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Lynchet-Type Terraces, Loess, and Agricultural Resilience on Chalk Landscapes in the UK and Belgium

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Lynchets, often the defining component of historic agricultural landscapes in northern Europe, are generally associated with soft-limestone geologies and are particularly well developed on loess-mantled landscapes. To understand their formation and chronology, the authors present their geoarchaeological analyses of lynchet soils and loess deposits at Blick Mead and Charlton Forest in southern England, and Sint Martens-Voeren in Belgium. The lynchets date from the late prehistoric to the medieval periods and were constructed by plough action at the English sites, and by both cut-and-fill and ploughing in Belgium. This has resulted in the preservation of highly fertile loessic soils across chalk slopes, lost elsewhere. Although each example is associated with local/regional agricultural histories, the lynchets' effective soil-retention capacities allowed them to survive as important heritage features with environmental benefits over millennia.

Keywords: agricultural lynchets, historical land use, slope-sediment transfer, loess, luminescence dating

Introduction

Lynchets cover significant areas of northern Europe (Brown et al., 2020: 566–67) but they have rarely been subjected to direct archaeological investigation (Brown et al., 2021: 2). Strictly speaking, lynchets are defined as created by medieval strip

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farming and ploughing along slope contours (cultivation lynchets; see Curwen, 1939: 46) but the term has been widely applied to small agricultural terraces without walls (Froehlicher et al., 2016: 173–85) and this is the definition we apply here. Lynchets and terraces present the most widespread geo-anthropological elements of landscape transformation prior to modern times (Figure 1). Here, we present the results of a detailed geoarchaeological investigation of the age, form, and function of lynchets within three typical lowland chalk systems.

Unlike steep-land agricultural terraces, which have recently received considerable archaeological attention (Harfouche & Poupet, 2021; Turner et al., 2021; Brown et al., 2023), lowland lynchets on soft rocks (e.g. chalklands) have seen relatively little modern scientific analysis. Although commonly described by nineteenth-century antiquarians, lynchets were not systematically studied until the development of aerial photographic archaeology in the 1920s (Crawford, 1923). This led to further work on their form within the wider historical landscape (Curwen, 1939: 45–52). By the 1960s, the analysis of the composition and distribution of lynchets across the UK and northern Europe demonstrated concentrations across steeper hillside landscapes with shallow soils over limestone geologies, particularly chalk (Whittington, 1962: 117; Fénelon, 1963: 24–28); much debate has centred on when these features were formed (Macnab, 1965: 279–90; Fowler & Evans, 1967: 289–301; Baker, 1969: 136–40).

More recently, geomorphological research in these areas has made it possible to date soils, given the presence of windblown silts (loess) which are highly fertile and can be accurately dated by sediment luminescence (Stevens et al., 2020: 3–4), in turn allowing for a better understanding of the historic formation of lynchets and increased potential of soil erosion (Evans et al., 2017: 49–51; Verhegge & Delvoie, 2021: 1–2). A greater understanding of formation processes and prehistoric land use across the chalklands of southern Britain (Bell, 1986: 72–73; Johnston et al., 2020, 2021: 185–207) and continental Europe (Rommens et al., 2007: 784–87; Fuchs & Lang, 2009: 22–24; Turner et al., 2021: 784–87), mapping, and morphological assessments of buried soils and lynchets have documented the progressive development, erosion, and redeposition of brown earth soils, calcareous colluvium, and agricultural horizons across these landscapes (Ford et al., 1990: 44–51; Macphail et al., 1990: 53–69; Allen, 1992: 37–52; Bell et al., 2020: 1–8).

The term lynchet has been used across northern Europe for small unwalled contour ridges created by the ploughing of strip fields. They have been identified in France (Schwartz et al., 2020; Keller et al., 2023; Etrlen et al., in press), Denmark (Nielsen & Dalsgaard, 2017), Germany (Larsen et al., 2016), Poland (Sobala, 2021), and Czechia (Zádorová et al., 2018; Zacharová et al., 2022) as well as England and Belgium. In some of these cases, such as the Danish and British 'Celtic' fields, lynchets are part of prehistoric field systems (Arnoldussen et al., 2021), but this is not typical. Hence the examples presented here are not part of prehistoric field systems.

The Distribution of Lynchets in England

England's Historic Environment Record (HER) provides spatial information on terraces and lynchets and reveals distinct relationships with their underlying geology (Figure 2). Lynchets are recorded more often (n = 5657) than terraces (n = 564) and this reflects the nature of the low-relief soft-rock landscape of England and the terminology used by the Ordnance

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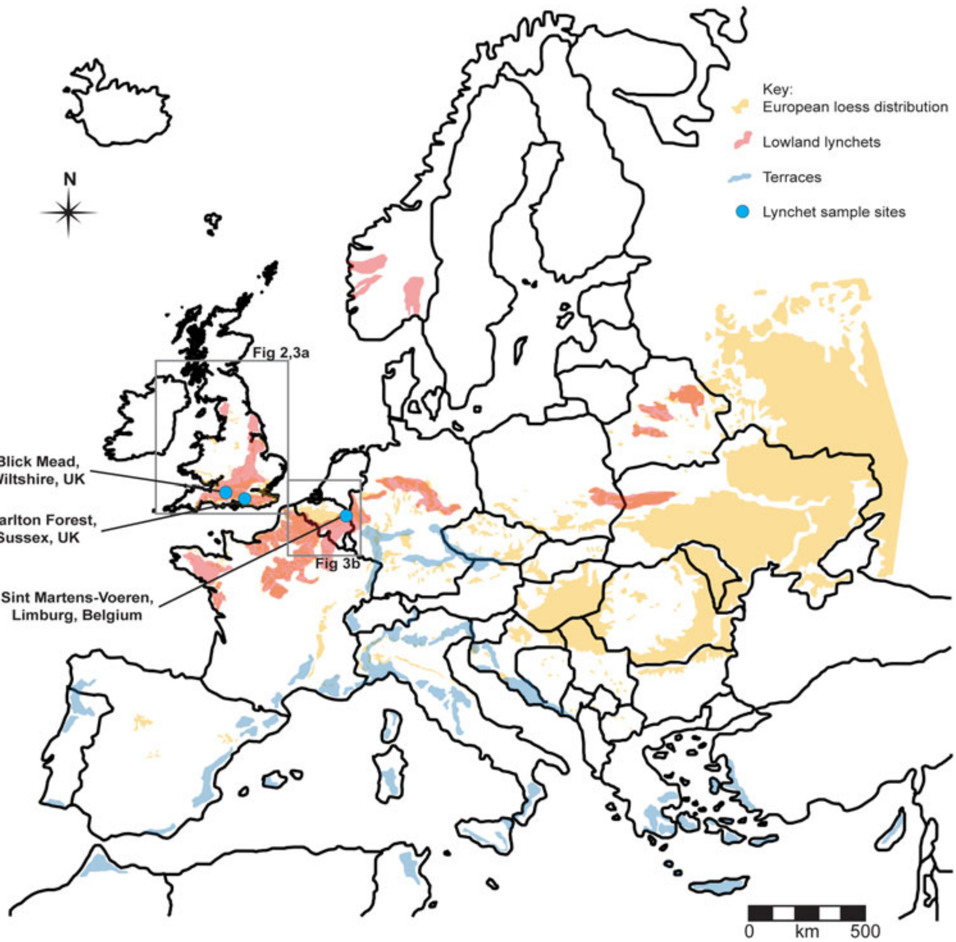
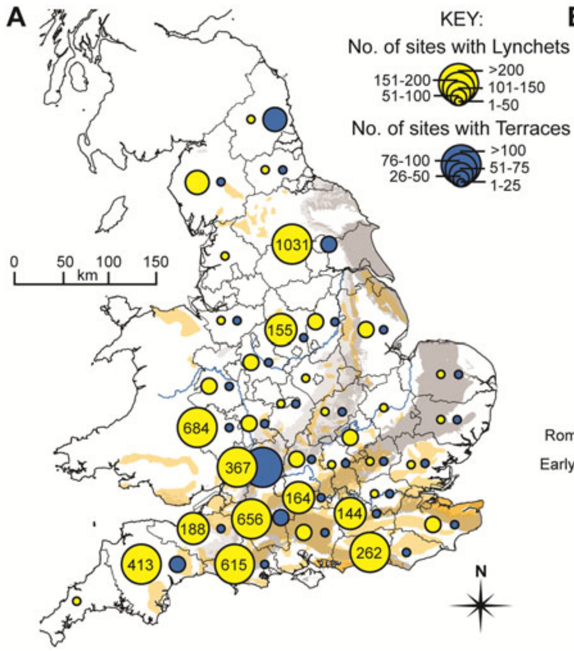


