

THE ENVIRONMENTAL SETTING FOR THE LATEGLACIAL RECOLONISATION OF THE SCHELDT BASIN (NORTH-WEST BELGIUM) BY THE FEDERMESSER-GRUPPEN

The area encompassing the valleys of the River Scheldt and its tributaries, situated in North-West Belgium, is very rich in both archaeological and palaeo-environmental archives. Intensive surveys of the past decades have revealed the presence of numerous Lateglacial sites, mostly belonging to the Federmesser-Gruppen (FMG), as well as deep continuous organic soil sequences, from a variety of contexts (dune slacks, palaeo-lakes, river and stream valleys; Crombé 2006), allowing a first analysis of human behaviour against the background of a changing landscape and climate, in particular during the Allerød and the transition towards the Younger Dryas.

GENERAL SETTING

After the River Meuse, the Scheldt is the largest river in Belgium with a total length of 430 km, of which 207 km run on Belgian soils (**fig. 1**). Its headwaters are situated in northern France, its debouchment is located in the south-west of the Netherlands, where it nowadays flows into the Westerscheldt. During the Lateglacial, however, the Scheldt north of Antwerp had a more northern course, joining the estuary of the Rivers Rhine and Meuse in the central western Netherlands. The Scheldt is fed by numerous tributaries, the most important ones being from south to north Rivers Lys, Kale/Durme, Dendre and Rupel. The total catchment area amounts to 21,863 km², subdivided into the Upper Scheldt Basin (from source to Ghent) and the Lower Scheldt Basin (from Ghent to its debouchment).

The area of the Upper Scheldt, called the »Flemish Ardennes«, is a hilly upland, consisting mainly of Tertiary hills with a maximum height of 157 m above present sea-level. The quaternary cover mainly consists of loam and sandy loam deposited during the Pleniglacial, forming thick packets in the valley bottoms and on ancient river terraces. On the hill tops on the other hand the Pleistocene cover is generally thin (< 1 m), partly due to erosion, allowing Tertiary sediments to outcrop. The topography along the northern Lower Scheldt Basin is much less pronounced. This area corresponds to a typical lowland area with numerous relatively small and elongated sand ridges formed by a local reworking of coversands mainly during the late Pleniglacial and Lateglacial cold phases (Heyse 1979). In the northern and western extremes, in the Scheldt Polders and Coastal Polders, respectively, the Pleistocene coversand landscape is covered by Holocene peat and (peri)marine deposits, protecting the prehistoric sites from erosion and destruction (Crombé 2005; 2006).

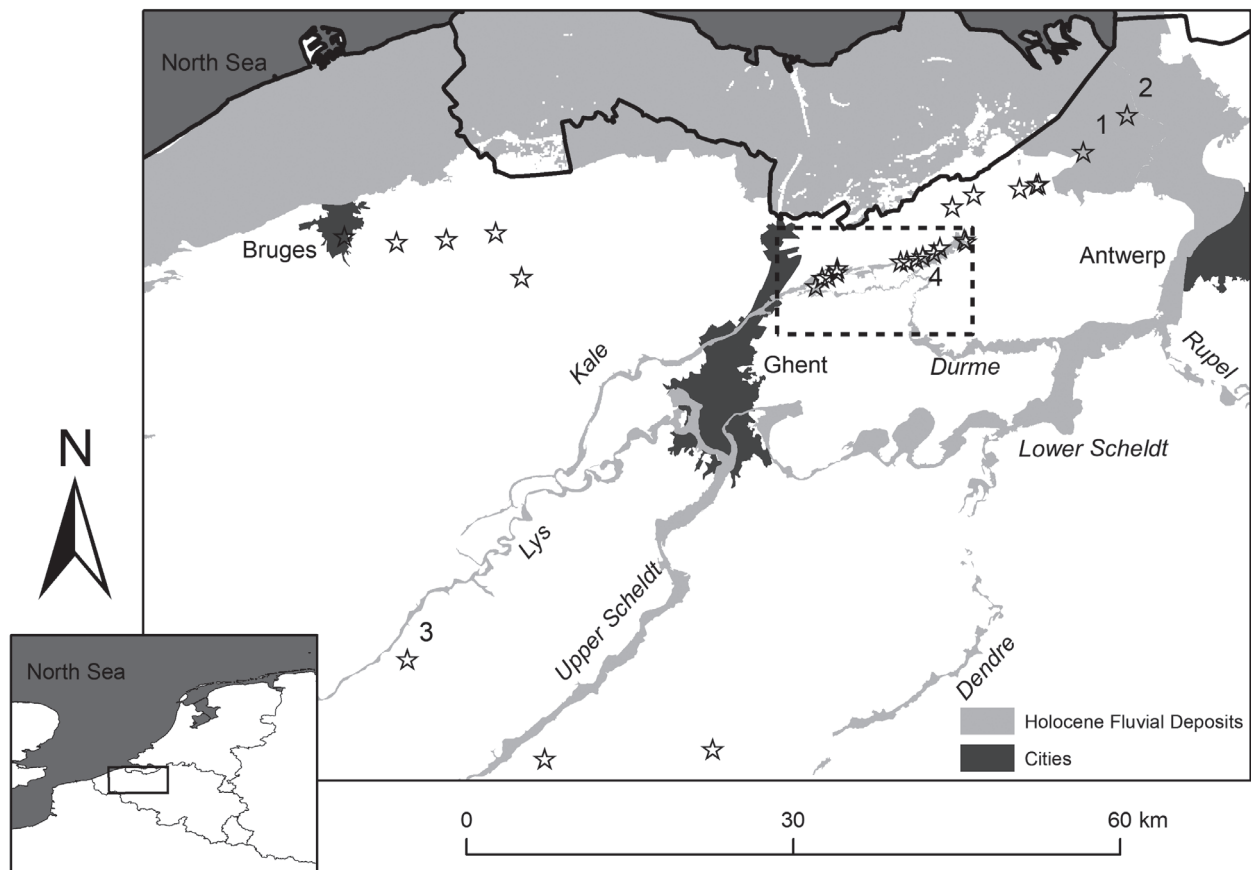


Fig. 1 The River Scheldt and its tributaries with indication of the FMG sites: **1** Verrebroek »Dok 2«. – **2** Doel »Deurganckdok-sector B«. – **3** Harelbeke »Gavermeersen«. – **4** Klein-Sinaai »Boudelo«. The small box (dashed lines) indicates the position of fig. 4. – (Map J. Verhegge).

