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Finding the Needle in the Haystack by Using Knowledge of Mesolithic Human Adaptation in a Drowning Delta

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Drowned landscapes; Mesolithic; Rhine-Meuse delta; underwater excavation.

Introduction

The Port of Rotterdam is presently expanding Rotterdam harbour into the North Sea. A new 20m deep harbour canal is being dredged to connect to the existing harbour, thereby destroying buried Early Holocene drowned fluvio-deltaic landscapes. Archaeological research in deposits of the Early Holocene age further upstream in the Rhine delta have revealed that Mesolithic hunter-gatherers adapted to the drowning landscape by using the highest parts of Late-Weichselian aeolian dunes for their hunting camps. This combined knowledge led to the challenge of finding such dunes in the harbour. At depths of 17–22m below OD in 17m water depth this was like looking for a needle in a haystack. Remnants of a river dune were indeed found followed by a spectacular—albeit small-scale—underwater investigation in 2011. This was the first time that many Mesolithic remains were encountered this deep and this far west.

Late-Weichselian to Middle-Holocene Landscape Evolution

The landscape evolution of the Holocene Rhine-Meuse delta in the Netherlands is extremely well-known.¹ More recently, the research on landscape evolution of the delta was extended further to the west and even offshore into the present southern North Sea.² Meanwhile, the underlying Late-Pleistocene Rhine deposits were studied by Buschers et al.³ Landscape evolution and palaeogeography of the delta are thus very well known in space and time.

In the Younger Dryas, the Rhine was a braided river with several braidplains slightly incised in a Pleniglacial river terrace (Fig. 1a). In times of low discharge, large parts of the braidplains fell dry. Sand was blown out of the dry parts of the braidplains onto the low river terrace where it was trapped by vegetation. This resulted in large aeolian river dunes that reach heights of up to 15m above the terrace surface. These dunes are now for

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- 1 Berendsen and Stouthamer 2001 for an overview of the research and a complete palaeogeographical reconstruction; Bosch and Kok 1994 and Kok and Groot 1998 for excellent 1:50 000 geological map sheets and detailed cross sections.
- 2 Hijma et al. 2009, 13–53; Hijma and Cohen 2010, 275–278; Hijma et al. 2012, 17–39.
- 3 Busschers et al. 2005, 25–41; Busschers et al. 2007, 3216–3284.

the large part buried under Holocene fluvial deposits and peat. They are present all along the former braidplains from Germany to Rotterdam. West of Rotterdam, they seem to disappear. This is in fact a data-artefact: here they are buried too deep for the hand core drillings to reach them. After the onset of the Holocene, the Rhine became a meandering river due to the ameliorating climate and more constant discharge (Fig. 1b). The fast rising sea-level in the Early-Holocene forced the Rhine to aggrade its floodplain. Before final drowning of the western delta in the early Atlantic,⁴ a freshwater delta existed here (Fig. 1c). In this drowning delta, the tops of the river dunes were present as dry islands.

Dry Islands in the Delta

The seasonal presence of Mesolithic hunter gatherers on the river dunes is well documented from many sites that have been excavated in the past decades. Several of these well-documented excavations have become famous, e.g. the Hazendonk⁵ and the Hardinxveld sites.⁶ The latter two were large excavations prior to the construction of the Betuwe route cargo railway from the Rotterdam harbour to Germany. At Hardinxveld, the oldest Mesolithic inhumation at that time and a dugout-canoe were among the spectacular results. Mesolithic hunter gatherers used the river dunes for their seasonal hunting camps. They kept coming back to the same locations for many years. This is hardly surprising because the tops of the river dunes were the only dry islands in a very wet swamp. That swamp, however, was very rich in food and thus attractive for the Mesolithic hunter gatherers. Although these excavations all took place on river dunes further east in the delta, it is expected that river dunes further to the west may have been used in the same way. Here the problem is how to find these dunes. Due to the Holocene sea-level rise, the Holocene deposits reach a thickness of up to 20m.⁷ The discovery of a small river dune under the Rotterdam city centre in an excavation that was necessary because of the construction of a new subway station proved that river dunes are present in the area at stake as well.⁸ At that Rotterdam river dune location however, no archaeological remains were found.⁹

