Comparison among Results of Comprehensive Analyses on the Core 323-PC1 from Lake Baikal, Southeastern Siberia

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Abstract

A piston-type Core 323-PC1 which had been obtained from the pelagic bottom, 710m deep below the present lake surface of the northern part of Lake Baikal, Southeastern Siberia, 55° 32′ 08″N and 109° 31′28″E, by a Joint Russian-American Cooperative Project in 1990 was analysed by several Japanese scientists from the view points of many items such as palynology, lithofacies and sedimentology, organic matter analysis, microanimal and phytoplanktonic remains together with several scientists of other countries.

The present writer compared comprehensively between results of those investigations avove-mentioned, especially pollen analysis and other analyses such as microanimal and diatom fossils, ^{14}C-age determination, and chemical analyses.

According to the present writer's pollen analysis, especially the pollen assemblages, kind of pollen grains and their frequency, the core sequence is divided into two parts as the upper and lower parts at the horizon of about 140cm below the present bottom surface. This horizon means the boundary between the Holocene and Late Pleistocene, and also is supported by the results of other investigations.

The diatomaceous upper part includs predominant diatom, microanimal and pollen grain fossils, dominant phytoplankton remains, and high contribution of allochthonous organic matter. On the other hand, in the lower part very few diatom, microanimal and pollen fossils, few phytoplanktonic remains and low contribution of allochthonous organic matter are found. Such phenomenon above-mentioned shows that only autochthonous organic matter exists in the lower part.

Such drastic difference recognized between the upper and lower parts suggests that the condition of phytoplanktonic propagation had been very severe in the northern part of Lake Baikal for the latest glacial age of the Late Pleistocene period, and theat on the contrary the condition above-mentioned had not been severe in the Holocene period.

Pollen assemblages and absolute number of pollen grain suggest that the present-day taiga

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and/or broad-leaved mixed forest have been distributed widely in the northern part of the Baikal area during the Holocene period. On the other hand, the flora as the presenr-day tundra occupied widely in the area during the last glacial age.

Introduction

Core no. 323-PC1 was drilled at the pelagic site, about 710m in depth below a lake surface, in the northern part of Lake Baikal by a Joint Russian-American Cooperative Project in 1990. The core samples were analysed by several Japanese scientists for comprehensive investigation on many items such as pollen analysis (Fuji, Norio), lithologic analysis (Takemura, Keiji *et al.*), organic matter analysis : carbon isotope, organic carbon, nitrogen (Ishiwatari, Ryoji), inorganic chemical analysis (Toyoda, K. *et al.*), animal microfossil (Kadota, S.), diatom analysis (Mori, S.), ^{14}C-ages (Ogura, K.). Results of these analyses were reported already in IPPCCE Newsletter no. 6 in 1992.

The aim of the present paper is to compare between pollen analysis and the results on many items such as microfossils, ^{14}C-age deterination, and organic chemistry obtained by the investigation of the Core 323-PC1.

The present writer would like to thank all member concerned with sampling of the core. The writer wish to express Dr. Horie, and Japanese scientists concerning the analyses of the core from Lake Baikal for their analytical efforts and valuable scientific helpings.

Samples and Lithofacies

Sampling locality for Core 323-PC1 is located at a depth of 710m in the northern part of Lake Baikal, 55°32′8″N and 109°31′28″E.

The Core is 461cm long and is composed mainly of massive clay and silty clay intercalating thin fine- and/or medium-grained sand layers which are about 5 to 15cm thick. This sequence of the core is divided generally into two parts at the horizon of 140 to 150cm deep. The upper part is mainly composed of silty size and looked like diatomaceous qyttia in which abundant fossil diatoms were found (Mori, 1992). On the contrary, the lower part is composed mainly of bluish gray clay and fine-grained silt, and very few fossil diatoms are included.

Distinct difference between the upper and lower part of the core should be influenced by productivity in this lake.

^{14}C-Age Determination

Radiocarbon ages of some horizons of Core 323-PC1 had been measured by the method stated by Nakamura *et al.* (1990).

