Possible Traces of Reindeer Corralling at a Hearth-Row Site from 1000–1300 CE in Northern Norway

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Abstract

In this paper, we aim to present a methodology for identifying reindeer corralling-herding in connection with prehistoric hearth-row sites in Northern Fennoscandia by using a multiproxy approach of geochemical and geophysical analyses. In previous studies, these sites have been associated with Sámi settlements based on their geographical distribution and archaeological material. The approach is demonstrated in a case study from the Steintjørna site in the municipality of Sør-Varanger in the county of Finnmark, Norway. In order to identify traces of reindeer corralling, fractionation analyses of both organic and inorganic phosphates have been conducted on samples collected from areas near hearths as well as from the surrounding environment. The results show high amounts of organic to inorganic phosphate in two areas extending outward from the hearths terminating the row, which indicate reindeer corralling in small pen-like areas that otherwise lack visible remains and structures.

1 Aims

This study presents how a multiproxy approach, utilizing geochemical and geophysical methods, can be used for the purpose of defining spaces of reindeer corralling in settlement areas. The scientific discourse regarding the introduction of reindeer herding is rather extensive and diverse (for a general review see Sommerseth 2011) and is further exemplified by earlier works by Aronsson (1991), Hedman (2003), Lundmark (1982), Mulk (1994) and Storli (1994). Archaeological interpretations of Sámi settlements often point out the possibility of reindeer being used for milking and transportation, but also the fact that such activities have left no visible traces in the archaeological material (Aronsson 2009, Aronsson 2017, Hedman 2003, Karlsson 2009). Remains of reindeer in settlements are usually demonstrated in the faunal bone material and whether these, often charred, remains derive from domesticated or wild reindeer is indeterminable by osteological methods (Hedman 2003). However, keeping reindeer in restricted areas has been shown to cause long-lasting alterations in vegetation, soil nutrients and microbial activities (Egelkraut 2017). In order to overcome the difficulties of using material remains for studying reindeer herding, additional methods or proxies are needed. The environment and its various culturally induced changes could be used as such proxies, as there are several different sources from which information can be extracted, sources that are usually resilient to decomposition over time.

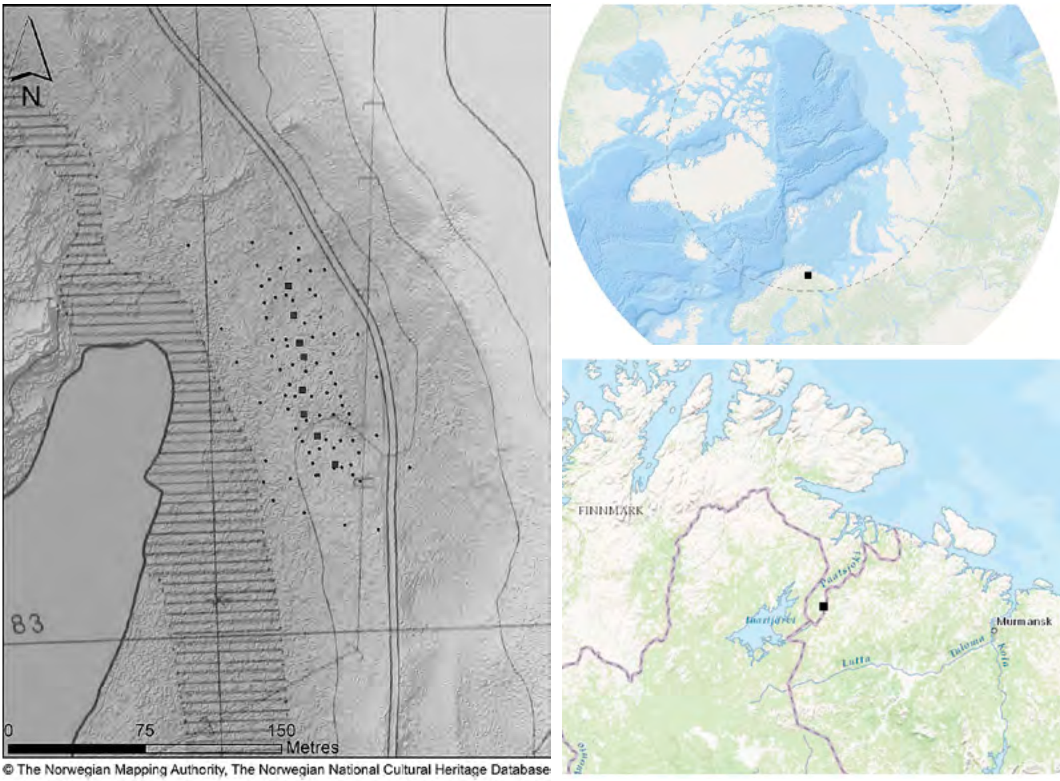

Figure 1. A topographic map is displayed on the left, with the locations of hearths and sampling points marked with squares and dots. To the right, the top map shows where in the Arctic region the site is situated while the bottom map shows its location in Finnmark, Norway.

