



RESEARCH ARTICLE



## Iron and Viking Age grapes from Denmark – vine seeds found at the royal complexes by Lake Tissø

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### ABSTRACT

Since the mid 1990s the National Museum of Denmark and Museum Vestsjælland have conducted excavations on two royal residential complexes from late Germanic Iron Age and Viking Age. During the excavations a range of samples were collected for macrofossil analysis. In two of these samples two seeds of vine grapes dated to the late Germanic Iron Age and the Viking Age were discovered. So far they are the oldest grape seeds discovered in the present Danish area.

One of the seeds was chosen for strontium isotope analysis in order to determine the provenance of the grape. The strontium isotopic composition of the grape seed yielded a  $^{87}\text{Sr}/^{86}\text{Sr}$  ratio of 0.71091 ( $\pm 0.00004$ ;  $2\sigma$ ) which falls within Denmark's strontium isotopic baseline range indicating that the seed could be of local origin.

Archaeological and historical evidence seem to point to that people in the Iron and Viking Age knew and consumed wine and even had access to gain potential know-how related to wine production. Hence, even though it is not possible to determine whether the two seeds found at Tissø are a result of either grape consumption (fresh or dried) or used for wine production, these finds point to that grapes and probably wine were products consumed by the elite at Tissø.

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### Introduction and archaeological background

Since the mid 1990s the National Museum of Denmark and Museum Vestsjælland have conducted excavations on one of the richest Northern European sites from late Germanic Iron Age and Viking Age. The site is located on the western bank of the Lake Tissø, Western Zealand (Figure 1) (see, e.g. Jørgensen 1998, 2009, 2013, 2014). During the excavations, the site has revealed the remains of two royal residential complexes (c. 500–1050 CE) and a wealth of other features like assembly sites, market and craft areas and a range of ritual sites (Figure 2) (e.g. Jørgensen 2014, Jørgensen *et al.* 2014). The first estate was located at Bulbrogård (c. 550–700 CE) and when this site was abandoned a succeeding estate was established c. 600 m to the south at Fugledegård (c. 700–1050 CE) (Bican 2010, Jørgensen 2014). In connection with some of the investigations in recent years, in particular the excavation campaigns in 2012–13,<sup>1</sup> a range of samples were collected for macrofossil analysis. It was in two of these samples

that the remains of vine grapes were found and so far they are the oldest grape seeds discovered in the present Danish area.<sup>2</sup> Due to the uniqueness of the find an archaeobotanical analysis was conducted together with a strontium isotope analysis. In the following the results of these two analyses will be presented followed by a discussion of the possible archaeological context in which we can place the grape seeds. The latter is done in order to get a sense of how and for what purposes the grapes ended up at a royal settlement complex on Western Zealand.

### The find circumstances

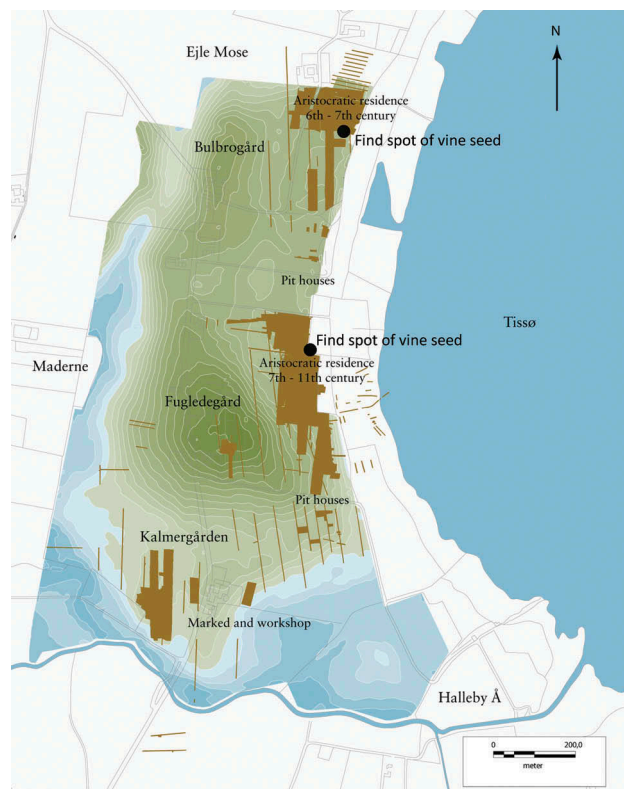
In connection with the investigations of the first residence at Bulbrogård in 2012–13 a range of pit houses were excavated. Most of them were quite damaged of ploughing through the years, and therefore only the bottom layers were preserved. However, one pit house, BU-A2308 differed from the others given that the house had two layers



