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Alluvial fans as an effect of long-term man–landscape interactions and moist climatic conditions: A case study from the Glubczyce Plateau, SW Poland

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ABSTRACT

At the mouth of periodically drained valleys in the loess Glubczyce Plateau (SW Poland), favorable conditions for deposition of alluvial fan sediments occur, so these forms are very common in the investigated area. The origin of the forms analyzed is related to long-term human–landscape interactions, because deforestation and land-use changes started in the Neolithic, ca. 5.5 ka BC, causing intensification of soil erosion processes. Willful and continuous interference by man into natural environment began at that time. Thus, human impact is responsible for acceleration of runoff and mobilization of sediment which formed alluvial fans at the mouths of episodically drained valleys. The objectives of this study are (1) to measure the morphological and topographical characteristics of the fans, (2) to describe and analyze the inner structures of the alluvial fans analyzed and (3) to date the alluvial fan deposition.

The alluvial fans are mainly formed of silty–clayey massive sediments. The gravel–sand layers occurring in two exposures indicate the incision of the valleys in the older Pleistocene sediments underlying the loess upland deposits and intensive phases of erosion in the course of which coarser material could have been transported.

Radiocarbon dating of the peat filling the bottoms of the valleys and underlying the mineral deposits of the fans indicates that sediment transfer from cultivated valley slopes and its deposition at the mouth of the valleys was recorded in alluvial fan sediments by the Neolithic (6895 ± 140 BP). During this period, erosion was probably intensified by a moister climate. Radiocarbon dating of organic layers, which were discovered inside the sediments of two fans, show that the youngest dated stage of intensified erosion took place in Early Medieval Times, when the Glubczyce Plateau was colonized again by Slavs after the "settlement depression" during the Migration Period.

1. Introduction

Alluvial fan deposits form part of fluvial sediment cascades and are widely researched to record changes in sedimentation and catchment condition. Numerous studies are concerned with inner structure, morphology and hydrology of alluvial fans (e.g., Blissenbach, 1954; Rachocki, 1981; Harvey, 1988; Blair and McPherson, 1992; Calvache et al., 1997; Blair and McPherson, 1998). To date, the majority of investigations of alluvial fans were conducted in mountain and fore-mountain areas, where forms built of coarse-grained sediments, often derived partly from debris flows, were analyzed (Bull, 1977; Brazier, 1987; Chamyal et al., 1997; Gómez-Villar and Garcia-Ruiz, 1997; Sorriso-Valvo et al., 1998; Harvey et al., 1999a; Webb et al., 1999; Gómez-Villar and Garcia-Ruiz, 2000; Anderson et al., 2000; Zanchetta et al., 2004). It is assumed that particularly four factors control the evolution of alluvial fans: intrinsic controls (e.g., Patton and Schumm, 1975; Scott and Erskine, 1994), changes of base level (Miall, 1992; Harvey et al., 1999a), climatic variations (Wasson, 1977; Starkel, 1991; Chamyal et al., 1997; Harvey et al., 1999b; Larue, 2002), land use changes (Teisseyre, 1995; Coulthard, 2001; Coulthard et al., 2002; Larue, 2002; Klimek, 2003; Zygmunt, 2004; De Moor and Verstraeten, 2008), or the relative roles of climate or human activities (Ballantyne, 1991; Chiverrell et al., 2007, 2008).

It seems as if alluvial fans received particular attention where they form distinctive landforms. However, more subdued alluvial fans in low-relief settings and humid regions carry a similar potential for the study of past environmental change (e.g., Faulkner, 2002; Chiverrell et al., 2007; De Moor and Verstraeten, 2008; Panin et al., 2009-this issue). This holds true especially for the study of longer-term human impact on catchment condition and fan development because settlement activities often have been concentrated in humid basinal and piedmont areas. In Poland, the Glubczyce Plateau (upper Odra basin, Fig. 1) provides such a suitable study area because it has been one the most attractive agricultural areas for millennia owing to its favorable soil and climatic conditions. Here, long-term human–landscape interactions resulted in the nearly complete clearing of pristine forests. Prehistoric settlement concentrated mainly on the edges of

