The settlement of Iceland: A preliminary analysis of strontium isotopes in human remains

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Introduction

This project involves the study of the pattern of the settlement of Iceland through the analysis of strontium isotope of human tooth enamel from skeletons dating to the pagan (c. pre AD 1000) and early Christian (c. post AD 1000) periods.

> Although strontium *concentrations* in plant and animal tissue vary with trophic position, the isotopic composition of strontium is not changed (fractionated) by biological processes due to the very small relative mass differences of the strontium isotopes (m=84, 86, 87 and 88). The lack of mass fractionation of strontium in processes that are ephemeral relative to the age of the Earth is well established by more than three decades of research on the strontium isotope compositions of natural and synthetic materials (e.g. Faure, 1986). The strontium isotope composition of bones and teeth, therefore, will match those of the diets of the individuals, which in turn will reflect the strontium isotope composition of the local geology.
>
> (Price *et al.*, 1994: 320).

As the enamel of teeth does not regenerate, the strontium isotope composition of an individuals enamel will match the strontium composition of the geology of the area where that individual lived constantly until about 6 years of age, by which time most of the enamel of the permanent dentition (apart from the third molar) is fully formed (Hillson, 1996). Therefore, by studying the strontium isotope of dental enamel from pagan and early Christian skeletons in Iceland it should be possible to identify the immigrants from the resident Icelanders.

Iceland is a fascinating place in which to study strontium isotopes. It is one of the youngest landscapes on the earth, a volcanic island that emerged from the sea over the last 25 million years. This new volcanic bedrock has one of the lowest strontium isotope signatures on earth. Any migrants from northern Europe to the island will exhibit highly distinctive strontium isotope ratios in their tooth enamel, as they will most likely have come from geologically much older areas, such as south-western Norway, the Scottish isles and Ireland.

The aim of this pilot study was to test the strontium isotope method on Icelandic material, to see, if by selecting a large enough sample, that those not born in Iceland could be isolated, and therefore make a larger scale study of the colonization of Iceland possible; e.g. how long did the "Settlement period" last, where did the settlers come from, did the settlers in one area come from the same place?

The sample

There are a total of 182 skeletons preserved from pagan burials in Iceland. Of these about 30% are well preserved. More than 90% of the burials are adults; approximately 68% are male and 32% are female (Gestsdóttir, 1998b).

A total of 46 pagan skeletons from 36 locations were sampled. Of these 14 were single inhumations and 6 were both skeletons from double inhumations. The rest are 1-3 skeletons from burial groups of between 2-14 individuals. In most instances there is no clear dating evidence for these burials. The pagan period in Iceland is traditionally considered to last from the first settlement towards the end of the 9th century until AD 1000. Datable grave goods from pagan burials support this, all of them falling in the period between the middle of the 9th century – 10th century. Of the pagan-period skeletons sampled here, 22 (47.8%) have datable grave goods. Samples have been taken of several pagan skeletons for C14 dating, but none of those results have been published as yet. For further detail of the pagan skeletons in the sample see Appendix A.

For the Christian burials the remains from two cemeteries, Skeljastaðir in Þjórsárdalur and Haffjarðarey in Haffjörður were analysed. The cemetery at Skeljastaðir was excavated in 1939 by the then state antiquarian Matthías Þórðarson, as a part of a Nordic project involving the excavation of eight Viking age farms in Þjórsárdalur (Þórðarson, 1943). The cemetery had been greatly disturbed before the excavation. Records from last decades of the 19th century detail the erosion of the site (Jónsson, 1885). Eiður Kvaran, an anthropologist at the University of Greifswald, Germany, carried an excavation out there in 1935. He excavated at least 30 skeletons and took them to Germany, where they were subsequently lost during the Second World War (Þórarinsson, 1968). Skeljastaðir is not mentioned in any documentary sources, but the oral tradition states that Skeljastaðir cemetery had served all of Þjórsárdalur

(Jónsson, 1885). There is no dating evidence suggesting when Skeljastaðir cemetery first came into use, but it is likely that burials there ceased when Þjórsárdalur was abandoned due to the AD 1104 eruption in Mt. Hekla (Þórarinsson, 1968), although more recent studies at Stöng, a neighbouring settlement, suggests activity there into the 13th century (Vilhjálmsson, 1988). The nature of the burials, the fact that there is little or no intercutting of the graves, suggests that the cemetery was not in use for a very long period, not more than a 100 years or so, c. AD 1000-1104 (Þórðarson, 1943). Fifty-six skeletons from the cemetery at Skeljastaðir are preserved in the Icelandic National Museum, and 33 of these were sampled. For further information on the Skeljastaðir skeletons sampled, see Appendix B.

