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The Svanemølle Harbour site, Copenhagen. Groundtruthing of a submerged Mesolithic site detected by acoustic remote-sensing.

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Lately we have published positive results obtained with the HALD method (Human Altered Lithics Detection), which is a method for acoustic detection of submerged Stone Age sites based on that lithic pieces knapped by humans respond to acoustic signals within a certain frequency interval (3-23 kHz) whereas naturally cracked lithic pieces do not. This works even for pieces buried several meters into the lake- or seafloor sediments no matter what these sediments consist of, sand, clay, silt, etc. (Grøn et al. 2021). In our last paper we discussed some rather convincing acoustic indications of the existence of a quite extensive Mesolithic site off the Svanemølle Harbour, Copenhagen, which in the actual area is around 7.5-9.0 meters deep (Grøn et al. 2021). The dating of this supposed site was based on indications that it was a coastal site in combination with its depth. As the acoustic method (HALD) facilitates detection of knapped lithics buried under several meters of sea floor sediment (Grøn et al. 2021), fast and efficient groundtruthing of such buried cultural features is often demanding. As no Mesolithic material was exposed on the sea floor in relation to the Svanemølle Harbour site indications, it was decided to inspect cores from relevant positions of the seafloor for settlement material.

A series of vibrocores of 7.4 cm in inner diameter that were taken by GEUS (the Geological Survey of Denmark and Greenland) were able to penetrate only close to 1 m into the very hard seafloor in the central part of the area, which consists of compact clayey till with layers of sandy material. In each of the two central cores taken approximately 20 m from each other (Fig. 2) was found two small pieces of knapped flint. Two of these – from the one core - did not have their depth below the seafloor registered. The two others were found between 80 and 90 cm below the surface of the seafloor. Statistically this points to a density of knapped lithics around 230 pieces per square meter in the central part of the site. Smaller lithic densities in the more peripheral parts of the detected area could well explain the lack of knapped lithic pieces in the cores from these areas.

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nr.	Length, mm	Width mm	Thickness mm	Weight g	Depth below seafloor cm
A	8.3	4.9	1.3	0.1	80-90
B	16.1	10.3	2.3	0.3	80-90
C	15.2	14.3	2.1	0.4	?
D	11.7	9.0	1.5	0.1	?

Tabel 1 – The measures of the four pieces of knapped flint

The four pieces (fig.1) are sharp with no patination or other surface alternations, apart from that their edges are slightly dented. This indicates that they may have been rolled in a dynamic coastal zone. This fits well the content in the core material of sand, granules and pebbles together with fragments of marine molluscs such as Mytilus as well as a fragment of a Littorina shell. The lithic pieces cannot be classified as regular blades or flakes, but as pieces of small-scale debris (≤17 mm) of the kind found in large amounts on settlement surfaces where flint knapping has been carried out Table 1, Figure 1. [original measurements for this paper]

A and D are small pieces of debris with regular dorsal negative scars from human knapping. A has got a bit of chalk cortex left on it and a point-shaped platform. D's platform has broken off. Piece C has been produced on the one side of a larger flake with some chalk cortex remaining on it. Piece B is a similar type of fracture from a larger flake. The material is mainly Late Cretaceous for D possibly clear and translucent Danien flint.

The find of the pieces of knapped lithics in two of them nearly 1 m below the seafloor in a clayey till context with elements pointing to a coastal environment, proves the presence of a concentration of Mesolithic material at this location as suggested by the acoustic response earlier recorded (Grøn et al. 2021). The geological situation indicates that this material represents a settlement deposited/inhabited in the Mesolithic. Even if it should be a secondary deposit covered by about 1 m of sediment, the published observations demonstrate the HALD method's ability to detect sediment covered knapped lithic materials.

As modelling has proved highly ineffective for mapping of submerged Stone Age sites it is important to document the effectiveness of alternatives also for sites buried several meters into the seafloor sediments (Grøn et al. 2021, Grøn et al. in press a; Grøn et al. in press b).

