Possibilities for early settlement on the Norwegian Continental Shelf

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Rokoengen, K. & Johansen, A. B.: Possibilities for early settlement on the Norwegian Continental Shelf. *Norsk Geologisk Tidsskrift*. Vol. 76, pp. 121–125. Oslo 1996. ISSN 0029-196X.

The end of the last glaciation was marked by enormous changes in the distribution of ice, sea and land. The Norwegian shelf areas were ice free for a long period prior to mainland Norway, and the relative sea level may have been so low that land areas existed both in the Northern North Sea, and off Mid and North Norway. Thus there may have existed possibilities for early settlement on the shelf. More information about variations in ice front position and relative sea level is, however, needed to pinpoint the most promising areas in which to search for possible traces of human activity. So far, a piece of flint and a cobble of sandstone that may have been fashioned by man have been found, but further integrated Quaternary geological and archaeological investigations are needed to give more detailed information.

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Introduction

The end of the last glaciation was a period marked by huge environmental changes, including redistribution of ice, sea and land. The deglaciation gave possibilities for settlement in new areas, while other areas had to be abandoned due to sea-level rise. Two factors have been very important for early human activity: distance to the ice front and to the sea. The variations in ice front position and relative sea level are thus crucial in evaluating the possibilities and limitations for early immigration on the shelf.

The purpose of this paper is to elucidate the possibilities for early immigration on the Norwegian Continental Shelf based on glacial history, sea-level changes and possible stone tools found off Mid-Norway. It is hoped that it will also stimulate detailed Quaternary geological and archaeological investigations giving more information about the challenging story of the first Norwegians.

Glacial history

The last glacial period (Weichselian) was not a uniform, continuous cold period for 100,000 years. The west coast of Norway was ice free for several periods, with possibilities for human survival. The youngest ice-free period seems to have been about 30,000 yr BP (e.g. Mangerud et al. 1981; Larsen et al. 1987; Mangerud 1991). During recent decades an increasing number of localities with sub-till sediments have also been found in northern (Olsen 1989) and southeastern Norway (e.g. Bergersen & Garnes 1971; Thoresen 1990; Rokoengen et al. 1993). It would be surprising if Norway had not been settled also in these periods, but the traces will be very difficult to find.

During the last glacial maximum the ice sheet expanded dramatically, covered mainland Norway and extended in the west to the edge of the continental shelf for several thousand years. This must have made human activity impossible in Norway and driven even the reindeer hunters southwards to the ice front in Denmark and Germany.

The extent of the last glacial maximum on the shelf is still uncertain (Dawson 1992; Holtedahl 1993). Most scientists seem to agree that the ice reached the shelf edge during the maximum extent (according to the prevailing view until about 18,000 yr BP) followed by a gradual and regular retreat to the coastal areas about 13,000 yr BP (e.g. Andersen 1981).

The reconstruction of the former extent of the ice sheet on the shelf has been severely hampered by the lack of dates from the glacial deposits there. The radiocarbon dates off Mid-Norway confirm, however, the extension of grounded ice to the shelf edge at the last glacial maximum. The dates indicate, furthermore, that the ice partly reached the shelf edge as late as 13,000 yr BP, followed by a deglaciation of the shelf in less than 1000 years (Rokoengen 1979; Bugge 1980; Gunleiksrud & Rokoengen 1980).

The detailed conditions during deglaciation are, however, still quite uncertain. Local ice domes and ice streams giving complex ice movements may have been left for some time. Parts of the North Sea Plateau were probably ice free even before 15,000 yr BP when the ice in the Norskerenna area (Fig. 1) became floating (Lehman et al. 1991; Sejrup et al. 1994; Rokoengen 1995).

The deglaciation opened the Norwegian areas again. If the reindeer followed the ice margin during summertime