The earliest documented reference to the cemetery in Haffjarðarey dates to 1223. Although it is not known when the cemetery first came into use, it is known is that it went out of use in 1563, and so it was probably in use for approximately five centuries, c. 1200-1563 (Steffensen, 1945). The island is severely affected by erosion, and sources from the early 18th century mention exposure of human skeletal remains in the cemetery these (*JJ:*p45). Bones were first removed from the cemetery in Haffjarðarey in 1905, when Vilhjálmur Stefánsson removed at least 50 skulls that lay on the surface and took with him to the United States. There are also records of medical students removing bones from the site for comparative material. Jón Steffensen and Kristján Eldjárn excavated the bones from the Haffjarðarey cemetery preserved in the Icelandic National Museum, in 1945. They excavated a total of 24 *in situ* skeletons, and in addition removed bones representing at least 34 individuals, so the total collection represents 58 individuals. The extent of the erosion of the cemetery prior to the excavation in 1945 means that it is difficult to determine how large a percentage of the original population this represents. (Steffensen, 1945). The lack of any dating evidence from the excavation means that it is not known when in the period of use of the cemetery the skeletons excavated date. A total of ten skeletons from Haffjarðarey were sampled. For further information on the Haffjarðarey skeletons sampled, see Appendix B.

For the location of the sites sampled in this project, see Figure 1.

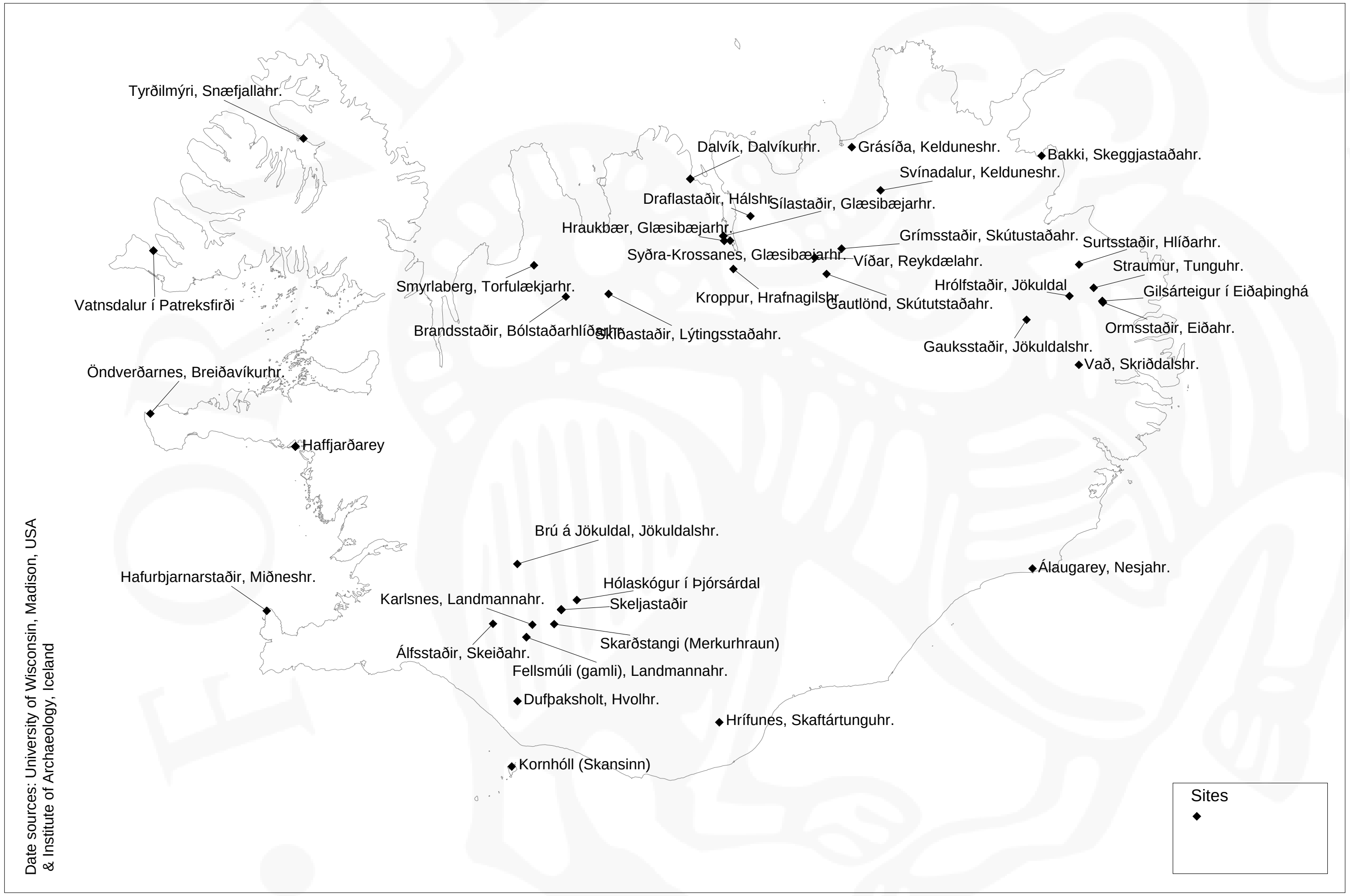

Figure 1. The sites

The total number of enamel samples to be examined in this study was 90. Where possible the first molar was sampled, with a quarter of the tooth sawed off. In those instances where an incisor, canine or premolar was sampled, half the tooth was used for the analysis. Teeth displaying pathological lesions or non-metric traits were avoided, as were teeth still sat in the alveolar bone, even if it meant sampling teeth other than the first molar.

