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The impact of coastal erosion and rising sea levels on archaeological sites in Walcheren, province of Zeeland, in the Middle Ages

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Contents

1 The impact of coastal erosion on cultural heritage

1.1 Introduction

The Netherlands, a land of intricate waterways, lush green landscapes, and rich cultural heritage, bears witness to a history shaped by its dynamic relationship with water. Situated along the North Sea coast Walcheren, a part of the province Zeeland in the southwestern part of the Netherlands (Fig 1.1), features a wide variety of historical and archaeological evidence pointing to its significance dating back to the prehistory. During the Middle Ages, this region served as a crossroads of trade, commerce, and cultural exchange. However, amidst the serene beauty of Walcheren's coastal landscapes lies a silent threat – coastal erosion and rising sea levels. Over the centuries, these environmental forces have relentlessly reshaped the coastline, reclaiming land and submerging ancient settlements beneath the waves. As the sea encroaches upon the shores, it not only alters the physical landscape but also forms a danger to the invaluable cultural heritage concealed beneath the earth and water.

Figure 1.1, Location of the study area, the former island Walcheren, in the province of Zeeland. (Adapted from: Wikipedia, https://nl.wikipedia.org/wiki/Bestand:Zeeland_in_the_Netherlands.svg and Google, https://www.google.com/maps)

1.2 Research questions

The aim of this thesis is to investigate the impact of coastal erosion and rising sea levels, and their impact on archaeological sites in Walcheren, with a focus on the Middle Ages spanning from 400/500 AD to 1500 AD. Specifically focusing on how these environmental factors have influenced (and continues to affect) these coastal and (potential) underwater sites. By examining the archaeological record within this time period, this study seeks to clear up how environmental factors have influenced and continue to affect coastal and potential underwater sites in Zeeland.

This main theme will be answered on the hand of six questions, which will follow in the upcoming text.

- What is the known history of Walcheren during the Middle Ages?

- Where are known archaeological sites/finds located?

- Is there a pattern or are there certain locations/villages?

- Do the location choices of older settlements already take into account the sea?

- Did this influence their lifestyle and (maritime) trading?

- How does the sea(level, in combination with coastal erosion) influence the land?

1.3 Methods

At the heart of this investigation lies a multidisciplinary approach, drawing upon insights from archaeology and environmental science. Through the combination of diverse data sets and methodologies, I will construct a holistic understanding of the complex dynamics shaping the landscape of Walcheren.

Through a comprehensive analysis of Walcheren's archaeological record, this thesis aims to shed light on the intricate relationship between environmental change and cultural preservation. Showing the impact of coastal erosion and rising sea levels' on archaeological sites in Zeeland serves not only as a window into the past but also as a call to action for the preservation of cultural heritage in the face of environmental uncertainty in the future.

This research is based on data from existing sources. Literature will be used to gather information about the known history about Zeeland and its settlements, based on historical sources, about the landscape dynamics an archaeological research.

Archis, CHS Zeeland and archaeological reports will be used for data on the exact locations of settlements and their surroundings (https://www.zeeland.nl/loket/kaarten-en-cijfers/, https://dans.knaw.nl/nl & https://archis.cultureelerfgoed.nl).This data will be combined with geological data of past landscape changes, to look at the relation between location choice and settlement history to give more information and possibly link specific factors together.

In the second chapter I will tell what the natural landscape looked like at the time and how the cultural landscape looked like. I will be using literature to learn what's already known about Zeeland's history and where its towns and villages were located over time. The goal is to gather information about the landscape dynamics and how the landscape has changed. In chapter 3 I will show where most important sites were located during the Middle Ages with help from Archis. Here I will also use literature and additionally archaeological research. After mapping the area and the settlements, in chapter 4 tries I will try to explain patterns or specific locations that could show evidence for adaptations due to sea level rise. This could be useful to understand why people might have settled in certain places. Chapter 5 is the synthesis, In which I will put all previously gathered information together, to paint a clearer picture of Zeeland's past. Lastly I will explain how humans during the Middle Ages already had to deal with the sea and how they adapted themselves, to see if people and the environment have influenced each other over time.

2 The history of Walcheren

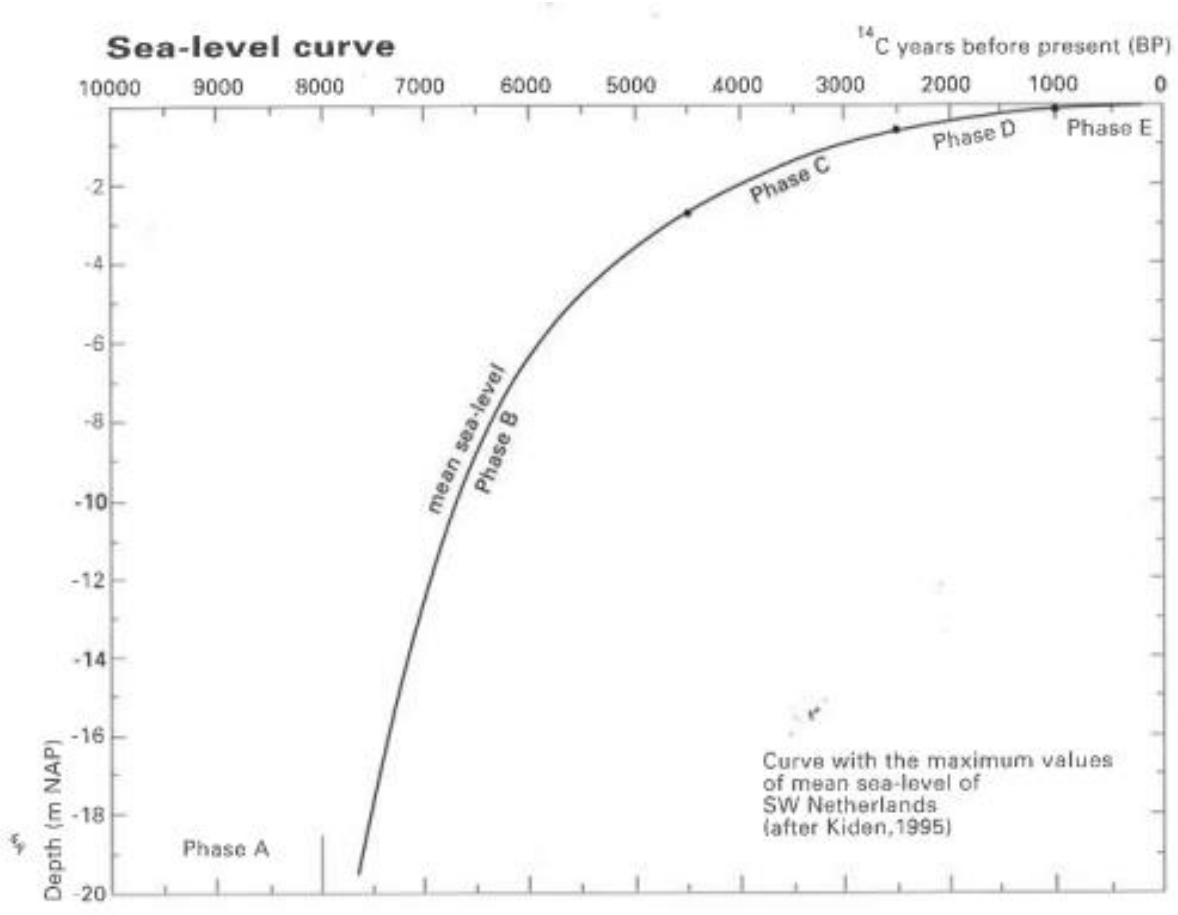
The natural history of Walcheren shows a dynamic landscape that has been shaped by natural processes as well as human interventions. The island's formation through sediment deposition, the creation of dunes, and the influences of sea levels have played pivotal roles in defining its geographical features. These natural factors provided both opportunities and challenges for inhabitants during the Middle Ages, influencing both settlement patterns and economic activities. This understanding can help with picturing how this could have affected the cultural and settlement history of the region.

These natural factors provided both opportunities and challenges for inhabitants during the Middle Ages, influencing settlement patterns and economic activities. This resilience of the landscape together with the capability of humans to adapt to environmental changes, shows the relationship between the people of Walcheren and their environment.

2.1 Natural history/ landscape

The landscape of Walcheren has a very dynamic and varied history in periods of sedimentation, erosion and peat formation. The nature of the coastal landscape is strongly determined by the influence of the sea, but also the Scheldt River (van Zijverden & Kuiper, 2003, p. 19).

The geological development is largely determined by the relative sea level rise, in combination with the tides (Berendsen et al., 2021, p. 290). Throughout the history of Zeeland many changes have been happening in the landscape. To get a complete picture of the historical landscape, it is best to start out with the early Holocene sea level rise.



Figuur 2.1, Holocene sea level curve. (Vos & van Heeringen, 1997, p. 13, Figure 6).

Around 9000-7000 BC there was a rapid sea level rise of more than 75 centimetres per century, that inundated the present North Sea (Fig 2.1, Phase B). In this period Walcheren was not even close to the sea at all and the only surface water in the area came from the Scheldt River. As the sea level kept on rising higher and higher, the coastline approached the place that is now called Zeeland, around 7000 BC. Although the sea level rise was declining after 6000 BC, from over 75 centimetres to c. 30 centimetres per century, it inundated a large portion of Zeeland and changed the Scheldt delta into an estuary, with tidal channels, marshes and mudflats (Fig 2.2) (Vos & van Heeringen, 1997, p. 9). The deposits that belong to this period are called Wormer Member (Stouthamer et al., 2023, p. 307).