**Figure 1.** Location of the Tissø complex in Western Zealand, Denmark.

preserved, whereby it became possible to extract stratified samples. Yet, there was no clear differentiation in the samples and they all contained typical settlement refuse consisting of a small amount of carbonised seeds of hulled six-rowed barley, oats, bread wheat and field weeds. Although all samples were more or less similar, one sample from the bottom part of the filling material of the pit house differed from the rest as a carbonised seed of common grape vine (*Vitis vinifera*) was found.

At the complex situated at Fugledegård, excavations carried out in 2013 were conducted in what is considered to be the blacksmith area connected to the residential area. Here a smaller area containing an intact cultural layer FG-A108 dated to the Viking Age was investigated. Under the excavations a range of samples were collected for macrofossil analysis. The samples were gathered from different levels of the culture layer and in five different square metres. The main content in these samples was typical household refuse such as grains and a very small amount of seeds from ruderal plants and field weeds. However, as was the case with the pit house at Bulbrogård, one sample from the culture layer,

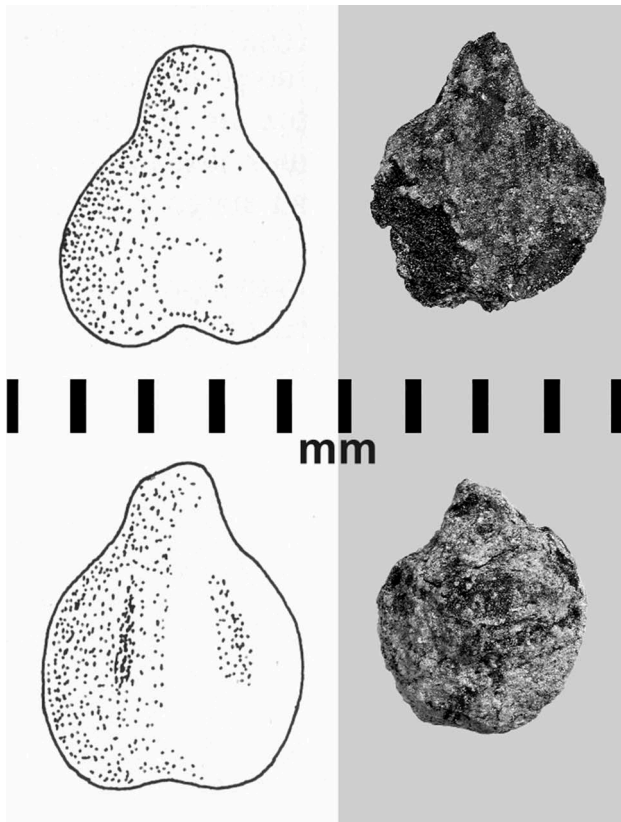


**Figure 2.** Excavation plan of the Tissø complex with the finds of grape seeds marked. Map by Bican, J.F., Brejnholt, P. & Jørgensen, M.N., National Museum of Denmark.

contained a carbonised seed from common grape vine. The samples, furthermore, contained remains from collected berries and nuts such as shells from hazel (*Corylus avellana*) and seeds from sloe (*Prunus spinosa*) and elder (*Sambucus nigra*).

### The grape seeds

The grape seeds had been preserved by charring before deposition in the refuse layers. The two seeds were 4.0–4.3 mm long and 3.1–3.6 mm wide (Figure 3). This is rather small compared with modern grape seeds but comparable with the seeds from a contemporary find from Gotland/Sweden (Hjelmqvist 1993) (Figure 3). Furthermore, the carbonisation may also have reduced the size as modern tests have shown that grape seed shrinks 8–13% during charring (Smith and Jones 1990). The grapes could be from either of the two subspecies, wild grape vine (*Vitis vinifera* ssp. *sylvestris*) or cultivated grape vine (*Vitis vinifera* ssp. *vinifera*). Stummer (1911) has on the basis of 1200 measurements of seeds from the two subspecies concluded that the



**Figure 3.** The two grape seeds from Tissø to the right, to the left the two grape seeds from Gotland (Hjelmqvist 1993). Photos: John Lee, National Museum of Denmark.

breath/length ratio for wild grape seeds lies between 54 and 83 and the same ratio of cultivated grape seeds lies between 44 and 75. The two grape seeds from Tissø have a breath/length ratio of 77 and 84 placing them in the *syvestris* type, but according to Smith and Jones (1990) the ratio can increase during charring. This makes an identification to subspecies level on the basis of the breath/length ratio, uncertain when it comes to single seeds of a species with such a high variability, as also described by Schiemann (1953, p. 319).

