

Analysis and comparison of ancient and Viking-era DNA

Introduction

This is an updated version of a previously published paper through the Gotland project regarding available ancient and Viking-era DNA and whether these haplogroups have been noted with members of the Gotland project. This was first intended to be a separate section in the update of the first paper "On the DNA of the Gotlanders", which was published within the project in November 2019. But since this document covered more than 30 pages, we decided to publish this as a separate paper, but to update it with new available information.

Since the project's first paper was released in November 2019, there have been many developments in this area. The most significant event is naturally the study "Population genomics of the Viking world"ⁱ, however there are also other studies that we have reviewed that indicate the presence of more haplogroups in mtDNA such as the study "The stone cist conundrum: A multidisciplinary approach to investigate Late Neolithic/Early Bronze Age population demography on the island of Gotland"ⁱⁱ from 2018. The number of members in the project has also increased and more members have taken the Mt Full Sequence analysis, which provides increased opportunities to analyse and follow the development of mtDNA and more members have done Y700, which enables us to track the paternal lines throughout history. Unfortunately, mtDNA is more difficult to analyse than yDNA. This implies some practical difficulties as there should preferably be access to both HVR1 and 2 as well as Coding Regions to be able to make a good comparison with sufficient confidence intervals to be able to draw any conclusions, and this is not always available in the historical DNA.

What foremost became apparent after the Viking study was published was that our theories, which we presented in our first paper, seemed to be supported. The study implied that the number of haplogroups increased for both yDNA and mtDNA. The study of the Viking age genome presents a large increase in the number of mtDNA haplogroups and we see many new haplogroups represented such as W, X and a number within H, I, J, K, HV etc. For the male population, there is an apparent shift at some point in the Stone Age / Bronze Age when the first haplogroups that arrived on Gotland at least decrease and new haplogroups make their now earliest known entrance on the Gotland stage as I-M253, R-M343, R-M240 and also N-M231, G- M201 and E-M215.

The previously noted male haplogroups seem to decrease significantly with the arrival of new groups, perhaps as violence and war made their way onto the scene during the Bronze Age. According to some researchers, the Bronze Age ended with "collapse and mass death"ⁱⁱⁱ and the world of violence seems to have arrived^{iv}. This must of course also have affected the women negatively, but they seem to have remained to a greater extent, which affected the amount of mtDNA haplogroups detected by the studies. We also know from German studies that the daughters were married off during the Bronze Age and left the childhood home^v. It may be that the daughters also travelled to Gotland and, possibly, this custom was more widespread in early Europe and not limited to the area that constitutes today's Germany, and in itself led to a spread in the female haplogroups while the male groups did not move in the same systematic way. But the slave trade has also implied an effect. When Gotland was a rich farmers' society during the Viking Age, many could certainly afford to have slaves. It was not only the Vikings who kept slaves, but this occurred at least from the Bronze Age onwards. These enslaved women were brought from different parts of Europe, and this could possibly provide at least a partial explanation for why there are more different mtDNA haplogroups than for yDNA. As the slaves were also sexually exploited by their owners and in many cases certainly had offspring, this also contributed to the genetic development. But let us look further at the updated results of the reviews that we have been able to perform thanks to the members of the project.

MtDNA

When did the women arrive in Gotland? The question may appear strange as the oldest human remains from Stora Förvar are dated from the Middle Stone Age and evidently the women were present on Gotland at that time. The question is however more rhetorical in nature and should not be interpreted literally but is based on the amount of mtDNA haplogroups that are represented in the historical material from Gotland

During our review and update of the historical results based on the material available, we realised that the material would need to have a better structure to better understand when the women arrived on Gotland based on the dating of historical Gotland finds. The results have been compiled in the table below.

Period		Year (BC /BCE, AD)	Comment	Haplogroups ^{vi}
Stone age	Old stone age (paleolithic)		No finds in Gotland	-
	Middle stone age (mesolithic)	Ca 9.500 – 4.000 BC ^{vii}	Stora Förvar, Stora Bjers	U4a1, U4a2, U5a1
	New stone age (neolithic)	Ca 4.000 – 1.700 BC ^{viii}	Ansarve (funnel beaker) Ajvide, Fridtorp, Ire, Västerbjers, Hemmor (pitted ware) Häffinds (hgb003, hgb008, hgb011 samt hgb006) Suderkvie (sud003) Utalskog (uta002)	U4, U4a2, U4b, U4d, U5, U5a, U5a1, U5a2, U5a1a, U5b, U5b1d, U5b1d2, U5b2a2, U5b2b1a, U5b2a1a1, HV0, HV0a, HV12, H7d, J1c5, J1c8a, K1a1, K1a2b, K1a3, K1a3a, K2b1a, V, T2b, T2b8, T2b11
Bronze age ^{ix}	Old bronze age	Ca 1.700 – 1.100 BC	Häffinds (hgb005, hgb007, hgb012, hgb010, hgb001, hgb013, hgb015, hgb014, hgb002) Hägur Suderkvie (sud001, sud002) Utalskog (uta001)	HV0a, T1a1, J1c7a, T2b5, U5a1c1, H2a5, H1a, U4a2, K1b2a, H1e1a
	Late bronze age	Ca 1.100 – 500 BC	No noted finds	-
Iron age ^x	Old iron age <ul style="list-style-type: none"> Pre-Roman iron age Roman iron age 	Ca 500 BC – 400 AD	No noted finds	-
	Late iron age <ul style="list-style-type: none"> Migration period Vendel period Viking age 	Ca 400-1100 AD Ca 400–550 AD Ca 550-750 AD Ca 750-1100 AD	Viking age (VK48, VK50, VK51, VK53, VK56, VK57, VK58, VK60, VK63, VK64,	HV9, HV9b H1, H1a, H1a1, H1b1+16362, H1b5,

Period		Year (BC /BCE, AD)	Comment	Haplogroups ^{vi}
			VK232, VK251, VK428, VK429, VK430, VK431, VK432, VK433, VK434, VK435, VK437, VK438, VK439, VK440, VK441, VK450, VK452, VK453, VK454, VK455, VK456, VK457, VK458, VK459, VK460, VK461, VK462, VK463, VK464, VK467, VK468, VK469, VK471, VK472, VK473, VK474, VK475, VK476, VK477, VK478, VK479	H1e1a, H1m, H1+16189, H2a1, H3ac, H5, H6a1a, H7b, H8c, H10e, H13a1a1b, H56, H70 I1a1, I1a1a3, I1a1e, I3, I4a1, I5a J1b1a1, J1c1b1a, J1c6, J1d K1a4a1a2b N1a1a1, N1a1a1a1 U4a2a, U5a2c1, U5b2a2, U5b1e1 T1a5a, T1a1b, T2b, T2b+152 V W3a1 X2+225

The oldest finds are still those from Stora Förvar. The haplogroups U4a1, U4a2 och U5a1 agrees with what have been noted in finds from Mesolithic Europe. But something happened when the ice had disappeared and more areas became habitable and we note that the number of mtDNA haplogroups increases. It is no longer just the daughters and grand-daughters of Ursula that call Gotland their home but also haplogroups like HV0, H, J, K, V och T is now present. Waves of settlers must have arrived in the interval between the Mesolithic and Neolithic period and continued through the Bronze age. The groups noted imply an immigration from the East. This continued during the late stone age (Neolithic period).

Haplogroup U is believed to have arisen in west Asia, but subgroup U4 probably arose in Eastern Europe about 40.000 years ago and can have evolved to U4a in the Baltics^{xi}. Haplogroup U4b is believed to have originated in the north-east Altai-region in Russia^{xii}. However, if the researchers believe to have identified where U π originated, its sister U5 is shrouded in mystery. The estimated age varies between 35- 50 000 years, but it probably arose in Europe as it was present there before the last glacial maximum^{xiii}. U5b1 probably originated in southern Europe or in Central Europe^{xiv}. U3 is also represented in the project. It is thought to have originated in the Middle East and/or have a Caucasian origin as U1^{xv}. Both groups are however rare in the present geographical vicinity^{xvi}.

Haplogroup HV is an ancient haplogroup that originated about 24,000 years ago, in western Asia, near the Caucasus. Although it is more often associated with the older Bronze Age, we can see that it was represented on Gotland already in the Stone Age and perhaps arrived during the same period as the other haplogroups. Exactly how it migrated to Gotland is however difficult to answer. It could have arrived via Eastern Europe or taken the detour through Central Europe.

Haplogroup H was not represented through the historical material and in our paper of November 2019 we asked ourselves what this was due to, whether it was that the haplogroup came later to Gotland or that it was due to the lack of finds. Haplogroup H originated about 20,000 years ago in Southeast Asia and is a mutation of HV^{xvii}. We now know that it was represented via Ansarve in the later stone age (Neolithic) on Gotland and that it further occurs during the Bronze Age. H7d, which was the mtDNA for the individual Ansarve 16, is one of the more frequent subgroups and occurs in the European Stone Age. It is however not clarified if the haplogroup occurred in the Early Stone Age in southern Europe or whether it arrived via the Middle East during the latter part of the period^{xviii}. During the older Bronze Age, we note representatives from both H1a, H1e and H2a in Hägür and Utalsskog. Both H1 and H2 are believed to have lived in Mesolithic Europe and the subgroup H1a, H1e and H2a are found throughout Europe.

Haplogroup I, despite it now being relatively rare in the geographical vicinity, was more common in Denmark during the Iron Age (around 1,200 BC to 550 AD) and the Viking Age (793–1066 AD). While competition from other groups probably caused it to decline, it is still located in Europe^{xix}. What this implies for Gotland, based on the island's special location and well-known trade routes, is not yet clarified. No individual has been determined to belong to mtDNA I in Paleolithic, Mesolithic or Neolithic Europe, but this was first noted in Catalonia around 3,500 to 3,000 years BC, before it began to occur more regularly during the Early Bronze Age^{xx}. This indicates that it arrived in Gotland at a later stage. We have noted it among tested individuals in the VK study but not in the prehistoric material, which may be an indication that this theory is correct.

Haplogroup J is also represented through J1c and subgroups via Ansarve but also during the Bronze Age via Häffinds. It arrived via the Middle East^{xxi}, but how it came to Gotland and the nearby geographical vicinity is the subject of discussion. Although it has been assumed that the haplogroup spread from southern Europe after the ice began to recede, researchers discuss whether J instead took refuge in the Middle East during the recent glacial maximum and spread to Europe from there^{xxii}. Subgroup J1c is today quite common among individuals originating in Europe and in the geographical vicinity. Immigration to Gotland, however, probably took place from southern Europe via tribes that migrated north when the ice melted and the areas became habitable.

Haplogroup K has been noted during the Neolithic. Although haplogroup K originated in western Asia and from there migrated to Europe, it is believed that K2b1 originated in Mesolithic Eastern Europe and then spread from there because K1a originated in the Middle East and spread with agriculture. It is interesting that K1a was noted through the Ire9 individual, dated to the Middle Stone Age, and see both K2b and K1a among the Ansarve individuals, a group classified as funnel beakers, as well as in the individual Visby 7 in the pitted ware-group. In the older Bronze Age, we see K1b in sud001. Haplogroup K thus has a long presence on Gotland.

Compared to November 2019, we now have members who have been sequenced as haplogroup K1 and in the subgroups. Although we have not seen any exact match against the historical material, we hope to see more K in future historical analyses on Gotland or in the geographical vicinity that throws more light on the migration to Gotland.

Haplogroup T also occurs in the historical material through T2b in individual Ire6 from the Middle Stone Age pitted ware-cultur, but also in the funnel beakers from Ansarve (Ansarve 3) and later during the

Bronze Age via individual hbg010 from Häffinds in Burs. It is also via Häffinds and the individual hbg012 that haplogroup T1 is noted. Haplogroup T originated about 29,000 years ago, probably in the eastern Mediterranean / Middle East. T1 and T2 probably both arose at the end of the ice age^{xxiii}. In historical finds from Europe, the haplotype has been noted in the Yamna culture^{xxiv}. Human remains from the Late Mesolithic period have been sequenced as T (probably T1a and sequenced as T2b), suggesting that it may be an ancient haplogroup in the geographically vicinity^{xxv}. The latest findings noted are that T1a and T2b came to Europe from Anatolia during the latter part of the ice age^{xxvi}. If these findings can be supported going forward, it could imply that these haplogroups are one of the earliest to reach Gotland when migration to the north started as the ice sheet melted.

Haplogrupp V also constitutes an old group on Gotland. The oldest to date, also the only listed member, is Ajvide52. Haplogroup V probably originated in the western Mediterranean, possibly the Iberian Peninsula, about 14,000 years ago. From there it spread from there all over Europe and occurs today in some places such as Scandinavia, where it is particularly associated with the Sami population. In historical finds in the geographical vicinity, the haplotype has been noted in Neolithic finds in Germany from about 5,000 years BC. The finds have stated as belonging to the corded ware-culture^{xxvii}.

