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Published in:
Journal of Archaeological Science: Reports

DOI:
10.1016/j.jasrep.2017.10.017

Publication date:
2017

Document Version
Publisher's PDF, also known as Version of record

Citation for published version (APA):

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Download date: 30. Dec. 2017
A reconstruction of the stratigraphic position of a former Middle Palaeolithic surface site at Rotselaar – Toren ter Heide (Flemish Valley, Belgium) using mechanical sounding and geochemical fingerprinting

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1. Introduction

The open air-site of Rotselaar – Toren ter Heide located at the southeastern edge of a 2000 km\textsuperscript{2} depression in northern Belgium known as the Flemish Valley (Fig. 1) has delivered one of the largest Middle Palaeolithic assemblages of Flanders. During the early 1970s a large sandpit was exploited there on the right bank of the present river Winge, near to its confluence with the river Demer which flows into the Flemish Valley. The sands were dredged up and exposed on a large sedimentation plain before they were transported and used for the construction of highway dykes. Abundant Pleistocene faunal remains surfaced attracting the attention of many local collectors. At some point lithic artefacts appeared as well and, as was the case for the animal bones, they ended up in an unknown number of private collections. A few years later, one of us (PVP) established contact with some of these amateur archaeologists and managed to assemble a sample of about 180 lithic artefacts for a short assessment of the Rotselaar industry (Van Peer, 1982).

Even if it is certain that this sample only represents a small part of the original assemblage that was encountered in the sand exploitation it remains one of the largest Middle Palaeolithic collections from the Flemish lowland until today. This case particularly demonstrates the degree to which the latter region is underinvestigated with regard to its Pleistocene occupation history, as compared to neighbouring regions such as the loess plateaus and the Meuse valley to the south. Most probably, in fact, the Flemish Valley has been frequently occupied during Middle Palaeolithic times (Van Peer, 2001). This is suggested by the remarkably large number of findspots, especially if the total absence of any systematic survey is taken into account. However, at none of these locations the stratigraphic context of the archaeological material is known even if only at the crudest level of precision. As a consequence, the ‘empty’ Flemish Valley is largely neglected in syntheses of the Palaeolithic in Belgium, a priori preventing any consideration of its role in settlement systems of Neanderthals and perhaps early modern humans (Cahen, 1984; Di Modica, 2011; Di Modica et al., 2016).

Working from the simple idea that the present distribution and character of Palaeolithic occurrences in the Flemish Valley suffers heavily from taphonomic bias and inadequate research strategies, we have started the Flemish Valley Survey Project in 2015 in order to explore its Pleistocene record using a hydraulic coring installation. As our initial research area we have selected the Eastern Branch of the Flemish Valley or, in other words, the Dyle/Demer river basin (Fig. 1).

Until now we have executed systematic coring at four locations in this target area including a site adjacent to the former quarry at Rotselaar - Toren ter Heide. The site is situated very near to the present confluence of Dyle and Demer at the town of Werchter. From that point onwards, the Dyle takes its course in northwestern direction and discharges into the Scheldt river. The 1970s exploitation pit on the right bank of the Winge river is now a large recreational lake, making the most proximate stratigraphic context for the lithic industry inaccessible. The nearest plot available for systematic coring was on the left bank of the Winge immediately opposite of the former quarry (RTH-1; Fig. 2).

Our specific aim here was to assemble evidence that would allow us to infer the stratigraphic context of the 1970s surface finds. Our hopes were for ‘smoking gun’ evidence, i.e. the encounter of archaeological evidence in one of our sediment cores. While this has not happened up to now we believe that the stratigraphic and geochemical data that we have obtained allow us to reconstruct the original stratigraphic position for the site with a large degree of confidence.

2. Materials and methods

Coring at our target area RTH-1 proceeded in two phases. First, we sampled the 3 ha area in a randomly distributed set of 22 coring points. Using a Geoprobe device we retrieved 50 mm sediment columns in consecutive 1.5 m plastic liners. At most coring points, the total depth...
reached was 6 m below surface; at just a few points it was possible to drill 5 consecutive liners to reach −7.5 m. At one coring point (C3) we achieved −12 m but this was done using a small liner type (30 mm). These 22 cores served the construction of a Local Core-stratigraphic Model (LCM) for RTH-1.