Seeds from wild grape can also be identified on the basis of the surface pattern with a ridge on one of the sides (Stummer 1911) but the seeds from Tissø were too damaged to be identified by this character as the surface patterns could not be seen.

Janushevich and Nikolaenko (1979, p. 124) describe finds from Krim of grape seeds that could represent a hybrid between the wild and the cultivated grape. These finds are dated to the period contemporary with the Danish Pre-Roman and Roman Iron Age. The two seeds from Tissø resemble

these hybrids as do the seeds from Gotland (Hjelmqvist 1993). However, a certain determination of the Tissø seeds to the exact type is unfortunately not possible.

### Datings of the grape seeds

In order to be certain that the grape seeds are not modern seeds that have entered the prehistoric features, one of the seeds was C14 dated. The other seed was kept for strontium isotope analysis. The dated seed came from the cultural layer and was dated to the Viking Age between 780 and 980 CE (UBA-29010) (Figure 4).

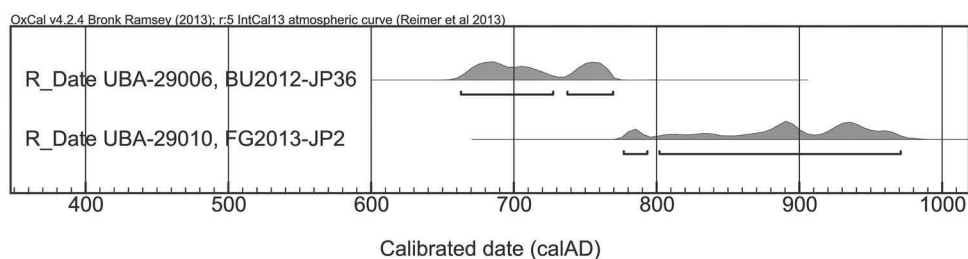
A twig from the bottom layer of the pit house where the other grape seed was found was dated to the late Germanic Iron Age (UBA-29006) (cf. Figure 4) indicating that this grape seed was 100–200 years older than the seed from the cultural layer.

### Strontium isotope analysis

A grape seed that weighed 4.4 mg was chosen for strontium isotope analysis in order to determine the provenance of the grape. A previous pilot study by Heier *et al.* (2009) showed that strontium isotope analyses of archaeological carbonised grains from calcareous soils (similar to the soils found in Denmark) can be used to investigate the provenance of cremated plant remains. Heier *et al.* (2009) pre-cleaning procedure consisted of a hydrochloric acid (HCl) leaching step. In our present study we have added yet another step to ensure the removal of other non-carbonate contaminant dust particles such as silicates. This step consists of an extra 20% hydrofluoric acid (HF) leaching step that effectively removes solid microparticles (Frei *et al.* 2009, 2015). Subsequently the seed was washed ultrasonically in ultrapure (MilliQ™) water.

The seed was introduced into a pre-cleaned 7-ml Teflon beaker (Savillex™) and thereafter dissolved in a 1:1 mixture of nitric acid (HNO<sub>3</sub>) and hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) (Seastar). The solution was dried down overnight on a hotplate at 80°C.

The sample was taken up in a few drops of 3N HNO<sub>3</sub> and then loaded on a decomposable extraction column with a 0.2-ml stem volume charged with intensively pre-cleaned mesh 50–100 SrSpec™



**Figure 4.** AMS radiocarbon dates of a twig from Bulbrogård (top) and a grape seed from Fugledegård (bottom) calibrated with OxCal v4.2.3 (Bronk Ramsey 2013) and IntCal13 (Reimer *et al.* 2013).

(Eichrome Inc.) resin. The elution recipe essentially followed that by Horwitz *et al.* (1992), scaled to our needs. Sr was eluted/stripped by pure deionised water and then the eluate was dried on a hotplate.

