Vikings everywhere: An analysis on Viking Age grave artifacts, DNA, and strontium isotopes

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An analysis on Viking Age grave artifacts, DNA, and strontium isotopes

by

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Abstract

This thesis analyses the mobility of the Vikings and their cultural inheritance through Viking Age grave artefacts, DNA and strontium isotopes. Approaching this theme from three different point of views, with the use of multiple sub questions. This thesis uses existing data from different scientific papers. This data is filtered and documented in Excel and QGIS. The data from 52 Viking graves and 223 DNA samples is visualized and discussed. Comparing the results of these three different data sets gives us the possibility to recognize patterns. The results reveal a small portion of evidence on the difference in Norwegian, Swedish and Danish Viking mobility and cultural dispersion.

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Glossary

Anglo-Norse: A term to describe people from Scandinavia that migrated and occupied the British Isles between the 8th century AD and 13th century AD

Anglo-Saxon: A term to describe the people that inhabited England from the 5th century AD to the 10th century AD

Hiberno-Norse: A term to describe the people that were mixed of Scandinavian and Gaelic ancestry. The result of Scandinavian Vikings and local Irish people merging cultures.

Hiberno-Norwegian: A term to describe people that descent from Norwegian and Gaelic origins.

Norse: A term to describe people from Scandinavia, this includes Denmark, Norway, and Sweden.

Chapter 1

Introduction

The word Viking is commonly used to describe the people from Medieval Scandinavia, but there is a lot of depth to the word that most people do not know. Some parts in Viking archeology are underexposed and therefore, within this thesis, I try to analyze the mobility of the Vikings into Western and Eastern Europe and their cultural inheritance by analyzing Viking Age graves. Specifically, the analysis of grave artefacts, ancient DNA, and strontium isotopes. Approaching this theme from three different point of views, it presents the possibility to get an insight into the difference of Scandinavian Vikings. By using an extended DNA analysis by researchers (Margaryan et al, 2020) on the Viking world, and combining this data with grave analysis and strontium analysis from around medieval Europe, it is possible to get some new insights into the Viking age dynamics. Besides that, the main aim of this thesis is **to analyze Viking movement and difference in material culture.** The sub questions in this thesis are formulated with the purpose of supporting in formulating a conclusion.

Sub questions:

- Is it possible to distinguish Danish, Swedish and Norwegian Vikings by looking at their burial practices, DNA, and strontium isotopes?
- What can the artefacts in Viking Age graves tell us about the mobility of the material culture between the Scandinavian Vikings?
- What can the artefacts in Viking Age graves tell us about the movement and influence of the Vikings between 800-1050 AD?
- To what extent does strontium and DNA analyses of Viking Age human remains give us useful information on movement patterns of the Vikings?
- Will DNA, artefact origin and strontium tell us the same story?

furthermore, a brief overview of this thesis. The existing literature that connects with this thesis is reviewed. Explanation of the background information and arguments supporting this thesis is presented within chapter 2. Chapter 3 covers the methodology and the results. In the chapter 4, the results will be discussed. In the last chapter, 5, a conclusion is formulated.

Chapter 2

Literature review

Within Viking archeology much research is done on many different topics, such as expansion, trade, social and political hierarchy, war and much more. Some topics are easier to study or analyze than others. DNA and strontium analysis are expensive and so is fieldwork. Because of this, the amount of information that this thesis needs could be limited in some parts. The amount of Viking graves is large, however the number of papers and studies about Viking grave analyses is rather scarce. This thesis tries to fill a gap between Viking grave analysis, specifically the artefacts found within, DNA analysis of Viking human remains and strontium isotope analysis. Research on the difference between Norwegian, Danish and Swedish Vikings have not been studied extensively. The cultural and burial practices and different type of analysis can help Viking archeology shed light on the difference between these various Scandinavian Vikings. But before going into the specific literature, it is first a good idea to give a brief explanation on the different aspects of the Vikings.

What is a Viking?

A Viking is a word to describe many things. In Old English, the term Viking was first used. It was used to refer to robbers or coastal marauders (Richards, 2005, p. 2). Throughout time there have been many different names to describe these 'raiders' from the North, depending on which area. The concept "Viking" can be used to describe a number of things. It can refer to a single person or a group, sometimes even a specific activity (Nordeide & Edwards, 2020, p. 2). In Old Norse, the word Viking could be described as 'sea warrior' (Downham, 2012). Nowadays, the word Viking also describes the people from Medieval Scandinavia (Norway, Denmark, and Sweden) and the later influences in other parts of the world. Downham states that, some people use the word Viking to describe to Scandinavian influence from around 780 AD to 1050 AD, hence the word "Viking Age".

The Viking Age

The Viking Age is typically dated from 800 AD to 1050 AD. According to the traditional view, the start of this period is characterized by the attacks on the British Isles (Nordeide & Edwards, 2020, p. 4). The attack on the Lindisfarne monastery started a chain reaction of raids around medieval Europe and beyond. If you characterize the Viking Age by raids, then you can say that this is the start. Recent excavations have found one of the oldest Scandinavian trading centers, Ribe. Together with other small emporia, Ribe emerged around 600 AD (Raja & Sindbaek, 2018), which is earlier than the typical start of the Viking Age. This indicates that Medieval Scandinavia was an active place even before the first Viking raids. Depending on how you characterize the Viking Age, there will always be different starting points to indicate when the Viking Age began. A starting point could be the first raids or the first trading towns. Giving an end-date to the Viking Age is also controversial. Some scholars believe that the end of the Viking Age can be defined by the arrival of Christianity in Scandinavia, others say it is characterized by urbanization, change in politics or other (Nordeide & Edwards, 2020, p. 4).

Viking Expansion

Patterns of migration can be traced through multiple sources. Cultural inheritance, DNA, or social structures. People travelled great distances, from area to area. But many descendants kept their Scandinavian identity alive. In this case the Danes, Norwegian and Swedish 'Vikings' (Downham, 2012, p. 4). We can see this inheritance of identity throughout the places that Vikings have been to. Archeological evidence, together with many historical written sources indicate the range of the Vikings. Of course, Medieval England, Scotland and Ireland have seen a great amount of turmoil from the Vikings. But that was not just it, the Vikings also expanded eastwards, southwards and even

further to the west (Iceland and Greenland). There is much evidence for Viking activity in Eastern-Europe, according to Nordeide and Edwards (2020), there are more Scandinavian artefacts found in Eastern-Europe than there is in the western part of Europe. The southern parts of present Europe, France, Spain, and Italy have also known Viking activity. This indicated the scope of where the Vikings were able to travel to and leave traces of their presence.

Evidence of Viking activity

The Vikings were skilled seafarers. By exploring, trading routes established, and connectivity increased. There were multiple reasons for the people of Scandinavia (not only the Vikings) to travel to different parts of the world. As I mentioned before, the word Viking can be used for many things. This does not stop at only people, but also thoughts or lifestyle. In this case I use the word Scandinavians to indicate the people that are related to the "Vikings". Many medieval Scandinavians moved to the British Isles, other parts of Scandinavia and even Greenland and towards present day Russia. Not only for the purpose of raiding, but also for living and trading. We can see the influences and remains of the Vikings through multiple pieces of evidence. Not only through Archeological evidence, but also through language and other cultural influxes. As Winroth (2014) explains in his book, *The Age of the Vikings*, that many Scandinavians moved elsewhere and all with different reasons. The English language is even greatly influenced after the "invasion" of the Vikings into East-England. Which is known as The Danelaw. Obviously, this is a great indicator of Viking influence. But other evidence such as artefacts, monuments, architecture, and other Viking archeology is also really interesting and important. When solely looking at tangible evidence of Viking activity, there are is a great number of archeological evidence of Viking activity in the world. Much research has been done on numerous aspects of Viking life, which I explained previously in short. The good things about this, is that we, archeologist, and historians, have a good impression of the Vikings in its whole. But not all the Vikings were the same. There were Danish Vikings, Swedish Vikings, and Norwegian Vikings. The difference in this medieval Norse population is in my opinion not enough represented. For example, there are multiple Viking graves found in the British Isles, but are these graves Norwegian, Swedish or Danish Vikings. That is something that I wish to find out in this thesis.

Viking graves

Is it possible to distinguish the origin of the dead by looking at grave artefacts? Or do we need other information to make these claims. One thing in this thesis that is a key aspect, to finding this out, are grave artefacts. A great amount of Viking grave artefacts has been found throughout places in Europe. These grave goods are a critical source of information to tell us more about the material culture of certain people. The Viking graves that are the most promising are the ones dated between 800 – 1050 AD. The problem is that we cannot be certain that these artefacts originate from this period. The Viking grave artefacts only tell us, that they are related to the Viking culture. The artefact itself does not explain itself, it is important to look at other elements, such as the context of the burial and everything around it. One of the best ways to trace human movement across the globe is by looking at the disposal of the dead (Halsall, 2000, p. 259). The Vikings had different ways of deal with de dead. Cremation or burying the dead were both common. In medieval Scandinavia, during the Viking Age, the burial practices were alike (Arcini et al, 2018). To some degree, depending on the area and period of time, there have been changes in the burial practices in Scandinavia. With the arrival of Christianity, cremation became less frequent under Christian rulers. (Arcini et al, 2018, p. 5). The use of grave goods of various kinds remained. Some examples of common Viking grave goods are brooches, beads, knives, clothing, weaponry, armory. Through many of these grave goods, a grave can be identified as Viking.

