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ABSTRACTS

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Pedro Cunha, Alessandro Fontana and Andrei Panin

PATTERNS AND CONTROLS ON FLUVIAL INCISION IN THE LOWER DOURO RIVER (WESTERN IBERIA) FOLLOWING ENDORHEIC-EXHOREIC DRAINAGE REORGANIZATION

A. Gomes[1], P. P. Cunha[2], A. A. Martins[3], M. Stokes[4], R. Fernandes[1]

[1] *University of Porto, CEGOT - Centre of Studies in Geography and Spatial Planning, Dep. Geography, Portugal, atgomes@letras.up.pt; ruimoraisfernandes@gmail.com*

[2] *University of Coimbra, MARE - Marine and Environmental Sciences Centre; Dep. of Earth Sciences, Portugal, pcunha@dct.uc.pt*

[3] *University of Évora, ICT – Institute of Earth Sciences, Dep. of Geosciences, Portugal, aamartins@uevora.pt*

[4] *School of Geography, Earth and Environmental Sciences, University of Plymouth, United Kingdom, m.stokes@plymouth.ac.uk*

The Douro River, is ~900 km long and has a drainage basin of ~97,600 km^2, crossing most of the Iberian Peninsula from east to west (Fig. 1). The study area of the present work comprises the Lower Douro River (LDR), limited upstream by a relevant hard basement knickzone known as the Arribas do Douro. This case study is an outstanding example of a transition from endorheic to exorheic drainage, expressed by a major continental-scale drainage reorganization, followed by the ongoing stage of fluvial incision.

By middle Cretaceous, the passive Western Iberian Margin started to be tectonically reactivated by an increasing N-S to NW-SE compression, leading to intraplate deformation. The deformation climax reached since ~ 9.5 Ma (middle Tortonian) lead to the differential uplift of crustal blocks [1, 2].

Until ~3.7 Ma (middle Pliocene) the regional drainage was towards east, to the endorheic Douro Cenozoic Basin (DCB) (Fig. 1). The cause for the transition was not a capture (fluvial piracy) due to a progressive upstream erosive evolution by a former small Atlantic river, cutting on the progressively high hard basement. Instead, the recently proposed mechanism is by overspill [3, 4]. Although the endorheic-exorheic reorganization leading to an Atlantic system, has recently been investigated [2, 3, 4, 5, 6], the fluvial incisional stage of the main river and tributaries is less understood along the LDR, which will be characterized and discussed here (Fig. 1).

Along the LDR, Douro cuts down through hard granitic and metamorphic rocks crossed by active fault zones, before reaching the Atlantic coast. The main valley comprehends a terrace staircase of 11 levels, being the upper ones straths and the 3 lower ones aggradational (with a thickness of deposits).

In this work, we characterize the transient landscape relief of four distinct sectors along the LDR (Figs. 4, 5, 6, 7), in terms of: with-valley floor ratio, degree and rates of incision, uplift rates, migration of the 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 four sectors are separated by two major NNE-ESE strike-slip fault zones, namely the Penacova-Régua-Vérin fault zone (PRVfz) and the Manteigas-Vilariça-Bragança fault zone (MVBfz), which are in general, associated to huge gorges along the uplifted blocks between pull-apart basins (e.g., Régua and Vilariça-Pocinho) where the aggradational terraces are well expressed.

The 4 sectors of the LDR 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 less 500 m); II) from the Tâmega confluence till the tectonic corridor of Mesão Frio-Régua – uplifted reliefs of the Occidental Mountain Range; III) from Régua till the pull-apart basin of Pocinho-Vilariça – High Plateaus of Northern Portugal; IV) from Pocinho till the elbow that marks the DCB – the old erosion surface of the Iberian Meseta.