The strontium sample was dissolved in 2.5  $\mu$ l of a Ta<sub>2</sub>O<sub>5</sub>-H<sub>3</sub>PO<sub>4</sub>-HF activator solution and directly loaded onto previously outgassed 99.98% single rhenium filament. The samples were measured at 1250–1300°C in dynamic multi-collection mode on a VG Sector 54 IT mass spectrometer equipped with eight faraday detectors (Institute of Geoscience and Natural Resources Management, University of Copenhagen). Five nanogram loads of the NBS 987 Sr standard gave <sup>87</sup>Sr/<sup>86</sup>Sr 0.710236 (+/- 0.000010). Error is reported in Table 1 which is within-run (2  $\sigma_m$ ) precision of the individual run.

The results of the strontium isotope analysis of the cremated grape seed are presented in Table 1. The result revealed that the seed has a strontium isotopic composition of <sup>87</sup>Sr/<sup>86</sup>Sr 0.71091. Previous studies delineating the range of bioavailable strontium isotope compositions characteristic for Denmark (excluding the island of Bornholm in the Baltic sea, and hereafter referred as Denmark) – also called baseline – have resulted in a baseline range defined by <sup>87</sup>Sr/<sup>86</sup>Sr values of 0.708–0.711 (Frei and Frei 2011, Frei and Price 2012). Consequently, as the strontium isotopic composition of the grape seed falls within Denmark's strontium isotopic baseline range it indicates that the seed is probably of local origin. However, the strontium isotope results could also match other parts of Europe with similar isotopic compositions of bioavailable strontium. Such areas include Northern Germany, some areas in

Britain (Evans *et al.* 2010) or even far more long distant areas, that have long been known for their wine production such as Northern Italy, where modern prosecco vineyards have recently yielded a range a strontium isotopic range of <sup>87</sup>Sr/<sup>86</sup>Sr between 0.70706 and 0.71215 Italy (Petrini *et al.* 2015).

### Archaeological and historical evidence of the use of grapes

We do not know what the Tissø grapes presented above were used for, but obviously the find of grapes at the royal residences generates new archaeological perspectives which deserve some attention. In the following different sources will be discussed in order to try to contextualise the vine grapes, which could be of local provenance and not imported (cf. above). At present there are two scenarios in which we can choose to see the grapes: I: the fruits of the vine plant were consumed raw or dried, as either fresh grapes or raisins, II: the grapes were used to produce beverages (probably alcoholic drinks) such as wine. However, before discussing these scenarios in more detail the archaeobotanical evidence of prehistoric grapes and a rough outline of archaeological objects connected to wine will be presented. In this respect we will start by investigating if vine could be cultivated within Southern Scandinavia in prehistoric Iron and Viking Age.

### Vine cultivation; the climatic conditions

Studies of different proxies such as tree rings, pollen, oxygen isotope analysis measured in ice cores from

**Table 1.** Strontium isotope analysis of one of the grape seeds retrieved from the Tissø complex.

Lab. Nr.	Pre-cleaning procedure	Dissolution procedure	Weight (mg)	Sr (ppm)	<sup>87</sup> Sr/ <sup>86</sup> Sr	2 SE (abs)
KF 847	HCl and HF leachates	HNO <sub>3</sub> and H <sub>2</sub> O <sub>2</sub>	4.4	14.234	0.71091	0.00004

Greenland, as for example, compiled by Ljungqvist (2010), indicates that the climate in the period from 800–1200 C.E. (the so-called medieval warm period) was comparable to the present-day Danish climate. This climate was probably suitable for the cultivation of grapes. This can be supported by the fact that a letter from Pope Gregor IX (Hermansen 1938) mentions vineyards owned by the Cistercian monastery in Sorø only 25 km southeast of Tissø. This letter was written in 1228 at the end of the warm period where the climate was beginning to turn colder. Also an indirect indication of grape cultivation in the same period is provided by a recipe that mentions the use of fresh grapes in the oldest Danish herbal book by the Danish physician Henrik Harpenstreng (Kristensen 1908–20). It thus seems likely, that the climate during the late Germanic Iron Age and the Viking Age periods was also suitable for cultivating vine locally within the Danish area.