DNA and strontium isotopes

When researching the possible origins of a person, it is always good to have multiple proxies to investigate this. Of course, the grave goods contain much information of a person's possible relationship with a specific culture. But this does not immediately mean that their origin is the same as the material culture. Therefore, in this thesis, I have tried to approach this analysis from three different angles. DNA and strontium isotope analysis are great indicators of one's place of origin or place of living. Unfortunately, in the world of Viking archeology there are not many DNA research available. Fortunately for this thesis, extensive DNA analysis has been done on multiple Viking skeletons around the world. This research called *Population genomics of the Viking world.* By Margaryan et al, 2020, collected many ancient DNA samples and compared them with present day population of multiple countries. This allows to compare the DNA origin with the grave goods origins. Unfortunately for this thesis, the amount of strontium analysis done on Viking skeletons has been rather scarce. But there have been a couple of papers including the strontium analysis by looking at the remaining teeth or bones of an individual. Strontium differs from DNA in a way, that one can say something about the place of stay. Which can tell us if the person was living as a local or non-local.

Gaps and limitations

Within Viking archeology many topics have been researched quite well and some have not received as much attention. It is easy to throw a label on everything with the word "Viking" only if it is a little bit related to that culture. The problem or research gap within Viking archeology, was the fact that almost none of the articles or research papers talk about the distinction between the Norwegian, Swedish and Danish Vikings. This is something that should be looked at in more depth. But how can we differentiate this. With the method used in this thesis, it is possible to make a start to this process. Is it possible to determine the origin of a Viking by looking at their burial gifts or does DNA and strontium analysis conclude something different? By approaching this gap from three different point of views, we are hopefully able gain some knowledge about it. When searching for related papers on Viking grave analyses, the analysis of the authors had to be respected . Whenever there was a clear sign of an origin of a certain artefact, I collected it. Sometimes these origins were not so specific, which made it more difficult.

The DNA analysis has been helpful in this research. Especially, for that fact that there has not been much DNA research done on Vikings. The DNA analysis suggested that Danish Vikings were more present in England, Norwegian Vikings were more present in Scotland, Ireland, and Iceland/Greenland and that the Swedish Vikings were more bound to travel eastwards into Eastern-Europe (Margaryan et al, 2020). Do the grave artefacts support this claim? Can we see this in some strontium analysis too? The collaboration between artefacts, DNA and strontium could provide us with data on the possible origins and extent of the Vikings.

Chapter 3

Methodology

The data used in this analysis is gathered both for quantitatively and qualitatively use. The data for grave artefacts and strontium isotope analyses has mainly been retrieved from existing papers. The Viking graves analysis needed to have a comprehensive analysis of the graves and their belongings. A key element in this search for data about the grave goods, was the possible origin of these artefacts. The artefacts needed to have a clear lead from where they could have originated from or were influenced culturally by other areas of Viking Scandinavia. This data, the possible origin of the artefacts, together with all the additional information is collected and incorporated into a single Excel sheet. This additional information can be seen in an example below (table 1)

grave	country	X-coordinate	Y-coordinate	DNA	Strontium	artefacts	graveritual	kind of grave	sexe	age	source	description	Page	burial

Table 1: Overview of collected information of the Viking graves

As much information as possible was collected. But not all attributes were present in every grave description. For this research, the key elements were the possible origins of the artefacts. Which could have a specific origin such as Norwegian, Swedish or Denmark. Other were not that specific and had to be classified as a broader category, such as Norse or Hiberno-Norse. Furthermore, the coordinates were retrieved via Google Maps. The coordinates are important for the visual representation of the data. Also, the country of origin of the grave is documented for a better understanding of the data in the end phases of the analysis. Few of the Viking grave papers or articles did have an additional strontium analysis, which made the data more complete. There are also some other attributes documented, but these were not used in the analysis. In total there are 52 Viking graves (Appendix 2) in this dataset. 47 of the 52 graves had a good indication of the artefact origin and 16 of the 52 graves had a strontium indication. This dataset was then visualized using QGIS. Most of the data on grave artefacts and strontium have been collected from scientific archeological papers, that can be found on numerous scientific platforms on the internet.

DNA data

As said before, the amount of DNA analysis on Viking graves are low. But luckily there has been done extensive research on Viking DNA by Margaryan et al, 2020. The data of this research has been used in this thesis. The data of the Viking DNA analysis has been documented in an Excel file (Appendix 2). This Excel file consists various data. Different samples of DNA were linked to a “Museum ID” and the country of origin. The samples could also be categorized by time frame. Which enabled me to select the samples most suitable for this research in this case, samples from 800 – 1050 AD. The samples were stored in a new Excel file, which is only used for the visualization of the results. In the original data file, there is a sheet named “ancestry estimates”, which calculated the amount of similar ancient DNA to the DNA of people in various countries nowadays. This number can be read as percentage. This would allow me to see the possible origins of the ancient samples. The ancestry estimates were divided over multiple areas which can be seen in table 2

UK "British-like"/"North Atlantic"	Denmark "Danish-like"	Sweden "Swedish-like"	Norway "Norwegian-like"	Poland "Polish-like"	Italy "Southern European-like"	Finland "Finnish-like"

Table 2: Overview of possible DNA origins

These estimates were calculated in percentages. So, for example, sample 1 is from England and has 40% Danish-like DNA. This allowed me to create a table with all the estimates of the suitable samples. Which would then allow me to create a clear overview of the DNA data (Table 3)

Results

The analysis based on the possible origins from the Viking grave artefacts are as following.

Figure 1: Grave artefact origins in the British Isles

The first map (figure 1) that has been created is the grave artefact origins of Viking graves in The British Isles. We see a number of Viking graves in present day Scotland, England, and Ireland. The total number of Viking graves used in this area is 27. So, 27 graves with a strong indication of the origins of the artefacts. The possible origins have been characterized into specifics and some are broader specified. In some areas there have been found multiple graves and in others they are scarcer.

After the British Isles, we can see an overview of the graves with an artefact origin indication (figure 2). We see Norway, Sweden, and Denmark with a few Viking graves. In comparison to the British Isles, here the sample number is 18.

In figure 3 we see a few Viking graves in parts of Eastern-Europe and present-day Russia. 3 of the 4 samples in Eastern- Europe are found in Western-Russia and 1 is found in present day Ukraine. The sample size of Viking graves in Eastern-Europe is small due to the recorded archeological research on Viking graves. But for this because it was important to include these. By representing many areas, we have more information that provides us with meaningful insights.

Which patterns can we see? Norwegian Viking influence is mostly seen in the Northern parts of Scotland and Ireland. The material culture in Ireland merged which resulted in a Hiberno-Norse culture. The Isle of Man is also dominantly influenced by Norwegian material culture. Danish material culture mainly traveled to England but were also present in other parts of Scandinavia. The

Swedish Viking culture does not seem to be much present in the West, but mainly in the East. In Scandinavia we see an inter-exchange of material culture.

The results of the artefact origins analyses tell us, that the Norwegian Viking influence is somewhat scattered around the British Isles. We see influence in Scotland, Ireland, and some in England. The Swedish artefacts are underrepresented, we only see some in the northern parts of Scotland. The Danish artefacts are mostly found in England. However, many of the artefacts found in the graves could not be assigned to a specific country of origin. We see a mix of the existing culture and the non-native cultures. For example, in Ireland we see that many artefacts are Hiberno-Norse. And in England we see Anglo-Norse origins. Also, some artefacts are just Norse because these artefacts are found everywhere in Viking Age Scandinavia.

In Norway we see multiple origins. Mostly from Norway itself, but also some Anglo-Norse, Hiberno-Norwegian and Hiberno-Norwegian. In Sweden we can see that the artefacts mostly originate from Finland. Some are Baltic and some are Danish. This is quite a difference with the artefacts in Norway. In Denmark, the artefacts are predominantly Danish, with some Norwegian origins

The Viking grave artefacts found in Russia are characterized as Swedish. The artefacts found in multiple graves in present day Ukraine are mostly Norse.

