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Younger Dryas flood events: A case study from the middle Warta River valley (Central Poland)

Joanna Petera-Zganiacz [a, *], Danuta A. Dzieduszyńska [a], Juliusz Twardy [a], Dominik Pawłowski [b], Mateusz Płóciennik [c], Monika Lutyńska [d], Piotr Kittel [a]

[a] University of Łódź, Faculty of Geographical Sciences, Department of Geomorphology and Palaeogeography, Narutowicza St. 88, 90-139 Łódź, Poland
[b] Adam Mickiewicz University, Institute of Geology, Faculty of Geographical and Geological Science, Maków Polnych 16, 61-606 Poznań, Poland
[c] University of Łódź, Department of Invertebrate Zoology and Hydrobiology, Banacha St. 12/16, 90-237 Łódź, Poland
[d] Adam Mickiewicz University, Department of Quaternary Geology and Paleogeography, Dzięgielowa 27, 61-680 Poznań, Poland

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ABSTRACT

The Weichselian Late Glacial sequence composed of Younger Dryas overbank deposits and the Alleröd/Younger Dryas organic-rich series from the Warta River valley, Central Poland, were studied within a project, including sedimentological criteria, analysis of aquatic invertebrates (cladocerans and chironomids) remains and diatoms. The well-dated sequence of events on the floodplain, mainly due to the determination of the age of *in situ* riparian forest, provided a basis for a reconstruction of local conditions of palaeofloods in a wide context of global climatic changes at the Weichselian decline. The flash floods were largely affected by catchment topography, forest destruction in response to the Younger Dryas cooling, and permafrost reappearance. The floods have been detected as the causative factors in a river style change.

1. Introduction

Processes registered in river valleys are valuable geoarchives used for extensive palaeogeographical conclusions, mainly concerning the origin and the age of geological and palaeogeomorphological surfaces. A prominent part of the work on the palaeoenvironment concerns the response of fluvial systems to change between cold and warm cycles (e.g. Kozarski and Rotnicki, 1977; Schumm, 1977; Starkel, 1983, 1991; Vandenberghe, 1995, 2002, 2003; Mol et al., 2000; Kasse et al., 2003, 2005, 2010; Starkel et al., 2007). A river response to different environmental conditions determines phases of erosion and aggradation, channel pattern transformation and sedimentological changes in deposits. It is widely known that river activity is controlled by climatic factors. Although, when considering river adaptation to short oscillations, climate-derived and non-climatic factors such as the occurrence of permafrost or seasonally frozen ground, vegetation cover, catchment size, topography and lithology (Vandenberghe, 2003) must be taken into account. According to Starkel (1983, 1991, also Schumm, 1977) among conditions that directly affect river channel pattern are river discharge and sediment load, while their relationship determines the trend to erosion or accumulation.

Geologists and geographers are interested in the adjustment of fluvial systems to the Weichselian Late Glacial overall amelioration of the climate, and the time of the turn from braiding to meandering. Moreover, the question of the river response to cooling of the Younger Dryas is under wide discussion. According to the results obtained for various regions of the European Plain, in the case of this rapid climatic shift, rivers either maintained a meandering style or more commonly changed to braiding (Vandenberghe et al., 1994; Bohncke et al., 1995; Kasse, 1995; Starkel and Gębica, 1995; Turkowska, 1995; Huisink, 1997, 2000; Mol et al., 2000; Starkel, 2002; Starkel et al., 2007; Kaiser et al., 2012). Attention is paid to the role of vegetation cover, which despite the generally open Younger Dryas landscape, could have persisted on the floodplains and could have prevented crossing the threshold values (after the concept of Schumm, 1979) to initiate change in fluvial systems (Vandenberghe, 1995; Huisink, 2000; Turner et al., 2013).

The study area is situated in Central Poland, in the middle section of the Warta River valley (Fig. 1A). During the previous multiproxy palaeoecological study from the site Koźmin Las (Dzieduszyńska et al., 2014), a depositional sequence was

* Corresponding author.
E-mail addresses: jap@geo.uni.lodz.pl, jpetera@wp.pl (J. Petera-Zganiacz), dadziedu@geo.uni.lodz.pl (D.A. Dzieduszyńska), twardy@geo.uni.lodz.pl (J. Twardy), dominikp@amu.edu.pl (D. Pawłowski), mplociennik10@outlook.com (M. Płóciennik), lutynska@amu.edu.pl (M. Lutyńska), pkittel@wp.pl (P. Kittel).