The origin of **Haplogroup W** is not completely clarified. The haplogroup may have originated during the latter part of the ice age^{xxviii}. The first known ancient finds of haplogroup W are from Barcın and Çatal Höyük in Anatolia (modern day Turkey) on the edge of the fertile crescent in Neolithic times and date to about 8,000 years ago. In our paper from 2019, we wrote that, although there are no known historical finds from Gotland that have been determined to be W, we would expect the haplogroup to have existed on Gotland, as it is so associated with early European history. W has now been noted in the Viking Age finds.

For mtDNA, we have done two reviews. We have compared individuals belonging to the Viking-culture were buried on Gotland to members of the project and made an overall review of whether there are relationships with Vikings who were buried elsewhere. We start with the review of the Vikings to the members of the project. The result was as follows:

Individual	Place		Ancestry	Haplogroup	MTDNA-polymorphism (rCRS)	Haplogroup in project	Kit	MTDNA-polymorphism in kit (rCRS)	Common mutations (rCRS)	Shared mutations	Mutations in kit	Mutations vk individual
VK48	Gotland_Kopparsvik-212/65	Male	Unknown	H10e	263G 750G 1438G 4769G 8860G 14470A 15326G 16221T	Ja	442360	16093Y, 16221T, 16519C, 207A, 263G, 750G, 1438G, 3363T, 4769G, 8860G, 12636T, 14470A, 15326G	263G 750G 1438G 4769G 8860G 14470A 15326G 16221T	8	13	8
							MI27311	16093C, 16221T, 16519C, 263G, 309.2C, 750G, 1438G, 4769G, 8860G, 14470A, 15326G	263G 750G 1438G 4769G 8860G 14470A 15326G 16221T	8	11	8
VK50	Gotland_Kopparsvik-53.64	Male	Swedish/Finnish	H1+16189	263G 750G 1438G 3010A 4769G 8860G 15326G 16189C	Nej						
VK51	Gotland_Kopparsvik-88/64	Male	Finnish	U5b1e1	73G 150T 152C 263G 750G 1438G 2706G 2757G 3197C 4769G 5656G 7028T 7768G 8860G 9477A 10283G 11467G 11719A 12308G 12372A 12616C 13617C 14182C 14766T 15326G 16189C 16192T 16270T 16465T	Nej						
VK53	Gotland_Kopparsvik-161/65	Male	Polish/Finnish	HV9b	263G 750G 1438G 2706G 4769G 7028T 8860G 8994A 15326G 16249C 16311C	Nej						
VK56	Gotland_Frojel-001A98	Female	Finnish	H6a1a	239C 263G 750G 1438G 3915A 4727G 4769G 8860G 9380A 11253C 15326G 16362C 16482G	Ja	417454	16362C, 16482G, 239C, 263G, 750G, 1438G, 3915A, 4727G, 4769G, 8860G, 9380A, 11253C, 11860T, 15326G	239C, 263G, 750G, 1438G, 3915A, 4727G, 4769G, 8860G, 9380A, 11253C, 11860T, 15326G, 16362C, 16482G	13	14	13
							IN39258	16129A, 16362C, 16482G, 239C, 263G	239C, 263G, 16362C, 16482G	4	5	13
							MI34566	16362C, 16482G, 16519C, 239C, 263G, 750G, 1438G, 3915A, 4727G, 4769G, 7775A, 8860G, 9380A, 11253C, 15326G	239C, 263G, 750G, 1438G, 3915A, 4727G, 4769G, 8860G, 9380A, 11253C, 15326G, 16362C, 16482G	13	15	13
VK57	Gotland_Frojel-03601	Male	Unknown	J1c6	73G 185A 228A 263G 295T 462T 489C 750G 1438G 2706G 3010A 4025T 4216C 4769G 7028T 8860G 10398G 11251G 11719A 12612G 13708A 14766T 14798C 15326G 15452A 16069T 16126C	Nej						
VK58	Gotland_Frojel-03604	Female	Brittish/Danish	I4a1	73G 199C 204C 250C 263G 750G 1438G 1719A 2706G 4529T 4769G 7028T 8251A 8519A 8860G 10034C 10238C 10398G 10819G 11719A 12501A 12705T 13780G 14766T 15043A 15326G 15924G 16129A 16223T 16304C 16391A	Nej						
VK60	Gotland_Frojel-00702	Male	Polish/Finnish	H13a1a1b	263G 750G 1438G 2259T 4745G 4769G 7337A 8860G 13326C 13680T 14727C 14872T 15326G	Nej						

Individual	Place		Ancestry	Haplogroup	MtDNA-polymorphism (rCRS)	Haplogroup in project	Kit	MtDNA-polymorphism in kit (rCRS)	Common mutations (rCRS)	Shared mutations	Mutations in kit	Mutations vk individual
VK63	Gotland_Frojel-01499	Female	Unknown	H56	263G 750G 1438G 4769G 8860G 11788T 15326G	Ja	480941	16172C, 263G, 750G, 1438G, 4769G, 8674R, 8860G, 11788T, 15326G	263G 750G 1438G 4769G 8860G 11788T 15326G	7	9	7
							MI16573	263G, 750G, 1438G, 4769G, 8860G, 10907C, 11788T, 15326G	263G 750G 1438G 4769G 8860G 11788T 15326G	7	8	7
VK64	Gotland_Frojel-03504	Male	Brittish/Polish/ Finnish	I1a1	73G 199C 203A 204C 250C 263G 750G 1438G 1719A 2706G 3447G 3990T 4529T 4769G 6734A 7028T 8251A 8616T 8860G 9947A 9966A 10034C 10238C 10398G 10915C 11719A 12501A 12705T 13780G 14766T 15043A 15326G 15924G 16129A 16172C 16223T 16311C 16391A	Nej						
VK232	Gotland_Kopparsvik-240.65	Male	Unknown	N1a1a1	73G 199C 204C 263G 669C 750G 1438G 1719A 2702A 2706G 3336C 4769G 5315G 7028T 8860G 8901G 10238C 10398G 11719A 12501A 12705T 13780G 14766T 15043A 15326G 16172C 16223T 16248T 16355T	Nej				Kit 286067, IN89170 can be downstreams		
VK251	Gotland_Kopparsvik-30.64	Male	Unknown	U5b1e1	73G 150T 152C 263G 750G 1438G 2706G 2757G 3197C 5656G 7028T 7768G 8860G 9477A 10283G 11467G 11719A 12308G 12372A 12616C 13617C 14182C 14766T 15326G 16192T 16270T 16465T	Nej						
VK428	Gotland_Frojel-00287	Female	Unknown	K1a4a1a2b	73G 146C 263G 497T 750G 1189C 1438G 1811G 2706G 3480G 4295G 4769G 6260A 7028T 8860G 9055A 9698C 10398G 10550G 11299C 11467G 11485C 11719A 11840T 12308G 12372A 13401C 13740C 14167T 14766T 14798C 15326G 15884A 16224C 16245T 16311C	Nej						
VK429	Gotland_Frojel-01599	Female	Italian/Danish	H70	263G 750G 1438G 4769G 8860G 9033G 15326G	Nej						
VK430	Gotland_Frojel-00502	Male	Unknown	T1a1b	152C 195C 263G 709A 750G 1438G 1888A 2706G 4216C 4769G 4917G 7028T 8697A 8860G 9899C 10143A 10463C 11251G 11719A 12633A 13368A 14281T 14905A 15326G 15452A 15607G 15928A 16126C 16186T 16189C 16294T	Ja	IN75940	16126C, 16163G, 16186T, 16189C, 16294T, 16519C, 73G, 152C, 195C, 263G, 709A, 750G, 1438G, 1888A, 2706G, 4216C, 4769G, 4917G, 7028T, 8697A, 8860G, 9899C, 10143A, 10463C, 11251G, 11719A, 12633A, 13368A, 14281T, 14905A, 15326G, 15452A, 15607G, 15928A, 16126C, 16186T, 16189C, 16294T	152C 195C 263G 709A 750G 1438G 1888A 2706G 4216C 4769G 4917G 7028T 8697A 8860G 9899C 10143A 10463C 11251G 11719A 12633A 13368A 14281T 14905A 15326G 15452A 15607G 15928A 16126C 16186T 16189C 16294T	28	35	28
VK431	Gotland_Frojel-00487A	Male	Unknown	H2a1	263G 750G 951A 8860G 15326G 16354T	Ja	IN95287	16354T, 263G, 750G, 951A, 1772G, 5447T, 8860G, 15326G	263G 750G 951A 8860G 15326G 16354T	6	8	6

Individual	Place		Ancestry	Haplogroup	MtDNA-polymorphism (rCRS)	Haplogroup in project	Kit	MtDNA-polymorphism in kit (rCRS)	Common mutations (rCRS)	Shared mutations	Mutations in kit	Mutations vk individual
VK432	Gotland_Frojel-00303	Female	Unknown	J1b1a1	73G 242T 263G 295T 462T 489C 750G 1438G 2158C 2706G 3010A 4216C 4769G 5460A 7028T 8269A 8557A 8860G 10398G 11251G 11719A 12007A 12612G 13708A 13879C 14766T 15326G 15452A 16069T 16126C 16145A 16172C 16222T 16261T	Ja	552281	16069T, 16126C, 16145A, 16172C, 16222T, 16261T, 73G, 242T, 263G, 295T, 315.1C, 462T, 489C	73G 242T 263G 295T 462T 489C, 16069T, 16126C, 16145A, 16172C, 16222T, 16261T	12	12	34
VK433	Gotland_Frojel-01798	Female	Italian/Danish	H5	263G 456T 750G 1438G 4769G 8860G 15326G 16304C	Nej						
VK434	Gotland_Frojel-01288	Female	Unknown	U5b2a2	73G 150T 263G 750G 1438G 1721T 2706G 3197C 3212T 4732G 4769G 7028T 7768G 8860G 9477A 11467G 11719A 12308G 12372A 13617C 13637G 14182C 14766T 15326G 16189C 16270T 16398A	Nej						
VK435	Gotland_Frojel-02500	Female	Unknown	T1a5a	73G 263G 709A 750G 1438G 1888A 2706G 4216C 4769G 4917G 5378G 6152C 7028T 8697A 8860G 10463C 11251G 11719A 12406A 12633A 13368A 14766T 14905A 15326G 15452A 15607G 15928A 16126C 16163G 16186T 16189C 16218T 16294T	Nej						
VK437	Gotland_Frojel-02303	Female	Unknown	V	72C 263G 750G 1438G 2706G 4580A 4769G 7028T 8860G 15326G 15904T 16298C		468399	72C, 263G, 750G, 1438G, 2706G, 4580A, 4769G, 6773T, 7028T, 8860G, 15326G, 15904T, 16093C, 16188T, 16298C	72C 263G 750G 1438G 2706G 4580A 4769G 7028T 8860G 15326G 15904T 16298C	12	15	12
							490773	72C, 263G, 16298C	72C, 263G, 16298C	2	3	12
							676542	72C, 263G, 16298C	72C, 263G, 16298C	3	3	12
							B59462	72C, 263G, 16298C	72C, 263G, 16298C	3	3	12
							BP10337	72C, 263G, 750G, 1438G, 2706G, 4580A, 4769G, 6722A, 7028T, 8860G, 15326G, 15904T, 16298C	72C 263G 750G 1438G 2706G 4580A 4769G 7028T 8860G 15326G 15904T 16298C	12	13	12
VK438	Gotland_Frojel-04498	Male	Unknown	H1	263G 750G 1438G 3010A 4769G 8860G 15326G	Nej				Kit 519100 och 764844 kan vara nedströms		
VK439	Gotland_Frojel-02498	Female	Unknown	U4a2a	73G 195C 263G 310C 499A 750G 1438G 1811G 2706G 4646C 4769G 5999C 6047G 7028T 8818T 8860G 11332T 11467G 11719A 12308G 12372A 14620T 14766T 15326G 15693C 16356C!	Nej						
VK440	Gotland_Frojel-003A88	Female	Unknown	T2b+152	73G 152C 263G 709A 750G 930A 1438G 1888A 2706G 4216C 4769G 4917G 5147A 7028T 8697A 8860G 10463C 11251G 11719A 11812G 13368A 14233G 14766T 14905A 15326G 15452A 15607G 15928A 16126C 16294T 16296T 16304C	Nej						

