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Palaeoenvironmental Reconstructions at Corneşti-Iarcuri (Southwestern Romania) – Preliminary Results from Geomorphological, Pedological and Palynological On-Site Studies

This paper provides a glimpse into the palaeoecological conditions at the prehistoric settlement Corneşti-Iarcuri in the southwest Romanian Banat, which is known as the largest Bronze Age fortification in Europe. Preservation of pollen is generally poor in the region, where extensive marshlands have been drained and converted into arable lands since the 18th century. Remarkably, some fossil topsoils buried under thick colluvial[1] layers within the fortification proved to contain pollen. Together with the sediments themselves, which serve as direct evidence for anthropogenically influenced geomorphodynamics and could partially be put into chronological context by radiocarbon dating, the on-site palynological data offer a unique opportunity to reconstruct the palaeoenvironmental setting at Corneşti. Results reveal that during the Chalcolithic period, a partially cleared open woodland with Tilia, Quercus and Corylus prevailed. Soil erosion began in some central parts of the settlement site, resulting in the accumulation of up to 90 cm of colluvium in the main valley. Until the Early Iron Age, regional tree percentages dropped from around 38 to 22 %, while anthropogenic indicators (Cerealia, Plantago lanceolata, Polygonum aviculare) increased from 11 to 16 %. Meanwhile, between 50 to 170 cm of colluvium were deposited at the investigated floodplain sites.

Introduction

Corneşti-Iarcuri, the largest known prehistoric settlement in Europe, is situated approximately 20 km north of the town of Timişoara in Romania's Banat region. As the southeastern part of the Great Hungarian Plain, the Banat is bordered by the rivers Tisza in the west, Danube in the south, Mureş in the north and the western Romanian Carpathians (Apuseni mountains) in the east (**Fig. 1**). The landscape is characterised by undulating loess-covered piedmont hills and wide alluvial plains, which had been dominated by vast wetlands until far-reaching drainage measures were put into effect from the 18th century onwards. Albeit separated by the Carpathians, the natural vegetation is regarded as forming the westernmost portion of the Eurasian forest steppe belt.[2]

The archaeological site of Corneşti lies at about 140 m asl on a gently dipping plain, intersected by two small northeast-southwest oriented valleys that are incised to depths between 20 and 50 m.[3] Spreading over 17 km², it is surrounded by four ramparts of a total length of 33 km.[4] They are made of earth-filled wooden boxes that are believed to have reached 5 m in width and 6 m in height.[5] The ramparts have been dated to the Late Bronze Age and the transition to the Iron Age;[6] additional datings have recently been carried out under the scope of the LOEWE research initiative 'Prehistoric Conflict Research – Bronze Age Fortifications between Taunus and Carpathian Mountains'. Even though the Late Bronze Age is recognized as the main occupation phase of the site,[7] settlement activities have been documented from almost all archaeological periods since the Neolithic.

Our DFG-sponsored project is concerned with "Archaeobotanical investigations on the landscape and vegetation history of the Late Bronze Age fortification Corneşti-Iarcuri and its environs in the Romanian Banat". The research focuses on

1 All colluvial deposits mentioned in this text are of Mid- to Late Holocene origin, and their genesis is closely linked to settlement activities at Corneşti-Iarcuri.
2 Magyari *et al.* 2010.
3 Micle *et al.* 2009.
4 Szentmiklosi *et al.* 2011; Heeb *et al.* 2015.
5 Heeb *et al.* 2017 Fig. 3.
6 Harding 2017.
7 Szentmiklosi *et al.* 2011.

off-site and on-site archives as well as the analysis of macro-plant remains obtained during archaeological excavations.[8]

The detection of off-site archives is important as a general source of information on the Holocene vegetation development. Due to the intensive drainage measures contributing to the mineralisation of potentially organic deposits, it turned out to be labourious and difficult to find adequate locations. Undisturbed archives in the form of lakes or peat bogs only exist at distances of at least 100 km in high-altitude areas of the southern or eastern mountain ranges.[9] We managed to find one suitable site near Vinga, 7 km north of Corneşti, where pollen have been preserved under alluvial to lacustrine conditions and will be discussed in a separate publication.

The exploration of on-site archives within the fortification itself has been accompanied by research on the deposition history in order to get a wider picture on Holocene landscape dynamics in relation to the occupation of Corneşti. The sedimentology and geomorphology of the site have already been intensively studied by Nykamp,[10] who focused on alluvial fans and linked them to activity phases during its settlement history, describing daub- and charcoal-bearing colluvial layers of up to 3 m thickness, and dating some of the charcoals to the transition of the Bronze to the Iron Age and the Chalcolithic.

Palaeoenvironmental research in the greater region

Most studies have concentrated on montane environments in the eastern,[11] western[12] and southern[13] Carpathians, where classical archives such as bogs or lakes are present. Other research took place in lower mountain ranges[14] or intramontane basins, for example in Transylvania[15] or Hungary,[16] where environmental conditions can largely be parallelized with those in the study area.

The Holocene climatic history has mainly been reconstructed by isotope ($\delta^{18}O$ and $\delta^{13}C$) studies on speleothems which account for a gradual warming from around 11700-11500 BP, more pronouncedly from 8200 BP onwards until approximately 5200 BP, interrupted by some smaller oscillations, but with generally higher temperatures than the present ones.[17] Towards the Early Atlantic, precipitation seems to have been on the increase,[18] while the climate of the Mid- and Late Atlantic became cooler and probably more arid, as attested by lake level fluctuations.[19] This implies that an explicit Holocene climate optimum can actually not be accounted for.[20] The same holds true for the development of temperatures during the Subboreal, but several authors agree that at least the second half was characterised by higher rainfall which prompted a rise in lake levels and the formation of swamps.[21] In the Subatlantic, more continental conditions became established.[22]

The Holocene vegetation evolution in the Great Hungarian Plain starts with a quick shift from postglacial forest steppes with coniferous and cold deciduous taxa to mesothermophilous forests dominated by oak and hazel at around 11000 BP. Between c. 6000 and 4000 BP, first *Carpinus* and eventually *Fagus* gained central importance, but since 3700 to 3000 BP, forests were increasingly replaced by steppe vegetation as a result of anthropogenic influence, coupled with higher aridity.[23] Magyari *et al.*[24] investigated the prevalent view that the wooded steppe in Hungary can be regarded as a natural vegetation formation which became established in

[8] For preliminary results of the latter, see Krause *et al.* in press

[9] E.g. Rösch/Fischer 2000; Farcaş/Tanţău 2012.