According to the ^{14}C-age data, the large sedimentation rate (mm/yr) of the upper part of the core may be caused by the high productivity in the drainage area. This phenomenon shows

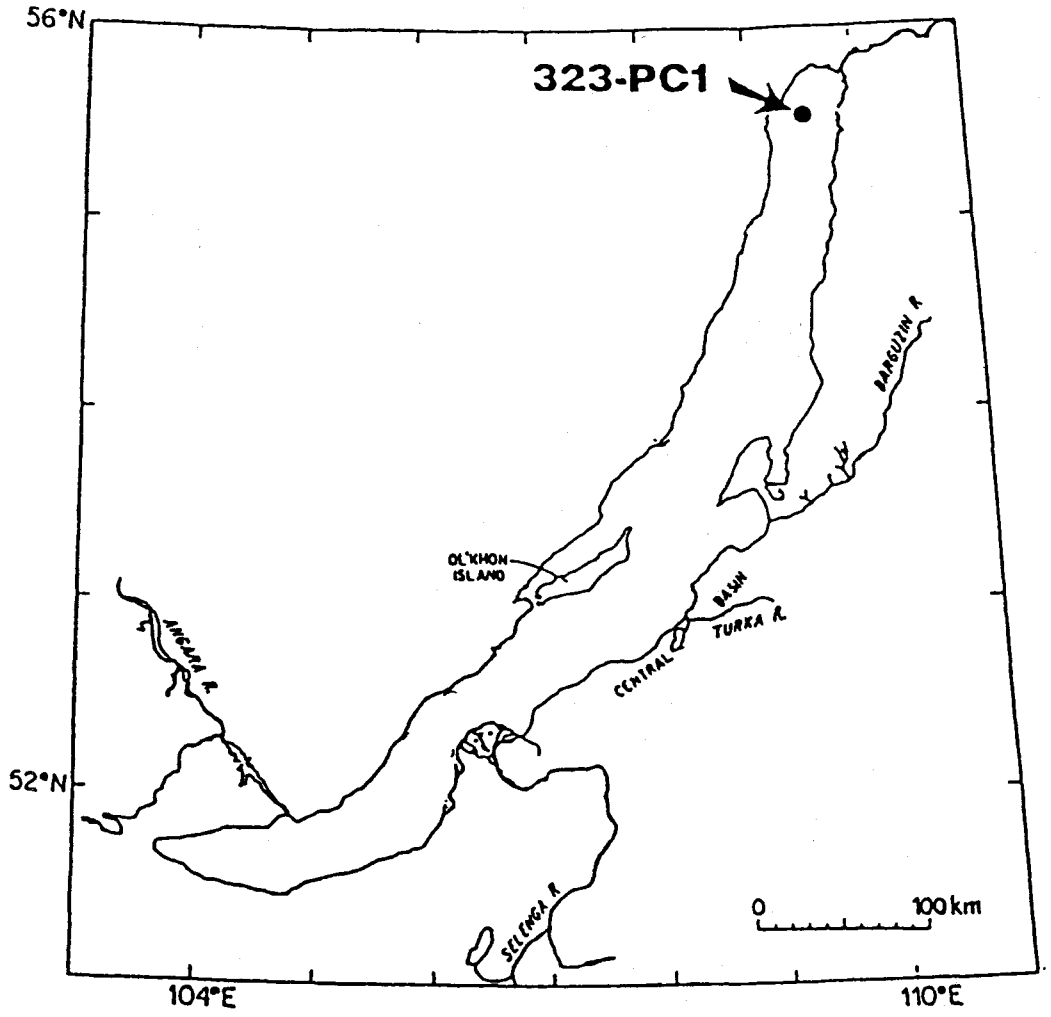


Fig. 1. Location map of Lake Baikal. Black arrow indicates the sampling point of 323-PC1

that the upper part of the core may be chronologically correlated with the Holocene. Namely, these data such as ^{14}C-age, high productivity, large sedimentation rate and lithofacies of the Core 323-PC1 indicate that the boundary between the upper part and lower part is correlated with the border between the Pleistocene and Holocene as reported already by the present writer (Fuji, 1992).

Table 1 Radiocarbon Age (^{14}C) of a 4.6-m-long Core (Lake Baikal)

Sample no.	Dvepth, cm	Age, years BP	Theoretical age of the sample, years BP
BA-1	11.5−12.5	6.150±120	720
BA-3	53.5−54.0	8.770±140	3,340
BA-5	101.5−105.5	14.660±190	9,230
BA-15	221.5−222.0	22.120±350	16.690
BA-19	451.5−452.0	25.250±490	19,820

Note. The calculations use a value of 5,570 years as the ^{14}C half-life period,the reference year is 1950. The error full within the confidence interval σ.