Figure 1. *Distribution of European loess (based on Catt, 1988; Lehmkuhl et al., 2021), lynchet and terrace 'common' distribution, and location of case studies.*

Survey and aerial photographic surveys (Crawford, 1923). With this caveat in mind, the results demonstrate distinct clustering of lynchets in southern England across areas with both Jurassic limestone and Cretaceous chalk bedrock. The frequency of lynchets in the southern and south-western counties reflects the presence of chalk and Jurassic limestones in the North and South Downs, Salisbury Plain, the Chiltern Hills, and Cranborne Chase. Although less common, terraces have a similar distribution, except for Northumberland, where there is a greater number recorded over lynchets.

Dating lynchets has been problematic (see Johnston et al., 2021: 185–207). Both form and archaeological associations have been most commonly used. About half the HER records have associated dates; of these, over half (56 per cent) suggest that both lynchets and terraces originated in the medieval period (AD 1066–1540), and a further twenty-seven per cent date to the post-medieval period (AD 1540–1750). This is, however, likely to be a considerable overestimation and probably reflects the re-use of older sites. The few excavations undertaken have yielded more early dates than the twelve per cent recorded for



B

Period	No. of Lynchet/Terrace sites by period	% of total known records
Modern	3	0.10
Post Medieval	839	27.23
Medieval	1718	55.76
Early Medieval	19	0.62
Romano-British	194	6.30
Iron Age	125	4.06
Bronze Age	44	1.43
Neolithic	12	0.39
Unknown	127	4.12
Unrecorded	3140	
Total Recorded	3081	100
Total Records	6221	

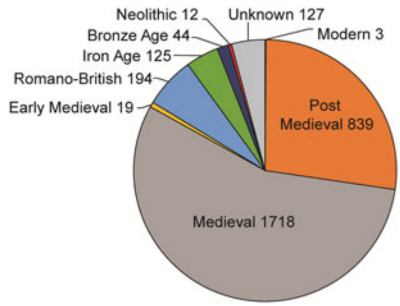


Figure 2. *A: distribution of lynchet (n = 5657) and terrace (n = 564) sites based on HER data with underlying Jurassic and Cretaceous limestone bedrock by county across England; B: number of lynchet/terrace sites by period across England.*

the Bronze Age to early medieval periods in the HER. For example, extensive landscape surveys and scientific analysis of field systems on the Berkshire Downs around Lambourne demonstrated that lynchets were created during the Romano-British period (Ford et al., 1990: 44–51; Bowden et al., 1993: 109–33). More recently, the refinement in optically stimulated luminescence (OSL) dating has allowed both lynchets and terraces to be dated more reliably (Brown et al., 2020: 575). At Lyminge, Kent, OSL was used alongside traditional geoarchaeological methods to date trackways bounding lynchets to the late prehistoric and Romano-British periods (Bell et al., 2020: 4–8). OSL has also successfully been used to date and understand the field boundaries of Cornwall (Vervust et al., 2020a: 428–31) and northern England (Vervust et al., 2020b: 64-68). In the Ingram Valley in Northumberland, a mix of OSL, radiocarbon, and hydrogen pyrolysis (HyPy) radiocarbon dating (Ascough et al., 2009) has revealed that terraces were created in the Early Bronze Age (Brown et al., 2023: 352).

The Distribution of Lynchets in the Low Countries

In Belgium and the Netherlands, the greatest concentration of lynchets is found across the chalk and loess dominated central belt (Langohr, 1993; Meijs, 2002; Van den haute et al., 2003; Vancampenhout et al., 2013) and the Limburg Hills. These features, known as '*graften*' or '*graaf*', are derivatives of '*graven*' or '*graben*' (to dig), and the etymology, alongside historical research, suggests major anthropogenic formation (Alleijn & Saris, 1980; Van Westreenen, 2008: 183-88). Both cartographic and placename evidence suggests they date from at least the medieval period and that they were elements of common small-scale grazing systems when not being cultivated, and that the risers (in contrast to the horizontal beds) could provide wood and other shrub resources (Van Westreenen, 2008: 183–88). However, the nature of the underlying chalk and limestone has led some scholars to infer a natural origin based on stratigraphic bedding (Kuyl & Felder, 1968: 116–22).

The formation of the lynchets across the Belgian and Dutch Limburg has been attributed to an increase in population in the Iron Age (Dirkmatt, 2006: 197–201). The development and use of lynchets in the Roman and medieval periods have also been attributed to increases in viticulture, particularly for the south-facing Limburg examples at Kolmont, Overeys, and Wahlwiller (Dirkmatt, 2006: 197–201). Nyssen et al. (2014: 172) also suggest that lynchet formation must have taken place in the Gallo-Roman and medieval periods due to increased soil erosion from agricultural cultivation, and because similar practices have also been shown to have existed over large areas of the Low Countries (Van Oost et al., 2005: 193–203). Across the Lanakerveld area of Maastricht in the southern Netherlands, lower gradient lynchets are only visible as subtle surface earthworks due to extensive soil erosion (Meurkens et al., 2009: 49–52). Indeed, the modernization of cultivation techniques after AD 1900 and land consolidation after AD 1950 led to the loss of more than half the Dutch lynchets in the twentieth century (Baas et al., 2012: 9). Multidisciplinary research on lynchet formation processes at Groensdael has proposed that they result from downslope sediment erosion and colluviation driven by arable cultivation and water transfer over the last millennia (Nyssen et al., 2014: 172–73). Since this estimate is based on tillage translocation rates generalized from Ethiopia, one of the aims of our research was to test this predicted age in an analogous system close to Groensdael.

Material and Methods

Detailed methodological descriptions of all analytical techniques are given in the online Supplementary Materials, with only brief descriptions here. Lynchet morphology was identified by a combination of airborne laser scanning (or LiDAR), unmanned autonomous vehicle (UAV) photography using structure-from-motion (SfM), and terrestrial laser scanning (Cucchiaro et al., 2021).