[10] Nykamp *et al.* 2015; 2016; 2017.

[11] E.g. Farcaş *et al.* 1999; 2013; Feurdean 2004; Florescu *et al.* 2004; Forray *et al.* 2015; Magyari *et al.* 2009; Geanta *et al.* 2014.

[12] E.g. Bodnariuc *et al.* 2002; Feurdean/Willis 2008; Feurdean *et al.* 2009; Grindean *et al.* 2015; 2017.

[13] E.g. Farcaş *et al.* 1999; Magyari *et al.* 2009; Rösch/Fischer 2000.

[14] E.g. Björkman *et al.* 2002; Farcaş/Tanţău 2012; Feurdean 2004; 2005; Feurdean/Astalos 2005; Feurdean/Bennike 2004; Feurdean *et al.* 2008; Tanţău *et al.* 2003; 2006; 2009; 2011.

[15] Feurdean *et al.* 2007; 2015; Grindean *et al.* 2014.

[16] Magyari *et al.* 2001; 2008; 2010; 2012; Gardner 2002; Jakab *et al.* 2004; Jakab/Sümegi 2010; Sümegi *et al.* 2012; Willis *et al.* 1995.

[17] Constantin *et al.* 2007; Feurdean *et al.* 2007; 2014; Perşoiu 2017.

[18] Gardner 2002; Kiss *et al.* 2015.

[19] Magyari *et al.* 2010.

[20] Constantin *et al.* 2007; Onac *et al.* 2002.

[21] Kiss *et al.* 2015; Magyari *et al.* 2001.

[22] Feurdean *et al.* 2013; Perşoiu 2017.

[23] Feurdean/Tanţău 2017; Tomescu 2000; Chapman *et al.* 2009.

[24] Magyari *et al.* 2001; 2010.

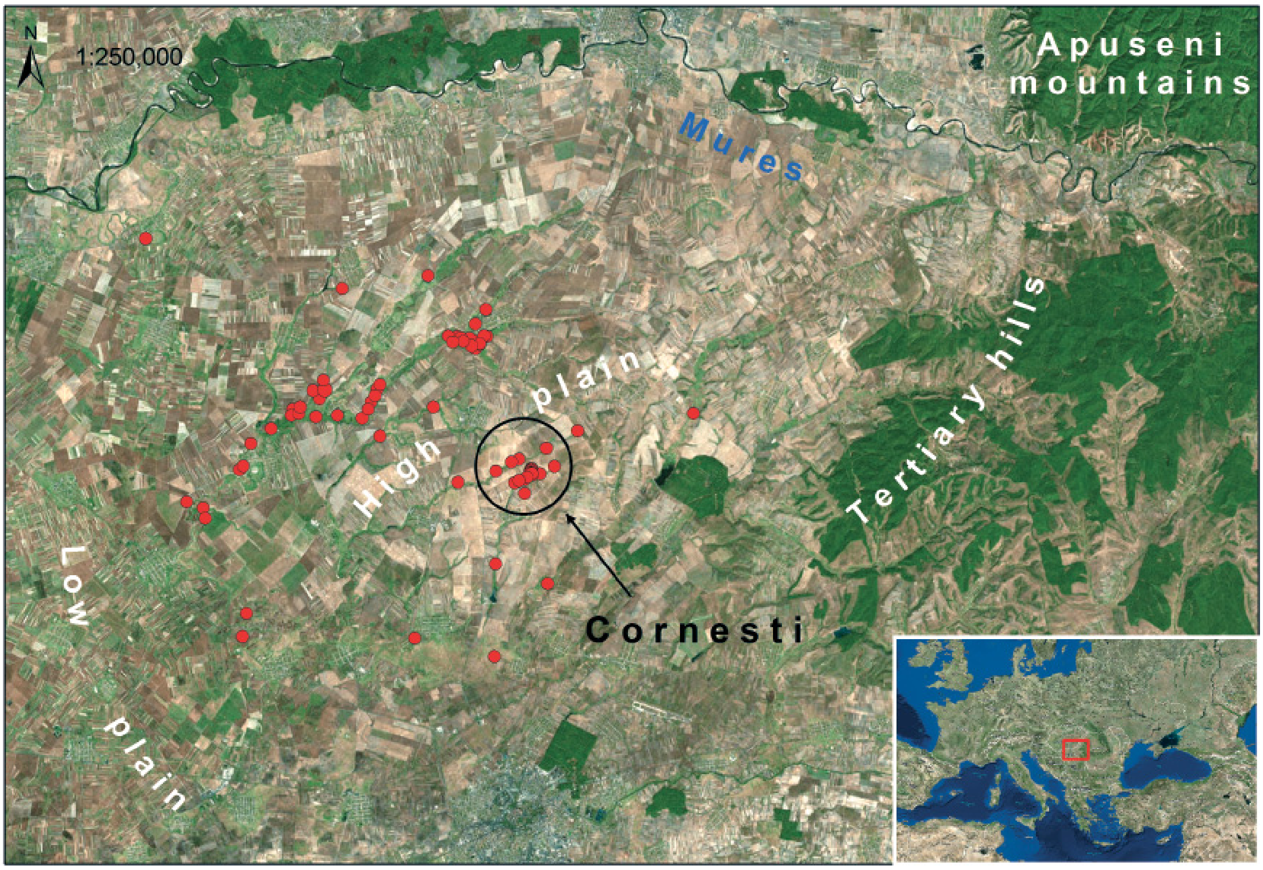


Fig. 1 Overview of study area and coring sites (map by the authors; image source: ESRI open data)

the Boreal. But instead, with the exception of some edaphically dry areas, they noted an expansion of deciduous forests during that phase. Studies in the Transylvanian lowlands point to a similar vegetation development: After an Early Holocene mixed oak forest phase, *Carpinus* took over at the onset of the Subboreal, followed by beech around 4000 to 3000 BP and accompanied by increasing signs of deforestation.[25] However, primary indicators of human impact can be traced back as far as the Mid-/ Late Neolithic. [26]