#### **Archaeobotanical evidence**

Archaeobotanical evidence of grapes in Scandinavia is known from only two other sites before the Middle Ages. In Hedeby (ON *Haithabu*) in the region of Northern Schleswig, excavations provided the find of an uncarbonised seed of grape. In this matter it has been generally accepted that the Hedeby grape could be the remains of import of raisins or badly sieved wine (Behre 1983). Both are aspects which would resemble Hedeby's function as a trading centre, where all kind of goods passed through (Jankuhn 1986). In addition to this, two uncarbonised seeds from common grape vine were found in an urn from a Viking Age grave on Gotland, Sweden (cf. Figure 3) (Hjelmqvist 1993). Hjelmqvist has proposed that these grapes most likely could have been cultivated locally, however he also suggests the possibility of import of dried grapes (Ibid.). To these two finds we can now add the two grape seeds found at the Tissø complex. Other than these scarce finds, we have to go as far away as York, England to find traces of prehistoric grapes in Northern Europe. Here several finds have been made of grapes dated as early as to the 2–4th centuries CE (Hall and Kenward 1990) and later from the 9–13th centuries CE (Kenward and Hall 1995).

Prior to the find presented here, the oldest known Danish seeds from grapes comes from an excavation at Kgs. Nytorv in Copenhagen dated to the late medieval period (Moltsen and Henriksen 1998). However, this was in an area where we know that the Danish king had a vineyard in the same period (Fabricius 2009).

#### **Archaeological evidence**

While evidence of the consumption of raisins or fresh grapes in prehistoric Scandinavia is almost non-existent, there are plenty of wine-related archaeological objects from Denmark. Here especially the Roman drinking sets with vessels and sieves built into a scoop etc. provide us with some indications of a sort of wine-consumption knowledge already in the Roman Iron Age – although we here need to consider if the Roman drinking sets served the same function in the North as they did in the Roman areas. In a recent study of a wine sieve from the Bronze Age and a bronze bucket from the late Pre-Roman Iron Age found in Denmark, McGovern *et al.* (2013) have through chemical analyses established that the objects under study contained traces of wine. However, since the container and the wine sieve are imports from Southern and Eastern Europe, where we know they produced and consumed wine, the traces could stem from their original function on the continent. Thereby these finds do not necessarily reflect that Bronze and Iron Age Scandinavians consumed wine – although import of wine is a possibility from early on. At the harbour site of Hedeby as well as in the Frisian trading town of Dorestad (both trading centres throughout the Nordic Viking Age), remains of wine barrels are found (e.g. Jankuhn 1986:152). This could imply that wine, although somewhat later than the Roman drinking sets, was actually a traded commodity and in demand from some people in the North. The wine barrels were at these two sites reused as lining for wells (Behre 1983, p. 109) but whether they actually contained wine when arriving at the sites is uncertain.

Other than these finds, we do not have any clear archaeological indications of wine production or consumption within Scandinavia. What we do have, however, is different Frankish annals and continental descriptions, which mention wine in

connection with Viking Age Scandinavians. In the following some contemporary written sources from the continent will be considered, since they can add some information, particularly regarding the reason why two grape seeds ended up in the archaeological remains at Tissø.

### Written sources

Despite the small number of actual seeds from vine grapes in Scandinavia we do have numerous contemporary written sources which address wine in connection with late Iron and Viking Age Scandinavians. For example, the accounts from the Royal Frankish Annals (*Annales regni Francorum*) describe several episodes of how men from the North and the Normans, who had settled in Normandy, France, both raided and from time to time negotiated tribute payments which involved wine in order to leave the Frankish Empire in peace (e.g. Albrechtsen 1976). The Royal Frankish Annals also describe that when Harald Halfdansson (i.e. *Harald Klak*) in 826 sailed down the Rhine approaching the Ingelheim *Pfalz* complex, near Mainz, to be received at the royal court by Louis the Pious (son of Charlemagne) he would a few days after receive large amounts of gifts and also *wine fields* (e.g. Wamers 2016, p. 69 f.). Almost 40 years later, in 864, the *Annales Bertiani*, reports that Rodulf (a Dane related to Rorik in Dorestad) demanded a tribute payment where Lothar II should ‘... raise four denarii from every landholding (*mansus*), together with a large amount of flour, *wine*, beer and cattle’ (Coupland 1998, p. 101, emphasis added). Some years later, in 885 the Annals of Fulda describes how Godfrid (a Dane who had become a vassal of Charles the Fat) sent two men to the Emperor saying that if he wanted Godfrid to remain faithful and loyal he should enlarge his territory by granting him *wine-producing* lands from the royal fisc in Koblenz, Andernach and Sinzig, and it seems that he actually got what he wanted according to the Annals of Fulda (Coupland 1998, p. 111). Also the *Vita Anskarii* (written around 875 CE by Rimbert) provides clues which indicate that some Scandinavians knew of and indeed consumed wine. In the *vita*, a description is found of a woman in Birka, Sweden who refuses to sacrifice to the old heathen gods because she is a converted Christian.

