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The Neolithic wetland site of Ename-Stuw (Scheldt valley, BE)

Philippe Crombé, Jonathan Jacops, Vera Ameels, Sofie Debruyne, Koen Deforce, Isabelle De Groote, Guy De Mulder, Éva Halbrucker, Jean-Pierre Parent, Prudence Robert, Hans Vandendriessche & Dimitri Teetaert

1. Introduction

In 2002 the construction of a new lock at Ename, situated along the Middle Scheldt valley in W Belgium, was initiated (**Fig. 1**). During the digging of a large construction pit of 140 x 50 m numerous archaeological finds, including lithic artefacts, animal and human bones, pottery, wooden posts and antler mattocks, appeared. Most of these finds were retrieved from gullies and features filled with layers of shells and humic clay and were clearly dating to the Neolithic (Ameels *et al.*, 2003).

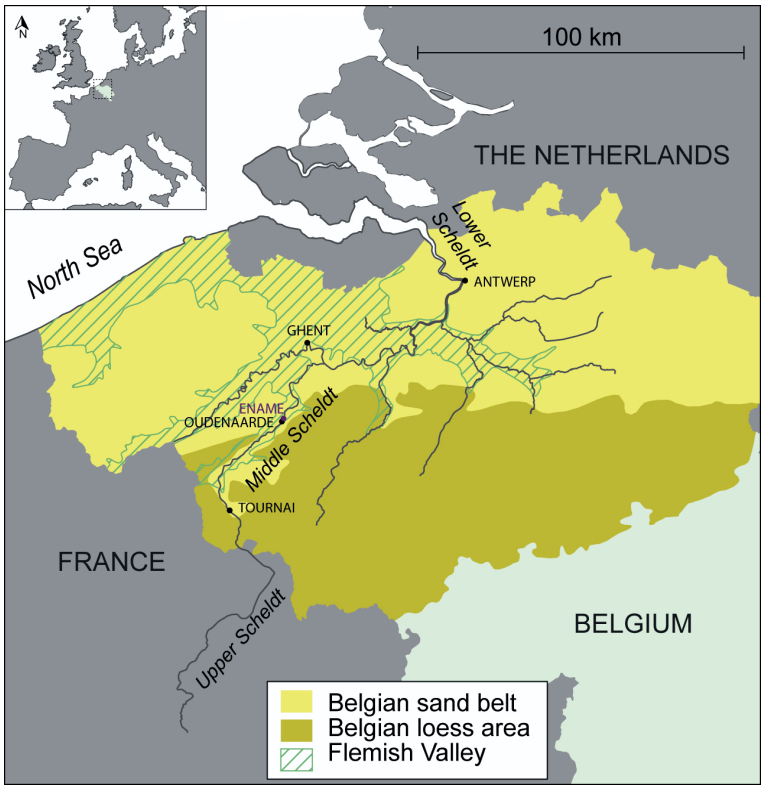

Fig. 1 – Map of Belgium with indication of the site of Ename.

Unfortunately, due to the lack of an appropriate archaeological legislation at that time, no mandatory preliminary archaeological research and ensuing archaeological measures were imposed, nor could the construction works be stopped. Archaeologists were just authorized in the spring and fall of 2003 to conduct some limited salvage excavations before the lock was constructed. In total, scarcely 293 m² of the 6000 m² could be excavated, leaving most of the site(s) unstudied before destruction. Fortunately, many finds could still be retrieved during archaeological inspections in the course of the construction works. However, most of these finds were collected out of context or with bad stratigraphical control.

Yet, within the Belgian context the wetland site of Ename is still exceptional, even more than 20 years after its discovery. So far, research in the Belgian river floodplains has been limited compared to surrounding regions, most research focusing on the valleys of the Lower-Scheldt and Meuse and on the Mesolithic time-period (van der Sloot *et al.*, 2003; Crombé, 2006; Meylemans *et al.*, 2013; Vandendriessche *et al.*, 2019; Lavachery, *et al.*, 2023). As a result, very little is currently known about the Neolithic within the Belgian wetlands. In particular, the discovery of organic remains from plants, animals and humans makes the site of Ename exceptional within Neolithic research. In this paper, the site-stratigraphy and chronology as well as the archaeological finds, including wooden poles, pottery, lithic artefacts and antler tools, and some palaeoenvironmental data from pollen and molluscs will be presented and discussed. The human remains and vertebrate fauna will be published in separate papers.

2. Site description

2.1. Site location

The site of Ename-Stuw is located on the right bank of the middle reach of the Scheldt, between the city centre of Oudenaarde and the village of Ename (**Fig. 1**). The middle reach of the Scheldt follows the course of a larger Pleistocene valley that was connected with the Flemish Valley to the north (Tavernier & De Moor, 1974). This valley was incised in early Eocene marine layers and filled with fluvial deposits during the Late Pleistocene. Subsequently, the valley sides and floor were covered by aeolian sediments: sand in the Belgian sand belt, north of Oudenaarde (Gent Formation) and silt in the loess area, south of Oudenaarde (Romont Group) (**Fig. 1**). At the end of the Pleniglacial or the beginning of the Lateglacial, the braided river system of the Scheldt transformed to a meandering river system (De Moor & Heyse,1978; Kiden 1991; Meylemans *et al.* 2013), which reworked the aeolian sediments and evacuated part of it, lowering and flattening a part of the valley floor. The flattened part became the flood-plain for the Lateglacial and Early Holocene Scheldt (Kiden, 1991; Bogemans *et al.*, 2012; Meylemans *et al*., 2013).

The river system of the Early Holocene middle (and lower) reach of the Scheldt and its tributaries is described as an 'underfit' system, composed of diffuse streams in a marsh environment within the confines of the Lateglacial meandering palaeochannel. Due to increasing afforestation and low discharge, depositional processes were largely limited to peat accumulation, without significant channel formation or lateral erosion (Kiden, 1991; Verbruggen et *al.*, 1991; Bogemans *et al.*, 2012). This peat was initially formed in an environment of fens and subsequently carr vegetation (Storme *et al.*, 2017). From the Middle Holocene onwards, peat also accumulated outside the Lateglacial palaeochannels, and eventually covered the entire floodplain. During the Late Holocene increased human impact on the surrounding landscape caused the formation of the modern meandering river system with small dimensions, and associated mud accumulation on the floodplains (Meylemans *et al*, 2013). Finally, the system was canalized from the Middle Ages onwards.

The Early Holocene situation at Ename-Stuw, however, is totally different. Here, remains of several river channels were found which differ substantially both in dimensions (bankfull depth < 3 m) and infilling (inclined sets of fining-upward sand-silt couplets) from the main Scheldt river palaeochannel. This suggests the existence of an anastomosing river system, consisting of several small, generally low-energy, meandering channels, which were subject to variations in stream intensity during short periods of deposition. One of these channels, dated to the late Boreal, has been extensively studied from a palaeoecological point of view (Storme *et al.*, 2019).

2.2. Stratigraphy and features

Salvage excavations have been conducted in four sectors within the lock construction pit and one situated south of it (**Fig. 2**). The stratigraphy and features within each sector will be described below as far as information is available. However, the adjacent sectors 1 and 3 will be combined as these belong to the same site. Overall, the archaeological levels are situated between 4.5 and 6 m TAW (= local ordnance datum), covered by (organic) clay and shell-rich layers (resp. layers 8 & 10 & 9; **Fig. 3**) which were mechanically removed during the construction works.

2.2.1. Sector 1 and 3

Within these sectors a large and deep pit-like feature was discovered, which, unfortunately, could only be excavated partially. It was situated along the southern flank of a large sandy elevation, probably a levee or scroll-bar. The excavated part of this feature displays an irregular rounded contour, but it is not clear whether the feature on its whole was circular (**Fig. 3, 4**). It could also be part of a more gully-like feature. This bowl-shaped pit has an estimated diameter between 10 and 15 m and is 3.0 to 3.5 m deep. It has a complex infilling,

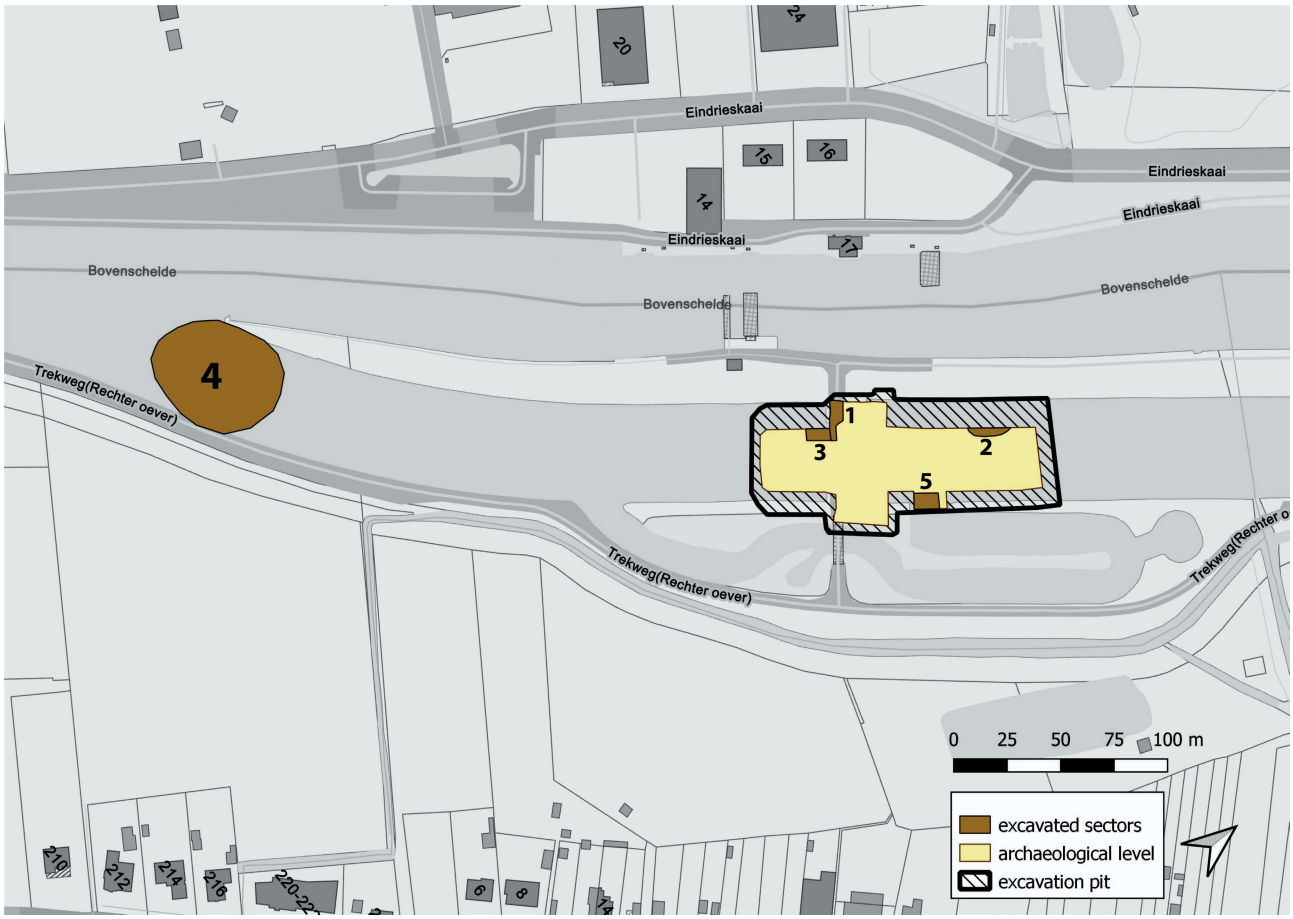

Fig. 2 − Map of the site of Ename-Stuw with indication of the five investigated sectors.

which unfortunately was not studied in detail in the field. The lowest infilling (layers 1" to 3) mainly consists of alternating layers of organic clay and mottled greasy clay with only few dispersed shells. This contrasts sharply with the upper layers (layers 4 to 7) which are very rich in shells and wood fragments, such as twigs and branches. Numerous large lumps of calcium carbonate concretion occur along its eastern flank and in its upper infilling. The feature is covered by three layers (layers 8-10), among which a very organic to peaty clay layer (layer 8), which occur over the entire surface of the construction pit.

Stratigraphically, this large feature cuts through the infilling of a late Boreal gully (layer 15; Storme *et al*., 2019); hence it cannot be older than the Atlantic. Its origin – manmade or naturally formed – remains difficult to determine but the numerous similarities in infilling (mainly of the lower layers), size and location with the adjacent Boreal gully rather point to a natural origin.

At the bottom of this large feature numerous wood fragments, among which several pointed poles, were found, some fragments having a length of more than 2 m. Most of them were lying horizontally or slightly obliquely and in an intermixed position, one above the other. This most likely indicates that they were no longer in their original position but have been displaced probably due to fluvial activity. This is supported by the fact that most wood fragments have the same general orientation, roughly north(east)-south(west). They might have accumulated at the end of the gully during an erosion phase.

At a higher level two extra poles were found, one in a vertical position, another obliquely positioned. Both are covered by shell-layer 5, which runs over the entire surface of this large feature and yielded lots of archaeological finds. The same holds for the above-lying layers 6 and 7, resp. characterized as a humic clay layer and a dense shell layer. At least 3 vertically positioned pointed poles were found outside the limits of this large feature, and were most likely still in their original position.

2.2.2. Sector 2

Only a very small portion of this sector was excavated. Associated with a shell-rich layer, a timber plank made of oak (*Quercus* sp.) was found, which unfortunately is no longer preserved. The above-lying layer contains some animal bone remains.

2.2.3. Sector 4

This sector is situated outside the construction pit in a channel that was dug along the southside in order to connect the new lock with the current Scheldt river. There is, however, no stratigraphical information available for this sector.

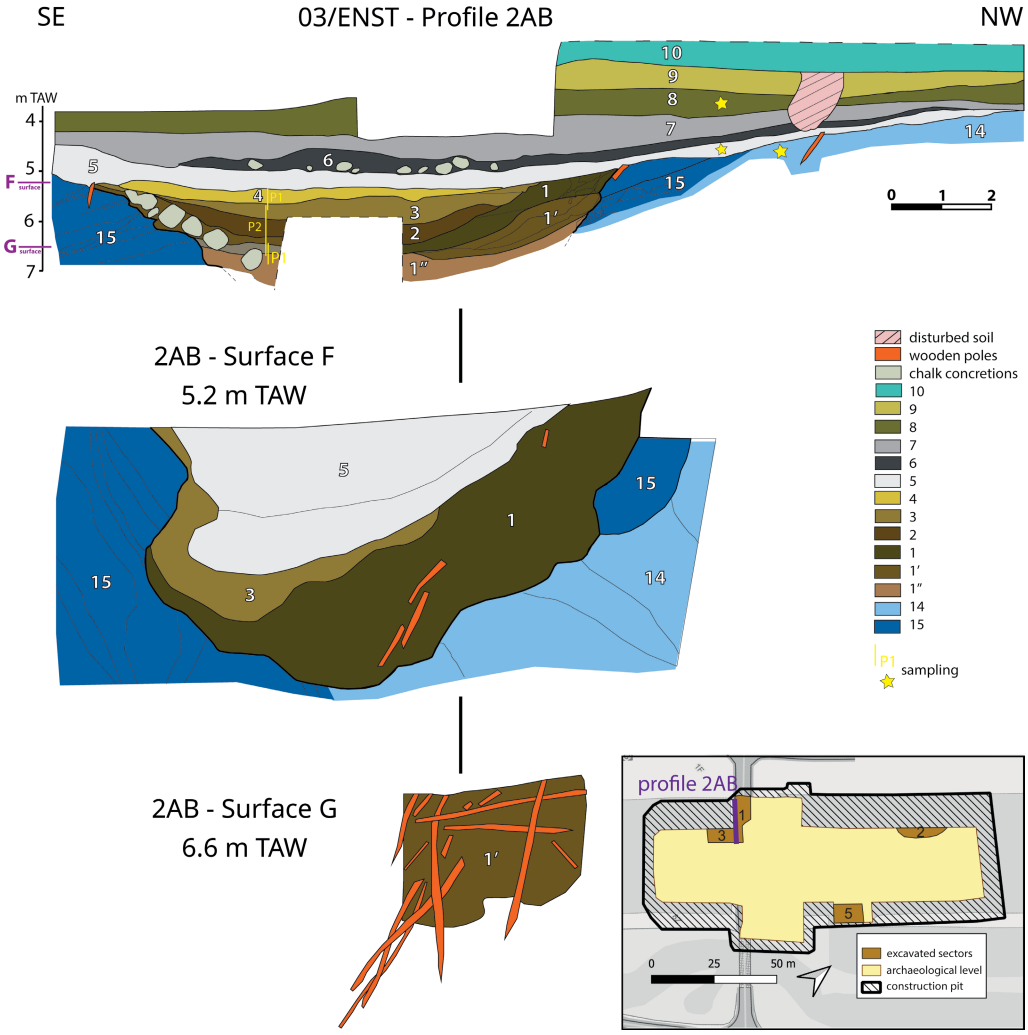

Fig. 3 – Horizontal and vertical plan of the large pit feature within sector 1. Key (from top to bottom):
10. dark grey greasy clay;
9. strongly calcareous layer with numerous fragmented shells;
8. dark brown strongly organic (peaty?) clay with numerous wood fragments, including some large trunks;
7. alternation of fine layers of shells and twigs;
6. organic clay with intercalated sand layers;
5. dense layer of fragmented shells;
4. dark brown sandy layer with numerous shells;
3. dark brown clay with dispersed shells and twigs;
2. strongly organic clay;
1. mottled clay; 1'. organic clay; 1". mottled clay;
14. alternating layers of dark grey clay and sand (infilling undated gully?);
15. alternating layers of clay and sand (infilling Boreal gully).

