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Holocene sediment dynamics in the environs of the fortification enclosure of Cornești-Iarcuri in the Romanian Banat

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ABSTRACT

The presented study combines data from geomorphological, geochemical, sedimentological, chronometric, and archaeological records providing first insights into the Holocene landscape development in the environs of the Late Bronze Age fortification enclosure Cornești-Iarcuri. This large-scale archaeological site is located in a loess-covered, undulating landscape at the eastern edge of the Great Hungarian Plain, in western Romania. Sediment archives from geomorphologically different locations, closely related to the Copper Age to Late Bronze Age settlements, are presented. Mainly stable geomorphic conditions throughout the Holocene occurred on the high plains of the Vinga Plain as indicated by chemical alteration of the loss deposits and soil formation processes exceeding 2 m. In contrast, two cores from an alluvial fan of a minor drainage system in direct vicinity of the archaeological site document varying morphodynamics throughout the Holocene. Phases of geomorphic activity and stability are indicated by the formation of fan deposits and paleosols developed in these sediments. ¹⁴C dates from charcoal extracted from the fan sediments show maximum deposition ages between c. 4400 cal. BP and c. 2900 cal. BP. Thus, the formation of the charcoal coincides with the Copper Age to Late Bronze Age development of the settlement sites. Daub pieces, incorporated into these reworked soil sediments, provide evidence for human activities in the catchment. This, in turn, may indicate that the erosion processes that led to the fan formation are linked to those activities. However, reworking and redeposition of the charcoal and daub bearing sediments due to retrogressive erosion during the last millennia cannot be excluded.

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1. Introduction

Among terrestrial archives, alluvial fans are often considered to provide a great potential to record past morphodynamics and changes in catchment conditions due to the close proximity of the sediment source in respect to the accumulated alluvial fan. Especially fans originating from small-scale catchments, formed at the confluence of a gully into the main valley, are considered to have a high spatial resolution and a close coupling to hillslope erosion (Chiverrell et al., 2007; Zygmunt, 2009; Dreibrodt et al., 2010a;

Dotterweich et al., 2012). Alluvial fans are regarded to react highly sensitive towards land use changes in their upslope catchment areas which may cause gradual soil degradation or severe soil erosion events (Dotterweich et al., 2012). Whereas long-term climatic changes seem to play a minor role with respect to the formation of alluvial fans, peaks of soil erosion occur in phases of more frequent extreme precipitation events together with high land use intensities (Valentin et al., 2005; Dotterweich et al., 2012). In consequence, studying alluvial fans that originate from small-scale catchments often reveal crucial information on past land use changes (Dotterweich, 2008; Zygmunt, 2009). Integrating archaeological records, alluvial fans represent archives in which the interactions of humans and their environments can be investigated (Chiverrell et al., 2007; Dreibrodt et al., 2010a; Dotterweich et al., 2012).

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In the surroundings of Cornești-Iarcuri in western Romania such favorable conditions to study past human–environmental interactions are found. The archaeological site of Cornești-Iarcuri is known as the largest fortified settlement of Prehistoric Europe (Szentmiklosi et al., 2011). It is located at the eastern edge of the Great Hungarian Plain, about 20 km north of Timișoara (Fig. 1). The site consists of four earth-filled wooden ramparts (Szentmiklosi et al., 2011) that enclose several Late Bronze Age settlements. However, the settlement history in its environs started already in the Copper Age (Szentmiklosi et al., 2011; Heeb et al., 2012). The surrounding landscape, the southern part of the Vinga Plain, is today characterized by wide plains that are completely deforested and intensively used for agriculture. The Vinga Plain is built of Early to Late Pleistocene sediments composed of gravel, sand, silt and clay that were covered by Quaternary loess and loess-like deposits (Institutul Geologic, 1966; Borsy, 1990; Grigoraș et al., 2004). Two general units characterize the landscape in the vicinity of Cornești-Iarcuri: the slightly undulating high plain and the intersecting saucer-shaped valleys (Leser and Stäblein, 1985). Alluvial fans originate from tributary valleys and interfinger with the alluvial plains of the receiving streams (Nykamp et al., 2015).

Little is known about human–environmental interactions in the environs of Cornești-Iarcuri. Apart from a case study about the human influence on the development of the drainage network in its built-up area (Nykamp et al., 2015) no geoscientific research has been carried out. In their landscape archaeological approach, Nykamp et al. (2015) apply GIS techniques to link hydro-morphological relief anomalies to archaeological evidence. The results indicate that the presence of the fortification enclosures and settlements had a substantial impact on the evolution of the drainage network, as some of the tributaries could be directly associated with verified gates of the fortifications or to settlements within, respectively. They conclude that trampling by moving humans and animals favored the development of gullies leading to the formation of hollow ways along the ancient paths (Nykamp et al., 2015). To enhance the understanding of the human impact on the landscape evolution in the surroundings of Cornești-Iarcuri our study aims to investigate Holocene soil formation and sediment dynamics at two geomorphologically different locations in its vicinity. We document present-day morphodynamics and identify former periods of fan formation and pedogenesis through the characterization and interpretation of dated sediment archives. The geoscientific records are combined with archaeological evidences of the Copper Age to Late Bronze Age settlement areas providing first insights into the human impact on the Holocene landscape development in the environs of Cornești-Iarcuri.