Individual	Place		Ancestry	Haplogroup	MtDNA-polymorphism (rCRS)	Haplogroup in project	Kit	MtDNA-polymorphism in kit (rCRS)	Common mutations (rCRS)	Shared mutations	Mutations in kit	Mutations vk individual	
VK441	Gotland_Frojel-032A98	Female	Unknown	J1c1b1a	73G 185A 263G 295T 462T 482C 489C 750G 1438G 2706G 3010A 3394C 4216C 4769G 5773A 7028T 7184G 8860G 10398G 10463C 11251G 11719A 12612G 13708A 14766T 14798C 15326G 15452A 16069T 16126C	Nej							
VK450	Gotland_Kopparsvik-35	Female	Unknown	J1c1b1a	73G 185A 228A 263G 295T 462T 482C 489C 750G 1438G 2706G 3010A 3394C 4216C 4769G 5773A 7028T 7184G 8860G 10398G 10463C 11251G 11719A 12612G 13708A 14766T 14798C 15326G 15452A 16069T 16126C	Nej							
VK452	Gotland_Kopparsvik-111	Male	Unknown	T2b	73G 263G 709A 750G 930A 1438G 1888A 2706G 4216C 4769G 4917G 5147A 7028T 8697A 8860G 10463C 11251G 11719A 11812G 13368A 14233G 14766T 14905A 15326G 15452A 15607G 15928A 16126C 16304C	Ja	374590	73G, 263G, 709A, 750G, 930A, 1438G, 1888A, 2706G, 4216C, 4769G, 4917G, 5147A, 7028T, 8697A, 8860G, 10463C, 11013T, 11251G, 11719A, 11812G, 13368A, 14233G, 14766T, 14905A, 15326G, 15452A, 15607G, 15885T, 15928A, 16126C, 16294T, 16296T, 16304C	73G 263G 709A 750G 930A 1438G 1888A 2706G 4216C 4769G 4917G 5147A 7028T 8697A 8860G 10463C 11251G 11719A 11812G 13368A 14233G 14766T 14905A 15326G 15452A 15607G 15928A 16126C 16304C	29	33	29	
							495172	73G, 263G, 709A, 750G, 930A, 1438G, 1888A, 2706G, 4216C, 4769G, 4917G, 5147A, 7028T, 8020A, 8697A, 8860G, 9861C, 10463C, 11251G, 11719A, 11812G, 13368A, 13967T, 14233G, 14766T, 14905A, 15326G, 15452A, 15607G, 15928A, 16126C, 16294T, 16296T, 16304C	73G 263G 709A 750G 930A 1438G 1888A 2706G 4216C 4769G 4917G 5147A 7028T 8697A 8860G 10463C 11251G 11719A 11812G 13368A 14233G 14766T 14905A 15326G 15452A 15607G 15928A 16126C 16304C	29	34	29	
							IN43744	73G, 263G, 709A, 750G, 930A, 1438G, 1888A, 2706G, 4216C, 4769G, 4917G, 5147A, 7028T, 8697A, 8860G, 10463C, 11251G, 11719A, 11812G, 13368A, 14233G, 14766T, 14905A, 15326G, 15452A, 15607G, 15928A, 16126C, 16294T, 16296T, 16304C	73G 263G 709A 750G 930A 1438G 1888A 2706G 4216C 4769G 4917G 5147A 7028T 8697A 8860G 10463C 11251G 11719A 11812G 13368A 14233G 14766T 14905A 15326G 15452A 15607G 15928A 16126C 16304C	29	31	29	
							MI22827	73G, 263G, 709A, 750G, 930A, 1438G, 1888A, 2706G, 4216C, 4769G, 4917G, 5147A, 7028T, 8020A, 8697A, 8860G, 9861C, 10463C, 11251G, 11719A, 11812G, 13368A, 13967T, 14233G, 14766T, 14905A, 15326G, 15452A, 15607G, 15928A, 16126C, 16294T, 16296T, 16304C	73G 263G 709A 750G 930A 1438G 1888A 2706G 4216C 4769G 4917G 5147A 7028T 8697A 8860G 10463C 11251G 11719A 11812G 13368A 14233G 14766T 14905A 15326G 15452A 15607G 15928A 16126C 16304C	29	34	29	
							IN46626	73G, 263G, 356.1C, 16126C, 16294T, 16296T, 16304C,	73G, 263G, 16126C, 16304C,		4	7	29
VK453	Gotland_Kopparsvik-134	Male	Unknown	H8c	146C 152C 195C 263G 709A 750G 1438G 4769G 8860G 13101C 13711A 15326G 16288C 16362C	Nej							
VK454	Gotland_Kopparsvik-140	Female	Unknown	HV9	263G 750G 1438G 2706G 4769G 7028T 8860G 8994A 15326G 16311C	Nej							
VK455	Gotland_Frojel-03401	Female	Danish/Norwegian	U5a2c1	73G 263G 750G 1438G 2706G 3197C 4769G 7028T 8860G 9469T 9477A 10619T 11467G 11719A 12308G 12372A 13617C 14766T 14793G 15326G 16192T 16256T 16270T 16526A	Nej							
VK456	Gotland_Frojel-02404	Female	Brittish	I1a1e	73G 199C 203A 204C 250C 263G 750G 1438G 1719A 2706G 3447G 3990T 4529T 4769G 6734A 7028T 8251A 8616T 8860G 9947A 9966A 10034C 10238C 10398G 10915C 11719A 12501A 12705T 13404C 13780G 14766T 15043A 15326G 15924G 16129A 16172C 16223T 16311C 16391A	Nej							

Individual	Place		Ancestry	Haplogroup	MtDNA-polymorphism (rCRS)	Haplogroup in project	Kit	MtDNA-polymorphism in kit (rCRS)	Common mutations (rCRS)	Shared mutations	Mutations in kit	Mutations vk individual
VK457	Gotland_Frojel-03299_1	Female	Unknown	I5a	73G 199C 204C 250C 263G 750G 1438G 1719A 2706G 4529T 4769G 5074C 7028T 8251A 10034C 10238C 10398G 11719A 12501A 12705T 13780G 14233G 14766T 15043A 15326G 15924G 16129A 16148T 16223T 16391A	Nej						
VK458	Gotland_Frojel-03299_3	Female	Unknown	I1a1a3	73G 199C 250C 263G 750G 1438G 1719A 2706G 3447G 3990T 4529T 4769G 6734A 7028T 8251A 8616T 8860G 9053A 9947A 9966A 10034C 10238C 10398G 10915C 11719A 12501A 12705T 13780G 14766T 15043A 15326G 15924G 16129A 16172C 16223T 16311C 16319A 16391A	Nej						
VK459	Gotland_Frojel-02198	Female	Unknown	W3a1	73G 207A 263G 709A 750G 1243C 1406C 1438G 2706G 3505G 4769G 5046A 5460A 7028T 8251A 8860G 8994A 11674T 11719A 11947G 12414C 12705T 13263G 14766T 15326G 15784C 15884C 16223T 16292T	Nej						
VK460	Gotland_Frojel-04898	Female	Unknown	I3	73G 152C 239C 250C 263G 750G 1438G 1719A 2706G 4529T 4769G 7028T 8251A 8860G 10034C 10238C 10398G 11719A 12501A 12705T 13780G 14766T 15043A 15326G 15924G 16129A 16223T 16391A	Nej				Kit 449791 and 653385 can be downstreams		
VK461	Gotland_Frojel-025A89	Male	Unknown	H7b	263G 750G 1438G 4769G 4793G 5348T 8860G 15326G	Nej						
VK462	Gotland_Frojel-025B89	Female	Unknown	H1e1a	263G 750G 1438G 3010A 4769G 5460A 8512G 8860G 14902T 15326G	Nej						
VK463	Gotland_Frojel-019A89	Male	Unknown	H1b5	263G 750G 1438G 3010A 4769G 8860G 12130C 15326G 16189C 16356C	Nej						
VK464	Gotland_Frojel-019B89	Female	Unknown	H1	263G 750G 1438G 3010A 4769G 8860G 15326G	Nej						
VK467	Gotland_Kopparsvik-181	Male	Unknown	H1a	73G 263G 750G 1438G 3010A 4769G 8860G 15326G 16162G	Ja	519100	73G, 263G, 16162G,	73G, 263G, 16162G	3	3	9
							764844	73G, 263G, 50G, 1438G, 3010A, 4769G, 7755C, 8860G, 11257T, 13926C, 15326G, 16162G	73G 263G 750G 1438G 3010A 4769G 8860G 15326G 16162G	9	12	9
VK468	Gotland_Kopparsvik-235	Male	Danish/Italian	H1a1	73G 263G 750G 1438G 3010A 4769G 6365C 8860G 15326G 16162G 16209C	Ja	N136887	73G, 263G, 315.1C, 16162G, 16209C, 16519C	73G, 263G, 16162G, 16209C	4	11	11
VK469	Gotland_Kopparsvik-260	Male	Unknown	H3ac	263G 750G 1438G 4769G 6266G 6776C 8860G 15326G	Nej						
VK471	Gotland_Kopparsvik-63	Male	Unknown	H1m	263G 750G 1438G 3010A 4769G 8860G 15323A 15326G	Nej						
VK472	Gotland_Kopparsvik-112	Female	Unknown	H13a1a1b	263G 750G 1438G 2259T 4745G 4769G 7337A 8860G 13326C 13680T 14727C 14872T 15326G	Nej						

Individual	Place		Ancestry	Haplogroup	MTDNA-polymorphism (rCRS)	Haplogroup in project	Kit	MTDNA-polymorphism in kit (rCRS)	Common mutations (rCRS)	Shared mutations	Mutations in kit	Mutations vk individual
VK473	Gotland_Kopparsvik-126	Male	Danish/Polish	N1a1a1a1	73G 152C 199C 204C 263G 669C 750G 1438G 1719A 2702A 2706G 3336C 4769G 5315G 7028T 8164T 8860G 8901G 9300A 10238C 10398G 11719A 12501A 12705T 13780G 14766T 15043A 15326G 16172C 16223T 16248T 16320T 16355T	Ja	IN89170	16147A, 16171G, 16172C, 16223T, 16248T, 16320T, 16355T, 16519C, 55C, 57C, 73G, 152C, 199C, 204C, 263G, 573.1C, 573.2C, 573.3C, 573.4C, 669C, 750G, 1438G, 1719A, 2706G, 3336C, 4769G, 5315G, 7028T, 8164T, 8860G, 8901G, 9300A, 10238C, 10398G, 11719A, 12501A, 12705T, 13780G, 14766T, 15043A, 15326G, 15924G	73G 152C 199C 204C 263G 669C 750G 1438G 1719A 2706G 3336C 4769G 5315G 7028T 8164T 8860G 8901G 9300A 10238C 10398G 11719A 12501A 12705T 13780G 14766T 15043A 15326G 16172C 16223T 16248T 16320T 16355T	32	43	32
							MI19590	6147A, 16172C, 16223T, 16248T, 16320T, 16327T, 16355T, 73G, 150T, 152C, 199C, 204C, 263G, 573.1C, 573.2C	73G 152C 199C 204C 263G 16172C 16223T 16248T 16320T 16355T	10	15	33
VK474	Gotland_Kopparsvik-137	Male	Polish	J1d	73G 263G 295T 462T 489C 750G 1438G 2706G 3010A 4216C 4769G 7028T 7789A 7963G 8860G 10398G 11251G 11719A 12612G 13708A 14766T 15326G 15452A 16069T 16126C	Nej						
VK475	Gotland_Kopparsvik-187	Male	Polish	H1a	73G 263G 750G 1438G 3010A 4769G 8860G 15326G 16162G	Ja	519100	73G, 263G, 16162G,	73G, 263G, 16162G	3	3	9
							764844	73G, 263G, 50G, 1438G, 3010A, 4769G, 7755C, 8860G, 11257T, 13926C, 15326G, 16162G	73G 263G 750G 1438G 3010A 4769G 8860G 15326G 16162G	9	12	9
VK476	Gotland_Kopparsvik-225	Female	Unknown	X2+225	73G 153G 195C 225A 263G 750G 1438G 1719A 2706G 4769G 6221C 6371T 7028T 8860G 11719A 12705T 13966G 14470C 14766T 15326G 16189C 16223T 16278T	Nej						
VK477	Gotland_Kopparsvik-228	Female	Danish/Italian	H1b1+16362	263G 750G 1438G 3010A 3796G 4769G 8860G 15326G 16189C 16356C 16362C	Ja	772987	263G, 523-, 750G, 1438G, 2772T, 3010A, 3796G, 4769G, 6932G, 8860G, 15326G, 16189C, 16356C, 16362C		11	14	11
VK478	Gotland_Kopparsvik-271	Female	Polish/Finnish	H1m	263G 750G 1438G 3010A 4769G 8860G 15323A 15326G	Nej						
VK479	Gotland_Kopparsvik-272	Male	Brittish/Danish	H1a1	73G 263G 750G 1438G 3010A 4769G 6365C 8860G 15326G 16162G 16209C	Ja	N136887	73G, 263G, 16162G, 16209C	73G, 263G, 16162G, 16209C	4	4	11

In addition to the Vikings who were buried on Gotland, we have also performed an overall review of whether there are relationships with Vikings who were buried elsewhere. We have partly done this by searching through the haplogroups that are listed to see if the same haplogroup is listed for a Viking buried on Gotland is listed for a Viking buried elsewhere. The result of this was as follows:

