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Patterns and controls on fluvial incision in the lower Douro River (Western Iberia) following endorheic-exorheic drainage reorganization

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The Douro River, is ~900 km long and has a drainage basin of ~97,600 km², crossing most of the Iberian Peninsula from east to west. The evolution of the Douro system documents an outstanding example of a continental-scale drainage reorganization, reflecting a transition from endorheic to exorheic conditions. By the middle Cretaceous, the passive Western Iberian Margin was tectonically reactivated by an increasing N-S to NW-SE compression, leading to intraplate deformation. This deformation peaked at ~9.5 Ma (middle Tortonian) resulting in differential uplift of crustal blocks. Until ~3.7 Ma (middle Pliocene) the regional drainage was routed east into the endorheic Douro Cenozoic Basin (DCB).

The Lower Douro River Section (LDRS) is limited upstream by a pronounced knickzone called the Arribas do Douro developed into resistant basement bedrock. Along the LDRS, the Douro incises into hard granitic and metamorphic rocks crossed by active fault zones, before reaching the Atlantic coast. The main valley along the LDRS displays a fluvial staircase configuration of 11 levels, with the upper levels occurring as erosional bedrock straths and the 3 lowest levels as straths with a fluvial sediment cover.

Recent work has indicated that capture-related re-organization via headwards erosion of a small Atlantic draining system was unlikely due to the high resistance of the basement bedrock and instead overspill is a more plausible explanation (Cunha et al., 2019). Although the endorheic-exorheic reorganization leading to an Atlantic system, has recently been investigated, the fluvial incisional stage of the main river and tributaries is less understood along the LDRS.

In this work, the characterization the transient landscape relief of four distinct sectors along the LDRS, in terms of: valley floor width-height ratio, degree and rates of incision, uplift rates, migration of successive erosion waves and knickpoint propagation, preservation of old plateaus of the regional planation surface, influence of lithology on the relief evolution, and the staircase arrangement along the main course considering the presence/absence of aggradational levels. The LDRS can be divided in four sectors separated by two major NNE-SSW strike-slip fault zones, which are represented morphologically as river gorges along the uplifted blocks between pull-apart basins (e.g., Régua and Vilarica-Pocinho). The less uplifted areas are also where the aggradational strath terraces are well expressed.

The 4 sectors are: I) from the river mouth till the confluence of the main northern tributary, the Tâmega River – adjacent to a wide littoral platform with inland hills (top surface <500 m); II) from the Tâmega confluence to the Mesão Frio-Régua tectonic corridor, corresponding to the uplifted relief of the Occidental Mountain Range; III) from Régua to the Pocinho-Vilarica pull-apart basin, corresponding to the High Plateaus region of Northern Portugal; IV) from Pocinho to the river elbow that marks the DCB margin, the old erosion surface of the Iberian Meseta.

Cunha, P.; Martins, A.; Gomes, A.; Stokes, M.; Cabral, J.; Lopes, F.; Pereira, D.; de Vicente, G.; Buylaert, J-P.; Murray, A.; Antón, L. 2019. Mechanisms and age estimates of continental-scale endorheic to exorheic drainage transition: Douro River, Western Iberia. *Global and Planetary Change*, 181, 102985.