Lakes and Their Sediments around Yala Glacier

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Abstract

The preliminary investigation of the lakes around Yala Glacier was carried out. There are four groups of lakes in the area. The research was done mainly upon the lake sediments and water. In the sediments, we were able to detect the activity of ^{137}Cs, a fallout radionuclide, which offers information for the dating of the sediments. The vertical distribution of ignition loss, which reflects the organic content, in the sediment cores is affected by the climatic change and the geographical change in the lakes. The quality of lake water was compared with those of glacier and river water and we considered how it was determined.

1. Introduction

We had the opportunity to investigate the lakes around Yala (Dakpatsen) Glacier in the Langtang Region from November to December in 1981 and from September to November in 1982. In the region, the lakes are distributed from about 3,700 meters to 5,100 meters above mean sea level, which are divided into four groups according to their localities:

A; Trang chu, the lake at the tip of Khyimjung Glacier, 4,175 meters above sea level,

B; Tsona, the group of five lakes, located on the opposite side of River Tsang-bo to Kyangchen Base House, at 3,749 meters above sea level, the lowest among the lakes in the region,

C; no name, the lake at the end of Yala Glacier, to the west of the Glacier Camp, approximately 5,000 meters above sea level,

D; no name, the pair of lakes at the tip of Yala Glacier, to the east of the Glacier Camp, approximately 5,090 meters above sea level,

In the report, we will make clear the characteristics of each lake group, considering the qualities of lake sediments and lake water.

2. General view of each lake group

Here we will show the general aspect of each lake group mentioned above.

A: The lake is recharged by the melted water of Khyimjung Glacier and is surrounded by both an end moraine and an outcrop of a large rock which was once scoured by the glacier. Late in September in 1982, the water level of the lake was observed to rise gradually from 11 to 15 o'clock and seemed to show a daily variation due to the change in the amount of recharge from the glacier. Almost all of the lake basin is covered with fine sands.

B: The lakes are located on the same moraine as Kyangchen Base House is, and are recharged by the groundwater coming down from the mountain nearby. The groundwater coming out on the moraine from the mountainside is first stored in the lakes and then drains into the river. Each lake is about 10–30 meters long and about 1.5 meters deep, and is surrounded

by grass fields. The bottom is covered with fine mud about 15 cm thick, containing a great deal of organic matter from the grass fields nearby.

C: Having the largest basin among these lakes, the lake is surrounded by both a large end moraine and a large abrased rock area at the end of Yala Glacier. Late in September in 1982, the lake was observed to be about 50 meters long. From that time on, its size decreased by late October, looking like a river approximately 5 meters wide running in the basin. In the summer, the lake is recharged by melted water from the glacier. In the winter, the water level of the lake decreases with the decrease in the discharge from the glacier. In the central point of the basin, the bottom is covered with fine sands.

D: The two lakes are placed up and down on the indentations in the outcrop of the large rock. The melted water from Yala Glacier runs into the upper lake and then flows down into the lower lake. Each lake is approximately 15 meters long and the bottom of the lake is covered with coarse stones.

3. Some observations and comments

We were able to obtain samples of the lake sediments and the lake water together with the river water nearby. Some of the results have already been obtained and others have not yet. Here we will introduce the results obtained so far.

