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Chronology of fluvial terrace sequences for large Atlantic rivers in the Iberian Peninsula (Upper Tagus and Duero drainage basins, Central Spain)

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ABSTRACT

This work analyses the chronology of fluvial terrace sequences of the two most important fluvial basins from central Spain draining to the Atlantic Ocean (Upper Tagus and Duero drainage basins). Both basins evolved under similar Mediterranean climatic conditions throughout the Pleistocene and present comparable number of fluvial terraces (16–17) after excluding the higher terrace levels of the Tagus (T1–T5) entrenched in the Raña surface. These higher "rañizo terraces" was formed in response to fan-head trenching in this high alluvial piedmont (+220 m) and therefore not properly controlled by Quaternary fluvial downcutting. The study accomplishes the implementation of multiple regression analyses for terrace height-age relationships. To transform relative terrace heights above the present river thalwegs (i.e. +100 m) in numerical ages *a "height-age transference function"* has been developed on the basis of preliminary statistical geochronological approaches proposed for Central Spain. The resultant height-age transference function gather 73 published geochronological data for terrace sequences, featuring a 3rd Order Polynomial Function (R^2 0.90). This function describes the overall trend of valley downcutting for the last c. 2.3 Ma in Central Spain and is used to assign numerical ages to terrace levels at different relative elevation.

1. Introduction

This work collects all the available published numerical age-data on the fluvial sequences in the upper Tagus and Duero drainage basins (Central Spain) in order to offer a statistical approach on the theoretical terrace ages. The Mathematical approach is based on multiple correlations between terrace altimetry (above the present thalwegs) and the reported numerical ages, which come from a wide variety of dating methods such as Luminescence (TL, OSL, ESR), Th/U and U/U series, Amino-Acid Racemization (AAR) and radiocarbon dating (^{14}C). Moreover, the numerous available set of paleontological data on Pleistocene macro, microfauna and Palaeolithic sites have been integrated in the obtained theoretical chronosequences. This work develops and updates similar preliminary terrace age-height correlation proposals outlined in previously published papers by Cunha et al. (2012), Silva et al. (2013b), Rosina et al. (2014) and Roquero et al. (2015a). The integration of paleontological and archaeological data, classically used as relative age-markers during the whole 20th century, provides a preliminary approach on the relationships between fluvial incision-aggradation cycles and the changing Pleistocene climates defined by the conventional scales of Marine Isotopic Stages (MIS). Significant approaches on this matter have been synthesized in the works of Bridgland et al. (2006) worldwide or by Santisteban and Schulte (2007) and Roquero et al. (2015a) for the particular case of the Iberian Peninsula.

During the last 10 years the available data base on numerical ages for the Atlantic river basins of central Spain is significantly increasing (Fig. 1). These corresponds to dating of fluvial terraces of the main valleys of the upper Tagus and Duero drainage basins. Numerical dating for the Tagus basin is widely available for terraces down to +40 m in the Jarama (Panera et al., 2011; Pérez-González