In addition 4 modern sheep bones and teeth from the northern, eastern, southern and western regions of the country were sampled to confirm the local Icelandic strontium isotope signal, for comparative purposes. These were from Jaðar, Heggstaðanes (north), Brú, Biskupstungur (south), Ormarsstaðir, Fellum (east) and Kjóafell, Kjós (west).

Method

The tooth samples were mechanically abraded with a Dremel tool fitted with a sanding bit to remove any visible dirt and/or preservative and drilled to remove the enamel layer from the underlying dentine.

Tooth enamel samples were then transferred to sterile savilex digestion vials and hot digested in ultrapure concentrated nitric acid, dried in a sterile laminar flow drying box, and redisolved in ultrapure 2.5 N hydrochloric acid. This procedure was repeated if there were any trace organics remaining in the sample. Strontium was then isolated using cation exchange chromatography with 2.5 N hydrochloric acid as the mobile phase.

Samples were then mounted on zone-refined tantalum filaments, and strontium was analysed using a thermal ionisation multiple collector mass spectrometer (TIMS). 87Sr/86Sr ratios were corrected for mass fractionation in the instrument using the exponential mass fractionation law and 86Sr/88Sr = 0.1194. The samples were measured using a MicroMass Sector 54. ^{87}Sr/^{86}Sr analyses (n = 40) of the NIST SRM strontium carbonate yielded a value of 0.710259 +/- 0.0003 (2 SE). Internal precision (standard error) for the samples analysed at UNC-CH is typically 0.000006 to 0.000010, based on 100 dynamic cycles of data collection.

Results

The results of the strontium analysis of the human dental enamel are detailed in Appendix C, and the distribution of the strontium analysis is shown in Figures 2 and 3. The results of the analysis of the sheep teeth, which form the base line against which the human tooth enamel strontium signatures are compared against, are shown in Appendix D.

As can be seen the majority of the results fall between sample 1 (0.705620) and sample 81 (0.709325), and which marks the natural variation within Iceland, as supported by both the comparative material and Figure 2. However, between samples 81 and 82 (0.709722) there is a clear break, and a sharp upward move in the curve in the last nine samples (82-90) indicating that they did not originate in Iceland.

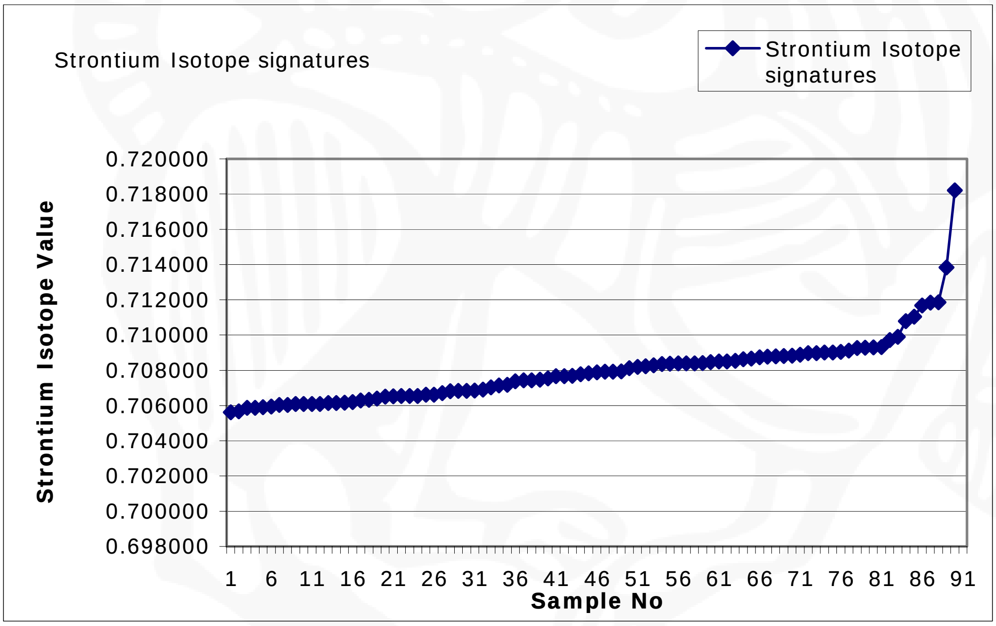

Figure 2. Strontium isotope signatures

The factors that need to be discussed in view of these results are the reason for the variation within the "Icelandic" samples (1-81) and the origin of the individuals who clearly fall outside that range (samples 81-90).