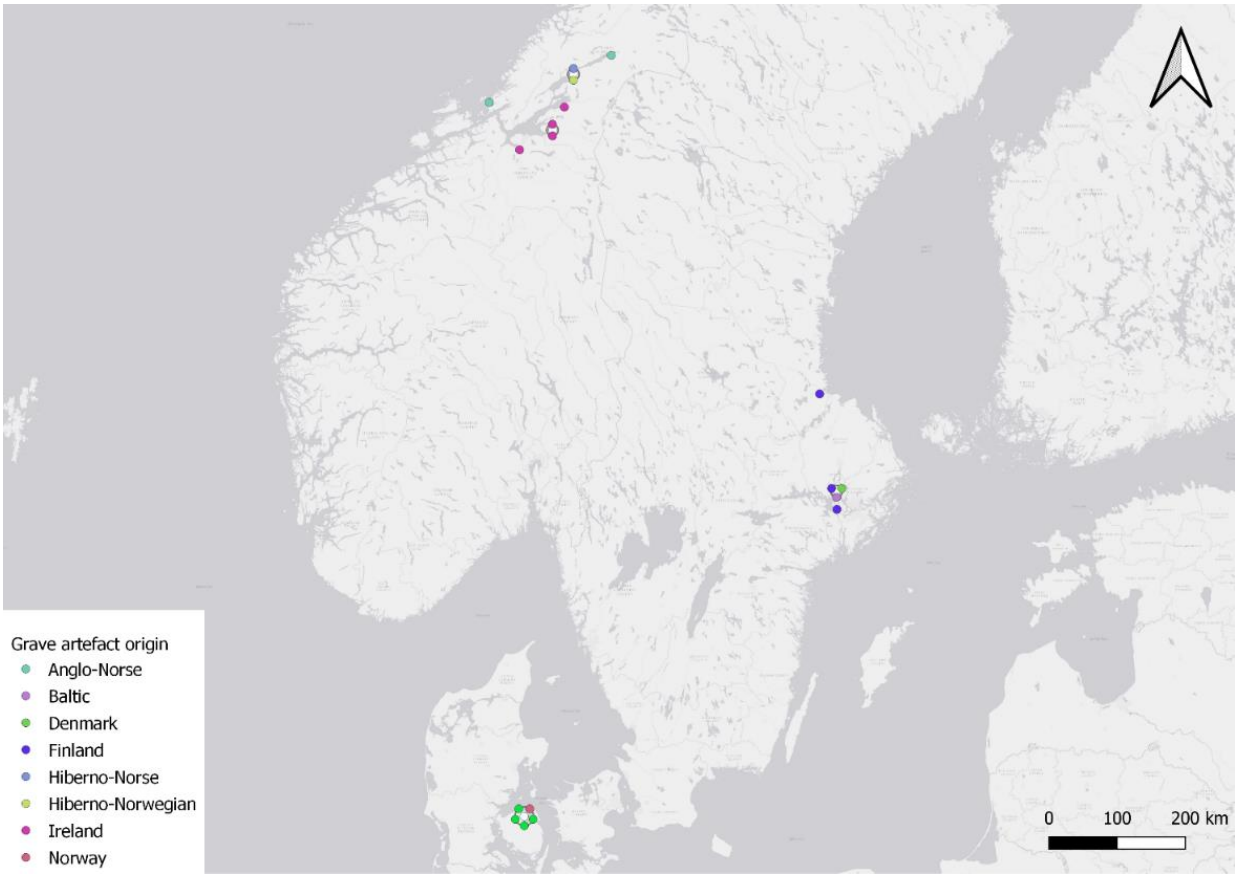

Figure 2: Grave artefact origins in Scandinavia

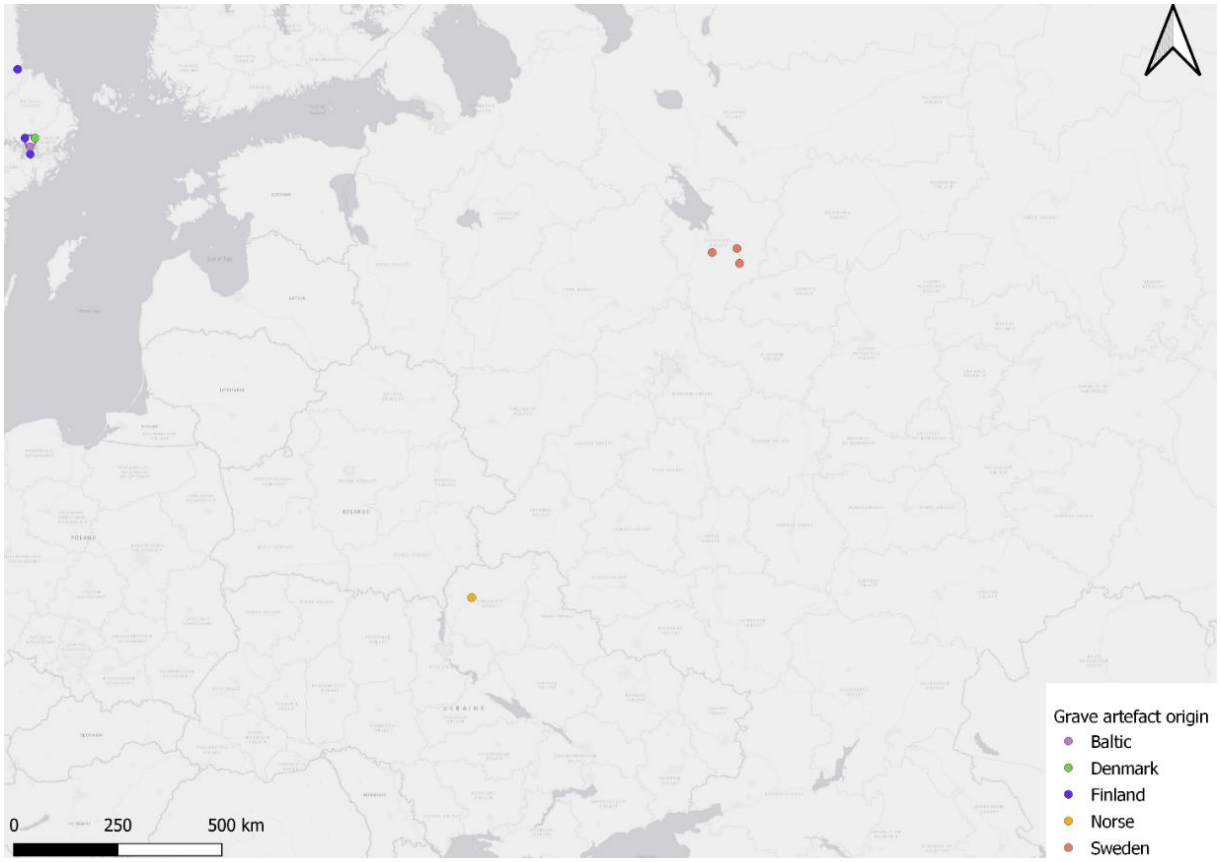

Figure 3: Grave artefact origins in Eastern-Europe

Strontium analysis

In figure 4 we can see an overview of the Viking graves that have been analysed by using a strontium analysis. A total of 16 graves have provided this research with information about their possible origins according to strontium isotopes. The origins differ from the artefact origins, because pinpointing an origin by strontium is more difficult. In some cases, it was not possible to provide a specific origin, hence the broader origins.

We see that many Viking remains are not local to their burial places. the strontium analysis shows us that the Vikings travelled great distances. It seems that they had a preferred place to travel to. We see Danish origins in England, which supports the artefact results. With strontium it is much more difficult to estimate a specific place of origin, so we cannot say anything about the Norwegians going to Ireland and Scotland. However, we see that Denmark knows many non-local people and we see the same in Sweden.

