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Soil Degradation and Shifting Habitation Patterns in the Sand Landscapes of the Southern Netherlands

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Soil degradation; Pleistocene sand landscapes; shifting habitation patterns; Iron Age; Southern Netherlands.

Long-term archaeological data gathering in the southern Netherlands may deliver an interesting scale model that is suitable for the Pleistocene sand areas of the Northwest European Plain (Fig. 1). On a micro scale level it has become clear that Bronze Age and Iron Age farmers intensively used the landscape, resulting in relatively dense distribution patterns of settlements all over the sand plateaus. However, this agricultural use of the landscape—related to the 'celtic field' system—led to a process of soil degeneration during which initially brown moder podzols gradually transformed into degenerated humus podzols that could no longer be used as farmland.

According to the model developed by Spek[1] and Roymans/Gerritsen,[2] this process of 'secondary podzolisation' particularly affected those sections of the landscape that were dominated by dry sandy soils with a low loam content (between c. 10 and 20%; see Fig. 2). In the later Iron Age the changing soil conditions resulted in a dramatic shift in the habitation pattern that clearly manifests itself in the Roman period (Fig. 3); on the local scale habitation moved from the degenerated soils to nearby zones with better soil conditions (higher loam content), which became more densely inhabited now than in the Bronze Age/Early Iron Age. The zones where the Roman period settlements concentrated also became the zones where we can find early medieval habitation and where in the late medieval period the *plaggen* soils started to develop.

This paper presents several case studies to explain the process of shifting habitation patterns and to test the model of soil degradation by a program of grain size analyses (GSA) and thermogravimetric (TGA) analysis. With these laboratory analyses we are able to compare samples in terms of the division in grain sizes as well as of calcareous and organic content to support claims on soil quality. It is our hypothesis that the basic 'resetting of the landscape' in the later Iron Age had a fundamental long-term impact on the spatial organization and use of the landscape up until the later 19th century. Furthermore we are testing whether this soil degeneration process is applicable on variable scale models, and whether other methodologies and resulting observations may give clues to the supposed land movement in the past.

Our first case study concerns the micro region of Someren (Nr. 2 in Fig. 1). Since the early 1990s, large scale excavations have been carried out on a sand plateau covered with *plaggen* soils directly east of the modern village of Someren. A total of almost 40ha of arable land has been excavated. Under the *plaggen* soils there was a multi-period settlement nucleation from the Bronze Age until the High Middle Ages, after which the habitation moved to the lower parts of the plateau.[3] Spread over the arable land samples were taken from the sand layer directly underneath the *plaggen* soil for grain size analysis.