Individual	Location	Biological gender	Mt-DNA	Match mtDNA
VK48	Gotland_Kopparsvik-212/65	Male	H10e	VK510 and VK552 from Estonia matched
VK50	Gotland_Kopparsvik-53.64	Male	H1+16189	No match noted
VK51	Gotland_Kopparsvik-88/64	Male	U5b1e1	VK196 from Grönland matched.
VK53	Gotland_Kopparsvik-161/65	Male	HV9b	VK170 from Isle of Man matched.
VK56	Gotland_Frojel-001A98	Female	H6a1a	Match to VK148, VK414, VK415, VK484, VK491 and VK516
VK57	Gotland_Frojel-03601	Male	J1c6	No match noted
VK58	Gotland_Frojel-03604	Female	I4a1	No match noted
VK60	Gotland_Frojel-00702	Male	H13a1a1b	Match to VK472 on Gotland, no other match noted.
VK63	Gotland_Frojel-01499	Female	H56	No match noted
VK64	Gotland_Frojel-03504	Male	I1a1	Match noted to VK290 from Denmark and VK523 from Norway
VK232	Gotland_Kopparsvik-240.65	Male	N1a1a1	No match noted
VK251	Gotland_Kopparsvik-30.64	Male	U5b1e1	VK196 from Greenland matched.
VK428	Gotland_Frojel-00287	Female	K1a4a1a2b	Match to VK403 from Skara (Sweden).
VK429	Gotland_Frojel-01599	Female	H70	No match noted
VK430	Gotland_Frojel-00502	Male	T1a1b	Match to VK315 from Denmark
VK431	Gotland_Frojel-00487A	Male	H2a1	Match to VK182 from Greenland VK342 and VK354 from Öland (Sweden)
VK432	Gotland_Frojel-00303	Female	J1b1a1	Match to VK15 from Russia, VK208 from Orkney, VK367 from Denmark, VK386 from Norway and VK397 from Skara.
VK433	Gotland_Frojel-01798	Female	H5	Match to VK46 and VK239 from the Faroe islands and VK218 from Russia
VK434	Gotland_Frojel-01288	Female	U5b2a2	No match noted
VK435	Gotland_Frojel-02500	Female	T1a5a	No match noted
VK437	Gotland_Frojel-02303	Female	V	VK437 match to VK266 from Sweden, VK537 from Italy, VK539 and VK540 from the Ukraine, VK547 from Norway and VK550 from Estonia.
VK438	Gotland_Frojel-04498	Male	H1	VK438 and VK464 match to VK213 from Denmark and VK534 from Italy.
VK439	Gotland_Frojel-02498	Female	U4a2a	Match to VK486 from Estonia
VK440	Gotland_Frojel-003A88	Female	T2b+152	Match to VK274 from Denmark.
VK441	Gotland_Frojel-032A98	Female	J1c1b1a	Only match to VK450.
VK450	Gotland_Kopparsvik-35	Female	J1c1b1a	Se above for VK441
VK452	Gotland_Kopparsvik-111	Male	T2b	Match to VK22 and VK161 from Russia, VK287 from Denmark and VK389 from Norway.
VK453	Gotland_Kopparsvik-134	Male	H8c	No match noted

Individual	Location	Biological gender	Mt-DNA	Match mtDNA
VK454	Gotland_Kopparsvik-140	Female	HV9	No match noted
VK455	Gotland_Frojel-03401	Female	U5a2c1	No match noted
VK456	Gotland_Frojel-02404	Female	I1a1e	Match to VK172 from the UK.
VK457	Gotland_Frojel-03299_1	Female	I5a	No match noted
VK458	Gotland_Frojel-03299_3	Female	I1a1a3	No match noted
VK459	Gotland_Frojel-02198	Female	W3a1	Match to VK338 from Denmark
VK460	Gotland_Frojel-04898	Female	I3	Match to VK391 from Norway.
VK461	Gotland_Frojel-025A89	Male	H7b	Match to VK417 from Norway
VK462	Gotland_Frojel-025B89	Female	H1e1a	Match to VK260 from the UK, VK269 from Sweden and VK253 from Öland (Sweden).
VK463	Gotland_Frojel-019A89	Male	H1b5	Match to VK492 from Estonia.
VK464	Gotland_Frojel-019B89	Female	H1	See above for VK438.
VK467	Gotland_Kopparsvik-181	Male	H1a	Match between VK467 and VK475 from Gotland to VK369 from Denmark and VK482 and VK496 from Estonia.
VK468	Gotland_Kopparsvik-235	Male	H1a1	Match between VK468 and VK479 from Gotland to VK149 and VK175 from the UK as well as VK371 and VK411 from Denmark.
VK469	Gotland_Kopparsvik-260	Male	H3ac	No match noted
VK471	Gotland_Kopparsvik-63	Male	H1m	Match between VK471 and VK478 from Gotland to VK204 from Orkney islands.
VK472	Gotland_Kopparsvik-112	Female	H13a1a1b	Match to VK60 from Gotland.
VK473	Gotland_Kopparsvik-126	Male	N1a1a1a1	No match noted
VK474	Gotland_Kopparsvik-137	Male	J1d	No match noted
VK475	Gotland_Kopparsvik-187	Male	H1a	Se VK467 ovan.
VK476	Gotland_Kopparsvik-225	Female	X2+225	No match noted
VK477	Gotland_Kopparsvik-228	Female	H1b1+16362	Match to VK398 from Skara.
VK478	Gotland_Kopparsvik-271	Female	H1m	See VK471 above.
VK479	Gotland_Kopparsvik-272	Male	H1a1	See VK468 above.

Some comments to the above table with regards to mtDNA are as follows:

- VK48 matches against VK510 and VK552. VK552 and VK48 have the same polymorphism as VK510 has an additional polymorphism. As the complete HVR1, HVR2 and coding region are not available, it is not possible to determine if there is a closer relationship or not. There is no determination of the lineage for VK48 and VK510 is mainly of Swedish descent while VK552 is mainly Danish and then Swedish / Norwegian. If this indicates that they were related at a longer distance is difficult to determine as this may be based on the parents' lineage. Kits 442360 and MI27311 have H10e and by comparison it has been noted that kit MI27311 shares the polymorphism 16093C with VK510 which is not noted in the analysis for VK48 or VK552. As there is no total agreement, the probability of a closer relationship is not high.
- There is no noted match for VK50.

- VK51 and VK251 match to VK196 from Greenland. There are however more than two polymorphisms that separates them and thus they are most likely not close relatives. VK51 is stated to be mainly of Finnish descent. The descent for VK196 is not known. The haplogroup is not represented in the Gotland project.
- VK53 match VK170 från Isle of Man. However, if the polymorphisms available are the same for the individuals, we do not have the complete HVR1, HVR2 and coding region it is not sufficient to determine if there is a closer relationship. VK170 is stated mostly be of Norwegian descent and then Swedish and some Danish, while VK51 is stated to be mostly Polish and Finnish. HV9b is not represented in the Gotland project.
- A number of individuals (VK148, VK414, VK415, VK484, VK491 och VK516) matched VK56 and is sequenced as H6a1a. There is a significant geographical spread as VK148 were found in the UK, VK414, VK415 and VK516 came from Norway and VK484 and VK491 were located in Estonia. Kit 417454, IN39258 and MI34566 are all in the same haplogroup. The polymorphisms available were the same for all three individuals but for VK148. Through a comparison between the individuals noted above and the kit with the same haplogroup we noted that polymorphisms for the individuals could be matched to those of the aforementioned kits. As we did not have availability of the coding region for kit IN39258 and when the full set of polymorphisms were not available for the Viking individuals, we cannot determine how close the kinship is. There is a kinship but if this arose during the Viking age or earlier cannot be determined.
- VK63 is the only individual noted in their haplogroup but H56 is represented in the project by kit 480941 and MI16573. It is not likely that kit 480941 and MI16573 has a close kinship based on the differences in the polymorphisms. There are similarities to VK63 in both kits but there are also polymorphisms available that cannot be noted for VK63, which reduces the likelihood of a closer relationship.
- VK64 in I1a1 match to VK290 from Denmark and VK523 from Norway. It is probable that there was a closer kinship between the individuals as all noted polymorphisms matched. The haplogroup I1a1 has not been noted through the Gotland project.
- VK428 in haplogrupp K1a4a1a2b match to VK403 from Skara (Sweden). It is likely that there was a closer kinship as all noted polymorphisms matched. The haplogroup is not represented in the Gotland project.
- VK430 in T1a1b match to VK315 from Denmark. The kinship is however probably quite distanced as not all polymorphisms agree. The haplogroup is represented through kit IN75940 aall polymorphisms for VK430, however kit IN75940 has more polymorphisms than VK430. The member does not have any known connection to Gotland but are of an Egyptian descent, however the mtDNA clearly indicates an origin from the British Isles and Scandinavia. This could regard a woman with an origin on the British Isles, either sold as a slave or possibly married to Vikings from the geographical vicinity whose female descendants have then migrated to southern Europe and onwards. There may be a relationship to VK430 as all polymorphisms for VK430 match, however we do not know which polymorphisms that may have originated after the Viking age or if the polymorphisms in kit IN75940 that are not noted in VK430 implies that the relationship is distant.
- VK431 match to VK182 from Greenland and VK342 as well as VK354 from Öland (Sweden). All polymorphisms are not available, which implies that there is not possible to conclude on the closeness of the kinship, however all available polymorphisms matches. H2a1 is noted in the Gotland Project through kit IN95287. All polymorphisms for VK431 is noted in this member, but also two additional polymorphisms. This implies that it is not possible to determine if there is a closer kinship or not.

- There is a number of individuals sequenced as haplogroup J1b1a1 besides VK432 from Gotland. These are VK15 from Russia, VK208 from the Orkney islands, VK367 from Denmark, VK386 from Norway and VK397 from Skara (Sweden). For VK208 one polymorphism was missing, otherwise the individuals displayed an exact match. This indicates that the kinship is not close. In the Gotland Project, kit 552281 has been sequenced as J1b1a1. For HVR1 and HVR2, there was a difference of one polymorphism but as the Coding Regions was not available, the closeness of the kinship cannot be determined.
- VK433 in H5 match to VK46 and VK239 from the Faroe Islands and VK218 from Russia. The available polymorphism matched for all individuals but as a complete set were not available we cannot determine how close the kinship was. H5 is not represented in the Gotland Project.
- VK437 in haplogroup p V match VK266 from Sweden, VK537 from Italy, VK539 and VK540 from the Ukraine, VK547 from Norway and VK550 from Estonia. All available polymorphism match but few are available whereby the exact relationship cannot be determined. It is also possible that one, or more, of the tested individuals would be placed in a subgroup to V if further testing could be performed. In the Gotland Project, kits 468399, 490773, 676542, B59462 and BP10337 have been sequenced as haplogroup V. The coding region was only available for kit 468399 and BP10337. There is a kinship but it is not possible to determine the nature and closeness of this due to the lack of available polymorphism. There is however a 50% chance that kit 490773 and B59462 are related through their maternal lineage during the last 700 years.
- VK438 and VK464 in H1 match to VK213 from Denmark and VK534 from Italy. The available polymorphism were the same for all individuals but we lack information to determine how close the kinship could be. H1 is not represented in the Gotland Project.
- VK439 in U4a2a match VK486 from Estonia. The polymorphisms match, whereby it can be assumed that the kinship was relatively close. The haplogroup is not represented in the Gotland Project.
- VK440 in T2b+152 match VK274 from Denmark. The polymorphisms match, whereby it can be assumed that the kinship was relatively close. The haplogroup is not represented in the Gotland Project.
- VK441 and VK450 are both sequenced as J1c1b1a and both individuals are from Gotland. While there is a kinship, there are differences in the polymorphisms implying that the relationship was not close.
- VK452 in T2b match VK22 and VK161 from Russia, VK287 from Denmark and VK389 from Norway. Within that group, it is VK22 from Russia and VK287 from Denmark that has the best match, and there we may have a closer kinship. One polymorphism was not noted in VK452, implying that the kinship between VK452 and the other individuals are more distant. In the Gotland Project, kit 374590, 495172, IN43744 and MI22827 have been sequenced as T2b. Upon a comparison of the individual polymorphisms, no exact match was noted between the kits in the Gotland Project and the VK-individuals as polymorphisms were noted in the modern DNA-samples that were not noted with the VK-individuals. Granted, some of these polymorphisms may have originated after the Viking age, however it is likely due to that the lineage is not the same.
- VK456 in I1a1e match VK172 from the UK. All polymorphisms match whereby the kinship may be close. The haplogroup is not represented in the Gotland Project.
- VK459 in W3a1 match VK338 from Denmark. Upon a comparison of polymorphisms we note that the kinship is likely to be distant as there are differences in the polymorphisms. The haplogroup is not represented in the Gotland Project.
- VK460 in I3 match to VK391 from Norway. When comparing the polymorphisms, it can be concluded that the relationship is rather distant as there is a number of differences between the

individuals, however the quality of the material must also be considered. The haplogroup is not noted through the Gotland Project.

