results from numerous exhumation phases since Mesozoic time, with the last evidence of thrusting during the Late Miocene collision. The post-orogenic decay shows an interesting pattern of vertical motions with normal faulting in the NE Carpathians, homogeneous rebound in the East and South Carpathians and significant uplift and subsidence in the SE Carpathians linked to mantle processes. It has undergone long-term reorganization of the source-to-sink system (e.g. opening of the Danube and Olt gateways, Transylvanian and Eastern Foreland basin inversion, drainage divide migration in the SE Carpathians) that significantly impacted the Danube-Pannonian-Black sea sediment flux. Moreover its differential exhumation history has been well constrained by a dense network of low-temperature thermochronometers and geophysical studies making this area a natural laboratory to study differential post-orogenic evolution and its impact on the drainage network morphology on a single mountain range.

The main controlling factors across the range are explored using objective and systematic extraction of topographic metrics along the range: the normalized channel steepness, knickpoints location, concavity index and drainage divides morphology, crossed with tectonic, lithology and exhumation history from this well constrained region. We show that large-scale signals extracted using systematic methods demonstrate remarkable differences in landscape along a same range.

First results suggest that despite of significant differences in the metrics along the different areas, changes in the source-to-sink system appears to be primarily linked to asymmetric base levels (elevation or nature) on both sides of the range. Transient signals, such as knickpoints, terraces or spatially varying concavity indexes and normalized channel steepness are widely detected through some of these areas suggesting the ones that are the most subjects to further evolution.