Study area

The Great Hungarian Plain forms part of the Carpathian Basin which started to subside in the Early to Mid-Miocene, while the surrounding mountains were uplifted and folded. It was subjected to first marine (Tethys), then lake (Pannonian) transgressions until sedimentation started to exceed subsidence by the end of the Pliocene/ beginning of the Pleistocene, also accompanied by differential uplift at the fringes. The crystalline basement is consequently covered by up to 1000 m of marine, lacustrine, and fluviodeltaic sediments.[27]

The study site (**Fig. 1**) is located in the so-called Vinga High Plain (90–190 m asl) which gently inclines to the southwest and forms part of the Mureş alluvial fan that was partly active until Holocene times – a Mureş palaeomeander approximately 30 km west of Corneşti could be dated to 7100 BP by OSL.[28] While the eastern part comprises several loess-covered Pleistocene terraces with a relatively coarse texture (gravels and sands), the western section is dominated by 5 to 15 m of Holocene alluvium, deposited in broad valleys. It also prevails in the lower plains and contains some reworked Pleistocene sands and gravels. The majority, however, consists of relatively clayey 'alluvial loess' (sometimes also called 'infusion loess'), believed to have originated from former Pannonian sediments reworked by aeolian

[25] Feurdean *et al.* 2007; 2015; Tanţău *et al.* 2006.
[26] Feurdean *et al.* 2017; Grindean *et al.* 2014.
[27] Kiss *et al.* 2015; Ţărău *et al.* 2014.
[28] Kiss *et al.* 2015.

activity during the Pleistocene and frequent river avulsions throughout the Holocene.[29]

Typic Chernozems are still widespread in the northwestern part of the Vinga Plain; some have undergone decalcification and/or leaching, thus transitioning into (luvic) Phaeozems.[30] They are characterised by very dark brown to black mollic topsoils with humus contents around 2–3.5 %.[31] Eroded subtypes ar**e** prevalent on many slopes, particularly because loess soils have been subjected to intensive agricultural use. In the valleys, dark-coloured alluvial soils are abundant which have been termed fluvi-gleyic Chernozems[32] or Humogleys.[33] As they are usually clay-rich, they have also been mapped as Pelosols or, more frequently, as Vertisols, when respective properties were evident. Craciun *et al.*[34] report that, outside of Lluvisol-dominated areas, smectites are prominent within the clay mineral spectrum. The vertic properties can be disguised, however, as soils are often inundated.

The recent climate in the Banat is transitional, i.e. predominantly temperate (Cfb, according to Köppen), with a northeastward increase of continental and orographic effects (Dfb), while frequent cyclones from the Mediterranean cause positive precipitation anomalies especially in the western parts. Due to the maritime influence, winters are mild and short, but when northeastern conditions prevail, harsh frosts may occur. Mean annual temperatures range between 12 °C (with average summer temperatures above 22 °C in July) and 6 °C towards the eastern highlands. Annual rainfall (with spring maxima) in the central and western parts of the Vinga Plain is 550 mm per year, with a potential evapotranspiration around 700 mm and occasional summer droughts.[35]

The Banat is part of the Pannonian floristic province, but congruently with the interlocking climatic subzones it represents an ecotone between the central eastern European and south European vegetation units, comprising numerous intra- and azonal elements. The potential natural vegetation is believed to consist of a typical forest steppe towards the central parts of the Great Hungarian Plain and open deciduous woodlands at its periphery, similar to the Transylvanian lowlands or large areas of the Ukraine.[36] Contemporary woodlands are mostly dominated by *Quercus robur*. Other temperate summergreen species are *Fraxinus excelsior/angustifolia/ornus*, *Tilia tomentosa*, *Acer campestre/tataricum*, *Cornus mas/sanguinea*, *Ulmus glabra/laevis*. On drier sites such as loess-covered areas, thermo-/xerophilous (Balkan-type) oak associations (*Quercus pubescens/cerris/frainetto*) can be found.[37] As a consequence of thorough drainage, the former floodplain forests composed of *Salix alba* and *Populus* sp. have been replaced by a cultural steppe with some singular forest islands and marsh remnants.[38]

Methods

With special focus on the alluvial deposits inside of the fortification (**Fig. 3**), 16 cores were collected by vibracoring with a petrol-powered hammer and corers of 1 and 2 m length (60 mm Ø). Sediment units were subsampled for geochemical analyses at a minimum of 30-cm intervals or less, when lithological or pedogenic changes were evident. Samples for pollen analysis were taken wherever pollen preservation seemed likely, putting particular emphasis on the different colluvia separated by fossil topsoils in the 2nd m. All soil types were identified according to the World Reference Base for Soil Resources,[39] including those on the interfluves that were sampled with a Puerckhauer auger (n = 23; **Fig. 3**) and will be covered in detail in a later publication.

