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Coupling of Geomorphological, Geophysical, Geochemical and Archaeological Spatial Data for a Study of the Interface of the Latène and Przeworsk Cultures in NE Germany

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Coupling of Geomorphological, Geophysical, Geochemical and Archaeological Spatial Data for a Study of the Interface of the Latène and Przeworsk Cultures in NE Germany

Landscape evolution; Przeworsk culture; geomorphological and geochemical analyses; geophysical prospection.

Two different types of Iron Age settlements are known from the Southern Harz-Foreland (northern Germany): the local Iron Age culture and the Przeworsk culture. Sites of the Przeworsk culture (c. 2,1 ka BP) are the subject of an interdisciplinary project of the Freie Universität Berlin within the excellence cluster TOPOI, focussing on landscape evolution south of the Harz Mountains since the early Holocene. The Przeworsk culture migrated to peripheral positions at the northern edge of the fertile floodplain of the Helme River. This is in contrast to the locally already existing society of the Latène culture that was organized around central sites.

The basic research questions addressed here are: (1) how did the palaeoenvironment develop after the Late Glacial; (2) how were the settlement sites of the Przeworsk's culture organized in space and time; (3) did their peripheral settlements have any impact on the local environment; (4) what was the relationship between the Przeworsk culture and the already existing local Iron Age culture?

In northern Germany the Harz Mountains are the highest mountain range (Brocken: 1141m) and extend for about 110km NW-SE and 40km NE-SW. The Harz Mountains consist of Palaeozoic and Mesozoic rocks that attracted human activity in the region long before the well-known ancient mining sites where copper and silver ores were exploited from the Middle Ages. Metal use from the Harz Mountains can be traced back before the Bronze Age when bog-ore deposits and iron-rich clay concretions (so-called Geoden) of the Buntsandstein Formation were used.[1] The investigated settlement sites are situated between the Thuringian Basin to the south and the Palaeozoic rocks of the southern Harz Mountains, just north of the fertile plain 'Goldene Aue' of the River Helme. Triassic sediments of the Buntsandstein Formation (silts and sandstones) form the bedrock and dominate the locations. The slopes are covered by periglacial debris and Pleistocene loess. The three investigated sites of the Przeworsk culture (Himmelgarten, Leimbach, Urbach) are situated in similar positions along the transition zone from the southern slopes of the Harz Mountains to the Goldene Aue within first-order tributary valleys of the Helme River. These settlements are about 3–4km apart, have straightforward catchment areas of ca. 10km^2 with a relatively strong relief (c. 400–150m a.s.l) and all are positioned on

1 Heise 2012.

the so-called Niederterrasse (lower terrace) along the western bank of the tributaries. Detailed studies at the Leimbach site near to the 'Krummbach' tributary using geophysical surveys, archaeological excavations, and geochemical analyses of soil samples yield the following results.

The valley fills bottom out on sandstone bedrock or periglacial sandstone debris and consist of five to six meters of sediments that represent and archive the late Glacial—Holocene—to subrecent landscape evolution. Above the bedrock there follows a basal zone of sandy silt and clay with reworked loess and occasionally periglacial debris that have been dated to 21.5 to 13.4 cal ka BP. Organic-rich calcareous clays intercalated with freshwater calcareous mud and calc-tufa represent the early- to mid-Holocene (10.5 to 6.8 cal ka BP) and comprise the already described 'Rieth'-Series.[2] Flood plain sediments—^{14}C-dated from 3.6 to 1.6 cal ka BP—follow with a distinct transition to the underlying Rieth-series. The late Holocene is represented by up to 2m thick colluvial layers that consist of clastic sediments that often formed alluvial fans reaching into the tributaries and were ^{14}C-dated from 1.6 to 0.4 cal ka BP.

The geophysical surveys in Leimbach were undertaken applying large scale magnetic surveys and, additionally, resistivity surveys at selected areas. For the magnetic surveys a portable multichannel device using up to 10 gradiometers was used prior to the archaeological excavations. The resistivity surveys were performed with a PC-controlled multichannel resistivity meter GeoTom MK100IP/SIP that is able to control up to 100 electrodes in various electrode configurations and measures at frequencies between 1 Hz and 25 Hz. The magnetic surveys at Leimbach cover an area of 15.5ha. The magnetic gradient map shows archaeological remains of the Iron Age settlement, indicated by more or less circular positive anomalies caused by settlement pits of different kinds, as well as large-scale magnetic features that are aligned in a WNW-ESE direction, orientated almost perpendicular to the lower-lying valley of the 'Krummbach' (Fig. 1 site Leimbach). Additionally, resistivity measurements along a north-south oriented 350m long profile crossing these magnetic anomalies were performed. The resulting resistivity cross-section shows low resistivity values of c. 30–40 Ωm near the Senfzengraben in the south, as well as for the bedrock. The WNW-ESE aligned channels identified in the magnetic mass show mainly high resistivity values with about 60 Ωm down to a depth of 2m. Highest resistivity values are found on the plateau of the settlement and result from a high accumulation rate of loess and sand.