Looking for the Needle in a Haystack

The deepening of the Yangtzeharbour (Fig. 2b) to 22m is part of the Maasvlakte 2 expansion of the Rotterdam harbour. In a preliminary desktop survey, the possible presence of river dunes under the Maasvlakte 2 construction area was noticed (among many other things).¹⁰ Hence, further archaeological research here was necessary. A special agreement between the Port of Rotterdam, the Cultural Heritage Agency of the Netherlands and BOOR (Rotterdam Archaeological Department) in 2008 provided the formal framework for further archaeological research that was necessary because of the construction of Maasvlakte 2.¹¹ The work in the Yangtzeharbour is part of that research, for which Manders et al.¹² provided a scientific framework. Many Mesolithic artefacts have been found on the artificial beach of Maasvlakte 1.¹³ The sand for this beach was dredged from

4 Hijma and Cohen 2010, 275–278; Hijma and Cohen 2011, 1453–1485.

5 van der Woude 1983; van der Woude 1984.

6 Louwe Kooijmans 2001b; Louwe Kooijmans 2001a.

7 van Staalduinen 1979; Vos and Bazelmans 2011, 30.

8 Guiran and Moree 2009.

9 Guiran and Moree 2009, 33.

10 Helsing, Sueur, and Vos 2004, 10.

11 Anonymus 2008.

12 Manders et al. 2008.

13 Manders et al. 2008, 15–16.

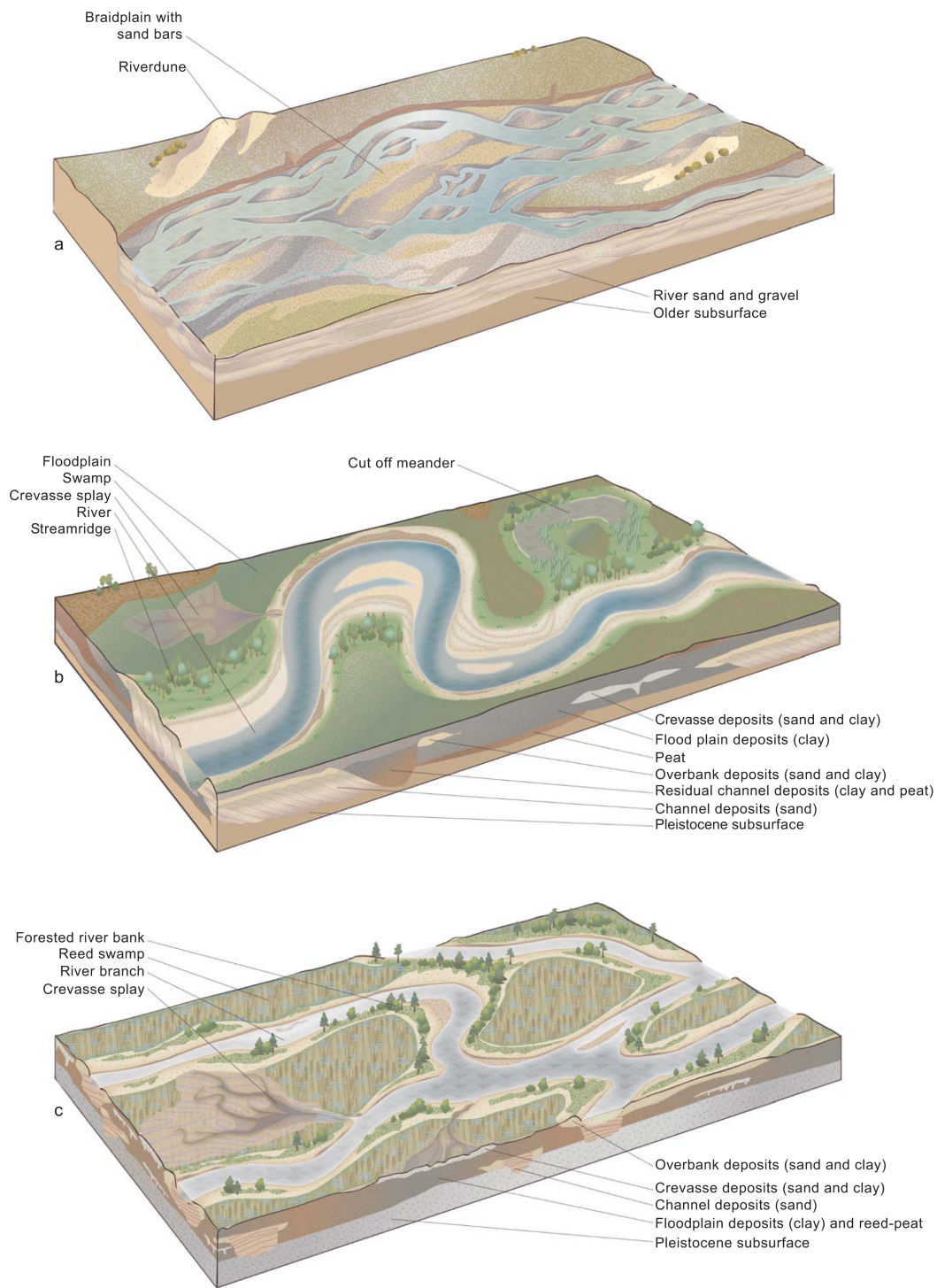


Fig. 1 | Younger Dryas to Early-Holocene landscape evolution in the Rhine-Meuse delta west of Rotterdam (see Fig. 2 for location). (a) Rhine-Meuse braidplain in the Late-Weichselian. Note the presence of aeolian river dunes on the low river terrace adjacent to the braidplain. (b) Rhine-Meuse meandering river in an aggrading floodplain in the Early-Holocene. (c) Aggrading anastomosing Rhine-Meuse branches in a freshwater deltaic setting at the Early- to Middle-Holocene transition. Block-diagrams from Weerts et al. 2011b, 19.

the North Sea floor nearby. This, too, points to the possible presence of archaeological remains under the Yangtzeharbour. The challenge has now become how to find out