Conclusion and further work

Of the 90 individuals in the sample, 9 individuals have strontium levels which fall outside the normal Icelandic range, and were therefore clearly not born in Iceland and did not to move there until after 6 years of age. These are 8 individuals from pagan burials, Hafurbjarnarstaðir, Miðneshreppur, Gullbringu- og Kjósarsýsla (HBS-A-6), Skarðstangi, Merkurhraun, Rangárvallasýsla (MEH-A-1), Draflastaðir, Hálsahreppur, Suður-Þingeyjarsýsla (DSH-A-1), two individuals from Sílastaðir, Glæsibæjarhreppur, Eyjafjarðarsýsla (SSG-A-1 & SSG-A-4), Dalvík, Dalvíkurhreppur, Eyjafjarðarsýsla (DAV-A-9), Kroppur, Hrafnagilshreppur, Eyjafjarðarsýsla (KRE-A-1) and Brú, Jökulsdalhreppur, Árnessýsla (BAJ-A-1). The ninth individual is from the cemetery at Skeljastaðir, Árnessýsla (ÞSK-A-39). The next step will therefore be to obtain comparative material from the areas where the individuals are likely to have originated, to establish an idea of where they came from. The areas that will firstly be concentrated on are south-west Norway, the Scottish isles and Ireland, and work has already commenced in finding collaborators to provide comparative samples.

The Icelandic variation in strontium signature, from 0.705620 (ÞSK-A-28) to 0.709325 (SSG-A-3), is most likely explained by variation in diet, from almost entirely terrestrial (the lower figures) to almost entirely marine (the higher figures). This is because Iceland is geologically young and the rubidium has not had time to decay into strontium 87, so the strontium ratio of Icelandic rock is very low, circa 0.703, which means that the strontium ratio of people who lived mainly on a terrestrial diet will be closer to that figure. On the other hand the strontium ratio of seawater around the globe is much higher circa 0.7095 so people eating a fully marine diet will have strontium ratios nearer that. The mapping of the spatial distribution of the strontium isotope signatures supports this theory; in most instances there is a correlation between the accessibility to the sea and the strontium isotope signature. This is further supported when looking at the results from the two cemetery sites, Skeljastaðir and Haffjarðarey. Skeljastaðir cemetery is situated as far inland as settlement is possible within Iceland, while Haffjarðarey is on a small island. This means that the diet of the people who lived in these two locations is likely to have been drastically different, as is reflected in the results of the results of the strontium