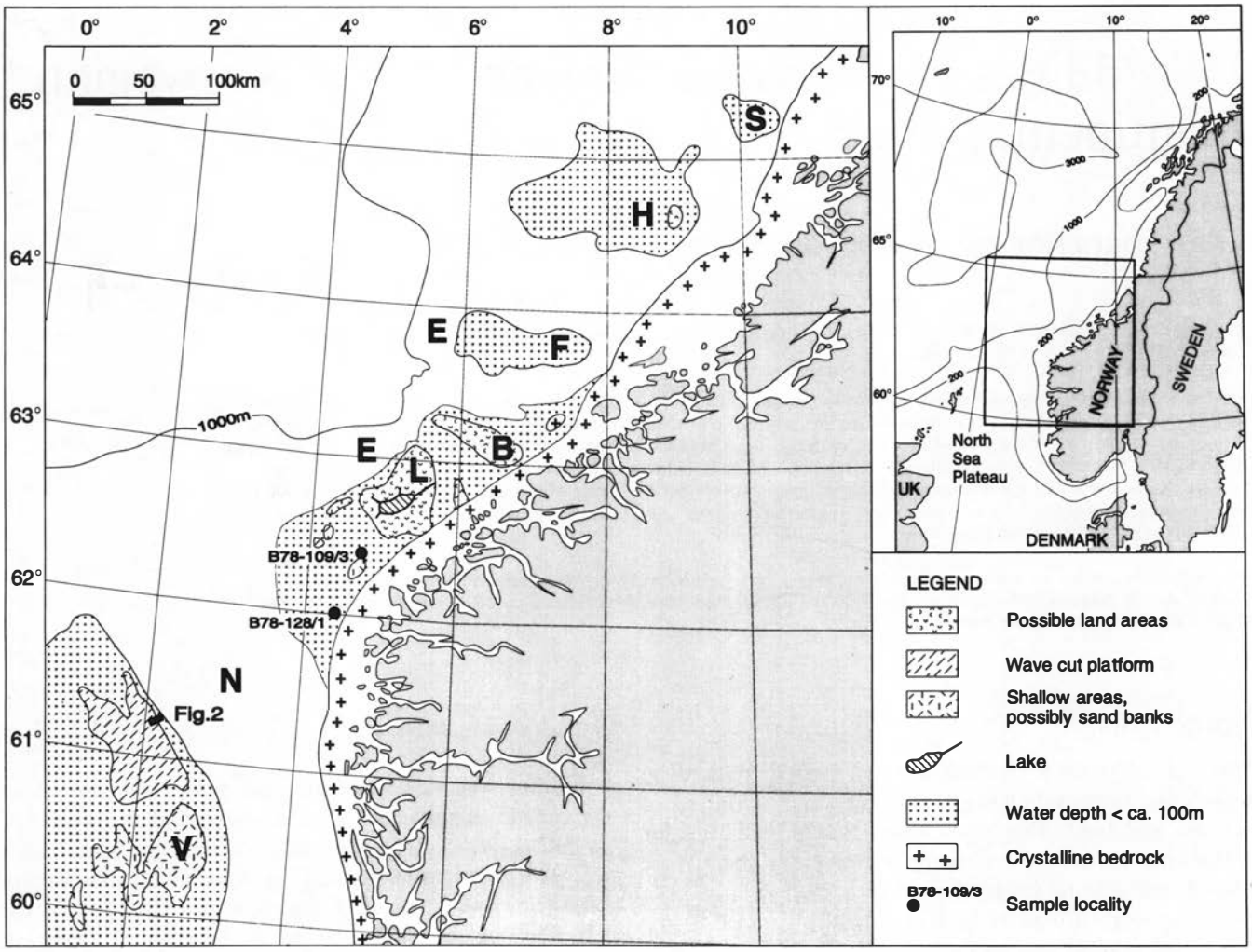

Fig. 1. Assumed palaeogeography off Mid-Norway and in the Northern North Sea with lower sea level just after the last deglaciation. S – Sklinnabanken, H – Haltenbanken, F – Frøyabanken, B – Buagrunnen, L – Langgrunna, E – Eggakanten, N – Norskerenna, V – Vikingbanken (modified from Rokoengen 1992). Locations of samples mentioned in the text are indicated (after Rokoengen & Rise 1989).

in these periods too, and hunters followed the reindeer, the ice front must have been a very important feature. It has been suggested (Rokoengen 1992) that the 'Ginnungagap' in the old Nordic mythic poems (e.g. Voluspå and Snorre Sturlason ca. 1220) could represent a description of a glacial environment, and offer an alternative, geological interpretation to 'the empty space before creation of earth and heaven'.

Sea-level changes

During the deglaciation and shortly afterwards, the relative sea level on the shelf was considerably lower than it is today. For some time now it has been known that parts of the Norwegian Continental Shelf are covered by sediments indicating shallow water and wave erosion (Sars 1872), but little is known about age, regional distribution and correlation between the different areas. Most palaeogeographical reconstructions have also used a constant lowering of sea level, e.g. 90 m or 120 m. Regional investigations have, however, shown that the submerged coastal features are tilted, just like the strandlines on land in Norway (e.g. Rokoengen et al. 1982; Rokoengen & Dekko 1993).