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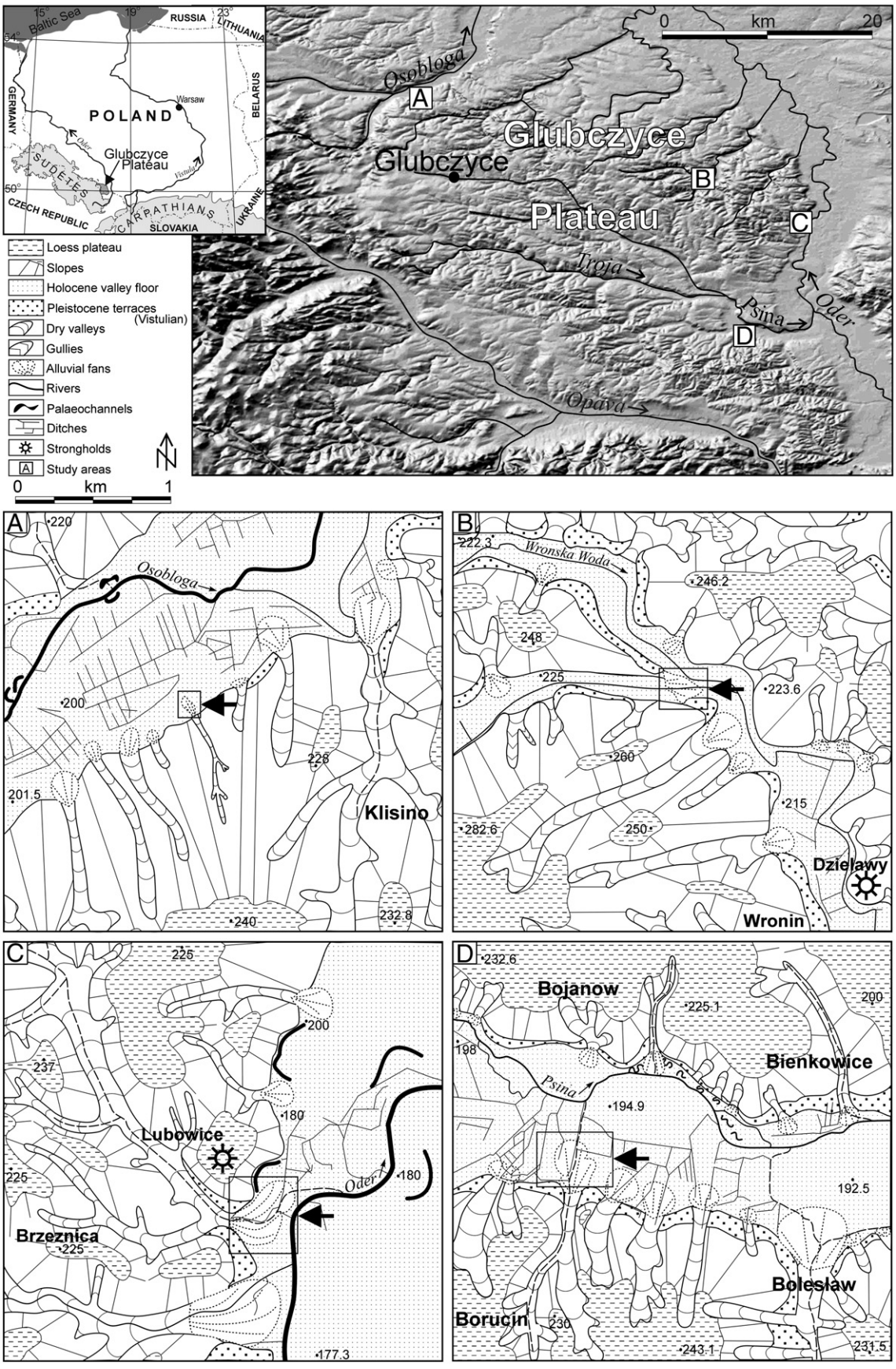

Fig. 1. Location and geomorphological maps of the study areas (A— Klisino, B— Wronin, C— Lubowice, D— Borucin).