Palynological Analysis

On the basis of the present writer's investigation of about twenty samples analized for the Core 323-PC1, the present writer can state several conclusions such as follows:

(1) The pollen assemblages of core samples are divided into two pollen zones as Zone A and Zone B, and also ten pollen subzones as Subzones A-1 to A-4 and Subzones B-1 to B-6 respectivelly.

(2) The Pollen Zone A is characterized by predominate *Abies*, *Larix*, *Pinus Haploxylon* -type, and *Picea* with common or rare *Betula*, *Lepidobalanus*, *Salix*, *Alnus* and forbs, which have been grown widely in the present-day taiga and/or broad-leaved mixed forest in and around the Baikal basin, the southeastern Siberia.

(3) The Pollen Zone A may be chronologically correlated with the Holocene, and the Pollen Zone B with the latest Pleistocene respectivelly.

(4) In the Pollen Zone A, the Pollen Subzone A-4 may be correlated with the Boreal, A-3 with the Atlantic, A-3 with Subboreal and A-1 with Subaslantic pollen-period respectivelly.

(5) From the view points of an absolute number of pollen grains and spores, and pollen assemblages, the Pollen Zone B may be correlated with the last glacial stage.

Diatom Analysis

According to an investigation of fossil diatoms (Mori, 1992), predominate diatoms (about 30 -85$\times10^{=}$ frustule/g) are found in Sample Nos. 1-6 of the upper part of the core. *Aulacozeira baicalensis* is predominate, and dominate diatoms are *A. islandica* morphotype *helvetica* and