Environmental proxies have been used in earlier studies of reindeer herding. Aronsson (1991) analysed pollen cores from several sites with reindeer pens, which showed that the pens had been fertilized through intensified manuring by reindeer, resulting in increased phosphate levels (PO_4) inside the pen as well as apparent changes in vegetation. Later studies by Karlsson (2006) also showed enrichment of citric soluble P-PO_4 in a reindeer milking pen at Nilasvallen in Northern Sweden.

Our purpose is to apply an approach based on ideas on soil amendments and manuring in prehistoric and historic agrarian contexts (Engelmark & Linderholm 1996; Grabowski & Linderholm 2014) to a Sámi settlement in Northern Fennoscandia. In this study, we aim to test the idea that reindeer corralling in close connection to settlement areas should result in similar responses as in stabling or manuring in agrarian systems. However, in comparison the intensity may be significantly lower as the extent of reindeer herds, the spatial organization and the timeframe of use are unknown. We have analysed additional parameters on samples presented in a previous study (Jerand et al. 2016) that mainly focused on household spatial organization. Furthermore, we are convinced that information on reindeer herding can be collected from several proxies apart from artefacts, bone materials and historical sources; namely the soil.

2 Archaeological context

The hearth-row site of Steintjørna is located in the valley of the River Pasvik in Finnmark, Norway (Fig. 1, see Olsen, this volume). The river is the outlet of Lake Inari in Finland and flows through Russia and Norway to discharge in Bøkfjorden, a southern branch of the main Varanger Fiord. The river is a distinctive feature in the landscape that has also marked parts of the border between Russia and Norway. The area is part of the taiga zone with a vegetation cover of pine, spruce and, among other ground covering plants, crowberries. The most common soil type is podzol (IUSS Working Group WRB 2015).

The hearth-row site is situated on the western side of the river, 1–2 kilometres from the border to Russia, close to the small woodland lake of Steintjørna. The site consist of eight hearths with a north-northwest to south-southeast orientation, placed at ca. 6–18 m intervals. The site has been investigated on two occasions. Three hearths were excavated in 2012 whilst the five remaining hearths were excavated in the following year. Trenches were dug to investigate the presumed living areas around the hearths. Both charcoal and bone material have been radiocarbon dated, showing that the site was in use between 1000–1300 CE (Hedman et al. 2015). The eight hearths are quite similar to one another, both in morphology, being rectangular with frames of stone encompassing a layered packing of stones, and size, with widths and lengths measuring between ca. 0.9–1.4 m and respectively 17–2,2. m and with areas ranging from 1.7 to 2.5 m^2. The larger hearths were centrally located within the row, these hearths and their presumed living area contained significantly more finds and bone material than the hearths terminating the row.

Flint and pieces of cut copper or bronze alloy were the most common finds but there were also arrowheads, knives and strike-a-lights. Reindeer predominated in the bone material along with the occurrence of various species of fish, and the faunal material together with the morphology of the hearths suggests site use during the winter season (Hedman et al. 2015). Analysis of patterns in age attributes in the reindeer bone material may indicate small-scale reindeer herding, although analyses of this kind depend highly on the cropping strategy that was used (Hedman et al. 2015).

Two sampling strategies were applied: grid sampling covering the whole site area and sampling focused on the areas near hearths, to cover both central and peripheral activities. The enriched B-horizon was consistently the targeted layer, although for several control samples the leached E-horizon and the parent material, or C-horizon, were also sampled. The phosphate deposition was, for all hearths, heavily oriented towards the eastern short sides that together with high concentrations of finds and bone material have been interpreted as entrances to the presumed dwelling (Jerand et al. 2016).

