Postglacial marine and lacustrine sediments in Lake Linnévatnet, Svalbard

JOHN INGE SVENDSEN, JON Y. LANDVIK, JAN MANGERUD AND GIFFORD H. MILLER

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John Inge Svendsen, Jon Y. Landvik and Jan Mangerud, Department of Geology, Sect. B, Allégt. 41, N-5007 Bergen, Norway; Gifford H. Miller, University of Colorado, INSTAAR, Campus Box 450, Boulder, CO 80309, U.S.A.

Lake Linnévatnet is situated near the mouth of Isfjorden, on the west coast of Spitsbergen (Fig. 1A). According to Denton & Hughes (1981) and Mangerud et al. (1987) it lies within the Late Weichselian ice boundary, whereas according to Boulton (1979) and Troitsky et al. (1979) it is outside that boundary. The purpose of this paper is to describe the stratigraphy of the lake sediments and discuss the timing of the glacial retreat.

The lake floor and its sediment sequence was mapped with a Raytheon penetrating echosounding system (RTT-1000A) during the summer of 1984 (Mangerud et al. 1985) and was subsequently cored from the winter ice in 1986. Most of the cores have not yet been studied in detail, but a simplified stratigraphy of the lake sediments is presented here.

The lake surface is located 12 m a.s.l. and the basin is nearly 40 m deep. The main sediment supply is from a meltwater stream which enters the southern end of the lake. The physiography of the lake is described by Bøyum & Kjensmo (1978). They also studied a 6 m long Mackereth core from the deepest part of the lake which penetrated into marine sediments of Early Holocene age (Bøyum & Kjensmo 1980). The postglacial marine limit is between 65 and 78 m a.s.l. (Sandahl 1986; Sandahl et al. unpublished), and for the first 2,500 years after deglaciation the lake was a fjord. After emergence from the sea the lake was dammed up by a beach terrace across the valley, approximately 30 m a.s.l. (Sandahl 1986). The outlet subsequently eroded to the present level of 12 m a.s.l.

Stratigraphy

The stratigraphy derived from the penetrating echosounding is consistent throughout the lake basin, with two distinct units above the acoustic basement (Fig. 1B and 1C). The coring showed that the only major reflector that could be identified was the boundary between the upper lacustrine sediments and the Early Holocene marine sediments. The acoustic basement is distinct and it is interpreted as the surface of bedrock or possibly till. Maximum thickness of the sequence in the central part of the lake is about 16 m.

Sediment cores were recovered with piston samplers at the southern end of the lake (Fig. 1B). This part of the lake, which is about 10–15 m deep, includes two sub-basins separated by a ridge. The eastern sub-basin lies outside the delta front and receives sediments from the main river. The western basin is partly shielded from this source by the north-south trending ridge and receives almost all its sediments from a small nearby cirque with young end-moraines. Studies of Holocene glacier variations will be undertaken in this basin.

The preliminary results presented here (Fig. 1D) are based on a 12 m long core (no. 14) from a small well-defined bedrock depression in the eastern sub-basin (Fig. 1B). This core is particularly relevant for dating the deglaciation because it penetrated to a resistant layer which is interpreted as bedrock or till. The marine sequence consists of a normally consolidated silty clay with some dropstones. Different beds are distinguished by texture and colour. The variation in colour is primarily caused by the differing amounts of monosulphides present. In addition, there is variation in the frequency of molluscs and icedrop material throughout the sequence. The highest concentration of coarse grained material is found in the upper half of the sequence with a distinct maximum between 8.1 and 7.9 m. Interbedded in the sequence are some 5 to 10 cm thick well-defined sorted sand layers. These layers also contain some clasts of silt and clay at the base. The sand was probably deposited from high-density turbidity currents from the steep slopes surrounding the basin. In the upper part of the formation, flow-structures, small-scale folds, faults, joints and mud clasts were observed, indicating synsedimentary slumping activity.

According to a sea level curve constructed by Sandahl (1986) the basin emerged about 9,500 years B.P., and at that time a continuous lacustrine sedimentation began. The boundary between the marine and lacustrine sediments is very pronounced, as the marine formation is nearly massive, whereas the lacustrine is distinctly laminated. In the lacustrine formation the thickness, frequency and texture of the individual laminae vary. The lower part of the lacustrine sequence is different from the sediments above due to a higher content of carbonate matter (Fig. 1D). This part is characterized by distinct black (monosulphidic) laminae which decrease in frequency upwards. The lamination is partly on a submillimeter scale, but individual lamina may be more than 5 mm thick. Most laminae are normal graded with a lower light and upper dark zone. It is not clear whether the laminae were formed by individual meltwater plumes entering the lake, or whether they represent yearly varves.