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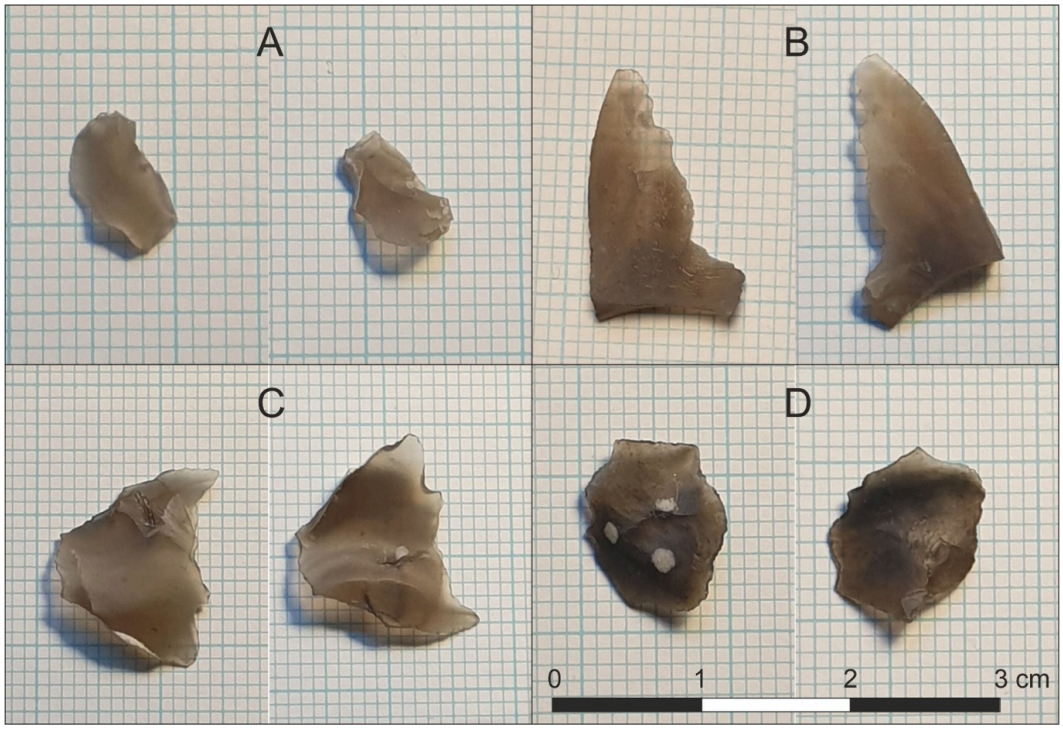

Figure 1 – The four pieces, A-D, of knapped flint, each seen from both sides.

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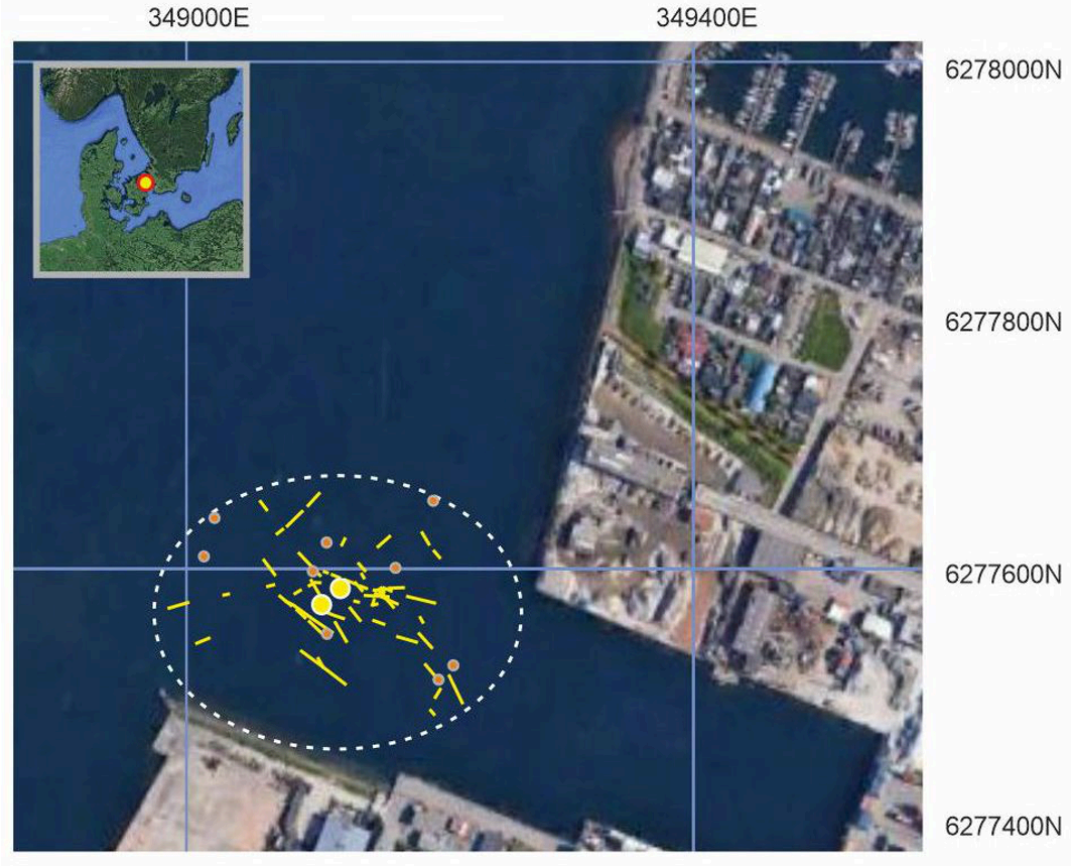