Transects of cores (up to 6m depth; Fig. 1b) show that the linear geomorphological structures follow isobaths and that they are incised into the basement of clayey to silty Buntsandstein. The channels are filled from bottom to top with skeletal (periglacial) debris, loess-like sediments (carbonatic but free of organic substances), a Przeworsk culture occupation layer, enriched in organic substances and with higher magnetic susceptibility, and colluvial sediments at the top (Fig. 2). We interpret these linear structures—that today often form dry valleys—as paleo-channels that were incised into the bedrock and incised further under periglacial conditions during the late Glacial, when tundra-like conditions with permafrost prevented the water from percolating and allowed dissection. Thereafter they were covered by loess-like sediments and with the increasing vegetation cover they probably became inactive. During the settlement phase of the Przeworsk culture the isobath were filled with up to 2m of sediments when severe colluvial mass movements occurred.

This is also corroborated by detailed geochemical and sedimentological analyses (soil analyses including magnetic mass susceptibility, grain size analyses, carbon determination, phosphate analyses) of the pits and house settlings originally identified by the geophysical prospection. Below the plough horizon (Ap = top 40cm) these circular features

2 Unger and Rau 1965.

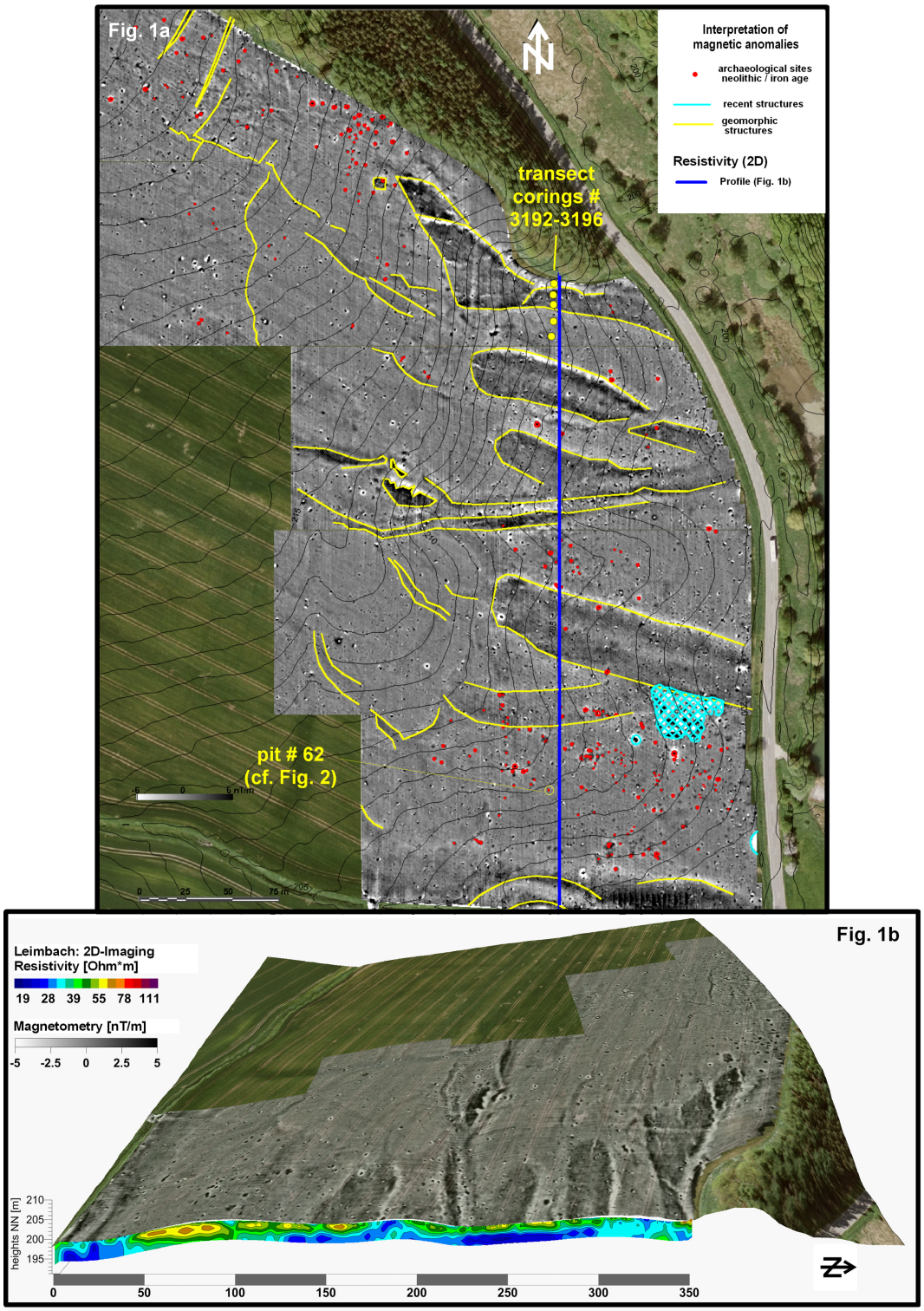

Fig. 1 | (a) Leimbach site with the first-order tributary Krummbach along the eastern side and the subsurface remains of the settlement. The orthophoto in the background is taken from GeoBasisDE / TLVermGeo. Superimposed on the aerial photography is the magnetic survey (±3 nTm^{-1}) as a grey-scale image (±6 nTm^{-1}). From the magnetic survey archaeological remains—indicated by more or less circular positive anomalies—were identified. At settlement areas (f.e. in the north and in the south) the magnetic anomalies show concentrations. Large scale anomalies were interpreted as geomorphological structures and verified by transects of cores (cf. legend), (b) ERT cross-section superimposed on the magnetic map.