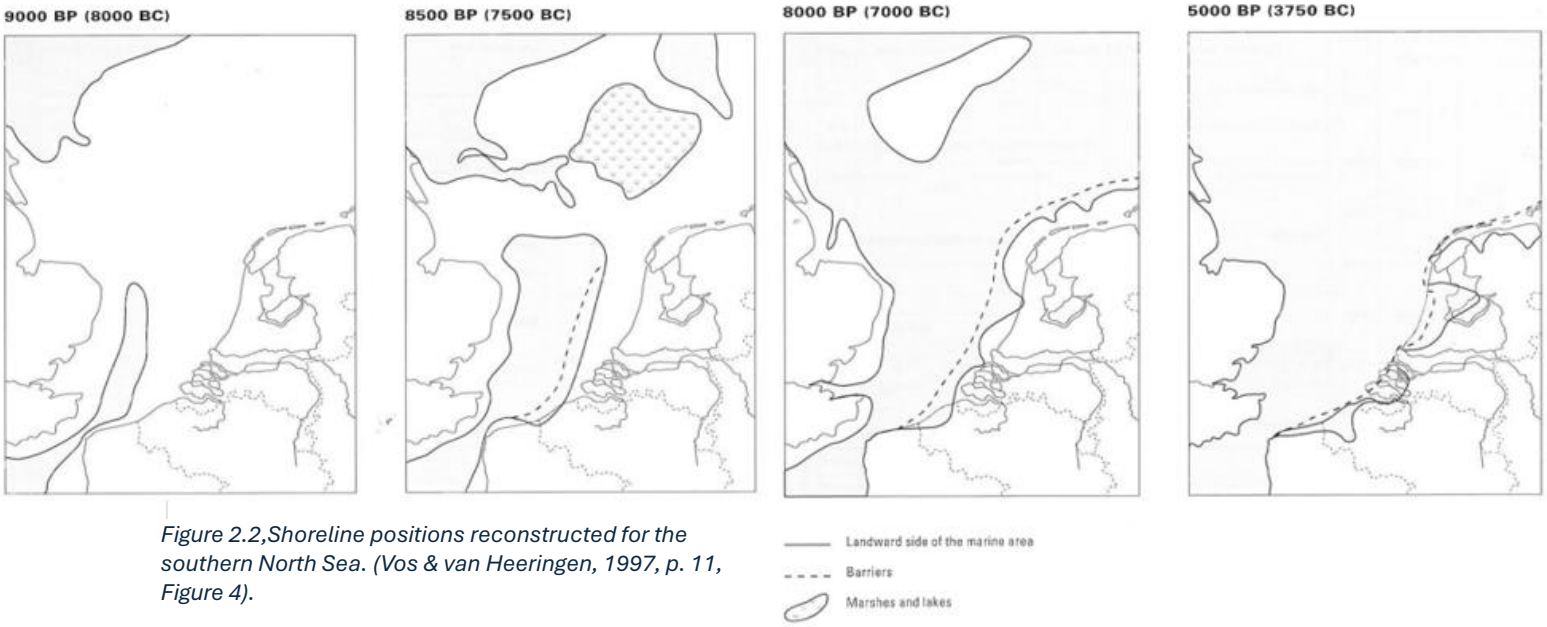


Figure 2.2,Shoreline positions reconstructed for the southern North Sea. (Vos & van Heeringen, 1997, p. 11, Figure 4).

Around 3100 BC (Fig 2.2, Phase C) the tidal inlets silted up and that the landscape changed into a 'closed' shoreline with coastal barriers and dunes protecting the land from the sea. On the other side of this barrier and dune system marshes could develop, these deposits are named Hollandveen Member (Vos & Van Heeringen, 1997, p. 9).

Peat develops at places that are protected from the sea, which implies that the peat is located behind beach ridges and dunes. Therefore beach ridges and dunes were already located, along the shoreline, at the time of this development. The position of these ridges shifted further inland with time, and some of the earlier developed peat was eroded.

The peat that has been flooded by sea water became a valuable resource, because of the presence of salt. Walcheren existed for a large part of peat, which could be extracted to exploit salt from it. This was done on a big scale by the Romans. In Roman times, the natural tidal channels were adapted to drain the high peat area behind it. Ditches and canals were connected to these channels, that drained the higher peat hinterland and making it habitable (Vos & Zeiler, 2008, p. 89). Sometime after the Romans had left, nearly all of Walcheren became inundated by the sea, except for the dunes situated along the island. This happened in the 6th and 7th century AD (van Heeringen et al., 1995, p. 220).

In places that had a further distance from sea rain-fed oligotrophic peat bogs developed (Berendsen et al., 2021, p. 292). In this period fluvial sediments were deposited along the Scheldt river, such as clay and channels filled with gyttja (Vos & van Heeringen, 1997, p. 9). In the tidal channels, also known as creeks, themselves sand was deposited.

Around 1000 AD, the coastal barriers and dunes became locally dissected and tidal inlets allowed the sea-water to enter the region during high tides (Fig 2.3). Large tidal channels eroded the underlying deposits of the Wormer Member and Hollandveen Member. On other places most of the peat became covered with clay (Vos & van Heeringen, 1997, p. 31). These deposits, that came from the tidal inlets, have been assigned to the Walcheren Member and are still on the surface to this day (Berendsen et al., 2021, p. 293).

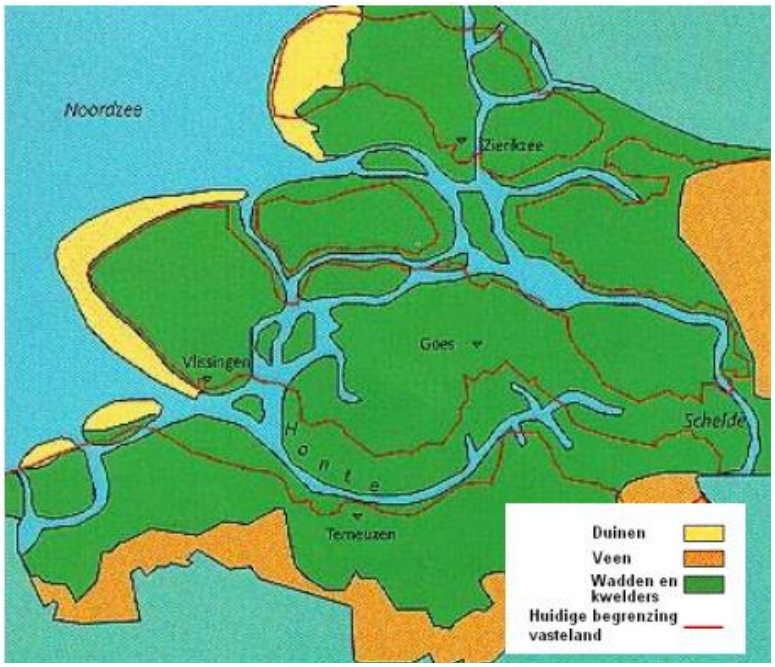


Figure 2.3, Coastal barriers and dunes locally dissected through by sea, which resulted in tidal inlets, around 1000 AD (Brouwer & Akkerman, 2007, p. 19, Figure 2.8).

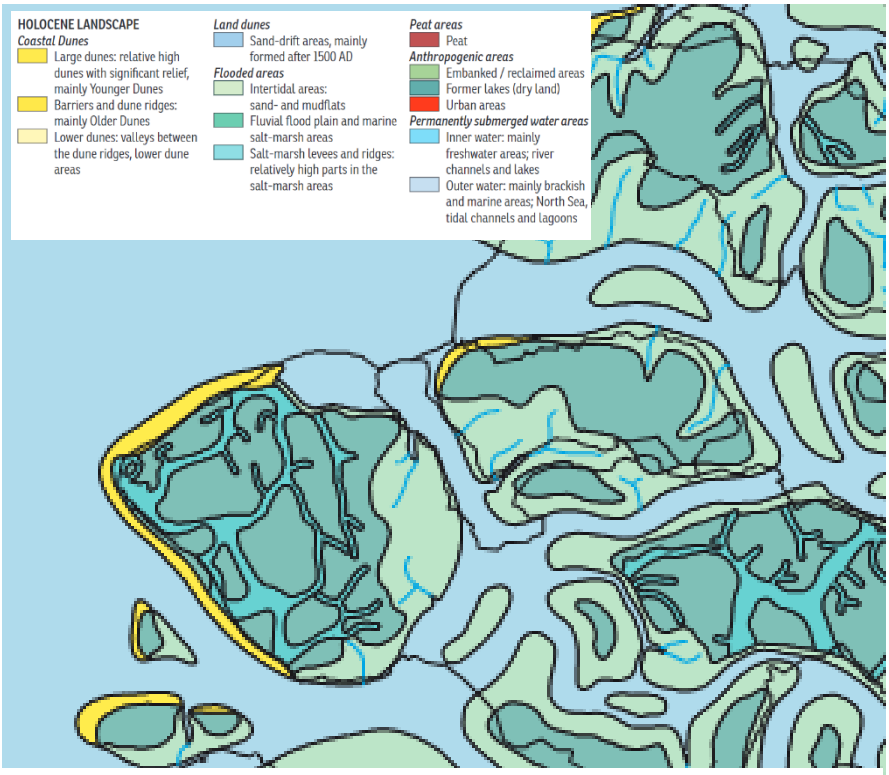


Figure 2.4, The landscape in Zeeland around 800 AD. (Vos, 2015, p. 85, Figure 3.1.1h).

The salt extraction continued in the Medieval period, resulting in big peat extraction pits (Berendsen et al., 2021, pp. 292-293). These big scale exploitations turned out to become a disaster, because with the extraction of peat and the drainage of the area, the peat and clay compacted. Even when the water would have returned, it would never regain its original thickness, due to the different characteristics of the sediments.

This process was amplified because the sea could now penetrate into the heart of the peat areas through the dense systems of canals and ditches, where the peat soil was also artificially lowered. A result of this was that the peat in these places eroded away completely around 800 AD (see Fig 2.4) (Vos & Zeiler, 2008, pp. 89-91). As a result of this erosion and mostly through subsidence the relative higher parts of the land, the clayey salt marshes, started to change in their elevation and became lower (Fig 2.5). This is called differential subsidence, meaning that the clayey ground along the sandy channel lowered more or faster than the channel itself,. This is followed by a inversion of the elevation of the land, after which the sandy creeks formed into creek ridges and became the new highland on Walcheren. Inhabitants had to deal with this constant change, until dikes were built which made the water more predictable (Stouthamer et al., 2023, p. 307).

