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Land use history and historical soil erosion at Albersdorf (northern Germany) — Ceased agricultural land use after the pre-historical period

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ABSTRACT

The Holocene landscape history and historical soil erosion were reconstructed at Albersdorf (Schleswig-Holstein, Germany) from soils and colluvial layers. In contrast to many landscapes in central Europe, agricultural land use and soil erosion were more frequent during pre-historical times, whereas it has almost ceased after the advent of history. Pre-historical soil erosion rates from about 0.1 to 6.9 t ha^{-1} a^{-1} were reconstructed with no significant differences between the prehistoric cultural phases. The study of buried soils within the soil/soil-sediment-sequences provided evidence for an acceleration of soil formation processes probably as a consequence of excessive prehistoric woodland pasture on poor sandy soils.

1. Introduction

The development of the central European landscapes under the influence of man reaches far back. In particular the onset of agriculture with the domestication of animals and the cultivation of plants caused a strong impact of man on the environment (Goudie, 1994). Hence, central European landscapes can not be understood without knowledge about historical land use practices, provided by the archaeological research (e.g. Kalis et al., 2003). Climate change and its impact on the vegetation and the genesis of the floodplains were in the focus of research. Especially through palynological methods, Holocene vegetation history was reconstructed (e.g. Firbas, 1949, 1952; Behre and Kucan, 1994; Küster, 1998, 2001; Dörfler, 2001; Kalis et al., 2003). Additionally, geomorphological and geoarchaeological investigations on sequences of colluvial layers and soils provide inside into the history of the environment in high spatial resolution (e.g. Bork et al., 1998). Embedded and buried artefacts often enable a direct linkage between settlement and environment history. Combined with appropriate excavation methods (selection of catchments, dimension of exposures) and dating techniques, investigations on colluvial deposits allow the reconstruction of values of past soil erosion rates and soil formation at a local scale. Successful applications of the interdisciplinary landscape analyses were proved by Bork et al. (1998), Bork and Lang (2003), Dotterweich (2003), Dotterweich (2005), Dreibrodt and Bork (2005), Reiß et al. (2006), Schmidtchen and Bork (2003) for sites in Germany. Mieth et al. (2002) Mieth and Bork (2003) applied this method very successful on Eastern Island and Bork et al. (2001) in China. Hence, with the application of the routine employed at the investigation sites, data can be compared worldwide.

Similar works with a geoarchaeological approach were published amongst others by Bell and Boardman (1992), Bell and Walker (2005), David et al. (1998), Fuchs et al. (2004), Kaiser et al. (2007), Lang et al. (2003) or Rommens et al. (2007).

In England many studies have investigate the causes and consequences of recent soil erosion on agricultural used land (e.g. Boardman, 1990; Boardman et al., 1996; Foster et al., 2000; Walling et al., 2002; Wilkinson, 2003; Boardman, 2003).

Such data are needed if one considers about timing, intensity and causes of environmental change associated with human activities as geomorphologic agent (Hooke, 2000; Wilkinson, 2005).

The results from Albersdorf are compared with data from other sites in Germany in this paper to test whether they are significant on a local or regional scale.

2. Investigation area

The investigation area is located in the “Dithmarscher Geest” of Schleswig-Holstein (northern Germany) approximately 65 km westward of Kiel. The present relief and the parent material were formed

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during the middle and younger Pleistocene age (Walter, 1992). The material which provides the substrate for Holocene soil formation was deposited during the Saalian Glaciation (180,000–128,000 BP) (Ehlers, 1990; Fränzle, 2004). During the Weichselian Glaciation (117,000–11,560 BP, Streif, 2002) periglacial processes changed the surface morphology (Fränzle, 2004). A thin discontinuous cover of drifting sands was deposited above the glaciofluvial deposits during this period. The distance between the ice shield of the Brandenburger–Stadial and the investigation area amounted to approx. 25–30 km (cf. Strehl, 1986). Fränzle (2004) found mainly poor clayed and acidic Cambisols, Podzols and Luvisols (all according to FAO, 1998) in this substrate under forest. He concludes that the mighty poor clayed subsurface soil, the deep decalcification and strong trend to podzolisation of the Luvisols are the results of the long exposure of the material spanning two interglacial periods.

The recent annual temperatures averages out to 8.2 °C with an annual precipitation of 851.6 mm (station Helse, 53°58″N, 9°01″E, 2 m a. s. l., Müller-Westenmeier et al., 1999).

Deschampsia flexuosa–Fagus sylvatica woods dominate as potential natural vegetation on oligothrophic habitats in the Saalian Geest of Dithmarschen. *Quercus robur* dominates low and middle woods (in the region called Kratts) with absence or a very low presence of *Fagus sylvatica* (Dierßen, 2004).

The three investigations sites (Bredenhoop, Falloh and Reddersknüll) in vicinity of the Archaeological Ecological Centre of Albersdorf (AÖZA) are situated at the outlets of trough-shaped periglacial valleys into the recent valley of the river Gieselau (Fig. 1). Preceding studies were carried out on colluvial layers and soils in a small watershed (Schmidtchen et al., 2003) as well as on pollen from a peat profile of an adjacent fen (Dörfler, 2005). Both sites are in vicinity to our investigation sites and the results are included in the discussion.