The combination of gridded sampling at relatively high density and small stratigraphic columns produces a large set of Core Stratigraphic Units (CSU), posing particular challenges for the stratigraphic correlation of all these bits of evidence. Our procedure of core chaining involves, first, the identification of themost obvious homologies among a set of selected reference cores distributed evenly across the RTH-1 area (Fig. 3). This provides a basic framework of named layers into which the subsequent cores can be gradually inserted. It is hereby assumed that the reference core sample will reveal a minimal number of essential stratigraphic units of the targeted area, c.q. RTH-1, guiding the insertion of additional cores. Even if not every single Core Stratigraphic Unit will have homologies in one or more other cores, its correct position in the overall relative chronological sequence can be worked out with this procedure. In this sense, the latter is not unlike the Harris matrix used at historical archaeological sites (Harris, 1979).

In this process of chaining more homologies will become apparent. The spatial ‘logic’ that such named layers assume when the cores are arranged on some spatial vector provides an independent check of the reliability of the established homologies.

On the basis of the palaeotopographical reconstructions enabled by the LCM, a new phase of archaeological survey coring was initiated in the central part of RTH-1 and in a selected stratigraphic window between 3 and 7 m below surface. This time we used a Sonic Aqualock 100 mm system. Our goal now was to find direct evidence of human occupation. We retrieved 26 open sediment cores which were sampled at the coring location in 0.5 m spits and sieved at a 1 mm mesh. The stratigraphic units encountered in these cores were briefly described and interpreted by reference to the RTH-1 base layers as registered in the LCM.

The chemical composition of sediments was established with μXRF (M4 Tornado, Bruker) and quantified through “fundamental parameters”. Measurements were performed at 50 kV and 200 μA with an Rh tube without filter. Maps were measured at a pixel size of 15 μm at a scanspeed of 15 ms/ pixel. To improve the signal to noise ratio 3 accumulations were performed for each map. Sands and clays were powdered in a Mc Crone in order to homogenize the samples and to reduce grain sizes. The homogeneous grain-size distribution allows circumventing any grain-size induced matrix effects. Samples from CSU201, CSU202, and CSU267 were compressed into pellets using a Bruker pellet press at 6 bar. The other samples were manually compressed because it was impossible to press them with the device. For lithic artefacts, portions of the surfaces covered with diagenetic capping were scanned for geochemical composition. As the depth of penetration of the X-rays exceeds the thickness of the taphonomic deposition on the flint surface, the results were corrected for their flint contribution.1

3. Results

3.1. Description of the RTH-1 stratigraphy

At RTH-1 a total number of 286 CSUs were distinguished. In Fig. 3 they are represented in the format of a matrix whereby CSU IDs are placed at the bottom of their vertical reach. We used 6 reference cores to establish a stratigraphic framework comprising 10 base layers for subsequent correlation of the remaining cores.2 In the account below

1 This was done according to the following procedure. Measurements of elements in bulk flint were standardized to SiO₂ at unit value = standardized flint proportion. The relative amount of SiO₂ measured in the diagenetic capping multiplied with the standardized flint proportion of a given element, gives the flint contribution of that element. This flint contribution is subtracted from the measured proportion of the element concerned.

2 Core7 experienced technical problems at the level of liner 3 and was omitted. Cores 1 and 2 are immediately adjacent to each other, in order to compare the evidence acquired with different liner diameters (50 and 30 mm).
we describe the major stages of site formation as derived from the interpretation of the completed LCM (Fig. 4). We are leaving the uppermost 2.5 m of the cores out of consideration as these sediments represent Holocene floodplain development. Formal descriptions of Layers and Core Stratigraphic Units can be found in the Supplementary Information.

