

# Pleistocene sea level changes and glacial history of the Hornsund area, Svalbard

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The first radiocarbon datings of shells and whale bones from raised marine terraces of Hornsund (Birkenmajer & Olsson 1970) showed that with regard to Quaternary geology South Spitsbergen is very different from the rest of Svalbard. Birkenmajer & Olsson (1970) concluded that the 7.5–9.0 m terrace is about 9,400 years B.P. (uncorrected). This altitude is unusually low in comparison with other Svalbard regions where in the Preboreal-Boreal period the relative sea-level was 30–50 m or even 70 m higher than today (Salvigsen 1981). On the other hand, in the Hornsund area very high terraces were recorded. Werenskiöld (1922) reported the existence of a 340 m terrace in Sørkapp Land. In Steinvikdalen, Jahn (1959) found a well developed pebble beach at 200–230 m level as well as evidence of sea washing reaching 275 m a.s.l.

The geochronological interpretation of marine and glacial deposits of the Hornsund area in this paper is based on geomorphological investigations and new radiocarbon, and TL dates.

## Marine terraces

The age of the 7–9 m terrace has been determined by comparing radiocarbon datings from three sites. On Store Dunøya, below a 2 m layer of upper pebbles, peat was found and dated at 7,250 years B.P. In Nottinghambukta, in the lower part of an exposed section in the 7 m terrace there is sea tangle (*Laminaria*) which has been dated at 7,690 ± 90 years B.P. The upper part of the section consists of pebbles with shells dated at 7,230 ± 50 years B.P. In Burgerbukta, on the surface of the 9 m terrace a piece of driftwood was found and dated at 5,050 ± 60 years B.P. The samples have been dated by M. Pazdur at Gliwice.

The interpretation of these datings is as follows: The deposits of the 7–9 m terrace reflect a marine transgression which lasted from about 7,200 to 5,000 years B.P. This transgression reached the 9 m level which the shore had passed during the regression 9,400 years B.P. (Birkenmajer & Olsson 1970). During the period 8,000–7,200 years B.P. the sea oscillated at a level of 1–4 m a.s.l. Which is the highest level reached by the sea during the Late Vistulian (= Weichselian)-Early Holocene time? The shoreline corresponding to this level has been determined on the basis of detailed geomorphological studies, and it is 25 m in Hornsund and 32 m in the area between Torellbreen and Orvindalen. If the Early Holocene emergence of Svalbard is the result of a glacio-isostatic effect, then this effect was weakest in Hornsund. Hence it may be concluded that during the Main Vistulian (18,000 years B.P.) this region was the one least loaded with ice.

The Middle-Vistulian marine transgression, about 45,000–27,000 years B.P., is known from many regions in Svalbard. Based on geomorphological observations we may conclude that at that time the sea in the Hornsund region reached a maximum level of 38–42 m. In Turrsjødalen the 38 m terrace is built of deposits which originally made a sandur. It is cut off by a 7 m cliff which could have developed only during the Early Holocene marine transgression. Thus, the 38 m terrace is probably of a Vistulian age. The thermoluminescence (TL) datings suggested the age of this terrace to be 27,000 ± 4,000 years (dated by J. Butrym at Lublin). The altitude of the Middle-Vistulian shoreline is rather small. Hence we may suppose that the glaciers during Early Vistulian and Main Vistulian were small as well.

The uppermost marine terraces occur in the Hornsund area at an altitude of 220–230 m. Starting from Steinvikdalen we traced the highest shoreline along the west coast of Spitsbergen, and this level descends northwards. At the mouth of Bellsund it is about 120 m. It should be noted that Mangerud et al. (this volume) consider these 'terraces' to be much older rock platforms of uncertain origin.

If we assume the local elevation of this shore level to be proportional to the thickness of the ice that covered the land during the corresponding glaciation, we might infer that the Hornsund area was the centre of a thick ice sheet during that glaciation. In accordance with former suggestions, this glaciation must be of Pre-Vistulian age, probably of Late Saalian age. A similar opinion was presented by Feyling-Hanssen & Ulleberg (1984) for the Sarsbukta area.

## Glacial deposits

In the large valleys of the Hornsund region only one type of basal till was observed lying on bedrock. Likewise, on the bottom of the Hornsund fjord only basal till occurs, covered by sandy and muddy deposits of a thickness of several dozen meters (Zalewski et al. 1984). In the large valleys the basal till is reworked by the sea to 120–230 m level. Thus, the basal till represents a record of the great Pre-Vistulian glaciation of the Hornsund area.

Counterparts of the upper Vistulian till, known from other regions of Spitsbergen (Landvik & Salvigsen 1985), can in the Hornsund area only be found in small, nonglaciated cirques and in the glacier forefields. Also the moraines of no longer existing slope glaciers as well as those of rock glaciers may be regarded as corresponding with the upper till. The Vistulian till never extends more than 1 km outside the ice-cored moraines from

the Little Ice Age. In Burgerbukta we can prove that the Mühlbacher, Kvalfangar and Wiber glacier group extended further during the Little Ice Age than during the Main Vistulian.

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