- VK461 in H7b match to VK417 from Norway. The available polymorphisms match exactly, implying that there may be a closer kinship. Further polymorphisms would however need to be compared to determine if this is correct or not. The haplogroup is not represented in the Gotland Project.
- VK462 in H1e1a match to VK260 from the UK, VK269 from Sweden and VK253 from Öland (Sweden). When comparing the available polymorphisms, there is an exact match between VK462, VK260 and VK253, while there is a polymorphism missing in VK269. Further polymorphisms would however need to be compared in order to be able to determine if there is a closer kinship. The haplogroup is not represented in the Gotland Project.
- VK463 in H1b5 match to VK492 from Estonia. All available polymorphisms agree, however further polymorphisms need to be compared in order to determine if there is a closer kinship or not. The haplogroup is not represented in the Gotland Project.
- There is a match for haplogroup H1a between VK467 and VK475 from Gotland to VK369 from Denmark and VK482 as well as VK496 from Estonia. All available polymorphisms match, whereby there may be a closer kinship. Further polymorphisms would however have to be analysed and compared to determine if this is correct. In the Gotland Project, the haplogroup is represented through kits 519100 and 764844. Even if there is a relationship as the kits are sequenced in the same haplogroup, the polymorphisms does not match whereby the relationship is likely quite distant.
- There is a match between VK468 and VK479 from Gotland in H1a1 to VK149 and VK175 from the UK and VK371 and VK411 from Denmark. All polymorphisms match exactly, whereby the relationship can be close. Further polymorphisms would however need to be analysed to determine if this is correct or not. In the Gotland Project, the haplogroup is represented in kit N136887. While we do not have the Coding Region for N136887 we cannot fully conclude on the relationship however as there are differences in the comparison of HVR1 and HVR2 it is likely to be quite distant.
- There is a match between VK471 and VK478 from Gotland in H1m to VK204 from the Orkney islands. There is a full match on all available polymorphisms, but further polymorphisms would have to be compared in order to investigate if there is a closer kinship. The haplogroup is not represented through the Gotland Project.
- VK473 in N1a1a1a1 do not match via the mtDNA to another individual but the haplogroup is represented through the Gotland Project via kits IN89170 and MI19590. The coding region is not available for kit MI19590, whereby a full analysis cannot be performed. There is however differences in the polymorphisms whereby a closer kinship is not considered as likely.
- VK477 in H1b1+16362 match to VK398 from Skara (Sweden). All available polymorphisms agree but further polymorphisms need to be compared to determine if the relationship is close or not. In the Gotland Project, it is kit 772987 that is sequenced in the same haplogroup. As we do not have access to the coding region for the kit, we cannot conduct a full analysis. There are however noted differences in the polymorphisms available, indicating that the relationship is likely to be distant.

In addition to this, we have also compared the available haplogroups in the Gotland Project to the study "Viking Genomics...." in order to investigate if there are haplogroups in the project that were not included in the analysis above where there may be a match in the haplogroup. The result of this comparison was as follows:

- Kit N50634 match to VK392 from Norway in haplogroup H1g1. There are however differences in the polymorphisms between the kit and VK392 whereby the kinship is most likely distant.
- Kit IN25333 match to VK122 and VK544 from Iceland in haplogroup H24a. The polymorphisms available for the VK-individuals match exactly but there are differences in the polymorphisms for kit IN25333. Thus, the kinship is likely to be distant.
- With regards to haplogroup H1c3 there are two individuals in the study, VK153 and VK154 from Poland that are sequenced as belonging to this haplogroup. The polymorphisms available for the VK-individuals match exactly. There are three kits in the Gotland Project that are sequenced as H1c3. These are kits BP11989, IN16805 and 724732. The closest match appears to be kit 724732, but as there are differences in the polymorphisms the filiation is likely to be distant.
- VK265 from Sweden has mtDNA H13a1a, which is also the haplogroup of kit IN30166. As there are differences in the polymorphisms the filiation is likely distant.
- The individuals VK145 from the UK and VK241 from the Faroe islands are both sequenced in haplogroup H17. In the Gotland Project, it is 563541 that is placed in the same haplogroup. Even if the polymorphisms for VK145 and VK241 match, there are differences to kit 563541 whereby the kinship is likely to be distant.
- Haplogroup H24a has been noted with the individuals VK122 and VK544 from Iceland and also with N92308 in the Gotland Project. Even if the polymorphisms for VK122 and VK544 match, there are differences compared to N92308, whereby the kinship is likely to be distant.
- Haplogroup H27 has been noted with VK380 from Öland (Sweden) and with kit B637135. As there are differences in the polymorphisms, the kinship is likely to be distant.
- VK399 has haplogroup H4a1a1a, which have been noted with kit 471838 and 502375. The Coding Regions are however not available for any of the kits, which renders the analysis difficult. As there are differences in the polymorphisms available, it is not likely that the relationship is close.
- VK261 from the UK and VK515 from Norway have both been sequenced as haplogroup H52. In the Gotland Project, the haplogroup has been noted with kit B582542. The polymorphisms available for the VK-individuals matches exactly but there are differences to kit B582542, whereby the filiation is likely to be distant.
- VK31 from Skara (Sweden), VK279 from Denmark and VK420 from Norway has haplogroup I4a. In the Gotland Project, kit MI32603 has been sequenced as I4a. With regards to the individuals in the study, there is an exact match. There is a match to MI32603 but since the Coding Region is not available for the kit, a complete analysis cannot be made.
- VK513 from Greenland has haplogroup J1c1b, which is the same for kit 636820. There are differences in the polymorphisms between VK513 and kit 636820, and there is only some 50% chance that the common maternal ancestor lived within the last 1.300 years.
- VK215 and VK216 from Denmark have been sequenced as J1c2k, as has kit 286087. There are however differences in the polymorphisms between VK215 and VK216, implying that the kinship was distant. We do not have the Coding Regions for kit 286087 and thus we cannot complete the analysis. However, since there are differences in the polymorphisms available, a closer relationship is not considered as likely.
- VK366 from Denmark has been sequenced as haplogroup J2a1a1a, as is kit IN39619. There are four polymorphisms that are not the same when comparing VK366 and kit IN39619, and there is only a 50% chance that the common maternal ancestor lived within the last 1.300-year period.
- VK551 from Estonia had haplogroup J2a1a1a2, which is the same as for kit 488136. As there are differences in the polymorphisms, a closer kinship is not considered as likely.
- Haplogroup J2b1a is shared by several individuals in the study. This is VK108 from Ljungbacka in Sweden, VK206 from the Orkney islands, VK220 from Russia, VK289 and VK373 from Denmark

and VK357 from Öland (Sweden). The polymorphisms for these individuals match exactly, whereby it is likely that the kinship was close. In the Gotland Project, kit MI27312 has been sequenced in the same haplogroup. As we do not have access to the Coding Regions we cannot complete the analysis. As there are differences in the polymorphisms available, a closer relationship is not considered as likely.

- VK33 and VK406 from Skara and VK258 from the UK have been sequenced as haplogroup K1a4a1. The polymorphisms for these individuals match exactly, whereby the kinship is likely close. Kit 642993 is sequenced in the same haplogroup but as there are quite significant differences in the polymorphisms, it is very unlikely that there is a close kinship.
- VK40 from Skara and VK295 from Denmark are both sequenced as haplogroup T1a1. The polymorphisms for the individuals are an exact match, whereby a closer kinship is probable. The three kits in the Gotland Project sequenced as T1a1 are 510363, 749069 and 421027. As the Coding Regions are not available for 510363, 749069 a full analysis cannot be performed. For the available polymorphisms, there are however differences already on an HVR1-level, implying that any kinship is quite distant.
- VK281 from Denmark is in T2, a haplogroup shared by 683751, 327242 and 335260. What is interesting is that all these three kits have a Gotlandic maternal line. The polymorphisms for kits 327242 and 335260 fully match for both HVR1, HVR2 and Coding Regions. This renders a 95% confidence interval that they share a common maternal ancestor within the last 550 years. Compared to kit 683751, there are differences in the polymorphisms on an HVR1-level, implying that the maternal ancestor lived more than 1.300 years ago. A comparison of VK281 and the kits renders such differences that it is quite unlikely that there is any closer kinship.
- VK303 from Skara (Sweden) has haplogroup T2a1b1a1, which is also the haplogroup of kit 343978. Based on the differences noted on an HVR1-level, there is no close kinship between VK303 and kit 343978.
- VK489, that was located in Estonia, is in haplogroup T2e1, which is the same group as for kit IN13612. Due to the differences in polymorphisms between the two, we can conclude that there is no close kinship.
- VK35 from Skara (Sweden) is sequenced as T2f1a1, which is the same for kit 553929. As the Coding Regions are not available, a full analysis cannot be performed, however based on the noted differences on an HVR1-level, there is no close kinship.
- VK270 from Sweden has haplogroup U4. This is shared with kit 569739. As a full sequence test has not been performed, we cannot do a full analysis. As there are differences noted in the available polymorphisms, it is not likely that they would be sequenced in the same final haplogroup.
- VK255 from Russia and VK385 from Denmark have been sequenced as haplogroup U4c1. This is the same haplogroup as for the kits 438175 and IN57497. These both kits match on an HVR1 and HVR2-level, implying a 50% possibility that they share a common maternal ancestor within the last 700 years. Based on the differences in the polymorphisms between the VK-individuals and the kits, there is no close kinship.
- VK326 from Denmark and VK413 from Russia are sequenced as U5b1+16189+16192 and have a complete match in the polymorphisms. This specific haplogroup is shared by kits 763406 and IN24756. This is a mother and son that has a Gotlandic maternal lineage. There is however no close kinship to VK326 or VK413.
- VK191 from Greenland is sequenced as haplogroup W, which is the same haplogroup as for IN56352. A full mt Sequence-test has however not been performed for the kit and through a comparison, it is likely that kit IN56352, through a full sequence-test, would be placed in a subgroup to W. There is thus no close kinship.

So when did the women come to Gotland and do these historical women have offspring that can be traced today? The answer is that they seem to have come in waves, from the first immigration when the ice disappeared, to a seemingly larger wave of immigration during the latter part of the Stone Age / Early Bronze Age to the great influx of the Iron Age and the Viking Age. At the same time as the previously noted groups continued to immigrate, new groups established themselves on Gotland. These came from central, southern and eastern Europe and we see that more of the descendants of Eva's daughters make their entrance into the history of Gotland through the haplogroups HV, H, J, K and T. The latter part of the Stone Age/early bronze age must have implied a lot of activity on Gotland when new population groups arrived and began to populate the island. Although we see differences on the yDNA side in connection with the Bronze Age with regard to which haplogroups were represented during the Stone Age compared with later periods, the history of women in Gotland in that aspect goes further back.

Through the study, an analysis of the admixture was also performed. The authors distinguish between the Nordic countries and the UK / UK, Italy / Southern Europe, Finland and Poland. There are some men who are partly of British descent, which may indicate that women were brought to Gotland from the British Isles as their yDNA does not indicate that they descend from that part of the world on the paternal side. It is not unlikely that there was extensive slave trade and / or that women came to Gotland as married from this, and other, part of the world, and that these women had offspring that left their mark on the Gotlandic DNA tapestry. Have those women had descendants that we can trace today? Unfortunately, mtDNA is more difficult to analyse than yDNA as mtDNA mutates less frequently and more irregularly. In order to obtain a reasonable certainty in the comparisons between two individuals' mtDNA to determine kinship, both need to have done a full sequence mtDNA-test to have the results of both HVR1, HVR2 and Coding Region. If a complete analysis could not be made of the historical material's mtDNA, and HVR1, HVR2 and/or Coding Region are not available, then the quality of the comparison is quite significantly reduced and the confidence interval drops to 50% and lower. Based on the analysis, it is not possible at present to establish that there is a direct relationship between people in the Viking Genomics study and members of the project on the maternal lineage. There is a relationship, but we cannot establish that anyone in the project has any of the individuals in the VK study as a direct maternal ancestor. If we reflect on this, the women in the Viking-age appear to have been more mobile than the men as there can be a kinship between individuals in the study that were found in different geographical locations. However, further research would be needed to confirm this.

yDNA

If women have continuously moved to Gotland since the end of the ice age, then what is the history of man? It appears to be different to that of woman in some crucial points. In order to illustrate the development, we prepared the same table for yDNA as for mtDNA. However, the analysis is not as detailed as there are no haplogroups for yDNA in many cases. All individuals have both mtDNA and yDNA but only the biological males have yDNA. This is also more difficult to analyse than mtDNA in historical findings as it consists of more genomes.