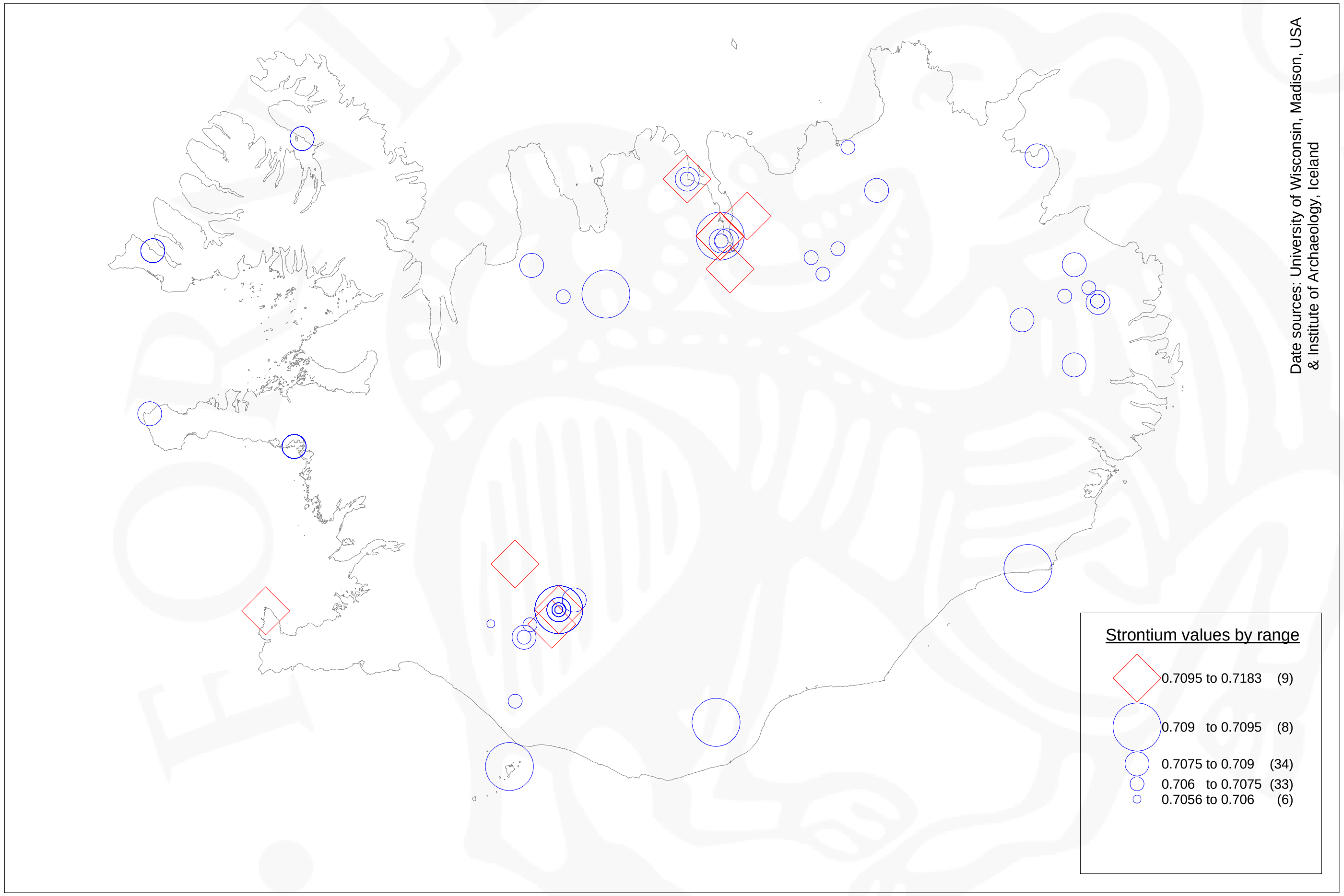

Figure 3. Strontium isotope signatures by range.

analysis. The ten skeletons analysed from Haffjarðarey all have a strontium isotope signature above 0.7078, towards the higher end of the normal range for Iceland, suggesting that their diet was mainly marine based. Of the Skeljastaðir material, 24 (72.7%) have a strontium isotope signature under 0.7075, or towards the lower end of the normal range, suggesting that their diet was mainly terrestrial based. Of the rest of the Skeljastaðir skeletons, 8 (24.2%) have signatures indicating that their diet before 6 years of age was mainly marine based, and 1 (3%) was clearly not born in Iceland. See Figure 4 for further information.

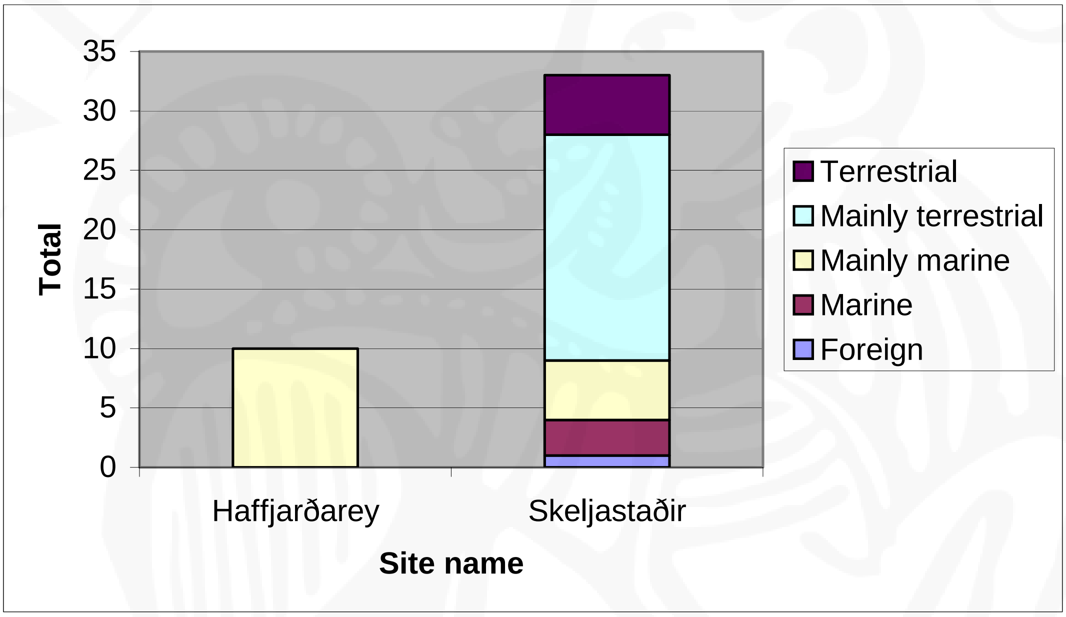

Figure 4. Distribution of strontium isotope signature in the Skeljastaðir and Haffjarðarey cemeteries

These results suggest that the potential analysis of this material is great, as strontium in the human body is also stored in the bones, and as bones continue to be remodelled throughout life, the strontium isotope signature in the bones will reflect the geology and the diet of the region that that person spent the last few years of their life in. This means that it would be possible to look at individual changes in marine versus terrestrial diet and use that data to hypothesise about changes in diet, which is most likely to be associated with movement of people within Iceland.

Today there are two projects involved in carrying out C14 dating of pagan and early Christian skeletons in Iceland, and collaborations with these projects will mean that more accurate information as to the date of each site will be available in the future.

The potential for further isotope analysis in Iceland:

- Identifying the immigrants. It may be possible to estimate how long the "Settlement period" lasted and what percentage of the population the immigrants represented. This could only be done when more accurate dates are made available.
- Identifying the area of origin of the immigrants. Did most of the immigrants come from the same place? Were the immigrants from the same place settling the same areas in Iceland? This would also open up opportunities for co-operation with work being carried out in the places where the immigrants originated.
- Further study of the variation of the strontium ratios within the Icelandic material. Is this mainly influenced by the terrestrial versus marine diet? This would create further opportunities for dietary studies in Iceland.
- Comparisons of tooth versus bone strontium isotope ratios within individuals, to record changes in diet, which in turn could probably be useful for the study of movement within Iceland, as these changes are most likely to be caused by changes in accessibility to food recourses.