Assumed palaeogeography off Mid-Norway and in the Northern North Sea with lower sea level just after the last deglaciation is shown in Fig. 1. The northern part of the North Sea Plateau is extremely flat (Fig. 2). It dips north–north–westwards with a gradient of about 0.4 m/km, and profiles of up to 30 km long show deviations of only a few metres from a straight line. Wave erosion is believed to have been the dominant agent in forming the flat area, interpreted as a wavecut platform of about 40 × 60 km (Fig. 1). This part of the North Sea Plateau consists mostly of firm overconsolidated clay, partly interpreted as till (Fig. 2). The firm clay is covered by one or several layers of sand and gravel, ranging from a few centimetres to about one metre in thickness (Rise & Rokoengen 1984; Rise et al. 1984; Skinner et al. 1986).

The eastern edge of the North Sea Plateau and the upper part of the slope, which can be as steep as 10°, are

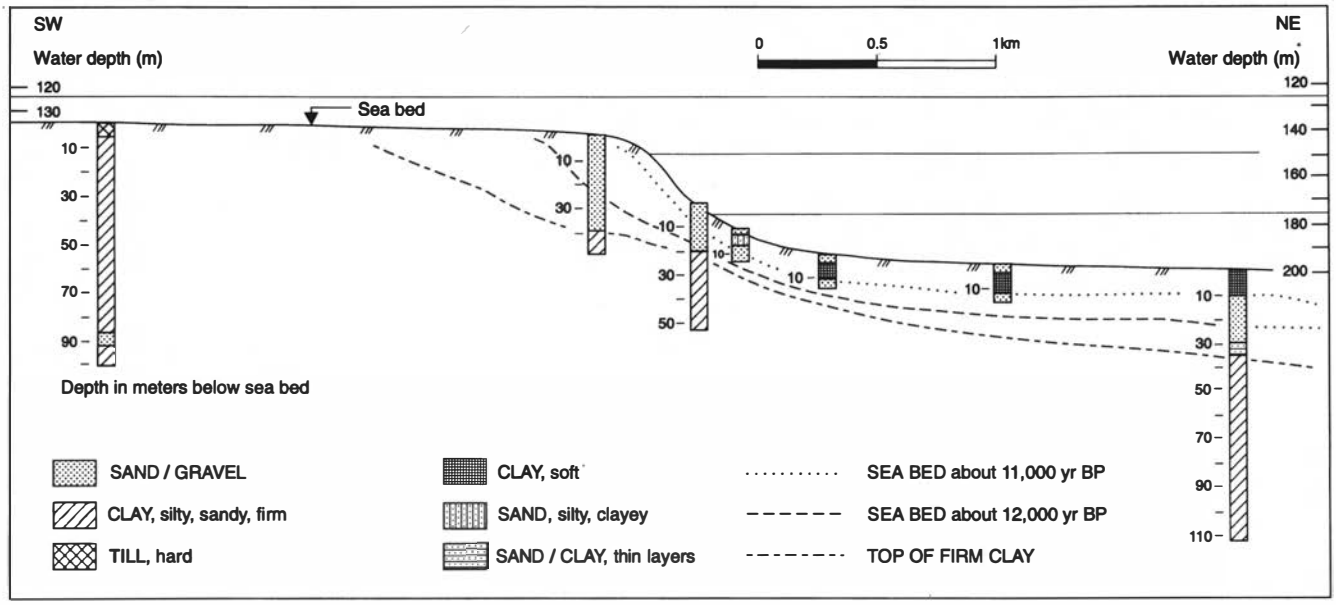

Fig. 2. Schematic section showing the conditions at the edge of the North Sea Plateau (location see Fig. 1). The soil drillings were done for the platform foundation at the Gullfaks Field (after Rokoengen et al. 1982).

very striking features (Fig. 2). Along the edge a coastal unit of up to 40 m sand and gravel is found. Shallow seismic profiles show distinct layering dipping eastwards, gradually building out the plateau. Soil borings reveal that the sediments are coarsening upwards. Radiocarbon datings show that the deposition of sand and gravel started before 12,500 yr BP and ended about 10,000 years ago (Rokoengen et al. 1982).