Period		Year (BC /BCE, AD)	Comment	Haplogroups ^{xxxix}
Stone age	Old stone age (paleolithic)		No finds in Gotland	
	Middle stone age (mesolithic)	Ca 9.500 – 4.000 BC ^{xxx}	Stora Förvar ^{xxxi} , Stora Bjers (SBj)	I-M438 – P37.2
	New stone age (neolithic)	Ca 4.000 – 1.700 BC ^{xxxi}	Ansarve (funnel beaker) Ajvide, Fridtorp, Ire (pitted ware) Häffinds, Suderkvie, Utalskog	HIJK-F929, I-M438 – P37.2, I-M438- CTS595, I-M438-A512, I-M438-M423,
Bronze age ^{xxxiii}	Old bronze age	Ca 1.700 – 1.100 BC	Häffinds, Högur, Suderkvie, Utalskog	Ingen yDNA tillgänglig
	Late bronze age	Ca 1.100 – 500 BC	No noted finds	
Iron age ^{xxxiv}	Old iron age <ul style="list-style-type: none"> Pre-Roman iron age Roman iron age 	Ca 500 BC – 400 AD	No noted finds	
	Late iron age <ul style="list-style-type: none"> Migration period Vendel period Viking age 	Ca 400-1100 AD Ca 400–550 AD Ca 550-750 AD Ca 750-1100 AD	Viking age (VK48, VK50, VK51, VK53, VK57, VK60, VK64, VK232, VK251, VK430, VK431, VK438, VK452, VK453, VK461, VK463, VK467, VK468, VK469, VK471, VK473, VK474, VK475, VK479	R-M343, R-M420, I-M253, N-M231, I-M438, CT, E-M215, G-M201

The material available is deficient with respect to yDNA, but a shift seems to have occurred between the Stone Age and the Bronze / Iron Age. The old male haplogroups disappeared with the arrival of new groups, perhaps when violence and war made their way onto the scene during the Bronze Age. According to some researchers, the Bronze Age ended with “collapse and mass death”^{xxxv} and the world of violence began^{xxxvi}. The earlier men appear to have disappeared at some point in history and the new men remained. Further research is however needed to understand why this occurred

There is no representative in the project for the oldest groups of I-M438 (old I2). In the table below, we include our review of the available haplogroups through the Viking Genomics study and mapped these to members of the project. The result was as follows:

Individual	Place	Haplogroup	Subclade FamilyTree	Overall analysis
VK471	Gotland_Kopparsvik-63	R-M420	R-M417	Only analysed until R-M417. All in the Gotland project that belong to R-M420 and that have been tested further have so far also been sequenced through R-M417. This applies to kits IN82768, BP10514, 449791, 420973, 338076, 400031 and MI11037. R-M417 is, however, a subgroup that arose during the Stone Age, so it is not possible to see if kinship exit at a later stage.
VK48	Gotland_Kopparsvik-212/65	R-M420	R-FGC52679	Kit MI11037 is the closest relative to VK48 in the Gotland project. They share haplogroups up to YP275, indicating that their common ancestor lived at least during the Iron Age. The relationship may have occurred later than that.
VK60	Gotland_Frojel-00702	R-M420	R-YP1026	Kit IN82768, BP10514, 449791 and IN46582 shares lineage via Z280, that dates from approximately the Copper Age, but is then sequenced through YP951, which indicates a Slavic / Czech origin. VK60 belongs to CTS1211, which also indicates a Slavic / Czech origin but there is no close kinship.
VK64	Gotland_Frojel-03504	R-M420	R-BY58559	There is no close relative in the Gotland Project for VK64. The kits that have an initially common lineage are kits IN82768, BP10514, 449791 and IN46582 which all have Z280. This is a late Stone Age / Copper Age group that belongs to the Baltic-Slavic subgroup.
VK232	Gotland_Kopparsvik-240.65	R-M343	R-P310 eller R-Y16505	Kit N112691, IN26214, IN87304, 25534, 305274, 579206, N37019, MI26207, 408740, MI32603 pass through R-P310. If the placement in Y-16505 is correct, kit 425534 is related and should have a common ancestor in the early Nordic Bronze Age. Kit MI32603 would be the closest relative in the project as a common ancestor probably lived during the Nordic Bronze Age, possibly during the early Iron Age.
VK57	Gotland_Frojel-03601	R-M343	R-L151	A number of kits in the project pass through L151 (German Bronze Age) including kits N112691, IN26214, IN87304, 425534, 305274, 579206, N37019, 408740 and M132603. However, the relationship is in the

Individual	Place	Haplogroup	Subclade FamilyTree	Overall analysis
				European Bronze Age and no further analysis is possible as there is no sequencing into any later subclade. placement in the younger subgroup
VK431	Gotland_Frojel-00487A	R-M343	R-P312	Kit N112691, IN26214, IN87304 pass through R-P312, which is associated with the Germanic Bronze Age (bell beakers) No further analysis is possible.
VK468	Gotland_Kopparsvik-235	R-M343	R-BY125166	The closest relatives in the Gotland Project are kits 408740 and M132603, which both comes through Z9. A common ancestor is likely to have lived during the European Bronze Age.
VK469	Gotland_Kopparsvik-260	R-M343	R-FGC17230	The closest relatives in the Gotland project are kit MI32603 and 425534. Kit MI32603 shares the ancestral line with VK469 up to Z345, which brings us into the Nordic Bronze Age. Kit 425534, shares the ancestral line with VK469 and MI32603 up to Z8, which takes us into the time of the Nordic Bronze Age. Kit 425538, however, then belongs to Z346-> DF101, which is a Germanic group but probably immigrated to Sweden in the Bronze Age.
VK251	Gotland_Kopparsvik-30.64	R-M420	R-M459	VK251 is only analysed until R-M459. All members of the Gotland Project in R-M420 are sequenced through this subclade, which is dated to the Stone Age. No further analysis is possible.
VK438	Gotland_Frojel-04498	R-M420	R-CTS11962	Kits 420973 and 338076 both pass through CTS11962 and then via L1029, indicating an origin via Russia / Balkans /the Baltics. A common ancestor would probably have lived in the European Bronze Age if no closer relationship can be established by placing VK438 and 452 in further subclades.
VK452	Gotland_Kopparsvik-111	R-M420	R-CTS11962	
VK453	Gotland_Kopparsvik-134	R-M420	R-YP256	Kit 420973 and 338076 are both sequenced through R-M458. A common paternal ancestor should have lived late Stone Age/ European Copper Age.
VK475	Gotland_Kopparsvik-187	R-M420	R-BY27605	VK475 shares the paternal lineage with VK60 and is placed in a subgroup of R-YP1026, which is VK60's final haplogroup. Kits IN82768, BP10514, 449791 and IN46582 share the paternal lineage through Z280, however no closer relative is found in the project.
VK463	Gotland_Frojel-019A89	R-M420	R-Y13467	VK463 shares paternal lineage with VK475 until sometime in the late Bronze Age. Kits IN82768, BP10514,

Individual	Place	Haplogroup	Subclade FamilyTree	Overall analysis
				449791 and IN46582 share this lineage through Z280 but no closer relative is found in the project.
VK51	Gotland_Kopparsvik-88/64	N-M231	N-L1026	Kits 261179 and N50634 both pass through L1026. This information however only implies that a common ancestor lived in the Neolithic.
VK430	Gotland_Frojel-00502	N-M231	N-S18447	VK430 shares the paternal lineage with VK51 but continues past L1026 further down into L550 and probably towards the Fennoscandian S9378-> N-S18447. It is Kit 261179 and N50634 that are most closely related to VK430. The common ancestor probably lived at the beginning of the Nordic Bronze Age.
VK461	Gotland_Frojel-025A89	N-M231	N-Y5005	VK4561 shares lineage with VK51 and VK430 but continues past CTS2929 and is rather a Baltic / Karelian branch. It is kit 261179 and N50634 that are most closely related to VK430. The common ancestor probably lived at the end of the Stone Age / Copper Age.
VK50	Gotland_Kopparsvik-53.64	I-M253	I-Y22923	In the project, it is kits 61105 and 407837 that share an ancestor on the first half of 17th century Gotland that is most closely related to VK50. Kit 61105 is placed in Y22923, which is the same haplogroup as VK50 and shares at least 8 SNPs, which is an indication of kinship through the paternal lineage. Since kit 407837 is related to 611605, that member would probably also be placed in the same haplogroup.
VK473	Gotland_Kopparsvik-126	I-M253	I-S14887	There is a kinship with all kits sequenced via P109 (MI19627, 405733, 318523 and IN57497) but it is kit 405733 that is most closely related as 405733 is placed in S14887. A relationship through the paternal lineage can thus be established, but not exactly when this occurred. In this case, S14887 is a haplogroup from the Nordic Bronze Age.
VK53	Gotland_Kopparsvik-161/65	I-M438	I-CTS10228	There are no close relatives in the project. All I2 kits in the project (438175, N130382, BP11989, MI27311, 668730, 480941) pass I-L460 but the haplogroup originated sometime during the early Stone Age, implying that the kinship is very distant.

Individual	Place	Haplogroup	Subclade FamilyTree	Overall analysis
VK467	Gotland_Kopparsvik-181	CT	Not determined	No relative via the project. Probably classified in further subgroups to CT as it is an old haplogroup. May be related to VK474 if he were to be classified via E-M96.
VK474	Gotland_Kopparsvik-137	E-M96	E-Y4971	No relative via the project. May be related to VK474 if he were to be classified via E-M96.
VK479	Gotland_Kopparsvik-272	G-M201	G-Y106451	The closest relatives in the project are kits 346205 and 373933 which both match VK479 down to FT7941. This probably dates the relationship to at least the Iron Age.

Haplogroup R occurs quite frequently in the study. R originated about 27,000 years ago, in Central or Southern Asia^{xxxvii}. This haplogroup was divided into R1a (now R-M420) and R1b (now R-M343). R-M420 probably originated after the last ice age but whether it was in Eastern Europe or India / Pakistan is subject to discussions^{xxxviii}. The three main branches of R1b probably originated in the Middle East^{xxxix}.

Many of the Vikings found on Gotland belong to R-M343 (old R1b)^{xl}.

- VK232 – FamilyTree indicates that VK232 is in R-P310 but there is a suggested alternative sequencing in R-Y16505. R-P310 is a subgroup of L23, which was one of the dominant subgroups during the Yamna period. P-310 is a Central European Bronze Age group. If the position in R-Y16505 is correct, VK232 belongs to the U106 subgroup and then further down to Z381, L48, Z9 and Z27. U106 is a Central European group that probably originated during the Bronze Age and L48 and Z9 are Central European /Germanic. Members of this branch are said to belong to both a number of older French kings and German nobility. There was no determination on VK232 but his alternative location can be interpreted as belonging to a group that migrated further north from Central Europe and thus came to Gotland. However, it is not clarified whether he was born on Gotland or whether he came to Gotland during the Viking Age.
- VK57 is analysed as far as L151, which brings us to the Bronze Age in present day Germany. VK431 shares ancestry with VK57 and VK232 through L23-> L51-> P310 and then through L151 to R-P312. L51 and P310 are first noted in the Bell Beaker-period in present day Germany. This culture appear to be a mix between the Yamna and Neolithic, probably through the women living in Europe when R-M343 arrived.
- VK468 is related to VK232 and VK431. They both share their ancestry via the L23, one of the dominant subgroups of the Yamna period, and the R-P310, a Central European Bronze Age group. VK468 further belongs to the U106 subgroup and then further down to Z381, L48, Z9. U106 is a Central European group that probably originated during the Bronze Age and L48 and Z9 are Central European / Germanic. The lineage for VK468 then continues through Z381-> L48-> Z9-> Z331-> Z330, which leads to present-day Germany, and the further lineage down via CTS7411, which appears to be a Central European subgroup. Again, it is very unclear whether VK468 was born on Gotland. The lineage has been determined mainly Danish and southern European, but to a lesser extent also British / North Atlantic and Norwegian.

- VK469 is also related to VK232, VK431, VK468 and VK57, but the closest relative is VK232, if the alternatively proposed sequencing in Y16505 is correct. This implies that VK232 can also be placed in the Central European Bronze Age via Yamna further down in U106-> Z381-> L48-> Z9-> Z27. VK469 may however have a different origin than the others in R-M343 as his further lineage continues via Z2-> Z7-> Z8-> Z1-> Z344, which leads us to Scandinavia (Norway), UK and Germany. Unfortunately, there was no analysis of descent in the material we had access to. However, VK469 may be a descendant of one of those who brought the Bronze Age to Scandinavia^{xli}.

Except for R-M343 R-M420 (old R1a^{xlii}) appears to be one of the dominating haplogroups of the Vikings buried in Gotland. Although the R-M420 probably originated close in time to R-M343, their respective stories differ after that.