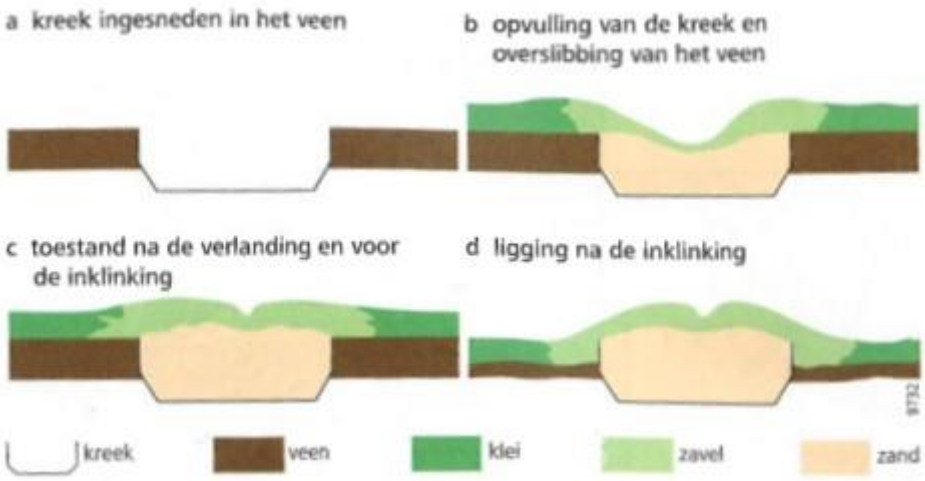


Figure 2.5, Schematic development of the formation of creek ridges. a= active tidal channel, incised in the underlying peat, b= backfill of the active tidal channel and the over silting of the peat, c= situation after the land dried up and before subsidence, d=placement after subsidence (Stouthamer, 2023, p. 295, Figure 11.7).

These creek ridges that were formed during Middle Ages were an important factor for the locations of settlements. Since they were on a higher elevation than the rest of the land, people preferred them to settle down. Although this was quite some centuries ago, creek ridges are still visible nowadays. A beautiful representation of this can be seen on Fig 2.6, made by Bennema (1947). Here you can clearly see that a lot of contemporary cities and villages are built on creek ridges.

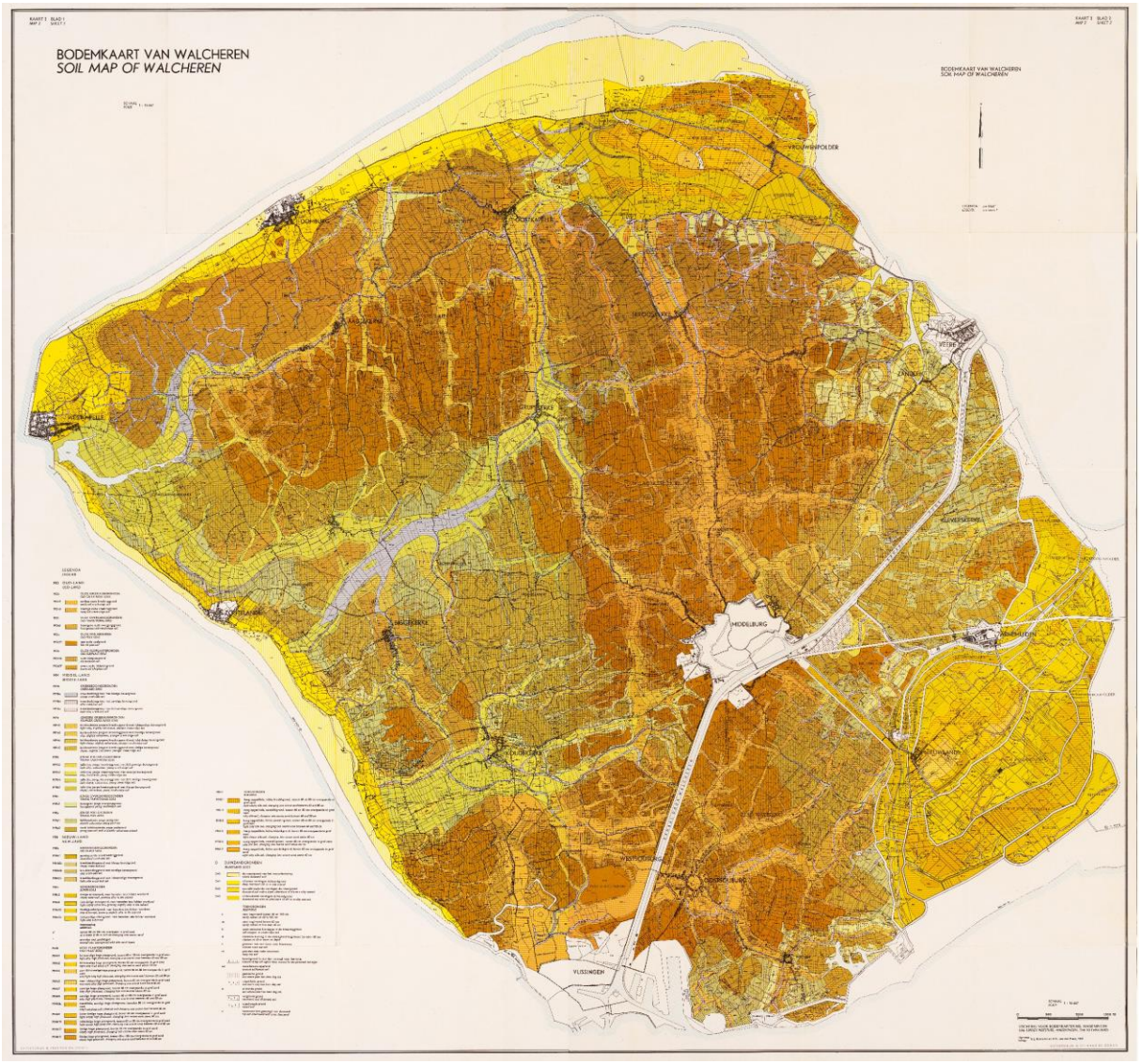


Figure 2.6, Soil map of Walcheren. The older tidal channels can be seen here, which turned into creek ridges where settlements could be built on higher grounds (Bennema et al., 1952).

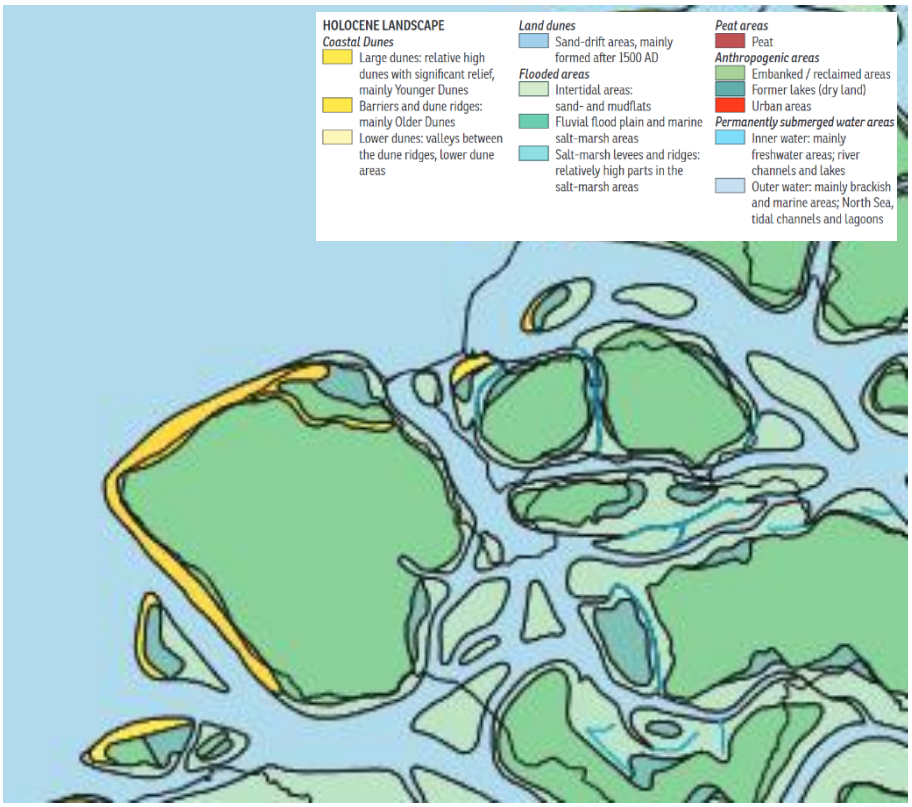


Figure 2.7, The landscape in Zeeland around 1200 AD. (Vos, 2015, p. 85, Figure 3.1.1i).

Where Walcheren in the Early Middle Ages only consisted of salt marshes, alluvial plains and tidal mudflats, around 1200 AD, it had changed into diked salt marshes and river plains. This is shown by the disappearance of the active rivers and creeks on Walcheren (see Fig 2.7). This was adjusted by humans to be able to live on these lands, without having much hindrance of the (sea)water.