1 Spek 1996.
2 Roymans and Gerritsen 2002.
3 Hiddink and De Boer 2011.

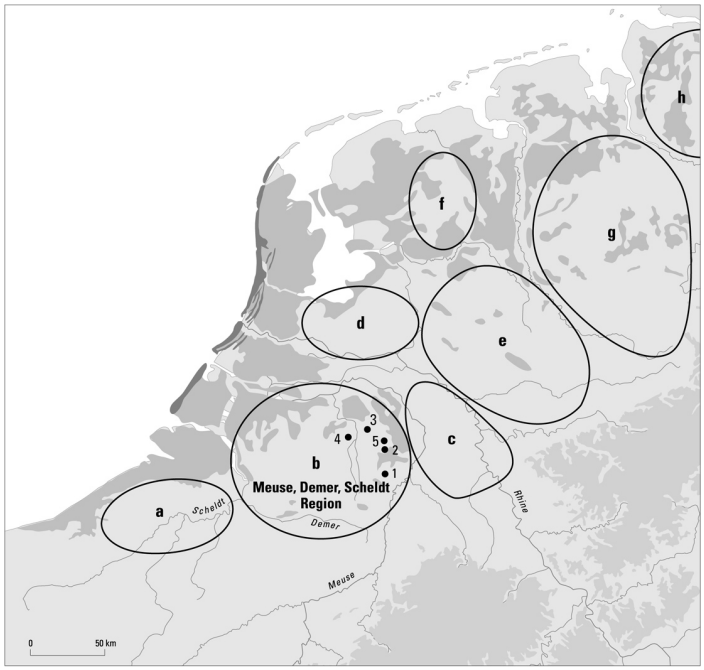

Fig. 1 | Pleistocene coversand landscapes in the Northwest European Plain. Legend: (a) Flemish sand plateau, (b) Meuse-Demer-Scheldt region, (c) Meuse-Rhine region, (d) Veluws-Utrechts plateau, (e) East Netherlands-Westphalian sand plateau, (f) Drenthe plateau, (g) Lower Saxonian sand region, (h) Elbe-Weser triangle. Legend for the location of the key sites discussed in this paper in the Meuse-Demer-Scheldt region: 1 Weert-Nederweert; 2 Someren; 3 Lieshout; 4 Veldhoven-Zilverackers; 5 Deurne.

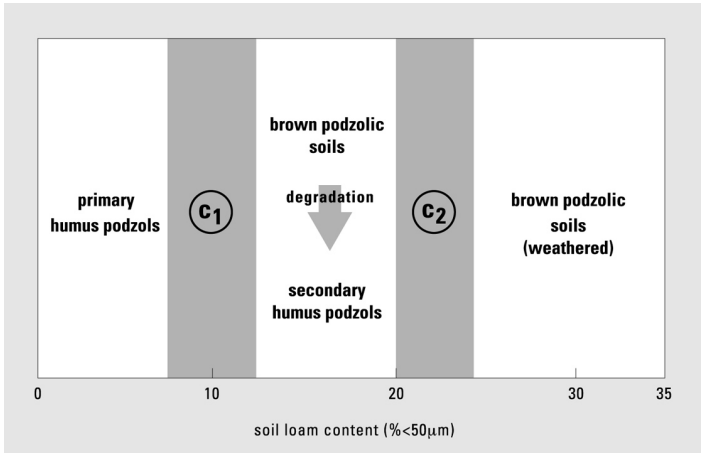

Fig. 2 | Critical loam-content boundaries for the podzolisation of dry sandy soils (after Spek 1996, Fig. 4).

In general the analysis showed remarkably high values for loam content (= clay and silt fraction), between 35 and 50%, although some variability occurred over the plateau. West of Someren sand samples were taken from soils in sub-modern heathland zones at locations with evidence only of habitation in the Bronze Age and Early Iron Age. The analyses point here to considerably lower loam content with an average value of 13%.[4] The latter group clearly concerns secondary degraded soils that were not suitable for cultivation and habitation after the Early Iron Age.

In the last decennia large scale excavations have been carried out on diverse locations in the micro-region Weert-Nederweert within the zone of late medieval/pre-modern arable land (Nr. 1 in Fig. 1).[5] The results of these excavations in the micro-region showed multi-period settlement traces starting from the Late Bronze Age/Early Iron Age onwards. In a selection of 21 sites samples have been taken for grain size analysis to obtain the loam content,[6] of which the majority of samples showed values of more than 30%,

