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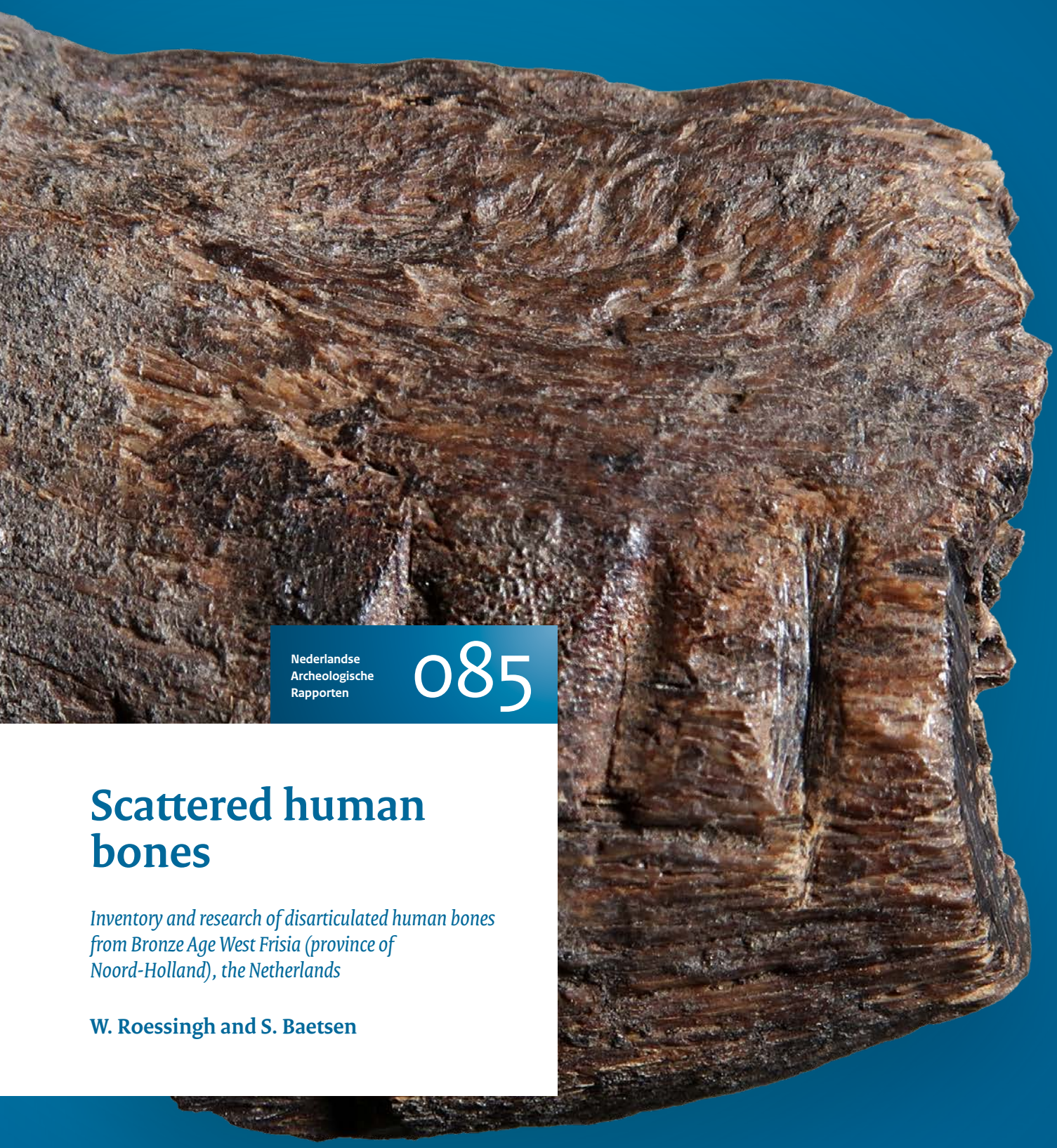

Nederlandse
Archeologische
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085

Scattered human bones

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W. Roessingh and S. Baetsen

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Contents

Summary

The eastern part of West Frisia (province of Noord-Holland, the Netherlands) was intensively inhabited in the Middle and Late Bronze Ages, between c. 1600 and 800 BC. Archaeologists have been excavating in the region for more than 50 years, uncovering almost 90 ha of the Bronze Age landscape. The excavation plans are impressive and reveal a complete cultivated landscape, with many houses, ditches, plots of arable land, pastures and structures for storage. The area must have been one of the most densely populated areas in the Netherlands during the Bronze Age. Barrows are also known in the region, but in relatively low numbers compared to the estimated population size. One of the interesting questions is therefore: What is the nature of the West Frisian Bronze Age funerary ritual? Archaeologists regularly find disarticulated human bones in West Frisian settlements, but these intriguing finds have never been studied in detail. In this study, one of a series of studies referred to as pre-Malta research, we focus on these human bones in order to gain a better understanding of the mortuary practices.

We made an inventory of all disarticulated human bones from West Frisian Bronze Age settlement contexts and ring ditches around barrows and found that disarticulated human bones have been found in many different types of contexts, but mostly in settlement ditches, house ditches and ring ditches. This may not come as a surprise, given that settlement ditches dominate the settlement sites and that ditches around houses and barrows have generally been intensively excavated. We therefore do not think there was a pattern in the deposition of the bones in specific types of contexts; they are found amongst 'normal' settlement waste.

After the inventory process was complete, the human bones were analysed by a physical anthropologist, who found that, although many different skeletal elements are present in the assemblage, fragments of the cranium and long bones are dominant. These are the most robust and recognisable parts of the skeleton, which may explain this overrepresentation. During this first step in the analysis, the physical anthropologist recognised traces of cutting, gnawing and weathering. These traces were investigated in detail by different other specialists.

Traces of cutting were also recognised by the microwear specialist. Some of these cuts were probably created in the Bronze Age, probably with bronze tools. Because of the low numbers of traces and the lack of reference material, it was not possible to reconstruct the exact purpose of the cuts. The cuts may be an indication of a specific activity, for example the removal of soft tissue or the severing of tendons. Gnawing marks on some of the bones are evidence that (parts of) the body of the deceased were exposed at the ground surface, probably shortly after death. Traces of weathering and secondary use were also identified on some of the bones. It is unclear for what purposes these bones were used. In one case, it is likely that the bone, a fragment of a cranium, was used as a tool. A selection of the bones with traces was analysed with X-ray fluorescence (XRF) and scanning electron microscope with energy-dispersive X-ray spectroscopy (SEM-EDX). The main goal of these analyses was to obtain more insight into the material used to create the cuts. Establishing the tool material proved to be difficult. During the microwear analyses, traces of cutting with what was probably a bronze tool were identified, but during the XRF and SEM analyses, no particles of copper or tin were identified. In some cases, minerals from the soil have become trapped in the cutmark, which is evidence that the bone had been deposited in the ground without adhering soft tissue.

Finally, the internal preservation and age of the cuts was analysed. By classifying the degree of internal preservation of bones from a single context, it was possible to determine that one of the bones had a different preservation. This variation in preservation may be due to differences in the direct contexts the bones were buried in or to major changes in the burial context during the post-mortem interval (i.e. differences or changes in humidity, acidity, root activity, oxygen availability). Furthermore, it turned out to be possible to distinguish early post-mortem traces of manipulation from late post-mortem traces, using luminescence studies, and this allowed us to establish that some of the cuts were most likely made during the Bronze Age.

The various studies yielded all kinds of interesting results, but interpreting these results is a complex matter. Actually identifying traces of ancient cutting and correctly interpreting

them in terms of human actions is difficult because there are all kinds of factors that influence (human) bones, such as post-depositional processes. Experimental archaeology can offer a solution here. It is important to find out how bone reacts in different contexts and to what extent soil conditions influence the identification and interpretation of traces on bone. Experiments involving cutting into the bone, both with and without adhering soft tissue, and with different tools made of various materials, are easy to perform. The cut marks can then be examined in detail both before and after they have been buried in the soil. Experiments can also be used to determine how old and new cut marks can be distinguished from each other. Luminescence research can play an important role in this.

We conclude this study with some models that may explain the occurrence of disarticulated human bones in settlement contexts. We make a distinction between a model in which the remains are deliberately deposited and one in which they are accidentally deposited in a context. In the case of deliberate deposition, we assume that the remains had a special meaning. We propose a number of different scenarios for what that special meaning might be. For example, people may have collected specific elements of the skeleton to curate. We expect that this would be evidenced by traces on the bone that may indicate special treatment of the material, and deposition of the bones in special places. In our research, we found only a few indications that point to special treatment of the human bones. In most cases, the bones appeared to have been treated no differently than household waste that ended up in features. We therefore assume that much of the human bones in settlement contexts did not receive any special treatment. In the Bronze Age, people would have regularly worked on and near the barrows, and there is a good chance that graves were destroyed during these works, as can be seen in the site of Andijk-Noord, where the remains of several individuals ended up in a ring ditch.

More research is needed to gain further insight into the burial ritual in the West Frisian Bronze Age and the significance of the isolated human bone material. We make some recommendations for this. We recommend that during fieldwork, extra attention should be paid to barrows and (in the Bronze Age) disturbed mounds and graves and that features in the vicinity of disturbed burial mounds are also examined in detail for the presence of human bone. During wet sieving the fill of house ditches, the remains of very young individuals have been found. This is a group that is underrepresented in formal burial contexts and we therefore recommend that the fill of these features should be wet sieved more often to provide new insights into the funerary ritual. The traces on bones tell a story in themselves. We recommend that, in order to properly identify and interpret these traces, additional experimental research should be conducted to allow further insight into the life cycle of the bones and the way Bronze Age communities treated their deceased.

Samenvatting

Het oostelijk deel van West-Friesland (provincie Noord-Holland) was een aantrekkelijk woongebied in de midden- en late bronstijd, tussen ca. 1600 en 800 v.Chr. Archeologen doen al vele decennia onderzoek naar dit laat-prehistorische cultuurlandschap waarvan ondertussen al bijna 100 hectare is opgegraven. De onderzoeken hebben indrukwekkende overzichten opgeleverd van een compleet ingericht landschap met vele huisplaatsen binnen uitgestrekte slootverkavelingen met akkers, weilanden en opslagstructuren die verspreid in het landschap liggen. Kenners schetsen dit gebied als de dichtstbevolkte regio van Nederland in de bronstijd.
Grafheuvels daarentegen zijn wel bekend, maar in veel lagere aantallen. Het is dan ook de vraag hoe de bewoners met hun overleden familieleden zijn omgegaan.
In de West-Friese nederzettingen zijn de afgelopen jaren met enige regelmaat losse, menselijke botresten opgegraven. Tot voor kort waren deze intrigerende vondsten nog niet integraal bestudeerd. Daar komt met deze studie nu verandering in. In dit onderzoek hebben we ons gericht op losse botten uit nederzettingscontext, met als belangrijkste doel meer te weten te komen over het grafritueel en de omgang met de overledenen in de West-Friese bronstijd.
In het kader van deze Pre-Malta-studie zijn alle menselijke resten uit West-Friese nederzettingscontext geïnventariseerd, inclusief de resten die in ringsloten rond grafheuvels zijn gevonden. Uit deze inventarisatie blijkt dat de botten uit verschillende contexten afkomstig zijn. Ze zijn aangetroffen in nederzettingsgreppels, in huisgreppels en in ringsloten rond grafheuvels. Verwonderlijk is dat niet, immers nederzettingsgreppels zijn in grote aantallen opgetekend en huisgreppels en ringsloten zijn in de regel intensief onderzocht. We zien dan ook geen duidelijk patroon in de depositie van los, menselijk botmateriaal in specifieke contexten. De botten worden doorgaans tussen het 'normale', huishoudelijk afval aangetroffen.
Na deze inventarisatie is het botmateriaal geanalyseerd door een fysisch antropoloog, waarbij per skeletelement de belangrijkste kenmerken zijn genoteerd. In het assemblage zijn diverse elementen van het skelet aanwezig; fragmenten van schedels en lange beenderen domineren in de dataset. Dit zijn ook de meest robuuste en herkenbare delen van het skelet. Tijdens deze eerste onderzoeksfase herkende de fysisch antropoloog snijsporen en sporen van vraat/verwering. Deze sporen zijn vervolgens in meer detail onderzocht door diverse specialisten.
De gebruikssporenspecialist identificeerde ook enkele snijsporen als relicten die vermoedelijk in de bronstijd waren toegebracht. De geringe hoeveelheid snijsporen maakte het niet mogelijk te achterhalen wat het doel van het snijden is geweest. Ook ontbreekt het nog aan voldoende referenties om gefundeerde conclusies daaraan te verbinden, maar te denken valt aan het lossnijden van pezen om ledematen uit elkaar te halen, ontvlezing of bewerking van het bot.
Vraatsporen op enkele botten zijn een duidelijke aanwijzing dat de overledene (of overblijfselen daarvan) vermoedelijk vrij kort na de dood aan het oppervlak heeft gelegen. Ten slotte vertoonden enkele botten sporen van verwering en secundair gebruik. Over de aard van dat gebruik tasten we in het duister, maar in één geval lijkt een stuk schedel gebruikt te zijn als een werktuig.
Een kleine selectie van menselijke botten met sporen is met röntgenfluorescentie (XRF) en elektronenmicroscopie (SEM-EDX) onderzocht. Met XRF is de elementaire samenstelling van het oppervlak in en rond de snijsporen gemeten. Met SEM zijn deze sporen op het bot gedetailleerd, in hoge resolutie, bekeken. Het doel van beide onderzoeken was te achterhalen met welk (contact)materiaal (brons, vuursteen of anderszins) de snijsporen zijn toegebracht, maar dit bleek een lastige opgave. Het gebruikssporenonderzoek leek uit te wijzen dat enkele snijsporen met een bronzen werktuig waren toegebracht. Resten van koper of tin werden echter niet vastgesteld tijdens het XRF- en SEM-onderzoek. Wel konden enkele natuurlijke elementen afkomstig uit de kleibodem in de sporen worden geïdentificeerd. Dit is een aanwijzing dat het bot, zonder zacht weefsel, in de bodem terecht is gekomen.
Tot slot is van enkele botfragmenten met sporen de conserveringsgraad en de relatieve ouderdom vastgesteld door middel van luminescentie. Door het classificeren van de conserveringsgraad van enkele botten uit eenzelfde context is vastgesteld dat een van de botten een afwijkende conservering had. Mogelijk dat dit

skeletelement (of alle andere fragmenten) in een context heeft gelegen met een afwijkende bodemgesteldheid. Aan de hand van verschillen in de intensiteit van luminescentie is van een klein aantal snijsporen de relatieve ouderdom vastgesteld. Dit maakte het mogelijk om enkele snijsporen met enige zekerheid als 'oud' aan te merken. Deze snijsporen konden dan ook worden toegeschreven aan handelingen in de bronstijd.
De verschillende studies leverden allerlei interessante resultaten op, met één belangrijke boodschap, namelijk dat dit het een complexe materie is. Het daadwerkelijk identificeren van oudtijdse snijsporen en het gefundeerd interpreteren in termen van menselijk handelen is weerbarstig. Er zijn allerlei factoren van invloed op het menselijk botmateriaal, denk aan de post-depositionele processen, die het eenduidig verklaren bemoeilijken.
Experimentele archeologie kan hier uitkomst bieden. Het is van belang te achterhalen hoe bot reageert in verschillende contexten en in hoeverre de bodemomstandigheden van invloed zijn op de identificatie en interpretatie van sporen op bot. Experimenten waarbij met verschillende werktuigen van diverse materialen wordt gesneden in het bot (met en zonder zacht weefsel) zijn eenvoudig uit te voeren. De snijsporen kunnen dan in detail worden onderzocht voordat deze in de bodem belanden en na begraving. Ook kan met behulp van experimenten worden bekeken hoe oude en nieuwe snijsporen van elkaar kunnen worden onderscheiden. Luminescentieonderzoek kan daarbij een belangrijke rol spelen.
Deze studie sluiten we af met enkele modellen die mogelijk een verklaring zijn voor het voorkomen van losse menselijke resten in nederzettingscontext. Hierbij maken we een onderscheid in een model waarbij de resten bewust en onbewust in een context zijn gedeponeerd. Bij een bewuste depositie gaan we ervan uit dat de resten een speciale betekenis hadden. Om te achterhalen of iets een speciale betekenis had, hebben we verschillende scenario's uitgewerkt. Men kan bijvoorbeeld alleen specifieke elementen van het skelet hebben verzameld en die langere tijd hebben bewaard. Sporen op het bot kunnen duiden op een speciale behandeling of bewerking van het materiaal en de botten kunnen ook op speciale plaatsen zijn gedeponeerd. In ons onderzoek hebben we slechts enkele aanwijzingen gevonden de wijzen op een bijzondere behandeling van het menselijk botmateriaal. In de meeste gevallen lijkt het materiaal niet anders te zijn behandeld dan het huishoudelijk afval dat in grondsporen terecht is gekomen. We gaan er dan ook vanuit dat veel van het losse menselijke botmateriaal in nederzettingscontext geen speciale behandeling heeft gekregen. Op en nabij de grafheuvels met (formele) begravingen vonden in de bronstijd regelmatig werkzaamheden plaats. De kans is groot dat hierbij graven verstoord zijn. Een goed voorbeeld hiervan zien we in Andijk-Noord, waar de resten van verschillende individuen in de ringsloot terecht zijn gekomen.
Om meer inzicht te krijgen in het grafritueel in de West-Friese bronstijd en de betekenis van het los menselijk botmateriaal is meer onderzoek gewenst. Hiervoor doen we enkele aanbevelingen. Tijdens veldwerk is het van belang dat extra aandacht wordt besteed aan grafheuvels en (in de bronstijd) verstoorde heuvels en graven. Daarbij is het van belang dat grondsporen in de nabijheid van verstoorde grafheuvels in detail worden onderzocht op de aanwezigheid van menselijk botmateriaal. Het zeven van vondstrijke contexten zoals huisgreppels kan resulteren in nieuwe inzichten in het grafritueel. Zo werden resten van zeer jonge individuen in de vulling van huisgreppels gevonden, een groep die ondervertegenwoordigd is in een formele grafcontext. De sporen op het botmateriaal vertellen een verhaal op zichzelf. Om die sporen goed te identificeren en interpreteren, is het van belang dat meer experimenteel onderzoek wordt gedaan. Daardoor krijgen we meer inzicht in de levensloop van de botten en de omgang van de bronstijdgemeenschappen met hun overledenen.

1 Introduction

W. Roessingh

1.1 Why study disarticulated human bones from West Frisian Bronze Age settlements?

Bronze Age research has a long tradition in the Netherlands, starting with barrow research on the sandy soils in the central and northern parts of the Netherlands as early as the 1910s.[1] In the decades that followed, other parts of the Netherlands became subject to Bronze Age barrow research, such as Toterfout-Halfmijl[2] in the province of Noord-Brabant and Zwaagdijk[3] in the region West Frisia (province of Noord-Holland). After the Second World War, as the number of large-scale projects, such as land consolidations and the construction of new housing estates and motor ways, dramatically increased, large areas were excavated. During these excavations, impressive settlement sites were encountered. Together, the excavations of settlement sites and barrows provide us with a relatively detailed understanding of Bronze Age societies in the Netherlands.

For archaeologists studying Bronze Age societies, the relationship between the living and the dead has always been an important research theme, e.g. how status and identity in life shaped funerary ritual[4], how funerary landscapes were created and maintained,[5] and to what degree people received a formal burial.[6] The latter is an important question, because during the Middle Bronze Age (1800-1100 BC) the ratio of houses to barrows shows a discrepancy. In West Frisia, for example, while hundreds of houses have been excavated in large-scale excavations, only few barrows have been discovered. Similar observations can be made for the Dutch river area.[7] This has led researchers to conclude that only a small segment of the Bronze Age inhabitants of the Netherlands received burial in a barrow. Estimates indicate that as little as 15% of the Middle Bronze Age population received such a burial.[8] This raises the question "What happened to the supposedly remaining 85% of the deceased in the Middle Bronze Age?"

The answer to this question may lie in a more thorough investigation of other possible mortuary practices. During excavations of Bronze Age sites, for example, disarticulated human bones are sometimes found in settlement features and in the ring ditches of barrows. This is especially the case in regions that have relatively good preservation circumstances, such as the eastern part of West Frisia (Fig. 1.1). In this former wetland, an impressive Bronze Age cultural landscape was uncovered over the course of many excavations, primarily as the result of large-scale land consolidations. Due to the calcareous soil, organic material, such as bone, is still well preserved here. This makes this region very suitable for an inventory and pilot study of these disarticulated human bones.

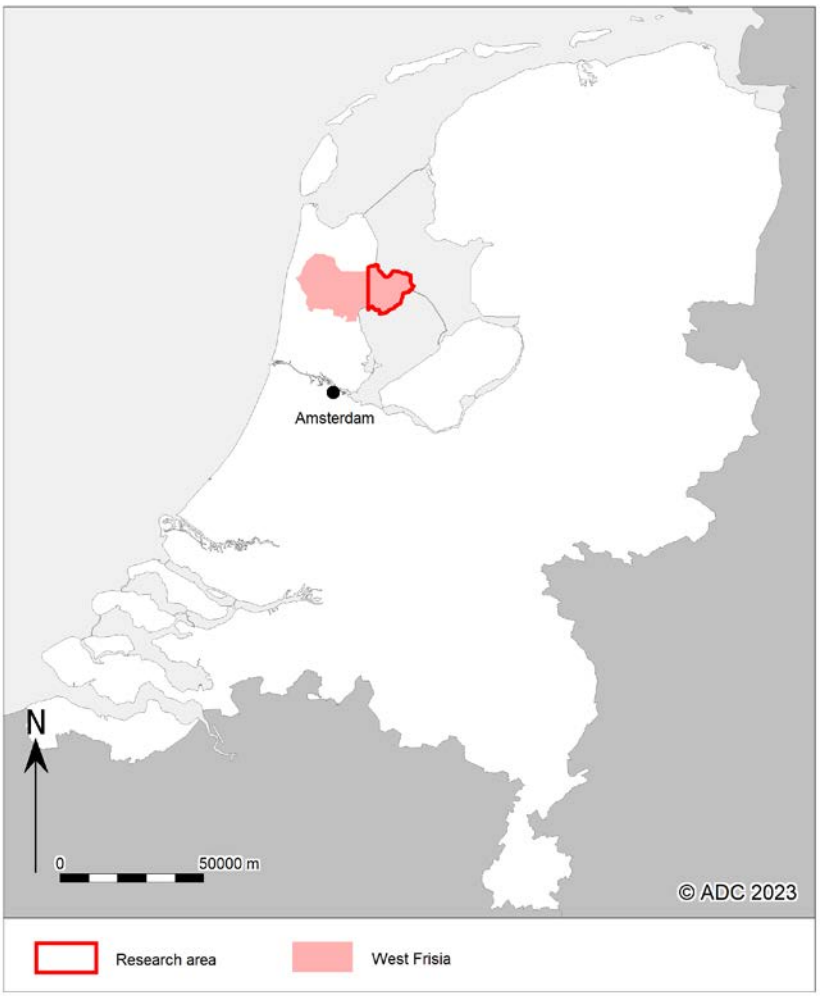

Figure 1.1. Location of the research area within the region of West Frisia in the Netherlands.

This project is one of the series of studies referred to as Pre-Malta research ('pre-Malta onderzoek'), and as such falls under the programme Knowledge for Archaeology of the Cultural Heritage Agency of the Netherlands (RCE). The programme aims to obtain datasets

1 See, for example, Holwerda 1907; Van Giffen 1920.
2 Glasbergen 1954a/b.
3 Van Giffen 1944.
4 Lohof 1994; Drenth & lohof 2005; Fontijn *et al.* 2013.
5 Bourgeois 2013; Doorenbosch 2013.
6 Lohof 1991; Theunissen 1993.
7 Theunissen 1999; Arnoldussen 2008.
8 Lohof 1991; Theunissen 1993.

from excavation data before the introduction of the Valetta convention in 2007. With the use of currently developed research methods and techniques, the Pre-Malta research programme enables the study of archaeological remains from old excavations, which means that substantial new knowledge can be obtained about the past.

1.2 Bronze Age research in West Frisia

1.2.1 Research history

West Frisia has proved to contain one of the best preserved Bronze Age cultural landscapes in the Netherlands. The presence of Bronze Age communities in the region was first observed in the beginning of the 20*th* century, when several flint sickles were found on arable land.[9] In 1937 a student noticed some suspicious elevations in the terrain near the village of Zwaagdijk. In the beginning of the 1940s some of these elevations were investigated by Van Giffen of the Biologisch-Archeologisch Instituut (BAI) from the University of Groningen. During this research various Bronze Age barrows were discovered (Fig. 1.2).[10] Until the 1960s, archaeological research was mostly restricted to the excavation of barrows.[11] The BAI was the first to investigate these barrows, followed by the Instituut voor Prae- en Protohistory (IPP) from the University of Amsterdam.

By the 1950s, quite a lot of information had been gathered on the Bronze Age barrows of West Frisia, but the location and nature of the associated settlement sites was still unknown. This changed from the mid-1950s onwards, when large-scale soil surveys were performed in the region. During these surveys, for the first time, remains of settlement were found. The results of the survey and the locations of these ancient habitation sites were published on the soil map by Ente.[12] When chance finds from one of the habitation sites were brought to the attention of the IPP, this resulted in the first large-scale excavation of a settlement site, namely, Hoogkarspel-Tolhuis (Fig. 1.3 and Fig. 1.4, left). From the start, the results of Bronze Age settlement research in West Frisia were promising.

The true impetus to investigate this well-preserved Bronze Age cultural landscape was the land consolidations planned for the 1970s. In this period about 30 ha of the Bronze Age landscape was excavated.[13] The Rijksdienst voor het Oudheidkundig Bodemonderzoek (ROB)[14] launched a large research project in West Frisia. In 1972, field surveys were planned around Andijk, followed by the excavation of two sites with high densities of finds, in 1973 (Andijk-Noord and Andijk-Zuid: Fig. 1.3). In this way, Andijk formed the prelude to the most famous and most extensive excavation in the region: Bovenkarspel-Het Valkje (Fig. 1.3). Between 1974 and 1978, more than 15 ha were excavated (Fig. 1.4, right and Fig. 1.5). In the meantime, the IPP carried out large-scale excavations near the village of Hoogkarspel. The period of large-scale excavations by the IPP and ROB ended by the end of the decade. In 1979 and 1980, additional excavations were done at Opperdoes (Opperdoes-Noord and Opperdoes-Zuid: Fig. 1.3), where for the first time Iron Age finds were encountered.

The ratification of the Valletta Convention in 1992, provided a new incentive for archaeological research into the Bronze Age of West Frisia. During this so-called

9 Pleyte 1902.
10 Van Giffen 1944.
11 For an overview of the barrow research in West Frisia, see Steffens 2013.
12 Ente 1963.
13 Roessingh 2018, 27, Fig. 2.1.
14 Currently known as RCE.

Figure 1.2.One of the barrows at Zwaagdijk shown during the excavations led by Van Giffen (Van Giffen 1944, 195, Fig. 4).

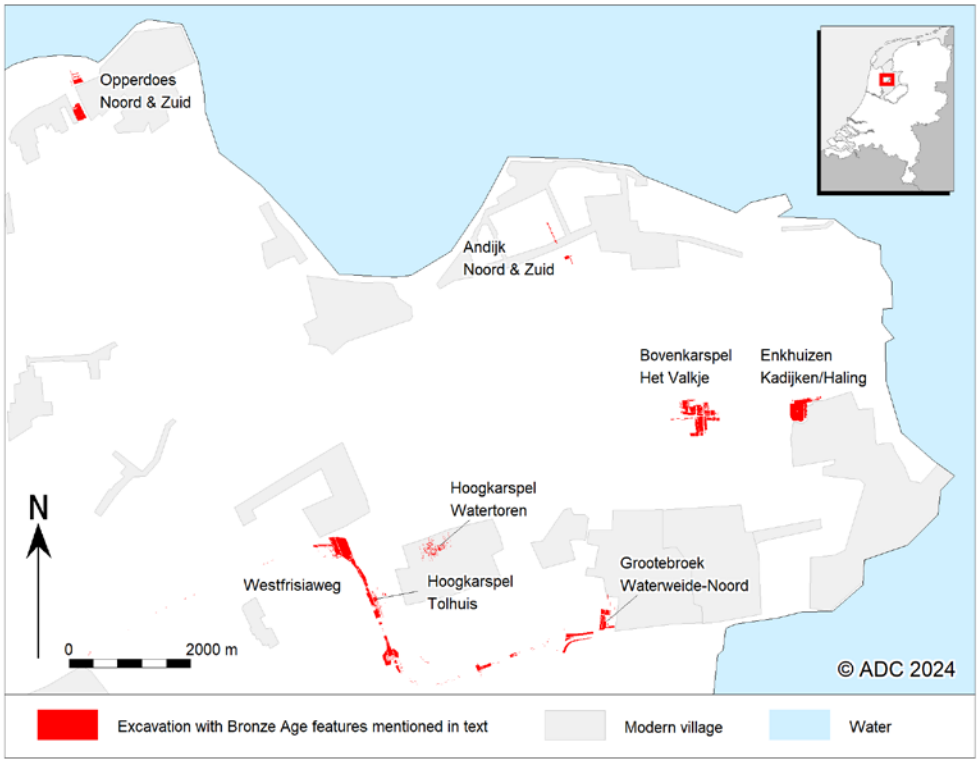

Figure 1.3. Location of the excavations in West Frisia, mentioned in the text.

Figure 1.4. Photos showing the fieldwork at Hoogkarspel-Tolhuis (left: Bakker, Woltering & Manssen 1968, 192, Fig. 1) and Bovenkarspel-Het Valkje (right: collection ROB).

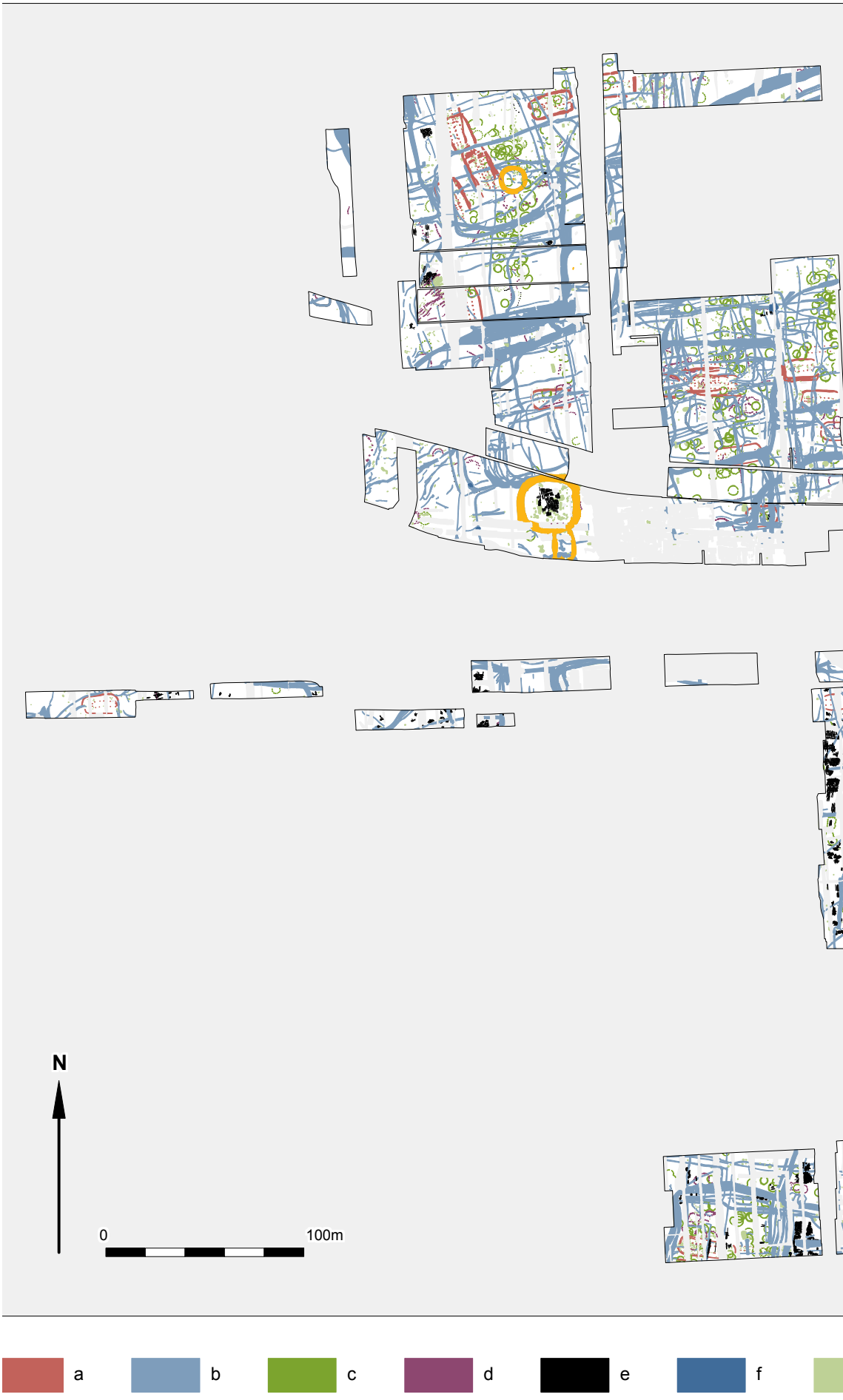

Figure 1.5. Plan view showing all the features at the site Bovenkarspel-Het Valkje. Legend: a house site, b ditch, c ring ditch, d row of pits, e row of stakes, f well, g pit, h barrow ring ditch, i plough marks, j modern feature (Roessingh 2018, 201, Fig. 6.14).

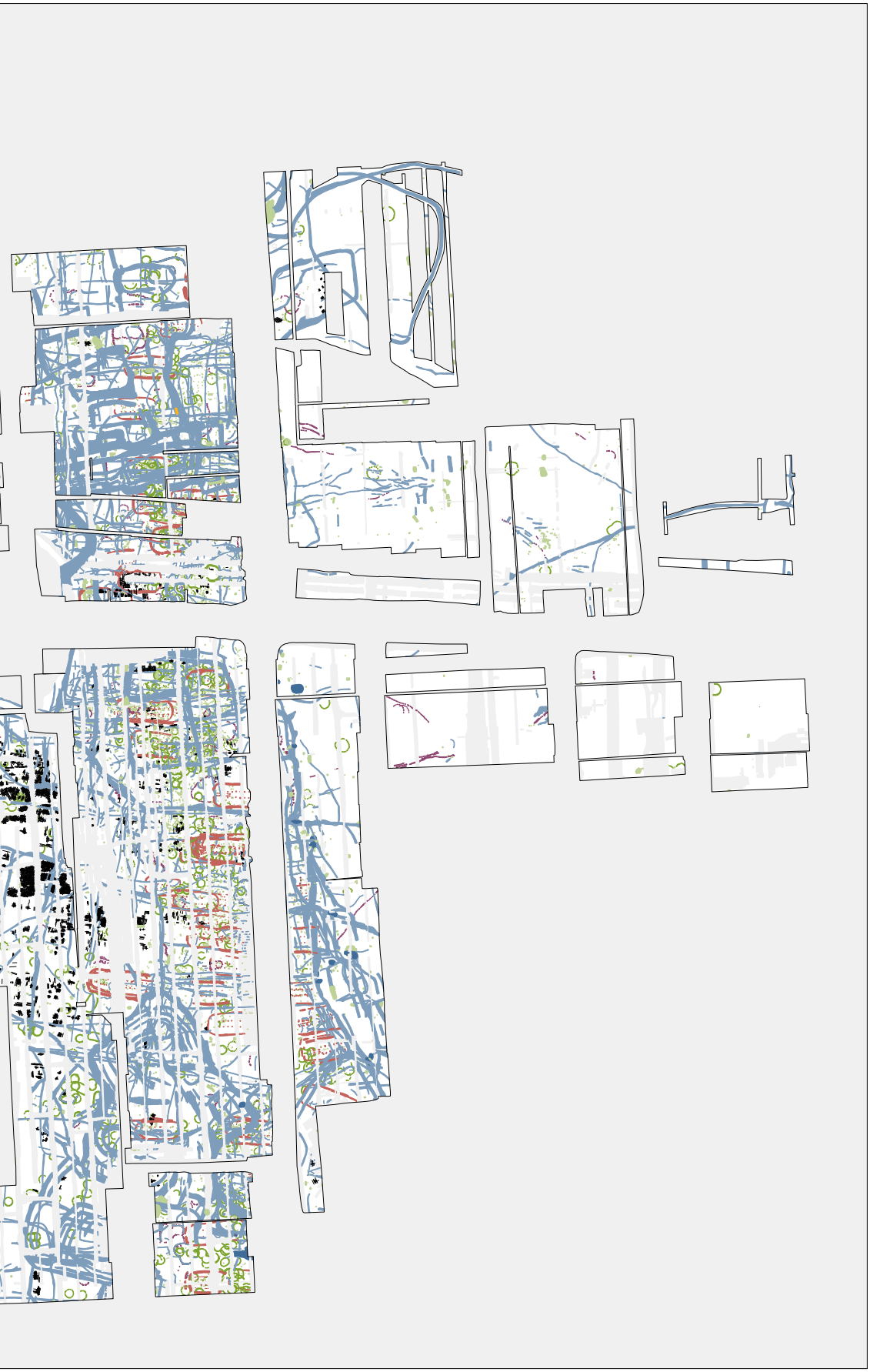

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Figure 1.6. Photos showing the fieldwork at the site Grootebroek-Waterweide Noord (Roessingh 2022, 61, Fig. 4).

development-led archaeological research no less than 60 ha of the landscape was excavated.[15] The excavations near the town of Enkhuizen around 2010 showed us that the Bronze Age cultural landscape was even more extensive than previously thought.[16] The large-scale excavations between 2014 and 2017 prior to construction of a main road called the Westfrisiaweg near the village of Hoogkarspel, illustrate this. Over a distance of 6 km, a total of 25 ha was excavated and all trenches revealed numerous Bronze Age features (Fig. 1.3).[17] The more recent excavations in the area tend to focus on specific research objectives, such as house sites, barrows and arable land (Fig. 1.6).[18]

1.2.2 Bronze Age West Frisia

From the large-scale excavations in the 1960s and 1970s and on the development-led excavations in the decades since then, the following image of Bronze Age West Frisia arises. Excavation plans show an extensive and well-preserved cultural landscape, with houses, ditch systems and barrows, covering dozens of hectares. Most of the settlements dated to the Middle Bronze Age, and up till now almost 300 house plans have been excavated. Tens of thousands people must have lived in this region during the Middle and Late Bronze Age.

The different settlement structures of West Frisian Bronze Age settlement sites are schematically illustrated in Figure 1.7. The houses have a three-ailed construction, with entrances on both short sides of the house. They have an average length of 20 m and a width of c. 6 m. Walls were probably constructed of sods. Each house is surrounded by a ditch, termed the house ditch. These ditches functioned as drainage for the house site. The sites are dominated by settlement ditches, which also have an important drainage function. Furthermore these ditches demarcate and connect different areas used by the inhabitants, such as house sites and arable land. On each site, we find small, circular structures with a diameter of c. 4 m. These structures consist of ditches or small pits. The exact function of these structures is unclear; they probably functioned

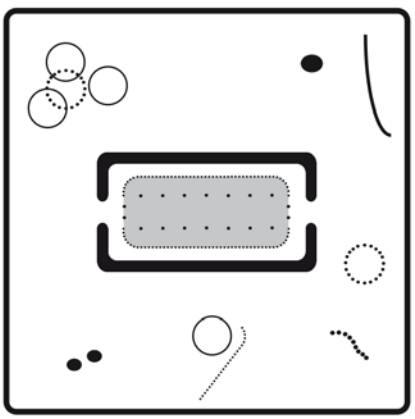


Figure 1.7. Schematic overview of the different settlement structures that can be found on West Frisian Bronze Age settlement sites (Roessingh 2018, 15, Fig. 1.2).

15 Roessingh 2022, 91.
16 Roessingh & Lohof 2011; Roessingh 2013; Lohof & Roessingh 2014.
17 Roessingh & Tol 2019.
18 See, for example, the excavations of the sites Grootebroek-Waterweide (Roessingh 2021; 2022) and Hoogkarspel-Reigersborg Zuid V (Roessingh & Jezeer 2024).

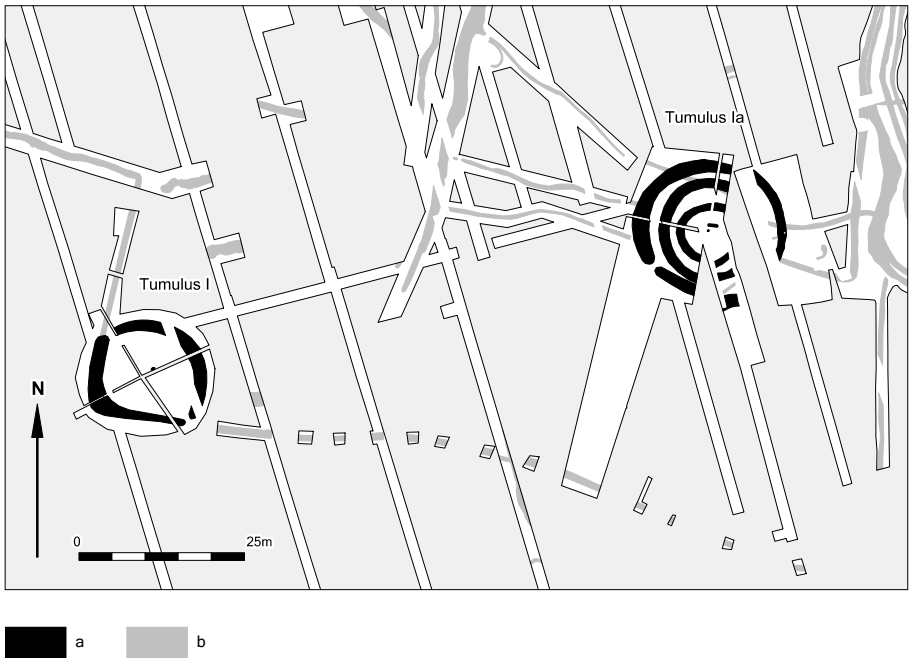


Figure 1.8. Plan view of Hoogkarspel-Watertoren, where two barrows were incorporated into the settlement landscape. Legend: a ring ditches, b settlement ditches (Roessingh 2018, 123, Fig. 4.72).

as a demarcation of storage (four-posters are absent). There are also rows of stakes or pits, as well as isolated pits or wells. These wells are mostly related to a ditch system.

We assume that the West Frisian Bronze Age communities buried only a select number of individuals in barrows. These barrows have an average diameter of 20 m, and the mound itself is seldom preserved. Around each barrow, a ring ditch was dug out. The ditches that demarcate the barrow sometimes consist of long ditch segments instead of a continuous ditch. In some cases, the demarcation of the barrow consist of smaller pits. The burials mainly consist of inhumations. Many of the excavated barrows show multiple periods of use, and because the new barrow is always a bit larger than its predecessor, the different phases can be easily reconstructed by studying the ring ditches.

Some observations can be made about the location of the barrows in the cultural landscape. Some of the barrows are located in isolation, whereas others are part of a cluster or row of funerary monuments. The barrows must have been closely connected with the land of the living. They are often literally incorporated in the settlement landscape, as can be seen at the site Hoogkarspel-Watertoren (Fig. 1.3 and Fig. 1.8). But in general, the barrows and settlements are not always so explicitly connected. Some areas might be characterised as true barrow landscapes, with no clear indications of settlements nearby.[19]

The barrows played an important role for the communities, and the location of these funerary monuments is in most cases respected by subsequent constructions. In the relatively flat terrain[20] with relatively low bushes[21], the mounds and wide deep ditches must have been visible and in use for many generations. This is also illustrated by the different barrow phases and the large number of burials.

1.3 Disarticulated human bones in Bronze Age West Frisia

Based on excavation data from the north-eastern and southern part of the Netherlands, we assume that Bronze Age communities buried only a select number of individuals in barrows: about 15% according to Lohof and Theunissen.[22] One of the intriguing questions is what happened to the other 85%. West Frisia is probably one of the best regions to answer this question, due to the excellent preservation of

19 See, for example, the many barrows near the village of Zwaagdijk (for a recent overview with references, see Van der Heiden & Feiken 2018) and the site Hoogkarspel-Tumuli (Roessingh 2018, 127-129).
20 Van Zijverden 2017, 132.
21 Van Amerongen 2016.
22 Lohof 1991; Theunissen 1993.

organic remains and the enormous dataset available from excavations. To sum up, about 90 ha of the settlement landscape has been excavated, comprising thousands of settlement features and hundreds of thousands of finds.[23] Of the 175 barrows known from the region,[24] about 40 have been (partly) excavated (Appendix IV). During these excavations, conducted by different researchers, the presence of human remains in features other than burials was observed. This makes the question that was raised in the text earlier, about what happened to the rest of the deceased, more pressing in terms of how the Bronze Age funerary ritual can be defined.

Bakker was the first to explicitly mention the disarticulated human bones, in his inventory of human remains from West Frisia. His inventory resulted in a total of 53 finds with human remains.[25] Brandt furthermore described the variety of mortuary practices in Bronze Age West Frisia, stating that '*Many human remains were found between the normal settlement 'residue' in ditches*'.[26] Runia also mentioned the disarticulated bones in settlement contexts in the publication of his chemical analyses of human remains from Bronze Age West Frisia.[27] In the following decennia, numerous large-scale excavations were carried out and human remains appeared quite regularly in settlement features. Even though the human remains did not go completely unnoticed, this dataset was never used to its full potential either.

1.4 Disarticulated human bones from other regions and periods

West Frisia is not the only region in the Netherlands where disarticulated human bones have been found in Bronze Age settlements. Most of the other Dutch Bronze Age sites with human bones were found in the Dutch river area where preservation circumstances are favourable to bone as well. A recent inventory has shown that most of these bones originate from cultural layers (which are absent in West Frisia) and were mostly found through wet sieving.[28] The other Dutch region with quite a few disarticulated human bones from settlements is the western coastal area of the province of Noord-Holland.[29]

Outside the Netherlands, the occurrence of disarticulated human bones in Bronze Age settlements is a current research topic. It seems to be a widespread phenomenon, encompassing Scandinavia (e.g. in Sweden[30]), central Europe (e.g. the Czech Republic[31] and Romania[32]) and the British Isles (Ireland[33] and England[34]). Based on these finds, interesting observations can be made on the way Bronze Age people looked after their dead.

From Britain, numerous Bronze Age and Iron Age settlement contexts have yielded disarticulated human bones. Different scientific techniques have been applied to them in order to obtain more insight into mortuary practices. Recently, Brück and Booth presented the results of radiocarbon, histological and contextual analyses of human remains from non-mortuary contexts dating from the Middle Bronze Age and Late Bronze Age in Britain.[35] Especially in the Late Bronze Age, human bones are often found in settlement contexts and other non-funerary locations, such as wells. The results of their scientific analysis have shown that some of these bones come from primary burials, while others were subjected to post-mortem treatment, such as excarnation. Some bones had been curated for a long time. These intriguing theories are based on the results of detailed studies on the bones and offer interesting new perspectives on the way we look at mortuary practices. We applied some of these analysis in our project on the West Frisian bones. In the past, some of the disarticulated bones from West Frisia were observed to show traces of post-mortem manipulation, such as gnawing marks, for example,[36] but in our analysis, we will look into these traces in more detail.

In our project, we focus on disarticulated human bones from Bronze Age contexts from West Frisia. It is important to keep in mind that the presence of such bones is, of course, not an exclusively Bronze Age phenomenon; disarticulated human bones are known from other periods as well. Examples from the Mesolithic through to modern times give us insight into the way people in the past took care of their dead and may have used or manipulated human bones through time. From the Netherlands, one of the earliest examples comes from Mesolithic Doggerland, where some barbed points made on human bone were found.[37] Another early example comes from the

23 Roessingh 2022, 91.
24 Steffens 2013, 38.
25 Bakker 1974.
26 Brandt 1980, 149.
27 Runia 1987, 214-233.
28 Verhoeven 2022, 46. In the Dutch river area, a total of 11 sites with human bones are known, with a total of 87 bones. Most of the bones (N=49) were found during a recent excavation of the site Tiel-Panovenweg A (Verhoeven 2022, 32, table 5; Baetsen & Kenemans 2023). Some of the bones were (partly) burned (Verhoeven 2022, 45, table 11).
29 A total of 20 fragments were discovered from three sites near the village of Heiloo: De Koning & Tuinman 2019, 28, 123, 151; Veselka & Moesker 2021; Nieweg 2023, 84. Most of these bones were found in a (peat/arable) layer associated with a settlement. Two fragments were found in settlement features.
30 Erikson 2005.
31 Pankowská 2009; Pankowská *et al.* 2022.
32 Harding 2000, 309.
33 Cleary 2018.
34 Brück 1995; 2006; 2017.
35 Brück & Booth 2022.
36 See, for example, Roessingh & Lohof 2011, 221.
37 Dekker *et al.* 2021.

Late Mesolithic site Hardinxveld-Polderweg, where many disarticulated human bones were found, one of them displaying cut marks.[38] In West Frisia, one of the earlies examples of manipulation of human skeletal remains comes from the Late Neolithic site Mienakker. A skeleton found at this site shows some peculiarities: multiple skeletal elements are missing, and yet there is no evidence of post-depositional processes that may have disturbed the burial. It is likely that these elements were already absent at the time of burial.[39] These examples are important for our understanding of the possible ways in which the Bronze Age inhabitants of West Frisia treated their dead.

1.5 Research goal and research questions

Based on the above, it has become evident that there is much research potential in the disarticulated bones from Bronze Age West Frisia. This is not just because of the good preservation, but also because of the quality of the contextual data. The extensive barrow research and the many hectares of excavated settlement area provide us with the possibility to understand the wide variety of mortuary practices.

The main research goal in this project was to come to a better understanding of the mortuary practices between c. 1600-800 BC in West Frisia that are not considered to be what we call 'formal burials' - i.e. burials in a barrow or graves without a monumental structure, indicated as 'flat grave'. They seem to involve other forms of treating the dead, such as excarnation, manipulation, curation, and the reopening of burials.

A further research goal is to raise awareness around non-formal or invisible mortuary practices, to gain insight into the variety of mortuary rituals practiced in regions with poor preservation circumstances and to gain insight into the field strategies and science-based analyses that are needed to further investigate this research topic.

In order to reach these goals, the following research questions were formulated:[40]

- What is the variation in type and context of the disarticulated human bones?
- Where are the disarticulated human bones found and from which period do they date?
- What is the relationship between the disarticulated human bones and the (in)complete burials that are known from the region?
- What indications can be found on the human remains of intentional human action (excarnation or manipulation) and post-depositional processes (gnawing traces or erosion)?
- What kinds of new research strategies going to be helpful in future field research?
- What is the potential for science-based methods in answering the following:
- In which period were the human remains deposited?
- What is the relationship between and origin of disarticulated human bones and incomplete burials?

1.6 Research approach and structure of the book

To answer these research questions, we first created an inventory of all disarticulated human bones from West Frisian settlements and ring ditches from barrows, by studying literature (Appendix I). Many of the West Frisian Bronze Age human bones are stored in the provincial archaeological depot of the province of Noord-Holland, in Castricum. This is where we went to relocate and then re-examine the remains. Initially, we restricted our list of bones that were to be relocated to those from settlement contexts, such as ditches and pits. But after discussions with the supervisory committee, we also included disarticulated human bones from features associated with barrows, such as ring ditches. Although these remains are associated with a funerary context, they are not formal burials and were therefore eligible to be included in our research.

In order to get more insight in the find context of the human remains, a contextual analysis was carried out (Chapter 2). The dating of the disarticulated bones was obtained by a detailed study of horizontal stratigraphy of features (Appendix I), together with a study of associated finds such as pottery (Appendix III), the typology of individual features (which provides a rough date) and available radiocarbon dates. Some of the bones have

[38] Smits & Louwe Kooijmans 2001, 419-440.

[39] Plomp 2013, 176-178.

[40] These questions connect to the following questions from the Dutch national research agenda for archaeology (Nationale Onderzoeksagenda Archeologie): what is the nature and variety of mortuary practices? (question 45) and what is the context and meaning of disarticulated human bones in and outside settlements? (question 54). Source: www.noaa.cultureelerfgoed.nl.

been radiocarbon dated as part of this project. This selection was based on the presence of peculiarities observed on the bones or the uncertain date of the context or site (Appendix II). This contextual information, together with an inventory of the excavated barrows (Appendix IV), provides insight into the relationship between disarticulated bones and burials that are known from the region.

The disarticulated human bones were all analysed in detail by the project's physical anthropologist in order to obtain insight into gender, age, diseases, etc. (for details, see Chapter 3). Special attention was paid to non-pathological traces, which were further studied by different science-based (microscopical) analyses, namely microwear (Chapter 4), SEM (Chapter 5, Appendix VI), XRF (Chapter 6) and histology and luminescence (Chapter 7). In these chapters the specific methodology is presented. All the information from this pilot study is synthesised in Chapter 8. In Chapter 9 we provide recommendations for further and more detailed studies on this intriguing subject.

1.7 Project research team

This research project was funded by the Cultural Heritage Agency (RCE) and supervised by L. Theunissen. The project was led by W. Roessingh and S. Baetsen, both working at the archaeological company ADC ArcheoProjecten. At the start of the project a supervisory committee was formed, consisting of passionate Bronze Age researchers: L. Theunissen (RCE), H. Fokkens (Leiden University) and E. Lohof. The manuscript was peer reviewed by S. Schrader (Leiden University). A team of six senior researchers worked on this publication.

W. Roessingh (ADC ArcheoProjecten) is a senior archaeologist who has been studying the West Frisian Bronze Age for about 15 years. He is involved in various excavations in the region and in 2018 he finished his PhD on West Frisian Bronze Age settlements. During his PhD he collected and analysed many data which was very useful for this study. S. Baetsen (ADC ArcheoProjecten) is a senior specialist in physical anthropology. He has studied human remains dating from the Early Neolithic through to World War I, for more than 25 years.

Four specialists have been studying a selection of the disarticulated human bones that showed non-pathological marks. The microwear analyses was carried out by A. Verbaas (Stichting LAB, Leids Archeospecialistisch Bureau). She is a senior researcher with over 15 years of experience in microwear analysis. She works as a teaching assistant at Leiden University and over the last ten years has been involved with a number of experimental research projects. I. Joosten (RCE) is a senior researcher and carried out analyses with the scanning electron microscope (SEM) analysis. Her colleague B. van Os (RCE), also a senior researcher, was responsible for analyses with X-ray fluorescence (XRF). T. Krap (Maastricht University) is assistant-professor in forensic medicine, anthropology and taphonomy. He is interested in taphonomic changes and studied the preservation and luminescence of a selection of the bones. M. Bruinsma (Leiden University) is a MSC student and studies manipulation on human bones. For her thesis she investigates luminescence properties of various human bones, including some West Frisian bones.

Acknowledgements

This research project started in the beginning of the coronavirus pandemic in 2020. That is one of the reasons why the whole project lasted longer than was planned. Due to the lock down many of the bones could be accessed at a much later date than first planned. It was furthermore difficult to find specialists working with histology to participate in the project. Eventually we managed to gather a great team of project members to work on the remains. We are very grateful for the patience and trust of Liesbeth Theunissen and Rik Feiken (RCE) in the project.

We had a number of meetings with the supervisory committee consisting of Liesbeth Theunissen, Harry Fokkens and Eric Lohof. These meetings were informal but always very constructive. The discussions and critique helped us greatly when we sometimes got stuck in the process of writing. During the project Saxion student Gwen Verhoeven wrote her bachelor thesis on prehistoric disarticulated human bones outside West Frisia. We would like thank her for inspiring discussions and fine collaboration. We also thank Jordy Aal (BAAC) for visiting us and discussing the different non-pathological marks on the human bones. Student Marjolein

Bruinsma (Leiden University) studied many more human bones for her thesis, at Amsterdam Medical Center. We are grateful for her recommendations for further research with luminescence imaging.

Also many thanks to our colleagues at ADC ArcheoProjecten who participated in the publication: Karen de Vries who assisted us with structuring the text in the synthesis and visualize scenarios, Marlon Hoppel for photography, Ben Naardin for creating and adjusting databases and editing texts and finally Jordy Jetses for gathering literature and discussions.

Last, but not least, we are very grateful to Suzanne Needs-Howarth for thoroughly correcting the English grammar. Her constructive comments have been very helpful for us.

2 The archaeological context of disarticulated human bones from Bronze Age West Frisia

W. Roessingh

2.1 Introduction

The main goal of our research project is to interpret the disarticulated human bones from Bronze Age West Frisia. To obtain insight in the meaning behind the deposition of the bones, it is important to first conduct a detailed analysis of their find context. For this analysis, the following research questions were formulated (Section 1.5):

- What is the variation in type and archaeological context of the disarticulated human bones?
- Where were the disarticulated human bones found and from which period do they date?
- What is the relationship between the disarticulated human bones and the (in)complete burials that are known from the region?

In this chapter, each site and context with disarticulated human bones will be presented individually. After a short introduction to the site, the specific field strategies will be touched upon, because these may have had an influence on the interpretation of the finds. Next, the types of features that yielded disarticulate human bones and (possible) related structure(s) will be discussed, including, where possible, more details about the stratigraphical position of the bones. In this chapter, only the type of skeletal element is mentioned; specific details about the individual bones can be found in Chapter 3 and Appendix V.

Most of the disarticulated human bones were found together with other finds.[41] The human remains were therefore often interpreted by the initial researchers as 'waste' instead of a deliberate deposition. To gain insight into the deposition process, it is important to be aware of the presence of other finds and (post) formation processes. An inventory was therefore made of any associated finds (Appendix III), and the main results are included in the text.

Finally, it is important to date the remains. The most reliable dating method for our purposes is radiocarbon dating of the bone itself. A selection of 24 human bones were therefore subjected to radiocarbon dating, this resulted in a total of 21 new dates (Appendix II). Sometimes radiocarbon dates from associated organic material were available. Another source that of material that can be used for dating the filling of features is pottery (Appendix III).[42] Furthermore the features can be roughly be dated by type of structure and horizontal stratigraphy. All this information is included in the text and summarised in a catalogue (Appendix I).

2.2 The dataset and the sites

Our review of published excavation data resulted in a dataset of at least 300 fragments of human disarticulated human bones (Appendix I). Unfortunately many finds appeared to be lost. After completing the inventory, we were able to relocate 231 fragments that belonged to the bones of 69 individuals (IDs). We could establish that 65 of these individuals (ID1-ID65) appeared to be of human origin (Table 2.1). Fortunately, a lot of useful information about the missing finds was published by IJzereef and Runia, such as the original find number, type of context and a preliminary identification of the skeletal element.[43] For Bovenkarspel-Het Valkje, it was possible to relate most of the missing finds to their context.[44] For Hoogkarspel-Tolhuis, the exact location of almost half of the missing finds could be reconstructed. To conclude, the disarticulated human bones of 132 individuals could be used for contextual analysis (Appendix I, Table 2.1 and Fig. 2.1).

In Section 2.3 the individual sites with disarticulated human bones will be briefly introduced, in alphabetical order (see also Appendix VII). In these introductions, information about the potential of the data per site will be addressed. For the interpretation of the disarticulated human bones, it is important to get insight in the recovery and excavation strategies used in the field, such as wet sieving or selective sectioning. For the excavations carried out in the past 15 years for example, the field strategies are most of the time made explicit in the excavation report and other find categories have already been analysed and published. But most of our data come from excavations that were carried out in the 1960s and 1970s and that were never fully analysed or

41 Brandt 1980, 149.

42 Pots from the Middle Bronze Age and beginning of the Late Bronze Age (c. 1600-1000 BC) have relatively thick walls. In the Late Bronze Age (c. 1000-800 BC) the pottery is finer, with thinner walls and more variation in form (Brandt 1988; Roessingh

43 IJzereef 1981, 209-211; Runia 1987, 229-239.

44 Roessingh 2018, 261, Plate 6.88.

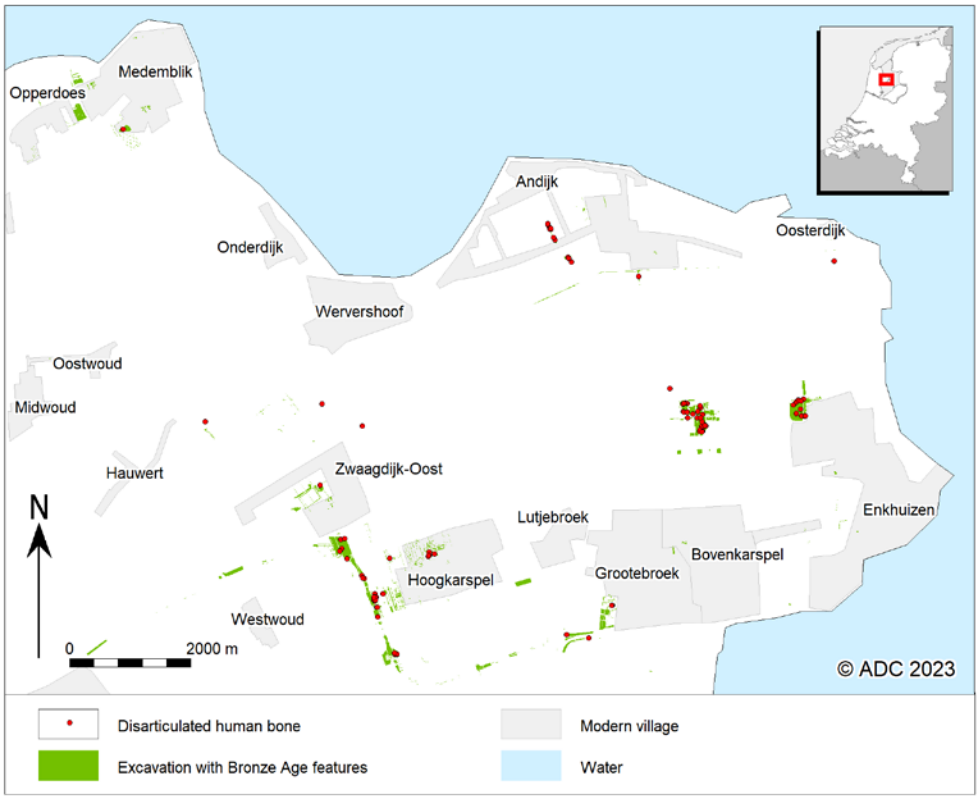


Figure 2.1. Location of all disarticulated human bones (N=132 IDs) plotted on West Frisian Bronze Age sites.

published. It is difficult to interpret finds of disarticulated human bones when information on associated finds is not available or when the dating of the feature containing the human remains is unclear. Another problem with interpretating finds of human bones from the older excavations is the absence of drawings or photographs of the sections of features. Most of the time, only the depth of features was written on the field drawing.

2.3 The sites and context of the human bones

2.3.1 Andijk-1982

This site can be characterised as a barrow with two ring ditches that represent two time periods. The barrow was excavated in the summer of 1982 by the IPP, and the primary results were published by Metz.[45] According to Metz, fragments of human bones were found '*on two locations in the ring ditches*'.[46] The ring ditch of the first period varied in depth from 20 to 50 cm. The ring ditch of the second period was about 30 cm deep.

During the inventory, three find numbers comprising human bones were found (ID15-ID17), all cranial fragments. They probably all came from a ring ditch, but the exact location of the finds is unknown. ID15 and ID17 each consist of a single fragment of a cranium. ID16 consists of several cranial fragments. There is little information available about associated finds (Appendix III).[47] Presumably most finds from the site came from ring ditches. Based on the characteristics of the pottery, the site can probably be dated to the Middle Bronze Age. Some (animal?) bone, wood and charcoal were also found.

The barrow probably dates to the Middle Bronze Age, but this is based on (fragmented) pottery. In order to obtain a more precise date, one of the cranial fragments that comprise ID16 was submitted for radiocarbon dating. This yielded a date in the second half of the Middle Bronze Age (Appendix II).[48]

45 Metz 1993, 190-197.
46 Metz 1993, 197.
47 Metz 1993, 197.
48 Poz-147608: 3000±30BP (1381-1124 cal BC). For details, see Appendix II.

Table 2.1. West Frisian Bronze Age sites with disarticulated human bones in alphabetical order. For details, see Appendix I.

Site	Number of disarticulated human remains (individuals) according to literature	Number of disarticulated human remains (individuals) according to our inventory	Number of disarticulated human remains (individuals) used in contextual analysis	Notes
Andijk-1982	2	3	3	-
Andijk-Noord	18	17	18	1 find number could not be relocated
Andijk-Zuid	2	2	2	-
Andijk-Zuid (2011)	1	1	1	-
Bovenkarspel-Het Valkje	28	2	28	26 find numbers could not be relocated
Enkhuizen-De Tent	6	5	6	1 find number could not be relocated
Enkhuizen-Kadijken/ Haling	14	13	13	1 find number animal bone
Enkhuizen-Rode Paard	1	0	0	animal bone
Grootebroek-Waterweide Noord	2	2	2	-
Hauwert-Notweg 6	1	0	1	recently excavated, not yet in depot
Hoogkarspel-Hoogkarspeltunnel	1	1	1	-
Hoogkarspel-Houterpolder West	4	4	4	-
Hoogkarspel-Markerwaardweg	9	8	8	1 find number animal bone
Hoogkarspel-Tolhuis D	1	0	1	find number could not be relocated
Hoogkarspel-Tolhuis F	28	0	28	find numbers could not be relocated
Hoogkarspel-Tumuli	1	0	1	find number could not be relocated
Hoogkarspel-Watertoren	1	0	1	find number could not be relocated
Hoogkarspel-Watertoren Tumulus I	6	3	6	3 find numbers could not be relocated
Hoogkarspel-Watertoren Tumulus II	2	0	2	find numbers could not be relocated
Medemblik-Schepenwijk II	1	1	1	find number could not be relocated
Venhuizen-Voetakkers	2	2	2	-
Wervershoof-De Ark 1954 (tumulus XIII)	1	1	1	-
Wervershoof-Eendenkooi (2016)	1	0	1	recently excavated, not yet in depot
Westwoud-Binnenwijzend 100	1	0	0	animal bone
Zwaagdijk-Oost	1	0	1	find number could not be relocated
Grootebroek-Zesstedenweg 13	1	0	0	animal bone
Venhuizen-Kestelo	4	0	0	find numbers could not be relocated; no contextual information available
Total	**140**	**65**	**132**	

2.3.2 Andijk-Noord

In 1973, the site Andijk-Noord was excavated by the ROB. Narrow trenches revealed a settlement site with houses and barrows.[49] A total of 18 IDs comprising disarticulated human bones are known from this site.[50] Most of the IDs (N=12) come from the ring ditches of barrow 2 (GRH02) or associated features and include different elements of the skeleton.[51] The other IDs were found in house ditches (N=4), a ditch (N=1) and a circular ditch (N=1). The Bronze Age features from Andijk-Noord can all be dated to the Middle Bronze Age, based on the pottery and results of radiocarbon analyses.[52]

A selection of the features (66%) was sectioned during fieldwork, but none of these sections were drawn. The depth of features was noted on the field drawing. A selection of the features were further excavated for finds.[53] The find numbers were noted on the field drawing, but only the vertical position of these finds is not known. A selection of the find categories have been analysed and published.[54]

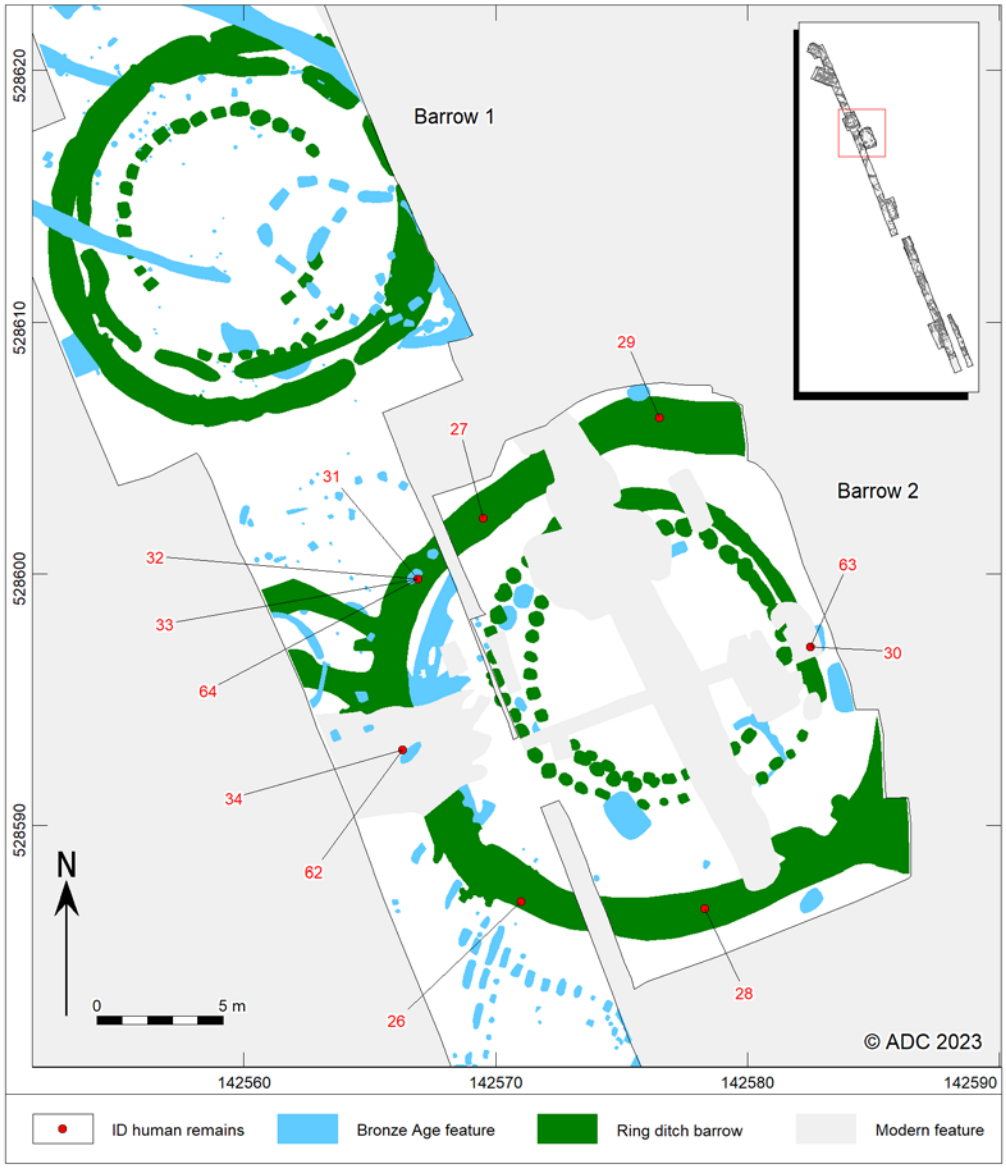


Figure 2.2. Andijk-Noord. Location of disarticulated human bones in features associated with barrow 2.

49 Roessingh 2018, 158-186.
50 ID26-40 & ID62-64.
51 Cranial fragment (ID31); cranial fragments (ID32); femur fragment (ID26 & ID29); femur fragments (ID63); complete femur (ID62); mixture (ID27, ID28, ID30, ID33, ID34 & ID64). ID30 may represent a disturbed primary burial (Section 3.4).
52 Roessingh 2018, 185-186. These dates are, however, not very reliable, because material used to preserve the bone may have had influences on the outcome of the analysis (Roessingh 2018, 154-156).
53 Roessingh 2018, 135.
54 The animal bones were published by Van Mensch & IJzereef (1975) and Aal (2015). Pottery was dated by Roessingh (2018, 185).

Barrow 2 is a three-phase funerary monument. In the first two phases, a circular pit structure was constructed around the barrow (GRH02a, GRH02b). In the third and latest phase, a wide ring ditch was excavated around the monument (GRH02c). In this ring ditch, a total of eight IDs were found (Fig. 2.2).[55] The other four IDs were recovered from modern features but can probably be associated with the funeral monument.

All the features were sectioned, and the ring ditches were sectioned at various locations. Many of the human bones were recognised as such in the field. We may assume that all the features associated with the barrow were completely excavated. The ring ditch of the third phase (GRH02c) had a depth that varies from 40 to 60 cm. In some cases, skeletal elements of different individuals were collected in the field under a single find number. It is not known whether these finds were found in that specific spot; the bones were probably collected around the area of the specific find number (for example within a couple of metres).

Associated finds from the ring ditch with the human bones (GRH02c) consist of many animal bones (>6 kg) and some fragments of pottery, burned clay and stone (Appendix III).[56] The Bronze Age features from Andijk-Noord probably all date to the Middle Bronze Age, based on the pottery. The results of the radiocarbon dating on some bones also suggest a Middle Bronze Age date, although there is some discussion about the interpretation of these dates.[57] For this project, two disarticulated human bones from the ring ditch with human bones have been submitted for radiocarbon dating (ID26, ID62). The calibrated dates of both samples cover a long time period in the Middle Bronze Age.[58]

A total of six IDs were recovered from settlement features in Andijk-Noord (Fig. 2.3 and Fig. 2.4).[59] Except for a radius fragment (ID39), all these finds consist of cranial fragments.

