

Háskóli Íslands

Hugvísindasvið

Fornleifafræði

Iron Production in Iceland

A reexamination of old sources

Ritgerð til B.A. prófs í fornleifafræði

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Abstract

There is good evidence for iron smelting and production in medieval Iceland. However the nature and scale of this production and the reasons for its demise are poorly understood. The objective of this essay is to analyse and review already existing evidence for iron production and iron working sites in Iceland, and to assess how the available data can answer questions regarding iron production in the Viking and medieval times

Útdráttur

Góðar heimildir eru um rauðablástur og framleiðslu járns á Íslandi á miðöldum. Mikið skortir hins vegar upp á skilning á skipulagi og umfangi þessarar framleiðslu og skiptar skoðanir eru um hvers vegna hún leið undir lok. Markmið þessarar ritgerðar er að draga saman og greina fyrirliggjandi heimildir um rauðablástursstaði á Íslandi og leggja mat á hvernig þær heimildir geta varpað ljósi á álitamál um járnframleiðslu á víkingaöld og miðöldum.

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Introduction

Iceland is a country located in the North Atlantic (Björn Jóhannesson 1960). There is high incidence of peat soil, which can include bog iron (Björn Jóhannesson 1960: 42). Iceland is considered young not only because of its geological formation but because its soil dates back to only 10,000 years old (Björn Jóhannesson, 1960: 41). Bog iron can be found in wetlands, and this was used locally during the Viking Age and throughout the medieval era (Þorbjörn Friðriksson and Márgret Hermanns-Auðardóttir 1992). Bog iron can be detected by the slick film that its presence leaves in water (Weronska 2009) The settlement of Iceland started around or shortly after AD 870, some 400 years after the start of the Late Iron Age in Scandinavia (Baudou 1992).

Research related to the distribution of iron production sites in Iceland has been started being carried out by danish archaeologist, Dr. Niels Nielsen, who was the first to make a comprehensive study of iron smelting locations. His study specifically centered on investigating several sites, as well as listing smithy sites around the country (Nielsen 1926: 137-147). Because of the fact that he was unable to date the sites, which he categorized as Viking Age sites or medieval, his research nowadays is considered to be incomplete (Smith 2005: 198)

The settlement of Iceland started around or shortly after AD 870, some 400 years after the start of the Late Iron Age in Scandinavia (Baudou 1992). A comparison of techniques between iron smelting in Iceland and Norway, which is where several authors (Smith 2005; Þorbjörn A. Friðriksson and Margét Hermanns-Auðardóttir 1992) believe is where most settlers seem to have come from will be made to have a contrast between the conditions necessary for smelting in two countries with different landscapes and resources.

Research background.

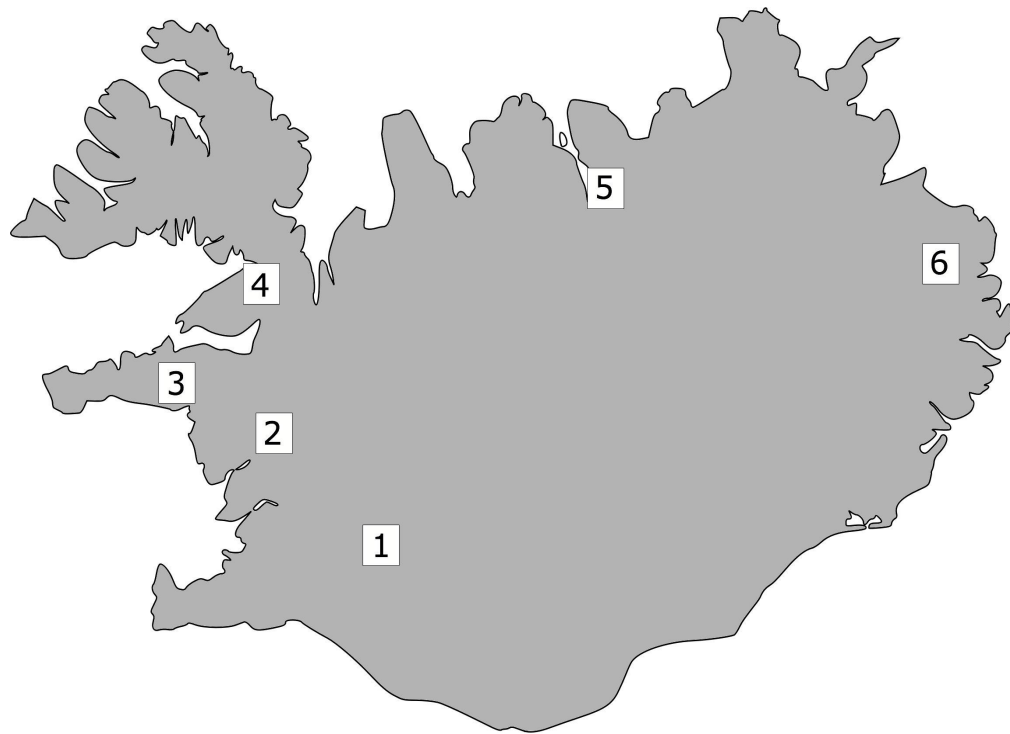
Several sites with slag material have been found in Iceland, which are associated with iron working, both from smithies as well as bloomeries. The bloomery process is the method by which iron is produced directly (Buchwald 2005: 90), bloomeries are the places in which the process of smelting iron takes place. In contrast smithies are places in which the product coming from the bloomery is worked, but also where any type of iron work (refining, repair) is done.

Several authors have discussed ironworking in Iceland. In terms of distribution of iron production sites in Iceland, Þorbjörn Friðriksson and Margrét Hermanns-

Auðardóttir, published a map of the location of iron working sites based on Nielsen's list. With this information about location, said authors suggested the possible trade routes from central production sites, in which smelting took place, into farms and other areas (Þorbjörn A. Friðriksson and Margrét Hermanns-Auðardóttir 1992).

The first person to properly research iron production in Iceland was Dr. Niels Nielsen, a Danish archaeologist who had previously worked in Jutland, in Denmark, conducting a similar type of research. He travelled around Iceland in 1923 and 1924. In his publication he listed 46 iron production sites (Kristín Huld Sigurðardóttir 2004: 119; Nielsen 1926: 137-147). His study focused on research of smelting slag and charcoal, as he did not excavate every site which he listed on his book, except for Gamli-Ossabær, and Belgsá in Fnjóskadalur). He was particularly descriptive of two specific areas, Borgafjörður with four sites and Fnjóskadalur with fourteen (Niels Nielsen 1926: 137-147). The most extensive descriptions are of two specific sites, Belgsá in Fnjóskadalur and Gamli-Ossabær in Landeyjar. The value of these observations is nowadays considered limited, since Nielsen's method of documentation was incomplete and he had no way of dating the site. His conclusion that the furnaces he found were different from Scandinavian ones is now considered unlikely (Smith 2005: 198).

Nielsen's research and subsequent investigations resulted in the identification of more than 100 sites (Kristín Huld Sigurðardóttir 2004), centered in six main areas of the country.



The areas are as follows:

1. Þjórsárdalur
2. Borgarfjörður
3. Snæfellsnes
4. Dalasýsla
5. Fnjóskadalur
6. Fljótshálsa

Þorkell Jóhannesson, an Icelandic historian, continued the research Dr. Niels Nielsen had started in regards to the distribution of iron production sites. *Iðnasaga*, where part of his research was published, was published in 1943. Using the list Dr. Nielsen had compiled he added further sites that he investigated and counted a total of 58, five of them located in Þjórsárdalur. Þorkell concluded, based on documentary evidence, that iron production had ceased by the 15th century, when foreign iron was bought both for the quality and because it was cheaper than the local product (Þorkell Jóhannesson 1943: 57-58).

Þorkell Jóhannesson and Niels Nielsen are the only two researchers in Iceland who have published a list of systematic research regarding iron production sites. Research on individual sites which are smithies or smelting sites has been continued, however no other compilation of every site found that presents ironworking has been

made. Margrét Hermanns-Auðadóttir and Þorbjörn Friðirkisson, who have as well studied several sites have yet not released a list in the same manner as Nielsen and Jóhannesson did, for that reason, the history of the research is discontinued after them.

Structure of the essay

The aim of this essay is to determine which conditions are necessary for the processing of bog ore and to analyse the distribution of sites. The essay will first focus in describing the basic background of the Iron Age, which is the period in which iron is adopted as a society-wide technology and therefore relevant in the discussion of bog iron processing. Iron working as a general activity will be described, not only limited to Iceland, which is a recently colonized island but also in Scandinavia in general. The characteristics of bog iron and the soil characteristics which facilitate its formation will be described in an attempt to understand its relation with the iron production industry. Dr. Niels Nielsen's list of production sites will be scrutinized, and an attempt to assess the value of his research will be made. A comparison between different maps depicting the location of iron production areas will be made. To add on, Þorkell's list will also be reviewed and to complete, utilising Sarpur a new list of possible sites will be compiled.

Chapter I: Historical background.

Brief historical background: The Iron Age in Scandinavia

The Iron Age in Scandinavia started later than further south in Europe, around the century 5th BC.

In Scandinavia the Iron Age is divided into two, the Early Iron Age before 1 AD followed by the Late Iron Age which includes the Viking Age, spanning from AD 800 to AD 1050 (Baudou 1992: 115). The economy during the Iron Age was of similar nature to that of the Bronze age and the Neolithic, based on agriculture and the domestication of animals such as sheep and cows (Milisauskas 2011: 409). The most relevant improvement regarding technology during this era was the adoption of iron. Although evidence of iron usage in previous times is noted, during the Iron Age the usage of iron became a common denominator in all of Europe. It began being used in ornaments and in several types of tools.

Iron also proved to be a more versatile working material, because it was widely available all around Europe and accessible, unlike bronze (Milisauskas 2011: 410). Its easy accessibility meant it was a cheaper material to exploit and skilled workforce was not required either (Heckschen 1968: 41)

In Scandinavia, questions remained unanswered about how the production of iron was organized. however several iron smelting areas have been identified which were dedicated to industrial-scale production of iron blooms, such as Jämtland, Gotland and Trøndelag (Baudou 1992: 123).

The settlement of Iceland

The settlement of Iceland is traditionally dated to AD 870-930. This date is supported both by the tephrochronology (Þorleifur Einarsson 1960) as well as pollen analysis conducted in regard to the changes of vegetation (Margrét Hallsdóttir 1987).

Iceland was settled by people with a north European Iron Age technology (Orri Vésteinsson et al., 2002: 99). The patterns of settlement chosen greatly affected the future of Icelandic vegetation and soil. The settlers, in order to convert forests into pastures, set of a process of deforestation, which contributed to the erosion of the soils. Although this behavior is understandable, it would in the future cause an environmental

impact that would make settlers vulnerable (Orri Vésteinsson et al., 2002: 102). The deforestation probably due to the creation of pastures must have occurred at a rapid rate after the settlement. Although the process of deforestation was in full force at the beginning of it, it continued throughout the medieval era, thus resulting in the landscape Iceland has today. The idea of rapid deforestation is supported by scientific evidence, provided by the analysis of pollen from birch (*Betula nana/pubescens*). The studies show a decline in pollen which implies the decrease of birch (Margrét Hallsdóttir 1996, Egill Erlendsson and Kevin J. Edwards 2009). By the end of the 12th century, it was not only erosion of the lands which had changed the environment of the island but there was also a change in temperature. Mann et al. (2009) state on their research the presence of a little ice age from 1400-1700, and a warm period from 950-1250 AD (Mann et al. 2009: 1256). This climatic change caused temperatures to drop to lower levels, which in turn affected the land productivity and the conditions for agriculture (Carter 2015: 31).

Dating of sites has suggested that the process of settling advanced at great speed (Orri Vésteinsson and McGovern 2012: 209). Most settlements in Iceland occurred in the lowlands where agriculture was possible. According to Orri Vésteinsson, the settlement period can be divided in two well defined phases. The first phase was the establishment of settlements in wetland areas, with fertile lands in which animal husbandry could be sustained (Orri Vésteinsson 1998: 21). The second phase corresponded to the settling of less accessible places and areas inland. The initial phase of settlement was characterized by proximity to the coast, possibly for the availability of fish during the winter (Orri Vésteinsson 1998: 10). There are various archaeological indications of transfer of farms and abandoned structures, possibly due to better conditions in other areas. Supposedly, when the forest clearance was being done during the first phase, it had the effect that some settlers transferred inland (Orri Vésteinsson 1998: 12). This transfer is due to the possibility to access better farmland for grazing which may have been covered by forests before.

The process of iron production in Scandinavia

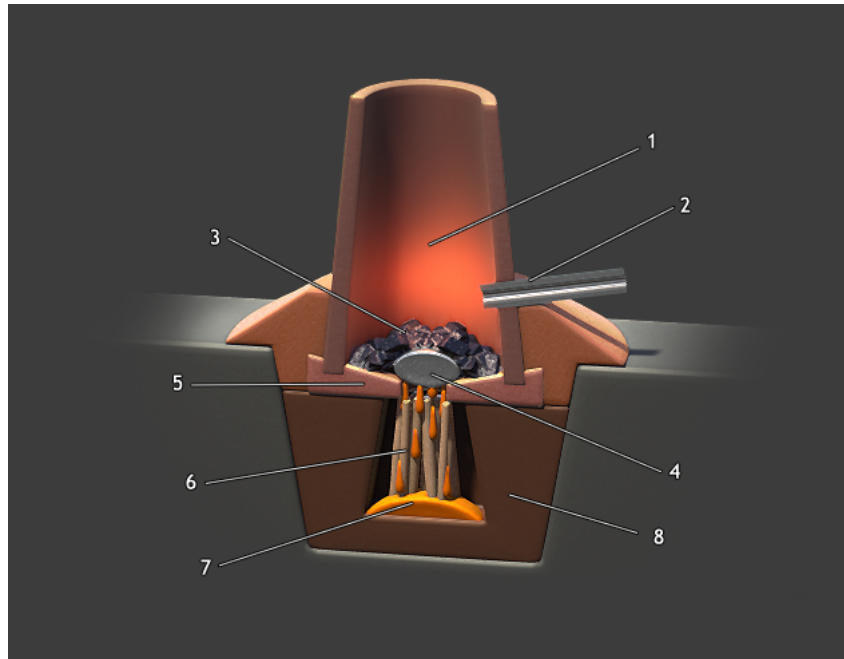
Although iron ores are available throughout Europe and particularly in Scandinavia, iron production did not start until a quite late period of human history. The advantages of iron over bronze (the previously used material) are obvious. What caused then a delay in the development of iron production? The answer to this is related to the

technologies and the process of smelting iron itself. Other metals have lower melting temperatures, which means that any impurities or slags are removed in the process of smelting. Thus, iron production became an integral part of the economy.

