

TECTONIC CONTROLS ON FLUVIAL LANDSCAPE DEVELOPMENT IN CENTRAL-EASTERN PORTUGAL: INSIGHTS FROM LONG PROFILE TRIBUTARY STREAM ANALYSES

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This study examines the long profiles of tributaries of the Tejo (Tagus) and Zêzere rivers in central eastern Portugal (West Iberia) in order to provide new insights into the patterns, timing and controls on drainage development during the Pleistocene to Holocene incision stage.

The long profiles were extracted from lower order tributary streams associated with the trunk drainage of the Tejo River and one main tributary, the Zêzere River (Fig. 1). These streams flow through a landscape strongly influenced by variations in bedrock lithology (mainly granites and metasediments), fault structures delimiting crustal blocks with distinct uplift rates, and a base-level lowering history (tectonic uplift / eustatic).

The long profiles of the tributaries of the Tejo and Zêzere rivers record a series of transient and permanent knickpoints. The permanent knickpoints have direct correlation with the bedrock strength, corresponding to the outcropping of very hard quartzites or to the transition from softer (slates/metagreywagues) to harder (granite) basement.

The analyzed streams/rivers record also an older transient knickpoint/knickzone separating: a) an upstream relict graded profile, with lower steepness and higher concavity, that reflects a long period of quasi-equilibrium conditions reached after the beginning of the incision stage; and b) a downstream reach displaying a rejuvenated long profile, with steeper gradient and lower concavity, particularly for the final segment, which is often convex (Fig. 2).

The rejuvenated reaches testify the upstream propagation of several incision waves that are the response of each stream to continuous or increasing crustal uplift and dominant periods of base-level lowering by the trunk drainages, coeval of low sea level conditions.

The long profiles and their morphological configurations enabled spatial and relative temporal patterns of incision to be quantified for each individual tributary stream. The incision values of streams flowing in uplifted blocks of the Portuguese Central Range (PCR) (ca. 380-280 m) indicate differential uplift and are higher than the incision values of streams flowing on the adjacent South Portugal planation surface – the *Meseta* (ca. 200 m).

The normalized steepness index, calculated using the method of Wobus et al. (2006), proved to be sensitive to active tectonics, as lower k_{sn} values were found in relict graded profiles of streams located in less uplifted blocks, (e.g. Sertã stream in the PCR), or in those flowing through tectonic depressions.