- VK471 is placed in R-M417. It is a Central European subgroup that has been demonstrated in the ceramic culture in Germany, but also in Asia. No further lineage can be determined as further placement in downstream groups has not been possible.
- VK48 has its origins via M417, a subgroup of R-M240 found in Mesolithic northern Europe. The continued lineage via Z283 and Z282 indicates a Slavic origin but VK48 then belonged to the subgroup Z283 which is considered to be a Central European / Eastern European branch. It has been dated to the Copper Age (the transition between the Stone Age and the Bronze Age in Europe), although it has not been found on Gotland or in Sweden. However, VK48's ancestors migrated north and he also belongs to Z283-> Z284-> Y2395, which is a Scandinavian group but also spread with the Vikings to the British Isles. VK48 may have been born on Gotland, but the lineage is probably Scandinavian / Norwegian based on belonging to Y2395.
- VK438 and VK452 share lineage with VK48 until Z282, which implies that their common lineage was separated at some time since the Stone Age / European Copper Age or early Bronze Age. The ancestral line for VK438 and VK452 both goes through R-CTS11962. None of these had a determination via the study, but if they did not turn out to belong to different subclades after CTS11962, they at least had a common paternal ancestor. The lineage for VK438 and VK452 goes via M417, which was noted during the European Middle Stone Age (Mesolithic). The further lineage via Z283 takes us to Central Europe and the further placement in Z282, F6155 and M458 take us down via the proto-Slavic tribes and have also been demonstrated in the corded ware culture. Via Y2604 we remain in Central Europe. An additional location would have given us greater guidance in his descent if his lineage was Central European / Slavic / Polish or Baltic. It is not possible to determine whether he was born on Gotland or whether he came to Gotland during the Viking Age.
- With VK60 and VK475, we get to add another branch of the R-M420 tree to the history of Gotland. VK60 and VK475 shares a lineage with VK48, VK438 and VK452 to Z282, which again implies that their common lineage was separated at some time since the Stone Age / European Copper Age or early Bronze Age. While VK60 / VK475 ancestors went north and VK438 / VK452 stayed in Central Europe, we continue via VK60 in Z280, which is a Baltic-Slavic subgroup. Via CTS1211-> YP1019-> YP1024 we arrive in the Baltic States (Lithuania), Russia, Belarus, Ukraine. The pedigree for VK60 / VK475 has been set to be mainly Finnish but also with Polish and southern European descent. As for the others, it is not possible to determine whether VK60 was born on Gotland or arrived on Gotland during the Viking Age. His haplogroup and lineage indicate that the subgroup came during the Viking Age. VK475 may have been born on Gotland as he is placed in a subgroup to VK60 end group but the exact mutual relationship VK475 - VK60 has not been determined.
- VK463 belongs to R-Y13467. VK463 is thus related to both VK60, VK475, VK48, VK438 and VK452 up to Z282 in the late Stone Age / European Copper Age or early Bronze Age. However, VK463

then shares lineage with VK475 until CTS1211-> FT92022 before VK463 continues via YP1034-> YP4258-> R-Y13467. This appears to be an Eastern European / Baltic branch. There is no determination of the pedigree of VK463, but based on yDNA we would probably guess that a determination of the pedigree would be mostly Polish and possibly Finnish.

- VK64 also belongs to M417-> Z283-> Z282, which again takes us to the Central European Late Stone Age / European Copper Age or Early Bronze Age. However, VK64's ancestral line then continues via Z92-> YP270-> YP351-> YP9081, which indicates a Polish / Russian lineage in the early Bronze Age. The pedigree according to the analysis made is not the same as for VK60. Although the descent was mainly determined to be Finnish, there was also a relatively large proportion of Polish and British descent. How it should be interpreted in relation to the haplogroup and subgroups is not easy to determine, but it may be a consequence of mobility during the Viking Age. It could also be a result of having offspring with slaves or marrying a woman from another area.
- VK453 shares lineage with VK438 and VK452 via the Late Stone Age / European Copper Age Z282 into CTS11962-> M417, which was noted during the European Middle Stone Age (Mesolithic). The further lineage via Z283 bring us to Central Europe and the further placement in Z282, F6155 and M458 takes us via the proto-Slavic tribes and have been noted in the corded ware culture. Via Y2604, VK438 and VK452 we remain in Central Europe, but the lineage for VK453 continues through L260, which is a West Slavic group and YP256. Via the last group, we again remain in Central Europe. YP256 branches into subclades that are associated with Finland, Eastern Europe, Ukraine and others. We do not know where VK453 would be placed through further tests, and no test of pedigree has been made.

In the Gotland Project, the group R-M420 and R-M343 is the largest yDNA group after I-M253. We wish that members, who today are only placed in the R-M420 and R-M343, would to expand their tests so that more clues would become available. For R-M343, the material we have to work with indicates that many have a Germanic / Central European origin and furthermore those with a Baltic / Slavic origin via Z280 and YP951. We also see the Germanic descent within the R-M420 but also an earlier immigration to Scandinavia from the continent. We probably have both a lot of the descendants of those who came via the Hanseatic League but also previous immigration to Gotland directly from Central Europe / present-day Germany.

No less than three of the individuals in the study were placed in haplogroup **N-M231**. It probably originated about 20-30,000 years ago in Eurasia^{xliii} and came from the east to Gotland. Since 2019, two further members belonging to this haplogroup have joined the Gotland Project, implying a total of four members now. Based on the material, we wrote in our paper from 2019 that the influx of N-carriers to Gotland may have come from Finland, the Baltic states and / or Poland. The analysis for the three individuals in the study is as follows^{xliv}:

- VK51 is categorised via N-M231 and further in L29-> N-Tat-> F1419-> L708-> N-L1026. L1026 is estimated to have originated about 4,400 years ago^{xliv}. It is a Finno-Ugric branch that arose during the latter part of the Stone Age. This leaves some questions about VK51's further origins since L1026 originated prior to the Bronze Age. The two kits that are most closely related, 261179 and N50634, both pass through L1026 but then continue to L550, which is at least partly associated with the Vikings. VK51 is stated to be mostly Finnish with elements of Polish, and it is unclear which final haplogroup he would be placed in.
- VK430 belongs to N-S18447. Although VK51 is at least currently placed in L1026, VK430 continues further via Y6058-> CTS10760-> CTS2929-> L550. This subgroup is estimated to have originated about 3,600 years ago and takes us to the Nordic Bronze Age. The further placement in S9378->

N-S18447 (final haplogroup) probably places VK430 among the Fennoscandians based on the current information of FamilyTree DNA and YFull. VK430 was not the only Viking to be placed in this branch as also VK419 (Norway) was sequenced with S9378 as its final haplogroup. VK419 has been determined mostly Swedish and Norwegian with Finnish ancestry, so the same placement would probably be given to VK430.

- VK461 shares the ancestral lineage with VK51 until L1026 and then VK430 to CTS2929, which is a Baltic / Nordic branch. However, VK461's lineage continues via CTS9976-> L1022-> Y5004-> N-Y5005 (final haplogroup). This places us in the Baltics / Karelia. No ancestry is stated in the study for VK461, but it should be mostly Finnish.

The interesting thing about the review of N-M231 is that all three individuals are sequenced via L550, which is a Nordic / Baltic subgroup dating to the Nordic Bronze Age which has also been called "Baltic Finnish"^{xlvi}. In the Gotland Project, there are five individuals sequenced as N-M231. The two who have had extended tests performed have a mixed background. There is both mainly Finnish roots but also ancestry that indicates a link towards the Rurik dynasty, which is said to have founded the Kiev empire^{xlvii} as kit N50634 passes via Y4339 but then continues down into Y12104. VK430 shares the lineage until L550 but then passes through S9378 while the Rurik dynasty continues via Y4341 on to Y10931^{xlviii}. We would be happy to see further tests on N-M231, as few have had a Y700, in order to shed more light on the development of the lineage on Gotland.

Although haplogroup I, especially since haplogroup **I-M253** (old I1a) is the dominant haplogroup among the members of the Gotland Project, it is in the minority among the tested remains found on Gotland. In the study, there is a total of 62 individuals sequenced as I-M253 and subclades of a total of 300 individuals with yDNA haplogroup (approximately 21%). This is a lower proportion than today's estimated 35-45%. This is a continuing mystery. When did this large group arrive as we, so far, see so few traces of it in the historical DNA on Gotland? We have given this a lot of consideration as it is one of the dominant groups in Scandinavia. Two of the tested individuals in the study have been placed in I-M253, but their genetic lineage differs somewhat and does not give a clear picture of I-M253's development on Gotland.

- VK50 belongs to I-M253 but the lineage goes via DF29-> CTS6364-> M227. This lineage brings us via north-eastern Europe to the Viking Age. I-M227 is found to a lesser extent in Scandinavia, but is also noted in France, Russia and Switzerland. It has been suggested that this can be attributed to the Vikings who travelled east, as well as to other emigration from Scandinavia^{xlix}. VK50 was mainly Swedish but also had Finnish ancestry and some Polish descent according to the results of the study. It should be noted that M227 does not belong to L22, today one of the most common Nordic subgroups of I-M253.
- VK473 shares lineage with VK50 until CTS6364, but there, during the Stone Age, the lineage is separated and VK473 continues via L22, a very common Nordic subgroup. The lineage continues to P109-> S7660-> I-S14487 (final haplogroup). This is most often found in Sweden, Denmark and Finland and originated during the Nordic Bronze Age. According to the study, the determination of the ancestry of VK473 is mostly Polish, some Danish and Finnish. It may appear strange, but VK473 can originate from northerners who settled in the eastern Baltic Sea area and then came to Gotland. Judging by YFull and the few matches available there, as well as matches via FamilyTree, it can be a Finnish subgroup. That VK473 was sequenced as S14487 as a final haplogroup is interesting for another reason as it is the haplogroup that the princes of Monaco in the Grimaldi family belong to until Prince Louis II, dead in 1949ⁱ and who was then succeeded by Prince Rainier, the son of his daughter the princess Charlotte. Maybe the house Grimaldi has a Gotland origin?

We know that, during prehistoric times from a genetic perspective, Gotland was most likely not Scandinavian but Baltic, Central European and Eastern European. The Viking culture, however, is found on Gotland and, according to what Gutasagan tells us, it was the Asa-religion that was the predominant one at this time. This indicates that the Gotlanders at that time were closer to the Nordic countries from a cultural and religious perspective. It is however noted that there are more I-M253 in Sweden, Norway and Denmark in the Viking study than on Gotland so this may be a purely cultural aspect and not a genetic one. Was I-M253 at that time a more Scandinavian haplogroup that did not come to Gotland until the latter part of the Viking Age / early Middle Ages or was there a larger immigration during the Hanseatic period, after the Danish conquest in 1361? The mystery continues to grow as we, through our analysis, have noted among the I-M253s that made the Y700 that there is, so far, a relatively even distribution between L22 / P109 which is usually said to be the large Nordic subgroup and Z58, which is usually said to be the Germanic / Lowland group. If we take a closer look at L22 / P109, we see signs of both Swedish, Norwegian and Danish descent through, for example, S10891 and Y3664. If we look at Z58, we see that the lineage continues through Z382, which may be the result of an early immigration, as well as the Z60 that indicates immigration from the continent. One possibility is that the I-M253 group on Gotland is more diversified than in the rest of Sweden and Scandinavia. We wish that more members, who today are only placed in I-M25, to expand their tests that can perhaps shed light into the history of I-M253 in Gotland.

In addition to I1 (I-M253), **haplogroup I-M438** (former I2) is also represented among the tested individuals. This group is interesting as we have seen that the historic men on Gotland, and in the geographical vicinity, belonged almost exclusively to I2 / I-M438. Haplogroup I2 (I-M438) was the main male haplogroup in Mesolithic Europe until about 6,000 BC^{li}. There are not many individuals among the historical Gotlandic finds for whom it has been possible to determine the male haplogroup, but all those for whom this has been successful have been determined to be I2 (I-M438). In the historical DNA, six individuals have been sequenced as I2 and further subclades. The man in Stora Bjers and Ajvide 58 was determined to be I2, subclade I2a1 (I-M438 subclade I-P237.2 + or I-L68). Additional analysis performed by other geneticists indicate that the Ajvide 58 individual may be placed in subclade I-CTS772 (PF3631). This subgroup indicates an Eastern European ancestry, where it is the main male haplogroup^{lii}. Ajvide 59, which may not have lived exactly at the same time as Ajvide 58, but at least relatively close in time, has been sequenced as I-PF3796 by other geneticists. I-PF3796 is a subclade of haplogroup I (I-M170) and thus cannot be placed in either I2 (I-M438) or I1 (I-M253). The Ire8 man has been determined to be I2a1b1a1 (S2703). The subclade I2a1b1a1 / S2703 is found in the British Isles, including Ireland, but also in Sweden, Germany and Poland and originated somewhere between the Neolithic and the Bronze Ages^{liii}. The same haplotype I2a1b1a1 / S2703 has been noted for Ansarve14 and 16, while Ansarve 18 has been analysed as far as I2a1b (now I-M423).

VK473 is placed in I-M438. Although there is a kinship as both Ajvide58 and Stora Bjers are sequenced through P37, and as the remaining Ajvide is in subclades to I-M423, VK473 separates from these men when he, after I-M423, pass through L621 and further in CTS10936-> CTS10228 (final haplogroup). This indicates a Slavic descent. The age determination of CTS10228 is unclear and varies between 5,600 years and 2,300 years. But the haplogroup may have spread to Gotland via the Slavic expansion during the migration period. I-M438 was a large historic group but its dominance was broken through the arrival of new groups. The few individuals sequenced as I-M438 is an indication that the group was not as frequent during the Viking age as earlier in history.