Soil and sediment sampling from lynchets and control profiles was conducted from archaeological excavations, test pits, and boreholes. Sequences were hand-excavated back to clean, undisturbed layers before graphic and descriptive recording, field analysis, and monolith sampling of the complete sedimentological sequences.

Sediment samples were analysed using loss on ignition (LOI) for organic, carbonate, and dry bulk density, magnetic susceptibility (MS), particle size analysis, portable X-ray fluorescence (pXRF), portable optically stimulated luminescence (pOSL), and soil micromorphology to investigate soil and sediment history. Direct dating was conducted using OSL (Table 1) of the silt-sized quartz fraction, following Shen et al. (2007).

Site-Based Results and Interpretations

Results and interpretations of the scientific data from the three case study areas are discussed alongside hilltop control locations, and more detailed analysis and

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Table 1. *Summarized OSL and radiocarbon dates from the sampled lynchet sequences across the three locations (for full table, see Supplementary Material Table S1). * = Roberts, 2019.*

Site	Location	Depth (m)	OSL age (ka)	Code	BC/AD age range (at σ2, 95.4 per cent)	Period
Blick Mead, Wiltshire, UK	Lynchet	0.30	0.55 ± 0.03	SBG096	AD 1440–1500	Medieval
		0.50	0.96 ± 0.05	SBG094	AD 1010–1110	Medieval
		1.20	2.36 ± 0.13	SBG090	470–210 BC	Early to Middle Iron Age
		1.60	3.27 ± 0.24	SBG086	1490–1010 BC	Middle to Late Bronze Age
	Beneath lynchet	1.70	5.89 ± 0.33	SBG077	4200–3540 BC	Late Mesolithic to Early Neolithic
	Hilltop loess	0.90	43.17 ± 2.35	SBG265	43.5–38.8ka BC	Late Pleistocene
		1.20	48.77 ± 2.49	SBG263	49.24–44.26ka BC	Late Pleistocene
Charlton Forest, W. Sussex, UK	Lynchet	0.15	1.17 ± 0.05	SBG121	AD 800–900	Early medieval
		0.31	1.60 ± 0.23	SBG120	AD 190–650	Late Romano-British to early medieval
		0.82	3.55 ± 0.13	SBG117	1600–1400 BC	Middle Bronze Age
		0.90*	2917 ± 30	SUERC-67326	1211–1016 BC	Middle to Late Bronze Age
	Hilltop loess	0.65	12.72 ± 0.46	SBG112	11.16–10.24 ka BC	Late Pleistocene
Sint Martens-Voeren, Limburg, Belgium	Lynchet	0.44	0.88 ± 0.36	SBG126	AD 780–1500	Early medieval to medieval
		1.12	1.72 ± 0.08	SBG124	AD 220–380	Late Roman to early medieval
	Hilltop colluvium	0.30–0.40	3.65 ± 0.24	SBG387	1870–1390 BC	Early to Middle Bronze Age
	Hilltop loess	0.75–0.85	13.46 ± 0.85	SBG386	12.29–10.95 ka BC	Late Pleistocene

discussion from the three sites is present in the Supplementary Material (S11–14).

Blick Mead lies on the eastern edge of the Stonehenge World Heritage site (Figure 3a and c), with subtle, low-angle lynchets developed within a dry valley from eight to nine per cent. The largest lynchet was present at the edge of the River Avon floodplain at the toe-end of a dry valley where it rose to a maximum of 1.70 m above the Middle-Upper Cretaceous chalk bedrock (Figure 3, c2) and preserved a unique Mesolithic occupation site (Jacques et al., 2018).

Sedimentological analysis of the sequence demonstrated a complex stratigraphy (Figure 4) with evidence of a thin pre-lynchet loessic soil above the chalk. The onset of lynchet formation was OSL dated (SBG080 and SBG086) to the Middle to Late Bronze Age and composed of weakly banded sandy silt-clay horizons (Table 1, Supplementary Material, Table S1). Over time, sedimentation upon the lynchet shifted between coarser material, possibly reflecting increased cultivation activity, and finer more organic horizons, suggesting reduced cultivation, surface weathering, and the erosion of arable soils between the Early and Middle Iron Age (SBG090).

The sedimentary record changed markedly in the upper metre of the sequence, suggesting a return to more intensive cultivation from the Middle Iron Age to the medieval period. Inititially there is

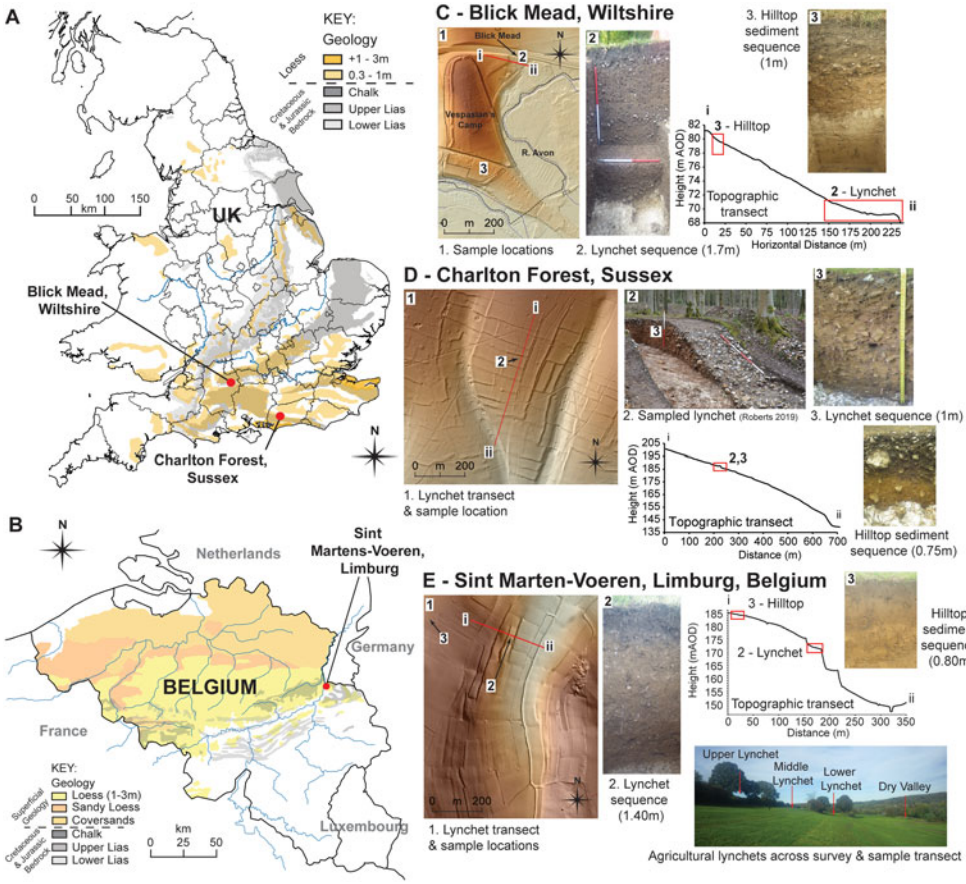

Figure 3. *A and B: lynchet sample locations across England and Belgium in relation to underlying limestone geology and loess; C: detailed location and information for samples from Blick Mead, Wiltshire (lat.: 51.177313, long.: -1.7884306); D: Charlton Forest, W. Sussex (lat.: 50.932239, long.: -0.69141984); E: Sint Marten-Voeren, Belgium (lat.: 50.738762, long.: 5.8074479).*

distinctive cyclical deposition of coarser and finer sediments demonstrating cultivation/tillage and erosion across the site with varying degrees of intensity through the late prehistoric and early historic periods. An additional OSL date (SBG084) at the southern end of the lynchet (Table S1), dated to AD 290–470, implies enhanced lynchet formation in the Late Romano-British period, and the presence of greater amounts of degraded microcharcoal particles, organics, and carbonate may also indicate deliberate anthropogenic additions to the soils to increase or maintain fertility.