MATERIALS AND METHODS

Palaeo-environmental dataset

The valley of the River Scheldt, in particular its lower course, and some of its tributaries, especially the River Kale/Durme, have been studied intensively in the last decades in the context of both academic and developer-led («commercial») research. Different aspects of the Lateglacial and Early Holocene palaeo-landscapes have been intensively investigated, allowing a rather detailed reconstruction of the palaeo-vegetation through the study of pollen and plant macro-remains (Bos et al. 2017; 2018a; Deforce et al. 2005; Deforce 2011; Perdaen et al. 2011a; Storme et al. 2017; Verbruggen 1971; Verbruggen/Denys/Kiden 1996) as well as the geomorphology and palaeo-hydrology (Bogemans et al. 2012; De Moor 1963; Heyse 1979; Kiden 1989; 1991; Tavernier/De Moor 1974; Vanmaercke-Gottigny 1964). In addition, the chronological framework of the Lateglacial and Early Holocene landscape evolution is well documented by means of numerous radiocarbon dates (Crombé et al. 2012; Crombé/Robinson/Van Strydonck 2014; Meylemans et al. 2013) and a limited number of OSL dates from aeolian sediments (Bogemans/Vandenbergh 2011; Derese et al. 2010).

Archaeological dataset

The Scheldt Basin has been the subject of intense archaeological research, including surveys (field-walking, aerial photography, augering, test-pitting) and excavations, some of which covering large surfaces (e.g. Doel »Deurganckdok«, Kerkhove »Stuw«, Oudenaarde »Donk«, Verrebroek »Dok«). However, the research intensity varies considerably among the different subregions of the Scheldt Basin, resulting in somewhat biased distribution maps. Research into the Lateglacial (Final Palaeolithic) and Early Holocene (Mesolithic) archaeology has been most intense in the coversand lowland corresponding to the Lower Scheldt Basin. Systematic field walking in large parts of this area – conducted mainly by amateur archaeologists from the 1980s onwards (Crombé et al. 2011) – has led to the discovery of numerous, albeit mostly destroyed (ploughed) sites located on dry coversand ridges. The survey of the river floodplains, on the other hand, has only started in the late 1990s (Bats 2007; Bats/Bastiaens/Crombé 2006; Crombé 2006; Meylemans et al. 2013), yielding the first covered prehistoric sites in the valley of the River Scheldt and its tributaries. Some of these have been excavated in the framework of large infrastructural works, e.g. harbour expansion (Crombé 2005), water management projects (Meylemans et al. 2013; Perdaen et al. 2011b), and sand extraction (Parent/Van der Plaetsen/Vanmoerkerke 1986/1987). Lateglacial and Early Holocene archaeological research in the southern upland started already in the late 19th century, but focused almost exclusively on dryland locations, with a special interest in the hill tops and plateaus (Crombé 1989). Investigation of the valley bottoms has only been initiated recently and hence remained so far limited to occasional projects, e.g. at Spiere, Kerkhove, Oudenaarde, and Ename.

RESULTS

Late Glacial environment: Palaeo-hydrology, palaeo-topography and palaeo-vegetation

River floodplains

Within the floodplain of the Scheldt and its tributaries, remains of abandoned single-channels of meandering river systems, locally forming large oxbows, have been detected during surveys, some of which have been analysed in detail (figs 2-3). In the Scheldt these palaeo-channels locally reach dimensions of 200 m width and 6-9 m depth (Bogemans et al. 2012; Kiden 1989; 1991); in the Kale/Durme tributary channels of c. 30-50 m width and 4-6 m depth have been reported (Crombé et al. 2013; De Smedt et al. 2012). The size of these meandering channels clearly indicates that the Lateglacial rivers had a discharge at least three to five times larger than today (Kiden 1989; 1991). This is also confirmed by the dimensions of the Lateglacial palaeo-meanders, which were much larger compared to present-day oxbows, locally extending 3-4.5 km inland. The higher discharge during the Lateglacial probably is due to higher levels of meltwater in spring and a less dense vegetation which induced more intense run-off (Kiden 1991).

The exact dating of the initial incision of these meandering channel systems is still not well established. The basal infill of sandy gyttja or scroll-bar sediments in two deep channels – one at Kalken in the Lower Scheldt Valley (Meylemans et al. 2013) and another at Vinderhoute in the Upper Kale Valley (Verbruggen 1971) – yielded ages of $12,460 \pm 60$ years ¹⁴C-BP (Beta-245745) and $12,655 \pm 70$ years ¹⁴C-BP (GrN-6062), respectively. These situate the start of the infilling during the Bølling (GI-1e) or even slightly earlier. However, given the presence of numerous reworked pollen, e.g. from several thermophilous (*Corylus*, *Carpinus*) and Tertiary species, as well as the high percentages of *Pinus*, the reliability of these early radiocarbon dates is

