Geochemical survey of potential archaeological sites on an island in Lake Vättern, Sweden

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Introduction

Visingsö Island in Sweden's Lake Vättern has had continuous settlement since the Neolithic, playing a vital role during the intense political change of the iron-age and early medieval times. The dynamic history demonstrates great potentiality for archaeological research and is demanding of archaeological survey. Identification of potential archaeological sites on a minimal budget is important for preservation of heritage and future research. The goal was to create a geographic regional map of using simple reconnaissance techniques. A combined approach using geochemical analysis and Geographic Information Systems was used to develop a geographical map of potential archaeological sites on Visingsö. Soil samples were collected systematically according to GPS coordinates using a 30cm soil auger. The phosphate levels were analyzed qualitatively using the Eidt method which provides accurate archaeological site identification. Phosphate, a chemical marker of human bone, fecal residue, and settlement materials, is selected especially for its slow rate of degradation, proving a vital asset to archaeological analysis. The qualitative spot tests of phosphate geochemistry ranks tested samples on the scale of 1-5, with 3, 4, and 5 being the most indicative of past human occupation. These values were entered in GIS to produce a geographical model of the potential sites on Visingsö. Such a product is important for the preservation of archaeological material, heritage identification, and the investigation of archaeological sites on the island in the future. This supports the possibility of providing valuable information about the archaeological context of a region on a minimal budget.

Figures 1&2. Iron-Age Cemetery and ruins of Näs Castle

Methods

Phosphate levels, in particular, degenerate very slowly in normal conditions and can be easily measured though qualitative analysis with few supplies. The Eidt method analyzes phosphate levels accumulation as a result of long term human occupation. Organophosphate esters are a byproduct of bone decomposition, manure, trash pits, and architectural structures, which quickly convert into inorganic phosphate bonded in an ionic manner to various metals (calcium, iron, and aluminum) in the soil (Eidt 1977)..

Being a large area, limitations were applied to where soil chemistry analysis was conducted on Visingsö. Soil samples were collected from probable locations based on place-name, historical documentation, or likely strategic settlement location. A UTM coordinate grid was applied to the map of the island, permitting a systematic approach to be taken for soil sample collection. Using a team of individuals, a leader directed the samples to be taken from the center of each UTM 50 meter square using handheld GPS devices. Each team member used a 30cm long metal auger device to collect 10cm soil increments down to the sterile layer, which was usually between 60cm and 90cm. Breaking the samples into 10cm sections allowed for the data to be analyzed both horizontally and vertically, creating a better understanding of which cultural layer had the highest phosphate levels. However, this method is not without its limitations; a low pH and naturally high levels of phosphate can skew results (Eidt 1977). The soil of Scandinavia maintains low natural phosphate levels between 50 and 200 parts per million (ppm), which can increase 10-100 times the original levels at Iron Age sites (Callmer 1986). Being an agricultural community, plowing is frequently conducted on the island, which could be another implication. Fortunately, academic research has found that frequent plowing only decreases the phosphate levels by 10% over 1000 years (Eidt 1984).

Methods Continued

Collected soil samples were sorted and analyzed in a field laboratory. Qualitative spot tests were performed using the method developed by Eidt (1973). This system was a quick and efficient way to analyze the phosphate levels only requiring a few supplies: several plastic bottles, ash-free filter paper, 5M hydrochloric acid, chemically pure ammonium molybdate, chemically pure ascorbic acid, and distilled water. From these supplies, two separate reagents were synthesized. 30mL of 5M HCl was added to 30g of ammonium molybdate and then dissolved in 100mL cold distilled H_2O, which became Reagent A. Reagent B was made by completely dissolving 1g ascorbic acid in 200mL distilled H_2O (Eidt 1973). The lab procedure simply followed by placing around 50mg of each sample on a filter paper, then placing 2 drops of Reagent A followed by 2 drops of Reagent B 30 seconds later (Eidt 1973). A half a minute after then second drops, the phosphate levels could be read qualitatively. The system used in this lab went as followed: 5=very dark blue, very high PO_4^{3-}; 1=no color change, very low PO_4^{3-}.

The qualitative results of the field laboratory were downloaded into ArcGIS several times a week, which provided an updated spatial analysis of the field work. Each phosphate spot test result was entered in with the corresponding UTM GPS point, therefore providing an accurate production of a map.