Geochemical laboratory analyses of selected profiles focused on pH (KCl; DIN 19684; 78 samples), humus content (loss on ignition;[40] 78 samples) and granulometry (pipette method after Köhn;[41] n = 33). 54 samples (0.3 cm^3) were prepared for pollen analysis, following the standard procedure after Fægri/Iversen[42] with the addition of *Lycopodium* tablets in order to determine pol-

[29] Grigoraş *et al.* 2004; Urdea *et al.* 2012; Dicu *et al.* 2013; Ianoş 2002; Rogobete *et al.* 2011.
[30] Sherwood *et al.* 2013.
[31] Grigoraş *et al.* 2004.
[32] Dicu *et al.* 2012; Grigoraş *et al.* 2004.
[33] Grigoraș/Piciu 2005.
[34] Craciun *et al.* 2010.
[35] Grigoraş *et al.* 2004; Rieser 2001; Ţărău *et al.* 2010.
[36] Magyari *et al.* 2010.
[37] Sümegi *et al.* 2002.
[38] Neacşu *et al.* 2015; Rieser 2001.
[39] IUSS Working Group 2015.
[40] Riehm/Ulrich 1954.
[41] Werner 1973.
[42] Fægri/Iversen 1989.

len concentrations.[43] Pollen grains were embedded in silicone oil and examined under the light microscope (magnification factors 470 and 756). Taxa were identified with the aid of the departmental reference collection and respective literature.[44] The pollen types were divided into local (wetland and aquatic plants including Cyperaceae, spores) and regional taxa (including Poaceae). Owing to the poor preservation conditions, the total pollen sums were rather low, amounting to 311 grains in Profile I and 316 in Profile II with mean pollen concentrations of 873 grains cm^{-3} in Profile I and 1855 grains cm^{-3} in Profile II, respectively. Charcoal from two samples was radiocarbon-dated by acceleration mass spectrometry (AMS) at the Archaeometry department of the Curt Engelhorn Centre, Mannheim. Results were calibrated with OxCal 4.2.[45]

Results and discussion

Sediments

The most common surface deposits in the Corneşti area are reddish (Munsell colour 10 YR 3/4) silty clays which are apparently deeply pre-weathered and contain plenty of carbonate concretions. Termed 'Vinga clays' by Dragulescu *et al.*[46] and Mihaila/Popescu,[47] they have been ascribed to the Upper Pleistocene. Subsequent to the formation under stillwater conditions, solifluction is believed to have led to their prevalent accumulation on top of loess, as is also evident in the profiles presented by Sherwood.[48] However, since the granulometric conformity of Quaternary deposits in the area pertains to the 'Pannonian loess' as well, not only the underlying alluvial silty clay loams but also the near-surface deposits have often been referred to as loessic and loess-like. Against an average silt/clay ratio of 2.5 in a loess cover near Vinga, the values within the floodplain profiles vary between 1.4 in suspected Vinga clays and 2 in supposed alluvial loess derivates, while pedisediments show overlapping spectra, depending on their dominant source(s) of material (**Fig. 2**). All of this indicates a range of interfingering, reworked and mixed facies. At greater depths, around 7 m according to Nykamp *et al.*,[49] old Mureş fan deposits are present, consisting of sands and gravels which are also accessible at several pits along the main valley of Corneşti. On the lower slopes and in dell-shaped depressions, colluvia prevail, sometimes forming fans at the edges of valleys or the interior of ramparts.

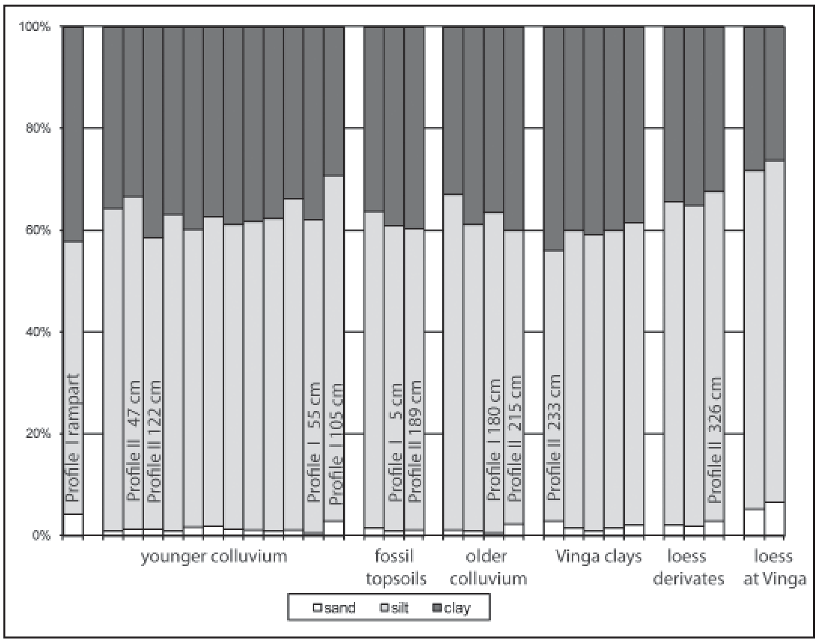
Soils

Soils are predominantly characterised by gradual transitions between horizons and layers, accounting for the omnipresence of bioturbation, and possibly also peloturbation/self-mulching. Smectite contents are probably high, as clay mineral analyses carried out in the neighbouring Apa Mare river system at Vinga yielded smectite/mixed layer values up to 67 % of supposedly authigenic origin. Like the slopes, valley bottoms contain buried soils with humic horizons (SOM values between 1.6 and 2.7 %), covered by younger pedisediments (**Fig. 2**). The upper boundary of the buried soils is often obscured; however, a confusion with clay- and humus-enriched horizons as they have partly evolved on the interfluves[50] is unlikely – not only due to the stratigraphic positions of the humic topsoils (mostly in the 2nd m underneath relatively thick colluvia; **Fig. 2**), but also the lower pH-values, and, finally, the occurrence of pollen.

Chronostratigraphy

Regarding the origin of the sediments in which the mentioned fossil topsoils have developed, fluvial transport from greater distances can be ruled out in view of the small catchment and low stream capacity. In most cases, they are thought to be *in-situ* 'Vinga clays' containing the characteristic carbonate nodules, but having changed colour in the course of gleization. On the other hand, occasional finds of daub and charcoal point to an older generation of colluvium. Its distribution and thickness are assumed to be highly variable both longitudinally and transversely as a direct result of the land-use history and the erosional dissection

43 Stockmarr 1971.
44 E.g. Moore *et al.* 1991; Punt and Clarke 1976–2003; Reille 1992; 1998.
45 Bronk Ramsey 2017; Reimer *et al.* 2013.
46 Dragulescu *et al.* 1968.
47 Mihaila/Popescu.1987.
48 Sherwood 2013.
49 Nykamp *et al.* 2016.
50 Nykamp *et al.* 2016.