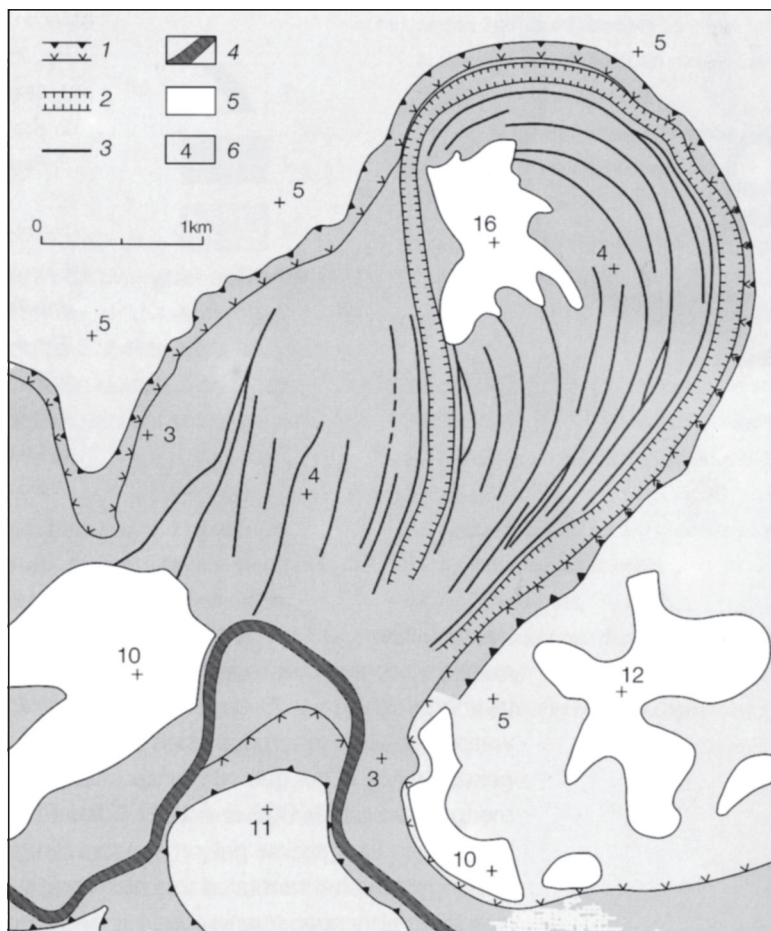
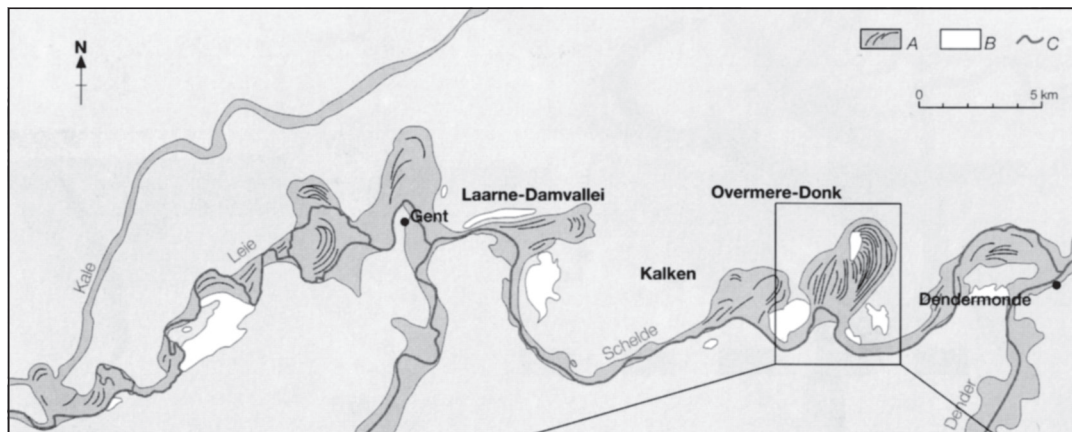


Fig. 2 Above: Lateglacial palaeo-meanders along the Lower Scheldt and Lower Lys Rivers: **A** palaeo-meanders with fossil scroll-bars; **B** river dunes; **C** present-day rivers. – Left: detail of the Lateglacial palaeo-meander of Overmere-Donk: **1** border of the Lateglacial floodplain; **2** fossil Lateglacial river channel; **3** scroll-bars; **4** present-day river bed; **5** river dunes; **6** altitude in m TAW (= mean low water tide level in Oostende). – (After Kiden/Verbruggen 2001, fig. 7).

generally contested (Kiden 1991; Storme et al. 2017; Verbruggen 1971), as they may have been performed on eroded older material.

The first reliable radiocarbon dates all come from calcareous gyttja found in several channels immediately above the sandy basal sediments. In the Lower Scheldt Valley the oldest dates are around $11,120 \pm 60$ years ^{14}C -BP (Beta 245744) and $10,910 \pm 60$ years ^{14}C -BP (Beta 245743; Meylemans et al. 2013), corresponding to the final Allerød (GI-1a) and the beginning of the Younger Dryas (GS-1). Similar dates have been obtained from several channel sections in the Kale/Durme Valley (Bos et al. 2018b; Crombé et al. 2013; Crombé/Robinson/Van Strydonck 2014). With the exception of one date from Ename ($11,210 \pm 50$ years ^{14}C -BP; Deforce 2004), no radiocarbon dates are yet available for the Upper Scheldt Valley, but pollen evidence

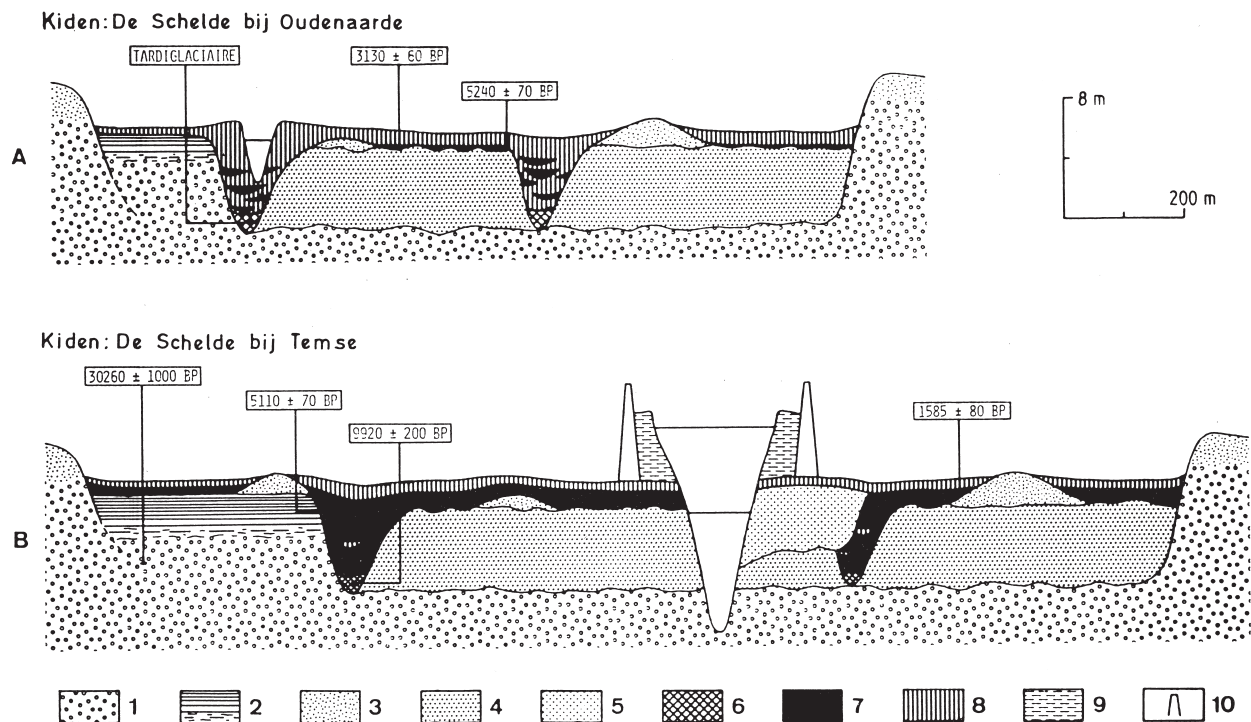


Fig. 3 Schematic cross-sections of the valleys of the Upper Scheldt (**A**) and Lower Scheldt (**B**): **1** braided river channel-fill and bar deposits. – **2** fining upward overbank deposits. – **3** aeolian deposits. – **4** Lateglacial meandering river lateral accretion deposits forming scroll-bars. – **5** Subatlantic meandering river lateral accretion deposits. – **6** gyttja. – **7** peat and clayey peat. – **8** fluvialite clay and silt. – **9** estuarine intertidal deposits. – **10** man-made embankments. – (After Kiden 1991, fig. 12.3).