VK474 belongs to an interesting haplogroup as he is sequenced as belonging to **haplogroup E^{liv}**, which is rare in the geographical vicinity. E originated in present-day Somalia or Ethiopia just over 26,000 years ago, and did not reach the Levant until just over 8,000 years ago. There is a European subgroup called E-

V13, but VK474 does not belong there but to M213 and further to L791 and Y4971. This indicates that VK474 belonged to a group that emerged during the latter part of the Stone Age. I have not seen that VK474 was placed in a wider subgroup and there is a possibility that he belonged to the branch that continues via Y4792 which originated in Europe / Turkey and then moved further north in Europe, His decent was 98% Polish and the remaining Danish and Italian /southern Europe. VK474 can also be a descendant of slaves. So far, we have not noted a member of the Gotland Project who belongs to haplogroup E. There is another Viking in the study who belongs to E, VK362 who was buried in Denmark. However, he does not belong to the same haplogroup but to E-CTS5856 (possibly E-Z16663), which is a subgroup of E-V13 that probably spread across Europe during the Bronze Age.

VK479 is classified in **haplogroup G^{lv}**, which is a relatively rare haplogroup in the geographical vicinity. VK479 belongs to G2a, which is now called P15. They began to spread in the Stone Age from the area around present-day Iran / Iraq and are believed to have brought agriculture via Anatolia further into Europe. VK479 also belongs to L140-> L497, which takes us to the later European Stone Age into the Bronze Age. The lineage continues via Z726-> CTS4803, which takes us into the latter part of the Western European Bronze Age and then probably further into the Western European Iron Age. This is in line with the determination of the ancestry, which in the study was stated to be mostly Danish and British / North Atlantic.

VK467 is classified in **haplogroup CT**. It is one of the original haplogroups and has reportedly not been noted in modern humans. The men noted in CT are in either CF or DE. DE is divided into D-CTS3946 and E-M96 while CF is divided into Asian and oceanic haplogroup C-M130 and F-M89^{vi}. Perhaps VK467 represents a remnant of our prehistory and perhaps he would have been placed in the E-M96 or a subgroup and is a result of the slave trade or former soldiers of the Roman Empire. The latter is pure speculation on our part, but the fact that VK467 is classified in CT tickles both the mind and the imagination.

We have also compared VK individuals found on Gotland against the others in the study to see if the same haplogroups occur in other places. The result was as follows:

Individual	Location	Sex	Y-DNA	Match yDNA
VK48	Gotland_Kopparsvik-212/65	Male	R-FGC52679	No match noted
VK50	Gotland_Kopparsvik-53.64	Male	I-Y22923	VK380 is in the same haplogroup
VK51	Gotland_Kopparsvik-88/64	Male	N-L1026	No match noted
VK53	Gotland_Kopparsvik-161/65	Male	I-CTS10228	No match noted
VK57	Gotland_Frojel-03601	Male	R-L151	VK217 is in the same haplogroup
VK60	Gotland_Frojel-00702	Male	R-YP1026	No match noted
VK64	Gotland_Frojel-03504	Male	R-BY58559	No match noted
VK232	Gotland_Kopparsvik-240.65	Male	R-P310 eller R-Y16505	If R-P310 is correct, there is a match to VK75, otherwise no match has been noted
VK251	Gotland_Kopparsvik-30.64	Male	R-M459	Not sufficient sequencing to be meaningful to

				conduct any further matching.
VK430	Gotland_Frojel-00502	Male	N-S18447	No match noted
VK431	Gotland_Frojel-00487A	Male	R-P312	No match noted
VK438	Gotland_Frojel-04498	Male	R-CTS11962	Match noted for VK212 and VK408
VK452	Gotland_Kopparsvik-111	Male	R-CTS11962	See above for VK438
VK453	Gotland_Kopparsvik-134	Male	R-YP256	No match noted
VK461	Gotland_Frojel-025A89	Male	N-Y5005	No match noted
VK463	Gotland_Frojel-019A89	Male	R-Y13467	No match noted
VK467	Gotland_Kopparsvik-181	Male	CT	No match noted
VK468	Gotland_Kopparsvik-235	Male	R-BY125166	No match noted
VK469	Gotland_Kopparsvik-260	Male	R-FGC17230	No match noted
VK471	Gotland_Kopparsvik-63	Male	R-M417	Not sufficient sequencing to be meaningful to conduct any further matching.
VK473	Gotland_Kopparsvik-126	Male	I-S14887	No match noted
VK474	Gotland_Kopparsvik-137	Male	E-Y4971	No match noted
VK475	Gotland_Kopparsvik-187	Male	R-BY27605	No match noted
VK479	Gotland_Kopparsvik-272	Male	G-Y106451	No match noted

For yDNA, this is an indication that there were relatively few matches. It is really only VK50 that is analysed so far down that we can say that he and VK380 were probably closely related on the paternal side. This may explain the estimated ancestry for VK50 as he has mainly been analysed to be primarily of Swedish descent and secondarily Finnish. There is no assessment of the lineage for VK380, but since he was found on Öland, which is so close to the Swedish mainland that there is reason to assume that the Vikings on Öland would have the same or similar profile as those of Swedish descent. VK50 may have moved to Gotland either directly or someone / a few generations away and that the lineage is on Öland or the Swedish mainland. Although there are individuals that match each other at the haplogroup level, these are matches that either appear to have taken place in the Stone Age or the Bronze Age. What we can note, however, is that there are few matches overall and that the matches are two Swedish (VK380 and VK217), the rest are Russian (VK408), from Greenland (VK75) and from Poland (VK212). Maybe the Viking men did not move in the same extent as the women? This is a question that we cannot answer in the project.

We have also made a review and comparison of haplogroups noted in the study against haplogroups in the yDNA project. The following matters were noted:

- VK259 and VK449 share a paternal lineage with kit 579206, which has a documented line to 17th century Gotland with Anders Persson, born 1682 in Lokrume and his father Pehr Andersson, dead in Lokrume in December 1735. Both VK259 and VK449 belong to R-M343, former R1b. With these two, the Gotland R1b tree grows further. Both belong to the R-P310. This, as noted earlier in this paper, was a Central European Bronze Age group that was one of the dominant groups during the Yamna period. Both are then placed in the U106 subclade, a Central European group that probably originated during the Bronze Age. But here their lineage differs from what we previously

found for VK232, VK468 and VK469 as they continue to Z18, implying that we end up in the Nordic Bronze Age. Through the continued lineage in Z17-> Z372-> S5695-> S4031-> S3207 we continue further into the Iron Age. S3207 has been noted in the Nordic countries and in Scotland, where it was certainly brought by the Vikings. The ancestry for VK259 has been stated as mostly British / Atlantic and Norwegian and to some extent Finnish as VK449 is British / Atlantic, Danish and Norwegian and somewhat Swedish. Whether VK259 and VK449 were born on Gotland and then died in the UK in connection with Viking raids or similar, or whether they lived there and their descendants moved to Gotland cannot be determined. Based on the assessment of their ancestry, it is somewhat more likely that the descendants moved to Gotland, but this is very difficult to conclude on.

- Kit 420973 is in the same haplogroup as VK309 from Varnhem (Sweden), R-YP6189. They have, as stated in the review of Vikings found on Gotland, their lineage via M417, a subclade to R-M240 found in Mesolithic northern Europe. The further origin via Z283-> Z282-> F6155-> M458-> Y2604 we continue via the proto-Slavic tribes (has also been noted in the corded ware culture) to Central Europe. L1029-> YP1703 brings us towards the present Czech Republic. Since the haplogroup was noted during the Viking Age, it may have ended up in Sweden in connection to the Slavic expansion in late antiquity^{vii}.
- There are five individuals in the study who either have I-P109 (subgroup I-M253-> L22) as the final haplogroup or pass through P109. All those in the Gotland project that are located via I-M253-> L22-> P109 are thus related to these individuals. However, this haplogroup arose in the Late Stone Age / Early Bronze Age, implying that the common ancestor lived far back in time.
- Kit 651365 currently is placed in haplogroup I-Z042. This is a subclade to I-Z041 and I-Z2040. This applies to the two individuals VK445 and VK446 found in Denmark. Through Z2040 we end up in the later Stone Age. It cannot be ruled out that a closer relationship could be proven if VK445 and VK446 was further analysed.
- It was noted that VK39 from Varnhem (Sweden) has a shared paternal lineage with VK479 from Kopparsvik on Gotland. However, VK39 has its current final haplogroup in G-Z1817, which is the same for VK479. However, it is not possible to see if VK39 would still be in the same haplogroup as VK479 if a further analysis could be made.

Conclusion

If the women came to Gotland continuously during the history of the island, the history of man appears to deviate from that of woman. Stone Age groups seem to have disappeared and new groups arrived. Although both men and women immigrated to Gotland in waves, immigration seems to have had a more dramatic effect on men as noted through the apparent change in noted haplogroups. Based on the analysis, it is at least two kits that is related to an individual of the Viking-study, one kit where it is very likely and another where a Y700 can show kinship. No kinship with the prehistoric groups have been noted, although we still believe that if any descendant of this group were to be found anywhere in Europe, Gotland could be the place for this based on its location and history.

It can be questioned if we now, with the increased opportunities for analysis of results that are available to us, have come closer to the answer to the question where the Gotlanders came from. The answer to that question can be answered with a no, but that would not be a fully accurate answer. In a way, we have come closer to the history, even though we have at the same time realised how more complex the picture, and the story, is. We understand more but despite that, the mystery has increased.

From today's geographical perspective, Gotland is part of Scandinavia. While Sweden and Denmark have both claimed supremacy over the island throughout history, the available DNA evidence paints a slightly different story. It is however important to understand that DNA evidence from the early period in the history of the human population on Gotland is scarce, and that new findings from this and other periods could point us in a different direction entirely.

During prehistoric times, Gotland was, from a genetic perspective, not mainly Scandinavian but rather Baltic, Central European and Eastern European. In the project, we have theorised that most of the inhabitants lived in small "village states", but that the first inhabitants were relatively easily defeated by the peoples who then arrived to the probably sparsely populated island and the population was mixed up. Perhaps it was these first small village states that was the origin of today's parishes that still exist. The women remained to a greater extent than the men in this turbulent time, and we see that their history on Gotland continue to differ from that of man.

As we have written, the Bronze Age probably implied a relatively high rate of immigration of new ethnic groups to the island. This is noticeable by the DNA results that are available as the haplogroups increase markedly. We see a continued large spread and variation in mtDNA. Among yDNA, the variation is lower, but we now see with the increased number of Y700 tests that are done that, although there are a number of main groupings, the number of subclades increases. This in itself indicates that there may be a kinship between the Gotlanders, but the kinship on the paternal side so far appears to have occurred back in time. For example, through DNA analysis, we can say that kit IN95287 and kit 611605 share an ancestor who lived just over 4,000 years ago. Where the person lived is difficult to say, but it was probably not on Gotland.

Through DNA, we are also beginning to discern the nuances of the immigration to Gotland. We see the descendants of those who migrated during the Bronze Age, of the slaves who were brought here and the Vikings who brought them here, but also those who came via the Hansa and those who came later. Kits N112691 and IN26214 are probably descendants of slaves from the British Isles as their DNA takes us back to Ireland / Scotland. Kit 680955 probably came via Eastern Europe and left the Caucasus sometime in the (early) Bronze Age and migrated west. Kit 611605 is related to VK50 on the paternal side and the line has been on Gotland since at least the year 950-1050. Kit MI11037 is probably related to VK48 and kit 408740 and M132603 is probably related to VK468, at least via a common ancestor who lived sometime during the Bronze Age. We then have kits IN82768, BP10514 and 449791 which may have arrived in Gotland through the Hanseatic league. The mitochondrial DNA is more difficult to analyse than yDNA, but we see

(probably) the descendants of those who came during the Bronze Age or earlier than that, the thralls who were brought here and those who came to marry or accompanied their husbands.

We now also see that the fathers of the Gotlanders appear to remain to a greater extent than before and we can see descendants of the Viking Age inhabitants in the Gotland project. The earliest Gotlanders we know, the descendants of the sons not been found, however the history of their mothers differs from that of the men at this point. Some of the tested individuals are probably descendants of both those who immigrated earlier and those who came during the later parts of the Bronze Age and the Iron Age, as well as that they came to Gotland through marriage to Vikings and as their slaves. Regardless of the reason, we see a great diversification of the population. It is a sudden emergence of new haplogroups, which implies new cultures and groups of people arriving.

It is however difficult to know whether the significantly increased number of haplogroups that resulted from the study^{lviii}, arrived in Gotland during the Viking Age, or whether immigration to the island gained momentum earlier in the Iron Age or whether it even occurred during the changes brought about by the Bronze Age. In order to further understand this, more tests of historical material are required. It is clear, however, that the population on Gotland increased and that their descent became more and more widespread. There is a scarcity of tested historical remains, and we respect the fact that the results from a study can completely change the current understanding of the history. But from being more Baltic, Central European and Eastern European during the early history, the population gradually became more connected to Scandinavia. How this happens and when can only be answered by more research and we hope to be able to return to this, and other questions, later in our continued reviews.

For the Gotland Project July 287, 2021

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- v <https://www.sciencemag.org/news/2019/10/why-are-adult-daughters-missing-ancient-german-cemeteries>
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