VIKING EXPANSION AND THE SEARCH FOR BOG IRON

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ABSTRACT

The Vikings have been highly romanticized in popular literature, portrayed as ferocious warriors and incredible explorers. What we do not see are the strategies and skills that made them successful. This paper focuses on the settlement and expansion patterns of the Norse people, and how they used bog iron as an important resource to aid their expansion across the seas. We will plot known Viking settlement sites against bog iron extraction areas in order to highlight iron's importance as a resource to the Vikings. Bog iron is a type of iron found in bogs, lakes, and rivers that is abundant, easily extracted and processed. This made it an ideal source of iron for a population that was looking for accessible resources in newly settled areas. An examination and subsequent comparison of archaeological site reports from Viking settlements in Northern Europe and North America reveals that there is a direct relationship between Viking sites and bog iron deposits.

INTRODUCTION

The Vikings were a dominant force in northern Europe for approximately 300 years (Brink, Price 2008). They originated in

Scandinavia and due to being excellent mariners they dispersed and settled in large portions of northern Europe. Frequently during this expansion, the Vikings had the opportunity to settle in a variety of locations of their choosing. This was either because the land was uninhabited, as in Iceland, or because their fighting prowess was far superior to that of the farmers that inhabited these new regions. As such, their settlement locations were not random, and not simply born out of convenience.

Until now, no substantial research has been conducted to correlate bog iron and Viking settlement locations. Bog iron was the primary source of iron ore throughout the Viking world (Brink, Price 2008). This is because it has many properties useful for shipbuilding, such as a resistance to rust. We propose that there is a positive relationship between settlement locations during the period of Viking expansion and the availability of bog iron at these locations. This paper includes a detailed explanation of bog iron use and manufacture patterns in order to show that Vikings actively sought bog iron as a prerequisite for establishing a settlement.

Bog iron is typically found in peat bogs and, to a lesser extent, in rivers and lakes. It is easy to spot potential areas that contain bog iron as there is generally surface discoloration in stagnant areas that provide a visual marker for the dissolved iron content in the water (Weronska 2009). As compared to conventional and complex mining, bog iron extraction is a relatively simple course of action. The bog ore is easy to process with limited technology due to the fact that it does not need to be molten to remove many impurities. Additionally, bog ore often contains silicates, the majority of which do not purify out with the slag. This leaves a final product with a glassy finish that helps to resist rust, which is ideal for saltwater conditions.

The production of iron in Scandinavia began in Denmark in 500 BC (Eriksson 1960) and spread to Norway and Sweden shortly thereafter. Many bog iron processing pits have been found near major waterways and since the Vikings utilized them for many different reasons, this not unexpected. While archaeo-

logical remains related to the production of iron were originally mistaken for cooking pits, a more recent reconsideration of the evidence has shown that these pits are actually the result of a process of pre-treating the bog ore (Espelund 2006). These pits represent the first stages of bog iron metal work and tend to be in close proximity to bog iron sites as well as other types of settlements.

In order to determine if an archaeological site was important for the production of bog iron, various site reports such as Warmlander's 2010 investigations of a Viking Chieftain's farm at Hrísbrú in Iceland and Helge Ingstad's writings about the Viking settlement at L'Anse aux Meadows will be examined. We will be looking to see whether or not the sites contain any processed iron, iron artifacts, anvil stones, buildings dedicated to iron production (smithies), smelting furnaces, and most importantly slag (remnants of the smelting processes). The sites' locations will be investigated to see if they have been constructed near bogs, lakes, or rivers that may have provided the ore for smelting.

SCANDINAVIA

In Scandinavia, specifically at the site of Mosstrond in Norway, a more recent evaluation of pits which were originally thought to be used for cooking or ceremonies have been shown to be used in a pre-treatment of bog-iron (Espelund 2006). These flagstone-lined dug-in furnaces are referred to as *hellegyter*, by the archaeologist T. Hauge (Espelund 2006), and are described as being 45cm deep, 50cm across at the bottom, and 60cm across at the top. Large quantities of slag have been found in association with these pits, sometimes as much as 50kg (Espelund 2006), which emphasizes their importance in the iron production industry of Scandinavia. Carbon-14 dating has placed the *hellegyter* at Mosstrond from 550-800 A.D. Eriksson (1961) states that bog iron dominated the iron production of Norden, the Norse populated areas including Scandinavia, Denmark, Finland and

others, from 500 to 1300 A.D. According to Espelund (2006), Mosstrond is well known as having been a prominent iron production location. Since the damming of Lake Mosvatnd, the water level has erased many peat bogs that were once scattered throughout the area. Despite this, bog-iron ore can be found in the gravel along its shores (Espelund 2006).