points to an initial infilling from the start of the Younger Dryas (Parent/Van der Plaetsen/Vanmoerkerke 1986/1987). So although the timing of the incision of the meandering channels is not yet precisely fixed, it is clear that it occurred before the end of the Allerød/start of the Younger Dryas when the final channels started to fill in locally. This is in agreement with data from other river valleys, such as the Somme (Antoine et al. 2000), the Meuse (van Huissteden/Kasse 2001), and the Niers-Rhine Valley (Kasse et al. 2005). In all these valleys the incision of a large single channel meandering system has been dated to the Allerød, while the Bølling is characterised as a transitional phase between a braided and a meandering system. Remains of such a transitional system, characterised by several straight, small, and shallow channels which were active at the same time, have only been found so far within the Moervaart depression along the Kale/Durme River (Crombé et al. 2013; De Smedt et al. 2012) (**fig. 4**). Radiocarbon dates from a series of these anastomosing channels demonstrate that the infilling started at the transition from the GS-2a (Oldest Dryas) to the GI-1e (Bølling) or early in the GI-1e between $12,450 \pm 50$ years ^{14}C -BP (Beta-302750) and $11,925 \pm 55$ years ^{14}C -BP (KIA-47009), and continued during the main part of the Allerød (GI-1c) (Crombé/Robinson/Van Strydonck 2014). However, some channels may be younger as indicated by a late Allerød date from the basis of a small anastomosing channel at Wachtebeke ($11,345 \pm 50$ years ^{14}C -BP; KIA-46184; Crombé et al. 2013; Crombé/Robinson/Van Strydonck 2014).

The later evolution of the Scheldt River system, however, deviates considerably from the river valleys in surrounding countries. In the case of the Meuse the cold conditions of the Younger Dryas led to a return to a multi-channel braided system followed by a new deep channel incision at the start of the Holocene (Hoek/Bohncke 2002), while in the case of the Somme the Younger Dryas coincides with a major infilling of the alluvial plain followed also by a new major channel incision at the start of the Preboreal. On the contrary, in the Scheldt Basin the Allerød meandering channel system remained active during the Younger Dryas and

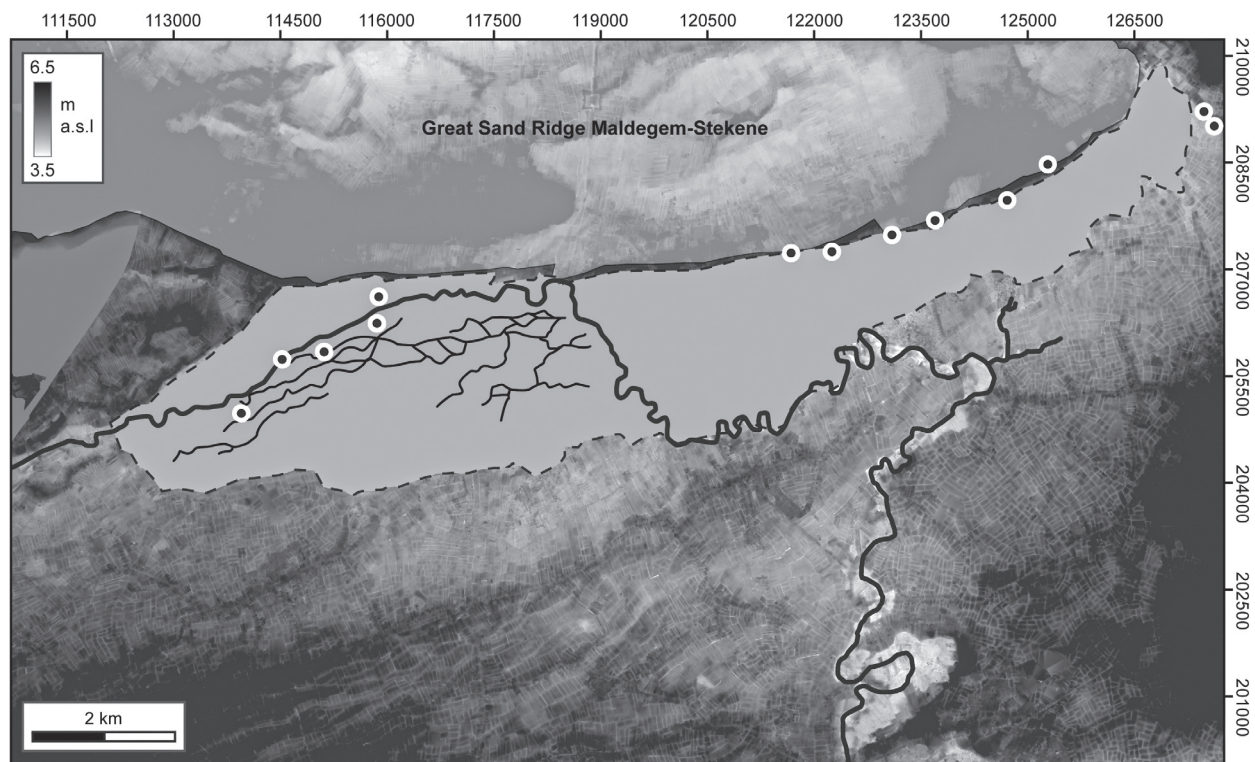


Fig. 4 Map of the Moervaart palaeo-lake through which the single-channel meandering River Kale/Durme runs (underlying map = digital elevation model; Lidar, AGIV 2001-2004). The dots indicate the position of FMG sites. In the west, there are remains of an older, anastomosing river system consisting of several small and shallow channels, reconstructed on the basis of data from augering, electromagnetic interference (EMI) and digital elevation modelling. Most FMG sites along these shallow channels are situated on small levees. In contrast, no sites are known along the lower Kale/Durme River in the east.

into the Holocene (Bogemans et al. 2012; Crombé et al. 2013; Crombé/Robinson/Van Strydonck 2014; Kiden 1991; Storme et al. 2017); however, with a clear change in sedimentation from calcareous gyttja to peat in the course of the Preboreal. The latter was probably the result of a lowering of the water level caused by increased evapotranspiration following the installation of a dense pine (*Pinus*) forest as well as higher temperatures. The sedimentary characteristics indicate an evolution from deep, stagnant, or slow-running water during the late Allerød and early parts of the Younger Dryas to very shallow and marshy conditions during the later Younger Dryas and the beginning of the Holocene. Due to the reduced fluvial activity during the Younger Dryas, river (parabolic) dunes were created within or just outside the Lateglacial floodplain. Some of these were OSL dated to $12,000 \pm 900$ years (OSL)-BP ($n=5$) (Bogemans/Vandenbergh 2011).