In the northern part of the excavation, four IDs were recovered from house ditches belonging to three different houses (Fig. 2.3). These houses may have been in use at the same time.[60] ID37 (a fragment of a cranium) was found in the house ditch of house 9, which was 60 cm deep. Together with the human bone (and collected in the same find number) also some animal bones and fragments of stone and pottery were found (Appendix III). Interesting is the location of this house, on the location of the old barrow 1 (GRH01). This funerary monument must have already been levelled when the house was constructed.[61] Two bone fragments from the house ditch were radiocarbon dated, which yielded a date in the second half of the Middle Bronze Age to the beginning in the Late Bronze Age.[62]

About 50 m north of house 9 lay the two-phased house 6. In the house ditch of the second phase (HS06b), another fragment of a cranium

55 Roessingh 2018, 178-180.
56 The animal bones were analysed by Aal (Aal 2015, Appendix C).
57 Roessingh 2018, 185-186.
58 ID26: Poz-147690: 3230±35BP (1607-1421 cal BC); ID62: Poz-147700: 3095±35BP (1436-1264 cal BC). For details, see Appendix II.
59 ID35-38 & ID40.
60 Roessingh 2018, 167-170.
61 Roessingh 2018, 178-180.
62 Roessingh 2018, 185, Table 5.21: GrN-12366: 3070±30BP (1415-1236 cal BC) & GrN-12367: 3020±80BP (1442-1028 cal BC). It is not clear if the bone sampled for radiocarbon dating was human or animal.

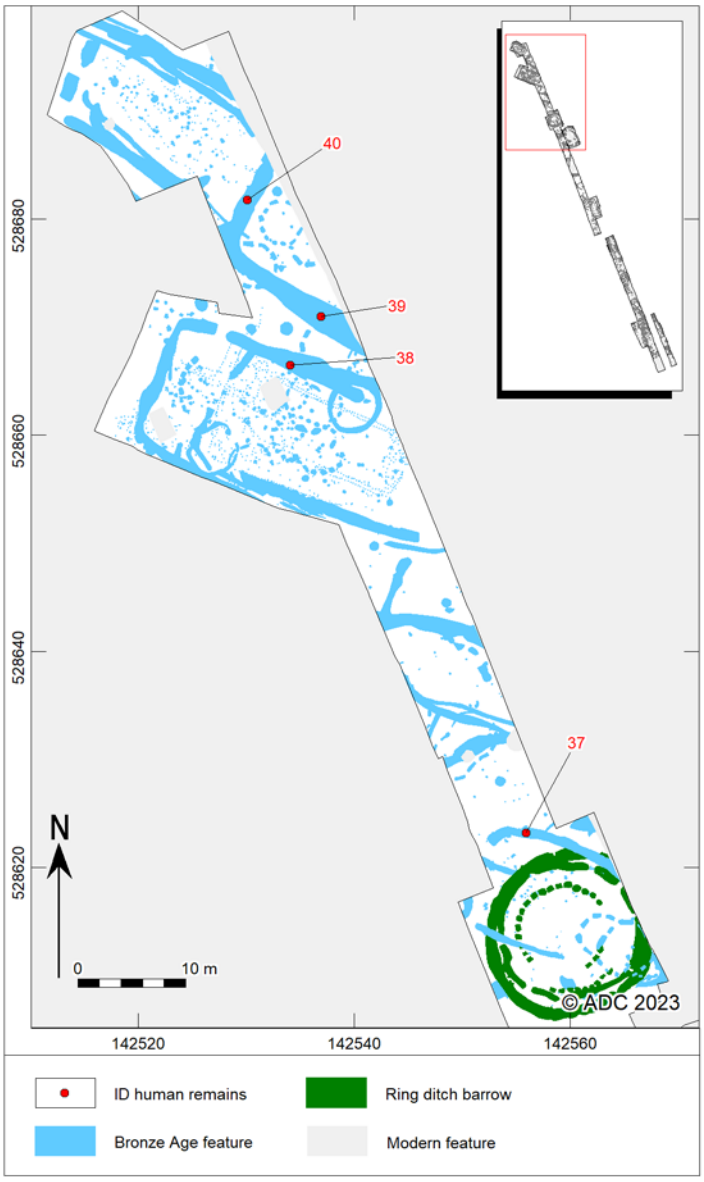


Figure 2.3. Andijk-Noord. Location of disarticulated human bones in settlement features in the northern part of the excavation.

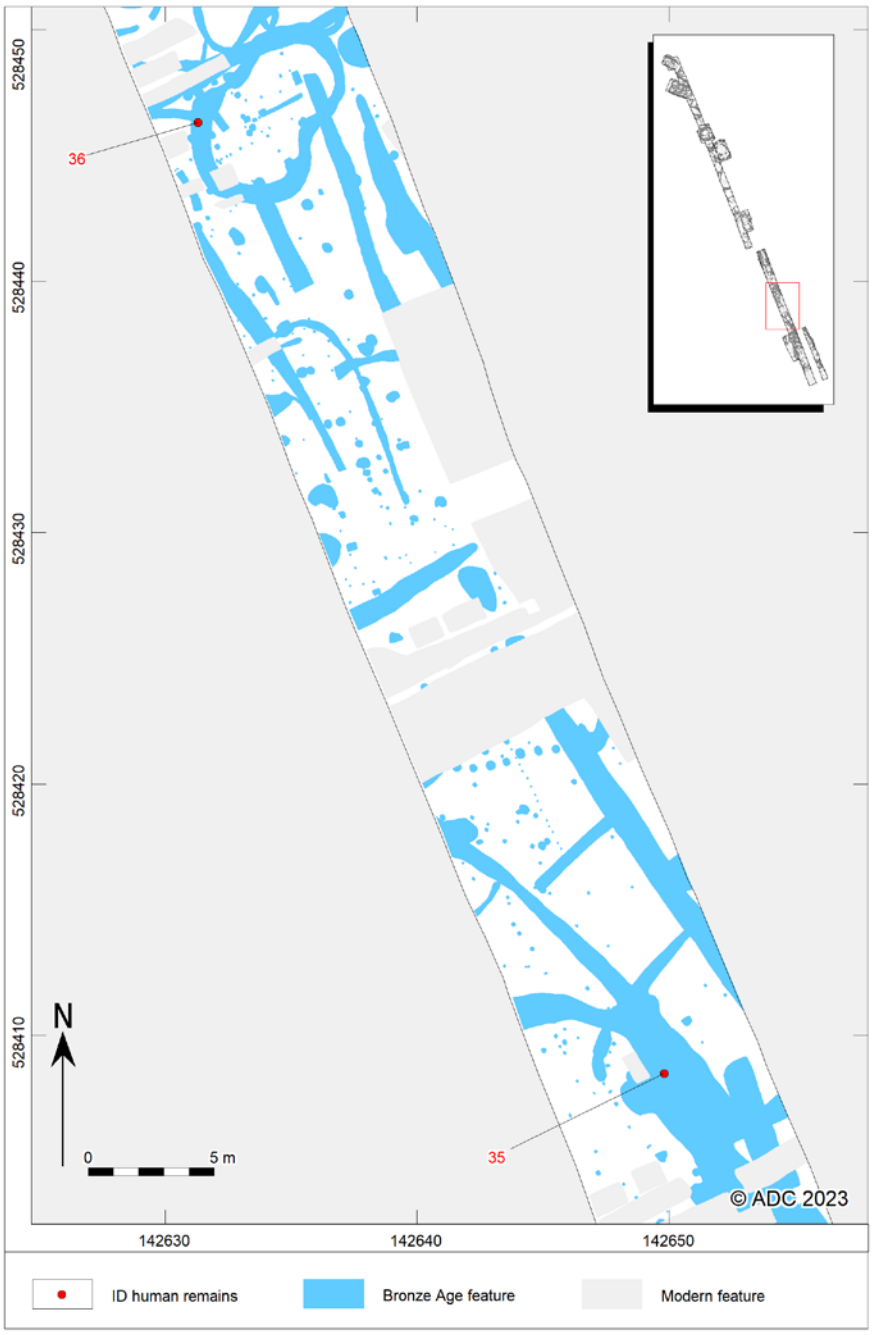


Figure 2.4. Andijk-Noord. Location of disarticulated human bones in settlement features in the southern part of the excavation.

was found (ID38). Together with the human bone (and collected in the same find number) also many animal bones (>1 kg), together with some pottery fragments were found. At other locations in the house ditches, more animal bones (c. 1 kg) and some pottery fragments were discovered (Appendix III).

Some cranial fragments (ID40) and a fragment of a radius (ID39) were found in the house ditch of house 8. Together with ID40 (and collected in the same find number) also many animal bones (>2 kg), some fragments of pottery and stone were found. Together with ID39 (and collected in the same find number) also many animal bones (>3.5 kg) and fragments of pottery were found (Appendix III).[63] For this project, a fragment of ID39 was submitted for radiocarbon dating. This yielded a relatively old date for the site (Early Bronze Age to beginning of the Middle Bronze Age) (Appendix II).[64]

In the southern part of the excavation, two more finds comprising disarticulated human bones were found in settlement features (Fig. 2.4). ID36 consist of some cranial fragments that were found in a figure-eight-shaped circular ditch with an impressive depth of 65 cm (KG16).[65] The structure measures 7 by 4.5 m and pre-dates house 2. Together with the cranial fragments (and collected in the same find number) also many animal bones (>1 kg), together with some pottery fragments were found (Appendix III).

Further south, ID35 (some cranial fragments) was found in a settlement ditch 2 (GR02). Together with these cranial fragments (and collected in the same find number) many

63 Roessingh 2018, 167, Table 5.16.
64 ID39: Poz-147691: 3470±35BP (1890-1688 cal BC). For details, see Appendix II.
65 These small, circular structures usually have a modest depth, of 10-30 cm.

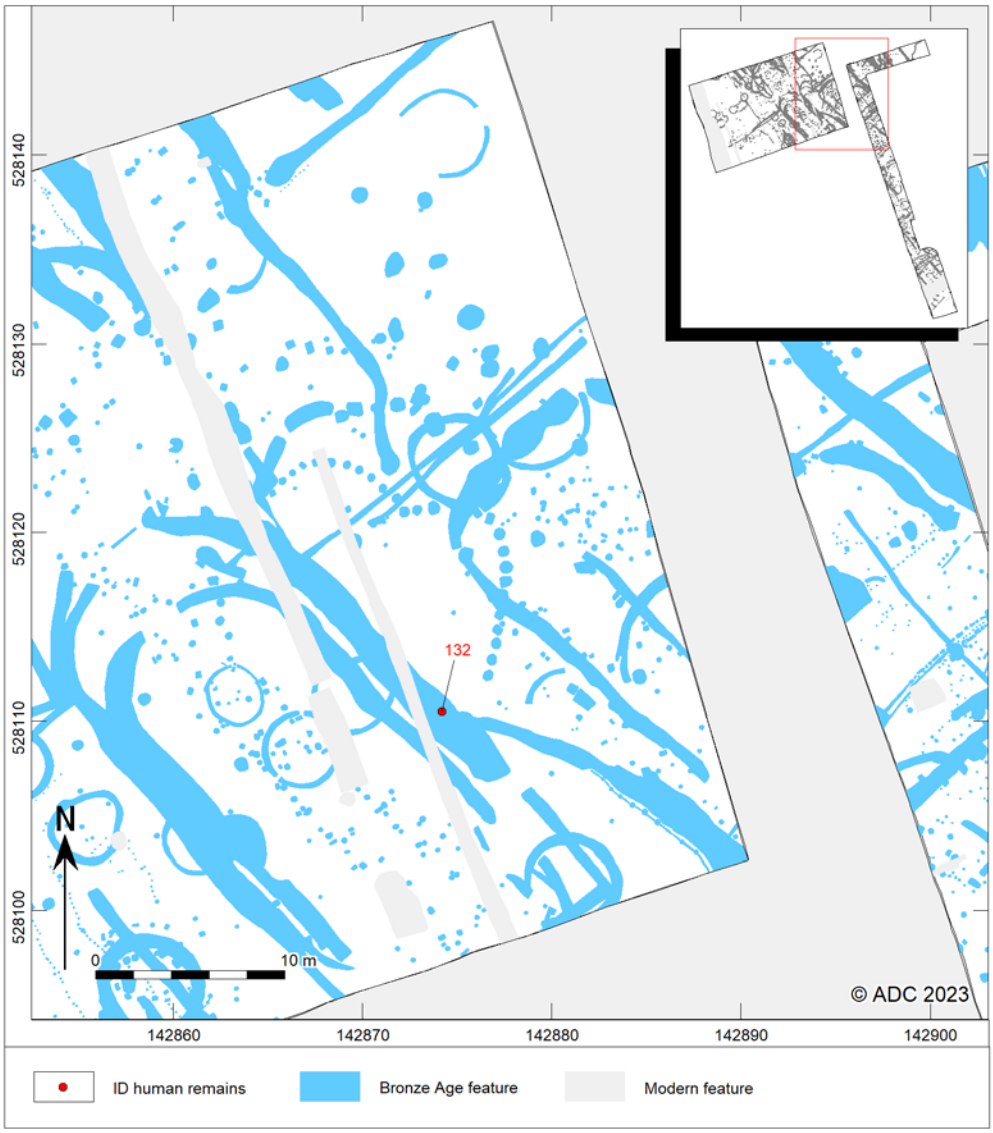


Figure 2.5. Andijk-Zuid. Location of the disarticulated human bone in the northern part of the excavation.

animal bones (almost 2 kg), together with many fragments of stone and a fragment of pottery were found. At other locations in the ditch, more finds were collected: many animal bones (>4 kg) and some stone and pottery fragments (Appendix III). The ditch seems to cut through most other features in the area and must therefore be one of the youngest features in this area.[66]

2.3.3 Andijk-Zuid

Andijk-Zuid was, like Andijk-Noord, excavated by the ROB. At this site, many houses and ditches were found. In contrast to Andijk-Noord, a relatively large area was excavated.[67] Two find numbers comprising disarticulated human bones are known from this site, both from settlement features.[68] The Bronze Age features from Andijk-Zuid can all be dated to the Middle Bronze Age, based on the pottery and the results of radiocarbon analysis.[69]

Of the features, 75% were sectioned during fieldwork. Except for one feature, none of the sections of features were drawn. The depth of features was noted on the field drawing. A selection of the features was further excavated for finds.[70] The find numbers were noted on the drawing, but of these finds only the horizontal position is known. A selection of the find categories was analysed and published.[71]

In the north of the site, a femur fragment was found in the house ditch of house 4 (ID132, Fig. 2.5). This is a house plan with probably two phases.[72] Together with the human bone (and collected in the same find number) also a lot of animal bones (almost 3 kg) and many fragments of pottery, stone and burned clay were found. At other locations in the house ditch, more animal bones (>4 kg) and fragments of pottery and stone were collected (Appendix III). Two fragments of (animal?) bone from the house ditches were submitted for radiocarbon dating, which yielded dates in the Middle Bronze Age.[73]

In the southern part of the excavation, the second disarticulated human bone, a fragment of a humerus, was found in a house ditch of house 6 (ID41, Fig. 2.6). This house site has two

66 There are, however, no clear sections, and looking at the field drawing does not help to clarify the horizontal stratigraphy (see also Roessingh 2018, 39).
67 Roessingh 2018, 137-158.
68 ID41 & ID132. During our inventory, only ID41 was found.
69 Roessingh 2018, 154-155. These dates however are not very reliable, because material used for preservation may have had influences on the outcome of the analysis (Roessingh 2018, 154-156).
70 Roessingh 2018, 135.
71 Animal bones were published by Van Mensch & IJzereef (1975) and Aal (2015). Pottery was dated by Roessingh (2018, 154).
72 Roessingh 2018, 143-148.
73 GrN-11974: 3230±30BP (1608-1432 cal BC) & GrN-11975: 3265±30BP (1619-1458 cal BC). For details, see Roessingh 2018, 366-367 (Appendix II).

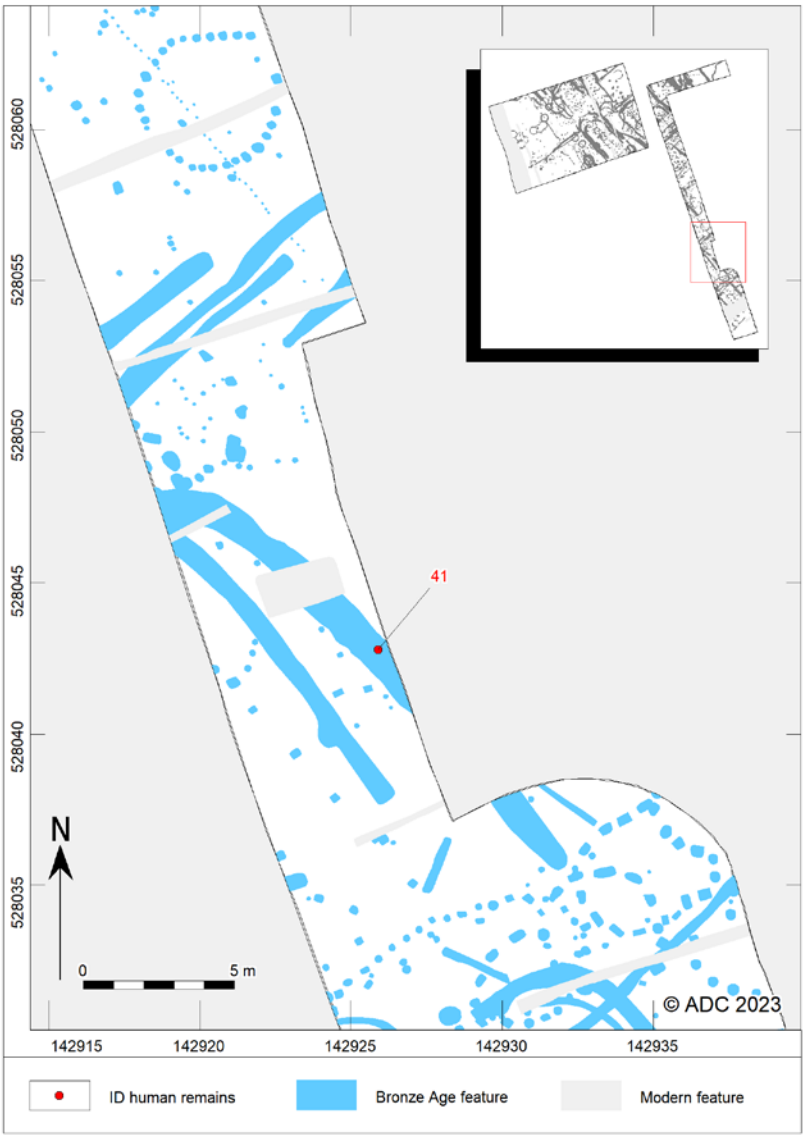


Figure 2.6. Andijk-Zuid. Location of the disarticulated human bone in the southern part of the excavation.

phases, and the human bone comes from the house ditch of the first phase (HS06a). Together with the human bone (and collected in the same find number) animal bones (>0.5 kg) and some fragments of pottery, stone and burned clay were found. In other locations in the ditch, more animal bones (c. 0.5 kg) and a fragment of pottery and stone were found (Appendix III). For this project, a sample of ID41 was submitted for radiocarbon dating, which yielded a date in the second half of the Middle Bronze Age (Appendix II).[74]

[74] ID41: Poz-147692: 31150±35BP (1492-1279 cal BC). For details, see Appendix II.
[75] Arkema & Vossen 2013.
[76] Arkema & Vossen 2013, 28, 65.
[77] GrA56554: 2905±35BP (1257-999 cal BC); GrA56555: 2895±35BP (1249-949 cal BC). For details, see Arkema & Vossen 2013, 28.
[78] Roessingh 2018, 189-300.
[79] This phasing is based on radiocarbon dates (Roessingh 2018, 296-297, Table 6.23). These dates, however, are not very reliable, because the material used for preservation purposes may have had an influence on the outcome of the analysis (Roessingh 2018, 154-156).

2.3.4 Andijk-Zuid (2011)

During this excavation, part of a settlement site was excavated. Based on the pottery and characteristic of the features, the site could be dated to the Middle Bronze Age. Radiocarbon dates also suggest an occupation phase in the Late Bronze Age.[75] A fragment of a human pelvis was found in the upper fill of ditch 3 (ID53, Fig. 2.7). The ditch is interpreted as a possible house ditch by the initial researchers.[76] This interpretation seems unlikely, however, because other features of this presumed house site (post holes and another house ditch) are absent. Together with the human bone (and collected in the same find number) many animal bones were found in the ditch (c. 1.5 kg), as well as fragments of pottery, stone and a piece of flint. The ditch was dated to the end of the Middle Bronze Age and beginning of the Late Bronze Age based on two radiocarbon dates on charcoal.[77]

2.3.5 Bovenkarspel-Het Valkje

The excavation at Bovenkarspel-Het Valkje was one of the first large-scale excavations in the region, carried out by the ROB. During a five-year campaign (1974-1978) an area of approximately 15 ha was excavated. Like most of the older excavations, the results of these excavations were never published in their entirety. However, a study of the features and phasing of the site was recently published.[78]

The settlement site Bovenkarspel-Het Valkje have been dated to the Middle Bronze Age and Late Bronze Age. Habitation started sometime around 1600 BC, and the site may have been inhabited till the end of the Late Bronze Age, around 800 BC.[79] The Middle Bronze Age settlement was inhabited for many centuries. In the area numerous ditch systems and plots of houses were discovered. The fact that many house sites show multiple occupation phases suggests this area was considered to be a favourable location for habitation.

Of the features, c. 30% were sectioned during fieldwork. Only some sections were drawn, especially deep wells and features associated with houses. The depth of features

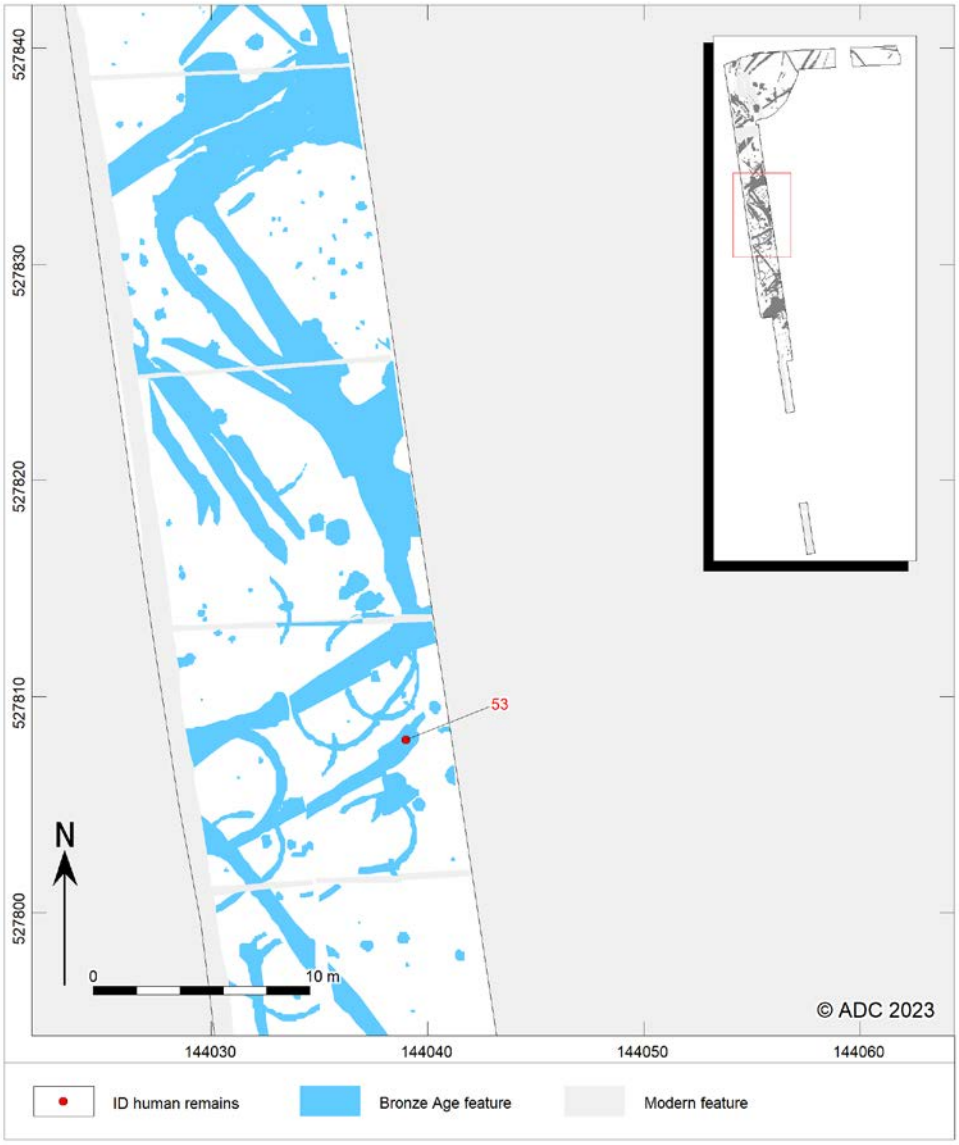


Figure 2.7. Andijk-Zuid (2011). Location of a disarticulated human bone in a Late Bronze Age ditch.

was noted on the field drawing and an (unknown) selection of the features was further excavated for finds.[80] The find numbers were noted on the drawing, and of these finds only the horizontal position is known. A selection of the find categories was analysed and published.[81] Unfortunately, there is no information available about associated finds from the contexts with human remains because the finds from Bovenkarspel-Het Valkje have never been fully analysed.

A total of 28 IDs from Bovenkarspel-Het Valkje are known from literature.[82] Only two of these (ID43 and ID42) were found during our inventory.[83] Because the location of the find numbers comprising disarticulated human remains is well known from the field drawings, the context information is still available (Table 2.2 and Fig. 2.8).[84] Most of the IDs could be associated with Middle Bronze Age contexts (N=18). Only a few contexts date to the Late Bronze Age (N=7).[85] We should keep in mind that – just like other finds from Late Bronze contexts – the finds themselves may date to the Middle Bronze Age, as Late Bronze Age features are always present at locations with Middle Bronze Age occupation and the digging of ditches in the Late Bronze Age may have resulted in older finds ending up in these younger features. The three other IDs were recovered from modern features.

Table 2.2. Bovenkarspel-Het Valkje. Number of features of each type and date containing disarticulated human bones.

Context	N of features
Ditch (Middle Bronze Age)	10
House ditch (Middle Bronze Age)	5
Pit / well (Middle Bronze Age)	2
Ring ditch (Middle Bronze Age)	1
Pit / well (Late Bronze Age)	3
Ditch (Late Bronze Age)	3
Layer (Late Bronze Age)	1
Modern context	3

80 Roessingh 2018, 192-198.

81 For an overview, see Roessingh 2018, 198-203. Find numbers or lists with contexts are absent in most publications. To obtain insight into the other find categories from features where disarticulated human bones were found, an (unpublished) list of primary determinations made by the author was used. For most categories, items were only counted for this list; pottery was also weighed (for details, see Appendix III).

82 IJzereef 1981, 209-211; Runia 1987, 229-239. For an overview, see Roessingh 2018, 261-269.

83 During our search, we were able to relocate a lot of the find numbers, but only animal bones were present in the bags. In only two cases did we find human remains among the animal bones.

84 Roessingh 2018, 200, Fig. 6.13.

85 Another explanation for the relatively low number of human remains from Late Bronze Age features from Bovenkarspel has to do with interpretations made during fieldwork. During the first campaign, when most of the Late Bronze Age ditches in the northern part of the site were discovered, these ditches were thought to be of modern origin (Roessingh 2018, 196).

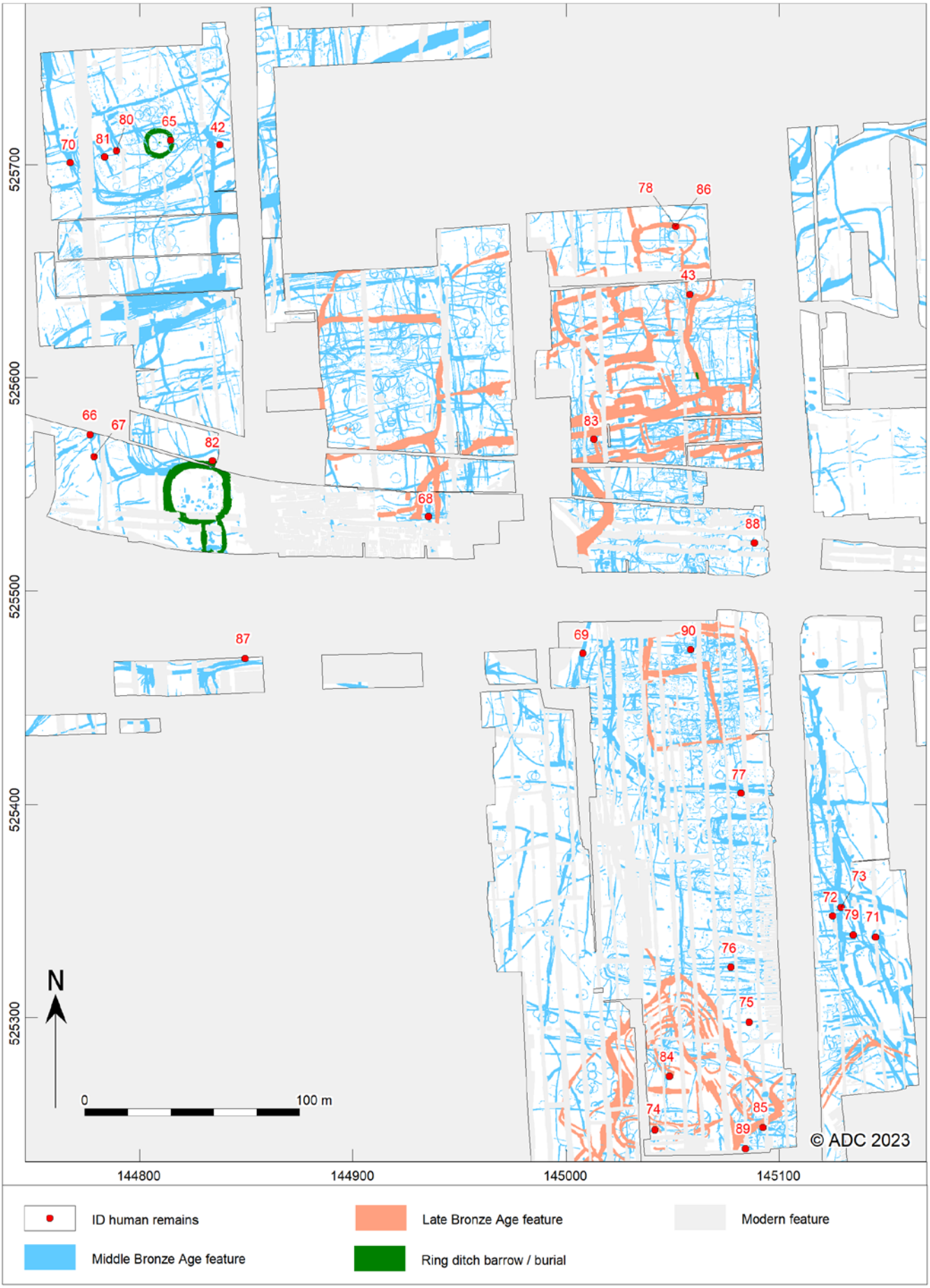


Figure 2.8. Bovenkarspel-Het Valkje. Location of the disarticulated human bones.

Middle Bronze Age context

From a Middle Bronze Age context, there are 18 IDs. Two more IDs from modern features probably also date to the Middle Bronze Age (Table 2.2). The human bones are widely distributed over the site (Fig. 2.8).

A concentration of five IDs was found in the northwest, in the vicinity of a two-phased ring ditch of barrow 1 (GRA01). No burials were found. The barrow is one of the older features of the site, based on horizontal stratigraphy and a radiocarbon date.[86] In the eastern part of the youngest ring ditch, a fragment of a human phalanx (ID65) was found. The bone was discovered in the second fill of this youngest ditch (Fig. 2.9). Together with the human bone (and collected in the same find number) some animal bones were found (Appendix III).
The other four IDs in this area were found in the vicinity of the barrow and were recovered from settlement features. West of the ring ditch, ID70 (a fragment of a femur) was found in a settlement ditch. No other associated finds are known from this location. Based on horizontal stratigraphy, the ditch can be associated with a relatively young ditch system.[87]

Another fragment of a femur (ID80) was found in a ditch that may be part of house site 4. On this house site no less than four consecutive houses could be reconstructed.[88] This same find number comprised some fragments of animal bones, pottery and burned clay (Appendix III).

Another femur fragment (ID81) comes from a house ditch from the third and last phase of house 5 (house 5c). This same find number comprises many animal bones (c. 200 fragments), together with many pot sherds (c. 50 fragments) and some pieces of stone and burned clay (Appendix III). Charcoal from this house ditch was radiocarbon dated, which yielded a date in the second half of the Middle Bronze Age and beginning of the Late Bronze Age.[89]

East of the ring ditch, a fragment of a sacrum (ID42) was found in a narrow, isolated settlement ditch. This same find number also comprises some fragments of animal bone (Appendix III). ID42 was one of the two disarticulated human bones we could find during our inventory. A sample of the sacrum was submitted for radiocarbon dating, which yielded a date in the Middle Bronze Age.[90]

Approximately 140 m south of barrow 1, barrow 2 was discovered (GRA02). Of this barrow, a wide ring ditch with two parallel ditches in the south were preserved. Like barrow 1, it yielded no burials.[91] Some disarticulated human bones were found just north of the ring ditch, in a small (20 by 40 cm), isolated pit (ID82). The remains consist of fragments of a cranium and a mandibula. This pit has a depth of only a couple of cm. Some fragments of animal bones and pottery were collected under this same find number (Appendix III). Based on the horizontal stratigraphy, the pit predates the ring ditch.[92]

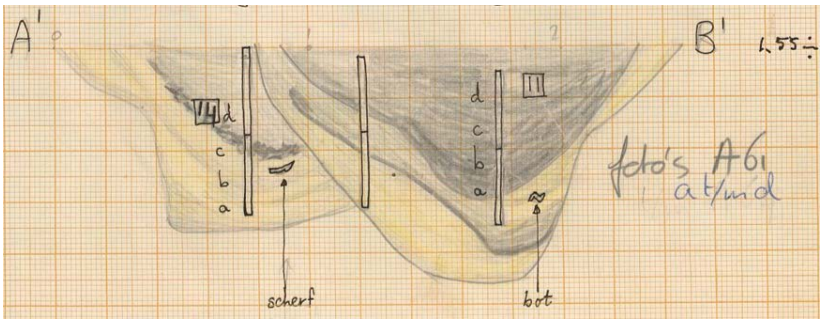


Figure 2.9. Section drawing of the eastern part of the ring ditch of barrow GRA01. In the right a fragment of 'bot' (Dutch for bone) was found, referring to the human bone ID65.

About 35 m west of barrow 2, two finds comprising human remains were found in the same settlement ditch, approximately 10 m apart (ID66 and ID67). ID66 is a cranial fragment, ID67 is a fragment of a mandibula. The same find number as ID66 also comprises some animal bones (Appendix III). This settlement ditch belongs to one of the youngest features in this area of the site.[93]

In the central part of the excavation, three IDs can be associated with Middle Bronze Age features. In the north, a fragment of a femur was found in the house ditch of house 25 (ID68). Together with this femur, two animal bones were found (Appendix III). The features of house 25 cut through most of the other Middle Bronze Age features, so this house must belong to one of the youngest features in this area of the site.

Two other human bones (ID69 and ID77) were discovered in settlement ditches that probably belonged to the same settlement ditch system, a system that was in use for a long time. Both finds are femur fragments. The same find number as ID69 also comprises many animal bones (>100 fragments), together with some fragments of pottery and stone. The same find number as ID77 also comprised some animal

86 GrN-7472: 3275±35BP: 1631-1455 cal BC (Roessingh 2018, 263-265; 296-297, Table 6.23).
87 Roessingh 2018, 274, Plate 6.103.
88 Roessingh 2018, 225, Plate 6.43.
89 GrN-7511: 2990±40BP: 1386-1059 cal BC (Roessingh 2018, 296-297, Table 6.23).
90 Poz-147693: 3190±35BP: 1517-1406 cal BC. For details, see Appendix II.
91 Roessingh 2018, 264-266.
92 According to IJzereef, some human remains were also found in the ring ditch, but details about these finds are unclear (IJzereef unpublished, 97; Roessingh 2018, 265, note 283).
93 Roessingh 2018, 277, Plate 6.106.

bones (Appendix III). Based on horizontal stratigraphy, both ditches probably belong to one of the younger ditch systems of the settlement in this part of the excavation.[94]

A cluster of four IDs was found in the south-eastern part of the excavation. Three of the IDs were discovered in ditches belonging to a ditch system that was in use for a long time. A cranial fragment (ID72) comes from one of the older ditches (phase 3).[95] This ditch predates house 32. Associated finds in this find number consist of animal bones and some fragments of pottery, burned clay and stone. A fragment of one of the bones from the house ditch was submitted for radiocarbon dating, which yielded a date in the second half of the Middle Bronze Age.[96] ID79 and ID73, both cranial fragments, were found in one of the youngest ditches (phase 4 and phase 6, respectively).[97] The find numbers of both IDs also comprise many animal bones (>100 fragments), some pottery, burned clay and stone fragments (Appendix III).

The fourth human bone in this cluster is a fragment of a tibia (ID71) discovered in a 2 m deep well (WA19). This same find number comprised many animal bones and a fragment of pottery (Appendix III). Based on the horizontal stratigraphy, this well probably belongs to one of the youngest features of this area. A bone from this well was submitted for radiocarbon dating, which yielded a date in the second half of the Middle Bronze Age.[98]

In the southern part of the excavation, three IDs can be associated with features from the Middle Bronze Age. All of the human remains were found in house ditches: ID76 (house 50), ID75 (house 54) and ID74 (house 56a). ID76 is humerus fragment, ID74 a femur fragment. This find numbers of ID76 and ID74 also comprised some animal bones and pottery fragments. ID75 is another femur fragment, and this find number also contained many animal bones and some fragments of stone (Appendix III). Houses 50 and 54 can be characterised as single, isolated house sites. ID74 was found in the house ditch of the earliest house of house site 56. On this house site, two phases were recognised.[99]

Probable Middle Bronze Age context

Two IDs were discovered in modern features and probably date to the Middle Bronze Age, based on the absence of Late Bronze Age features in the direct surroundings: ID87 (calcaneus fragment) and ID88 (femur fragment). Both finds were discovered in modern ditches in the west-central part (D87) and east-central part (ID88) of the excavation.

Late Bronze Age context

From a Late Bronze Age context, there are seven IDs. One more find from a modern feature probably also dates to the Late Bronze Age (Table 2.2).

In the north-central part of the excavation four IDs were found in features associated with a complex Late Bronze Age ditch system (cluster 1). Based on several radiocarbon dates, this cluster probably dates to the 10*th* century BC.[100] The many ditches probably surrounded houses.[101]

In the northern part, the skeletal elements of at least two individuals (ID78 and ID86) were found in a 52 cm deep pit, together with many other finds (Fig. 2.10). ID78 consists of a femur fragment and a 'lower part of the leg' (Appendix I). ID86 is a fragment of a femur of a second individual (Chapter 3). Associated finds from this pit consist of a large number of animal bones (>400 fragments) and pottery (c. 200 fragments), together with some fragments of burned clay, stone and flint (Appendix III). This pit was dug into in a ditch (LBT07) that probably surrounded a house.

About 30 m south of ID78 and ID86, a fragment of a cranium was found in a pit (ID43). This same find number comprised many animal bones (>100 fragments) and pottery (>50 fragments) (Appendix III). ID43 was one of the two disarticulated human bones we were able to relocate during our inventory. For this project, a sample of the cranium was submitted for radiocarbon dating, which yielded a date in the second half of the Middle Bronze Age and beginning of the Late Bronze Age. A Late Bronze Age date is most likely for this bone.[102]

Farther south another fragment of a cranium (ID83) was found in a ditch, that connects ditches from ditch system LBT04. The same find number also comprises many animal bones (>100 fragments), pottery (>3 kg) and some stones (Appendix III). From this location, a sample containing charcoal was submitted for radiocarbon dating. This yielded a date in the second half of the Late Bronze Age.[103]

The text on the drawing translates as 'Below this [ditch] a prehistoric well or pit is

94 ID77 comes from a ditch that must be older than the ditch where ID69 was found (Roessingh 2018, 282, Plate 6.111).
95 Roessingh 2018, 282, Plate 6.111.
96 GrN-12437: 3030±35BP: 1391-1211 cal BC (Roessingh 2018, 296-297, Table 6.23).
97 Roessingh 2018, 282, Plate 6.111.
98 GrN-11979: 3095±30BP: 1429-1280 cal BC (Roessingh 2018, 296-297, Table 6.23).
99 Roessingh 2018, 224, Plate 6.42.
100 Roessingh 2018, 248-250.
101 Roessingh 2018, 242.
102 Poz-147694: 2955±35BP: 1272-1021 cal BC. This sample has a relatively high δ13C value, so the calibrated date is probably too old. This interpretation corresponds with the many fragments of Late Bronze Age pottery in this pit. For details, see Appendix II.
103 GrN-7508: 2740±40BP: 976-811 cal BC (Roessingh 2018, 296-297, Table 6.23).

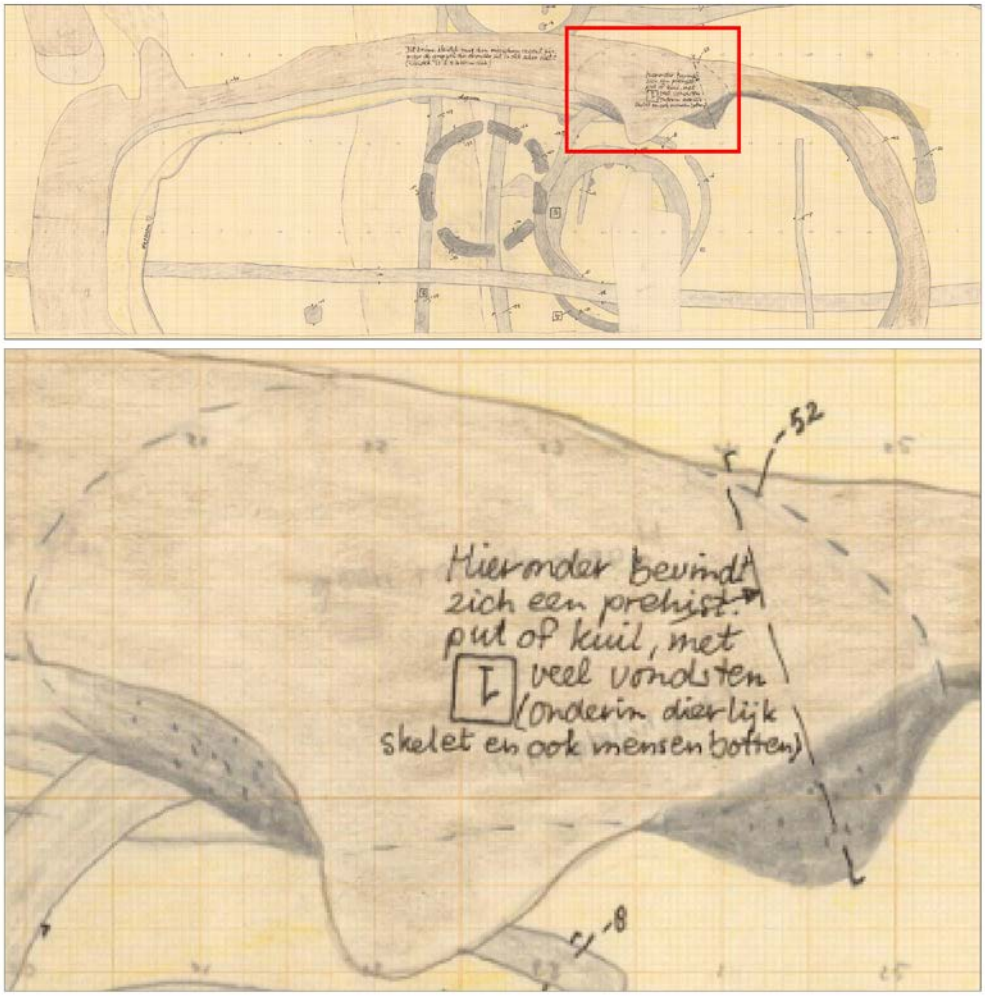


Figure 2.10. Bovenkarspel-Het Valkje. In the Late Bronze Age ditch a 52 cm deep pit was discovered with many finds, including human bones of at least two individuals (ID78 and ID86).

located, with many finds (in the lower fill an animal skeleton and human bones).'

In the central part of the excavation, an almost square-shaped ditch system was found (cluster 2).[104] Based on several radiocarbon dates, this cluster can probably be dated to the 9*th* century BC.[105] During the excavation, a thin cultural layer of sand and clay was found on different spots between these ditches. Many finds were collected from this layer, including a fragment of a cranium (ID90), c. 100 fragments of animal bone, almost 4 kg of pottery fragments and some stones (Appendix III). A sample with charcoal from the same spot as the human bone was submitted for radiocarbon dating, which yielded a date in the second half of the Late Bronze Age.[106]

Two IDs were found in Late Bronze Age features in the southern part of the excavation. One of the human bones is a fragment of a phalanx (ID84) that comes from a ditch belonging to a complex ditch system (cluster 3). This same find number comprised many fragments of animal bones and pottery (Appendix III). This ditch is one of the many narrow ditches that probably surrounded a house.[107] Based on horizontal stratigraphy, these ditches could be associated with the second phase of cluster 3.[108] There are a few radiocarbon dates from cluster 3 that show the area was probably inhabited in the 10*th* or 9*th* century BC.[109]

A cranial fragment (ID85) was found in a house ditch of house 55a. This same find number comprised some animal bones and stone fragments (Appendix III). Based on horizontal stratigraphy, this house site must belong to one of the youngest houses of this

104 Roessingh 2018, 242-245.
105 Roessingh 2018, 248-250.
106 GrN-8562: 2690±25BP: 897-806 cal BC (Roessingh 2018, 296-297, Table 6.23).
107 The empty zones within these ditch systems seem to suggest houses were present. However, no features of these Late Bronze Age houses were preserved (Roessingh 2018, 245-247).
108 Roessingh 2018, 247, Plate 6.70.
109 Roessingh 2018, 248-250.

area; this corresponds with the pottery found in associated house features, that suggest the house dates to the Late Bronze Age.[110] This is one of the very few Late Bronze Age house sites from West Frisia.

Probable Late Bronze Age context
From a modern ditch in the southern part of the site, a fragment of a femur was found (ID89). In the direct vicinity of this bone, many Late Bronze Age features were found. It is thus likely that this find is associated with a feature from this period.

2.3.6 Enkhuizen-De Tent

In 1960, the southwest quadrant of a barrow (also known as Tumulus I) was excavated by the IPP.[111] During the excavation, a total of five disarticulated human bones were found.[112] The precise stratigraphical position of the finds is not clear. Two of the bones were discovered close to each other in the second-period ditch: a fragment of a clavicle (ID21) and a fragment of a cervical vertebra (ID22). In the 'flank'[113] of the barrow, a fragment of a clavicle (ID19) and a fragment of a scapula (ID20) were found. ID18, a fragment of a cranium, may have been found in the first-period ditch. According to Runia, the distance between ID21/22 and ID19 was about 10 m.[114] There is little information about associated finds. During the excavation, some fragments of animal bones and stones were found, but their precise location is unclear.[115]

The date of the barrow is unknown. For this project, samples of three human bones were submitted for radiocarbon dating (ID19, ID20 and ID21). This yielded three dates in the second half of the Middle Bronze Age.[116]

2.3.7 Enkhuizen-Kadijken/Haling

Between 2006 and 2012, many excavations were carried out northwest of the town of Enkhuizen.[117] Like the Hoogkarspel-Tolhuis sites, this area can be characterised as one large settlement area that must have been in use for a very long time. A total of almost 10 ha was excavated, and numerous houses and ditch systems were discovered. Most of the features in Enkhuizen date to the Middle Bronze Age. Only some ditches have their origin in the Late Bronze Age. In the Enkhuizen sites, a total of 13 IDs were found (Fig. 2.11). Most of the bones are associated with features dating to the Middle Bronze Age (Table 2.3).

During the fieldwork at Enkhuizen-Kadijken, all the features were sectioned and completely excavated. The house ditches received special attention because these contained many finds. A selection of the fill of these ditches was wet sieved, which yielded many finds, including small, fragmented material.[118] At the adjacent parcel of land to the west, the site Enkhuizen-Haling, the main goal of the excavation was to document all features and focus on specific features and structures in order to answer new research questions.[119] This yielded a relatively small amount of human bones (N=1; Fig. 2.11).

Table 2.3. Enkhuizen-Kadijken/Haling. Number of features of each type and date containing disarticulated human bones.

Context	N of features
House ditch (Middle Bronze Age)	6
Pit / well (Middle Bronze Age)	3
Ditch (Middle Bronze Age)	1
Circular ditch (Middle Bronze Age)	1
House ditch (Middle- Late Bronze Age)	1
Unknown	1

Many bones were found in house ditches (N=7). Six of these date to the Middle Bronze Age and come from three house sites. One of these house sites (house 15) is situated in the north of the excavation area and has three phases. The house ditch of the second phase (house 15b) yielded ID48, a fragment of a tibia. This bone was found together with a fragment of stone (Appendix III). Samples from postholes from the individual phases were sampled for radiocarbon dating. This yielded dates in the second half of the Middle Bronze Age.[120] For this project, a sample of ID48 was submitted for radiocarbon dating, which also yielded a date in the second half of the Middle Bronze Age.[121]

The second house site with disarticulated human bones is house 10, in the southeast of the excavation. In one of the house ditches, a

110 Roessingh 2018, 218-220.
111 Lehman 1963; Runia 1987, 222.
112 According to Lehman, also mandibula fragments (ID91) were found (Lehman 1963, 240). But these fragment were not relocated by Runia (1987, 222) or during our inventory.
113 It is unclear what exactly is meant by *'de flank'* (the flank), it probably refers to the barrow mound.
114 Runia 1987, 222.
115 Lehman 1963, 240.
116 ID19: Poz-147610: 3070±35BP (1421-1226 cal BC); ID20: Poz-147611: 3115±30BP (1447-1286 cal BC); ID21: Poz-147612: 3120±35BP (1494-1283 cal BC). For details, see Appendix II.
117 Roessingh & Van Zijverden 2007 (Enkhuizen-Kadijken); Roessingh & Lohof 2011 (Enkhuizen-Kadijken); Roessingh & Vermue 2011 (Enkhuizen-Kadijken); Van der Linde & Hamburg 2014 (Enkhuizen-Haling). The human remains from Enkhuizen-Kadijken were analysed by Zeiler & Pasveer (Roessingh & Lohof, 221, Table 8.1). The disarticulated human bone from Enkhuizen-Haling was analysed by Van der Jagt (2014, 52).
118 Roessingh & Lohof 2011, 26. In the excavation report, which contexts were selected for wet sieving is not made explicit. After analysing the original dataset, we were able to reconstruct which features from structures were (partly) wet sieved: GR05, GR07, HS01, HS08, HS10, HS11a, HS11b, KG37, KG54 & KK156.
119 Van der Linde & Hamburg 2014, 9.
120 One of the samples had an outcome in the Early Iron Age and does not represent the habitation period. For details, see Roessingh & Vermue 2011, 14-16.
121 Poz-147695: 3035±35BP (1409-1134 cal BC). For details, see Appendix II.

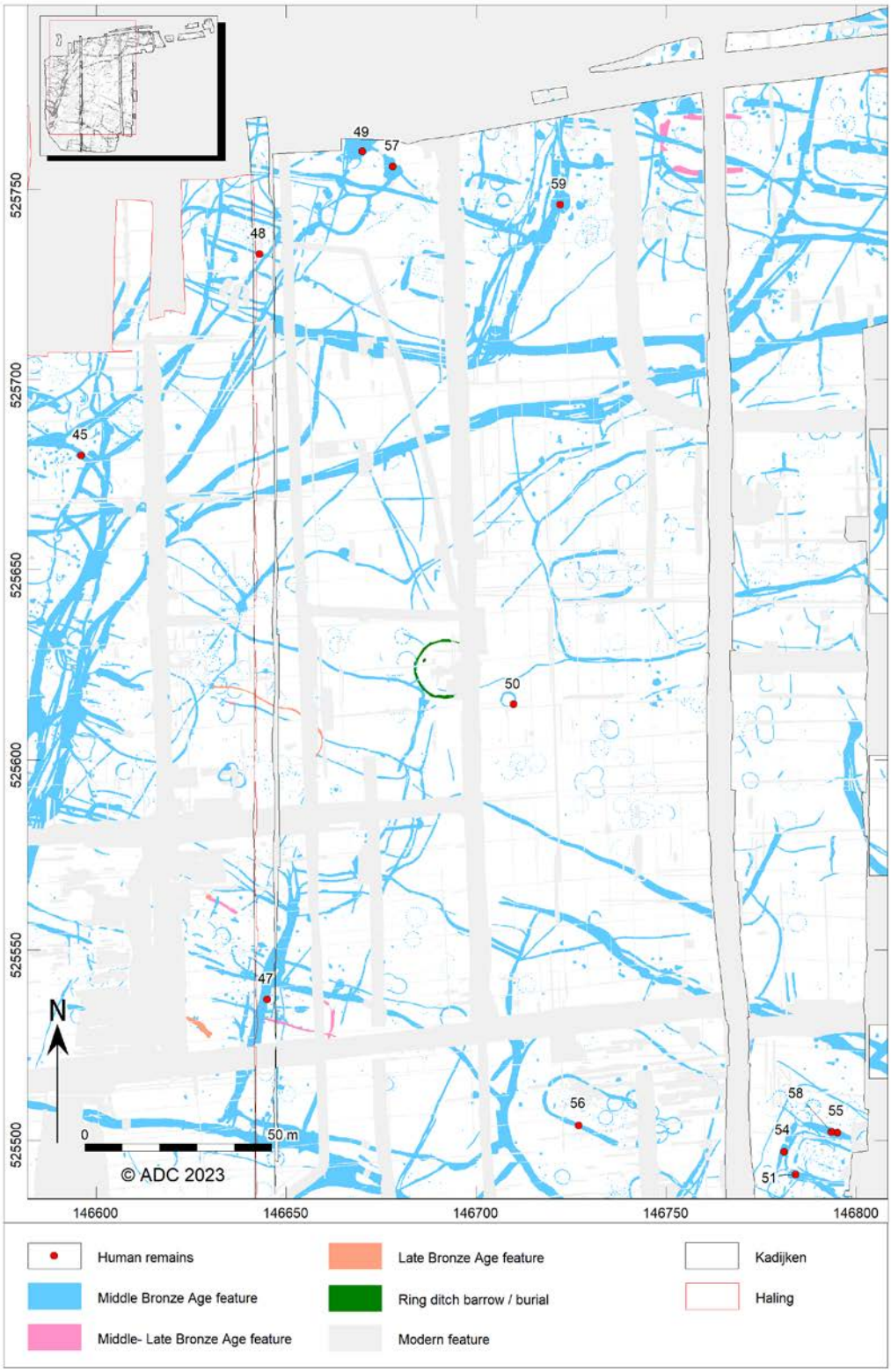


Figure 2.11. Enkhuizen-Kadijken/Haling. Location of the disarticulated human bones.

fragment of a fibula was found (ID56). This same find number comprised some fragments of animal bones, pottery, burned clay and stone. In other spots in this house ditch, many more finds were collected: more than 4 kg of animal bones, almost 300 g of pottery and 800 g of stone fragments, as well as many small fragments of burned loam and flint (Appendix III). This is one of the very few contexts that were (partly) wet sieved.

Pottery from features associated with the house date to the Middle Bronze Age.[122] This corresponds with the radiocarbon date from a sample from a posthole relating to the house. Based on the radiocarbon date, this house was probably inhabited in the second half of the Middle Bronze Age.[123] For this project, a sample of ID56 was submitted for radiocarbon dating, which also yielded a date in the second half of the Middle Bronze Age.[124]

The third house site with disarticulated human bones is located in the southeast: house site 11 (Fig. 2.12). On this spot, at least four consecutive houses could be reconstructed. [125] No

[122] Roessingh & Bloo 2011, 83.
[123] For details, see Roessingh & Lohof 2011, 360, Appendix II.
[124] Poz-147698: 3040±35BP (1411-1203 cal BC). For details, see Appendix II.
[125] Roessingh & Lohof 2011, 83-93.

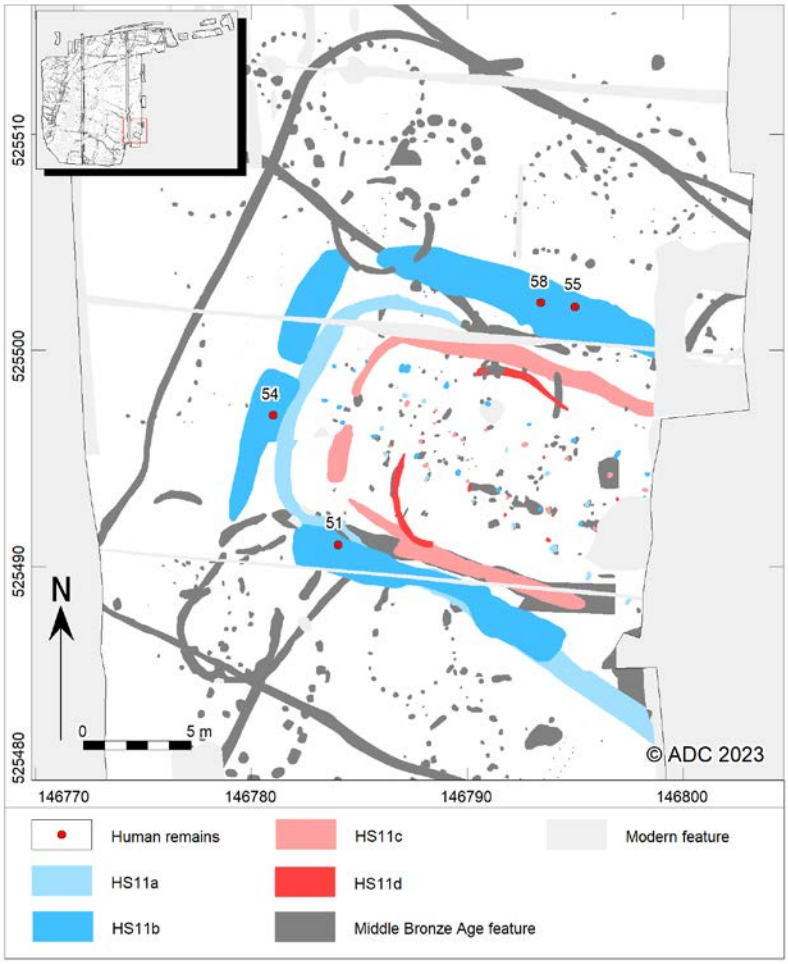


Figure 2.12. Enkhuizen-Kadijken. Detail of house site 11 with location of the disarticulated human bones.

fewer than four finds comprising disarticulated human bones were discovered. All these bones come from the house ditch that belongs to the second house phase (HS11b). Like the house ditch of house 10, this house ditch was also (partly) wet sieved. In the northern ditch, human bones from two individuals were found 1.5 m apart: a fragment of a femur (ID55) and fragments of a scapula, pelvis and femur (ID58). The same find number as ID55 comprised few additional finds: animal bone, pottery, stone and burned clay. Together with ID58 quite a few fragments of pottery and stone were found. Other find numbers from this ditch contained many more finds of the same categories (Appendix III).

In the western and southern house ditch, fragments of a cranium (ID54) and radius (ID51) were found: ID54 from the west ditch and ID51 from the east ditch. ID54 also comprised some animal bones. ID51 was found together with many animal bones (c. 40 fragments) and some fragments of pottery, burned clay and stone. At another spot in this house ditch, many more animal bones (>50 fragments) were collected (Appendix III).

Two radiocarbon dates are available from features of the house site, and these suggest the house site was inhabited in the second half of the Middle Bronze Age.[126]

The last find with disarticulated human bones from house ditches at this site was found in the western house ditch of house 14. Here some cranial fragments were found (ID47), together with many fish bones.[127] From the same house ditch, many fragments of pottery and stone were collected (Appendix III). A sample from this ditch was submitted for radiocarbon dating, which yielded a date in the period in the end of the Middle Bronze Age and first half of the Late Bronze Age. The type of pottery suggests a date in the Late Bronze Age.[128]

Five of the disarticulated human bones were found in other settlement features. In the northern part of the site, three bones were discovered in wells. Two wells with human bones are located close to each other: well 1 (WA01: ID49) and well 2 (WA02: ID57). The find number with ID49 is a complete radius. Other finds from well 1 consist of many animal bones (30 fragments) and some fragments of pottery and stone. ID57 consists of a cranial fragment and was found together with some animal bones. Other find numbers from this well contained many animal bones (>100 fragments) and some pottery and stone fragments (Appendix III). The wells date somewhere in the Middle Bronze Age, based on some fragments of pottery.[129] To narrow down this date, samples of both human bones were sent in for radiocarbon dating. Only ID49 contained enough collagen for a date. This yielded a remarkably old date, from the Late Neolithic through to the beginning of the Middle Bronze Age.[130]

The third human bone from a well is a fragment of a humerus in well 12 (WA12, ID59). This find number also comprises some animal bones. Other find numbers from the well consist of many animal bones (>3 kg) and some fragments of pottery (Appendix III). This pottery can probably be dated to the Middle Bronze Age.[131] The well was discovered in a ditch system that may be associated with nearby house sites. A sample of ID59 was submitted for radiocarbon dating, which yielded a date in the second half of the Middle Bronze Age. However, this date is

126 For details, see Roessingh & Lohof 2011, 360, Appendix II.
127 Roessingh & Vermue 2011, 24-25.
128 For details, see Roessingh & Vermue 2011, 13-14.
129 Roessingh & Bloo 2011, 175, Table 6.11.
130 Poz-147696: 3550±35BP (2019-1767 cal BC). This date is too old, probably due to the relatively high δ13C value. For details, see Appendix II.
131 Roessingh & Bloo 2011, 175, Table 6.11.

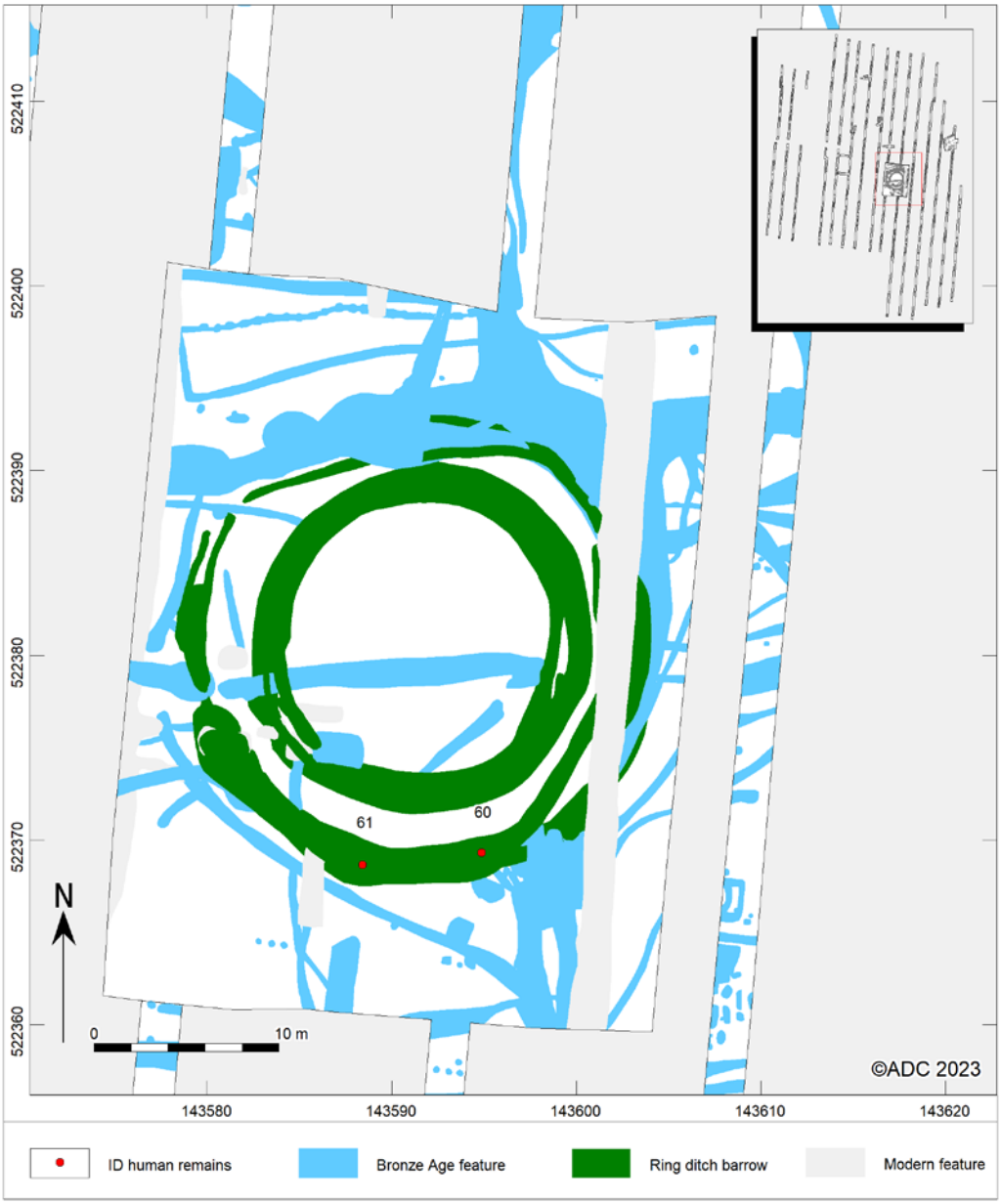


Figure 2.13. Grootebroek-Waterweide Noord. Location of the disarticulated human bones.

probably too old, due to the relatively high δ13C value.[132]

In the central part of the excavation, a small, circular structure (KG37) was located. The fill of this structure was (partly) wet sieved, which yielded ID50, a molar. Besides this human tooth, many small fragments of animal bone were found (Appendix III).[133] In the north-western part of the excavation, a human femur fragment (ID45) was found in a settlement ditch.[134] A sample of this bone sent for radiocarbon dating by the researchers after fieldwork, which yielded a date in the second half of the Middle Bronze Age.[135] The last disarticulated human bone is another molar (ID52), found in the northern part of the excavation, on the field just outside the excavation trenches.

2.3.8 Grootebroek-Waterweide Noord

In 2021, a large area west of the village of Grootebroek was excavated by ADC ArcheoProjecten. This site, known as Grootebroek-Waterweide Noord, consisted of numerous ditches, a two-period barrow, a house site and arable land.[136] Two fragments of a femur (ID60 and ID61) were found in features associated with the second phase of the barrow (Fig. 2.13). Features in various locations were sectioned and carefully excavated in segments, but this resulted in only a handful of finds.

ID60 was found in the second ring ditch (GRS02), more precisely in the youngest of two phases in this ditch (GRS02b). The bone comes from one of the first fills in this ditch (Fig. 2.14). At other places in the ring ditch, only some fragments of animal bone were found (Appendix III).

[132] Poz-147699: 3180±35BP (1511-1327 cal BC). For details, see Appendix II.
[133] Normally these circular structures contain very few finds (Roessingh & Lohof 2011, 114). This example shows that the finds from these structures are probably present but very fragmented and that they can only be found by wet sieving.
[134] Together with this human bone, a single fragment of animal bone was found (c. 1.5 kg). It is unclear what kind of element this is, but we presume from the weight that it is a (complete) cranium.
[135] GrA-57738: 3080±30BP (1427-1260 cal BC). For details, see Van der Linde & Hamburg 2012, 37, Table 4.5.
[136] Roessingh 2022.

Figure 2.14. Grootebroek-Waterweide Noord. Section of the second-phase ring ditch (GRS02), showing the original location of ID60 (red circle).

Figure 2.15. Grootebroek-Waterweide Noord. Section of the second-phase ring ditch (GRS02) and the deep well (WA02) underneath it, showing the original location of ID61 (red circle).

About 6 m west of ID60, well 2 (WA02) was discovered in the second-phase ring ditch. ID61 was found near the bottom of this well (Fig. 2.15). The same find number also comprised some small animal bone fragments. Other finds from the well consist of some more animal bones and fragments of wood (Appendix III).

For this project, samples of both bones were submitted for radiocarbon dating. ID61 was dated to the second half of the Middle Bronze Age. Dating of the first sample of ID60 failed due to the lack of collagen in the sample. A second sample was submitted for radiocarbon dating, and this yielded a date in the period Early Bronze Age to first half of the Middle Bronze Age.[137]

2.3.9 Hauwert-Notweg 6

During an excavation in 2018 by RAAP, some features dating to the Late Neolithic-Early Bronze Age were discovered near the village of Hauwert.[138] In one of the pits (V6-S13, Fig. 2.16), two fragments of human bone (costae and radius) were discovered (ID131).[139] The only other find in this find number (and this context) was a small fragment of animal bone (Appendix III). A fragment of one of the human bones was submitted for radiocarbon dating, which yielded a date in the end of the Late Neolithic through to the beginning of the Middle Bronze Age.[140]

137 ID61: Poz-147701: 3090±30BP (1424-1270 cal BC); ID60: Poz-150579: 3425±35BP (1876-1622 cal BC). The δ13C and δ15N values are not known for ID60, so it is unclear whether these values had an influence on the outcome of the date. For details, see Appendix II. Four other radiocarbon dates from features associated with the barrow all seem to suggest a date for the barrow in the second half of the Middle Bronze Age (Roessingh in prep.).

138 Wink & De Groot 2022.

139 Van Gent 2022, 40-41.

140 ICA-19B/1228, 3570±30BP (2025-1775 cal BC) (Wink & De Groot 2022, 51, Table 11).

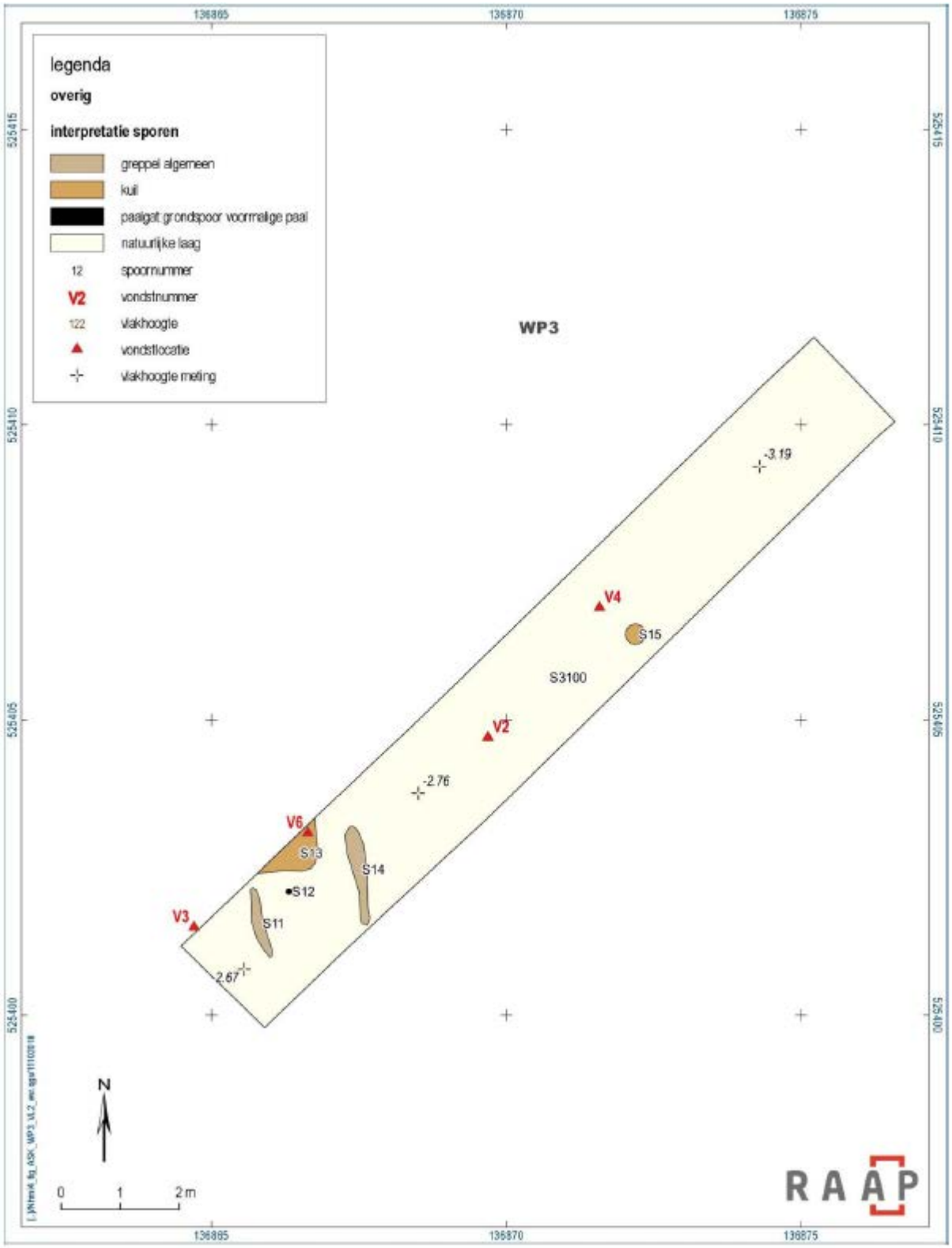


Figure 2.16. Hauwert-Notweg 6. V6 in pit S13 (red circle) indicates the location of the disarticulated human bones (ID131) (after Wink & De Groot 2022, 36, Fig. 16).