In his paper on the charcoal iron industry of Scandinavia, Eriksson (1961:268) provides a map that plots the locations of major settlements such as Telemark and Bergslagen, in relation to known areas that would have allowed for bog iron extraction. The areas around Telemark and Bergslagen in particular were found to have numerous pockets of available bog iron. Another interesting correlation seen on this map is the lack of settlements where there is no evidence for bog iron deposits. Trondheim is the only settlement of a noticeable distance from any deposit. This could possibly be due to our lack of knowledge regarding the location of bog iron deposits at that time, or maybe it was simply a site that was used to gather other resources. Regardless, the information presented here provides good evidence for the importance of this resource to the Norse population.

Since bog iron was originally used to create farming tools and only later used for boat nails and weapons (Eriksson 1961), the local smithies were fairly small-scale operations used by multiple farms. With the relative ease of pre-treatment in the *hellegyter*, any farmer would have been able to produce iron ingots, bars of raw iron that could be processed at a neighbour's smithy. Knowledge that related to accessing iron was widely known among the Norse people (Eriksson 1961), and any settlers leaving Scandinavia would have brought this information with them. The exact techniques that were used vary with time and location due to restrictions within the different environments, and the development of new technological innovations. The fact that most people would have known the basics of metal work may have allowed for easier colonization and expansion. This is demonstrated by evidence for unskilled smelting at L'Anse aux Meadows. As discussed later in this paper, the people were not

as well versed in smelting as compared to people at the "Iron Farms" in Iceland, but they still produced iron.

If more data were available relating to the exact chemical composition of slag found in association with smithies and other metal working areas, the use of these pre-treatment pits would be even more easily tracked throughout the environment. In slag that is produced by smelting iron ore, the SiO2 % is always 25%, regardless of region, time frame or technique (Espalund 2006). However if it has only gone through pre-treatment the SiO2 % is much lower (approximately 10%). More research could possibly track this unique technique, not only across Norse colonies, but also across other societies.

ICELAND

Three main categories of bog iron sites are seen in Iceland. These are based on the level of specialization and dedication towards the production of bog iron. Large scale processing sites, which are also known as "Iron Farms" seem to have been established primarily for the mass production of bog iron. Smaller scale production sites, which consist of large farmsteads and some of the original Icelandic settlements, seem to produce only enough iron to be self-sufficient. Finally there are the non-production sites, which contain little to no evidence that iron was produced there. These non-production sites consist primarily of small farms and possible trading centers, such as markets or ports, and do contain processed iron ingots and artifacts. This would suggest that these sites had iron supplied to them through trade with the large scale "Iron Farms". Eight Icelandic sites in particular will be examined in the following section. These sites include: Hrísheimur and Hofstaðir (large scale "Iron Farms"); Granastaðir, Háls, and Hrísbrú (large farms with small scale iron production); Reykjavík (an original settlement with small scale iron production); Sveigakot (a small farm with no iron production); and Gásir (a port town with no iron production).

The small-scale sites will be examined first, starting with the site of Reykjavík which is located along the western coast of Iceland and is considered to be one of the first Viking settlements (Einarsson 1995). The first settlement at Reykjavík included a smithy with a furnace for the smelting of bog iron, as well as slag deposits (Einarsson 1995). This indicates that there was iron production at this settlement. However the amount of iron produced was likely only enough to satisfy the settlement's regular iron consumption. While there are no bogs in the vicinity of the site (Einarsson 1995), the local land has been terraformed by generations of Icelanders and any bog that may have existed could have been filled in. *Reykjavík* is located on lowlands along the coast so the likelihood that a bog once existed in the area is very high.