Sandy lowland (Lower Scheldt Basin)

The landscape in the northern sandy lowland was very dynamic as a result of a changing climate during the Lateglacial. At the start, local reworking of Pleniglacial (cover)sands triggered the formation of dunes, a process which was reactivated during the subsequent cold Dryas stages (Heyse 1983). Most dunes are rather small, except for one called »the Great Sand Ridge of Maldegem-Stekene«, running over a distance of c. 80km from west to east across the sandy lowland (Heyse 1979; 1983). According to recent data (Bos et al. 2013; Crombé et al. 2012), this massive dune was formed mainly during the Older Dryas (GI-1d) and Younger Dryas (GS-1) and consists of numerous intersecting and overlapping smaller dunes. In between these

sand dunes hundreds of relatively small- to medium-sized, closed, and shallow depressions were formed by local aeolian erosion, so-called blow-outs. Judging by the presence of humiferous to peaty sediments at their base, it can be concluded that these shallow depressions were temporarily wet, ranging from ponds during the Bølling to shallow dune slacks in the Allerød (Bos et al. 2013; Crombé et al. 2012).

Another type of open-water system within the sandy lowland consisted of shallow freshwater lakes which appeared along the southern steep edge of »the Great Sand Ridge«. Contrary to the dune slacks, these were not formed by wind erosion, but by local accumulation of groundwater and surface water which had become blocked by »the Great Sand Ridge« (De Moor/Heyse 1978; Verbruggen/Denys/Kiden 1996). By far the largest one was Lake Moervaart extending over a surface of approximately 25 km² (Heyse 1983; Crombé et al. 2013) (fig. 4). Starting as swampy depressions during the Bølling, they evolved in the course of the Allerød into shallow lakes with fluctuating water levels (3-6 m), probably as a result of increased precipitation and local seepage (Bos et al. 2013; Crombé et al. 2013; Denys/Kiden/Verbruggen 1998). The highest water level in the Moervaart Lake was reached at the transition from the early to the middle Allerød, as indicated by the abundance of aquatic plant species, such as waterlily (*Nymphaea*), Eurasian watermilfoil (*Myriophyllum*), and buckbean (*Menyanthes trifoliata*) (Bos et al. 2017).

The vegetation around these dune slacks and lakes gradually became more closed in the course of the Allerød (Bos et al. 2018a). Initially birch (*Betula*) and willow (*Salix*) were the dominant tree species, although grasses and sedges remained largely present along the banks. From c. 11,300 years ¹⁴C-BP onwards Scots pine (*Pinus sylvestris*) increased in importance and finally became the most frequent species. By the end of the Allerød the Arboreal Pollen ratio locally reached 80-90 %, indicating the presence of an almost entirely closed coniferous forest (Bos et al. 2013; 2018a; Deforce et al. 2005; Verbruggen/Denys/Kiden 1996).

Clearly before the onset of the colder Younger Dryas, more precisely during the *Pinus*-stage of the Allerød, a clear decrease of the water level occurred both in the dune slacks and lakes. Dune slacks got filled in with aeolian sands (Bos et al. 2013; Crombé et al. 2012), while in the lakes (Lakes Moervaart and Snellegem) the lacustrine sediments got covered by peat indicating a change to a marshier environment (Denys/Verbruggen/Kiden 1990; Denys/Kiden/Verbruggen 1998). This marked lowering of the water level was recently synchronised with the Intra-Allerød Cold Period (GI-1b) on the basis of a Bayesian modelling of radiocarbon dates (Crombé/Robinson/Van Strydonck 2014), yet the chronological precision still demands further improvement.

Loamy upland (Upper Scheldt Basin)

From the southern upland area no palaeo-environmental information is currently available, except for the Scheldt floodplain (see above). This is mainly due to erosion of Lateglacial levels situated on hill tops and slopes, as well as plateau edges. In addition, so far only little environmental research has been conducted in small stream valleys (Maarkebeek, Zwalmbeek, etc.) that feed the River Scheldt and its tributaries.

FMG occupation

Lithic assemblages

Except for some isolated late Magdalenian/Creswellian finds in the upland area (Crombé 1989; Vandendriessche et al. 2016), there are currently no traces of human occupation in the Scheldt Basin prior to the