2. Study site

2.1. The Great Hungarian Plain

The surface of the Great Hungarian Plain (GHP) (Fig. 1a) is built up from Quaternary fluvial and aeolian deposits. Accordingly, the Great Hungarian Plain is subdivided into wide alluvial plains and large alluvial fans, which are broadly covered by loess or sand dunes (Lóczy et al., 2012).

The tectonic activity of the Pannonian Basin significantly influenced the formation of the alluvial fans of the Great Hungarian Plain. Although the entire basin subsides during the Quaternary, some areas sank with lower velocities and therefore formed relative uplifts. Areas with highest Quaternary subsidence rates, such as the South Tiza Graben or the Körös Basin, sank as much as 300–700 m while other parts of the basin, such as the eastern part of the Mureș alluvial fan, sank to a much lesser degree (Borsy, 1990; Kiss et al., 2012, in press). In the western piedmont

area of the Zaránd Mountains the Mureș River deposited large amounts of gravel, while the more distal parts of its alluvial fan are characterized by sandy, silty and clayey sediments that were deposited through frequent avulsions (Borsy, 1990; Nádor, 2008; Urdea et al., 2012). The amount and type of sediment transported by the Mureș River was determined by the alternation of the Quaternary glacial and interglacial periods. During the dry and cold glacials coarse sediments were produced and low mean discharges were characteristic whereas the warm and wet interglacials favored chemical weathering and created high mean discharges (Urdea et al., 2012).

In the Pleistocene, extensive parts of the Great Hungarian Plain were covered by loess and alluvial loess (Borsy, 1990; Haase et al., 2007). Chernozems have developed in these aeolian sediments while the sandier areas are characterized by Cambisols (Borsy, 1990). The soils formed on loess or loess-like sediments are generally highly erodible and even loess-covered lowland areas are prone to gully formation. Water-controlled erosion is dominated by sheet wash, and rill and gully erosion processes on harvested agricultural areas. It is intensified by limited infiltration due to compaction, sealing or crusting of the surface or subsurface pan formation, respectively (Lóczy et al., 2012).

With the beginning of the Holocene, the Preboreal showed rapid warming and increased humidity. The temperatures further increased during the Boreal, but it remains unclear whether it was moister or drier compared to present-day conditions. The climate at the beginning of the Atlantic became warmer and moister in comparison to the preceding Holocene periods, but in the course of the Atlantic it became increasingly drier. With the Subboreal, a marked decrease in temperatures occurred whereas precipitation amounts increased. The temperatures slightly increased with the beginning of the Subatlantic, while precipitation decreased (Kiss et al., 2015).

2.2. The Vinga Plain

Cornești-Iarcuri is situated in the southern part of the Vinga Plain (Fig. 1b and c), which belongs to the geomorphic unit of the Romanian high piedmont plain. The high piedmont plain was formed by large coalescing lobes of the Mureș alluvial fan, surrounded by the piedmont hills in the east, the low piedmont plain in the west and south and the Holocene alluvial plain of the Mureș River in the north (Badea et al., 1979; Ianoș, 2002; Grigoraș et al., 2004; Micle et al., 2009). Quaternary loess and loess-like deposits cover extensive parts of the Vinga Plain (Grigoraș et al., 2004). A moderate temperate climate, with annual mean precipitation of 550 mm and a potential evapotranspiration of about 700 mm, prevails on the Vinga Plain (Grigoraș et al., 2004).

Luvic Chernozems predominate in the northern part of the study area, while in the central and southern parts mainly Luvic Phaeozems are developed. Both soil types show a very dark brown to black mollic A-horizon, loamy to clayey textures and humus contents around 2.0–3.5% (Grigoraș et al., 2004). Soil profiles in the environs of Cornești-Iarcuri usually show typical features of Calcic Chernozems with calcrete horizons of different development stages at depths ranging between 50 and 110 cm as described by Sherwood (2013). Indications for the formation of paleosols of presumably Pleistocene age are assumed for the area of the high plain in the environs of Cornești-Iarcuri (Sherwood, 2013). Eroded Chernozems characterize the hillslopes of the valleys and colluvial deposits, in terms of slope sediments that are linked to human activity causing soil erosion (cf. Leopold and Völkel, 2007), are formed at the foot slopes. Fluvic-gleyic Chernozems prevail in the alluvial plains of the valleys (Grigoraș et al., 2004; Sherwood, 2013).

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