2.3.10 Hoogkarspel-Hoogkarspeltunnel

Directly west of the Tolhuis F site (see below), an excavation was carried out in 2014 by ADC ArcheoProjecten.[141] This settlement site, known as Hoogkarspeltunnel, is part of the settlement area from Hoogkarspel-Tolhuis excavations. Its excavation allowed for a large number of the Tolhuis settlement features to be investigated further (Fig. 2.19). In the southern part of the excavation, fragments of a cranium (ID46) were found in the upper fill of well WA07, approximately 40 cm below the excavation level. Other finds from this well consist of some animal bones and a fragment of pottery (Appendix III). The well was excavated within a wide ditch system (GR02b). Based on a radiocarbon date from an associated ditch, this ditch system can probably be dated somewhere towards the end of the Middle Bronze Age.[142]

2.3.11 Hoogkarspel-Houterpolder West

In 2014 and 2015, the site Houterpolder West, near the village of Hoogkarspel, was excavated by ADC ArcheoProjecten.[143] During the excavation, a large area of a Bronze Age settlement site with barrows could be investigated. Different house sites and numerous ditches dating to the Middle Bronze Age were discovered. Some ditches were originally dug at the end of the Middle Bronze Age or beginning of the Late Bronze Age. Besides these settlement features, two barrows were found. Four disarticulated human bones were found at the site (Fig. 2.17), three from ring ditches (ID23-ID25) and one from a settlement ditch (ID44).

All features were sectioned and completely excavated. The ring ditch of barrow 1 was excavated in segments. After sectioning the ditch at different locations, the features were

[141] Jezeer 2019.
[142] Jezeer 2019, 179.
[143] Zandboer & Roessingh 2019.

Figure 2.17. Hoogkarspel-Houterpolder West. Location of the disarticulated human bones.

carefully excavated in segments to collect finds.

In the ring ditch of barrow 1, two disarticulated human bones were found in the eastern part of the ditch (ID24 and ID25). ID24 consists of cranial fragments and was found in the upper fill of the ditch, approximately 15 cm below the excavation level. In the same feature, one fragment of animal bone was found (Appendix III). ID25 consists of femur fragment and a tibia fragment and was also found in the upper fill of the ditch, 7 m north of ID24. These bones were found just below the excavation level. Besides the human bones, only two fragments of animal bone and a fragment of pottery were found in the feature (Appendix III).

The western barrow (barrow 2) yielded a fragment of a humerus from the southern part of the ring ditch (ID23). This bone also comes from the upper fill of the ditch, just below the excavation level. Just like the other ring ditch, this ditch contained very few finds. Only two fragments of animal bone were found (Appendix III).

Radiocarbon dates from the ring ditches seem to suggest the barrows were in use in the second half of the Middle Bronze Age.[144] For this project, samples of all the three human bones from the ring ditches were submitted for radiocarbon dating. Dating of ID24 was not possible due to the lack of collagen in the sample. ID23 and ID25 were both dated to the second half of the Middle Bronze Age.[145]

The fourth find comprising a disarticulated human bone from this site are some fragments of a cranium (ID44), from a settlement ditch (GR26) that runs just north of barrow 2. The bones were found in the upper fill of the feature, just below the excavation level. The ditch cuts through the ring ditch of barrow 2.[146] Many animal bones (>0.5 kg) were collected under the same find number (Appendix III). A radiocarbon date from material in the ditch corresponds with the relatively young date of this feature: end of the Middle Bronze Age to beginning of the Late Bronze Age.[147]

2.3.12 Hoogkarspel-Markerwaardweg

In 2014 and 2015, an area of 12 ha was excavated northwest of the village of Hoogkarspel. This site, known as Hoogkarspel-Markerwaardweg, was excavated by Archol. During the excavation, an impressive settlement landscape was discovered, with many features and structures from the Middle Bronze Age and Late Bronze Age.[148] A total of eight disarticulated human bones were found at this site (Fig. 2.18). The human remains were found in different types of features, most of them dating to the Middle Bronze Age (Table 2.4).

Table 2.4. Hoogkarspel-Markerwaardweg. Number of features of each type and date containing disarticulated human bones.

Context	N of features
House ditch (Middle Bronze Age)	2
Ditch (Middle Bronze Age)	2
Ditch (Middle- Late Bronze Age)	1
Posthole (Middle- Late Bronze Age)	1
Ditch (Late Bronze Age)	2

Middle Bronze Age context

From Middle Bronze Age contexts, two disarticulated human bones were found in the northern part of the site (ID2 and ID3). ID2 consists of a mandibula fragment with some teeth and comes from a narrow settlement ditch that may be associated with house site 12, in the northwestern part of the site.[149] Besides this human bone, a few animal bones were found in this feature (Appendix III).

Some fragments of a cranium (ID3) were found in the house ditch of house 27. This same find number comprised many animal bones together with some burned clay (Appendix III). The date of both the ditch and the house ditch is not known, as there are no radiocarbon dates from these contexts and there was no pottery in the features. The ditch pre-dates some Late Bronze Age ditches and probably dates to the Middle Bronze Age. The house most likely also dates to the Middle Bronze Age and may be associated with a Middle Bronze Age ditch system nearby. These ditches probably surrounded the house sites and arable land.[150]

In the centre of the excavation, two finds comprising human cranial fragments were found in settlement ditches (ID7 and ID10). ID7 is a cranial fragment that comes from a ditch system (GR26). This same find number comprised some

144 Zandboer & Roessingh 2019, 306-311.
145 ID23: Poz-147613: 3070±35BP (1421-1226 cal BC); ID25: Poz-147614: 3145±30BP (1499-1311 cal BC). For details, see Appendix II.
146 Zandboer & Roessingh 2019, 311.
147 Poz-92465: 2950±30BP (1260-1051 cal BC). For more details, see Tol & Roessingh 2019, 57, Table 4.2.
148 Van Zon 2019.
149 Van Zon 2019, 75, Fig. 5.13. The features in this area are not well preserved, probably due to land consolidations on the high sandy ridge (Van Zon 2019, 70).
150 Van Zon 2019, 110, Fig. 5.40 (zone 3).

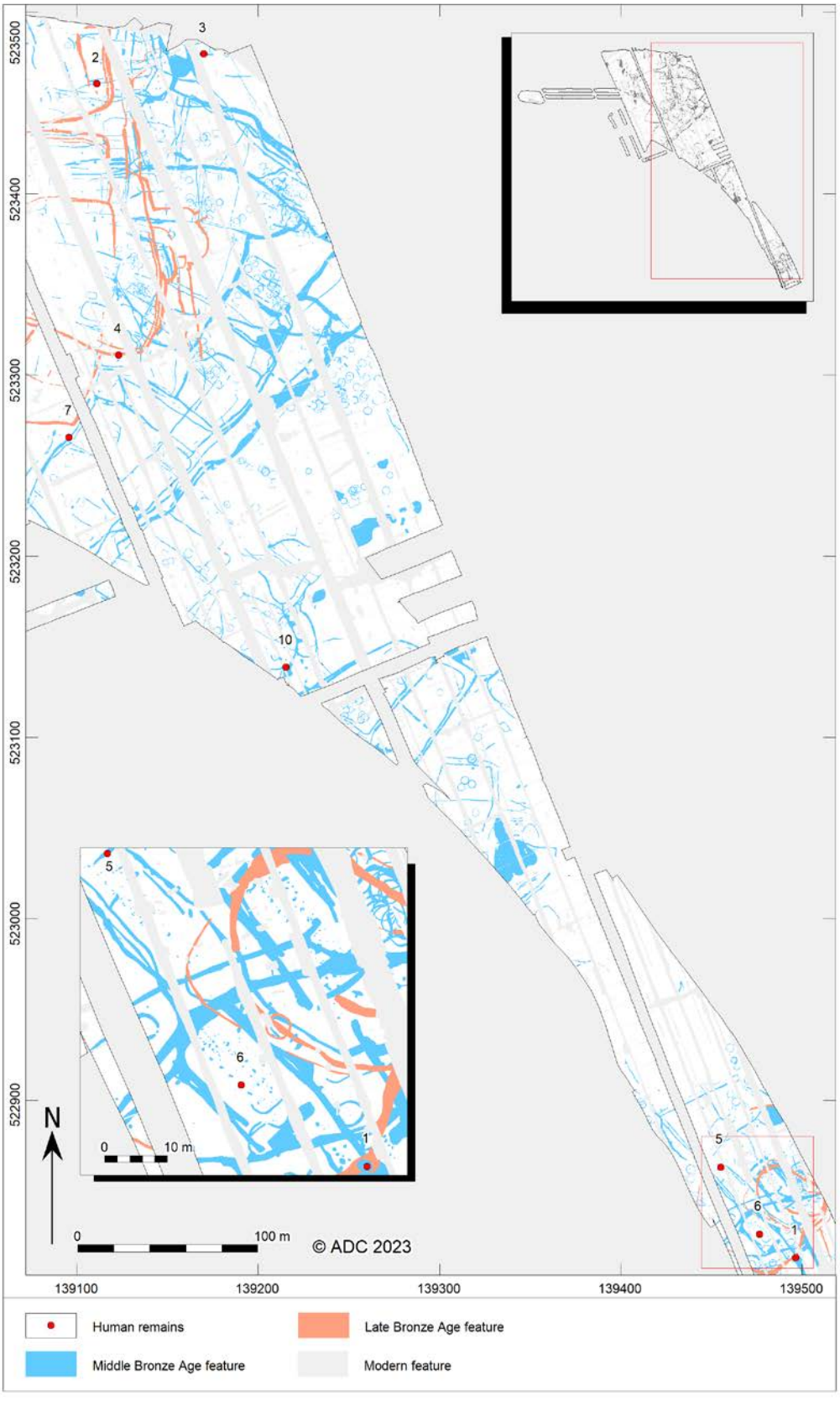


Figure 2.18. Hoogkarspel-Markerwaardweg. Location of the disarticulated human bones.

animal bones, and at other locations in the ditch more animal bones (>2.5 kg) were collected (Appendix III). The ditch probably dates to the Middle Bronze Age, based on horizontal stratigraphy.[151] ID10 consists of some fragments of a cranium that were found in a ditch surrounding house 2 (GR08a).[152] From this ditch, also some animal bones, fragments of pottery and stone were collected (Appendix III).

In the southern part of the excavation, a fifth find with some disarticulated human bones (ID5) was found, in the house ditch of the third phase of house 17 (HS17c). ID5 consists of fragments of a femur together with a illium. Beside these human bones, some animal bones were collected under the same find number (Appendix III). Two radiocarbon dates are available from postholes relating to this house site. Neither date is very useful because they represent a very long lifespan.[153] Based on the pottery in features associated with the house site, it was probably inhabited in the Middle Bronze Age.

ID6 is a fragment of a cranium from the southern part of the site. It was found in a posthole of house site 19. This house site has three phases, and the posthole can be associated with the third of these (HS19c). Besides the human bone, also some animal bones and burned clay were collected under this same find number (Appendix III). From this house site, no fewer than four radiocarbon dates are available.[154] The results suggest this house site was inhabited at the end of the Middle Bronze Age - beginning of the Late Bronze Age.

Late Bronze Age context

Two finds comprising disarticulated human bones were found in features dating to the Late Bronze Age. ID4 is a fragment of a cranium that was found in one of the settlement ditches in the northern part of the excavation (GR18b). This ditch is part of a ditch system with different phases.[155] In other parts of the ditch, some animal bones were found, as well as many fragments of pottery and some fragments of stone (Appendix III). Based on the pottery, this ditch system dates to the Late Bronze Age. This corresponds with the results of two radiocarbon dates available from this ditch and four other radiocarbon dates from other ditch phases.[156] For this project, the human bone was sampled for radiocarbon dating, and this yielded a Middle Bronze Age date.[157] Looking at the results of the dates, the human bone must be at least 200 years older than most of the other finds in the ditch.

In the southern part of the excavation, some fragments of a cranium (ID1) were found in a ditch (GR14b) that surrounds house 31.[158] In other locations of the ditch, many animal bones were found (>4 kg), together with many pottery fragments and burned clay (Appendix III). This ditch system can probably be dated to the (first half of the) Late Bronze Age, based on a radiocarbon date, pottery and horizontal stratigraphy.[159]

2.3.13 Hoogkarspel-Tolhuis D

The first West Frisian Bronze Age settlements were discovered in the 1960s, near the village of Hoogkarspel. The excavations, known as Hoogkarspel-Tolhuis, were carried out by the IPP. At Hoogkarspel-Tolhuis D, two Middle Bronze Age barrows were excavated, together with some Late Bronze Age settlement ditches (Fig. 2.19).[160] In one of these Late Bronze Age ditches, a disarticulated human bone, a fragment of a femur, was found (ID92). The exact context of this find is unclear. Fragments of animal bones were also collected, but the location of these (and perhaps other) finds is unknown (Appendix III).

2.3.14 Hoogkarspel-Tolhuis F

At Hoogkarspel-Tolhuis F, a large settlement site was excavated by the IPP. Numerous houses and ditch systems were discovered, most of them dating to the Middle Bronze Age. In two locations, a complex of Late Bronze ditches was found together with two house sites (Fig. 2.19).[161] A total of 28 finds comprising disarticulated human bones were found at the site. None of these bones could not be relocated during our inventory, but the exact location of many of them (N=16) is known from literature (Table 2.1).

Five of the human bones were found in features dating to the Middle Bronze Age (N=5). The other 11 finds were associated with Late Bronze Age features (Table 2.5). The Late Bronze

151 Van Zon 2019, 110, Fig. 5.40 (zone 3).
152 Van Zon 2019, 104 (zone 2); 109, Fig. 5.39.
153 HS17a: Poz-92483: 3010±35BP (1388-1127 cal BC); HS17c: Poz-92480: 3285±35BP (1644-1460 cal BC). For more details, see Tol & Roessingh 2019, 57, Table 4.2; Roessingh 2019, 683.
154 HS19a: Poz-92482: 2940±35BP (1258-1027 cal BC); HS19a: Poz-98821: 2930±35BP (1226-1014 cal BC); HS19b: Poz-92484: 2920±35BP (1218-1011 cal BC); HS19c: Poz-92479: 2960±30BP (1263-1056 cal BC). For more details, see Tol & Roessingh 2019, 57, Table 4.2.
155 Van Zon 2019, 113, Fig. 5.43 (zone 3).
156 GR18b: Poz-92469: 2795±35BP (1027-842 cal BC) & Poz-92082: 2725±35BP (968-808 cal BC). For more details and other radiocarbon dates from this ditch system, see Tol & Roessingh 2019, 57, Table 4.2.
157 Poz-147604: 3040±35BP (1411-1203 cal BC).
158 Van Zon 2019, 98 (zone 1); 112, Fig. 5.42.
159 GR14b: Poz-101534: 2925±30BP (1215-1022 cal BC). For more details, see Tol & Roessingh 2019, 57, Table 4.2. Roessingh & Verniers 2019, 411, Tables 14.7 and 14.8.
160 Bakker & Brandt 1966, 181-224; Roessingh 2018, 94; 97.
161 Roessingh 2018, 55-131.

Age features cut through numerous Middle Bronze Age features, so some of the bones from Late Bronze Age contexts may also date to the Middle Bronze Age.

There is little information available about the field methods used. In the later campaigns, choices had to be made because of a lack of time. Not all of the features were sectioned or completely excavated, for example.[162] The finds have not yet been analysed, so it is not possible to say anything about associated finds from features where human bones were found.

Table 2.5. Hoogkarspel-Tolhuis F. Number of features of each type and date containing disarticulated human bones.

Context	N of features
Ditch (Middle Bronze Age)	2
Pit / well (Middle Bronze Age)	1
Circular ditch (Middle Bronze Age)	2
Ditch (Late Bronze Age)	7
Pit / well (Late Bronze Age)	4

Middle Bronze Age context

From a Middle Bronze Age context, there are five finds comprising disarticulated human bones. Two of the finds come from circular structures and are fragments of a femur (ID95 and ID106).[163] ID106 was found in the north of the excavation, in a circular ditch (KG25) associated with a cluster of circular structures. ID95 comes from a circular ditch (KG98) in the central part of the excavation. In this area, numerous circular structures were found, and sometimes at least eight consecutive structures could be reconstructed.[164] The presence of finds in circular structures is exceptional, because these features normally barely contain any finds.[165]

In the southern part of the excavation, two disarticulated human bones were found in the same ditch, about 4 m apart: ID112 (a fragment of a tibia) and ID113 (a fragment of a tibia). This ditch is one of the many settlement ditches that were found between houses 4 and 5 and houses 5 and 10.[166] The fifth human bone is a fragment of a femur (ID103) that was found in well 2 (WA02). The well was discovered in a settlement ditch. A Late Bronze Age ditch system runs parallel to this ditch, which may suggest a relative late (Middle Bronze Age) date.

Late Bronze Age context

All of the disarticulated human bones from Late Bronze contexts (N=11) were found in the Late Bronze Age complex in the northeastern part of the site (cluster 2). This cluster consists of various ditches, which were probably in use at the same time and functioned as drainage for a house site: house 2.[167] The finds were concentrated in two areas within this cluster (Fig. 2.19): the southwest (N=3) and the northeast (N=8).

In the west, three human bones were discovered close to each other. ID93 and ID108 were found in what was presumably the same ditch, about 3 m apart. ID93 is a fragment of an ulna and ID108 is a fragment of a humerus. This ditch is one of the two parallel ditches that connects cluster 2 with cluster 1. Approximately 7 m south, a fragment of a cranium (ID107) was found in a ditch that may also have been part of the above-mentioned parallel ditch system.

The second cluster of human bones was located in the northeast. Within an area of approximately 25 x 20 m, no fewer than eight bones were discovered in Late Bronze ditches and pits (Fig. 2.19). Five of the finds can be associated with wide ditches surrounding house 2. Two of them come from the same location in the outer ditch: ID110 (femur fragment) and ID111 (humerus fragment). In a ditch 4 m closer to the house, ID94, a cranial fragment, was found. In the ditch closest to the house, the other two disarticulated human bones were discovered: a fragment of a humerus (ID98) and a fragment of a cranium (ID114).

Within the ditch system of cluster 2, three more finds comprising disarticulated human bones were found, all in smaller features. These features are all located near house 2. ID99 and ID105 were found in the same pit. ID99 consists of a fragment of a humerus and vertebrae, whereas ID105 is a fragment of a phalanx. Based on horizontal stratigraphy, this pit predates the house. The third human bone is a fragment of a cranium (ID97) discovered in a little, rectangular pit that, based on horizontal stratigraphy, postdates house 2.[168]

162 Roessingh 2018, 60-62.
163 One may question the exact context of ID95, because the original find number is crossed out on the field drawing.
164 Roessingh 2018, 81, Plate 4.28.
165 See, for example, the few finds from the many round structures at the sites of Enkhuizen-Kadijken (Roessingh & Lohof 2011, 114) and of Hoogkarspel-Tolhuis and Bovenkarspel-Het Valkje (Roessingh 2018, 339).
166 Roessingh 2018, 76, Plate 4.23.
167 Roessingh 2018, 92-94.
168 One of the postholes was found underneath this pit.

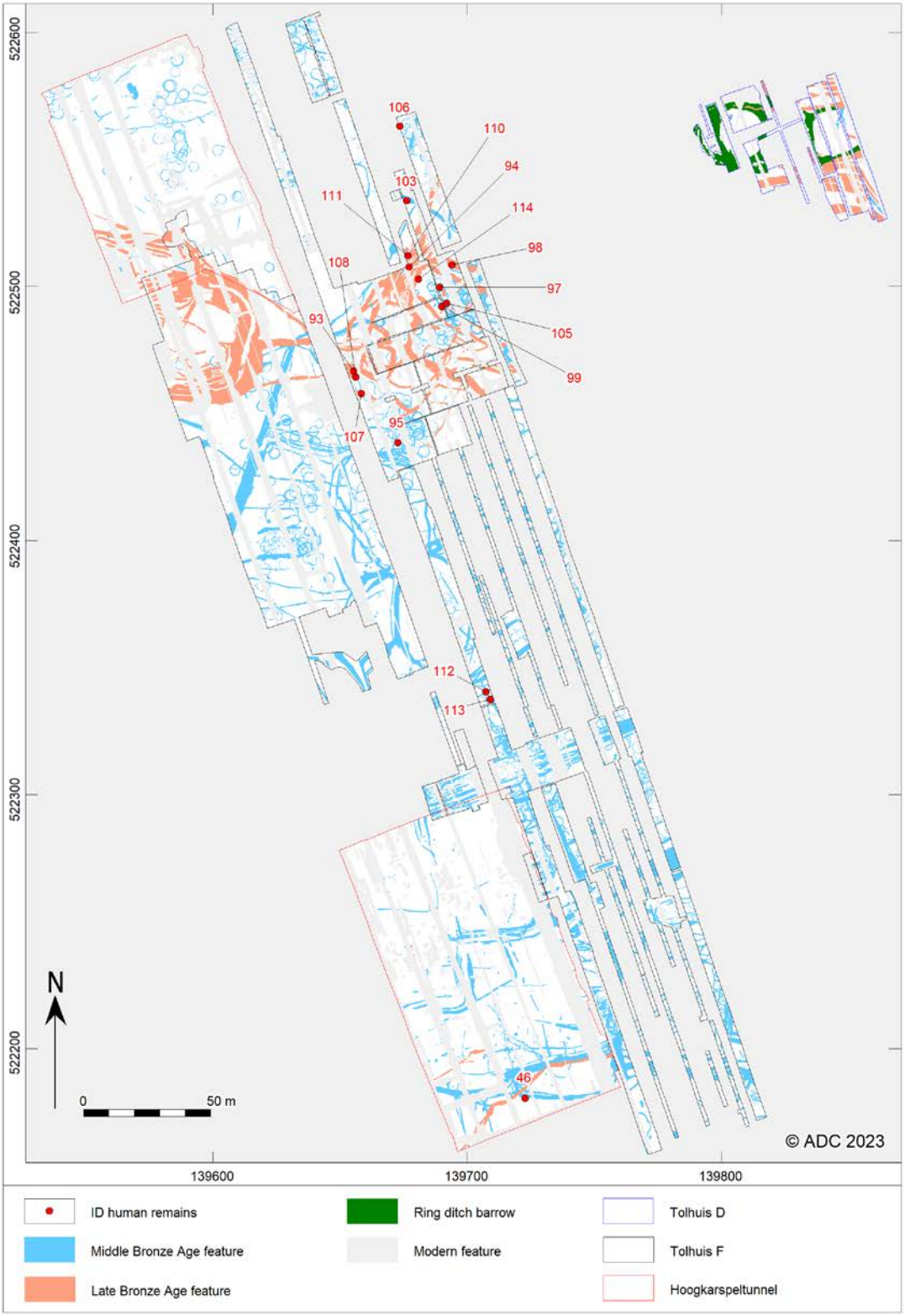


Figure 2.19. Hoogkarspel-Tolhuis D/F and Hoogkarspel-Hoogkarspeltunnel. Location of the disarticulated human bones.

2.3.15 Hoogkarspel-Tumuli

During a rescue research northwest of Hoogkarspel, the IPP excavated narrow, long trenches in order to find barrows for further investigation. A total of 11 barrows were partly excavated.[169] A fragment of a cranium (ID121) was found in (or near?) one of the barrow features. The exact location of these bones is unclear, and it is not known whether there were any associated finds.[170]

2.3.16 Hoogkarspel-Tumulus I, Hoogkarspel-Tumulus Ia and Hoogkarspel-Watertoren

North of Hoogkarspel, different excavations were carried out by the IPP on the site known as Hoogkarspel-Watertoren. In 1958, a barrow was excavated in this area (known as Hoogkarspel-Tumulus I).[171] During a large-scale excavation in the mid-1970s, the area around tumulus I was further investigated, uncovering a second barrow (tumulus Ia), as well as features of a settlement with some houses and numerous ditches.[172] The site was probably occupied during the Middle Bronze Age and perhaps also during the beginning of the Late Bronze Age.[173]

In the ring ditch of tumulus I, six finds comprising disarticulated human bones were found (ID11-13 and ID123-126).[174] All of the finds comprise (single) cranial fragments, and ID125 also comprises a fragment of a femur. Five of the bones were found in the upper fill of the ring ditch. Only ID123 was found in a lower fill. The exact location of four of these finds is known (Fig. 2.20). There is no information available about associated finds.

Tumulus Ia is located ca. 75 east of tumulus I. Tumulus Ia is a three-phase barrow,

Figure 2.20. Hoogkarspel-Tumulus I. Location of the disarticulated human bones.

169 Roessingh 2018, 65-66,127-129.
170 Runia 1987, 232.
171 Bakker 1959.
172 Modderman 1974; Bakker *et al.* 1977; Roessingh 2018, 62-65, 111-129.
173 Roessingh 2018, 122-123.
174 Van der Feen, De Boer & Renaud 1959, 176-177.

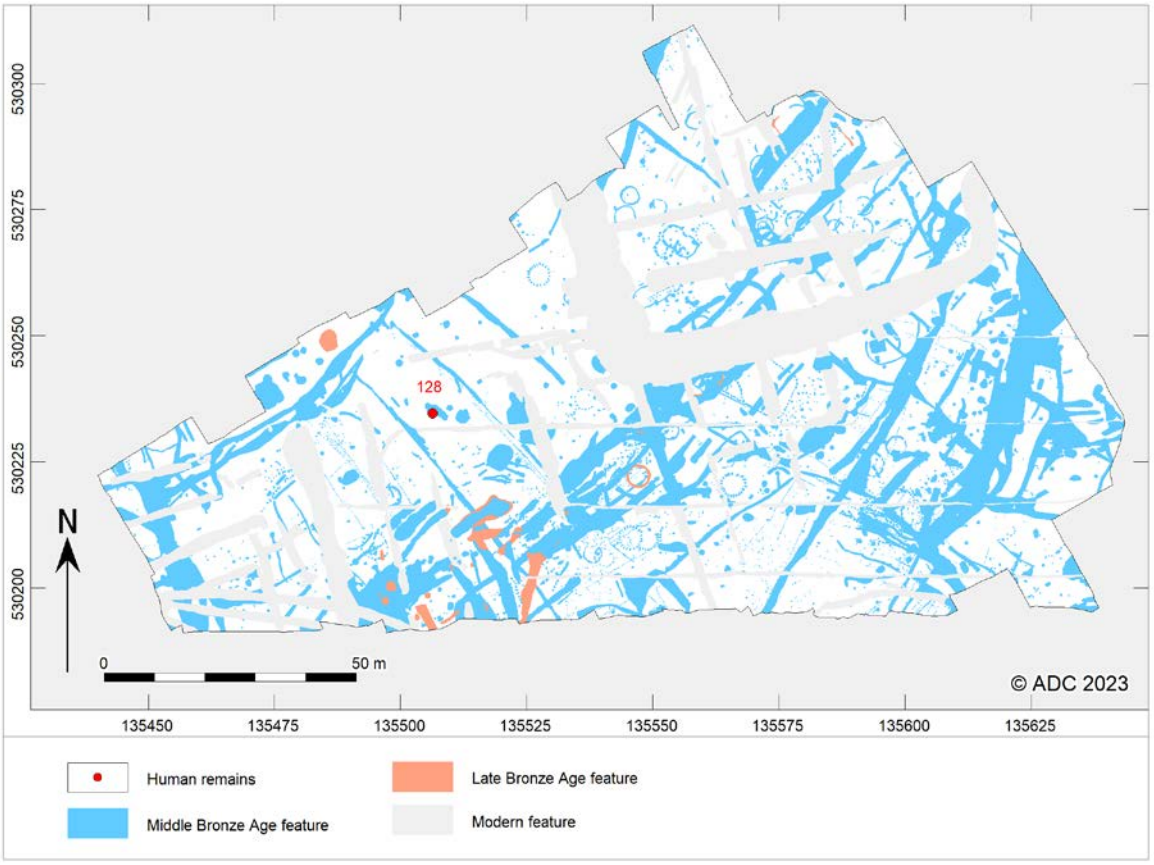


Figure 2.21. Medemblik-Schepenwijk II. Location of the disarticulated human bone.

with three ring ditches. From the outer ring ditch (relating to the third phase), two finds comprising cranial fragments are known (ID126 and ID127). Both finds come from the eastern part of the ring ditch, but the exact location is unclear.[175] There is no information available about associated finds.

From the settlement site Hoogkarspel-Watertoren, one find comprising disarticulated human bones is known (ID122). This find includes a fragment of a cranium, a molar and '*other bones*' (Appendix I). The exact location of the find is not clear; the human bones were found in the ditches surrounding 'house area 1' in the northwestern part of the site.[176] Other finds in this area consist of some animal bones (Appendix III). The ditches belong to a farmyard (erf 5), dating to the last phase of the settlement.[177]

2.3.17 Medemblik-Schepenwijk II

In 2007, ACVU-HBS excavated a Bronze Age settlement site south of the city of Medemblik. The site is dominated by Middle Bronze Age features such as settlement ditches, house sites and pits. Some ditches dating to the Late Bronze Age were also found.[178] In the western part of the excavation, a long, narrow Middle Bronze Age pit was documented (5.2 by 1.7 m). In this feature, a fragment of a cranium was found (ID128, Fig. 2.21). The depth of the pit is unknown, the bone comes from the upper fill. The pit is associated with a large ditch system.[179] There is no information available about associated finds.

2.3.18 Venhuizen-Voetakkers

In 2015, a narrow strip of a Bronze Age settlement site was excavated by Archol near the village of Venhuizen. The site is dominated by narrow, straight ditches and different house sites dating to the Middle Bronze Age. Some of the ditches were also in use during the Late Bronze Age.[180]

Two disarticulated human bones were found at this site (ID8 and ID9, Fig. 2.22).[181] Both finds come from ditches dating to the Middle Bronze Age. ID8, a fragment of a femur, comes from the upper fill of a narrow ditch in the northwest. This same find number comprised an animal bone (Appendix III). This ditch can be associated with a larger ditch system where

175 Bakker 1974, 9.
176 Van Mensch & IJzereef 1977, 206.
177 Roessingh 2018, 114-115, 119.
178 Schurmans 2010, 28, 200.
179 Schurmans 2010, 198-200 (greppelsysteem 1). The excavators define this context as a ditch.
180 Van der Leije 2019.
181 In the excavation report these bones were published with the wrong toponym (Roessingh 2019, 699, Table 22.3: V124 & V418).

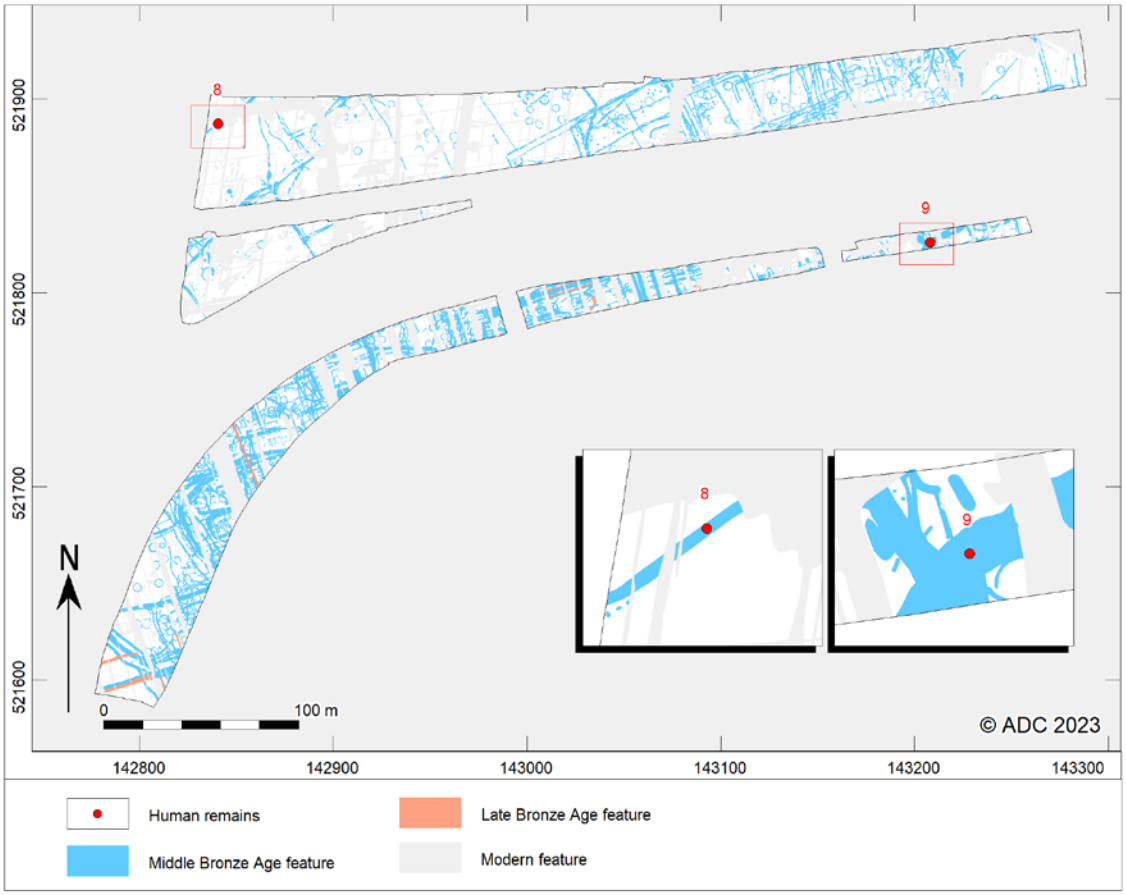


Figure 2.22. Venhuizen-Voetakkers. Location of the disarticulated human bones.

house sites were absent.[182] For this project, a sample of ID8 was submitted for radiocarbon dating, which yielded a date in the second half of the Middle Bronze Age.[183] This date corresponds with most of the other radiocarbon dates from the site.[184]

ID9, fragments of a cranium, was found in the upper fill of one of the ditches in the southeastern part of the site. This same find number comprised many animal bones, together with some pottery fragments (Appendix III). This ditch is one of at least four phases of a ditch system that must have been in use for a long time.[185]

2.3.19 Wervershoof-De Ark Tumulus XIII

Near the villages of Wervershoof and Zwaagdijk lie a cluster of Bronze Age barrows. In 1954, the IPP excavated one of these barrows, a four-phase barrow known as tumulus XIII.[186]

In ring ditch II (period IV), some disarticulated human bones (fragments of a femur and a fragment of a tibia) were found (ID14).[187] The exact location of these bones (or associated finds) is unknown, but it is known they were found together with some other finds in the southwestern part of the ring ditch.[188] A sample from this ring ditch yielded a radiocarbon date in the Late Bronze Age.[189] This is a very young date for this feature, and one that does not correspond with the Middle Bronze Age pottery found in the ditch.[190] The sample comes from the 'homogeneous fill' of the ditch, which corresponds with the upper fill.[191]

2.3.20 Wervershoof-Eendenkooi 2015

In 2015, the RCE carried out small-scale research on the site Wervershoof-Eendenkooi, a scheduled monument where a lot of Bronze Age barrows are located. The research aimed at an evaluation of

182 Van der Leije 2019, 371 (greppelsysteem 1).
183 Poz-147606: 3110±30BP (1442-1286 cal BC). For details, see Appendix II.
184 Most of the Middle Bronze Age features from the site probably date in the second half of the Middle Bronze Age, based on the results of the radiocarbon dates (Van der Leije 2019, 379-381).
185 Van der Leije 2019, 374 (greppelsysteem 9).
186 Van der Waals 1961.
187 Clason 1961, 91.
188 Van der Waals 1961, 70-71.
189 GRO-2168: 2725±45BP (982-803 cal BC). For details, see Van der Waals 1961, 73-74. For this project, a sample of ID14 was submitted for radiocarbon dating, but the sample did not contain enough collagen for a date. For details, see Appendix II.
190 Van der Waals 1961, 69-70.
191 Van der Waals 1961, 69.

this scheduled monument.[192] During the excavation, different human bones were found, most of which are (probably) be associated with burials. In one of the test trenches, a fragment of a cranium (ID129) was found. Because of the small dimensions of the trench, the context type is not clear; it may be a pit or a ditch.[193] There is no information available about associated finds. The date of the feature is not known, but it can probably be associated with one of the surrounding barrows, which are placed in the Early Bronze Age-Middle Bronze Age.[194]

2.3.21 Zwaagdijk-Oost 2001

In 2001, some test trenches were excavated in the village of Zwaagdijk-Oost by the Amsterdams Archeologisch Centrum (AAC).[195] In one of the trenches, a fragment of a cranium (ID130) was found in a rectangular pit (Fig. 2.23 and Fig. 2.24). The pit measures 1 by 2.5 m and had a depth of 35 cm, and the section (Fig. 2.23) shows five fills. ID130 was found in fill 3, which seems to consist of deliberately dumped finds and silty sand.[196] This same find number comprised a fragment of an elk antler, together with some pottery, burned clay and stone. Other find numbers from the pit consist of some more animal bones, pottery and stone (Appendix III). The pit was dug after the occupation of house b.[197] Based on the pottery found in the pit, this feature dates to the Middle Bronze Age.[198]

2.4 Discussion

In this chapter the West Frisian Bronze Age sites with disarticulated human bones have been introduced and discussed in order to answer the

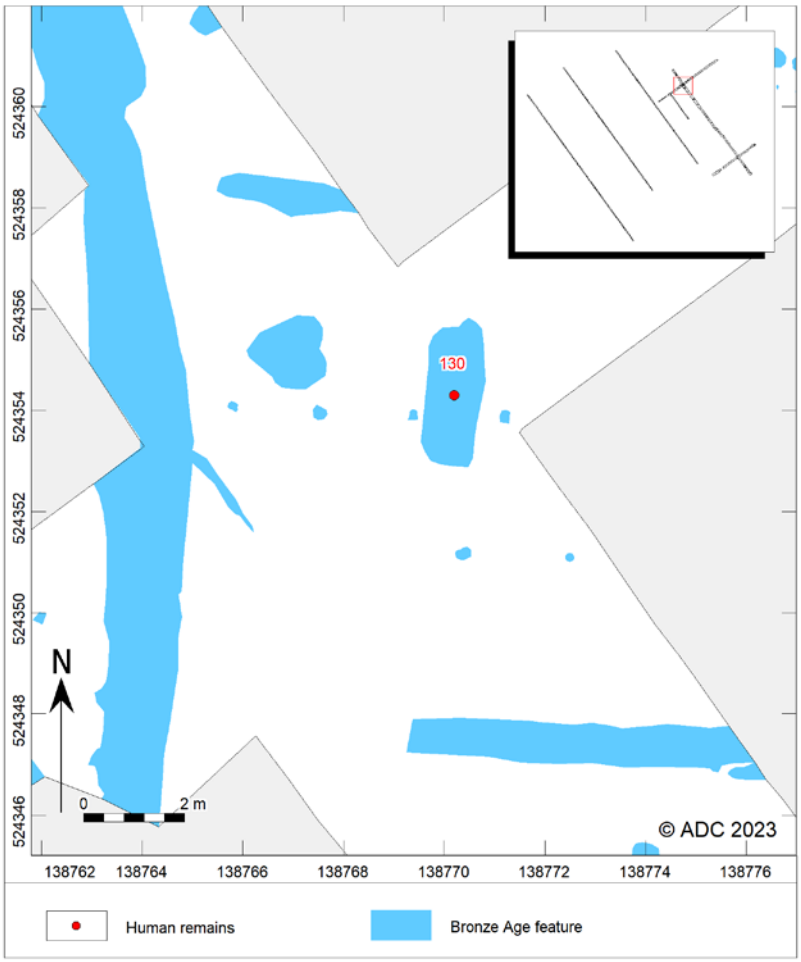


Figure 2.23. Zwaagdijk-Oost 2001. Location of the disarticulated human bone.

192 Van der Heiden & Feiken 2018.
193 Van der Heiden & Feiken 2018, 120; Laarman 2018, 143.
194 Van der Heiden & Feiken 2018, 156-158.
195 Besselsen, Lange & Flamman 2002.
196 Besselsen, Lange & Flamman, 27, Plate 10; 65.
197 Besselsen, Lange & Flamman, 24, 25, Plate 8.
198 Besselsen, Lange & Flamman, 57, Appendix II.

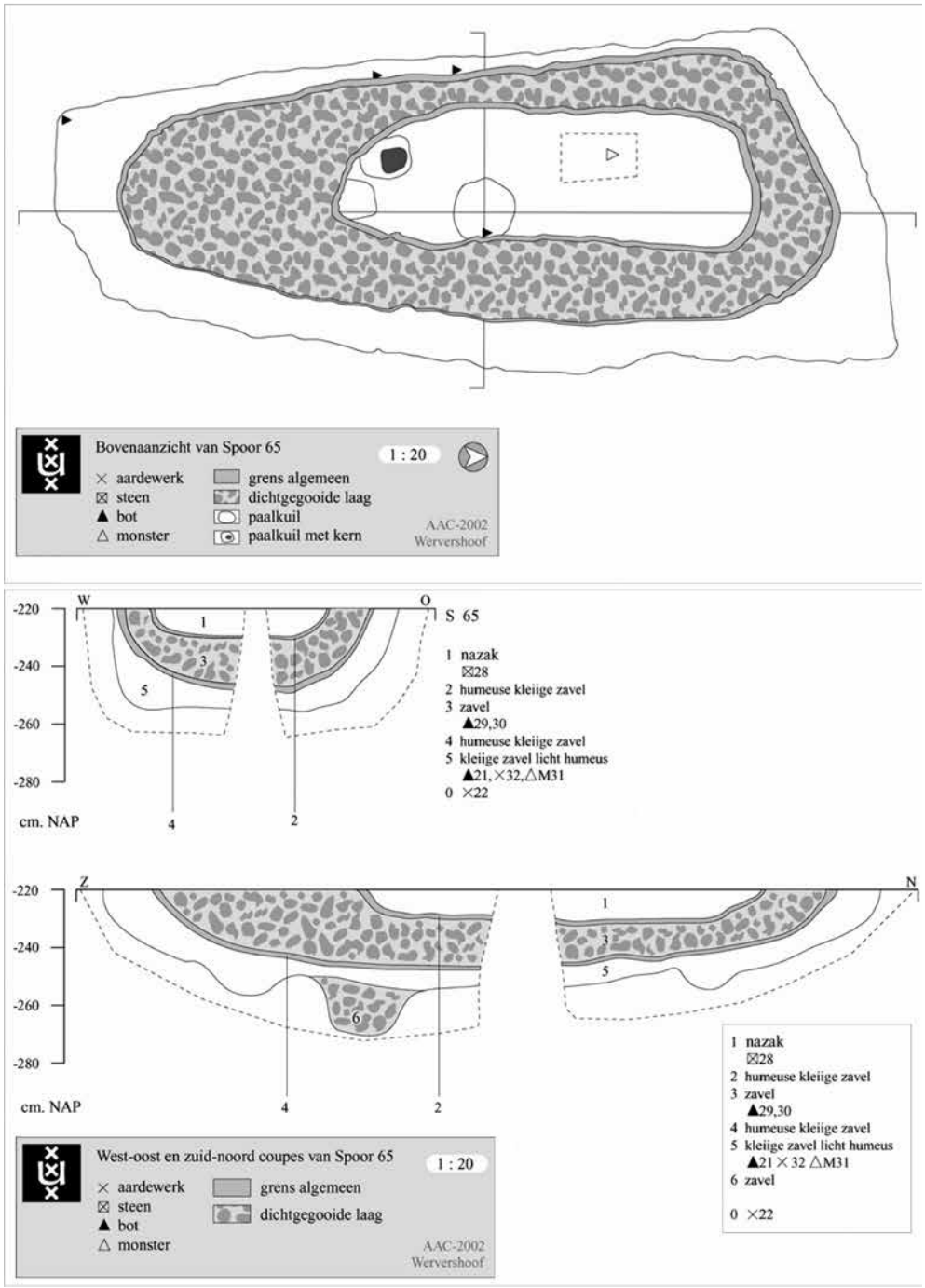


Figure 2.24. Zwaagdijk-Oost 2001. Location of the well-documented, rectangular pit containing ID130. The exact location of the human bone is however unknown (Top, after: Besselsen, Lange & Flamman 2002, 26, Plate 9; Bottom, after: Besselsen, Lange & Flamman 2002, 27, Plate 10).

Legend: aardewerk = pottery; steen = stone; bot = bone; monster = sample; grens algemeen = overall boundary; dichtgegooide laag = filled-in layer; paalkuil = posthole; paalkuil met kern = posthole with post; nazak = subsidence; humeuse kleiige zavel; humic clayey sand; licht humeus = somewhat humic.

following research questions (Section 1.5):

- What is the variation in type and archaeological context of the disarticulated human bones?
- Where were the disarticulated human bones found and from which period do they date?
- What is the relationship between the disarticulated human bones and the (in)complete burials that are known from the region?

In this section the results of our inventory will be summarized and furthermore discussed.

Context of the disarticulated human bones

When we look at the contexts we see that there are a total of 129 IDs that could be associated with a settlement or mortuary context (Appendix I). The majority (N=94) were found in settlement contexts, and the remainder (N=35) come from features associated with mortuary practices. When we take a closer look at the contexts, we can distinguish different types of features (Tables 2.6 and 2.7). Within settlement contexts, most disarticulated human bones were found in ditches. Ditches dominate the settlement sites, so this finding may not be a surprise.[199] Besides ditches, many human bones are also found in house ditches and pits or wells. Apart from these settlement features, ring ditches around barrows also contain many disarticulated human bones.

Age of the disarticulated human bones

The date of most human bones can only be determined by radiocarbon dates from the specific context and/or associated finds, horizontal stratigraphy, and so forth. Most of the bones were found in Middle Bronze Age contexts that have been dated between c. 1600 and 1100 BC (Fig. 2.25). Older features or finds are scarce on these settlement sites.[200] So we may assume that most of these bones date to the Middle

[199] The many finds from Late Bronze Age ditches can be explained by the (near-) absence of other feature types from this period.

[200] Roessingh 2018, 311.

Table 2.6. Context of the disarticulated human bones and date of contexts.

Context	Middle Bronze Age	Late Bronze Age	Other	Total
Ditch	19	12	7	38
Ring ditch	22	0	9	31
House ditch	19	1	1	21
Pit / well	10	8	2	20
Circular ditch	4	0	0	4
Modern feature	0	0	3	3
Barrow flank (mound?)	2	0	0	2
Posthole	0	0	1	1
Layer	0	1	0	1
Unknown	2	0	9	11

Table 2.7. Context of the different skeletal elements, sorted by total number of finds per context.

Context	Cranium	Femur	Various elements	Humerus	Mandibula	Radius	Tibia	Fibula	Phalanx	Clavicula	Molar	Pelvis	Calcaneus	Cervicale vertebrae	Sacrum	Scapula	Ulna	Total
Ditch	17	9	1	2	3	0	1	1	1	0	0	1	0	0	1	0	1	38
Ring ditch	14	3	10	1	0	0	0	0	1	1	0	0	0	1	0	0	0	31
House ditch	7	6	2	2	0	2	1	1	0	0	0	0	0	0	0	0	0	21
Pit / well	6	3	4	2	0	1	2	1	1	0	0	0	0	0	0	0	0	20
Unknown	2	1	1	0	2	2	1	0	0	1	1	0	0	0	0	0	0	11
Circular ditch	1	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	4
Modern	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	3
Barrow flank (mound?)	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	2
Posthole	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Layer	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Total	**49**	**26**	**18**	**7**	**5**	**5**	**5**	**3**	**3**	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**132**

Bronze Age, more precisely in the second half of the Middle Bronze Age. Several finds comprising human bones are known from Late Bronze Age features as well. In these cases, we should keep in mind these bones may also date to the Middle Bronze Age, given that Late Bronze Age sites can always be found in the same location as Middle bronze Age sites.

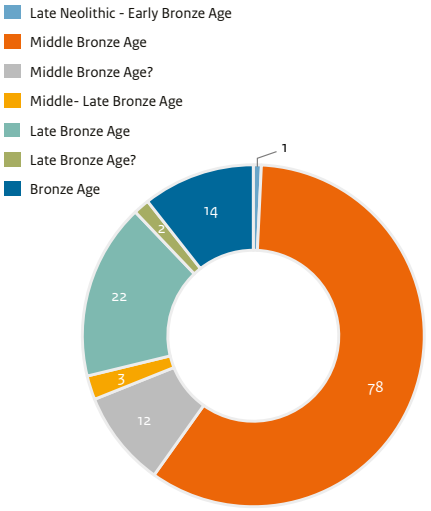


Figure 2.25. Number of finds comprising disarticulated human bones and the date of the context in which they were found.

For this project, a total of 24 bones were selected for radiocarbon analysis. Of these, 21 bones contained enough collagen for a date (Appendix II). The selection of these bones was mostly based on the presence of non-pathological marks on the bone. In some cases, no dates were available for the site, such as the old excavation at Enkhuizen-De Tent. Most of the bones (N=19) come from contexts that can probably be dated to the (second half of the) Middle Bronze Age based on associated pottery and horizontal stratigraphy. Two of the bones come from Late Bronze Age contexts, which makes a Late Bronze Age date for these finds most likely.

The assumption that most of the bones date to the second half of the Middle Bronze Age was proven correct (Fig. 2.26). The oldest date (2019-1767 cal BC) comes from a bone from the site Enkhuizen-Kadijken (ID49). This bone has a relatively high δ13C value, which probably explains the old date. The other two older dates come from bones from a house ditch at Andijk-Noord (ID39) and a ring ditch at Grootebroek-Waterweide Noord (ID60). The outcome of both samples suggests a date in the beginning of the Middle Bronze Age.

Two of the bones were found in a Late Bronze Age context (ID4 and ID43). One of these bones, from the site Hoogkarspel-Markerwaardweg (ID4), dates to the second half of the Middle Bronze Age. This bone must have been about 200 years older than most of the other finds from this ditch. The youngest date comes from a bone from Bovenkarspel-Het Valkje (ID43) that was found in a Late Bronze Age pit. The radiocarbon date places the bone at the end of the Middle Bronze Age and beginning of the Late Bronze Age. This bone has a relatively high δ13C value, so can probably be dated to the Late Bronze Age.

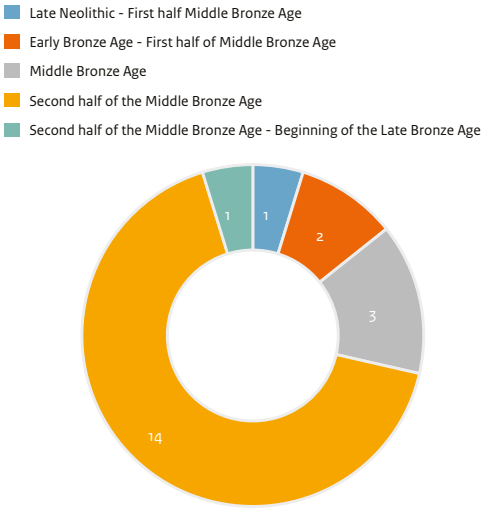


Figure 2.26. Schematic overview of the radiocarbon dates of 21 bones.

Disarticulated human bones vs formal burials

In order to gain insight into the relationship between the disarticulated human bones from settlement contexts and ring ditches, on the one hand, and 'formal' (in)complete burials, on the other hand, it is important to obtain an overview of the West Frisian burials. In the region, 42 barrows have been (partly) excavated (Appendix IV). We may assume every barrow originally contained at least one burial. During barrow excavations, however, we do not often find the burials or disarticulated human bones (Appendix IV). One of the most plausible explanations for

the absence of burials is that the barrows were levelled and the burials within them were destroyed.

The destructive land consolidations from the 1960s and 1970s must have had a huge impact on the preservation of burials in barrows. Of most of the barrows, only the deep ring ditches now remain. The mounds were levelled, and in this process many burials must have been destroyed. The human remains from these burials have disappeared, as they could not become incorporated in the (by then already silted-up) Bronze Age features. From these levelled barrows, only the deepest burials survive, as can be seen, for example, at the sites of Enkhuizen-Kadijken and Hoogkarspel-Houterpolderweg West. Barrow excavations pre-dating these land consolidations show intact barrow mounds with quite a few burials, such as Zwaagdijk-Eendenkooi and Oostwoud-Tuithoorn.

It is not only the 20*th* century allotments and other destructive ground works that are responsible for the absence of many burials. Burials may have been destroyed, even in the Bronze Age itself. The presence of relatively high amount of disarticulated human bones in the (deeper) fills of ring ditches may support this hypotheses; the many human bones in one of the ring ditches around a barrow at Andijk-Noord are a good example. Many barrows were expanded during the Bronze Age, which may have caused the dispersal of human remains from their original burial location. At some sites, settlement structures, such as settlement ditches and houses, were planned on top of older funerary monuments. This may have caused a distribution of disarticulated human bones around the barrow, as we have seen at Bovenkarspel-Het Valkje.

As we have seen, most of the disarticulated human bones were found together with other finds like animal bones, pottery and stone (Appendix III).[201] These other finds can be interpreted as refuse, and we have no reason to suggest these human bones were also not treated as such (Chapter 8). Looking at the total number of finds from Bronze Age sites, we can conclude the disarticulated human bones make up only a fraction of the total (Table 2.8). The high number of human bone fragments from the sites Hoogkarspel-Markerwaardweg and Hoogkarspel-Houterpolder West can be explained by the many cranial fragments, belonging to single individuals (Appendix V).

Table 2.8. Percentage of disarticulated human bone fragments from a selection of large settlement sites.

Site	Sum finds (frgm.)	Human bone (frgm.)	Individuals (IDs)	% human bone frgm.	Excavated completely?
Hoogkarspel-Slimweg	2.700	0	0	0	yes
Hoogkarspel-Streekweg	2.000	0	0	0	yes
Hoogkarspel-Houterpolder West	11.000	21	1	0.19	yes
Medemblik-Schepenwijk	7.500	1	1	0.01	yes
Hoogkarspel-Hoogkarspeltunnel	3.700	6	1	0.16	yes
Bovenkarspel-Het Valkje	98.000	≥27	≥27	≥0.03	no
Venhuizen-Voetakkers	6.300	6	2	0.10	yes
Hoogkarspel-Markerwaardweg	23.000	70	8	0.30	yes
Enkhuizen-Kadijken	12.000	25	14	0.21	yes
Andijk-Zuid	1.700	2	2	0.12	no
Andijk-Noord	1.100	≥11	≥7	≥1	no

[201] In some cases the only find in a find number was a human bone. In these cases the human bone was identified as 'human' in the field, and is therefore collected as a single 'special' find'. Associated finds were present, but administrated in another find number (Appendix III). This could for example be reconstructed at some of the modern excavations where people with physical anthropological knowledge were part of the field team (i.e. Enkhuizen-Kadijken, Hoogkarspel-Markerwaardweg and Grootebroek-Waterweide Noord).

3 Osteological analysis of the disarticulated human bones

S. Baetsen

3.1 Introduction

In order to interpret the disarticulated human bones, a systematic approach was needed. Therefore all unburnt human bone or possible human bone fragments known from literature needed to be analysed again. They were located and collected from the 'Archeologisch Depot of the province of Noord-Holland' and then identified, described and analysed. The results were put into a database. Because marks indicating cutting, gnawing or specific erosion are unexpected in non-mortuary contexts, special attention was given to such marks. These marks could suggest a specific treatment or post-mortem modification of the bone, whether deliberate or not. Macroscopic observations often are limited only to the outside of the bone. Microscopic research can provide more detailed information about modification processes and contribute to explanations of how the bones ended up in these contexts. For example, histological research can suggest several stages of degradation of the bone relating from specific circumstances. We therefore carried out both kinds of analyses. In Chapters 4-7, the results of different analysis that were carried out on a selection of the human remains will be described in more detail.

As noted in Section 1.5, this study aims to use standard osteological analysis of disarticulated human bones to answer the following questions:

- What is the variation in skeletal parts and related contexts?
- What are the characteristics (age at death and sex) of the disarticulated human bones?
- What indications can be found on the human remains of intentional human action (excarnation / manipulation) and post-depositional processes (gnawing traces or erosion)?

In general in West Frisia, Bronze Age are discovered during the excavation of barrows or flat graves. Only a small number of disarticulated bones has been found during the excavation of settlement features. During the inventory, we noticed that quite a large proportion of these disarticulated human remains were found in ring ditches around barrows and were interpreted as part of the funeral practice. We decided to include these remains in our research because, just like the settlement finds, these finds could also be part of the non-funeral deposits. An overview including skeletal element identification of the human bone fragments, find context and references can be found in Appendix I. The results of the osteological analysis will be discussed in the following sections.

3.2 Methods

Our approach was to first use macroscopical analyses, focussing on specific physical anthropological characteristics and description of potential post-mortem modifications of the human bones. The standard quality regulations for Dutch archaeology (KNA version 4.1) specify which qualifications specialist researchers must have. However, there are no fixed guidelines for the methods to be used in bio-archaeological research, as they must be flexible and adapted to the most recent developments in science.[202] Nowadays, guidelines proposed by *Barge's Anthropologica*, the Amsterdam Academic Medical Center and Leiden University are frequently used.[203]

In order to determine sex, specific morphological characteristics of the pelvis and cranium are used.[204] If characteristics are contradictory or absent, metrical dimensions can be used in the determination.[205] It should be taken into consideration that metrical values tend to be population specific and should be interpretated with caution.

Assessment of age at death is based on various methods. The age of non-adult individuals is based on the development of deciduous and permanent teeth, ossification of the axial skeleton (spine and cranial parts), development of specific diaphysis, and state of epiphyseal fusion.[206] For adult individuals, the skeletal age at death is preferably estimated using a combination of characteristics.[207] With age-related bone changes in adult individuals, accuracy will increase as more characteristics can be assessed.

The stature of an individual can be estimated by measuring the long bones, preferably those of the leg, and applying the measurements in specific formulas.[208] Bone

202 Centraal College van Deskundigen 2018, protocol 4006, Specialistisch Onderzoek.
203 Maat, Van den Merwe & Hoff 2012; Waters-Rist *et al.* 2016.
204 Acsádi & Nemeskéri 1970; Workshop of European Anthropologists 1980.
205 Stewart, 1979; MacLaughlin & Bruce 1985.
206 Rauber-Kopsch 1914; Maresh 1955; Workshop of European Anthropologists 1980; Brothwell 1981; Ubelaker 1989; Scheuer & Black 2000.
207 Brooks & Suchey 1990; Brothwell 1981; Buckberry & Chamberlain 2002; Iscan, Loth & Wright 1984, 1985; Lovejoy *et al.* 1985; Rösing 1977; Meindl & Lovejoy 1985; Hermann *et al.* 1990, 67.
208 Breitinger 1937; Trotter 1970; Trotter & Gleser 1958.

changes most likely to be caused by pathological processes (diseases) and anatomical variations (anomalies) are described and classified according to frequently used standard examples.[209]

3.3 Results

3.3.1 Introduction

During the analysis, a total of 63 hypothetical individuals could be identified, and each of these was given a unique identifier (ID number) (Appendix V). Some of these individuals consist of one complete bone, others of multiple bone fragments that were assessed as most probably belonging to the same real-life individual (Section 2.2). In the next paragraphs, the results of the bio-archaeological analyses will be summarised in alphabetical order by site.

3.3.2 Andijk-1982

During the 1982 excavations at Andijk, cranial fragments were found, probably belonging to three individuals (ID15-17). ID15 is a single isolated parietal fragment belonging to a juvenile or young adult (12 to 25 years old). ID16 consist of the occipital and parietal cranial parts of a young person (3 to 12 years old). ID15 and ID16 have a youthful appearance, with sharply pointed and elongated coronal and sagittal sutures, and may belong to the same individual. ID17 is possibly an adult individual.

3.3.3 Andijk-Noord

A total of 18 IDs were found at the site Andijk-Noord. The majority were found in a ring ditch (ID26-34, ID62-64) and others (ID35-40) in settlement features. The fragments not relating to the ring ditch are almost all cranial parts. The ditches including ID35-37, ID38 and ID40 contained parts of the temporal, occipital and frontal bone, including the orbitals. All seem to be of adult individuals, although the age range of ID36 is wider than that of the others. At least two (ID35 and ID38) appear to be of male individuals. The diaphysis of a radius (ID39) belongs to an adult (>35 years of age). In the same house ditch, fragments of a cranium were found from another individual (ID40). These fragments belong to a young adult.

The fragments from the ring ditches come from a greater variety of skeletal parts. Besides cranial parts, also pelvic fragments (ilium and ischium), mandibles and several diaphyses were found. Some of the elements are even complete: ID27 comprises an entire right ulna, ID28 a mandible with six dental elements, and ID31 and ID62 and entire right femur. Interesting are the bone fragments associated with ID30 because they originate from several different skeletal parts. Present are cranial parts (temporal and occipital); fragment(s) of a mandible and pelvis (ischium); and diaphysis of a humerus, radius, femur, tibia and fibula. All could have belonged to a single individual based on size, bone surface weathering and dimensions, a male between 30 and 50 years at death (Section 3.4). However, fragments of a left and a right femur diaphysis that belong to a 4-8-year-old child are also present in this concentration (ID63).

A complete mandible including all six molars, as well as cranial fragments and parts of the left iliac bone, represent ID28. The iliac bone features female traits, but the morphology of the mandible is more suggestive of a young male. However, it is known that in the Low Countries, mandibles of females tend to exhibit developmental characteristics that are more similar to those of males,[210] and this suggests that the degree of robusticity is not a reliable sex indicator for this skeletal part. Therefore we argue that the mandible is also from a female and that all the fragments here originate from a single person.

At this site multiple individuals (ID31-33, ID64) were registered under one find number.[211] The part of a cranial frontal bone looks male, and the sutures indicate an age between 30 and 50 years (ID31). Fragments of a left temporal bone and an entire right femur may also belong to this individual based on proportion and appearance. A second frontal bone with matching left and right parietal bones shows female traits and sutures indicating an age between 18 and 25 years (ID32). The diaphysis of a radius and the iliac and ischial parts of a pelvis

[209] Aufderheide & Rodríguez-Martín 1998; Ortner 2003; Waldron 2009, 24-71.
[210] Maat, Mastwijk & Van der Velde 1997.
[211] ID64 could not be relocated during our inventory.

Figure 3.1. Andijk-Noord. Possible cutmarks on a femur diaphysis (ID30).

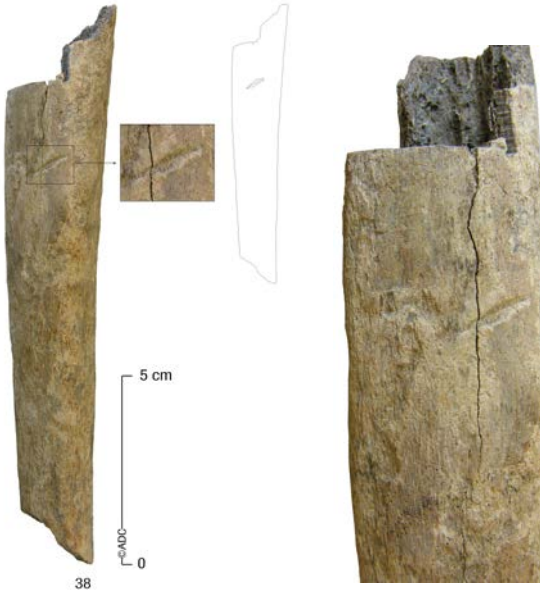


Figure 3.2. Andijk-Noord. Possible cutmark on a tibia (ID34).

Figure 3.3. Andijk-Noord. Possible cutmarks on a radius diaphysis (ID39).

belong to a third person (ID33) present in this concentration. Pelvic features indicate that these originate from a female older than 45 years.

Another two individuals (ID34 and ID62) were also registered under one find number. The fragments of a parietal bone and the diaphysis of a right tibia and femur appear to be from a 20-40-year-old individual, and no clear features indicating sex were visible (ID34). A second adult, a probable male, is represented by an entire right femur (ID62). Part of a left femur diaphysis including the proximal end makes up ID26. It probably belonged to a male too based on its robust traits. But it can be excluded that it was part of the skeleton of the other individuals here based on different proportions and morphology.

Non-pathological alterations are visible on the surface of many of the human bone fragments from this site. Discolouration, peeling and splintering can be seen, especially on the diaphyseal parts but also on an ilium (ID28) and a frontal cranial part (ID32). Besides these possible cutmarks, there are also scraping or chopping marks visible. Cutmarks seem to be present below the proximal epiphysis of an adult femur and on a non-adult diaphysis (ID30) (Fig. 3.1). A cutmark also seems to be visible on a full-grown tibia (ID34; Fig. 3.2). Multiple possible cutmarks can been seen on the surface of the radius diaphysis of ID39 (Fig. 3.3). The scratches on the outside of a cranial frontal bone (ID36) appear to be of more recent date based on their bright colouration and sharp edges.

Figure 3.4. Andijk-Zuid. Possible gnawing marks on a humerus diaphysis (ID41).

3.3.4 Andijk-Zuid

Two disarticulated human bones were found in settlement features at Andijk-Zuid (ID41 and ID132). ID41 is a small, thin part of a left humerus diaphysis and shows non-pathological changes, possibly the result of gnawing (Fig. 3.4). ID132 is a femur fragment of an adult individual.[212]

3.3.5 Andijk-Zuid (2011)

A fragment of a human pelvis was found in a ditch during the excavation of this site (ID53). Based on morphological features it was part of the skeleton of a 20-29-year-old person, most probable a female.

3.3.6 Bovenkarspel-Het Valkje

Many disarticulated human bone fragments were found at Bovenkarspel-Het Valkje (N=27). Unfortunately, except for two finds (ID42 and ID43), the fragments themselves could not be located in storage and therefore could not be re-studied. The basic descriptions are still available from the literature.[213] Because the settlement features have been re-analysed recently, we were able to locate the contexts of these human bone fragments.[214]

The majority of fragments are femoral and cranial (Appendix I), as is the case on almost all of the other sites. It is not further specified to which part of the cranium the cranial fragments belonged. For the femoral fragments, we assume it concerns diaphyseal parts. They are the thickest and the most resistant and therefore more likely to survive and be found archaeologically. A bit in contrast to this, is the identification of a single, complete calcaneus (ID87) and a phalange (ID84). These skeletal parts are rarely found as disarticulated human bone fragments. Phalanges are relatively small in size and calcanea are very fragile because of their high proportion of spongious bone. It is not obvious why these specific parts are present here.

Another remarkable find is that of a cranium, apparently showing female characteristics, and a mandibula found together and said to belong to a single individual (ID82). The fact that they were found together suggest the parts still were connected when deposited, possibly by soft tissue, which could indicate that the head was still in one piece but disarticulated from the rest of the body. In general, cranial or mandibular fragments in secondary context are found separate. However, it cannot be ruled out that it was moved from its primary context and that both parts of the head were picked up and re-deposited together.

The fragments belonged to adult individuals, with one exception. A left femur fragment was estimated to have been part of the skeleton of a 3-7-year-old child (ID68), probably based on the diaphyseal length, but that could not be checked.

Only two of the 27 IDs from Bovenkarspel-Het Valkje were found during our inventory. One of them is a large part of a human sacrum, found in a ditch. Its features indicate that it most likely belonged to a male individual of at least 35 years of age (ID42). It is unusual to find a human sacrum among disarticulated human bones, as the majority consist of cranial and diaphyseal parts. Human vertebrae and the smaller bones of the feet and hands are seldom found.[215] The second find was identified as the right temporal bone of the cranium (ID43). The morphological characteristics appear to be male and of an adult.

[212] Runia 1987, 227 (find number II-64). This bone could not be relocated during our inventory.
[213] IJzereef 1981, 209-211; Runia 1987, 229-232.
[214] Roessingh 2018, 189-300.
[215] The sacrum fragment (ID42) was found in a bag full of animal bones. According to IJzereef, this find number (30-1-40) contained a fragment of a humerus belonging to an adult individual (IJzereef 1981, 209). However, this humerus could not be relocated during our inventory. Whether this sacrum and humerus belonged to the same individual is unclear. The same is true for ID43, a fragment of a cranium. According to IJzereef (1981, 209) two fragments of a human cranium of an adult (20 to 30 years of age) were included in this find number (38-2-1). We found only one, which is probably the third cranial fragment from the same individual in this find number. We therefore assume that 'our finds' were not recognised by IJzereef as being of human origin.

Figure 3.5. Enkhuizen-De Tent. Clear cutmarks on a clavicle (ID19, top left; ID21, top right) and a scapula (ID20, bottom).

3.3.7 Enkhuizen-De Tent

Another interesting assemblage was found at Enkhuizen-De Tent. This site, a barrow with ring ditches, provided disarticulated human bone fragments belonging to five individuals (ID18-22).[216] The diaphysis of a left clavicle (ID21), a right clavicle (ID19), a right scapula (ID20), a fifth or sixth cervical vertebra (ID22) and the fragment of a right temporal bone (ID18) were identified. All appear full grown and therefore adult. Well-developed degenerative changes along the vertebral body of ID22 suggest an age over 35 years. Although the right and left clavicle differ a little in proportions and morphology, it is possible that all five disarticulated human bone fragments belong to just one, adult individual. Their context is a first-phase ring ditch (ID18), a second-phase ring ditch (ID21 and 22) and the flank of a barrow (ID19 and 20). All these contexts can be associated with a single barrow (Tumulus 1).

Some clear cutmarks can be seen on the diaphysis of a right clavicle (ID19, Fig. 3.5), left clavicle (ID21, Fig. 3.5) and right scapula (ID20, Fig. 3.5). It is tempting to interpret these bone fragments as belonging to a single individual and the marks as resulting from deliberate post-mortem modifications.

3.3.8 Enkhuizen-Kadijken/Haling

At Enkhuizen-Kadijken/Haling, a variety of settlement contexts contain disarticulated human bones. In all, bones of 13 individuals were found, the majority in house ditches but some in wells and in a circular ditch. A loose molar (dental element 17 or 18) was found outside the excavation trenches (ID52). Most intriguing are three small bones from a perinatal baby (ID58) found in a house ditch. Identified are a femur diaphysis and part of the ischium and a scapula. Other human bone fragments from house ditches are cranial and diaphyseal parts. Both

[216] According to Lehman (1963, 242) mandibula fragments were also found (ID91), but these could not be relocated by Runia or during our inventory.

ID47 and ID54 contain parts of a left and right parietal bone, including the sagittal and coronal cranial sutures, indicating an age between 20 and 40 years. Because the cranial parts are present in duplicate, they must be of different individuals. Besides these, the diaphysis of a tibia (ID48) and a radius (ID51) (both showing features of an adult male) and of fibula (ID56), as well as the proximal end of a femur (ID55), were found in house ditches. Another diaphysis, of a left femur, was found in a ditch (ID45). Three human bones were found in wells, a complete, adult right radius (ID49); a fragment of an adult, male humerus diaphysis (ID59); and the occipital part of a cranium (ID57), including sutures indicating an age at death between 18 and 25 years.

A loose human tooth was found in a circular ditch. It can be identified as a complete premolar from the left side of the mandible. Because there is hardly any attrition (wear) of the crown, it probably belonged to a young adult (ID50) who was between 18 and 25 years at death or at the time of tooth loss.

The femur diaphysis of ID45 shows non-pathological changes, probably due to post-

Figure 3.6. Enkhuizen-Kadijken. Possible gnawing marks and polishing on a fibula (ID56, left) and possible cutmarks on a humerus diaphysis (ID59, right).

depositional processes. However, on both the diaphysis of a tibia (ID48) and on a fibula (ID56) possible gnawing marks are visible. The surface of the fibula shows small, polished spots that could indicate some kind of secondary use of the bone (Fig. 3.6 left). A diaphysis of a right humerus (ID59) shows some marks, near the proximal end, that might be related to cutting in the bone (Fig. 3.6 right).

3.3.9 Grootebroek-Waterweide Noord

At this site, two human bone fragments were found, both of them in a ring ditch and both part of the femur diaphysis. The one piece (ID60) concerns the distal part, and its features indicate that the bone probably belonged to an adult. The other piece (ID61) most likely belongs to an adult male. However, their differing dimensions suggest they do not belong to the same individual.