Acknowledgements

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Appendix A. Pagan burials

Place name	Accession no.	Age[1]	Sex
Álaugarey, Nesjahr.	AEY-A-1	35-45	Female
Álfsstaðir, Skeiðahr.	ASS-B-1	18-25	Female
Brú á Jökuldal, Jökuldalshr.	BAJ-A-1	45+	Male?
Bakki, Skeggjastaðahr.	BBE-A-1	35-45	Male?
Brandsstaðir	BRB-A-1	18-25	?
Dalvík, Dalvíkurhr.	DAV-A-1	25-35	Male
	DAV-A-5	45+	Male
	DAV-A-9	18-25	Female?
Draflastaðir, Hálshr.	DSH-A-1	35-45	Male
Dufþaksholt, Hvolhr.	DUH-A-1	35-45	Male
Fellsmúli (gamli), Landmannahr.	VDS-A-1	Adult	?
	VDS-B-1	45+	Male?
Gauksstaðir, Jökuldalshr.	GSJ-A-2	45+	Male?
Gautlönd, Skútutstaðahr.	GLÞ-A-1	35-45	Male
Gilsárteigur, Eiðaþinghá	GTE-A-1	18-25	Male
	GTE-A-2	35-45	Male
Grásíða, Kelduneshr.	GSV-A-1	18-25	Male
Grímsstaðir, Skútustaðahr.	GRS-A-1	35-45	Male
Hafurbjarnarstaðir, Miðneshr.	HBS-A-6	35-45	Male
Hólaskógur í Þjórsárdal	ÞHS-A-1	35-45	Female?
Hraukbær, Glæsibæjarhr.	HRB-A-1	Adult	Male
	HRB-A-2	18-25	Female
Hrífunes, Skaftártunguhr.	HRS-A-2	35-45	?
Hrólfstaðir, Jökuldal	HSJ-A-1	35-45	Male
Karlsnes, Landmannahr.	KNS-A-1	35-45	Male
Kornhóll (Skansinn)	SVE-B-1	Adult	Female?
Kroppur, Hrafnagilshr.	KRE-A-1	35-45	Male?
Ormsstaðir, Eiðahr.	ORE-A-1	45+	Male
Sílastaðir, Glæsibæjarhr.	SSG-A-1	45+	Male
	SSG-A-3	35-45	Male
	SSG-A-4	35-45	Female?
Skarðstangi (Merkurhraun)	MEH-A-1	45+	Female?
Skíðastaðir, Lýtingsstaðahr.	VSL-A-1	36-45	Female?
Smyrlaberg, Torfulækjarhr.	SBT-A-1	45+	Male
Straumur, Tunguhr.	STT-A-2	45+	Male
Surtsstaðir, Hlíðarhr.	SSJ-A-2	35-45	Male
Svínadalur, Kelduneshr.	SVK-A-1	35-45	Male
Syðra-Krossanes, Glæsibæjarhr.	SYK-A-1	45+	Male
Tyrðilmýri, Snæfjallahr.	TMY-A-1	Adult	Male?
	TMY-A-2	25-35	Male?
Vað, Skriðdalshr.	VAS-A-1	35-45	Male
Vatnsdalur í Patreksfirði	VDP-A-5	35-45	Female
	VDP-A-6	25-35	Male
	VDP-A-7	35-45	Male
Víðar (Másvatn), Reykdælahr.	MKR-A-1	35-45	Male
Öndverðarnes, Breiðavíkurhr.	DKS-A-1	18-25	Unknown

[1] The ageing and sexing of the skeletons was carried out by Hildur Gestsdóttir (1998b).

Appendix B. Christian cemeteries

Site name	Accession number	Age[2]	Sex
Skeljastaðir	ÞSK-A-01	35-45	Female
	ÞSK-A-02	45+	Female
	ÞSK-A-05	18-25	Female
	ÞSK-A-07	45+	Male
	ÞSK-A-09	35-45	Female
	ÞSK-A-11	45+	Female
	ÞSK-A-12	35-45	Female
	ÞSK-A-15	35-45	Female
	ÞSK-A-16	35-45	Female
	ÞSK-A-17	35-45	Female?
	ÞSK-A-18a	35-45	Female
	ÞSK-A-19	35-45	Female
	ÞSK-A-20	25-35	Female
	ÞSK-A-24a	25-35	Female
	ÞSK-A-25	35-45	Female
	ÞSK-A-26	35-45	Male
	ÞSK-A-27	45+	Male
	ÞSK-A-28	35-45	Male
	ÞSK-A-30	25-35	Male
	ÞSK-A-31	25-35	Male
	ÞSK-A-32	18-25	Male
	ÞSK-A-36	35-45	Male
	ÞSK-A-37	45+	Male
	ÞSK-A-38	35-45	Male
	ÞSK-A-39	45+	Female
	ÞSK-A-40	45+	Male
	ÞSK-A-41a	25-35	Male
	ÞSK-A-42	35-45	Male?
	ÞSK-A-47	25-35	Male
	ÞSK-A-48	35-45	Male
	ÞSK-A-55	45+	Male
	ÞSK-A-59	45+	Female
	ÞSK-A-60	35-45	Male?
Haffjarðarey	HFE-A-11	30-59	Male
	HFE-A-14e	30-59	Male
	HFE-A-14f	Adult	Female
	HFE-A-14g	Adult	Female
	HFE-A-16	Adult	Female
	HFE-A-18	50+	Male
	HFE-A-19	30-59	Male
	HFE-A-20	30-59	Male
	HFE-A-22	30-59	Male
	HFE-A-24	Adult	Female
	HFE-A-34	Adult	Female