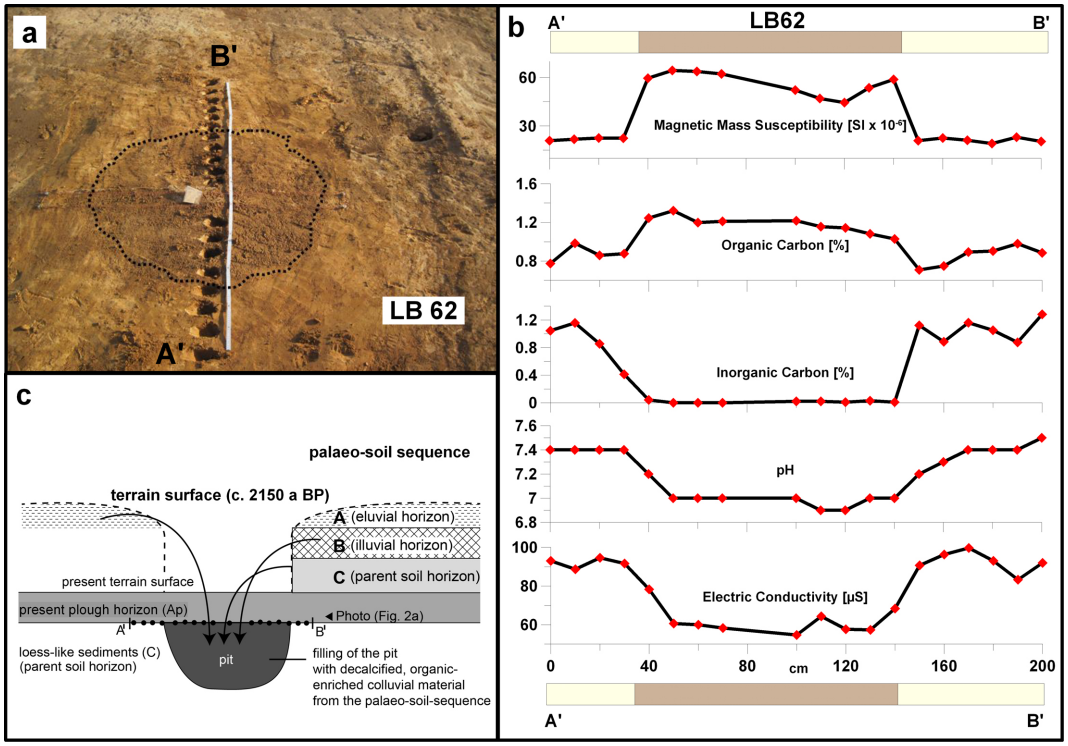

Fig. 2 | (a) photo of pit # 62 below the present plough horizon (Ap), (b) geochemical and sedimentological analyses horizontally across every 10cm of the circular pit # 62 exhibiting magnetic susceptibility; total organic carbon (TOC) and total inorganic carbon (TIC) contents; substrate pH-value and electric conductivity, (c) sketch of the development of the circular pits.

are clearly distinguishable due to their dark coloring (Fig. 2). Samples were taken every 10cm horizontally across the pits into the surrounding loess-like sediments (C-horizon). The pits show diameters between 1 and 2,5m and originate in carbonatic, silty (loess-like) sediments representing the parent soil horizon (C-horizon). The filling of these pits consists of decalcified sediments with higher organic carbon and phosphate contents as well as enriched magnetic susceptibility (Fig. 2). The pits were filled with anthropogenic input (Przeworsk culture) together with colluvial sediments and palaeo-soil material.

The integration of the results from archaeological, geophysical, geomorphological, and geochemical investigations revealed that the settlement sites of the Przeworsk culture underwent periods with severe colluvial mass movement, and therefore only low-lying anthropogenic features (e.g. pits) are found in situ. At the beginning of the occupation by the Przeworsk culture (c. 2,1 ka BP) the original relief of the settlements was different from the present topography. The relief variation was more accentuated and the incised periglacial valleys were steeper. At the hilltops of the settlements at least 80cm from the original soil profiles have been transported into lower positions where up to 2m of colluvial sediments and a cultural layer were deposited.

The interdisciplinary approach at the Iron Age settlements illustrates the potential of different techniques. The near surface remains of the settlement as well as geomorphological features were detected by large scale geophysical surveys. Following targeted excavations, corings and material analyses revealed the data base for archaeological analyses and landscape reconstructions.

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