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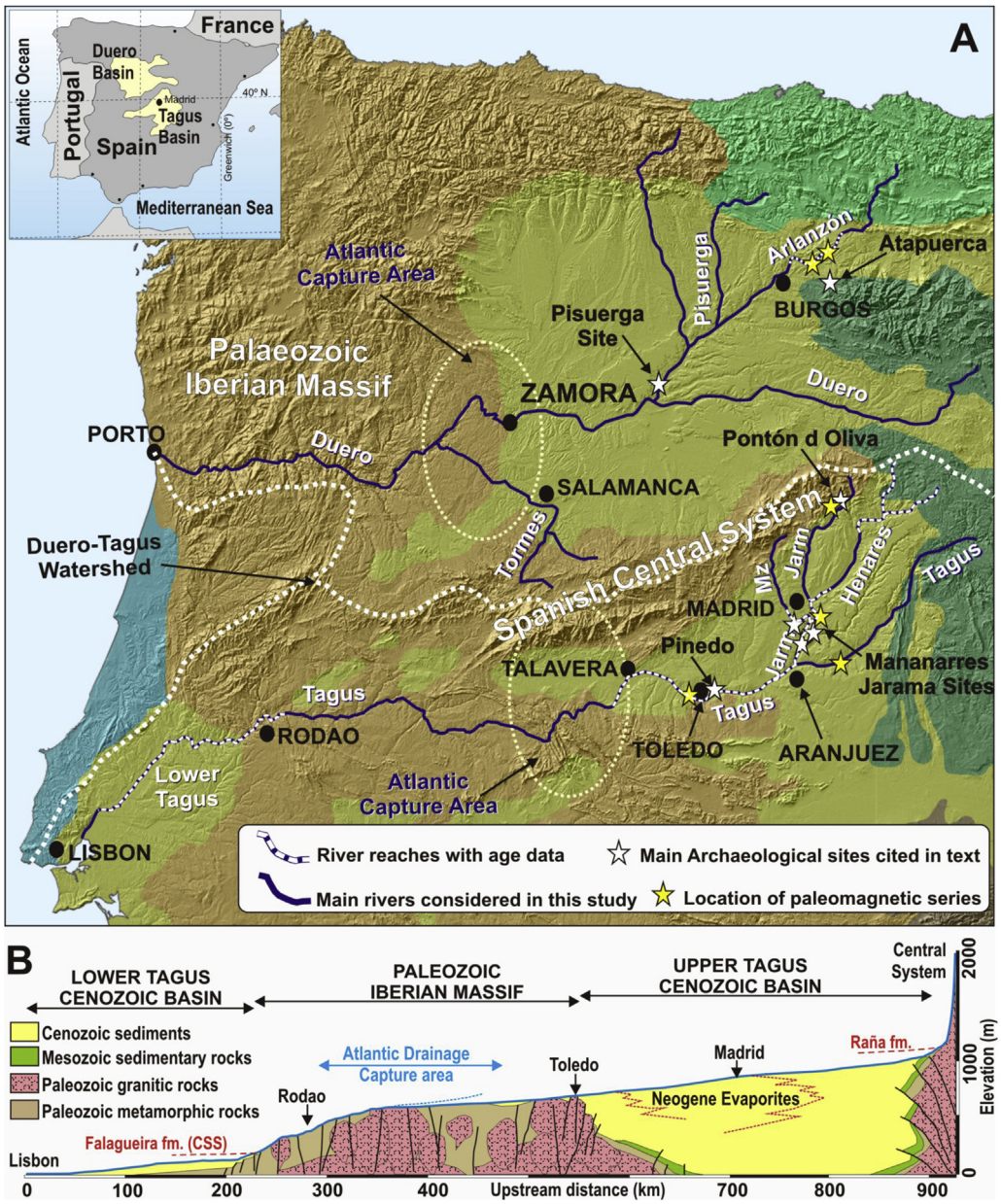

Fig. 1. A. Location of the studied fluvial catchments dissecting the Neogene basins (yellow) in Central Spain, showing the river valley segments with available geochronological data on fluvial terraces, main paleomagnetic series and archaeological sites cited in text (see inset legend). B. Schematic longitudinal profile of the Tagus between central Spain and Portugal illustrating the different segments considered in this study. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

et al., 2013), Manzanares (Pérez-González et al., 2008; Silva et al., 2013a) Tagus (López Recio et al., 2015; Roquero et al., 2015a) and Henares valleys (Benito Calvo et al., 1998; Ortiz et al., 2005). On the contrary, numerical ages for the upper Duero Basin are scarce, but comprise the set of older fluvial levels ever dated in Central Spain. These corresponds to the fluvial terraces between +35 m and +75 m in the Arlanzón valley (Figs. 1 and 2) which are related to the Atapuerca archaeological sites (Benito Calvo et al., 2008; Moreno et al., 2012). Additionally, the still scarce number on paleomagnetic data for fluvial terraces in both drainage basins (Pinilla et al., 1995; Benito-Calvo et al., 2008; Pérez-González et al., 2013) allow to put preliminary constrains to the location of the Brunhes – Matuyama reversal within the terrace sequences. Available paleomagnetic data for the higher terrace levels offer significant constrains for the location of the Matuyama subchrons of Jaramillo and Olduvai within the valleys of the Jarama (Tagus) and Arlanzón (Duero) offering similar results (Pérez-González et al., 2013). The set of dated terraces in the Upper Tagus basin is complemented by geochronological data available from the Lower Tagus basin in the Portuguese zone (i.e. Cunha et al., 2008, 2012; Martins et al., 2009, 2010a; Rosina et al., 2014) in order to explore preliminary relationships between these two different sectors of this particular drainage basin.

This study focus on available geochronological information (numerical age-data) and refers readers to original sources for detailed data on geological setting, archaeology, paleontology and soil chronosequences of the studied drainage basins. The main issue of this paper is to compile, summarize and structure all the available geo-chronological data for analyze the long-term evolution of the studied drainage basins, provide an overall comparison