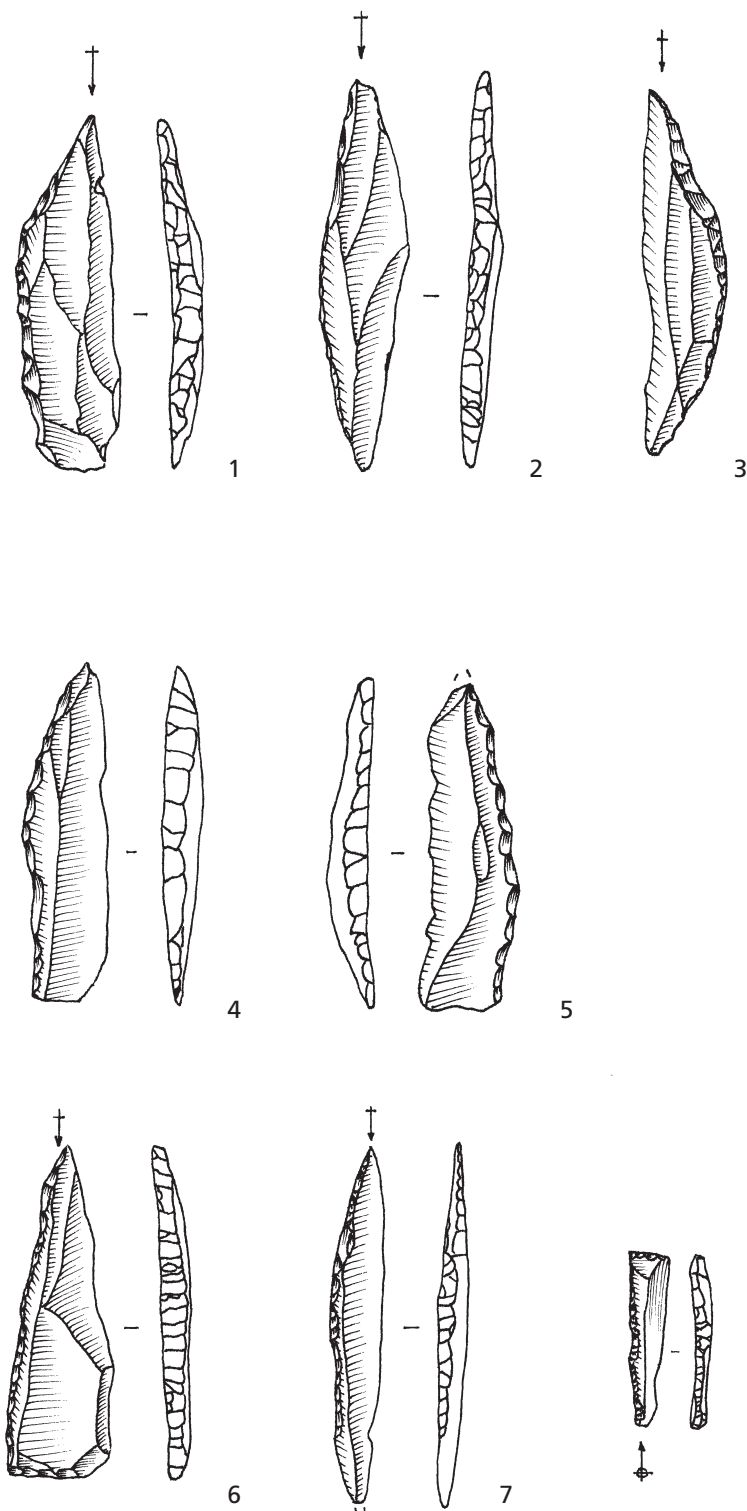


Fig. 5 Selection of backed points from the Scheldt Basin attributed to different stages of the Allerød and Younger Dryas: **1-3** early FMG (Doel »Deurganckdok«). – **4-5** late FMG (Stekene »Heirweg«). – **6-9** final FMG (Maurie-like point: Klein-Sinaai), and Younger Dryas traditions (Blanchères point: Evergem »De Nest«; microlithic armatures: Ruien »Rosalinde«). – (Drawings J. Sergant).

FMG. A clear explanation for this absence of human occupation during the Bølling has not yet been found, but it could be that the environment was still too unstable for humans to settle. The sand dunes were still in formation and probably not yet well-developed, making the area not well suited for erecting camp sites. In addition, there may have been a problem with the availability of drinking water, certainly in the sandy lowland where the dune slacks and lakes only appeared later during the Allerød (fig. 5).

At the moment it looks as if the FMG hunter-gatherers were the first re-colonisers of the Scheldt Basin after the Lateglacial Maximum. At least 30 FMG sites are actually known in the Scheldt Basin (Ameels/Van Vlaenderen 1995; Crombé/Verbruggen 2002; Crombé et al. 2011) (fig. 1). Except for a few, these are all eroded plough-layer sites known from field surveys. As a result little is currently known about the chronology and settlement organisation of the FMG in the Scheldt Basin. The lithic assemblages found on these surface sites are generally limited in size, ranging between 500 and 1,000 artefacts. The main raw material consists of local flint of mediocre quality found as relatively small nodules on Tertiary outcrops. The use of better quality, black fine-grained flint of Obourg-type is generally restricted to less than 10 % (Crombé et al. 2011). Besides backed points and blade(let)s the lithic toolkit comprises standardly numerous scrapers and burins, the latter mainly dihedral and made on truncation.

So far just four sites have yielded *in situ* finds. The site of Verrebroek »Dok 2« (Crombé et al. 1999; Crombé 2005) consists of a very small knapping post (<1 m²) without diagnostic tools, found along a former dune slack on top of a humiferous layer dated by pollen analysis and radiocarbon method to the Older Dryas and/or the start of the Allerød (Crombé et al. 2012; Van Strydonck 2005). A radiocarbon date obtained on a sample of burnt bark found in the same stratigraphical position as the flint artefacts yielded a result of 11,900±90 years ¹⁴C-BP (UtC-9434), corresponding to the Older Dryas/Allerød transition (Van Strydonck/Crombé 2005). This date is also corroborated by the knapping characteristics which indicate careful and rather intense core preparation (frequent rejuvenations, high frequency of faceted butts, etc.) and the use of a soft stone hammer (Perdaen/Crombé/Sergant 2004; Perdaen/Ryssaert 2002). These features are typical of early rather than late FMG in Western Europe (Bodu/Valentin 1997; Fagnart 1997). Pollen and charcoal analyses (Deforce et al. 2005) indicate that the occupation took place in an environment with up to 45 % of willow (*Salix*) and a wet vegetation consisting mainly of *Cyperaceae* (sedge family) and *Poaceae* (grass family).

At the site of Doel »Deurganckdok-sector B« (Crombé et al. 2000; Crombé 2005) FMG lithic remains have been found on a coversand ridge covered by Holocene peaty and fluvial deposits. Despite this covering, large parts of the site were disturbed by intense later occupations dated to the Late Mesolithic (>100 hearth-pits) and Early Neolithic (Swifterbant Culture). In addition – due to advanced bioturbation – the FMG remains were intermixed with lithics from these younger phases. However, based on a combination of attributes, such as raw material, weathering (patination), and morphology, it was possible to select c. 600 artefacts which can be attributed to the FMG with a high degree of certainty. Despite the absence of radiocarbon dates, here too, the knapping characteristics and the presence of some »bipointes« (fig. 5, 1-3) seem to point to an early stage of the FMG, although the presence of late FMG artefacts is not excluded (Perdaen/Crombé/Sergant 2004).

A third excavated site is situated within the extensive site-complex along the northern bank of the Moervaart palaeo-lake (see below). At Klein-Sinaai »Boudelo« (Vanmoerkerke/De Belie 1984) at least five lithic scatters were discovered by chance during the excavation of a Medieval abbey. According to a first preliminary excavation report, the FMG remains (1,757 lithic artefacts) were found in a sandy layer with iron nodules, situated c. 10 cm above a layer containing scattered charcoal fragments. The latter might correspond to the well-known Usselo-layer, but this unfortunately cannot be verified since the site is not accessible any longer and the charcoal has not been preserved. No further spatial information is available, but in all scatters some typical FMG tools (backed points and blades, burins) have been reported. Worth mentioning are two »bipointes« and one »Maurie-like point« (fig. 5, 6), which might point to an early and final FMG occupation of the site, respectively.