As in Iceland, in Sweden bog iron was easy to extract and did not require a skilled workforce, the bog iron is continually replenished by the precipitation of iron in the water (Heckschen 1968: 41). This meant that organization did not need to be as complex as in later periods when scale and size of operations required a different system, such as with the beginning of mining ores (Heckschen 1968: 42).

The process of iron smelting was done in furnaces with the bloomery method. The furnace was made of clay, most common material in Scandinavia, or other materials, possibly turf in the case of Iceland (Þorbjörn A. Friðriksson and Margrét Hermanns-Auðardóttir 1992). The objective was to heat the furnace to more than 1000 C. Due to the composition of iron, it requires higher temperatures (approximately 1538 C) to be reached in order to melt (Buchwald, 2005: 63). The iron oxides are indeed reduced and manage to form a spongy mass, a bloom. In order to remove the slag from the iron bloom it is necessary to smith it. Different types of slags are produced depending on the characteristics of the furnace or of the raw materials (Blakelock et al., 2009). Impurities are incorporated into the slag once the bog ore is being smelted. Because when the bloom forms slag and charcoal incorporate to it, it is necessary to hammer the bloom, usually done while it is still red-hot, in order to remove this excessive material.

Commonly in Scandinavia the type of furnaces utilized for the melting process were the same as in the rest of Europe, that is, the shaft furnaces (Stenvik 2003: 124-125). Shaft furnaces had slag pits and were fired with wood or other sources of fuel. The slag that would fall from the bloom of iron would get in the slag pit until it filled up. When that happened the furnace had to be broken down, the slag removed and the furnace rebuilt (Steinvik 2003: 125).



Mynd 1 Shaft furnace based on illustrations of Pleiner's book of Iron in archaeology (Pleiner 2000: 134)

The illustration above shows what a shaft furnace with a slag pit could look like. The numbers represent the different components of the furnace.

1. Body of the furnace, typically made of clay (Short 2010: 119).
2. Tuyere, to which bellows were attached to maintain constant temperature and heat (Short 2010:119)
3. Charcoal or fuel.
4. The bloom of iron (blástrjárn)
5. Clay disc for support.
6. Willow, which was used to stop the bloom from falling into the slag pit.
7. Slag separated from the bloom.
8. Earth surrounding the slag pit.

As the shaft furnace has been mentioned as the most typical type in Iceland, it is still important to give a classification of the different types of furnaces used during that period. This will help provide a better understanding of the furnaces found in Iceland.

Bowl-furnaces: This type of furnace is the simplest type to craft and therefore it is thought to be mainly used during the earliest period of smelting (Pleiner 2000: 163). This type of furnace is „an open hollow on earth lined with refractory clay“ (Pleiner 2000: 163).

Slag pit-furnaces: Building walls up made it possible to smelt bigger quantities of iron (this type of furnace has been explained above), and it is a pit in which the slag falls

into that is the addition. Different types of slag pit-furnaces exist, in which the design of the pit and its relation with the wall varies.

Scharmbeck/Drengsted furnace: A free standing shaft with a conical hearth (Pleiner 2000: 177); this type of furnace was investigated in the area of Hamburg.

Slog pits from Hegglesvollen: This particular furnace is described as an unusual type of slag pit furnace (Pleiner 2000:180). This type of furnace was seen in the area of Trondheim. The slag pits were left open by a slot on the side of the slope.

Shaft furnaces: Can be either operated with bellows or by induced draught (Pleiner 2000:190), containing or not containig slag pits.

Chapter II: Bog iron, slags and iron smelting in Iceland

Bog-iron: Its properties.

Bog iron ore is a subtype of bog ores the main component of which is iron. Bog iron ores have a brownish-reddish color and are usually found in peat bogs or swamps, that is, locations with shallow groundwater (Thelemann et al., 2017).

Due to the technology available during the Iron Age, and before the invention of blast furnaces, the preferred utilization of ores was those formed by sedimentary process, such as bog iron. Bog iron has limited quantity per volume of soil but is renewable. The formation of bog iron is “dependent on the local geomorphology of the terrain and the subsoil, these leads as a result to different types of concentrations” (Weronska 2009: 25). As has been described before, bog ore formation is heavily affected by both climate and the level of humidity. The distribution of the bogs in Iceland are usually uneven (Smith 2005:189) and the conditions that determines the areas for its formation besides their presence in wetlands seem not to be understood.

The characteristics of Iron make it bind more tightly to oxygen, than other elements, thus higher temperatures are required to reduce FeO to pure Fe (Killick 2014). In order to have an ore become usable for iron making purposes, it is important to reduce the ore into pure iron (Fe) the other materials composing the ore are separated in the form of impurities (slag). Bog ores are easy to reduce although their pure iron content varies, making some ores unusable for smelting (Pleiner 2000: 88).

The iron oxides Fe_2O_3 are during the process reduced to magnetite Fe_3O_4 , then to FeO and as a final result to pure iron: Fe .

Slag

Slags are produced during the process of smelting the bog iron. It is what is considered metalworking waste. Slag is usually composed by a mixture of metal oxides and silicon dioxides. In the case of slags originated from bog iron, they are usually composed by iron oxide (FeO), fayalite ($(\text{Fe}_1\text{X})_2\text{SiO}_4$) hercynite (FeAl_2O_4), leucite ($\text{KA1Si}_2\text{O}_6$) and glass (Vagn F. Buchwald 2001: 12)

Although in general slags became detached from the bloom and remained on the site of production, in some cases slag became attached to the bloom and was then present in all the process of iron working, until the final item had taken its shape (Buchwald and Wivel 1998). Due to the type of furnaces utilized during the Viking

Age (shaft furnaces) the temperatures they were able to reach did not cause slag to achieve a fully liquid state (Hauptmann 2014). Slag formation is dependent on the size and shape of the vessel in which the iron ore is smelted and on manual techniques (Pernicka 2014).

In Icelandic archaeology, slags are the best source of information regarding iron production. Many sites have not been fully excavated, however slag has been retrieved from them as slags are one of the materials that are most commonly found in excavation sites.

Commonly, slag waste in great quantities could indicate the presence of regular iron production. Therefore, it is slags which give the most information to help establish the distributions of sites in Iceland and, based on that, that the distribution of iron reserves.

Iron smelting in Iceland

Iceland is a country which has a high incidence of wetlands. There are variety of theories in regard to the fuel used to heat furnaces. Originally the first assumption of archaeologist was that charcoal was utilized as a main source of fuel, and therefore, birch forests were exploited for this purpose. However, upon recent research of remains in Hofstaðir, residues from combusting peat as well as turf were found (Simpson et.al 2003). Charcoal came from birch forests, which at the beginning of the settlement, as Íslendingabók suggests, covered a great part of Iceland. Margrét Hermanns Auðardóttir points out as an interesting fact that it seems as if birch woodlands lasted longer in those areas in which ironmaking was an important part of the economy (Margrét Hermanns Auðardóttir 2000: 5) which suggest careful managing of the forests exploited. However it may also mean that other forms of fuel were preferred as a whole, and that it was not in fact wood the main material for the functioning of the furnaces. If in places in which iron production is considered to be important in a certain area, but that area coincides with preservation of forests, the conclusion is that the material used to fuel furnaces may have been another one.

Iron making sites based on Nielsen's list and further updates such as Þorkell's and Margrét's and Þorbjörn's, were concentrated in six different areas, however from those six there are three regions in particular which have the greatest number of sites. These regions are Þjórsardalur, Fljótsdalshérað and Fnjóskadalur. However, as observed in chapter 3 of this thesis, the identification of these areas become somewhat

obsolete when Nielsen's methodology for classification of sites included sites which he had not investigated or had not been excavated. Thus, plenty of the sites he listed are lacking information to adequately conclude whether they are smithies, iron smelting sites or none of the previously mentioned.

The concentration of iron working sites contributes to a belief in the existence of trade routes in order to distribute the finished product. Margrét Hermanns Auðardóttir for example, maintains that there may have been a possible center of commerce for area in the fishing and farming districts, and that there existed bloomery centers, or sites dedicated to the production of iron for exchange and trade.

It is believed that in Iceland there was almost no industrial type production of iron and it was mainly oriented towards self sufficiency (farms providing for themselves the necessary iron they needed) and not commercial exchange (Buchwald 2001: 87). Areas that were further away could have benefited from exchanging. There are cases regarding the presence of exchange of salt water fish in inland regions, which suggests that an exchange network may have been present (Orri Vésteinsson 1998:10).

Technologies applied for iron smelting: Iceland and Norway?

The production of bloomery iron in northern Iceland as well as certain areas of southern Iceland according to Espelund's view, was similar within Iceland (Espelund 2007: 48). Although there seems to be evidence regarding similarities between methods of production between Sweden and Norway, the case itself is not so obvious with Iceland and Norway. To begin with, there is a serious lack of information regarding furnaces in Iceland itself, which makes it complicated to state that methods of production may be similar. Espelund claims that the only differentiation from the methods was the use of different type of furnace (being that it lacked the clay material that Norwegian furnaces were made of, clay). It is a common debate among archaeologists from what material Icelandic were made of. Other researches suggest that the usage of clay was replaced by turf, since dry turf is a good insulating material (Þorbjörn A. Friðriksson and Margrét Hermanns-Auðardóttir 1992).

The main component of analysis in iron production sites is slag. However, the slag heaps cannot so far, provide information regarding how the methods of iron smelting were applied and in which manner.

Regarding the origin of the slags, and thus the origin of the iron produced, Kristín Huld Sigurðardóttir's research about slag samples sheds light on the difficulty of probing the origin of slags. In her study Kristín Huld Sigurðardóttir 2004: 199) she concluded that although some differences between the smelting slag from Sweden and Norway could be observed(Kristín Huld Sigurðardóttir 2004: 120) , it was not possible to establish definite criteria for differentiation. The study was done analysing the chemical composition of different samples of smelting slag. This would mean that ore is hard to pin to a determined location and therefore making a comparison between the slags (which came from ore) from Iceland and Norway is difficult.

In regards to the techniques of ironmaking in Icelandic soil, two materials were necessary for the bloomery process. The first factor is ore and the second one is fuel (commonly believed to be used is wood). Both were widely available during the settlement period. In current day, wood is a rarity, covering only 1% of the land, with some recent new trees being planted. But, accounts of Íslendingabók suggest complete coverage of the lowlands and Trbojević's thesis estimates that 25% of the country was covered in wood forests. Espelund suggests that the preservation of trees in the iron making area of Fnjóskadalur was due to the farmers finding advantages in using birch for iron production rather than letting sheep graze. However Simpson's and Orri Vésteinsson's (2004) research about different fuel methods (such as peat or turf) would counteract said theory. Because if another fuel material existed, then deforestation cannot be attributed to the need for charcoal.

Chapter III: Bloomeries and smithies in Iceland

As has already been mentioned it was Dr. Niels Nielsen, a Danish geographer, who initiated research into iron production sites in Iceland by compiling a list of sites with evidence for some type of iron work (be it smithing or iron smelting). Later archaeologists have expanded his list, adding sites as they were discovered.

If Nielsen's research is accurate, and the sites he lists truly relate to iron production, it can be inferred that there is a high number of iron-working sites in Iceland, nowadays archaeologists cite more than 100 (Þorbjörn A. Friðriksson and Margrét Hermanns-Auðardóttir 1992), while 46 were mentioned in Nielsen's list.

Nielsen's list seemed to indicate that iron-working was confined to certain areas and this has led to discussions about possible regional specialisation in iron production and internal exchange of the metal (Margrét Hermanns-Auðardóttir 1992). One issue with Nielsen's original list is that it is not always clear whether a site listed was a bloomery or a smithy site or what criteria he – as well as later researchers – have used to distinguish between the two.

Descriptions of iron-working sites in older sources are often very limited and unspecific, making it difficult to characterize many of the sites. Some sites were called bloomeries even though no ovens were observed, others were deemed smithies because of their size. Generally the type of slag found is hardly ever mentioned.

The following table is divided in five. The first and second columns correspond to the name of the site and the number given by Nielsen. The third column gives the information provided in Nielsen's list. The fourth is information regarding the site provided by more modern sources or excavations, or the mention of lack of further information. Finally the fifth column gives the present author's assessment about what type of activity the available sources suggest took place at the site. The fifth column contains the sources relating to each site.

Site name	Site no.	Nielsen's information	Other information	Interpretation	Sources
Gamli-Ossabær (also known as Gamli-Vorsabær), Landeyjar (Rangárvallasýsla)	1	Remains of an iron site and a smithy are listed as found (Nielsen 1926:137). This site was researched and excavated by Nielsen himself and therefore a detailed description of it is given in his 1927 publication. He mentions the presence of slag in certain layers of this site.	Artefact Þjms. 9354 named "rauðablástursleifar", the artefacts listed as Þjms. 6212A and Þjms. 6162B are mentioned to belong to a smithy.	Likely a smithy.	Nielsen 1926.
Alviðra (Árnessýsla)	2	This site is listed by Nielsen as a possible smithy. An attempt to excavate in the place was unsuccessful due to the conditions of the terrain, and provided no results (Nielsen 1926:137). A description of the	A 12 cm slag (Þjms. 9354) from this site is in Þjóðminjasafn along with artefacts from Gamli Vorsabær, with the number Þjms. 9354. It is registered that Nielsen was the one who gave the artefact, which is smelting slag.	Unlikely to be a smithy.	Sigrúður Vigfússon 1882 Thoroddssen 1908 Nielsen 1926

		<p>soil states that charcoal and slag could be observed on the ground. Sigurður Vigfússon mentions Alviðra in a short paragraph- which is a footnote- he mentions this as a site in which slag has been found (Sigriður Vigfússon 1882: 72). Thoroddsen, cites Sigurður (Thoroddsen 1908 :325), making him the only source of support.</p>	<p>A 12 cm slag(ÞJMS 9354) from this site is in Þjóðminjasafn.</p>		
<p>Tungufell (Árnessýsla)</p>	3	<p>A possible smelting site found underneath some ruins, Nielsen mentions how smelting slag was found, and probably rauði was being smelted „(Nielsen 1926:137).</p>	<p>Sarpur registers no artifacts from Tungufell. An investigation in the area of Hrunamannahreppi was conducted in 1988. A report was written by Sigurjón Helgason, Tungufell is mentioned, however the research</p>	<p>Unlikely to be a smelting site.</p>	<p>Nielsen 1926 Sigurjón Helgason 1990</p>

			was done in Hrunakrökur close by.		
Borg (Borgarfjarðarsýsla)	4-7	According to Egill's saga, Skallgrímr had a smithy in a place called Rauðanes. Nielsen claims there are several iron production sites in the area (Nielsen 1926: 138). Sigurður Vigfússon (1886: 15) also reported the presence of slag in the area as well as Kålund (1887: 378-379.) Nielsen seems not to have visited the site itself and the provides a description of 3 sites without naming them specifically.	Research conducted in the area of Borg.	Likely to be a smithy.	Kålund 1887 Sigurður Vigfússon 1886 Nielsen 1926
Dalsmynni	8	Landmáanabók refers to this as the site where Rauða-Björn, known as the first iron maker in Iceland,	No slag remains or any physical proof were registered to support the theory of a smithy at this site,	Unlikely to be a smithy. Not enough physical	Landnámabók

		lived. Nielsen lists this specific site only citing Landmáanabók. Nielsen did not visit the site.	Landmanabók is used as the main source for this assertion.	evidence provided.	
Smiðjuhóll (Mýrasýsla)	9	Kålund mentions that at Smiðjuhóll there is a legend of how the place obtained its name (Kålund 1887: 383). As well is mentioned the fact that there must have been found an iron smelting site, due to the legend mentioning how the place had a smithy made by Skallgrímr. Nielsen mentions that upon visiting in 1923, no traces of iron were found.	No further research seems to have been done in the area, Nielsen visited the site and claimed he found no traces of iron, yet he still listed this site as a possible smelting site.	Unlikely to be a smithy.	Kålund 1887 Nielsen 1926
Hítardalur (Mýrasýsla)	10	A priest mentions this site as an iron production one in 1700. No research into the site itself was done.	It is a brief mention in a 1772 manuscript. Subsequent fieldwork at the site (2014, by Steinunn	Unknown	Nielsen 1926 Steinunn Kristjánsdóttir and