Some splintering spots on the surface of one of the diaphyses (ID60) seem to be the result of weathering. On the other (ID61), small incisions that may be cutmarks are visible towards the proximal end, close to the *linea aspera* (Fig. 3.7).

Figure 3.7. Grootebroek-Waterweide Noord. Possible cutmarks on a femur diaphysis (ID61).

3.3.10 Hauwert-Notweg 6

ID131 consists of two fragments of human bone, a fragment of the left costae and a fragment of the right radius. A cranial fragment included in this find number may also be of human origin. It is likely that the human remains belong to the same individual.[217]

3.3.11 Hoogkarspel-Hoogkarspeltunnel

The site Hoogkarspel-Hoogkarspeltunnel, located directly west of the site Hoogkarspel-Tolhuis F, provided only one human bone fragment. A part of the left parietal bone of the cranium was present in a well (ID46). Because the fragments are thin and fragile, it is thought they do not belong to an adult. They appear larger than those of a baby but smaller than those of an adolescent. Most probable they originate from a juvenile skull, belonging to an individual 7 to 12 years of age.

3.3.12 Hoogkarspel-Houterpolder West

At the site Hoogkarspel-Houterpolder West, four disarticulated human bones were found. Three of them come from ring ditches: cranial parts (N=1) and diaphyseal parts (N=2). Some cranial fragments were found in a settlement ditch. In one ring ditch, parts of the parietal and occipital bone, of an adolescent or young adult (ID24)

[217] Van Gent 2022, 40-41. This bone was not yet available at the Provincial Depot.

based on their limited thickness and elongated, sharp sutures, were found. Parts of a humerus diaphysis and humerus distal epiphysis make up ID23. The robustness and dimensions suggest they were part of an adult male skeleton. A third ID was given to parts of the diaphysis of a left femur and a left tibia. Found together, they probably belong to a single individual (ID25): an adult male based, again, on robustness and dimensions. These same traits suggest that this left femur and left tibia do not belong to individual ID24, a young adult, whose remains were found close by, in the same ring ditch. Fragments of a frontal and left and right parietal bone were recovered from a settlement ditch (ID44). These belonged to a (probably) male between 30 and 50 years at death based on cranial traits and obliteration (closing) of the cranial sutures.

The femur diaphysis of ID25 exhibits non-pathological changes on the surface. Near the proximal end, a few small incisions are present, maybe the result of cutting (Fig. 3.8).

Figure 3.8. Hoogkarspel-Houterpolder West. Possible cutmarks on a femur diaphysis (ID25). The big cut was made during sampling for radiocarbon dating.

3.3.13 Hoogkarspel-Markerwaardweg

Fragments of human bone were found in eight features at the site Hoogkarspel-Markerwaardweg. The majority (ID1-ID4, ID6, ID7 and ID10) are cranial parts, specifically parts of the frontal, parietal, temporal and occipital bones from the left as well as the right side. Part of the right side of the mandible is also present (ID2) and still contains three molars, dental elements 46, 47 and 48. The only non-cranial skeletal elements present here are the diaphysis of a left and right femur and a left ilium (ID5). Based on their size, we estimate that they belonged to a 2-4-year-old child. This age corresponds with the cranial parts of ID1 (1 to 3 years). Therefore these skeletal remains could originate from the same individual. These two remains were found c. 65 m apart from each other (Fig. 2.17).

All the other fragments appear to be from adult individuals. For two individuals (ID3 and ID10), the age range could be narrowed down, based on the endo- and ectocranial obliteration of the cranial sutures, to an age between 20 and 40 years. However, in some cases using the state of the sutures proved to be unreliable because too many variations are possible. The age at death of another individual (ID2) was estimated between 18 and 25 years based on dental eruption and slight tooth wear. Almost no distinct pelvic, cranial or metrical traits were available to determine sex. In only one case (ID10) did cranial traits (four in total) show characteristics that appear to be male. Pathological bone changes were not observed, nor were marks that could indicate chopping, cutting or gnawing.

3.3.14 Hoogkarspel-Tolhuis D

A fragment of a right femur was found in one of the ditches at this site (ID92).[218]

3.3.15 Hoogkarspel-Tolhuis F

A considerable number of disarticulated human bone fragments (N=28) were found during excavations at Hoogkarspel-Tolhuis F. As was the case at Bovenkarspel-Het Valkje, none of the fragments could be relocated in storage and additional analyses were therefore not possible. However, basic descriptions are available here, too,[219] and re-analyses of the settlement features have made it possible to locate the contexts of these human bone fragments.[220]

The majority of the bone fragments are femoral and cranial (Appendix I), but there are also a fair number (N=7) of fragments belonging to the arm. There are at least four parts that belong to a humerus, two to a radius and one to an ulna. Remarkable at this site is a fragment of a humerus (probably a diaphysis) found together with two fragments of vertebrae (ID99). The description does not specify what type of vertebrae. Because they are mentioned as fragments, we assume that they are not complete. It is impossible to tell if the humerus and vertebrae belong to one individual. But because these skeletal elements do not connect directly when in anatomical articulation, it seems unlikely that they belong to the same individual. The phalanx (ID166) is an unusual find because of its small size. Without wet sieving, these small elements are seldomly found.

As at most sites, the majority of the fragments appear to belong to adult individuals. Among the disarticulated human bone fragments at Hoogkarspel-Tolhuis F, two items most likely originate from non-adults. Part of a right femur was identified as belonging to a person younger than 10 years at death (ID100). Assessment of age for part of a mandible put the individual between 15 and 20 years (ID116). Probably this was based on tooth wear, but the method used in the age assessment is not specified. From the descriptions, it seems that most of the fragments would not be suitable for morphological determination of sex. Only two possible males were identified, but the description does not specify on what basis.

3.3.16 Hoogkarspel tumuli

A fragment of a cranium and a condyle(?) were found during the excavation of barrows northwest of Hoogkarspel (ID121).[221]

3.3.17 Hoogkarspel-Tumulus I and Ia and Watertoren

At Hoogkarspel-Tumulus I, remains from a total of six individuals were found in different parts of a ring ditch surrounding the tumulus. Five of the individuals are represented only by cranial parts, and one individual (ID125) by a femur fragment. Three of the individuals were relocated during our inventory (ID11-13), all represented by cranial parts only. There is one fragment (ID11) that belongs to the right parietal part of a cranium. It looks full grown and most probably belonged to an adult. A second human cranial fragment (ID12) was found in the ring ditch, but it is not clear what part of the cranial it belongs to. It was found together with a burned bone fragment that could be animal or human. The third cranial fragment (ID13) seems to be burned. It can be identified as human and is part of the temporal bone of the cranium, possibly an adult based on its dimensions. This fragment could be part of the disarticulated remains of a cremated individual. There are no clear indications that the cranial parts in the ditch belonged to the skeleton of a single person.

The three other individuals from the Tumulus I site (ID123-125) are all represented by cranial parts and on also by a fragment of a femur (ID125).[222]

From the site Tumulus Ia, two finds including cranial fragments are known from one of the ring ditches (ID126 and ID127).[223] During excavation of the site Hoogkarspel-Watertoren, one human bone was found in a settlement context. One find number with disarticulated human bones is known from this site (ID122); it includes a fragment of a cranium, a molar and 'other bones' (Appendix I).[224]

218 Bakker & Brandt 1966, 181-224; Roessingh 2018, 94, 97. This bone could not be relocated during our inventory.
219 Runia 1987, 224-226.
220 Roessingh 2018, 55-132.
221 Runia 1983, 232 (Hw 78); Roessingh 2018, 65-66, 127-129. These bones could not be relocated during our inventory.
222 Bakker 1958, 176-177, Bakker 1974, 5.
223 Bakker 1974, 9. These bones could not be relocated during our inventory.
224 Van Mensch & IJzereef 1977, 206. These bones could not be relocated during our inventory.

3.3.18 Medemblik-Schepenwijk II

This site yielded a fragment of a human cranium (ID128) and was found in the upper fill of a long narrow pit.[225]

3.3.19 Venhuizen-Voetakkers

At Venhuizen-Voetakkers, two disarticulated human bone fragments were found in ditches, parts of a femur diaphysis (ID8) and fragments of the right parietal bone of the cranium (ID9). Based on their proportions, the cranial parts could belong to a juvenile but more likely to an adult. The antero-posterior diameter, measured at the midshaft of the femur diaphysis, is 2,51 mm. This indicates that the individual it belonged to probably was female. On the femur diaphysis (ID8), a possible cutmark is visible (Fig. 3.9).

Figure 3.9. Venhuizen-Voetakkers. Possible cutmark on a femur diaphysis (ID8).

3.3.20 Wervershoof-De Ark Tumulus XIII

An excavation at the site Wervershoof-De Ark Tumulus XIII produced two human bones (ID14), both from the right side of the body: a femur including the distal epiphysis and a tibia diaphysis. Their dimensions and robustness suggest they both belonged to an adult male. These may originate from the same individual.

3.3.21 Wervershoof-Eendenkooi (2016)

In one of the test trenches, a fragment of a cranium (ID129) was found in a pit or ditch.[226]

3.3.22 Zwaagdijk-Oost

During the excavation of this site, a fragment of a cranium (ID130) was found in a pit.[227]

3.4 Conclusions and discussion

Our inventory and analyses of disarticulated human bones originating from settlement features rather than burial contexts have provided data that allow us to answer the research goals that we formulated (Section 1.5):

- What is the variation in skeletal part representation and contexts?
- What are the characteristics (age at death and sex) of the disarticulated human bones?
- What indications are there on the human remains of intentional human action (excarnation or manipulation) and post-depositional processes (gnawing traces or erosion)?

In this section the results of the analysis will be summarized and furthermore discussed.

Variation in skeletal parts and contexts

The majority of the disarticulated human bones consist of a single skeletal element or multiple fragments that belong to the same individual skeletal element. The most commonly represented skeletal elements are the cranium

[225] Schurmans 2010, 28, 200. This bone could not be relocated during our inventory.
[226] Van der Heiden & Feiken 2018, 120; Laarman 2018, 143. This bone was not yet available at the Provincial Depot.
[227] Besselsen, Lange & Flamman 2002, 24. This bone was not relocated during our inventory.

and the femur (Table 3.1). So the majority of the bone fragments come either from the most recognisable skeletal element (the cranium) or from the largest and most resistant element (the femur, specifically the diaphysis) in the human skeleton.

Most of the bones (N=85) were found in features associated with habitation: ditches, house ditches and pits or wells. Disarticulated human bones were also quite often found in features associated with funerary monuments (N=33). Almost all of these bones were found in ring ditches around barrows (N=31). However, this high number dominated by the bones that were found in features associated with a single barrow, at the site Andijk-Noord (N=12).
A total of 18 finds are represented by more than one skeletal element (Table 3.1), collected on (probably more or less) the same spot by the excavators. For eight of these finds individuals, the portion present, together with the age at death and sex, suggest they belonged to the same individual.[228] Most of the time only two or three skeletal elements are assigned to these individuals. The remarkable exception is Andijk-Noord (ID30), where a ring ditch yielded fragments of a cranium, mandibula, humerus, radius, pelvis, femur, tibia and fibula, probably belonging to one individual. They could represent the remains of a disturbed primary burial.

At Andijk-Noord, the excavation of the ring ditch around one of the barrows yielded many human remains. In three locations, three find numbers were documented. Two of these three find numbers include the skeletal elements of two individuals each. The third find number comprised the bones of a minimum of four individuals.[229] True settlement features, such as ditches, have also yielded remains of different individuals together or close to each other (Chapter 2). In the house ditches of two house sites at Andijk-Noord, for example, skeletal elements belonging to two individuals were found.[230] One of the house ditches at Enkhuizen-Kadijken also yielded the remains of multiple

Table 3.1. Number of finds by skeletal element (category) and context, sorted by total number of finds per element.

	Ring ditch	Barrow flank (mound?)	Ditch	House ditch	Pit/well	Circular ditch	Posthole	Layer	Modern	Unknown	Total
Cranium	14	0	17	7	6	1	1	1	0	2	49
Femur	3	0	9	6	3	2	0	0	2	1	26
Various elements	10	0	1	2	4	0	0	0	0	1	18
Humerus	1	0	2	2	2	0	0	0	0	0	7
Mandibula	0	0	3	0	0	0	0	0	0	2	5
Radius	0	0	0	2	1	0	0	0	0	2	5
Tibia	0	0	1	1	2	0	0	0	0	1	5
Fibula	0	0	1	1	1	0	0	0	0	0	3
Phalanx	1	0	1	0	1	0	0	0	0	0	3
Clavicula	1	1	0	0	0	0	0	0	0	1	3
Molar	0	0	0	0	0	1	0	0	0	1	2
Pelvis	0	0	1	0	0	0	0	0	0	0	1
Calcaneus	0	0	0	0	0	0	0	0	1	0	1
Cervical vertebra	1	0	0	0	0	0	0	0	0	0	1
Sacrum	0	0	1	0	0	0	0	0	0	0	1
Scapula	0	1	0	0	0	0	0	0	0	0	1
Ulna	0	0	1	0	0	0	0	0	0	0	1

[228] ID5 (femur, tibia); ID14 (femur, tibia); ID25 (femur, tibia); ID27 (ulna, radius); ID28 (mandibula, cranium); ID30 (cranium, mandibula, humerus, radius, ischium, femur, tibia, fibula); ID58 (scapula, pelvis, femur) and ID63 (left femur, right femur).

[229] Find number 37: ID31-33 and ID64; Find number 38: ID34 and ID62; Find number 62: ID30 and ID63.

Table 3.2. Sex and age at death of the individuals by context.

Sex	Ring ditch	Barrow flank (mound?)	Ditch	House ditch	Pit/well	Circular ditch	Posthole	Layer	Modern	Unknown	N
Male	1	0	6	2	1	0	0	0	0	0	10
Male?	7	0	3	5	4	1	0	0	0	1	21
Female	1	0	1	0	1	0	0	0	1	0	4
Female?	2	0	3	0	0	0	0	0	0	0	5
Unknown	20	2	25	14	14	3	1	1	2	10	92
Age at death	**Ring ditch**	**Barrow flank (mound?)**	**Ditch**	**House ditch**	**Pit/well**	**Circular ditch**	**Posthole**	**Layer**	**Modern**	**Unknown**	**N**
Perinate	0	0	0	1	0	0	0	0	0	0	1
Child	2	0	1	2	1	0	0	0	0	1	7
Child–young adult	1	0	0	1	0	0	0	0	0	1	3
Young adult	5	0	4	1	2	2	0	0	0	1	15
Adult	12	1	26	14	14	2	0	0	2	5	76
Adult?	4	1	3	1	0	0	0	0	1	0	10
Unknown	7	0	4	1	3	0	1	1	0	3	20

individuals (a minimum of two).[231] During the excavations at both Hoogkarspel-Tolhuis and Bovenkarspel-Het Valkje, numerous human bones were collected under a single find number (Appendix I). These bones could not be relocated during our inventory, so it remains unclear whether there are multiple individuals included in those cases.[232]

Sex and age of the individuals

It is difficult to determine the sex and age of the individuals, because in most cases only small fragments of the bones are preserved. As can be seen in Table 3.2, both sexes are represented in the human remains. Males seem to be overrepresented, but taking into account the relatively low number of bones and the uncertainty inherent in sex determination, it would be unwise to rely on these proportions. Most of the human remains belong to adult individuals. This is not a surprise, as the skeletal elements of young persons are more fragile and without wet sieving these smaller elements will seldomly be found. For example, the remains of a perinate were found during wet sieving of the fill of a feature, as were some of the skeletal elements that could be associated with children.

Manipulation of the remains

One of the intriguing things observed on some of the disarticulated human bones are traces of non-pathological marks (Table 3.3). On some of the bones (N=8), what appear to be old cuts were observed, and in three cases traces of possible gnawing were observed. Quite a few bones (N=11) showed traces of erosion of the surface. The possible cutmarks seem to suggest that people moved and used these remains. The surface erosion and gnawing marks indicate that the bones must have lain on the surface for quite a while. To interpret these marks and obtain insight into the way people took care of their deceased, these marks were further investigated by different specialists (Chapters 4-7).

230 HS06: ID38 and ID41; HS08: ID39 and ID40.
231 HS11b: ID51, ID54, ID55 and ID58.
232 In one of the pits at Bovenkarspel-Het Valkje, the remains of at least two individuals were found: ID78 and ID86 (Section 2.3.5, Appendix I).

Table 3.3. Results of analysis of non-pathological marks.

ID	Site	Skeletal element	Non-pathological marks?	Old cutmarks?	Erosion?	Gnawing marks?
26	Andijk-Noord	femur	yes	no	yes	no
27	Andijk-Noord	ulna, radius	yes	no	yes	no
29	Andijk-Noord	femur	yes	no	no	no
32	Andijk-Noord	cranium	yes	no	yes	no
34	Andijk-Noord	cranium, tibia, femur	yes	possibly	yes	no
36	Andijk-Noord	cranium	yes	no	no	no
39	Andijk-Noord	radius	yes	possibly	no	no
40	Andijk-Noord	cranium	yes	no	no	no
62	Andijk-Noord	femur	yes	no	yes	no
41	Andijk-Zuid	humerus	yes	no	yes	possibly
19	Enkhuizen-De Tent	clavicle	yes	yes	no	no
20	Enkhuizen-De Tent	scapula	yes	yes	no	no
21	Enkhuizen-De Tent	clavicle	yes	yes	no	no
45	Enkhuizen-Haling 13	femur	yes	no	yes	no
56	Enkhuizen-Kadijken 2009	fibula	yes	no	yes	possibly
59	Enkhuizen-Kadijken 2009	humerus	yes	possibly	yes	no
48	Enkhuizen-Kadijken 2011	tibia	yes	no	no	possibly
60	Grootebroek-Waterweide Noord	femur	yes	no	yes	no
61	Grootebroek-Waterweide Noord	femur	yes	possibly	no	no
23	Hoogkarspel-Houterpolder west	humerus	yes	no	no	no
25	Hoogkarspel-Houterpolder west	femur, tibia	yes	no	no	no
8	Venhuizen-Voetakkers	femur	yes	possibly	no	no
14	Wervershoof-De Ark Tumulus XIII	femur, tibia	yes	no	yes	no

4 Microwear analysis of non-pathological marks on the bones

A. Verbaas

4.1 Introduction and research goals

During the macroscopic analysis by the physical anthropologist, non-pathological marks were observed on some of the bones (Chapter 3; Table 3.3). A selection of 12 bones with non-pathological marks were investigated by microwear analysis to answer the following question (Section 1.5):

- What indications can be found on the human remains of intentional human action (excarnation or manipulation) and post-depositional processes (gnawing traces or erosion)?

The primary goal of the microwear analysis was to establish whether it is possible to differentiate between recent traces (excavation related), post-depositional traces (such as gnawing or erosion), and old traces related to intentional human actions. The secondary goal, restricted to the putative cutmarks, was to determine the material of the tool that made the cut.

4.2 An introduction to microwear analysis and its potential

Microwear analysis can aid in interpreting the traces left on tools and objects and thus how they were produced, used and discarded. The method was first developed for flint tools but is nowadays applied on all sorts of materials and tools.[233] In the last decades, microwear analysis has become an important tool in the reconstruction of artefact biographies. It may thus be a very useful method in understanding mortuary practices by Bronze Age communities. It is important to keep in mind that with microwear analysis we do not *determine* the traces on objects or tools, it's always an interpretation.[234] In general it is possible only to interpret the raw material of the tool used to modify the bones, and in some cases it is even possible to differentiate between the kinds of tool used.[235]

Microwear analysis is based on a visual comparison with traces on experimentally used tools, using a reference collection of experiments on different materials. For this analysis, the reference collection of the Leids Archeospecialistisch Bureau (Leiden Laboratory for Material Culture Studies) was used. Although this reference collection is quite extensive, it does not include many experiments done with bronze tools on bone. Fortunately, V. Gentile, a researcher from Leiden University, is now experimenting with microwear on bronze weapons.[236] He was able to help us interpret some of the marks that were observed on the human bones.

4.3 Methods and assumptions

In general, it is quite easy to differentiate between traces of cutting and gnawing and between 'old' cuts and modern cuts using a hand lens (10-20X magnification). To obtain more insight into the origin of the traces, it is necessary to use a stereomicroscope (10-60X magnification). Microscopic examination has to be carried out by a microwear analyst or by somebody with experience with these traces, always in comparison with references (results of experiments) in order to arrive at reliable interpretations.

Old traces vs new traces

Bones are relatively soft and therefore vulnerable to degradation in the soil after deposition. During archaeological fieldwork, bone is sometimes damaged by a spade or mechanical excavator. During post-excavation work, including washing and storage, bone is also sometimes damaged. With microwear analysis, its generally possible to differentiate between old and modern traces. Bones can (and will be) altered in the ground by different types of weathering or manipulation. Rougher surfaces will weather more quickly than smoother surfaces.[237] This distinction can also be observed in polished bone tools, for example. But all bone objects will weather over time. When the bone is damaged during excavation or post-excavation, the traces will cut through the eroded surface. These characteristic traces made by a modern spade, for example, can be readily identified: the bone will exhibit an oblique cut plus a break on opposing surface. When old traces weather, the degradation is seen in the damage as well and will thus be similar on the surface and inside the cutmarks. It can, however,

233 Marreiros *et al.* 2015.
234 Van Gijn 2014.
235 See, for example, Christidou 2008.
236 Gentile 2022; Gentile, Van Dijk & Ter Mors in prep.
237 Observation by the author.

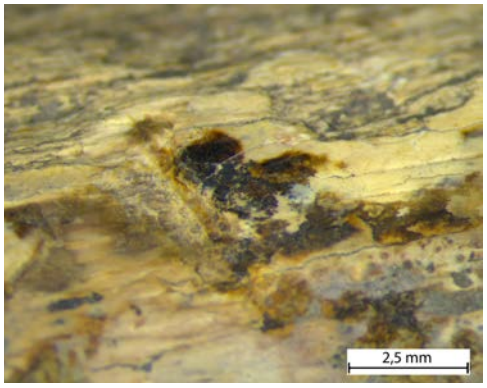


Figure 4.1. Andijk-Noord: Detail of a modern cutmark on femur ID29.

be difficult to know whether the surfaces have undergone comparable weathering, as cuts are often smoother than the surrounding bone and therefore may have a different way of weathering.

Traces of flint tools vs traces of bronze tools
Tools of different materials leave different traces during use.[238] Flint tools leave a V-shaped cut with fine, long, irregular scratches in the cut traces. The base of the cut and the edges are generally slightly rounded. Bronze knives leave traces that are more regular, and the base and edges of the cuts are sharper and more angular compared with cuts made with flint tools. Additional experiments, with many different kinds of tools, are needed to better differentiate between these traces.

4.4 Results

A description of the traces on the analysed bones can be found below. A summary of the results of the analysis can be found in Table 4.1.

Andijk-Noord ID27: Ulna from a ring ditch (traces of erosion?)
The trace on ID27 is not very clear, but it is probably an old cut or scratch. No cortex has formed in the trace, but this is probably due to the smooth surface of the trace being better preserved. The trace does not penetrate the weathered layer. The surface is slightly concave. This has to do either with the tool that was used or with preservation.

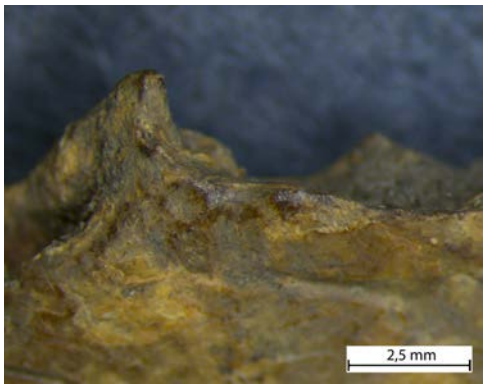


Figure 4.2. Andijk-Noord. Detail of polish marks on different parts of the cranial fragment of ID36.

[238] See, for example, Beller, Greenfield & Hitchcock 2008; Okaluk & Greenfield 2022.

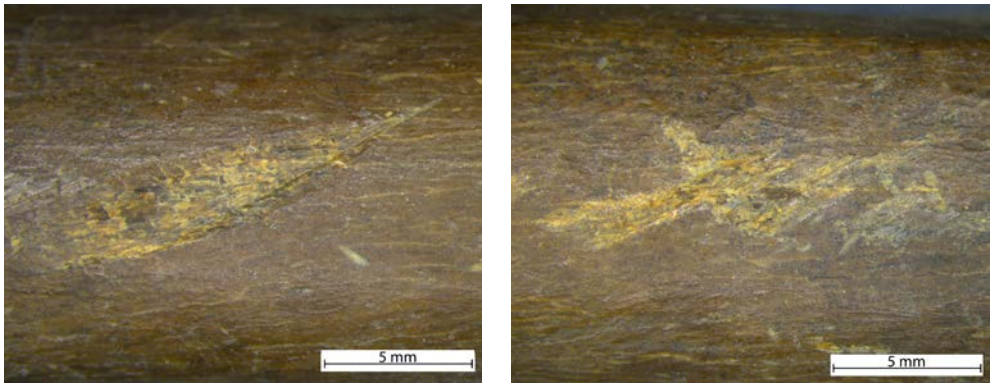


Figure 4.3. Andijk-Noord. Detail of probable modern cutmarks on radius ID39.

Andijk-Noord ID29: Femur from a ring ditch (unknown traces)
On this bone, analysis revealed the trace of a modern cut, probably made with a spade during excavation (Fig. 4.1). Next to this trace, a very smooth surface is visible, where the cortex of the bone has been removed. This is also a modern trace, but it is not clear whether it relates to the cut trace or is the result of general weathering of the bone and of transport and other handling during or after excavation.

Andijk-Noord ID34: Tibia from a ring ditch (possible cut and erosion)
On ID34, the trace is not entirely clear, but because small stripes are also present outside the trace, this is probably a modern trace.

Andijk-Noord ID36: Cranium from a circular ditch (unknown traces)
On the edges of this cranial fragment, both on the protruding parts and along the straighter edge, polish is visible (Fig. 4.2). This could be natural or due to weathering, but based on the distribution and the characteristics of the polish, this polish seems to be related to secondary use. The polish is more developed on one side of the points, indicating a scraping motion. The polish was not studied with higher magnifications, but it does not appear to be post-depositional and dates probably to the Middle Bronze Age.

Andijk-Noord ID39: Radius from a house ditch (possible cut)
There are several traces visible on this bone, and they all seem modern. Along the entire length of the bone, several modern scratches are visible. Other, deeper traces cut through the cortex, exposing the lighter-coloured bone underneath (Fig. 4.3). In one location (Fig. 4.3, left), the different layers that have been cut through are visible.

Andijk-Zuid ID41: Humerus from a house ditch (possible gnawing and erosion)
On this bone several traces are visible. First, some parallel, old cut traces with irregular interspacing are present. The cut traces are weathered along with the rest of the bone. Due to weathering it is, for now, impossible to

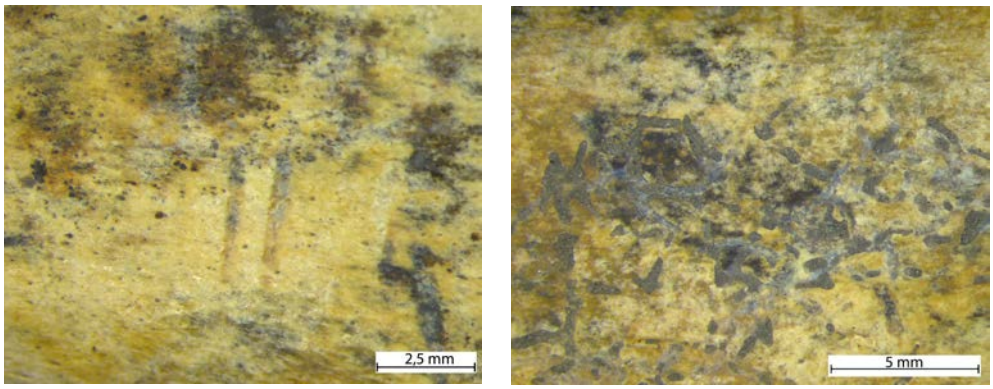


Figure 4.4. Andijk-Zuid. Detail of probable modern cutmarks (left) and traces of gnawing (right) on humerus ID41.

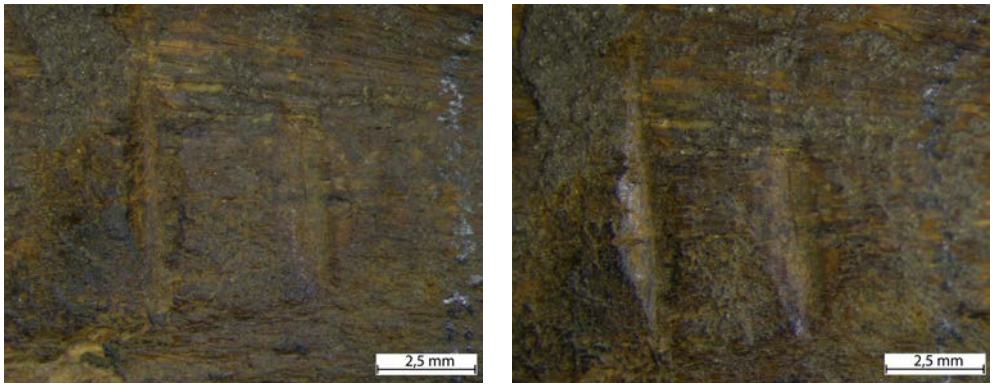


Figure 4.5. Enkhuizen-De Tent. Detail of two parallel cuts made with a bronze tool on clavicula ID19.

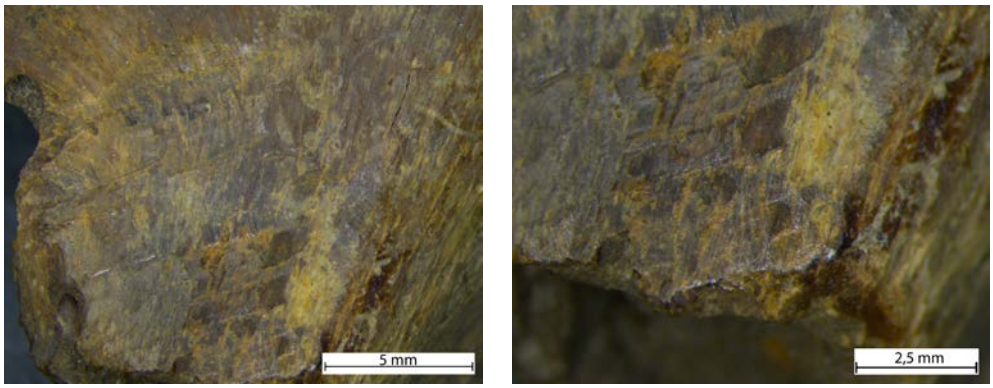


Figure 4.6. Enkhuizen-De Tent. Detail of traces made with a tool (probably bronze) on scapula ID20.

interpret the kind of tool used. In one location (Fig. 4.4, left), two parallel, straight and relatively short cutmarks are visible. Second, some post-depositional traces of gnawing visible (Fig. 4.4, right). These traces are very characteristic, with their irregular depth and winding pattern. Third, some possible cutmarks can be seen next to the traces of gnawing. Because of their proximity to the gnawing marks, they are hard to interpret, but they seem to cut through the cortex, into the lighter-coloured layer below, and are therefore probably excavation traces.

Enkhuizen-De Tent ID19: Clavicula from the flank (mound?) of a barrow (cuts)
On this bone two old cutmarks are present (Fig. 4.5). One incision starts and creates a smooth surface on one side and exits on the other side. The side where the incision started is slightly less worn than the side with the break. Because the startpoint of the incision is smoother, it has weathered more slowly than the endpoint, which is on the other, rougher side. The cutmarks are quite close to each other, and slightly diagonal, fine scratches with a very sharp base are visible, possibly indicating the use of a bronze tool. The appearance of two cuts next to each other is known from experiments with bronze weapons[239] and is the result of the weapon bouncing after the initial strike. This bouncing can also happen when a knife is used for defleshing or other activities.

Enkhuizen-De Tent ID20: Scapula from the flank (mound?) of a barrow (cuts)
There is a high density of old cut- or chopmarks present on this bone. It is not clear what kind of tool has caused these traces, but they are the result of several obliquely oriented movements. The small stripes follow the direction of the cut, just as in recent experiments by Gentile, indicating that a bronze tool was used.[240] The traces are slightly hollow, but for now it is unclear whether this is the result of weathering or of the tool used. The cuts are directed from two sides, possibly to remove tendons or other soft tissue.

Enkhuizen-De Tent ID21: Clavicula from a ring ditch (cuts)
On this bone a cut combined with a large scratch are present (Fig. 4.7, left). It is not entirely certain whether these are old or the result of contact with the bucket of a mechanical excavator. The scratch is undulating in side view (Fig. 4.7, right). This is a peculiar trace, which probably does not come to exist accidentally or during defleshing. The end of the scratch is missing, having been sawn of during sampling for radiocarbon dating. The scratches in the groove and the scratch are

[239] Gentile, pers. comm., 2022.
[240] Gentile 2022.

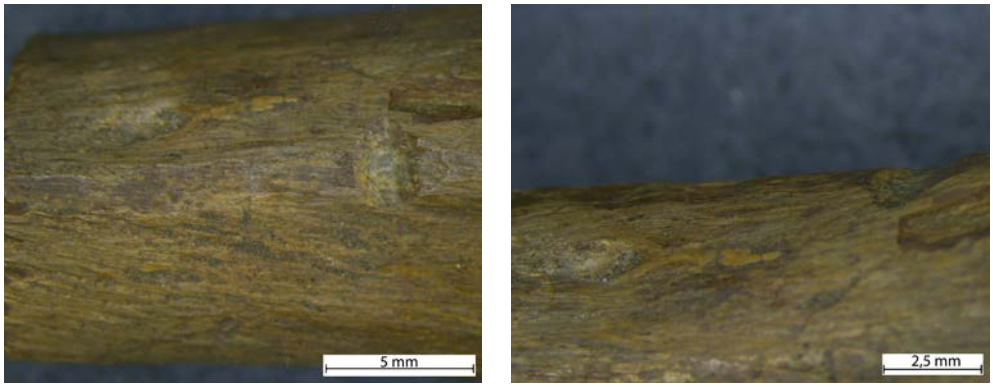


Figure 4.7. Enkhuizen-De Tent. Detail of cut (left) with a large scratch (right) on clavicula ID21.

slightly diagonal, pointing towards a diagonal strike with a large blade, for example a large knife, a sword or the bucket of a mechanical excavator.

Enkhuizen-Kadijken ID56: Fibula from a house ditch (possible gnawing and erosion)
Traces of gnawing are present on the bone. These seem post-depositional. If they were made by a (Bronze Age) dog, one would expect these traces to be visible on both sides of the bone, corresponding to it being held between the upper and lower jaw of the animal. But due to the breakage of this bone, we cannot tell whether the corresponding marks were once present. The extremities of the bone are rounded and polished (Fig. 4.8), more so in one fragment than in the other. These traces seem to be the result of secondary use (after the gnawing), based on both distribution and polish characteristics.

Enkhuizen-Kadijken ID59: Humerus from a well (possible cut and erosion)
No traces visible.

Venhuizen-Voetakkers ID8: Femur from a settlement ditch (possible cut)
The trace visible on this bone is a recent trace, caused by a spade. The cortex has been cut and has crumbled on both sides (Fig. 4.9, top), creating an irregular edge. On the other side of

Figure 4.8. Enkhuizen-Kadijken. Detail of gnaw marks and traces of polishing on fibula ID56.

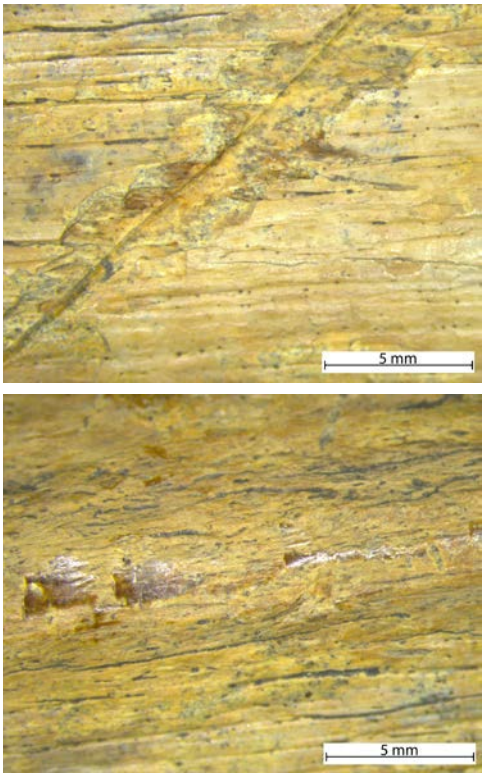


Figure 4.9. Venhuizen-Voetakkers. Detail of a modern cut (top) and (possible) traces of a vise used during sampling (bottom) on femur ID8.

Table 4.1. Results of microwear analysis.

Site	ID	Element	Context	Primary context	Interpretation physical anthropology	Interpretation microwear analysis
Andijk-Noord	27	ulna	barrow	ring ditch	erosion	old(?) trace (unknown tool) or scratch
Andijk-Noord	29	femur	barrow	ring ditch	unknown non-pathological marks	modern traces (spade)
Andijk-Noord	34	tibia	barrow	ring ditch	cutting? & erosion	modern(?) trace
Andijk-Noord	36	cranium	settlement	circular ditch	unknown non-pathological marks	polish? (secondary use)
Andijk-Noord	39	radius	settlement	house ditch	cutting?	modern trace (unknown tool)
Andijk-Zuid	41	humerus	settlement	house ditch	gnawing? & erosion	old traces, unknown traces, gnawing
Enkhuizen-De tent	19	clavicula	barrow	flank of barrow (mound?)	cutting	old traces (bronze?)
Enkhuizen-De tent	20	scapula	barrow	flank of barrow (mound?)	cutting	old traces (bronze?)
Enkhuizen-De tent	21	clavicula	barrow	ring ditch	cutting	unknown traces (large tool)
Enkhuizen-Kadijken	56	fibula	settlement	house ditch	gnawing? & erosion	polish (secondary use), gnawing
Enkhuizen-Kadijken	59	humerus	settlement	well	cutting? & erosion	no traces visible
Venhuizen-Voetakkers	8	femur	settlement	ditch	cutting?	modern traces (spade/vise)

the bone there are some modern traces next to where the bone was cut during sampling for radiocarbon dating. The crosshatch pattern was caused by the clamps of a vise. Some other traces are probably caused by the clamps of a vise as well (Fig. 4.9, bottom). In this location, movement of the bone while clamped in the vise caused the traces.

4.5 Discussion and recommendations

Four of the bones studied exhibit 'old' traces. Two of these show indications of a bronze tool. The other traces that were flagged as possible cutmarks seem to be excavation damage or damage of uncertain origin. Two of the bones (ID36 and ID56) exhibit rounding and polish that differs from the rest of the surface. The characteristics of the polish, the location and distribution of these traces, and the manner of rounding indicate they may have been used as a tool. The bones have not been extensively shaped before their (possible) use. Expedient bone tools seem do to be common in the Bronze Age in the Netherlands.[241] And even though it is not very common, the use of human bones for tools is observed more often in the Netherlands (Chapter 1).

The use of human bones for these tools seems to be a deliberate choice, even though it is still unclear why human bone was used. As the current analysis was only a preliminary study, the bones have not been studied further. A complete microwear analysis, also using higher magnifications, may give more insight into these traces and allow interpretation of whether these bones were indeed used as tools, what materials were worked, and in which way. It would also be recommended to reanalyse the entire assemblage of human bone to see whether other bones display similar traces of secondary use.

As described above, the analysis of cutmarks can be undertaken on different levels. The first level is to differentiate between old and new traces. This distinction can generally be made with the use of a hand lens and access to a physical reference collection or a photographic reference collection. The second level would be to identify the raw material of the tool used. The third level would be to interpret the kind of tool used and to establish what kind of activity resulted in the observed traces. These second and third levels of analysis need to be done by a microwear analyst with access to a reference collection containing the relevant experiments. However, these experimental samples are not yet available in the Netherlands. Future experimental programmes should simulate the following scenarios (among others), executed with different kinds of tools and raw materials (for example, bronze, flint and other stone tools):

- the traces are the result of combat;
- the bodies were defleshed;
- the bones were further worked after defleshing (this can be done on both fresh and dry bone, leaving different traces).

This enhanced reference collection would allow us to make interpretations of the traces found on these human bones from West Frisia.

[241] Edmonds 2018.

5 Scanning electron microscopy analysis of cut marks on the bones

I. Joosten

5.1 Introduction

Some of the disarticulated human bones showed clear traces of having been cut. Using energy-dispersive X-ray spectroscopy (EDX) in a scanning electron microscope (SEM), it is possible to detect residues of the tools used on the bone. If the cutmarks were made with a bronze tool, for example, bronze residues, such as copper or tin, could be detected on the bone. To obtain more insight into the material used to create the cutmarks, a pilot was carried out: three bones with clear cutmarks were studied with the SEM.

5.2 Method

The SEM uses a focused beam of electrons that is scanned along the surface of a sample to create a magnified image. Interaction between the electron beam and the sample produces a wide range of information. The backscattered electrons (BSE) used in this study create an image in which the intensity of the image is mainly related to the chemical composition of the sample. Heavier components (e.g. iron) show up brighter than lighter components (e.g. silica). Due to the bombardment with electrons, the atoms in the sample will also emit X-rays, each with a characteristic energy spectrum. EDX spectroscopy can thus be used to identify the elements present within the sample.

For this pilot, the human remains were studied in a JEOL JSM-IT700HR scanning electron microscope with a JED-2300-Fully integrated JEOL EDS system (100 mm2 SDD). The SEM was operated in low-vacuum mode at a chamber pressure of 30 Pa, with an operating voltage of 20 kV and working distance of 10 mm. The bones were not coated prior to analysis.

5.3 The samples

For this pilot, three samples were selected for SEM analysis (Table 5.1, Fig. 5.2). The first sample (ID19) shows two small, clear cuts, and during the microwear analysis (Section 4.3) these cuts were interpreted as being old. The second

Figure 5.1. A part of the SEM equipment in use.

Table 5.1 The samples that were analysed with SEM.

Site	ID	Element	Context	Primary context	Interpretation physical anthropology	Interpretation microwear analysis
Enkhuizen-De Tent	19	clavicula	barrow	flank of barrow (mound?)	cutting	old traces (bronze?)
Enkhuizen-De Tent	21	clavicula	barrow	ring ditch	cutting	unknown traces (large tool)
Venhuizen-Voetakkers	8	femur	settlement	ditch	cutting?	modern traces (spade/vise)

sample (ID21) shows one large cut made with a large tool. It is unknown whether this cut is old or modern. The third sample (ID8) shows a long cut, and during microwear analysis this cut was interpreted as being modern.

5.4 Results and interpretation

The observations and interpretation per sample can be found in the text below. The main results of the analysis are summarised in Table 5.2. The EDX spectra per sample can be found in Appendix VI.

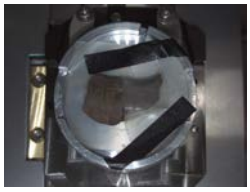
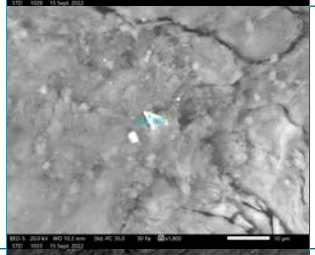
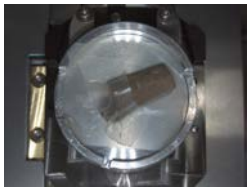
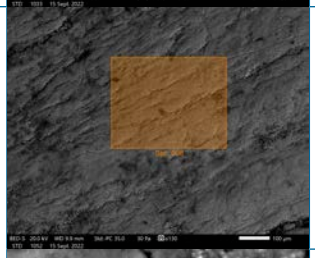
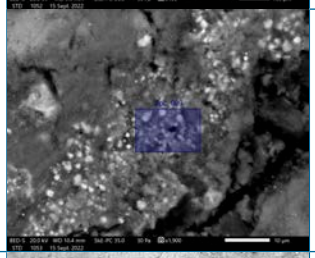
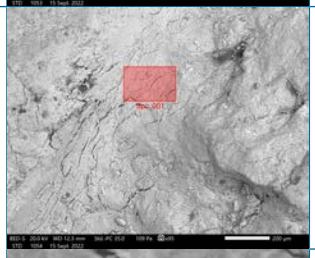
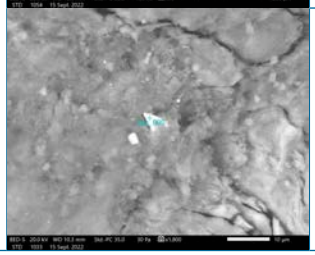
Enkhuizen-De Tent ID19: Clavicula from the flank of a barrow
The main elements that were identified during the analysis were calcium (Ca) and phosphorus (P). The BSE image of the surface of the sample shows a lot of small light areas, which indicate material of heavier elements, such as metals or higher, or of denser material. However, EDX analysis of these areas showed the presence of iron (Fe), manganese (Mn), titanium (Ti) and silicium (Si). These elements are an indication of the natural soil. Particles of Fe that may indicate iron tools are absent. Indications for the use of bronze tools, that is, copper (Cu) and tin (Sn), were not identified. The surface outside the two cutmarks was also analysed, and one light particle gave an unexpected outcome: nickel (Ni). This may indicate the use of a metal (surgical) tool during (or after) the excavation.

Enkhuizen-De Tent ID21: Clavicula from a ring ditch
On this sample, we found the same elements as on sample ID19, but without signs of (modern) Ni. A dense concentration of small particles of iron sulphide (pyrite) is another indication that natural soil elements are present on the sample. This means that the sample was not completely cleaned after excavation and, by extension, that indications of bronze tools (Cu and Sn) would have been identified if present. The presence of pyrite is an indication that the bones must at some point have been in anaerobic, sulphate-rich conditions.

Venhuizen-Voetakkers ID8: Femur from a settlement ditch
This sample showed the same elements as sample ID21. Remarkable is the absence of any traces of Fe, a metal that would be expected in

Figure 5.2. Detail of the cutmarks on Enkhuizen-De Tent ID19 (left), Enkhuizen-De Tent ID21 (centre) and Venhuizen-Voetakkers ID8 (right).

Table 5.2. Images taken during the scanning electron microscopy analysis, chemical elements present and their interpretation. Major element (bold), minor element (normal) and trace element (brackets).

Individual (ID)	Backscattered electron image (BEI)	Spectrum	Chemical elements	Interpretation
ID19 		001 light part	(C), O, (Na), (Al), (Si), P, Ca, (Mn), Fe	bone and soil
		005 bright particle	Ni	from modern tool?
ID21 		008 matrix	(C), O, P, Ca	bone
		009 light particles	S, Fe	framboidal pyrite
ID8 		001	(C), O, (Na), (Al), (S), P, Ca	bone
		003 light part	(C), O, (Na), (Al), (Si), P, Ca, (Ti), (Mn), Fe	bone and soil

an obvious modern cut. On this sample some indications of soil elements are also present, such as small particles of iron sulphide (pyrite) and even a diatom. As was the case for sample ID21, the presence of these elements shows that the sample was not completely cleaned after excavation. Indications of a modern metal tool, such as a spade (Fe), would have been identified if present.

5.5 Discussion and recommendations

The three samples that were analysed with the SEM all had clear cuts. During the microwear analysis, the traces on two of these samples (ID19 and ID21) were interpreted as 'old', probably of Bronze Age date. The cut on a third sample (ID8) was interpreted as 'modern'. During the SEM analysis, no remains of metal elements were identified in the traces. On the surface on one of the samples, Ni was identified. This is an indication that modern tools were used after excavation of the bone, maybe for sampling or cleaning.

It is remarkable that no traces of such elements as iron were identified in the cut that must be of modern age (ID8). It is possible the bones were cleaned thoroughly and that this resulted in the absence of elements of the tools used. However, in the modern cut of this example, elements were identified that clearly indicate the presence of (old) soil, suggesting the bone was not, in fact, thoroughly cleaned. Although this is just a pilot, it is important to keep in mind that absence of evidence is not evidence of absence. More experiments with bones and tool marks is highly recommended (Chapter 9). Those experiments should be applied with different kinds of tools, made of different kinds of materials - not only bronze and iron knives, but also modern tools used by archaeologists in the field. These cuts should be made on bone with and without adhering soft tissue. The next step is to examine these cuts thoroughly with the different methods used in this study (microwear, SEM, XRF, and luminescence). For comparative purposes, we suggest the same sample be analysed:

- directly after the bones have been cut;
- after the bones have been buried for a while but not yet thoroughly cleaned;
- after the bones have been thoroughly cleaned.

6 X-ray fluorescence analysis of cut marks on the bones

B. van Os

6.1 Introduction

During analysis of the bones by the physical anthropologist, non-pathological traces were observed on some of the bones (Chapter 3). After microwear analysis (Chapter 4) and SEM analysis (Chapter 5) on some of these bones, five additional bones were selected for analysis with X-ray fluorescence (XRF). As was the case for the SEM analysis, the main goal of this analysis was to obtain more insight into the material used to create the cuts. In contrast to SEM, XRF allows us to investigate a larger surface of the bones in our search for residues. In addition, with XRF, the detection limits for trace elements that can be diagnostic for cutmarks, such as copper or other metals, are much lower (1-5% absolute for SEM, compared with 1-20 ppm for XRF).

6.2 Methodology

The hand-held XRF (HH XRF) analyses were carried out using a Thermo Scientific Niton XL3t GOLDD+ energy-dispersive hand-held XRF analyser, equipped with a silicon drift detector. Analyses were performed using a portable test stand. The Cu/Zn-mining mode was used, with a measuring time of 110 s, using four sequential

Table 6.1. The samples that were analysed with XRF.

Site	ID	Element	Context	Primary context	Interpretation physical anthropology	Interpretation microwear analysis	Interpretation SEM analysis
Andijk-Noord	36	cranium	settlement	circular ditch	unknown non-pathological marks	polish? (secondary use)	-
Enkhuizen-De Tent	19	clavicula	barrow	flank of barrow (mound?)	cutting	old traces (bronze?)	no elements of metal tools
Enkhuizen-De Tent	21	clavicula	barrow	ring ditch	cutting	unknown traces (large tool)	no elements of metal tools
Enkhuizen-Kadijken	56	fibula	settlement	house ditch	gnawing? & erosion	polish (secondary use), gnawing	-
Venhuizen-Voetakkers	8	femur	settlement	ditch	cutting?	modern traces (spade/vise)	no elements of metal tools

Figure 6.1. The p-XRF in use in the laboratory stand (left) and hand-held (right).

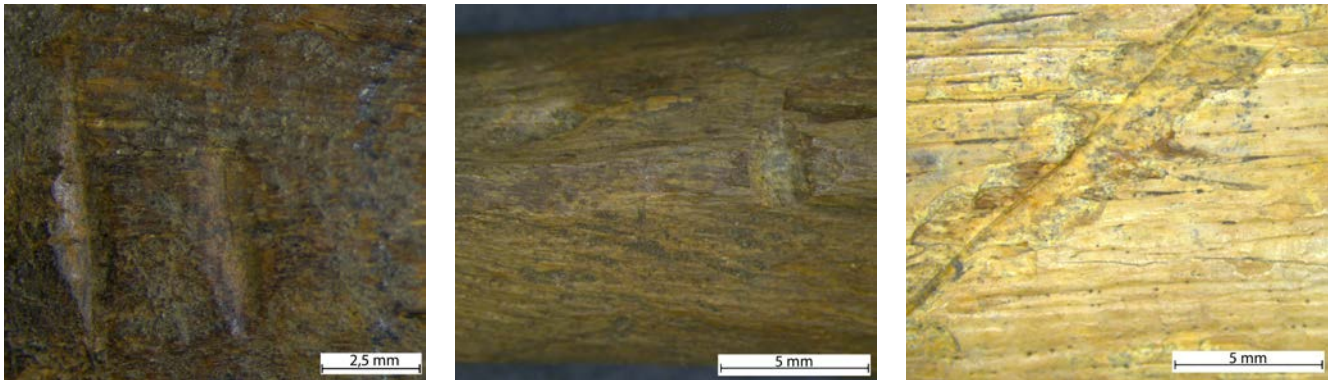


Figure 6.2. Detail of the cutmarks on Enkhuizen-De Tent ID19 (left), Enkhuizen-De Tent ID21 (centre) and Venhuizen-Voetakkers ID8 (right).

energy settings: Light range (Mg to Cl) at 8 kV 200 mA; low range (K to Ti) at 20 kV 100 mA; main range (V to Ag including L-lines for Pb); and high range (Cd- Ba) both at 50 kV, 40 mA. A brief summary of the calibration and performance is presented here. Since factory calibrations are a potentially serious source of error when using HH XRF, the machine calibration was checked and adapted using a set of 14 powdered (ISE) standard samples.[242] Accuracy was tested using the BAMS005B standard. For safety during normal use, a measurement stand is used to prevent unwanted X-ray exposure. In cases where the objects do not fit the stand or the spot to be analysed cannot be reached when the XRF is in the stand, the machine is hand-held, after the necessary precautions have been taken to prevent unwanted X-ray exposure.

6.3 The samples

For this pilot, five samples were selected for analysis (Table 6.5). Three of these samples (ID19, ID21 and ID8) show clear cuts. During the microwear analysis (Chapter 4), those on ID19 and ID21 were interpreted as being old (ID19) and possibly old (ID21) and that on ID8 was interpreted as being modern (Fig. 6.2). During analysis with SEM, no indications of metal were identified on these three samples. In the other two samples (ID36 and ID56), traces of (possible) polishing and gnawing (ID56) were observed during the microwear analysis (Fig. 6.3).

6.4 Results and interpretation

Enkhuizen-De Tent ID19: Clavicula from the flank (mound?) of a barrow

Observations

These cuts seem old, which can be seen on the surface of the bone: minerals (FeP) are present in the cut and along the margins of the cut. Elements of the soil (mainly sand) are fixed on the bone surface like a crust. This suggests that the soft tissue had already eroded when the

[242] www.wepal.nl.

Figure 6.3. Detail of the traces of (possible) polishing on Andijk-Noord ID36 (left) and polishing and gnawing on Enkhuizen-Kadijken ID56 (right) analysed with XRF.

bone was deposited in the context. The cuts are quite wide, possible indicating a tool with a somewhat blunt blade.

XRF
The sample was examined in three locations (Table 6.2). Outside the cuts, a lot of Si and Al was identified, which may relate to clay soil. No Cu or Sn were identified.

Enkhuizen-De Tent ID21: Clavicula from a ring ditch
Observations
Inside the cut, numerous small, parallel cuts can be seen, as well as some small, black spots that are probably minerals from the soil. As was the case with ID19, a lot of sand can be seen on the bone, including in the many small cracks in the bone, and as was the case with ID19, this probably indicates that the bone was deposit in the context without adhering soft tissue.

XRF
The sample was examined in three locations (Table 6.2). A lower concentration of Fe and a higher concentration of Mn was identified compared with ID19. As these elements are redox sensitive and most likely higher in the oxygenated part of the profile, this may indicate that this bone was found in a higher position in the soil matrix than ID19. There is less Pb in this sample compared with ID19. The source of lead is most likely air pollution due to the use of leaded petrol until the mid-1980s, with higher concentrations in the upper part of the soil.[243] No Cu or Sn were identified.

Venhuizen-Voetakkers ID8: Femur from a settlement ditch
Observations
This bone sample had been more thoroughly cleaned than ID19 and ID21. The bone is lighter in colour as well. However, soil is present within the (broken) bone, which suggests that the bone was deposited in the context after it no longer had adhering soft tissue. The cut is slightly curved and was probable made with a modern trowel.

XRF
The sample was examined in three locations (Table 6.2). Like in ID8, the amount of Fe is a bit lower in this sample. The amount of Pb is remarkably higher on one side of the bone than on the other side. This is an additional indication that the Pb derives from the modern topsoil, and it indicates that the side with the higher amount of Pb must have been the upper face when the bone was still in situ within the context. One of the XRF spots is located *within* the bone, where a section was taken for radiocarbon dating. One might expect a large amount of Fe here, from the saw blade used in sampling. During the analysis, the amount of Fe_2O_3 was found to be eight times that identified in the other spots measured on this bone. It is remarkable how much Fe is present *within* the bone. Although this could be caused by contamination during radiocarbon sampling, a natural diagenetic cause is far more likely. Not only iron shows elevated concentrations, but also manganese and arsenic. As these elements are not expected to be present in the saw blade, the source may be groundwater-soil interaction with the burial environment of the bone causing mobilisation of these redox-sensitive elements and, later, precipitation after reoccurrence of oxygenated conditions.

The amount of Pb within this bone was lower than that on the surface of this sample. This is illustrative for the mobility of the (modern) Pb from the atmosphere into the soil. As conditions in the soil are mostly slightly acidic, dependent on the availability of buffering carbonate-rich phases, such as shell or ash, Pb will be mobile. Bone also contains carbonate, but because this carbonate also will dissolve under conditions of low pH, the pH will increase (resulting in lower acidity) in the direct environment of bone. Under such alkaline conditions, Pb may be immobilised as lead carbonate or lead hydroxide at the bone's surface. No Cu or Sn were identified, indicating either that the bone was not cut with a bronze object or that traces of metal have been dissolved.

Andijk-Noord ID36: Cranium from a circular ditch
Observations
The sample is brown coloured, caused by iron hydroxide deposits. The (possible) signs of polishing that were identified during the microwear analysis are younger than the Fe deposit. Whether the shine was caused by polishing is uncertain; it may well have been

[243] Walraven *et al.* 2014.

caused by erosion that caused flaking. One side of the fragment looked clearly cut. These '*retouche*' cuts look modern.

XRF

The sample was examined in one location (Table 6.2). Although the iron hydroxide staining is pronounced, the observed iron concentration is no higher than in other samples. Clearly the iron staining is only present at the surface. Changing redox conditions from anaerobic to aerobic could have caused the oxidation of pyrite that formed just after deposition of the bone. Therefore the iron staining most likely is recent, caused by changes in land use or by lowering of the ground water table.

[244] McGowan & Prangnell 2006; Nriagu 1976; Huisman *et al.* 2017The Netherlands and Norway that contained bone fragments were studied. The goal was to investigate the type and the timing of decay processes to better understand the taphonomy of bones in such sites. Using optical microscopy and scanning electron microscopy with energy dispersive X-ray spectroscopy (SEM-EDX.

Enkhuizen-Kadijken ID56: Fibula from a house ditch

Observations

Some small, round, black spots were identified on the bone. These may well be vivianite or its oxidised counterpart, iron (III)phosphate. Vivianite is an indicator for anaerobic or anoxic

Table 6.2. Results of XRF analysis. <d.l.=below detection limit, Bal = Balance. Components (C, H, N, O) not measured by XRF excluding oxygen bound to metals (i.e.: O_2 in SiO_2).

XRF no.	ID	Element	Location	SiO_2 %	CaO %	P_2O_5 %	K_2O %	Al_2O_3 %	TiO_2 %	Fe_2O_3 %	MnO %	Bal %
390	19	clavicula	next to cut, sandy	52	22	11	1.3	8.2	0.44	1.9	0.14	3.3
391	19	clavicula	at cut	18	33	19	0.41	4	0.11	6.6	1	17
392	19	clavicula	spongious bone	11	29	19	0.38	1.9	0.12	6.4	1	31
393	21	clavicula	at cut	3.3	41	30	0.08	0.67	<d.l.	0.72	0.24	25
394	21	clavicula	at cut	8.1	44	29	0.17	2.2	<d.l.	0.56	0.29	16
395	21	clavicula	intersection	3.2	37	27	0.12	0.53	0.05	1.6	0.42	30
396	8	femur	at cut	1.3	41	21	<d.l.	<d.l.	<d.l.	0.58	0.15	36
397	8	femur	background	5.2	48	30	0.06	0.8	<d.l.	0.52	0.15	15
398	8	femur	rust remains	2	56	28	0.1	<d.l.	0.09	5.6	0.89	7.4
399	36	fibula	scuff marks	4.3	45	31	0.05	0.68	<d.l.	0.97	0.31	18
400	56	fibula	gnawing marks	20	33	20	0.36	2	0.14	2.5	0.5	22

XRF no.	ID	Element	Location	S %	Zn ppm	Cu ppm	Pb ppm	Zr ppm	Sr ppm	Rb ppm	As ppm	Ba ppm
390	19	clavicula	next to cut, sandy	0.29	194	<d.l.	73	70	707	23	17	460
391	19	clavicula	at cut	0.41	257	<d.l.	50	20	818	11	46	633
392	19	clavicula	spongious bone	0.28	135	<d.l.	<d.l.	36	775	19	22	444
393	21	clavicula	at cut	0.64	506	<d.l.	<d.l.	<d.l.	566	<d.l.	6.9	469
394	21	clavicula	at cut	0.58	416	<d.l.	<d.l.	<d.l.	638	<d.l.	6.2	363
395	21	clavicula	intersection	0.64	253	122	29	6.3	613	4.7	11	380
396	8	femur	at cut	0.28	121	<d.l.	41	23	557	9.7	43	276
397	8	femur	background	0.42	167	<d.l.	114	37	615	13	46	323
398	8	femur	rust remains	0.36	99	<d.l.	20	68	450	39	110	721
399	36	fibula	scuff marks	0.46	296	<d.l.	34	6.7	768	<d.l.	16	168
400	56	Fibula	gnawing marks	0.14	483	<d.l.	13	13	592	9	72	321

burial conditions.[244] This would need to be confirmed by SEM. Within the bone, a lot of soil is present, which suggests that the bone was deposited in the context without adhering soft tissue. The surface of the bone looks very eroded, probably due to the oxidation of pyrite. Oxidation of pyrite produces sulfuric acid, causing dissolution of bone. The presence of pyrite means the subsoil must have been brackish and anoxic.

XRF

The sample was examined in one location (Table 6.2). The very high SiO_2 content found at the marks indicates that the pores and crevices in the bone are filled with soil material. In addition, the relatively high iron content indicates hydromorphic, most likely anaerobic, burial conditions, which are also indicated by the relatively high arsenic content.

6.5 Discussion and recommendations

Like the SEM analysis, different elements could be identified on the bones during the XRF analysis, but no chemical elements indicative of metals. Instead, not only elements of the bone, but also some elements from the surrounding soil were identified. Such findings will sometimes give an interesting insight into the state of erosion of soft tissue at the time when the bone was deposited. As we have seen in most of the samples, the soft tissue had already eroded when the bone was deposited. Identification of minerals will also give insight into the kinds of soil processes in and around the bones. With this information, we can sometimes reconstruct the vertical position of the bones in context (ID21).

To learn more about the kinds of tools and materials used in cutting, experimental research is needed (Chapter 9). As it is very useful to look at the cuts in more detail, it is therefore recommended to make sections of the cuts from the experiments to compare them with the cuts on archaeological material. These sections could be studied effectively using a Hirox 3D digital microscope, for example. With this microscope, very detailed images of the cuts can be made, which may give us more insight into the tools used. Furthermore, the effects of soil degradation on bones (such as decomposition, corrosion and formation of minerals) will be of help in interpreting marks and chemical elements on bones. These soil degradation processes can be studied effectively by analysing bones before and after burial, using Fourier-transform infrared spectroscopy or Raman spectroscopy.[245]

[245] Reidsma *et al.* 2016; Fernandes *et al.* 2013; Brock *et al.* 2017.

7 Taphonomic investigation of the bones

T. Krap

7.1 Introduction

A collection of human bones dating from the Bronze Age and excavated from a ring ditch around a burial mound in West Frisia, were found to be of interest for archaeological reconstruction of past activities. A previous investigation of the bone collection had shown possible traces of old cutting and gnawing, both of which are considered damage due to manipulation. The bones had previously been sampled for radiocarbon dating and thus showed evident post-burial and post-excavation handling and cutmarks (also considered traces of manipulation). Within the wider archaeological investigation, the focus of this study lies on providing information to be able to better explain the mortuary rite, which includes such scenarios as pre-burial manipulation of the deceased and reburial.

In this Chapter a distinction was made between early post-mortem (around the time of burial, that is, old) and late-post-mortem (very recent, that is, fresh) traces of manipulation. Traces of early post-mortem manipulation can support or refute hypotheses regarding the burial rite; these therefore must be distinguished from late-post-mortem traces of manipulation, which are less likely to be related to the practices of a past population.

When investigating bones, it is important to assess not only the timing of the manipulation, but also the degree of (internal) preservation, for two reasons. The first reason is that the preservation can tell us about burial context(s). Bones of the same structure and collected from the same taphonomic context are more likely to be in the same state of (internal) preservation (whereby the variables of the burial environment with the greatest effect on preservation are a low pH and moving water, followed by oxygen availability).[246] When such bones differ greatly in preservation, this can support hypotheses that posit a change in burial context, including a change following (re)burial practices.[247] The second reason is that the degradation of the bone matrix can have an influence on the outcome of the technique, known as photoluminescence, that was applied during this study.[248]

This chapter seeks to answer the following research questions:

- What is the external preservation based on assessment of the periosteal surface by means of the scale published by Behrensmeyer?[249] This question was assessed for ID29, ID31, ID34 and ID62.
- What is the internal preservation based on assessment of the internal microstructure by means of the scale published by Hedges, Millard & Pike?[250] This question was assessed for ID29, ID31, ID34 and ID62.
- Does the degree of preservation differ or correspond amongst the bone samples, and how does this relate to the taphonomic context? This question was assessed for ID29, ID31, ID34 and ID62.
- Is it possible to distinguish early post-mortem traces of manipulation from traces that were caused late post-mortem? This question was assessed for ID19, ID21, ID29, ID34, and ID61.

7.2 Methodology

In total, 19 samples were investigated. Four samples were selected to assess the internal preservation state, by analysing the bone matrix microscopically (known as histological analysis) (ID29, ID31, ID34, and ID62). Based on the results of the previous physical anthropological analysis, four samples were selected to assess the moment in time that traces of manipulation were created (ID19, ID21, ID29, and ID34). Following macroscopic screening under white light for potentially interesting traces of manipulation, a fifth sample was included in the analyses of assessing the moment when traces of manipulation were created (ID61). See Table 7.1 for an overview of the samples, including anatomical and archaeological details based on previous research on these samples.

7.2.1 Preservation

Bone consists of an inorganic (mainly hydroxyapatite) and an organic (mainly type 1 collagen) component, laid down in an interwoven structure. During life, human cortical bone is remodelled by the bone remodelling

246 Hollund *et al.* 2012; Child 1995.
247 Booth & Madgwick 2016.
248 Ramstahler *et al.* 2011.
249 Behrensmeyer 1978.
250 Hedges, Millard & Pike 1995, 203.

Table 7.1. Prior information for samples subjected to luminescence and preservation analysis.

Site	ID	Interpretation physical anthropology	Interpretation microwear analysis	Element	Context	Analysis undertaken
Andijk-Noord	29	unknown non-pathological marks	modern traces (spade)	femur	ring ditch	luminescence & preservation
Andijk-Noord	31	no traces	not analysed	femur	ring ditch	preservation
Andijk-Noord	34	cutting? & erosion	modern(?) trace	tibia	ring ditch	luminescence & preservation
Andijk-Noord	62	unknown non-pathological marks	not analysed	femur	ring ditch	preservation
Enkhuizen-De Tent	19	cutting	old traces (bronze?)	clavicula	flank of barrow (mound?)	luminescence
Enkhuizen-De Tent	21	cutting	unknown traces (large tool)	clavicula	ring ditch	luminescence
Grootebroek-Waterweide Noord	61	cutting?	not analysed	femur	ring ditch	luminescence

Table 7.2. Scoring index used to assess bone surface weathering.

Stage	Description
0 (excellent)	bone surface shows no sign of cracking or flaking.
1 (good)	bone shows cracking, normally parallel to the fibre structure (i.e. longitudinal in long bones). Articular surfaces may show mosaic cracking.
2 (fair)	outermost concentric thin layers of bone show flaking, usually associated with cracks, in that the bone edges along the cracks tend to separate and flake first. Long, thin flakes, with one or more sides still attached to the bone, are common in the initial part of this stage.
3 (moderate)	bone surface is characterised by patches of rough, homogeneously weathered compact bone, resulting in a fibrous texture. In these patches, all the external, concentrically layered bone has been removed. Weathering does not penetrate deeper than 1.0–1.5mm; bone fibres are still firmly attached to each other.
4 (low)	bone surface is coarsely fibrous and rough in texture; large and small splinters occur and may be loose enough to fall away from the bone when it is moved; weathering penetrates into inner cavities. Cracks are open and have splintered or rounded edges.
5 (poor)	bone is falling apart in situ, with large splinters lying around what remains of the whole, which is fragile and easily broken by moving. Original bone shape may be difficult to determine. Cancellous bone usually exposed, when present.

Table 7.3. Histological index used to assess degree of diagenetic change.

Index	Approximate proportion of bone intact (%)	Description
0 (poor)	<5	no original features identifiable other than haversian canals
1 (low)	<15	small areas of well-preserved bone present or some lamellar structure preserved by pattern of destructive foci
2 (moderate)	<33	clear lamellate structure preserved between destructive foci
3 (fair)	>67	clear preservation of some osteocyte lacunae
4 (good)	>85	only minor amounts of destructive foci; otherwise generally well preserved
5 (excellent)	>95	very well preserved; almost indistinguishable from fresh bone

unit, consisting of osteoclasts and osteoblasts. The bone remodelling unit creates canals with circumferential layers of bone and lacunae that house osteocytes; these structures are called osteons.[251] The bone matrix can be viewed with light microscopy of a thin slide (3-10µm) or thick slide (20-80µm).[252]

The post-mortem taphonomic agents bacteria and non-neutral pH are able to alter the microstructure of bone, affecting both the external surface and internal structure. Here, external preservation is assessed by means of a scoring index proposed by Behrensmeyer (Table 7.2),[253] whereas internal preservation is assessed

[251] Gilbert 2000; Gocha, Robling & Stout 2018; Tate 2011.
[252] Krap & Van de Goot 2012; Maat, Van den Bos & Aarents 2001.
[253] Behrensmeyer 1978, 151.

by means of the Oxford Histological Index (OHI), proposed by Hedges, Millard & Pike (Table 7.3).[254]

7.2.2 Luminescence imaging and analysis

Bone exhibits a biophysical characteristic called luminescence when illuminated.[255] The cause of the luminescent characteristic is mainly attributed to the collagen network interwoven in the bone matrix, although the mineral fraction of the bone, adipose, body fluids and contaminants also contribute to the intensity and observable wavelength bandwidth.

To visualise luminescence, a bone sample is exposed to light of a specific wavelength bandwidth, and the excited light is then filtered out for the observer and the imaging device by means of a long-pass filter (Fig. 7.1). For this study, the bandwidth of excitation light was from 420nm to 470nm and the thickness of the long-pass filter was 476nm, a combination that generally leads to the highest luminescence intensity.[256] Photographs were taken with a full-frame, digital single-lens reflex camera (Nikon D700) equipped with either a 35mm AF-D or a 60mm AF-D macro lens. The intensity of luminescence of the samples was assessed for the periosteal surface, any fracture surfaces present and any traces of manipulation in order to differentiate between 'fresh' traces and "old" traces based on the degradation of collagen on the surface of the bone. Exposure to taphonomic agents – e.g. soil bacteria, high or low pH, organic matter – leads to degradation. The exposure to the taphonomic agents of the exposed internal structure and of the periosteal surface is equal in cases where a fracture or scratched surface was already present at the time of burial. This leads to an approximately equal loss of intensity of luminescence. In cases where there is more recent damage to the bone, a fresher surface is created. This surface will lag behind in the degree of degradation compared with the periosteal surface, which has been exposed to the burial environment and taphonomic agents from the start. This lag leads to differences in the intensity of luminescence, whereby the more recently exposed surface will generally exhibit a higher intensity when compared with the periosteal surface. To best visualise the difference in intensity, it is, in most cases, necessary to create a fresh cut as an internal reference because the potential luminescence intensity of the sample since degradation is not limited to the surface of the bone. It is not necessary to create a fresh cut when there is already known recent damage to the bone, such as damage resulting from sampling for DNA or isotope analysis.

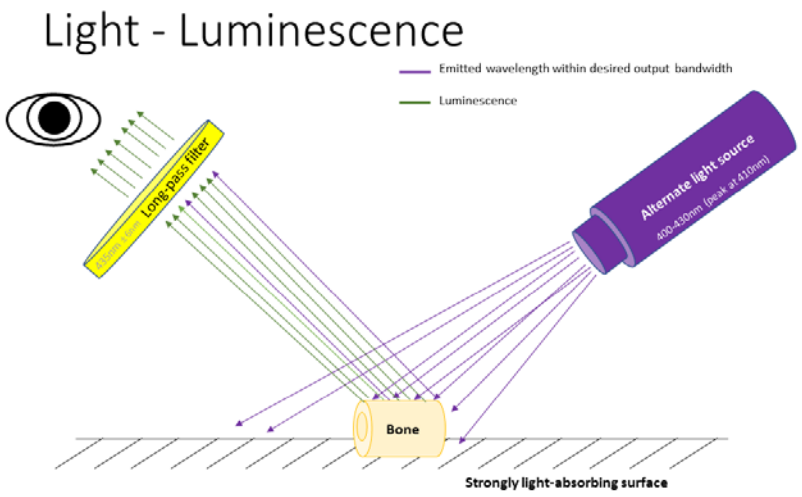


Figure 7.1. Schematic overview visualising luminescence of a bone sample (image: Tristan Krap).