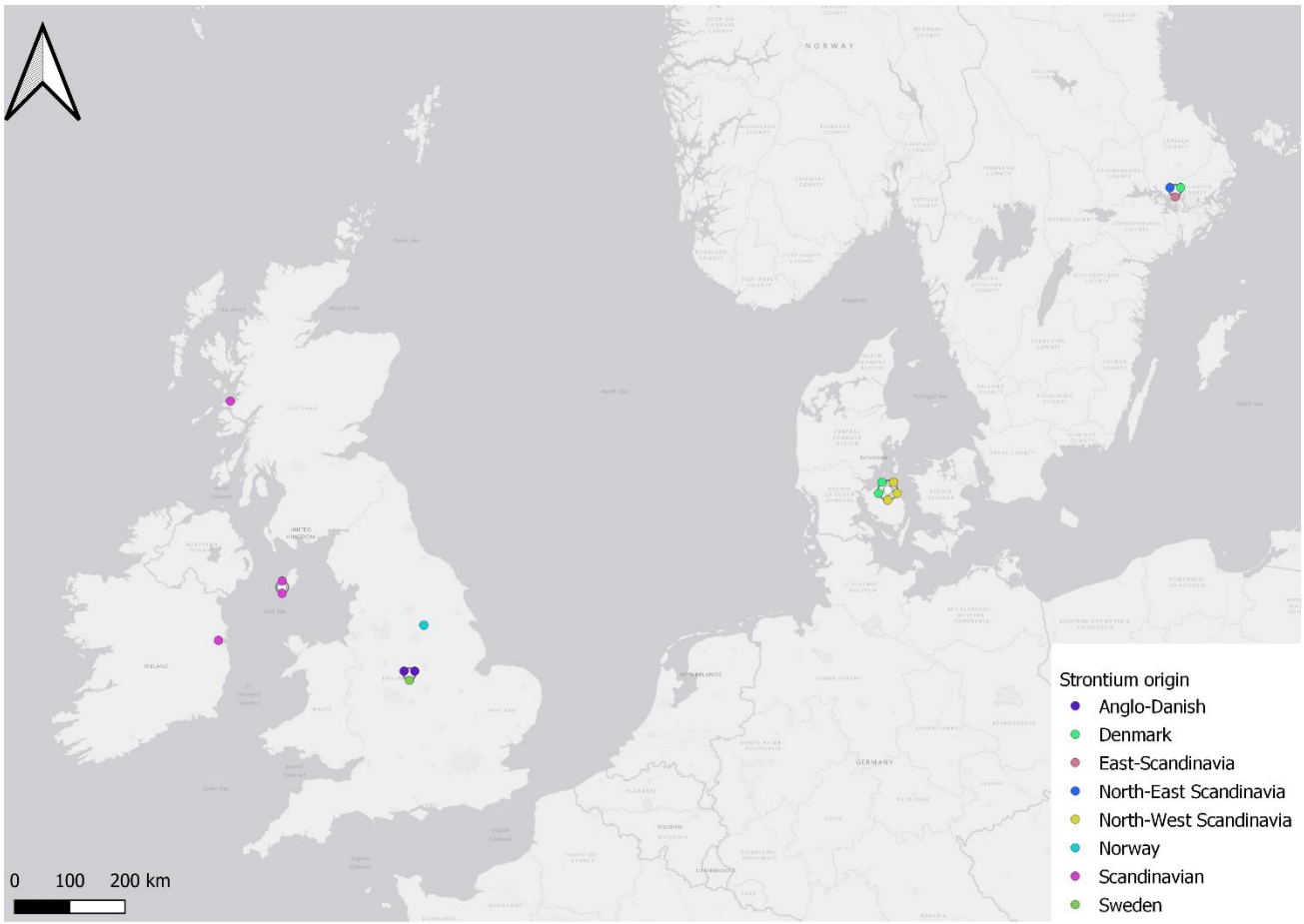

Figure 4: Strontium origins from strontium analyses of human Viking remains

DNA analysis

The DNA results differ from the artefacts and strontium, not only visually but also quantitively. The sample number of the DNA analyses is 223. These are ancient DNA samples extracted from Viking related graves. The results that can be seen in table 3 are the average of all the samples in that country. These number should be read as percentages. The origins are categorized by present day countries. We can see UK/British, Danish, Swedish, Norwegian, Polish, Italian and Finnish like origins. So, for example, in Denmark all the samples are calculated by the mean. So, of all the samples in Denmark, 10,5% is UK/British-like and 45,9% is Danish- like.

Table 3: Results of DNA analyses

Country	UK/British-like	Danish-like	Swedish-like	Norwegian-like	Polish-like	Italian-like	Finnish-like
Denmark	10,5	45,9	10,0	5,1	7,9	18,3	2,2
England	20,7	34,0	9,9	14,6	2,6	14,3	3,9
Greenland	19,4	12,7	1,0	54,1	1,8	9,2	1,9
Iceland	41,6	5,0	2,1	39,3	1,2	8,2	2,5
Isle of Man	0,2	3,7	9,9	86,2	0	0,1	0
Norway	20,3	8,4	11,6	51,3	0,6	3,8	3,8
Poland	0	5,0	20,2	0,4	54,1	1,5	18,8
Russia	7,9	15,6	17,8	3,4	26,6	10,5	18,3
Scotland	68,1	6,7	3,2	14,8	2,2	4,1	0,9
Sweden	14,0	26,5	13,6	7,2	10,8	15,3	12,7
Ukraine	0,9	01,1	20,2	23,7	28,7	8,5	17,0

In Denmark we see that the Danish-like DNA is dominant with 45,9%. In England the Danish-like DNA is also dominant with 34%. In Scotland, the UK/British-like DNA is dominant with 68,1%, however we can see that Norwegian-like DNA is second with 14,8%. On the Isle of Man, Norwegian-like DNA is most common with a staggering 86,2%. This high percentage could be due the fact that the sample size is very small, which saturates the results with Norwegian-like DNA. Norway sees a lot of Norwegian-like DNA (51,3%), but also UK/British-like (20%). In Sweden, the Danish-like DNA takes the upper hand with 26,5% which is not a lot and means that there are other influences that are well represented, almost equally. Italian-like DNA is 15,3%, UK/British-like DNA is 14% and Swedish-like DNA only 13,6%. So, the local DNA in Sweden is less than the non-local such as Danish and British. This is interesting, it could mean that a lot of inhabitants of Sweden travelled from another area to Sweden in the Viking Age period. In the additional countries, we see that Iceland has mostly UK/British-like DNA (41,6%) and Norwegian-like DNA (39,3%). In Greenland, the ancient samples are represented by mostly Norwegian-like DNA (54,1%). In Russia, the Polish-like DNA is mostly seen with 26,6%. But in Poland there is also some Finnish DNA (18,3%) and close after each other the Swedish (17,8%) and Danish-like DNA (15,6%). In Poland the Polish-like DNA is dominant (54,1%), but in the Polish samples we also see much Swedish-like (20,2%) and Finnish-like DNA (18,8%). At last Ukraine, here we see variety of origins. We can see mostly Polish-like DNA (28,7%) and a close second and third are Norwegian-like (23,7%) and Swedish-like DNA (20,2)

With these results it is possible to analyse the origins from DNA and compare them with the origins of the artefacts and the strontium analyses.

Chapter 4

Discussion

The results are very varying. Norwegian Vikings seem to be more present in Ireland and Scotland according to the artefacts. We cannot say for sure that the Danish and Swedish Vikings had great representation in the British Isles. The broader categories such as Anglo-Norse and Hiberno-Norse or Norwegian, could indicate a fusion of material culture. However, this could also just mean that the artefacts were just traded more in these parts. The interesting thing is when we look at Scandinavia and Eastern-Europe where we see different results. The analyses concluded that Norwegians were more active in Scotland and Ireland, the Swedish Vikings went eastwards, and the Danes went to England (Margaryan et al, 2020). We see this partly in the artefacts. But I must say this with caution, because I am not a Viking artefact specialist and most of these claims on the origin of these artefacts in the original papers are not for certain.

Strontium analyses results

The strontium analyses gave us results, which differ in some way from the results of the artefacts. In Ireland, Isle of Man and Scotland we see that the strontium samples indicate that they are Scandinavian. Scandinavian is broad; however, this tells us that the people buried there were in fact not local residents. In England there are a variety of origins. Anglo Danish, Norwegian and Swedish are the results of the strontium analyses. In Denmark, we see that North-West Scandinavia and Denmark are dominant. Some of these Viking graves in Denmark belonged to local people, however some were not that local. North-West Scandinavia could mean Norway, which means that there were also non-local people in Viking Age Denmark. In Sweden the Viking Age graves according to strontium analyses are Scandinavian. There is many variety in strontium origins in the Scandinavian samples.

DNA analyses results

What does this mean in the bigger picture? Well, we can say that the Danish Vikings were more represented in England, besides Denmark itself. The Norwegian Vikings were more interested in going to the west, to the countries Greenland, Iceland, Scotland, and the Isle of Man. Also, there some influence of Norwegian Vikings in Ukraine. The Swedish Vikings went mostly to countries in Eastern parts of Europe such as Russia, Ukraine, and Poland. The results of this DNA analysis and the research done by Margaryan (2020) match and therefore the conclusions about this analysis are alike.

Putting everything together

When we look at the results from the DNA analysis, there is a lot to say about the dispersion of the Scandinavian Vikings into other parts of the world. There were some limitations to the artefact analyses, it could be that the sample size was too small. The lack of sufficient data on Viking grave analysis and their artefacts could have played a role. I would say that with the limited data available, a good enough result has been created in this thesis on grave artefacts. It is possible to distinguish the material culture of Scandinavian Vikings. Their material culture can be used as a proxy to research the Viking networks. The strontium analyses also lay partially in line with the results of the DNA analyses. However, the specification of origin is where strontium analyses let us down. Many of the strontium results do have a broader origin, which is good for the bigger picture but not for a detailed analysis. The results did meet the expectation to a certain level; however, the lack of detailed descriptions was a spanner in the works.