		(Antiquarian report)	Kristjánsdóttir and Vala Gunnarsdóttir.)		Vala Gunnarsdóttir 2014
Saurar (Snefellsnesssýsla)	11	<p>According to Nielsen there is an iron production site in this area. As support, he mentions slag originating in this area as proof, being in the Museum of Reykjavík/Þjóðminjasafn..</p> <p>Nielsen did not visit the site. Sigurður Vigfússon visited the site as recommendation by Dr Jón Hjaltalín who told him he had found several iron artefacts there. Sigurður himself found charcoal remains and slag in some ruins.</p> <p>(Antiquarian report)</p>	2012 research (Guðmundur Sigurðarsson; Zöega, B.) mentions Saurar. There is in Sarpur, tools that correspond to iron smithing. Þjms. 4033/1894-76 is a nail nipper dating around the 1100 found in the area. As well was found a 1000 blakcsmith's tongue to hold red hot iron with (Þjms. 2147/1882-110)	Likely to be a smithy.	<p>Nielsen 1926</p> <p>Guðmundur Sigurðarsson, Zöega B. 2012.</p> <p>Sigruður Vigfússon 1882</p>
Hrísar (Snefellsnesssýsla)	12	Hrísar in Snæfellsnesssýsla, is also mentioned as Hrísakot in modern sources.	No slag block is registered in Sarpur.	Unlikely to be a smelting site.	<p>Kålund 1882</p> <p>Nielsen 1926</p>

		<p>A 9 pound slag block was found as proof of iron smelting, according to Kålund.</p> <p>(Antiquarian report)</p>	<p>There have been investigations taking place in Hrisakot, however there are no mentions of iron in this investigation, or anything related to the presence of a smithy in this specific site.</p> <p>Hrísar in Snæfellsnesssýsla is mentioned in the Erybyggja saga in passing. The assertion that smelting slag was found in the area is based on an older source Kalund cited, from 1817. The source maintains that a man had found tracks of an iron production site and slag in the soil (Kalund 1877: 448) Further research in Hrísar was done in modern times, however there is no mention of anything iron related.</p>		
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Svelgsá (Snefellsnesssýsla)	13	Nielsen mentions that in this place, slag was found. (Nielsen's observation)	Smelting slag and charcoal are registered in Sarpur as being found by Nielsen. Svelgsá has been mentioned in further modern research regarding Snæfellsness peninsula, however there are not many mentions (but some, research) regarding the iron production.	Likely a smelting site	Nielsen 1926 Matthías Þórðarson 1920
Valshamar (Snefellsnesssýsla)	14	Slag was found in this location, according to Nielsen. (Nielsen's observation.)	Sarpur turns in no information regarding slag. Valshamar is briefly mentioned in the Sturlunga Islendinga saga. However the lack of further investigations does not help contribute into determining what type of site this may be.	Unknown.	Nielsen 1926

Dunkur (Dalasýsla)	15	It is said a smithy is there, but upon research Nielsen sustained there were not traces to detect it.	No further research seems to have been conducted	Unlikely to be a smithy.	Nielsen 1926
Ljárskógar (Dalasýsla)	16-20	The remains of a smelting site have been noted, slag has been found as well as an iron stick (Nielsen 1926: 141) Ljárskógar is mentioned in Gettisaga. Nielsen provides five number in this site, and describes ruins in proximity to each other with no specific naming.	Further research not conducted in modern time. Ljárskogar is mentioned in articles because in that area a three brooch of copper was found. The most information can be observed in an article from Morgunblaðið, published in 1938 in which a detailed article regarding bloomeries and smithies and iron sites investigated by Nielsen. Specifically regarding Ljárskógar it cites there a hole of 10 to 15 meters long full of slag.	Likely a smelting site.	Nielsen 1926

Glerárskógar (Dalasýsla)	21	Nielsen claims large blocks of slag were found in the surface. There is no reference in his description so it could be assumed he was the one to find it.	As well as some previous sites, the slag is not registered in Sarpur	Unknown	Nielsen 1926
Sælíngsdalstunga (Dalasýsla)	22	Slag and charcoal were found. Extraction of iron could not be proved.	The site has barely been researched and mentioned briefly in sources a century old.	Unknown	Nielsen 1926
Ljótólfsstaðir (Dalasýsla)	23	Látnamabók mentions there is a smithy in this area. Nielsen did not visit the site.	No indication of further research into the smithy function of the site. Other research in the area however was conducted.	Unlikely to be a smithy.	Látnamabók Nielsen 1926
Brjánslækur (Barðastrandarsýsla)	24	A document from 1446 supports that a smithy was located in this area.	Further research regarding the iron production aspect seems to have not been done.	Likely to be a smithy.	Nielsen 1926

Smiðjuoddi/Ping mannaá (Barðastrandarsýsla)	25	This site is suspected to be the workplace of Gestur Oddleifsson. Tracks of ironworking have been noticed, upon initial excavation slag related to iron smelting was discovered. (Nielsen's observation)	A sledgehammer found, and oral tradition support this theory.	Likely to be a smithy.	Nielsen 1926
Pingeyrasandur (Húnavatnssýsla)	26	Nielsen reaffirms, citing Kålund, who does a brief mention of slag in the area in some of his footnotes, which he seems to have known due to the National Museum's findings, that there must have been an iron production site in the area, however upon his own research he found no evidence of it. (Nielsen's observations)	No further research regarding iron production seems to have been conducted.	Unknown.	Kålund 1882 Nielsen 1926

Smiðjubakki/ Fljótshorn (Skagafjarðarsýsla)	27	An account of a Danish traveler in 1780 suggests the place is called Smidiebacke, and a smithy can be seen, its remains being visible on the top of a hill. It seems as if Nielsen did not check this place himself. Very little information besides one page in an economy manuscript from the 18 th century can be found. (Antiquarian report)	Researching with the saga map database and attempt to find “Smidiebacke/Smiðjubakki” was done. it seem as if it is not a legend originating from the sagas.	Unlikely to be a smithy.	Nielsen 1926
Fnjóskadalur Suður- Þingeyjarsýsla.	28- 42	In Fnjóskadalur several sites were mentioned by Nielsen to be iron smelting and iron working sites. He particularly mentions Belgsá where he mentions having found a different type of iron furnace than those from the rest of Scandinavia.	There is enough modern research to proof that indeed Fnjóskadalur is a site in which numerous iron production sites, or sites in which iron smelting or working may have taken place.	Likelky a smelting and smything area.	Nielsen 1926

		(Nielsen's observation)			
Belgsá, Fmjóskadalur (S-Þingeyjarsýsla)	28	First researched by dr. Niels Nielsen as it has been mentioned previously, during the years 1923 and 1924. Nielsen categorized this oven as a "herdgrupestype" (Nielsen 1926: 154).	Three slag heaps were found near the farm of Belgsá. Due to wind erosion it is possible to visibly see remains from constructions in this site. the volume of the slags were large. Kristín Huld Sigurðardóttir categorized this type of oven as a different one that Niels Nielsen had concluded.	Likely a smelting site.	Nielsen 1926 Kristín Huld Sigurðardóttir 2004
Þórðarstaðir (S-Þingeyjarsýsla)	29	Mentioned by Nielsen as a site in which iron production took place. (Nielsen 1926: 145-146)	Some iron objects are registered in Sarpur originating in this area. 943/1873-26. However no pieces of slag are registered under this site.	Unknown	Nielsen 1926
Bakki/ Bakka (S-Þingeyjarsýsla)	30	Mentioned by Nielsen as a site in which iron production took place. (Nielsen 1926: 145-146)	No further research seems to have taken place.	Unknown	Nielsen 1926

Veturliðastaðir (S-Þingeyjarsýsla)	31	Mentioned by Nielsen as a site in which iron production took place. (Nielsen 1926: 145-146)	No further research seems to have taken place.	Unknown	Nielsen 1926
Vaglir (S-Þingeyjarsýsla)	32	Mentioned by Nielsen	No further research seems to have taken place.	Unknown	Nielsen 1926
Viðivellir (S-Þingeyjarsýsla)	33	Nielsen excavated a mound in this site in 1926, he found slag, charcoal and ash. No furnaces were found (Nielsen 1926: 145-146)	Viðivellir presents slag, at creeks. No traces of a furnaces were found	Unknown.	Nielsen 1926
Draflastaðir (S-Þingeyjarsýsla)	34	Mentioned by Nielsen (Nielsen 1926: 145-146)	The site was studied by Kristján Eldjárn in 1952, and a grave was found close to a farm. No remains of any iron could be observed (Kristján Eldjárn, 2000: 193-94) Is an ancient church site.	Unknown	Nielsen 1926
Skarð (S-Þingeyjarsýsla)	35	Mentioned by Nielsen (Nielsen 1926: 145-146)	No further research seems to have taken place.	Unknown	Nielsen 1926

Lítla-Holi (S-Þingeyjarsýsla)	36	Mentioned by Nielsen (Nielsen 1926: 145-146)	No further research seems to have taken place	Unknown	Nielsen 1926
Vindhólanes (S-Þingeyjarsýsla)	37	Mentioned by Nielsen (Nielsen 1926: 145-146)	No further research	Unknown	Nielsen 1926
Kvíasel (S-Þingeyjarsýsla)	38	Mentioned by Nielsen as a site in which iron production took place. (Nielsen 1926: 145-146).	No further research seems to have taken place.	Unknown	Nielsen 1926
Vindheimar (S-Þingeyjarsýsla)	39	At this farm Nielsen found coal. (Nielsen 1926: 145-146) „á þessum stöðum er mér kunnugt, að merki sjást eftir rauðablástur í Fnjóskadal; á Vindhólanesi og í Kvíaseli (þessir staðir eru báðir í Bleiksmýrardal)	No further research seems to have taken place.	Unknown	Nielsen 1926
Búðarbrekka (S-Þingeyjarsýsla)	40-41	Nielsen mentions two sites in close proximity of Búðarbrekka in which slag had been found, as well there was charcoal (Nielsen 1926: 146)	No further research seems to have been conducted.	Likely a smithy	Nielsen 1926

Lundur (S-Þingeyjarsýsla)	42	Nielsen mentions this site (Nielsen 1926: 146) Two places, á bæ og við Búðará – Sigurð Sigurdsson.	Lundur as well as viðivellir had slag. A report by Margrét and Þjörnpór attests that samples of mounds were taken from lundur to perform c14.	Unknown	Nielsen 1926
Ljósavatn (S-Þingeyjarsýsla)	43	Slag was found by Daniel Bruun and Finnur Jónsson in some ruins.	Slag from Brunn's excavation is mentioned however it is not registered on Sarpur.	Unknown	Nielsen 1926
Grenjaðarstaður (S-Þingeyjarsýsla)	44	Dipl. Isl. Bd. III p. 711 mentions that in Grenjastastaður stands an iron smelting (rauðasmiðja) site (Antiquarian report)	No further research conducted, and no proof of iron remains were found, only the written source	Unknown	Nielsen 1926
Kelduhverfi (N-Þingeyjarsýsla)	45	A testimony of iron extraction obtained from Ólafsson and Pálsson (1772: 663) No other proof or other indications which support this. An iron object	The lack of specification regarding what area of Kelduhverfi the slag found complicates further research.	Unknown	Ólafsson and Pálsson 1772 Nielsen 1926

		however, was found in 1906 when a house was being built. (Antiquarian report)			
Kirkjubær í Hróarstunga (NMúlasýsla)	46	Kålund affirms that in this area there were traces of a smelting site. (Antiquarian report)	Kålund's mention is brief, and although Kirkjubær is mentioned in sources as a church. There is not either any object registered in Sarpur that is related to working with iron. In Kalund's mention, he says tracks of iron working can be found, however he does not cite any source for this assertion (Kalund 1882: 206)	Unlikely to be a smelting site	Kålund 1882 Nielsen 1926

The list that Niselen compiled although extensive, provides very limited descriptions. The majority of the sites had not been extensively investigated. Many were included only on the basis of a saga reference or because slag or iron artefacts had been found. It is well known that it is impossible to infer the function of a whole site from a single object, as there can be many reasons for why a certain object was found in a specific location. However, in some cases Nielsen provides details of sites in which charcoal and layers of slag could be observed. Although new research has proved how some of the sites mentioned by Nielsen were indeed related to some kind of iron activity, most were not. Some of them have not even been researched beyond the surface.

With the exception of the Fnjóskadalur sites and Gamli Ossabær, excavated by Nielsen himself, none of the other sites had been investigated by 1927.

Nielsen focused his research on the technological aspects of slag, with the objective of classifying it. He distinguished between slag from an iron working site and the slag from a smelting site. However, this technological aspect cannot be observed with transparency on his investigation and compilation. The information given by Nielsen is very sparse. Based on information given in Sarpur, however, he seems to have mainly given the museum what he considered to be smelting slag (blástursgjall). There is a total of four results that come up when researching “smelting slag” on Sarpur (searching: blástursgjall), the rest of the slag is classified simply as “slag” (gjall).

It is important to note as well, as can be observed by the table above, that most of the sites Nielsen listed as iron smelting or iron-working sites, had not been visited by himself. Kålund was a main source of Nielsen, but he had recorded, mostly in footnotes, stories about smithies. Most of Kålund’s evidence was oral tradition, or records of specific iron objects curated in the Museum in Reykjavík/Þjóðminjasafn.

Even when there was concrete evidence for iron working or smelting, such as slag, and recorded on the corresponding reports it has in many cases proven difficult to trace this artefacts down in Sarpur or subsequent reports.