[2] The ageing and sexing of the skeletons from Skeljastaðir was carried out by Hildur Gestsdóttir (1998a), and of those from Haffjarðarey by Jón Steffensen (1945).

Appendix C. Results of the strontium analysis

	Place name	Accession no.	Strontium	Standard error ± 1 SD
1	Skeljastaðir	ÞSK-A-28	**0.705620**	0,0007
2	Skeljastaðir	ÞSK-A-12	**0.705678**	0,0006
3	Skeljastaðir	ÞSK-A-55	**0.705872**	0,0008
4	Álfsstaðir, Skeiðahr.	ASS-B-1	**0.705878**	0,0007
5	Skeljastaðir	ÞSK-A-05	**0.705906**	0,0008
6	Skeljastaðir	ÞSK-A-40	**0.705951**	0,0007
7	Karlsnes, Landmannahr.	KNS-A-1	**0.706031**	0,0008
8	Skeljastaðir	ÞSK-A-36	**0.706039**	0,0008
9	Skeljastaðir	ÞSK-A-38	**0.706080**	0,0006
10	Fellsmúli (gamli), Landmannahr.	VDS-A-1	**0.706084**	0,0007
11	Gilsárteigur í Eiðaþinghá	GTE-A-1	**0.706095**	0,0008
12	Skeljastaðir	ÞSK-A-26	**0.706096**	0,0008
13	Skeljastaðir	ÞSK-A-11	**0.706135**	0,0009
14	Skeljastaðir	ÞSK-A-48	**0.706141**	0,0008
15	Skeljastaðir	ÞSK-A-15	**0.706153**	0,0008
16	Skeljastaðir	ÞSK-A-31	**0.706203**	0,0007
17	Skeljastaðir	ÞSK-A-01	**0.706281**	0,0008
18	Dufþaksholt, Hvolhr.	DUH-A-1	**0.706333**	0,0006
19	Hraukbær, Glæsibæjarhr.	HRB-A-2	**0.706400**	0,0009
20	Víðar (Másvatn), Reykdælahr.	MKR-A-1	**0.706498**	0,0007
21	Skeljastaðir	ÞSK-A-42	**0.706528**	0,0006
22	Skeljastaðir	ÞSK-A-30	**0.706534**	0,0008
23	Skeljastaðir	ÞSK-A-09	**0.706535**	0,0008
24	Skeljastaðir	ÞSK-A-59	**0.706536**	0,0008
25	Gautlönd, Skútutstaðahr.	GLÞ-A-1	**0.706613**	0,0008
26	Skeljastaðir	ÞSK-A-17	**0.706619**	0,0008
27	Skeljastaðir	ÞSK-A-27	**0.706713**	0,0009
28	Skeljastaðir	ÞSK-A-24a	**0.706817**	0,0009
29	Skeljastaðir	ÞSK-A-47	**0.706824**	0,0007
30	Grásíða, Kelduneshr.	GSV-A-1	**0.706836**	0,0008
31	Skeljastaðir	ÞSK-A-32	**0.706846**	0,0008
32	Straumur, Tunguhr.	STT-A-2	**0.706909**	0,0008
33	Skeljastaðir	ÞSK-A-41a	**0.707038**	0,0008
34	Grímsstaðir, Skútustaðahr.	GRS-A-1	**0.707132**	0,0007
35	Skeljastaðir	ÞSK-A-60	**0.707180**	0,0008
36	Brandsstaðir	BRB-A-1	**0.707373**	0,0008
37	Dalvík, Dalvíkurhr.	DAV-A-5	**0.707427**	0,0008
38	Hrólfstaðir, Jökuldal	HSJ-A-1	**0.707435**	0,0007
39	Gilsárteigur í Eiðaþinghá	GTE-A-2	**0.707466**	0,0008
40	Skeljastaðir	ÞSK-A-16	**0.707543**	0,0006
41	Surtsstaðir, Hlíðarhr.	SSJ-A-2	**0.707669**	0,0008
42	Skeljastaðir	ÞSK-A-20	**0.707669**	0,0008
43	Skeljastaðir	ÞSK-A-18a	**0.707693**	0,0006