Fig. 4 − Cross-section of the large pit feature within sector 1, with the pointed poles and wood fragments near its base.

2.2.4. Sector 5

In this sector along the eastern side of the construction pit a small gully filled with peat was discovered. Associated with this gully a limited number of finds was recovered, including some animal and human bone remains.

3. Site chronology

In total 28 AMS-radiocarbon dates have been obtained on different types of organic material (**Tab. 1**). Twelve dates (KIA-dates) were obtained directly after the excavations, while the remaining ones (RICH-dates) were done recently. All samples were prepared at the Royal Institute for Cultural Heritage (RICH), Brussels; dating was performed either at Kiel (KIA-dates) or Brussels (RICH-dates). Calibration was performed using IntCal20 (Reimer *et al.,* 2020) and Oxcal version v4.4 (Bronk Ramsey, 2009).

3.1. Site level

Taken together, the radiocarbon dates demonstrate that the area of the new lock was occupied during the Neolithic, between *ca*. 4500/4350 cal BC and *ca*. 2150/1900 cal BC, corresponding to the time-span of the Middle to Final Neolithic in Belgium (**Fig. 5**). Just one date, obtained on an antler mattock, dates to the Middle Bronze Age. There are no older (Mesolithic or Palaeolithic) dates, which is in agreement with the typo-technological dating of the archaeological finds (*cf*. 6-8).

Clearly the Neolithic occupation was not continuous, as there are several relatively short hiatuses in the chronological spread of the dates (**Fig. 5**). The most important one is situated shortly before and after 3500 cal BC, corresponding to the Late Neolithic in Belgium. This

^{14}C lab code	BP age	Standard deviation	Stratigraphic position	Sampled material	C:N
SECTOR 1					
RICH-34196	5281	30	layer 5	Human, metacarpal	3.1
KIA-23426	5160	35	layer 5	Undetermined animal bone	10.5
KIA-23409	4490	30	Oblique position, upper infilling (layer unknown)	Wooden pole (*Fraxinus excelsior*)	
RICH-34203	4487	29	Layer 5 or 7	Wolf, metapodial	3.2
KIA-23421	4485	30	Horizontal position, bottom layer pit	Wooden pole (*Fraxinus excelsior*)	
KIA-23410	4390	30	Oblique position, pre-dates layer 5	Wooden pole (*Fraxinus excelsior*)	
KIA-23411	4365	30	Horizontal position, bottom layer pit	Wooden pole (*Fraxinus excelsior*)	
RICH-34205	3982	28	Layer 5 or 7	Aurochs, femur	3.1
KIA-23415	3715	25	Vertical position, pre-dates layer 5	Wooden pole	
RICH-34198	3686	28	Layer 5 or 7	Human, rib fragment	3.0
RICH-34197	3685	28	Layer 5 or 7	Human, scapula	3.2
KIA-23428	3660	25	Layer 5	Antler, mattock	3.2
SECTOR 2					
RICH-34206	5607	30	Shell layer	Dog, lower jaw	3.3
RICH-31519	5317	25	Shell layer	Human, partial cranium	3.2
KIA-23424	4900	30	Shell layer	Undetermined animal bone	3.3
RICH-34204	3976	28	Above shell layer	Cattle, skull	3.2
SECTOR 3					
KIA-23422	4385	30		Wooden pole (*Fraxinus excelsior*)	
RICH-34199	4084	30		Human, humerus	3.1
RICH-34202	3854	29		Human, juvenile femur	3.2
RICH-31516	3721	23		Human, fibula	3.2
KIA-23423	3635	35		Wild boar	3.2
KIA-23427	3345	30		Antler, mattock	3.3
SECTOR 4					
RICH-34200	3994	27		Human, femur	3.2
RICH-34201	3704	28		Human, femur	3.1
ZONE 5					
KIA-24837	3870	35		Human, skull	
Non-localized finds					
RICH-34195	4127	30		Human, talus fragment	3.2
RICH-34194	3718	28		Human, skull fragment	3.1
RICH-31517	3699	23		Human, skull fragment	3.1

Tab. 1 – List of the radiocarbon dates from Ename-Stuw. Calibration is performed with Oxcal version 4.4 (Bronk Ramsey, 2009) and the IntCal20 calibration curve (Reimer *et al.,* 2020).

gap is even more pronounced if only the dates on human remains are considered (**Fig. 6**); the chronological gap encompasses the entire 4th millennium cal BC and the start of the 3rd millennium cal BC, i.e. the Late Neolithic and start of the Final Neolithic. Remarkably, most of the dated wooden poles date to this hiatus (**Fig. 6**), suggesting that they belong to an occupation phase for which no human remains have been found.

Clearly the bulk of the radiocarbon dates (16/28 dates) belong to the 3rd millennium cal BC (**Fig. 5**), indicating that the main occupation dates to the Final Neolithic. This is in full agreement with the archaeological remains, in particular the pottery (*cf.* 6).

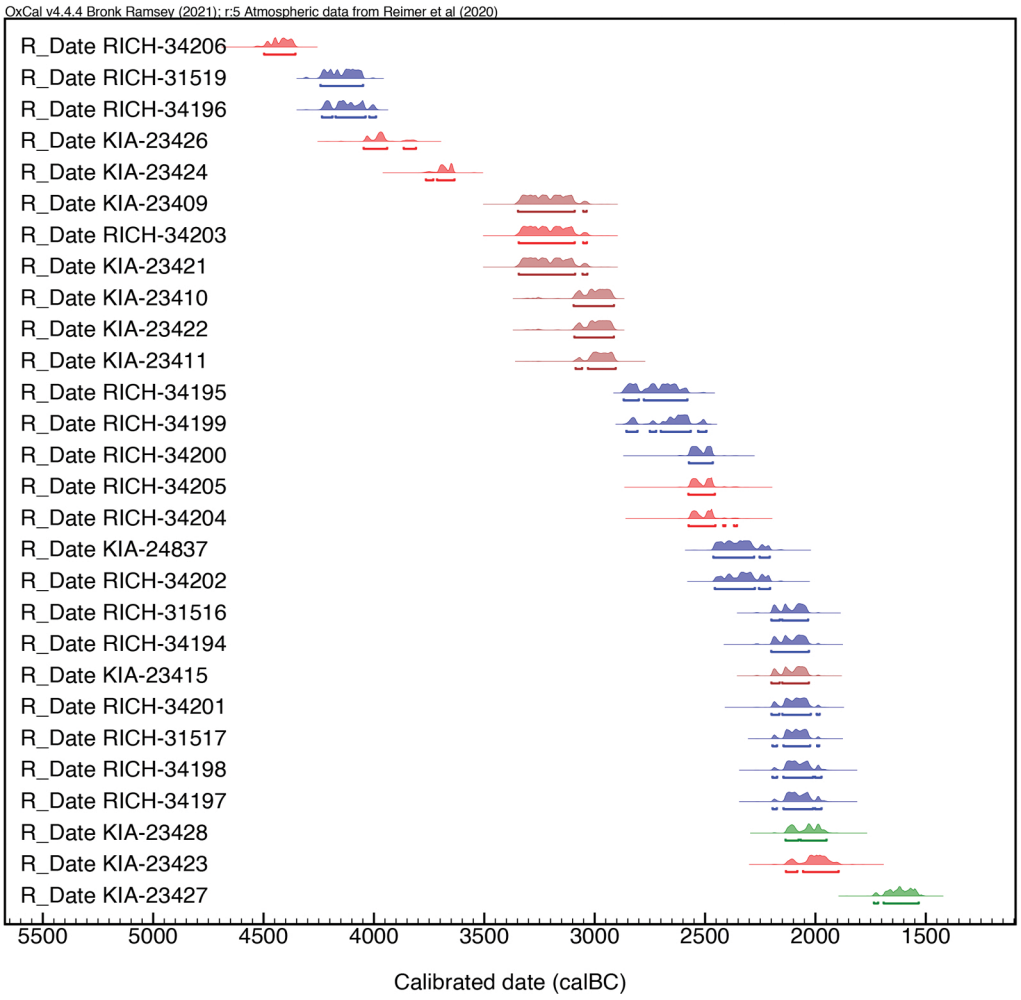

Fig. 5 – Calibrated radiocarbon dates ordered chronologically. Red: animal bone; blue: human bone; brown: wooden pole; green: mattock

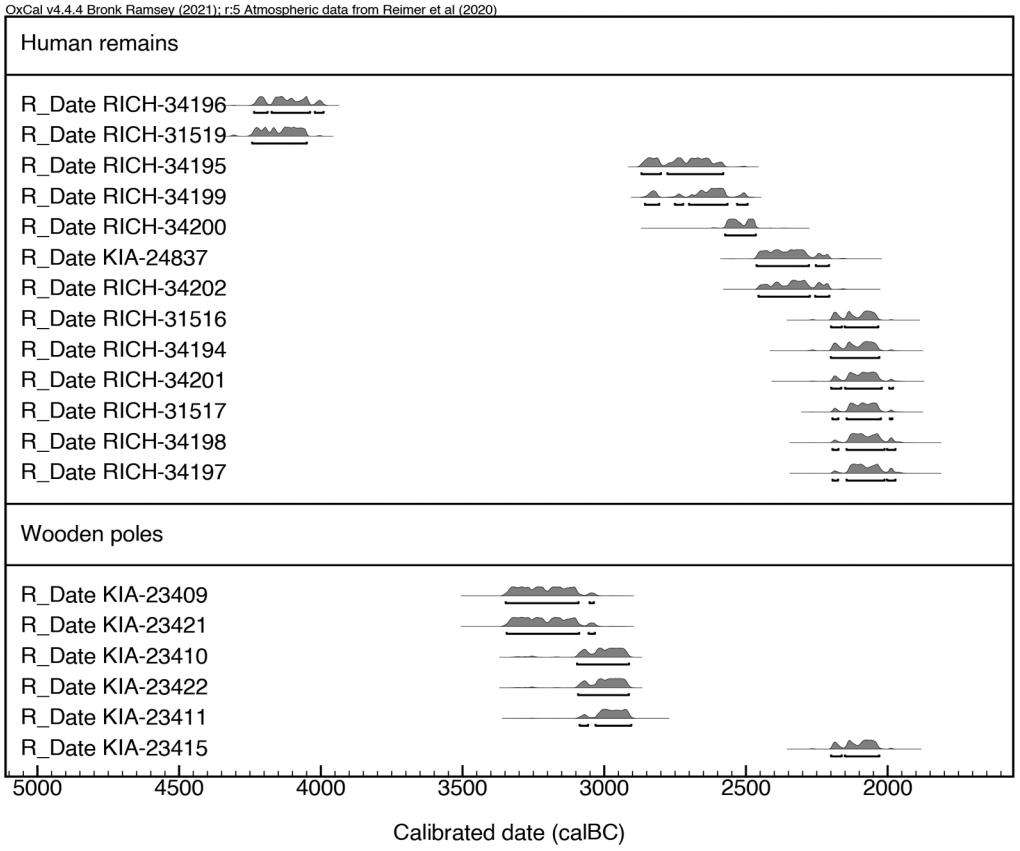

Fig. 6 – Calibrated radiocarbon dates performed on human remains and wooden poles.

3.2. Sector level

3.2.1. Sector 1 and 3

Sector 1 is the only sector that yielded some stratigraphical information allowing to model the radiocarbon dates to a certain level (**Fig. 7**). The dates performed on two poles from the bottom of the feature (KIA-23421 & KIA-23411) fall within the range of *ca*. 3350 to 2900 cal BC. However, since they were found in a secondary position, they do not date the initial formation of the feature. Either these poles were eroded from the adjacent levee during the formation of the gully, in which case they pre-date the gully. Alternatively, they belong to a wooden structure that was installed in the gully, such as a fish weir, and got disturbed as a result of fluvial activity. In that case the poles post-date the formation of the gully. Either way, a date obtained on a bulk sample of plant remains (KIA-24813: 4290 ± 35 BP) from one of the lowest layers of the feature's infilling suggests a formation shortly before 3000/2900 cal BC, so near the end of the Late Neolithic.

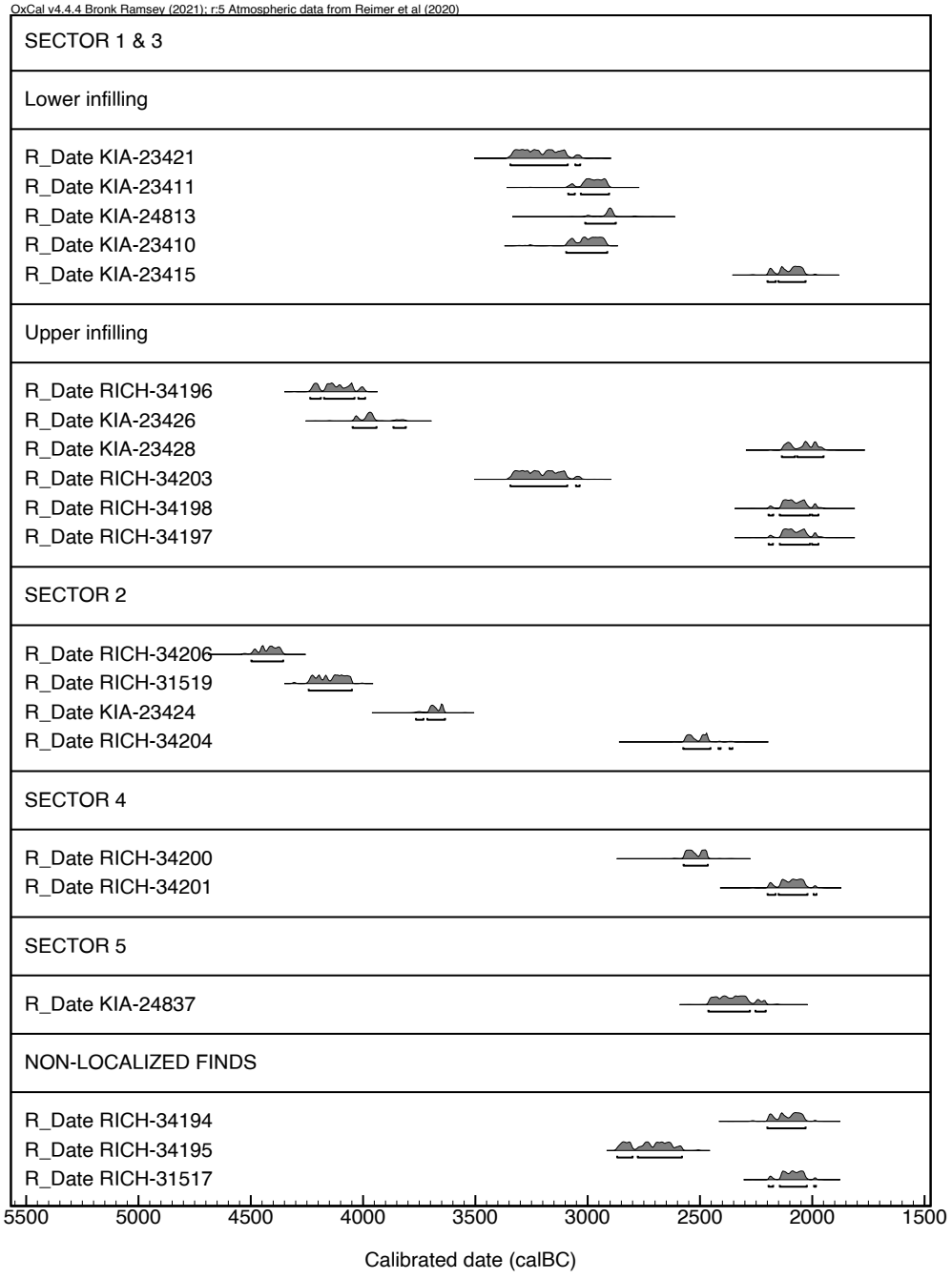

Fig. 7 – Calibrated radiocarbon dates per sector.