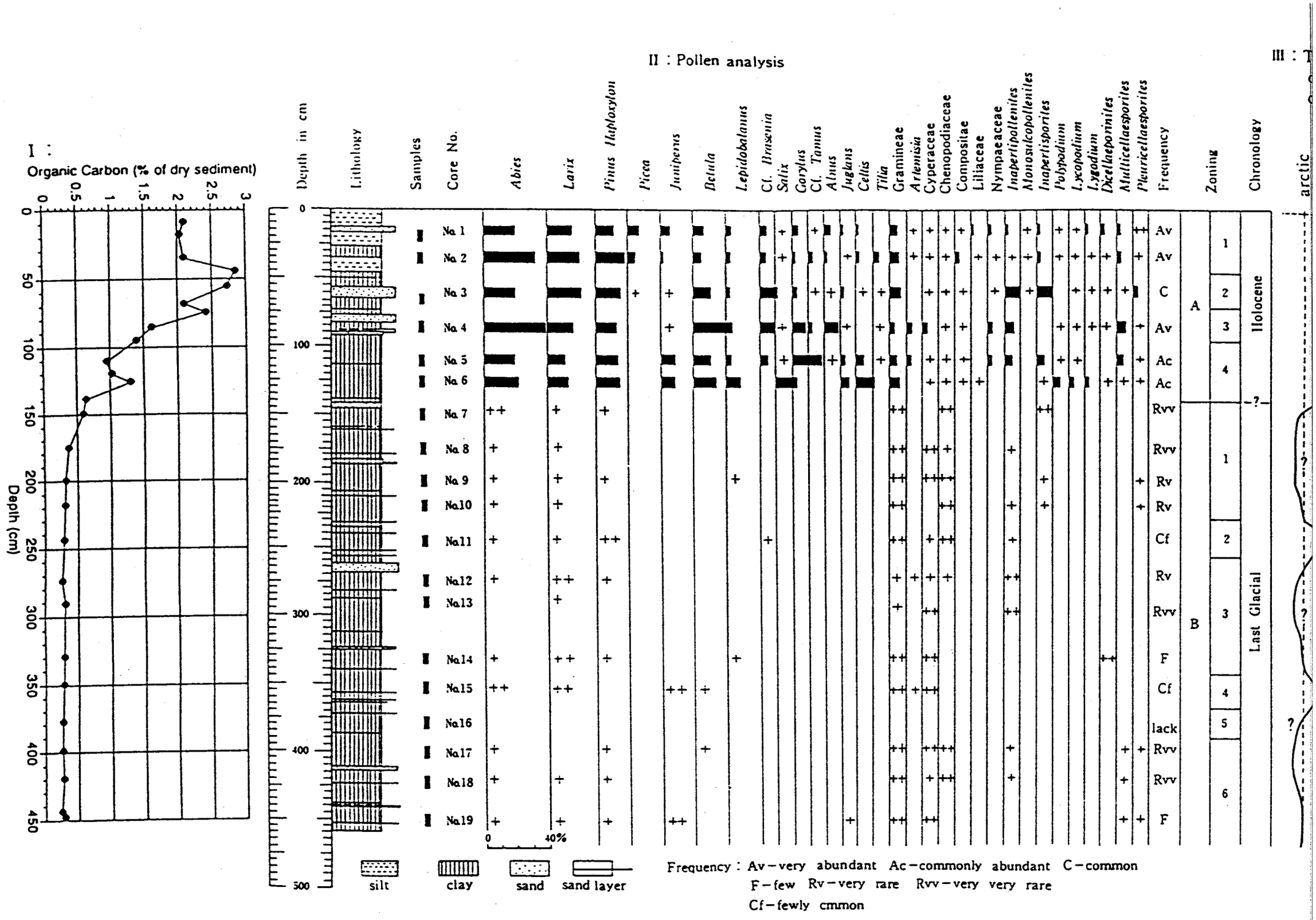
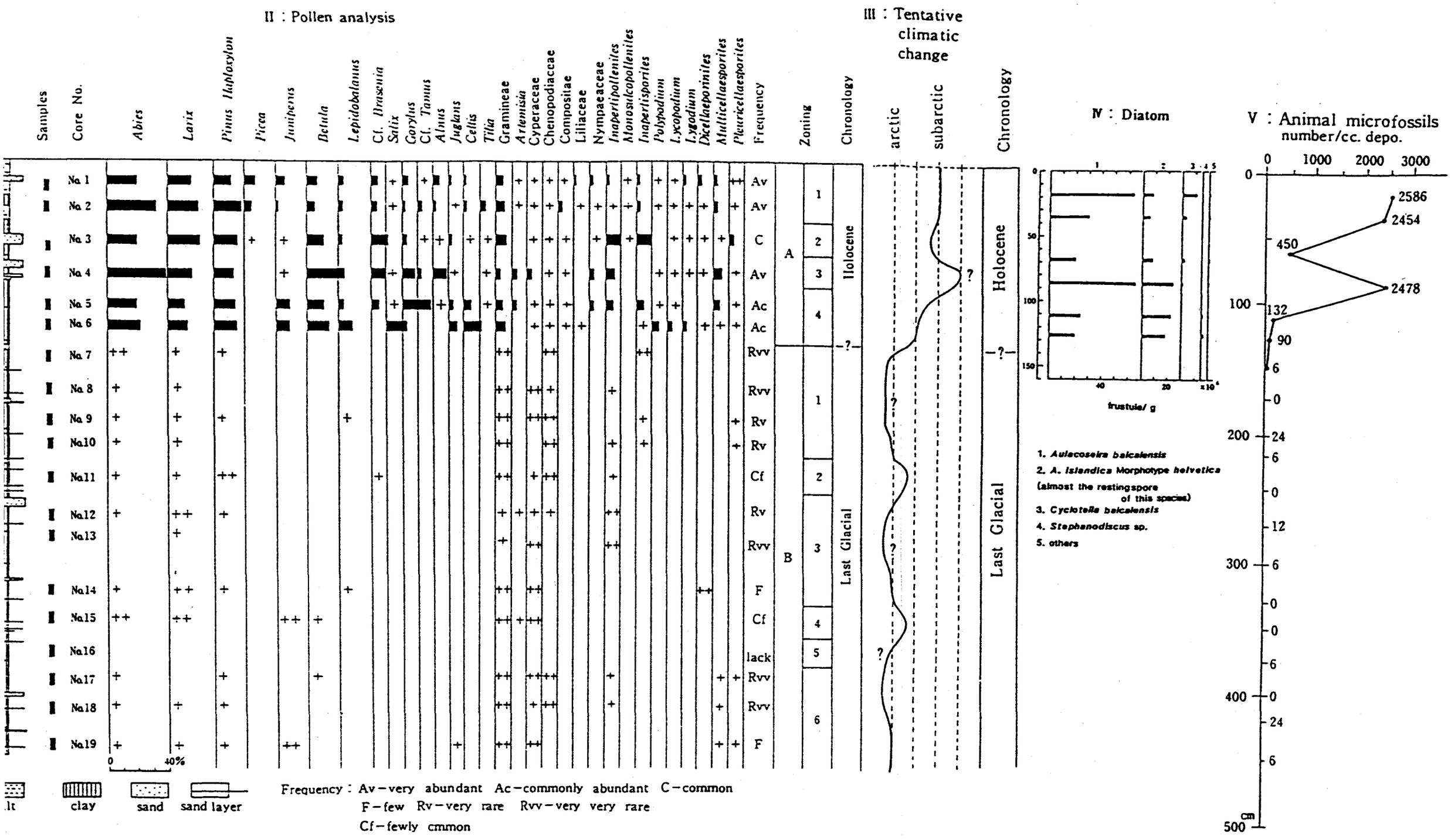