a

b

Fig. 2 a Grain size composition of floodplain deposits from Corneşti; **b** Examples of fossil topsoils (top: 2nd and 3rd m of floodplain profile, bottom: 2nd and 3rd m of slope profile with underlying loess) (graphic and photos by the authors)

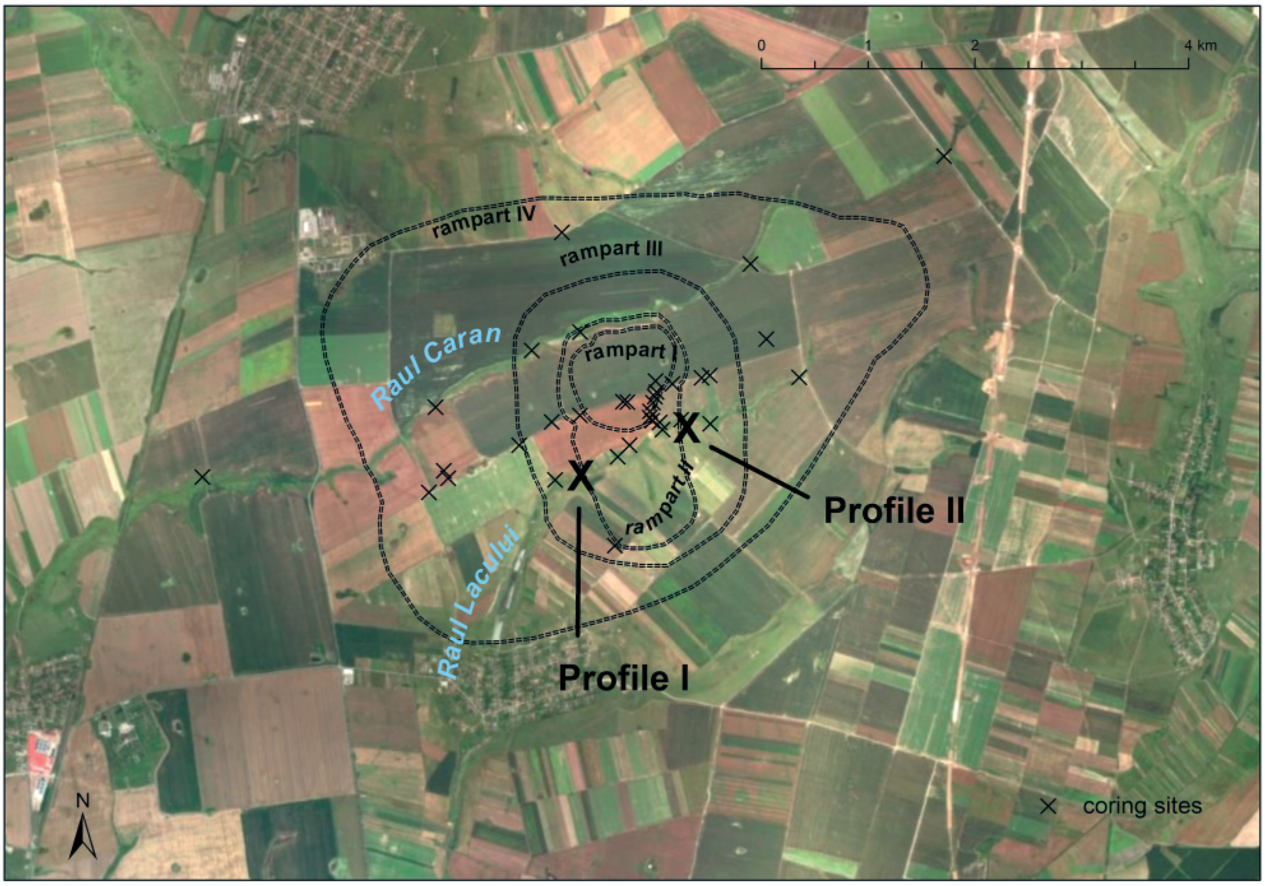


Fig. 3 Positions of coring sites at the fortification (illustration by the authors; image source: ESRI open data)

of the settlement site.[51] Our two pollen-bearing profiles suggest that both sediments in question are older colluvia by not only containing Late Holocene pollen assemblages but also charcoal dated to the Copper and Iron Age (see below).

The profiles presented here (**Figs. 3-5**) originate from the main valley of Corneşti ('Lacului' or 'Lake' Valley). The first one, Profile I, is situated immediately below Rampart II (western part) which is still approximately 140 cm high. Underneath the wall-construction material, a fossil topsoil was found that had developed inside 170-cm thick colluvial loams of differing granulometric composition. They lie on top of another 90-cm thick silty to clayey colluvium, comprising ceramics as well as iron/manganese mottles and carbonate nodules. Below a depth of 260 cm lies a layer of alluvial loess with a high percentage of $CaCO_3$ concretions and some iron/manganese oxides (in which another fossil A-horizon is developed). The cultural layer contains pollen at 194 and 220 cm depth (height of rampart subtracted). A piece of charcoal at 194 cm has been dated to 4350 ± 28 uncal. BP (cal. BC 3078 – 2903; 2-sigma); i. e. the Copper Age as *terminus post quem*. It may therefore be assumed that the upper 170 cm of pedisediments immediately underlying the rampart are a product of land-use dynamics during the period between the radiocarbon date given above and the time that the fortification was erected.

The second sediment core, Profile II, lies immediately upstream of the eastern flank of Rampart II and consists of colluvial silty clays to a depth of 170 cm. Below, a fossil A horizon of 20 cm is located inside 50 cm of silty clay loams which grade into thick silty clays. The loams are colluvial in nature; however, in terms of colour and texture, they are almost indistinguishable from the deposits beneath, assumed to belong to the 'Vinga clays'. This illustrates the overall difficulty in specifying this important transition between Pleistocene and young Holocene deposits concerning almost all investigated profiles. Below 315 cm, a lighter coloured (10 YR 4/2) silty clay loam with many iron/manganese mottles and secondary carbonate concretions, most likely loess loam, is found down to the maximum coring depth of 5 m. Unlike the almost sterile fossil topsoils in Profile I,

[51] Nykamp *et al.* 2015.