The date of a higher positioned oblique pole (KIA-23410) fits with that of the lower poles, indicating that it was also displaced. Contrary, the only vertically positioned pole (KIA-23415) which is situated below the artefact-bearing shell-layer 5 is much younger and might be the only one still in its original position. It dates to the *ca*. 2200-2000 cal BC, which corresponds to the end of the Final Neolithic. This date correlates perfectly with a date obtained on an antler mattock (KIA-23428) from the layer 5 and the typological dating of the pottery (*cf*. 7). However, both other dates from layer 5 (RICH-34196 & KIA-23426[1]) are clearly too old for this context since they pre-date the initial formation of the feature. Both dates go back to the late 5th millennium cal BC which proves that they have been eroded. This also holds for the wolf remains from layer 5 or 7, which yielded a date (RICH-34203) similar to the wooden poles found at the base of the feature. In contrast, both dated human remains from layer 5 or 7 (RICH-34198 and RICH-34197) perfectly fit with the mattock date.

In conclusion, the limited stratigraphical information points to an initial incision of this large feature around the Late to Final Neolithic transition and an infilling which covers almost the entire 3rd millennium cal BC. Also, the upper infilling includes older archaeological finds which were clearly eroded from elsewhere on the site, probably at short distance given their overall good preservation.

3.2.2. Sector 2

Four radiocarbon dates were obtained from this small sector (**Fig. 7**). However, they do not seem to be compatible. The youngest date from a cattle skull (RICH-34204) can be explained by its position above the shell layer, from which the other dated samples were retrieved. Contrary to this, the age difference between the three dated samples from the shell layer remains difficult to assess. Overall, they fall within the chronological range of the Middle Neolithic in Belgium, which seems to be confirmed by the pottery (*cf*. 7).

3.2.3. Sector 4

Both dates obtained on human bone material from this sector (RICH-34200 and RICH-34201) are not compatible as demonstrated by a failed X2-test (df=1 T=55.5 (5 % 3.8). However, both are situated within the range of the Final Neolithic, more precisely the second half of the 3rd millennium cal BC (**Fig. 7**).

3.2.4. Sector 5

The best-preserved human skull originates from this small sector. Its date (KIA-24837) falls within the range of most other dates on human bone from the site, *i.e.* the Final Neolithic, more specifically the second half of the 3rd millennium cal BC (**Fig. 7**).

3.2.5. Non-localized finds

This also holds for three dated human bones which could not be linked to a specific sector of the site. All three date back to the 3rd millennium cal BC: one to the first half (RICH-34195), the two others (RICH-34194 and RICH-31517) to the second half (**Fig. 7**).

4. Palaeoenvironment

4.1. Pollen

Three samples from sector 1 have been studied for pollen and spores (**Fig. 3**). A fourth sample that has been processed for pollen analysis, *i.e.* a sample from the upper part of layer 8, showed too poor preservation of palynomorphs and has not been studied (**Tab. 2**).

1. Date KIA-23426 has a very high C:N ratio (10.5), which clearly points to contamination with exogeneous carbon (humic acids). Hence, the date most likely is too young.

	Layer 14 (?)	*Layer 5*	*Layer 8*
Sample	1	2	3
Trees and shrubs			
Acer	-	0.5	-
Alnus	-	39.3	94.6
Betula	0.7	1.9	0.2
Corylus avellana	56.9	20.2	1.5
Fraxinus excelsior	0.2	1.0	-
Hedera helix	0.2	-	-
Humulus lupulus	0.7	-	-
Pinus sylvestris	4.3	2.4	-
Quercus	15.1	15.2	1.9
Salix	0.5	0.5	-
Tilia	0.5	3.0	-
Ulmus	7.7	0.7	0.2
	0.5	-	-
ΣAP	*87.3*	*84.8*	*98.5*
Herbs			
Apiaceae	0.5	1.0	-
Artemisia	0.2	0.3	-
Asteraceae Liguliflorae	0.2	0.2	-
Brassicaceae	0.2	-	-
Calluna vulgaris	0.2	-	-
Cerealia type	-	0.5	-
Cyperaceae	0.5	4.5	0.4
Matricatia type	-	0.2	0.0
Poaceae	7.7	6.6	1.0
Plantago lanceolata	-	0.2	-
Ranunculus acris type	-	0.7	-
Ranunculus arvensis type	0.5	-	-
Rosaceae	-	-	0.2
Rumex acetosa type	0.2	-	-
Rubiaceae	0.2	-	-
Senecio type	-	0.5	-
Solanum dulcamara	0.3	-	-
Urtica dioica type	2.1	0.3	-
ΣNAP	*12.7*	*15.2*	*1.5*
ΣP (n)	*575.0*	*573.0*	*518.0*
Aquatics			
Myriophyllum spicatum	0.5	-	-
Potamogeton	0.3	-	-
Sparganium type	0.5	1.4	-
Typha latifolia	0.2	-	-
Spore plants			
Equisetum	-	0.5	-
ferns indet.	0.5	5.6	0.2
Polypodium vulgare	-	0.5	-
Pteridium aquilinium	0.2	0.9	-
Ricia	-	0.2	-
Algae			
Pediastrum	-	0.5	-
Tetraedron	0.2	-	-
Fungi			
Glomus	-	0.3	-
	-	-	-
Inderminata	1.6	0.5	0.2
Total sum (n)	*598*	*633*	*520*

Tab. 2 − Pollen composition on the three analysed samples from sector 1.

Sample 1 was taken from a bulk sample of the sediment associated with a large red deer antler (*Cervus elaphus*) likely recovered from layer 14 below the infilling of the deep pit/gully, although its stratigraphic position was not completely clear. It is dominated by *Corylus* and also shows rather high values of *Quercus*, *Ulmus* and *Pinus* (**Tab. 2**). In combination with the absence of *Alnus*, this pollen assemblage indicates a Boreal age of this sample, more precisely the *Corylus* dominated part of regional pollen assemblage zone SB4 defined by Storme *et al.* (2017). The pollen assemblage also shows a high agreement with those from early Holocene alluvial deposits from the same construction pit that have been studied earlier and that were dated between *c*. 9350 and 9050 cal BP (Storme *et al*., 2019). The vegetation alongside the river must have been rather open with a herb-dominated vegetation (e.g. *Urtica dioica and Solanum dulcamara*) and some sparse *Salix* trees.

Sample 2, originating from layer 5, is dominated by *Alnus* and has also high percentages of *Corylus* and *Quercus*. The assemblage reflects a much denser riverine forest with *Alnus*, *Fraxinus*, *Ulmus* and *Salix*, and woodlands with *Corylus*, *Quercus*, *Tilia* and *Acer* outside of the valley floor. The occurrence of Cerealia pollen and some other indicators for anthropogenic activities, e.g. *Plantago lanceolata*, although all with very low percentages, indicate agricultural activities, either in the vicinity of the site or in areas upstream. This spectrum can be correlated with the Atlantic, which is in accordance with the radiocarbon evidence (*cf.* 3.2.1).

Sample 3 from layer 8 is extremely dominated by *Alnus* with 94.6 % of the pollen sum, reflecting an alder carr vegetation on the valley floor, and only very few other taxa.

4.2. Molluscs

Mollusc remains from sieve samples (**Tab. 3**), as well as hand-collected material were studied. The sieve samples were taken from bulk samples from sector 1, and

Molluscs from sieve samples – Sector 1	*Layer 5*	*Layer 7*	*Layer 8*	*Layer 9*	*Sediment associated with deer antler*	*Total*
	(cf. pollen sample 2)	*(2 samples analysed)*	*(cf. pollen sample 3)*		*(cf. pollen sample 1)*	
Land snails						
Succineidae	-	1	-	-	4	*5*
Vallonia pulchella (smooth grass snail)	-	1	-	-	-	*1*
Clausilia bidentata (common door snail)	-	-	-	-	1	*1*
Zonitoides nitidus (shiny glass snail)	-	-	5	-	7	*12*
Monacha sp.	-	-	1	-	-	*1*
Freshwater snails						
Theodoxus fluviatilis (river nerite)	24	35	2	10	-	*71*
Bithynia leachii (Leach's bithynia)	-	1	5	1	-	*7*
Bithynia tentaculata (common bithynia)	16	37	23	21	41	*138*
Valvata cristata (flat valve snail)	-	1	-	-	-	*1*
Valvata macrostoma	-	1	-	-	-	*1*
Valvata piscinalis (common valve snail)	13	43	6	23	3	*88*
Acroloxus lacustris	-	1	-	-	-	*1*
Galba truncatula (dwarf pond snail)	-	2	1	2	-	*5*
Stagnicola palustris complex (marsh pond snail)	3	9	10	1	3	*26*
Radix auricularia (ear pond snail)	1	2	4	2	21	*30*
Radix labiata/balthica-complex (common pond snail)	1	1	3	2	1	*8*
Lymnaea stagnalis (great pond snail)	1	-	-	-	-	*1*
Physa fontinalis (common bladder snail)	-	-	-	-	1	*1*
Planorbarius corneus (great ram's horn)	-	-	-	-	1	*1*
Planorbis planorbis (margined ram's horn)	1	9	11	7	1	*29*
Anisus leucostoma (button ram's horn)	-	2	-	-	-	*2*
Anisus spirorbis (button ram's horn)	1	4	2	-	-	*7*
Anisus vortex (whirlpool ram's horn)	-	1	1	1	-	*3*
Bathyomphalus contortus (twisted ram's horn)	-	6	7	2	-	*15*
Gyraulus albus (white ram's horn)	-	8	2	6	-	*16*
Gyraulus laevis (smooth ram's horn)	-	2	3	-	1	*6*
Segmentina nitida (shiny ram's horn)	-	2	-	1	-	*3*
Ancylus fluviatilis (river limpet)	-	3	-	1	-	*4*
Freshwater bivalves						
Unio crassus	9	-	-	-	-	*9*
Sphaerium corneum (horny orb mussel)	9	4	1	5	11	*30*
Sphaerium rivicola (nut orb mussel)	4	9	7	-	-	*20*
Pisidium amnicum (river pea mussel)	13	6	1	7	4	*31*
Pisidium casertanum (Caserta pea mussel)	3	-	1	4	-	*8*
Pisidium henslowanum (Henslow's pea mussel)	-	2	2	1	-	*5*
Pisidium milium (quadrangular pea mussel)	-	1	-	-	-	*1*
Pisidium nitidum (shining pea mussel)	-	1	-	1	-	*2*
Pisidium pulchellum (iridescent pea mussel)	-	1	-	-	-	*1*
Pisidium subtruncatum (short-ended pea mussel)	-	-	1	-	-	*1*
Pisidium supinum (hump-backed pea mussel)	1	4	1	2	-	*8*
Total	*100*	*200*	*100*	*100*	*100*	*600*

Tab. 3 – Number of identified specimens of mollusc remains from wet-sieved samples from sector 1. From each sample 100 specimens were identified. The selection includes only complete, or nearly complete, shells. The valves of bivalves were counted as separate specimens.

Tab. 4 – Number of identified specimens of hand-collected mollusc remains from the sectors 1, 2, 3, 4 and 5.
The shells were all complete, or nearly complete. The table represents the entire collection, not a subsample.

HAND-COLLECTED MOLLUSCS	*Sector 1*	*Sector 2*	*Sector 3*	*Sector 4*	*Sector 5*	*Sector unknown*	*Total*
Land snails							
Monacha sp.	-	1	-	-	-	3	*4*
Cepaea sp.	-	1	-	-	-	1	*2*
Freshwater snails							
Viviparus contectus (Lister's river snail)	-	-	-	-	-	1	*1*
Radix auricularia (ear pond snail)	-	1	-	-	-	2	*3*
Lymnaea stagnalis (great pond snail)	-	-	1	-	-	1	*2*
Planorbarius corneus (great ram's horn)	-	1	-	-	-	1	*2*
Freshwater bivalves							
Pseudunio auricularius (river pearl mussel)	10	6	8	4	12	15	*55*
Unio crassus	-	1	1	1	3	25	*31*
Unio pictorum (painter's mussel)	-	3	-	-	-	3	*6*
Unio tumidus (swollen river mussel)	-	3	4	3	-	6	*16*
Anodonta anatina (duck mussel)	-	3	-	-	-	1	*4*
Total	*10*	*20*	*14*	*8*	*15*	*59*	*126*

wet-sieved on a 2 mm mesh. The hand-collected shells (**Tab. 4**), mainly large freshwater mussels, came from the sectors 1, 2, 3, 4 and 5. The identification of the species was done under an optical microscope and with the help of the following reference works: Cameron, 2008; Gittenberger & Janssen, 2004; Glöer & Meier-Brook, 2003; Kerney & Cameron, 1980; Killeen *et al.*, 2004; Prié, 2017.

The preservation of the material is excellent. The samples, and hand-collected finds, consist largely of complete shells, including paired bivalve valves, of adult and juvenile animals. The natural colour, luster and periostracum are preserved on the majority of the shells. There is hardly any burnt, weathered or fossilised material. The remains seem to represent a natural population, and show no evidence of selection, manipulation or consumption by humans.

The species composition is largely dominated by freshwater molluscs. Combined with the non-weathered condition of the material, and the deposition of large amounts of well-preserved freshwater mussel shells, this shows that the studied contexts were situated in a permanently flooded, rather low-energy environment. Terrestrial species are poorly represented, and are typical for a moist to wet habitat (Succineidae, *Vallonia pulchella*, *Clausilia bidentata*, *Zonitoides nitidus*), as expected alongside a river.

The studied material contains many species typical for stagnant or slow-flowing water with a rich vegetation (*Radix auricularia*, *Stagnicola palustris*, *Lymnaea stagnalis*, *Anisus spirorbis*, *Anisus vortex*, *Planorbis planorbis*, *Planorbarius corneus*, *Bathyomphalus contortus*, *Bithynia leachii*, *Segmentina nitida*, *Physa fontinalis*). Nonetheless, *Pseudunio auricularius*, *Unio crassus*, *Pisidium amnicum*, *Pisidium henslowanum*, *Pisidium supinum*, *Theodoxus fluviatilis* and *Ancylus fluviatilis* are clear indicators for the availability of flowing water as well.

In this respect, there is a parallel with the palynological results described in 4.1. Layer 5 (corresponding to pollen sample 2) contains a larger amount of flowing-water molluscs than layer 8 (corresponding to pollen sample 3), while layer 8 is richer in stagnant-water molluscs. This may confirm the presence of an alder carr vegetation in layer 8, as indicated by the pollen.