Of concern is as well, how the list is organized. Some sites, Nielsen went himself to research but found no evidence of any iron working, yet he still included those sites in the list, in spite of the lack of proof.

Subsequent research, such as Þorkell Jóhannesson's article in *Iðnasaga*, is all based on the foundation of Nielsen's research. There is a lack of criticism and revision of old source works in general in Icelandic research. The sagas are still used as a main source for locating sites for excavation. It is impossible to deny the usefulness of written material and the contribution it makes to modern research. However it is important as well to take a critical view of the veracity of said information.

Þorkell Jóhannesson expanded the list of iron working sites after new discoveries had been made. In total he made an addition of nine sites. New additions are made in regards to the Fnjóskadalur and Þjórsárdalur area. These new additions, unlike Nielsen's list, are based on actual excavation work, most of those sites researched by Þorkell Jóhannesson himself.

The sites added by Þorkell Jóhannesson are the following:

Site name	Site no.	Þorkell Jóhannesson's information	Other information	Interpretation	Sources
Snæbjarnarstaðir í Fnjóskadal (S-Þingeyjarsýsla)	47	Addition to Nielsen's list. No description provided.	A spearhead said to be found in Snæbjarnarstaðir is registered in the National Museum of Iceland. Þorbjörn Friðriksson did a survey about this place (Guðmundur Sigurðarson & Zöega, G. 2013: 12)	Likely a smithy	Þorkell Jóhannesson 1963 Guðmundur Sigurðarson & Zöega, G. 2013
Smiðjusei í Bleiksmýrardal (S-Þingeyjarsýsla)	48	Addition to Nielsen's list. No description provided.	Smiðjusei is mentioned in Skógar í Fnjóskdal's report (Guðmundur St. Sigurðarsson and Zoega, G. 2013) Þorbjörn Friðriksson cored this site (Margrét Hermanns-Auðardóttir 1995: 23-24) as well as other of the sites in Fnjóskadalur.	Likely a smithy.	Þorkell Jóhannesson Margrét Hermanns-Auðardóttir 1995 Guðmundur St. Sigurðarsson and Zoega, G. 2013
Helgastaðir í Króksdal (S-Þingeyjarsýsla)	49	Addition to Nielsen's list. No description provided.	Excavations were done in Helgastaðir in 2005, a report was written by Orri Vésteinsson. As stated in the report three ruins associated with iron smelting are known in the area. The sites were also recorded in 1972 however the most	Likely a a smelting site.	Þorkell Jóhannesson 1963 Sigurður Þórarinnsson 1976

			recent report establishes that features observed in that previous fieldwork are no longer visible. A spread of smelting slag is visible in the southern side of the remains. There is also a smelting site in Smiðjuskógur, adjacent to Helgastaðir. There is a habitation structure next to the smelting site, however the smelting could have pre- or postdated the occupation.		Orri Vésteinsson 2010
Fjall í Aðaldal (S-Þingeyjarsýsla)	50	Addition to Nielsen's list. No description provided.	The site was investigated by Þorkell Jóhannesson himself. The data regarding this site is limited.	Unknown	Þorkell Jóhannesson 1963
Sámsstaðir í Þjórsardal (Árnessýsla)	51	Addition to Nielsen's list. No description provided.	An excavation in 1971 done by Sveinbjörn Rafnsson seems to support this sites as an iron working one. Several pieces connected to iron working are registered in Sarpur, including a bloomery slag. As well other type of slag was found previous to the 1971 excavation in the area.	Likely a smelting site.	Þorkell Jóhannesson 1963 Sveinbjörn Rafnsson 1976
Stöng í Þjórsardal (Árnessýsla)	52	Excavation in 1939 uncoverd a smithy	The site has been excavated twice, first in 1939 and the second time in 1982. Iron working artefacts were found in 1939.	Likely a smithy.	Þorkell Jóhannesson 1963

		and iron related artefacts.			Vilhjálmur Örn Vilhjálmsson 2009
Lambhöfði í Þjórsárdal (Árnessýsla)	53	Was excavated in 1939, by Rousell.. There seems to have been sufficient proof of possible iron working.	On the excavations done in 2001, in this area, the ground was found to have remains of ash, charcoal and turf debris (Steffen Stummann Hansen & Orri Vésteinsson eds. 2002). A knife was also retrieved, through the report makes sure to clarify that this further layers may not have relation with more recent ones.. Pieces of slag are registered in Sarpur (2005-20-34)	Likely a smithy	Steffen Stummann Hansen & Orri Vésteinsson eds. 2002 Þorkell Jóhannesson 1963
Innri Áslákstunga í Þjórsárdal (Árnessýsla)	54	Addition to Nielsen's list. No description provided.	This site was researched by Þorsteinn Erlingsson in 1899. The slag is registered on Sarpur (ÞJMS 1992-35-13), as well as other more recent slag findings in 2005, ÞJMS 2005-20-3	Likely a smithy	Þorsteinn Erlingsson 1899 Þorkell Jóhannesson 1963
Bergþórshvoll í Landeyjum (Rangárvallasýsla)	55	Addition to Nielsen's list. No description provided.	This site is mentioned because of the sagas of Icelanders. Slag pieces are registered in Sarpur. An article from 1952 describes the history of research in the area (Kristján Eldjárn & Gísli Gestson 1951-1952: 9) previously	Likely a smithy.	Kristján Eldjárn & Gísli Gestson 1951-1952 Þorkell Jóhannesson 1963

			<p>investigated by Sigurður Vigfússon in 1883 when a test hole was dug (Kristján Eldjárn & Gísli Gestson 1951-1952: 9) During 1928-1927 Matthias Þórðarsson excavated the site. The remains of a smithy were found, along with slag (Kristján Eldjárn & Gísli Gestson 1951-1952: 25)</p>		
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Bloomeries or sites in which smelting took place may have been smithies as well, in which refining of blooms was carried out. There is no specific methodology for defining the size of a bloomery, of whether it functioned at industrial levels for providing more farms or whether it was self sufficient.

The following table provides details about the iron production and iron working sites investigated in Iceland since the publication of Þorkell Jóhannesson's paper in 1943. The list is based on sites in which slag was registered in Sarpur. Key words related to iron production and smithying were searched to make the list (such as gjall-slag-, rauðablásturgjall- smelting slag- and other variations). Sites are classified as unknown if there is not enough information about the site and the context in which the findings were made to reach a classification, even if there is presence of slag.

Site name	Site no.	Research	Further information	Interpretation	Sources
Nes við Seltjörn, Seltjarnarneshreppur (Gullbringusýsla)	56	In 1995 excavations were started by Fornleifastofnun Íslands (Orri Vésteinsson 1995) Metalworking debris was identified (Guðmundur Ólafsson and Sigrid Cecile Juel Hansen 2007)	Several pieces of slag are registered in Sarpur. Among them some correspond to smelting slag.	Likely a smithy.	Orri Vésteinsson 1995 Guðmundur Ólafsson and Sigrid Cecile Juel Hansen 2007 Guðrún Alda Gísladóttir 2015
Landssímareitur í Reykjavík (Gullbringusýsla)	57	The research was conducted by Vala Björg Garðarsdóttir. Excavated in 2016, the area c dating from 9th-13th century showed traces of iron-processing and artefacts related to ironworking, such as slag. (Agnes Stefánsdóttir and Ásta Hermannsdóttir 2018: 19)	Area C seems to have been used for iron working. A report on the site is yet to be released.	Likely a smithy	Agnes Stefánsdóttir and Ásta Hermannsdóttir 2018 https://www.mbl.is/frettir/innlent/2018/10/11/skyrsla_um_landssimareit_e_nn_okomin/
Aðalstræti 14-16 í Reykjavík (Gullbringusýsla)	58	A preliminary report from 2001, states that slags had been found and their qualities seem to indicate they are smithing slag, although an analysis should be conducted (H.M Roberts ed. 2001: 71)	Slag pieces dated to the Viking age found suggests the site might be a smithy.	Likely a smithy	H.M Roberts ed. 2001
	59	Research started in 2013 and two	An iron processing area (area	Likely a smelting	Agnes Stefánsdóttir and Ásta

Auðkúla, Arnarfjörður á miðöldum (V-Ísafjarðarsýsla)		areas were investigated in 2016. In the area B the remains of smelting ovens (most likely the depression) were found. A charcoal pit was excavated as well (Agnes Stefánsdóttir and Ásta Hermannsdóttir 2018: 38)	b) was found. There were as well remains of iron smelting ovens. The report is yet to be released.	site.	Hermannsdóttir 2018
Árbær í Reykjavík (Gullbringusýsla)	60	The site is currently being excavated, a smithy was found (Sólrún Inga Traustadóttir 2018: 13), previous excavations have revealed the presence of slag debris (Sólrún Inga Traustadóttir 2018: 17)	Several slag pieces found, registered on Sarpur.	Likely to be a smithy.	Sólrún Inga Traustadóttir 2018
Þúfur, Vatnsfjarðarsveit (N-Ísafjarðarsýsla)	61	An artefact of slag was given by Ásgeir Svanbergsson, found after planting a garden, the artefacts were slag debris related. It is known a smithy was there in 1900. (http://www.sarpur.is/Adfang.aspx?AdfangID=1847864)	The slag is from iron bog. ÞJMS 2001-23-6.	Likely a smithy	Sarpur.
Bessastaðir á Álftanesi (Gullbringusýsla)	62	From 1987 until 1996 excavations took place on the site (Guðmundur Ólafsson 2010: 5) Bessastaðir is currently being investigated, slag debris was found as well as	Both smelting and smelting slag were found. The report of the 2018 excavation is yet to come out (2018-71-136 and 2018-71-	Likely a smelting site.	Guðmundur Ólafsson 2010 https://www.mbl.is/frettir/innlent/2018/10/25/sodholur_fra_10_old_fundus_t/

		smelting debris.	165)		
Laufásbær, Höfðahverfi (S-Þingeyjarsýsla)	63	The site was excavated in 1999 (Orri Vésteinsson 2000:4), various slag debris artefacts were found. A smithy is located there, dated around the 19th/20th century. Older ruins from before the 16th century were found as well	Slag is registered in Sarpur under ÞJMS 2000-32-37 and ÞJMS 2000-32-28	Likely a smithy.	Orri Vésteinsson 2000
Skriðuklaustur, Fljótsdalur (N-Múlasýsla)	64	Research began in 2000, directed by Steinunn Kristjánsdóttir, with the objective of studying the monastery (Steinunn Kristjánsdóttir 2003: 5)	Fundarskrá 2008 and 2007 present the major amount of slag recovered. Several pieces of slag are registered on Sarpur.	Likely a smithy.	Steinunn Kristjánsdóttir 2003 Steinunn Kristjánsdóttir 2008 Steinunn Kristjánsdóttir 2013
Gamla Sel/Skraðssel, Landmannahreppur (Rangárvallasýsla)	65	Investigation has been conducted since 1998, this farm site was built in 1894 and lasted 40 years (Bjarni F Einarsson 2017) a smithy is located in the area, the floor full of charcoal and ash (Bjarni F. Einarsson 2017: 41) Smithies studied in Iceland tend to be dated at older dates. This is a considerably modern smithy. It is important to include every type of smithy in the land in order to properly make a list of iron working sites.	The slag found was dated from 1721-1894. Burnt and unburnt coal and iron (Bjarni F. Einarsson 2017: 43)	Likely a smithy.	Bjarni F Einarsson 2017

Hrísbrú, Mosfellsdalur (Kjósarsýsla)	66	The Mosfell archaeological project took place from 1995 to 2012. An analysis of the mettallurgic work in Hrísbrú was made (Sebastian K.T.S. Wärmländer et al. 2010: 2286), and the objects found suggest small scale iron-production and working.	Both slag debris and hammerscales have been found and are registered in Sarpur. The findings point towards a smithy (Sebastian K.T.S. Wärmländer et al. 2010: 2286)	Likely a smithy.	Sebastian K.T.S. Wärmländer et al. 2010 Jesse Byock et al. 2005
Þórarinsstaðir, Seyðisfjarðarhreppur (N-Múlasýsla)	67	Excavations started in 1998, with the objective of researching a timber church from the 11th century (Steinunn Kristjánsdóttir 1999: 5)	Several slag pieces are registered on Sarpur (Þjms 1999-25-38 and 1999-25-299)	Likely a smithy.	Steinunn Kristjánsdóttir 1999 Steinunn Kristjánsdóttir 2004
Þórarinsstaðir, Hrunamannahreppur (Árnessýsla)	68	Investigated by Kristján Eldjárn in 1945 (Kristján Eldjárn 1943-1948: 9) The remains of houses were found (Kristján Eldjárn 1943-1948: 31) as well as sheeð sheds. On the sheep shed B, charcoal and slag debris was retrieved (Kristján Eldjárn 1943-1948: 33) Eldjárn sustains that these artefacts may have been there previosuly to the shed's building, and that would explain their presence there (Kristján Eldjárn 1943-1948: 34) The sheep sheds are scattered on the homefield sorrounding the houses.	Slag lumps are registered on Sarpur.	Likely a smelting site.	Kristján Eldjárn 1943-1948 Gísli Gestsson og Jóhann Briem (1954)

		Iron ore was stored in one of the sheds, and 7 to 8 meters from it the remains of a forge were found.			
Hólmur/Árnanes, Nesjasveit. (A-Skatafellsýsla)	69	The site was first excavated in 1997 (Bjarni F. Einarsson 2003: 4) Excavations continued on the following years and new structures were researched (Bjarni F. Einarsson 2006)	The slag found is registered on Sarpur.	Unlikely to be a smithy.	Bjarni F. Einarsson 2003 Bjarni F. Einarsson 2006
Stóra-Ávik, Víkursveit (Strandasýsla)	70	Dawn Elise Mooney conducted an investigation in this site in search for charcoal-pits in the coastal area (Dawn Elise Mooney 2016: 8)	Four artefacts of slag are registered on Sarpur.	Unknown.	Dawn Elise Mooney 2016
Munkaþverá, Staðabyggð (Eyjafjarðarsýsla)	71	Research began in 2013, the site used to be a monastery from 1155 to 1551 (Steinunn Kristjánsdóttir et al. 2016: 3) Excavations began in 2015.	Slag registered on Sarpur (ÞJMS 2015-21-15 and ÞJMS 2016-17-2)	Unknown. unlikely to be an iron production place.	Steinunn Kristjánsdóttir et al. 2016 Steinunn Kristjánsdóttir et al. 2015
Garðastræti 23, Grjótaþorp (Gullbringusýsla)	72	Investigations were conducted in 2009 (Oddgeir Hanson 2009) One piece of slag was found (Oddgeir Hanson 2009: 32)	One slag (either smelting or smelting) registered on Sarpur. The context of the find is not recorded. 2009-74-285	Unlikely to be a smithy or an iron smelting site.	http://www.sarpur.is/Adfang.aspx?AdfangID=1654868 Oddgeir Hanson 2009
Kolkuós, Viðvíkursveit	73	The first excavation was conducted in 2003, coastal erosion has made	Slag is registered on Sarpur.	Unknown	Ragnheiður Traustadóttir et al. 2011