7.3 Results

7.3.1 Preservation

Externally, three of the four bones examined for preservation showed few signs of deterioration, and one bone, ID29, exhibited a high degree of cortical flaking and longitudinal cracks, resulting in a score of 4 on the Behrensmeyer scale (Table 7.4).[257] ID29 and ID34 were found to be brittle during the process of creating the microscopical slides. ID31 and ID62 had a high score on the OHI scale. ID34 showed more patches of deterioration, resulting in a lower score, of 2. ID29 exhibited the most deterioration, resulting in a low score. Most foci were found originating from the haversian canals and covering the concentric lamellae of the osteon.[258]

[254] Hedges, Millard & Pike 1995, 203.
[255] Krap *et al.* 2017; Bachman & Ellis 1965.
[256] Krap *et al.* 2012.
[257] Behrensmeyer scores for the periosteal surface (Behrensmeyer 1978) and Oxford Histological Index (OHI) scores for the internal microstructure samples (Hedges, Millard & Pike 1995, 203).
[258] The microscopic slides have been stored and are available upon request; micrographs are also available upon request.

Table 7.4. Results of histological analysis.

Site	ID	Element	Behrensmeyer score	OHI score
Andijk-Noord	29	femur	4	1
Andijk-Noord	31	femur	1*	3–4
Andijk-Noord	34	tibia	1**	2 + lacunae
Andijk-Noord	62	femur	1*/**	4

* Large, longitudinal crack was excluded from scoring.

** High degree of plant root etching on periosteal surface was excluded from scoring.

7.3.2 Luminescence imaging

Enkhuizen-De Tent ID19: Clavicula with traces of cutting
This bone fragment exhibited two marks of c. 5mm in length and c. 1mm in width in a transverse orientation in relation to the bone's long axis. The marks were located on a part of the fragment that was less luminescent than the surrounding periosteal surface. Although there was a stain observable under white light at the location of the marks, the less luminescent area was larger than the observable stain. The inner area of the marks exhibited a lower intensity of luminescence when compared with the periosteal surface of the fragment (Fig. 7.2).

Enkhuizen-De Tent ID21: Clavicula with traces of cutting
This bone fragment exhibited one mark of c. 3mm in length (transverse direction) and c. 4mm in width (longitudinal direction), that was oval-shaped on the surface, with wedge shaped depression, in a transverse orientation in relation to the bone's long axis. The bone fragment also exhibited a transverse sawing surface on both sides, of which one side contained an additional part with a structure containing a fracture surface instead of a sawing surface. Superficial surface damage was found next to the mark near the transverse sawing, including the part exhibiting a fracture surface. Both the oval, V-shaped mark and the superficial surface damage exhibited a high intensity of luminescence, comparable in intensity to the transverse sawing surface (Fig. 7.3).

Andijk-Noord ID29: Femur with unknown non-pathological marks and modern traces
This bone exhibited severe cortical flaking, hampering luminescence analysis. It exhibited halo, or sandwich-like, luminescence on sample site surfaces (where a wedge-shaped sample had been taken for isotope analysis).[259]
Suspected traces of manipulation did exhibit a slightly higher luminescence compared with the direct periosteal surface around the trace; however, the luminescence intensity did not exceed that of other spots on the periosteal surface and was not as intense as the halo phenomenon seen at the sample locations (Fig. 7.4).

Andijk-Noord ID34: Tibia with possible traces of cutting and a (possible) modern trace
One of the samples exhibited a mark of c. 13mm in length and c. 2mm in width in oblique orientation on the bone. Approximately 18mm away from this mark, a smaller mark was found, measuring c. 6mm in length and c. 1mm in

[259] Ramsthaler *et al.* 2011.

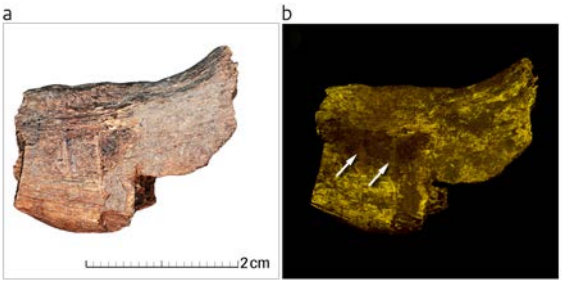


Figure 7.2. Enkhuizen-De Tent ID19. a: white light photo, b: luminescence image (420-470 nm).

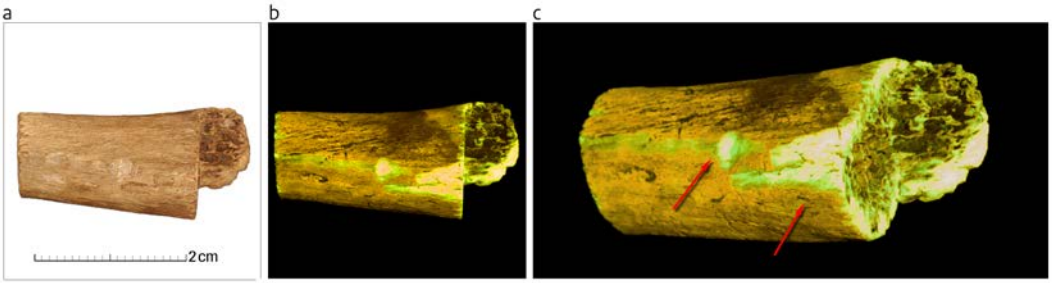


Figure 7.3. Enkhuizen-De Tent ID21. a: white light photo, b: luminescence image (420-470 nm), c: detail transverse surface and traces of manipulation.

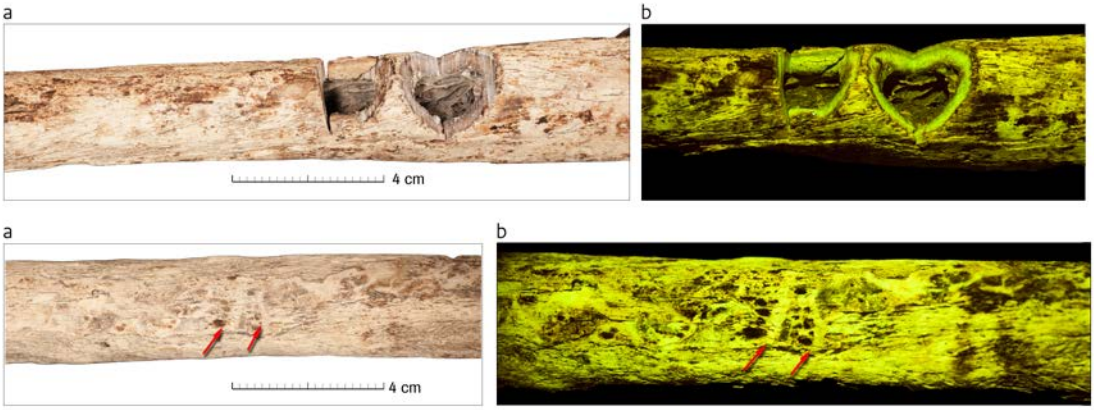


Figure 7.4. Andijk-Noord ID29. Above, detail of sampling site for isotope analysis. a: white light photo, b: luminescence image (420-470 nm). Below, detail of cortical surface with suspected traces of manipulation. a: white light photo, b: luminescence image (420-470 nm).

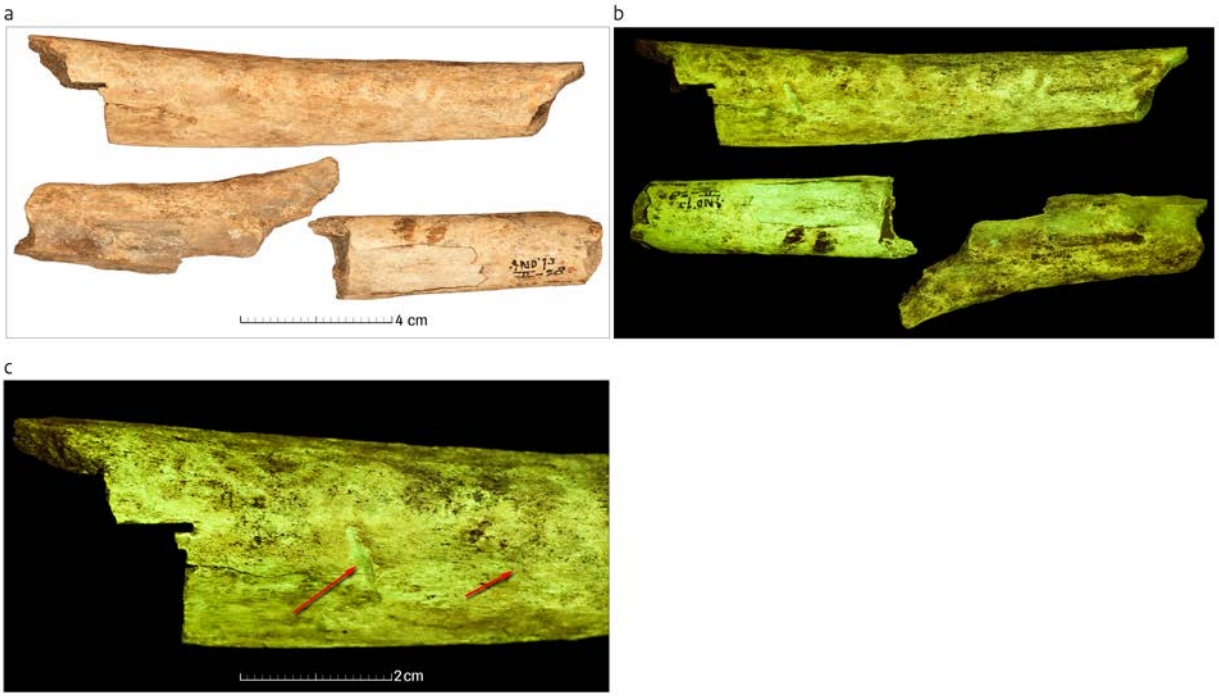


Figure 7.5. Andijk-Noord ID34. a: white light photo, b: luminescence image (420-470 nm), c: detail traces of manipulation.

width, in a transverse orientation on the bone. Both these marks exhibited a higher intensity of luminescence when compared with the periosteal surface of the sample (Fig. 7.5).

Grootebroek-Waterweide Noord ID61: Femur with possible traces of cutting

This bone, a femur, contained at least two areas with visible traces of manipulation. The first area, about halfway the femoral shaft, exhibited three traces of c. 6 to 8mm in length and c. 0.5mm in width, in transverse orientation. The second area, just distal from the femoral neck and the greater tubercle, exhibited two traces of c. 10mm in length and c. 1mm in width, in transverse orientation. The traces in the first area exhibited a lower intensity of luminescence of the surface of the trace when compared with the periosteal surface. For this reason, an internal control mark (Fig. 7.6, green arrow) was made, and it exhibited a higher intensity of luminescence when compared with the luminescence of the three traces of manipulation. Traces in the second area

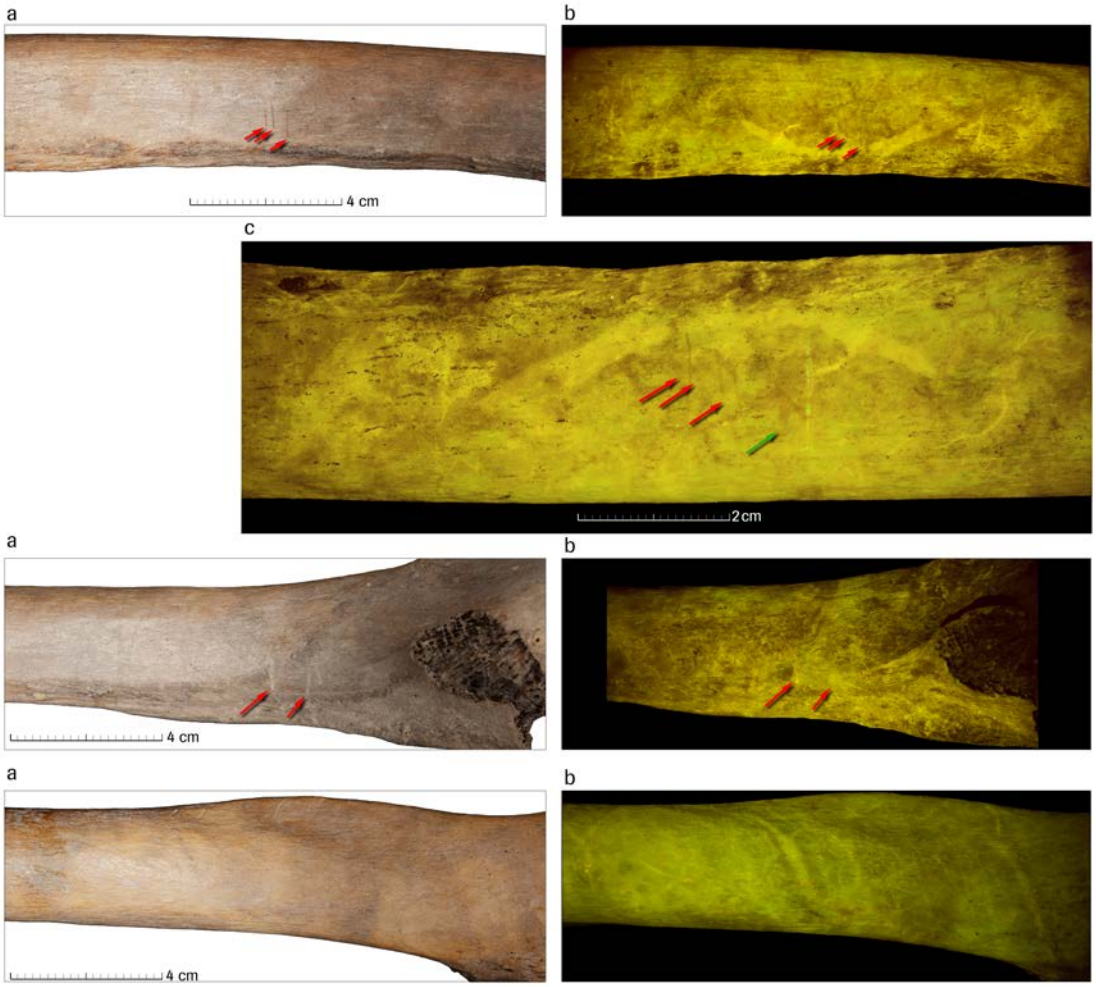


Figure 7.6. Grootebroek-Waterweide Noord ID61. Above, detail traces of manipulation. a: white light photo, b: luminescence image (420-470 nm), c: traces of manipulation (red arrows) including a reference mark to show the potential luminescence just below the surface (green arrow). Centre, detail traces of manipulation. a: white light photo, b: luminescence image (420-470 nm). Below, periosteal surface. a: white light photo, b: luminescence image (420-470 nm).

exhibited a higher intensity of luminescence when compared with most of the periosteal surface but fall within the observable variance. The periosteal surface exhibited an irregular pattern of areas and striae with low luminescence and high luminescence not caused by cortical flaking (Fig. 7.6).

7.4 Interpretation

Bones exposed to similar conditions for a long duration are more likely to exhibit the same or similar taphonomic deterioration. Differences in bone deterioration within archaeological sites are known and can be explained by local differences in bacterial cultures, chemical composition of the soil and variation amongst individuals in bone mineral density and collagen integrity.[260] The older an individual becomes, the more bone has been remodelled, and bone can be remodelled multiple times. Next to remodelling, with age both the mineral and organic components change; bone mineral density lowers with age, and the collagen fibres lose their elasticity.[261] Therefore, it is important to assess the degree of remodelling so that one can avoid applying the OHI to samples that differ too much.

The degree of remodelling was found to be similar amongst the bone samples. Of the four

[260] Hedges, Millard & Pike 1995.
[261] Bousson *et al.* 2001; Wang *et al.* 2002; Stein *et al.* 1999.

bones, one bone (ID29) differed to a large extent in preservation, even though radiocarbon dating placed the bone in the same period. This difference in preservation may be due to differences in the direct contexts the bones were buried in or to major changes in the burial context during the post-mortem interval (i.e. differences or changes in humidity, acidity, root activity, oxygen availability).[262] A thorough investigation of the burial context is necessary to rule out or rule in factors that may have affected the bone, since differences in soil type and layering, microbiology and acidity lead to differential degradation. Differences cannot be attributed to funerary treatment unless these natural factors have been ruled out. The other three bones were very well preserved considering the post-mortem interval and taphonomic context.

It proved to be possible to distinguish early post-mortem traces of manipulation from late post-mortem traces (Table 7.5). Similarity in luminescence intensity of the trace and the periosteal surface showed that ID19 probably contains old traces. Minor uncertainty is caused by a stain localised around the area that contains the traces. This stain covers both the trace and a substantial area of the periosteal surface, hampering a direct comparison between the periosteal surface and the trace. The difference in luminescence intensity between the traces and the periosteal surface indicates that the traces on ID21 and ID34 are most likely very recent. The degree of deterioration of the periosteal surface of bone ID29 hampered the interpretation of the possible marks of manipulation by differences in luminescence intensity. ID61 exhibited a combination of most likely old and very recent traces. Most of the recent ones are superficial and could have been caused by either a very recent change in the burial context; incorrect handling of the bone, whereby the bone came into contact with a hard surface; or incorrect storage, whereby multiple bones were placed in the same container or bag and there was enough movement to cause scraping damage. Considering that more IDs comprised multiple bones that had been stored loosely in plastic bags and that these IDs did not show this superficial damage and high intensity luminescence pattern, it seems more likely that the trace on the item from ID61 examined here is due to a recent change in burial context or incorrect handling. A recent change in burial context that could lead to patterns such as this is an increase in plant roots, leading to decalcification by excretion of acids (highly likely considering the pattern and depth), or animal scavenging. Incorrect handling could have occurred during previous investigations.

[262] Hollund *et al.* 2012; Booth 2016.

Table 7.5. Results of luminescence and preservation analyses.

Site	ID	Element	Analysis performed	Preservation	Interpretation physical anthropology	Interpretation microwear analysis	Interpretation of when trace was created
Enkhuizen-De Tent	19	clavicula	luminescence	-	cutting	old traces (bronze?)	more likely old traces
Enkhuizen-De Tent	21	clavicula	luminescence	-	cutting	unknown traces (large tool)	most likely very recent traces
Andijk-Noord	29	femur	luminescence & preservation	externally and internally low	unknown non-pathological marks	modern traces (spade)	undeterminable
Andijk-Noord	31	femur	preservation	externally and internally excellent	no traces	not analysed	-
Andijk-Noord	34	tibia	luminescence & preservation	externally and internally good	cutting? & erosion	modern(?) trace	most likely very recent traces
Grootebroek-Waterweide Noord	61	femur	luminescence	-	cutting?	not analysed	combination of most likely old and very recent traces
Andijk-Noord	62	femur	preservation	externally and internally excellent	unknown non-pathological marks	not analysed	-

7.5 Advice for excavation and storage for follow-up analysis

To better understand and interpret the taphonomic context, it is of importance that the burial context is documented extensively. This documentation should include information on soil layers in relation to the spatial location of the find, photographs of the context and the find, information on tunnels and soil fauna, and presence and location of roots. Soil samples should be collected from the precise location the bone samples were excavated from, to enable at least a pH measurement and, preferably also, microbiological and chemical analyses on the actual content of the soil. In case of a suspected "cadaver decomposition island" (CDI), soil samples should be taken from the centre, periphery and immediate surroundings of the CDI.[263] To minimise modern changes to bone that might hamper follow-up analysis, bone samples should be stored individually, preferably in breathable packaging, to prevent deterioration due to condensation and continuation of microbiological degradation, surrounded by bubble wrap to protect the sample from external mechanical forces.[264]

[263] Carter, Yellowlees & Tibbett 2007; Carter & Tibbett 2008; Aitkenhead-Peterson *et al.* 2012.

[264] During recent study of luminescence on human bones from different periods, some bones from West Frisia were examined (Bruinsma 2024). Recommendations for the use of luminescence on human bones can be found in Appendix VIII.

8 Synthesis

W. Roessingh and K.M. de Vries

8.1 Introduction

Traditionally, the main focus of Bronze Age funerary archaeology has been on the barrow ritual: a formal burial practice that is very visible in the archaeological record. However, it seems that not all members of society were buried under a barrow. It is estimated that only ca. 15% of the population received such a burial.[265] What happened to the other estimated 85% of Bronze Age society after death is still matter of debate. The disarticulated human bones that are sometimes encountered in West Frisian Bronze Age settlements and funerary sites may provide insight into alternative, less formal burial practices.

In this study, the disarticulated human bones from the Bronze Age sites of West Frisia are used to obtain a fuller understanding of Bronze Age funerary practices. Of course, there are many different ways in which disarticulated human bones can end up in the archaeological record. Not all of these bones are necessarily the result of deliberate human action in the past. To the naked eye, there is little difference between a disarticulated bone that was purposefully buried in a pit and one that was carelessly discarded. Therefore, for this pilot study, an approach was used in which information on context was combined with physical-anthropological analysis and in which a sample of the bones was subjected to microwear analysis, SEM analysis, XRF analysis and taphonomic research.

In this chapter, the outcomes of these studies will be presented. The focus will be on (possible) human actions in the past. In order to structure the data and the argument, we have chosen to present two possible scenarios: one in which the disarticulated human bones are the result of deliberate manipulation of the deceased and one in which the disarticulated human bones are the result of the disturbance of burials. As will become evident, these two scenarios could have co-existed during the Bronze Age. In the sections below, the two scenarios are first briefly discussed. After that, the outcome of the analyses is discussed in terms of what evidence supports the scenario of deliberate manipulation and what evidence supports the scenario of accidental disturbance of burials.

8.2 Deliberate manipulation of bones or accidental disturbance of burials?

As was said above, this study proposes that the occurrence of disarticulated human bones can be explained by two different scenarios. In the first scenario, the disarticulated human bones are the result of deliberate actions in the past that were part of a meaningful set of conventions around how to treat the dead. In this scenario, different appropriate funerary rites existed side by side. The rite chosen depended on culturally specific variables (Fig. 8.1).

As was said above, barrow burials or burial in flat graves are the best studied forms of Bronze Age burial. But these forms were probably not the most frequently use, as it is estimated that only 15% of the dead received this treatment. The

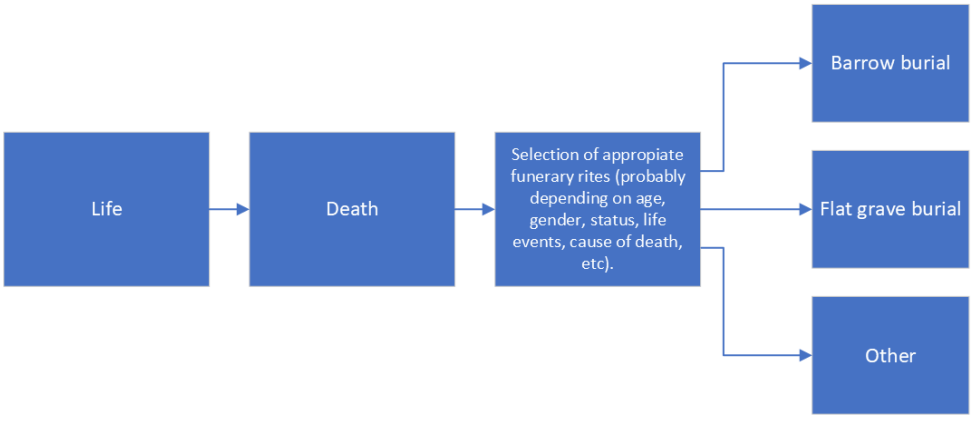


Figure 8.1. A schematic overview of the variety of Bronze Age mortuary practices.

[265] Estimated by Lohof for the Bronze Age in the north-eastern parts of the Netherlands (1991, 225; 1994, 113). For the Bronze Age funerary site of Toterfout-Halve Mijl, Theunissen estimates that 13 to 16% of the overall population was given a mound burial (1993, 40).

other 85% of the deceased are archaeological less visible. These deceased may have received a different type of burial ritual, and this may explain, among other things, the disarticulated human bones in both settlement and funerary contexts.[266]

The question we aim to answer here is how we can identify deliberate manipulation within the assemblage of disarticulated human remains. Based on research in other areas, we know that in the case of manipulation, there is frequently a preference for specific parts of the body to be curated (Fig. 8.2).[267] If there was such a preference in West Frisia, we would expect to see traces of deliberate manipulation on those bones. If this manipulation of specific parts of the body was common practice, this should be reflected in an overrepresentation of specific skeletal parts in the archaeological record.

Marks on bones can also point towards excarnation.[268] Traces of cutting, perforations or worn surfaces may therefore be indicative of other types of manipulation. The weathering of bones may tell us that bones were kept aboveground for substantial periods of time before finally ending up in the ground. When there was no longer any need for the disarticulated bones to be in circulation, there may have been specific contexts that were considered suitable for their (secondary) burial. These characteristics can be observed in the results of the different types of analysis used in this study.

In the second scenario, disarticulated bones are the result of the disturbance of formal burials (deliberate or accidental). When barrows were levelled or flat graves were cleared, human bones may have been encountered and removed from their primary context, whether or not these burials were recognised as such. Subsequently, these bones may have been left lying at the surface. At some point, they may have been discarded together with settlement refuse. In this scenario, bones could end up in domestic contexts and in find assemblages that can be considered settlement waste, and in this scenario, the expectation is that there would be no patterning, because there was no selection, or that any the patterning observed can be explained by taphonomic processes. In addition to this, there must be some evidence for the disturbance of burials, for example barrows in the direct vicinity of the settlement. Again, these characteristics can only be observed when information on context is combined with physical-anthropological analyses.

[266] Another possible explanation for the missing 85% is that many members of society were cremated instead of inhumated. Unless cremated remains are buried in a container or scattered at the surface, the chances of finding them in archaeological contexts is small.
[267] Brück 2019.
[268] N ieuwhof 2015, 270-272.

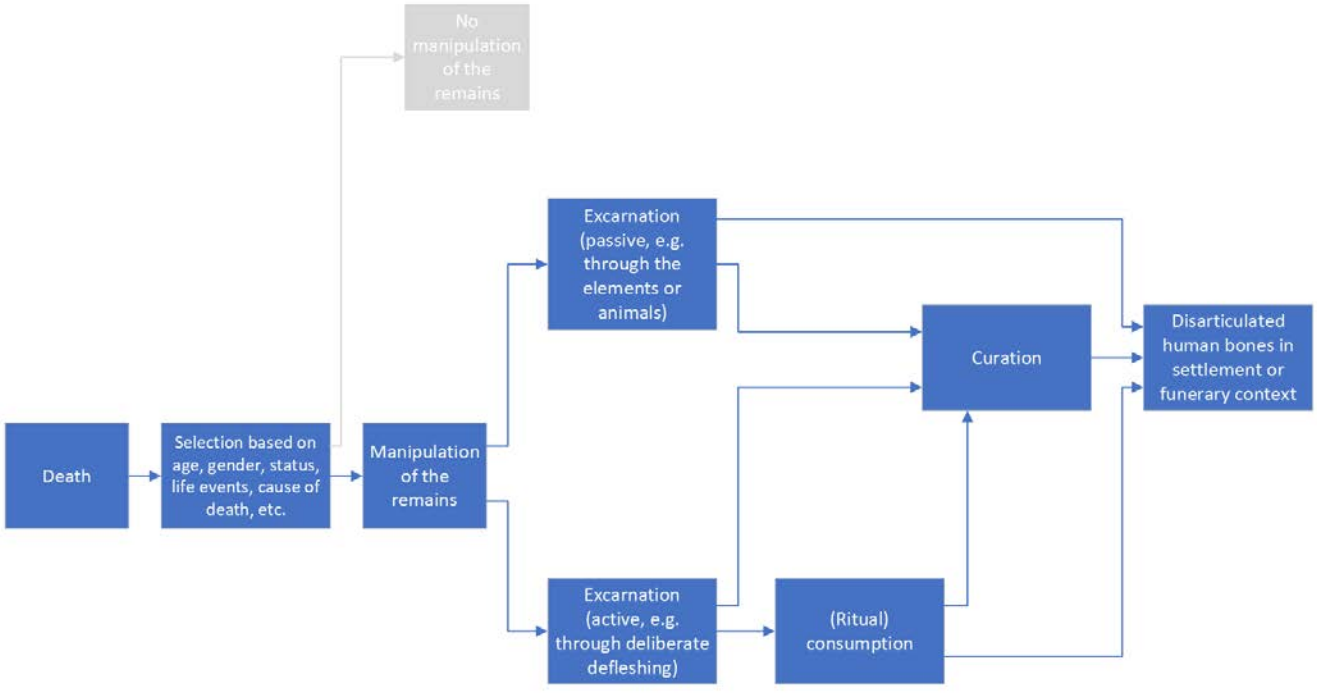


Figure 8.2. Different scenarios for the manipulation of human remains based on examples from other periods and regions.

8.3 Evidence for deliberate manipulation of human remains

As we have said, in order to make a reasonable case for the scenario of deliberate manipulation, two criteria seem to be important: (1) deliberate selection of specific parts of the body and (2) signs of manipulation on the bones themselves. In this section, the evidence from West Frisia for these two criteria is discussed.

Selection of body parts

The observations on the evidence made in Chapter 2 and Chapter 3 point towards the selection of specific body parts. Especially (parts of) the cranium and the femurs are frequently found both in settlement and in funerary contexts (Table 3.1). In many societies, these bones, especially the cranium, may carry special meaning.[269] However, we have to be careful not to overinterpret all crania and femurs finds as curated bones, because these bones are also the best recognisable skeletal elements (cranium) and are the largest and most resistant (femur, specifically the diaphysis). We assume that the overrepresentation of the cranium and the femur is at least in part the result of excavation methodology and differential preservation (Chapter 9) and not solely the result of a selection of specific skeletal elements in the past.

In addition to this, there is no clear evidence that specific age groups or a particular sex was targeted for manipulation. It was difficult to determine the sex and age of the individuals, because in most cases only small fragments of the bones were preserved. In 40 of 92 cases, biological sex could be assigned with some degree of confidence (Table 3.2). Male individuals seem to be overrepresented, but given the relatively low number of bones that could be sexed and the uncertainty of the sex determinations, it would be unwise to make generalisations. When patterns are visible, they are more likely the result of taphonomic processes. For example, most of the human remains belong to adult individuals, which can be explained by the fact that the skeletal elements of young persons are more fragile. Still, skeletal elements of 11 young persons are also present in the dataset, making up ca. 15% of the total number of individuals, and even the remains of a perinate and young children were found (Chapter 3). This is an important observation, given that formal burials of younger individuals are scarce in Bronze Age West Frisia.[270]

Traces of manipulation on the bones

Practices of deliberate manipulation have received much attention in archaeology. Some British Late Bronze Age sites have yielded intriguing examples of disarticulated human bones with traces of manipulation. Some of these bones come from primary burials, while others were the result of post-mortem processes, such as excarnation and curation.[271] In the terp area in the northern Netherlands, there is also evidence that bodies were manipulated after death and that bones were curated, but it comes from the Iron Age and the Roman period.[272] In West Frisia, however, there is evidence from earlier periods of these practices. On the Late Neolithic site of Mienakker, a grave was discovered containing the incomplete skeleton of an adult male. It is likely that his legs were already absent at the moment of burial. His right arm, including the scapula, may have been removed from the body before the cartilage had decayed.[273]

Prior to this study, indications for manipulation of the West Frisia Bronze Age skeletal elements had not been noticed. During the physical anthropological analyses, multiple bones showed so-called non-pathology-related alterations, such as discoloration, peeling and splintering. Besides these, in eight cases marks of possible cutting, scraping or chopping were visible (Chapter 3). A closer examination of these marks (Chapters 4-7) showed that in four cases there were clear cuts on the bones that probably originated from manipulation (cutting) in the Bronze Age. Two bones showed other traces of curation.

The bones with traces of manipulation are a diverse group. An ulna from a ring ditch (Andijk-Noord ID27) probably showed an old cut or an old scratch. A humerus from a house ditch (Andijk-Zuid ID41) showed possible traces of a cutmark and possible evidence of gnawing. A clavicula from the flank of a barrow (Enkhuizen-De Tent ID19) showed cutmarks that could be related to (specific) treatment of the body like defleshing, with the use of a bronze tool. A

269 Brück 1995, 257.
270 From West Frisia, we have two examples of child burials: a newborn child in Tumulus I from Grootebroek (Van Giffen 1953, 36) and a 7-year-old child in Tumulus II from Hoogkarspel-Tolhuis D (Bakker & Brandt 1966, 190-191).
271 Brück & Booth 2022.
272 Nieuwhof 2015.
273 Plomp 2013, 176-178.

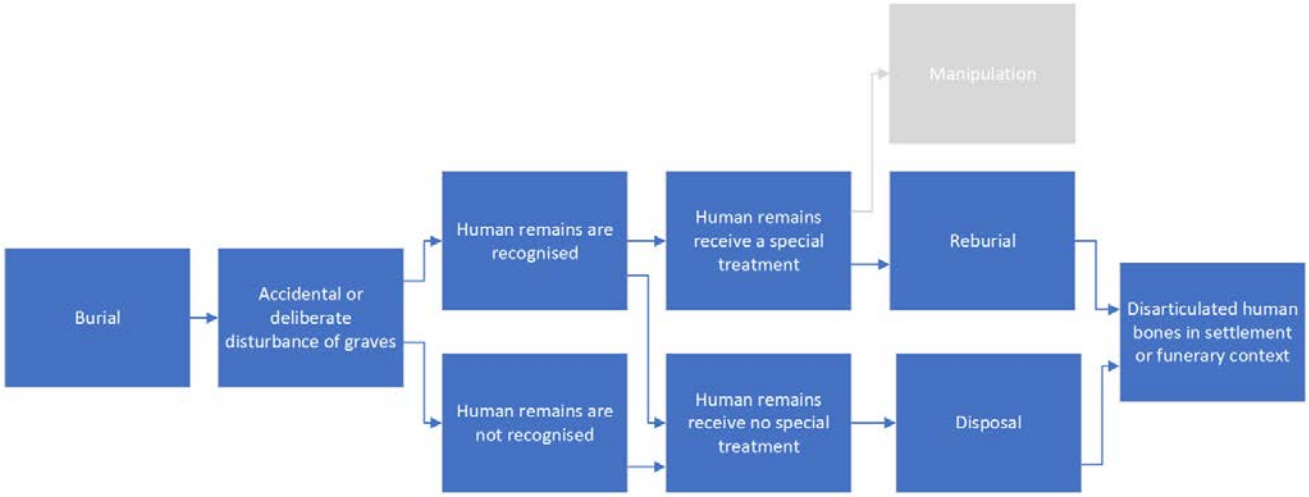


Figure 8.3. Schematic overview of disarticulated human bones as a result of accidental or deliberate disturbance of burials.

scapula from the flank of a barrow (Enkhuizen-De Tent ID20) showed multiple traces of cut- or chop marks. These were possibly made with a bronze tool and could also be an indication of a specific activity, for example the removal of soft tissue or the severing of tendons. In addition to these four examples of bones with cutmarks, there are two bones that show traces of secondary use. A cranial fragment from a circular ditch (Andijk-Noord ID36) showed a polish probably from a scraping motion. A fibula from a house ditch (Enkhuizen-Kadijken ID56) showed traces of both gnawing and a polish resulting from secondary use. Notably, the bone was used after a Bronze Age dog gnawed on it.

Especially the two bones from Enkhuizen-De Tent confirm that manipulation of bones occurred in Bronze Age West Frisia. The cutmarks on the clavicula are reminiscent of the neolithic skeleton from Mienakker from which the right arm was removed. In addition to this, there is some evidence that bodies were not always directly buried, but were exposed to the weather and scavenging animals. Clean bones are of no interest to scavenging animals. This means that the gnawing probably occurred quite soon after death, before the body had completely decomposed.[274] Both bones with gnawing marks were found in settlement contexts.

Based on the analysis, it has become clear that in two instances disarticulated bones were handled for some time, resulting in a polish, before they were deposited. In both cases, the bones originated from settlement contexts. The cranial fragment with scraping marks is reminiscent of the Iron Age and Roman period cranial fragments that were worked into bowls from the terp-area.[275] These finds are interpreted as bones turned into inalienable objects that became part of family collections.[276]

Synthesis

Based on the above, it has become evident that there is some patterning in the skeletal elements that were encountered. Most often, cranial and femur fragments have been found. This may indicate a preference for the retention of specific parts of the body. However, we have to be careful not to interpret all these finds as the result of deliberate selection. These two bones belong to the best recognisable and the most resistant parts of the body.

Next to this, there are six bone fragments that point towards the defleshing and curation of human bones in Bronze Age sites in West Frisia. Whether they are rare exceptions or point towards a much more widely shared practice is difficult to say.

8.4 Evidence for the disturbance of burials

Another possibility for the occurrence of disarticulated bones is the accidental or deliberate disturbance of older graves (Fig. 8.3).

[274] Nieuwhof 2015, 272.
[275] Nieuwhof 2015, 262-269.
[276] Nieuwhof 2015, 275.

In order to establish this, again, two criteria need to be met. First, the distribution of these finds should resemble that of refuse. Secondly, there should be physical evidence of disturbed burials or at least indications for graves in the vicinity of the locations were the disarticulated bones were encountered.

8.4.1 Patterning of disarticulated human bones and associated finds

Establishing what is and is not refuse is not as straightforward as it may seem. In the literature, different approaches exist to the concept of refuse. From a functional perspective, the term refuse can be used to describe objects which use-life has been terminated and are not selected for re-use. Their presence in the ground, as the result of discard, can be labelled as refuse.[277] Other authors, however, emphasise the cultural considerations that surround concepts such as dirt and refuse. Dirt and uncleanness, and perhaps also waste, are objects that are out of place that challenge a shared notion of hygiene and disrespect conventions how to deal with unwanted objects. This can be solved through order.[278] The difference between the two is that, from a functional perspective, objects in the ground can be considered refuse. From the cultural perspective it follows that objects are only refuse as long as they are not appropriately dealt with. As soon as they are discarded in the right place, they no longer challenge the notions of hygiene or care for convention.

During large scale excavations of West Frisian Bronze Age sites, often thousands of finds are collected. These finds all come from dug out features.[279] Almost all of these finds can be interpreted as refuse. In the vicinity of house sites, where most of the household activities must have taken place, we find concentrations of animal bones, pottery and stone. In order to interpret the instances when disarticulated human bones are found in funerary or settlement context, it is important to look at associated finds. In our study we could determine that almost all of the disarticulated human bones were found together with many other types of finds (Table 2.8). These associated finds mainly consist of fragments of animal bones, pottery and stone. At least at their moment of deposition, the human bones did not receive any obviously different treatment than ordinary household items. This may mean that the disarticulated bones should be interpreted as refuse. There is also a possibility that the disarticulated bones were meaningful objects when used, but when they lost their use did not need to be deposited in special locations or in special ways.

8.4.2 Evidence for levelling of barrows and flat graves

The second criterion comprises evidence that burials were disturbed, for example, when a new house was constructed on a location that was previously used as burial grounds. In West Frisia, both settlement and funerary sites are often a complex palimpsest. On many sites we can see a change of function of areas over time. The reconstruction of the sequence of different structures like houses, arable land, ring ditches and barrows can make these changes visible (Fig. 8.4). It is not unreasonable to think that barrows or flat graves were levelled by the inhabitants during these long sequences of digging ditches, constructing houses and abandoning house sites. As a result skeletal elements could be intermixed with settlement refuse. It is therefore necessary to have a closer look at the distribution of the human bones found in settlement features near barrows and in ring ditches around barrows.

Disarticulated human bones in settlement context
From the contextual analysis of the finds, it is becomes clear that disarticulated human bones are frequently found in settlement contexts. Based on a literature study, the context of at least 300 fragments of disarticulated human bones could be reconstructed (Appendix I). These fragments have belonged to c. 125 individuals and most of the bones (75%) were found in settlement contexts, the other 25% were found in ring ditches around barrows. When the specific contexts are studied, it is evident that disarticulated human bones can be found in all types of settlement features. The majority is found in ditches, house ditches and deep pits, in association with pottery sherds,

277 Schiffer 1972, 160-161.
278 Douglas 2002, 9, 50.
279 In West Frisia, human remains dating from the Bronze Age have not yet been encountered from other possible find contexts, such as cultural layers or gullies.

Figure 8.4. Bovenkarspel-Het Valkje. The Middle Bronze Age barrow 1 was forgotten or lost its significance and other structures were built on top of it in the Middle Bronze Age. This probably led to the disturbance of the barrow burials and eventually to the distribution of human remains in settlement features.

animal bones etc. (Table 2.6). Again, this patterning does not seem do represent true preferences in the past, but rather a research bias. House ditches and deep pits are known to be real artefact-traps, and therefore they are often excavated more carefully. For example, the fillings of house ditches have sometimes been sometimes wet sieved, which resulted in many finds including (small) human bones (Chapter 9). It is therefore likely that the distribution of the disarticulated human bones is not the result of special deposition practices.

Sometimes, the layout of the wider cultural landscape can also explain why disarticulated human bones are found in settlement context. At Andijk-Noord for example, a relatively high number of disarticulated bones were found in settlement features. This high number of finds and their concentrated distribution may well be explained by the presence of burial grounds in the direct vicinity of the settlement. Directly west of these finds numerous ring ditches of barrows were documented during field surveys.[280] Like we have suggested at Bovenkarspel-Het Valkje (Fig. 8.4), it is plausible that burials from the barrows were destroyed when the settlement site was planned and that human remains became dispersed in nearby settlement features.

[280] Roessingh 2018, 186, Fig. 5.57; 188.

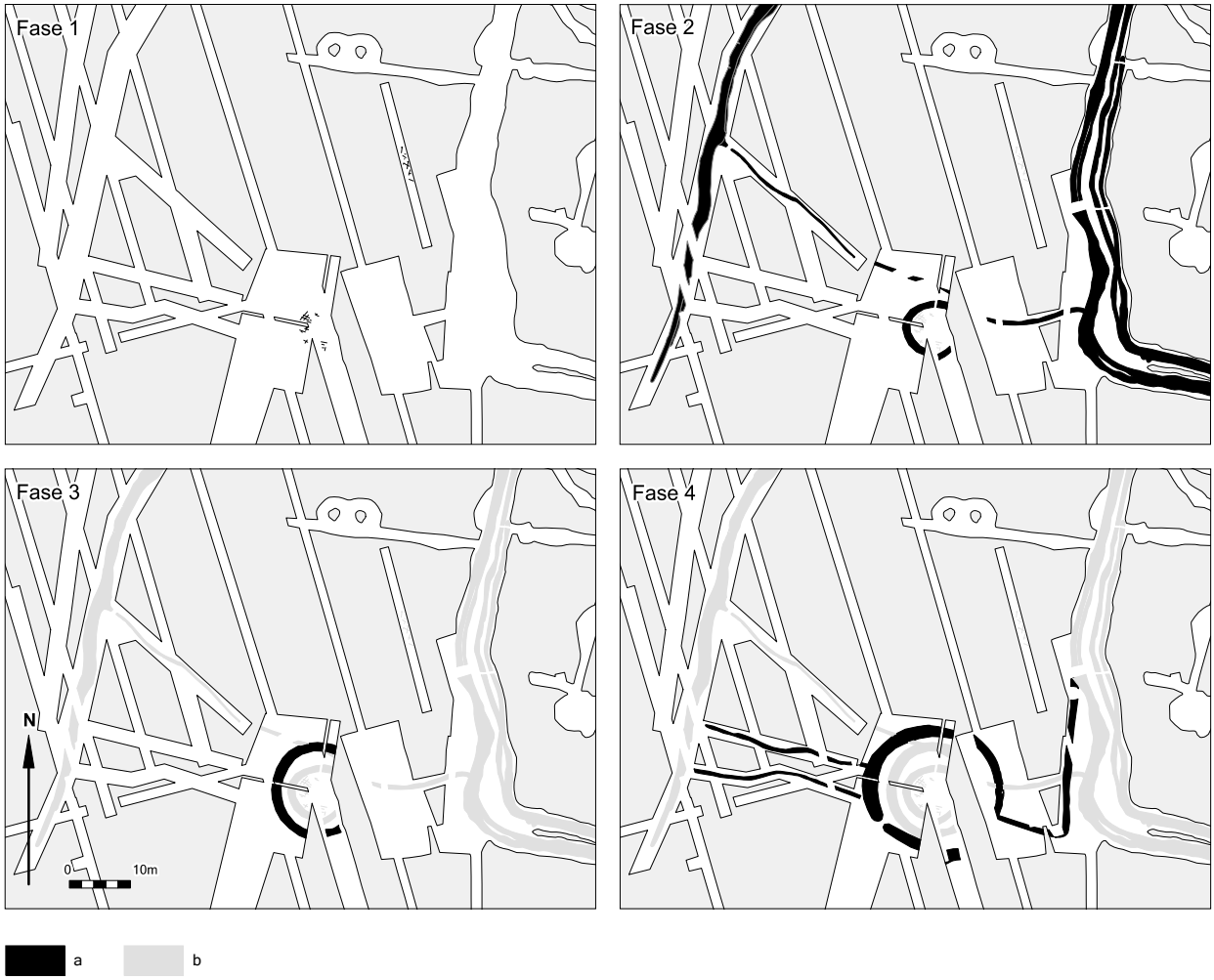


Figure 8.5. Hoogkarspel-Watertoren. Barrow Tumulus Ia was incorporated into the system of ditches of the Middle Bronze Age settlement. Legend: a features of a phase, b older features (Roessingh 2018, 126, Fig. 4.76).

The eastern part of West Frisia is one of the most intensively excavated areas in the Netherlands, up till now about 90 hectare of Bronze Age settlement sites have been excavated.[281] And even though disarticulated human bones are encountered in settlement contexts, they constitute only a small percentage of the total of finds. They cannot be considered a typical find category for Bronze Age West Frisia. For the older rescue excavations, such as Hoogkarspel, Andijk and Bovenkarspel, the recovered finds represent only a selection because not all features could be excavated. For the large-scale, development-led excavations, such as Enkhuizen-Kadijken and the Westfrisiaweg sites, all features have been carefully examined and all finds have been collected. On many of these sites, no or only few disarticulated human bones have been found (Table 2.8). This may be explained by the fact that most barrows were not disturbed when settlement sites expanded or were relocated. Existing barrows were incorporated into the settlement system, as is evident in Hoogkarspel-Watertoren for example (Fig. 8.5). This may explain the overall low number of finds of disarticulated bones in settlement contexts as well as in features associated with the barrows (see below).

Disarticulated human bones in funerary contexts

Not all disarticulated human bones were found in settlement context. From the total, c. 25% of the finds originate from features that are associated with barrows, especially ring ditches. Again, these finds are rare. In the region 42

[281] Roessingh 2022, 51.

barrows were (partly) excavated and 81 barrow phases were reconstructed.[282] Disarticulated human bones were encountered in 11 features associated to a barrow phase (Appendix IV).

Even if the finds are scarce in funerary contexts, they still may be the result of deliberate manipulation of the body of the deceased. The only difference is that its final place of deposition was in a funerary context and not in a domestic one. The disturbance of burials can also possibly explain why disarticulated human bones occur in funerary contexts. Many of the barrows show multiple building phases, these barrows were expanded in the Bronze Age and new ring ditches were dug out (Appendix IV). During these activities some burials could have been destroyed and the human remains may have been deposited in the (new) ring ditches.

Only occasionally, there is evidence that the remains were recognised as such and that the remains received a secondary burial. The ring ditch of barrow 2 in Andijk-Noord contained numerous disarticulate human bones and many other finds. In that ring ditch a total of 240 finds were collected, including no less than 53 human bone fragments belonging to at least six individuals (Chapter 3). These human remains may have been part of different burials that were destroyed while expanding the barrow. The bones were found dispersed on many locations in that ring ditch. In only one spot, numerous skeletal elements of probably the same individual were placed together, suggesting a selective deliberate deposition.[283] The distribution of the other disarticulated bones appears to be quite random, suggesting all bones entered the ground at one moment in time without any apparent care to deposit them as individuals or as one group. In addition to this, the associated finds of the other disarticulated bones, again, argue against a scenario of manipulation and special deposition practices. Also when human bones were found in funerary contexts, they were frequently associated with other finds such as animal bones and pottery fragments (Appendix III).

Synthesis

Based on the discussion above, it is evident that disarticulated human bones are rare finds both in settlement and in funerary contexts. In general, barrows seem to have been respected and even incorporated into the settlement system. There is some evidence to suggest that burials were disturbed when new barrows were erected or new houses were built. In these (rare) instances, human remains do not always seem to have received any special treatment. They ended up in settlement context together with other settlement refuse or were deposited in the ring ditches around the barrows together with other objects. However, there are few instances where human remains were recognised as such and received special treatment or a secondary burial.

8.5 Conclusion

This research started with the question whether a more detailed analysis of disarticulated human bones in settlement contexts in Bronze Age West Frisia may lead to a better understanding of funerary practices. Based on the observations in the individual chapters and the different scenarios discussed in this chapter, it can be concluded that for most disarticulated bones there is little evidence that their occurrence was the result of post-mortem manipulation of the deceased. Selection of specific parts of the body is difficult to prove. Only a few bones show traces that point towards manipulation and curation. In most instances, the disturbance of one or multiple graves seems to be the best explanation for the presence of disarticulated human bones in any context.

We can never be sure whether the Bronze Age inhabitants of West Frisia recognised the bones from these graves as human remains. It is evident, even if the humans were recognised as human bones, that in most cases the remains did not receive any special treatment, such as reburial. The disarticulated bones ended up between the settlement waste and were deposited together in features that needed to be filled. Also in the instances that disarticulated human bones were found in funerary contexts (i.e. ring ditches), they often did not receive a special treatment. Body parts or individuals were deposited together with other objects such as animal bones, pottery sherds and stone fragments.

Even though most finds do not support the practice of manipulation of human remains or

[282] These phases or periods could usually be distinguished by means of the different ring ditches around the barrow.

[283] In Enkhuizen-Kadijken there is evidence that a perinate was placed in a house ditch (ID58). We may view this as part of its primary burial.

the practice of secondary burial, in some cases there is evidence that people interacted with the remains in special ways. In four cases there is evidence of cut marks on the bones and in two cases polish on the bones seem to be related to secondary use. These traces are intriguing and provide a small glimpse into Bronze Age funerary practices beside the barrow ritual.

Apparently, under some circumstances the body of the deceased may be excarnated and bones could be curated for some time. At least for some period of time, these bones may have held special meaning for the members of the society. Still, when these bones lost their special meaning, they ended up in features amongst the objects of daily life.

9 Recommendations

W. Roessingh

9.1 Introduction

In this research, an inventory was made of disarticulated human bones from Bronze Age West Frisia in order to obtain a better understanding of the full range of Bronze Age funerary practices. During the inventorying and analyses of the bones, we were confronted with certain problems and intriguing new perspectives. In this chapter, some recommendations for field strategies and new scientific research will be presented. This may lead to more insights into the way people treated their dead in Bronze Age West Frisia and other parts of the Netherlands.

9.2 Field strategy

9.2.1 In search of disturbed burials?

Over the past decade, various West Frisian Bronze Age settlement sites have been fully excavated. This eventually led to the discovery of a relatively low number of disarticulated human bones, among thousands of other finds. From this, we may conclude that disarticulated human bones are rare finds. The bones are often found together with other objects. At least at the moment they were discarded, they were not treated any differently than ordinary domestic refuse (Chapter 8). After our inventory and analyses, we proposed that the human remains in Bronze Age settlement features and ring ditches are in most cases likely to be the result of the disturbance of burials. This means that formal burials under a barrow of in a flat grave must have been destroyed during the Bronze Age.

To test this hypothesis, it is important to be aware of the presence of disturbed burials under barrows and the presence of disarticulated human bones in all features close to barrows. It is recommended that the project team is assisted by a physical anthropologist or a person who has expertise in recognising and excavating human remains, sampling strategies, etc. DNA analysis on human bones found close to each other may prove how many graves were destroyed.

9.2.2 House ditches as find traps?

The ditches around houses contain relatively large numbers of finds, and it should not be a surprise that quite a few disarticulated human bones were found in these ditches (Table 2.6). Normally, these house ditches are excavated by hand or, carefully, with a mechanical excavator, and this results in the discovery of relatively large bone fragments. The wet sieving of fills in search of small finds is not a standard method in this region, and the fill of house ditches was (selectively) wet sieved at only a small proportion of the sites. Wet sieving yielded many finds, including small (portions of) human bones. In one case, several skeletal elements of a perinate were found. This find is extraordinary, as these young individuals are almost always absent in our datasets. Perhaps the deposition of (in)complete skeletons of these individuals was a common practice in the Bronze Age. For future research, it is recommended that the entire fill of these find traps be wet sieved in order to obtain more insight into these finds and possible deposition processes.

9.3 Cleaning and storing of human remains

During the analyses undertaken for this monograph, non-pathological marks were observed on some of the bones, including cuts, gnawing and polishing. It can be difficult to establish the origin of these marks and to differentiate between old and newer traces. New scientific and experimental research may help us gain more insight in these marks (Section 9.4). But even the best research techniques do not obviate the need to minimise recent damage to the human remains. To facilitate further analyses on the human remains, it is essential to only lightly clean the bones and to not completely remove all the surrounding soil and to store them carefully, avoiding contact with other (hard) materials. If radiocarbon sampling is to be conducted, this should be done after analysis for non-pathological traces, so that sampling can avoid the locations on the bone with old traces.

9.4 Analyses on human bones: the need for experimental research

In the Netherlands, there is no bone microwear reference collection available that has been subjected to experiments involving incidental cutting, chopping, battle marks or modern damage (e.g. from a spade or mechanical excavator). Experimental research should involve different materials and tools being used on the bones and can focus on the use of bones as tools as well. There is little information available on the way in which human bones degenerate in the soil under the specific circumstances in the region of West Frisia. To understand the effects on degeneration of the bone while it is still in the ground, it is important to document the above-mentioned experiments on bone with and without adhering soft tissue, both before the bone is placed in the ground and after it has been in the ground for a longer time period, and under different circumstances. This reference material is much needed for proper interpretation of microwear analysis, SEM, XRF and luminescence (Appendix VIII). Research incorporating this reference material will give us new insights into the actions that were performed on humans, bodies and bones in the past and modern times.

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Appendices

I Catalogue disarticulated human bones from Bronze Age West Frisia

Individual (ID)	Site	Number of fragments	Age def	Sex def	Age simple	Time period	Primary context	Context	Skeletal parts simple
1	Hoogkarspel-Markerwaardweg	26	1 to 3	unknown	child	LBA	settlement	ditch	cranium
2	Hoogkarspel-Markerwaardweg	1	18 to 25	unknown	young adult	MBA	settlement	ditch	mandibula
3	Hoogkarspel-Markerwaardweg	9	20 to 40	unknown	adult	MBA	settlement	house ditch	cranium
4	Hoogkarspel-Markerwaardweg	1	>18	unknown	adult	LBA	settlement	ditch	cranium
5	Hoogkarspel-Markerwaardweg	3	2 to 4	unknown	child	MBA	settlement	house ditch	mix
6	Hoogkarspel-Markerwaardweg	1	unknown	unknown	unknown	MBA-LBA	settlement	post hole	cranium
7	Hoogkarspel-Markerwaardweg	1	>18	unknown	adult	MBA	settlement	ditch	cranium
8	Venhuizen-Voetakkers	1	>18	female?	adult	MBA	settlement	ditch	femur
9	Venhuizen-Voetakkers	5	>12	unknown	adult	MBA	settlement	ditch	cranium
10	Hoogkarspel-Markerwaardweg	28	20 to 40	male	adult	MBA	settlement	ditch	cranium
11	Hoogkarspel-Watertoren Tumulus I	1	adult?	unknown	adult?	MBA?	burial mound	ring ditch	cranium
12	Hoogkarspel-Watertoren Tumulus I	2	adult?	unknown	adult?	MBA?	burial mound	ring ditch	cranium
13	Hoogkarspel-Watertoren Tumulus I	1	adult?	unknown	adult?	MBA?	burial mound	ring ditch	cranium
14	Wervershoof-De Ark Tumulus XIII	2	>18	male?	adult	LBA?	burial mound	ring ditch	mix
15	Andijk 1982	1	12 to 25	unknown	young adult	MBA	burial mound	ring ditch	cranium
16	Andijk 1982	6	3 to 12	unknown	child	MBA	burial mound	ring ditch	cranium
17	Andijk 1982	1	<18	unknown	young adult	MBA	burial mound	ring ditch	cranium
18	Enkhuizen-De Tent	3	>18	male?	adult	MBA	burial mound	ring ditch	cranium

Skeletal parts	Findnr.	Trench nr	Level	Feature nr	Filling	Structure	Feature depth	Additional remarks	Excavator	Literature
cranium	1854	72	1	4194	2	GR14b	64	pressure on right side skull	Archol	Roessingh & Tol 2019, 58, 699
mandibula,molar	769	39	1	1614	1	-	38	little wear, segment 5, 2 caries and tartar	Archol	Roessingh & Tol 2019, 699
cranium	2450	101	1	6475	2	HS27a	70	-	Archol	Roessingh & Tol 2019, 699
cranium	178	9	1	393	1	GR18b	84	left side of skull, found in segment 1.	Archol	Roessingh & Tol 2019, 58, 699
femur,illium	1496	70	1	3488	1	HS17c	15	depth is average of structure	Archol	Roessingh & Tol 2019, 58, 80, 682, 699
cranium	1471	64	1	3206	1	HS19c	49	depth is average of structure	Archol	Roessingh & Tol 2019, 58, 80, 682, 699
cranium	1220	48	1	2030	1	GR26	44	found near ring ditch	Archol	Roessingh en Tol 2019, 697, 699
femur	124	41	1	907	1	-	-	diafysis, (sub) recent cutmark	Archol	Roessingh & Tol 2019, 699 (Voetakkers instead of Markerwaardweg)
cranium	418	60	1	1915	1	-	-	unfused cranial sutures	Archol	Roessingh & Tol 2019, 699 (Voetakkers instead of Markerwaardweg)
cranium	67	6	1	262	-	GR08a	64	(sub) recent damaging	Archol	Roessingh & Tol 2019, 58, 699
cranium	27 (1)	1	-	SW quadrant	-	Tumulus I	-	findnr 1 in database	IPP	Bakker 1974, 4; Bakker 1958, 177
cranium	30 (9)	1	-	NW quadrant	-	Tumulus I	-	findnr 9 in database	IPP	Bakker 1974, 4; Bakker 1958, 177
cranium	36 (19)	1	-	SE	-	Tumulus I	-	findnr 19 in database	IPP	Bakker 1974, 5; Bakker 1958, 177
femur,tibia	5	1	-	-	-	tumulus XIII-ring ditch II period IV	-	-	IPP	Bakker 1974, 5; Runia 1987, 217; Clason 1961, 91; Van der Waals 1961
cranium	3	1	-	-	-	-	-	-	IPP	De Vries-Metz 1983, 201; Runia 1987, 232; Metz 1993, 197
cranium	39	1	-	-	-	-	-	much charcoal	IPP	De Vries-Metz 1983, 201; Runia 1987, 232; Metz 1993, 197
cranium	45	1	-	-	-	-	-	-	IPP	De Vries-Metz 1983, 201; Runia 1987, 232; Metz 1993, 197
cranium	50	1	-	-	-	Tumulus 1	-	-	IPP	Runia 1987, 222

Individual (ID)	Site	Number of fragments	Age def	Sex def	Age simple	Time period	Primary context	Context	Skeletal parts simple
19	Enkhuizen-De Tent	1	adult?	unknown	adult?	MBA	burial mound	flank	clavicle
20	Enkhuizen-De Tent	1	>35	unknown	adult	MBA	burial mound	flank	scapula
21	Enkhuizen-De Tent	1	adult?	unknown	adult?	MBA	burial mound	ring ditch	clavicle
22	Enkhuizen-De Tent	1	>35	unknown	adult	MBA	burial mound	ring ditch	cervical vertebrae
23	Hoogkarspel-Houterpolder West	2	adult	male?	adult	MBA	burial mound	ring ditch	humerus
24	Hoogkarspel-Houterpolder West	2	12 to 25	unknown	young adult	MBA	burial mound	ring ditch	cranium
25	Hoogkarspel-Houterpolder West	1	adult	male?	adult	MBA	burial mound	ring ditch	mix
26	Andijk-Noord	3	adult	male?	adult	MBA	burial mound	unknown	femur
27	Andijk-Noord	3	adult	male?	adult	MBA	burial mound	ring ditch	mix
28	Andijk-Noord	3	18 to 25	female?	young adult	MBA	burial mound	ring ditch	mix
29	Andijk-Noord	1	14 to 20	unknown	child-young adult	MBA	burial mound	ring ditch	femur
30	Andijk-Noord	19	30 to 50	male	adult	MBA	burial mound	ring ditch	mix
31	Andijk-Noord	1	30 to 50	male?	adult	MBA	burial mound	ring ditch	cranium
32	Andijk-Noord	21	18 to 25	female?	unknown	MBA	burial mound	ring ditch	cranium
33	Andijk-Noord	1	>45	female	adult	MBA	burial mound	ring ditch	mix
34	Andijk-Noord	3	20 to 40	unknown	adult	MBA	burial mound	ring ditch	mix
35	Andijk-Noord	3	20 to 40	male	adult	MBA	settlement	ditch	cranium
36	Andijk-Noord	3	12 to 25	unknown	young adult	MBA	settlement	circular ditch	cranium
37	Andijk-Noord	1	adult	unknown	adult	MBA	settlement	house ditch	cranium
38	Andijk-Noord	1	adult	male	adult	MBA	settlement	house ditch	cranium
39	Andijk-Noord	1	>35	unknown	adult	MBA	settlement	house ditch	radius
40	Andijk-Noord	3	18 to 25	unknown	young adult	MBA	settlement	house ditch	cranium
41	Andijk-Zuid	1	13 to 18	unknown	child-young adult	MBA	settlement	house ditch	humerus

Skeletal parts	Findnr.	Trench nr	Level	Feature nr	Filling	Structure	Feature depth	Additional remarks	Excavator	Literature
clavicle	27	1	-	-	-	Tumulus 1	-	perfect counterpart of find nr. 56	IPP	Runia 1987, 222
scapula	37	1	-	-	-	Tumulus 1	-	-	IPP	Runia 1987, 222
clavicle	56	1	-	-	-	Tumulus 1	-	perfect counterpart of find nr. 27	IPP	Runia 1987, 222
cervical vertebrae	58	1	-	-	-	Tumulus 1	-	osteoporosis?	IPP	Runia 1987, 222
humerus	778	21	2	227	1	GS02	48	-	ADC	Roessingh & Tol 2019, 699
cranium	1071	23	1	112	1	GS01	36	-	ADC	Roessingh & Tol 2019, 699
femur,tibia	752	22	1	14	1	GS01	40	old(er) chopmarks	ADC	Roessingh & Tol 2019, 699
femur	39	3	1	-	-	GRH02c	-	-	ROB	Aal 2015, 110; Runia 1987, 228
ulna,radius	44	3	1	-	-	GRH02c	-	including 3 fragm possible no. 44	ROB	Aal 2015, 110; Runia 1987, 228
mandibula,cranium	46	3	1	-	-	GRH02c	-	including two jaw fragments	ROB	Aal 2015, 110; Runia 1987, 228
femur	45	3	1	-	-	GRH02c	-	-	ROB	Aal 2015, 110; Runia 1987, 228
cranium,mandibula,humerus,radius,ischium,femur,tibia,fibula	62	3	1	-	-	GRH02c	-	-	ROB	Aal 2015, 111; Runia 1987, 229
cranium	37	3	1	-	-	GRH02c	-	-	ROB	Aal 2015, 94, 110; Runia 1987, 227
cranium	37	3	1	-	-	GRH02c	-	-	ROB	Aal 2015, 94, 110; Runia 1987, 227
illium,ischium,radius	37	3	1	-	-	GRH02c	-	-	ROB	Aal 2015, 94, 110; Runia 1987, 227
cranium,tibia,femur	38.1	3	1	-	-	GRH02c	-	-	ROB	Aal 2015, 105; Runia 1987, 228
cranium	3	2	1	-	-	GR02	50	fragments likely from the same person	ROB	Aal 2015, 104; Runia 1987, 229
cranium	30	2	1	-	-	KG16	65	Runia only saw one of the elements	ROB	Aal 2015, 107; Runia 1987, 227
cranium	36	3	1	-	-	HP09	60	-	ROB	Aal 2015, 99; Runia 1987, 227
cranium	48	3	1	-	-	HS06b	34	-	ROB	Aal 2015, 97; Runia 1987, 229
radius	49	4	1	-	1	HS08	3	-	ROB	Aal 2015, 108; Runia 1987, 229
cranium	50	3	1	-	-	HS08	72	-	ROB	Aal 2015, 98-99; Runia 1987, 229
humerus	117	9	1	-	1	HS06a	60	-	ROB	Aal 2015, 94-95; Runia 1987, 227

Individual (ID)	Site	Number of fragments	Age def	Sex def	Age simple	Time period	Primary context	Context	Skeletal parts simple
42	Bovenkarspel-Het Valkje	1	>35	male?	adult	MBA	settlement	ditch	sacrum
43	Bovenkarspel-Het Valkje	1	adult	male?	adult	LBA	settlement	pit	cranium
44	Hoogkarspel-Houterpolder West	21	30 to 50	male?	adult	MBA-LBA	settlement	ditch	cranium
45	Enkhuizen-Haling	1	adult	male?	adult	MBA	settlement	ditch	femur
46	Hoogkarspel-Hoogkarspeltunnel	6	<18	unknown	young adult	MBA	settlement	well	cranium
47	Enkhuizen-Kadijken	3	20 to 40	unknown	adult	MBA-LBA	settlement	house ditch	cranium
48	Enkhuizen-Kadijken	1	adult	male?	adult	MBA	settlement	house ditch	tibia
49	Enkhuizen-Kadijken	1	adult	unknown	adult	MBA	settlement	well	radius
50	Enkhuizen-Kadijken	1	18 to 25	unknown	young adult	MBA	settlement	circular ditch	molar
51	Enkhuizen-Kadijken	1	adult	male?	adult	MBA	settlement	house ditch	radius
52	Enkhuizen-Kadijken	1	12 to 25	unknown	young adult	BA	unknown	dump	molar
53	Andijk-Zuid (2011)	1	20 to 29	female?	young adult	LBA	settlement	ditch	pelvis
54	Enkhuizen-Kadijken	7	20 to 40	unknown	adult	MBA	settlement	house ditch	cranium
55	Enkhuizen-Kadijken	1	>14	unknown	adult	MBA	settlement	house ditch	femur
56	Enkhuizen-Kadijken	1	adult	unknown	adult	MBA	settlement	house ditch	fibula
57	Enkhuizen-Kadijken	3	18 to 25	unknown	young adult	MBA	settlement	well	cranium
58	Enkhuizen-Kadijken	3	0	unknown	perinate	MBA	settlement	house ditch	mix
59	Enkhuizen-Kadijken	1	adult	male?	adult	MBA	settlement	well	humerus
60	Grootebroek-Waterweide Noord	1	unknown	unknown	unknown	MBA	burial mound	ring ditch	femur
61	Grootebroek-Waterweide Noord	1	adult	male?	adult	MBA	burial mound	well	femur
62	Andijk-Noord	2	adult	male?	adult	MBA	burial mound	ring ditch	femur

Skeletal parts	Findnr.	Trench nr	Level	Feature nr	Filling	Structure	Feature depth	Additional remarks	Excavator	Literature
sacrum	4	30	1	-	-	-	22	findnumber wrong in IJzereef	ROB	Roessingh 2018, 262; IJzereef 1981, 209; Runia 1987, 230
cranium	1	38	2	-	-	KLX0	-	-	ROB	Roessingh 2018, 262; IJzereef 1981, 209; Runia 1987, 230
cranium	1035	21	2	105	1	GR26	74	-	ADC	Roessingh & Tol 2019, 699-700
femur	169	10	1	56	1	-	60	-	Archol	Van der Linde & Hamburg 2014, 57, 62
cranium	155	7	1	51	1	WA07	124	-	ADC	Roessingh & Tol 2019, 699-700
cranium	17	2	1	19	2	HS14	40	-	ADC	Roessingh & Vermue 2011, 14, 23, 30
tibia	42	4	1	75	1	HS15a-b	34	gnawing marks	ADC	Roessingh & Vermue 2011, 14, 23, 30
radius	1169.1	77	2	16	1	WA01	280	-	ADC	Roessingh & Lohof 2011, 120, 221, 394
molar	374	19	1	53	-	KG37	42	-	ADC	Roessingh & Lohof 2011, 102, 221
radius	383	1	1	296	-	HS11b	42	-	ADC	Roessingh & Lohof 2011, 90, 221
molar	1100	-	-	999	-	-	-	no specific find location	ADC	Roessingh & Lohof 2011, 221
pelvis	87	5	1	162	1	Ditch 3	44	-	Oranjewoud	Arkema & Vossen 2013, 26-28, 50-51
cranium	701	44	1	181	6	HS11b	26	os parietale	ADC	Roessingh & Lohof 2011, 90, 221
femur	576	44	1	50	1	HS11b	73	gnawing marks and tooth marks	ADC	Roessingh & Lohof 2011, 90, 221
fibula	496	39	1	11	1	HS10	84	gnawing marks on both ends	ADC	Roessingh & Lohof 2011, 83, 221
cranium	1189.2	77	2	26	1	WA02	210	occiput, pathology?	ADC	Roessingh & Lohof 2011, 120, 221
scapula,pelvis,femur	686	44	1	50	1	HS11b	73/42	femur proximal part, ilium from pelvis	ADC	Roessingh & Lohof 2011, 90, 221
humerus	961	59	2	220	1	WA12	290	possible tooth marks, meningitis, gnawing marks	ADC	Roessingh & Lohof 2011, 121, 221
femur	93	6	1	1047	9	GRS02b	-	-	ADC	Roessingh in prep
femur	101	6	2	1140	1	WA02	-	-	ADC	Roessingh in prep
femur	38.1	3	1	-	-	GRH02c	-	-	ROB	Aal 2015, 105; Runia 1987, 228

Individual (ID)	Site	Number of fragments	Age def	Sex def	Age simple	Time period	Primary context	Context	Skeletal parts simple
63	Andijk-Noord	2	4 to 8	unknown	child	MBA	burial mound	ring ditch	mix
64	Andijk-Noord	unknown	unknown	unknown	unknown	MBA	burial mound	ring ditch	mix
65	Bovenkarspel-Het Valkje	unknown	adult	unknown	adult	MBA	burial mound	ring ditch	phalanx
66	Bovenkarspel-Het Valkje	unknown	adult?	unknown	adult?	MBA	settlement	ditch	cranium
67	Bovenkarspel-Het Valkje	unknown	adult	male	adult	MBA	settlement	ditch	mandibula
68	Bovenkarspel-Het Valkje	unknown	juvenile (>3 yrs)	unknown	child	MBA	settlement	house ditch	femur
69	Bovenkarspel-Het Valkje	unknown	young adult	unknown	young adult	MBA	settlement	ditch	femur
70	Bovenkarspel-Het Valkje	unknown	adult	male	adult	MBA	settlement	ditch	femur
71	Bovenkarspel-Het Valkje	unknown	adult	unknown	adult	MBA	settlement	well	tibia
72	Bovenkarspel-Het Valkje	unknown	adult	unknown	adult	MBA	settlement	ditch	cranium
73	Bovenkarspel-Het Valkje	unknown	around 40	male	adult	MBA	settlement	ditch	cranium
74	Bovenkarspel-Het Valkje	unknown	adult?	unknown	adult?	MBA	settlement	house ditch	femur
75	Bovenkarspel-Het Valkje	unknown	adult	male?	adult	MBA	settlement	house ditch	femur
76	Bovenkarspel-Het Valkje	unknown	unknown	unknown	unknown	MBA	settlement	house ditch	humerus
77	Bovenkarspel-Het Valkje	unknown	adult	female	adult	MBA	settlement	ditch	femur
78	Bovenkarspel-Het Valkje	unknown	adult	male	adult	LBA	settlement	pit	mix
79	Bovenkarspel-Het Valkje	unknown	around 30	male	adult	MBA	settlement	ditch	cranium
80	Bovenkarspel-Het Valkje	unknown	adult	unknown	adult	MBA	settlement	ditch	femur