The sediment associated with a deer antler (corresponding to pollen sample 1) is rather poor in molluscs, in comparison to the other contexts, and has an anomalous species composition. First, it contains no *Theodoxus fluviatilis*, an easy to recognize species that was present in all the other samples, often relatively abundant. Second, there is a remarkably large number of *Radix auricularia*, adult and juvenile, while this species occurs sparsely in the other samples. Is this anomaly due to the Boreal age of the sample, as suggested by the pollen? Or does it reflect a specific biotope, with stagnant or slow-flowing water, and possibly some pollution?

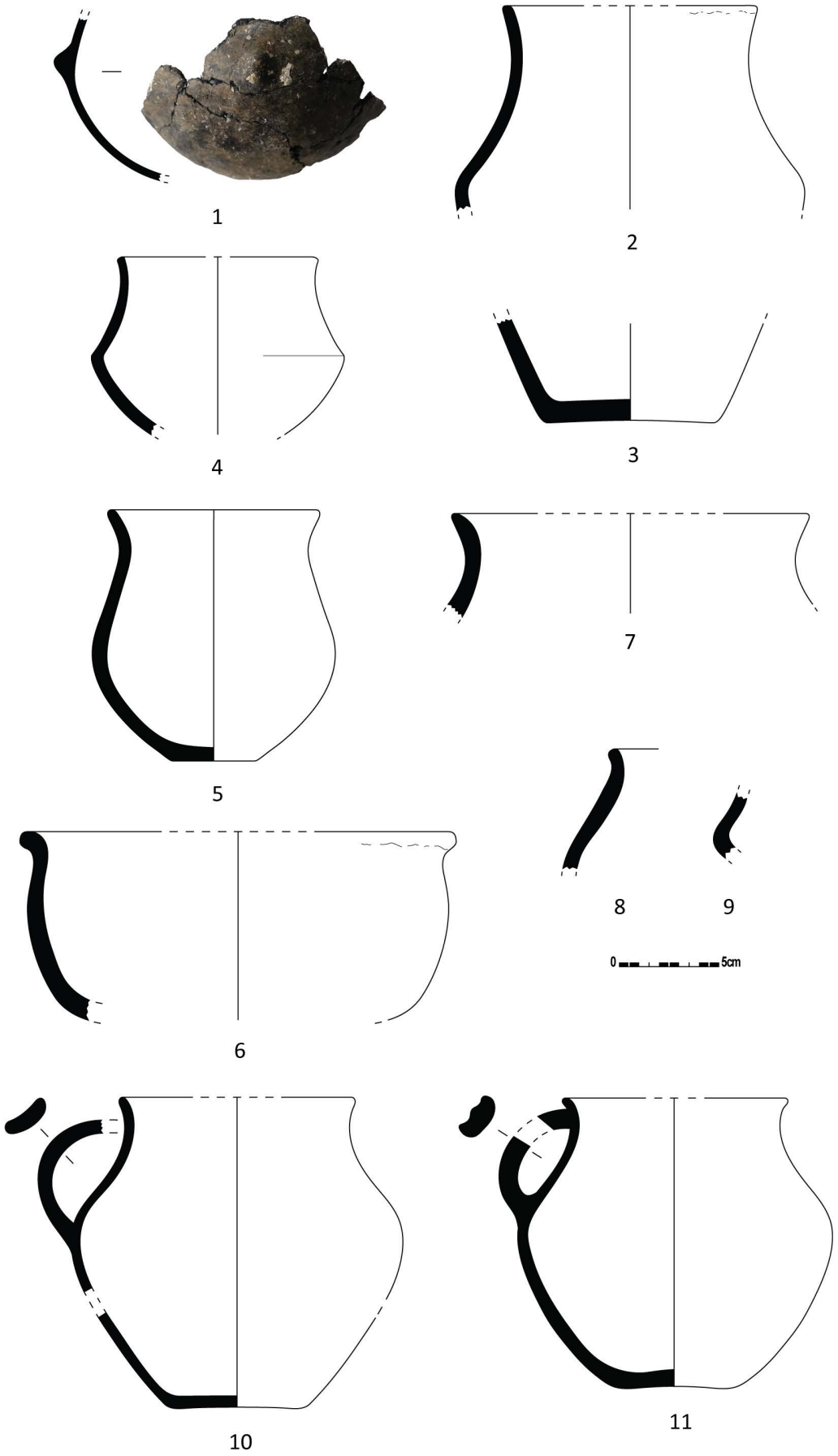

Fig. 8 − Undecorated pottery from sectors 1 and 3. Scale: 1/3.

A remarkable feature of the collection from Ename-Stuw is the presence of the river pearl mussel *Pseudunio auricularius* in relatively large numbers (NISP 55, MNI 37). At present, this species is extinct in Belgium, and there are only a few published records from archaeological deposits, all from the Scheldt valley. Two loose valves were found at the Roman site 'Wijmeers' (Meylemans *et al.*, 2022) and two paired valves were reported from a Holocene (5750 ± 40 BP) gully at Kallo (Kuijper, 2006: 41). The typical habitat of this species are large and slow-flowing, lowland rivers with well-oxygenated, calcium-rich water (Araujo & Ramos, 2000).

5. Wooden poles

A total of 62 wooden elements, mostly coming from sector 1 and 3, have been studied (**Tab. 5**). A timber plank, recovered from sector 2, was identified as oak (*Quercus* sp.). 28 of the pointed poles have been studied, showing that these were made from common ash (*Fraxinus excelsior*)(n=18), alder (*Alnus* sp.)(n=8) and willow (*Salix* sp.) (n=2). In addition, 32 pieces of roundwood fragments with no visible traces of woodworking have been studied. These have been found together with the pointed wooden poles and might represent poles as well, *e.g.* with the pointed end broken off or not being preserved, or natural unworked driftwood. The assemblage of these roundwood fragments is highly comparable with the pointed poles, *i.e.* mostly consisting of common ash and alder and some smaller amount of willow. Also, one additional wood fragment of oak has been identified.

Pointed poles	
Alder (*Alnus* sp.)	8
Common ash (*Fraxinus excelsior*)	18
Willow (*Salix* sp.)	2
Unworked (?) roundwood fragments	
Alder (*Alnus* sp.)	13
Common ash (*Fraxinus excelsior*)	16
Oak (*Quercus* sp.)	1
Willow (*Salix* sp.)	2

Tab. 5 − Wood determination of the timber roundwood fragments.

6. Pottery

The excavations yielded 132 pottery fragments (i.e. after refitting) with a total weight of 6.14 kg. Pottery was found in all sectors, mainly in sectors 1 and 3, but stratigraphical information is largely missing. The pottery is relatively well-preserved and many potsherds could be refitted into archaeologically (almost) complete profiles. However, post-depositional calcium carbonate concretions are encrusted in variable quantities on the pottery from all sectors.

Following a preliminary study by Ameels *et al.* (2003), the pottery from Ename Stuw was fully analysed at Ghent University. Apart from typological analysis, this included a detailed study of fabrics and pottery forming techniques. Fabrics were analysed using an Olympus SZX7 stereomicroscope at magnifications x8-x40. The size of temper inclusions was registered as follows: fine (1-2 mm), medium-sized (3-4 mm), coarse (> 4 mm). The pottery was macroscopically examined, under low-angle light, to study variations in the surface topography as well as the orientation of the clay mass, pores and non-plastic inclusions in radial (= cross) section. The interpretation of the observed *macrotraces* and *macrostructures* in terms of forming techniques and methods (Roux, 2016) is based on ethnographic, (ethno)archaeological and experimental reference studies (Rye, 1981; Livingstone Smith, 2001; Martineau, 2000, 2005; Gomart, 2014; van Doosselaere *et al.*, 2016). The presence of calcium carbonate concretions however severely hampered the study of pottery forming techniques, which requires a clear view of the pottery surfaces and radial sections. As a result, these techniques could only be studied on part of the pottery.

6.1. Sectors 1 and 3

Sectors 1 and 3 yielded 59 pottery fragments (*ca*. 3.5 kg). Despite this relatively low number of sherds, the diagnostic fragments, including rim and base sherds, decorated body sherds and larger profiles, can be attributed to a minimum of 14 vessels. These are discussed below, beginning with the undecorated pottery.

The first vessel is only represented by an upper to lower body profile (**Fig. 8:1**). It is a thin-walled vessel (5 mm thick), most likely a bowl or beaker, with a small round knob applied at the upper to lower body transition. It was made from a relatively fine clay, abundantly tempered with fine to coarse burnt bone fragments. The vessel body was built by use of the coiling technique, more specifically by a systematic external overlap of strongly deformed clay coils. This is indicated by the presence and orientation of so-called "Z" configurations in the clay mass, pores and non-plastic inclusions visible in radial section (Gomart, 2014; van Doosselaere *et al*., 2016). The vessel has a dark grey core and inner surface and a dark brownish grey outer surface, indicating that is was fired in a fully reduced atmosphere. The second vessel is a closed (rim diameter < largest body diameter) bottle-shaped vessel with a long everted neck and pronounced upper to lower body transition (**Fig. 8:2**). It has a rim diameter of 12 cm and is between 6-8 mm thick. It was made from a silty to slightly sandy clay, tempered with medium-sized to coarse grog. Sporadically, fragments of burnt bone are observed in this fabric. It is not clear whether these were added as temper or represent accidental inclusions in the clay. The pottery forming techniques are difficult to study but it is clear that both the inner and outer vessel surfaces are burnished. The vessel has a dark grey core and greyish brown surfaces. This indicates firing in a reduced atmosphere followed by an oxidizing phase at the end, possibly during cooling of the fired vessel(s). Based on strong similarities in fabric and firing, a base and lower body fragment likely belong to the same vessel (**Fig. 8:3**). It is a flat, slightly lenticular base with a thickness of 12 mm. The thickness at the lower body measures 8-9 mm. This bottle-shaped vessel was used to cook or process organic substances, as indicated by the preservation of a small amount of residue on the inside of the neck, upper and lower body. Some patches of residue are also visible on top of the rim and on the outside of the neck, which is likely related to foodstuff boiling over.

The third vessel is a small, closed beaker with carinated upper to lower body transition (**Fig. 8:4**). It has a short upper body, long everted neck and flattened lip. The rim diameter is 9 cm and the vessel is 6-7 mm thick. It was either made from a sandy clay tempered with grog, or a silty clay with grog and sand temper. The distinction between a natural sandy clay and the addition of sand as temper can often only be made based on thin section analysis, which was not performed for this study. This vessel could have been built by use of the coiling technique, based on the quadrangular fracture pattern of the potsherds (Livingstone Smith, 2001; van Doosselaere, 2014), but the use of other techniques cannot be excluded. The outer vessel surface is burnished or polished. The vessel has a dark grey core and dark (brown)grey surfaces, indicating a fully reduced firing. Small amounts of residue on the inner surface show that his vessel was used for cooking. The fourth vessel is a small, slightly closed beaker with short everted neck, rounded lip and a flat base (**Fig. 8:5**). It has a rim diameter of 10 cm. The vessel body is 6-8 mm thick, the base is 7 mm thick. Temper consists of abundant, coarse grog. However, following the excavations, this vessel has been fully restored, which limits further technological analysis. Dark patches of soot on the outside of the lower body indicate that this vessel was heated over a fire. The sixth vessel is a thick-walled (10-12 mm) open bowl or dish (**Fig. 8:6**), with a short everted rim and rounded lip. It was made from a relatively fine clay, tempered with fine to coarse grog. At least part of this vessel seems to have been built by coiling. Its dark grey core and surfaces indicate a fully reduced firing. Three vessels are only partly preserved. This includes an everted rim/neck fragment of a closed vessel shape, most likely a beaker, with a rim diameter of 18 cm (**Fig. 8:7**), the upper part of a closed vessel with an insloping upper body, short everted neck and rounded lip (**Fig. 8:8**), and a small body fragment of a presumably closed vessel with carinated upper to lower body transition (**Fig. 8:9**). All three vessels are tempered with grog and have a reduced (dark grey) core and slightly oxidized (greyish brown to brown) surfaces.

Two profiles belong to similar thin-walled beakers or jugs with one ear (**Fig. 8:10, 11**). Both have a rim diameter of 11.5 cm, a short everted neck and rounded lip, and a single ear going from the upper/lower body transition to the neck. The first vessel (**Fig. 8:10**) has a flat base and a smooth ear. Its body is 5-6 mm thick, its base 7-8 mm thick. The vessel was made from

relatively fine clay, tempered with medium-sized to coarse grog. Sporadically, fragments of burnt bone are observed in this fabric. These are either added as temper or represent accidental inclusions in the pottery clay. The vessel body was likely built by coiling and both surfaces are burnished. It has a reduced (dark grey) core and oxidized (light brown to brown) surfaces. The second vessel (**Fig. 8:11**) has a slightly lenticular base and a ribbed or profiled ear. Its body is 7-8 mm thick. Temper consists of grog. However, following the excavations, this vessel has been fully restored, limiting further technological analysis. Both these vessels have small amounts of residue on their inner surfaces, which shows that they were used to process organic substances.

Sectors 1 and 3 also yielded the remains of four decorated vessels. There is one rim/neck fragment of a decorated bell beaker (**Fig. 9**), with a rim diameter of 15 cm and a thickness of 6-7 mm. It has a long, everted neck and flattened lip. The visible decoration is applied with a comb and organised in horizontal bands, separated by zones without decoration. Decoration below the rim consists of a series of parallel, diagonal pointed impressions, delineated by a horizontal line of pointed impressions. This is followed by an empty zone of 2 cm wide. Decoration on the neck consists of a broader, somewhat irregular band of impressions of 3,3 cm wide. At the top and bottom of this band, the decoration is very similar to that below the rim, forming some kind of ladder motive. The broader area in between is filled with pointed impressions in a cross-hatched pattern. This decoration was likely repeated over the entire vessel body. The bell beaker is made from a slightly sandy, glauconite-rich clay. It was probably tempered with fine grog, although temper is not well visible. It has a reduced (dark grey) core and slightly oxidized (greyish brown to brown) surfaces. Another everted rim/neck fragment belongs to a large, closed, thick-walled vessel (10-11 mm) with plastic decoration on the neck

Fig. 9 – Rim/neck fragment of a bell beaker from sector 3. Scale: 2/3.

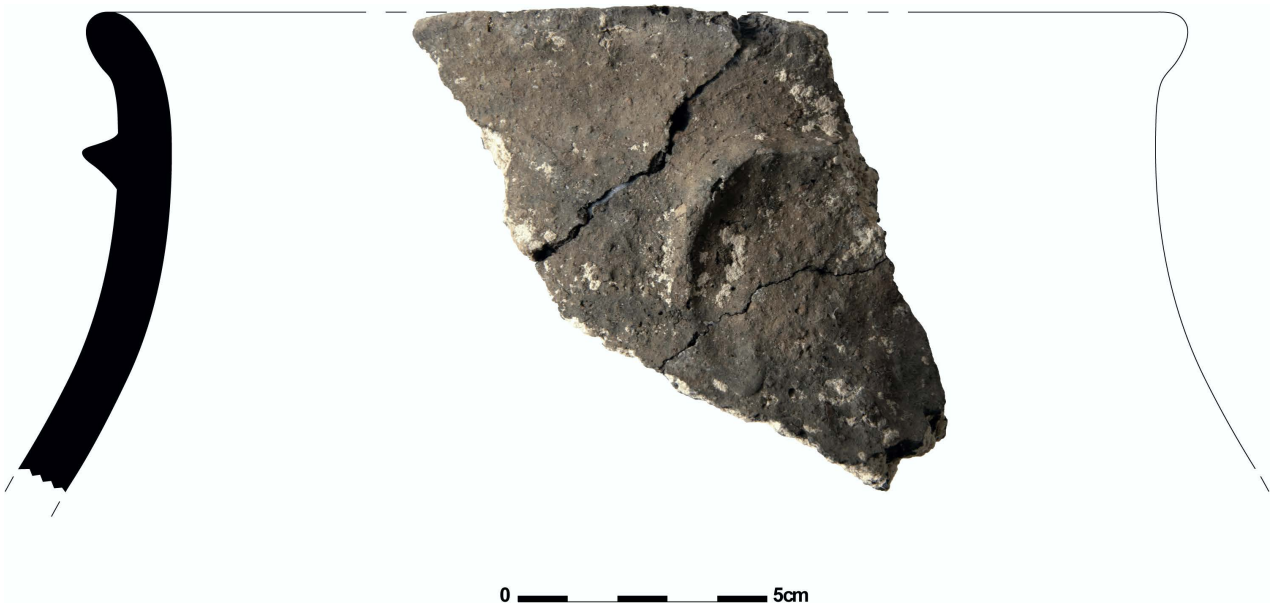

Fig. 10 – Rim/neck fragment with horseshoe handle from sector 3. Scale: 2/3.