	Place name	**Accession no.**	**Strontium**	**Standard error ± 1 SD**
44	Svínadalur, Kelduneshr.	SVK-A-1	**0.707778**	0,0007
45	Syðra-Krossanes, Glæsibæjarhr.	SYK-A-1	**0.707822**	0,0007
46	Haffjarðarey	HFE-A-34	**0.707886**	0,0007
47	Fellsmúli (gamli), Landmannahr.	VDS-B-1	**0.707913**	0,0008
48	Skeljastaðir	ÞSK-A-19	**0.707927**	0,0007
49	Gauksstaðir, Jökuldalshr.	GSJ-A-2	**0.707934**	0,0007
50	Hólaskógur í Þjórsárdal	ÞHS-A-1	**0.708113**	0,0008
51	Dalvík, Dalvíkurhr.	DAV-A-1	**0.708200**	0,0008
52	Haffjarðarey	HFE-A-24	**0.708238**	0,0006
53	Haffjarðarey	HFE-A-14g	**0.708276**	0,0008
54	Hraukbær, Glæsibæjarhr.	HRB-A-1	**0.708351**	0,0007
55	Smyrlaberg, Torfulækjarhr.	SBT-A-1	**0.708372**	0,0007
56	Haffjarðarey	HFE-A-19	**0.708396**	0,0007
57	Bakki, Skeggjastaðahr.	BBE-A-1	**0.708401**	0,0007
58	Haffjarðarey	HFE-A-16	**0.708401**	0,0008
59	Haffjarðarey	HFE-A-22	**0.708407**	0,0009
60	Skeljastaðir	ÞSK-A-07	**0.708456**	0,0007
61	Vatnsdalur í Patreksfirði	VDP-A-7	**0.708498**	0,0006
62	Haffjarðarey	HFE-A-11	**0.708505**	0,0008
63	Vatnsdalur í Patreksfirði	VDP-A-5	**0.708539**	0,0007
64	Vað, Skriðdalshr.	VAS-A-1	**0.708629**	0,0007
65	Haffjarðarey	HFE-A-14f	**0.708671**	0,0009
66	Ormsstaðir, Eiðahr.	ORE-A-1	**0.708745**	0,0007
67	Öndverðarnes, Breiðavíkurhr.	DKS-A-1	**0.708773**	0,0008
68	Tyrðilmýri, Snæfjallahr.	TMY-A-2	**0.708797**	0,0007
69	Tyrðilmýri, Snæfjallahr.	TMY-A-1	**0.708804**	0,0006
70	Haffjarðarey	HFE-A-14e	**0.708827**	0,0009
71	Vatnsdalur í Patreksfirði	VDP-A-6	**0.708884**	0,0007
72	Haffjarðarey	HFE-A-18	**0.708964**	0,0007
73	Haffjarðarey	HFE-A-20	**0.708964**	?
74	Skeljastaðir	ÞSK-A-25	**0.709001**	0,0007
75	Skeljastaðir	ÞSK-A-37	**0.709001**	0,0007
76	Skeljastaðir	ÞSK-A-02	**0.709051**	0,0007
77	Skíðastaðir, Lýtingsstaðahr.	VSL-A-1	**0.709117**	0,0009
78	Álaugarey, Nesjahr.	AEY-A-1	**0.709270**	0,0008
79	Kornhóll (Skansinn)	SVE-B-1	**0.709277**	0,0008
80	Hrífunes, Skaftártunguhr.	HRS-A-2	**0.709304**	0,0008
81	Sílastaðir, Glæsibæjarhr.	SSG-A-3	**0.709325**	0,0008
82	Skeljastaðir	ÞSK-A-39	**0.709722**	0,0008
83	Hafurbjarnarstaðir, Miðneshr.	HBS-A-6	**0.709906**	0,0007
84	Skarðstangi (Merkurhraun)	MEH-A-1	**0.710792**	0,0007
85	Draflastaðir, Hálshr.	DSH-A-1	**0.711042**	0,0007
86	Sílastaðir, Glæsibæjarhr.	SSG-A-4	**0.711674**	0,0007
87	Dalvík, Dalvíkurhr.	DAV-A-9	**0.711835**	0,0007
88	Kroppur, Hrafnagilshr.	KRE-A-1	**0.711861**	0,0007

	Place name	Accession no.	Strontium	Standard error ± 1 SD
89	Brú á Jökuldal, Jökuldalshr.	BAJ-A-1	**0.713839**	0,0008
90	Sílastaðir, Glæsibæjarhr.	SSG-A-1	**0.718212**	0,0008

Appendix D. Comparative material

Place name	Material	Age (in years)	Strontium signature
Brú, Biskupstungum (South Iceland)	Sheep Tooth	6-7V	**0.706067**
Kjóafell, Kjós (West Iceland)	Sheep Tooth	5V	**0.706384**
Ormarsstaðir, Fellum (East Iceland)	Sheep Tooth	7-8V	**0.705922**
Jaðar, Heggstaðanes (North Iceland)	Sheep Tooth	10V	**0.706965**