Hrísbrú is a large site located in western Iceland, just north of Reykjavík in the Mosfell Valley. The site consists of a very large farm that is thought to belong to a chieftain or elite Icelandic family (Warmlander 2010). Hrísbrú, like Reykjavík, has a dedicated smithy with a smelting furnace, large slag deposits, and is located next to moderately sized, iron producing bog (Warmlander 2010). The iron production at this site would have been more substantial than what was found at Reykjavík. However, Hrísbrú was a large farm which would have had a higher iron consumption rate than that of Reykjavík, and therefore the iron produced was probably only enough to supply the farmstead.

Granastaðir is a large farm site located in central Iceland, south of Gásir in Eyjafjardarsysla. Granastaðir is a slightly smaller farm than Hrísbrú, but still includes a smithy with a smelting furnace (Einarsson 1995). Due to the large bog and slag deposits located at Granastaðir, it would appear that iron production was on an even larger scale here than at Hrísbrú. The iron production at this site would have easily sustained the farm with enough left over for trading purposes (Einarsson 1995).

The next site is the farm of Háls located in northern Iceland, between Gásir and Hofstaðir. Háls is an interesting site because even though it was a small farm, it had a comparatively large

iron production industry (Smith 1995). Much like Hrísbrú and Granastaðir, Háls includes a smithy, smelting furnaces, slag deposits, and is located next to a bog (Smith 1995). Unlike the other sites, the relatively small size of Háls compared to its iron production facilities suggest that bog iron could have been a staple of trade or wealth for Háls. This does not place Háls into the large-scale production classification because the iron industry found at this site is much smaller than that of Hofstaðir or Hrísheimur.

We will now look at the two large-scale iron production sites, aptly dubbed "Iron Farms" (Evardson 2006), due to their massive iron production capability. Hofstaðir is located in northern Iceland in the Mývatnssveit, next to a massive iron producing bog. Hofstaðir, though quite large, seems to be more specialized in the processing of iron than other farms such as Hrísbrú or Granastaðir are (Ascough 2007). Hofstaðir includes a smithy with a large smelting furnace (Ascough 2007). However, the amount of slag and a closer proximity to such a massive bog would indicate that the ability to produce iron would have greatly exceeded other sites. This would have made Hofstaðir a very wealthy settlement as it is a large farm with a large iron production industry attached to it.

The largest site of iron production site would be that of Hrísheimur, located in northern Iceland next to Hofstaðir in the Mývatnssveit. Hrísheimur, unlike the above-mentioned sites, was specifically built to harvest and process bog iron (Edvardsson 2006). The site contains at least one smithy, though it has been suspected that there may have been a second building, separate from the smithy, used for iron production due to the presence of iron filings (Edvardsson 2006). There may have also been several smelting furnaces near the bog, which would explain the large amount of slag that is deposited across the site (Edvardsson 2006). There is no doubt that Hrísheimur was established for large scale iron production, though it has also been theorized that the site was set up to supply all of the local farmsteads in the area with iron and a communal iron works (Edvardsson 2006).

The last two sites, Sveigakot and Gásir, contained no evi-

dence of iron production, but did contain processed iron ingots. Sveigakot is located south of Hrísheimur in the Mývatnssveit. This site is a small farm, which seems to have been abandoned between its establishment in the late 9th century and its subsequent re-establishment during the 12th century (McGovern 2006). This site contains some iron ingots, but there is no evidence to suggest it was used for iron production (McGovern 2006). Sveigakot is located very close to Hrísheimur and most likely supplied the "Iron Farm" with agricultural supplies in exchange for iron (McGovern 2006). The last site is the port of Gásir, which is located on the northern coast of Iceland, to the west of Hofstaðir. Gásir is a fairly recent settlement that dates to the 12th century (McGovern 2008). Iron ingots and agricultural products that are not thought to have been produced on site suggest that this settlement may have served as both a port and as a local centre for trade (McGovern 2008).