Skeletal parts	Findnr.	Trench nr	Level	Feature nr	Filling	Structure	Feature depth	Additional remarks	Excavator	Literature
L femur,R femur	62	3	1	-	-	GRH02c	-	-	ROB	Aal 2015, 105; Runia 1987, 228
cranium,mix	37	3	1	-	1	GRH02c	11	-	ROB	Aal 2015, 94
phalanx	15	44	1	-	-	GRA01	92	-	ROB	Roessingh 2018, 262; IJzereef 1981, 209; Runia 1987, 230
cranium	3	201	1	-	-	-	25	-	ROB	Roessingh 2018, 262; IJzereef 1981, 211; Runia 1987, 231-332
mandibula	1	197	2	-	-	-	46	-	ROB	Roessingh 2018, 262; IJzereef 1981, 211; Runia 1987, 231
L femur	2	185	2	-	-	HS25	10	-	ROB	Roessingh 2018, 262; IJzereef 1981, 211; Runia 1987, 231
femur	8	150	3	-	-	-	45	-	ROB	Roessingh 2018, 262; IJzereef 1981, 211; Runia 1987, 231
L femur	9	45	1	-	-	-	-	-	ROB	Roessingh 2018, 262; IJzereef 1981, 209; Runia 1987, 230
R tibia	24	117	2	-	-	WA19	200	-	ROB	Roessingh 2018, 262; IJzereef 1981, 211; Runia 1987, 231
cranium	15	117	2	-	-	-	40	Runia: find no 117-1-15	ROB	Roessingh 2018, 262; IJzereef 1981, 211; Runia 1987, 231
cranium	12	117	2	-	-	-	40	-	ROB	Roessingh 2018, 262; IJzereef 1981, 211; Runia 1987, 231
L femur	21	103	2	-	-	HS56b	10	-	ROB	Roessingh 2018, 262; IJzereef 1981, 211; Runia 1987, 231
R femur	2	102	2	-	-	HS54	18	-	ROB	Roessingh 2018, 262; IJzereef 1981, 211; Runia 1987, 231
humerus	15	101	2	-	-	HS50	54	not in Runia 1987	ROB	Roessingh 2018, 262; IJzereef 1981, 210
femur	26	99	2	-	-	-	32	-	ROB	Roessingh 2018, 262; IJzereef 1981, 210; Runia 1987, 230
L femur,lower part leg	1.2	48	1	-	-	KLX0	-	-	ROB	Roessingh 2018, 262; IJzereef 1981, 209; Runia 1987, 230
cranium	8	117	2	-	-	-	-	-	ROB	Roessingh 2018, 262; IJzereef 1981, 210; Runia 1987, 231
femur	40	40	1	-	-	-	64	not in Runia 1987	ROB	Roessingh 2018, 262; IJzereef 1981, 209

Individual (ID)	Site	Number of fragments	Age def	Sex def	Age simple	Time period	Primary context	Context	Skeletal parts simple
81	Bovenkarspel-Het Valkje	unknown	adult	male?	adult	MBA	settlement	house ditch	femur
82	Bovenkarspel-Het Valkje	unknown	30 to 40	female	adult	MBA	settlement	pit	mix
83	Bovenkarspel-Het Valkje	unknown	adult?	unknown	adult?	LBA	settlement	ditch	cranium
84	Bovenkarspel-Het Valkje	unknown	adult?	unknown	adult?	LBA	settlement	ditch	phalanx
85	Bovenkarspel-Het Valkje	unknown	30 to 50	male?	adult	LBA	settlement	house ditch	cranium
86	Bovenkarspel-Het Valkje	unknown	unknown	unknown	unknown	LBA	settlement	pit	tibia
87	Bovenkarspel-Het Valkje	unknown	adult?	unknown	adult?	MBA?	settlement	modern	calcaneus
88	Bovenkarspel-Het Valkje	unknown	adult	unknown	adult	MBA?	settlement	modern	femur
89	Bovenkarspel-Het Valkje	unknown	adult	female	adult	LBA?	settlement	modern	femur
90	Bovenkarspel-Het Valkje	unknown	unknown	unknown	unknown	LBA	settlement	layer	cranium
91	Enkhuizen-De Tent	unknown	unknown	unknown	unknown	MBA	burial mound	unknown	mandibula
92	Hoogkarspel-Tolhuis D	unknown	adult	female?	adult	LBA	settlement	ditch	femur
93	Hoogkarspel-Tolhuis F	unknown	adult	unknown	adult	LBA	settlement	ditch	ulna
94	Hoogkarspel-Tolhuis F	unknown	unknown	unknown	unknown	LBA	settlement	ditch	cranium
95	Hoogkarspel-Tolhuis F	unknown	adult	unknown	adult	MBA	settlement	circular ditch	femur
96	Hoogkarspel-Tolhuis F	unknown	adult	unknown	adult	BA	settlement	ditch	cranium
97	Hoogkarspel-Tolhuis F	unknown	adult	unknown	adult	LBA	settlement	pit	cranium

Skeletal parts	Findnr.	Trench nr	Level	Feature nr	Filling	Structure	Feature depth	Additional remarks	Excavator	Literature
R femur	35	40	1	-	-	HS05c	-	-	ROB	Roessingh 2018, 262; IJzereef 1981, 209; Runia 1987, 230
cranium,mandibula	1	17	1	-	-	KLX1-24	2	-	ROB	Roessingh 2018, 262; IJzereef 1981, 209; Runia 1987, 230
cranium	4	8	1	-	-	-	20	-	ROB	Roessingh 2018, 262; IJzereef 1981, 209; Runia 1987, 230
phalanx	16	97	2	-	-	-	40	-	ROB	Roessingh 2018, 262; IJzereef 1981, 209; Runia 1987, 230
cranium	11	103	1	-	-	HS55a	26	-	ROB	Roessingh 2018, 262; IJzereef 1981, 210; Runia 1987, 231
tibia	1.1	48	1	-	-	KLX0	-	not in Runia 1987	ROB	Roessingh 2018, 262; IJzereef 1981, 209
R calcaneus	1	157	3	-	-	-	-	-	ROB	Roessingh 2018, 262; IJzereef 1981, 211; Runia 1987, 231
femur	1	173	0	-	-	-	-	not in Runia 1987	ROB	Roessingh 2018, 262; IJzereef 1981, 211
R femur	3	98	1	-	-	-	-	-	ROB	Roessingh 2018, 262; IJzereef 1981, 210
cranium	1	150	1A	-	-	LG	-	findnumber uncertain	ROB	Roessingh 2018, 262; IJzereef 1981, 211; Runia 1987, 231
mandibula	-	1	-	-	-	Tumulus 1	-	Lehman mentions a human mandible in the ring ditch, but not in the findlist	IPP	Runia 1987, 222; Lehman 1963, 240
R femur	-	-	-	-	-	-	-	in publication no findnumber mentioned	IPP	Bakker & Brandt 1966, 216-217; Bakker 1974, 8
L ulna	479	20	3	-	-	GR108	-	-	IPP	Runia 1987, 226
cranium	323	14	3	-	-	GR111	-	vaguely written, as structure ditch VII in find list	IPP	Runia 1987, 225
L femur	83	10	3	-	-	KG098	33	cross through findnumber	IPP	Runia 1987, 224
cranium	177	12	-	-	-	Ditch I	-	-	IPP	Runia 1987, 225
cranium	194	12	1	-	-	-	-	-	IPP	Runia 1987, 225

Individual (ID)	Site	Number of fragments	Age def	Sex def	Age simple	Time period	Primary context	Context	Skeletal parts simple
98	Hoogkarspel-Tolhuis F	unknown	adult	unknown	adult	LBA	settlement	ditch	humerus
99	Hoogkarspel-Tolhuis F	unknown	adult	unknown	adult	LBA	settlement	pit	mix
100	Hoogkarspel-Tolhuis F	unknown	>10	unknown	unknown	BA	settlement	ditch	femur
101	Hoogkarspel-Tolhuis F	unknown	25 to 35	unknown	adult	BA	settlement	ditch	mandibula
102	Hoogkarspel-Tolhuis F	unknown	adult	unknown	adult	BA	settlement	pit	fibula
103	Hoogkarspel-Tolhuis F	unknown	adult	male?	adult	MBA	settlement	well	femur
104	Hoogkarspel-Tolhuis F	unknown	unknown	unknown	unknown	BA	settlement	ditch	cranium
105	Hoogkarspel-Tolhuis F	unknown	adult	unknown	adult	LBA	settlement	pit	phalanx
106	Hoogkarspel-Tolhuis F	unknown	adult	male?	adult	MBA	settlement	circular ditch	femur
107	Hoogkarspel-Tolhuis F	unknown	unknown	unknown	unknown	LBA	settlement	ditch	cranium
108	Hoogkarspel-Tolhuis F	unknown	adult	unknown	adult	LBA	settlement	ditch	humerus
109	Hoogkarspel-Tolhuis F	unknown	adult	unknown	adult	BA	settlement	ditch	fibula
110	Hoogkarspel-Tolhuis F	unknown	adult	unknown	adult	LBA	settlement	pit	femur
111	Hoogkarspel-Tolhuis F	unknown	adult	unknown	adult	LBA	settlement	pit	humerus
112	Hoogkarspel-Tolhuis F	unknown	adult	unknown	adult	MBA	settlement	ditch	femur
113	Hoogkarspel-Tolhuis F	unknown	adult	unknown	adult	MBA	settlement	ditch	tibia
114	Hoogkarspel-Tolhuis F	unknown	adult	unknown	adult	LBA	settlement	ditch	cranium
115	Hoogkarspel-Tolhuis F	unknown	adult	unknown	adult	BA	settlement	unknown	radius
116	Hoogkarspel-Tolhuis F	unknown	15 to 20	unknown	child-young adult	BA	settlement	unknown	mandibula
117	Hoogkarspel-Tolhuis F	unknown	adult	unknown	adult	BA	settlement	unknown	clavicle

Skeletal parts	Findnr.	Trench nr	Level	Feature nr	Filling	Structure	Feature depth	Additional remarks	Excavator	Literature
humerus	207	12	1	-	-	GR111	-	as structure ditch VI in find list.	IPP	Runia 1987, 225
R humerus,vertebrae	217	13	3	-	-	-	-	vaguely written	IPP	Runia 1987, 225
R femur	269	14	3	-	-	Ditch II	-	2x number on the map, vaguely written	IPP	Runia 1987, 225
mandibula,molar	269	14	3	-	-	Ditch II	-	2x number on the map, vaguely written	IPP	Runia 1987, 225
fibula	278	14	-	-	-	Pit b	-		IPP	Runia 1987, 225
femur	485	22	3	-	-	WA02	-	-	IPP	Runia 1987, 226
cranium	322	14	-	-	-	Ditch I	-	-	IPP	Runia 1987, 225
phalanx	173	12	1	-	-	Ditch IV	-	-	IPP	Runia 1987, 224
R femur	352	15	3	-	-	KG025	20	as structure circular ditch V in find list	IPP	Runia 1987, 225
cranium	475	20	3	-	-	Ditch 475	-	-	IPP	Runia 1987, 226
humerus	482	20	3	-	-	GR108	-	-	IPP	Runia 1987, 226
fibula	494	22	-	-	-	Ditch 494	-	-	IPP	Runia 1987, 226
femur	496.1	23	3	-	-	GR111	-	-	IPP	Runia 1987, 226
L humerus	496.2	23	3	-	-	GR111	-	-	IPP	Runia 1987, 226
femur	528	25	3	-	-	Ditch 528	-	-	IPP	Runia 1987, 226
tibia	543	25	3	-	-	Ditch 543	65	-	IPP	Runia 1987, 226
cranium	320	14	3	-	-	GR102	-	L os parietale and parts of margo sagittalis and margo occipitales; s structure Ditch VIII in find list; osteoporosis	IPP	Runia 1987, 225
radius	258	-	-	-	-	-	-	-	IPP	Runia 1987, 225
R mandibula	65	-	-	-	-	-	-	-	IPP	Runia 1987, 224
L clavicula	18	4	-	-	-	-	-	bronze in profile, findnumber outside trench	IPP	Runia 1987, 224

Individual (ID)	Site	Number of fragments	Age def	Sex def	Age simple	Time period	Primary context	Context	Skeletal parts simple
118	Hoogkarspel-Tolhuis F	unknown	adult	unknown	adult	BA	settlement	unknown	radius
119	Hoogkarspel-Tolhuis F	unknown	adult	unknown	adult	BA	settlement	unknown	tibia
120	Hoogkarspel-Tolhuis F	unknown	unknown	unknown	unknown	BA	settlement	unknown	cranium
121	Hoogkarspel-Tumuli	unknown	unknown	unknown	unknown	MBA?	unknown	unknown	mix
122	Hoogkarspel-Watertoren	unknown	17 to 25	unknown	young adult	MBA?	settlement	ditch	mix
123	Hoogkarspel-Watertoren Tumulus I	unknown	young adult	unknown	young adult	MBA?	burial mound	ring ditch	cranium
124	Hoogkarspel-Watertoren Tumulus I	unknown	unknown	unknown	unknown	MBA?	burial mound	ring ditch	cranium
125	Hoogkarspel-Watertoren Tumulus I	unknown	unknown	unknown	unknown	MBA?	burial mound	ring ditch	mix
126	Hoogkarspel-Watertoren Tumulus Ia	unknown	unknown	unknown	unknown	MBA?	burial mound	ring ditch	cranium
127	Hoogkarspel-Watertoren Tumulus Ia	unknown	unknown	unknown	unknown	MBA?	burial mound	ring ditch	cranium
128	Medemblik-Schepenwijk II	unknown	unknown	unknown	unknown	MBA	settlement	pit	cranium
129	Wervershoof-Eendenkooi (2016)	unknown	young adult	unknown	child	BA	unknown	unknown	cranium
130	Zwaagdijk-Oost	unknown	juvenile	unknown	child	MBA	settlement	pit	cranium
131	Hauwert-Notweg 6	unknown	unknown	unknown	unknown	LN-EBA	settlement	pit	mix
132	Andijk-Zuid	unknown	adult	male	adult	MBA	settlement	house ditch	femur

Skeletal parts	Findnr.	Trench nr	Level	Feature nr	Filling	Structure	Feature depth	Additional remarks	Excavator	Literature
R radius	257	14	2/3	-	-	-	-	2x on the map, different contexts	IPP	Runia 1987, 225
tibia	425	19	-	-	-	-	-	-	IPP	Runia 1987, 226
cranium	242	-	-	-	-	-	-	-	IPP	Runia 1987, 225
cranium,condyle	78	-	-	-	-	-	-	-	IPP	Runia 1987, 232
cranium,molar,mix	unknown	-	-	-	-	Yard5	-	Bakker (4 bone fragments), Runia (1 fragment); fragment of R part maxilla with C1, P1, P2, M1, M2, M3	IPP	Bakker et al. 1977, 206; Runia 1987, 227; Roessingh 2018, 115, 118, afb. 4.64, 4.67
cranium	20 (27)	-	-	-	-	Tumulus I	-	missing in Bakker 1974	IPP	Bakker 1958, 176
cranium	35 (18)	-	-	-	-	Tumulus I	-	-	IPP	Bakker 1974, 5; Bakker 1958, 177
cranium,femur	33 (16)	-	-	-	-	Tumulus I	-	-	IPP	Bakker 1974, 5; Bakker 1958, 177
cranium	unknown	-	-	-	-	Tumulus Ia/II	-	In the third ring ditch, eastern side	IPP	Bakker 1974, 9
cranium	unknown	-	-	-	-	Tumulus Ia/II	-	In the third ring ditch, eastern side	IPP	Bakker 1974, 9
cranium	9	25 (2)	-	6	-	-	-	-	VuHBS	Schurmans 2010, 28, 84, 200
cranium	132	5	1	44	-	-	1-9	determination not entirely certain, it is refered to as pit (Van der Heiden en Feiken 2018, 143) and ditch (Van der Heiden en Feiken 2018, 120)	RCE	Van der Heiden & Feiken 2018, 120, 143
cranium	22	1	1	65	3	-	35	-	ARC	Besselsen et al. 2002, 24, 51, 61
L costae,R radius	6	3	1	-		-	-	-	RAAP	Wink & De Groot 2022
R femur	64	5	1	-	1	HP04a	43	-	ROB	Aal 2015, 94; Runia 1987, 227

II Radiocarbon dates of disarticulated human bones

Individual (ID)	Context	Structure	Site	Findnr	Feature nr	Element	Labcode	Uncalibrated	Error	Calibrated from	Calbrated to	d13C
49	well	WA01	Enkhuizen-Kadijken	1169	16	radius	Poz-147696	3550	35	2019	1767	-19.6
39	house ditch	HS08	Andijk-Noord	49	-	radius	Poz-147691	3470	35	1890	1688	-20.1
60	ring ditch	GRS02b	Grootebroek-Waterweide Noord	93	1047	femur	Poz-150579	3425	35	1876	1622	-
26	ring ditch	GRH02c	Andijk-Noord	39	-	femur	Poz-147690	3230	35	1607	1421	-20.3
42	ditch	-	Bovenkarspel-Het Valkje	4	-	sacrum	Poz-147693	3190	35	1517	1406	-20.1
59	well	WA12	Enkhuizen-Kadijken	961	222	humerus	Poz-147699	3180	35	1511	1327	-19.0
4	ditch	GR18b	Hoogkarspel-Markerwaardweg	178	393	cranium	Poz-147604	3040	35	1411	1203	-20.0
8	ditch	greppelsysteem 1	Venhuizen-Voetakkers	124	907	femur	Poz-147606	3110	30	1442	1286	-20.7
14	ring ditch	ringditch II	Wervershoof-De Ark Tumulus XIII	5	-	femur	Poz-147607	3110	30	1442	1286	-20.0
16	ring ditch	-	Andijk-1982	39	-	cranium	Poz-147608	3000	30	1381	1124	-20.6
19	flank barrow	tumulus I	Enkhuizen-De Tent	27	-	clavicula	Poz-147610	3070	35	1421	1226	-20.9
20	flank barrow	tumulus I	Enkhuizen-De Tent	37	-	scapula	Poz-147611	3115	30	1447	1286	-20.3
21	ring ditch	tumulus I	Enkhuizen-De Tent	56	-	clavicula	Poz-147612	3120	35	1494	1283	-20.6
23	ring ditch	GRS02	Hoogkarspel-Houterpolder West	778	227	humerus	Poz-147613	3070	35	1421	1226	-20.5
25	ring ditch	GRS01	Hoogkarspel-Houterpolder West	752	14	femur	Poz-147614	3145	30	1499	1311	-20.4
41	house ditch	HS06a	Andijk-Zuid	117	-	humerus	Poz-147692	3115	35	1492	1279	-20.6
45	ditch	-	Enkhuizen-Haling	169	56	femur	Poz-149611	3120	35	1494	1283	-
48	house ditch	HS15b	Enkhuizen-Kadijken	42	75	tibia	Poz-147695	3035	35	1409	1134	-20.5
56	house ditch	HS10	Enkhuizen-Kadijken	496	11	fibula	Poz-147698	3040	35	1411	1203	-20.3
61	well	WA02	Grootebroek-Waterweide Noord	101	1140	femur	Poz-147701	3090	30	1425	1270	-20.1
62	ring ditch	GRH02c	Andijk-Noord	38	-	femur	Poz-147700	3095	35	1436	1264	-20.9
43	pit	-	Bovenkarspel-Het Valkje	1	-	cranium	Poz-147694	2955	35	1272	1021	-19.6
24	ring ditch	GRS01	Hoogkarspel-Houterpolder West	1071	112	cranium	Poz-0	>0	-	-	-	-
44	ditch	GR26	Hoogkarspel-Houterpolder West	1035	105	cranium	Poz-0	>0		-	-	-
57	well	WA02	Enkhuizen-Kadijken	1189	26	cranium	Poz-0	>0	-	-	-	-

d15N	Period	Cutting?	Non path marks?	Gnawling?	Remarks
13.3	LNEO-MBA-A	no	no	no	relatively high in d13C, results probably too old
14.0	EBA/MBA-A	yes	yes	no	-
-	EBA/MBA-A	yes	no	no	radiocarbon date from excavation (Roessingh in prep.)
14.1	MBA	no	yes	no	-
14.4	MBA	no	no	no	-
15.7	MBA	yes	yes	no	relatively high in d13C, results probably too old
13.8	MBA-B	no	no	no	-
12.2	MBA-B	yes	yes	no	-
13.7	MBA-B	no	no	no	-
14.3	MBA-B	no	no	no	-
13.6	MBA-B	yes	yes	no	-
14.1	MBA-B	yes	yes	no	-
13.8	MBA-B	yes	yes	no	-
14.4	MBA-B	no	no	no	-
13.4	MBA-B	yes	yes	no	-
11.6	MBA-B	yes	yes	no	-
-	MBA-B	yes	yes	no	radiocarbon date from excavation report (Van der Linde & Hamburg 2014, 37, tab. 4.5)
9.9	MBA-B	no	no	yes	-
13.2	MBA-B	yes	yes	no	-
13.7	MBA-B	yes	yes	no	well was dug in ring ditch GRS02b
12.9	MBA-B	yes	yes	no	-
13.5	MBA-B/LBA	no	no	no	relatively high in d13C, results probably too old
-	-	no	no	no	back-up also failed
-	-	no	no	no	back-up also failed
-	-	no	no	no	-

III Catalogue associated finds

Site	Individual (ID)	Find number only human bone?	Associated finds	Find no	Context	Structure
Hoogkarspel-Markerwaardweg	1	no	other find numbers from feature	1057, 862, 1056, 1847, 1542, 1840, 1841, 1845, 1854, 1857, 1859, 1864	ditch	GR15
Hoogkarspel-Markerwaardweg	2	no	other find numbers from feature	770, 777	ditch	-
Hoogkarspel-Markerwaardweg	3	no	other find numbers from feature	2441, 2448, 2449, 2450,	house ditch	HS27a
Hoogkarspel-Markerwaardweg	4	no	other find numbers from feature	137, 138, 140, 142, 161, 172, 175, 178, 603, 557	ditch	GR18b
Hoogkarspel-Markerwaardweg	7	no	other find numbers from feature	786, 787, 1220, 1226, 1228, 1229, 1235, 1236, 1237, 1262	ditch	GR26b
Hoogkarspel-Markerwaardweg	10	no	other find numbers from feature	36, 38, 51, 67, 89, 52, 713	ditch	GR08a
Andijk-1982	15	no	other find numbers from feature	unknown	barrow feature	-
Andijk-1982	16	no	other find numbers from feature	unknown	barrow feature	-
Andijk-1982	17	no	other find numbers from feature	unknown	barrow feature	-
Hoogkarspel-Houterpolder West	23	no	other find numbers from feature	778, 1020, 1021, 1022, 1098	ring ditch	-
Hoogkarspel-Houterpolder West	24	no	other find numbers from feature	1071, 1075	ring ditch	-
Hoogkarspel-Houterpolder West	25	no	other find numbers from feature	752, 1063, 1065, 1079, 1085	ring ditch	-
Andijk-Noord	35	no	other find numbers from feature	6,12	ditch	GR02
Andijk-Noord	38	no	other find numbers from feature	56	house ditch	HS06b
Andijk-Noord	39	no	other find numbers from feature	49	house ditch	HS08
Andijk-Noord	40	no	other find numbers from feature	49	house ditch	HS08
Andijk-Zuid	41	no	other find numbers from feature	110, 111, 120	house ditch	HS06a
Hoogkarspel-Houterpolder West	44	no	other find numbers from feature	1036, 1037, 1038, 1064	ditch	GR26
Enkhuizen-Haling	45	no	other find numbers from feature	82	ditch	-
Hoogkarspel-Hoogkarspeltunnel	46	no	other find numbers from feature	15, 80, 114	well	WA07
Enkhuizen-Kadijken	47	no	other find numbers from feature	19	well	WA01
Enkhuizen-Kadijken	49	no	other find numbers from feature	1164, 1163, 1222, 1221, 1223, 1236	well	WA01
Enkhuizen-Kadijken	51	no	other find numbers from feature	331,332,333,370	house ditch	HS11b
Andijk-Zuid (2011)	53	no	other find numbers from feature	97	ditch	ditch-3
Enkhuizen-Kadijken	54	no	other find numbers from feature	648,682	house ditch	HS11b
Enkhuizen-Kadijken	55	no	other find numbers from feature	577,578,581,644-647,680,681,683,685,686,690,703	house ditch	HS11b

Feature no	Animal bone (n)	Animal bone (gr)	Pottery (n)	Pottery (gr)	Stone (n)	Stone (gr)	Other find cat. (n/gr)
S3288,S3289,S3613,S3643,S3770,S4194	98	4202	28	395	-	-	loam (3/193)
S1601	8	53	-	-	-	-	-
S6475	-	-	-	-	1	31	loam (7/44)
S421,S1138	12	295	38	195	3	61	-
S926,S1868,S2030,S2120	60	2522	-	-	-	-	-
S132,S248,S262,S280,S309,S1271	14	456	3	65	1	124	-
-	-	-	21	-	-	-	some wood and charcoal
-	-	-	21	-	-	-	some wood and charcoal
-	-	-	21	-	-	-	some wood and charcoal
S21-227, S27-98,S21-227	2	53	-	-	-	-	-
S23-112	1	11	-	-	-	-	-
S22-14, S23-15	2	36	1	4	-	-	-
-	107	4238	8	-	10	-	-
-	34	925	4	-	6	-	-
-	66	2071	10	-	-	-	-
-	85	3789	19	-	36	-	loam (1/-)
-	24	501	1	-	1	-	-
S27-104, S27-80, S21-300	50	855	-	-	-	-	-
-	-	-	-	-	-	-	-
-	14	159	1	29	-	-	-
S2-19	unknown	unknown	45	470	14	826	-
S77-15,S77-16,S77-17,S77-19,S77-53,S77-54,S77-55,S77-57,S77-58	30	2286	2	153	1	134	-
S1-296,S1-230	56	2017	-	-	-	-	-
-	1	15	-	-	-	-	-
S44-181,S44-182,S1-357	5	299	-	-	-	-	loam (1/126
S44-50,S44-220	82	624	26	191	26	854	loam (3/15), flint (1/8)

Site	Individual (ID)	Find number only human bone?	Associated finds	Find no	Context	Structure
Enkhuizen-Kadijken	56	no	other find numbers from feature	216,450,497,498,541,542,544,547,548,552,555,582, 594	house ditch	HS10
Enkhuizen-Kadijken	57	no	other find numbers from feature	1037, 1212, 1213, 1214, 1215, 1216, 1217, 1218, 1220, 1234	well	WA02
Enkhuizen-Kadijken	58	no	other find numbers from feature	577,576,578,581,644-647,680,681,683,685,690,703	house ditch	HS11b
Enkhuizen-Kadijken	59	no	other find numbers from feature	926,927,929,930,936, 937,	well	WA12
Grootebroek-Waterweide Noord	60	no	other find numbers from feature	92, 144, 160, 165,	ring ditch	Burial mound
Grootebroek-Waterweide Noord	61	no	other find numbers from feature	166 167 168	well	Burial mound
Andijk-Noord	64	no	other find numbers from feature	37	ring ditch	GRH02
Medemblik-Schepenwijk II	128	unknown	other find numbers from feature	unknown	pit or ditch	unknown
Wervershoof-Eendenkooi Tumulus XIII	129	no	other find numbers from feature		pit or ditch	-
Zwaagdijk-Oost	130	no	other find numbers from feature	unknown	-	-
Andijk-Zuid	132	no	other find numbers from feature	23, 24, 27, 38, 46, 47, 63	house ditch	HS04a
Hoogkarspel-Markerwaardweg	1	yes	same find number as ID	1854	ditch	GR15
Hoogkarspel-Markerwaardweg	2	yes	same find number as ID	769	ditch	-
Hoogkarspel-Markerwaardweg	3	no	same find number as ID	2450	house ditch	HS27a
Hoogkarspel-Markerwaardweg	4	no	same find number as ID	178	ditch	GR18b
Hoogkarspel-Markerwaardweg	5	no	same find number as ID	1496	house ditch	HS17b
Hoogkarspel-Markerwaardweg	6	no	same find number as ID	1471	posthole	HS19c
Hoogkarspel-Markerwaardweg	7	no	same find number as ID	1220	ditch	GR26b
Venhuizen-Voetakkers	8	no	same find number as ID	124	ditch	-
Venhuizen-Voetakkers	9	no	same find number as ID	418	ditch	-
Hoogkarspel-Markerwaardweg	10	no	same find number as ID	67	ditch	GR08a
Hoogkarspel-Tumulus I	11	unknown	same find number as ID	27 (1)	ring ditch	Tumulus I
Hoogkarspel-Tumulus I	12	unknown	same find number as ID	30 (9)	ring ditch	Tumulus I
Hoogkarspel-Tumulus I	13	unknown	same find number as ID	36 (19)	ring ditch	Tumulus I
Wervershoof-De Ark Tumulus XIII	14	unknown	same find number as ID	unknown	-	-
Andijk-1982	15	unknown	same find number as ID	3	ring ditch	-
Andijk-1982	16	unknown	same find number as ID	39	ring ditch	-
Andijk-1982	17	unknown	same find number as ID	45	ring ditch	-
Enkhuizen-De Tent	18	unknown	same find number as ID	50	ring ditch	Burial mound
Enkhuizen-De Tent	19	unknown	same find number as ID	27	flank barrow	Burial mound

Feature no	Animal bone (n)	Animal bone (gr)	Pottery (n)	Pottery (gr)	Stone (n)	Stone (gr)	Other find cat. (n/gr)
S39-11,S12-70	304	4093	34	284	92	800	loam (158/1133), flint (7/10), slag (3/6)
S77-26, S77-46,S77-47,S77-48,S77-49,S77-50	127	5073	8	124	7	553	-
S44-50,S44-220	83	641	37	202	29	913	loam (5/60), flint (1/8)
S59-220, S59-207,S59-318,S59-319	28	3026	3	77	-	-	-
-	6	211	-	-	-	-	-
-	7	256	-	-	-	-	wood
-	7	1208	2	-	5	-	-
unknown	unknown	unknown	unknown	unknown	unknown	unknown	-
-	unknown	unknown	unknown	unknown	-	-	-
-	14	-	9	74	2	55	-
-	58	4256	9	-	11	-	coprolite (1/-)
S4194	-	-	-	-	-	-	-
S1614	-	-	-	-	-	-	-
S6475	20	330	-	-	-	-	loam (3/39)
S393	-	-	-	-	-	-	loam (1/4)
S3488	3	43	-	-	-	-	-
S3206	9	55	-	-	-	-	loam (2/7)
S2030	2	39	-	-	-	-	-
S907	1	153	-	-	-	-	-
S1915	20	1273	2	59	-	-	-
S262	-	-	-	-	-	-	shell (3/6)
SW quadrant	11	unknown	-	-	-	-	-
NW quadrant	11	unknown	-	-	-	-	-
SE part	11	unknown	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	some	-	-	-	some	-	-
-	some	-	-	-	some	-	-

Site	Individual (ID)	Find number only human bone?	Associated finds	Find no	Context	Structure
Enkhuizen-De Tent	20	unknown	same find number as ID	37	flank barrow	Burial mound
Enkhuizen-De Tent	21	unknown	same find number as ID	56	ring ditch	Burial mound
Enkhuizen-De Tent	22	unknown	same find number as ID	58	ring ditch	Burial mound
Hoogkarspel-Houterpolder West	23	yes	same find number as ID	778	ring ditch	-
Hoogkarspel-Houterpolder West	24	yes	same find number as ID	1071	ring ditch	-
Hoogkarspel-Houterpolder West	25	yes	same find number as ID	752	ring ditch	-
Andijk-Noord	26	no	same find number as ID	39	ring ditch	GRH02
Andijk-Noord	27	no	same find number as ID	44	ring ditch	GRH02
Andijk-Noord	28	no	same find number as ID	46	ring ditch	GRH02
Andijk-Noord	29	no	same find number as ID	45	ring ditch	GRH02
Andijk-Noord	30	yes	same find number as ID	62	ring ditch	GRH02
Andijk-Noord	31	no	same find number as ID	37	ring ditch	GRH02
Andijk-Noord	32	no	same find number as ID	37	ring ditch	GRH02
Andijk-Noord	33	no	same find number as ID	37	ring ditch	GRH02
Andijk-Noord	34	no	same find number as ID	38	ring ditch	GRH02
Andijk-Noord	35	no	same find number as ID	3	ditch	GR02
Andijk-Noord	36	no	same find number as ID	30	circular ditch	KG16
Andijk-Noord	37	no	same find number as ID	36	house ditch	HS09
Andijk-Noord	38	no	same find number as ID	48	house ditch	HS06b
Andijk-Noord	39	no	same find number as ID	49	house ditch	HS08
Andijk-Noord	40	no	same find number as ID	50	house ditch	HS08
Andijk-Zuid	41	no	same find number as ID	117	house ditch	HS06a
Bovenkarspel-Het Valkje	42	no	same find number as ID	30-1-4	ditch	-
Bovenkarspel-Het Valkje	43	no	same find number as ID	38-2-1	pit	-
Hoogkarspel-Houterpolder West	44	no	same find number as ID	1035	ditch	GR26
Enkhuizen-Haling	45	no	same find number as ID	169	ditch	-
Hoogkarspel-Hoogkarspeltunnel	46	yes	same find number as ID	155	well	WA07
Enkhuizen-Kadijken	47	no	same find number as ID	17	well	WA01
Enkhuizen-Kadijken	48	no	same find number as ID	42	house ditch	HS15a-b
Enkhuizen-Kadijken	49	yes	same find number as ID	1169	well	WA01
Enkhuizen-Kadijken	50	no	same find number as ID	374	circular ditch	KG37
Enkhuizen-Kadijken	51	no	same find number as ID	383	house ditch	HS11b
Enkhuizen-Kadijken	52	no	same find number as ID	1100	dump	-
Andijk-Zuid (2011)	53	no	same find number as ID	5-1-87	ditch	ditch-3
Enkhuizen-Kadijken	54	no	same find number as ID	701	house ditch	HS11b
Enkhuizen-Kadijken	55	no	same find number as ID	576	house ditch	HS11b
Enkhuizen-Kadijken	56	no	same find number as ID	496	house ditch	HS10

Feature no	Animal bone (n)	Animal bone (gr)	Pottery (n)	Pottery (gr)	Stone (n)	Stone (gr)	Other find cat. (n/gr)
-	some	-	-	-	some	-	-
-	some	-	-	-	some	-	-
-	some	-	-	-	some	-	-
S21-227	-	-	-	-	-	-	-
S23-112	-	-	-	-	-	-	-
S22-14	-	-	-	-	-	-	-
-	19	952	-	-	-	-	loam (3/-), coprolite (1/-)
-	10	273	3	-	2	-	-
-	22	507	.-	-	-	-	-
-	35	1849	5	-	7	-	-
-	-	-	-	-	-	-	-
-	30	1226	-	-	-	-	-
-	30	1226	-	-	-	-	-
-	30	1226	-	-	-	-	-
-	30	1706	-	-	2	-	-
-	38	1861	1	-	19	-	-
-	90	1248	9	-	-	-	-
-	5	91	1	-	4	-	-
-	54	1313	4	-	-	-	-
-	84	3786	19	-	-	-	-
-	68	2068	10	-	10	-	wood (1/-)
-	26	685	2	-	2	-	loam (1/-)
-	14	-	-	-	-	-	-
-	135	-	54	518	-	-	-
S21-105	47	805	-	-	-	-	-
S56	1	1472	-	-	-	-	-
-	-	-	-	-	-	-	-
S2-19	-	-	-	-	-	-	many fish bones
S4-75	-	-	-	-	1	3	-
S77-16	-	-	-	-	-	-	-
S19-53	50	19	-	-	-	-	-
S1-296	39	309	4	147	9	92	loam (2/4), charcoal (3/2)
S999	-	-	-	-	-	-	-
-	53	1367	12	111	5	117	flint (1/1), organic (8/2)
S44-181	5	180	-	-	-	-	-
S44-50	1	17	1	11	3	60	loam (2/54)
S39-11	5	135	1	4	2	362	loam (3/20)

Site	Individual (ID)	Find number only human bone?	Associated finds	Find no	Context	Structure
Enkhuizen-Kadijken	57	no	same find number as ID	1189	well	WA02
Enkhuizen-Kadijken	58	no	same find number as ID	686	house ditch	HS11b
Enkhuizen-Kadijken	59	no	same find number as ID	961	well	WA12
Grootebroek-Waterweide Noord	60	yes	same find number as ID	93	ring ditch	Burial mound
Grootebroek-Waterweide Noord	61	no	same find number as ID	101	well	Burial mound
Andijk-Noord	62	no	same find number as ID	38	ring ditch	GRH02
Andijk-Noord	63	no	same find number as ID	62	ring ditch	GRH02
Andijk-Noord	64	no	same find number as ID	37	ring ditch	GRH02
Bovenkarspel-Het Valkje	65	no	same find number as ID	44-1-15	ditch	GRA01
Bovenkarspel-Het Valkje	66	no	same find number as ID	201-1-3	ditch	-
Bovenkarspel-Het Valkje	67	no	same find number as ID	197-2-1	ditch	-
Bovenkarspel-Het Valkje	68	no	same find number as ID	185-2-2	house ditch	HS25
Bovenkarspel-Het Valkje	69	no	same find number as ID	150-3-8	ditch	-
Bovenkarspel-Het Valkje	70	yes	same find number as ID	45-1-9	ditch	-
Bovenkarspel-Het Valkje	71	no	same find number as ID	117-2-24	well	WA19
Bovenkarspel-Het Valkje	72	no	same find number as ID	117-2-15	ditch	-
Bovenkarspel-Het Valkje	73	no	same find number as ID	117-2-12	ditch	-
Bovenkarspel-Het Valkje	74	no	same find number as ID	103-2-21	house ditch	HS56b
Bovenkarspel-Het Valkje	75	no	same find number as ID	102-2-2	house ditch	HS54
Bovenkarspel-Het Valkje	76	no	same find number as ID	101-2-15	house ditch	HS50
Bovenkarspel-Het Valkje	77	no	same find number as ID	99-2-26	pit	-
Bovenkarspel-Het Valkje	78	no	same find number as ID	48-1-1	pit	-
Bovenkarspel-Het Valkje	79	no	same find number as ID	117-2-8	ditch	-
Bovenkarspel-Het Valkje	80	no	same find number as ID	40-1-40	ditch	-
Bovenkarspel-Het Valkje	81	no	same find number as ID	40-1-35	house ditch	HS05c
Bovenkarspel-Het Valkje	82	no	same find number as ID	17-1-1	pit	-
Bovenkarspel-Het Valkje	83	no	same find number as ID	8-1-4	ditch	-
Bovenkarspel-Het Valkje	84	no	same find number as ID	97-2-16	ditch	-
Bovenkarspel-Het Valkje	85	no	same find number as ID	103-1-11	house ditch	HS55A
Bovenkarspel-Het Valkje	86	no	same find number as ID	48-1-1	pit	-
Bovenkarspel-Het Valkje	87	yes	same find number as ID	157-3-1	ditch	-
Bovenkarspel-Het Valkje	88	yes	same find number as ID	173-0-1	ditch	-
Bovenkarspel-Het Valkje	89	no	same find number as ID	98-1-3	modern	-
Bovenkarspel-Het Valkje	90	no	same find number as ID	150-1A-1	layer	-
Enkhuizen-De Tent	91	unknown	same find number as ID	unknown	ring ditch	Burial mound
Hoogkarspel-Tolhuis D	92	unknown	same find number as ID	-	-	-
Hoogkarspel-Tolhuis F	93	unknown	same find number as ID	unknown	unknown	unknown
Hoogkarspel-Tolhuis F	94	unknown	same find number as ID	unknown	unknown	unknown
Hoogkarspel-Tolhuis F	95	unknown	same find number as ID	unknown	unknown	unknown
Hoogkarspel-Tolhuis F	96	unknown	same find number as ID	unknown	unknown	unknown

Feature no	Animal bone (n)	Animal bone (gr)	Pottery (n)	Pottery (gr)	Stone (n)	Stone (gr)	Other find cat. (n/gr)
S77-26	3	82	-	-	-	-	-
S44-50	-	-	14	120	8	366	-
S59-220	11	460	-	-	-	-	-
-	-	-	-	-	-	-	-
-	4	31	-	-	-	-	-
-	-	-	-	-	2	-	-
-	18	712	-	-	-	-	-
-	30	1226	-	-	-	-	-
-	15	-	-	-	-	-	-
-	4	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	2	-	-	-	-	-	-
-	110	-	2	23	1	-	-
-	-	-	-	-	-	-	-
-	40	-	1	17	-	-	-
-	36	-	2	50	2	-	loam (-/5)
-	260	-	21	478	10	-	loam (-/2) flint (-/1)
-	13	-	12	110	-	-	-
-	35	-	-	-	2	-	flint (-/1) coprolite (-/5)
-	19	-	1	-	-	-	-
-	17	-	-	-	1	-	-
-	428	-	192	1832	3	-	loam (-/3) flint (-/3)
-	121	-	16	129	7	-	loam (-/2)
-	10	-	3	42	1	-	loam (-/5)
-	198	-	46	664	3	-	loam (-/11)
-	5	-	2	40	-	-	-
-	105	-	-	3321	11	-	coprolite (-/38)
-	various	-	various	731	-	-	flint (-/11)
-	19	-	-	-	5	-	loam (-/1)
-	428	-	192	-	3	-	loam (-/3) flint (-/3)
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	80	-	110	1486	25	-	loam (-/4)
-	100	-	450	3865	23	-	-
-	some	-	-	-	some	-	-
-	some	-	-	-	-	-	-
unknown	unknown	unknown	unknown	unknown	unknown	unknown	-
unknown	unknown	unknown	unknown	unknown	unknown	unknown	-
unknown	unknown	unknown	unknown	unknown	unknown	unknown	-
unknown	unknown	unknown	unknown	unknown	unknown	unknown	-

Site	Individual (ID)	Find number only human bone?	Associated finds	Find no	Context	Structure
Hoogkarspel-Tolhuis F	97	unknown	same find number as ID	unknown	unknown	unknown
Hoogkarspel-Tolhuis F	98	unknown	same find number as ID	unknown	unknown	unknown
Hoogkarspel-Tolhuis F	99	unknown	same find number as ID	unknown	unknown	unknown
Hoogkarspel-Tolhuis F	100	unknown	same find number as ID	unknown	unknown	unknown
Hoogkarspel-Tolhuis F	101	unknown	same find number as ID	unknown	unknown	unknown
Hoogkarspel-Tolhuis F	102	unknown	same find number as ID	unknown	unknown	unknown
Hoogkarspel-Tolhuis F	103	unknown	same find number as ID	unknown	unknown	unknown
Hoogkarspel-Tolhuis F	104	unknown	same find number as ID	unknown	unknown	unknown
Hoogkarspel-Tolhuis F	105	unknown	same find number as ID	unknown	unknown	unknown
Hoogkarspel-Tolhuis F	106	unknown	same find number as ID	unknown	unknown	unknown
Hoogkarspel-Tolhuis F	107	unknown	same find number as ID	unknown	unknown	unknown
Hoogkarspel-Tolhuis F	108	unknown	same find number as ID	unknown	unknown	unknown
Hoogkarspel-Tolhuis F	109	unknown	same find number as ID	unknown	unknown	unknown
Hoogkarspel-Tolhuis F	110	unknown	same find number as ID	unknown	unknown	unknown
Hoogkarspel-Tolhuis F	111	unknown	same find number as ID	unknown	unknown	unknown
Hoogkarspel-Tolhuis F	112	unknown	same find number as ID	unknown	unknown	unknown
Hoogkarspel-Tolhuis F	113	unknown	same find number as ID	unknown	unknown	unknown
Hoogkarspel-Tolhuis F	114	unknown	same find number as ID	unknown	unknown	unknown
Hoogkarspel-Tolhuis F	115	unknown	same find number as ID	unknown	unknown	unknown
Hoogkarspel-Tolhuis F	116	unknown	same find number as ID	unknown	unknown	unknown
Hoogkarspel-Tolhuis F	117	unknown	same find number as ID	unknown	unknown	unknown
Hoogkarspel-Tolhuis F	118	unknown	same find number as ID	unknown	unknown	unknown
Hoogkarspel-Tolhuis F	119	unknown	same find number as ID	unknown	unknown	unknown
Hoogkarspel-Tolhuis F	120	unknown	same find number as ID	unknown	unknown	unknown
Hoogkarspel-Tumuli	121	unknown	same find number as ID	-	-	-
Hoogkarspel-Watertoren	122	unknown	same find number as ID	-	-	-
Hoogkarspel-Tumulus I	123	unknown	same find number as ID	20 (27)	ring ditch	Tumulus I
Hoogkarspel-Tumulus I	124	unknown	same find number as ID	35 (18)	ring ditch	Tumulus I
Hoogkarspel-Tumulus I	125	unknown	same find number as ID	33 (16)	ring ditch	Tumulus I
Hoogkarspel-Tumulus Ia	126	unknown	same find number as ID	-	ring ditch	Tumulus Ia/II
Hoogkarspel-Tumulus Ia	127	unknown	same find number as ID	-	ring ditch	Tumulus Ia/II
Medemblik-Schepenwijk II	128	unknown	same find number as ID	9	pit or ditch	unknown
Wervershoof-Eendenkooi Tumulus XIII	129	no	same find number as ID	132	pit or ditch	-
Zwaagdijk-Oost	130	no	same find number as ID	22 (S65)	Pit	-
Hauwert-Notweg 6	131	no	same find number as ID	V6/S13	pit	-
Andijk-Zuid	132	no	same find number as ID	64	house ditch	HS04a

Feature no	Animal bone (n)	Animal bone (gr)	Pottery (n)	Pottery (gr)	Stone (n)	Stone (gr)	Other find cat. (n/gr)
unknown	unknown	unknown	unknown	unknown	unknown	unknown	-
unknown	unknown	unknown	unknown	unknown	unknown	unknown	-
unknown	unknown	unknown	unknown	unknown	unknown	unknown	-
unknown	unknown	unknown	unknown	unknown	unknown	unknown	-
unknown	unknown	unknown	unknown	unknown	unknown	unknown	-
unknown	unknown	unknown	unknown	unknown	unknown	unknown	-
unknown	unknown	unknown	unknown	unknown	unknown	unknown	-
unknown	unknown	unknown	unknown	unknown	unknown	unknown	-
unknown	unknown	unknown	unknown	unknown	unknown	unknown	-
unknown	unknown	unknown	unknown	unknown	unknown	unknown	-
unknown	unknown	unknown	unknown	unknown	unknown	unknown	-
unknown	unknown	unknown	unknown	unknown	unknown	unknown	-
unknown	unknown	unknown	unknown	unknown	unknown	unknown	-
unknown	unknown	unknown	unknown	unknown	unknown	unknown	-
unknown	unknown	unknown	unknown	unknown	unknown	unknown	-
unknown	unknown	unknown	unknown	unknown	unknown	unknown	-
unknown	unknown	unknown	unknown	unknown	unknown	unknown	-
unknown	unknown	unknown	unknown	unknown	unknown	unknown	-
unknown	unknown	unknown	unknown	unknown	unknown	unknown	-
unknown	unknown	unknown	unknown	unknown	unknown	unknown	-
unknown	unknown	unknown	unknown	unknown	unknown	unknown	-
unknown	unknown	unknown	unknown	unknown	unknown	unknown	-
unknown	unknown	unknown	unknown	unknown	unknown	unknown	-
unknown	unknown	unknown	unknown	unknown	unknown	unknown	-
unknown	unknown	unknown	unknown	unknown	unknown	unknown	-
-	-	-	-	-	-	-	-
-	36	-	-	-	-	-	-
-	12	-	-	-	-	-	-
-	11	unknown	-	-	-	-	-
-	11	unknown	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
unknown	unknown	unknown	unknown	unknown	unknown	unknown	-
S44	unknown	unknown	unknown	unknown	unknown	unknown	-
-	1	-	2	11	1	40	loam (2/11)
-	1	1,8	-	-	-	-	-
-	49	2905	17	-	16	-	loam (14/-)

IV Catalogue excavated West Frisian Bronze Age barrows

Site	Barrow nr	Barrows	Periods	Ring structure/ ditch	Inhumation	Cremation	Burnt-skeleton-grave	Human remains ringditch/ mound (n of ID)
Andijk-1982	1	1	2	2	0	0	0	3
Andijk-Noord	1	1	3	3	0	0	0	0
Andijk-Noord	2	1	3	4	1	1	0	18
Bovenkarspel-Het Valkje	2	1	2	1	0	0	0	0
Bovenkarspel-Het Valkje	1	1	2	1	0	0	0	1
Enkhuizen-De Tent	1	1	2	2	0	0	0	6
Enkhuizen-Kadijken	1	1	1	1	1	0	0	0
Grootebroek-Tumulus	II	1	1	1	0	0	0	0
Grootebroek-Tumulus	I	1	3	3	3	0	0	0
Grootebroek-Tumulus	III	1	3	3	4	0	0	0
Grootebroek-Tumulus (AMR-project)	IV	1	1	1	0	0	0	0
Grootebroek-Tumulus (AMR-project)	V	1	3	3	0	0	0	0
Grootebroek-Waterweide Noord	1	1	2	2	0	0	0	2
Hoogkarspel-Houterpolder West	2	1	1	1	0	0	0	1
Hoogkarspel-Houterpolder West	1	1	1	1	1	0	0	1
Hoogkarspel-Tolhuis D	III	1	1	1	0	0	0	0
Hoogkarspel-Tolhuis D	II	1	1	1	1	0	1	0
Hoogkarspel-Tumuli	XIV	1	1	1	0	0	0	0
Hoogkarspel-Tumuli	XIII	1	1	1	0	0	0	0
Hoogkarspel-Tumuli	VIII	1	3	3	0	0	0	0
Hoogkarspel-Tumuli	XII	1	3	3	0	0	0	0
Hoogkarspel-Tumuli	X	1	3	3	0	0	0	0
Hoogkarspel-Tumuli	IV	1	1	1	0	0	0	0
Hoogkarspel-Tumuli	XI	1	2	2	1	0	0	0
Hoogkarspel-Tumuli	IX	1	1	1	0	0	0	0
Hoogkarspel-Tumuli	V	1	2	2	0	0	0	0
Hoogkarspel-Tumuli	VI	1	1	1	0	0	0	0
Hoogkarspel-Tumuli	VII	1	1	1	0	0	0	0
Hoogkarspel-Watertoren Tumulus	Ia	1	3	3	2	0	0	2
Hoogkarspel-Watertoren Tumulus	I	1	3	1	0	1	0	6
Medemblik Schuitenvoerderslaan	1	1	1	1	0	0	0	0
Medemblik Schuitenvoerderslaan	2	1	2	2	0	0	1	0
Oostwoud-Tuithoorn	I	1	2	1	2	0	0	0
Oostwoud-Tuithoorn	II	1	3	1	13	0	0	1
Wervershoof-De Ark	III	1	2	1	0	0	0	0
Wervershoof-De Ark	I	1	2	2	4	0	0	0
Wervershoof-De Ark	IV	1	1	1	6	0	0	0
Wervershoof-De Ark	XIII	1	4	3	1	0	0	1
Wervershoof-Eendenkooi	III	1	2	2	0	0	0	0
Wervershoof-Eendenkooi	I	1	2	1	0	1	0	0
Wervershoof-Eendenkooi	IV	1	2	2	6	0	0	0
Westwoud-Binnenwijzend	1	1	1	1	4	0	0	0

Completeness ring ditch (%)	Excavated completely?	Remarks	Reference
100,00	unknown	-	Metz 1983, 215; Runia 1987, 232; Metz 1993, 197
90,00	yes, probably	-	Roessingh 2018
90	yes, probably	-	Roessingh 2018
100	yes, probably	-	Roessingh 2018
100	yes, probably	-	Roessingh 2018
25	unknown	-	Lehman 1963, 235-243
100	yes	-	Roessingh & Lohof 2011
40	unknown	-	Van Giffen 1953, 36-37
100	unknown	-	Van Giffen 1953, 34-36
100	unknown	-	Van Giffen 1953, 37-39
10	no	-	De Groot & Soonius 2022
10	no	-	De Groot & Soonius 2022
100	yes	-	Roessingh 2022; Roessingh in prep.
60	yes	-	Zandboer & Roessingh 2019, 309-311; Roessingh 2019, 697
90	yes	-	Zandboer & Roessingh 2019, 309-311; Roessingh 2019, 697
80	unknown	-	Bakker & Brandt 1966, 182-183; Roessingh 2018, 97
90	unknown	in same secondary grave	Bakker & Brandt 1966, 182-183; Roessingh 2018, 97
20	no	-	Bakker 1979; Metz 1993, 114-115; Roessingh 2018, 127-129
40	unknown	-	Bakker 1979; Metz 1993, 114-115; Roessingh 2018, 127-129
40	no	-	Bakker 1979; Metz 1993, 114-115; Roessingh 2018, 127-129
60	no	possible cremations sieved: no cremated bones (pers. com. H. Fokkens)	Bakker 1979; Metz 1993, 115; Roessingh 2018, 127-129
80	no	-	Bakker 1979; Metz 1993, 114-115; Roessingh 2018, 127-129
90	no	-	Bakker 1979; Metz 1993, 114-115; Roessingh 2018, 127-129
90	no	possible three periods	Bakker 1979; Runia 1987, 232 (Hw 71); Metz 1993, 114-115; Roessingh 2018, 127-129
95	no	-	Bakker 1979; Metz 1993, 114-115; Roessingh 2018, 127-129
90	no	not completely excavated (Bakker 1979)	Bakker 1979; Metz 1993, 114-115; Roessingh 2018, 127-129
90	no	not completely excavated (Bakker 1979)	Bakker 1979; Metz 1993, 114-115; Roessingh 2018, 127-129
90	no	not completely excavated (Bakker 1979)	Bakker 1979; Metz 1993, 114-115; Roessingh 2018, 127-129
100	unknown	-	Modderman 1974, 251-259
100	unknown	-	Bakker 1959, 166-170
100	unknown	-	De Boer 2013, 63-66
100	unknown	-	De Boer 2013, 63-66
100	unknown	-	Van Giffen 1962 Fokkens et al. 2017, 108-117
80	unknown	-	Van Giffen 1962 Fokkens et al. 2017, 108-117
10	unknown	-	Van Giffen 1944, 121-221
100	unknown	-	Van Giffen 1944, 121-221
100	unknown	-	Van Giffen 1944, 121-221
100	unknown	-	Van der Waals 1961, 57-63
5	unknown	-	Van Giffen 1944
95	unknown	-	Van Giffen 1944
95	unknown	-	Van Giffen 1944
25	yes	-	Jezeer & Roessingh 2019, 200-214

V Catalogue osteological analysis

Individual (ID)	Site	Element	Number of fragments	Age	Sex
1	Hoogkarspel-Houterpolder West	cranium	26	1 to 3	unknown
2	Hoogkarspel-Markerwaardweg	R mandibula with three molars	1	18 to 25	unknown
3	Hoogkarspel-Markerwaardweg	cranium (os occipitale)	9	20 to 40	unknown
4	Hoogkarspel-Markerwaardweg	cranium (os frontale)	1	>18	unknown
5	Hoogkarspel-Markerwaardweg	L femur,R femur,L illium	3	2 to 4	unknown
6	Hoogkarspel-Markerwaardweg	cranium (frontalis/parietalis)	1	unknown	unknown
7	Hoogkarspel-Markerwaardweg	cranium (os parietale)	1	>18	unknown
8	Venhuizen-Voetakkers	femur diaphyse	1	>18	female?
9	Venhuizen-Voetakkers	cranium (os parietale)	5	>12	unknown
10	Hoogkarspel-Markerwaardweg	cranium (os frontalis,parietalis,occipitalis,temporalis)	28	20 to 40	male
11	Hoogkarspel-Watertoren	cranium (os parietale)	1	adult?	unknown
12	Hoogkarspel-Watertoren	cranium	2	adult?	unknown
13	Hoogkarspel-Watertoren	cranium	1	adult?	unknown
14	Wervershoof-De Ark Tumulus XIII	femur diaphyse / distale epiphyse,R tibia diaphyse	2	>18	male?
15	Andijk 1982	cranium (os parietalis with part of sutura sagitalis?)	1	12 to 25	unknown
16	Andijk 1982	cranium (L os parietalis and occipitalis)	6	3 to 12	unknown
17	Andijk 1982	cranium (R pars petrosa)	1	<18	unknown
18	Enkhuizen-De Tent	cranium	3	>18	male?
19	Enkhuizen-De Tent	R clavicle diaphyse	1	adult?	unknown
20	Enkhuizen-De Tent	R scapula	1	>35	unknown
21	Enkhuizen-De Tent	L clavicle diaphyse	1	adult?	unknown
22	Enkhuizen-De Tent	cervical vertebrae (almost complete 5th or 6th)	1	>35	unknown
23	Hoogkarspel-Houterpolder West	R humerus diaphyse	2	adult	male?
24	Hoogkarspel-Houterpolder West	cranium (os parietalis, occipitalis)	2	12 to 25	unknown
25	Hoogkarspel-Houterpolder West	L femur,tibia diaphyse	1	adult	male?
26	Andijk-Noord	L femur diaphyse	3	adult	male?
27	Andijk-Noord	complete R ulna,distal part R radius	3	adult	male?
28	Andijk-Noord	complete mandibula with teeth,cranium,L ilium	3	18 to 25	female?
29	Andijk-Noord	L femur diaphyse	1	14 to 20	unknown
30	Andijk-Noord	cranium (os occipitalis,temporalis),mandibula,R humerus,radius diaphyse,R ischium,femur,tibia,fibula diaphyse	19	30 to 50	male
31	Andijk-Noord	cranium (os frontalis)	1	30 to 50	male?
32	Andijk-Noord	cranium (os frontalis,L+R os parietalis)	21	18 to 25	female?
33	Andijk-Noord	L illium,ischium,L radius diaphyse	1	>45	female
34	Andijk-Noord	cranium (os parietalis),R tibia diaphyse,femur diaphyse	3	20 to 40	unknown
35	Andijk-Noord	cranium (L+R os temporalis including pars petrosa)	3	20 to 40	male
36	Andijk-Noord	cranium (L os frontalis)	3	12 to 25	unknown
37	Andijk-Noord	cranium (L os frontalis with part of orbita)	1	adult	unknown

Suitable for radiocarbon dating?	Suitable for DNA analysis?	Suitable for isotope analysis?	Suitable for histology?	Cutting?	Non-pathological marks?	Gnawing traces?	Description
yes	no	yes	no	no	no	no	-
yes	yes	yes	no	no	no	no	-
yes	no	yes	no	no	no	no	-
yes	no	yes	no	no	no	no	-
yes	no	yes	yes	no	no	no	-
no	no	no	no	no	no	no	-
yes	no	yes	yes	no	no	no	-
yes	no	yes	yes	possible	no	no	-
yes	no	yes	no	no	no	no	-
yes	no	yes	no	no	no	no	-
no	no	yes	no	no	no	no	-
no	no	no	no	no	no	no	second fragment burned (human?)
no	no	no	no	no	no	no	burned fragment
yes	no	yes	yes	no	possible	no	-
no	no	yes	yes	no	no	no	-
yes	no	yes	yes	no	no	no	-
no	no	yes	no	no	no	no	-
yes	yes	yes	no	no	no	no	-
yes	no	yes	yes	yes	no	no	two clear (old?) cuts
yes	no	yes	yes	yes	no	no	cavitas glenoidalis with reaction on bone (not yet arthrosis),os acromiale seems cut off (modern?)
yes	no	yes	yes	yes	no	no	small (old?) cuts
no	no	yes	no	no	no	no	degeneration intervertebral disc
yes	no	yes	yes	no	no	no	-
yes	no	yes	yes	no	no	no	-
yes	no	yes	yes	yes	yes	no	small cuts at joint end
yes	no	yes	yes	no	yes	no	-
yes	no	yes	yes	no	yes	no	non-pathological marks on ulna,no cutting
yes	yes	yes	yes	no	no	no	-
yes	no	yes	yes	no	yes	no	-
yes	no	yes	yes	no	no	no	-
yes	yes	yes	yes	no	no	no	In same find number fragments cranium (L os temporalis with pars petrosa),complete R femur (same ID?)
yes	no	yes	yes	no	no	no	-
yes	no	yes	yes	no	no	no	-
yes	no	yes	yes	possible	yes	no	non-pathological marks on both diaphyse, possible cuts on tibia diaphyse
yes	yes	yes	no	no	no	no	-
no	no	yes	yes	no	yes	no	-
no	no	yes	no	no	no	no	-

Individual (ID)	Site	Element	Number of fragments	Age	Sex
38	Andijk-Noord	cranium (os frontalis with both orbita)	1	adult	male
39	Andijk-Noord	radius diaphyse	1	>35	unknown
40	Andijk-Noord	cranium (L os occipitalis)	3	18 to 25	unknown
41	Andijk Zuid	L humerus diaphyse	1	13 to 18	unknown
42	Bovenkarspel-Het Valkje	sacrum	1	>35	male?
43	Bovenkarspel-Het Valkje	cranium (R os temporalis with pars petrosa)	1	adult	male?
44	Hoogkarspel-Houterpolder West	cranium (os frontalis,L+R parietalis)	21	30 to 50	male?
45	Enkhuizen-Haling	L femur diaphyse	1	adult	male?
46	Hoogkarspel-Hoogkarspeltunnel	cranium (L os parietalis)	6	<18	unknown
47	Enkhuizen-Kadijken	cranium (os parietalis)	3	20 to 40	unknown
48	Enkhuizen-Kadijken	R tibia diaphyse	1	adult	male?
49	Enkhuizen-Kadijken	complete R radius	1	adult	unknown
50	Enkhuizen-Kadijken	complete premolar mandibula (element 35)	1	18 to 25	unknown
51	Enkhuizen-Kadijken	R radius diaphyse	1	adult	male?
52	Enkhuizen-Kadijken	molar maxilla (element 18 or 17)	1	12 to 25	unknown
53	Andijk Zuid (2011)	pelvis (L ischum and ilium)	1	20 to 29	female?
54	Enkhuizen-Kadijken	cranium (L+R os parietalis)	7	20 to 40	unknown
55	Enkhuizen-Kadijken	femur epihyse	1	>14	unknown
56	Enkhuizen-Kadijken	R fibula diaphyse	1	adult	unknown
57	Enkhuizen-Kadijken	cranium (os occipitalis)	3	18 to 25	unknown
58	Enkhuizen-Kadijken	scapula,pelvis (ilium),femur	3	0	unknown
59	Enkhuizen-Kadijken	R humerus diaphyse	1	adult	male?
60	Grootebroek-Waterweide Noord	femur	1	unknown	unknown
61	Grootebroek-Waterweide Noord	R femur diaphyse	1	adult	male?
62	Andijk-Noord	complete R femur	2	adult	male?
63	Andijk-Noord	L femur,R femur	2	4 to 8	unknown

Suitable for radiocarbon dating?	Suitable for DNA analysis?	Suitable for isotope analysis?	Suitable for histology?	Cutting?	Non-pathological marks?	Gnawing traces?	Description
yes	no	yes	no	no	no	no	-
yes	no	yes	yes	possible	no	no	-
yes	no	yes	yes	no	no	no	-
yes	no	yes	yes	no	yes	no	-
yes	no	yes	no	no	no	no	degenerative S1 and auricular joint
yes	yes	yes	no	no	no	no	-
yes	no	yes	yes	no	no	no	-
yes	no	yes	yes	no	yes	no	-
no	no	yes	yes	no	no	no	-
yes	no	yes	yes	no	no	no	-
yes	no	yes	yes	no	no	possible	-
yes	no	yes	yes	no	no	no	-
no	yes	yes	no	no	no	no	-
yes	no	yes	yes	no	no	no	-
no	yes	yes	no	no	no	no	-
yes	no	yes	yes	no	no	no	-
yes	no	yes	yes	no	no	no	-
no	no	no	no	no	no	no	-
yes	no	yes	yes	no	yes	possible	-
yes	no	yes	no	no	no	no	-
no	no	yes	no	no	no	no	-
yes	no	yes	yes	possible	yes	no	cortecal defect bone surface
yes	no	yes	yes	no	no	no	-
yes	no	yes	yes	yes	no	no	small cuts proximal just next to linea aspera
yes	no	yes	yes	no	yes	no	-
yes	no	yes	no	no	no	no	-

VI Spectra samples SEM analysis

Fig. 1. Image of ID8 mounted on the SEM sample holder.

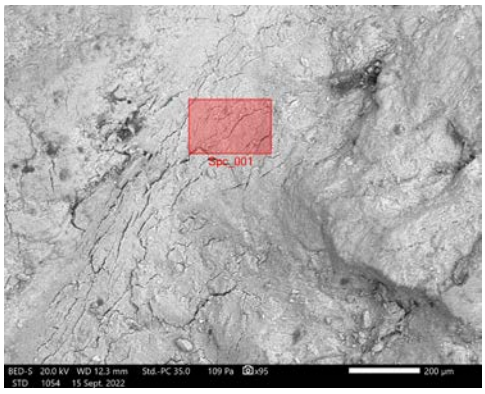

Fig. 2. Backscattered Electron image of the surface of ID8, analysis area 001 is indicated.

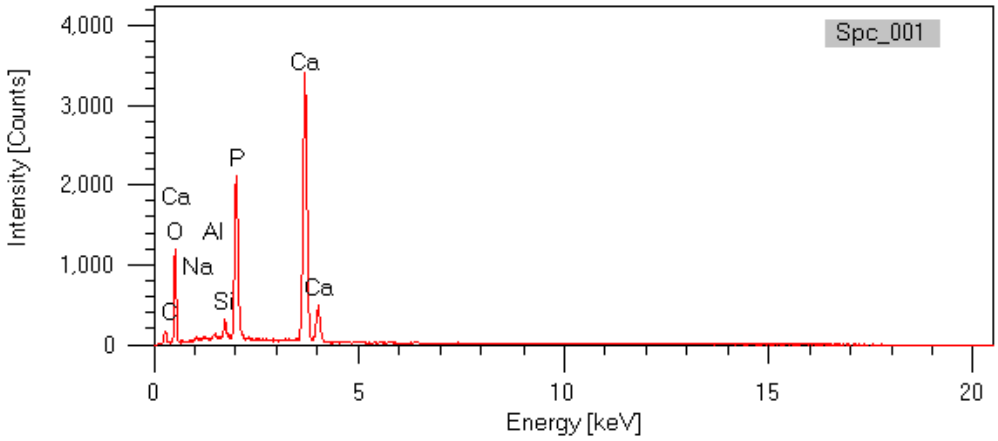

Fig. 3. Energy Dispersive X-ray spectrum of analysis 001 (ID8).

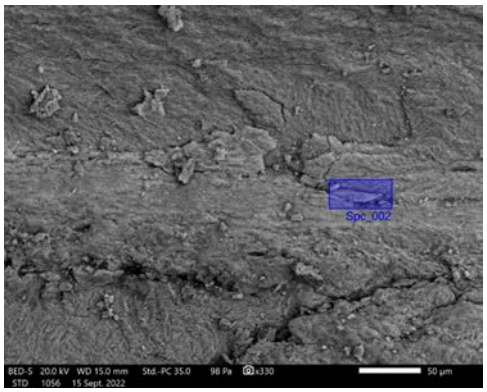

Fig. 4. Backscattered Electron image of the surface of ID8, analysis area 002 is indicated.

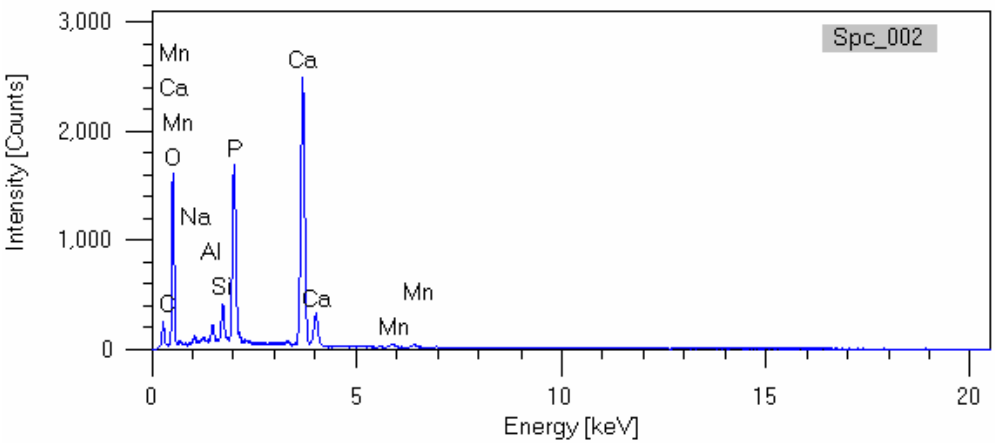

Fig. 5. Energy Dispersive X-ray spectrum of area 002 (ID8).

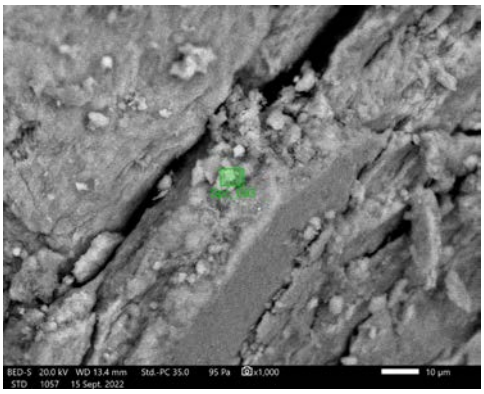

Fig. 6. Backscattered Electron image of the surface of ID8, analysis area 003 is indicated.

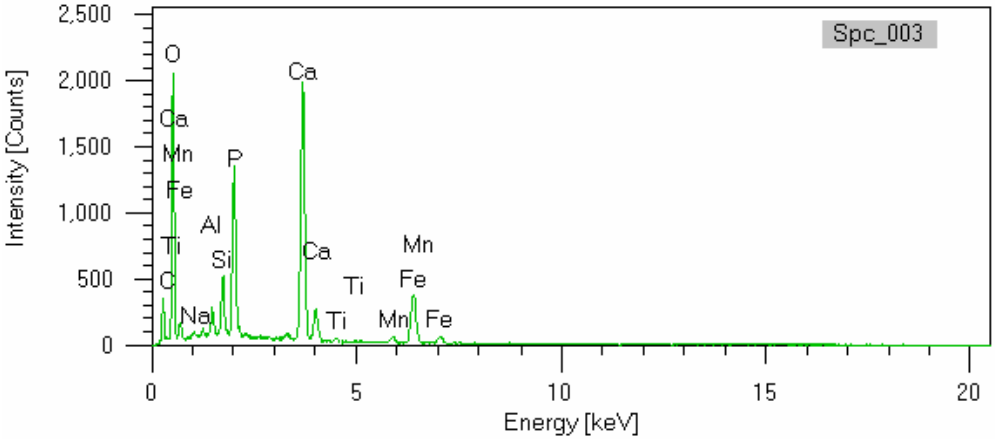

Fig. 7. Energy Dispersive X-ray spectrum of area 003 (ID8).

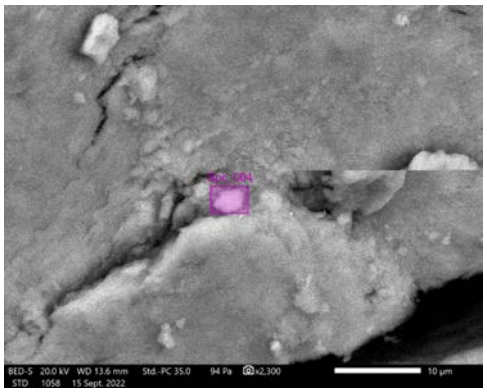

Fig. 8. Backscattered Electron image of the surface of ID8, analysis area 004 is indicated.

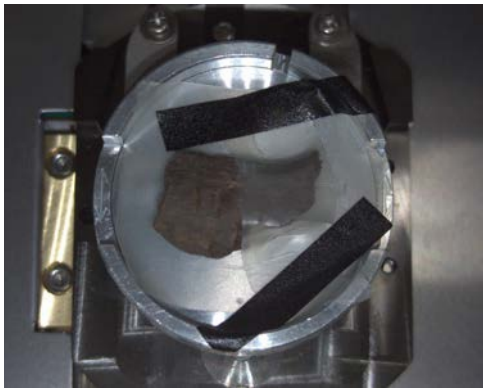

Fig. 9. Image of ID19 mounted on the SEM sample holder.

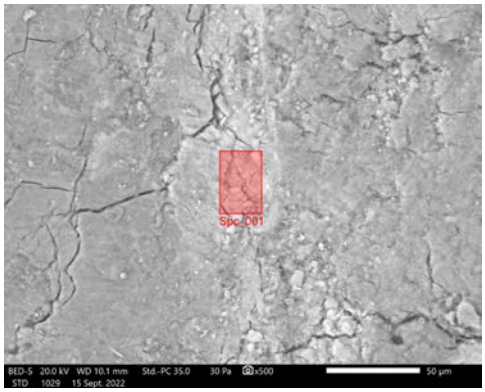

Fig. 10. Backscattered Electron image of the surface of ID19, analysis area 1 is indicated.