Chapter 5

Conclusion

The results of the analyses within this thesis are what they are. The DNA analyses shows a clear result on the DNA origins of the Viking age samples. The artefacts analyses do lay in line with the DNA results to some degree. It is possible to create a distinction between Norwegian, Danish and Swedish Vikings by analyzing their material culture that has been found within the graves spreading across the world. Although, with the available data results have been produced, but this only scratches the surface. The grave artefacts can tell us some about their origin. The place of production or where that artefact appeared the most. Some artefacts were more common in other parts of Scandinavia, which lets us know that there was some difference in material culture between Norwegian, Swedish and Danish Vikings. Also, when looking at the distribution of these artefacts together with the origin, a small insight in Viking movement can established. The strontium and DNA result approach these questions from a different perspective, the strontium tells us where someone has lived, and DNA tells us to whom someone is related. These three points of views tell us the same story to up to a certain level, but keep in mind the limitations of this research. I suggest that these topics on their own and together should be analyzed more detailed. Also, it would be of great importance to look for more Viking graves and document them clearer, especially the artefacts.

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Appendix 1: DNA samples

Raw data of the DNA samples used

Sample	Museum_ID	Country	UK "British-like"/"North Atlantic"	Denmark "Danish-like"	Sweden "Swedish-like"	Norway "Norwegian-like"	Poland "Polish-like"	Italy "Southern European-like"	Finland "Finnish-like"
VK542	Chernigov_НАІЗЧС КН 188	Ukraine	0,023	0,004	0,004	0,001	0,711	0,246	0,01
VK315	Denmark_Bakkendrup Grav 16	Denmark	0,111	0,682	0	0,025	0	0,181	0
VK369	Denmark_Bakkendrup losfund-2, conc.1	Denmark	0,035	0,407	0,001	0	0,011	0,534	0,011
VK294	Denmark_Bakkendrup losfund-2, conc.5	Denmark	0,049	0,713	0,041	0,023	0,104	0,062	0,008
VK281	Denmark_Barse Grav A	Denmark	0,009	0,269	0,613	0,001	0,008	0,06	0,04
VK291	Denmark_Bodkergarden Grav D, sk 1	Denmark	0,001	0,433	0,435	0,029	0,024	0,056	0,022
VK289	Denmark_Bodkergarden Grav H, sk 1	Denmark	0,177	0,704	0,003	0,114	0	0,002	0
VK364	Denmark_BogovejBN	Denmark	0,019	0,75	0	0,001	0,009	0,205	0,016
VK365	Denmark_BogovejBS	Denmark	0,066	0,107	0,006	0,066	0,029	0,724	0,001
VK363	Denmark_BogovejBT	Denmark	0,19	0,406	0,001	0,001	0,172	0,217	0,013

VK361	Denmark_Bogovej BX	Denmark	0,23	0,655	0,004	0,003	0	0,106	0,002
VK366	Denmark_Bogovej BY	Denmark	0,016	0,717	0,019	0,056	0,06	0,132	0,001
VK367	Denmark_Bogovej D	Denmark	0	0,004	0,46	0,019	0,061	0,004	0,452
VK288	Denmark_Bogovej Grav BA	Denmark	0,081	0,156	0,69	0,016	0,001	0,05	0,006
VK286	Denmark_Bogovej Grav BJ	Denmark	0,085	0,226	0,001	0,032	0,015	0,634	0,007
VK338	Denmark_Bogovej Grav BV	Denmark	0,053	0,77	0	0,002	0,001	0,173	0
VK320	Denmark_Bogovej Grav S	Denmark	0,047	0,648	0,242	0,057	0,001	0,003	0,001
VK362	Denmark_Bogovej LMR 12077	Denmark	0,045	0,135	0,06	0,026	0,363	0,346	0,026
VK368	Denmark_Bogovej T	Denmark	0,36	0,424	0,003	0,014	0,006	0,179	0,013
VK134	Denmark_Galgedil ALZ	Denmark	0,012	0,505	0,217	0,008	0,012	0,197	0,05
VK139	Denmark_Galgedil ANG	Denmark	0,015	0,001	0,002	0	0,968	0,012	0,002
VK370	Denmark_Galgedil ANO	Denmark	0,017	0,637	0,271	0,029	0,003	0,019	0,025
VK279	Denmark_Galgedil AXE	Denmark	0,02	0,523	0,442	0,01	0,001	0,003	0
VK373	Denmark_Galgedil BER	Denmark	0,069	0,694	0,001	0,004	0,002	0,229	0,001
VK372	Denmark_Galgedil KM	Denmark	0,009	0,273	0,25	0,414	0,002	0,052	0
VK446	Denmark_Galgedil LS	Denmark	0,186	0,737	0	0,052	0,007	0,016	0,001
VK141	Denmark_Galgedil OMB/BFQ	Denmark	0	0,639	0,29	0,042	0,002	0,001	0,026
VK278	Denmark_Galgedil TQ	Denmark	0,114	0,392	0,007	0,005	0	0,481	0

VK371	Denmark_Galgedil UD-Vest	Denmark	0,002	0,014	0,324	0,072	0,456	0,114	0,017
VK445	Denmark_Gl Lejre-A1896	Denmark	0,042	0,32	0,1	0,43	0,059	0,043	0,006
VK284	Denmark_Grydehoj A2058	Denmark	0	0,634	0,054	0,197	0,014	0,096	0,005
VK384	Denmark_Hesselbjerg Grav 14, sk EU	Denmark	0,121	0,805	0,003	0,011	0,002	0,052	0,005
VK300	Denmark_Hesselbjerg Grav 22, sk IR	Denmark	0,192	0,617	0	0	0,004	0,183	0,004
VK84	Denmark_Hesselbjerg Grav 3	Denmark	0,257	0,29	0,005	0,005	0,045	0,363	0,035
VK87	Denmark_Hesselbjerg Grav 41b, sk PC	Denmark	0,411	0,291	0,086	0,025	0,001	0,185	0,002
VK340	Denmark_Hesselbjerg Grav 5, sk V	Denmark	0,01	0,002	0,001	0,01	0,858	0,002	0,118
VK295	Denmark_Hessum sk 1	Denmark	0,017	0,763	0,105	0,016	0,002	0,027	0,07
VK316	Denmark_Hessum sk II	Denmark	0	0,853	0,021	0,098	0,025	0,001	0,003
VK274	Denmark_Kaargarden 391	Denmark	0,011	0,117	0,002	0,014	0,604	0,245	0,006
VK317	Denmark_Kaargarden Grav BF99	Denmark	0,124	0,248	0,03	0,001	0	0,588	0,008
VK285	Denmark_Kaargarden Grav BZ	Denmark	0,193	0,591	0,003	0,049	0,004	0,16	0
VK290	Denmark_Kumle Hoje Grav O	Denmark	0,002	0,062	0,495	0,431	0,005	0,004	0,001
VK319	Denmark_Ladby Grav 2	Denmark	0,151	0,324	0,002	0,02	0,026	0,443	0,034

VK301	Denmark_Ladby Grav 4	Denmark	0,085	0,425	0,001	0,009	0,01	0,455	0,015
VK385	Denmark_Lejre Grav 321	Denmark	0,085	0,305	0,003	0,094	0,017	0,485	0,013
VK324	Denmark_Ribe_K1552	Denmark	0,04	0,742	0,009	0,044	0,003	0,152	0,01
VK323	Denmark_Ribe_K1563	Denmark	0,229	0,709	0	0,001	0	0,06	0
VK322	Denmark_Ribe_K1568	Denmark	0,499	0,135	0	0,02	0,088	0,259	0
VK325	Denmark_Ribe_K1572	Denmark	0,067	0,895	0,001	0,03	0,005	0,002	0
VK326	Denmark_Ribe_K1578	Denmark	0,117	0,563	0,005	0,002	0,001	0,309	0,004
VK330	Denmark_Ribe_K1582	Denmark	0,414	0,213	0,004	0,041	0,036	0,215	0,076
VK327	Denmark_Ribe_K1586	Denmark	0,191	0,76	0,012	0,001	0,029	0,005	0,002
VK328	Denmark_Ribe_K1594	Denmark	0,103	0,597	0	0,018	0,02	0,262	0
VK329	Denmark_Ribe_K1600	Denmark	0,194	0,464	0	0,028	0,02	0,286	0,008
VK56	Gotland_Frojel-001A98	Sweden	0	0	0,003	0	0	0,001	0,996
VK60	Gotland_Frojel-00702	Sweden	0	0	0	0	0,285	0,058	0,657
VK429	Gotland_Frojel-01599	Sweden	0,095	0,438	0,013	0,096	0,009	0,334	0,016
VK433	Gotland_Frojel-01798	Sweden	0,025	0,716	0,009	0,009	0,023	0,217	0
VK456	Gotland_Frojel-02404	Sweden	0,959	0	0	0,004	0,001	0,033	0,003
VK455	Gotland_Frojel-03401	Sweden	0,073	0,852	0	0,075	0	0	0
VK64	Gotland_Frojel-03504	Sweden	0,238	0,008	0,004	0,009	0,244	0,032	0,466