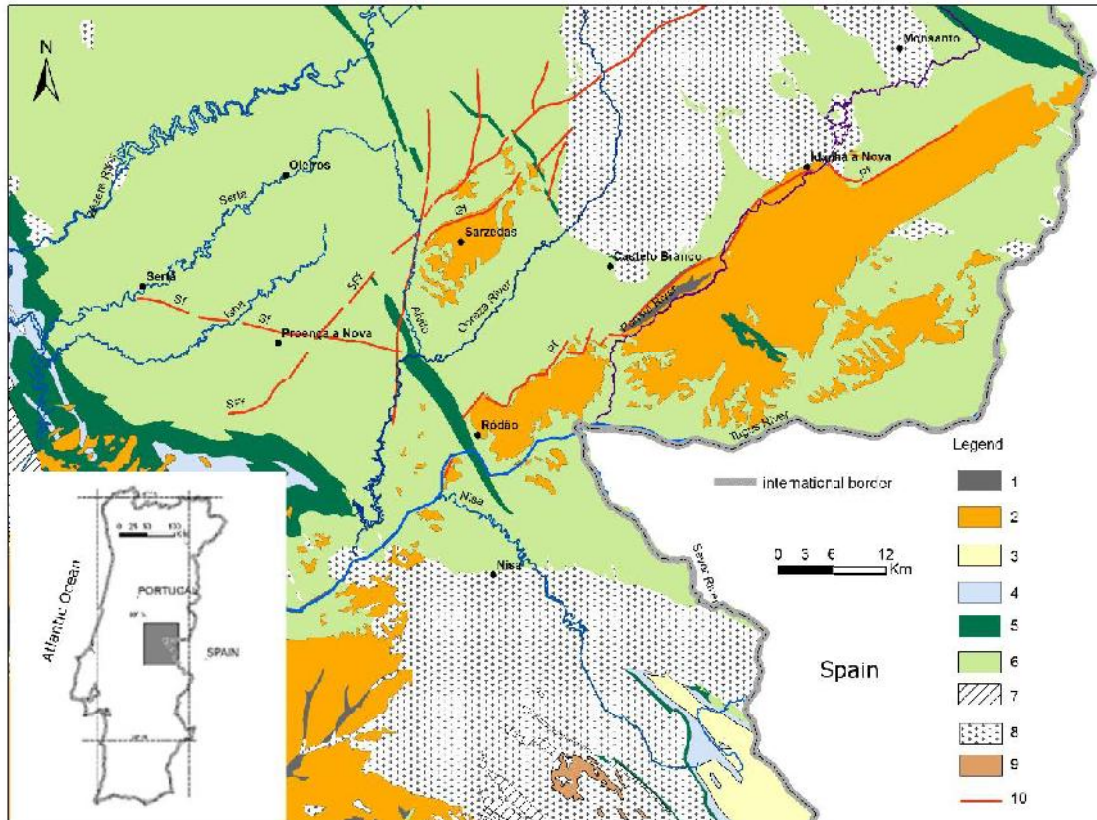


Fig. 1 Geological map of the study area. 1 – fluvial terraces (Pleistocene); 2 – sedimentary cover (Paleogene and Neogene); 3 – slates and metasandstones (Devonian); 4 – slates and quartzites (Silurian); 5 – quartzites (Ordovician); 6 – slates and metagreywackes (Precambrian to Cambrian); 7 – slates, metagreywackes and limestones (Precambrian); 8 – granites and ortogneisses; 9 – diorites and gabros; 10 - fault. SFf – Sobreira Formosa fault; Sf – Sertã fault; Pf – Ponsul fault; Gf – Grade fault.

The differential uplift indicated by the distribution of the k_{sn} values and by the fluvial incision was likely accumulated on a few major faults, as the Sobreira Formosa fault (SFf), thus corroborating the tectonic activity of these faults.

Due to the fact that the relict graded profiles can be correlated with other geomorphic references documented in the study area, namely the T1 terrace of the Tagus River (with an age of ca. 1 Myr), the following incision rates can be estimated: a) for the studied streams located in uplifted blocks of the PCR, 0.38 m/kyr to 0.28 m/kyr; b) for the streams flowing on the South Portugal planation surface, 0.20 m/kyr.

The differential uplift inferred between crustal blocks in the study area corroborates the neotectonic activity of the bordering faults, which has been proposed in previous studies based upon less robust data.