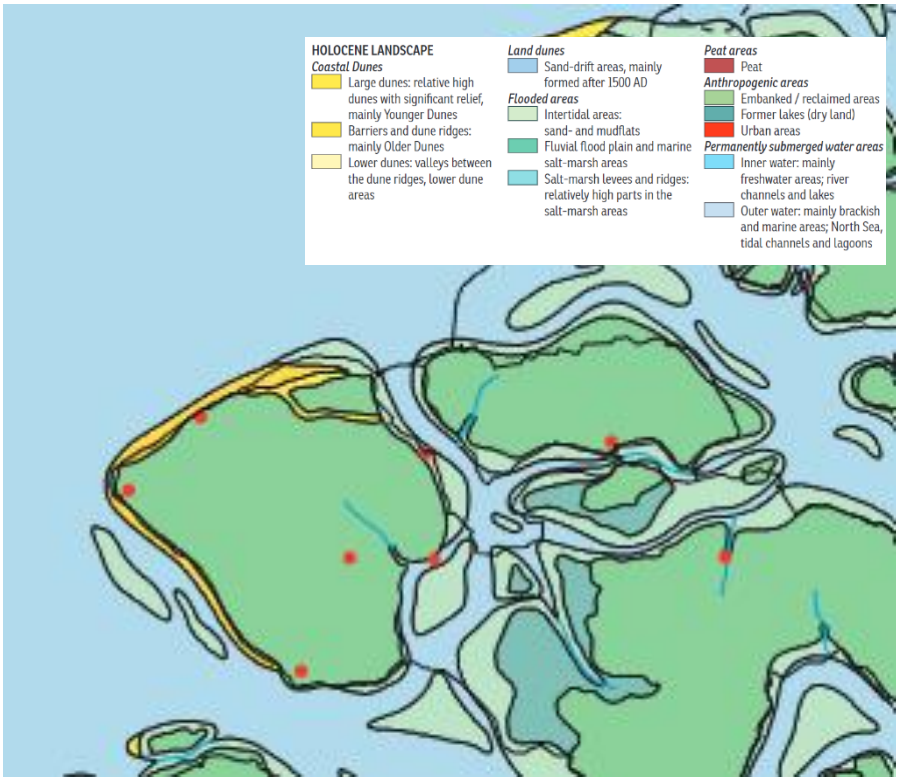


Figure 2.8, The landscape in Zeeland around 1500 AD. (Vos, 2015, p. 85, Figure 3.1.1j).

Something else that can be seen, somewhat later around 1500 AD, is that the coastline of Walcheren changed. On the northern side of Walcheren land was gained by the embankment of salt marshes (see Fig 2.8) (Berendsen et al., 2021, p. 296). The island on the south-western side of the island has shrunk considerably in size and nearly disappeared at this time. Also after all tidal inlets had disappeared in the previous period, it seems that the people allowed some water back to stream inland, most likely under the supervision of the inhabitants themselves.

2.2 Cultural history

Around 10 AD, the Romans settled in Zeeland and remained until the end of the third century. During Roman times, a castellum was built in Aardenburg. Additionally to this castellum two trading settlements were built in Colijnsplaat (Noord-Beveland) and Domburg (Walcheren) (see Fig 2.9). Products that were traded included wool and salt. From Walcheren there was easy access to the river Scheldt and the North Sea to trade with many other cultures. That trading was important can also be seen by the Nehalennia temple, which is an altar made for the goddess Nehalennia, who protects traders, travellers and sailors. Nehalennia has only been known to have been found on, the former island, Walcheren. Walcheren is most likely named after the settlement Walichrum, which was located between contemporary Domburg and Oostkapelle (Dijkstra, 2011, pp. 28-30). Walichrum was the first important trading settlement in Zeeland and functioned as a capital of the region. Since it was a thriving community with quite some wealth, it became a target for raiders, especially Vikings. At the end of the 9th century AD Walichrum ceased to exist, when it became inundated and the people moved further inland. Most of these people moved towards Domburg, the village that was closest to Walichrum.

In Domburg one of the three circular ramparts (see Fig 2.9) in Walcheren was located, the other ones were located at Oost-Souburg and Middelburg and were built around the 9th century AD. These circular ramparts were built on raised terrains that provided protection against the sea and served to protect the people and their most prized possessions against the Vikings, during an attack. Whenever they were not attacked the circular ramparts would remain empty. Around 1000 AD, people began living inside these circular ramparts, after the Viking raids had ended (van Heeringen et al., 1995, pp. 222-224). Later they served as a trading post between the Netherlands, Belgium and England. Multiple cities on Walcheren became important trading settlements, each having their own international trading network. These networks would eventually cease to exist at the end of the 18th century (Zeeuwse Ankers, n.d.)

Figure 2.9, The locations of circular ramparts within Zeeland. All villages that had circular ramparts around Zeeland are marked with a square around its village name. (Adapted from: Google, https://www.google.com/maps)

Figure 2.10, Walcheren around 1300 AD (https://www.archieven.nl/nl/zoeken).

Figure 2.10 shows a historical map of Walcheren around 1300 AD.

Some of the earliest known cities and villages from the Middle Ages on Walcheren are Walichrum, Serooskerke, Domburg, Middelburg, Oost-Souburg, (Oud-)Westkapelle, Oostkapelle, Zoutelande, Vlissingen, Veere, (Oud-)Arnemuiden and Schoneveld (Fig 2.10). The main towns are Domburg, Middelburg, Westkapelle and Vlissingen. The coast was characterized by beaches and dunes on the western side, and embankments with salt marshes on the eastern side. Of course throughout time many more villages were founded, hence why there are more villages seen in Figure 2.9, as the map originates around 1300 AD.

From these cities and villages Walichrum and Schoneveld do not exist anymore. Furthermore Oud-Arnemuiden and Oud-Westkapelle moved more inland to keep the village together and form contemporary Arnemuiden and Westkapelle. All these villages ceased to exist near the end of the Middle Ages (KGZW, n. b. & Zeeuws Archief, n.d. a, n.d. b, n.b. c).

Walichrum

According to Dijkstra (2011, p. 30) the first important settlement in the Middle Ages was located, on what is a beach today, in between Domburg and Oostkapelle. Some of the remains of this place have been revealed in previous centuries, giving a bit of information of the trading settlement that once was. From the year 600 AD, this settlement was one of the settlements that had a trading connection with England. Not only as a transit port, but also as a port of export of their own trading supplies. Around 700 AD, a preacher named Willibrord, introduced the inhabitants to Christianity, this lead to multiple abbeys being built over the following centuries. These abbeys were in control of the nearby salt marshes and offered protection for nearby civilians for a portion of their yield as payments. Around 1000 AD, the inhabitants of Walichrum had to constantly deal with sand blowing through the town, a result of the dune barrier shifting inlands. When they got too much hinder of this they all moved away, most people towards Domburg, which was the closest nearby village. The village of Walichrum disappeared somewhere in the 15th century (KZGW, n.d.). At first this meant that, due to the shifting of dune barriers, Walichrum disappeared below the dunes. When the dunes shifted even further inland and the sea got more inland, following coastal erosion, Walichrum disappeared in the sea.

Domburg

It has been postulated that the exports of products lead to the foundation of a new trading settlement in the dunes, which could be Domburg. From the 8th century onwards Walcheren had to deal with Viking raids, where villages got plundered and burnt down. As a reaction to this, certain defence mechanisms arose, like the start of building an own fleet of ships, guard posts in harbours and garrisons stationed along the coastline. Later on the circular ramparts were built, with a total of three on Walcheren. This functioned as a place where the locals and their livestock could take shelter against invasions of Vikings. Due to the relative density of circular ramparts on Walcheren, it is likely that it was inhabited by quite some people, that lived spread out over the whole of the island (Dijkstra, 2011, pp. 32-33).

In this period habitation was most likely near the dune areas and not on the creek ridges, as most found objects are from the areas near the dune barriers. Later, the circular ramparts lost their meaning and settlements arose in them, leading to the first constructed houses around 900 AD. Around 1000 AD, an increase of population happened according to van Heeringen et al. (1995, pp. 55-56).

Middelburg and surrounding villages

From the 10th century, Middelburg took over the function of Domburg, which used to be the economical, administrative and ecclesiastical centre on Walcheren (Dijkstra, 2011, p. 33). Middelburg was founded in the centre of the island Walcheren, on higher land, where two creek ridges crossed each other (Silkens, n.d.).

Due to the increased population, more parishes were founded in the centre of the island around 1100 AD. Churches were built and formed the centre of new villages. These churches were a requirement for the formation of an independent craft, made possible by artisans (in Dutch: 'ambachtsheren'). The influence of these artisans is still clearly visible in the names of some villages, they include their name and end in -kerke (church) (Dijkstra, 2011, p. 34).

When villages were threatened by natural disasters, such as flooding or shifting landscapes, they would move churches to other locations and took the old materials with them. This way houses and churches were translocated to another nearby area where it was (more) safe (Kuipers & van Dierendonck, 2004, p. 15).

The distribution of land between the different parishes resulted in the protection of only parts of the land by dikes. Later on, in the 12th century, this was done on a bigger scale, when they built dikes around the whole island of Walcheren (Dijkstra, 2011, pp. 33-34).

3 Walcheren in the Middle Ages

3.1 Data from Archis

In this chapter the medieval villages that have been listed in 2.2 will be discussed. The data is based on the Archis database (https://archis.cultureelerfgoed.nl/#/login), which includes all reported archaeological sites and finds that have been found in the Netherlands. For my research I will only focus on the archaeological sites and finds in Walcheren. Another database I will use is CHS Zeeland, a database that focuses on cultural historical Zeeland (https://www.zeeland.nl/loket/kaarten-en-cijfers/). The type of data that can be found here are geographically valuable areas, sea walls and historic landscapes.

To study the settlement history of Walcheren, I will map out all the cultural historical objects from the Middle Ages that are documented. Every object found (and reported on) is placed in Archis with a description and exact location. Specifically looking at cultural historical objects gives us a better picture of places where people used to live. The objects that are listed as a cultural historical objects come in different forms and sizes. The objects can be separated into three different categories, namely finds (pottery, bones, coins), complexes (settlements and cemeteries) and features (walls, pits and ditches). When putting this data together, certain clusters will form and potentially give information on inhabitable areas and important places, which can then be compared to historical data derived from maps.

I have analysed the data per municipality (Middelburg, Veere and Vlissingen), since Archis cannot process too many data in one query. I concentrated on objects that have been dated to the Middle Ages exclusively (500 AD- 1500 AD). The data concentrations will then be used to locate places that were habitable during the Middle Ages, even though they are not visible in the present-day.