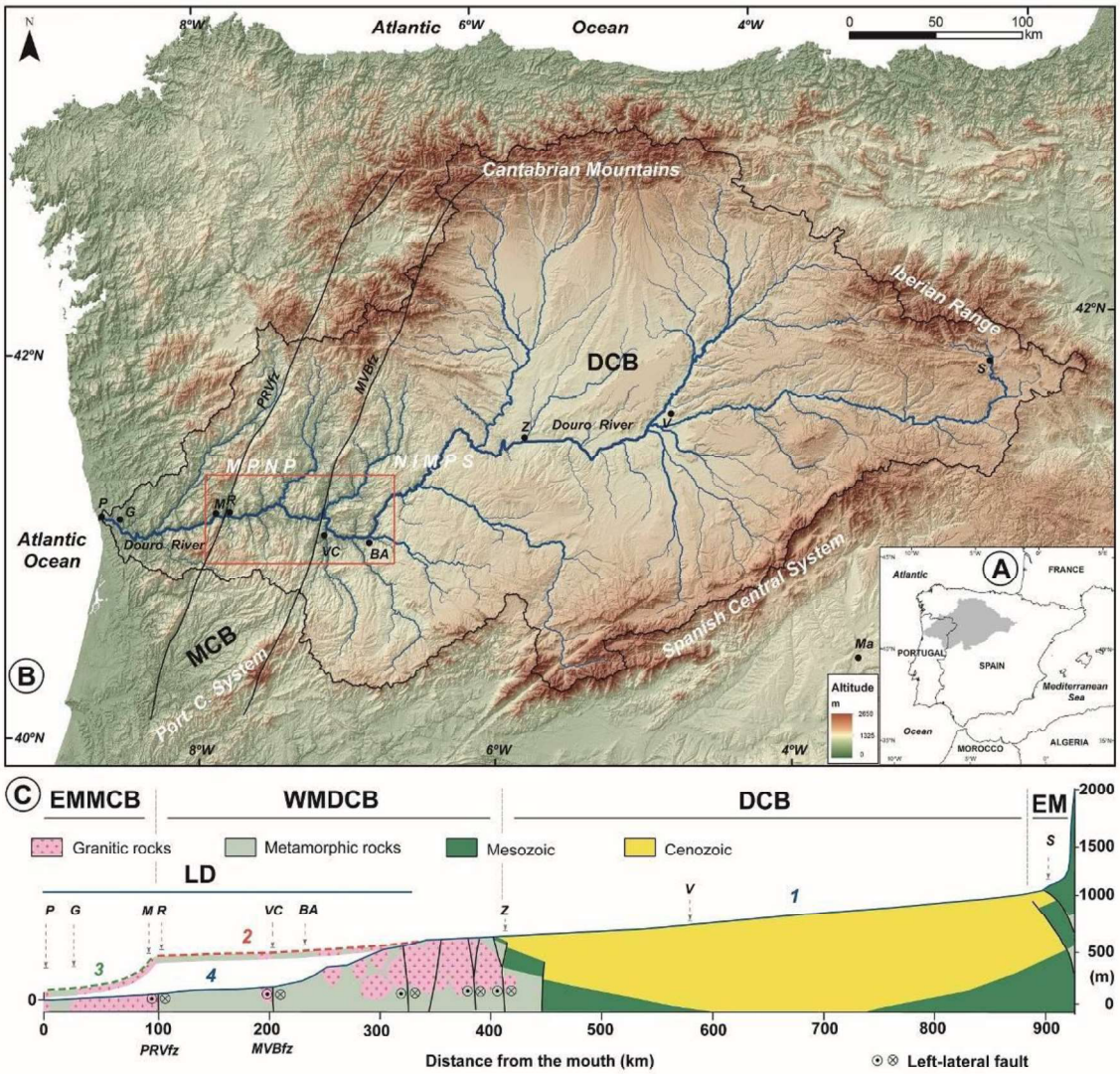

Fig. 1 - The Douro catchment (drainage divide=black line) and its drainage network (blue lines) (B), inset showing location in Iberia (A) and longitudinal profile (C) with bedrock geology. 1 - long profile of Douro River in the Douro Cenozoic Basin (DCB); 2 - long profile of the ancestral Douro in the study area; 3 - long profile of an ancestral coastal Atlantic river; 4 - long profile of the modern Douro downstream of the DCB; LD – Lower Douro.

Fig. 2 – Panoramic view of sector III from the Occidental Mountain Range (Alvão Mountain). High Plateau (MPNP) well preserved contrasting with the entrenched valley of Corgo River, a tributary of Douro of the right margin. Upstream of the minor bridge at left, there is the migration of the erosion wave and the transient knickpoint locate at the city of Vila Real.

Fig. 3 – Panoramic view of sector III upstream the village of Pinhão, where we observe the alternance of incision vs dynamic equilibrium marked by the staircase of strath terraces, highlighted by the location of the settlements and the bedrock terraces on the slopes.

Fig. 4 – Panoramic view of sector IV showing the transient landscape on the Côa River valley, a left margin tributary of Douro. On first plan, the spread of the incision upstream on the metamorphic soft basement, and the flattened erosion surface (NIMPS) that extends over the horizon to the residual quartzite relief of the Marofa Mountain (976 m).

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