3. Methods

3.1. Field methods

The three investigated watersheds (Bredenhoop, Falloh and Reddersknüll, cf. Fig. 1) are small, easy to delineate and apparently closed with respect to Holocene sediment export into adjacent systems. The first is important to minimize the probability of repeated reworking and redeposition, which often occurs in larger catchments (e.g. Lang and Hönscheid, 1999). The second enables the estimation of the area contributing to sediment production during the Holocene. The third is important with respect to the completeness of the sediment record. All investigation sites are situated in large periglacial valley bottoms with low slope angles. Assuming that the Holocene erosion processes have been less intensive compared with those of glacial times; the selected locations were expected to have been sediment sinks during the Holocene. This was tested via extensive excavations and additional auger cores.

With an excavator 13 exposures of appropriate dimensions were opened at the three investigation sites (6 exposures at Bredenhoop, 3 exposures at Falloh and 4 exposures at Reddersknüll). At each site the base of Holocene deposits was reached. After thoroughly cleaning and smoothing the profiles, the layers and soil horizons were separated. A lithological discontinuity with a rather sharp border to the underlying material or horizon, a growing thickness to the deepest part of a depression, a certain amount of organic matter and higher contents of charcoals and or artefacts were the criteria used for the identification of colluvial layers.

The colluvial layers and soil horizons were described with the following field methods. The colour was determined according to the Munsell system (Munsell, 2003). Texture, stone content, bulk density and soil formation processes were estimated according to the German

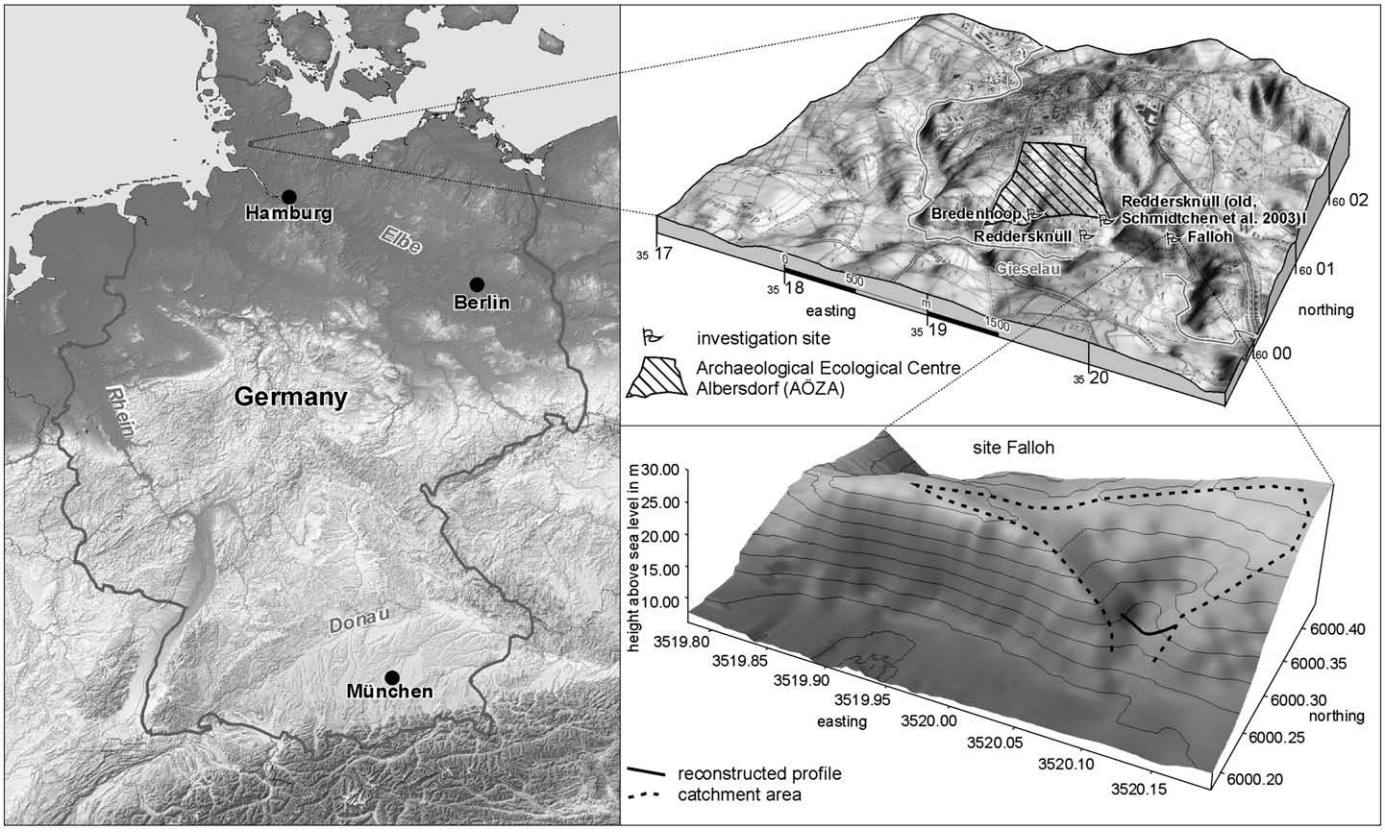

Fig. 1. Location of the study sites with a detailed 3D-view on the Falloh catchment area.