Problems of Quaternary geology and palaeoecology of North European seas

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The Quaternary geology in the recent 25 years has been characterized by an intense accumulation of data and by the development of a number of hypotheses on the history and evolution of the Barents Sea (Boulton 1979; Elverhøi & Solheim 1983; Vorren & Kristoffersen 1986). The main feature of the climate transformation in the Cenozoic era was the great continental glaciation and the oceanic periglacial area (Matishov 1984, 1987).

Characteristic forms of relief eroded by continental ice are fjords, marginal and transversal trenches, and marginal glacial formations of the sea floor. At a distance of 100 to 200 km from the coast, at depths of 50 to 400 m, several belts of Pleistocene glacial deposits of a total thickness of up to 200 m are found.

During glacial periods, the environment of glacial shelves has been determined by continental ice which has covered vast areas of the ocean floor. Vertical glacio-eustatic movements, reaching up to several hundred metres, absence of runoff of northern rivers, and change of the general circulation of the atmosphere and of the ocean have radically changed the course of events in the biosphere. In the open sea, pelagic organisms (e.g. plankton) have been affected more than others. At the stage of the maximum development of glaciations, ice flowed out to the shelf edge of Northern Europe, Greenland, Canada and Antarctica. Asynchronous formations of vast glacier covers on the sea floor are not ruled out. In such situations glaciers have affected the life both of planktonic and of benthic communities of the shelf. Regarding roughly the 'great' glaciation periods of the Barents Sea, we notice that the typically glacial Barents Sea Shelf has more than once been the scene of activity for glaciers which have flowed down from the surrounding continents (Matishov 1984). In the southern part of the sea, more than 150 m from the coast/shore, debris of Scandinavian and Kola crystalline rocks occur widely in recent deposits.

During the maximum of the glaciation (18,000 to 20,000 years ago) the greater part of the shelf was probably covered with continental ice of a thickness of up to 300 and even 700 m. Neighbouring glacier flows could unite/merge with their floating ice shelves over large depressions of the bottom of the central part of the Barents Sea. Areas with drifting icebergs and with pack ice are probable here (Fig. 1). During the glaciation the retreat was accompanied by a series of oscillations.

In the younger Dryas (11,000 to 10,000 years ago) the continental ice did not extend outside the fjord coast. Local glacier domes apparently developed on Bjørnøya, Hopen and the Central Bank. Glaciers on the Spitsbergen Bank moved mainly in southern and western directions along pre-Quaternary valleys. Such an intense asymmetry of the Bjørnøya-Hopen glacial cover has apparently been brought about by the comparatively dry and severe climate which dominated in the central areas of the Barents Sea. An analysis of the traces of glaciation on Hopen has shown that striated surfaces are here connected with the activity of pack ice or of floating ice (Hoppe 1981). In this connection Hoppe (1969) has his doubts in his previous conclusions as to the possible spread to Spitsbergen from the Barents Sea Shelf of the hypothetical glacier cover.

Constantly more geological data have appeared, testifying to the metachronology of development of the Quaternary glaciation in the Arctic and in middle latitudes. On the whole, the Weichselian glacial movements in Svalbard, in northern Poland and on the Russian plain coincide well in time. However, the early Weichselian glaciation (45,000 to 35,000 years ago) manifested itself most intensely in the Arctic. The scale of the subsequent movements decreased gradually, whereas in northeastern Europe a reversed picture is observed where the largest dimensions have been reached by the Late Weichselian glaciation. In the Late Weichselian, Svalbard was covered by a relatively thin glacier with its centre in the eastern part of the archipelago. It is quite possible that during the latest glaciation (21,000 to 17,000 years ago) the continental ice, flowing down from Novaja Zemlja, the northern Urals and the Kola Peninsula to the southeast of the Barents Sea Shelf, including the Pecora Sea, rushed asynchronously on to the sea floor. Under such circumstances the large Goose Bank, the northern Kanin Bank and other banks could have developed under terrestrial periglacial conditions.

Referring to palaeochemical problems of the ocean, it should be noted that in sea water, which has a mean salinity of 34.4‰, the content of chlorine reaches 19 g per litre. For that reason, as a geochemical indicator of fluctuations/variations of marine salinity, the chlorine content of pore water is used. Ions of chlorine (Cl) give the most reliable material for determining the directions of the changes of salinity of the near-bottom waters during sedimentation. An analysis of the chemical composition of pore water in 2–3 m long cores of Barents Sea bottom deposits has shown that pore water with respect to saline composition corresponds on the whole to sea water (Pavlova 1976). Besides, in a number of cases viscous, clayey deposits at the bottom of shelf trenches are characterized by a low content of chlorine (16.5 to 18.9 g per litre). This difference of one to two grams per litre testifies to the existence in the pre-Holocene history of the Barents Sea Basin of phases with less saline sea water.

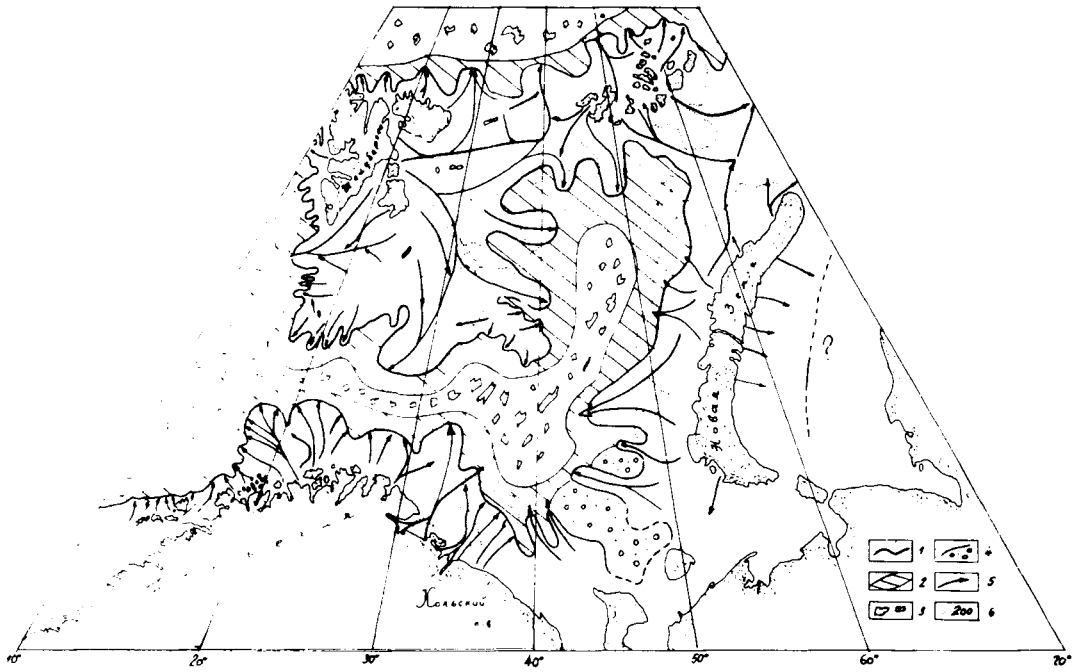

Fig. 1. Continental glaciation on the Barents Sea Shelf in the late Pleistocene (20,000–18,000 years ago). Probable scheme:
1) Maximum extent of the continental ice 20,000–18,000 years ago.
2) Ice shelf, floating ice.
3) Marine periglacial with drifting icebergs and pack ice.
4) Periglacial (terrestrial) zone of the shelf.
5) Flow lines.
6) Isobath 200 m.

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