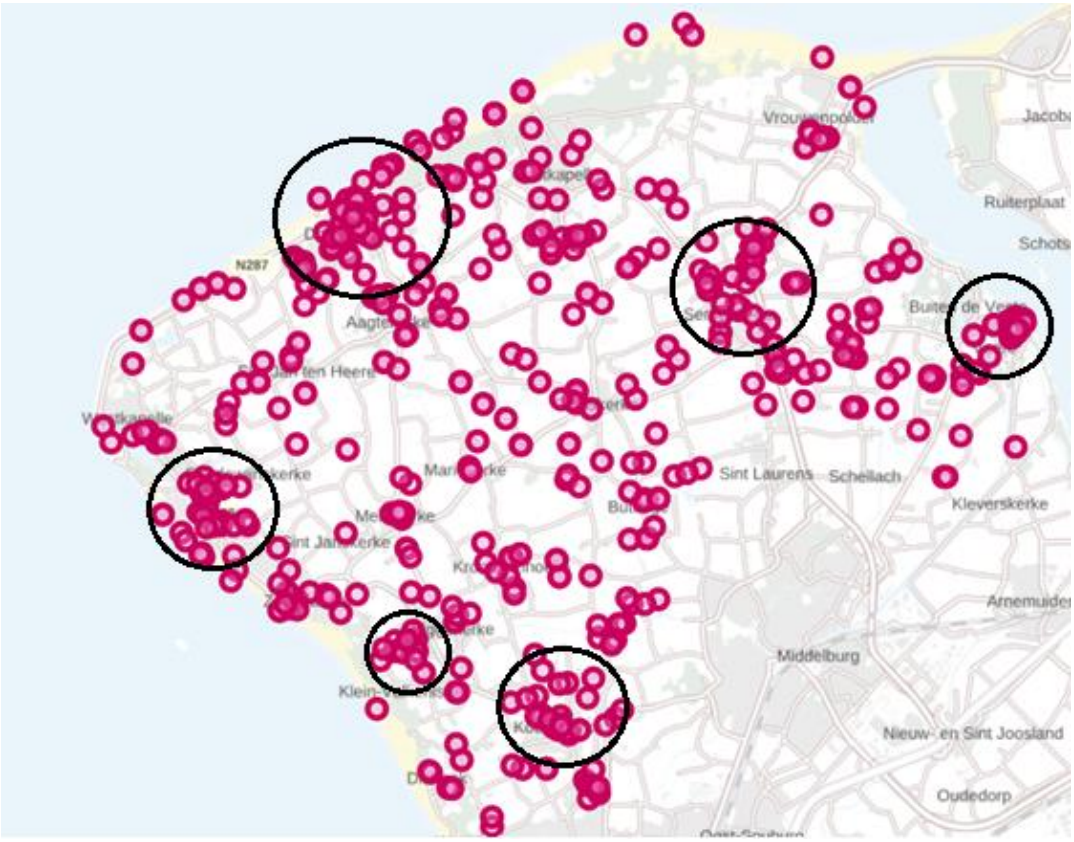


Figure 3.1, All cultural historical objects in the municipality Veere, by Archis. (Adapted from: Archis, https://archis.cultureelerfgoed.nl/zoekenenvinden//HY73-FEDK-8F76-RJEG#/cho/search/(cho:(filters:(datering_facet:!(periodes~~Historie~~Middeleeuwen),gemeente:!(Veere))))).

Figure 3.1 shows the result of the municipality of Veere. The map shows many sites, but several concentrations around contemporary Domburg, Serooskerke, Veere, Valkenisse, Zoutelande, Koudekerke and Joossesweg (Fig 3.1).

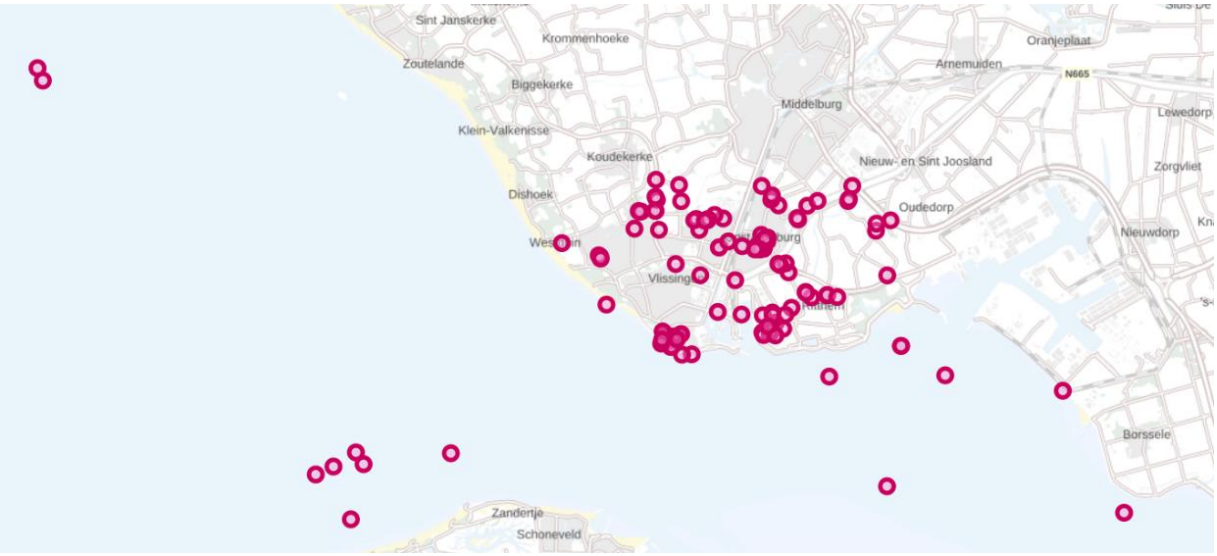


Figure 3.2, All cultural historical objects in municipality Vlissingen, Walcheren, by Archis. (Archis, https://archis.cultureelerfgoed.nl/zoekenenvinden//HY73-FEDK-8F76-RJEG#/cho/search/(cho:(filters:(datering_facet:!(periodes~~Historie~~Middeleeuwen),gemeente:!(Vlissingen))))).

Figure 3.2 shows the map of the municipality of Vlissingen. The concentrations of objects here are located around the southern part of the municipality and not in contemporary town Vlissingen or its villages. An interesting result are the objects that were found in the sea, since they could have belonged to places that have been inundated or affected by the sea, such as Schoneveld.

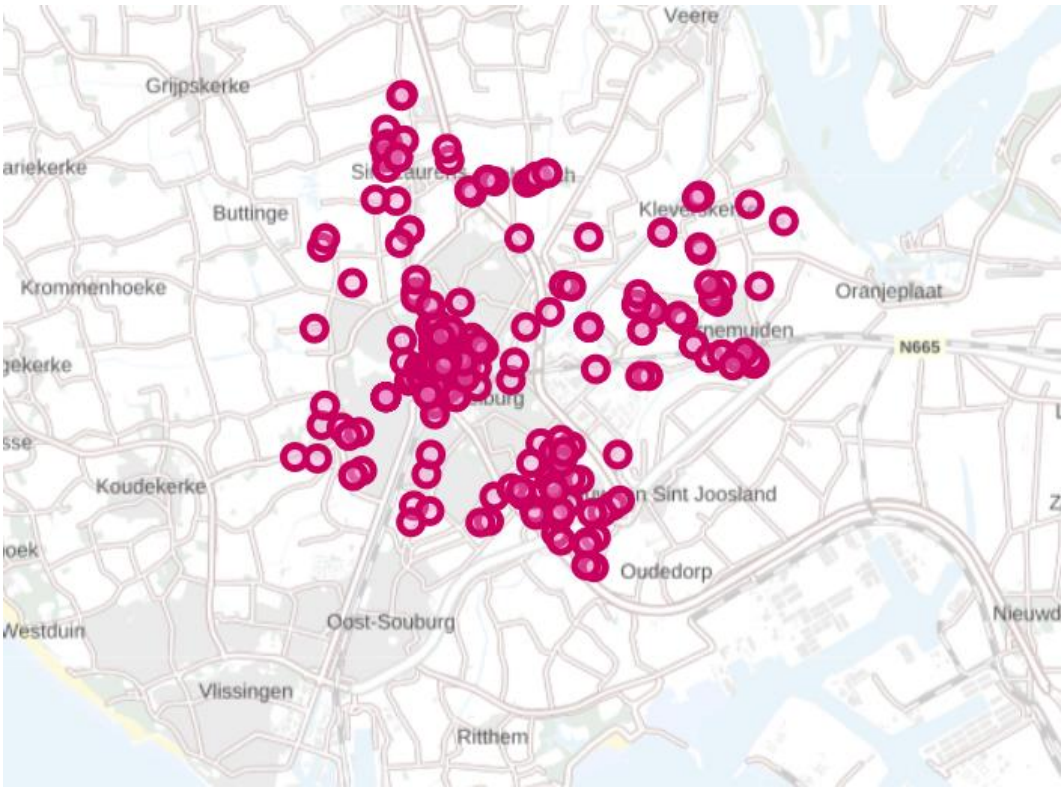


Figure 3.3, All cultural historical objects in municipality Middelburg, Walcheren, by Archis.(https://archis.cultureelerfgoed.nl/zoekenenvinden//HY73-FEDK-8F76-RJEG#/cho/search/(cho:(filters:(datering_facet:!(periodes~~Historie~~Middeleeuwen),gemeente:!(Middelburg))))).

Figure 3.3 shows the map of the municipality of Middelburg. The largest part of objects that have been found are located in the centre of Middelburg and the south-eastern part of Middelburg. Another place where objects come from is Arnemuiden.

3.2 Causes for the disappearance of villages and towns

During the Middle Ages several locations have been inundated by water coming from the sea. All of the known locations have been plotted on Figure 3.4 (adapted from: CHS Zeeland). On this map there are also a couple locations that disappeared after the Middle Ages.