A last FMG site was excavated at Harelbeke »Gavermeersen« in the context of sand extraction (Vermeersch 1976). Here FMG hunter-gatherers choose to settle on the dry northern bank of a large depression, situated

less than 1.5 km from the Lys floodplain, an important tributary of the River Scheldt. This shallow depression was filled with silty to clayey sediments sealed by peat, which unfortunately has neither been studied nor dated. The site itself (c. 2,183 lithic artefacts) is situated on the southern flank of a sandy ridge, which was largely affected by ploughing. Nevertheless, some lithics were still preserved underneath the plough-layer, albeit not allowing a meaningful spatial analysis.

Although the above excavations have revealed the presence of the early stages of FMG, in terms of overall technology the vast majority of lithic assemblages in the Scheldt Basin clearly relates to the classic/late FMG, characterised by uni-pointed backed armatures (**fig. 5, 4-6**) and a much less refined blade technology that focused on the production of irregular unstandardised blade(lets).

Distribution pattern

The distribution pattern of the FMG sites displays a marked concentration in the sandy lowland area (**fig. 1**). In the southern uplands FMG sites are currently hardly known, but this may be partly due to a lesser research intensity and taphonomic factors. Indeed, one needs to consider the possibility that numerous sites in this hilly area are hidden underneath colluvial deposits, as was recently attested at the Younger Dryas site of Ruien »Rosalinde« (Crombé et al. 2014). The few sites known so far in the uplands (e. g. Kluisberg, Pottelberg, Kemmelberg) are located on hill tops, in particular on local outcrops of Tertiary sands (Vandendriessche et al. 2016). A similar observation has been reported by Coudret and Fagnart (2006, 737) for the Somme region of northern France.

Within the sandy lowland region of the Lower Scheldt Basin FMG sites mainly occur along the dry banks of dune slacks and shallow lakes, sometimes forming extensive site-complexes running over several kilometres (Crombé et al. 2011; 2013). This pattern is most apparent along the Moervaart palaeo-lake (**fig. 4**), where a high density of sites has been observed along the relatively steep northern bank and on small sandy ridges, possible levees, within the western lake sector. These dense clusters of sites probably reflect frequent and recurrent visits of FMG hunter-gatherers to these lake areas. Most likely they were attracted by the rich and diversified ecology of these areas, which provided them with drinking water, rich hunting grounds, and plenty of plant material for both consumption and tool production (Crombé et al. 2013).

In contrast to this, the total absence of FMG sites along the floodplains of the River Scheldt and its tributaries is most remarkable and difficult to explain. Despite the intense archaeological research especially along the Lower Scheldt Valley, so far not a single FMG camp-site, except some isolated finds, has been discovered within the Lateglacial floodplains. Apparently the scroll-bars flanking the Allerød palaeo-channels were inhabited only from the Early (Boreal) Holocene onwards, when the rivers were already reduced to shallow slow-running streams (Ameels et al. 2003; Bats 2005; 2007; Bats/Bastiaens/Crombé 2006; Crombé et al. 2013; Meylemans et al. 2013; Parent/Van der Plaetsen/Vanmoerkerke 1986/1987; Perdaen et al. 2011a; 2011b). Even on the dry river dunes situated adjacent to the floodplains not one FMG site is currently known, while the evidence of Mesolithic and Neolithic occupation is overwhelming. This is particularly evident along the very intensively surveyed Durme River (Crombé et al. 2011; 2013; **fig. 4**, eastern section). Here field-walking yielded at least twelve Early (Boreal) Mesolithic sites, mostly situated on the left bank, while not a single FMG site, not even an isolated find, has been reported. Similarly, intensive surveys and large-scale excavations on the dry banks along the floodplains along the Upper Scheldt, e. g. at Ename (Ameels et al. 2003), Kerkhove (Crombé 1985; Sergeant et al. 2016), Spiere (Vanmoerkerke 1988; Vanmontfort et al. 2001/2002), Gavere (Vanmoerkerke 1986) and Melden (Crombé/Braeckman/Parent 1991), yielded plenty of Mesolithic and extensive Neolithic (Michelsberg Culture) sites, but no evidence of FMG occupation.

DISCUSSION

From the above it is clear that the Lateglacial environment in the Scheldt Basin was very dynamic. At present not all details of the Lateglacial environmental changes are fully understood, but the main trends are yet defined. During the time of occupation of the FMG, i. e. the Allerød, an important network of single-channel meandering rivers, with the Scheldt as the main river, as well as numerous shallow ponds and lakes had developed within an increasingly wooded environment dominated by first birch and later pine. Within this landscape FMG hunter-gatherers clearly preferred to settle along the banks of lakes and ponds, apparently leaving the river valleys aside. This is a very remarkable pattern which considerably differs from surrounding river valleys in Western Europe, where FMG hunter-gatherers intensively occupied the edges of Lateglacial floodplains. In the Dutch Meuse Valley FMG sites occur both along lake banks and the outer banks of Lateglacial oxbows (Deeben 1995). In northern France, the Somme and Seine Valleys have yielded plenty of sealed FMG sites situated along active river channels (Bodu/Debout/Bignon 2006; Coudret/Fagnart 2006). Similarly in the valley of the Rhine and its tributaries FMG sites, such as Andernach, Bad Breisig, Niederbieber and Kettig, are located close to active meandering channels (Street et al. 2006).

Why do the River Scheldt and its tributaries differ from this general pattern? Before addressing this question it needs to be investigated whether the actual distribution pattern is not biased. It has to be considered that some FMG sites may be hidden as a result of later sedimentation. As a matter of fact, most sites in adjacent valleys are covered by later sediments of different origin (alluvial, volcanic, aeolian, anthropogenic). However, it seems highly unlikely that this explains the total lack of FMG sites in the Scheldt floodplains. The small scroll-bars created as a result of the lateral migration of the meandering channels, which constituted the preferred habitats for human occupation during the Mesolithic, are often hardly covered, some are even visible in the present day landscape. So, if FMG sites are present on these small elevations, at least some of them would have been found during the intense surveys of the Scheldt floodplains. FMG remains were also not reported on the numerous drilled and/or excavated scroll-bars which are covered by Holocene fluvial deposits, e. g. at Oudenaarde, Kerkhove, Kalken, Wichelen, Bazel, and Melsele. Still, it cannot be fully excluded that some FMG sites have been missed during archaeological research. The discovery of a humiferous palaeo-sol situated at maximum 30 cm below the top of a scroll-bar at Wichelen »Bergenmeersen« (Perdaen/Meylemans/Vanholme 2013) demonstrates that some scroll-bars might have been covered by aeolian sands during the Younger Dryas. Knowing that archaeological research is often limited to the top of the Pleistocene sediments, it is possible that some covered FMG levels were not explored, but this certainly cannot explain the complete absence of sites in the floodplains. Aeolian sedimentation could also be potentially responsible for the lack of FMG sites on the dry banks along the margins of the floodplains. However, if the river dunes along the Scheldt and its tributaries were created during the Younger Dryas, as suggested by recent OSL research on some of them (Bogemans/Vandenberghhe 2011), they did not yet exist at the time of the FMG. So, at present it rather looks as if the banks of the Lateglacial floodplains and oxbows were not yet attractive for settling during the Allerød due to the absence of dry enough settlement locations, comparable to the inland dunes intensively occupied by FMG groups. Some isolated finds of FMG armatures nevertheless indicate that the Scheldt floodplains were visited by FMG hunter-gatherers, possibly in the context of hunting activities.