VK58	Gotland_Frojel-03604	Sweden	0,221	0,674	0,011	0,03	0,043	0,015	0,006
VK473	Gotland_Kopparsvik-126	Sweden	0,031	0,153	0,001	0,002	0,706	0,045	0,062
VK474	Gotland_Kopparsvik-137	Sweden	0	0,006	0	0	0,984	0,006	0,002
VK53	Gotland_Kopparsvik-161/65	Sweden	0,066	0,002	0,004	0,018	0,635	0,068	0,207
VK475	Gotland_Kopparsvik-187	Sweden	0	0	0,001	0	0,577	0	0,422
VK477	Gotland_Kopparsvik-228	Sweden	0,091	0,394	0,081	0,013	0,003	0,403	0,015
VK468	Gotland_Kopparsvik-235	Sweden	0,078	0,574	0,007	0,078	0,007	0,235	0,022
VK478	Gotland_Kopparsvik-271	Sweden	0	0	0	0	0,693	0	0,306
VK479	Gotland_Kopparsvik-272	Sweden	0,178	0,767	0	0,004	0,033	0,015	0,002
VK50	Gotland_Kopparsvik-53.64	Sweden	0	0	0,778	0,002	0,04	0,001	0,179
VK51	Gotland_Kopparsvik-88/64	Sweden	0,004	0	0,001	0	0,075	0,002	0,917
VK513	Greenland_Ø029_1088	Greenland	0,072	0,001	0	0,926	0	0,002	0
VK183	Greenland_Ø029a_KAL-1086 /skeleton F6	Greenland	0,38	0,055	0,01	0,395	0,009	0,132	0,02
VK184	Greenland_Ø029a_KAL-1087 / skeleton F7	Greenland	0,035	0,001	0	0,83	0,002	0,088	0,044
VK179	Greenland_Ø029a_KAL-1092 /skeleton F2	Greenland	0,205	0,065	0,038	0,612	0,037	0,021	0,021
VK187	Greenland_Ø64_K	Greenland	0,101	0,094	0,001	0,484	0,078	0,206	0,037

	NK2655#72								
VK186	Greenland_Ø64_KNK2655#78	Greenland	0,417	0,047	0,024	0,382	0,001	0,102	0,027
VK1	Greenland_Ø64_KNK2655x677	Greenland	0,268	0	0	0,699	0,006	0,025	0,002
VK6	Greenland_Ø64_KNK2655x678	Greenland	0,07	0,755	0,007	0,001	0,007	0,157	0,002
VK128	Iceland_HDR/111	Iceland	0,495	0,006	0,001	0,457	0	0,023	0,018
VK127	Iceland_HDR08	Iceland	0,374	0,016	0	0,415	0,025	0,122	0,049
VK99	Iceland_HSM-A-014	Iceland	0,501	0,001	0,038	0,287	0	0,136	0,038
VK98	Iceland_HSM-A-083	Iceland	0,192	0,039	0,018	0,714	0,004	0,027	0,006
VK225	Iceland_HSM-A-108	Iceland	0,09	0,33	0	0,334	0,022	0,22	0,005
VK122	Iceland_HSM-A-114	Iceland	0,223	0,001	0,001	0,756	0,002	0,016	0,001
VK110	Iceland_HSM-A-115	Iceland	0,633	0,015	0,06	0,235	0,004	0,022	0,031
VK227	Iceland_HSM-A-117	Iceland	0,204	0,002	0	0,51	0,044	0,23	0,009
VK111	Iceland_HSM-A-118	Iceland	0,787	0,022	0	0	0,014	0,145	0,032
VK230	Iceland_HSM-A-123	Iceland	0,6	0,004	0	0,302	0,004	0,086	0,003
VK101	Iceland_HSM-A-125	Iceland	0,403	0,006	0,002	0,506	0,014	0,066	0,002
VK95	Iceland_HSM-A-127	Iceland	0,74	0,119	0,054	0,004	0,032	0,014	0,038
VK102	Iceland_HSM-A-128	Iceland	0,365	0,099	0,023	0,446	0,004	0,048	0,014
VK123	Iceland_HSM-X-104	Iceland	0,612	0,143	0,007	0,046	0,02	0,171	0,003
VK129	Iceland_ING08	Iceland	0,014	0,026	0,121	0,68	0,009	0,001	0,149
VK543	Ireland_EP55	Iceland	0,349	0,011	0,01	0,549	0,02	0,06	0,001
VK544	Ireland_FG254	Iceland	0,077	0,026	0,011	0,803	0	0,082	0,001
VK545	Ireland_SSG12	Iceland	0,834	0,031	0,04	0,025	0,003	0,012	0,055
VK533	IronAge_DA290	Sweden	0,03	0,05	0,339	0,074	0,033	0,052	0,422
VK170	Isle-of-Man_Balladoole	Isle of Man	0,002	0,037	0,099	0,862	0	0,001	0

VK420	Norway_ Hedmark 2813	Norway	0,326	0,459	0,004	0,057	0,002	0,118	0,035
VK448	Norway_ Hedmark 4005	Norway	0,316	0,378	0,003	0,009	0	0,292	0
VK393	Norway_ Hedmark 4006	Norway	0,005	0,014	0,197	0,781	0	0	0,002
VK422	Norway_ Hedmark 4304	Norway	0,344	0,182	0,086	0,358	0,022	0,008	0
VK394	Norway_ Hedmark 4460	Norway	0,082	0,251	0,018	0,477	0	0,024	0,148
VK419	Norway_ Nordland 1522	Norway	0	0,008	0,504	0,368	0,001	0	0,119
VK388	Norway_ Nordland 253	Norway	0,001	0,025	0,256	0,701	0,004	0,001	0,013
VK524	Norway_ Nordland 3708	Norway	0,004	0,051	0,215	0,696	0,001	0,004	0,028
VK525	Norway_ Nordland 3709	Norway	0,939	0,007	0,001	0,019	0,002	0,032	0
VK530	Norway_ Nordland 4511	Norway	0,645	0,008	0,059	0,105	0,007	0,152	0,025
VK515	Norway_ Nordland 4512	Norway	0,251	0,005	0,007	0,549	0,022	0,069	0,097
VK547	Norway_ Nordland 4727	Norway	0	0	0,13	0,865	0	0	0,004
VK514	Norway_ Nordland 5195	Norway	0	0,025	0,083	0,734	0,001	0,014	0,143
VK526	Norway_ Nordland 5317	Norway	0,246	0,578	0,006	0,002	0,02	0,131	0,016
VK529	Norway_ Nordland 642	Norway	0	0	0,031	0,894	0	0	0,075
VK548	Norway_ Nord-Trondelag 3705	Norway	0,001	0,044	0,358	0,548	0,036	0,002	0,011
VK414	Norway_ Oppland 1517	Norway	0,001	0,006	0,005	0,94	0,002	0,031	0,014
VK415	Norway_ Oppland 1520	Norway	0,004	0,005	0,004	0,957	0,004	0,002	0,023

VK417	Norway_ Oppland 2808-2	Norway	0	0,001	0,299	0,68	0	0	0,02
VK387	Norway_ Oppland 3778	Norway	0,228	0,055	0,01	0,694	0,007	0,002	0,005
VK386	Norway_ Oppland 5305	Norway	0,887	0,001	0	0,056	0,007	0,001	0,048
VK516	Norway_ Sor-Trondelag 4481	Norway	0,001	0,009	0,437	0,484	0,002	0	0,067
VK392	Norway_ Telemark 1645	Norway	0	0	0,179	0,816	0,002	0	0,002
VK389	Norway_ Telemark 3697	Norway	0,042	0,068	0,118	0,564	0,022	0,097	0,09
VK528	Norway_ Troms 4049	Norway	0,965	0,009	0,001	0,005	0,003	0,006	0,01
VK520	Norway_ Troms 4184	Norway	0	0,004	0,011	0,985	0	0	0
VK442	Oland_1008	Sweden	0,176	0,08	0	0,029	0,044	0,591	0,081
VK352	Oland_1012	Sweden	0,115	0,422	0,161	0,092	0,035	0,026	0,148
VK342	Oland_1016	Sweden	0,012	0,003	0,419	0,133	0,218	0,016	0,199
VK343	Oland_1021	Sweden	0,003	0,015	0,961	0,008	0,003	0,003	0,007
VK353	Oland_1024	Sweden	0,29	0,371	0,012	0,052	0,003	0,271	0,001
VK354	Oland_1026	Sweden	0,092	0,007	0,371	0,045	0,329	0,05	0,106
VK333	Oland_1028	Sweden	0,111	0,463	0,007	0,086	0,009	0,322	0,002
VK344	Oland_1030	Sweden	0,26	0,474	0,003	0,042	0,095	0,048	0,077
VK345	Oland_1045	Sweden	0,264	0,054	0	0,102	0,025	0,553	0,002
VK355	Oland_1046	Sweden	0,134	0,512	0,003	0,011	0,001	0,337	0,002
VK346	Oland_1057	Sweden	0,248	0,352	0	0,001	0,103	0,207	0,089
VK334	Oland_1058	Sweden	0,116	0,026	0,389	0,01	0,147	0,135	0,178
VK444	Oland_1059	Sweden	0,321	0,282	0,014	0,058	0,002	0,325	0
VK337	Oland_1064	Sweden	0,19	0,569	0,022	0,068	0	0,151	0
VK348	Oland_1067	Sweden	0,023	0,042	0,426	0,224	0,052	0,055	0,178

