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Geomorphic markers of Quaternary tectonics in Westernmost Iberia: insights from the Lower Mondego River terraces (central Portugal)

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The Lower Mondego Valley (LMV), located in the Western Iberian passive margin which is under compressive tectonic reactivation since ca. 80 Ma, is used for deciphering long-term landscape evolution during the Quaternary and the control played by active 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 (allostratigraphic unit UBS13, recording an Atlantic fan-delta and adjacent shallow marine siliciclastic environments) and terrace levels (river and marine) are used as geomorphic markers to quantify fluvial development and tectonic activity. The main stages of evolution are a transition of endorheic to exorheic (Atlantic base level) drainage in the Mondego Cenozoic Basin, ca. 3.7 Ma ago, followed by onset of the fluvial incision stage (valley entrenchment) by ca. 1.8 Ma.

Electron spin resonance (ESR) dating 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 (T1, the older, to T6, the younger), inset in the UBS13 and previous to the modern alluvial plain, were characterized and correlated with marine terraces represented at Cape Mondego, near the river mouth. The fluctuating eustatic and climate controls are superimposed on a long-term crustal uplift.

The data show marked compartmentalization of fluvial system behaviour with changes in incision rates (acting as a proxy of uplift rates) from east to west, creating distinctly different sectors. Differential uplift is inferred between the valley sides and between the four main reaches in which the LMV is subdivided by major faults. Differential uplift is mainly related to regional fault sets trending N-S to NNW-SSE, NNE-SSW, ENE-WSW, and E-W to WNW-ESE. Using as geomorphic references the topmost deposits of the UBS13 unit and river terraces located above the alluvial plain, average long term incision rates were estimated ranging from 0.03 to 0.16 m/ka, depending

on the response of the Lower Mondego River to coupled regional uplift and differential uplift due to active faulting. Estimated average rates for the vertical slip component on the inferred active faults is ca.0.04 m/ka. This study demonstrates the applicability of river archives to assess not only the timing of uplift on a regional scale, but also the relative uplift of individual smaller tectonic blocks.