### 3.1.1. Site formation stage I: the Tertiary substrate

The substrate is formed by a compact fine sand of white-greyish colour with frequent organic inclusions. They are usually encountered from – 6 m downward and in the one core for which we drilled 8 consecutive liners (C3) they occur up to 12 m below surface. Here, a 0.1 m layer of compact grey-blue clay (CSU 0041) is present at the base of the exposed section of white sands. Such features clearly indicate that these sands belong to Oligocene Group of Tongeren (Vandenberghe, 2015). In several cores we did not reach the top of these sands, indicating that this topographic interface is strongly undulating as a result of posterior channel development. Especially in the northern part of RTH-1 a large depression is present (C9, C12, C19). In C3 the white sands appear to be present up to - 4.25 m suggesting that there existed an elevated plinth in the southern part until well into the more recent part of the Upper Pleistocene. We assume that it is this plinth that has been mostly targeted during the quarry activities of the 1970s sandpit. In several cores in the east part of RTH-1 the white sands are capped by a thin deposit of olive green compact fine sands. The contact is very diffuse and we interpret these sands to be part of the Oligocene substrate.

In a number of cores in the northern and western part of RTH-1 the white sands are absent and micaceous sands occur at their bases. They have a very characteristic dark grey-blueish colour and they are well sorted. No laminations are observed. These sands are quite similar to deposits at the base of the Formation of Diest. If they are Miocene marine deposits indeed, we are here at RTH-1 witnessing their wedging out on an older Oligocene core. It is remarkable that this geological boundary coincides quite precisely with the eastern contour of the still existing depression at Rotselaar – Toren ter Heide (Fig. 5). This suggests that it has been a major feature influencing on the Pleistocene development of the area.

### 3.1.2. Site formation stage II: the lower valley fill

The base of the Quaternary sequence is often marked by the presence of a gravel deposit containing characteristic small black chert pebbles. Such gravel lags occur mostly on top of the micaceous sands indicating that the latter have been preferentially eroded down to generally 6 m below surface. As a consequence of this the large depression still visible in the present topography originated in the western part of RTH-1.

A phase of important valley filling is represented by coarse glauconiferous sands containing organic laminations. These lower organic sands occur in the western depression as well as in a channel running...
from south to northwest (Fig. 6B). The sands can reach serious amplitudes such as in C8 where they occur up to 4 m below surface. After a phase of renewed gullying, the deposition of laminated organic sands continues but this time they are much finer especially in the southern part of RTH-1, reaching 3.5 m below surface. The presence of compact homogeneous fine sands in several cores (C4, C10, C15) can be an indication of contemporaneous aeolian activity in the area.

In C1 and C15 we have encountered a layer of compact yellow-brown loam on top of the lower organic sands. A thin veneer of the same loam is encountered in several other cores nearby. In the latter, small charcoal particles are contained in the loamy matrix which is slightly oxidized. In Fig. 5 the relative elevations of this yellow-brown loam are represented as contour lines. They clearly indicate that the loam has been deposited in a closed depression which must have existed at the top of the lower organic sands. The presence of redeposited white sands in C23, C22, C18, C17, and C15 suggests that the depression was partly blown in very soon after the deposition of the loam and the burning event. In C15 a 0.2 m peaty deposit (CSU202) occurs on top of those sands. In C23 the top of the redeposited white sands shows strong oxidation as a consequence of pedogenesis. We regard this and organic CSU202 in C15 as contemporaneous: soil formation occurred at the top of low dunes while peaty sediments were accumulated in the still existing depression. The pollen samples obtained from CSU202 revealed very poor preservation with mostly corroded or partly broken pollen grains.

### 3.1.3. Site formation stage III: the gravel terrace

The lower sequence at RTH-1 is truncated by an important gravel deposit across the entire area except in the most southern part. It is likely to correspond with one of the terrace levels identified by P. De Smedt (1973). In the central part this gravel occurs between −4 and −4.5 m whereas in the north its base is at −5.3 m. Sometimes, the gravel deposit can consist of several superimposed units. Its spatial disposition clearly shows how this channel has incised the older organic deposits in the south. The matrix of the gravel has a characteristic green colour. Gravels are sometimes frost-shattered and the top of the deposit is sometimes cryoturbated.