(**Fig. 10**). This decoration is only partly preserved but clearly represents a so-called horseshoe handle (*cf. infra*). The vessel has a rim diameter of 22 cm. It was either made from a sandy clay with fine to coarse grog temper or from a silty clay with sand and grog temper. This vessel has a reduced (dark grey) core, but the brownish grey surfaces could be slightly oxidized.

Several sherds could be refitted into the profile (rim to lower body) of a large, thick-walled (10-11 mm), closed beaker with everted neck and rounded lip (**Fig. 11:1**). It has a rim diameter of 26 cm. The beaker is decorated with an applied clay band or cordon on the neck, 2 cm below the rim, followed by a series of subparallel, shallow grooves on the upper body, each about 1 cm wide. The lower vessel body is not decorated. The vessel was made from a silty clay with abundant fine to coarse grog temper. The vessel body is entirely built by use of the coiling technique. The orientation of the clay, pores and non-plastic inclusions visible in radial section shows specific "S" configurations. This type of configuration indicates that the rough vessel shape was either built by alternate internal/external overlap of strongly deformed coils (Livingstone Smith, 2001) or by the superimposition of non-deformed coils, followed by stretching of the vessel wall (Martineau, 2000). In addition, several scrape marks on the inner surface indicate that scraping was used as a secondary forming method, to thin the vessel walls and possibly further shape the vessel. The outer vessel surface was eventually burnished, but the inner surface does not show any signs of additional finishing operations. The vessel has a reduced (dark grey) core, whereas the surfaces are dark grey at the upper, decorated part of the vessel and greyish brown at the lower part. Another profile belongs to a similar, but less wide, beaker shape (**Fig. 11:2**). It has a rim diameter of 20 cm and its thickness varies from 9 mm at the rim to 11 mm at the lower body. This beaker is heavily decorated. Three horizontal clay bands or cordons were applied on the outer surface, i.e. one on the neck and two smaller ones on the upper and lower body. In addition, the entire vessel body is decorated with paired fingernail impressions which were pinched into the wet clay. The vessel is made from a silty to slightly sandy clay with abundant fine to coarse grog temper. Similar to the other large beaker, the vessel body was built by use of

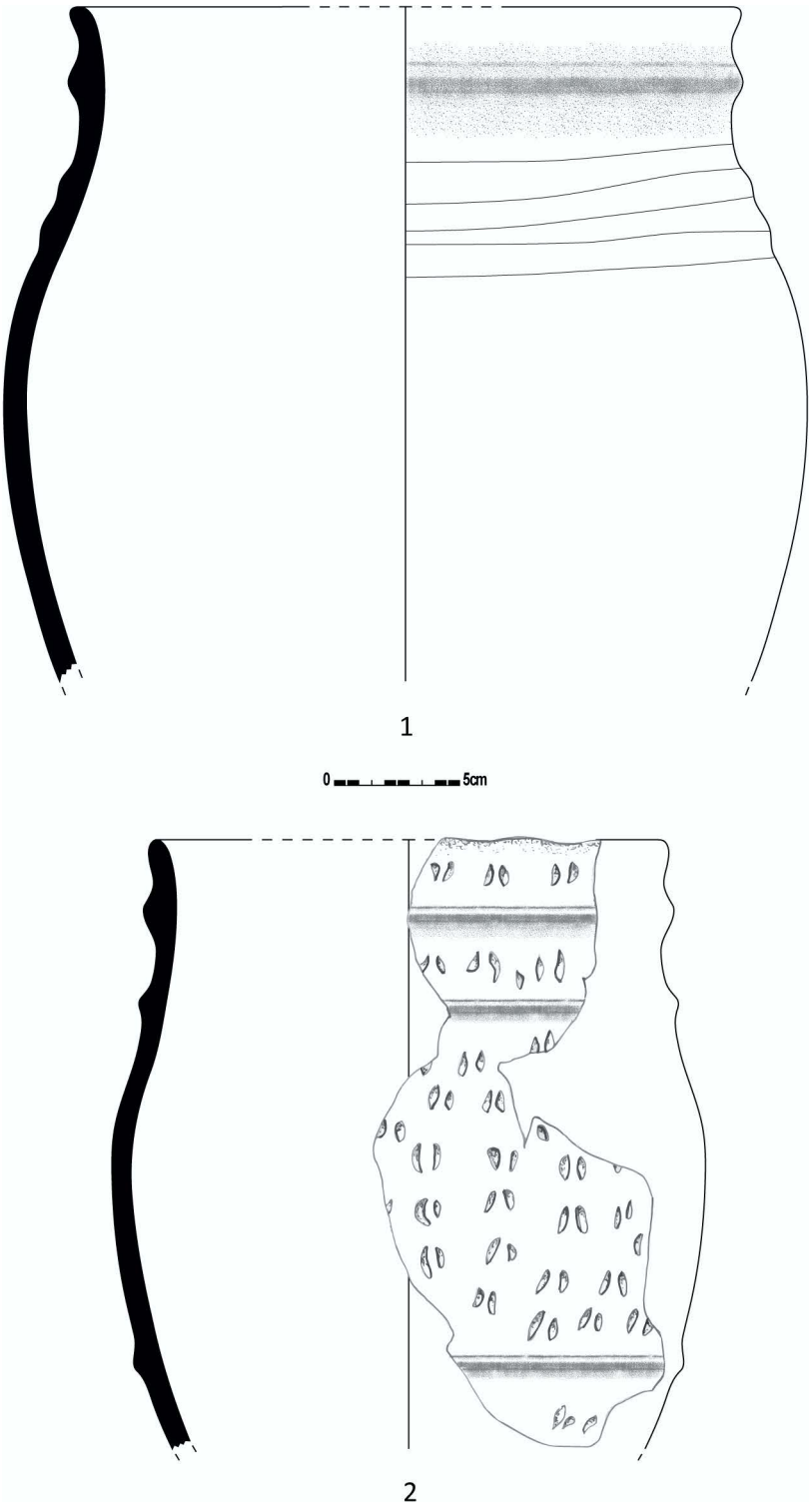

Fig. 11 − Decorated pottery from sectors 1 and 3. Scale: 1/3.

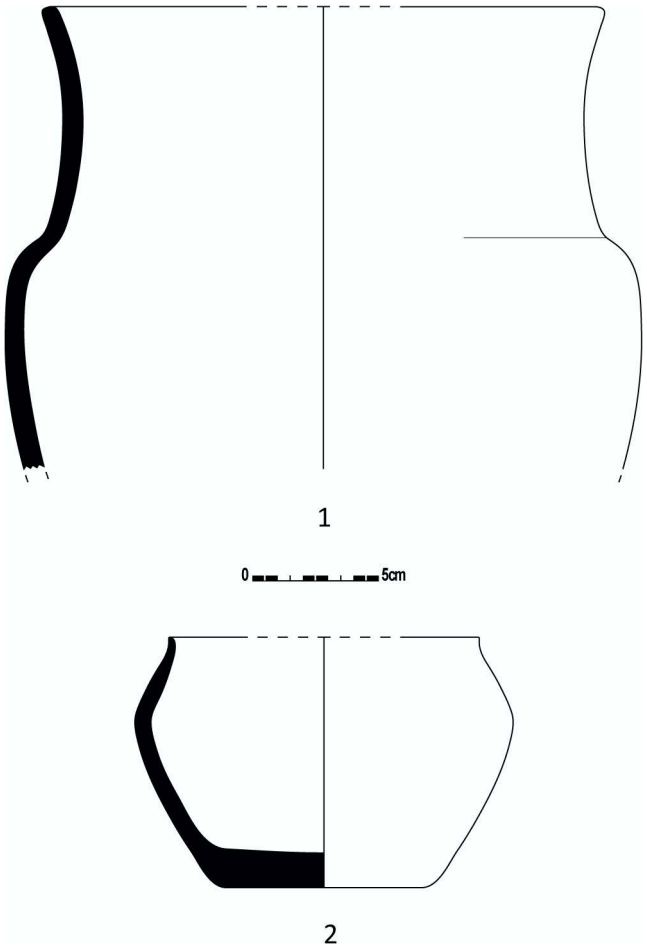

Fig. 12 – Undecorated pottery from sector 2. Scale: 1/3.

Fig. 13 – Body fragment of a large vessel decorated with paired fingernail impressions from sector 4. Scale: 1/3.

the coiling technique and "S" configurations are visible in radial section. The inner and outer surfaces were burnished before application of the decoration. Both decorated beakers have been used to cook or process organic substances, as small amounts of residue are preserved on their inner surfaces.

In addition to the remains of these 14 vessels, there are 11 undecorated body sherds that likely belong to other vessels. It mainly includes fragments of thick-walled (8-12 mm) and thin-walled pottery (6 mm) with grog temper, but also one sherd of a thin-walled vessel (4 mm) with fine grit temper and one sherd of a thick-walled vessel (9 mm) with coarse grit and grog temper.

6.2. Sector 2

Sector 2 yielded 25 pottery fragments (*ca*. 1.2 kg), all from two vessels. The first one is a large, slightly closed beaker with a long everted neck, short upper body and slightly carinated upper to lower body transition (**Fig. 12:1**). It has a rim diameter of 20 cm and is quite constantly 8 mm thick. The vessel is not decorated. A few fingertip impressions on top of the rim are likely related to the intentional flattening of the lip. The vessel was made from a silty clay, abundantly tempered with fine plant material and fine to coarse fragments of burnt and crushed flint. Occasionally, fragments of crushed quartz are observed as well. It was built by use of the coiling technique. Several "O" and "C" configurations are visible in the orientation of the clay, pores and non-plastic inclusions in radial section. These indicate that the vessel body was built up by the superimposition of non-deformed or only slightly deformed coils (Livingstone Smith, 2001; Gomart, 2014). Firing of the vessel seems to have been fully reduced, possibly with a short oxidizing phase at the end. Small patches of residue are visible on the inner surface, showing that this vessel was used to cook or process organic substances.

The second vessel is a small, closed biconical beaker with a short everted lip and a thick flat base (**Fig. 12:2**). Its upper to lower body transition is quite sharp or accentuated. The vessel has a rim diameter of 12 cm. Body thickness varies from 4 mm at the lip to 7 mm at the lower body, while the base is 15 mm thick. The vessel was made from a silty to sandy clay, tempered with fine grog. The upper body seems to have been built by superimposing non-deformed or only slightly deformed coils ("C" configurations in radial section), but the forming techniques for the lower body and base are unclear. The surfaces are polished. The vessel has a thin dark grey core, brownish grey margins and surfaces, and seems to have been fired in a fully reduced atmosphere.

6.3. Sector 4

Sector 4 only yielded two pottery fragments (0.11 kg), belonging to two vessels. The first fragment is a body sherd of a large, thick-walled (10 mm) vessel with a body decoration consisting of paired fingernail impressions (**Fig. 13**). This decoration is very similar to that of a large beaker from sector 1 (**Fig. 11:2**), but the body sherd clearly belongs to another vessel based on its fabric and find location. The vessel shape cannot be reconstructed, but it could have been a beaker of similar proportions. The vessel was made from a sandy, probably glauconite-rich clay, tempered with fine to medium-sized grog. It has

a reduced (dark grey) core and slightly oxidized (greenish brown) surfaces. The second fragment from sector 4 is an undecorated body fragment of a thin-walled (4 mm) vessel with flint temper.

6.4. Sector 5

Sector 5 yielded four pottery fragments (0.39 kg), three of which likely belong to the same vessel based on their thickness and fabric. It is a slender, open beaker with a weakly S-shaped profile and a flat base (**Fig. 14:1, 2**). It has a rim diameter of 16 cm. The thickness of the vessel body gradually increases from 10 mm at the rim to 16 mm at the lower body, and the base is 23 mm thick. The vessel was made from a slightly sandy clay with grog temper. The upper part of the vessel was formed by the superimposition of non-deformed or only slightly deformed coils ("C" configurations in radial section), while the lower part of the vessel was formed by the external overlap of strongly deformed coils ("Z" configurations in radial section). The base is too fragmentarily preserved to study the forming methods. The vessel has a reduced (dark grey) core and slightly oxidized (greyish to greenish brown) surfaces. Finally, one other body fragment from this sector belongs to another thick-walled (10 mm) vessel with grog temper. There is no information about the vessel shape.

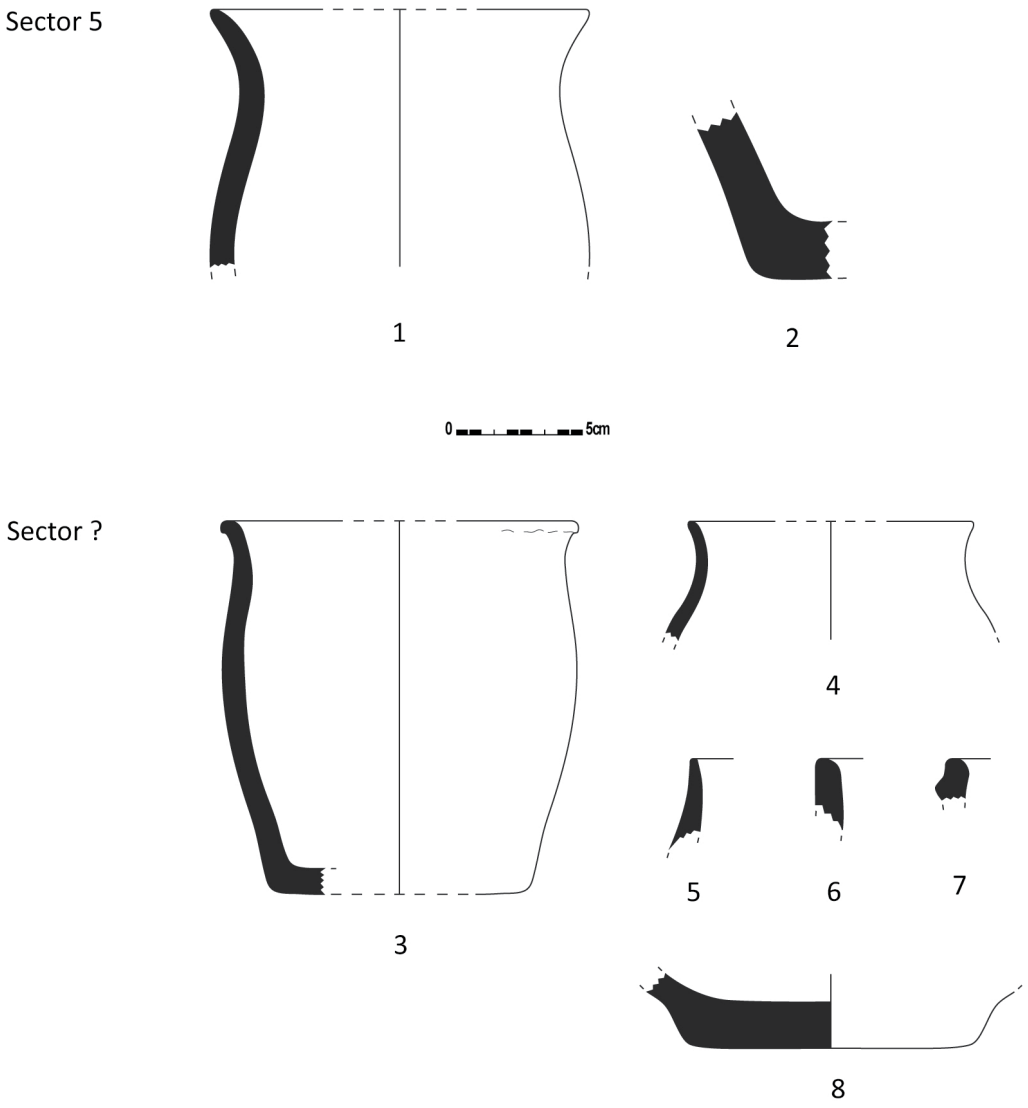

Fig. 14 – Undecorated pottery from sector 5 (above) and from unknown locations (below). Scale: 1/3.