In the uppermost section of the lynchet there is a phase of considerably coarser sedimentation dating to between the eleventh and fifteenth centuries AD (SBG094, 096). This darker, more organic horizon demonstrates clear evidence of regular modification and mixing through cultivation (Figure 4, slide 30–37 cm).

The intensification of agricultural practice across the site during the medieval period may be related to the refounding of Amesbury Abbey in AD 1177 (Norton, 2014). The development of an organic-rich, stoneless topsoil and subsoil most

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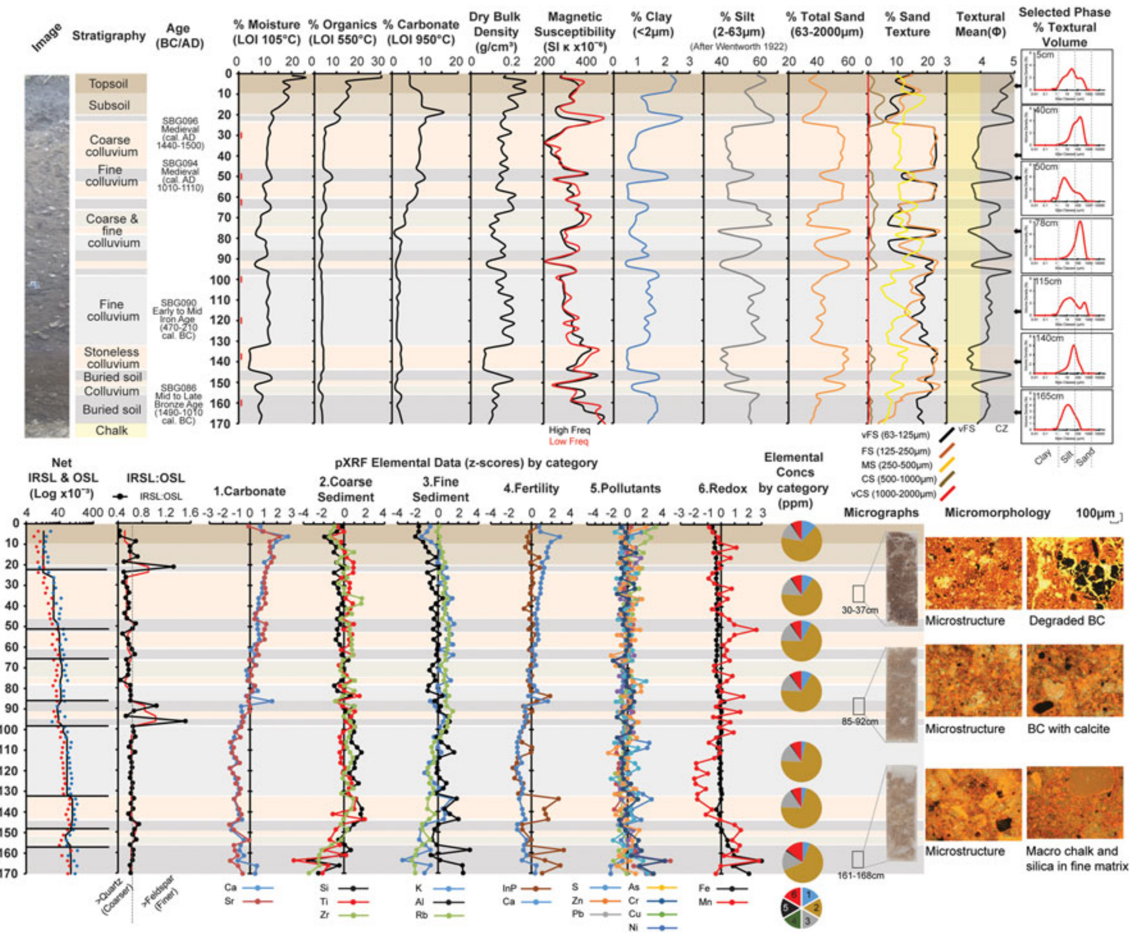

Figure 4. *Profile sedimentological analysis of the lynchet sequence at Blick Mead, Wiltshire, England.*

probably represents the reduction and, finally, the cessation of cultivation on the lynchet in the last 500 years. This may have been due to a shift from arable to pastoral land use in the post-medieval period caused by the Reformation and development of formal gardens in the eighteenth century AD.

The co-axial lynchet system at Charlton Forest, W. Sussex, was laid out on the undulating dip slope (8–9 per cent) of East Dean Woods within the South Downs in the upper Lavant valley, between the villages of Upwaltham and Singleton (Figure 3a and d). The lynchets, presently covered by post-war beechwood forestry with subordinate softwoods, were originally identified between Arundel and Harting in the early twentieth century (Wyatt, 1927). Curwen (1929: 93–95) also noted them, but these features were largely ignored in favour of more prestigious monuments such as enclosures, barrows, and hillforts. More recently the full extent of the lynchets has been revealed by high-resolution LiDAR (Manley, 2016). The LiDAR survey and associated excavation have revealed an extensive former agricultural landscape and other prehistoric features including Bronze Age barrows and burnt mounds, a possible Iron Age banjo enclosure, and a Romano-British temple. Initial analysis and dating of the lynchets suggest agricultural activity during the Iron Age and Romano-British periods (Roberts, 2019).

Sedimentological analysis of a 1 m-deep lynchet revealed a complex depositionary sequence and formation history (Figure 5). Above the basal chalk, a cultivated loessic deposit was identified with radiocarbon dating (SUERC-67326) (Roberts, 2019) suggesting that agricultural practice probably began in the Middle to Late Bronze Age (Table 1). The sediment properties of the initial agrarian activity reflects the direct cultivation of an original *in situ* loess-derived deposit, with a thin residual degraded soil horizon towards the top indicating the remnants of a prehistoric land surface.

From the Late Bronze Age onwards (SBG117) into the Iron Age, there appears to have been a progressive increase in cultivation activity and the deliberate input of both inorganic loessic material and organics to increase soil depth and fertility, a technique used widely across the north-western loess regions of Europe (Vanwalleghem et al., 2007: 583).

In the upper half of the lynchet, the sediment sequence displays more cyclical silt-dominated layers and coarser horizons reflecting phases of reduced activity and possible soil development and increased cultivation practice and heightened erosion throughout the Iron Age and Romano-British period, as suggested by the presence of ceramics.