(Skagafjarðarsýsla)		the process of investigation of the site difficult (Ragnheiður Traustadóttir et al. 2011: 6) The site is being washed away.			
Eiríksstaðir/Stóra-Vatnshorn, Haukadalur (Dalasýsla)	74	The site is said to have been built by Eiríkr rauði's father. Investigated in 1997 by Guðmundur Ólafsson. (Guðmundur Ólafsson 1998) The site had been previously excavated by Þorsteinn Erlingsson and Matthias Þórðarsson. Daniel Brunn maintained there was a smithy in this site (Guðmundur Ólafsson 1998: 10)	An artefact of slag was found. No other ones.(1997-180-1)	Unlikely to be a smithy or smelting site.	Guðmundur Ólafsson 1998 Þorsteinn Erlingsson 1899 Matthias Þórðarson 1964 Daniel Brunn 1897
Reykholt, Reykholtisdalhreppur (Borgarfjarðarsýsla)	75	Systematic excavations began in 1987, conducted by the National Museum of Iceland. A charcoal pit filled with charred wood, was thought to belong to a coal pit or a smithy (Guðrún Sveinbjarnardóttir 2012: 58) The pit is too small to be a charcoal pit, but similar pits/square shaped cisterns have been encountered in other smithies. In 2001 remains of a smithy were found (Guðrún Sveinbjarnardóttir 2012: 88) Work may have been	Pieces of slag found were identified as smithing slag (Guðrún Sveinbjarnardóttir 2012: 88)	Likely a smithy.	Guðrún Sveinbjarnardóttir 2012

		carried out in the open. Phase 2 occupation remains.			
Pingvellir , Þingvallasveit (Árnessýsla)	76	Excavated in 2009 was the church in Þinvellir, three areas were excavated. Several pieces of oblong slag are thought to be smelting slag from the tap slag type (Margrét hrönn Hallmundsdóttir & Hansen 2012: 18), identified by “the upper cooling surface and ropey morphology” (Lucas 2009: 272) The slag was found on a floor layer and would need more analysis.	The slag is registered on Sarpur.	Likely a smeting site.	Margrét Hrönn Hallmundsdóttir & Hansen 2012 Lucas 2009
Geirsstaðir/Litil-Bakki , Hróarstunga (N-Múlasýsla)	77	An archaeological dig was conducted in 1997. A viking long-house was unearthed as well as a torf church and other two buildings. Because of the slag found, this site is thought to have had some type of ironworking in place (Steinunn Kristjánsdóttir 1998: 26)	The slag is registered on Sarpur.	Likely to be a smithy.	Steinunn Kristjánsdóttir 1998
Hofsstaðir í Mývatnssveit (S-Þingeyjarsýsla)	78	First excavated in 1908 by Daniel Brunn. Excavations took place in 1991 to 1997. A total of 33kg in material was analysed and	The slag found was studied and corresponded to debris for iron smelting and smithying.	Likely a smithy and smelting site.	Lucas 2009 Lucas et al. 1999

		corresponded to smithing debris. Trenching done in 2018 revealed a slag deposit, smelting slag and hammerscale were recorded. Thus this site is thought to be both an iron smelting site as well as a smithy.			
Stóra-Borg undir Eyjafjöllum (Rangárvallasýsla)	79	Excavations took place in the 80's where a cemetery was researched (Mjöll Snæsdóttir 1987: 5) Research was conducted by Mjöll Snæsdóttir	The few slag pieces found seem to have been stray finds.	Unknown.	Mjöll Snæsdóttir 1987
Urriðakot í Garðabæ (Gullbringusýsla)	80	On investigation in 2010 a pit of charcoal was revealed. The pit contained peat, charcoal remains (Ragnheiður Traustadóttir et al. 2010)	Iron objects and slag found and registered in Sarpur.	Likely a smithy or smelting site	Ragnheiður Traustadóttir et al. 2010
Reynistaður , Sæmundarhlíð (Skagafjarðarsýsla)	81	The site, a monastery, was investigated by Steinunn Kristjánsdóttir and Vala Gunnarsdóttir in 2014. The monastery was in operation from 1295-1551 (Steinunn Kristjánsdóttir and Vala Gunnarsdóttir 2016: 6)	A little piece of smithy slag was found (ÞJMS 2014-21-2)	Unknown	Steinunn Kristjánsdóttir and Vala Gunnarsdóttir 2014 Steinunn Kristjánsdóttir and Vala Gunnarsdóttir 2016
Herjólfsdalur	82	The site was investigated by Marg	What could be smelting slag is	Likely a smithy	Margrét Hermanns-Auðardóttir 1989

(Vestmanneyjar)		Hermanns Auðardóttir. She discusses iron related finds on her thesis (Margrét Hermanns-Auðardóttir 1989: 29-31)	among the finds registered on Sarpur, but the majority is of smything.		
Belgsholt , Melasveit (Borgarfjarðarsýsla)	83	A registry of the findings is preserved in the National Museum, though there seems to be no information regarding an excavation. (Fundaskrá er varðveitt í heimildasafni Þjóðminjasafns Íslands.)	Several slag pieces found in 1992 are registered on Sarpur	Unknown	Sarpur.
Hamar í Hegrane (Skagafjarðarsýsla)	84	An excavation was conducted in the summer of 2014. In the north part of the building coal and slag were found, the small fireplaces were thought to be where iron was heated to be worked with (Guðmundur St. Sigurðarson 2014: 21)	The slag found is registered in Sarpur (ÞJMS. 2014-15-17) and (ÞJMS. 2014-15-18)	Likely a smithy	Guðmundur St. Sigurðarson 2014
Stóra-Seyla , Langholt (Skagafjarðarsýsla)	85	Investigations between 2012-2013 revealed the presence of a forging floor, in which slag was found. The smithy was left unexcavated but dated from the 9th-10th century	Slag was found on the forging floor.	Likely a smithy	Agnes Stegfansdóttir and Ásta Hermansdóttir 2016

		(Agnes Stegfansdóttir and Ásta Hermansdóttir 2016: 33)			
Keldur , Ragnárvellir (Rangárvallasýsla)	86	A smithy from the 17th century investigated by Guðmundur Ólafsson and Ragnheiður Traustadóttir. The investigation was carried out due to repairs in the town (Guðmundur Ólafsson and Ragnheiður Traustadóttir 2009)	The slag is from modern period.	Likely a smithy	Guðmundur Ólafsson and Ragnheiður Traustadóttir 2009
Þjótandi , Flói. (Árnessýsla)	87	Research of this site had started in 2007, with continuing research in following year, in which further ruins were unearthed (Bjarni F. Einarsson and Sandra Sif Einarsdóttir 2009: 7) Both charcoal and slag were found (Bjarni F. Einarsson and Sandra Sif Einarsdóttir 2009: 61) Although slag has been found, researches have not found traces of a smithy yet (Bjarni F. Einarsson and Sindri Ellertsson Csillag 2011: 136)	Slag artefacts have been found and are registered on Sarpur.	Unlikely to be a smithy	Bjarni F. Einarsson and Sandra Sif Einarsdóttir 2009
Grelutóttir/Hrafnseyri við Arnarfjörð (V-Ísafjarðasýsla)	88	In the first smithy coal and slag was found (Guðmundur Ólafsson 1980: 46) an oven seems to have been in this smithy. A little pit with	Some slag pieces are registered in Sarpur, as are pieces of the ovens. A stone suggests there may have been smithing as	Likely a smelting site.	Guðmundur Ólafsson 1980 Agnes Stefánsdóttir and Ásta Hermansdóttir 2018

		charcoal and slag around is thought to have been an oven where iron bog was melted (Guðmundur Ólafsson 1980: 49) A second smithy where slag and charcoal were located as well (Guðmundur Ólafsson 1980: 59) Slag from the second smithy was sent for investigation to Sweden (Guðmundur Ólafsson 1980: 63) One oven is thought to be a blowing furnace. Recently Margrét Hrönn Hallmundsdóttir has been surveying and excavating this site (Agnes Stefánsdóttir and Ásta Hermanssdóttir 2018: 36)	well.		
Vogur í Reykjanesbær (Gullbringusýsla)	89	Excavation research for this site started in 2002-2003, when a trial hole was dug, in this hole is that the slag was found. Recent research has been released, in 2014, regarding the investigation of Vogur (Bjarni F. Einarsson 2014)	Smithing slag ÞJMS 2011-23-182 and 2011-23-181 were found when a test hole was opened in 2003.	Unknown	Bjarni F. Einarsson 2014
Skógar í Fnjóskadal (S-Þingeyjarsýsla)	90	The excavation process started in 2011 and was completed by 2012. Two smelting huts with corresponding sets of furnaces were	Both smelting and smithing debris were found.	Likely a smelting site.	Guðmundur St. Sigurðarsson and Zoega, G. 2013

		unearthed in areas A7 and A5(Guðmundur St. Sigurðarsson and Zoega, G. 2013: 85). The earliest hut was dated pre 1104AD and the other post 1104AD but pre 1300AD			
Gásir , Kræklingahlíð (Eyjafjarðasýsla)	91	During the years 2002-2006 an excavation took place, Gásir was operating as a trading center according to sources during the 12th to 14th century (Sólveig Guðmundsdóttir Beck & Michéle Hayeur-Smith 2011: 3)	Fragments of hammerscale, commonly formed in secondary smithing were retrieved as well as metalworking slag.	Likely a smithy.	Sólveig Guðmundsdóttir Beck & Michéle Hayeur-Smith 2011
Papey , Djúpavogshreppur (S-Múlasýsla)	92	First investigated in 1967 by Kristján Eldjárns, the site is dated to the Viking Age (Kristján Eldjárn 1988) The pieces of slag found were a mix of rauða(red) and charcoal	Two big pieces of slag as well as iron bog are registered in Sarpur.	Unknown	Kristján Eldjárn 1988
Suðurgata 3-5 , Reykjavík (Gullbringusýsla)	93	The plot was investigated between 1971 and 1975, more information on Elsa Nordhal's book. Remains of structures from settlement and medieval age. A smithy was found (Anna Lís Guðmundursdóttir and Sverrir Snævar Jónsson :4)	Several articles of slag were found.	Likely a smithy	Elsa Nordhal 1988

Kirkjubæjarklaustur , Síða (V-Skaftafellsýsla)	94	The research of this site started in 1995, and excavations began on 2002 (Kristján Mímisson and Bjarni F. Einarsson 2002) Research was concluded on 2006 (Kristján Mímisson and Bjarni F. Einarsson 2009)	The slag found is registered on Sarpur.	Unknown	Kristján Mímisson and Bjarni F. Einarsson 2002 Kristján Mímisson and Bjarni F. Einarsson 2003 Kristján Mímisson et al. 2005 Kristján Mímisson and Bjarni F. Einarsson 2009
Breiðavík í Tjörnes (S-Þingeyjarsýsla)	95	Slag from the Viking Age as well as nails and other artefacts were discovered (Guðmundur Ólafsson 2001: 24)	Six slag lumps are registered in Sarpur 2000-4-10	Unlikely to be a smithy.	Guðmundur Ólafsson 2001
Kúabót/Hraunbær í Álftáver (V-Skaftafellsýsla)	96	The excavation process begun in 1972 (Gísli Gestson: 10) the remains of a house were encountered. On the area of the kitchen, a piece of slag was retrieved (Gísli Gestson and Lilja Árnadóttir 1986: 86)	A small lump of slag encountered on the kitchen area Þjms K-6011/1976-550-11	Unlikely to be a smithy	Gísli Gestson 1986 Gísli Gestson and Lilja Árnadóttir 1986
Hvítarholt, Hrunnamannahreppur (Árnessýsla)	97	Dated approximately around the 10 th century. Three houses and a barn were excavated, slag was retrieved from the floor, particularly the western part of House II (Þór Magnússon 1972:20), as well as House VI(Þór Magnússon 1972: 37) House VII	Slag pieces were found dispersed in various of the houses, the likelihood of smelting in this site is high, although there seems not to be a specific site to define as a smithy per say.	Likely a smithy.	Þór Magnússon 1972

		Skáli (Þór Magnússon 1972: 42), and Houses X and XI(Þór Magnússon 1972: 75)			
Þingnes/Elliðavatn í Reykjavík (Gullbringusýsla)	98	The site had previously been investigated from 1981 to 1986 by Þjóðminjasafns Íslands (Guðmundur Ólafsson 2003:35) and was re-investigated in 2003 with the cooperation of HÍ. On the north-east of ruins number seven a structured that hadn't been investigated appeared to be a smithy. In the floor appears to be charcoal remains on the floor, and a large amount of slag was identified (Guðmundur Ólafsson 2003: 61) the residues indicate some type of ironwork may have taken place, this smithy structure is dated to 900-1000 (Guðmundur Ólafsson 2006: 61)	Remains of iron slag are registered in Sarpur.	Likely a smithy.	Guðmundur Ólafsson 2003 Guðmundur Ólafsson 2006
Vík í Vikurpartur (Skagafjarðarsýsla)	99	First surveyed in 1896 by Daniel Brunn, in 2007 a trench was dug and in 2010 an excavation took place (Guðmundur St. Sigurðarson et al. 2012: 8) Ash and coal residue identify on one of the layers	Sarpur has registered two numbers for the slag found (Þjms. 2010-62-115 and Þjms. 2010-62-116)	Likely to be a smithy.	Guðmundur St. Sigurðarson et al. 2012

		indicates there might have been a smithy at some point (Guðmundur St. Sigurðarson et al. 2012: 9)			
Kópavogspingstaður (Gullbringusýsla)	100	Investigated from 1973 until 1976 by Guðrún Sveinbjarnardóttir. A smithy was found upon excavation (Guðrún Sveinbjarnardóttir 1986: 67) There was coal, slag, mold and turf (Guðrún Sveinbjarnardóttir 1986: 69) The age of the smithy was calculated around the 12, 13 or 14th century (Guðrún Sveinbjarnardóttir 1986: 73)	Several pieces of slag are registered in Sarpur.	Likely a smithy.	Guðrún Sveinbjarnardóttir 1986
Kleif/Burstafell I í Vopnafjarðarhreppur (N-Múlasýsla)	101	The artefacts registered were found on the year 1919 (see, Sarpur) The mention of some metal objects found can be seen in a 2005 report (Guðný Zöega et al. 2005: 40)	The artefacts registered on Sarpur are the following: Þjms. 7962-2/1919-203 ; Þjms. 7962-1/1919-202 and Þjms. 7963/1919-204	Unlikely to be a smithy.	Guðný Zöega et al. 2005
Þuríðarstaðir á Þórsmörk (Rangárvallasýsla)	102	Brynjúlfur Jónsson maintained in his research that in this site there were the ruins of a town, but that the ruins were not visible.	The following artefacts are registered under Þuríðarstaðir on Sarpur Þjms. 169-149 and Þjms. 9077/1925-46.	Unknown	Brynjúlfur Jónsson 1893 Brynjúlfur Jónsson 1894
Smiðjuskógur, Bárdardalur (S-Þingeyjarsýsla)	103	In Árbok 1976 information about a research done for the remains in this area was conducted, conclusion came that it was a smelting site due	Smelting slag is registered in Sarpur. As well a Sledgehammer was found (Þjms 1889-115)	Likely a smelting site.	Orri Vésteinsson ed. 2005 Kálund 1879. Sigurður Vigfússon 1893. Þorkell Jóhannesson 1943