### 3.1.4. Site formation stage IV: the upper valley fill

Several episodes of fluvial deposition are documented above the gravel terrace. The lowermost layer of these is made up of highly glauconiferous sands. Differential proportions of glauconite bring about the finely laminated aspect of this deposit, suggesting that the river acquired its sediment load from different parts of its catchment upstream. In other cores, mostly in the eastern part of RTH-1 coarse grey sands occur. Nowhere have these two layers been observed in stratigraphic superposition. The same is true for aeolian sands which continue to be present in cores C4, C10 and C17. These are all penecontemporaneous deposits of the first fill phase above the gravel terrace.

They are overlain by fine silty sands which can have an important
organic fraction in the southern part of the test area and, finally, by rather coarse glauconiferous bulk sands. The black glauconite grains give this unit a speckled aspect. At this time, the entire area of RTH-1 has been filled up to less than 2 m below surface. This forms the sub-
strate into which the Holocene Winge river has incised its present course.

3.2. Archaeological survey coring at RTH-1

The geomorphological processes documented in the Quaternary sequence of RTH-1 are almost exclusively fluvial in nature. On a sub-
strate of Tertiary sands sloping in northern direction several cycles of Pleistocene channel incision can be distinguished, the most important of which is the gravel terrace. This must represent a palaeo-Dyle inci-
sion as proven by the fact that the gravel contains rolled phanite fragments which originate from the Brabant Massive to the south.

The gravel terrace has badly eroded the sediments of the Lower Valley fill. The latter consists of both shallow gravel lags and coarse sands, sometimes with an important organic content. Isolated areas of aeolian accumulation exist as well. We interpret this as evidence of a landscape dissected by shallow gullies of a braided river system and with patches of low dunes. In a few cores such as C23 the top of such aeolian sands shows pedogenesis. This, and the important organic fraction of the gully sands testify to prevailing mild climatic conditions in an environment that seems well suited for human occupation. Some of these gullies may have been closed depressions at times as indicated.

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Fig. 4. The completed LCM for RTH-1, with core profiles between 2 m and 7.5 m below surface arranged on a North-South transect. Only CSUs that were correlated to Layers are shown except for unique CSU202 in Core 15, marked in red square. 1: speckled sands; 2: laminated silty sands; 3: laminated fine organic sands; 4: laminated glauconiferous sands; 5: coarse grey sands; 6: green gravel; 7: grey sands; 8: upper organic sands A; 9: upper organic sands B; 10: redeposited white sands; 11: yellow-brown loam; 12: lower organic sands; 13: gravel; 14: micaceous sands; 15: white sands. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Fig. 5. Digital Terrain Model (© GDI-Vlaanderen) of the Dyle-Demer confluence area with overlay of the 10 m contour line. Inset is a composite plan of RTH-1 at 6 m below surface (site formation stage I) showing the spatial disposition of the Tertiary substrate and the position of the yellow-brown loam depression at the base of the Quaternary sequence (site formation stage II). Dots represent cores with presence of micro-charcoal. ‘Plinth’ = area with white sands up to 4 m below surface. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)
by the presence of the yellow-brown loam in C1 and C15. Such depressions in particular may have been the areas of human occupation.

Given this palaeotopographical reconstruction, we selected the Quaternary sequence below the gravel terrace (3 to 7 m below surface) in the central part of RTH-1 for intensive coring (Fig. 2). Our target now was the retrieval of direct evidence of human occupation from that stratigraphic window. While this aim has not been met until now the intensified coring provided important information in support of the palaeotopographical reconstruction above. In Cores C61 and C72 (Fig. 6B) we encountered rolled lumps of the yellow-brown loam. In Fig. 6A the sampled section at C72 is shown. The rolled loam lumps were here encountered in Sampling Spit 4 where both the coarse glauconiferous sands and the base of the gravel terrace are represented. It is most likely that they occurred in reworked position in the latter.

In C62, the same lumps were encountered in Sampling Spit 1 whereas in Sampling Spit 2 fresh, tabular fragments of yellow-brown loam occurred. During the sampling of the 0.5 m spits in the field we had indeed observed the presence of a distinct thin layer of loam at the top of the lower organic sands. We can readily assume that the fresh loam fragments in Spit 2 are derived from this layer. For the most part, it has been eroded in the base of the gravel terrace where it occurs in the form of isolated rolled lumps.