6.5. Sector unknown

For 42 pottery fragments (0.94 kg) it is not clear from which excavation sector they originated. There is one archaeologically complete profile of an open beaker with weakly S-shaped profile, a short everted neck and a flat base (**Fig. 14:3**). It has a rim diameter of 11 cm. The vessel body is 7 mm thick at the rim, 10 mm thick at the lower body, and the base is 11 mm thick. The fabric consists of a silty clay, tempered with abundant fine to coarse grog. The vessel body was built by the superimposition of non-deformed or slightly deformed coils ("C" and "O" configurations in radial section). A series of shallow depressions on the outer surface, at the height of the upper and lower body, indicate use of the beating technique. This secondary forming technique involves the use of a paddle to shape the vessel wall by pounding it from the outside. This leaves specific macrotraces on the vessel surface, referred to as "beating facets" (Rye, 1981; Martineau, 2005; van Doosselaere, 2014). Both surfaces are smooth, probably as a result of the smoothing together of the coils by hand. There are no traces of additional finishing operations. The vessel has a reduced (dark grey) core and slightly oxidized (greyish brown to brown) surfaces. Small amounts of residue preserved on the inner and outer surfaces indicate that this vessel has been used to cook or process organic substances.

Other diagnostic fragments include: the upper part (rim to upper body) of a thin-walled (5 mm), closed beaker with everted neck and a rim diameter of 11 cm (**Fig. 14:4**); a straight rim with flattened lip of a thick-walled (11 mm) vessel (**Fig. 14:6**); and a rim fragment of another thick-walled (10 mm) vessel, with an applied clay band or *cordon ca*. 1 cmbelow the lip (**Fig. 14:7**). These all have grog temper. In addition, there is one rim/neck fragment of a closed vessel shape with flint temper (**Fig. 14:5**). Finally, there is an almost completely preserved flat base (20 mm thick), with the onset to the lower vessel body (11 mm thick) (**Fig. 14:8**). It is made from silty clay, tempered with abundant fine to coarse grog. Based on strong similarities in fabric and firing conditions, this base likely belongs to one of the large, decorated beakers from sector 1 (**Fig. 11:1**). The remaining 32 fragments are undecorated body sherds. It includes mainly thick- and thin-walled pottery with grog temper, as well as two fragments of thin-walled (6 mm) pottery with flint temper.

6.6. Relative chronology

The pottery from Ename Stuw represents a mix of remains from different periods. The thin-walled bowl or beaker with round knob and bone temper (**Fig. 8:1**) can likely be dated to the Early Neolithic period (late 6th to early 5th millennium cal BC). Bone temper is characteristic of Limburg pottery and pottery of the Blicquy/Villeneuve-Saint-Germain (BVSG) culture in central Belgium, and has occasionally also been observed in classic LBK pottery from sites in the Hainaut region (Constantin, 1985; Jadin *et al*., 2003; Burnez-Lanotte *et al.*, 2010). Moreover, this vessel seems to be built by a systematic external overlap of strongly deformed coils, which is a common primary forming technique for the production of Limburg and BVSG pottery (Gomart, 2014; van Doosselaere *et al.*, 2016; Gomart *et al.*, 2017). However, where knobs and lugs are frequent on BVSG pottery, they are generally absent from Limburg pottery (Ilett & Constantin, 2010; Gomart 2014). The bone-tempered vessel from Ename probably represents a beaker of the BVSG culture (*cf.* Constantin *et al.*, 2010, **Fig. 10:15**), dated to the first half of the 5th millennium cal BC. Small quantities of Early Neolithic pottery are sometimes found at wetland sites in the Scheldt basin, such as Bazel Sluis, Melsele Hof ten Damme and, closer to Ename, the site of Oudenaarde Donk Neo 1 (Parent *et al.*, 1987; Crombé & Vanmontfort, 2007; Crombé *et al.*, 2015; Teetaert & Crombé, 2022). This pottery was either left behind by early farmers from the loess during excursions outside their core area or was obtained by local hunter-gatherers through exchange with early farming communities or by collecting it from their abandoned settlements on the loess.

The beaker with long everted neck and carinated profile from sector 2 (**Fig. 12:1**) can be firmly dated to the Middle Neolithic period (*ca*. 4300/4250-3800 cal BC). Flint temper, especially

in combination with fine plant temper, is a typical trait of the Michelsberg culture/Group of Spiere pottery from the Scheldt basin (Vanmontfort 2001; Bostyn *et al.*, 2011; Teetaert, 2020; Teetaert *et al.*, 2020). Among the pottery from the Middle Neolithic site of Spiere De Hel, several parallels can be found for this particular vessel shape (e.g. Vanmontfort, 2004: fig. II 51). A few other body sherds with flint temper, from sector 4 and from unknown excavation sectors, probably also represent Middle Neolithic pottery. However, it should be noted that flint temper also occurs to a lesser extent in Final Neolithic pottery of the Deûle-Escaut group in northern France and Belgium, dated to *ca*. 2800-2400 cal BC (e.g. Deramaix, 1997; Bostyn & Praud, 2000; Sergant *et al.*, 2009; Praud *et al.*, 2015).

Most of the pottery from Ename Stuw can likely be dated to the Final Neolithic period and the transition to the Early Bronze Age, i.e. in the second half of the 3rd and first quarter of the 2nd millennium cal BC. The bell beaker from sector 3 (**Fig. 9**) can clearly be attributed to the Final Neolithic Bell Beaker culture and, based on the alternation of decorated and undecorated zones, can be classified as an (epi-)maritime bell beaker. Bell beaker finds are not uncommon in the Scheldt basin (for recent overviews, see Hoorne *et al.*, 2008; Crombé *et al.*, 2011). Previous finds from the area around Ename include the bell beakers from Kruishoutem Wijkhuis (De Laet & Rogge, 1972), Eine Heurnestraat (Hazen, 2018) and Oudenaarde Donk Neo 1 (Parent *et al.*, 1987a). Parallels for the cross-hatched decoration motive can for instance be found on the (epi-)maritime bell beakers from Sint-Denijs-Westrem – Flanders Expo zone 1 (Hoorne *et al*., 2008) and Temse-Krekel (Mariën, 1948; Van Roeyen, 1989), but also on one of the bell beaker sherds from Oudenaarde Donk Neo 1 (Parent *et al.*, 1987, fig. 15:A). The large beaker with so-called horseshoe handle on the neck (**Fig. 10**) is typical of the Early Bronze Age *groupe des urnes à décor plastique*, mainly known from northern France and the British Channel area (Burgess, 1987; Buchez, 2011; Buchez *et al.*, 2017). Four fragments of this type of pottery have been found at Dentergem Peperlabeek (Warmenbol, 1990), but apart from a few other examples, it is rarely found in Belgium.

It is likely that the two large decorated beakers from sectors 1 and 3 (**Fig. 11**) belong together, based on their similar shape. The large beaker with a *cordon* on the neck and shallow grooves on the upper body (**Fig. 11:1**) has no direct parallels in the Scheldt basin. However, in northern France comparable vessels are frequently found on Bell Beaker sites (Brunet *et al.,* 2004) and even on Early Bronze Age sites in association with *urnes à décor plastique* (Billard *et al*., 1996). ^{14}C-dating from a similar shape in Normandy confirms the attribution to the Early Bronze Age (Ghesquiere *et al.,* 2021). Paired fingernail impressions as body covering decoration (**Fig. 11:2**) are well known for the Final Neolithic period and are for instance frequently encountered on the so-called "*potbekers*", several of which have been found in the Scheldt basin (e.g. Desittere, 1970; Crombé, 1986; Hoorne *et al.*, 2009). Yet, this type of decoration is equally encountered on Early to Middle Bronze Age pottery, both in northern France and the Netherlands (e.g. Butler & Fokkens, 2005; Buchez *et al.*, 2017). For instance, at Argoeuves (Somme), one displaced vessel from a Middle Bronze Age burial monument shows a decoration of two *cordons* in combination with paired fingernail impressions. It has been dated to the Final Neolithic (Buchez *et al.*, 2017, fig. 13.30). Parallels can however also be found closer to Ename, at the site of Oudenaarde Donk Neo 5, located less than 5 km south-west from Ename Stuw. The pottery from this site includes both vessels with applied *cordons* on the neck and a very similar large beaker shape with a body covering decoration of paired fingernail impressions (Parent *et al.*, 1987a, fig. 32). According to the excavators (Parent *et al.,* 1987b), the context in which this pottery was found can be dated to the Final Neolithic, which is confirmed by a ^{14}C-date between 2896 and 2573 cal BC. In sum, combined with the radiocarbon evidence from Ename (*cf.* 3) it seems most likely that both beakers date to the (late) Final Neolithic period and/or the transition to the Early Bronze Age.

Several other vessels from Ename, such as the beakers with flat bases, sometimes with carinated profiles (**Fig. 8:2-7, Fig. 11:1-2**), could also fit within this time period. However, they can also be slightly older given the close affinities with pottery from the Deûle-Escaut tradition known from several settlements in northern France (Delassus *et al.,* 2009; Piningre, 1985;

	Typology	*Artefacts with use traces*
Debitage	N	N
Core	1	1
Flake	5	4
Blade	2	1
Bladelet	1	1
Polished/retouched tools		
Axe	1	1
Adze	1	1
Retouched polished axe-flake	1	1
Denticulated scraper (from polished axe-flake)	1	1
Denticulated core	1	1
Denticulated flake	1	1
Splintered piece (*pièce esquillée*)	1	1
Strike-a-light	1	1
Total	*17*	*15*

Tab. 6 – Typological composition of the lithic assemblage.

Martial & Praud, 2011; Brunet *et al.,* 2004) and northern Belgium (Demeyere *et al.,* 2006). This is corroborated by the radiocarbon evidence pointing to activities on the site of Ename during the late 4th and first half of the 3rd millennium cal BC, which corresponds to the timing of the Deûle-Escaut group. There are even parallels with the typical thick-walled pottery with S-shape and flat bottom from the Stein tradition as known from the Belgian-Dutch Meuse basin, dated to the late 4rd and early 3rd millennium cal BC (Verhart, 2010).

The vessel with a slightly S-shaped profile (**Fig. 14:3**) also has parallels in pottery from the so-called Channel North-Sea region (Manche - Mer du Nord). At the sites of Guilberville and Lingreville they are dated to the end of the 3rd millennium and beginning of the 2nd millennium (Marcigny, 2005). The date for the site of Cairon (Plaine de Caen) is slightly younger with an age between 1800-1700 BC (Ghesquiere *et al.,* 2021). A similar shape with a *cordon* has been found in a presumed inhumation grave at Rebaix – Couture-Saint-Vaast (Wallonia) and dated to the Early Bronze Age (Cammaert *et al.,* 1996); the vessel found in an inhumation burial at Fontaine-Notre-Dame (Nord) has unfortunately not been dated (Buchez *et al.,* 2017).

Finally, two beakers or jugs with ear from sectors 1 and 3 (**Fig. 8:10, 11**) could be younger. This vessel shape has parallels in Late Bronze Age pottery from the Scheldt basin (Henton, 2017, e.g. vessel type 70410) and in the northern Campine region (Hiddink, 2019: fig. 6.26). Pottery with an ear appears only sporadically during the Middle Bronze Age, as at Aalter Oostergem (De Mulder, 2013), but is well known during the Late Bronze Age (Henton, 2017).

7. Lithic industry

In total 17 lithic artefacts were discovered at the site (**Tab. 6**). Except for a core, five flakes and three blade(let)s, this small assemblage mainly consists of retouched and/or polished tools (N=8). The artefacts were subjected to a functional analysis under high -and low-power magnifications (Semenov & Thompson, 1964; Keeley, 1980) which indicated that 14 of the 17 lithic artefacts bear traces of use, related to a relatively large array of activities and contact materials: working hard animal matter (antler/bone), butchery, hide-working, whittling of wood, processing of mineral substances. Hafting traces were also observed on four implements (**Tab. 7**).

7.1. Knapping waste

The core and the retouched/polished tools are worth describing in greater detail. The core seems to evoke a relatively simple flaking strategy (at least in the final phase of its use). Making use of a single striking platform, flakes were detached along two thirds of its periphery. The visible flake negatives are however not complete. They are missing their proximal part, indicating that the core was abandoned after an attempt at striking platform rejuvenation (or a reorientation of the debitage to the striking platform?). It is

exhibiting edge damage that is related to use in a dynamic motion. However, the specimen is moderately burnt, which caused the whole surface to became highly scintillating. This made it impossible to interpret the traces any further.

7.2. Tools

The toolkit is mainly composed of denticulated artefacts on the one hand and polished artefacts on the other. The four denticulated tools include a thick flake with two denticulated edges, shaped by a series of pronounced and crude notches (**Fig. 15:1**), and a core on which a similar crudely denticulated edge was installed, this time with bifacial retouch (**Fig. 15:4**). Although the edges of these tools were intentionally shaped, according to the functional analysis, they were additionally modified by their use, which involved the processing of bone in a hard, crushing and dynamic motion (**Fig. 17:1 & 17:4**). The first tool in addition contained a white-cream coloured residue with a greasy, bubbly appearance and tissue-like structures. In this sense (both from a technological and functional point of view), these denticulated artefacts are analogous to the denticulated *faceted tools* known from

Motion and typological class/contact material	*Animal*						*Inorganic*	*Plant*		*Unspecific*	*Total*
	Bone /antler	*hide*	*Human hand*	*meat*	*unspecific*			*wood*			
					hard	*medium*		*hard*	*soft*	*hard*	
longitudinal											
denticulated flake					1						*1*
butch											
blade with use-retouch				1							*1*
flake				1							*1*
chopping											
polished adze										1	*1*
polished axe										1	*1*
crashing											
core										1	*1*
denticulated core										1	*1*
cut											
flake					1						*1*
flake with use-retouch					1						*1*
Retouched polished axe-flake					1						*1*
bladelet						1					*1*
hafting hand											
blade with use-retouch			1								*1*
hafting wood											
bladelet								1			*1*
scraping											
denticulated scraper		1									*1*
splintered piece	1										*1*
strike											
strike-a-light							1				*1*
whittling											
flake									1		*1*
Total	*1*	*1*	*1*	*2*	*4*	*1*	*1*	*1*	*1*	*4*	*17*

Tab. 7 – Wear traces found on the lithic tools from Ename-Stuw. Contact materials versus motion and tool type.

