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ABSTRACTS

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TECTONIC REACTIVATION OF A PASSIVE MARGIN LANDSCAPE: INSIGHTS FROM QUATERNARY RIVER TERRACES (LOWER MONDEGO RIVER, WESTERN IBERIA)

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The Mondego River is the longest river with headwater in Portugal, flowing in an ENE-WSW direction, from the Estrela Mountain (Portuguese Central Range) until the Atlantic Ocean (Fig. 1). Along the upstream steep valley, the Mondego runs over basement rocks, but in the Lower Mondego Valley (LMV, the study area) it runs (~50 km) over Mesozoic (carbonates and siliciclastics) and Cenozoic (siliciclastics) sedimentary rocks. From upstream to downstream, the LMV can be subdivided in four main reaches (I to IV) limited by major faults and a gorge.

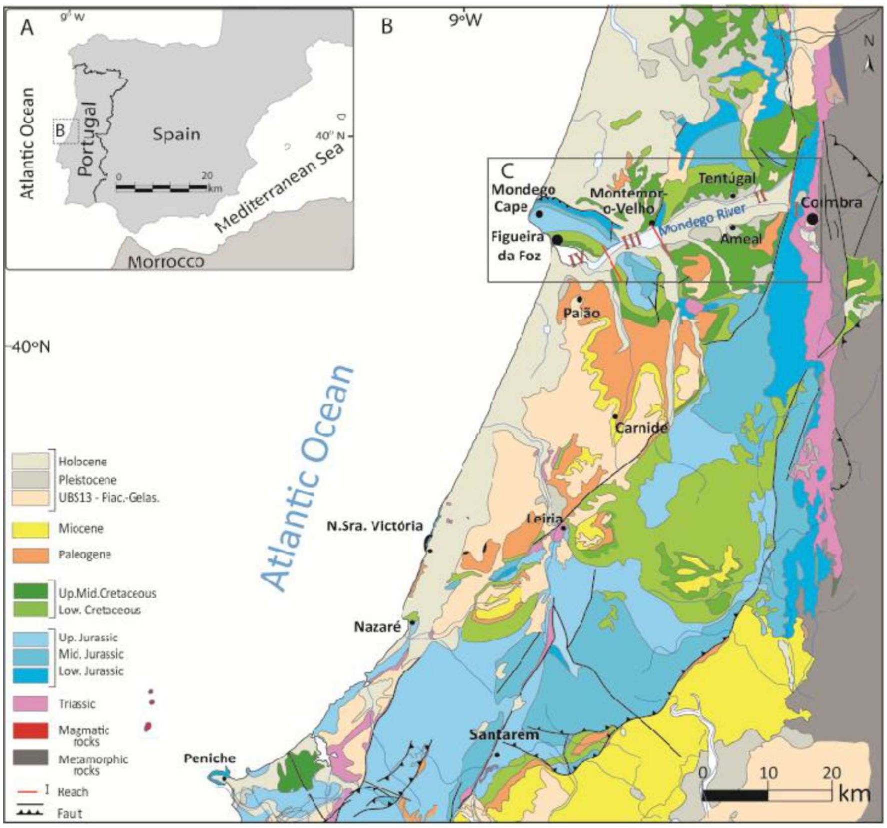

Figure 1. A – geographical setting within the Iberian Peninsula; B - geological map of central western mainland Portugal (modified from the Geological map of Portugal, 1/500000, LNEG); C – study area.

The study area has active tectonics and is located in the Western Iberian Margin, a passive margin under a compressive reactivation since ~80 Ma [1]. It is used for deciphering the long-term landscape evolution during the Quaternary and the control played by tectonics, eustasy and climate. The elaboration of a detailed geomorphological map allowed the establishment of the spatial and temporal distribution of the different geomorphological units and morphogenetic systems operating in the LMV. The culminant unit of the Mondego Cenozoic Basin (the allostratigraphic unit UBS13, recording an Atlantic fan-delta and adjacent shallow marine siliciclastic environments) [2, 3] and the terrace levels (fluvial and marine) are used as geomorphic markers to quantify the Lower Mondego River development and tectonic activity during the last ~3.7 Ma.

The main stages of geological evolution are: 1) by ~4 Ma, transition from endorheic to exorheic (Atlantic base level) drainage in the Mondego Cenozoic Basin; 2) by ca. 1.8 Ma, onset of the fluvial incision stage (valley entrenchment). Electron spin resonance (ESR) dating, integrated with previous OSL ages [4], is used to improve the chronological framework for the terrace staircases of the LMV and to decipher the response of the river to the regional uplift and other long-term controls (resistance of the substratum to erosion, eustasy and climate). Six river terrace levels (Tf1, the older, to Tf6, the younger) inset in the UBS13, were characterized and correlated with two terraces with marine deposits and with several wave-cut surfaces represented at the highly uplifted Mondego Cape [4]. The Tf1 (probably upper Calabrian) should correspond to the Middle Pleistocene Transition (MPT) cyclicity (Milankovicht cycles) and it seems that the glacio-climatic control strongly affects the terrace development after the MPT, during the 100 ka cyclicity. The fluctuating eustatic and climate controls are superimposed on a long-term crustal uplift. The data show marked compartmentalisation of fluvial system behaviour with changes in incision rates from east to west, creating distinctly different sectors. Differential uplift is deduced, between the valley sides and between the four main reaches in which the LMV is subdivided by major faults. Differential uplift is mainly related with regional fault systems, with trend: N-S to NNW-SSE; ENE-WSW; NNE-SSW and E-W to WNW-ESE. Using as geomorphic references the aggradation surfaces of the UBS13 and of the river terraces above the alluvial plain (UBS13 – 1.8 Ma, at +195 to +85 m; T1 – probably ~850 ka, at +128 to +72 m; T2 – ~670 ka, at +109 to +52 m; T3 – ~450 ka, +67 to +27 m; T4 – ~300 ka, +46 to 16 m; T5 – 100 ka, at +16 to +3 m), the estimated incision rates range from 0.08 m/ka to 0.34 m/ka, depending on the response of the lower Mondego River to coupled regional and differential uplift along the LMV. For each staircase, the average uplift rate ranges from 0.037 m/ka to 0.044 m/ka. Since the Early Pleistocene, the incision rates and uplift rates are increasing. This study demonstrates the applicability of river archives to access not just the timing of uplift on a regional scale, but also the relative uplift of individual tectonic smaller areas.

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