North of 62°N, only reconnaissance mapping of the shallow geology has been done (Bugge 1980; Rokoengen et al. 1980; Holtedahl 1993). The interpretation is, thus far, more uncertain than in the Northern North Sea. The shelf there is also so flat that only small variations in assumed earlier sea levels and gradients will strongly influence the palaeogeographical reconstructions (Fig. 1).

The shallowest areas on the Mid-Norwegian Continental Shelf today are found on Buagrunnen and around Langgrunna. Seismic profiles, sea-bed samples and bottom photographs indicate that the sea level can have been as much as 150 m lower than today in the middle part of the narrow shelf. In the Langgrunna area a large lake may possibly have existed for some time. Later tilting has given increasing water depths with increasing distance from the coast (Rokoengen et al. 1980; Rokoengen 1995).

No general agreement exists, however, about the palaeogeographical reconstructions and there has been argument against the possible existence of land areas on the shelf after deglaciation off both North and Mid-Norway (e.g. Fjalstad & Møller 1994; Møller 1995). The early human use of the areas has also been strongly questioned (e.g. Bjerck 1994).

Many problems are thus still unsolved, but it seems clear that during and just after the last glaciation the relative sea level on the shelf areas was much lower than it is today. We believe therefore that there could have existed land areas on the Norwegian Continental Shelf (Rise & Rokoengen 1984; Rokoengen & Dekko 1993; Rokoengen 1995).

Possible stone tools

In the southern part of the North Sea (e.g. The Dogger Bank) the extensive use of fish trawling nets has revealed the presence of land plants, peat and man-made tools. Also, in the British sector of the Northern North Sea an arrowhead of flint has been found (Long et al. 1986). So far, nothing so spectacular has been found on the Norwegian Continental Shelf.

In the map area shown in Fig. 1, a few hundred samples have been taken as part of IKU's regional mapping programme 1973–81. Grabs, gravity corers and vibro-corers were used, but the sample localities were selected to solve geological and not archaeological questions. Already on board during the cruise in 1978 some stones possibly not formed by natural processes were picked out (Figs. 1, 3 & 4), but it is only recently that these stones have been given a more detailed archaeological examination (Johansen & Rokoengen 1994).

Sample (B78-128/1) was taken at 169 m water depth with a gravity corer (10 cm inner diameter). The sample was 130 cm long and consisted of 35 cm silty sand with some gravel above more clayey sediments. In the top sand layer a piece of flint was found (Fig. 3). Shells (*Macoma calcarea*) from the interval 105–110 cm have been radiocarbon-dated to 12,320 ± 90 yr BP, and the flint must have been deposited later.

The piece of flint is sharp-edged, 18 mm long, 9 mm broad, 3 mm thick and weighs about 0.5 g. It appears

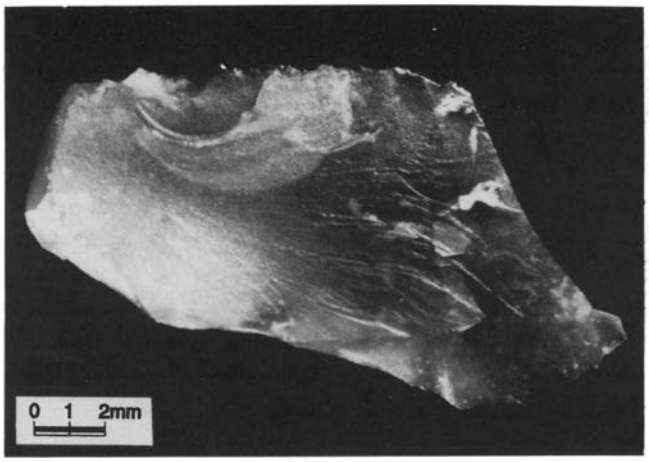

Fig. 3. Flint from sample B78-128/1. The fragment is 18 mm long and shows features typical of human treatment (after Johansen & Rokoengen 1994).