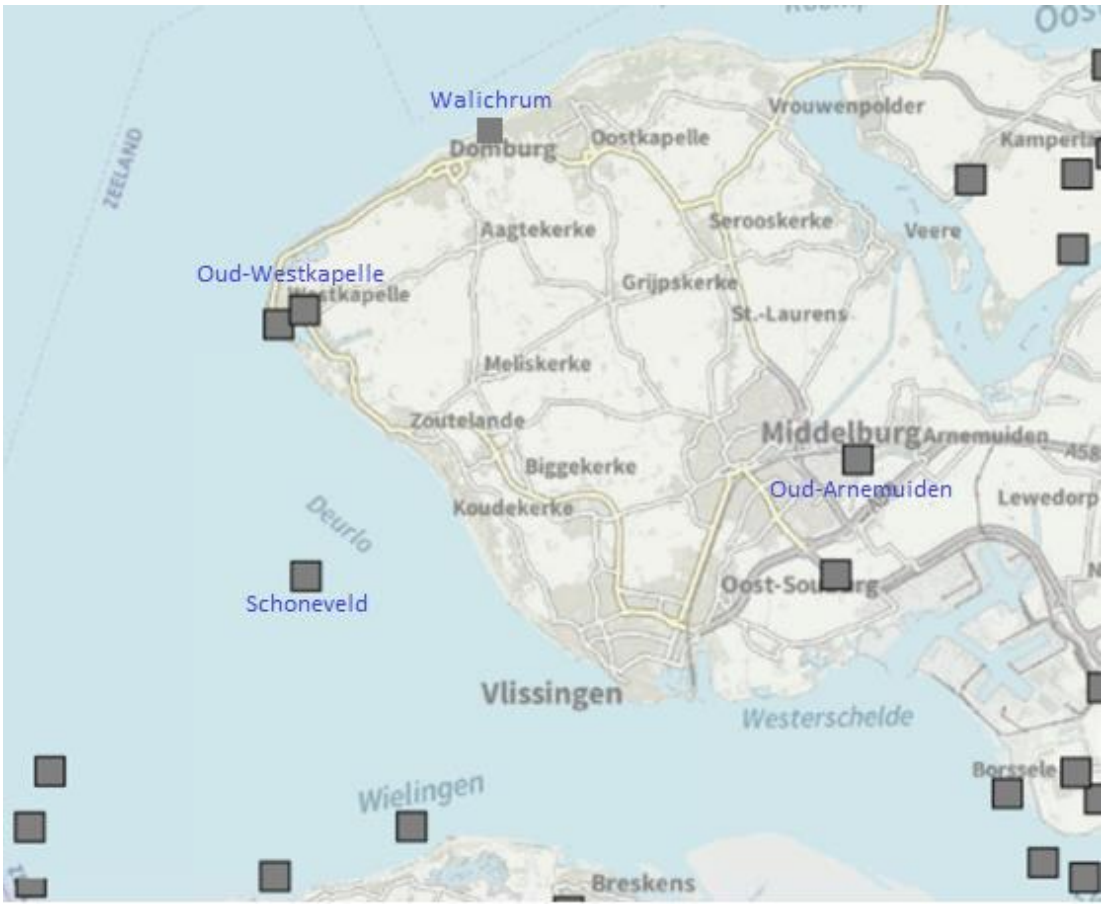


Figure 3.4, All known 'verdronken dorpen' (sunken villages) near Walcheren. (CHS Zeeland, https://kaarten.zeeland.nl/map/cultuurhistorie).

All locations are discussed below.

The people of Walichrum, once lived safely behind the dunes protected from the sea, until the dunes started to move more inland into the village (Bos et al., 2011, p. 47) (see also paragraph 2.2). This resulted in the abandonment of Walichrum, as people moved further inland, mostly towards Domburg (KGZW, n.d.). Later on the dunes moved even further inland, not protecting the old village anymore, leaving it to disappear below the sea. It disappeared as a result of coastal erosion of the northern part of the island.

Oud-Westkapelle was located on the western edge of Walcheren and therefore was vulnerable to coastal erosion and eventually got abandoned. This has led to the coastline moving slightly more inland. (Zeeuws Archief, n.d. a)

Schoneveld, which was a small island in the mouth of the Scheldt, would have belonged to the municipality of Vlissingen. It was part of a group of small islands, but Schoneveld was the only island

that was inhabited. Unfortunately the dikes on the island were dissected when during storm surge and the island became inundated. At its former location is now a sand bar called Schoneveldbank, named after the village (Zeeuws Archief, n.d. b).

Lastly there was Oud-Arnemuiden, a village that has been inundated two times. After the first time the village had been inundated, the inhabitants tried building it up again without much success, as the village got inundated again. Later they even tried it a third time and were successful after all. The place still exists as Arnemuiden (Zeeuws Archief, n.d. c).

Figure 3.5 shows an elevation map of contemporary Walcheren. On this map it is quite clear to see why these villages got abandoned and disappeared. Walichrum and Schoneveld are currently located in the North Sea and the other two are located in areas with a low elevation. The abandonment of the villages was a result of rising sea levels, natural forces and people not having enough knowledge, resources or will to fight against the sea. Due to their placements, there would be a constant 'war' between the people and the sea. These places can be categorized in villages that ceased to exist due to flooding and villages that ceased to exist due to coasts shifting more inland. Walichrum and Oud-Westkapelle had to deal with shifting coasts, making it eventually unliveable, causing an abandonment. Oud-Arnemuiden and Schoneveld were not capable enough to manage the water during floods, which eventually became fatal for the villages. When looking at Oud-Westkapelle and Oud- Arnemuiden, which communities continued to exist after people moved to contemporary Westkapelle and Arnemuiden, it becomes clear that people began to understand which places were it was the easiest to live at. When looking at the elevation levels at Westkapelle and Arnemuiden, it is clear to see that those are situated on a higher elevation than the rest of the nearby land.

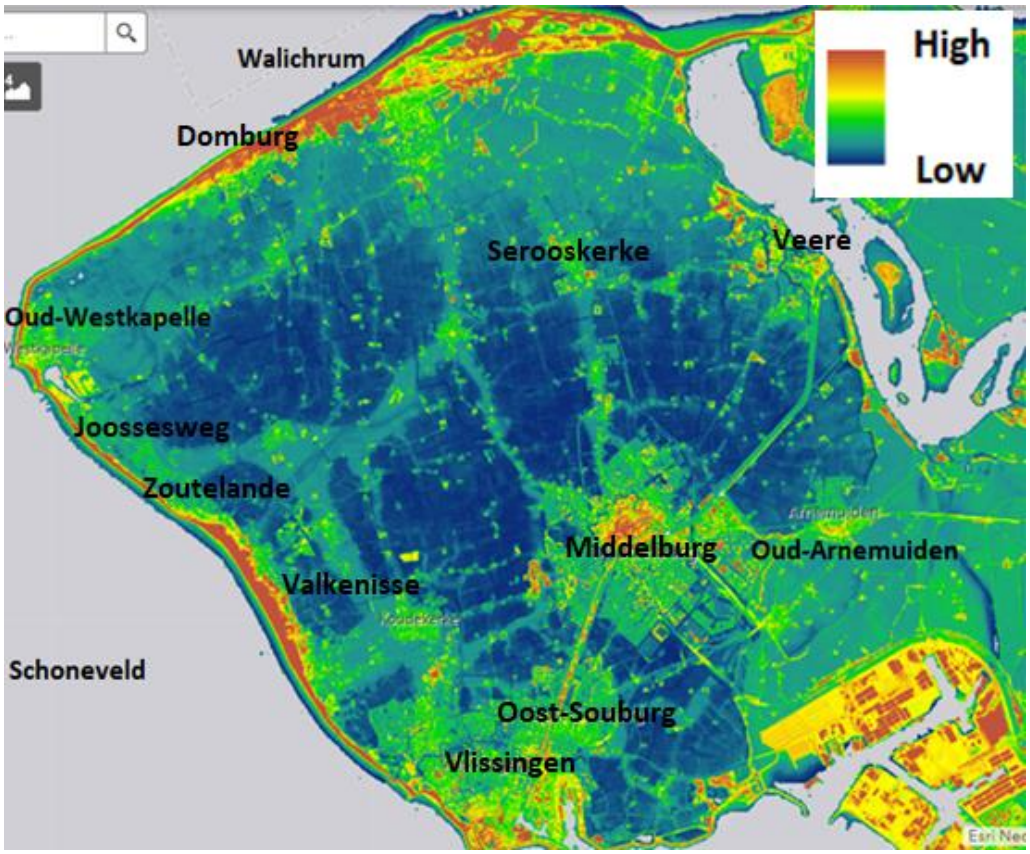


Figure 3.5, All discussed locations in contemporary Walcheren on an elevation map (Adapted from: AHN Nederland, https://www.ahn.nl/ahn-viewer).

Hence, of all concentrations found in Figures 3.1, 3.2 and 3.3 only Schoneveld ceased to exist. Middelburg, Vlissingen, Schoneveld, Domburg, Zoutelande, Westkapelle, Serooskerke, Veere, Valkenisse, Koudekerke, Arnemuiden and Joossesweg still exist today. Some villages have lost their importance, though, and did not really grow in size. Middleburg, Vlissingen, Koudekerke, Oost-Souburg, Domburg and are examples of contemporary cities that are still quite large, situated near water by either sea or river. Zoutelande, Westkapelle, Serooskerke, Veere, Valkenisse, Arnemuiden and Joossesweg also still exist, but they lost their importance, mostly due to upcoming cities in other places, like Holland.

4 Analysis: patterns in location choice

4.1 Preferences for certain landscapes or stable factors (analyse)

In this section, the analysis focuses on the correlation between medieval settlement locations and the geographical landscape features of Walcheren during the Middle Ages. By comparing the data from Chapter 2 on the natural and cultural history with the archaeological findings in Chapter 3, we can discern patterns and factors influencing settlement choices.

One prominent feature observed was the preference for settlements near stable and elevated landscapes (Fig 3.5). These areas provided natural protection against coastal erosion or flooding of the back barrier area. For example, the settlement of Walichrum, was located behind a dune ridge, which gave protection against the sea. However, as the coastline receded, this protection was no longer guaranteed, leading to its eventual abandonment. Political factors such as trade and warfare, could have influenced the location choice and longevity of all settlements mentioned before. The presence of circular ramparts at certain strategic points suggests a dual purpose of defence against both raiders (Vikings) and rising waters. These fortifications were situated on elevated grounds, which further protected against flooding.