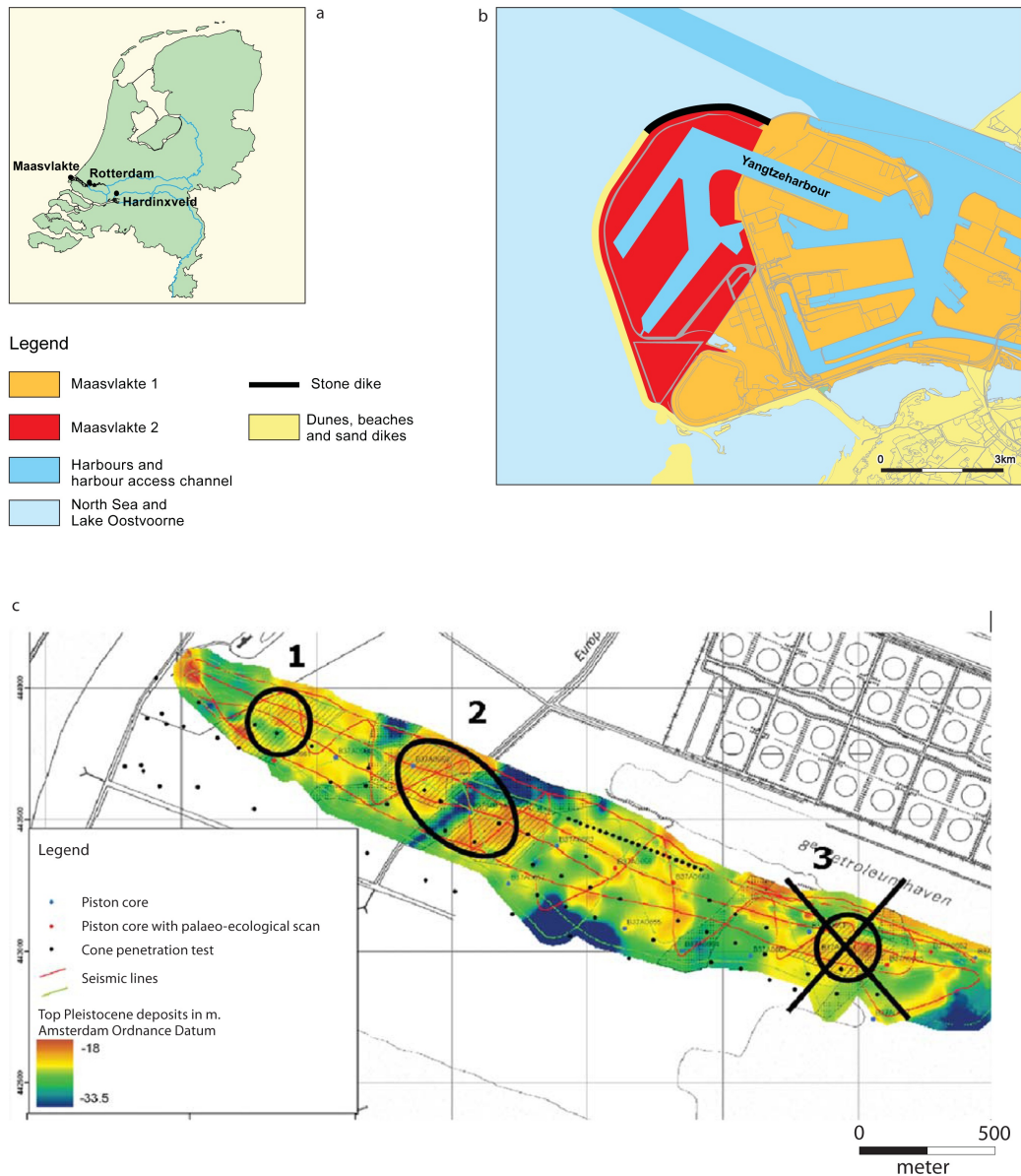


Fig. 2 | The Yangtzeharbour location. (a) Location of the Maasvlakte, Rotterdam and Hardinxveld in the Netherlands. (b) Location of the Yangtzeharbour in the Maasvlakte. (c) Location of the river dune under the Yangtzeharbour. (a) and (b) adapted from Weerts et al. 2011a, 81. (c) adapted from Vos et al. 2010 Bijlage 14.

if there is something under there, or not. This is much like looking for a needle in a haystack. The part of the Yangtzeharbour that has to be deepened is over 3km long and 500m wide. Water depth at the time was 17m.

A desktop study based on existing core descriptions and cone penetration tests dealing with possible Mesolithic archaeology under the Yangtzeharbour was published by Vos et al.¹⁴ One of the conclusions was that additional data collecting was necessary. This “field-work” was carried out in 2010 and clearly showed the presence of an intact drowned Early Holocene fluvial landscape underneath younger shallow marine deposits.¹⁵ Based on shallow seismics, existing cone penetration tests and 17 new piston cores with a penetration range from 2.2–4.5m, three areas with a high archaeological potential were recognised

14 Vos et al. 2009.

15 Vos et al. 2010.

	charcoal	9520
	wood	4
	plant material, burnt	15
	bone	4003
	bone, burnt	3582
	antler	0
	fish remains	147
	fish remains, burnt	0
Tab. 1 Archaeological remains in the sieve residues of the Yangtzeharbour excavation, first half of the sieve residue.	flint	1371
	flint, burnt	391
	stone other than flint	39

(Fig. 2c). In Areas 1 and 3, remnants of aeolian river dunes were expected. Area 2 shows a palaeo-channel of unknown origin with high grounds on either side. Area 3 was hard to access because of ship traffic. Areas 1 and 2 were selected for further detailed landscape research using new cone penetration tests, very detailed shallow seismics and 52 additional piston cores that yielded almost 200m of undisturbed sediment. In Area 1, the presence of a river dune was attested. In Area 2, a filled-in fluvial channel is present. This channel was later re-occupied by a tidal channel (from core-descriptions in de Vries¹⁶). Thirteen of the piston cores in Area 1 contained archaeological remains, predominantly charcoal but also (burnt) bone and flint fragments.