3.3. Description of the stratigraphic evidence from RTH-2

As indicated earlier, the immediate vicinity of the Rotselaar - Toren ter Heide findspot is now inaccessible. From interviews with local collectors who had monitored the 1970s quarry, we learned that artefacts seemed to appear when the southeastern part of the pit was in exploitation, grossly some 200 m beyond the eastern limit of RTH-1. Using a lightweight Drill direct push device we managed to retrieve 6 cores from the narrow pathway that surrounds the present Rotselaar lake (core location RTH-2).

We drilled those cores at the southeastern edge of the lake close to
the waterfront in an effort to approach the presumed site location as close as possible. However, three out of six cores, unfortunately, did not even reach 2 m below surface due to technical problems related to the high water table. The other three core columns are represented in Fig. 7. They are arranged on a west-east axis and CSUs and correlated with the RTH-1 sequence.

The strongly organic Holocene sediments at the top of the RTH-1 sequence reach considerable amplitude at RTH-2, especially in B2 where their base is at −4.25 m. We are witnessing here a deeply incised channel of the Winge which has subsequently shifted to its present course to the west. This Holocene channel incision has eroded almost all of the Upper Valley fill and the gravel terrace is met underneath. In B6 a larger portion of the Upper Valley fill is preserved. Interestingly, its top is at −1 m below surface. If this should be an indication that the underlying gravel terrace occurs at much higher elevation as well, we may be witnessing the edge of that terrace incision here. However, this would need further confirmation in additional cores.

Overall, the RTH-2 cores are sufficiently similar to what we have observed in RTH-1 in order to make the latter sequence relevant to a discussion of the stratigraphic position of the Rotselaar artefacts.

4. The original position of the Middle Palaeolithic site of Rotselaar – Toren ter Heide

4.1. Stratigraphic considerations

The lithics comprised in the published assemblage (Van Peer, 1982) present very different taphonomic conditions, from extremely rolled to fresh unpatinated. There is little doubt that they are derived from different stratigraphic positions. As far as the rolled artefacts are concerned, it is most likely that they come from one or more of the gravel deposits present in the Quaternary sequence described above. We pointed out that the gravel terrace contains cryogenically fractured gravels. Frost cracks are also observed on several rolled artefacts. Furthermore, a number of those artefacts are out of phtanite and this may constitute an additional argument pro association. Phtanite was seen to be part of the natural gravel terrace suite and an indication of its upper catchment in the Brabant Massive. While the spatial distribution of this raw material type across Middle Palaeolithic settlement systems has never been studied in any detail, the phtanite artefacts might suggest an original site location in the upper Dyle valley where it was eroded and redeposited downstream.
Of more importance, however, is the precise stratigraphic position of the fresh artefacts which must have been derived from a (near-) primary context. In the account above we have seen that the earliest Pleistocene precursor of the river Dyle has incised its course into Tertiary sediments, leaving a rather steep-sloped plinth of Oligocene sands in the southeastern part of RTH-1. The evidence from B6 at RTH-2 might be an indication of the same phenomenon, i.e. the presence of this elevated substrate which we suggested to have been the specific target of the 1970s exploitation. If this is the case indeed we can easily see why the archaeological evidence would come from precisely that area: a location at an elevated position above the edge of a floodplain would be hardly surprising.

The basal part of the Lower Valley Fill sequence at RTH-1 suggests a landscape with low levees and shallow gullies and depressions. We have interpreted the yellow-brown loam in several cores from central RTH-1 as the basal fill of such a depression. Cryoturbation at the top of this loam suggests stadial conditions during which aeolian redeposition of white sands both in the depression and on the southern plinth occurred. This was followed by serious relaxation of climatic conditions as evidenced by the pedogenetic weathering at the top of those redeposited sands and by the deposition of organic, peaty material shown in C15.

This interstadial palaeolandscape is present at elevations between +4 m asl (north) and +5.5 m asl (south) at RTH-1. If the RTH-1 sequence can serve as an adequate model for the larger area we believe that this is the stratigraphic window in which the fresh artefact assemblage of Rotselaar – Toren ter Heide must be placed for the following reasons:

1) It is the only instance in the entire Pleistocene sequence to hold evidence of interstadial conditions during which the presence of humans in this part of northwestern Europe is more likely.