3 Soil as Source Material

The use of geochemical analysis for defining settlement and arable soil is well established, and even more so in low nutrient soils with a low recent impact, in other words remote places. Activities from large-scale arable fields and settlement spaces to smaller-scale farmsteads and houses can be traced in variations of certain soil and sediment properties. Phosphate is one of these properties and the relationship between the accumulation of phosphates and human activity is well known (Linderholm 2010; Smil 2000; Tiessen 1995). In soils, phosphate naturally occur as inorganic compounds but they are in parts transformed into organic compounds before plant uptake. Manure and other phosphate accumulations from plants will therefore mainly consist of organic compounds. Phosphate is also stored in the bones of animals in inorganic compounds, which is why there is a recurring correlation between archaeological depositions of bone material and high soil phosphate concentrations.

Another property of relevance is the organic matter in the soil, both for understanding general soil formation and potential human impact. As materials containing high amounts of organic matter are being deposited (such as manure), the humic matter will subsequently increase and change the soil properties. Combining analyses of phosphate and organic matter in soils, makes it possible identify fertilized fields, lands for pasture and grazing or spaces with animal husbandry.

4 Methods

The analytical base for phosphate analysis in this study is the Arrhenius' citric acid extraction method (Arrhenius 1934), that was modified to encompass fractionation of inorganic and organic phosphate (Engelmark & Linderholm 1996). The phosphate content is expressed as mg/kg dry soil, extracted with citric acid (2 %).

The theoretical assumption for acid soils, such as podzol, is that mainly iron (Fe) and aluminium (Al) bound phosphate (PO_4) is brought into solution by citric acid extraction, as complex formations between Fe/Al and citric acid is strong. Organically bound soil PO_4 will only be hydrolysed to a small degree. That is why the organic PO_4 fraction is quantified by heating the sample in a laboratory furnace for 3 h at 550 °C, during which the organic matter is decomposed, thus releasing the organically bound phosphate. Since the subsequent post-heating measurement gives a reading of the sum of inorganic and organic phosphate (CitPOI), the organic fraction can be calculated by subtracting the total sum with the inorganic phosphate (CitPOI-CitP=CitPorg; Engelmark & Linderholm 1996; Linderholm 2010). By dividing the organic fractions with the inorganic the relation between them can be attained (CitPOI/CitP=PQuota).

In this publication phosphate data are presented as three parameters: inorganic phosphate (CitP), total phosphate as measured after ignition (CitPOI), and the relation between organic and inorganic fractions of phosphate (CitPOI/CitP=PQuota).

The soil organic matter content is determined by loss on ignition (LOI), in a furnace at 550 °C for 3 h (Carter 1993; Clark 2000).

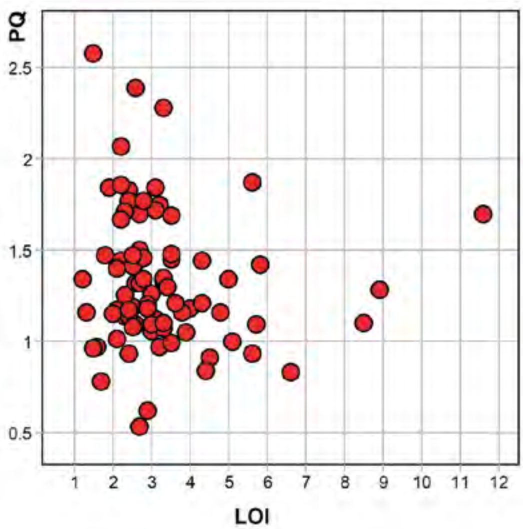

Figure 2. Scatter plot of PQuota and organic matter of analysed samples.

Magnetic susceptibility (MS) is analysed with a Bartington MS3 system equipped with a MS2B sensor. Data are reported as low frequency measurements (χlf 10^{-8} m^3 kg^{-1} mass specific susceptibility) on 10g soil (Dearing 1994; Walden et al. 1999).

For an extended methodological description, see Linderholm (2010).

5 Results

In the scatter plot showing the PQuota to LOI ratio of samples (Fig. 2) there are some differences compared to the agrarian model suggested by Engelmark & Linderholm (1996). In the prevailing podzol, the LOI is generally comparably lower but high PQuota in the B_1-B_2 horizons can be observed.