		to charcoal, smelting slag and other characteristics, dated to the Viking age. Sigurður Þórarisson however conducted radiocarbon dating research in 1972 in a site nearby Smiðjuskógur, it presented signs of being a viking age iron making site (Orri Vésteinsson ed. 2005: 4)			
Haffjarðarey í Kolbeinsstaðahreppur (Snæfells-og hnappadalssýsla)	104	Kristján Eldjárn and Jon Steffensen excavated a cemetery in Haffjarðarey in 1945(Jón Steffensen 1946: 144), the same year the smelting slag is registered in sarpur. Haffjarðarey í Kolbeinsstaðahreppur (Snæfells-og hnappadalssýsla)	Smelting slag is registered on Sarpur under number Þjms. 13449/1945-65	Unlikely to be a smelting site.	Jón Steffensen 1946
Sandmúli, Bárðardalur (S-Þingeyjarsýsla)	105	A hoard of silver coins was found on this site in 1909. An investigation conducted on 2005 turn few results regarding slag, only three pieces were found. (Orri Vésteinsson ed. 2010: 30)	Slag was recovered From the 2005 Investigations, and is registered on Sarpur along other finds.	Likely to be a smithy.	Orri Vésteinsson ed. 2010
Skeljastaðir, Þjórsardalur	106	Artefacts found are dated from the 11th century (Matthías Þórðarsson	Several articles of iron are registered in Sarpur, among	Likely a smelting site.	Matthías Þórðarsson 1943

(Árnessýsla)		1943)	them: tǫng, slag from smelting, iron lumps etc.		
Grímsstaðir (N-Pingeyjarsýsla)	107	Grímsstaðir was investigated in 1952, small artefacts, bones and slag were encountered (Þorkell Grímsson 1965: 84) A kuml was located. The site was dated to the 10th century (Þorkell Grímsson 86)	The following artefacts are registered on Sarpur: 15222-2/1952-96	Unlikely to be a smithy.	Þorkell Grímsson 1965
Hofsnesi í Öräfum (A-Skaftafellsýsla)	108	Information regarding Hofsnes (Elín Ósk Hreiðarsdóttir and Ragnheiður Glo Gylfadóttir 2011: 55) The smelting slag registered on Sarpur was found on some ruins.	Þjms. 1976-2 on Sarpur (lumps of smelting slag.)	Unknown	Elín Ósk Hreiðarsdóttir and Ragnheiður Glo Gylfadóttir 2011
Brúarreykir, Stafsholtungur (Mýrasýsla)	109	Unknown ruins can be observed in this site (Elín Ósk Hreiðarsdóttir ed. 2008)	Þjms. 12752/1939-225 are said to be all smelting slag.	Unknown	Elín Ósk Hreiðarsdóttir ed. 2008
Sandártunga, Þjórsardalur (Árnessýsla)	110	In the summer of 1949 Sandártunga was excavated (Kristján Eldjárn 1949: 110) Artefacts found suggest a long period of settlement, and smelting slag was found (Kristján Eldjárn: 112) Sandártuna has been recently revisited by Gavin Lucas (march, 2018) Gavin confirmed the presence of slag and charcoal and the possibility of a smithy being	Þjms. 14075/1949-33 is registered on Sarpur. Smelting Slag was Mentioned to be found, however It is not registered.	Likely a smithy	Kristján Eldjárn 1949 Lucas 2018 (Þjóðminjasafn talk)

		there (Lucas 2018: 16:32)			
Sandafelli á Gnúpverjaafretti (Árnessýsla)	111	In this sites there are the ruins of a smithy (Gísli Gestsson og Jóhann Briem 1954: 17) a slag heap was apparently in proximity (Gísli Gestsson og Jóhann Briem 1954: 18)	Slag was found and registered on Sarpur (ÞJMS 2005-20-44)	Likely a smithy	Gísli Gestsson og Jóhann Briem 1954
Rógshólar í Hrunnamannahreppur (Árnessýsla)	112	This site is mentioned on Árbók FI 1954, although not much information is given.	On Sarpur the followinf artefacts are regisered: Þjms 1967-103 and Þjms 1967-104	Unlikely to be a smithy.	Gísli Gestsson og Jóhann Briem 1954
Sölmundarholt í Þjósardalur (Árnessýsla)	113	At 50 meters from the ruins of Sölmundarholt, smelting slag was found (Gísli Gestsson og Jóhann Briem 1954: 11)	Slag registered in Sarpur as Þjms. 15496-1/1954-128 and Þjms. 15766/1957-29.	Unknown	Gísli Gestsson og Jóhann Briem 1954
Jólgeirsstaðir í Holt (Rangárvallasýsla)	114	Not many sources are available for Jólgeirsstaðir (Ásgeir Ólafsson 1966: 81)	Slag is registered on Sarpur under the number Þjms. 1973-144	Unlikely to be a smity.	Ásgeir Ólafsson 1966
Akbraut í Holt (Rangárvallasýsla)	115	In Akbraut there are ruins of a medieval church (Kristján Mímisson and Bjarni F. Einarsson 2008: 4) The site was excavated in 2007	Smything slag is registered on Sarpur, ÞJMS 1968-439 and 1987-306. Another slag object had been found in 2014 (ÞJMS 2018-6)	Unlikely to be a smithy.	Kristján Mímisson and Bjarni F. Einarsson 2008

Minni-Borg Undir Eyjafjöllu (Rangárvallasýsla)	116	Þórður Tómasson found slag among other artefacts in Minni-Borg (Þórður Tómasson 2008: 112)	On Sarpur Þjms 1968-471 is registered.	Unlikely to be a smithy.	Þórður Tómasson 2008
Fossá , Þjorsadalur (Árnessýsa)	117	In Árbók 1954, Gísli Gestsson and Jóhanns Briem mention this site and the discovery of slag (Gísli Gestsson og Jóhann Briem 1954: 12)	Both smelting and smything slag are registered on Sarpur.	Unknown	Gísli Gestsson og Jóhann Briem 1954
Reyðarfell/Húsafell 2 Hvítasiða (Mýrasýsla)	118	A medieval town was excavated (Þorkell Grímsson 1976)	Slag and coal were found.	Unknown	Þorkell Grímsson 1976
Örfirisey , Reykjavík (Gullbringusýsla)	119	There is a mention that old artefacts were found in this area (Anna Lisa Guðmundsdóttir 2009: 4) Örfirisey was a some point a trading center (Anna Lisa Guðmundsdóttir 2009: 7)	One single lump of slag is registered in Sarpur. ÞJMS 15861-1/1957-123	Unlikely to be a smithy.	Anna Lisa Guðmundsdóttir 2009
Bjarnastaðir , Bárðælahreppur (S-Þingeyjarsýsla)	120	The actual site in which this piece of slag was found is at Vaglagerði, north from Bjarnastaðir. (See Ragnheiður Glo Gylfadóttir ed. 2015:13-15 for further information describing the site)	One single piece of slag is registered in Sarpur	Unlikely to be a smithy.	Ragnheiður Glo Gylfadóttir ed. 2015
Hrossatungurúst , Þjorsardal	121	The remains of a townhouse are located in this area (Gísli Gestsson	Smything slag and what appears to be smelting slag are	Unknown	Gísli Gestsson og Jóhann Briem 1954

(Árnessýsla)		og Jóhann Briem 1954: 18) Items found indicate it may have been a farm.	registered on Sarpur (2005-20-23)		
Skálhot, Biskupstungur (Árnessýsla)	122	First investigated in 1893 by Brynjólfur Jónsson, at the year 1948-1986 Þjóminjasafn Íslands conducted further research, a smithy was attempted to be found, though it did not happen. However smything slag was found.	Smithing slag was found.	Likely a smithy.	Kristján Eldjárn, Håkon Christie & Jón Steffensen 1988.
Hrauntungu (S-Þingeyjarsýsla)	123	Researched by Daniel Brunn in 1897, he found remains of slag and charcoal, he thought this place to be a smithy. (Orri Vésteinsson 2004: 50)	In 1972 Sigurður Þórarinnsson took charcoal samples from Hrauntungu and dated it to the viking age(Sigurður Þórarinnsson 1976:25)	Likely a smithy.	Daniel Brunn 1898 Sigurður Þórarinnsson 1976 Orri Vésteinsson 2004
Ormsstaðir í Fljótsdalshéraði (S-Múlasýsla)	124	Research was conducted by Margrét Hermanns-Auðardóttir and Þorbjörn Friðriksson, the site had the presence of slag but was well a depression that could have been an oven, suggesting the site may have been a smelting one. (Smith 2005: 199)	Slag remains are registered on Sarpur. No information regarding the recovery of slag or the dating has been published (Smith 2005: 199)	Likely a smelting site	Smith 2005
Hrísheimar í Mytvatns	125	Excavations were done from 2002-2006. It is dated from the 9 to the	Many pieces of slag were found in this site, both from	Likely an smelting site	Ragnar Edvardsson 2003 Ragnar Edvardsson 2006

(S-Þingeyjarsýsla)		11th century. The ovens in Area A-C are interpreted to be for smelting the iron bog (Ragnar Edvardsson 2003:4-7)	smithing and smelting.		
Sveigakot (S-Þingeyjarsýsla)	126	Excavations concluded in 2006, the report maintains a smithy to be in place as well as smithing slag (Guðrún Alda Gísladóttir, Orri Vésteinsson ed. 2008: 11)	Both smelting and smithing slag were found (Orri Vésteinsson ed. 2002: 69)	Likely smelting and smithing site.	Guðrún Alda Gísladóttir, Orri Vésteinsson ed. 2008
Lækjargata 12 (Gullbringusýsla)	127	Buildings from the 18, 19 and 20th century were excavated as well as a possible smithy (Agnes Stefánsdóttir and Ásta Hermannsdóttir 2017: 19)	Further research needs to be conducted.	Unknown	Agnes Stefánsdóttir and Ásta Hermannsdóttir 2017
Naust á Akureyri (Eyjafjarðarsýsla)	128	An excavation report from 2008 mentions that during the 2006 excavations charcoal and slag were found in an area that seemed to indicate iron working was taking place in the area (Oddgeir Hansson 2008: 8) Calculated that the iron working took place from 950 until 11 century (Oddgeir Hansson 2008: 22)	Samples of slag were taken to be analysed (Oddgeir Hansson 2008: 18), the results seem to be missing. Because the slag has not been analysed it is not known exactly whether in this site smelting or just smithing took place. A lot of slag was found in subsequent excavations (Oddgeir Hansson 2009: 33) A report was done as	Likely a smithy	Oddgeir Hansson 2008 Oddgeir Hansson 2009 Hildur Gestsdóttir & Guðrún Alda Gísladóttir 2015

			well in 2015, however it does not have mentions of ironworking (Hildur Gestsdóttir & Guðrún Alda Gísladóttir 2015)		
Bálabrekku (S-Þingeyjarsýsla)	129	In Bálabrekku, a spread of bog iron was located. Also red mud with very high iron content, and closer to a ruin a piece of smelting slag. Although the dating of the sites are around the viking age, the possibility that the iron smelting was not during the 10th and 11th century and was done in later periods after the area had been abandoned still remains (Orri Vésteinsson ed. 2005: 69)	Smelting slag found in the area.	Likely a smelting site.	Orri Vésteinsson ed. 2005
Háls í Borgarfirði (Borgarfjarðarsýsla)	130	Furnaces bases, slag heaps and pits as well as smithing debris were some of the features found during excavations at Háls (Smith 2005: 188)	Furnaces bases were uncovered in 2000 excavations (Smith 2005: 190) Slag lumps could be identify adhering to the clay material.	Likely a smelting site	Kevin Smith 2005
Ytri-Þorsteinstaðar (Dalasýslu)	131	Research in this area proved that iron working from the settlement era took place in this site (Grétar Guðbergsson et al. 2011: 8)	The analysis of the pieces of slag seem to indicate the site may have been an iron smelting site. (Grétar Guðbergsson et al.	Likely a smelting site	Grétar Guðbergsson et al. 2011

			2011: 16)		
Þingeyrar í Húnaþingi (A-Húnavatnssýsla)	132	A monastery was run in this site from 1133-1551. Research has been taking place since 2014, excavations began in 2018, conducted by Steinunn Kristjánsdóttir. A smithy was revealed upon excavations (Steinunn Kristjánsdóttir 2018: 6)	2017 excavations found slag on the floor, indicating the presence of a smithy(Hermann Jakob Hjartarson, Steinunn Kristjánsdóttir og Joe W. Walser 2017: 8)	Likely a smithy	Steinunn Kristjánsdóttir 2018 Hermann Jakob Hjartarson, Steinunn Kristjánsdóttir og Joe W. Walser 2017
Undir Rauðukömbum, Þjórsardalur. (Árnessýsla)	133	Brynjúlfur Jónsson visited the site in the 19th century, he described the presence of a byre, a dwelling and a smithy, (Brynjúlfur Jónsson 1883)	The site has eroded and further information cannot be confirmed (Steffen Stummann Hansen and Orri Vésteinsson eds. 2002: 24)	Unknown	Brynjúlfur Jónsson 1883. Steffen Stummann Hansen and Orri Vésteinsson eds. 2002.
Krókdalur (S-Þingeyjarsýsla)	134	Research was conducted in the 18th and 19th century, and Daniel Bruun briefly surveyed and described the area. In 2004 an archaeological survey was carried out due to the increasing erosion of archaeological remains, the survey resulted in identifying three sites, a burial (possibly pagan) and iron-smelting sites (Orri Vésteinsson ed. 2005: 6).	The site's last research was conducted in 2005.	Likely a smelting site.	Orri Vésteinsson ed. 2004 Orri Vésteinsson ed. 2005
Ytri Ásar	135	Structural stones were found on a	No slag registered on Sarpur.	Unknown.	Ágnes Stefánsdóttir and Ásta