¹⁷ No remains were found in cores of Area 2.

The presence of archaeological remains on top of a buried river dune led, of course, to an underwater investigation, albeit on a small scale due to the circumstances. It was carried out in the autumn of 2011 using a special crane on a pontoon in the Yangtzeharbour. On three small locations on the dune, the sediment was removed to just above the level with archaeological remains. This level was carefully excavated using a special scraping grab with exact horizontal and vertical positioning. The sediment of each grab was transferred into two big bags on board the pontoon, yielding 316 big bags. The sediment of the big bags was subsequently sieved (10mm and 2mm mesh) on the Yangtzeharbour quay using water from the harbour. The sieve-residues have been sorted, resulting in many spectacular very well preserved (Early) Mesolithic remains including organics. Table 1 gives an impression of the results half way through the sorting operation.

Final Remarks

The combination of knowledge of Mesolithic human adaptation in a drowning delta from earlier research, modern surveying techniques and landscape modelling led to the finding of a needle in a haystack: a Mesolithic hunter gatherer camp at 17.5–20m below OD in 17m water depth. Additional laboratory research (¹⁴C and OSL dating, palaeo-ecology), detailed description of the archaeological remains and final interpretation are underway.

Fig. 1 was drawn by Klaas van der Veen and adapted by Menne Kosian. Fig. 2 was compiled by Menne Kosian from figures drawn by Marjolein Haars (a, b) and Deltares (c).

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¹⁶ de Vries 2012.

¹⁷ Schiltmans 2012, 4.

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