3.1. Lake sediments

We were able to obtain the sediments of the lakes A, B and C. The sediment core obtained from the lake A was 45 cm long. The sediment core from the lake B was 12 cm long, which was from the sediment surface to the rock under the sediments. When we went to the lake C to obtain the core sample of the sediments on October, 29, the water level of the lake was low and we could easily arrive at the central point of the lake. Unfortunately, however, the sediments were frozen and we were able to obtain a sediment sample of only a few centimeters depth. The value of ignition loss (IL) in the sediment sample of each lake is shown in Fig. 1. The value of IL reflects the organic content in the sample. The periodic variation in the organic mass in lakes, which is affected by the temperature and/or the lake size and environment, is probably recorded in the core sample of the sediements. In the lake B, the decrease in the value of IL in the upper a few centimeters was caused by the early diagenetic processes in the sediments. Such decrease was not observed in the core sample obtained from the lake A. The lake B is surrounded by the grass fields and much organic matter blows into the lake. The lake water always lies over the bottom sediments, which causes the early diagenetic processes in the sediments to occur. The glacier always brings the sands, which deposit on the bottom of the lakes along with some organic matter, into the lakes A and C. The lake bottom is sometimes frozen during the winter season because of the high altitude and the shallow water depth, which prevents progress in the early diagenetic processes in the sediments. The drainage area and the basin of the lake C are larger than those of the lake A, which brings about the larger value of IL in the sediment surface in the lake C than in the lake A. In the core sample obtained from the lake A, a clear vertical fluctuation in the value of IL was observed, which shows the change in the organic activities in the watersheds. The organic activities are probably affected by the temperature in the watersheds. Here the dating for the sediment core becomes important. We measured the activity of ^{137}Cs, a fallout radionuclide produced by nuclear weapon test series. From the sediment surface to a depth of 1 cm in the core, the activity of ^{137}Cs was detected to be 114 ± 13 pCi/kg. However, because the measure-

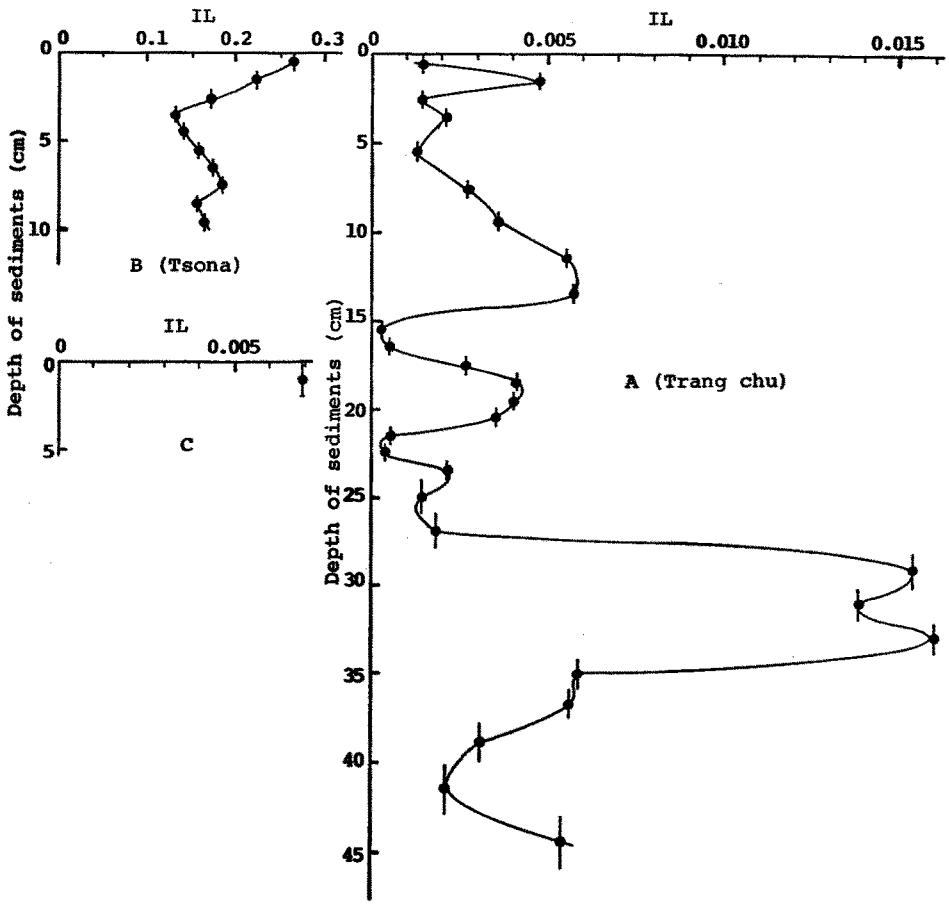

Fig. 1. Distribution of ignition loss (IL) in the lake sediments.

ment is not enough now for the dating, we introduce here only the value in the sediment surface. By measurement of the artificial radionuclide throughout the core, the dating of the sediment core will be attained. In the core, we were able to observe clearly the vertical distribution of grain-size and the alternation of black and white strata. There still remains some