Figure 3. An example of a field crew member conducting a soil sample

Results

The results found on the north end of the island were quite spectacular. Since the locations were simple cow pastures and Rape-seed fields, they went largely unnoted. However, the phosphate levels there indicated that there was more than what they could see. The darkest blue squares correspond to the spot tests ranked as 5's, or the highest phosphate levels. Having achieved such high concentrations suggests that at onetime within these UTM squares, there was a long duration of some sort of settlement. Many of the highest phosphate levels are surrounded by much lighter squares, which could mean that these residences of the past were not more than 50 meters wide.

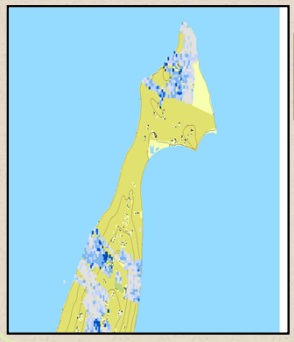

Figure 4. Phosphate results of North Visingsö using ArcGIS

Results Continued

Results from the north-central region of Visingö indicated larger areas of past settlement occupation. These areas of high phosphate could mean that there was a larger scale village that was once present. Upon future archaeological investigation, the time frame of these settlements could be accurately determined, however using current historical knowledge, it would not be inappropriate to estimate these sites to be from the iron-age or medieval periods. Iron-age/medieval Visingsö had higher occupation prevalence than earlier periods, which can be indicated by the large scale iron-age burials and the medieval Näs castle. It is also important to note that many of these regions of high phosphate identify with current towns/villages on the island, which means that these areas could have undergone continuous occupation since the iron-age.

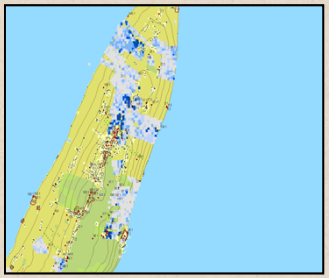

Figure 5. Phosphate results from the north-central region of the island

The results from south-central Visingsö did not reveal as many high concentration phosphate levels. However, the results that were found could be quite archaeologically significant. According to historical documentation, Ströja, Husaby and Vallby was all villages located around what are now the ruins of the Brahe Castle (Jansson 2000). The results from this area are outlined below:

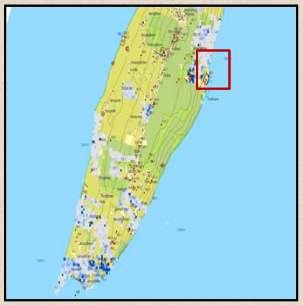

Figure 6. Results from the southern half of Visingsö. Highlighted region represents area around Brahe castle.

The southern tip of the island was once home to several kings of Sweden at Näs Castle. In 1167, King Karl Sverksersson was assassinated at this fortress as a result of the political instability of the growing state (Lindkvist 2003:226). Kings Erik Knutsson and Johan Sverkersson also found residence at Näs and died of natural causes there as well (Lindkvist 2003:226). For these reasons, it is not surprising that high phosphate levels were found on the southern end of Visingsö, where the ruins of Näs are found. What is more interesting, however, is the region of high phosphate located on the lower east side of the island near Kyrkan. High concentration here may indicate a past settlement. It is even likely that a village may have been one located here to support the residence of the king during medieval times.

Conclusions

The purpose of this investigation was to integrate qualitative soil chemistry and spatial analysis to produce a map of potential archaeological sites on the island of Visingsö in Lake Vättern. Given the circumstances already outlined, the likelihood of identifying abandoned and lost villages from the past was high. As expected, the qualitative approach of phosphate analysis along with the use of the ArcGIS software program produced a map that revealed the many areas of high phosphate that suggest archaeological significance.

Mapping the results of a qualitative phosphate analysis is a practical way to provide insight on the whereabouts of archaeological sites to both future researchers and inhabitants of a region. In the case of Visingö, where archaeology is still limited, eliminating the unknowns gives future investigators the opportunity of performing more successful excavations. Additionally, in Sweden, a country where heritage is well respected, the construction of new buildings on or near an archaeological site can lead to delay and hassle. By providing these results to the residents of Visingsö, they can chose to construct their new structures in areas that have low phosphate levels and actively seek the proper excavation of those areas with high phosphate levels. The importance of any potential artifacts is unknown, but anything found would help to build a more complete profile of Visingsö's t. Heritage is not something that is always passively inherited; sometimes it needs to be rediscovered. Through the methods suggested from this research, discovery could be one step closer.

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