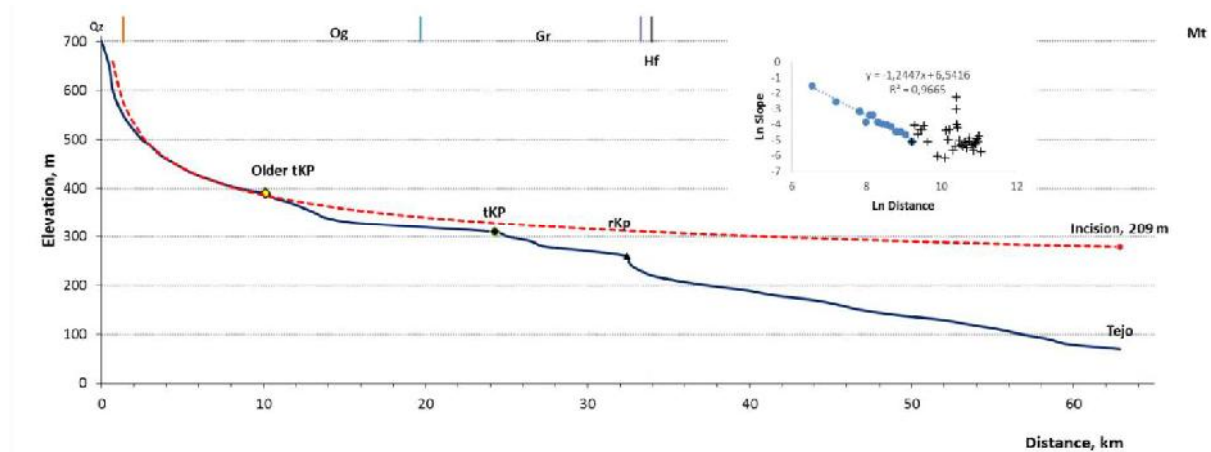


Fig. 2 Longitudinal profile of the Nisa stream a tributary of the Tejo River. Note the equilibrium relict profile upstream the older transient knickpoint (hatched line) and the downstream rejuvenated profile (continuous line). Legend: tKP – transient knickpoint; rKP – resistant knickpoint; Mt – schist and phyllite; Gr – granite; Hf – hornfels; Og – orthogneisse. In the inset Distance – Slope plots, fill circles correspond to the relict graded profile, crosses correspond to the rejuvenated profile located downstream the older transient knickpoint (tKP).

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ABSTRACT BOOK



Evolution of river valleys in Central Europe

Ed. Tomasz Kalicki, Marcin Frączek



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**Department of Geomorphology, Geoarchaeology
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***Evolution of river valleys
in Central Europe***

ABSTRACT BOOK

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Kielce - 2016

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Profile Czarna 4 – Subatlantic fill of Czarna Konecka palaeochannel downstream of Stąporków

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15:00-15:20 **Anna Marie Megens, Joseph Desloges** - *The development of sand-bedded rivers in glaciated southern Ontario*

15:20-15:40 **Anne Mather, Martin Stokes, Elizabeth Whitfield** - *Alluvial fans: their value as quaternary fluvial archives*

15:40-16:00 **Zhenbo Hu, Baotian Pan, Lianyong Guo** - *Origin of the Yellow River*

16:00-16:20 **Martin Stokes, Alberto Gomez-Fluvial archives as records of volcanic island denudation**

16:20-16:40 **Rebecca M. Briant, Kim Cohen, Stephane Cordier, Alain Demoulin, Mark Macklin, Anne Mather, Gilles Rixhon, Tom Veldkamp, John Wainwright, Alex Whittaker, Hella Wittmann** - *Issues in generating effective field-model comparison in landscape evolution modelling*

16:40-16:45 POSTER SESSION I: General problems

16:40-16:45 **Angel Soria Jáuregui, Enrique Serrano, María José González-Amuchástegui** - *Fluvial archives from the Tobalina valley (upper Ebro basin)*

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17:10-18:10 ORAL SESSION II: Methodological approaches to unravel fluvial system evolution (including dating and modelling)

Chairman of Oral Session II: Prof. Kazimierz Klimek

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17:30-17:50 **Jef Vandenberghe** - *Grain-size characterisation of alluvial and lacustrine sediments in a loessic setting*

17:50-18:10 **Sławomir Chwałek** - *Using hydroacoustic system in research of the riverbeds*

18:10-18:30 POSTER SESSION II: Methodological approaches to unravel fluvial system evolution (including dating and modelling)

18:10-18:15 **Francisco Jimenez-Cantizano, Loreto Anton, Candela Pastor-Martín** - *Study of morphological anomalies of Tajo watershed (Spain) from the analysis of both the digital elevation data and the streams longitudinal profile*

- 18:15-18:20 **Slawomir Chwałek** - *Geophysical underwater research on the Vistula River in Cracow*
- 18:20-18:25 **Gilles Rixhon, Stéphane Cordier, Simon Matthias May, Nina Szemkus, Rebecca Keulertz, Tibor Dunai, Steven Binnie, Ulrich Hambach, Helmut Brückner** - *Potentials and pitfalls of depth profile (^{10}Be), burial isochron ($^{26}\text{Al}/^{10}\text{Be}$) and palaeomagnetic techniques for dating early pleistocene terrace deposits of the Moselle valley (Germany)*
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20:00 ICE-BREAK PARTY

Tuesday, September 13, 2016 - Second day

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Chairman of Oral Session III: Prof. Stephane Cordier