Fig. 2. Comparison among the results of the comprehensive investigations on the Core 323-PC1 from the northern part of Lake Baikal, Southeastern Siberia.
I: Ishiwatari *et al.* (1993), II&III: Fuji (1992), IV: Mori (1992), V: Kadota (1992)



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Cyclotella baicalensis. On the contrary, Sample Nos. 7-19 of the lower part exhibit non-fossil diatom nature.

Fossil Microanimal Analysis

On the basis of investigation of fossil microanimals and phytoplanktonic remains (Kadota, 1992), these fossils and remains are found in the upper part, especially Sameple Nos. 1-5, while there are no fossil microanimas and phytoplanktonic remains in the lower part. Acccording to Kadota's result, although *Bosmina* is predominant (996) iddividuals/cc deposit), others are few. In phytoplanktonic remains, *Pediastrum* is in very rare frequency (96 individuals/cc).

These results from analyses of fossil diatoms, microanimals and phytoplanktonic remains are almost similar to the palynological result.

The drastic change of biomass should be due to the changes of hydrophysical condition, and the natural condition of development for phytoplankton in the northern area of Lake Baikal had been quite severe during the Late Pleistocene period.

Organic Chemistry

Organic carbon contents of the upper part of the Core 323-PC1 is 2.9%, while the lower part is 0.2% (Ishiwatari *et al.*, 1993), this result shows the same tendency as the results by Granina *et al.* (1992).

$\delta^{13}C$ data of bulk organic matter (BOM) show -22 to -30‰ (BDO). These frequencies are similar to the investigation by Colman *et al.* (1992).

C/N ratios (weight) in the upper part are 10-14, whereas those in the lower part are smaller than 10, especially those in the samples below 200 cm in horizon show range from 6.7 to 8.8.

These results show that BOM in the lower part is abundant in autochthonous OM, and that one in the upper part may be due to a large amount of terrestrial material.

According to Toyota *et al.*(1993), vertical profiles of autochthonous and allochthonous organic matter are calculated on the assumption that the C/N ration of authochthonous organic matter shows 6.4, which is average value of C/N ratio for the deposits below 200 cm-horizon. This result is consistent with the present writer's palynological investigation (Fuji, 1992) and exhibit the difference of amount of vegetation around northern Lake Baikal between the upper and lower parts. Such drastic change should be due to a different in climate and vegetation between the Holocene and the Latest Pleistocene period.

Conclusion

1) The present writer compared comprehensively between palynological analysis and other initial analytical results on many items such as microfossils. ^{14}C-age dating and chemistry by the Japanese scientists on the Core 323-PC1 obtained in the northern part of Lake Baikal,

Southeastern Siberia (55°32′08″N and 109°31′28″E).

2) On the basis of the palynological analysis, the core sequence is divided into two parts such as the upper and lower parts at the horizon of about 140cm below the present bottom surface of the lake. This horizon of the boundary is recognized as the boundary between the Holocene and the Late Pleistocene periods.

3) The begining of the upper part may have been chronologically and palynologically correlated with the Boreal stage of the Holocene period.

4) The present writer's assumption is supported by the results of other analytical items.

5) The upper part is mainly composed of silty size and diatomaceous gyttja in which abundant diatom, microanimal and pollen fossils, dominant phytoplankton remains and high contribution of allochthonous organic matter are included. On the other hand, very few diatom, microanimal and pollen grain fossils, few phytoplanktonic remains and low contribution of allochthonous organic matter are found in the lower part of the core. Such phenomenon suggests that only autochthonous organic matter exists in the lower part.

6) Such drastic change recognized between the upper and lower parts suggests that the condition of phytoplanktonic propagation had been very severe in the northern part of Lake Baikal during the latest age (cold age) of the Pleistocene period.

7) Pollen assemblages and absolute number of pollen grains suggest that the present-day taiga and/or broad-leaved mixed forest occupied in the northern part of the Baikal area for the Holocene period.

8) The flora such as the present-day tundra was distributed for the latest age (cold age) of the Pleistocene period.

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