VK335	Oland_1068	Sweden	0,091	0,61	0,025	0,017	0,008	0,239	0,011
VK349	Oland_1073	Sweden	0,776	0,06	0,032	0,06	0,05	0,016	0,007
VK336	Oland_1075	Sweden	0,197	0,243	0	0,004	0,042	0,513	0,001
VK350	Oland_1086	Sweden	0,209	0,098	0,062	0,046	0,008	0,562	0,015
VK332	Oland_1088	Sweden	0,154	0,524	0,013	0,049	0,011	0,244	0,004
VK357	Oland_1097	Sweden	0,2	0,23	0,014	0,015	0,015	0,524	0,001
VK443	Oland_1101	Sweden	0,002	0,008	0,241	0,001	0,319	0	0,43
VK358	Oland_1105	Sweden	0	0,001	0,734	0	0,011	0	0,254
VK202	Orkney_Buckquoy, sk 7B	Scotland	0,854	0,065	0,018	0,02	0,019	0,013	0,011
VK207	Orkney_BY78, Ar. 1, sk 1	Scotland	0,909	0	0	0	0,057	0,028	0,005
VK205	Orkney_Newark 68/12	Scotland	0,549	0,187	0,1	0,019	0,002	0,123	0,019
VK204	Orkney_Newark for Brothwell	Scotland	0,41	0,016	0,01	0,552	0,008	0,001	0,002
VK154	Poland_Bodzia E37	Poland	0	0,101	0,268	0,01	0,506	0	0,115
VK156	Poland_Bodzia E58	Poland	0,001	0,013	0,209	0,001	0,513	0,006	0,258
VK157	Poland_Bodzia E864/I	Poland	0	0,036	0,129	0	0,605	0,039	0,191
VK273	Russia_Gnezdovo 77-255	Russia	0,033	0,36	0,005	0,022	0,501	0,062	0,018
VK254	Russia_Gnezdovo 81-287	Russia	0,069	0,032	0,027	0,021	0,55	0,261	0,04
VK160	Russia_Kurevanikka_7283-3	Russia	0	0	0	0	0,982	0	0,018
VK219	Russia_Ladoga_5680-10	Russia	0,029	0,28	0,29	0,014	0,101	0,19	0,096
VK220	Russia_Ladoga_5680-11	Russia	0,046	0,188	0,165	0,152	0,049	0,051	0,348
VK15	Russia_Ladoga_5680-16	Russia	0	0,247	0,606	0,055	0,028	0,017	0,047

VK17	Russia_Ladoga_5680-17	Russia	0,001	0,021	0,41	0,002	0,065	0,023	0,478
VK18	Russia_Ladoga_5680-3	Russia	0,014	0,007	0,382	0,011	0,022	0,038	0,526
VK218	Russia_Ladoga_5680-4	Russia	0,661	0,13	0	0	0,105	0,092	0,012
VK19	Russia_Ladoga_5757-1	Russia	0,012	0,045	0,036	0,027	0,4	0,261	0,22
VK221	Russia_Ladoga_5757-14	Russia	0,002	0,403	0,034	0,069	0,118	0,164	0,21
VK540	Shestovitsa-k.32(23), b. 1.	Ukraine	0,001	0,023	0,253	0,41	0,14	0,006	0,167
VK539	Shestovitsa-k.32(23), b.2, pit Б.	Ukraine	0,003	0,006	0,348	0,299	0,009	0,002	0,333
VK265	Sweden_Karda 17	Sweden	0,23	0,108	0,003	0,061	0,026	0,562	0,01
VK266	Sweden_Karda 19	Sweden	0,082	0,396	0,003	0,005	0,049	0,433	0,032
VK108	Sweden_Ljungbacka_Grav4A_MHM6031	Sweden	0,152	0,39	0,089	0,207	0,056	0,099	0,008
VK308	Sweden_Skara 101	Sweden	0,069	0,472	0,066	0,274	0,003	0,115	0
VK30	Sweden_Skara 105	Sweden	0,102	0,746	0,001	0,006	0,014	0,131	0
VK40	Sweden_Skara 106	Sweden	0,205	0,668	0,038	0,032	0,001	0,055	0
VK35	Sweden_Skara 118	Sweden	0,007	0,723	0,05	0,187	0,001	0,017	0,015
VK34	Sweden_Skara 135	Sweden	0,059	0,895	0	0	0,007	0,037	0,001
VK396	Sweden_Skara 166	Sweden	0,187	0,412	0,003	0,005	0	0,391	0,002
VK29	Sweden_Skara 17	Sweden	0,163	0,374	0,281	0,099	0,003	0,008	0,072
VK33	Sweden_Skara 175	Sweden	0,044	0,265	0,439	0,048	0,025	0,076	0,103
VK406	Sweden_Skara 203	Sweden	0,016	0,051	0,508	0,221	0,002	0,139	0,062
VK403	Sweden_Skara 217	Sweden	0,367	0,101	0,033	0,176	0,001	0,321	0,001
VK401	Sweden_Skara 229	Sweden	0,064	0,284	0,009	0,485	0,002	0,06	0,096
VK398	Sweden_Skara 231	Sweden	0,123	0,335	0,003	0,044	0,08	0,386	0,03

VK400	Sweden_ Skara 236	Sweden	0,186	0,004	0	0,715	0,008	0,075	0,012
VK397	Sweden_ Skara 237	Sweden	0	0,196	0,148	0	0,648	0,001	0,006
VK303	Sweden_ Skara 27	Sweden	0,134	0,179	0,261	0,256	0,015	0,153	0,003
VK395	Sweden_ Skara 275	Sweden	0	0	0,001	0	0,154	0	0,845
VK399	Sweden_ Skara 276	Sweden	0	0,055	0,692	0,069	0,061	0,071	0,053
VK404	Sweden_ Skara 277	Sweden	0,024	0,04	0,475	0,139	0,104	0,018	0,2
VK306	Sweden_ Skara 33	Sweden	0,018	0,464	0,359	0,017	0,005	0,036	0,1
VK402	Sweden_ Skara 38	Sweden	0,286	0,362	0,004	0,118	0,011	0,217	0,002
VK42	Sweden_ Skara 62	Sweden	0,235	0,533	0,002	0,03	0,002	0,197	0,001
VK405	Sweden_ Skara 83	Sweden	0,8	0,049	0,018	0,103	0,009	0,008	0,013
VK527	Sweden_ Uppsala_ UM36031 _621	Sweden	0,002	0,079	0,438	0,034	0,173	0,087	0,187
VK517	Sweden_ Uppsala_ UM36031 _623b	Sweden	0,014	0,009	0,322	0,054	0,055	0,157	0,39
VK256	UK_Dorse t-3722	England	0,321	0,324	0,008	0,244	0,007	0,095	0
VK257	UK_Dorse t-3723	England	0,33	0,032	0,003	0,346	0,028	0,146	0,116
VK258	UK_Dorse t-3733	England	0,625	0,126	0,052	0,147	0,001	0,035	0,015
VK259	UK_Dorse t-3734	England	0,48	0,011	0,003	0,313	0,02	0,063	0,11
VK260	UK_Dorse t-3735	England	0,258	0,221	0,08	0,094	0,009	0,322	0,016
VK261	UK_Dorse t-3736	England	0,354	0,321	0,005	0,039	0,026	0,246	0,009
VK262	UK_Dorse t-3739	England	0,305	0,246	0,054	0,151	0,017	0,183	0,043
VK263	UK_Dorse t-3742	England	0,355	0,056	0,036	0,383	0,051	0,1	0,019
VK264	UK_Dorse t-3744	England	0,117	0,267	0,146	0,244	0,01	0,21	0,006
VK449	UK_Dorse t-3746	England	0,378	0,246	0,103	0,231	0,027	0,011	0,004
VK145	UK_Oxfor d_sk 1783	England	0,003	0,455	0,031	0,039	0,112	0,122	0,237
VK146	UK_Oxfor d_sk 1785	England	0,221	0,145	0,058	0,034	0,026	0,509	0,007