The spatial model of CitP distribution (Fig. 3) is based on both the grid sampling and the hearth-focused sampling. In general, high accumulations of soil P can be found around the hearths, though to a much lesser extent at the hearths at the outer end of the row. The four central hearths have a distinguishably higher P accumulation over a larger area. Worth noting is the remarkable

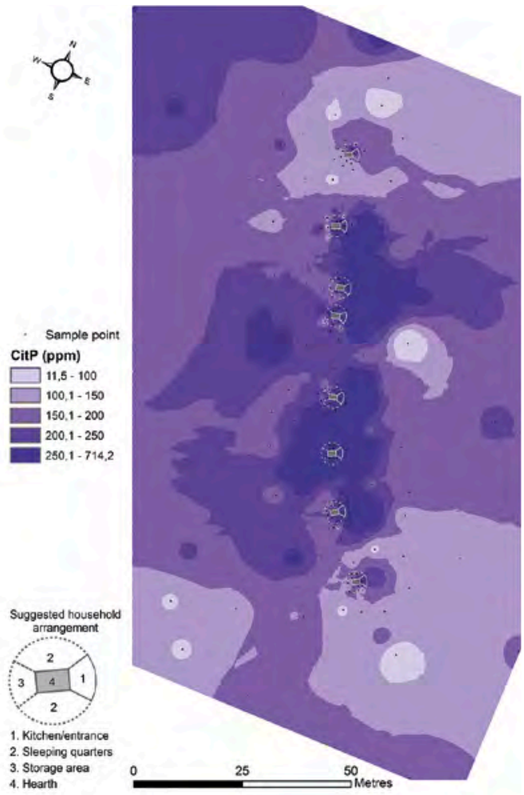

Figure 3. Interpolation of CitP with sampling points marked as black dots and a superimposed model suggesting household arrangements (further described in the lower left corner).

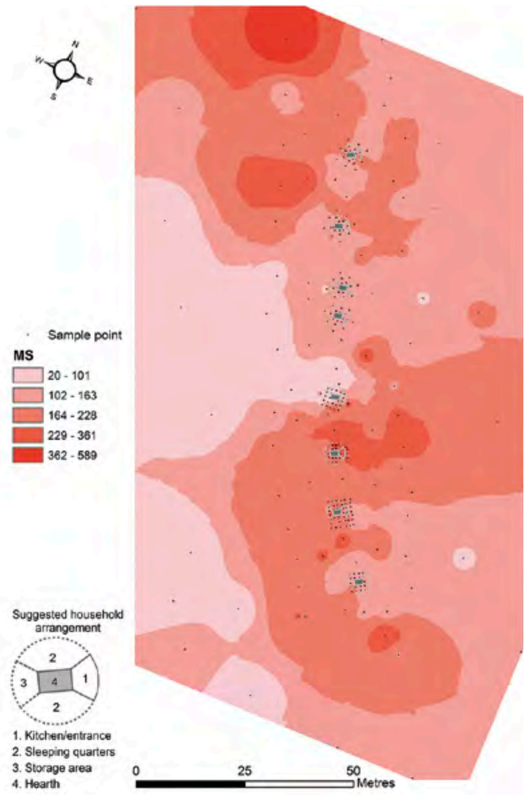

Figure 4. Interpolation of MS with sampling points marked as black dots and a superimposed model suggesting household arrangements (further described in the lower left corner).

patterning of the hearth-near areas, where higher accumulations can be seen at the eastern short sides of each hearth. This is further discussed in Jerand et al. (2016). There is also an area in the northwest with higher P accumulations.

The MS distribution (Fig. 4), also based on both grid sampling and hearth-focused sampling, is the lowest in the west and southwest, closer to the lake. In the northwest, there is one sample with high MS that probably enhances the surrounding areas to a certain degree, though disregarding this, the area still has a high MS compared to the general level. Another such area can be seen east of the lower central hearths. Considering the rather high levels of MS, contributions from bedrock and moraine have to be acknowledged and that not all variations can be attributed to cultural impact.

The spatial distribution of CitPOI (Fig. 5) is very similar to the distribution of CitP (Fig. 3), with high accumulations emphasized in the west and around the central hearths.

The MS550 (Fig. 6) analysis shows distribution similar to that of the MS, with an addition of a rather high response in the southwest, related to the wetland zone.

Higher amounts of organic matter are found in the south and southwest (Fig. 7). Areas surrounding the hearths at the outer ends of the row, in the north and southeast, generally seem to have lower amounts of soil organic matter.