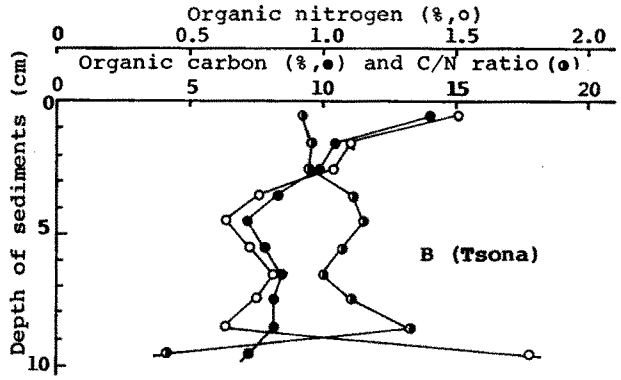

Fig. 2. Distributions of organic nitrogen and organic carbon in the lake sediments.

Table 1. Water quality of lakes

Lake	pH	Conductivity ($\mu\sigma$/cm)
A	6.80	23.0
D (upper)	6.55	10.5
D (lower)	7.62	13.8

Table 2. Concentration of chemical components on the river water (Chubi-chu) obtained on November 29 1981 (mg/l).

Altitude	pH	Na	K	Mg	Ca	Cl	HCO_3	SO_4	SiO_2
4,800 m	6.9	1.2	0.35	0.40	12.5	0.30	38.1	9.23	3.2
4,600 m	7.1	1.0	0.28	0.60	12.1	0.10	38.7	1.80	3.7
4,420 m	7.1	1.0	0.25	0.40	10.2	0.20	34.5	1.30	4.8
4,250 m	7.1	1.3	0.28	0.50	10.8	0.40	35.6	1.50	5.2
3,820 m	7.1	1.2	0.28	0.50	11.2	0.20	36.0	1.50	5.1

uncertainty regarding why such a grain-size distruibtion and the alternation of the strata have occurred.

In the core obtained from the lake B, the contents of organic nitrogen and organic carbon were observed as shown in Fig. 2. As the value of IL indicated, organic content in the lake sediments was relatively high, which shows the characteristics of lakes in low temperature, where the decomposition rate of the organic matter is very slow.

3.2. Lake water

Here we will introduce the water quality of the lakes, together with those of the glacier and the river nearby and consider the origin of the water quality. The water quality of the glacier in the boring core of Yala Glacier was reported by Watanabe et al. in this volume and that of the river in the region was reported by Yamada et al. (1983). Here we introduce the values of conductivity and pH in the lakes B and D in Table 1. Throughout the boring core, the values of conductivity and pH ranged, respectively, from 0.8 to 3.5 $\mu\sigma$/cm and from 2.9 to 5.8. Glacier ice containing CO_2 comes into contant with the rock and dissolves some chemical components into water, increasing the values of pH and conductivity. The difference of the values between in the upper and in the lower lakes of the lake D is due to the fact that the lower lake contains water having been in more contact with the rock. The concentrations of chemical components in the river (Chubi-chu) at several different altitudes are listed in Table 2. Taking the values of pH and the concentrations of chemical components in the glacier ice into consideration, some of the chemical components results from the dissolution of the rock. In the field observation, the pH value in the river water rose quickly in a few minutes after sampling (for example in the sample at 4,420 meters, it was 7.1, and after 1 min, it rose to 7.4, gradually increasing to reach the equilibrium value of 7.5 in 4 min), which was very interesting.

4. Conclusion

There are four groups of lakes around Yala Glacier. In the lakes, some observations were made upon the lake sediments and the lake water. The sediment core of 45 cm long was obtained in the central point of the lake basin at the tip of Khyimjung Glacier. The vertical distribution of ignition loss in the sediments was observed, which probably showed the past change in the organic mass in the lake. The activity of ^{137}Cs in the sediments was detected,

which will allow the dating of the sediment core. The measurements are now being taken and we will discuss all of the data later.

The lake water was considered to be the melted water from the glacier which had come in contact with rocks.

Reference

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