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Dating the Tejo river lower terraces in the Ródão area (Portugal) to assess the role of tectonics and uplift

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ABSTRACT

The Tejo river is one of the major drainages in Iberian Peninsula; it is a long-lived system (ca. 3.4 Ma) and provides an archive of long-term landscape development and environmental change controlled by tectonics, climate and eustasy. The most upstream Portuguese reach of the Tejo river, ~200 km from the Atlantic coast, shows evidence for five fluvial terraces (T1 to T5) with elevations reaching more than 120 m above the modern river bed. A chronological framework for these terraces is established here by integrating geomorphological, stratigraphical and archaeological information with ages from luminescence dating. Optically stimulated luminescence dating of K-feldspar, (involving the correction for anomalous fading of the luminescence signal), indicates that the younger terraces have a probable age range of: T5 — 31 to 40 ka; and T4 — 100 to ~280 ka. We deduce that the related major fluvial changes are likely to have been as follows: ~10 m of aggradation from ~280 to 100 ka (0.06 m/ka); 14 m of incision from 100 to 40 ka (0.23 m/ka); 8 m of aggradation from 40 to 31 ka (0.89 m/ka); 16 m of incision during the last 31 ka (0.52 m/ka). These values indicate that the duration and rate of both aggradation and river downcutting episodes were variable. There is widespread evidence for neotectonic activity in this intraplate region. Neither eustatic nor climatic changes during the Quaternary provide clear trends that might explain the observed pattern of valley incision, thus we conclude that this tectonic activity is the most likely driving mechanism. In the study area, the probable age of the Tejo river sediments deposited before the beginning of valley incision allows the calculation of a time-averaged incision rate of ~0.07 to 0.10 m/ka over the last ~2.6 Ma. This long-term incision was probably determined by an increase in the relative uplift rate, resulting from the intensification of intraplate compressive stress. During the late Cenozoic fluvial incision stage, the Ródão depression underwent less uplift than the adjacent areas along the river, in which the Tejo has incised a narrow valley into basement rock, with almost no terrace development. Terrace formation was also promoted by soft bedrock (Tertiary arkoses) and by impoundment of alluvium behind resistant barriers crossed by the river. Geomorphological evidence for terrace tectonic offset was also supported by luminescence dating.

1. Introduction

The Tejo, called Tajo in Spain, is the longest (1007 km) and one of the largest rivers of the Iberian Peninsula (catchment size of 78,463 km^2), draining to the Atlantic Ocean (Fig. 1). Is a perennial fluvial system with a present average flow of ~9 km^3 yr^{-1} (1952–1982) in the study area (~200 km upstream of the Atlantic coast). Before dam construction, erosion affected most of the catchment and deposition was localized to the lower reaches (Portuguese reaches IV and V) and on the adjacent Atlantic margin.

The Tejo river has a varying number of fluvial terraces along its course, up to five in the Portuguese transect. In Spain, up to 12 terrace levels can be observed between Talavera de la Reina and Malpica (in the "Campo Arañuelo area, in the western part of the Madrid Tertiary Basin). In the Spanish sector, the terraces are stepped between 8 m and 195 m above the present-day alluvial plain (Pérez-González, 1994; Silva et al., 1997; Silva, 2003). There the river incision began on a surface (the "*piedmont*" of Valdelaosa, altitude 623 m) much higher than that in the Portuguese Ródão area, where the incision started at an altitude of ~300–350 m (top of the Falagueira Formation; these altitudes refer to present elevation above sea level). Some recent geomorphological studies of the Tejo terraces have been made in the Spanish sector (e.g. Pérez-González, 1994; Gutiérrez-Elorza et al., 2002) and in the Portuguese sector (Martins, 1999; Cunha et al., 2005). However, only few, relatively young terrace ages have been published;

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