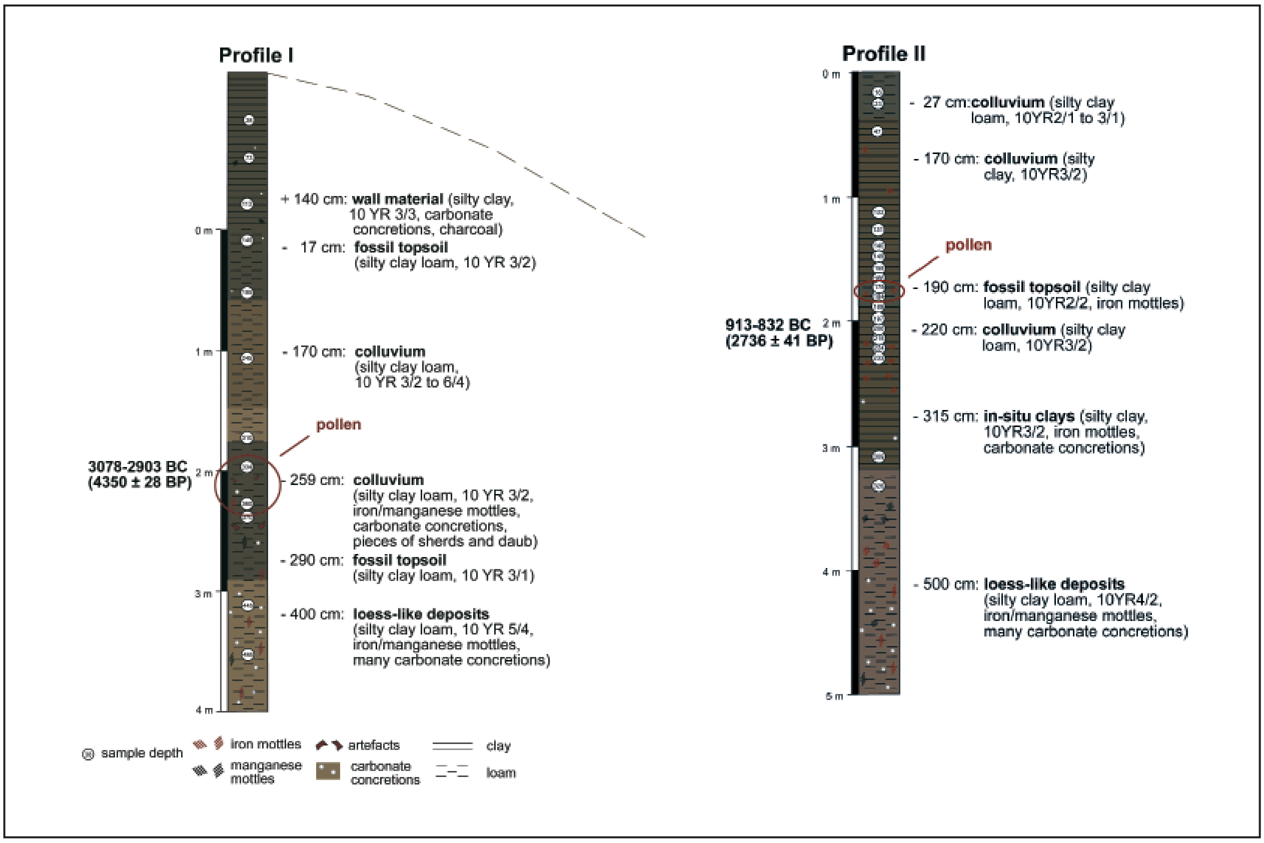


Fig. 4 Sedimentology and chronostratigraphy of the presented profiles (graphics by the authors)

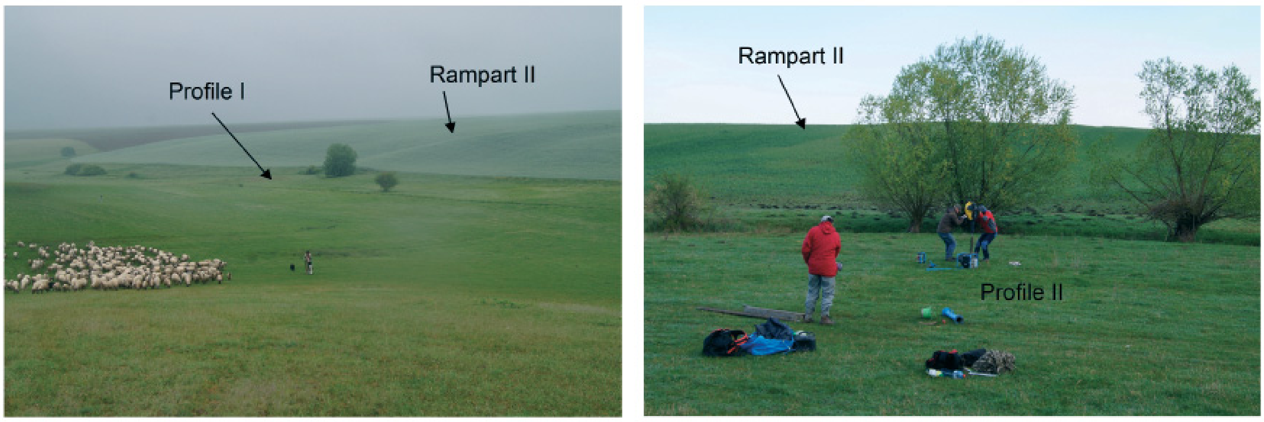


Fig. 5 Locations and surroundings of Profile I (left) and II (right) (photos by the authors)

the one in Profile II contains pollen. A piece of charcoal at 2 m depth was dated to 2736 ± 41 uncal. BP (cal. BC 913 – 832; 2-sigma) i.e. the Early Iron Age. Consequently, the upper colluvial strata have been deposited between the Middle Iron Age and the Modern Age.