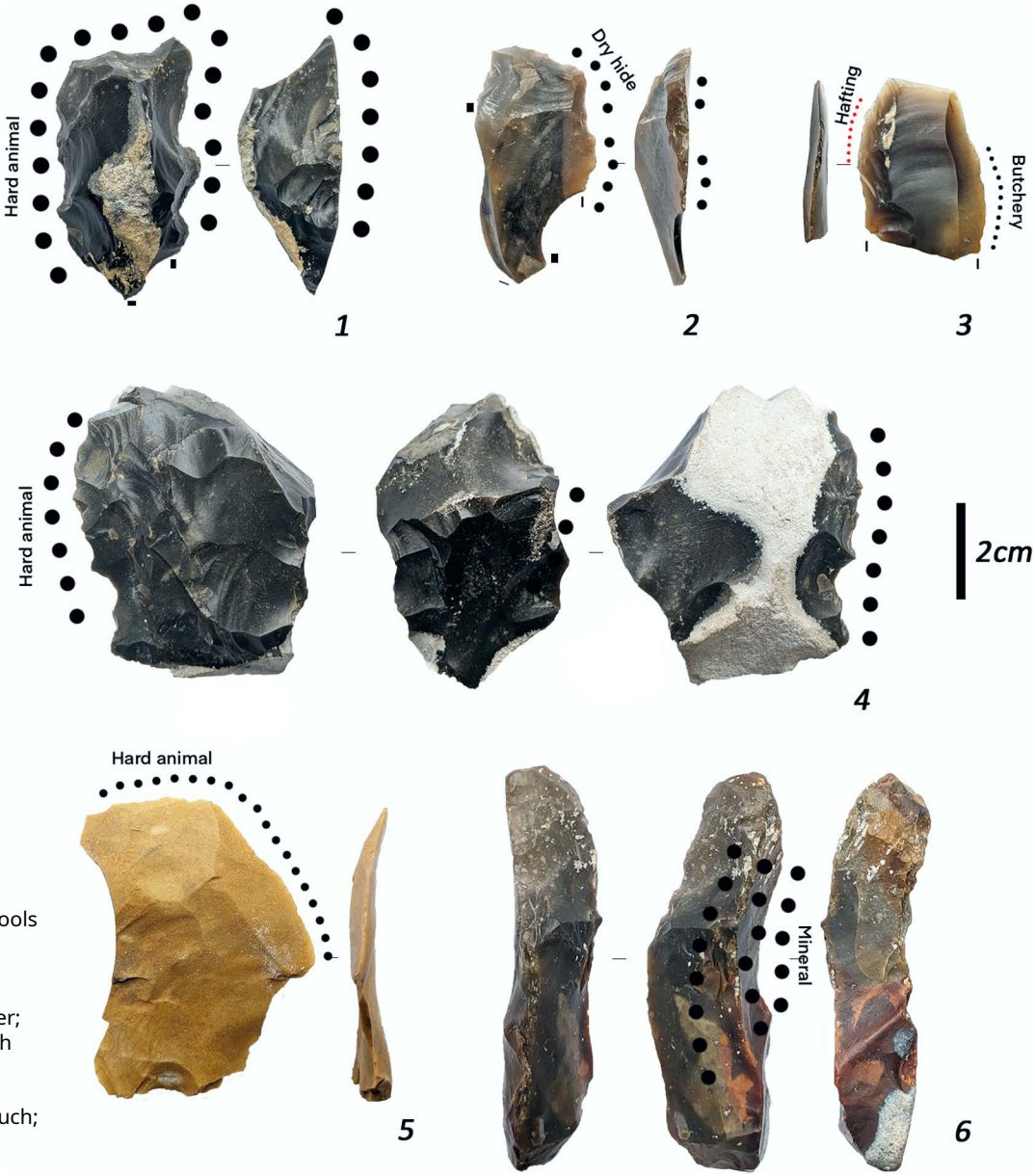

Fig. 15 – Retouched tools with indication of the usewear traces.
1. Denticulated flake;
2. Denticulated scraper;
3. Blade fragment with use-retouch;
4. Denticulated core;
5. Flake with use-retouch;
6. Strike-a-light.
Scale: 2/3.

Early Neolithic and Swifterbant contexts in Belgium (Halbrucker *et al.*, 2022). The other two denticulated artefacts are a scraper (made on a polished axe flake) with an irregular, slightly saw-toothed scraper front and adjoining edge (**Fig. 15:2**), which was used to scrape dry hide with added minerals (**Fig. 17:2**); and a blade fragment initially interpreted as a potential microdenticulated artefact (**Fig. 15:3**). Upon closer inspection, however, this interpretation could be rejected. Part of the observed edge modifications proved to be related to post-depositional damage, the others to handling (left edge) and to butchery activities (right edge) (**Fig. 17:3**). The edges are also not as finely serrated as one would expect them to be on a microdenticulated piece (e.g. Beugnier & Crombé, 2007).

Two complete polished tools and a retouched flake struck from a polished axe were also discovered at the site (in addition to the abovementioned scraper). The two complete tools are an adze and an axe, both made on flint. The adze (**Fig. 16:1**) has a typical plano-convex section, is more elongated than the axe and has a narrower cutting edge (14.2 x 5.6 x 3.6 cm). Due to an imperfect primary shaping of the adze preform, the transverse convexity of its upper side is not situated in the center of the mass of the artefact. In addition, the right and left edges are not symmetrical. The adze also shows a lesser degree of polishing, which could again be interpreted as a consequence of initial shaping mishaps, i.e. the more

concave parts of several severely hinged flake negatives remain unpolished.

The axe (**Fig. 16:2**) is wider but shorter than the adze (12.3 x 6.5 x 3.2 cm). According to the descriptive criteria employed by Giligny and Bostyn (2016:54), it has an overall trapezoidal morphology with its largest width towards the cutting edge, an oval section and rounded sides.

While both tools clearly show evidence of use, this evidence is better developed on the axe than on the adze. On the axe, several phases of chipping and splintering of the cutting edge and the butt, followed by a re-polishing and re-use could be recognized. The damage caused by a large (spall-like) splinter in the left corner on the upper face of the axe and the corresponding edge-chip on the lower face was for example restored by a re-polishing of the cutting edge. After this, the re-polished cutting edge was again clearly affected by use as evidenced by a new degradation of the polishing. The butt also displays impact-related flaking and re-polishing. Only two final and more deeply stepped and hinged negatives were not re-polished. These could indicate the end of use for this tool. On the adze, similar proof of at least one rejuvenation of the cutting edge could be found, although the edge-damage by chipping was clearly less invasive. High-power analysis of these tools was not possible because of working distance limitations of the equipment available to us, therefore indication of contact materials cannot be discussed.

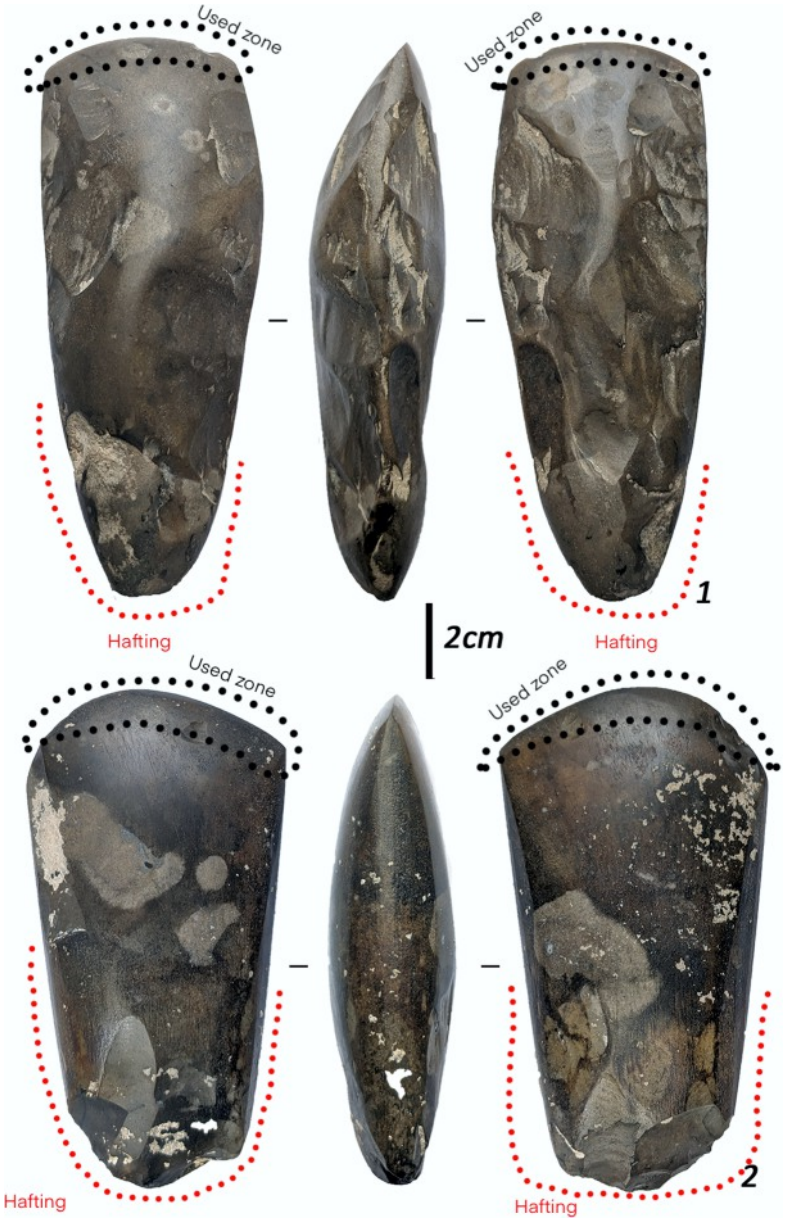

Fig. 16 – Polished artefacts with indication of the usewear and hafting traces. 1. Polished flint adze; 2. Polished flint axe. Scale: 1/2.

The remaining retouched tools found at the site are a strike-a-light (**Fig. 15:6**) made on a frost flake that was potentially slightly heated and a splintered piece. The strike-a-light is showing contact with a mineral substance (e.g. pyrite, marcasite) in a dynamic striking motion, with extremely rounded edges, and metallic residues are also present on the contact surface (**Fig. 17:6**). The splintered piece exhibits traces of scraping of bone/antler.

There are some other artefacts with use related traces on them. The retouched polished axe-flake and another two flakes are interpreted as used on hard animal matter in a cutting motion (**Fig. 15:5** & **Fig. 17:5**). There is a blade exhibiting medium hard animal matter cutting traces and on its other edge hafting traces in hard wood. A flake exhibits traces of soft wood whittling and another traces of butchering.

Finally, it is hard to make conclusive statements about the siliceous raw materials used at the site based on a macroscopic assessment alone, among others in the case of the polished flint axe and adze due to the fact that they are covered in a brown patination. However, at least four artefacts were made on regionally occurring Upper Turonian flint

Finally, it is hard to make conclusive statements about the siliceous raw materials used at the site based on a macroscopic assessment alone, among others in the case of the polished flint axe and adze due to the fact that they are covered in a brown patination. However, at least four artefacts were made on regionally occurring Upper Turonian flint (Vandendriessche *et al.,* 2021). The retouched polished axe-flake seems in addition to have been made on Haine Saint-Paul Formation flint from the Mons Basin (Collin, 2019).

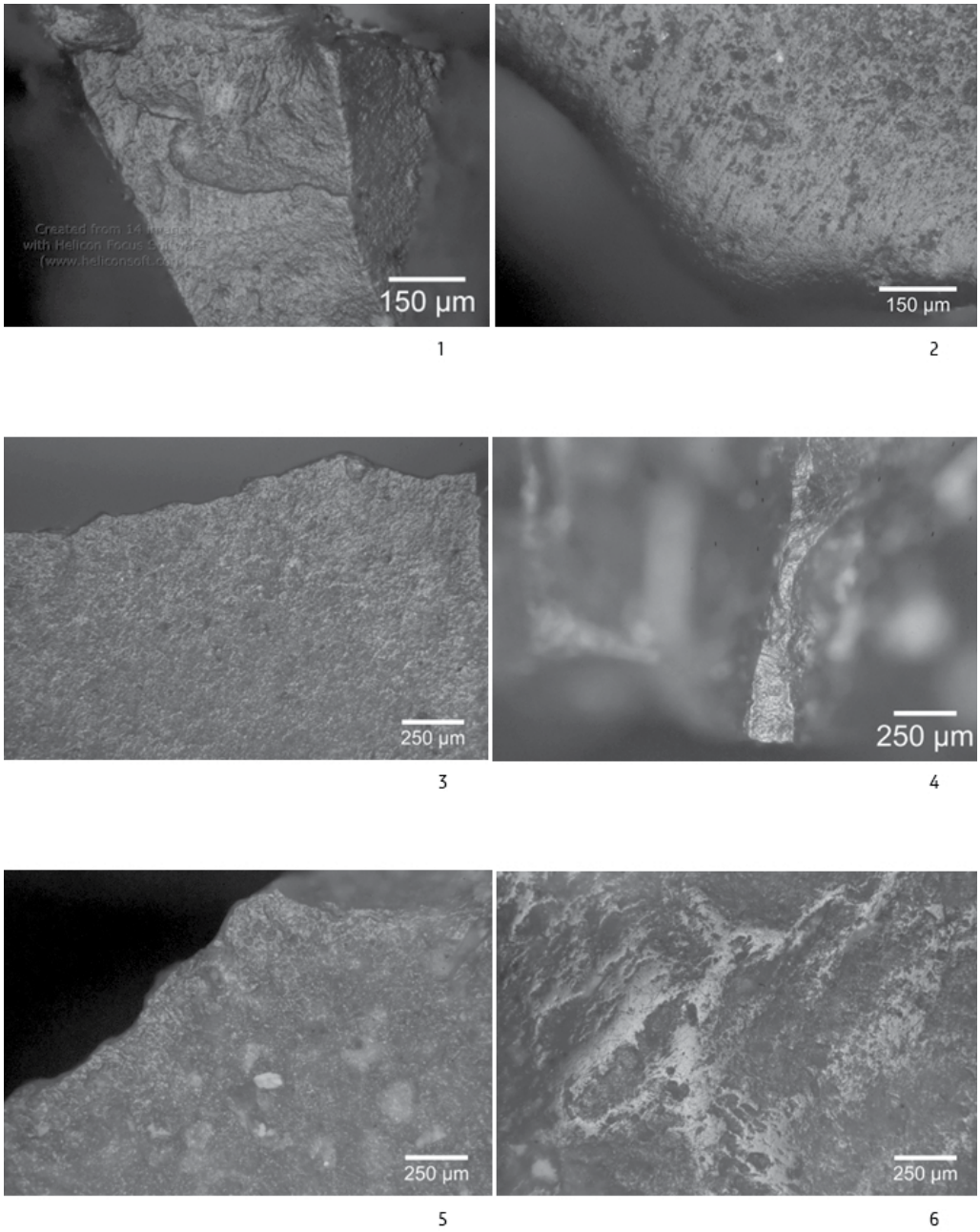

Fig. 17 – Micrographs of the use related traces on the tools presented on Fig. 15.
Numbers are consistent between the figures.
1. Dynamic motion on hard animal matter: Smoothening, greasy, very bright and flat polish with random directionality on a higher part of a large edge removal with rounded edges.
2. Dry hide scraping with added minerals: Rough, matt, bright, flat and pitted polish with long, thin and shallow striation, with transversal directionality on the very rounded edge.
3. Butchery: Rough, matt, bright, domed and pitted polish with parallel directionality on a rounded edge.
4. Crashing of unspecific hard material: Rough, greasy, very bright, flat and pitted polish on a rounded invasive lamellar edge scar.
5. Cutting hard animal matter: Smoothening, greasy, bright, flat and pitted polish on a rounded edge with long trapezoidal edge removal.
6. Strike-a-light traces: Isolated spot of smooth, matt, very bright, and flat polish with random directionality on very rounded aeras with some removals.

7.3. Interpretation

Based on the data described above and the generally modest size of the lithic assemblage, we have to stay cautious in our interpretations. The lithic assemblage appears to be very homogeneous from a typological point of view and fits perfectly in a Middle to Final Neolithic framework. Lacking armatures, a further chronological specification of the artefacts seems impossible, although the presence of the polished axe-flake from the Haine Saint-Paul Formation (see Collin, 2019), as well as the importance of denticulated tools might imply a greater share of Final Neolithic artefacts in the assemblage. The microwear analysis demonstrated that nearly all the artefacts were used, including the polished tools and five of the unretouched flakes and bladelets. However, considering the difficult circumstances of the excavation, this preponderance of tools might be partially explained as the result of a collection bias.

8. Antler tools

Three perforated mattocks were collected on the site, all three made on the basal part of red deer antler (**Fig.18**).