Figures 4.1 and 4.2 illustrate the landscape and distribution of archaeological data during the Early and Late Middle Ages (Dijkstra, 2011, p. 31-32). These maps show a compilation of the results discussed in the preceding chapters:

The majority of the dwellings is concentrated along the coastlines and near creeks, areas that offer both resources and transportation routes, but also face the highest risks of flooding. This shows that living near the coast is clearly preferred during the (Early) Middle Ages, even though the sea was not always a predictable factor during these times and some villages had to be abandoned due to inundation. One of the reasons for this is that the coastline was protected by dunes, causing a natural protection against the seawater. Additionally the dunes were higher than the hinterland, forming as another protection against the seawater.

The centre of Walcheren has a low population density, as shown by the low number of objects clusters. This could be a result of frequent floods that were brought in by the tidal inlets, in mainly the Early Middle Ages when there was still little protection to floods. In Figure 4.1 it is also clear to see that most objects are found on the salt marshes and not in the creek ridges. This makes senses since living there was not possible, since the creeks would still have been active. From the Late Middle Ages living on creek ridges becomes possible.

The only big exceptions to living along the coast are Middelburg and Arnemuiden, that were located in the centre of Walcheren. After all Middelburg literally means ‘circular rampart’ (burg)in the ‘middle’ of Walcheren. Just like Domburg (dunes) and (Oost-)Souburg (south) are name after their location (KZGW, n.d.). The reason for this location is that Middelburg and Arnemuiden are situated on creek ridges, getting protected from (sea)water. Also Middelburg was important at the time, thus getting the priority for defence, to stay a prosperous village.

In the Late Middle Ages (Fig 4.2), nearly all of the island is either part of the natural dune barriers or embanked by humans and thus dry land. The number of objects have increased dramatically, showing evidence of the increase in population, that spread over Walcheren. In this time period there seems to be one big cluster in Middelburg and a couple of smaller clusters near the villages Domburg, Serooskerke, Veere and Zoutelande. Even though the inhabitants were able to live all across Walcheren, most of them still settled in or around the bigger villages/cities. A reason for this could

simply be that these places, and especially Middelburg, were prosperous and were appealing to live at. Another reason is that these places where they lived simply existed of dry land. Since some of the surrounding areas were still wetlands, that were not habitable.

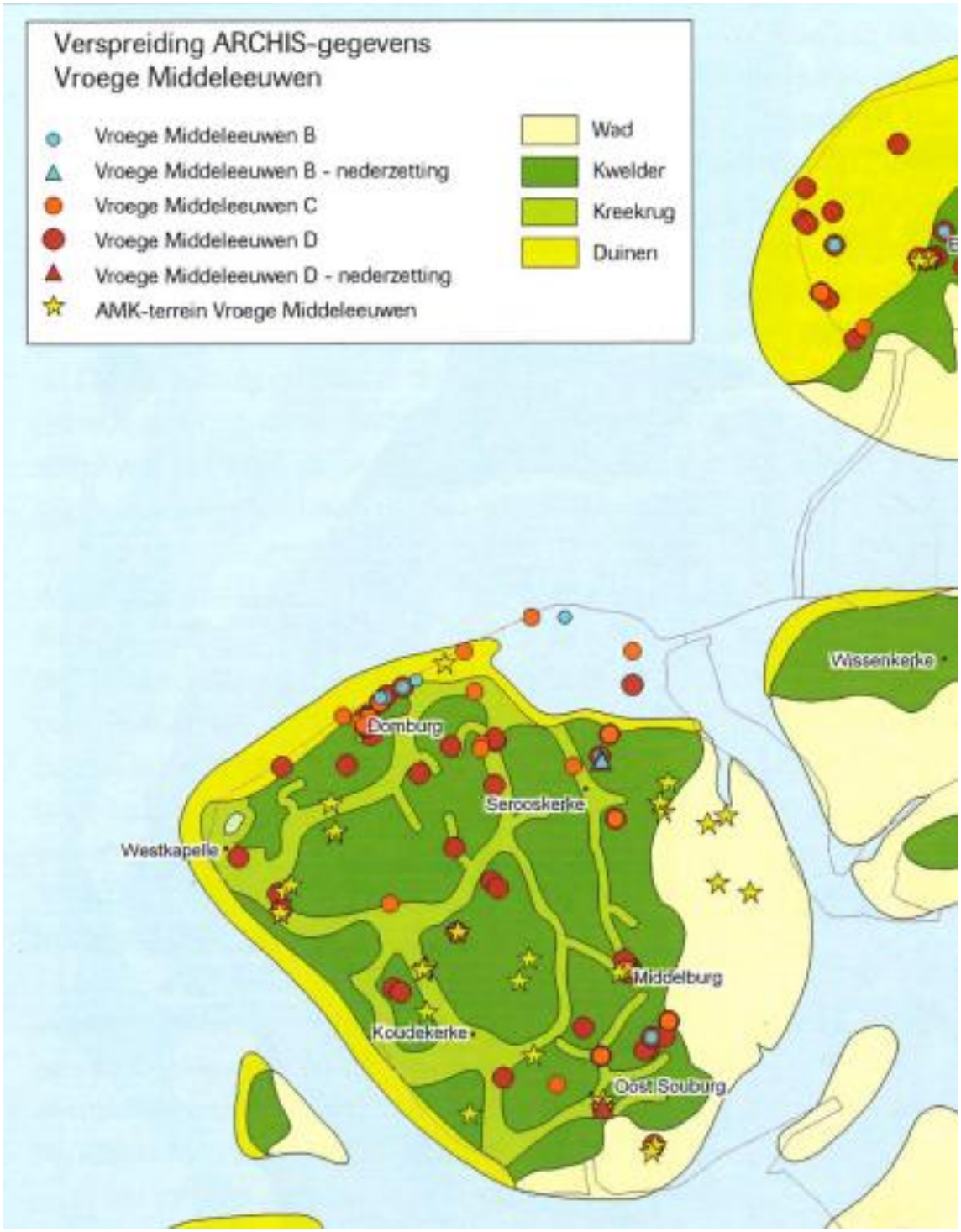


Figure 4.1, Distribution Archis-data Early Middle Ages. Shown on a palaeogeographical map, together with sites that are plotted (Dijkstra, 2011, p. 31, Figure 1.5).

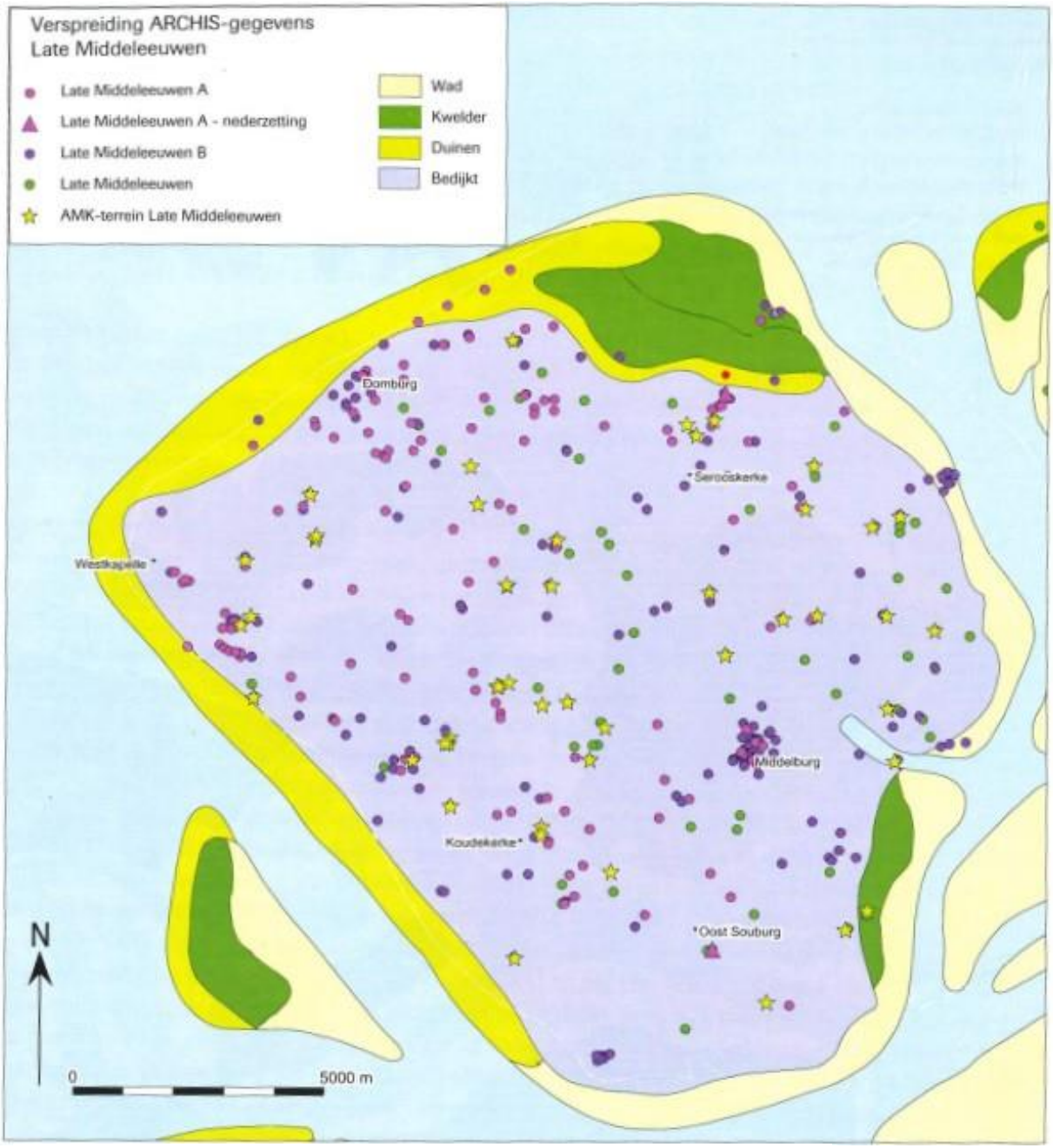


Figure 4.2, Distribution Archis-data Late Middle Ages. Shown on a palaeogeographical map, together with sites that are plotted (Dijkstra, 2011, p. 32, Figure 1.6).