Alternatively we need also to consider post-Allerød fluvial erosion of former FMG sites in order to explain the lack of sites in the floodplains. However, this explanation too seems rather unlikely as, contrary to other valleys in North-West Europe, the Scheldt Valley remained rather stable and much less dynamic during the subsequent Younger Dryas and Early Holocene. The single-channel systems from the Allerød persisted into the Holocene with a gradual infilling of the deep channels demonstrating a marked decrease of the fluvial

activity. In fact the Younger Dryas and Early Holocene rivers were largely reduced to slow running streams. It is only during the early stages of the Subatlantic that a new river channel with associated crevasse gullies was incised in the Scheldt floodplain (Bogemans et al. 2012; Kiden 1991). However, sedimentary properties seem to indicate a rather stable meandering channel with minor lateral migration, so the impact of this renewed fluvial activity on older prehistoric sites will have been rather limited.

So, actually there is little evidence which supports the idea that the distribution pattern of FMG sites at least along the Lower Scheldt Basin is seriously biased. Then how can we explain the absence of interest in the river floodplains? Maybe the river valleys were a too dynamic environment for FMG hunter-gatherers in order to exploit or settle? Large parts of the Allerød coincide with a phase of high discharge and fluvial erosion; river channels were not yet fixed but subject to continuous lateral migration, which ultimately led to the formation of very extensive oxbows. However, this argument does not hold for the later phases of the Allerød. The available radiocarbon evidence clearly indicates that the river systems in the Scheldt Basin stabilised ultimately during the final Allerød (GI-1a) and the transition towards the Younger Dryas (GS-1). At that time the channels started to fill in with organic sediments, indicating more tranquil flow rates. So one would at least expect FMG hunter-gatherer activity along the Scheldt and its tributaries at this late stage, even more so since around the same time the coversand interior faced an abrupt drop of the ground water level, turning most of the inland freshwater lakes and dune slacks into dry or marshy environments. This certainly must have had a considerable impact on the FMG hunter-gatherers who intensively exploited these lake banks. They were confronted with a sudden reduction of the available open water, which provided them with vital drinking water. Also the game populations must have been affected by this abrupt environmental change. The frequent occurrence of animal dung (coprophilous) fungi (*Bombardioidea* type, *Sporormiella* type, *Podospora* type, *Sordaria* type and other Sordariaceae; Bos et al. 2013) as well as high phosphate ratios (Louwagie/Langohr 2005, 103) indirectly demonstrate the presence of numerous large herbivorous mammals along the Allerød lake banks. These too will have suffered from the marked reduction in available drinking water and will have been forced to move to other areas. In this context the total absence of FMG sites along the main river valleys of the Scheldt Basin is very strange. Does it mean that these hunter-gatherers moved to other areas, altogether leaving the Scheldt Basin? Unfortunately, due to the complete absence of radiocarbon dates for the FMG, this hypothesis cannot yet be further explored but nevertheless seems plausible. It seems reasonable to assume that the important environmental changes occurring during the final Allerød and early Younger Dryas altered the settlement system of the contemporaneous hunter-gatherers, but further research is needed in order to fully understand the nature of the human response.

CONCLUSIONS

The most important observation from the above analysis is the so far total absence of FMG camp sites along the river floodplains of the Scheldt Basin. Apparently the first re-colonisers of North-West Belgium were more attracted to the dry banks of former freshwater lakes and ponds in the sandy interior, possibly indicating that the latter constituted a more stable and secure environment, contrary to the highly dynamic river valleys – at least until the final Allerød (GI-1a) when a sudden ground water lowering dramatically reduced the available amount of drinking water for both animals and humans. But even then, FMG hunter-gatherers apparently did not shift to the rivers, although these probably had become the only or at least the most important sources of drinking water within the area. However, in absence of faunal remains and well-dated FMG sites it remains difficult to assess the real extent of this hydrological event. Future Lateglacial research in the Scheldt Basin should therefore focus on the detection and excavation of sealed FMG sites, which can

still be expected along the banks of the numerous freshwater lakes and dune slacks. Sites such as Verrebroek »Dok 2« and Klein-Sinaai »Boudelo« clearly prove the existence of well-preserved FMG occupation levels underneath Younger Dryas aeolian sediments. Existing survey techniques should be further refined, allowing to map buried palaeo-landscapes on a larger scale and with a higher resolution (Missiaen et al. 2015; Verhegge/Missiaen/Crombé 2016) and to detect even the smaller and less dense sites (Crombé/Verhegge 2015). In addition much more research should be done on the contemporaneous environment in view of a better understanding of the landscape evolution, especially in response to a changing climate. The long and often continuous sedimentary sequences available in the numerous river channels and inland lakes make the Scheldt Basin an ideal context for a high-resolution, multi-proxy investigation of the Lateglacial and Early Holocene environment.

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Summary

In this paper the spatial distribution of Federmesser-Gruppen (FMG) sites in the Scheldt Basin is discussed. A clear pattern of focused occupation and exploitation of the dry banks of former dune slacks and freshwater lakes is observed, while the river floodplains were seemingly avoided. The latter may be due to the highly dynamic environment of the rivers, which were characterised by very high discharges and continuous erosion. During the late Allerød (GI-1a) and the transition towards the Younger Dryas (GS-1) the meandering rivers finally stabilised, gradually turning into slow running and shallow streams. This probably was the result of a general decrease of the ground water table, which also affected the inland lakes and ponds, reducing them to dry or swampy depressions. It is assumed that this marked hydrological event, which may be linked to cooling during the Intra Allerød Cold Period (GI-1b) and the subsequent Younger Dryas (GS-1), had a considerable impact on the settlement system of the FMG hunter-gatherers, who may have been forced to leave the Scheldt Basin.

Keywords

Scheldt Basin, Federmesser-Gruppen, site distribution, hydrological change, climate change