Models of landscape evolution are necessarily constrained by the lack of high-resolution data including multiple radiocarbon ages, also because the construction of ramparts has resulted in a number of slope ruptures[52] which complicate longitudinal profile correlations. Nevertheless, the obtained data provide some crucial insights in processes of erosion and deposition. The existence of 90 cm of Chalcolithic colluvium overlain by 170 cm of younger, pre-Late Bronze Age sediments reflect a considerable amount of anthropogenically induced mass movements. The erection of the rampart contributed to the preservation of the eroded soil material, which may otherwise

52 Micle *et al.* 2009.

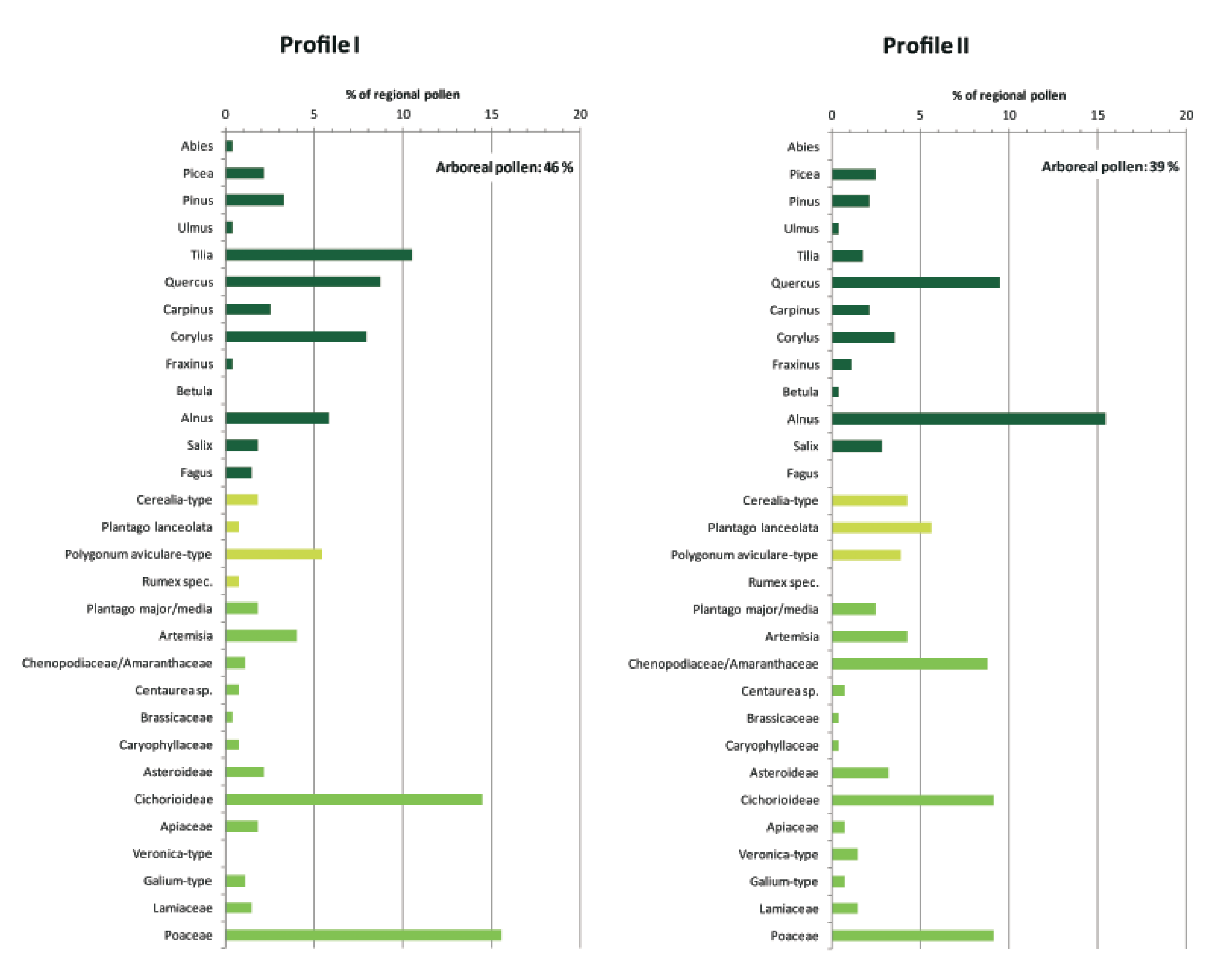


Fig. 6 Selected palynomorphs from the Copper Age (Profile I) and the Iron Age (Profile II) (graphics by the authors)

have been removed from similar floodplain positions. This underlines that large quantities of sediments must have been translocated within a relatively short period of time, notwithstanding the overall geomorphic stability on the interfluves where most soils have remained intact in general, even if the effects of widespread deflation have been discussed as well.[53]

None of the colluvia was dated to the Late Bronze Age settlement phase at Corneşti. This is mainly due to the fact that such deposits were not among the pollen-bearing strata, upon which age determination has focused so far. Early to Mid-Bronze Age deposits are however indirectly proven in Profile I. Their thickness of 170 cm, together with 90 cm of Chalcolithic material, reveals the high degree of land degradation at the centre of the site before the time of rampart construction. The findings are in line with the radiocarbon dates and chronostratigraphical interpretations presented by Nykamp *et al.*,[54] which show that the fan material between 145 and 225 cm depth was deposited between the Copper Age and the Early Iron Age. The 50 cm of Iron Age colluvium in Profile II also fit into this picture, but the development of the fossil topsoil equally proves that the period after deposition was followed by an interval of geomorphological stability. However, human impact intensified once again in a later period, as implied by the presence of 170 cm of (sub-) recent colluvium.

Pollen spectra

Even though sites with hydromorphic conditions can be found at Corneşti (particularly in the Caran valley), they do not contain reasonable amounts of pollen. Remarkably, larger numbers of palynomorphs which have synsedimentarily been incorporated in terrestrial soils do exist at least in a few horizons with increased organic matter contents

[53] Nykamp *et al.* 2017.

[54] Nykamp *et al.* 2016.