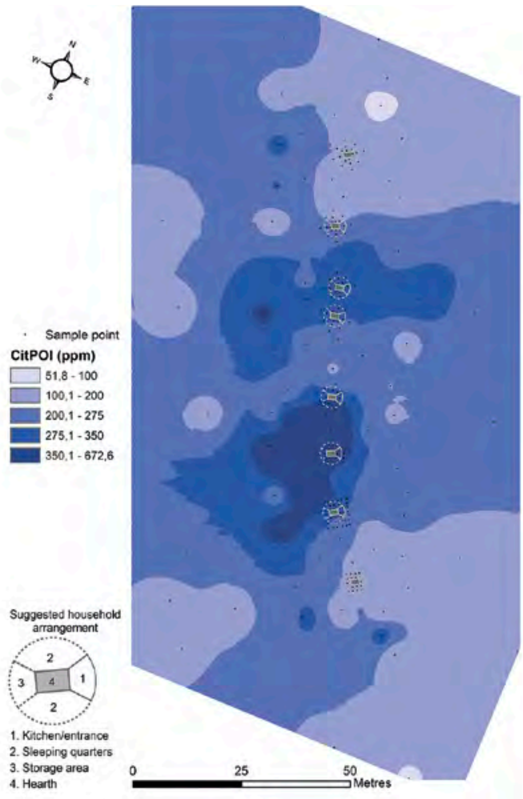

Figure 5. Interpolation of CitPOI with sampling points marked as black dots and a superimposed model suggesting household arrangements (further described in the lower left corner).

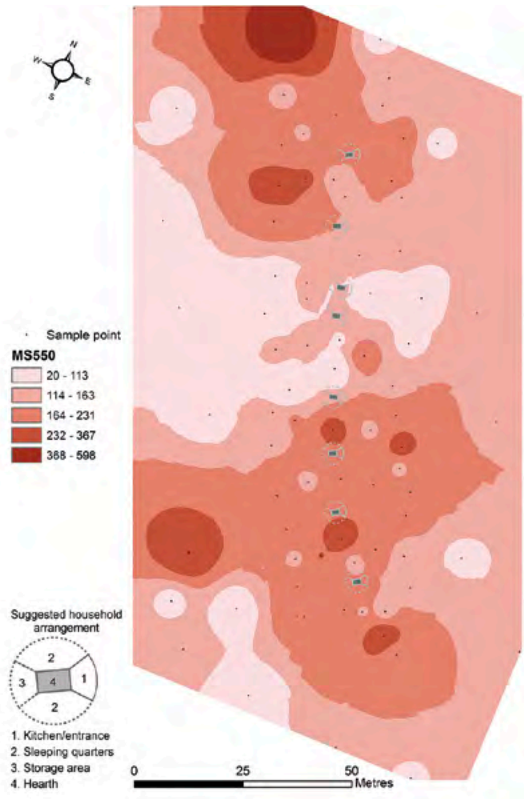

Figure 6. Interpolation of MS550 with sampling points marked as black dots and a superimposed model suggesting household arrangements (further described in the lower left corner).

There are three distinct areas with higher PQuota (Fig. 8), two are located outwards of the hearths terminating the row and one to the west of the lower central hearths.

PQuota lower than 1 imply a more complex iron chemistry in the soils (12 of a total of 80 samples). These samples are located close to the lake and the wetland zone in the western part of the site. The higher water table in conjunction with a mixture of water soluble Fe^{II} and precipitated Fe^{III} oxides that during combustion form less soluble complexes of Fe and PO_4-P is one possible explanation for this. The citric acid extraction is less effective dealing with these compounds and this is something that needs to be addressed in future studies.

6 Discussion

A dualistic response, or patterning, in finds, bones and CitP, was noted in the earlier study of the site (Jerand et al. 2016) and the results presented here show some similarities. The two areas with higher PQuota, close to the hearths terminating the row, indicate that reindeer may have been kept there in a restricted space. Together with the scarcity of the archaeological material in these two hearths, a possible interpretation could be that they in some way are connected with reindeer herding, perhaps housing the most active herders. This, in turn leads to the fact that analysing the use of space through observable cultural im-