Creek ridges can also be appointed as a factor, which people took into account when settling down. Figure 2.6 shows a beautiful representation of the soil on Walcheren, especially regarding creeks and creek ridges, made by Bennema (1947). On this map you can clearly see where the creeks used to run, which later on turned in creek ridges. These creek ridges were higher elevated than their surrounding, making it a favourable location to settle down and start a village. When looking for villages and cities on this map, you see that many of these are located on a creek ridge. This indicates how important they were in the Middle Ages when these places were founded. So creek ridges had a huge impact on the people on Walcheren who gladly profited of this fact.

Dijkstra's maps (Dijkstra, 2011, p. 31-32) are a useful tool to help us with matching the Archis objects in combination with the landscape. Since Dijkstra (2011, 30-34) does not mention the creek ridges at all, the map deriving from the Late Middle Ages is not telling the full story. The locations where these creek ridges are located play a pivotal role in the location of objects. This makes it that the map does not show anything useful. Even though the inland was protected by dikes, most of the villages still are located at the creek ridges, that were preferred. This is contrary to the Early Middle Ages, when the creeks were still active and there were no creek ridges. Areas near creeks at this time were unpredictable and unsafe to live at, due to flooding. A big reason to live near the dune barriers and not in the centre of Walcheren.

So while choosing a location to settle down was dependent on the type of landscape. Especially since the water on Walcheren was unpredictable. This was taken into account when villages were founded, which happened on the higher elevated pieces of land. The first villages appeared on dune barriers that offered natural protection, but people could also profit from it by maritime trading. Later on villages started to appear on creek ridges, these gave the same profits as dune barriers, except for maritime trading. Of course normal trading was always possible, as there was little to no hinder from (sea)water.

5 Discussion

5.1 Villages living together with the (sea)water

The analysis of settlement locations indicates that the inhabitants of Walcheren during the Middle Ages must have been aware of their environment and made conscious choices to adapt to the sea. Settlements were frequently established behind dunes and on elevated grounds to control the risks that were present from flooding and coastal erosion. This strategic placement highlights the ability to adapt to environmental changes and points to their resilience. The case of Walichrum, which experienced a gradual decline in population as the sea encroached, underscores this adaptive strategy. The relocation of functions to new settlements such as Domburg, which offered better protection and resources, demonstrates a dynamic response to changing environmental conditions. The construction of the circular ramparts, which provided both defence and flood protection, gives another example of the dual purpose employed to be benefitted by in multiple directions. These structures were not only fortifications against human threats but also elevated refuges against the sea, illustrating a better understanding of the interplay between human activity and environmental forces. The settlements had enough benefits for its inhabitants, that it outweighed the risks. The constant threat of the sea was something that they need to deal with, as it was also their most important source for resources and their economy.

Churches show similar evidence. They were vital in every village and prominently built in the centre. They were built usually built on elevated land, either on dune barriers, creek ridges or mounds. Furthermore when villages were threatened by natural disasters, such as flooding or shifting landscapes, they would not only move to another place, but even took materials with. This way houses and churches were translocated to another nearby area where it was (more) safe (Kuipers & van Dierendonck, 2004, p. 15).

In the Late Middle Ages, when most of the island was protected by dikes, safety was more guaranteed. Even though the dikes were not able to fully protect every place on Walcheren, it was one of the biggest adaptations to the sea at the time. After the construction of dikes people were able to live more spread out over the island, but still had a preference for higher elevations, such as creek ridges. This could be because a church and village were already present there, since they were founded during earlier times. So more a preference of living near a town and not for elevated land in the Late Middle Ages.

Changes in the natural landscape had a big influence in (maritime) trading. Throughout a big part of the Middle Ages Zeeland and especially Walcheren played a big part in the economy of multiple countries. Not only did Walcheren export their own goods (wool and salt), but they also they acted as a transit port. Here traders and tradeware from mostly the Netherlands, Belgium, England and France, but even other parts of Europe came together to trade. Since the island was one of the fastest ways to get to England, the trading settlements grew bigger. Due to all this trading Walcheren became prosperous, although it was usually one village or city that profited most from it. At the end of the Middle Ages Zeeland and Walcheren lost its importance to Holland, the economy was still doing good, but it had a smaller economic importance. This could have been caused by the better (maritime) trade routes and political importance of Holland.

The biggest change that can be seen, due to the sea, was that the main trading settlement moved from time to time. First Walichrum was important, followed by Domburg and eventually taken over by Middelburg. This sequence is mainly caused by the influence of the sea, Walichrum only lost its importance and inhabitants since the sea quite literally took over the village over time. It is still

unknown where it exactly was located, the one thing we do know is that it is now swallowed by the sea. Walichrum was located near Domburg, which is probably why everyone moved there, when it took over Walichrum's spot. Eventually Middelburg became the most important place in Walcheren. Here a circular rampart was located, that could protect people from raiders and water. Another feature it had was that it was located along water on the east side of Walcheren, meaning it was easily accessible by boat and on land. In contrary to Domburg, located at sea, the water at Middelburg was calmer and more predictable.

5.2 The influence of (sea)water on the occupation dynamics

Coastal erosion and rising sea levels have had a huge impact on the landscape and settlement patterns of Zeeland, particularly in Walcheren. The gradual changes in the landscape led to the disappearance of several settlements and necessitated continuous adaptation by the inhabitants. In general, the influence of the sea on the land has been characterized in two phases. First of the sediment deposition from rivers and the sea created peat bogs that were later extracted and the sandy creeks eventually formed creek ridges. Second the erosive forces of the sea and tidal inlets, which reclaimed land and inundated settlements over time.

In Zeeland and specifically Walcheren, this dynamic is evidenced by the numerous abandoned dwellings and villages, which evidences the (ongoing) battle between land and sea. The archaeological record provides a glimpse into these lost settlements, revealing patterns of human adaptation and resilience.

In conclusion, the analysis and discussion of settlement patterns in Walcheren during the Middle Ages reveal a complex interplay between human activity and environmental forces. The strategic placement of settlements, the construction of defensive and protective structures, and the continuous adaptation to changing conditions underscore the resilience and ingenuity of medieval communities in Zeeland.

6 Conclusion

This thesis has explored how coastal erosion and rising sea levels affected the archaeological sites in Walcheren during the Middle Ages. Here are the key findings, summarized in response to the main research questions:

What is the known history of Walcheren during the Middle Ages?

During the Middle Ages, Walcheren was home to important towns like Middelburg, Domburg, and Westkapelle. These towns were strategically located near water for economic and defensive (against water and raiders) purposes, playing a important role in trade and cultural exchange.

Where are known archaeological sites/finds located?

Most sites are located along the dune barriers of the island, except for a couple places at the south-eastern side of Walcheren, namely Middelburg and Arnemuiden. Finds can be found all over the island, although it is mostly found in bigger concentrations around villages or cities.

Is there a pattern or are there certain locations/villages?

Settlements were often established on higher grounds or in protected areas, showing a clear pattern of considering the sea's influence. Defensive structures were built to safeguard against both human threats and environmental challenges like coastal erosion and sea level rise.

Do the location choices of older settlements already take into account the sea?

The location choices for older settlements indicate that communities during the Middle Ages were aware of and planned for the sea's impact. They used natural defences and other strategies to protect their settlements from the sea.

Did this influence their lifestyle and (maritime) trading?

Living near the sea significantly influenced daily life and trade. The (maritime) trading networks were crucial for economic growth, despite the ongoing threat of rising sea levels and coastal erosion. The adaptability of the inhabitants on Walcheren helped them thrive in a challenging environment.

How does the sea(level, in combination with coastal erosion) influence the land?

The rising sea levels and coastal erosion continuously reshaped Walcheren's landscape, causing the inundation of land and submergence of settlements. The archaeological evidence of "verdronken dorpen" (drowned villages) highlights the resilience and adaptability of these medieval communities.

What is the impact of coastal erosion and rising sea levels on archaeological sites in Walcheren, province of Zeeland, in the Middle Ages?

Coastal erosion and rising sea levels during the Middle Ages in Walcheren significantly impacted the region's archaeological sites by submerging settlements, altering settlement patterns, influencing economic activities, and challenging the preservation of cultural heritage. These environmental changes necessitated human adaptation, as seen in the relocation of villages, construction of protective structures, and shifts in economic practices, all of which are crucial for understanding the historical landscape of Zeeland.

Abstract

This thesis investigates the impact of coastal erosion and rising sea levels on archaeological sites in Walcheren province of Zeeland during the Middle Ages, spanning from 400/500 AD to 1500 AD. The study integrates archaeological records, environmental data, and historical data to understand how environmental changes influenced settlement patterns and cultural heritage in the region.

Walcheren, located in the southwestern Netherlands, has a rich historical tapestry shaped significantly by its coastal landscape. The region's history of human habitation and economic activity has been linked to the dynamic environmental conditions influenced by the North Sea and the Scheldt River. This research aims to answer key questions about the history of Walcheren during the Middle Ages, the precise locations of archaeological sites, patterns in settlement location decisions, the role of sea levels in these decisions, and the broader impact of environmental changes on daily life and trade.

A multidisciplinary methodology was adopted, combining data from archaeological surveys, environmental science, and historical literature. Sources such as Archis, CHS Zeeland, and geological surveys provided a framework for analysing the interplay between landscape changes and human settlement patterns.

Findings reveal that the medieval inhabitants of Walcheren continuously adapted to the changing coastal landscape. Settlements like Walichrum, Oud-Arnemuiden, and Oud-Westkapelle faced (frequent) relocations due to inundation and rising sea levels. These movements were necessitated by the relentless encroachment of the sea and coastal erosion, prompting the construction of protective dikes and embankments around 1200 AD. The archaeological record indicates a pattern of strategic settlement on elevated or protected sites to mitigate the risks of coastal erosion and sea level rise.

The study concludes that the impact of coastal erosion and rising sea levels on Walcheren's medieval settlements was profound. The constant environmental changes necessitated significant adaptability and resilience from the inhabitants, who implemented various strategies to protect their settlements and sustain their economic activities. This research highlights the importance of considering environmental factors in the preservation of cultural heritage and provides a historical perspective on current challenges posed by climate change.

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