(V-Skaftafellssýsla)		field at Ytri Ásar, archaeologists believe it could have been a smithy(Ágnes Stefánsdóttir and Ásta Hermansdóttir 2018: 81), however not enough data is known to reach a conclusion.			Hermansdóttir 2018
Stöð í Stöðvarfirði (S-Múlasýsla)	136	9th century halls were excavated.(Ágnes Stefánsdóttir & Ásta Hermannsdóttir 2018: 88)	Among the structures photographed one of them seems to correspond to a smithy (Ágnes Stefánsdóttir & Ásta Hermannsdóttir 2018: 88)	Likely a smithy	Ágnes Stefánsdóttir & Ásta Hermannsdóttir 2018
Narfastaðir, Reykjadalur (S-Þingeyjarsýsla)	137	Soil core testing was performed in the area. Charcoal and turf were found, meaning that there could be either a smithy or a charcoal pit in this site (Ágnes Stefánsdóttir and Ásta Hermansdóttir 2016: 48)	Further research needs to be conducted.	Unknown	Ágnes Stefánsdóttir and Ásta Hermansdóttir 2016 Lísabet Guðmundsdóttir 2016 Adolf Fríðriksson et al. 2007
Kirkjugarðinum í Keflavík í Hegræni (S-Þingeyjarsýsla)	138	The remains of a smithy appear to have been found next to the entrance of the cemetery (Ágnes Stefánsdóttir & Ásta Hermannsdóttir 2018: 71)	Further research needs to be conducted.	Unknown	Ágnes Stefánsdóttir & Ásta Hermannsdóttir 2018
Fossárdalur (Árnessýsla)	139	ÞJMS 2005-20-10 two pieces of slag found in ruins in Fossárdalur. In the ruins of this area smelting slag was found (Gísli Gestsson og	More pieces of slag found in 2005 were lausafundur.	Unknown	Gísli Gestsson og Jóhann Briem 1954

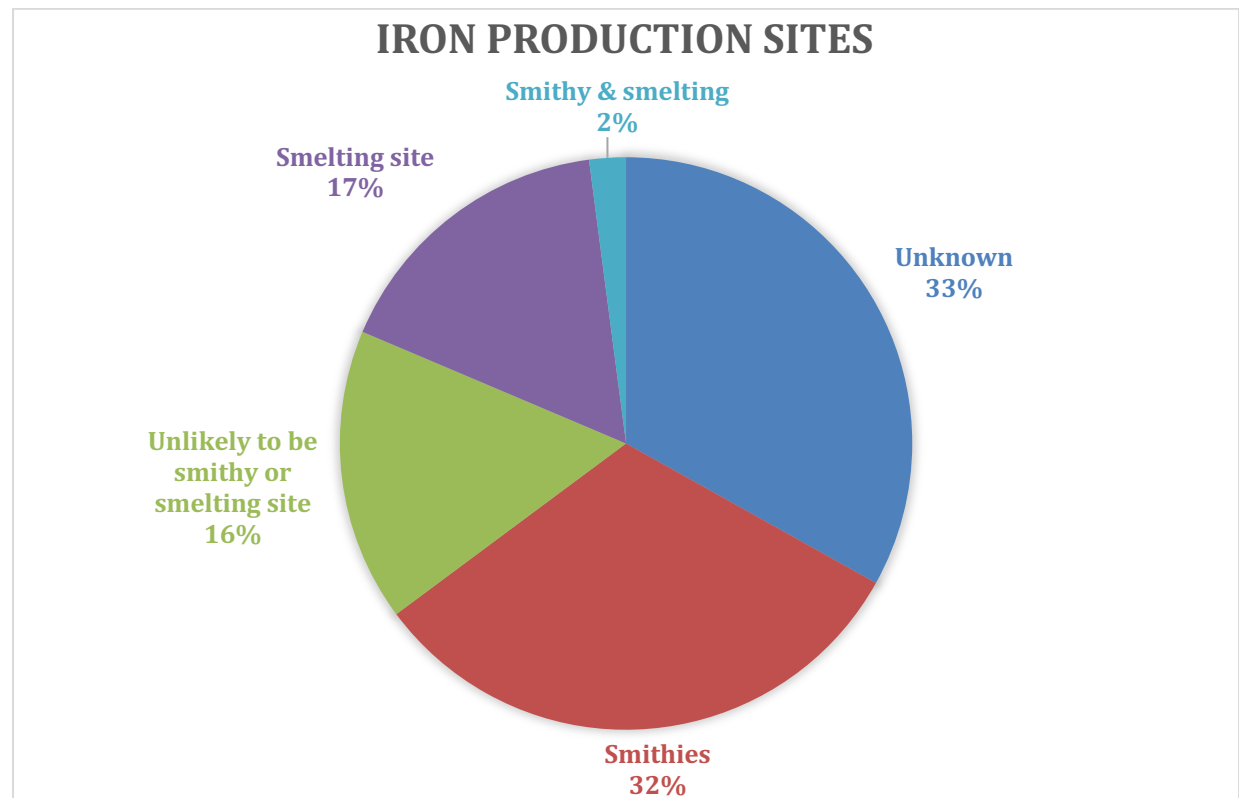
		Jóhann Briem 1954: 14)			
Hólar í Hjaltadal (Skagafjarðarsýsla)	140	Upon excavations on site, on the area A charcoal and slag was found (Ragnheiður Traustadóttir et al. 2002: 9)	Pieces of slag are registered on Sarpur.	Unknown	Ragnheiður Traustadóttir et al. 2002
Skarfanæs (Rangárvallasýsla)	141	In the remains of a smithy in the ruins of Skarfanæs, several pieces of slag were found (Kristborg Þórsdóttir & Ragnheiður Glo Gylfadóttir 2016: 15)	Several pieces of slag are registered in Sarpur.	Unknown	Kristborg Þórsdóttir & Ragnheiður Glo Gylfadóttir 2016
Drumboddsstaðir, Biskupstungur (Árnessýsla)	142	Mentions of a smithy from the settlement period. Slag from smelting, charcoal and other artefacts were found and registered on Sarpur. Leiði og smiðja landnámsmannsins Drumbodds, nálægt bænum, sem ber að vernda vegna aldurs. (Gísli Gíslason, Ingibjörg Sveinsdóttir & Ásgeir Jónsson 2017: 53)	In Sarpur, several slag pieces are registered (1961-133-3, 1961-90, 1961-133-2, 1961-133-1, 1961-133-4)	Unknown	Gísli Gíslason, Ingibjörg Sveinsdóttir & Ásgeir Jónsson 2017
Tröllakonugróf í Þjórsárdalur (Árnessýsla)	143	Smelting slag found on ruins in Tröllakonugróf east of Búrfellsháls in Þjórsárdal.	No further information.	Unknown	http://www.sarpur.is/Adfang.aspx?AdfangID=335624

Mýnes (S-Múlasýsla)	144	The iron bloom was found in 1906 when a house was dug (Kristján Eldjárn 1975: 104)	An iron bloom from a smelting site is registered on Sarpur. The find was located in Mýnes, in Eiðapinghá at S-Múlasýsla. It is thought to be from the middle ages.	Likely a smelting site	Margrét Hermanns-Auðardóttir, Þorbjörn Á. Friðriksson 1994, Þorkell Jóhannesson 1943 Kristján Eldjárn FI 1975
Niðurföll/Þykkvabæjarklaustur 2 (V-Skaftafellsýsla)	145	The site was a monastery between 1168 and 1548. Medieval artefacts are not preserved from this site. (Vala Gunnarsdóttir & Steinunn Kristjánsdóttir 2016: 41)	In Sarpur, slag remains from the ruins of a smithy are registered Þjms 1990-79-8	Unknown	Vala Gunnarsdóttir & Steinunn Kristjánsdóttir 2016 https://www.mbl.is/greinasafn/grein/102473/

Chapter V: Discussion and conclusions

An overview between settlements and iron production sites

Based on the tables on chapter three, the data was analysed as follows:



A total of 145 sites are listed in the tables in chapter III. Out of those, a 33%, 48 sites total, have insufficient data to determine the nature of the site, and were thus classified as unknown. For a site to be categorized as unknown one of the following characteristics needed to be present:

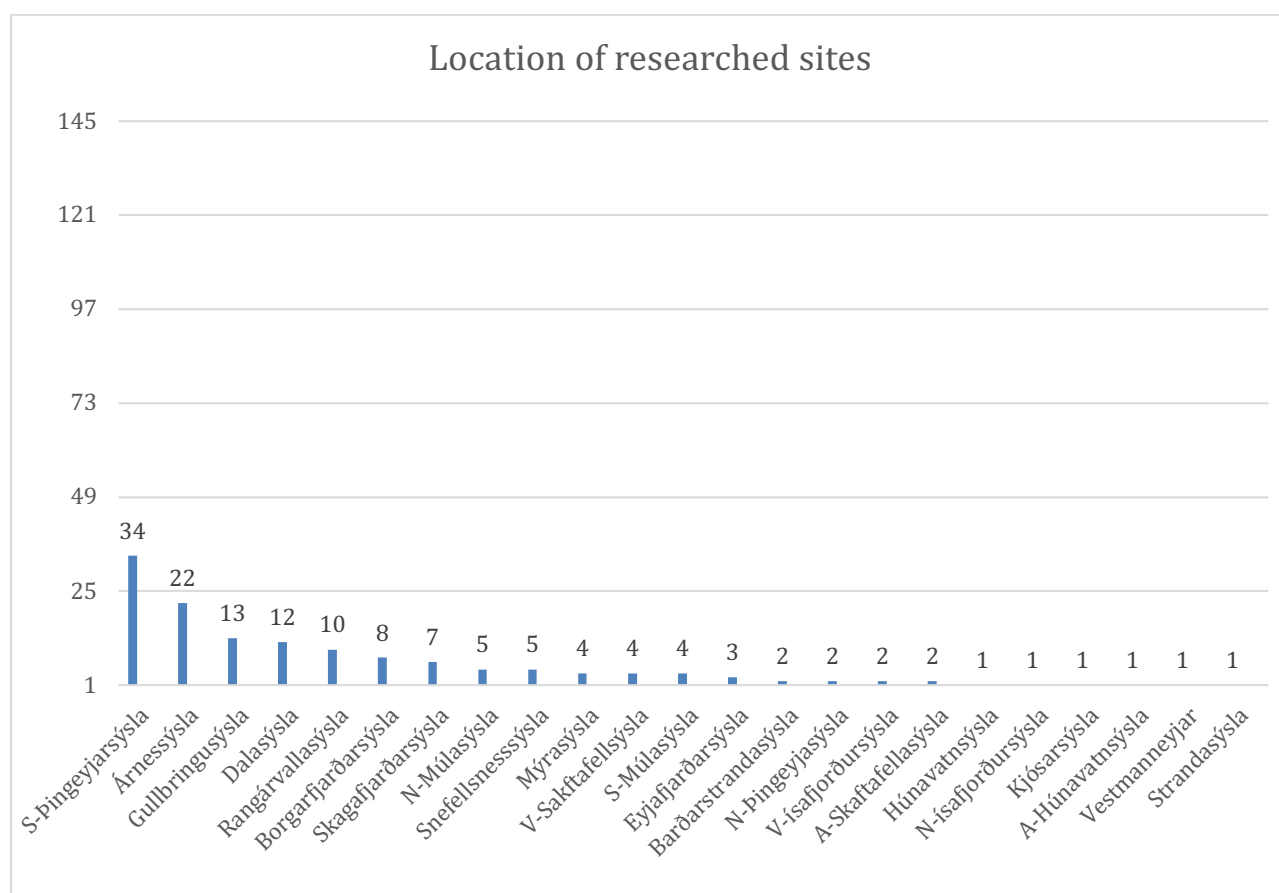
- a. No further research was conducted.
- b. If any report corresponded to the finding on Sarpur
- c. If the report of excavations mentioned stray slag being found but not the possibility of a smithy or smelting site being there.
- d. If the information on the report was inconclusive but there is not more research to reaffirm that there is no iron production site.

Regarding smithies, the amount of sites listed is 32%, or 46, based on the type of slag found, as well as structures excavated.

Regarding the 24 sites (16%) unlikely to either be smithies or smelting sites, this was determined based on information provided by the sources. For a site to be determined as unlikely, research had to be lacking (such as, cases in which a site was registered due to there being a legend of it being a smithy, the slag described was out of context with the site itself, or further research done in the area did not confirm the identification.

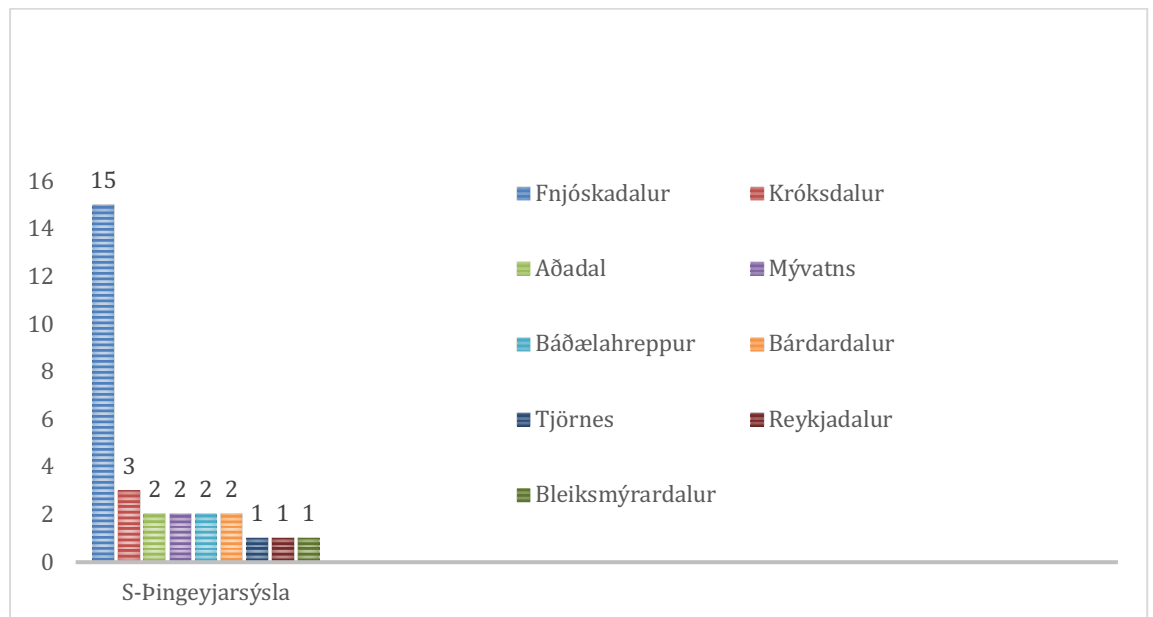
The smelting sites were 24, or 17% of the sites analysed. A total of 3 sites, rounding up to 2%, could have both been used as smithies and smelting sites parallel.

The following graphic divides all 145 sites into different areas of Iceland. Even sites that have been deemed unlikely of being iron production sites have been included.