4 Hiddink and De Boer 2011, 87–98.
5 Hiddink 2005.
6 Hiddink 2005, 44–46; Hiddink and De Boer 2011, 96.

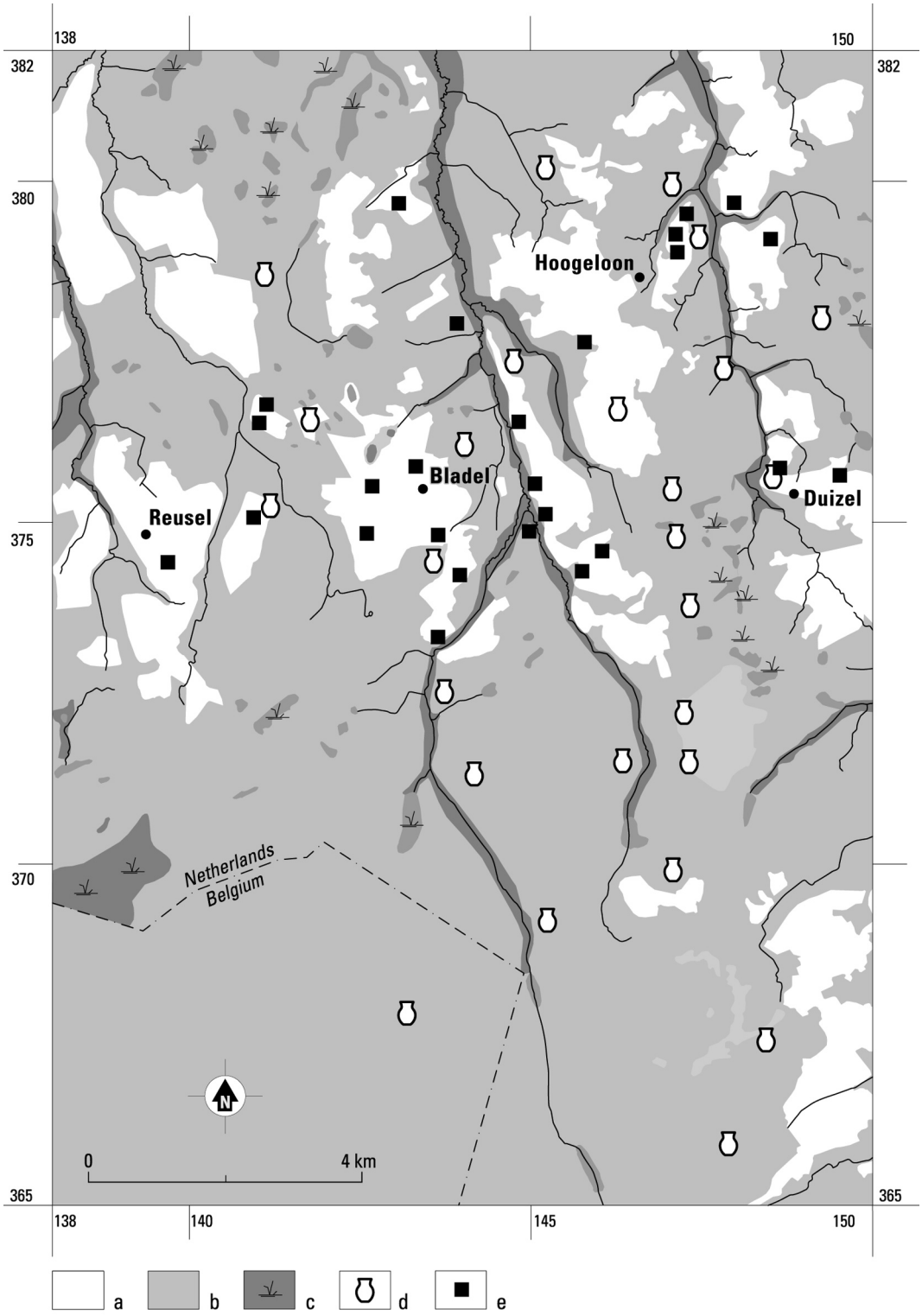

Fig. 3 | Simplified map of a 19th century landscape in the southern Netherlands, showing the shift in location of archaeological sites from the Early Iron Age (urnfields) to the Roman periods (settlements). After Roymans and Gerritsen 2002, Fig. 5. Legend: (a) pre-modern *plaggen* soil, (b) pre-modern heathland, (c) wetland/peat moor, (d) urnfield, (e) native-Roman settlement.

which corresponds to relatively fertile soils classified as brown podzolic soils (Fig. 2). Locally also sand layers with a lower loam content occur and it has been established that

loam-rich soils show traces of the formation of secondary humus podzols in the past, most likely due to local fluctuations in the ground water table.[7]