2) It is the only portion of the stratigraphic sequence to evidence riverbank conditions allowing the occupation of higher dry ground. The overlying part of the sequence consists exclusively of high energy fluvial deposits in which the presence of an occupation in primary context would be surprising.

3) None of the fresh artefacts bears any trace of cryogenic fracture, indicating that they were deposited under mild climatic conditions and that they have been rapidly covered as to be protected from posterior periglacial processes.

4) By contrast, many of those artefacts show a deposition of iron oxide sometimes including particles of manganese on one of their faces. The geochemical analysis of this adhering iron oxide is discussed below.

4.2. Geochemical analysis

In order to further investigate the likelihood of stratigraphic association between the fresh lithic artefacts and the fill sequence of a shallow depression such as in RTH-1 C15, we have compared the geochemical signatures of both the sediments from this stratigraphic window and of the diagenetic accretion on two flint artefacts from the 1970s collection, a single convex side scraper and a small amygdaloid handaxe (Fig. 8).

We have sampled the C15 sediments in a window between 4.5 m and 6 m below surface, stratigraphically ranging from the sands of CSU200 to CSU267 at the base (Fig. 3). In Fig. 9 the relative frequencies of elements and compounds of the various stratigraphic and archaeological units that were analyzed are given. A first observation of interest is the relatively important presence of phosphorus in the accretions whereas it is completely absent from the surrounding sediments. It is presently unclear how this should be explained.

We proceeded, first, by producing simple distinction profiles for the CSUs. The cell frequencies were recalculated as Z-scores using column averages and standard deviations. This allows to distinguish CSUs with relative enrichment (positive Z-scores) and relative deprivation (negative Z-scores) of a given element. These profiles are represented in Fig. 10 as line plots. It is clear that three groups can be identified among the CSUs whereby CSU267 stands out from all the others in its strong enrichment values of most elements. For the two lithic artefacts average raw percentages were calculated and overlain as an analogical line graph on Fig. 10, using a logarithmically scaled secondary axis. This allows a comparative assessment of the best represented elements and their relative representation in the measured CSUs. It is quite straightforward to see that the geochemical profile of the accretion has the best fit with CSU267, the yellow-brown loam. The latter is particularly enriched in precisely the major elements represented in the capping.

It can be concluded that from a geochemical perspective the stratigraphic association of the fresh lithic artefacts with a yellow-brown loam such as in RTH1 C15 is most likely.

4.3. The charcoal horizon

As indicated earlier we have not found any direct evidence, in the form of lithic artefacts, of Pleistocene human presence at RTH-1. Yet, there is the presence of charcoal in a number of cores to consider. This can be alternatively explained as the consequence of blown-out hearths that were fired by humans or as a natural bushfire. The former alternative is in fact not unthinkable as the charcoal is stratigraphically associated with the yellow-brown loam which we have identified as the most likely window of occupation.

The distribution of cores containing charcoal is shown in Fig. 5. It is remarkable that they are all situated on the eastern edge of the depression in which the yellow-brown loam has been deposited. In the case of a natural bushfire we might imagine airborne transport by western winds of charcoal particles originating from burning vegetation in the dry depression bottom. However, under that scenario the exclusive association of the charcoal with the yellow-brown loam seems unlikely. We should expect small charcoal particles to be distributed over a much larger portion of the landscape and to occur in contemporaneous sediments as well. This may be an argument in favour of strictly local hearthfires lit by humans in or around the depression. On the other hand, the exclusive association with the depression may only be apparent as the larger part of that landscape may not have been preserved. For example, it has been noticed before that the yellow-brown loam itself has been eroded in places by the gravel terrace, as evidenced in C61 and C72.

As a matter of fact, micro-charcoals are distributed across a much larger part of the Eastern Branch of the Flemish Valley. The full details of this await publication (Van Peer et al., In Preparation) but at all of our four coring locations so far (Fig. 1) we have encountered exactly the same association of small charcoal particles with a thin loamy deposit with posterior oxidation. Furthermore, this association is part of the same event sequence at each of those locations. It is always situated at the top of fluvial overbank deposits that may vary in grain size from silt to sand, marking the end of that depositional phase. In its turn, it is overlain by homogeneous fine sands of probable aeolian origin indicating drier climatic conditions. We propose to coin this distinct phenomenon as the Charcoal Horizon.