Figure 2 – The site off the Svanemølle Harbour with the suggested settlement area (white oval); strong acoustic responses from knapped lithics – yellow lines; cores with no lithic finds - orange circles with grey outline; cores with finds – yellow circles with white outlines. The coordinates are UTM zone 33.

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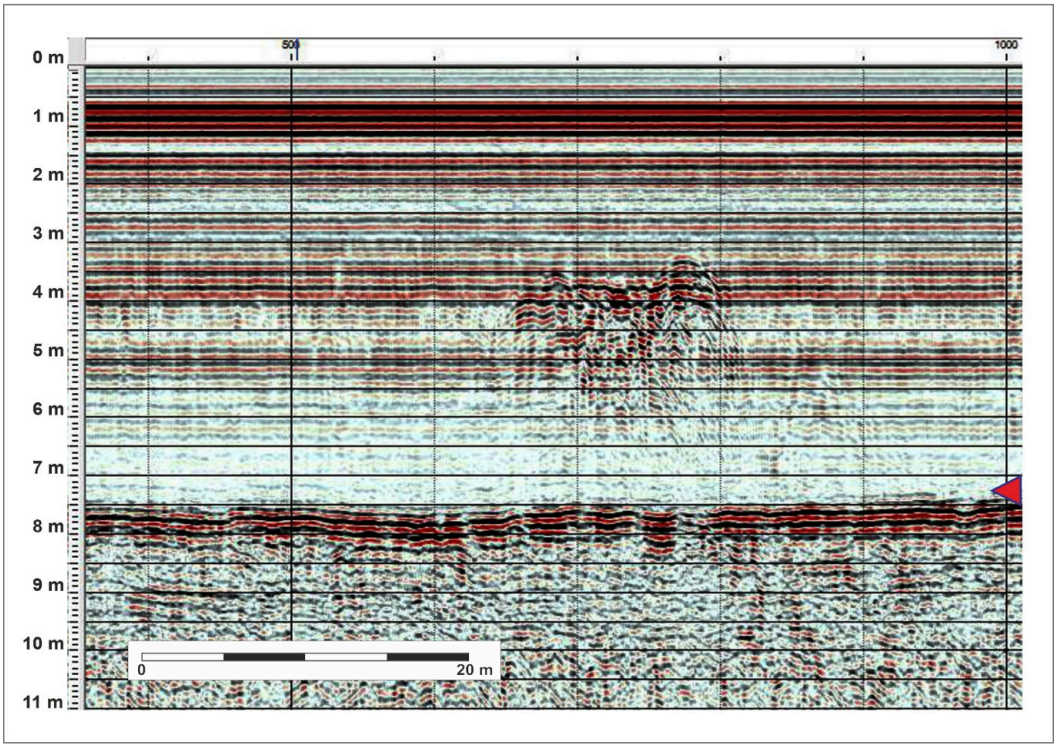

Figure 3 – A seismic profile recorded with our Teledyne Chirp III showing one of the strong acoustic responses from knapped lithics outside the Svanemølle Harbour. The water depth at the site is approximately 7,5 m.

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