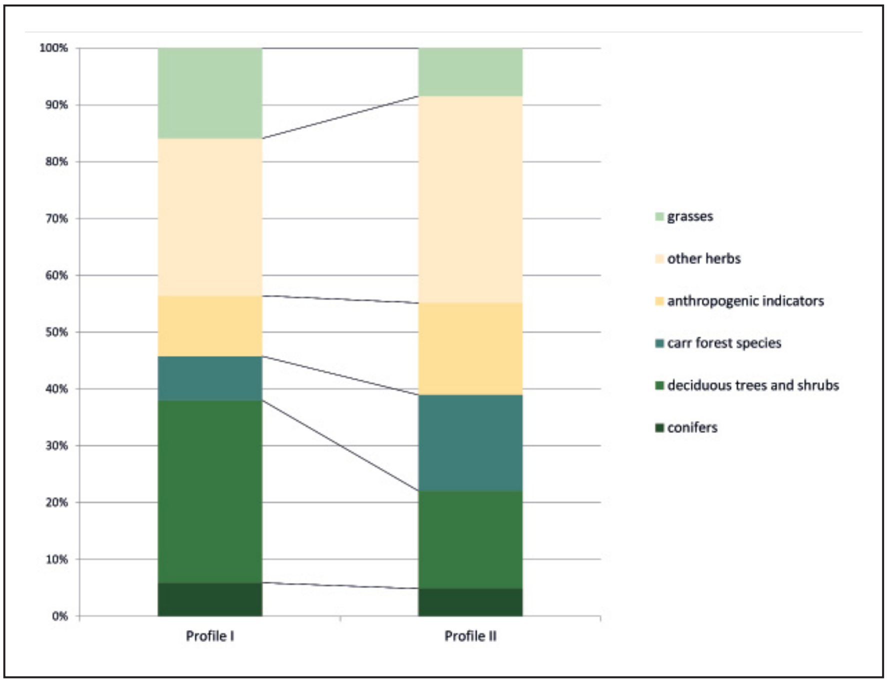


Fig. 7 Allocation of regional taxa from the Copper and Iron Age to ecological groups (graphic by the authors)

in the two profiles described above. Two samples each from the cultural layer of Profile I (194 and 220 cm below the surface) and the fossil topsoil of Profile II (at 175 and 184 cm depth) were subsequently analysed. **Fig. 6** shows relative frequencies of selected taxa at the two sites, expressed as percentages of the regional pollen sum. **Fig. 7** features their distribution into major ecological classes, i. e. coniferous and deciduous trees, trees from the local floodplain, anthropogenic indicators, other herbaceous plants and grasses.

Profile I contains about 46 % of woody taxa with *Tilia* as the dominant tree (over 10 %), followed by *Quercus* and *Corylus* (around 9 and 8 %). *Carpinus* is present, as well as *Fagus* and *Abies* which, together with the radiocarbon age, attest the Mid- to Late Holocene nature of the spectrum.[55] Primary and secondary indicators for human presence (here: *Cerealia*, *Plantago lanceolata* and *Polygonum aviculare*) reach levels of 11 % in the samples. Among the other herbs, Cichorioideae constitute the major part with 14 %, comparable to the values of grasses and most likely a result of selective corrosion.

In Profile II, an even lower percentage of arboreal pollen of around 39 % is evident among which *Alnus* dominates with approximately 15 %, proving that alluvial forests were present outside of Ram-part II until the Early Iron Age. However, if forest representatives *Alnus* and *Salix* are excluded from the regional tree spectrum, *Quercus* remains the major woodland constituent, while the other deciduous species have been reduced considerably, from a total of 32 to 17 %. The frequencies of anthropogenic taxa are distinctly higher than in Profile I and amount to 16 %. In the class of other herbs which have generally increased from 28 to 36 %, especially Chenopodiaceae show a drastic rise from 1 to 9 %. This serves as additional evidence for land degradation in the area caused by continuous human presence.

The tree values (without *Alnus*/*Salix*) of 38 % in Profile I indicate that a sparsely wooded steppe existed during the Copper Age. Until the Early Iron Age, the respective species had declined by over one-third to only 22 %. In most pollen profiles from the greater region,[56] tree percentages commonly do not drop below 60–65 % until approximately 3000 BP.[57] Reduced levels around 50 % have been documented in Lake Stiucii, Transylvania, for the Bronze Age[58] and the Matra up-

55 E. g. Fărcaș/Tanţău 2012.

56 Off-site data from the archaeological periods in question were not collected until our last coring campaign and are therefore not yet available for comparisons.

57 E.g. Magyari *et al.* 2010; Grindean *et al.* 2014.

58 Feurdean *et al.* 2015.

lands in northeastern Hungary for the Iron Age.[59] As a consequence of the different depositional environments, a direct comparison is difficult, but the divergence of values gives some clue to the degree of woodcutting that has obviously taken place at Corneşti even before the fortification was built.

The general composition of arboreal species shows the existence of a *Tilia/Quercus/Corylus* woodland, as was also common in northeastern Hungary at least before 3700 BP.[60] Until the Iron Age, *Quercus* had become the dominant tree at Corneşti, which has been equally observed in largely deforested areas from Hungary to Transylvania.[61]

Conclusion

The pollen-bearing on-site sediments in the prehistoric settlement Cornești-Iarcuri offer profound insights into its local vegetation and settlement history by depicting the environmental conditions before and after it became the largest known fortified site of the Late Bronze Age. Cereals (as a direct sign of agriculture) and ruderal plants (showing land-use in general) account for 11 % of regional pollen in the Copper Age and rise to 16 % in the Iron Age. This, in combination with the low amount of arboreal pollen, indicates substantial human impact. It is equally documented by slope erosion processes that led to the dissection of the settlement area and accumulation of up to 260 cm of sediment in the main valley. Composed of several distinct colluvia of Copper to Early Iron Age origin, it represents important steps in the creation of a cultural landscape. In turn, extended phases of geomorphological stability have not only been postulated for the interfluves, but are also attested by the occurrence of numerous fossil humic horizons within the valley deposits.

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