Reykjavík, established in the early 9th century (Einarsson 1995), is the oldest site that was examined and seems to represent the standard model of large farms in Iceland. This model includes access to a bog, a smithy, and an iron-smelting furnace in order to be self sufficient in terms of iron production. Hrísbrú, Granastaðir, Háls, and Hofstaðir were all established in the late 9th or early 10th century using the Reykjavík model, though Háls and Hofstaðir seem to have begun to rely on specialized iron production as a source of trade wealth (Warmlander 2010; Einarsson 1995; Smith 1995; Ascough 2007). Hrísheimur was established in the 12th century (Edvardsson 2006) and unlike the other settlements, was designed for large-scale iron production instead of a balance of iron production and agriculture. Sveigakot was small farm, most likely part of a larger farm such as Hofstaðir (McGovern 2006). It was established in the late 9th century, abandoned shortly after being created, and reestablished during the 12th century (McGovern 2006). Sveigakot was most likely reestablished in order to provide food and other agricultural products to Hrísheimur, which at the time seemed more concerned with the mass production of iron (Edvardsson

2006). Finally, there is Gásir, which was established in the 12th century (McGovern 2008). Gásir was a port and most likely a centre of trade for the local area (McGovern 2008) since it was neither a farm nor an iron producing settlement. Processed iron ingots have been found at Gásir which indicates that iron was processed elsewhere, such as Hrísheimur, and then transported to Gásir for trading purposes (Edvardsson 2006). Fish and other marine animal remains have been found at the inland sites of Hofstaðir and Hrísheimur (Ascough 2007), which may also indicate that trade occurred between Gásir and these two sites.

L'ANSE AUX MEADOWS

In the summer of 986 A.D. the North Atlantic Sagas tell us that 24 boatloads of people set out from Iceland on their way to Greenland under the leadership of Erik the Red (Fitzhugh, Ward 2000). Not all of these boats made it, but nevertheless the initial settlements of Greenland were successful. It is believed that the population of the Greenland settlements may have at one time peaked above 5000 (Brown 2000). This success, however, did not last indefinitely. A number of factors contributed to the eventual failure of the Greenland settlement, including a reduction in the number of Norwegian merchant ships visiting, and a complete lack of ships from Germany's Hanseatic League (Brown 2000). This meant that there was reduced trade access to necessary goods like iron and tools. As the Greenlanders processed their own bog ore, they further depleted the already scarce resources of wood. Recognizing the necessity of finding wood to burn for processing ore, Leif Eriksson set out west towards North America (Brown 2000).

Viking sagas mention that there were a number of locations along the North American coast that Vikings landed at, but there is currently only one confirmed Viking settlement, L'Anse aux Meadows. The excavations at L'Anse aux Meadows have turned up considerable evidence for the processing of bog

ore, and the production of iron. These findings seem to suggest that there was a purposeful effort to situate the settlement near bog ore sources. The settlement had a sedge peat bog immediately west of the Norse houses (Wallace 2000) and there have been substantial amounts of slag found similar to that at the Scandinavian sites. Fifteen kilograms of slag, most likely from a one-time firing of the furnace, was discovered and it is believed that this would have produced approximately 3kg of usable iron (Wallace 2000). Analysis of the slag showed that the ore had come from the nearby bog and that the workers processing the ore had not been skilled, as considerably more iron could have been smelted out of the ore (Wallace 2000). This supports the idea that iron processing knowledge was likely widespread and not restricted to major centers of trade and commerce. Explorers and settlers would likely have been capable of identifying bog ore sources and producing useable iron on their own.

In addition to slag, there were 98 nail fragments found on the site (Wallace 2000) as well as considerable evidence for woodworking which points to the settlement possibly being used for ship repair. This evidence, combined with the fact that so little iron was manufactured at the site, would suggest that the iron produced from bog ore was used primarily for new nails and not tools. As well, the furnace used to fire the ore was found, and the location of the smithy was determined to be in a separate building from the smelting. The settlement is located adjacent to a source of bog iron and was used for, amongst other things, iron production and ship repair. This provides evidence that the explorers, knowing their ships needed repair, actively sought out a location where they could acquire bog iron and produce new nails.