- 08:00-08:20 **Cornelis Kasse, Ronald van Balen, Sjoerd Bohncke, Jacob Wallinga, Mariëtte Vreugdenhil** - *Climate and base-level controlled fluvial system change and incision during the last glacial – interglacial transition, Roer river, The Netherlands - western Germany*
- 08:20-08:40 **Janusz Olszak, Józef Kukulak, Helena Alexanderson, Edit Thamó-Bozsó** - *Fluvial archives within tectonically active regions during the quaternary, Dunajec basin, Podhale, southern Poland*
- 08:40-09:00 **Pedro P. Cunha, António A. Martins, Jan-Pieter Buylaert, Andrew S. Murray, Luis Raposo, Paolo Mozzi, Martin Stokes** - *New data on the chronology of the Vale do Forno sedimentary sequence (Lower Tejo River terrace staircase) and its relevance as fluvial archive of the Middle Pleistocene in western Iberia*
- 09:00-09:20 **Tuncer Demir, Rob Westaway, David Bridgland** - *Late Cenozoic Euphrates Terraces developed as a result of regional and local tectonics, climate and volcanism: Turkey, Syria and Iraq*

09:20-09:35 POSTER SESSION III: Long term evolution of fluvial systems: fluvial system response to forcing (climate, tectonics, anthropogenic)

- 09:20-09:25 **Dariusz Krzyszkowski, Dariusz Wieczorek, Lucyna Wachecka-Kotkowska, Piotr Kittel** - *Mazovian fluvial and lacustrine sediments of the Czyżów Complex based on study of the Belchatów outcrop, Central Poland*
- 09:25-09:30 **Gilles Rixhon, Melanie Bartz, Mathieu Duval, Meriam El Ouahabi, Nina Szemkus, Helmut Brückner** - *Contrasted terrace systems of the lower Moulouya valley as indicator of crustal deformation in NE Morocco*
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- 10:40-11:00 **António A. Martins, João Cabral, Pedro P. Cunha, Martin Stokes, José Borges, Bento Caldeira, A. Cardoso Martins** - *Tectonic controls on fluvial landscape development in central-eastern Portugal: insights from long profile tributary stream analyses*
- 11:00-11:20 **Jutta Winsemann, Jörg Lang, Julia Roskosch, Ulrich Polom, Utz Böhner, Christian Brandes, Christoph Glotzbach, Manfred Frechen** - *Terrace styles and timing of fluvial terrace formation in the Weser and Leine valleys, northern Germany: response of the river system to climate change and glaciation*

11:20-11:35 POSTER SESSION IV: Long term evolution of fluvial systems: fluvial system response to forcing (climate, tectonics, anthropogenic)

- 11:20-11:25 **Daniël S. Rits, Ronald T. van Balen, Maarten A. Prins, Hongbo Zheng** - *Evolution of the alluvial fans of the Luo river in the Weihe basin, Central China, controlled by faulting and climate change - a reevaluation of the paleogeographical setting of Dali Man site*
- 11:25-11:30 **Jutta Winsemann, Janine Meinsen, Julia Roskosch, Jörg Lang, Christian Brandes, Manfred Frechen** - *Climate control on the evolution of late pleistocene alluvial fan systems in northwest Germany*
- 11:30-11:35 **Nurcan Avsin, Jef Vandenberghe, Ronald van Balen** - *Tectonic and climatic controls on Quaternary fluvial processes and terrace formation at the Goksu River, Southern Anatolia*

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- 13:00-13:20 **Edyta Kłusakiewicz, Tomasz Kalicki, Marcin Frączek, Paweł Przepióra** - *The Late Glacial and Holocene evolution of upper Kamienna River valley*

13:20-13:40 **Martin Gibling** - *Timeline for human influence on river landscapes: A review*
13:40-14:00 **Piotr Kalicki, Tomasz Kalicki, Piotr Kittel** - *River valleys evolution and men: a case study from Lomas de Lachay, Peru*

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16:50-17:10 **Andrea Mandarino, Michael Maerker, Marco Firpo** - *"It has always been there" ... or not? The Scrivia river planimetric changes during the last 150 years (NW Italy)*

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18:10-18:30 **David R. Bridgland, Mark J. White** - *Making sense of the Lower and Middle Palaeolithic: fluvial archives to the rescue*

18:30-18:50 **Marcin Frączek, Tomasz Kalicki, Adam Wawrusiewicz** - *Environmental context of Subneolithic settlement in the Upper Biebrza Basin (NE Poland)*

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