The sequence at Boortmeerbeek-Dreef, some 10 km downstream from RTH-1 is particularly instructive. In C15 at this locale, the Charcoal Horizon is stratified immediately above the uppermost layer of a sequence of three important peat accumulations. Their pollen analysis is still in progress but at this stage it is clear that the spectra are fully interglacial. In its turn the Charcoal Horizon is underlying yellow-green fine to medium sands with fossil bioturbations at their top. This evidence strongly suggests a chronological position at the very end of the Eemian Interglacial.
Thus, even if we have to arrive at the conclusion that the Charcoal Horizon at RTH-1 is not a confirmation of human presence in the stratigraphic window that we consider likely to hold such evidence, it obviously represents an important bit of information with regard to the chronostratigraphic interpretation of the sequence.

5 Chronological implications

The stratigraphic position that we have come to infer for the fresh artefact assemblage of Rotselaar – Toren ter Heide urges us to reconsider the dating of the site and, related to that, the presumed association of the lithics and the faunal remains (Van Peer, 1982; Van Neer and Geronpré, 1991).

In their report on ESR-dating of some faunal assemblages from the Eastern Flemish Valley Geronpré et al. (1993) wrote on the collection of Rotselaar – Toren ter Heide that ‘collectors noted that most fossils appeared when a more gravelly fraction was pumped up (1993: 151)’ (Fig. 11). If this assertion is reliable, the faunal remains can either derive from the gravel terrace or the shallow gravel lags documented at

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Fig. 8. Amygdaloid handaxe from Rotselaar - Toren ter Heide (collection Wim Wouters) showing the area of iron oxide deposition on one of its faces.

Fig. 9. Data for the diagenetic deposition on the artefacts are corrected for the contamination with flint measurements, according to the procedure explained in footnote 1. Values for CSUs are averages of different samples measured for each CSU. Shaded columns are not comprised in the geochemical profiles of Fig. 10.

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5 Mr. Jos Dormaels who was one of the collectors confirmed this information to us during an interview on May 2, 2017.
the base of the Lower Valley fill. This presumed association most probably implies one or more secondary, reworked contexts for the fossils and such would by no means be an exceptional occurrence in the Flemish Valley (Gautier, 1985). It also implies that there is no association with the fresh lithics for which we have inferred a different stratigraphic position above. Under this scenario, the two ESR age estimations that were obtained from two plates of mammoth molars have no relevance at all for the lithic industry. These estimations are 52 ka for sample 45 and 43.5 ka for sample 46 (Germonpré et al., 1993). In this form the dates have little value but they might suggest a GS12/13 age for at least part of the fauna and a stratigraphic association with the gravel terrace of which a middle pleniglacial age is not unlikely.

The fresh artefact assemblage can quite confidently be placed in a stratigraphic window below the gravel terrace. The yellow-brown loam depression at the base of the Quaternary sequence at RTH-1 hints at a topographical and climatological environment, an analogue of which Neanderthals might have occupied at RTH-2. If the Charcoal Horizon that was deposited during the existence of this landscape is a regional marker horizon indeed it is an important key to the chronostratigraphical correlation of the occupation site, dating it to the end of the

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6 Unfortunately no standard errors are given.
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Eemian (see Fig. 7). While we must be careful with inter-regional correlations the Charcoal Horizon in the Eastern Branch of the Flemish Valley recalls the LEAP-event documented in Central European varve sequences (Sirocko et al., 2005). This late Eemian aridity pulse is marked by the presence of alternating sand/silt and charcoal layers within a 468 yr-varve sequence at the onset of the Last Glacial 118,000 yrs ago. The lower organic sands at RTH-1 on top of which the yellow-brown loam has been deposited then are full Interoglacial deposits, contemporaneous with the Eemian peats at Boortmeerbeek.