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recognized which consists of overbank material overlying organic-rich deposits with the remains of a pine (*Pinus sylvestris* L.) and birch riparian forest, such as well-preserved subfossil tree trunks, up to 6 m in length and more than 0.2 m in diameter, and *in situ* stumps. The reconstruction revealed a series of terrestrial events on the floodplain, from the stablilization of the landscape, reflected in the development of initial soil and forest, afterwards interrupted by minor periodic floods, until the onset of the increased flooding

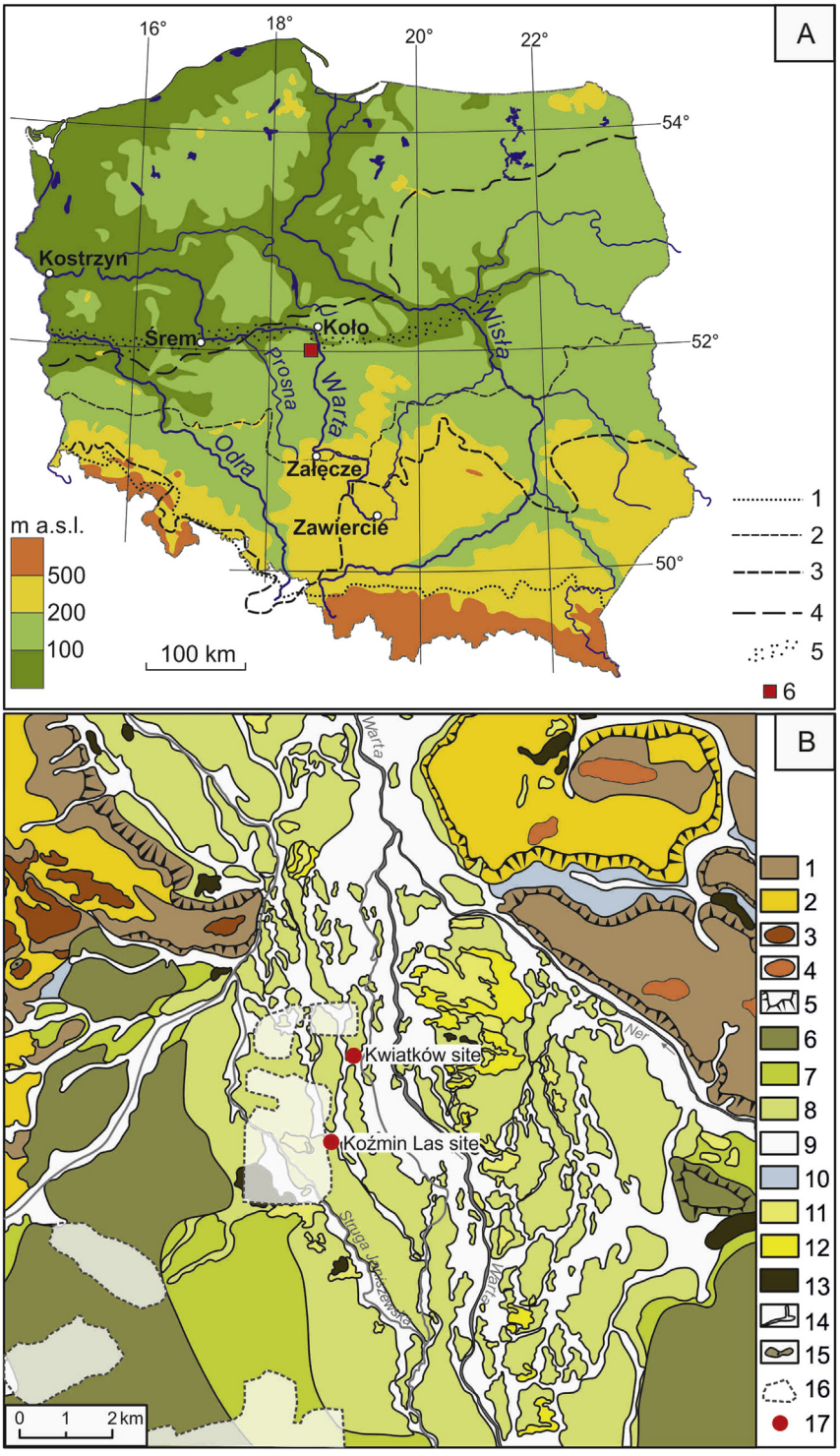

Fig. 1. Location of the investigated site in relation to the Pleistocene glaciations in Poland (A) and geomorphological situation (B). A. Extents of the ice-sheets (after Marks, 2005). 1 – maximum extent of Elsterian glaciation; 2 – maximum extent of Saalian glaciation; 3 – maximum extent of Warta stage; 4 – maximum extent of Weichselian glaciation; 5 – Warsaw–Berlin ice-marginal streamway; 6 – location of investigated area. B. Geomorphological map (after Forysiak, 2005 modified). 1 – morainic plain; 2 – glaciofluvial plain; 3 – end-moraines; 4 – kames; 5 – distinct slopes; 6 – lower terrace of Warsaw–Berlin ice-marginal streamway; 7 – alluvial high terrace; 8 – alluvial low terrace; 9 – valley floor; 10 – lacustrine plain; 11 – aeolian plain; 12 – dunes; 13 – peatlands; 14 – valleys of various origin; 15 – kettle holes; 16 – post-exploitation areas and outcrops of the Adamów Lignite Mine; 17 – location of the investigated sites.