Since there was no priest at Birka at that time, the woman kept a small container of wine which she instructed her daughter to give her when she died (Jesch 1991, p. 89 f.). Furthermore, the daughter was instructed to give away the mothers accumulated wealth in alms of the Frisian trading centre at Dorestad. Here Rimbert described that the daughter distributed the alms as she was told and visited holy places. However, one day miraculously her empty bag of money was replaced minus four pennies which she had spent on *wine* to refresh herself and her companions (Jesch 1991, p. 89 f.). Although one must always consider written sources, as the ones presented above, with great caution, they do provide a many faceted picture of Scandinavians having knowledge of wine as a beverage (for discussions concerning archaeology and the use of textual evidence see, e.g. Andrén 1998, Sherratt 2011, Shanahan 2015, particularly chapter 1).

### Local vine, wine or raisins?

As addressed above, there are some indications from both archaeology and historical sources that vine was known in Scandinavia during the later part of prehistory – and the current archaeobotanical and strontium isotope analyses of the Tissø seeds have only reinforced this picture.

It is given that the vine plants could have been used to provide the elite residing at the Tissø complex with fresh or dried grapes, consumed as a sort of raisins. However, we do also have indications of late Iron and Viking Age people enjoying alcoholic beverages. The consumption of alcoholic beverages in prehistoric Scandinavia is a topic many scholars find fascinating, and wine is no exception in this matter. There are thus several ongoing discussions concerning from when and to what extent Scandinavians knew of and consumed alcoholic beverages, including wine (See, e.g. Nielsen 2002, p. 184 and particularly the following discussion, pp. 202 f.; Koch 2003, McGovern *et al.* 2013). It is, still, commonly agreed that whatever the extent of wine for consumption within Scandinavia it probably came to the North as an imported luxury/trade good, since the nearest known vine fields are in present-day Germany (e.g. Winroth 2012, p. 81 f.). This is, however, something that needs to be reconsidered since

theoretically the present find from Tissø could have served to produce wine after the continental model.<sup>3</sup>

If one trusts the written sources, they indicate that some higher standing Scandinavians (probably people from the aristocratic/kingly elite) knew of and consumed wine and that some of the Danes in service in the Frankish Empire also gained access to wine-producing fields. The latter is especially interesting, since the granting of wine-producing fields in the Frankish Empire could mean that some Scandinavians would then gain knowledge on how to produce wine – knowledge which they could then bring back to Scandinavia. The knowledge of wine could also have its origin from people travelling to England (hence, the grape seeds from York). However, direct archaeological evidence of wine production within Scandinavia is unfortunately lacking and we can thus only imagine what the vine grapes were used for. It is, nevertheless, of significance that the evidence points towards vine plants or seeds at some point being imported from the south and/or the insular areas and hereafter locally cultivated. It is tempting to place the grapes within the wine scenario based particularly on the written evidence – however, at present it is just as likely that the grapes were consumed fresh or dried. In order to broaden our knowledge of the use of vine grapes within Scandinavia, one can thus hope that the present find is only the beginning and that more seeds from grapes will be discovered in the future.

## Notes

1. The excavations carried out in 2012–13 were funded by *Aage & Johanne Louis Hansens fond til almene formaal*. The analyses presented in this article are part of the 5-year research project ‘pre-Christian cult places’ (2010–15) on the National Museum of Denmark financed by A. P. Møller og Hustru Chastine Mc-Kinney Møllers Fond til almene Formaal.
2. Pollen from grapes dated to the neolithic has been found in two places in Denmark. It cannot be determined if these comes from wild or cultivated grapes (Mikkelsen 1949, Troels-Smith 1953).
3. Although it cannot be determined if the seeds came from the wild, the cultivated or a hybrid variety of grape all of these could have been used for the production of wine. Ocete *et al.* (2015) have successfully made wine with high alcohol content from wild grapes.

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