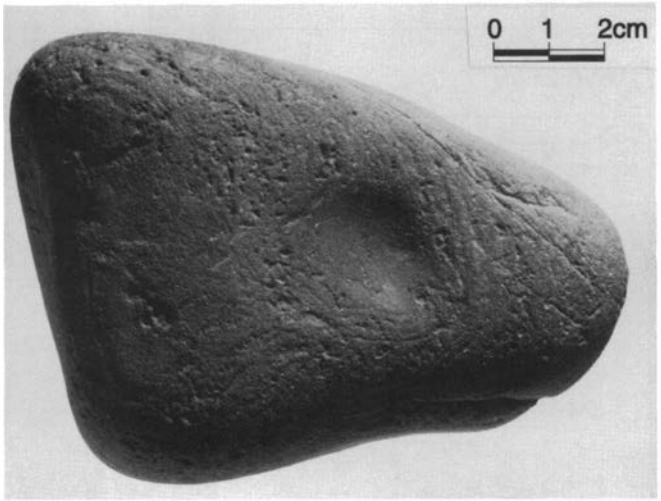

Fig. 4. A sandstone cobble from sample B78-109/3. The stone is 12 cm long and has a very even ('polished') base. Note that the depression in the middle of the stone also has a very even surface (after Johansen & Rokoengen 1994).

very similar to flint material found at Stone-age settlements. The details in form (Fig. 3) make it difficult to find an explanation other than that the flint was fashioned by man.

Sample (B78-109/3) was taken at 156 m water depth with a large grab covering an area of about 1 m^2. The sample consisted of 10 cm grey-green sand with stone, gravel and shell fragments above a sandy, gravelly clay. A cobble of sandstone was found in the top layer (Fig. 4). Shells (*Mya truncata*) from the same layer gave a radiocarbon age of $10{,}770 \pm 120$ yr BP, but this age cannot be directly correlated to the deposition of the sandstone cobble.

The sandstone cobble is 12 cm long, 8 cm broad, 4.5 cm thick and weighs about 670 g. The 'base' (not shown in Fig. 4) has a polished appearance, but even more striking is the approximately 3-mm-deep depression with diameter 2.5 cm. The surface in this depression is also more even than the rest of the cobble. Such features could be a result of grinding, but other explanations cannot be excluded (Johansen & Rokoengen 1994).

The sandstone has later been subject to closer geological analyses. Thin section examination showed a calcite cemented fine-grained sandstone with no visible porosity. The sandstone is well sorted with a dominant grain size of about 0.05 mm (varying from 0.02 to 0.1 mm). The composition shows approximately 80% quartz, 10% feldspar, 5% mica, 5% pyrite and accessory content of epidote, zircon and titanite.

The thin section description (S.O. Johnsen, NTH, pers. comm.) and the lack of microfossils (M. Smelror, IKU pers. comm.) both indicate that the sandstone could be of Cambro-Silurian age and originates from mainland Norway. When compared with the bedrock map of Norway (Sigmond et al. 1984), the sample shows a strong resemblance to rocks from Unit 52 found at about 62°N (A. Solli, NGU, pers. comm.). Another possible origin could be Mesozoic rocks found further south in the Norskerenna area (Fig. 1).

We are the first to admit that the traces from possible early human activity on the Norwegian shelf areas found so far are not very impressive. It is also possible that the described samples may have been transported and dropped by drifting ice or (less likely) from modern boats. It should, however, be noted that the IKU sampling covers an area of about 100 m^2 of a shelf area of several thousand square kilometres. The sampling was also aimed at geological not archaeological features, and several samples were taken in rather deep water. The chances of sampling man-made objects would therefore be very low indeed. In this context two possible finds are encouraging and we will not at present exclude the possibility that some areas on the Norwegian shelf may contain rich remnants of early human activity.

Conclusions

1. Distances to the ice front and to the sea have been critical for the early immigration to Norway.
2. The possibility of early settlement is very dependent on the shelf having become ice free a long time before mainland Norway.
3. The relative sea level on the shelf was much lower than it is today at and just after the deglaciation.
4. Better knowledge about variations in ice front position and relative sea level is needed to pinpoint the most promising areas in which to search for possible traces of early human activity.
5. It is hoped that future integrated Quaternary geological and archaeological investigations will throw new light on the challenging questions about early immigration on the Norwegian Continental Shelf.

Acknowledgements. – We are grateful for the invitation to present some thoughts and ideas from our talk at NGF's meeting in Trondheim in January 1995. We

thank IKU Petroleum Research for permission to use the data from the regional mapping programmes and everybody involved in the project, especially during cruise 7810. The radiocarbon datings were done by Laboratoriet for radiologisk datering, Trondheim. The drawings for this paper were executed by A. I. Johansen, NTH, and the photographs were taken by P. E. Fredriksen, Vitenskapsmuseet. S. E. Lauritzen and J. Mangerud offered useful comments as referees and S. J. Lippard improved the English language in the final manuscript. The help and contributions from all persons and institutions are gratefully acknowledged.

Manuscript received October 1995

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