VK147	UK_Oxford_sk 1864	England	0,096	0,483	0,074	0,176	0,068	0,087	0,015
VK150	UK_Oxford_sk 1866	England	0,256	0,342	0,001	0,092	0,006	0,302	0
VK165	UK_Oxford_sk 1876	England	0,003	0,88	0,065	0,024	0,003	0,023	0,002
VK166	UK_Oxford_sk 1891	England	0,235	0,268	0,082	0	0,003	0,32	0,092
VK167	UK_Oxford_sk 1898	England	0	0,661	0,151	0,106	0	0,036	0,044
VK168	UK_Oxford_sk 1899	England	0,014	0,524	0,267	0,027	0,005	0,158	0,005
VK143	UK_Oxford_sk 1951	England	0,124	0,672	0	0,095	0,022	0	0,087
VK151	UK_Oxford_sk 1963	England	0,001	0,453	0,269	0,107	0,003	0,16	0,009
VK172	UK_Oxford_sk 1968	England	0,179	0,008	0,024	0,763	0,009	0,004	0,012
VK173	UK_Oxford_sk 1978	England	0,333	0,512	0	0,002	0,01	0,135	0,008
VK174	UK_Oxford_sk 1984	England	0,005	0,172	0,614	0,008	0,079	0,109	0,013
VK176	UK_Oxford_sk 1990	England	0,003	0,441	0,216	0,238	0,034	0,014	0,054
VK175	UK_Oxford_sk 1996	England	0,003	0,475	0,312	0,002	0,081	0,005	0,122
VK177	UK_Oxford_sk 2056	England	0,277	0,356	0,009	0,023	0,008	0,325	0,003
VK178	UK_Oxford_sk 2057	England	0,326	0,495	0	0,001	0,028	0,146	0,003

Appendix 2: Grave analyses

Raw data of the Viking graves with artefact origins and some strontium origins

grave	country	X-coordinate	Y-coordinate	DNA	Strontium	artefacts	graveritual	kind of grave	sexe	age	source	description	Page	burial
1	England	53,5722088	-1,189055		Norway	Norway	inhumation	grave pit	female	45+	Speed et al, 2004		62,63,75	
2	England	54,763442	-3,333129			England	inhumation	barrow			Abramson, 2000		85	
3	England	52,839744	-1,485799			Norse	inhumation	barrow			Richards, 2004	charcoal remains	28-31	1
4	England	52,839744	-1,4858			Denmark	inhumation	barrow	female		Richards, 2004		34-36	6
5	England	52,839744	-1,485801			Norse	cremation	barrow			Richards, 2004		36-38	7
6	England	52,839744	-1,485802			Norse	cremation	barrow			Richards, 2004		42-45	11
7	England	52,839744	-1,485803			Anglo-Norse	cremation	barrow		18-45	Richards, 2004		54-68	50
8	England	52,839744	-1,485804			Norse	cremation	barrow		18-40	Richards, 2004		69-	56
9	England	54,35941	-4,52199			Norse	inhumation	barrow	male	20-25	Fell et al, 1983	wooden coffin or timber burial chamber, female sacrifice 20-30yo	16	Ballateare
10	England	54,379979	-4,433982			Norse	inhumation	cist			Fell et al, 1984	wooden grave chamber	16	Cronk Mooar
11	England	54,0875	-4,6979		Scandinavian	Norse	inhumation	boat burial	male		Fell et al, 1985	also female skeleton	16	Balladoole
12	England	54,173278	-4,75322297		Scandinavian	Norse	inhumation	grave pit	female		Symonds et al, 2014	could also be married to norse man	7-	Peel castle
13	Scotland	56,285238	-5,140311			Norse					Gordon, 1990		152	
14	Scotland	56,080997	-6,211768			Norse	inhumation	sand grave	male	40-52	Becket et al, 2013	stones covering or cairn. Infant bone cremated. No warrior, difficult to pinpoint origin	308	
15	Scotland	58,220249	-6,949535			Norse	inhumation	grave pit		6	Dunwell et al, 1995	infant	734	F
16	Scotland	58,220249	-6,949535			Norse	inhumation	grave pit	male	35-45	Dunwell et al, 1995	surrounding stones, small mound	731-739	C
17	Scotland	58,220249	-6,949535			Norse	inhumation	grave pit	male	40+	Dunwell et al, 1995	surrounding stones, small mound	731-739	D
18	Scotland	58,220249	-6,949535			Norse	inhumation	grave pit	female	35-45	Dunwell et al, 1995	surrounding stones, small mound	731-739	E
19	Scotland	58,569654	-4,762354			Sweden	inhumation	grave pit	male	8-13y	low et al, 1991	sand dune	25-	
20	Scotland	56,762241	-6,016884		Scandinavian	Norway	inhumation	boat burial			Harris et al, 2017		193-	
21	Scotland	56,059636	-6,229041			Norse	inhumation	cist			Ritchie, 1981	burial of dog suggests Norway	267-	
22	Ireland	53,343091	-6,322361			Norway	inhumation				Briggs, 1985		98-	
23	Ireland	53,511784	-10,134987			Hiberno-Norse	inhumation		male		sheehan, 1987		62-	
24	Ireland	53,355349	-6,329612			Norway	inhumation		female		hall, 1974		39-	
25	Ireland	53,318821	-6,232789			Hiberno-Norse	inhumation	barrow			hall, 1978		65-	
26	Ireland	53,345465	-6,313108		Scandinavian	Norway	inhumation		male		Sikora et al, 2011		170-	
27	Scotland	58,559309	-3,777394			Norway	inhumation	cist	male		Edwards, 1927		203-	
28	Norway	63,52273	11,121845			Ireland			female		Heen-Pettersen, 2014		6	Hoset
29	Norway	63,454112	10,944496			Ireland			female		Heen-Pettersen, 2014		6	Vaernes
30	Norway	63,724081	11,307006			Ireland			female		Heen-Pettersen, 2014		7	Halsan
31	Norway	64,245897	12,382557			Anglo-Norse			female		Heen-Pettersen, 2014		8	Nes
32	Norway	63,77248	9,582442			Anglo-Norse			female		Heen-Pettersen, 2014		9	Snasa
33	Norway	63,997711	11,483183			Hiberno-Norwegian	inhumation	boat burial	male		Heen-Pettersen, 2019	on top of older barrow	10,11	Lo
34	Norway	64,113377	11,546243			Hiberno-Norse	inhumation	cist	female		Heen-Pettersen, 2014		14-17	Skei
35	Norway	63,285264	10,278373			Ireland	inhumation	barrow	female and male		Heen-Pettersen, 2014	double burial	20-21	Melhus
36	Ukraine	51,473588	31,415704			Norse	cremation	barrow			Murasheva et al, 2021		1-	
37	Sweden	59,32221	17,56564			Finland	inhumation	chamber grave	male		Price et al, 2018		29	XI
38	Sweden	60,649197	17,168441			Finland	cremation	boat burial			Price et al, 2018		29	Hemlingby
39	Sweden	59,53221	17,557954		East-Scandinavia	Baltic	inhumation	chamber grave	female and male		Price et al, 2018	Double burial	29	644
40	Sweden	59,53221	17,557955		Denmark	Denmark	inhumation	chamber grave	female		Price et al, 2018		32	585
41	Sweden	59,53221	17,557956		North-East Scandinavia	Finland	inhumation	chamber grave	male		Price et al, 2018		36	496/855
42	Denmark	55,524268	10,385976		North-West Scandinavia		inhumation		female	35-45	Price et al, 2015		11	AMB
43	Denmark	55,524268	10,385976		North-West Scandinavia		inhumation		male	30	Price et al, 2015		11	UO
44	Denmark	55,524268	10,385976		North-West Scandinavia	Norway	inhumation		male	40-45	Price et al, 2015		6,11	TA
45	Denmark	55,524268	10,385976		Denmark		inhumation		female	40+	Price et al, 2015		9,1	SG
46	Denmark	55,524268	10,385976		Denmark		inhumation		female	50	Price et al, 2015		9,1	WG
47	Russia	57,532141	39,813542			Sweden	cremation	barrow			callmer, 1994		34-	Petrovskoe
48	Russia	57,783171	39,734577			Sweden	cremation	barrow			callmer, 1994		34-	Mikhailovskoe
49	Russia	57,715305	38,955123			Sweden	cremation	barrow			callmer, 1994		34-	bol'shoe
50	England	52,838559	-1,551328		Sweden						Budd et al, 2003		138	G529
51	England	52,838559	-1,551328		Anglo-Danish		inhumation		male		Budd et al, 2003	Childhood maybe in denmakr or lower countries	138	X70
52	England	52,838559	-1,551328		Anglo-Danish		inhumation		male		Budd et al, 2003	Childhood maybe in denmakr or lower countries	138	X23