All this evidence indicates that the Eemian Eastern Branch of the Flemish Valley was a marshy lowland which, however, did attract Neanderthal groups when it dried out at the beginning of the Last Glacial. It is not excluded that part of the faunal collection was actually associated with such occupations, given its species composition. Mammoth, woolly rhinoceros, steppe bison and horse are present. Other less well-represented species include reindeer, giant deer, wolf, cave lion and hyena (Van Neer and Gernonpré, 1991).

6. Discussion and prospects

The stratigraphic reconstruction of this Middle Palaeolithic assemblage from Rotselaar – Toren ter Heide previously without context, opens up various interesting perspectives.

Foremost, obviously, it provides the empirical grounds to establish the age of the site with the ‘common’ degree of confidence for cross-dating. Rotselaar – Toren ter Heide is now the only site from the northwestern lowland fringe of the European continent for which a precise chronostratigraphical position can be proposed on reasonably solid grounds. In that capacity it becomes relevant to historical interpretation and the site provides additional support for the claim that Neanderthals were capable of and effectively did use Eemian alluvial lowlands (Locht et al., 2016). At Rotselaar, we seem to be witnessing a spatial association with closed depressions and low levees. The precise lay-out of this site-context, obviously, has to remain elusive. In particular, it is by no means certain that the fresh artefact assemblage would actually represent one short occupation event. The stratigraphic reconstruction exercise presented here is valid in the first place for artefacts with an ironoxide deposition present and the association of the others is only an assumption. Interestingly, on the basis of the small sample of artefacts that we have still available for study there would seem to be an association of this taphonomic feature with one particular flint type. This is a fine-grained shiny grey-green flint with a dark, blackish rolled cortex. On the other hand, a large diversity of raw materials is represented in this assemblage including Wommersmert quartzite, micaceous quartzite, and different flint types. Are these indications that this is a mixed assemblage of different occupation events which may have been spatially segregated? In that case Rotselaar – Toren ter Heide is a low-density site recalling the Eemian site of Caours (Antoine et al., 2006), among others, and it begs the question as to how exactly Neanderthals exploited such alluvial lowlands.

With this question unresolved there is little point in searching cultural affiliations for the Rotselaar – Toren ter Heide assemblage. Previously, it has been identified as Mousterian of Acheulean Tradition (Van Peer, 1982) but this was only based on the fact that handaxes were present. Some of the handaxes seem to exhibit Micoquian traits just as well, e.g. the object geochemically analyzed here, suggesting similarity with early glacial assemblages of the Paris basin (Blaser and Chaussé, 2016). However, the northern France case particularly demonstrates that as our chronologies become more refined the spatio-temporal patterning of Middle Palaeolithic variability becomes ever more intricate (Locht et al., 2016). This makes the understanding of local formation processes at such sites ever more urgent (Turq et al., 2013).

Finally and importantly, this Rotselaar – Toren ter Heide case demonstrates that it is possible to go much further in the post hoc study of surface assemblages than we are inclined to think. By the same token, it shows that feasible survey strategies can be devised for deeply buried archaeological sites without soliciting exuberant logistical and financial demands. In particular, the present paper demonstrates how palaeoeto graphical modelling at high resolution can be achieved, leading to important surface restrictions of zones that require further investigation. In the context of developer-led archaeological investigation, in particular, this can prove to be a significant methodological contribution.

Acknowledgements

This is publication no. 1 of the Flemish Valley Survey Project, funded by the Research Council of KULeuven (OT/14/031). Geochemical analysis was funded by the Flemish Research Foundation (FWO) under grant number G.0cC43.15. We express our gratitude to members of Prehistoric Archaeology Unit for their contribution to the Flemish Valley Survey Project: Bart Vannomントントト and Jo Claeyx. The following benevolent collaborators assisted in the fieldwork: Bart Wils, Frans Gyssenberg, Gabriel Ronse, and Carlotta Van Peer. Veerle Lauwers of WINAR regional archaeological service kindly provided the picture of Fig. 11. We acknowledge WINAR for mediating negotiations with various governmental administrations and Geosonda N.V. for their optimal collaboration in the fieldwork. Special thanks to Wim Wouters for donating artefacts to Prehistoric Archaeology Unit and to Jos Dornmaels for granting us access to his collection.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jasrep.2017.10.017.

References