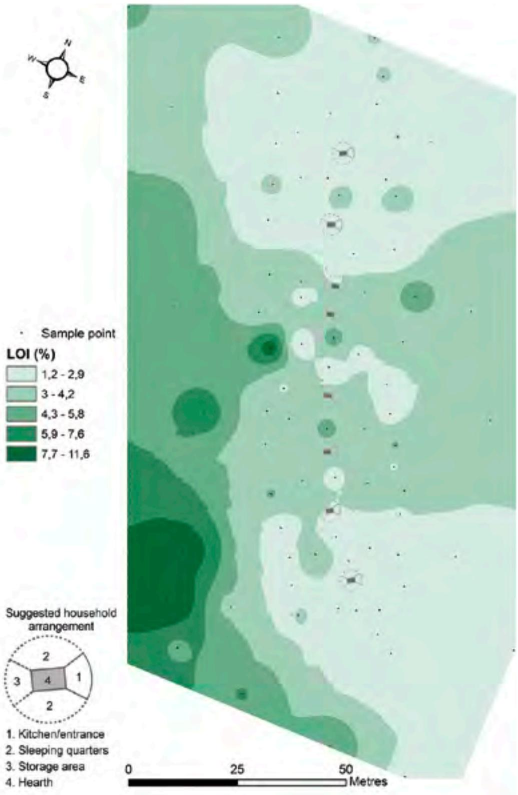

Figure 7. Interpolation of LOI with sampling points marked as black dots and a superimposed model suggesting household arrangements (further described in the lower left corner).

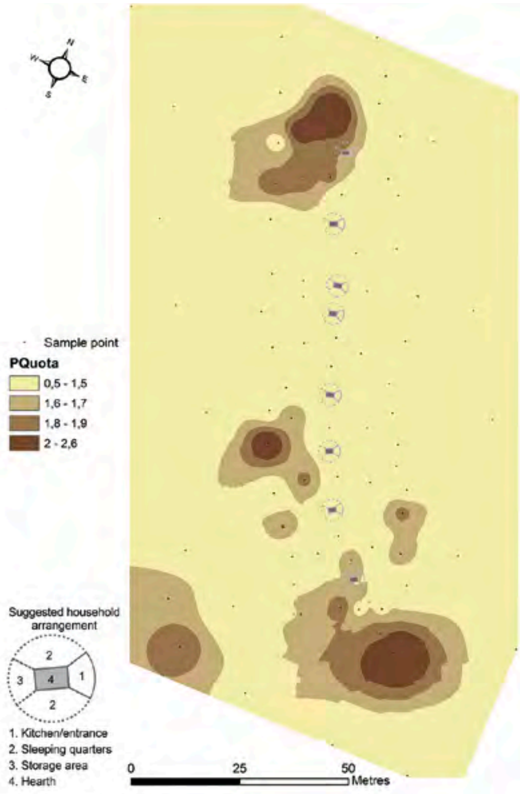

Figure 8. Interpolation of PQuota with sampling points marked as black dots and a superimposed model suggesting household arrangements (further described in the lower left corner).

pacts in the soil, can be used as a proxy for understanding socio-economic organization.

Other reasons for this soil response could theoretically be a variance in soil characteristics; given the context, this seems unlikely. Undoubtedly, this approach can be utilized when studying reindeer husbandry as well as site organization. Although we cannot present absolute evidence for the corralling of reindeer or the keeping of reindeer close to the settlement area, there are strong implications, at least for the latter. Still, as traces of such activities are rarely visible to the naked eye in the archaeological material it is evident that sources like these has to be taken into account.

However, to analyse this further, multiproxy approaches are needed in order to generate more information. A combination of archaeology, pollen analysis, soil science, soil micromorphology and macrofossil analysis will give a more complete story of the hearths and the people who used them, from the immediate environment to the landscape scale. Another decisive variable is the sampling, where basic research is needed. As mentioned previously, for acidic soils the B-horizon usually is sampled, though it might be that it could be more informative to use eluviation horizons, as phosphate may not have been fully relocated during the roughly 700–1100 years of post-soil formation.

There are also additional methods, such as aDNA, which could greatly improve our knowledge of these phenomena (Rawlence et al 2014), given that the preservation in soil-sediments is satisfactory. The methods presented above are more suited for identifying and locating areas in which animals might have been corralled, but whether people were keeping reindeer, goats or even cows can only be assumed, even though some are more likely than others. This is one of many areas in which aDNA would be of great use. However, in order to locate suitable sampling points for this kind of analysis the proxies mentioned previously are still crucial to study.

From a soil chemical point of view, addition of manure is no different whether is derives from cattle in Iron Age farmsteads or reindeer in relation to Sámi dwellings. If the use of space was manifested in the construction of a longhouse or a circumpolar Sámi hearth, is not important in relation to the methods we chose to employ. Reindeer-related activities have been shown to induce a significant change in vegetation and to a certain extent to the soil chemistry (Aronsson 1991, Grøn et al. 1999, Karlsson 2006, Egelkraut 2017) and this study does not contradict the results from the aforementioned investigations. Consequently, the outcome of the methods employed at Steintjørna, may be considered an encouraging approach for future investigations in order to shed light on reindeer management in the spatial contexts of Sámi dwelling sites.

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