Following this, the sustained increase in coarser lynchet sediment, anthropogenic indicators (degraded carbonized and organic fragments), and ceramics indicated an increase in cultivation activity up to the Late Romano-British period (SBG120). The absence of pottery post-dating the late third century AD, though, suggests that cultivation had ceased well before the enclosure and afforestation with closed-canopy woodland associated with the creation of the Forest of Arundel in the twelfth century AD, marked by the development of the fine-grained surface topsoil and subsoil.

Sint Martens-Voeren in Limburg, Belgium, is located on the eastern edge of the Central Belgian loess belt. It has large lynchets at the junction between the steepest mid-valley Middle-Upper Cretaceous chalkland slopes (11.5 per cent) and the valley floor (Figure 3b and e).

Detailed analysis of the central lynchet revealed a 1.40 m sediment sequence and deposition from the late prehistoric period onwards (Figure 6). OSL dating towards the base of the lynchet (SBG124) indicated

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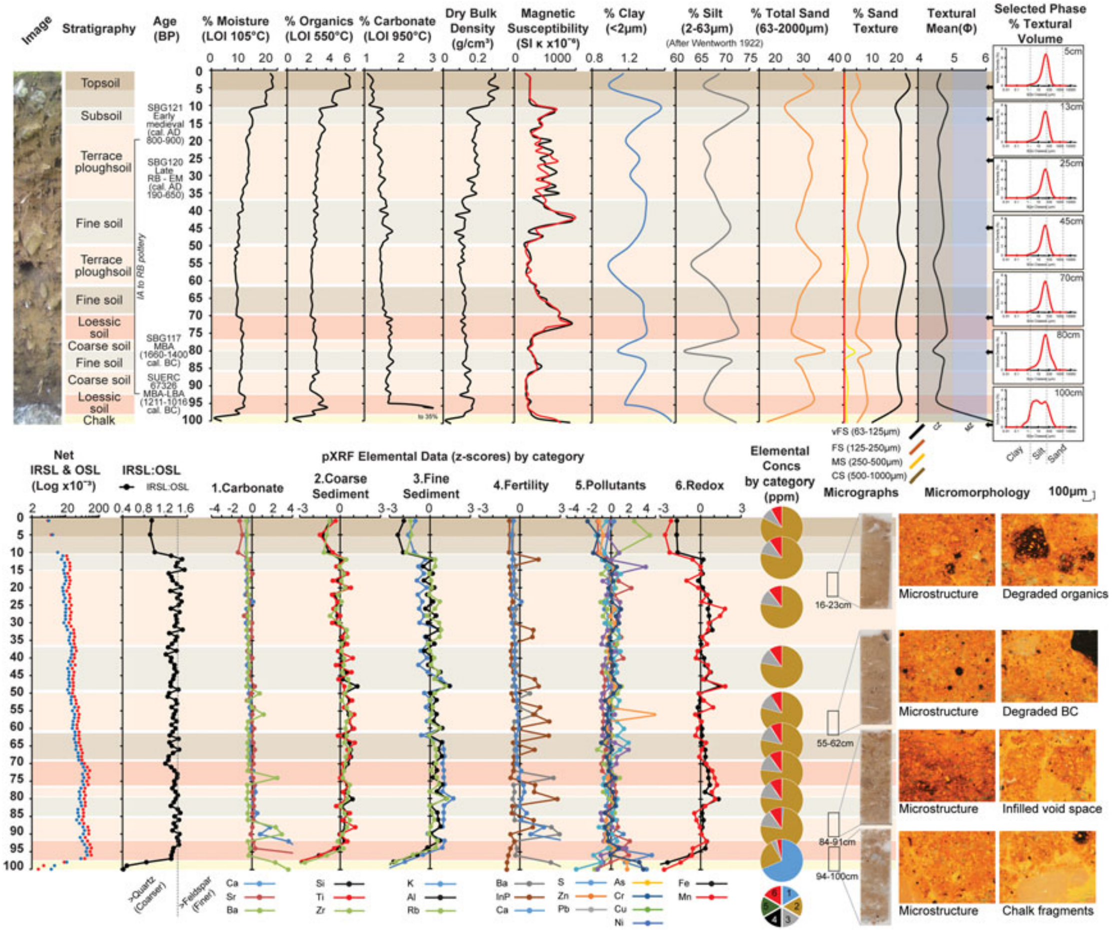

Figure 5. Profile sedimentological analysis of the lynchet sequence at Charlton Forest, W. Sussex, England.

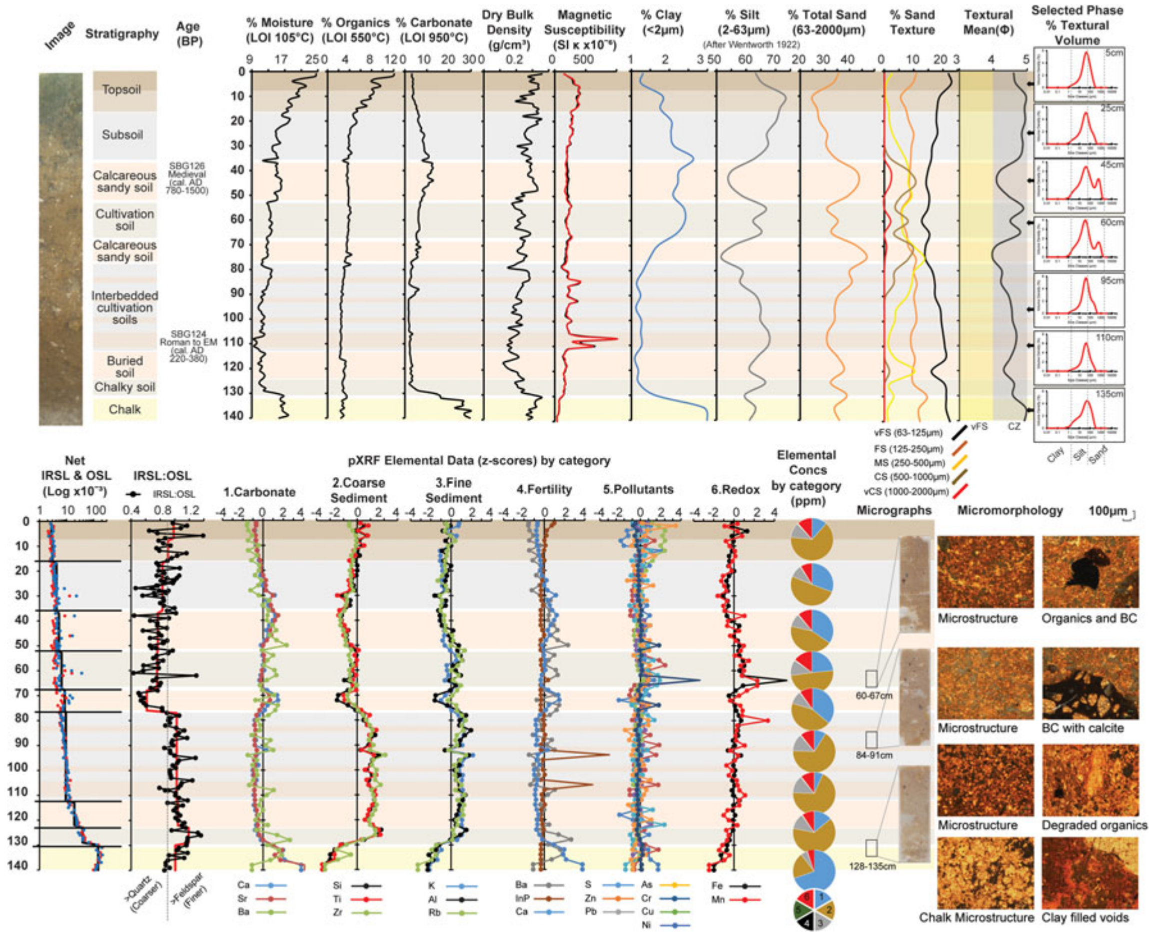

Figure 6. *Profile sedimentological analysis of the lynchet sequence at Sint Martens-Voeren, Limburg, Belgium.*

that agricultural practice and lynchet formation began before the Roman period, with early cultivation occurring on a pre-existing *in situ* loessic soil.