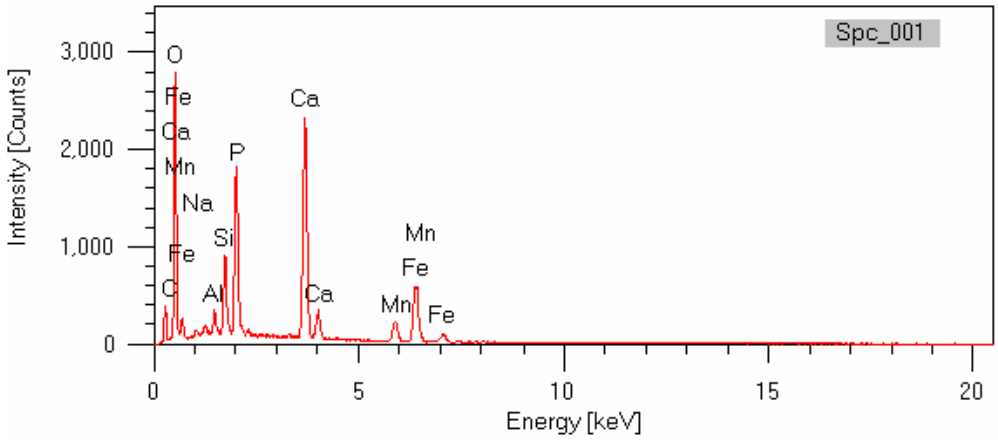

Fig. 11. Energy Dispersive X-ray spectrum of analysis area 001 (ID19).

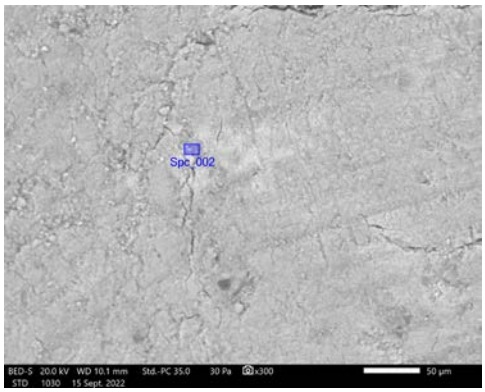

Fig. 12. Backscattered Electron image of the surface of ID19, analysis area 002 is indicated.

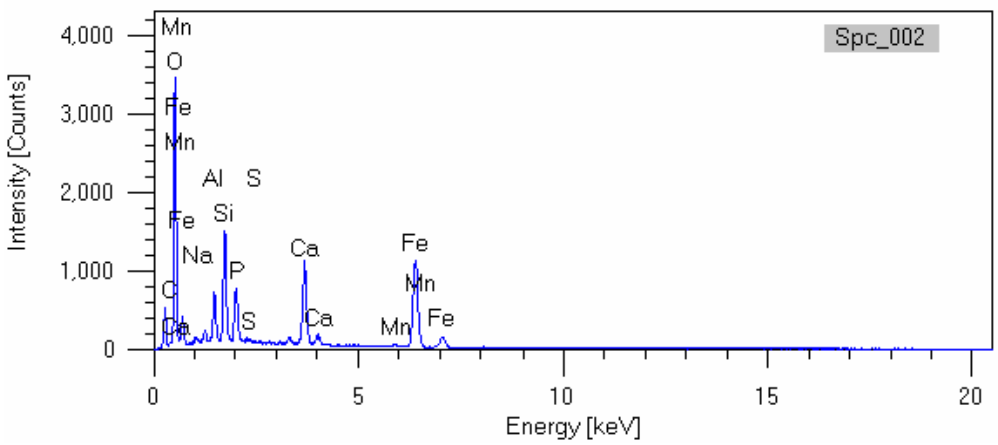

Fig. 13. Energy Dispersive X-ray spectrum of analysis 002 (ID19).

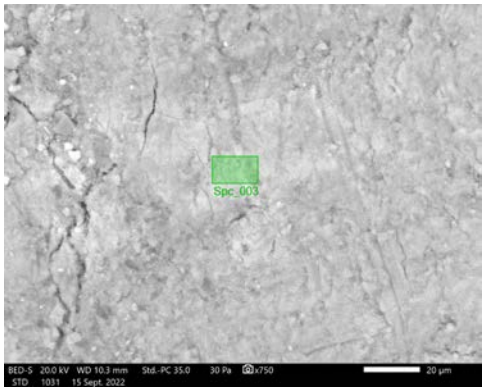

Fig. 14. Backscattered Electron image of the surface of ID19, analysis area 003 is indicated.

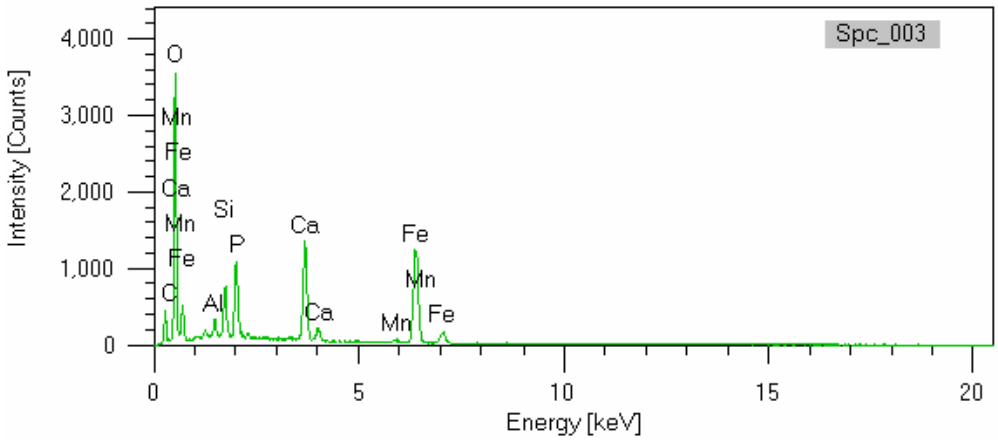

Fig. 15. Energy Dispersive X-ray spectrum of analysis 003 (ID19).

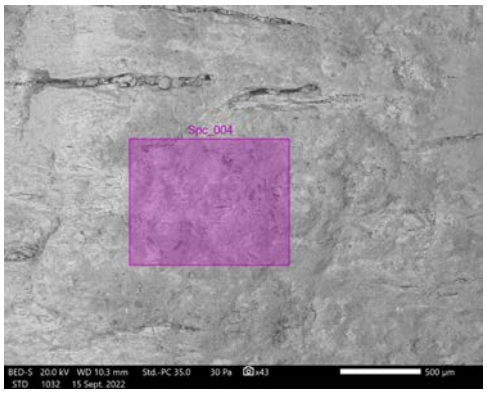

Fig. 16. Backscattered Electron image of the surface of ID19, analysis area 004 is indicated.

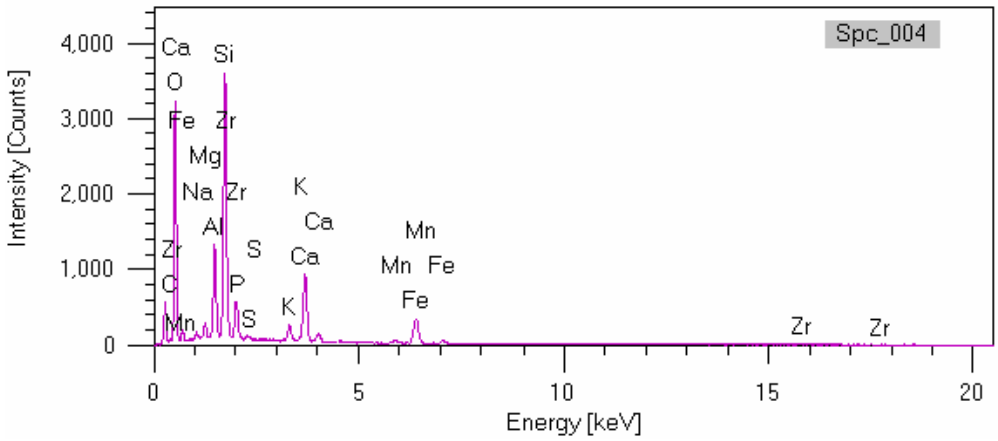

Fig. 17. Energy Dispersive X-ray spectrum of analysis 004 (ID19).

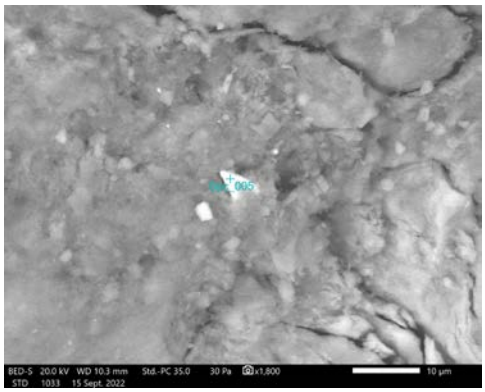

Fig. 18. Backscattered Electron image of ID19, analysis area 005 is indicated.

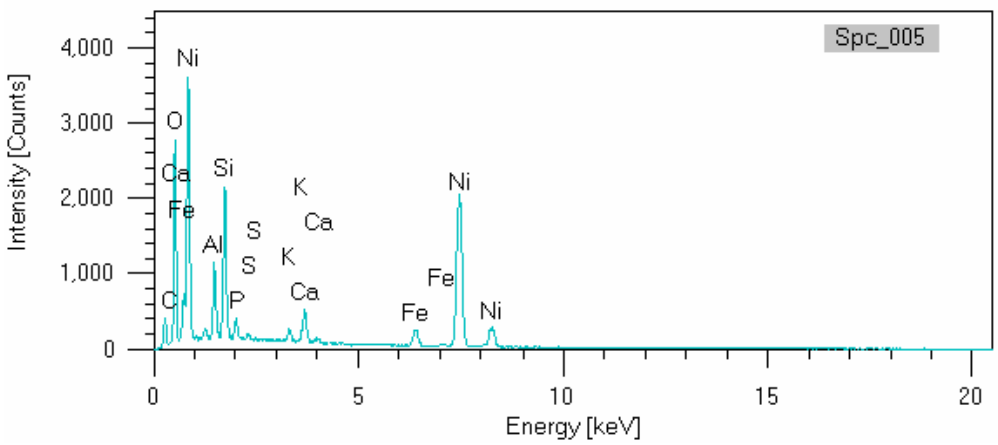

Fig. 19. Energy Dispersive X-ray spectrum of analysis 005 (ID19).

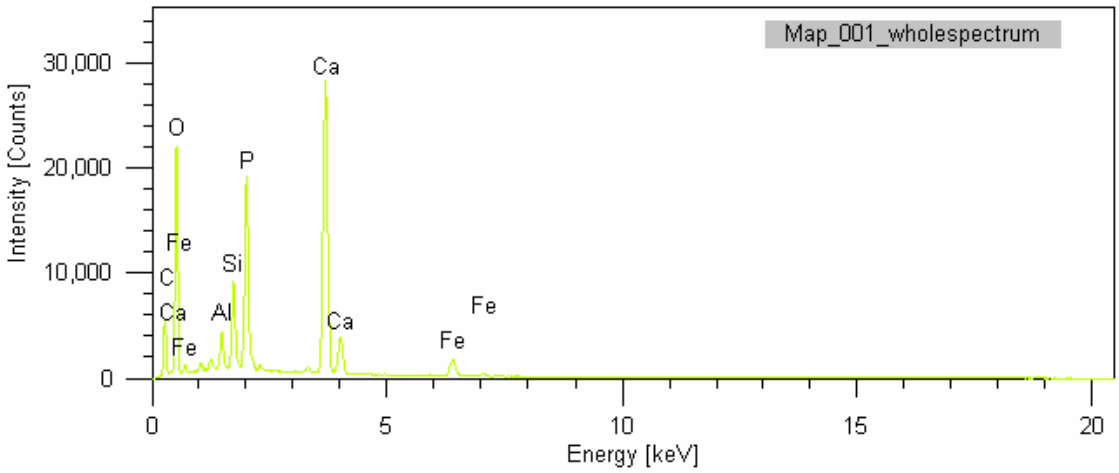

Fig. 20. Energy Dispersive X-ray spectrum of mapping 001 (ID19).

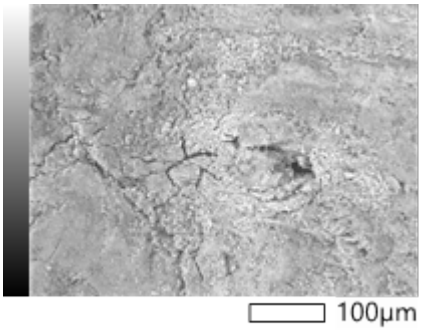

Fig. 21. Backscattered Electron image of mapped area 001 after the mapping (ID19).

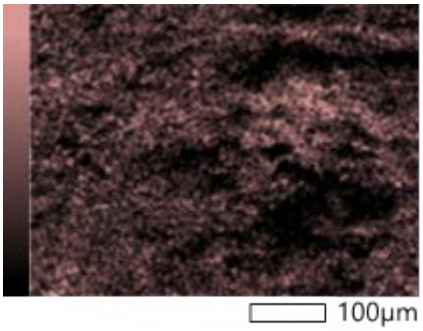

Fig. 24. Energy Dispersive X-ray false-color map by O-K emission (ID19).

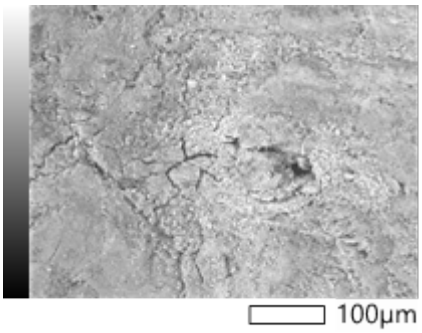

Fig. 22. Backscattered Electron image of the mapped area before the mapping (ID19).

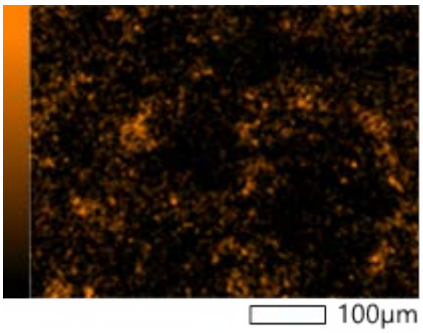

Fig. 25. Energy Dispersive X-ray false-color map by Al-K emission (ID19).

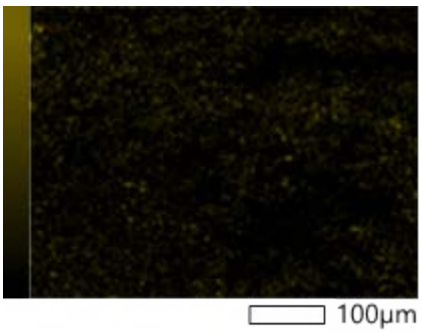

Fig. 23. Energy Dispersive X-ray false-color map by C-K emission (ID19).

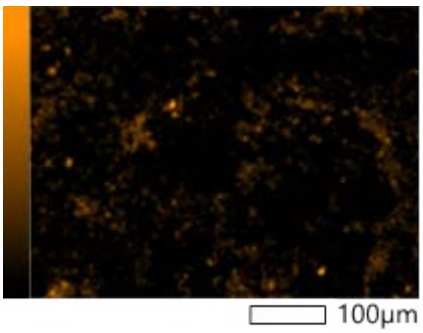

Fig. 26. Energy Dispersive X-ray false-color map by Si-K emission (ID19).

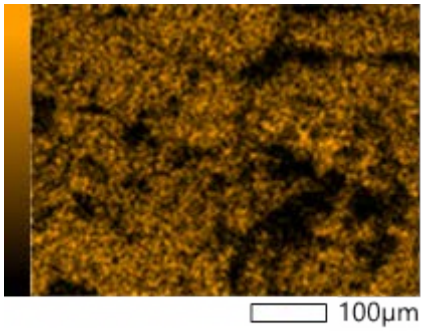

Fig. 27. Energy Dispersive X-ray false-color map by P-K emission (ID19).

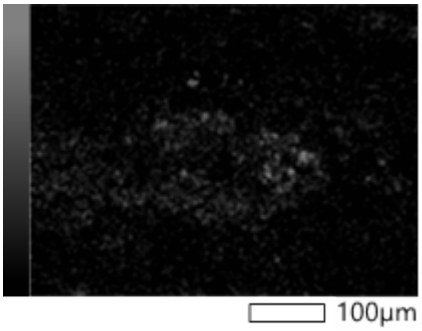

Fig. 29. Energy Dispersive X-ray false-color map by Fe-K emission (ID19).

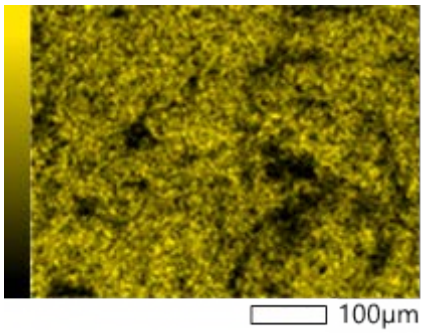

Fig. 28. Energy Dispersive X-ray false-color map by Ca-K emission (ID19).

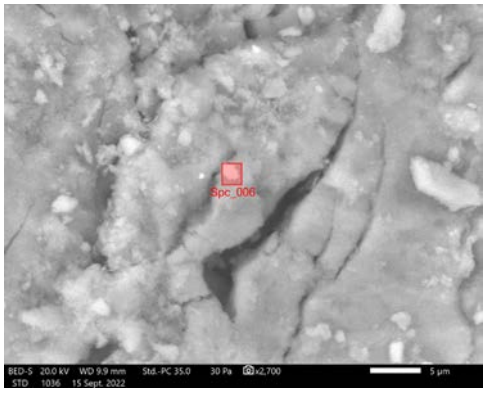

Fig. 30. Backscattered Electron image of ID19, analysis area 006 is indicated.

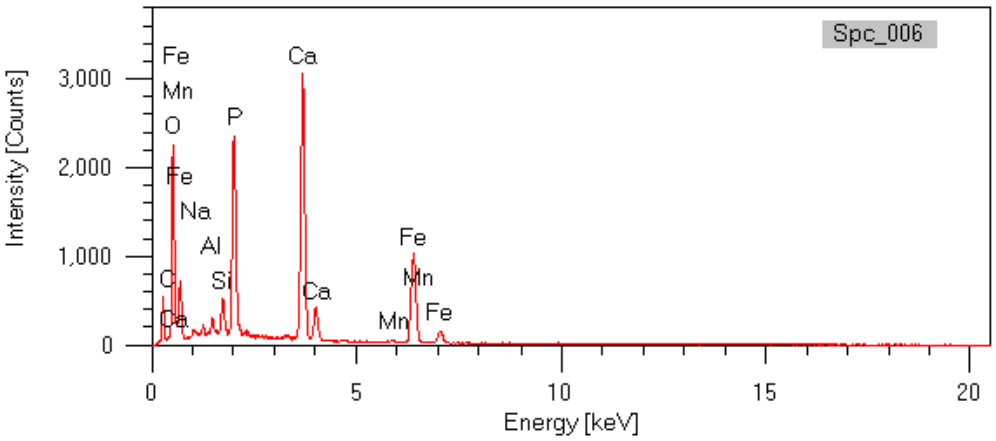

Fig. 31. Energy Dispersive X-ray spectrum of analysis 006 (ID19).

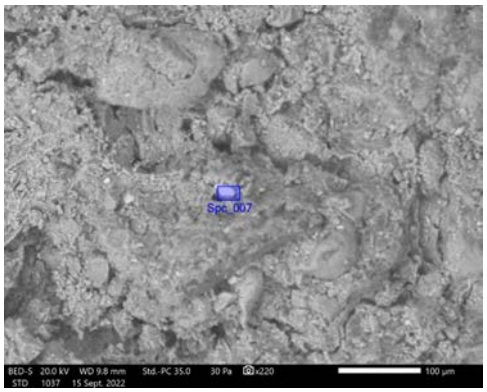

Fig. 32. Backscattered Electron image of ID19, analysis area 007 is indicated.

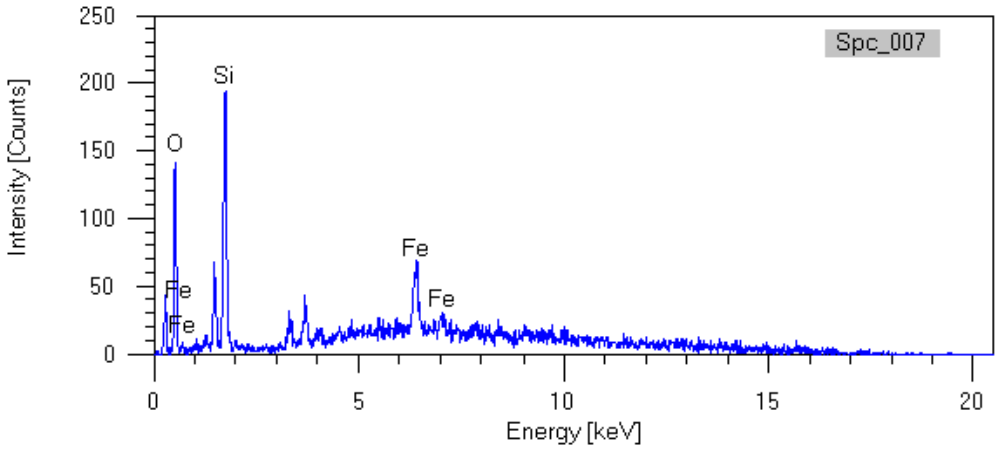

Fig. 33. Energy Dispersive X-ray spectrum of analysis 007 (ID19).

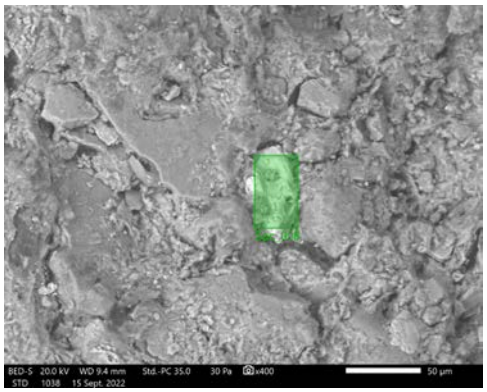

Fig. 34. Backscattered Electron image of ID19, analysis area 008 is indicated.

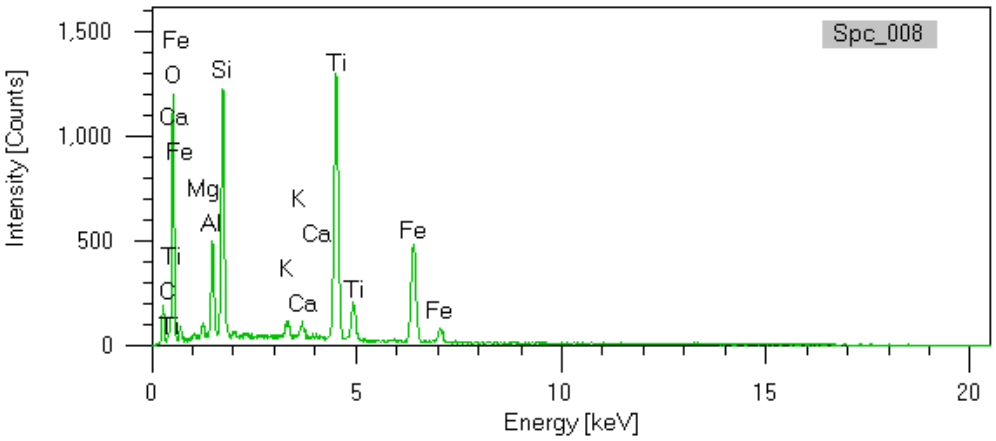

Fig. 35. Energy Dispersive X-ray spectrum of analysis 008 (ID19).

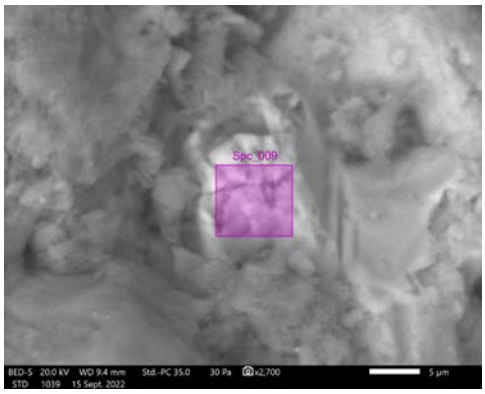

Fig. 36. Backscattered Electron image of ID19, analysis area 009 is indicated.

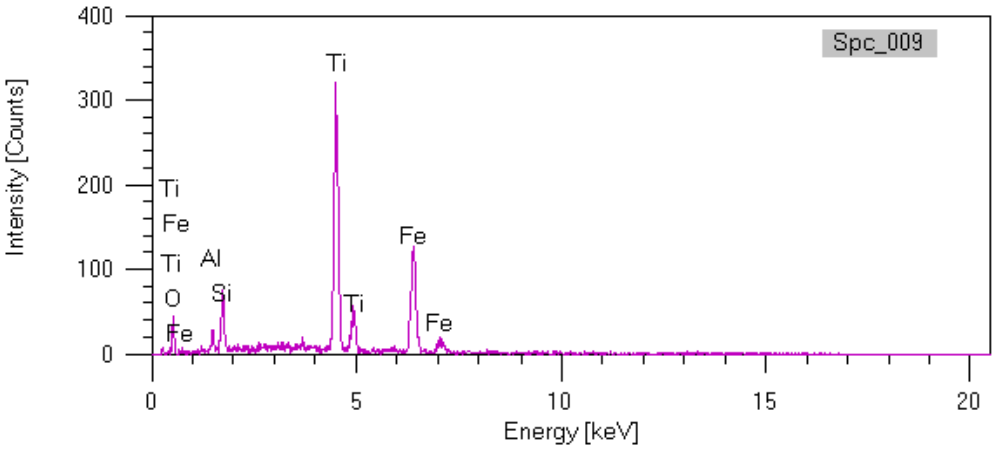

Fig. 37. Energy Dispersive X-ray spectrum of analysis 009 (ID19).

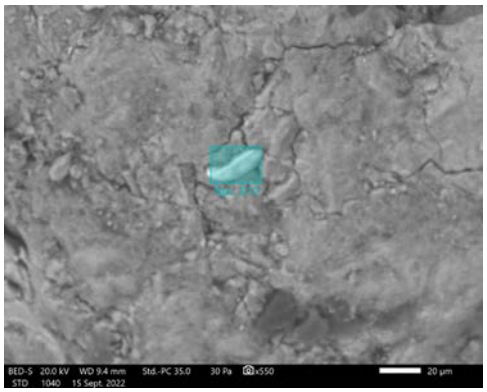

Fig. 38. Backscattered Electron image of ID19, analysis area 010 is indicated.

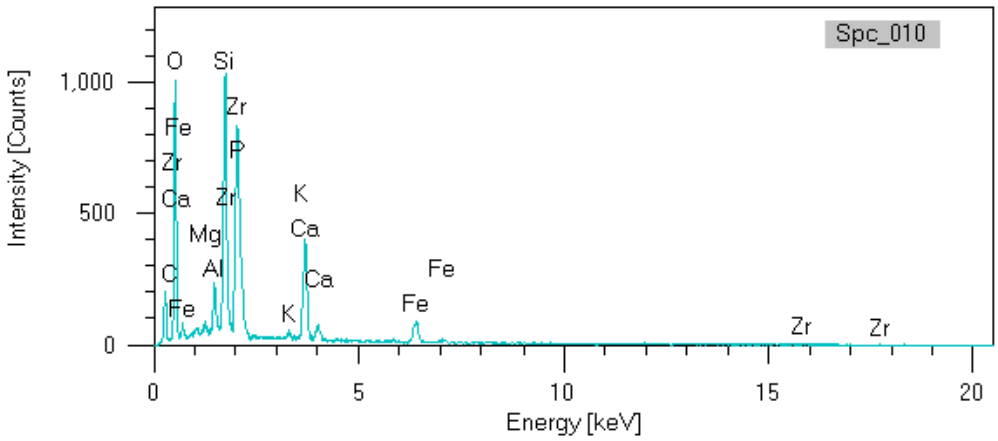

Fig. 39. Energy Dispersive X-ray spectrum of analysis 010 (ID19).

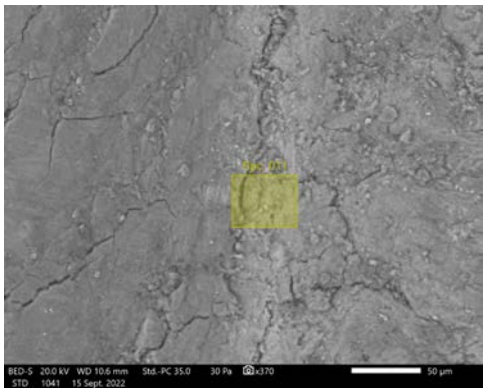

Fig. 40. Backscattered Electron image of ID19, analysis area 011 is indicated.

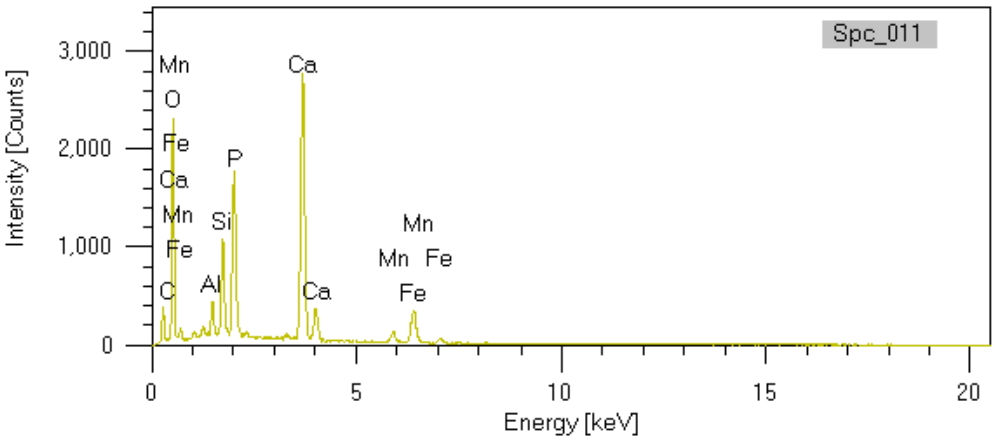

Fig. 41. Energy Dispersive X-ray spectrum of analysis 011 (ID19).

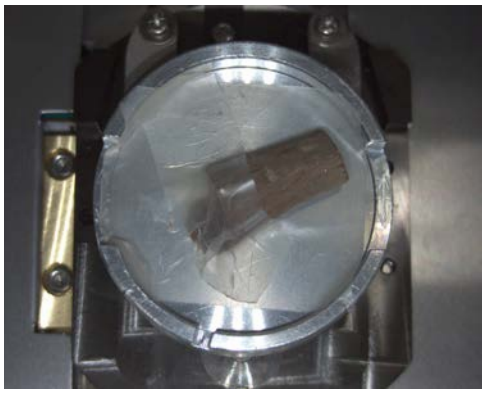

Fig. 42. Image of ID21 mounted on the SEM sample holder.

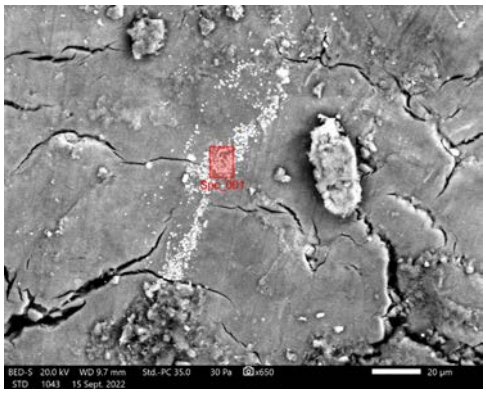

Fig. 43. Backscattered Electron image of the surface of ID21, analysis area 001 is indicated.

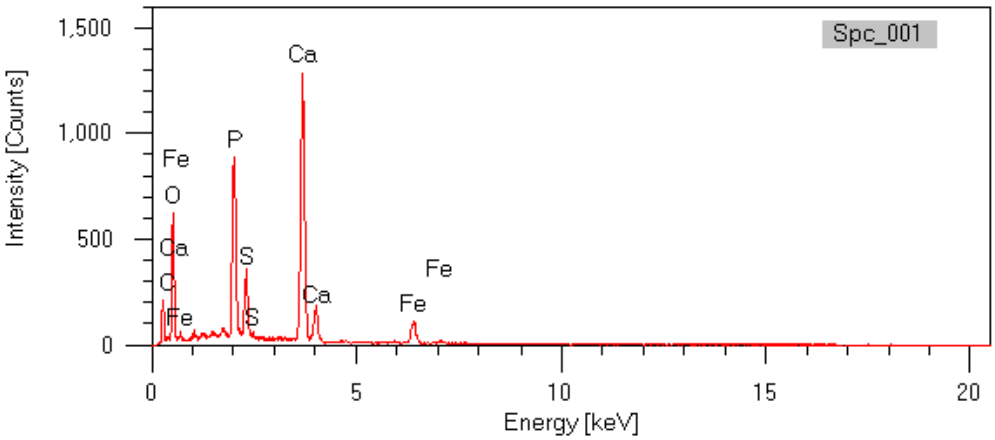

Fig. 44. Energy Dispersive X-ray spectrum of analysis 001 (ID21).

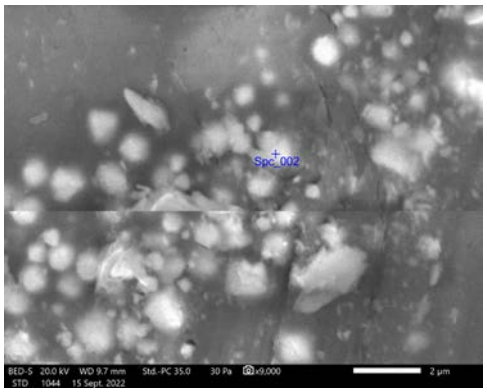

Fig. 45. Backscattered Electron image of the surface of ID21, analysis area 002 is indicated.

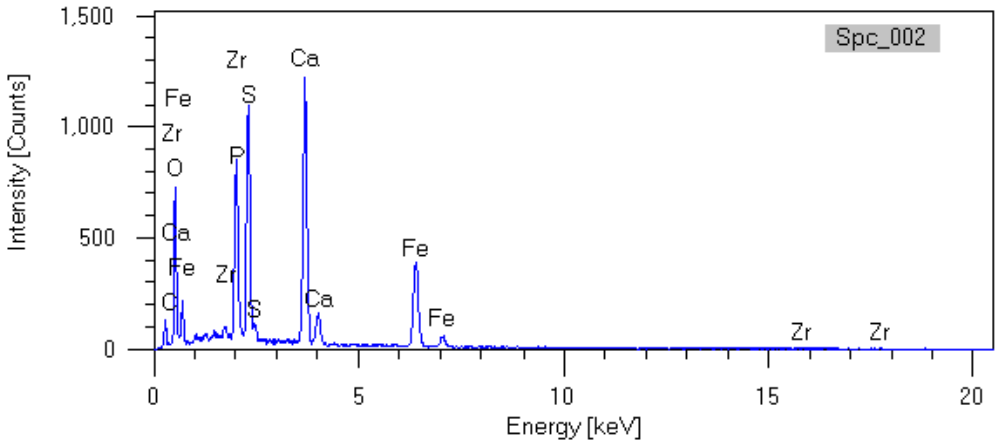

Fig. 46. Energy Dispersive X-ray spectrum of analysis 002 (ID21).

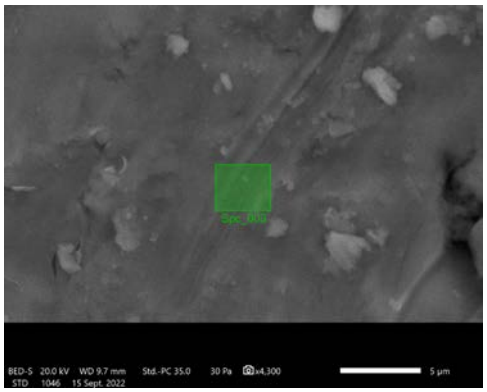

Fig. 47. Backscattered Electron image of the surface of ID21, analysis area 003 is indicated.

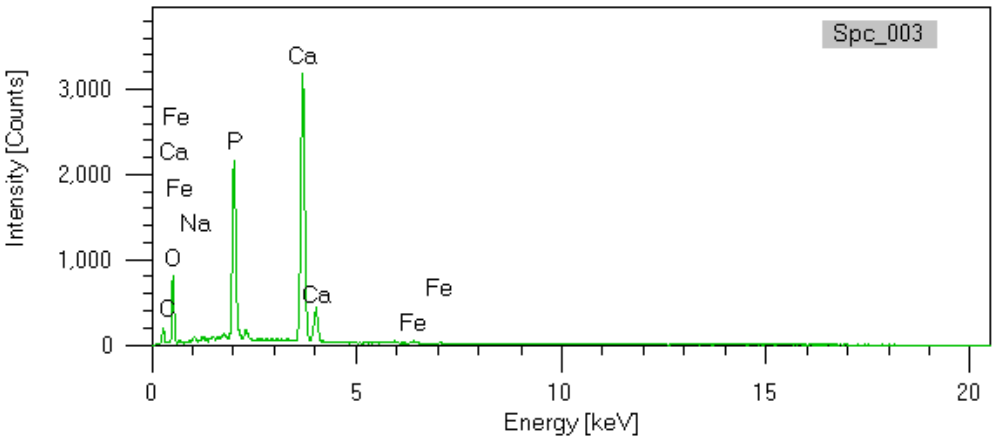

Fig. 48. Energy Dispersive X-ray spectrum of analysis 003 (ID21).

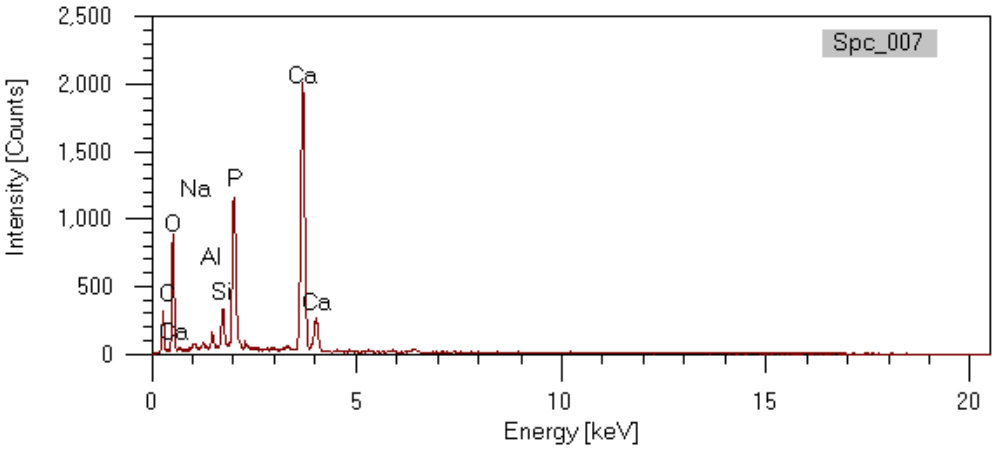

Fig. 49. Backscattered Electron image of the surface of ID21, analysis area 004 is indicated.

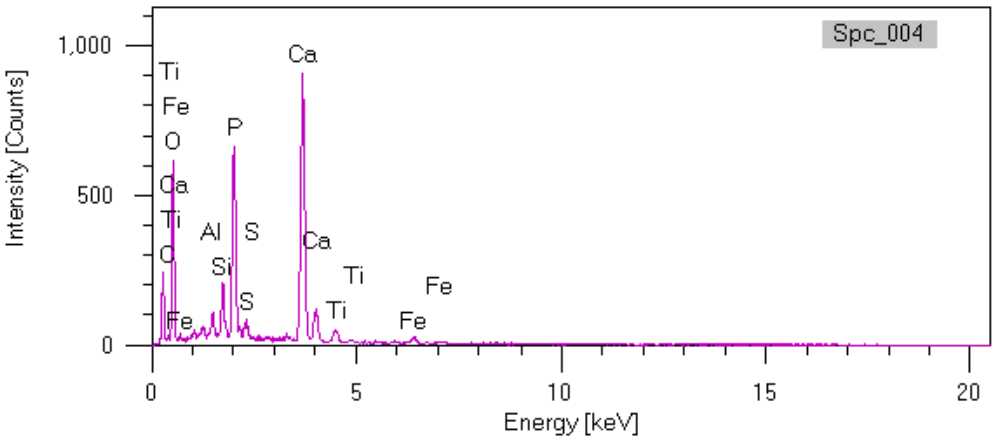

Fig. 50. Energy Dispersive X-ray spectrum of analysis 004 (ID21).

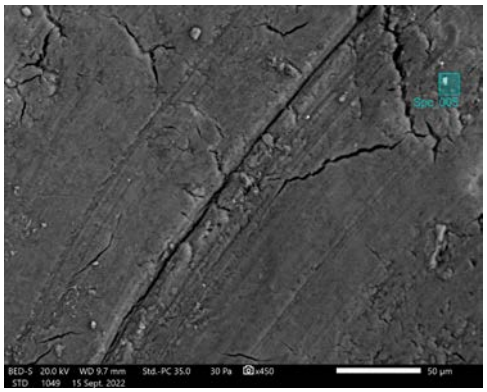

Fig. 51. Backscattered Electron image of the surface of ID21, analysis area 005 is indicated.

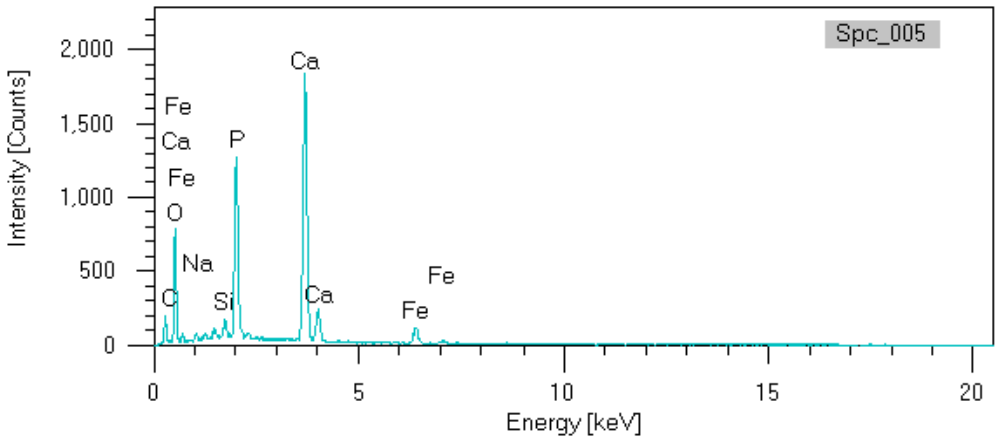

Fig. 52. Energy Dispersive X-ray spectrum of analysis 005 (ID21).

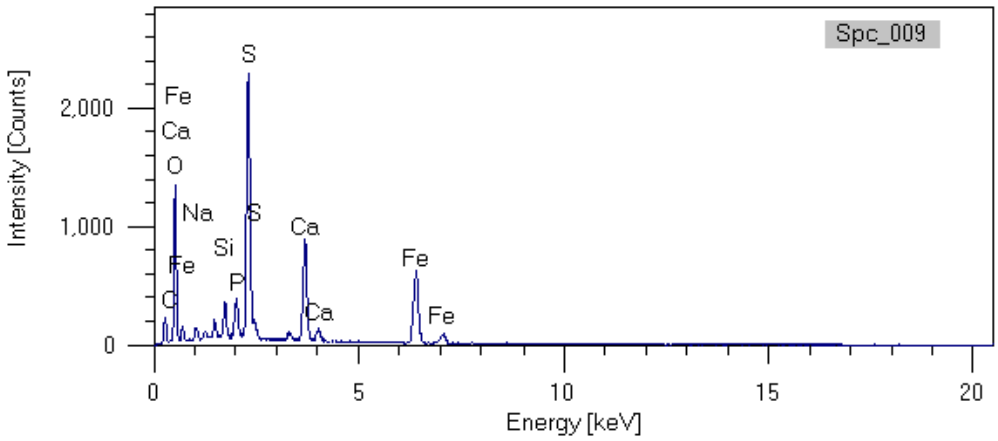

Fig. 53. Backscattered Electron image of the surface of ID21, analysis area 006 is indicated.

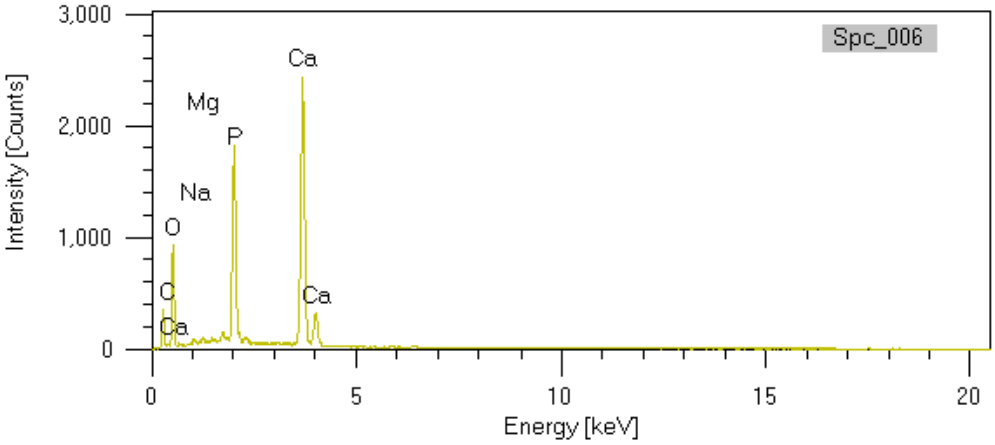

Fig. 54. Energy Dispersive X-ray spectrum of analysis 006 (ID21).

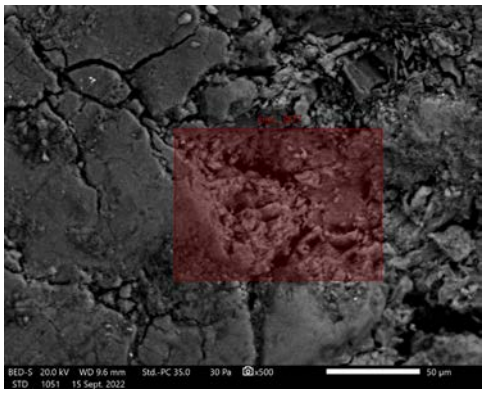

Fig. 55. Backscattered Electron image of the surface of ID21, analysis area 007 is indicated.

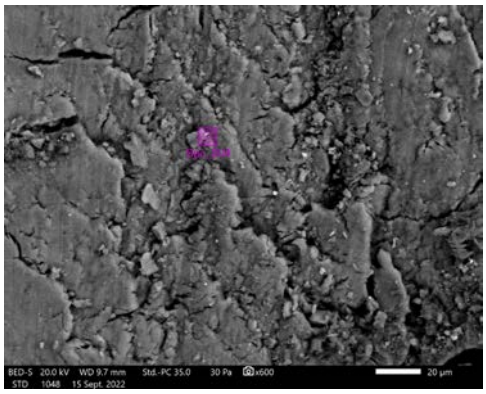

Fig. 56. Energy Dispersive X-ray spectrum of analysis 007 (ID21).

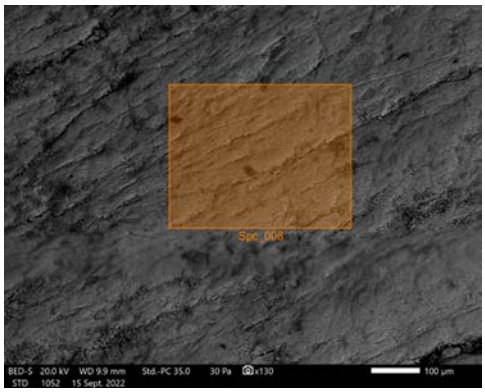

Fig. 57. Backscattered Electron image of the surface of ID21, analysis area 008 is indicated.

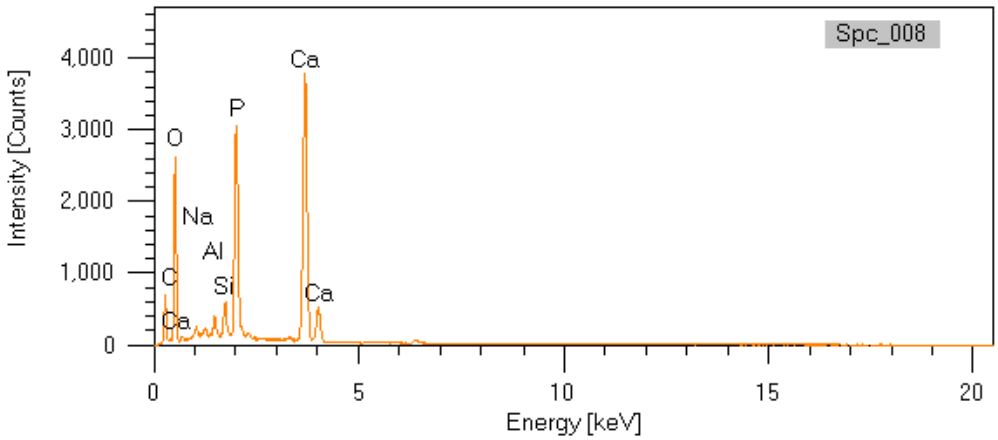

Fig. 58. Energy Dispersive X-ray spectrum of analysis 008 (ID21).

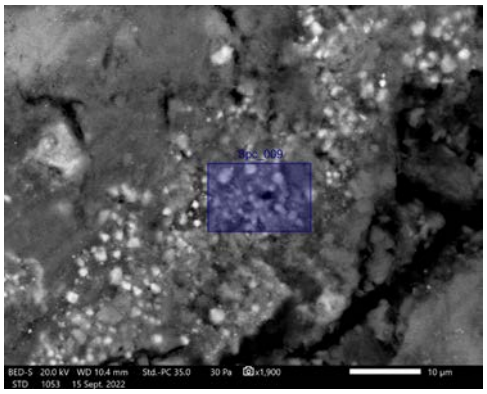

Fig. 59. Backscattered Electron image of the surface of ID21, analysis area 009 is indicated.

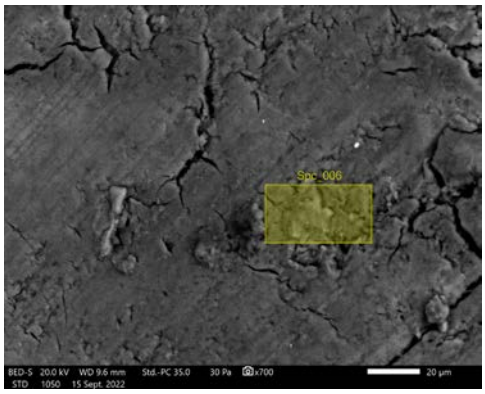

Fig. 60. Energy Dispersive X-ray spectrum of analysis 009 (ID21).

VII Catalogue studied disarticulated human bones

Andijk-1982

ID15-17

Figure 1. The site 'Andijk 1982'. The exact location of the human remains is unknown.

ID	ID15
Site	Andijk-1982
Town	Andijk
Municipality	Medemblik
Coordinates	144.550/525.950
Excavation company	IPP
Year of excavation	1982
Find nr	3
Trench nr	-
Level nr	-
Feature nr	-
Type of feature	Ring ditch
Structure	-
Context date	Middle Bronze Age
Context date based on	Pottery and radiocarbon date ID16
Skeleton element	Cranium (os parietalis including part of the sutura sagitalis)
Number of elements	1
Sex	Unknown
Age	12-25
Radiocarbon date element	-
Remarks	Could be same individual as ID16
Additional analysis	-
Literature	Metz, W.H., 1983: *Andijk, Archeologische Kroniek Noord-Holland over 1982*, 201. Metz, W.H., 1993: *Luchtfoto-archeologie in oostelijk West-Friesland. Mogelijkheden en resultaten van archeologische Remote Sensing in een verdwijnend prehistorisch cultuurlandschap*, Amsterdam (PhD thesis Amsterdam University), 190-197. Runia, L.T., 1987: The chemical analysis of prehistoric bones. A paleodietary and ecoarcheological study of Bronze Age West-Friesland, *BAR International Series* 363, 232.

ID	**ID16**
Site	Andijk-1982
Town	Andijk
Municipality	Medemblik
Coordinates	144.550/525.950
Excavation company	IPP
Year of excavation	1982
Find nr	39
Trench nr	-
Level nr	-
Feature nr	-
Type of feature	Ring ditch
Structure	-
Context date	Middle Bronze Age
Context date based on	Pottery and radiocarbon date ID15
Skeleton element	Cranium (os parietalis (left) and occipitalis)
Number of elements	10
Sex	Unknown
Age	3-12
Radiocarbon date element	Poz-147608: 3000±30BP (1381-1124 cal BC)
Remarks	Could be same individual as ID15
Additional analysis	Radiocarbon dating
Literature	Metz, W.H., 1983: *Andijk, Archeologische Kroniek Noord-Holland over 1982*, 201. Metz, W.H., 1993: *Luchtfoto-archeologie in oostelijk West-Friesland. Mogelijkheden en resultaten van archeologische Remote Sensing in een verdwijnend prehistorisch cultuurlandschap*, Amsterdam (PhD thesis Amsterdam University), 190-197. Runia, L.T., 1987: The chemical analysis of prehistoric bones. A paleodietary and ecoarcheological study of Bronze Age West-Friesland, *BAR International Series* 363, 232.

ID	ID17
Site	Andijk-1982
Town	Andijk
Municipality	Medemblik
Coordinates	144.550/525.950
Excavation company	IPP
Year of excavation	1982
Find nr	45
Trench nr	-
Level nr	-
Feature nr	-
Type of feature	Ring ditch
Structure	-
Context date	Middle Bronze Age
Context date based on	Pottery and radiocarbon date ID15
Skeleton element	Cranium (os parietalis (left) and occipitalis)
Number of elements	1
Sex	Unknown
Age	Young adult
Radiocarbon date element	-
Remarks	Could be same individual as ID15
Additional analysis	-
Literature	Metz, W.H., 1983: *Andijk, Archeologische Kroniek Noord-Holland over 1982*, 201. Metz, W.H., 1993: *Luchtfoto-archeologie in oostelijk West-Friesland. Mogelijkheden en resultaten van archeologische Remote Sensing in een verdwijnend prehistorisch cultuurlandschap*, Amsterdam (PhD thesis Amsterdam University), 190-197. Runia, L.T., 1987: The chemical analysis of prehistoric bones. A paleodietary and ecoarcheological study of Bronze Age West-Friesland, *BAR International Series* 363, 232.

Andijk-Noord

ID26-40, ID62 & ID63

Figure 2. The site 'Andijk-Noord' and the location of the analysed human remains.

ID	ID26
Site	Andijk-Noord
Town	Andijk
Municipality	Medemblik
Coordinates	142.571/528.587
Excavation company	ROB
Year of excavation	1973
Find nr	39
Trench nr	3
Level nr	1
Feature nr	-
Type of feature	Ring ditch
Structure	GRH02c
Context date	Middle Bronze Age
Context date based on	Pottery and radiocarbon dates on bones (ID26, ID29 & ID62)
Skeleton element	Femur (left) diaphysis including proximal epiphysis
Number of elements	1
Sex	Male (?)
Age	Adult
Radiocarbon date element	Poz-147690: 3230±35BP (1607-1421 cal BC)
Remarks	Traces of (non-pathological) marks
Additional analysis	Radiocarbon dating
Literature	Aal, J.H.J.M., 2015: *Between animals and bones. Reconstructing human behaviour by analysing taphonomic markers on osteological remains from Bronze Age settlement sites near Andijk, the Netherlands*, Leiden (Master thesis University Leiden), 110. Roessingh, W., 2018: *Dynamiek in beeld. Onderzoek van Westfriese nederzettingen uit de bronstijd*, Leiden (PhD thesis Leiden University), 177. Runia, L.T., 1987: The chemical analysis of prehistoric bones. A paleodietary and ecoarcheological study of Bronze Age West-Friesland, *BAR International Series* 363, 228.

ID	ID27
Site	Andijk-Noord
Town	Andijk
Municipality	Medemblik
Coordinates	142.569/528.602
Excavation company	ROB
Year of excavation	1973
Find nr	44
Trench nr	3
Level nr	1
Feature nr	-
Type of feature	Ring ditch
Structure	GRH02c
Context date	Middle Bronze Age
Context date based on	Pottery and radiocarbon dates on bones (ID26, ID29 & ID62)
Skeleton element	Ulna complete (right), Radius diaphysis and distal epiphysis (right)
Number of elements	6
Sex	Male (?)
Age	Adult
Radiocarbon date element	-
Remarks	Traces of (non pathological) marks on fragment ulna
Additional analysis	Microwear analysis: (old?) trace (unknown tool) or scratch
Literature	Aal, J.H.J.M., 2015: *Between animals and bones. Reconstructing human behaviour by analysing taphonomic markers on osteological remains from Bronze Age settlement sites near Andijk, the Netherlands*, Leiden (Master thesis University Leiden, 110. Roessingh, W., 2018: *Dynamiek in beeld. Onderzoek van Westfriese nederzettingen uit de bronstijd*, Leiden (PhD thesis Leiden University), 177. Runia, L.T., 1987: The chemical analysis of prehistoric bones. A paleodietary and ecoarcheological study of Bronze Age West-Friesland, *BAR International Series* 363, 228.

ID	ID28
Site	Andijk-Noord
Town	Andijk
Municipality	Medemblik
Coordinates	142.578/528.587
Excavation company	ROB
Year of excavation	1973
Find nr	46
Trench nr	3
Level nr	1
Feature nr	-
Type of feature	Ring ditch
Structure	GRH02c
Context date	Middle Bronze Age
Context date based on	Pottery and radiocarbon dates on bones (ID26, ID29 & ID62)
Skeleton element	Mandibula complete including six dental elements, cranium, illium (left)
Number of elements	3
Sex	Unknown
Age	18-25
Radiocarbon date element	-
Remarks	DNA analysis possible
Additional analysis	-
Literature	Aal, J.H.J.M., 2015: *Between animals and bones. Reconstructing human behaviour by analysing taphonomic markers on osteological remains from Bronze Age settlement sites near Andijk, the Netherlands*, Leiden (Master thesis University Leiden), 111. Roessingh, W., 2018: *Dynamiek in beeld. Onderzoek van Westfriese nederzettingen uit de bronstijd*, Leiden (PhD thesis Leiden University), 177. Runia, L.T., 1987: The chemical analysis of prehistoric bones. A paleodietary and ecoarcheological study of Bronze Age West-Friesland, *BAR International Series* 363, 228.

ID	ID29
Site	Andijk-Noord
Town	Andijk
Municipality	Medemblik
Coordinates	142.577/528.606
Excavation company	ROB
Year of excavation	1973
Find nr	45
Trench nr	3
Level nr	1
Feature nr	-
Type of feature	Ring ditch
Structure	GRH02c
Context date	Middle Bronze Age
Context date based on	Pottery and radiocarbon dates on bones (ID26, ID29 & ID62)
Skeleton element	Femur (left) diaphysis
Number of elements	1
Sex	Unknown
Age	14-20
Radiocarbon date element	GrN-11971: 3055±30 (1410-1220 cal BC)
Remarks	Traces of (non pathological) marks
Additional analysis	Microwear analysis: modern traces (spade); preservation analysis: Behrensmeyer score 4; luminescence analysis: undeterminable
Literature	Aal, J.H.J.M., 2015: *Between animals and bones. Reconstructing human behaviour by analysing taphonomic markers on osteological remains from Bronze Age settlement sites near Andijk, the Netherlands*, Leiden (Master thesis University Leiden), 110. Roessingh, W., 2018: *Dynamiek in beeld. Onderzoek van Westfriese nederzettingen uit de bronstijd*, Leiden (PhD thesis Leiden University), 177. Runia, L.T., 1987: The chemical analysis of prehistoric bones. A paleodietary and ecoarcheological study of Bronze Age West-Friesland, *BAR International Series* 363, 228.

ID	ID30
Site	Andijk-Noord
Town	Andijk
Municipality	Medemblik
Coordinates	142.583/528.597
Excavation company	ROB
Year of excavation	1973
Find nr	62
Trench nr	3
Level nr	1
Feature nr	-
Type of feature	Ring ditch
Structure	GRH02c
Context date	Middle bronze Age
Context date based on	Pottery and radiocarbon dates on bones (ID26, ID29 & ID62)
Skeleton element	Cranium (os occipitalis, temporalis), mandibula, humerus diaphysis (right), radius diaphysis including distal epiphysis (right), ischium (right), femur, tibia, fibula diaphysis. Second Femur diaphysis child (left & right)
Number of elements	19
Sex	Male
Age	30-50
Radiocarbon date element	-
Remarks	-
Additional analysis	-
Literature	Aal, J.H.J.M., 2015: *Between animals and bones. Reconstructing human behaviour by analysing taphonomic markers on osteological remains from Bronze Age settlement sites near Andijk, the Netherlands*, Leiden (Master thesis University Leiden, 111. Roessingh, W., 2018: *Dynamiek in beeld. Onderzoek van Westfriese nederzettingen uit de bronstijd*, Leiden (PhD thesis Leiden University), 177. Runia, L.T., 1987: The chemical analysis of prehistoric bones. A paleodietary and ecoarcheological study of Bronze Age West-Friesland, *BAR International Series* 363, 229.

ID	ID31
Site	Andijk-Noord
Town	Andijk
Municipality	Medemblik
Coordinates	142.557/ 528.600
Excavation company	ROB
Year of excavation	1973
Find nr	37
Trench nr	3
Level nr	1
Feature nr	-
Type of feature	Ring ditch
Structure	GRH02c
Context date	Middle Bronze Age
Context date based on	Pottery and radiocarbon dates on bones (ID26, ID29 & ID62)
Skeleton element	Cranium (os frontalis)
Number of elements	1
Sex	Male (?)
Age	30-50
Radiocarbon date element	-
Remarks	Individuals ID31, ID32 & ID33 collected under a single find number on the same spot. Remaining fragments of L os temporalis with pars petrosa & R femur possible also belonging to this individual.
Additional analysis	Preservation analysis: Behrensmeyer score 1
Literature	Roessingh, W., 2018: *Dynamiek in beeld. Onderzoek van Westfriese nederzettingen uit de bronstijd*, Leiden (PhD thesis Leiden University), 177. Runia, L.T., 1987: The chemical analysis of prehistoric bones. A paleodietary and ecoarcheological study of Bronze Age West-Friesland, *BAR International Series* 363, 227.

ID	ID32
Site	Andijk-Noord
Town	Andijk
Municipality	Medemblik
Coordinates	142.557/ 528.600
Excavation company	ROB
Year of excavation	1973
Find nr	37
Trench nr	3
Level nr	1
Feature nr	-
Type of feature	Ring ditch
Structure	GRH02c
Context date	Middle Bronze Age
Context date based on	Pottery and radiocarbon dates on bones (ID26, ID29 & ID62)
Skeleton element	Cranium (os frontalis + os parietalis (left + right)
Number of elements	21
Sex	Female (?)
Age	18-25
Radiocarbon date element	-
Remarks	Individuals ID31, ID32 & ID33 collected under a single find number on the same spot.
Additional analysis	-
Literature	Roessingh, W., 2018: *Dynamiek in beeld. Onderzoek van Westfriese nederzettingen uit de bronstijd*, Leiden (PhD thesis Leiden University), 177. Runia, L.T., 1987: The chemical analysis of prehistoric bones. A paleodietary and ecoarcheological study of Bronze Age West-Friesland, *BAR International Series* 363, 227.

ID	ID33
Site	Andijk-Noord
Town	Andijk
Municipality	Medemblik
Coordinates	142.557/ 528.600
Excavation company	ROB
Year of excavation	1973
Find nr	37
Trench nr	3
Level nr	1
Feature nr	-
Type of feature	Ring ditch
Structure	GRH02c
Context date	Middle Bronze Age
Context date based on	Pottery and radiocarbon dates on bones (ID26, ID29 & ID62)
Skeleton element	Illium (left), ischium & radius (left) diaphysis
Number of elements	1
Sex	Female
Age	>45
Radiocarbon date element	-
Remarks	Individuals ID31, ID32 & ID33 collected under a single find number on the same spot.
Additional analysis	-
Literature	Roessingh, W., 2018: *Dynamiek in beeld. Onderzoek van Westfriese nederzettingen uit de bronstijd*, Leiden (PhD thesis Leiden University), 177. Runia, L.T., 1987: The chemical analysis of prehistoric bones. A paleodietary and ecoarcheological study of Bronze Age West-Friesland, *BAR International Series* 363, 227.

ID	ID34
Site	Andijk-Noord
Town	Andijk
Municipality	Medemblik
Coordinates	142.557/528.593
Excavation company	ROB
Year of excavation	1973
Find nr	38.2
Trench nr	3
Level nr	1
Feature nr	-
Type of feature	Ring ditch
Structure	GRH02c
Context date	Middle Bronze Age
Context date based on	Pottery and radiocarbon dates on bones (ID26, ID29 & ID62)
Skeleton element	Cranium (os parietalis), tibia (right), femur diaphysis
Number of elements	3
Sex	Unknown
Age	20-40
Radiocarbon date element	-
Remarks	Traces of (non-pathological) marks: possible cutting on tibia. ID34 found on same location as individual ID62.
Additional analysis	Microwear analysis: modern(?) trace; preservation analysis: Behrensmeyer score 1; luminescence analysis: most very recent traces
Literature	Aal, J.H.J.M., 2015: *Between animals and bones. Reconstructing human behaviour by analysing taphonomic markers on osteological remains from Bronze Age settlement sites near Andijk, the Netherlands*, Leiden (Master thesis University Leiden), 105. Roessingh, W., 2018: *Dynamiek in beeld. Onderzoek van Westfriese nederzettingen uit de bronstijd*, Leiden (PhD thesis Leiden University), 177. Runia, L.T., 1987: The chemical analysis of prehistoric bones. A paleodietary and ecoarcheological study of Bronze Age West-Friesland, *BAR International Series* 363, 228.

ID	ID35
Site	Andijk-Noord
Town	Andijk
Municipality	Medemblik
Coordinates	142.650/528.409
Excavation company	ROB
Year of excavation	1973
Find nr	3
Trench nr	2
Level nr	1
Feature nr	-
Type of feature	Ditch
Structure	GR02
Context date	Middle Bronze Age
Context date based on	Pottery from the excavation and radiocarbon dates from other features
Skeleton element	Cranium (os temporalis including pars petrosa (left + right))
Number of elements	3
Sex	Male
Age	20-40
Radiocarbon date element	-
Remarks	DNA analysis possible
Additional analysis	-
Literature	Aal, J.H.J.M., 2015: *Between animals and bones. Reconstructing human behaviour by analysing taphonomic markers on osteological remains from Bronze Age settlement sites near Andijk, the Netherlands*, Leiden (Master thesis University Leiden), 104. Roessingh, W., 2018: *Dynamiek in beeld. Onderzoek van Westfriese nederzettingen uit de bronstijd*, Leiden (PhD thesis Leiden University), 177. Runia, L.T., 1987: The chemical analysis of prehistoric bones. A paleodietary and ecoarcheological study of Bronze Age West-Friesland, *BAR International Series* 363, 227.

ID	ID36
Site	Andijk-Noord
Town	Andijk
Municipality	Medemblik
Coordinates	142.631/528.446
Excavation company	ROB
Year of excavation	1973
Find nr	30
Trench nr	2
Level nr	1
Feature nr	-
Type of feature	Circular ditch
Structure	KG16
Context date	Middle Bronze Age
Context date based on	Pottery from the excavation and radiocarbon dates from other features
Skeleton element	Cranium (os frontalis (left))
Number of elements	5
Sex	Unknown
Age	12-25
Radiocarbon date element	-
Remarks	Traces of (non-pathological) marks
Additional analysis	Microwear analysis: polish? (secondary use); XRF analysis: no elements of metal tools
Literature	Aal, J.H.J.M., 2015: *Between animals and bones. Reconstructing human behaviour by analysing taphonomic markers on osteological remains from Bronze Age settlement sites near Andijk, the Netherlands*, Leiden (Master thesis University Leiden), 111. Roessingh, W., 2018: *Dynamiek in beeld. Onderzoek van Westfriese nederzettingen uit de bronstijd*, Leiden (PhD thesis Leiden University), 177. Runia, L.T., 1987: The chemical analysis of prehistoric bones. A paleodietary and ecoarcheological study of Bronze Age West-Friesland, *BAR International Series* 363, 227.

ID	ID37
Site	Andijk-Noord
Town	Andijk
Municipality	Medemblik
Coordinates	142.556/528.623
Excavation company	ROB
Year of excavation	1973
Find nr	36
Trench nr	3
Level nr	1
Feature nr	-
Type of feature	House ditch
Structure	HS09
Context date	Middle Bronze Age
Context date based on	Radiocarbon dates on bone
Skeleton element	Cranium (os frontalis (left) including part of orbita)
Number of elements	2
Sex	Unknown
Age	Adult
Radiocarbon date element	GrN12367: 3020±80BP (1436-1022 cal BC) and GrN-12366: 3070±30BP (1410-1220 cal BC)
Remarks	-
Additional analysis	-
Literature	Aal, J.H.J.M., 2015: *Between animals and bones. Reconstructing human behaviour by analysing taphonomic markers on osteological remains from Bronze Age settlement sites near Andijk, the Netherlands*, Leiden (Master thesis University Leiden, 99. Roessingh, W., 2018: *Dynamiek in beeld. Onderzoek van Westfriese nederzettingen uit de bronstijd*, Leiden (PhD thesis Leiden University), 177. Runia, L.T., 1987: The chemical analysis of prehistoric bones. A paleodietary and ecoarcheological study of Bronze Age West-Friesland, *BAR International Series* 363, 227.

ID	ID38
Site	Andijk-Noord
Town	Andijk
Municipality	Medemblik
Coordinates	142.534/528.666
Excavation company	ROB
Year of excavation	1973
Find nr	48
Trench nr	3
Level nr	1
Feature nr	-
Type of feature	House ditch
Structure	HS06b
Context date	Middle Bronze Age
Context date based on	Pottery from the excavation and radiocarbon dates from other features
Skeleton element	Cranium (os frontalis including parts of both orbita)
Number of elements	1
Sex	Male
Age	Adult
Radiocarbon date element	-
Remarks	-
Additional analysis	-
Literature	Aal, J.H.J.M., 2015: *Between animals and bones. Reconstructing human behaviour by analysing taphonomic markers on osteological remains from Bronze Age settlement sites near Andijk, the Netherlands*, Leiden (Master thesis University Leiden), 97. Roessingh, W., 2018: *Dynamiek in beeld. Onderzoek van Westfriese nederzettingen uit de bronstijd*, Leiden (PhD thesis Leiden University), 177. Runia, L.T., 1987: The chemical analysis of prehistoric bones. A paleodietary and ecoarcheological study of Bronze Age West-Friesland, *BAR International Series* 363, 229.

ID	ID39
Site	Andijk-Noord
Town	Andijk
Municipality	Medemblik
Coordinates	142.537/528.671
Excavation company	ROB
Year of excavation	1973
Find nr	49
Trench nr	4
Level nr	1
Feature nr	-
Type of feature	House ditch
Structure	HS08
Context date	Middle Bronze Age
Context date based on	Radiocarbon date on bone
Skeleton element	Radius diaphysis
Number of elements	1
Sex	Unknown
Age	>35
Radiocarbon date element	Poz-147691: 3470±35BP (1890-1688 cal BC)
Remarks	Possible traces of cutting.
Additional analysis	Microwear analysis: modern trace (unknown tool)
Literature	Aal, J.H.J.M., 2015: *Between animals and bones. Reconstructing human behaviour by analysing taphonomic markers on osteological remains from Bronze Age settlement sites near Andijk, the Netherlands*, Leiden (Master thesis University Leiden), 108. Roessingh, W., 2018: *Dynamiek in beeld. Onderzoek van Westfriese nederzettingen uit de bronstijd*, Leiden (PhD thesis Leiden University), 177. Runia, L.T., 1987: The chemical analysis of prehistoric bones. A paleodietary and ecoarcheological study of Bronze Age West-Friesland, *BAR International Series* 363, 229.

ID	ID40
Site	Andijk-Noord
Town	Andijk
Municipality	Medemblik
Coordinates	142.530/528.682
Excavation company	ROB
Year of excavation	1973
Find nr	50
Trench nr	3
Level nr	1
Feature nr	-
Type of feature	House ditch
Structure	HS08
Context date	Middle Bronze Age
Context date based on	Pottery from the excavation and radiocarbon dates from other features
Skeleton element	Cranium (os occipitalis (left))
Number of elements	3
Sex	Unknown
Age	18-25
Radiocarbon date element	-
Remarks	-
Additional analysis	-
Literature	Aal, J.H.J.M., 2015: *Between animals and bones. Reconstructing human behaviour by analysing taphonomic markers on osteological remains from Bronze Age settlement sites near Andijk, the Netherlands*, Leiden (Master thesis University Leiden), 98-99. Roessingh, W., 2018: *Dynamiek in beeld. Onderzoek van Westfriese nederzettingen uit de bronstijd*, Leiden (PhD thesis Leiden University) 177. Runia, L.T., 1987: The chemical analysis of prehistoric bones. A paleodietary and ecoarcheological study of Bronze Age West-Friesland, *BAR International Series* 363, 229.