Regarding the distribution of iron production sites, the table above allows for a pattern to be observed. Although among the numbers are also sites unlikely to be iron production sites or of unknown nature, it is still possible to observe an incidence of sites in certain areas of the country. Suður-Þingeyjarsýsla, in particular the area of

Fnjóskadalur has a quite high number of sites that were either smithies or smelting sites. The following graphic shows the distribution of sites in the area of Suður-Píngeyjarsýsla, which has the highest number of possible sites.

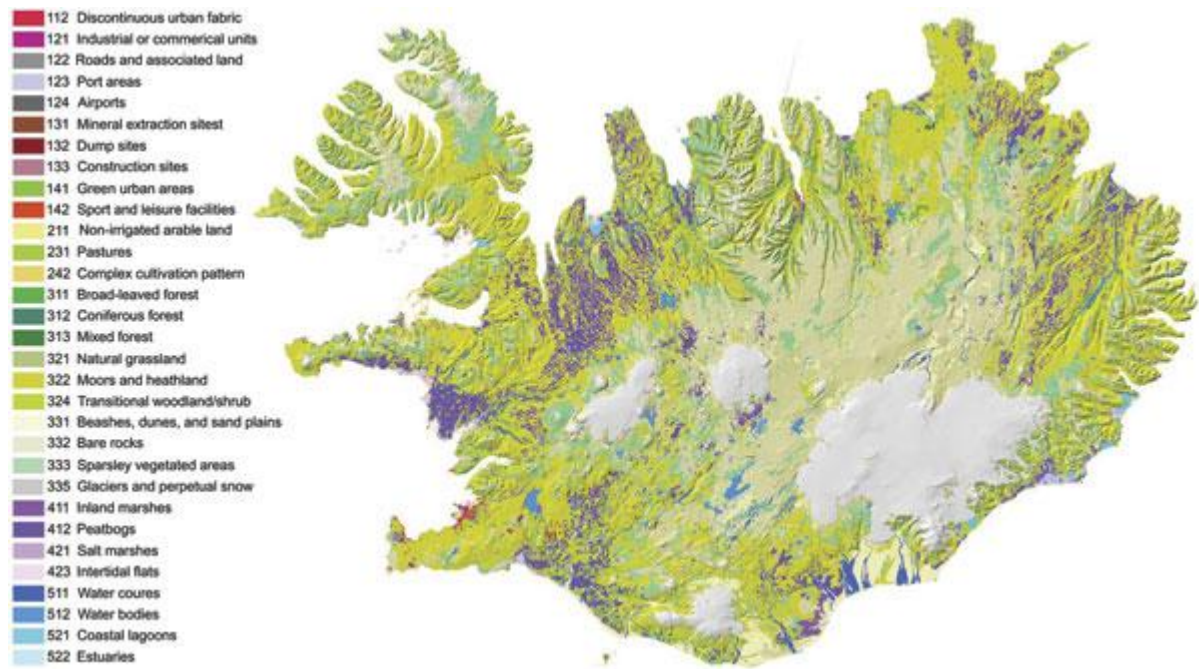


The same pattern can be observed in Þjórsárdalur around Árnessýsla, which is the location with the second highest amount of sites.

The pattern of distribution could correspond to the location of iron-rich bogs as well as the location of settlements. In order to get a better understanding about the distribution of bog-iron in Iceland and determine which conditions facilitate the exploitation of said iron, it is first necessary to analyse the location of iron bog in Icelandic soil.

As has been previously mentioned, bog iron is commonly found in peat bogs, swamps and marshes. Given that it is impossible to obtain a map of this geological distribution from the settlement period, a modern day map will be used, which points out the different types of vegetations and other features.

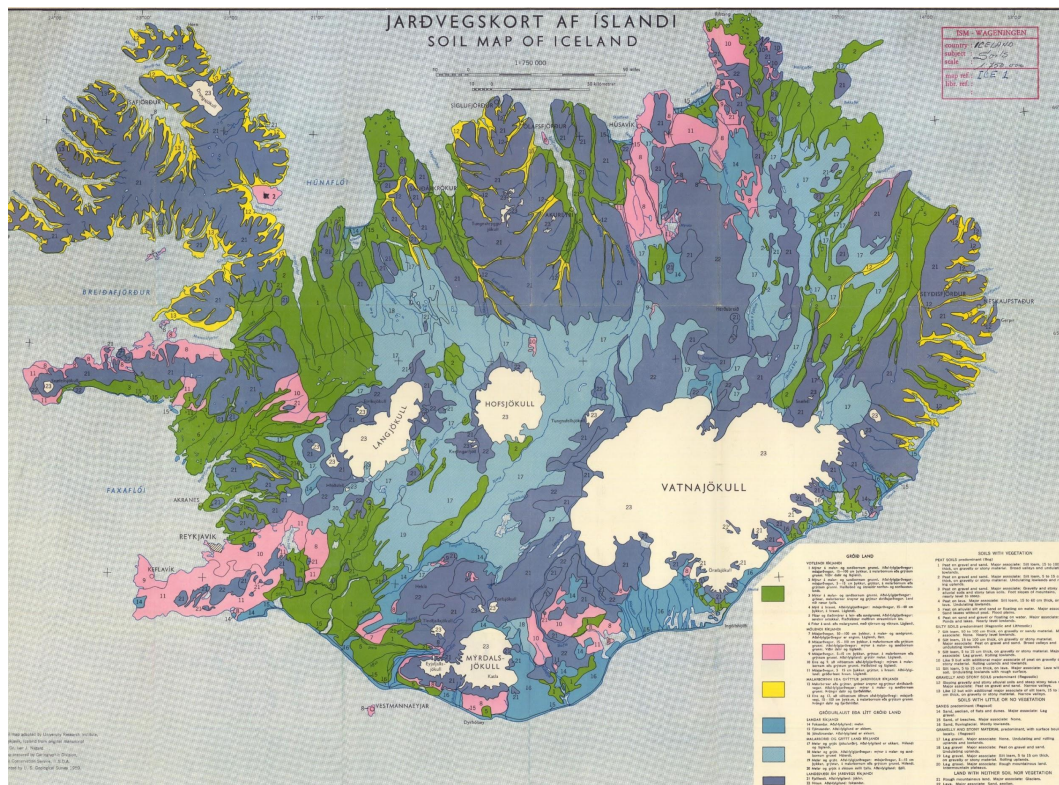
The map shows an analysis of land cover done by Kolbeinn Árnason and Ingvar Matthíasson. The mapping of the vegetation was completed in 2008.



(Figure by Kolbeinn Árnason & Ingvar Matthíasson 2008)

Peat bogs are marked with a dark purple color, as well as inland marshes in a slightly lighter purple. Water bodies are represented in blue.

There is that the landscape may have changed since the settlement of Iceland. The possibility of there being peat bogs in other areas is still present, however this specific map provides a visible source of Icelandic landscape and its vegetation to a general level. With this type of map, small bog reserves may not be registered. This however does not mean that every peat bog contains bog iron. However, with the help of other maps the idea is to locate the distribution of usable and exploitable iron bog.



(Map by Björn Jóhannesson 1960)

The map above done by Björn Jóhannesson shows the different soils in Iceland. Peat lands are represented by the color green. Both the vegetation map and the soil map agree on the areas which are currently dominated by peat and wetlands.

What conditions are necessary for the processing of bog-iron?

As has been repeatedly mentioned, bog-iron is easy to extract. To turn it into malleable iron requires two things. The first one is the bog iron itself. To construct an iron smithy or iron bloomeries it makes sense to be located as close as possible to the source of the material.

It is important to take into consideration as well that the adequate resources to produce the necessary tools would play a part in the process as well. The main one being furnaces. As has been discussed, there is not much information about the material from which the Icelandic furnaces were made.

The second component of great importance in the processing of bog-iron was charcoal. This means there was a need to be near birch forests in order to obtain the wood necessary to make the procedure work.

Wood in viking age society

Since wood has already been established as an important requirement for the processing of bog-ore, a brief analysis of its importance in Viking Age households will be given.

Deforestation, as stated before, is mentioned in *Íslendingabók* depicting the idea that the forest cover in previous centuries was much more extensive than it was in the medieval era. Although traditionally it was believed that wood was the main source of fuel in Viking Age farmsteads, archaeological research has shown this not to be the case. A wide variety of fuels were used (Trbojević et al., 2011: 32). A mixture of turf, peat and other materials was used in both Hofstaðir and Sveigakot (Simpson et al. 2003). Considering that peat was a known form of fuel, the question of what factors contributed to the ceasing of bloomeries arises. Even with the deforestation, bog iron could have continued to be processed by simply changing the material for fuel. In spite of this, by 1550 iron production in Iceland had ceased, instead importing iron from other foreign areas, transported by merchants (Þorkell Jóhannesson 1943: 57-58). What factors then could have caused iron smelting to become an uncommon activity?

Peat

As established before, charcoal was essential for the processing of bog iron because fuel was needed to heat the furnaces to smelt the iron into a bloom. Thus, the distribution of iron working sites would have been influenced by the location of birch forests. However, research conducted by Orri Vésteinsson and Simpson presents the theory of peat being utilized as a fuel for industrial purposes even in early periods of the settlement era, as observed in the excavations of Hofstaðir.

Analysis made both at Hofstaðir and Sveigakot showed the interesting discovery of dry turf being utilized as fuel. However possibly the most interesting aspect of this research was the increase of wood in later periods (Orri Vésteinsson and Simpson 2004: 182). If considering that the settlers were utilizing the same techniques for processing iron that they used in their homelands, the implication is that also in Scandinavia, peat might have been used as well rather than wood. However this is not the case in analysis from other Scandinavian countries, as charcoal remains the main component of bloomery sites excavated. This particular phenomenon in Iceland is puzzling, because at the time of the settlement, there was ample availability of wood.

Although turf was present in both sites, a main difference between them was that at Hofstaðir there was evidence for peat being burned at very high temperatures,

whereas Sveigakot had no evidence of peat being used. This caused the authors to wonder if peat was a material used for industrial purposes only (Orri Vésteinsson and Simpson 2004: 182).

This theory does indeed influence the pattern of distribution of bloomeries, since the workers would not have had as a necessity to install their facilities close to a birch forest, and therefore, given the rich amount of peat bogs in Icelandic soils give further liberty in the location of iron working sites.

The lack of furnaces as it has been discussed renders difficult the task of understanding bloomery sites and the way in which they worked. As said before, the most probable theory to justify the absence of furnaces in the archaeological record is the material with which they were built. In spite of the suggestion of furnaces being designed with turf which could sustain the high temperatures required and being a resource widely available, this concepts do not help shed a better understanding about the construction of bloomeries. Whatever resources may have been used to construct furnaces may also have had an influence in the distribution of the bloomeries, as well as having a direct effect in regards to the factors that influenced the procession of bog iron.

In regards to investigations related to this sites, there is vital information missing from most excavations done for the past century. But as well in the current time, there is very little classification of things such as slag. What is missing in the formula is a proper database for iron related findings (exclusively), a classification of different type of slag and a list for (possible) iron production sites, with information regarding excavations done in the site and information about previous excavations. Even if the information is different than what new research establishes, it is important to do a comparison between sources and find the things by which they share something and what it differentiates them. And this information should be available to the public as well. Icelandic archaeology should find a new approach in regards to recording. A more detailed account on artefacts would be of great help, as even interim reports are very basic in relation to artefacts, whereas extremely focused on the quality and type of layer presented on site.

Before further investigation of newer sites can be uncovered perhaps the re-excavation of old sites mentioned could enrich research more than continuing to toll up possible iron production sites on a never ending list of possibilities. Old sources need

to be seen, corrections need to be made when found, research has to be questioned, or else we are limiting investigation and collecting incomplete data.

Conclusion

The information compiled in this research is mostly related to the process of iron smelting and iron working, which is necessary to understand in order to determine which factors are needed for the procession of bog iron.

As has been stated in previous chapters, bog iron extraction was common during the settlement period, but a variety of factors caused the decrease of the iron production industry, which by the 16th century was non-existent. Iron smelting was still taking place during the medieval period, however written accounts do not provide much information.

The formation of bog iron can be affected by multiple factors such as climate change and the levels of humidity in the area. The settlement period greatly affected and changed the distribution of vegetation, due to the practice of clearing forests in order to build farmsteads. Although traditionally this deforestation is argued to have been the cause of decrease in iron production, recent research regarding fuel suggests a different perspective. Wood was not the only material used for fuel, as the archaeological record proves. This factors could be connected to the formation of bog iron, which must have experienced substantial changes during the process of deforestation that may have caused variation in the quality and the concentrations of iron. A variation in quality could be the reason why the industry of iron production began to decrease and subsequently cease to exist completely. Trading of blooms may have been common during the settlement period, which would justify the need of bloomeries producing the raw material.

Regarding which factors are needed for the processing of bog iron, both location and resources are important. The location needs to be an area in which there is bog iron.

The other condition needed is the fuel to heat the furnaces, which is also connected to the location. To process the bog iron woodland areas or peat bogs needed to be located in close proximity

The analysis of a variety of sites described in this research and the further mapping of these sites proves this two conditions to be relevant regarding the location of bloomeries. Bloomeries are located in areas close to peat bogs and in other cases to

what were originally forests. Excavations have revealed that an important factor in bloomeries themselves were the charcoal, and in recent research, peat (Orri Vésteinsson and Simpson 2004)

In regards to investigations related to this sites, there is vital information missing from most excavations done for the past century. But as well in the current time, there is very little classification of things such as slag. What is missing in the formula is a proper database for iron related findings (exclusively), a classification of different type of slag and a list for (possible) iron production sites, with information regarding excavations done in the site and information about previous excavations., more accessible database for the common public will have a positive impact in Icelandic archaeology, reduce the quantity of data and focus on the quality of it. Even if the information is different than what new research establishes, it is important to do a comparison between sources and find the things by which they share something and what it differentiates them. And this information should be available to the public as well. Icelandic archaeology should find a new approach in regards to recording. A more detailed account on artefacts would be of great help, as even interim reports are very basic in relation to artefacts, whereas extremely focused on the quality and type of layer presented on site.

Thus the conclusion reached is that there is a need to reconsider what is established as fact from the past, and maybe take a new approach in investigating iron and its production. Is iron on a site a sure indicator of production taking place? Are there really as many iron production sites, smithies and bloomeries as we may think, or is that heavily influenced by the presence of certain artefacts? How many of theses sites actually show presence of smelting taking place in the form of layers of peat and charcoal or the possible presence of ovens? How many of this places are actual smithies, exclusively for the refining of blooms of iron?

Unless there is extensive research on each specific site that is claimed to be an iron production site, a proper classification of slags well documented and well divided, and reports treating the topic of slag with as much importance as it deserves, further knowledge regarding the division of bloomeries and smithies is severely crippled.

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