Initial development of the lynchet appears to have been dominated by the gradual accretion of finer and coarse sediment deposition. These suggest continued but reduced cultivation and possibly more regular fallow periods (e.g. rotations). However, a clear sedimentological transition occurs at 0.80 m, indicating a change in this practice. Overall, the sequence becomes coarser, with changes in analytical results suggesting a change in source material provenance and agricultural practice. Although not directly dated, this may equate to the intensification of land use in the later Roman period.

Above this sediment, texture shifts again towards finer sedimentation, with analysis suggesting a reduced phase of cultivation intensity, and possible soil development. Finer sediment deposition may derive from continued surface sediment erosion during lower agricultural activity in the Roman to early medieval transition period.

By the early medieval period (SBG126), sedimentological evidence suggests renewed cultivation activity, possibly in line with an early development of openfield agriculture. The return of coarser lynchet sediments is combined with analytical evidence indicating that additional coarse material, possibly derived from domestic or settlement sources, may have been added as manure, a practice that would have continued right through the medieval period.

The subsequent shift to finer sediment deposition may derive from the reduction in arable cultivation across the valley, the growth and possible planting of vegetation on the lynchet risers and across the former medieval openfield system, as shown on historical maps, and the development of a more pastoral economy in the past 300 years.

At each site, a control profile was excavated in a hilltop location in order to characterize the nature of the surrounding soils away from the agricultural lynchets (Figure 7) (Supplementary Material S14). At Blick Mead and Charlton Forest, between 0.30 and 0.50 m of light yellowish brown to brownish yellow loess with a medium silt texture were identified. At Sint Martens-Voeren, the uppermost 0.50 m loess sequence was identified and consisted of a very pale brown to brownish yellow coarse silt. The analytical results of these loess deposits demonstrated that these horizons were physically undisturbed, compared to loessic horizons within the lynchets. Differences in the microstructure and sediment geochemistry of the loess could also be determined from the three sites, highlighting differences in provenance and degrees of post-burial alteration.

In terms of chronoologies, OSL dating of the loess at Charlton is consistent with Late Pleistocene dates from southern England (Parks & Rendell, 1992: 103), whilst at Blick Mead dates are consistent with loess deposits found at Bemerton, also in the Wiltshire Avon valley (Egberts et al., 2020: 130). At Sint Martens-Voeren, the OSL dates correlate with others from the Middle Belgian loess belt (Van Baelen et al., 2017: 63–65), although the date (1870–1390 BC) from colluvium directly above the loess indicates truncation and reworking of the original *in situ* loess through increased cultivation in the Early Bronze Age.

Discussion

Despite historical inconsistencies in their identification, lynchets are typically found within undulating landscapes across soft lithologies in Europe, particularly in southern England, France, and Belgium. Their representation in national

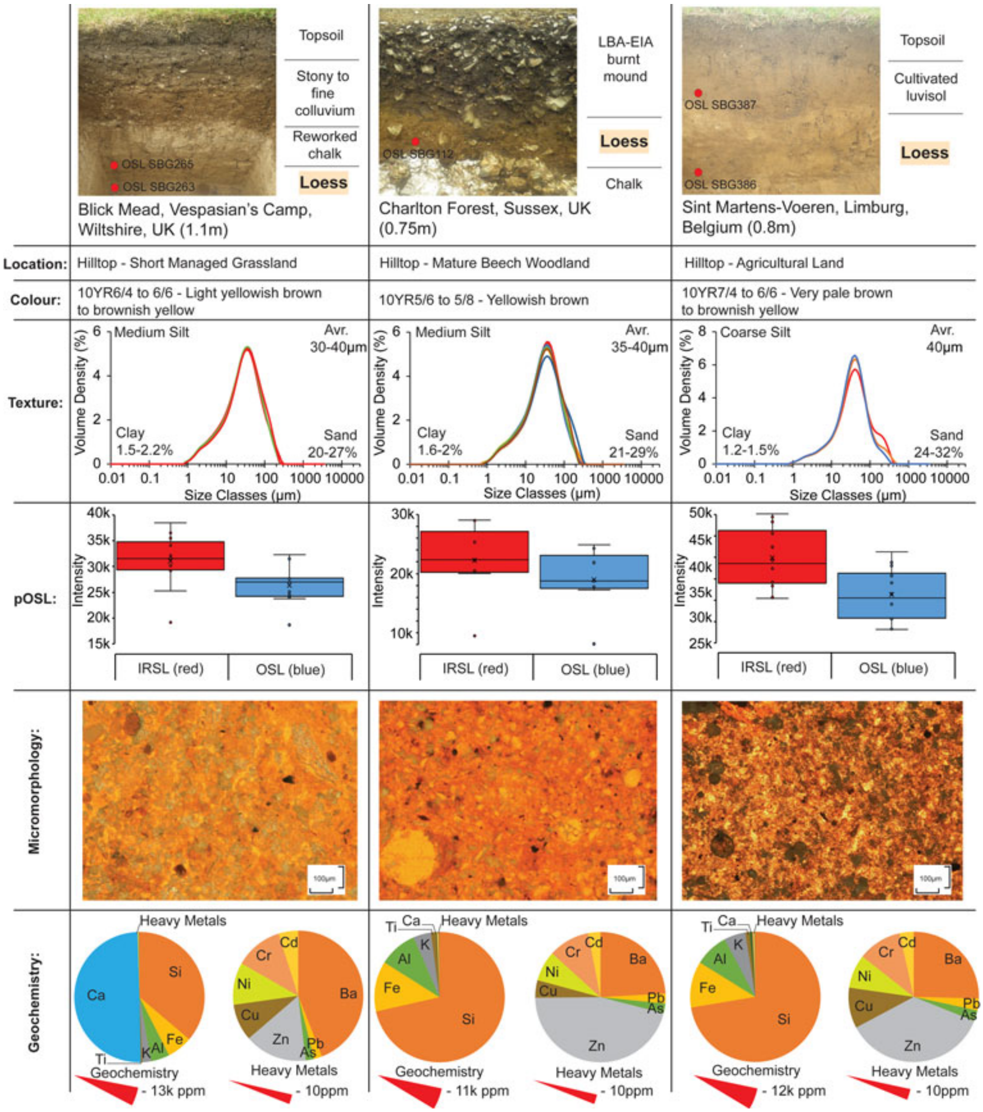

Figure 7. *Sedimentary characteristics of control profiles including* in situ *loess from Blick Mead, Charlton Forest, and Sint Martens-Voeren.*

archaeological records varies considerably, making comparisons between countries challenging. Even where broad spatial and chronological characterizations exist, as in England, the absence of detailed analyses has led to a lack of archaeological context for these important landscape features.

