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Slab Driven Quaternary Rock-Uplift and Topographic Evolution in the Northern-Central Apennines From Linear Inversion of the Drainage System

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ABSTRACT

Investigating rock-uplift variations in time and space provides insights into the processes driving mountain-belt evolution. The Apennine Mountains of Italy underwent substantial Quaternary rock uplift that shaped the present-day topography.

Here, we present linear river-profile inversions for 28 catchments draining the eastern flank of the Northern-Central Apennines to reconstruct rock-uplift histories. We calibrated these results by estimating an erodibility coefficient (K) from incision rates and catchment-averaged erosion rates obtained from cosmogenic-nuclide data, and we tested whether a uniform or variable K produces a rock-uplift model that satisfactorily fits independent geochronological constraints. We employ a landscape-evolution model to demonstrate that our inversion results are reliable despite substantial seaward lengthening of the catchments during uplift.

Our findings suggest that a rock-uplift pulse started around 3.0–2.5 Ma, coinciding with the onset of extension in the Apennines, and migrated southward at a rate of ~ 90 km/Myr. The highest reconstructed rock-uplift rates (>1 km/Myr) occur in the region encompassing the highest Apennine massifs. These results are consistent with numerical models and field evidence from other regions exhibiting rapid rock-uplift pulses and uplift migration related to slab break-off. Our results support the hypothesis of break-off of the Adria slab under the central Apennines and its southward propagation during the Quaternary. Moreover, the results suggest a renewed increase in rock-uplift rates after the Middle Pleistocene along the Adriatic coast, coeval with recent uplift acceleration along the eastern coast of southern Italy in the Apulian foreland.