Currently and within the coming years, large scale archaeological research is taking place in Veldhoven-Zilverackers over a large area of 400 to 500ha. (Nr. 4 in Fig. 1). The plan area of Zilverackers offers an excellent chance to explore the transformations, in a large area with a great variation in land use, from the Bronze Age up into the Late Medieval period. Underneath the plaggen soil at Zilverackers a landscape is sealed, with almost continuous evidence of shifting habitation over the area in the Bronze Age/Iron Age. Our preliminary data from 18 samples show that the soil of the sand underneath the plaggen soil layer generally has a rich loam content, which can be divided in two regions. Loam content in the northern part varies between 13% and 41% while the southern part shows values between 22 to 49%. The difference in soil quality between the northern and the southern part is confirmed by the TGA analysis showing higher organic and calcareous contents in the south compared to the north.[8] To the west side of the Zilverackers area a former heath area (Toterfout/Halve Mijl) is located with, according to the soil map, loam poor soils showing degenerated humus podzols. Within that area mainly Bronze Age and Early Iron Age archaeological evidence is present, including the well-known grave mounds of Toterfout/Halve Mijl. In 2012 a small research program, incl. GSA and TGA analyses, has started to compare the soil profiles and archaeological evidence between the former heath and plaggen soil areas.

In the micro region Lieshout large-scale excavations have been carried out in a former complex of plaggen soils on top of multi-period settlement traces from the Late Bronze Age/Early Iron Age onwards (Nr. 3 in Fig. 1). Grain size analysis of the sand layer directly underneath the plaggen soil shows remarkably low values of loam content between 3 and 14% in 19 samples with two samples showing higher values (35 and 41%).[9] Research nearby of a pre-modern acre complex with plaggen soils at Deurne shows excavated settlement traces from the Bronze Age/Early Iron Age onwards (Nr. 5 in Fig. 1). Also here the loam content over a relatively large area (20ha, 19 samples) appears to be low and varies between 7 to 22%.[10]

The focus of this research is thus the fast transformation of the landscape in the Middle and Late Iron Age, and its impact on the structure and order of the landscape in later periods until modern times. This pre-modern ordering of the sandy landscape was characterized by a structural bipartition in, on the one hand, relatively small inhabited and cultivated zones, and, on the other hand, large zones of extensively used waste lands with degenerated soils. The results of the case studies appear to support the Spek[11] and Roymans/Gerritsen[12] model, although both on a supra-regional and local level substrate and soil variability must be taken into account, to explain differences in the extent and timing of transformations and settlement mobility.[13] Analysis of coversand underneath plaggen soils at Deurne and Laarbeek proves that habitation on relatively loam-poor soils was not terminated in all places, but locally was extended into later periods.[14] Combining GS and TGA in the relatively large area of Veldhoven-Zilverackers shows that within cultivated zones with plaggen soils the quality of the soil is variable, possibly due to substrate differences.[15] Potential causes for the deviation of the Spek[16]

7 Hiddink 2005.
8 Kluiving et al. 2011.
9 Hiddink 2005, 56–58; Hiddink and De Boer 2011, 96.
10 Hiddink 2008.
11 Spek 1996.
12 Roymans and Gerritsen 2002.
13 Cf. Arnoldussen 2009; Hiddink and De Boer 2011, 98.
14 Hiddink 2005.
15 Kluiving et al. 2011.
16 Spek 1996.

and Roymans/Gerritsen[17] model are: a) the impact of fluctuating groundwater levels, b) local spatial as well as vertical variations in loam content of sand layers, c) impact of older formations with different hydrological properties in the shallow subsurface, depending on the grain size and transmissivity of the sediments. Future research should focus on comparing regions with different analytical techniques, taking general soil profile analysis into account. Also interesting is systematic sampling and soil investigation in prehistoric 'celtic field' complexes on degenerated soils in submodern heath lands.

17 Roymans and Gerritsen 2002.

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