The creation of the lynchets in all the cases analysed here preserved thicker soils on the slopes; this reduced the erosion rate, maintained fertility, and increased carbon storage across the original loess-mantled slopes, which are prone to soil erosion and gullying (Vanwalleghem et al., 2006: 393-99; Zhao et al., 2021: 14–15); indeed, research into the historical context of soil erosion and the development of lynchet features has revealed increased soil erosion rates owed to tillage in the Anthropocene (Nyssen et al., 2014:

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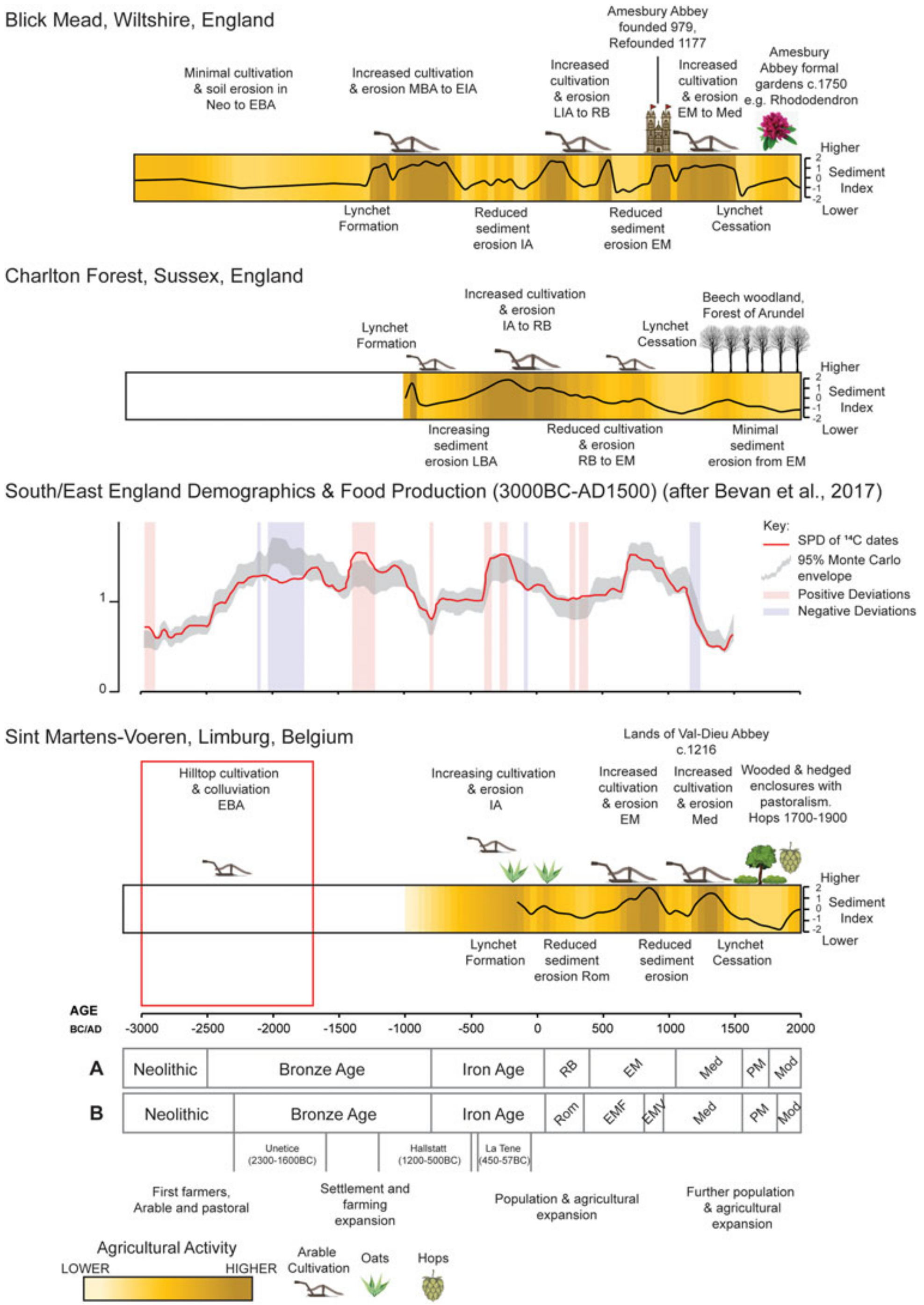

Figure 8. Comparative site chronology and process model for the three case studies. For definitions of historical and archaeological periods, see Supplementary Material S11.

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172–73; Vanwalleghem et al., 2017: 19–20; Poesen, 2018: 64–67).

The topography and stratigraphy of our three sites, as well as our analytical results, suggest that soil retention was facilitated in different ways (Figure 8). The gentle topography, laterally extensive cultivation stratigraphy, and lack of hiatuses or inversions suggest that our two English sites were created by ploughing from the Bronze Age onwards. As there is no evidence of cutting into the hillslope to redistribute soil, these are not cut-and-fill systems and so are most likely to have been created solely by ploughing and the tillage-induced redistribution of loessic soil. In contrast, the topography, variable tread soil thickness, and pIRSL:pOSL scatter in the fills of the Sint Martens-Voeren site all suggest that the upper loess and the underlying chalk, were cut into, and loess, chalk, and soil redistributed across the tread surfaces. This is an accentuation of the natural structure in the chalk, which is sub-horizontally bedded and of variable resistance (Nyssen et al., 2014: 169–70). It would therefore be more correct to regard the Sint Martens-Voeren lynchets as a terrace system with unwalled risers. On morphological grounds, the Belgian example resembles other steep and sharply defined systems such as the classic Mere lynchets on the scarps of Salisbury Plain and the Jurassic scarps of the Cotswold hills and Somerset in England (Whittington, 1962: 117–18).

All three sites reveal multiple phases of re-creation and use. The initial creation of the lynchet at Blick Mead can be seen in the context of Middle Bronze Age activity in the Stonehenge area that included the construction of multiple round barrows and the establishment of field systems (Richards, 1990; Roberts et al., 2017: 121–23). This is consistent with the construction of terraces in the Cheviot Hills in northern England during this period (Brown et al., 2023: 356). The Middle to Late Bronze Age start date for the Charlton Forest lynchets possibly reflects the deforestation of the South Downs during this period, as reflected by contemporaneous burnt mounds (Yates, 2007; Yates & Bradley, 2010: 53–61), and aligns with lynchet formation and land use at West Dean, close to Charlton Forest (Sillar et al., 2008: 54–57). Later Iron Age acceleration of agrarian practice and lynchet construction, including around hillforts, probably reflects population growth, as reflected by the construction of hillforts and proto-urban centres (*oppida*) prior to the Roman invasion (Bradley, 1971; Bowden, 2016), and the export of surplus grain from southern England to mainland Europe. Increased agricultural activity across the lynchets in the Roman period is likely to reflect the continuation of this system alongside the development of a new, enhanced domestic market.