A preliminary foraminifera analysis has been undertaken by Anne Katrine Lycke, University of Bergen. The fauna is dominated by different *Elphidium* species together with *Cassidulina reniforme*. The record is difficult to interpret, but a sudden increase in the diversity of species at the base of the core indicates a rapid improvement of the marine environment following the deglaciation. This is consistent with the lack of

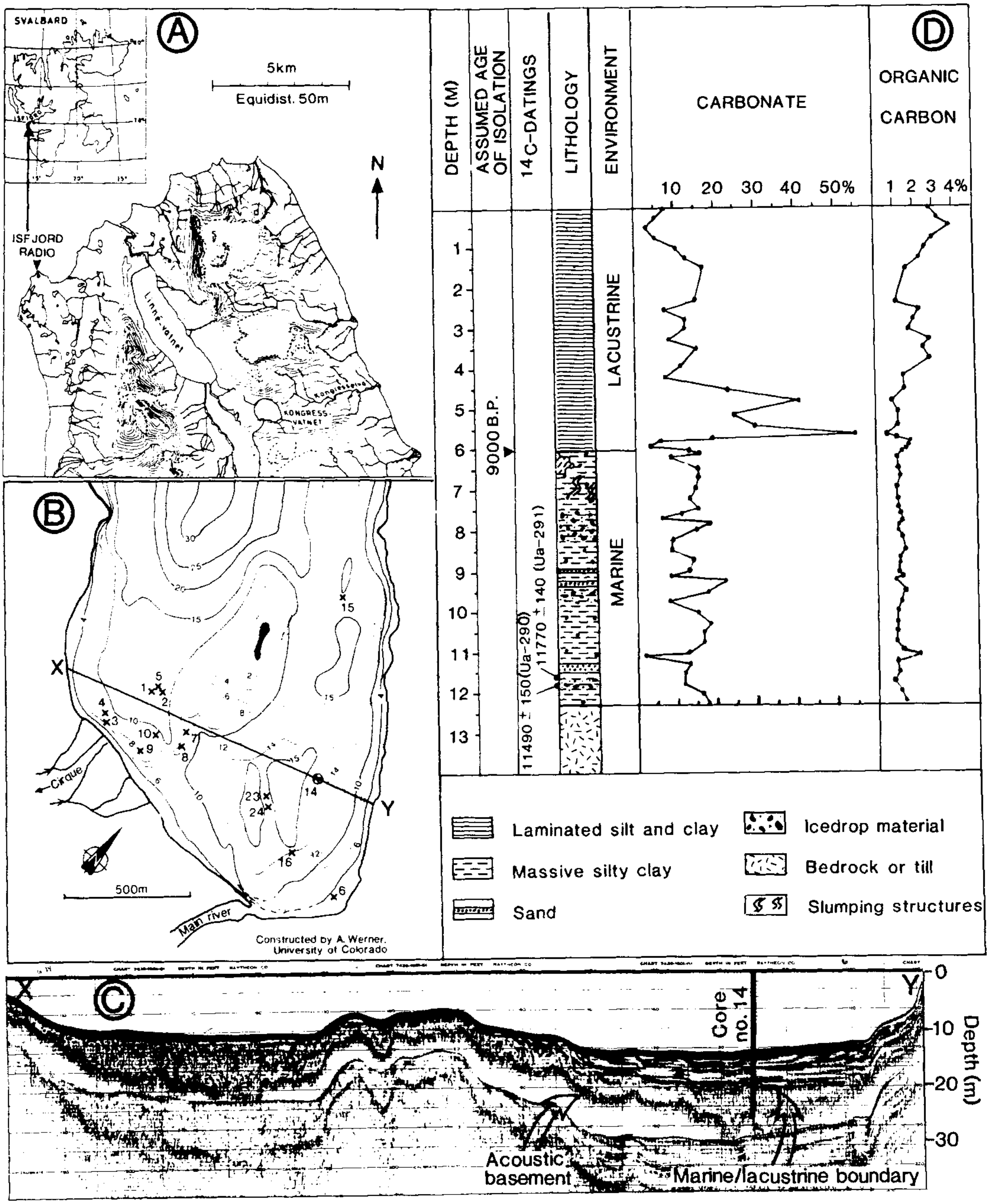

Fig. 1. A: Lake Linnévatnet and its surroundings with a key map of Svalbard. B: Bathymetric map of the southern part of Lake Linnévatnet. The depths are given in metres. Coring sites and the echo-sounding profile X-Y shown on Fig. 1C are indicated. C: An echo-sounding profile X-Y across the southern end of the lake (Fig. 1B). D: Description of core no. 14.

laminated glaciomarine sediments at the base of the core which may indicate a rapid retreat of the icefront. The variation in the frequency of molluscs and icedrop material might be a result of climatic changes, e.g. glacial activity during the Younger Dryas. A more detailed foraminifera analysis may help to clarify the cause of this variation.

Date of the glacial retreat

Two accelerator radiocarbon dates of molluscs, one from 50 cm and the other from 70 cm above the base of the core yielded 11,770 ± 140 (Ua-291, *Bathyarca glacialis*), and 11,490 ± 150 (Ua-290, *Nucula tenuis*) years B.P., respectively. We assume that the sedimentation rate was rapid. Thus these dates give a relatively precise age of the deglaciation and retreat of the valley glacier that occupied the basin during the Late Weichselian (Mangerud et al. 1987).

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