ID	ID62
Site	Andijk-Noord
Town	Andijk
Municipality	Medemblik
Coordinates	142.566/528.593
Excavation company	ROB
Year of excavation	1973
Find nr	38.1
Trench nr	3
Level nr	1
Feature nr	-
Type of feature	Ring ditch
Structure	GRH02c
Context date	Middle Bronze Age
Context date based on	Pottery and radiocarbon dates on bones (ID26, ID29 & ID62)
Skeleton element	Femur complete (right)
Number of elements	1
Sex	Male (?)
Age	Adult
Radiocarbon date element	Poz-147700: 3095±35BP (1436-1264 cal BC)
Remarks	ID62 found on same location as individual ID34. Cutting? And non-pathological marks.
Additional analysis	Preservation analysis: Behrensmeyer score 1
Literature	Aal, J.H.J.M., 2015: *Between animals and bones. Reconstructing human behaviour by analysing taphonomic markers on osteological remains from Bronze Age settlement sites near Andijk, the Netherlands*, Leiden (Master thesis University Leiden), 105. Roessingh, W., 2018: *Dynamiek in beeld. Onderzoek van Westfriese nederzettingen uit de bronstijd*, Leiden (PhD thesis Leiden University),177. Runia, L.T., 1987: The chemical analysis of prehistoric bones. A paleodietary and ecoarcheological study of Bronze Age West-Friesland, *BAR International Series* 363, 228.

ID	ID63
Site	Andijk-Noord
Town	Andijk
Municipality	Medemblik
Coordinates	142.583/528.597
Excavation company	ROB
Year of excavation	1973
Find nr	62
Trench nr	3
Level nr	1
Feature nr	-
Type of feature	Ring ditch
Structure	GRH02c
Context date	Middle bronze Age
Context date based on	Pottery and radiocarbon dates on bones (ID26, ID29 & ID62)
Skeleton element	Femur diaphysis child (left & right)
Number of elements	2
Sex	Juvenile
Age	4-8
Radiocarbon date element	-
Remarks	-
Additional analysis	-
Literature	Aal, J.H.J.M., 2015: *Between animals and bones. Reconstructing human behaviour by analysing taphonomic markers on osteological remains from Bronze Age settlement sites near Andijk, the Netherlands*, Leiden (Master thesis University Leiden), 111. Roessingh, W., 2018: *Dynamiek in beeld. Onderzoek van Westfriese nederzettingen uit de bronstijd*, Leiden (PhD thesis Leiden University), 177. Runia, L.T., 1987: The chemical analysis of prehistoric bones. A paleodietary and ecoarcheological study of Bronze Age West-Friesland, *BAR International Series* 363, 229.

Andijk-Zuid

ID41

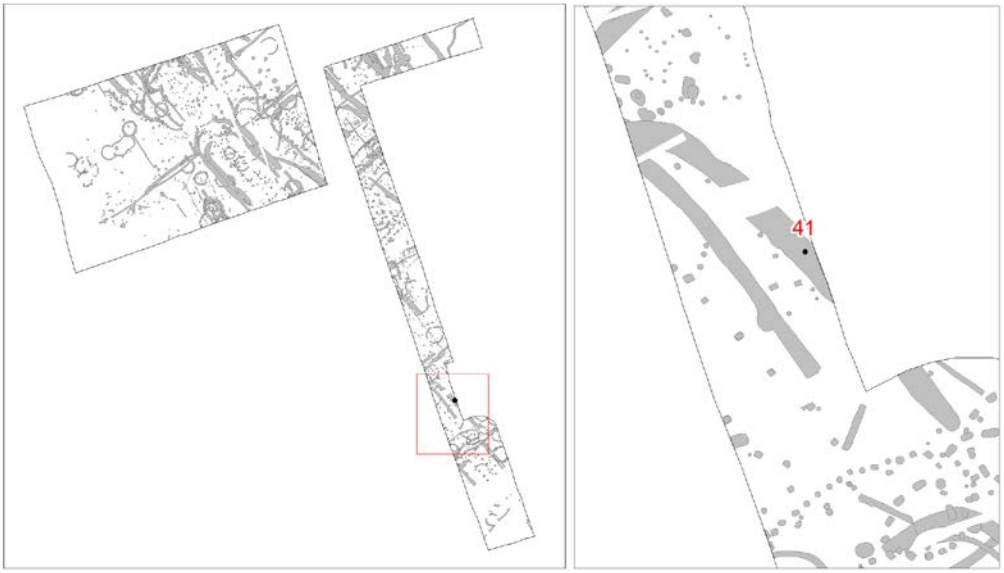

Figure 3. The site 'Andijk Zuid' and the location of the human remains.

ID	ID41
Site	Andijk-Zuid
Town	Andijk
Municipality	Andijk
Coordinates	142.926/528.043
Excavation company	ROB
Year of excavation	1973
Find nr	177
Trench nr	9
Level nr	1
Feature nr	-
Type of feature	House ditch
Structure	HS06a
Context date	Middle Bronze Age
Context date based on	Radiocarbon date on bone
Skeleton element	Humerus (left) diaphysis
Number of elements	1
Sex	Unknown
Age	13-18
Radiocarbon date element	Poz-147692: 3115±35BP (1492-1279 cal BC)
Remarks	Traces of (non-pathological) marks.
Additional analysis	Microwear analysis: old traces, unknown traces, gnawing
Literature	Aal, J.H.J.M., 2015: *Between animals and bones. Reconstructing human behaviour by analysing taphonomic markers on osteological remains from Bronze Age settlement sites near Andijk, the Netherlands*, Leiden (Master thesis University Leiden), 94-95 Roessingh, W., 2018: *Dynamiek in beeld. Onderzoek van Westfriese nederzettingen uit de bronstijd*, Leiden (PhD thesis Leiden University),177. Runia, L.T., 1987: The chemical analysis of prehistoric bones. A paleodietary and ecoarcheological study of Bronze Age West-Friesland, *BAR International Series* 363, 227.

Andijk-Zuid (2011)

ID53

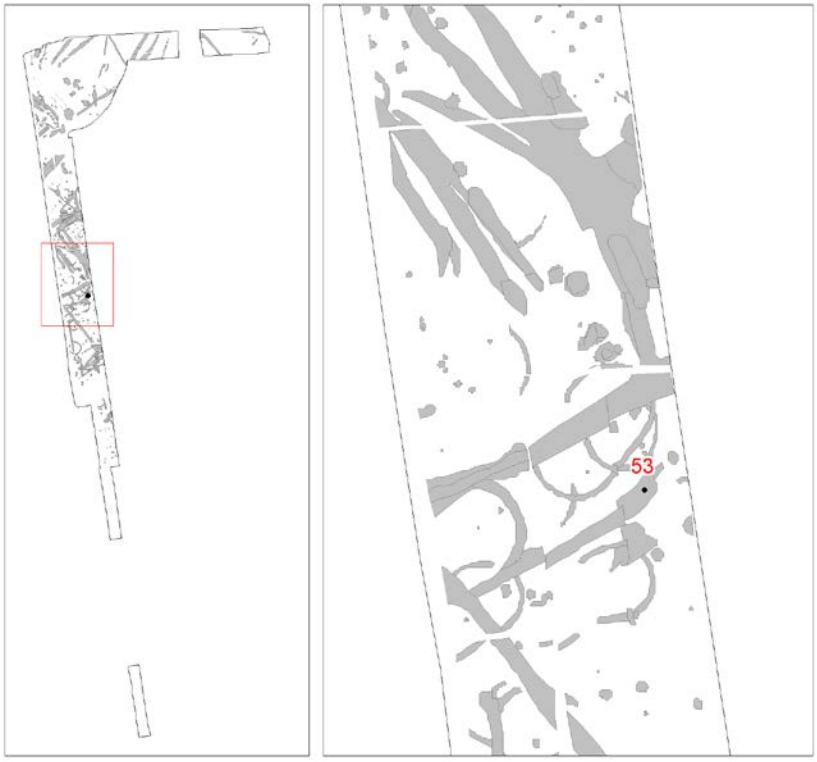

Figure 4. The site 'Andijk-Zuid (2011)' and the location of the analysed human remains.

ID	ID53
Site	Andijk-Zuid 2011
Town	Andijk
Municipality	Medemblik
Coordinates	144.039/527.808
Excavation company	Oranjewoud
Year of excavation	2011
Find nr	87
Trench nr	5
Level nr	1
Feature nr	162
Type of feature	Ditch
Structure	Ditch 3
Context date	Late Bronze Age
Context date based on	Based on 2 radiocarbon dates on charcoal (GrA 56554: 2905±35BP (1257-999 cal BC) and GrA56555: 2895±35BP (1249-949 cal BC).
Skeleton element	Pelvis (ischium (left) & ilium)
Number of elements	1
Sex	Female (?)
Age	20-29
Radiocarbon date element	-
Remarks	-
Additional analysis	-
Literature	Arkema, M. & I. Vossen 2013: *Inventariserend veldonderzoek door middel van proefsleuven en opgraving Bedrijventerrein Zuid te Andijk*, Heerenveen (Archeologische Rapporten Oranjewoud 2012/62), 26-28, 50-51.

Bovenkarspel-Het Valkje 1974

ID42 & ID43

Figure 5. The site 'Bovenkarspel-Het Valkje' and the location of the analysed human remains.

ID	ID42
Site	Bovenkarspel-Het Valkje
Town	Bovenkarspel
Municipality	Stede Broec
Coordinates	144.838/525.709
Excavation company	ROB
Year of excavation	1974
Find nr	4
Trench nr	30
Level nr	1
Feature nr	-
Type of feature	Ditch
Structure	-
Context date	Middle Bronze Age
Context date based on	Radiocarbon date on bone
Skeleton element	Sacrum (part of)
Number of elements	1
Sex	Male (?)
Age	>35
Radiocarbon date element	Poz-147693: 3190±35BP (1517-1406 cal BC)
Remarks	-
Additional analysis	-
Literature	Roessingh, W., 2018: *Dynamiek in beeld. Onderzoek van Westfriese nederzettingen uit de bronstijd*, Leiden (PhD thesis Leiden University), 262. IJzereef, G.F., 1981: B*ronze Age animal bones from Bovenkarspel. The excavation at Het Valkje*, Amersfoort (Nederlandse Oudheden 10), Amersfoort, 209. Runia, L.T., 1987: The chemical analysis of prehistoric bones. A paleodietary and ecoarcheological study of Bronze Age West-Friesland, *BAR International Series* 363, 230.

ID	ID43
Site	Bovenkarspel-Het Valkje
Town	Bovenkarspel
Municipality	Stede Broec
Coordinates	145.058/525.639
Excavation company	ROB
Year of excavation	1974
Find nr	1
Trench nr	38
Level nr	2
Feature nr	-
Type of feature	Pit
Structure	KLX0
Context date	Middle Bronze Age
Context date based on	Radiocarbon date on bone
Skeleton element	Cranium (os temporalis (right) including pars petrosa)
Number of elements	1
Sex	Male (?)
Age	Adult
Radiocarbon date element	Poz-147694: 2955±35BP (1272-1021 cal BC)
Remarks	DNA analysis possible
Additional analysis	-
Literature	Roessingh, W., 2018: *Dynamiek in beeld. Onderzoek van Westfriese nederzettingen uit de bronstijd*, Leiden (PhD thesis Leiden University), 262. IJzereef, G.F., 1981: B*ronze Age animal bones from Bovenkarspel. The excavation at Het Valkje*, Amersfoort (Nederlandse Oudheden 10), Amersfoort, 209. Runia, L.T., 1987: The chemical analysis of prehistoric bones. A paleodietary and ecoarcheological study of Bronze Age West-Friesland, *BAR International Series* 363, 230.

Enkhuizen-De Tent

ID18-22

Figure 6. The site 'Enkhuizen-De Tent'. The exact location of the human remains is unknown.

ID	ID18
Site	Enkhuizen-De Tent
Town	Enkhuizen
Municipality	Enkhuizen
Coordinates	147.270/528.060
Excavation company	IPP
Year of excavation	1960
Find nr	50
Trench nr	-
Level nr	-
Feature nr	-
Type of feature	Possible first period ring ditch
Structure	Tumulus 1
Context date	Middle Bronze Age
Context date based on	Radiocarbon dates ID19 & ID20
Skeleton element	Cranium (os temporalis including pars petrosa (right)
Number of elements	1
Sex	Male (?)
Age	Adult
Radiocarbon date element	-
Remarks	DNA analysis possible
Additional analysis	-
Literature	Lehmann, L.T., 1963: Het partiële onderzoek van tumulus I in de gemeente Enkhuizen, *Westfriese Oudheden* 6, 234-242. Runia, L.T., 1987: The chemical analysis of prehistoric bones. A paleodietary and ecoarcheological study of Bronze Age West-Friesland, *BAR International Series* 363, 222.

ID	ID19
Site	Enkhuizen-De Tent
Town	Enkhuizen
Municipality	Enkhuizen
Coordinates	147.270/528.060
Excavation company	IPP
Year of excavation	1960
Find nr	27
Trench nr	-
Level nr	-
Feature nr	-
Type of feature	Flank of barrow
Structure	Tumulus 1
Context date	Middle Bronze Age
Context date based on	Radiocarbon date on bone
Skeleton element	Clavicula (right)
Number of elements	1
Sex	Unknown
Age	Adult
Radiocarbon date element	Poz-147610: 3070±35BP (1421-1226 cal BC)
Remarks	Clear cut marks.
Additional analysis	Microwear analysis: old traces (bronze?); SEM / XRF analysis: no elements of metal tools, luminescence analysis; luminescence analysis: more likely old traces
Literature	Lehmann, L.T., 1963: Het partiële onderzoek van tumulus I in de gemeente Enkhuizen, *Westfriese Oudheden* 6, 234-242. Runia, L.T., 1987: The chemical analysis of prehistoric bones. A paleodietary and ecoarcheological study of Bronze Age West-Friesland, *BAR International Series* 363, 222.

ID	ID20
Site	Enkhuizen-De Tent
Town	Enkhuizen
Municipality	Enkhuizen
Coordinates	147.270/528.060
Excavation company	IPP
Year of excavation	1960
Find nr	37
Trench nr	-
Level nr	-
Feature nr	-
Type of feature	Flank of barrow
Structure	Tumulus 1
Context date	Middle Bronze Age
Context date based on	Radiocarbon date on bone
Skeleton element	Scapula (part of, including cavitas glenoidalis (right))
Number of elements	1
Sex	Unknown
Age	>35
Radiocarbon date element	Poz-147611: 3115±30BP (1447-1286 cal BC)
Remarks	Traces of cutting
Additional analysis	Microwear analysis: old traces (bronze?)
Literature	Lehmann, L.T., 1963: Het partiële onderzoek van tumulus I in de gemeente Enkhuizen, *Westfriese Oudheden* 6, 234-242. Runia, L.T., 1987: The chemical analysis of prehistoric bones. A paleodietary and ecoarcheological study of Bronze Age West-Friesland, *BAR International Series* 363, 222.

ID	ID21
Site	Enkhuizen-De Tent
Town	Enkhuizen
Municipality	Enkhuizen
Coordinates	147.270/528.060
Excavation company	IPP
Year of excavation	1960
Find nr	56
Trench nr	-
Level nr	-
Feature nr	-
Type of feature	Second period ring ditch
Structure	Tumulus 1
Context date	Middle Bronze Age
Context date based on	Radiocarbon date on bone
Skeleton element	Clavicula diaphysis (left)
Number of elements	1
Sex	Unknown
Age	Adult
Radiocarbon date element	Poz-147612: 3120±35BP (1494-1283 cal BC)
Remarks	Cut marks
Additional analysis	Microwear analysis: unknown traces (large tool); SEM / XRF analysis: no elements of metal tools; luminescence analysis: most likely very recent traces
Literature	Lehmann, L.T., 1963: Het partiële onderzoek van tumulus I in de gemeente Enkhuizen, *Westfriese Oudheden* 6, 234-242. Runia, L.T., 1987: The chemical analysis of prehistoric bones. A paleodietary and ecoarcheological study of Bronze Age West-Friesland, *BAR International Series* 363, 222.

ID	ID22
Site	Enkhuizen-De Tent
Town	Enkhuizen
Municipality	Enkhuizen
Coordinates	147.270/528.060
Excavation company	IPP
Year of excavation	1960
Find nr	58
Trench nr	-
Level nr	-
Feature nr	-
Type of feature	Second period ring ditch
Structure	Tumulus 1
Context date	Middle Bronze Age
Context date based on	Radiocarbon dates on ID19 & ID20
Skeleton element	Cervical vertebrae (5^{th} or 6^{th})
Number of elements	1
Sex	Unknown
Age	>35
Radiocarbon date element	-
Remarks	-
Additional analysis	-
Literature	Lehmann, L.T., 1963: Het partiële onderzoek van tumulus I in de gemeente Enkhuizen, *Westfriese Oudheden* 6, 234-242. Runia, L.T., 1987: The chemical analysis of prehistoric bones. A paleodietary and ecoarcheological study of Bronze Age West-Friesland, *BAR International Series* 363, 222.

ID45 (Enkhuizen-Haling)
ID47-52 & ID54-59 (Enkhuizen-Kadijken)

Figure 7. The site 'Enkhuizen-Haling/Kadijken' and the location of the analysed human remains.

ID	**ID45**
Site	Enkhuizen-haling
Town	Enkhuizen
Municipality	Enkhuizen
Coordinates	146.596/525.680
Excavation company	Archol
Year of excavation	2012
Find nr	169
Trench nr	10
Level nr	1
Feature nr	56
Type of feature	Ditch
Structure	-
Context date	Middle Bronze Age
Context date based on	Radiocarbon dates on bone
Skeleton element	Femur (left) diaphysis
Number of elements	1
Sex	Male (?)
Age	Adult
Radiocarbon date element	Poz-149611: 3120±35BP (1494-1283 cal BC) and GrA-57738: 3080±35BP (1427-1260 cal BC)
Remarks	Traces of (non pathological) marks
Additional analysis	-
Literature	Van der Linden, C.M. & T. Hamburg 2014: *Bronstijdbewoning in Gommerwijk West-West. Archeologisch onderzoek in Enkhuizen-Haling 13*, Leiden (Archol Rapport 227), 57, 62.

ID	ID47
Site	Enkhuizen-Kadijken
Town	Enkhuizen
Municipality	Enkhuizen
Coordinates	146.645/525.537
Excavation company	ADC
Year of excavation	2011
Find nr	17
Trench nr	2
Level nr	1
Feature nr	19
Type of feature	House ditch
Structure	HS14
Context date	Middle Bronze Age
Context date based on	Pottery and radiocarbon date on seeds from western house ditch (SUER37152/ GU25584: 2895±30BP (1211-994 cal BC).
Skeleton element	Cranium (os parietalis)
Number of elements	2
Sex	Unknown
Age	20-40
Radiocarbon date element	-
Remarks	-
Additional analysis	-
Literature	Roessingh, W. & F.J. Vermue 2011: *Enkhuizen-Kadijken, aanvullend onderzoek langs de westzijde van Kadijken-5B*, Amersfoort (ADC Rapport 2962), 14, 23, 30.

ID	ID48
Site	Enkhuizen-Kadijken
Town	Enkhuizen
Municipality	Enkhuizen
Coordinates	146.643/525.733
Excavation company	ADC
Year of excavation	2011
Find nr	42
Trench nr	4
Level nr	1
Feature nr	75
Type of feature	House ditch
Structure	HS15a-b
Context date	Middle Bronze Age
Context date based on	Radiocarbon date on bone
Skeleton element	Tibia (right) diaphysis
Number of elements	2
Sex	Male
Age	Adult
Radiocarbon date element	Poz-147695: 3035±35BP (1409-1134 cal BC)
Remarks	Possible gnaw marks
Additional analysis	-
Literature	Roessingh, W. & F.J. Vermue 2011: *Enkhuizen-Kadijken, aanvullend onderzoek langs de westzijde van Kadijken-5B*, Amersfoort (ADC Rapport 2962), 14, 23, 30.

ID	ID49
Site	Enkhuizen-Kadijken
Town	Enkhuizen
Municipality	Enkhuizen
Coordinates	146.670/525.760
Excavation company	ADC
Year of excavation	2009
Find nr	1169.1
Trench nr	77
Level nr	2
Feature nr	16
Type of feature	Well
Structure	WA01
Context date	Middle Bronze Age
Context date based on	Radiocarbon date on bone
Skeleton element	Radius (complete (right))
Number of elements	1
Sex	Unknown
Age	Adult
Radiocarbon date element	Poz-147696: 3550±35BP (2019-1767 cal BC)
Remarks	-
Additional analysis	-
Literature	Roessingh, W. & E. Lohof 2011: *Bronstijdboeren op de kwelders. Archeologisch onderzoek in Enkhuizen-Kadijken*, Amersfoort (ADC Rapport 2200/ADC Monografie 11), 120, 221, 394.

ID	ID50
Site	Enkhuizen-Kadijken
Town	Enkhuizen
Municipality	Enkhuizen
Coordinates	146.710/525.615
Excavation company	ADC
Year of excavation	2009
Find nr	374
Trench nr	19
Level nr	1
Feature nr	53
Type of feature	Circular ditch
Structure	KG37
Context date	Middle Bronze Age
Context date based on	KG37
Skeleton element	complete premolar from the left side of the mandible (dental element 35)
Number of elements	1
Sex	Unknown
Age	18-25
Radiocarbon date element	-
Remarks	DNA analysis possible
Additional analysis	-
Literature	Roessingh, W. & E. Lohof 2011: *Bronstijdboeren op de kwelders. Archeologisch onderzoek in Enkhuizen-Kadijken*, Amersfoort (ADC Rapport 2200/ADC Monografie 11), 102, 221.

ID	ID51
Site	Enkhuizen-Kadijken
Town	Enkhuizen
Municipality	Enkhuizen
Coordinates	146.784/525.491
Excavation company	ADC
Year of excavation	2009
Find nr	383
Trench nr	1
Level nr	1
Feature nr	296
Type of feature	House ditch
Structure	HS11b
Context date	Middle Bronze Age
Context date based on	HS11b is second phase of HS11. A grain sample (find nr. 355) from one of the northern posts of HS11 dated to SUERC-28663/GU21170: 3040±35BP (1410-1200 cal BC).
Skeleton element	Radius (right) diaphysis including proximal epiphysis
Number of elements	1
Sex	Male
Age	Adult
Radiocarbon date element	-
Remarks	-
Additional analysis	-
Literature	Roessingh, W. & E. Lohof 2011: *Bronstijdboeren op de kwelders. Archeologisch onderzoek in Enkhuizen-Kadijken*, Amersfoort (ADC Rapport 2200/ADC Monografie 11), 90, 221.

ID	ID52
Site	Enkhuizen-kadijken
Town	Enkhuizen
Municipality	Enkhuizen
Coordinates	146.762/525.781
Excavation company	ADC
Year of excavation	2009
Find nr	1100
Trench nr	-
Level nr	-
Feature nr	999
Type of feature	Dump
Structure	-
Context date	-
Context date based on	-
Skeleton element	Molar maxilla (dental element 17 or 18)
Number of elements	1
Sex	Unknown
Age	12-25
Radiocarbon date element	-
Remarks	DNA analysis possible
Additional analysis	-
Literature	Roessingh, W. & E. Lohof 2011: *Bronstijdboeren op de kwelders. Archeologisch onderzoek in Enkhuizen-Kadijken*, Amersfoort (ADC Rapport 2200/ADC Monografie 11), 221.

ID	ID54
Site	Enkhuizen-kadijken
Town	Enkhuizen
Municipality	Enkhuizen
Coordinates	146.781/525.497
Excavation company	ADC
Year of excavation	2009
Find nr	701
Trench nr	44
Level nr	1
Feature nr	181
Type of feature	House ditch
Structure	HS11b
Context date	Middle Bronze Age
Context date based on	HS11b is second phase of HS11. A grain sample (find nr. 355) from one of the northern posts of HS11 dated to SUERC-28663/GU21170: 3040±35BP (1410-1200 cal BC).
Skeleton element	Cranium (os parietallis (left+right))
Number of elements	6
Sex	Unknown
Age	20-40
Radiocarbon date element	-
Remarks	-
Additional analysis	-
Literature	Roessingh, W. & E. Lohof 2011: *Bronstijdboeren op de kwelders. Archeologisch onderzoek in Enkhuizen-Kadijken*, Amersfoort (ADC Rapport 2200/ADC Monografie 11), 221.

ID	ID55
Site	Enkhuizen-Kadijken
Town	Enkhuizen
Municipality	Enkhuizen
Coordinates	146.795/525.502
Excavation company	ADC
Year of excavation	2009
Find nr	576
Trench nr	44
Level nr	1
Feature nr	50
Type of feature	House ditch
Structure	HS11b
Context date	Middle Bronze Age
Context date based on	HS11b is second phase of HS11. A grain sample (find nr. 355) from one of the northern posts of HS11 dated to SUERC-28663/GU21170: 3040±35BP (1410-1200 cal BC).
Skeleton element	Femur proximal epiphysis
Number of elements	1
Sex	Unknown
Age	>14
Radiocarbon date element	-
Remarks	-
Additional analysis	-
Literature	Roessingh, W. & E. Lohof 2011: *Bronstijdboeren op de kwelders. Archeologisch onderzoek in Enkhuizen-Kadijken*, Amersfoort (ADC Rapport 2200/ADC Monografie 11), 221.

ID	ID56
Site	Enkhuizen-Kadijken
Town	Enkhuizen
Municipality	Enkhuizen
Coordinates	146.727/525.504
Excavation company	ADC
Year of excavation	2009
Find nr	496
Trench nr	39
Level nr	1
Feature nr	11
Type of feature	House ditch
Structure	HS10
Context date	Middle Bronze Age
Context date based on	Radiocarbon date on bone
Skeleton element	Fibula diaphysis
Number of elements	1
Sex	Unknown
Age	Adult
Radiocarbon date element	Poz-147698: 3040±35BP (1411-1203 cal BC)
Remarks	Traces of (non-pathological) marks.
Additional analysis	Microwear analysis: polish (secondary use), gnawing; XRF analysis: no elements of metal tools
Literature	Roessingh, W. & E. Lohof 2011: *Bronstijdboeren op de kwelders. Archeologisch onderzoek in Enkhuizen-Kadijken*, Amersfoort (ADC Rapport 2200/ADC Monografie 11), 221.

ID	ID57
Site	Enkhuizen-Kadijken
Town	Enkhuizen
Municipality	Enkhuizen
Coordinates	146.678/525.756
Excavation company	ADC
Year of excavation	2009
Find nr	1189.2
Trench nr	77
Level nr	2
Feature nr	26
Type of feature	Well
Structure	WA02
Context date	Middle Bronze Age
Context date based on	Pottery and location within the settlement
Skeleton element	Cranium (os occipitalis)
Number of elements	4
Sex	Unknown
Age	18-25
Radiocarbon date element	-
Remarks	-
Additional analysis	-
Literature	Roessingh, W. & E. Lohof 2011: *Bronstijdboeren op de kwelders. Archeologisch onderzoek in Enkhuizen-Kadijken*, Amersfoort (ADC Rapport 2200/ADC Monografie 11), 221.

ID	ID58
Site	Enkhuizen-Kadijken
Town	Enkhuizen
Municipality	Enkhuizen
Coordinates	146.793/525.502
Excavation company	ADC
Year of excavation	2009
Find nr	686
Trench nr	44
Level nr	1
Feature nr	50
Type of feature	House ditch
Structure	HS11b
Context date	Middle Bronze Age
Context date based on	HS11b is second phase of HS11. A grain sample (find nr. 355) from one of the northern posts of HS11 dated to SUERC-28663/GU21170: 3040±35BP (1410-1200 cal BC).
Skeleton element	Scapula including cavitas glenoidalis (right), pelvis (ischium (right), femur diaphysis (right)
Number of elements	3
Sex	Unknown
Age	Perinate (0)
Radiocarbon date element	-
Remarks	-
Additional analysis	-
Literature	Roessingh, W. & E. Lohof 2011: *Bronstijdboeren op de kwelders. Archeologisch onderzoek in Enkhuizen-Kadijken*, Amersfoort (ADC Rapport 2200/ADC Monografie 11), 221.

ID	ID59
Site	Enkhuizen-Kadijken
Town	Enkhuizen
Municipality	Enkhuizen
Coordinates	146.722/525.746
Excavation company	ADC
Year of excavation	2009
Find nr	961
Trench nr	59
Level nr	2
Feature nr	220
Type of feature	Well
Structure	WA12
Context date	Middle Bronze Age
Context date based on	Radiocarbon date on bone
Skeleton element	Humerus) diaphysis (right)
Number of elements	1
Sex	Male (?)
Age	Adult
Radiocarbon date element	Poz-147699: 3180±35BP (1511-1327 cal BC)
Remarks	Traces of (non-pathological) marks: possible cutting.
Additional analysis	Microwear analysis: no traces visible
Literature	Roessingh, W. & E. Lohof 2011: *Bronstijdboeren op de kwelders. Archeologisch onderzoek in Enkhuizen-Kadijken*, Amersfoort (ADC Rapport 2200/ADC Monografie 11), 221.

Grootebroek-Waterweide Noord

ID60 & ID61

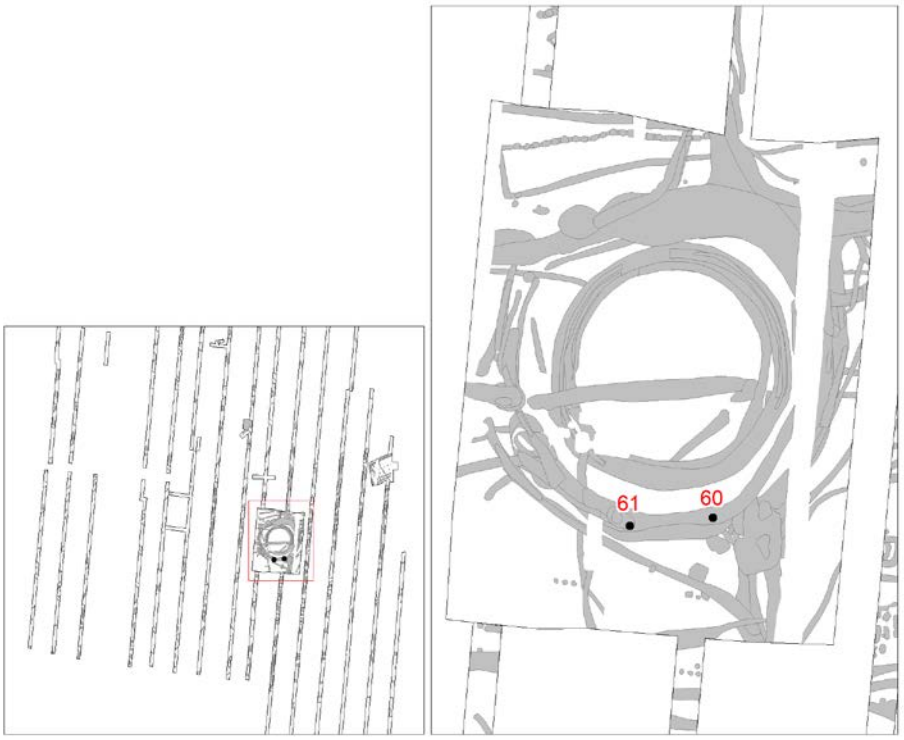

Figure 8. The site 'Grootebroek-Waterweide Noord' and the location of the analysed human remains.

ID	ID60
Site	Grootebroek-Waterweide Noord
Town	Grootebroek
Municipality	Stede Broec
Coordinates	143.595/522.369
Excavation company	ADC
Year of excavation	2021
Find nr	93
Trench nr	6
Level nr	1
Feature nr	1047
Type of feature	Second period ring ditch
Structure	GRS02b
Context date	Middle Bronze Age
Context date based on	Radiocarbon date ID61
Skeleton element	Femur diaphysis including distal epiphysis
Number of elements	1
Sex	-
Age	-
Radiocarbon date element	Poz-150579: 3425±35BP (1876–1622 cal BC)
Remarks	Possible traces of cutting
Additional analysis	-
Literature	Roessingh in prep.

ID	ID61
Site	Grootebroek-Waterweide Noord
Town	Grootebroek
Municipality	Stede Broec
Coordinates	143.588/522.369
Excavation company	ADC
Year of excavation	2021
Find nr	101
Trench nr	6
Level nr	2
Feature nr	1140
Type of feature	Ring ditch
Structure	WA02
Context date	Middle Bronze Age
Context date based on	Radiocarbon date on bone
Skeleton element	Femur diaphysis (right)
Number of elements	1
Sex	Male (?)
Age	Adult
Radiocarbon date element	Poz-147701: 3090±30BP (1425-1270 cal BC)
Remarks	Traces of cutting
Additional analysis	Luminescence analysis: combination of most likely old and very recent traces
Literature	Roessingh in prep.

Hoogkarspel-Hoogkarspeltunnel

ID46

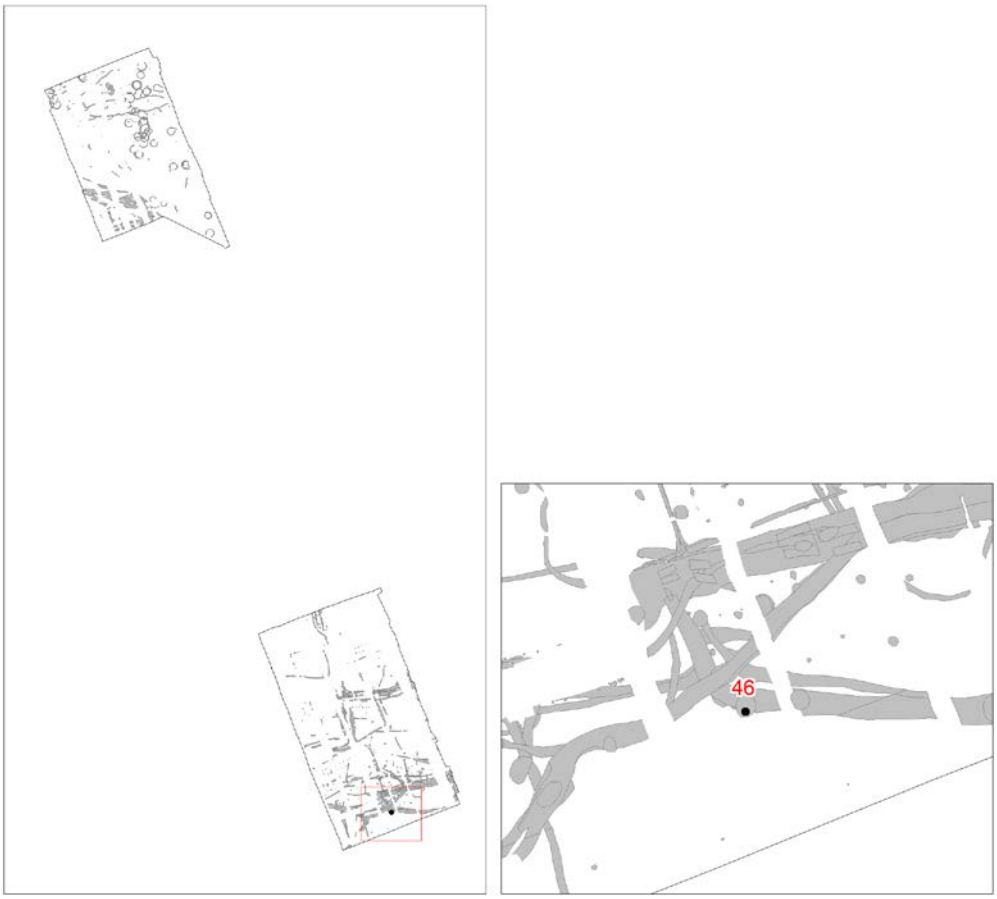

Figure 9. The site 'Hoogkarspel-Hoogkarspeltunnel' and the location of the analysed human remains.

ID	ID46
Site	Hoogkarspel Hoogkarspeltunnel
Town	Hoogkarspel
Municipality	Drechterland
Coordinates	139.723/522.181
Excavation company	ADC
Year of excavation	2014
Find nr	155
Trench nr	7
Level nr	1
Feature nr	51
Type of feature	Well
Structure	WA07
Context date	Middle Bronze Age
Context date based on	Location within the settlement and associated (dated) features nearby
Skeleton element	Cranium (os parietalis (left))
Number of elements	6
Sex	Unknown
Age	Juvenile
Radiocarbon date element	-
Remarks	-
Additional analysis	-
Literature	Roessingh, W. & A.J. Tol (red.) 2019: *Archeologie langs de Westfrisiaweg. Opgravingen van vindplaatsen uit de late prehistorie, middeleeuwen en Nieuwe tijd in het tracé van de Westfrisiaweg*, Amersfoort/Leiden (ADC Rapport 5000/Archol Rapport 461), 699.

Hoogkarspel-Houterpolder West

ID23-25 & ID44

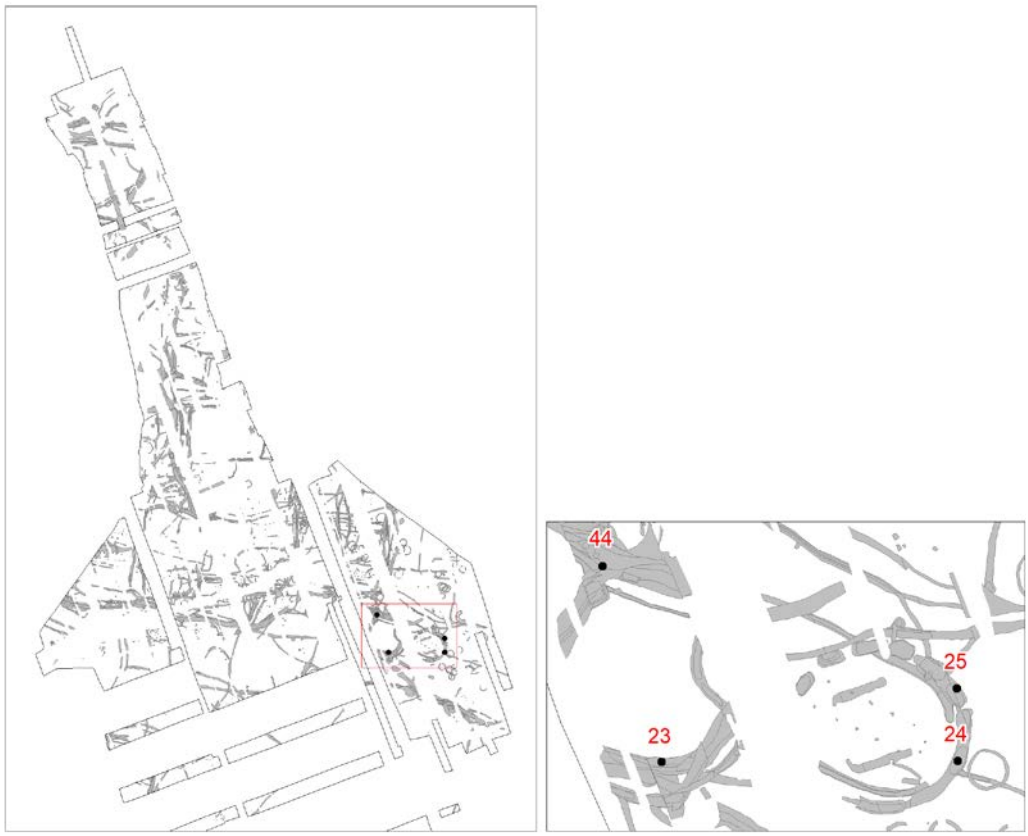

Figure 10. The site 'Hoogkarspel-Houterpolder West' and the location of the analysed human remains.

ID	ID23
Site	Hoogkarspel-Houterpolder West
Town	Hoogkarspel
Municipality	Drechterland
Coordinates	140.006/521.561
Excavation company	ADC
Year of excavation	2014
Find nr	778
Trench nr	21
Level nr	2
Feature nr	227
Type of feature	Ring ditch
Structure	GRS02
Context date	Middle Bronze Age
Context date based on	Radiocarbon date on bone
Skeleton element	Humerus diaphysis including distal epiphysis (right)
Number of elements	3
Sex	Male (?)
Age	Adult
Radiocarbon date element	Poz-147613: 3070±35BP (1421-1226 cal BC)
Remarks	-
Additional analysis	-
Literature	Roessingh, W. & A.J. Tol (red.) 2019: *Archeologie langs de Westfrisiaweg. Opgravingen van vindplaatsen uit de late prehistorie, middeleeuwen en Nieuwe tijd in het tracé van de Westfrisiaweg*, Amersfoort/Leiden (ADC Rapport 5000/Archol Rapport 461), 699.

ID	ID24
Site	Hoogkarspel-Houterpolder West
Town	Hoogkarspel
Municipality	Drechterland
Coordinates	140.036,25/521.561,12
Excavation company	ADC
Year of excavation	2014
Find nr	1071
Trench nr	23
Level nr	1
Feature nr	112
Type of feature	Ring ditch
Structure	GS01
Context date	Middle Bronze Age
Context date based on	Based on radiocarbon dates from ring ditch (Poz-92460: 3030±35BP (1405-1132 cal BC)) and ditch in the centre of the barrow (Poz-92461: 3035±35BP (1406-1135 cal BC)).
Skeleton element	Cranium (os parietalis, occipitalis (left))
Number of elements	9
Sex	Unknown
Age	12-25
Radiocarbon date element	-
Remarks	-
Additional analysis	-
Literature	Roessingh, W. & A.J. Tol (red.) 2019: *Archeologie langs de Westfrisiaweg. Opgravingen van vindplaatsen uit de late prehistorie, middeleeuwen en Nieuwe tijd in het tracé van de Westfrisiaweg*, Amersfoort/Leiden (ADC Rapport 5000/Archol Rapport 461), 699.

ID	ID25
Site	Hoogkarspel-Houterpolder West
Town	Hoogkarspel
Municipality	Drechterland
Coordinates	140.036,14/521.568,47
Excavation company	ADC
Year of excavation	2014
Find nr	752
Trench nr	22
Level nr	1
Feature nr	14
Type of feature	Ring ditch
Structure	GS01
Context date	Middle Bronze Age
Context date based on	Radiocarbon date on bone
Skeleton element	Femur and tibia diaphysis (left)
Number of elements	2
Sex	Male (?)
Age	Adult
Radiocarbon date element	Poz-147614: 3145±30BP (1499-1311 cal BC)
Remarks	Traces of cutting and traces of (non-pathological) marks on fragment of femur
Additional analysis	-
Literature	Roessingh, W. & A.J. Tol (red.) 2019: *Archeologie langs de Westfrisiaweg. Opgravingen van vindplaatsen uit de late prehistorie, middeleeuwen en Nieuwe tijd in het tracé van de Westfrisiaweg*, Amersfoort/Leiden (ADC Rapport 5000/Archol Rapport 461), 699.

ID	ID44
Site	Hoogkarspel-Houterpolder West
Town	Hoogkarspel
Municipality	Drechterland
Coordinates	140.000/ 521.581
Excavation company	ADC
Year of excavation	2014
Find nr	1035
Trench nr	21
Level nr	2
Feature nr	105
Type of feature	Ditch
Structure	GR26
Context date	Middle Bronze Age – Late Bronze Age
Context date based on	Based on radiocarbon date on charred seeds in GR26: Poz-92086: 2950±30BP (1260-1051 cal BC).
Skeleton element	Cranium; os frontalis & parietalis (left+right)
Number of elements	22
Sex	Male (?)
Age	30-50
Radiocarbon date element	-
Remarks	-
Additional analysis	-
Literature	Roessingh, W. & A.J. Tol (red.) 2019: *Archeologie langs de Westfrisiaweg. Opgravingen van vindplaatsen uit de late prehistorie, middeleeuwen en Nieuwe tijd in het tracé van de Westfrisiaweg*, Amersfoort/Leiden (ADC Rapport 5000/Archol Rapport 461), 699.

Hoogkarspel-Markerwaardweg

ID1-7 & ID10

Figure 11. The site 'Hoogkarspel-Markerwaardweg' and the location of the analysed human remains.

ID	ID1
Site	Hoogkarspel-Markerwaardweg
Town	Hoogkarspel
Municipality	Drechterland
Coordinates	139.497/522.813
Excavation company	Archol
Year of excavation	2014-2015
Find nr	1854
Trench nr	72
Level nr	1
Feature nr	4194
Type of feature	Ditch
Structure	GR14b
Context date	Middle Bronze Age
Context date based on	Based on radiocarbon date on charred seeds from GR14b: Poz-101534: 2925±30BP (1215-1022 cal BC).
Skeleton element	Cranium; os frontalis, occipitalis & parietalis (left & right)
Number of elements	26
Sex	Unknown
Age	1-3
Radiocarbon date element	-
Remarks	-
Additional analysis	-
Literature	Roessingh, W. & A.J. Tol (red.) 2019: *Archeologie langs de Westfrisiaweg. Opgravingen van vindplaatsen uit de late prehistorie, middeleeuwen en Nieuwe tijd in het tracé van de Westfrisiaweg*, Amersfoort/Leiden (ADC Rapport 5000/Archol Rapport 461), 58, 699.

ID	ID2
Site	Hoogkarspel-Markerwaardweg
Town	Hoogkarspel
Municipality	Drechterland
Coordinates	139.111/523.461
Excavation company	Archol
Year of excavation	2014-2015
Find nr	769
Trench nr	39
Level nr	1
Feature nr	1614
Type of feature	Ditch
Structure	-
Context date	Middle Bronze Age
Context date based on	Location within the settlement and associated (dated) features nearby
Skeleton element	Mandibula (right) including three dental elements (46, 47 & 48)
Number of elements	2
Sex	Unknown
Age	18-25
Radiocarbon date element	-
Remarks	DNA analysis possible
Additional analysis	-
Literature	Roessingh, W. & A.J. Tol (red.) 2019: *Archeologie langs de Westfrisiaweg. Opgravingen van vindplaatsen uit de late prehistorie, middeleeuwen en Nieuwe tijd in het tracé van de Westfrisiaweg*, Amersfoort/Leiden (ADC Rapport 5000/Archol Rapport 461), 58, 699.

ID	ID3
Site	Hoogkarspel-Markerwaardweg
Town	Hoogkarspel
Municipality	Drechterland
Coordinates	139.170/523.477
Excavation company	Archol
Year of excavation	2014-2015
Find nr	2450
Trench nr	101
Level nr	1
Feature nr	6475
Type of feature	House ditch
Structure	HS27a
Context date	Middle Bronze Age
Context date based on	Location within the settlement and associated (dated) features nearby
Skeleton element	Cranium (os occipitalis)
Number of elements	9
Sex	Unknown
Age	20-40
Radiocarbon date element	-
Remarks	-
Additional analysis	-
Literature	Roessingh, W. & A.J. Tol (red.) 2019: *Archeologie langs de Westfrisiaweg. Opgravingen van vindplaatsen uit de late prehistorie, middeleeuwen en Nieuwe tijd in het tracé van de Westfrisiaweg*, Amersfoort/Leiden (ADC Rapport 5000/Archol Rapport 461), 58, 699.

ID	ID4
Site	Hoogkarspel-Markerwaardweg
Town	Hoogkarspel
Municipality	Drechterland
Coordinates	139.123/523.311
Excavation company	Archol
Year of excavation	2014-2015
Find nr	178
Trench nr	9
Level nr	1
Feature nr	393
Type of feature	Ditch
Structure	GR18b
Context date	Middle Bronze Age
Context date based on	Radiocarbon date on bone
Skeleton element	Cranium (os frontalis)
Number of elements	1
Sex	Unknown
Age	>18
Radiocarbon date element	Poz-147604: 3040±35BP (1411-1203 cal BC)
Remarks	-
Additional analysis	-
Literature	Roessingh, W. & A.J. Tol (red.) 2019: *Archeologie langs de Westfrisiaweg. Opgravingen van vindplaatsen uit de late prehistorie, middeleeuwen en Nieuwe tijd in het tracé van de Westfrisiaweg*, Amersfoort/Leiden (ADC Rapport 5000/Archol Rapport 461), 58, 699.

ID	ID5
Site	Hoogkarspel-Markerwaardweg
Town	Hoogkarspel
Municipality	Drechterland
Coordinates	139.455/522.863
Excavation company	Archol
Year of excavation	2014-2015
Find nr	1496
Trench nr	70
Level nr	1
Feature nr	3488
Type of feature	House ditch
Structure	HS17c
Context date	Middle Bronze Age
Context date based on	Based on radiocarbon date on charred seeds from posthole HS17c: Poz-92483: 3010±35BP (1388-1127 cal BC).
Skeleton element	Femur diaphysis (left+right), illium (left)
Number of elements	3
Sex	Unknown
Age	2-4
Radiocarbon date element	-
Remarks	-
Additional analysis	-
Literature	Roessingh, W. & A.J. Tol (red.) 2019: *Archeologie langs de Westfrisiaweg. Opgravingen van vindplaatsen uit de late prehistorie, middeleeuwen en Nieuwe tijd in het tracé van de Westfrisiaweg*, Amersfoort/Leiden (ADC Rapport 5000/Archol Rapport 461), 58, 699.

ID	ID6
Site	Hoogkarspel-Markerwaardweg
Town	Hoogkarspel
Municipality	Drechterland
Coordinates	139.476/522.826
Excavation company	Archol
Year of excavation	2014-2015
Find nr	1471
Trench nr	64
Level nr	1
Feature nr	3206
Type of feature	Post hole
Structure	HS19c
Context date	Middle Bronze Age
Context date based on	Based on a radiocarbon date on charred seeds from house ditch HS19c: Poz-92479: 2960±30BP (1263-1056 cal BC).
Skeleton element	Cranium; frontalis & parietalis (left & right)
Number of elements	1
Sex	Unknown
Age	Unknown
Radiocarbon date element	-
Remarks	-
Additional analysis	-
Literature	Roessingh, W. & A.J. Tol (red.) 2019: *Archeologie langs de Westfrisiaweg. Opgravingen van vindplaatsen uit de late prehistorie, middeleeuwen en Nieuwe tijd in het tracé van de Westfrisiaweg*, Amersfoort/Leiden (ADC Rapport 5000/Archol Rapport 461), 58, 699.

ID	ID7
Site	Hoogkarspel-Markerwaardweg
Town	Hoogkarspel
Municipality	Drechterland
Coordinates	139.096/523.266
Excavation company	Archol
Year of excavation	2014-2015
Find nr	1220
Trench nr	48
Level nr	1
Feature nr	2030
Type of feature	Ditch
Structure	GR26
Context date	Middle Bronze Age
Context date based on	Location within the settlement and associated (dated) features nearby
Skeleton element	Cranium; os parietalis (left)
Number of elements	2
Sex	Unknown
Age	>18
Radiocarbon date element	-
Remarks	-
Additional analysis	-
Literature	Roessingh, W. & A.J. Tol (red.) 2019: *Archeologie langs de Westfrisiaweg. Opgravingen van vindplaatsen uit de late prehistorie, middeleeuwen en Nieuwe tijd in het tracé van de Westfrisiaweg*, Amersfoort/Leiden (ADC Rapport 5000/Archol Rapport 461), 58, 699.

ID	ID10
Site	Hoogkarspel-Markerwaardweg
Town	Hoogkarspel
Municipality	Drechterland
Coordinates	139.215/523.139
Excavation company	Archol
Year of excavation	2014-2015
Find nr	67
Trench nr	6
Level nr	1
Feature nr	262
Type of feature	Ditch
Structure	GR08a
Context date	Middle Bronze Age
Context date based on	Based on radiocarbon date on charred seeds from GR08a: Poz-101655: 3070±30BP (1415-1236 cal BC).
Skeleton element	Cranium; os frontalis and parietalis (left & right), os occipitalis and temporalis (left)
Number of elements	28
Sex	Male
Age	20-40
Radiocarbon date element	-
Remarks	-
Additional analysis	-
Literature	Roessingh, W. & A.J. Tol (red.) 2019: *Archeologie langs de Westfrisiaweg. Opgravingen van vindplaatsen uit de late prehistorie, middeleeuwen en Nieuwe tijd in het tracé van de Westfrisiaweg*, Amersfoort/Leiden (ADC Rapport 5000/Archol Rapport 461), 58, 699.

Hoogkarspel-Watertoren Tumulus I

ID11-13

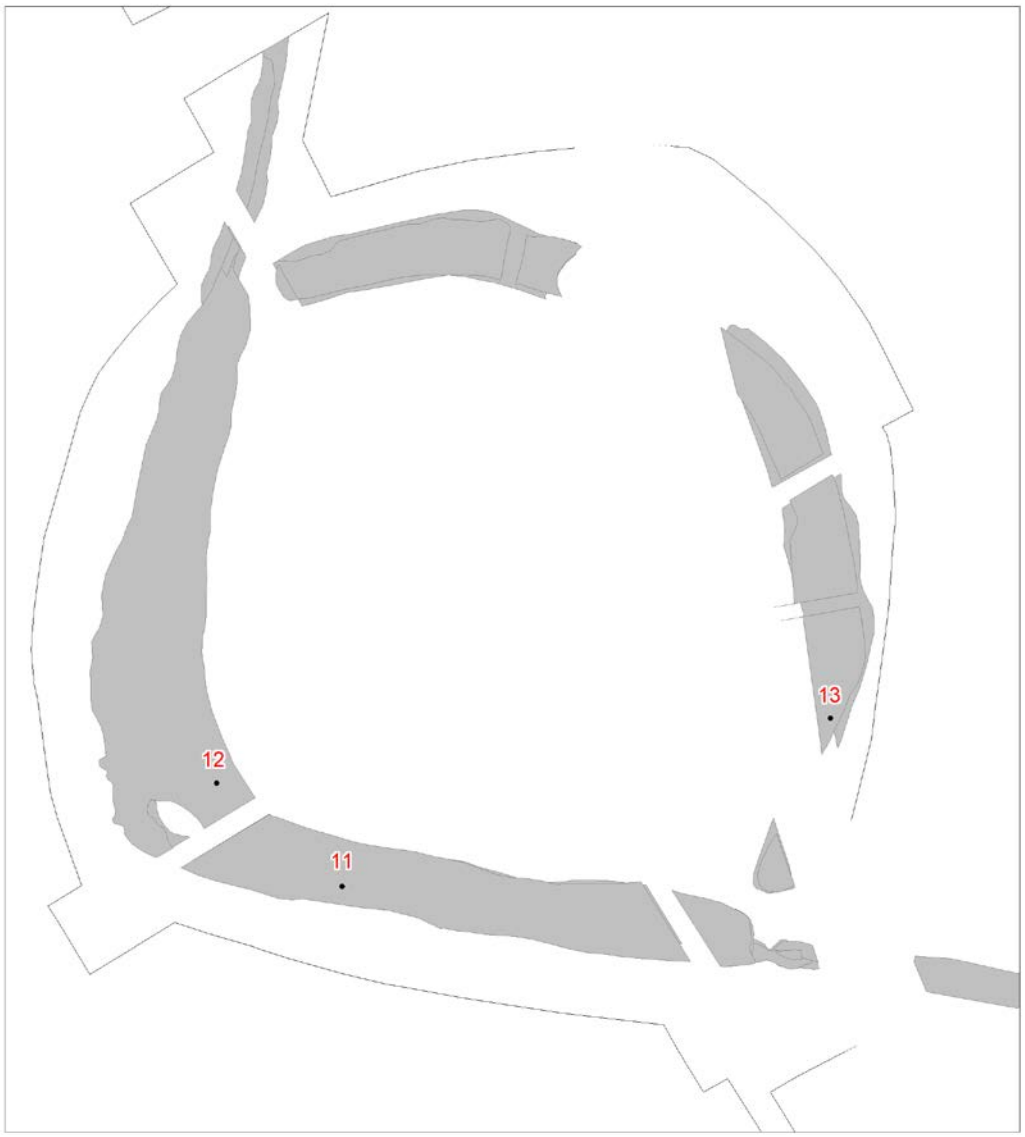

Figure 12. The site 'Hoogkarspel-Watertoren Tumulus I' and the location of the analysed human remains.

ID	ID11
Site	Hoogkarspel-Watertoren Tumulus I
Town	Hoogkarspel
Municipality	Drechterland
Coordinates	140.563,5/523.190,0
Excavation company	IPP
Year of excavation	1958
Find nr	27 (1)
Trench nr	-
Level nr	-
Feature nr	-
Type of feature	Ring ditch
Structure	Tumulus I
Context date	Middle Bronze Age
Context date based on	Location within the settlement and associated (dated) features nearby
Skeleton element	Cranium; os parietalis (right)
Number of elements	1
Sex	Unknown
Age	Adult (?)
Radiocarbon date element	-
Remarks	-
Additional analysis	-
Literature	Bakker, J.A., 1959: Opgravingen te Hoogkarspel I: Het onderzoek van tumulus I en naaste omgeving, *West-Frieslands Oud en Nieuw 26*, 177. Bakker, J.A., 1974: *Prehistorische mensenresten uit Westfriesland, volgens de archeologische berichtgeving (een literatuuroverzicht vermenigvuldigd ten behoeve van direct belanghebbende)*, Amsterdam (IPP-publicatie 165), 4.

ID	ID12
Site	Hoogkarspel-Watertoren Tumulus I
Town	Hoogkarspel
Municipality	Drechterland
Coordinates	140.560,6/523.192,4
Excavation company	IPP
Year of excavation	1958
Find nr	30 (9)
Trench nr	-
Level nr	-
Feature nr	-
Type of feature	Ring ditch
Structure	Tumulus I
Context date	Middle Bronze Age
Context date based on	Location within the settlement and associated (dated) features nearby
Skeleton element	Cranium (not identifiable)
Number of elements	2
Sex	Unknown
Age	Adult (?)
Radiocarbon date element	-
Remarks	-
Additional analysis	-
Literature	Bakker, J.A., 1959: Opgravingen te Hoogkarspel I: Het onderzoek van tumulus I en naaste omgeving, *West-Frieslands Oud en Nieuw* 26, 177. Bakker, J.A., 1974: *Prehistorische mensenresten uit Westfriesland, volgens de archeologische berichtgeving (een literatuuroverzicht vermenigvuldigd ten behoeve van direct belanghebbende)*, Amsterdam (IPP-publicatie 165), 4.

ID	ID13
Site	Hoogkarspel-Watertoren Tumulus I
Town	Hoogkarspel
Municipality	Drechterland
Coordinates	140.575/523.194
Excavation company	IPP
Year of excavation	1958
Find nr	36 (19)
Trench nr	-
Level nr	-
Feature nr	-
Type of feature	Ring ditch
Structure	Tumulus I
Context date	Middle Bronze Age
Context date based on	Location within the settlement and associated (dated) features nearby
Skeleton element	Cranium
Number of elements	1
Sex	Unknown
Age	Adult (?)
Radiocarbon date element	-
Remarks	Burned fragment
Additional analysis	-
Literature	Bakker, J.A., 1959: Opgravingen te Hoogkarspel I: Het onderzoek van tumulus I en naaste omgeving, *West-Frieslands Oud en Nieuw 26*, 177. Bakker, J.A., 1974: *Prehistorische mensenresten uit Westfriesland, volgens de archeologische berichtgeving (een literatuuroverzicht vermenigvuldigd ten behoeve van direct belanghebbende)*, Amsterdam (IPP-publicatie 165), 4.

Venhuizen-Voetakkers

ID8 & ID9

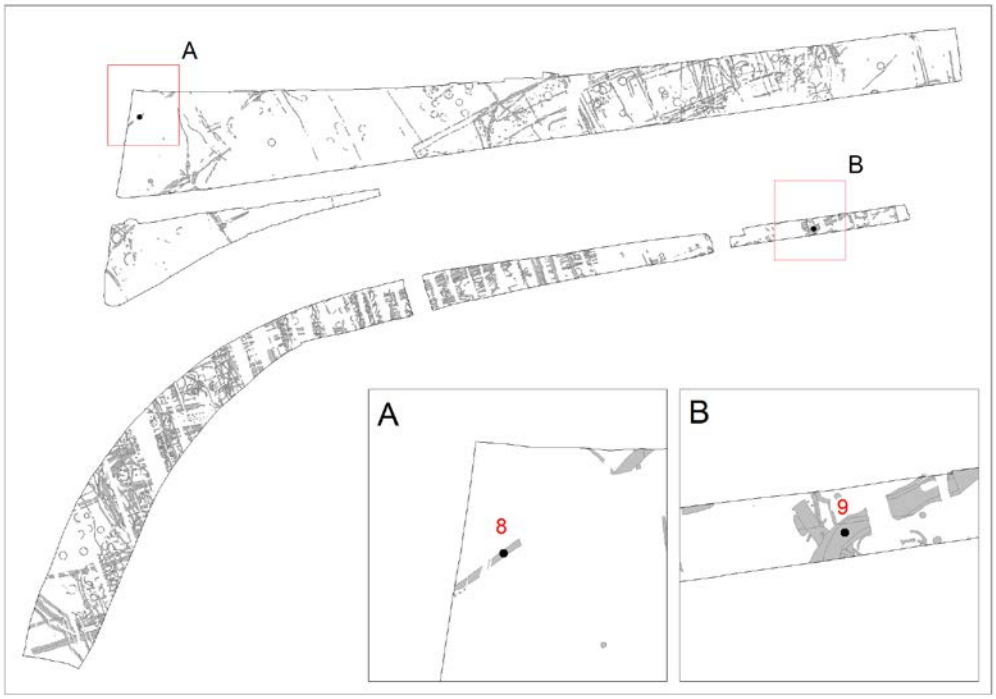

Figure 13. The site 'Venhuizen-Voetakkers' and the location of the analysed human remains.

ID	ID8
Site	Venhuizen-Voetakkers
Town	Venhuizen
Municipality	Drechterland
Coordinates	142.840521.887
Excavation company	Archol
Year of excavation	2014-2015
Find nr	124
Trench nr	41
Level nr	1
Feature nr	907
Type of feature	Ditch
Structure	-
Context date	Middle Bronze Age
Context date based on	Radiocarbon date on bone
Skeleton element	Femur diaphysis (right)
Number of elements	3
Sex	Female (?)
Age	>18
Radiocarbon date element	Poz-147606: 3110±30BP (1442-1286 cal BC)
Remarks	Possible traces of cutting. In original publication, findnr. 124 is associated with excavation Hoogkarspel-Markerwaardweg which is wrong.
Additional analysis	Microwear analysis: modern traces (spade/vise); SEM / XRF analysis: no elements of metal tools
Literature	Roessingh, W. & A.J. Tol (red.) 2019: *Archeologie langs de Westfrisiaweg. Opgravingen van vindplaatsen uit de late prehistorie, middeleeuwen en Nieuwe tijd in het tracé van de Westfrisiaweg*, Amersfoort/Leiden (ADC Rapport 5000/Archol Rapport 461), 58, 699.

ID	ID9
Site	Venhuizen-Voetakkers
Town	Venhuizen
Municipality	Drechterland
Coordinates	143.208/521.826
Excavation company	Archol
Year of excavation	2014-2015
Find nr	418
Trench nr	60
Level nr	1
Feature nr	1915
Type of feature	Ditch
Structure	-
Context date	Middle Bronze Age
Context date based on	Location within the settlement and associated (dated) features nearby
Skeleton element	Cranium; os parietalis (right)
Number of elements	5
Sex	Unknown
Age	>12
Radiocarbon date element	-
Remarks	In original publication, findnr. 418 is associated with excavation Hoogkarspel-Markerwaardweg which is wrong.
Additional analysis	-
Literature	Roessingh, W. & A.J. Tol (red.) 2019: *Archeologie langs de Westfrisiaweg. Opgravingen van vindplaatsen uit de late prehistorie, middeleeuwen en Nieuwe tijd in het tracé van de Westfrisiaweg*, Amersfoort/Leiden (ADC Rapport 5000/Archol Rapport 461), 58, 699.

Wervershoof-De Ark Tumulus XIII

ID14

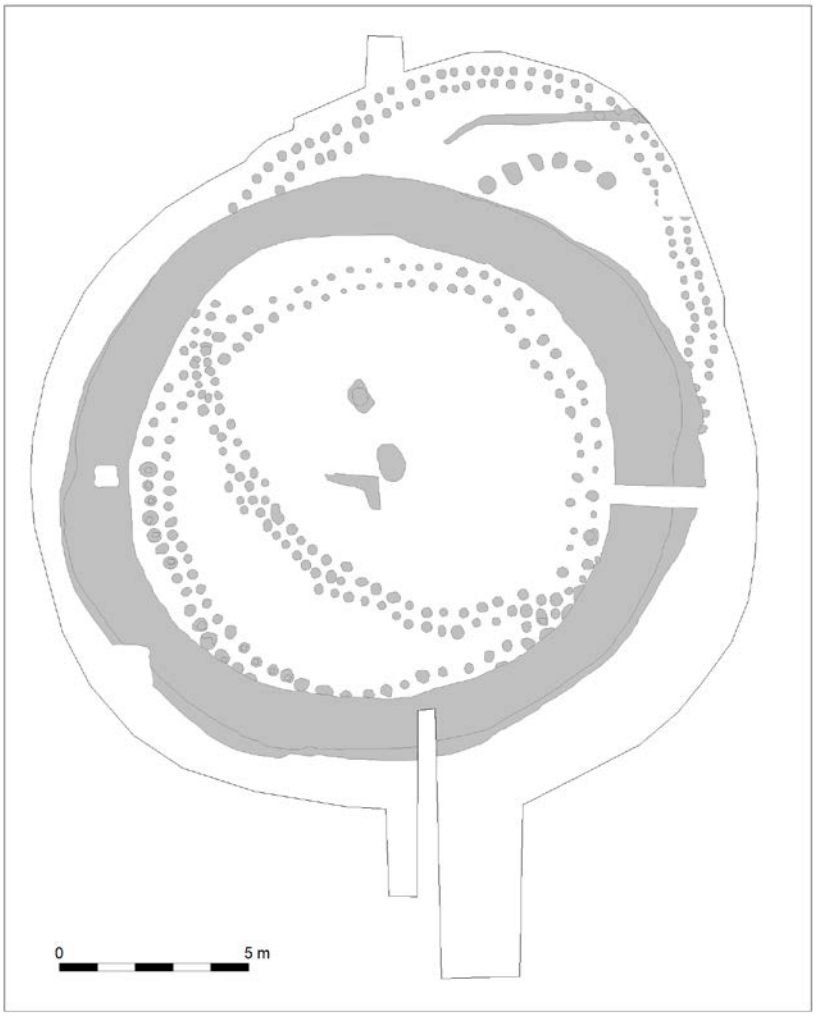

Figure 14. The site 'Wervershoof-De Ark Tumulus XIII'. The exact location of the human remains is unknown.

ID	ID14
Site	Wervershoof-De Ark Tumulus XIII
Town	Wervershoof
Municipality	Medemblik
Coordinates	139.470/525.330
Excavation company	IPP
Year of excavation	1954
Find nr	5
Trench nr	-
Level nr	-
Feature nr	-
Type of feature	Second period ring ditch (period IV)
Structure	Tumulus XIII, subtumulus IV
Context date	Middle Bronze Age
Context date based on	Radiocarbon date on bone
Skeleton element	Femur diaphysis including distal epifyse, tibia (right) diaphysis
Number of elements	2
Sex	Male (?)
Age	>18 (?)
Radiocarbon date element	Poz-147607: 3110±30BP (1442-1286 cal BC)
Remarks	-
Additional analysis	-
Literature	Bakker, J.A., 1974: *Prehistorische mensenresten uit Westfriesland, volgens de archeologische berichtgeving (een literatuuroverzicht vermenigvuldigd ten behoeve van direct belanghebbende)*, Amsterdam (IPP-publicatie 165), 4. Clason, A.T., 1961: Bijlage IV. De beenderen van tumulus XIII bij 'De Ark, gem. Wervershoof, in: J.D. van der Waals, De zool van tumulus XIII bij "De Ark", gemeente Wervershoof, *West-Frieslands Oud en Nieuw 28*, 91-96 91-96. Runia, L.T., 1987: The chemical analysis of prehistoric bones. A paleodietary and ecoarcheological study of Bronze Age West-Friesland, *BAR International Series* 363, 217. Van der Waals, J.D., 1961: De zool van tumulus XIII bij "De Ark", gemeente Wervershoof, *West-Frieslands Oud en Nieuw 28*, 52-96.

VIII Recommendations luminescence properties of human bones

M. Bruinsma

Introduction

In Chapter 7, an extensive report was provided on the research into the luminescent properties of a collection of human skeletal remains from West Frisia. The methods applied in this research regarding the alternate light source were also utilized in the master's thesis.[1] The thesis covers the examination of various archaeological collections that exhibited manipulations dating back to the Bronze Age, Middle Ages, and New Age. Manipulations refer to the intentional or unintentional application of alterations to human skeletal remains. Using the alternative light source, the possible manipulations on the human skeletal remains were exposed to a wavelength of 420-470 nm, after which the luminescent properties were investigated and compared with the surrounding periosteal surface. This thorough investigation has yielded valuable insights that can be applied in future scientific research on luminescence intensity in the context of manipulations. The recommendations arising from this research contribute to further study on the dating traces of manipulations on archaeological collections, and are of significant importance for the advancement of this field of research.

Standardization

To ensure uniformity and consistency, it is firstly recommended to apply a standardized method of examination. This starts with sample preparation. First of all, it is important to store the bone samples in the appropriate conditions to ensure that the quality remains stable and does not deteriorate. For this purpose, it is desirable to avoid high humidity and temperature fluctuations. According to specification DS04 of the Stichting Infrastructuur Kwaliteitsborging Bodembeheer[2], the storage room requires a relative humidity of 30% <RH< 65%, constant ± 5%. The temperature of this room should be 18°C ± 3°C. Inside the storage, fragments with degradation class 1, 2 and 3 can be stored for a considerable period of time. Fragile bone with a degradation class of 2 and/or 3 can only be treated on the surface that is not of interest for examination with the alternative light source. Preservatives used to stabilize the quality of fragile bone, such as PVAc, palaroid V72 and glue, can affect the luminescent properties of the surface, making it unusable for the examination method of this report.

Ensuring Clean Surfaces

Ensure that the surface of interest is clean from contaminants remaining from excavation or processing. Remove the dirt by using a soft toothbrush and rub it carefully over the surface. Allow the surface to dry before illuminating it with the light source.

Consistency in Examination

It is essential to work in a darkened room to minimize the exposure to light. Also, a dark background is of importance because it maximizes the contrast between the bone tissue and the surrounding background, which will help to make a more accurate observation. Ensure that the alternate light source is illuminated from a consistent distance so the luminescence intensity will be and remain consistent. To ensure a uniform distance, a tripod can be installed in which the light source can be inserted. The same consistency is recommended for photographing the bone, applying the same camera, lens, settings, and height. To comply with the above recommendations during analysis, it is advised to establish a protocol to ensure that the measurements are accurate, consistent, and scientifically valid. It is strongly recommended to use the same setting for examination with the alternate light source on skeletal remains. Consistency in usage of equipment are of importance so that the research is comparable and reproducible.

Future Research

The research of this thesis has been limited to the examination of human skeletal remains from three Dutch excavations from three

1 Bruinsma 2024.
2 https://www.sikb.nl/doc/BRL4000/Protocol%204010%20Depotbeheer%204_1.pdf; https://www.sikb.nl/doc/BRL4000/Protocol%204004%20Opgraven-lb%204_1.pdf

different time periods. It is of importance to be aware that the results obtained from this research should not be taken as a definitive standard for future comparable investigations. This implies that bones from other contexts may provide different results from the ones presented in this research report.

Future research could include comparing bone samples from different regions to investigate regional variability in luminescence intensity, assessing the luminescence properties of bone samples from diverse soil types to understand possible soil characteristics' impact. It is also important to conduct longitudinal studies to explore temporal changes in luminescence intensity, investigating the luminescent properties of bone samples from different age groups and sexes to assess demographic influences, and conducting comparative analysis of bone samples from different archaeological contexts to distinguish between ancient and recent manipulations and understand variations in dating manipulations. The relevance of said research lies in performing quality control checks to determine suitability of each well-preserved bone sample for the specific research using the alternative light source. Moreover, further research could indicate and standardize factors and confounding variables which could cause deviations in the research results.

This monograph brings together the results of an interdisciplinary study of the disarticulated human bones from West Frisian Bronze Age settlements (province of Noord-Holland). This part of the Netherlands was densely inhabited in the Middle and Late Bronze Age (c. 1600-800 BC). However, barrows are less common and funerary practices are still not well understood. Key question is: What happened to most of the deceased? To answer this, the disarticulated human bones from settlement context and ring ditches around barrows were investigated. The human remains were studied by several experts, focussing e.g. on microwear and luminescence analysis. The results take us a step further to a better understanding of the Bronze Age mortuary practices.

This scientific volume is intended for archaeologists and other professionals as well as enthusiastic volunteers involved in archaeology.

The Cultural Heritage Agency of the Netherlands provides knowledge and advice to give the future a past.