The proposed Late Iron Age inception date for the Sint Martens-Voeren lynchets may be seen in the context of a population increase and agricultural land use in line with the development of the La Tène culture (Meylemans et al., 2015: 210); colluviation appears to have started earlier (in the Late Bronze Age) across the hilltop landscape and so the Sint Martens-Voeren sequence is in many ways comparable to that at Charlton Forest.

The varied use of the lynchet systems into the early medieval period reflects more localized agricultural conditions in both the countryside and proto-urban centres across northern Europe. Abandonment appears to happen at different times: the agricultural land at Blick Mead became a pasture for the redeveloped Amesbury Abbey after AD 1177 (Norton, 2014), whilst Charlton Forest appears to have been abandoned in the Late Romano-British or early medieval period, before becoming part of the hunting forest of the

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Earls of Arundel and afforestation in the late thirteenth century AD (Roberts, 2018: 147–48).

By contrast, the Sint Martens-Voeren lynchets remained in use for horticulture until the eighteenth century AD, when they were converted to improved grazing land. Although hedgerow dating is not a precise technique, the high number of woody species growing today on the risers (over 9–10 woody species per 30 m) at Sint Martens-Voeren probably reflects a possible change to arboriculture *c.* 1000 years ago (Pollard et al., 1974). At Habsheim (Alsace, France), hedges defined along reference topographic sequences provided a history of erosion across the loess-dominated landscape (Froehlicher et al., 2016: 173–85). Similarly, distinctive farm and woodland boundaries have been identified at specific contour levels across large areas of western and central Europe (Szabó, 2010: 208–09). Sunken lanes, roads, and hollow-ways have also been used to analyse the distribution and transfer of agricultural soils in relation to loess landscapes (Deckers et al., 2005: 20–29; Bell et al., 2020: 1–8). These have been conducted in relation to topographic variation (De Geeter et al., 2020: 4), hydrology (Boardman, 2013: 1641–42), and within historically forested landscapes (Vanwalleghem et al., 2003: 18–24; Deckers et al., 2005: 25–28). Sint Martens-Voeren also shows local variation: the lynchets on the northern slope of the valley, 2 km away, were created by ploughing and, based on estimates of tillage erosion rates, an initial construction of the lynchets is estimated to have taken place in the Gallo-Roman to medieval periods (Nyssen et al., 2014: 172–73).

Conclusions

Loessic landscapes provide ideal agronomic conditions and facilitate the landscape-scale creation of agricultural (and in some cases co-axial) lynchet systems. The English sites presented here were first created in the Middle to Late Bronze Age by ploughing, and their formation was accelerated in the Iron Age and Romano-British periods. In the early medieval period, exploitation became more intermittent, with the Blick Mead site continuing to be used later than Charlton Forest. In contrast, lynchets at Sint Martens-Voeren were created by excavation (cut-and-fill) from the Iron Age onwards, following extensive cultivation and colluviation across the hilltop area from the Early Bronze Age, and used into the medieval and later historic periods.

Although they had previously been regarded as typical medieval lynchet sites, all three of our case studies show origins in prehistory with increased use in the Iron Age and Roman periods. The preservation of form and soil depth over several millennia indicates considerable resilience to soil erosion, which on these lithologies is known to be high under arable agriculture (Evans et al., 2017: 54–56; Boardman et al., 2020: 3931–33). Loess played an important role in this because it facilitated easy and landscape-scale lynchet creation and rapid soil thickening, fertility being maintained by organic inputs from crops and animals. The presence and survival of these lynchets in the present-day landscape reflects the low rates of soil loss on these features compared to surrounding areas with thin soils directly on chalk and a lack of post-medieval deep ploughing. This implies that lynchets had, and still have, the capacity to confer agricultural resilience if maintained and used appropriately. It is also likely that their destruction, or indeed re-cultivation, would produce increased erosion and sediment input into fluvial systems with resultant silting up and reductions in flood discharge capacities. Whilst we have been successful in establishing the date of inception of our three lynchet systems and traced their use history, several less tractable questions remain, including the relative intensity *vs* frequency of their use, crop variation in the past and, even more elusively, whether their creation was driven by 'bottom up' customs and practices, or 'top-down' regional-scale command economies.

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Supplementary Material

To view supplementary material for this article. please visit https://doi.org/10.1017/eaa.2024.6.

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Terrasses en rideau, lœss et résilience dans les paysages crayeux de Royaume-Uni et de la Belgique

On associe en général les rideaux, un des éléments clés des paysages agricoles historiques de l'Europe septentrionale, à des substrats géologiques calcaires tendres, qui sont particulièrement bien développés dans les campagnes couvertes de loess. Afin de mieux comprendre la formation et la chronologie de ces rideaux et dépôts de loess, les auteurs de cet article présentent les analyses géo-archéologiques de trois sites, Blick Mead et Charlton Forest dans le sud de l'Angleterre et Sint Martens-Voeren en Belgique. Les rideaux, établis entre la fin de la préhistoire et le moyen âge, ont été formés par labourage sur les sites anglais tandis qu'ils ont été créés en entaillant et en labourant les pentes en Belgique. Ces rideaux ont ainsi conservé des sols loessiques très fertiles sur les pentes calcaires alors qu'ils ont disparu ailleurs. Bien que chaque exemple ait sa propre histoire agraire, les rideaux sont un élément important du patrimoine qui, grâce à leur capacité de rétention des sols, ont servi au maintien de l'environnement pendant des millénaires. Translation by Madeleine Hummler

Mots-clés: rideaux agricoles, utilisation du paysage historique, transfert de sédiments sur pente, loess, datation par luminescence

Feldraine, Ackerterrassen, Löss und landwirtschaftliche Widerstandsfähigkeit in den Kreidelandschaften von England und Belgien

Die Ackerterrassen, oft ein bestimmender Bestandteil der historischen Agrarlandschaften in Nordeuropa, werden meistens mit einer weichen, kalkhaltigen Grundgeologie verbunden und sind in den mit Löss bedeckten Landschaften besonders gut entwickelt. Um ihre Chronologie und Entstehung besser zu erfassen, haben die Verfasser die Geoarchäologie von drei solcher Anlagen und Löss-Ablagerungen untersucht, nämlich in Blick Mead und Charlton Forest in Südengland und in Sint Martens-Voeren in Belgien. Die Ackerterrassen, welche von der späteren Frühgeschichte bis zum Mittelalter datieren, entstanden durch Pflügen in den Englischen Stätten und durch Einschneiden, Einfüllen und Pflügen in Belgien. Dies hat die hoch fruchtbaren Lössböden auf den Kreidehängen erhalten, die anderswo nicht erhalten blieben. Obwohl jede Fallstudie lokale oder regionale landwirtschaftsgeschichtliche Eigenheiten aufweist, hat das Bodenrückhaltevermögen der Ackerterrassen ihren Fortbestand als Bodendenkmäler mit wichtigen Vorteilen für die Umwelt gesichert. Translation by Madeleine Hummler

Stichworte: Ackerterrassen, historische Landnutzung, Ablagerung von Sedimenten an Hängen, Löss, Lumineszenzdatierung