- 18:1. Antler base mattock (173 x 83 x 69 mm), type Aa4 according to the typology of V. Hurt (1982). The cutting edge of this mattock, although partially destroyed, is intensely polished. The circular perforation, diameter varying between 26 (upper side) and 30 mm (lower side), has been laterally applied. The brow and frontal tines have been removed, leaving behind clear cut marks. Traces of polishing indicates that the basal remains of these tines were smoothed. The burr is still intact and does not display traces of human modification. This base mattock was found in the shell-layer within sector 1 and has been dated to the Neolithic-Bronze age transition, i.e. between 2136 and 1950 cal BC (KIA-23428; **Tab. 1**). This date fits perfectly with the chronology of the antler mattocks from the Scheldt basin (Crombé *et al.,* 1999, 2018).
- 18:2. Antler base mattock (*ca*. 204 x 48 mm), type Aa1-3 according to the typology of V. Hurt (1982). Unfortunately this mattock is no longer preserved; hence its description is based on a drawing and photo. Apparently this find had an intact oblique cutting edge and an oval-shaped perforation (diameter *ca*. 29 mm) parallel to it. The basal end shows traces of modification resulting in a roughly rounded end. This find was collected in sector 3 and ^{14}C-dated to the early/middle Bronze age, i.e. between 1736 and 1533 cal BC (KIA-23427; **Tab. 1**). A such it belongs to the younger cluster of base mattocks from the Scheldt basin (Crombé *et al.,* 2018). A piece of wood filling the eye of the antler mattock, and representing the remains of the original handle, was identified as hazel (*Corylus avellana*).
- 18:3. Antler base mattock (*ca*. 169 x 81 mm), type Aa1-3 according to the typology of V. Hurt (1982). This find is also no longer preserved. This much smaller example of a base mattock has the same general characteristics as the previous ones: an oblique and polished cutting edge combined with an oval-shaped perforation (diameter 34 mm). It was collected in sector 4 and has not been ^{14}C dated.

9. Discussion

Despite the poor quality of the contextual information and the secondary position of most finds, it is clear from the combined archaeological, archaeometric and palaeoecological evidence that the site of Ename-Stuw was used by Neolithic man over a long time-period. The oldest pottery characterized by bone temper points to presumably ephemeral activities during the Early Neolithic. Similar isolated pottery finds from the LBK and/or Blicquy group have been reported on several sites along the Scheldt basin, e.g. at Oudenaarde (Crombé & Vanmontfort, 2007), Bazel (Crombé *et al.,* 2015) and Melsele (Teetaert & Crombé, 2022), probably indicating contact/exchange with local communities of hunter-gatherers or expeditions of farmer-herders from the loess area.

During the Middle Neolithic activities probably increased, as evidenced by the finds of typical Michelsberg culture/Group of Spiere pottery and human bones dated to between *ca*. 4250 and 4000 cal BC. This is in line with the data from the nearby site of Oudenaarde-Donk Neo 1 (Parent *et al.,* 1987a; Crombé *et al.,* this volume), emphasising that these first farmer-

Fig. 18 – Antler mattocks from Ename-Stuw.

herders regularly left their main settlements situated on the adjacent dry river banks and hill-tops to exploit the wet environments of the former floodplain of the Upper/Middle-Scheldt. Unfortunately the available data from Ename do not allow to determine precisely which wild resources (plants, game, fish, ...) were exploited or whether these expeditions were accompanied by livestock or not.

Clearly the bulk of the pottery and radiocarbon dates belongs to the late 4th millennium up to the transition to the 2nd millennium cal BC, encompassing the later stages of the Late Neolithic, Final Neolithic and Early Bronze Age. Culturally, the pottery dated to the late Final Neolithic and Early Bronze Age can mainly be associated with respectively the Bell Beaker Culture and *Groupe des urnes à décor plastique*. The latter pottery presents close connections with the Atlantic pottery style from the Channel – North Sea/Manche-Mer du Nord area. None of the forms can be related to Hilversum style ceramics well known in north-eastern Belgium and the southern Netherlands (Drenth, 2018). The Scheldt basin therefore appears more culturally related to Atlantic traditions during parts of the Final Neolithic and the Bronze Age. Metalwork from this period seems to confirm this. At Asper, north of Ename-Stuw, an Atlantic copper tanged dagger dated to the Early Bronze Age has been dredged from the Scheldt (Verlaeckt, 1996). An identical type has been found in Wallers (département du Nord, France) close to the Scheldt (Warmenbol, 1996).

The frequency and intensity of usewear traces and food residues on respectively lithic and ceramic finds most likely indicate it concerns settlement waste. Former settlements probably were situated on the higher landscape entities, such as the levee or scroll bar adjacent to the

large and deep pit/gully. The wooden poles collected from the infilling of the latter as well as the few vertical poles found outside this feature probably belong to a wooden structure(s) within sector 1 and 3. A reconstruction of this feature remains impossible as most poles were found eroded in a secondary position. According to the radiocarbon dates, most poles belong to the end of the 4th millennium and transition to 3rd millennium cal BC. Strangely, no other settlement remains, e.g. pottery or antler mattocks, nor human remains could be specifically dated to this time-period, suggesting that the poles probably did not belong to a strict occupation zone but rather to a special activity or peripheral area (e.g. fishing weir, palisade, bank infrastructure, ...). Unfortunately all this remains difficult to verify as only a very small portion of the construction pit could be investigated and no excavations took place on the adjacent levee/scroll bar. The wood identification of the poles show that these most likely have been cut from the local vegetation, with all identified taxa, *i.e.* common ash, alder and willow, representing trees and shrubs typically growing in riverine woodlands (Maes *et al.,* 2006). Moreover, the local occurrence of these taxa has been demonstrated by the palynological analysis as well.

The marked difference in the infilling between the lower and upper fill of this large pit/gully clearly points to a difference in sedimentation dynamics. The overall clayey composition of the lower layers (layers 1" to 3) indicates a rather low-energy depositional environment. On the contrary the abundance of molluscs and sandy sediments in the upper layers, in particular layers 5 and 7 which contain the bulk of the archaeological material, testifies of a more dynamic phase. This is corroborated by the presence of eroded archaeological remains, predating the formation of the feature, such as the human remains dated to the Michelsberg culture phase. However, the fact that most finds dated to the Final Neolithic and Early Bronze age, in particular the pottery, are generally well-preserved (only slightly fragmented and large profiles can still be fitted together) suggests short-distance transport, *e.g.* from the adjacent levee, or deliberate deposition in the pit/gully. The latter could imply dumping of settlement waste and/or the deposition of pots in the context of rituals. Ritual or votive deposition of whole pots, so-called "bog pots", in wetlands (inland bogs, rivers and lakes) seems to have been a common practice in Neolithic NW Europe (Koch, 1998). Recent lipid analyses (Robson *et al.,* 2021) has shown that most of these "bog pots" were used before deposition, which might fit with the evidence from Ename. Ongoing analyses of the absorbed lipids in the Ename pots at the ISOFYS laboratory of Ghent University will certainly shed more light on the foodstuffs that have been cooked in these vessels (Teetaert *et al.,* 2024). However, it should be stressed that "bog pots" usually are restricted to specific vessel types (Bennike & Ebbesen, 1986; Koch, 1998), while at Ename food crusts are found on a wide variety of pot types. This might point to the fact that the latter (or part of them) did not take part in a votive deposition process.

This is partly corroborated by the other finds at Ename. In NW Europe "bog pots" are often found together or in association with other find categories, such as stone tools, in particular polished adzes and axes. However, contrary to the pottery these stone tools generally seem unused and made specifically to circulate in ritual and ceremonial networks (Bradley, 1990; van Gijn, 2010; Wentink *et al.,* 2011; Wentink, 2020). As such they have a more symbolic value rather than being functional. This is not the case for both axes found at Ename, which display clear evidence of intense use. Sometimes "bog pots" are also associated with human remains, so-called "bog bodies" (Koch, 1998). At Sigersdal in Denmark an intact Early Neolithic lugged flask was found together with two human skeletons, one of which had a cord around its neck (Bennike & Ebbesen, 1986). However, in Neolithic wetland contexts mostly disarticulated or partial remains of skeletons occur, which either reflect intentional depositions of a selection of bones (secondary burials) or post-depositional disturbance (van Beek *et al.,* 2023). The latter most likely applies to the human bones found at Ename, given their position in shell-rich layers which were formed under strong fluvial activity (*cf. supra*). The most plausible explanation for the presence of scattered human bone material at Ename is that they belong to former graves which were (partly) destroyed by fluvial erosion. Part of the ceramic vessels and even stone tools, especially the axes, may have served as burial gifts, as it is known that

mostly used artefacts are deposited in graves. The presence of graves is further supported by the physical state of the human bones (De Groote *et al.,* in press), which clearly show a uniform brown patina that appears to predate any subsequent weathering, fracturing or calcium carbonate depositions. In addition, the human bones do not present evidence of manipulation, such as cutmarks, or traces of animal gnawing which could support the theory of defleshing or excarnation in open air eventually on a platform or in a tree (Carr & Knusel, 1997) in the context of a "rite de passage" (van Gennep, 1960). Finally, the assemblage includes several bone types and individuals from different age and biological sex categories suggesting an accidental rather than selective assemblage (De Groote *et al.,* in press).

Overall the site of Ename-Stuw displays very close similarities to the nearby Neolithic wetland site of Oudenaarde-Donk Neo 1 (Parent *et al.,* 1987a). Here too, scattered human remains dated to the Middle and Final Neolithic (Crombé *et al.,* this volume; De Groote *et al.,* in press), showing no traces of weathering and manipulation were collected admixed with numerous settlement remains, including intensively used pottery (amongst which some almost complete specimens) and stone tools (Blancquaert, 1987). Most of this material was collected from a deep pit very similar in dimensions and infilling as the one at Ename-Stuw. This might point to an important fluvial erosion phase in (the beginning of) the 3rd millennium cal BC in the Scheldt valley, albeit the lack of detailed geomorphological and sedimentological studies at both sites does not allow to verify this. However, further upstream along the Scheldt, at the site of Bouchain situated south of Valenciennes in northern France (Salvador *et al.,* 2021), clear proof of increased fluvial activity and erosion dated to around 3000 cal BC has been attested. Similar evidence has recently been reported in the Somme valley (Garcia *et al.,* 2024) and southern UK (Collins *et al.,* 2006), linked to climate deterioration and/or human impact. The latter is corroborated by a recent study of human impact in the Scheldt basin, based on a quantification and modelling of archaeological sites, radiocarbon dates and pollen data (Van Maldegem *et al.,* 2024). This study demonstrates a steady increase of sites and dates especially along the Upper/Middle-Scheldt during the late 4th millennium and 1st half of the 3rd millennium cal BC, which might be interpreted as an indication of a population increase. This is also evidenced by the pollen data, which shows a gradual opening of the landscape from the 3rd millennium onwards (Van Maldegem *et al.,* submitted).

10. Conclusions

Despite the restricted stratigraphical information and secondary position of most finds, the present study could reconstruct to a certain level the occupation history of the Neolithic wetland site of Ename-Stuw. Clearly the site has known two important occupation phases, one during the Middle Neolithic and another covering the transition from the 4th to 3rd millennium up to the transition to the Bronze Age. The bulk of the archaeological finds, pottery, stone artefacts and antler mattocks, clearly can be attributed to the second phase. It is assumed that these finds belong to settlements situated on the adjacent levee/scroll bar(s) which were partially eroded at the start of the 3rd millennium probably as a result of intense fluvial activity. It is hoped that future geoarchaeological research in the Scheldt valley will provide more and better information on this Late Atlantic fluvial event, which clearly had an important impact on the preservation of prehistoric sites in the Scheldt basin.

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Abstract

This paper presents the results of a detailed analysis of the archaeological finds (pottery, lithic artefacts, antler tools, ...) collected during salvage excavations in 2003 at the wetland site of Ename-Stuw along the Upper/Middle-Scheldt valley (BE). The data are discussed in combination with a series of 28 radiocarbon dates performed on different materials, such as human and animal bone, wooden poles and antler tools, and some limited environmental data. Despite the restricted stratigraphical information and secondary position of most finds, the combined data allows to reconstruct the occupation history of this Neolithic wetland site. Besides some isolated finds belonging to the Early and Late Neolithic, two distinct occupation phases could be discerned: one during the Middle Neolithic and another covering the entire 3rd millennium and transition to the 2nd millennium cal BC (Final Neolithic-Early Bronze Age). Based on the intense use of the pottery (numerous remains of food crusts) and lithic artefacts (use wear traces) and the absence of evidence of weathering, gnawing and manipulation on the human remains, it is suggested that the finds are connected to former settlements with graves, which eroded as a result of fluvial activity at the transition from the 4th to 3rd millennium cal BC. As such, the site of Ename presents quite some similarities with the wetland site of Oudenaarde-Donk NEO 1, situated a few kilometres further upstream along the Scheldt.

Keywords: Ename, East Flanders (BE), wetland site, Scheldt valley, Neolithic, human remains, radiocarbon dates.

Samenvatting

In dit artikel worden de resultaten van een gedetailleerde studie van de archeologische vondsten (aardewerk, lithisch materiaal, geweien hakken, ...), afkomstig van noodopgravingen in 2003 in de alluviale vlakte van de Bovenschelde te Ename-Stuw (BE), gepresenteerd, samen met een reeks van 28 koolstofdateringen op menselijk en dierlijk botmateriaal, houten palen en hertshoornen hakken evenals beperkte paleolandschappelijke gegevens. Ondanks de geringe stratigrafische informatie en de secundaire positie van de meeste vondsten, laten de verzamelde data toe enig zicht te krijgen op de bewoningsgeschiedenis en functie van deze neolithische wetland site. Naast enkele geïsoleerde vondsten uit het vroeg en laat neolithicum, behoort het merendeel van de vondsten tot het midden en finaal neolithicum en de overgang naar de bronstijd. De talrijke sporen van intens gebruik, zowel op het aardewerk (aankoeksels) als op de stenen gebruiksvoorwerpen (microscopische gebruikssporen), suggereren dat de vondsten afkomstig zijn van aanpalende nederzettingen, die door fluviatiele erosie op de overgang van het 4de naar het 3de millennium cal BC, geërodeerd zijn. Op basis van de afwezigheid van sporen van verwering, knaagsporen of manipulatie lijken de aangetroffen menselijke resten te behoren tot verstoorde graven. Een deel van het aardewerk en lithisch materiaal werd mogelijk als grafgift gebruikt; opvallend is immers de relatieve gaafheid van het meeste aardewerk.

Trefwoorden: Ename, Oost-Vlaanderen (BE), wetland site, Scheldevallei, neolithicum, menselijke resten, koolstofdateringen.

Philippe Crombé
Éva Halbrucker
Hans Vandendriessche
Dimitri Teetaert
Ghent University, Department of Archaeology
Prehistory of NW Europe
Sint-Pietersnieuwstraat, 35
BE-9000 Gent
philippe.crombe@ugent.be
eva.halbrucker@ugent.be
hans.vandendriessche@ugent.be
dimitri.teetaert@ugent.be

Jonathan Jacops
Province of East Flanders
Heritage Department
Charles de Kerchovelaan, 189
BE-9000 Gent
jonathan.jacops@oost-vlaanderen.be

Vera Ameels
Sofie Debruyne
Agentschap Onroerend Erfgoed
Herman Teirlinckgebouw, Havenlaan, 88, bus 5
BE-1000 Brussel
vera.ameels@vlaanderen.be
sofie.debruyne@vlaanderen.be

Koen Deforce
Ghent University, Department of Archaeology
ArBoReaL - Archaeobotany Research Laboratory
Sint-Pietersnieuwstraat, 35
BE-9000 Gent
koen.deforce@ugent.be
&
Royal Belgian Institute of Natural Sciences
OD Earth and History of Life
Vautierstraat 29
BE-1000 Brussels
kdeforce@naturalsciences.be

Isabelle De Groote
Prudence Robert
Ghent University, Department of Archaeology
ArcheOs – Research Laboratory for Biological Anthropology
Sint-Pietersnieuwstraat, 35
BE-9000 Gent
isabelle.degroote@ugent.be
prudence.robert@ugent.be

Guy De Mulder
Ghent University, Department of Archaeology,
Protohistory of NW Europe
Sint-Pietersnieuwstraat, 35
BE-9000 Gent
guy.demulder@ugent.be

Jean-Pierre Parent
Boskant 14
BE-9700 Mater
jean-pierre.parent@telenet.be