CONCLUSION

The importance of bog iron can be seen through the continuous inclusion of smithies and smelting furnaces in Iceland and at L'Anse aux Meadows, combined with the close proximity of

these smithies and furnaces to iron producing bogs. The self-sufficient model of farming would allow Icelandic Vikings to eliminate any sort of dependence on imported iron imports, which would have been difficult and expensive to acquire, especially during the winter storm season. Isolated Viking settlements such as L'Anse aux Meadows and those in Greenland would have had few options for obtaining iron through trade. With the establishment of a focused iron industry at Hrísheimur in the 12th century, more Viking settlers would have been able to immigrate to Iceland and set up small farms or villages that did not need to include iron production abilities. By relying on trade with the large iron producing sites these smaller sites could then flourish, allowing for rapid Viking expansion in to Iceland. It also provided an opportunity for the establishment of port towns such as Gásir, which could then be used for transporting large quantities of processed iron around Iceland to other market hubs. These market sites would then become major Icelandic trading centers as well as stopping points for Viking explorers on their way to Greenland or Vinland.

This paper has shown that bog iron was an important resource for the Vikings. Local iron production in Norway was responsible for producing the majority of the farm tools and equipment that they used; it was also used for shipbuilding and weaponry. The Norse have a long history of iron production and bog iron was a major contributor to the raw iron that was used. With new evidence of a two stage refining process for bog iron, we have gained new insight into the importance of metal working in the Viking world. The ability to show that bog iron was important and found at most sites across Norway helped us track its migration along with the expansion of the Viking people. Demonstrating that this was a key resource they looked for when searching for a new settlement location. Further research is needed to uncover more of these pits, and to explore evidence that may have been overlooked at previously excavated sites. This information is required if we wish to fully understand this novel technique.

REFERENCES CITED

Ascough, Philippa et al.
2007 "Reservoirs and Radiocarbon: 14C Dating Problems in Mývatnssveit, Northern Iceland" *Radiocarbon* 49(2):947-961.

Brink, S. Price N.
2008 "The Viking World', Routledge p. 189, 476, 608.

Brown, D.
2000 "*Fate of Greenland's Viking"* Archaeological Institute of America. Online. Internet. Accessed: 10 Oct, 2010, <http://www.archaeology.org/online/features/greenland/>.

Edvardsson, Ragnar & Thomas McGovern
2006 "Hrísheimur Interim Report', HRH 2006.

Einarsson, B.
1994 "The Settlement of Iceland – A Critical Approach. Granastaðir and the Ecological Heritage" Hid Islenka Bokmenntafelag, Reykjavik.

Eriksson, G A.
1960 "Advance and Retreat of Charcoal Iron Industry and Rural Settlement in Bergslagen" Geografiska Annaler 42(4):267-284.

Espelund, A.
2006 "Pit Metallurgy?" Metalurgija – Journal of Metallurgy 12(2-3):155-164.

Fitzhugh, W. Ward, E.
2000 "Vikings: The North Atlantic Sagas" National Museum of Natural History, p. 190

Markewitz, D.
1998 "Lessons From the Viking Age – Development of an Interpretive Program for L'Anse aux Meadows NHS" paper presented to the 27th Annual Association for Living Historical Farms & Agricultural Museums (ALHFAM) Conference, University of Waterloo.

McGovern, Thomas et al.
2006 "Coastal Connections, Local Fishing, and Sustainable Egg Harvesting: Patterns of Viking Age Inland Wild Resource Use in

My´vatn District, Northern Iceland" *Environmental Archaeology* 11(2):187-205.

McGovern, Thomas et al.
2008 "The Hofstaðir Archaeofauna" In Lucas. '*Hofstaðir: A Viking Age Center in Northeastern Iceland',* University of Iceland.

Smith, K.
1995 "Landnam: The settlement of Iceland in Archaeological and Historical Perspective" World Archaeology 26(3):319-347.

Wallace, B.L.
2000 "The later excavations at L'Anse aux Meadows" In Lewis-Simpson, S. (ed). ***Vinland revisited: The Norse world at the turn of the first millenium***, Historic Sites Association of Newfoundland and Labrador, St John's, pp.165-180.

Warmlander, S; D. Zori; J. Byock; D. Scott
2010 "Metallurgic findings from a Viking Age chieftain's farm in Iceland" Journal of Archaeological Science 37:2284-2290.

Weronska A.
2009 "Influences of Environmental Conditions on Holocene Iron Ores Accumulation" Gospodarka Surowcani Mineralnymi – Mineral Resources Management 25(2):23-36.

Young T.P.
2005 "Interim report on the evaluation of metallurgical residue from Clonfad 3" Geo Arch Report 2005/09.