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Glaciological research in Hidden Valley, Mukut Himal in 1994

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Abstract

We carried out glaciological field work on glaciers and permafrost in Hidden Valley, Mukut Himal in October 1994 as a part of Glaciological Expedition in Nepal 1994 (GEN'94). The prime objective of present research was to clarify fluctuations of glaciers and permafrost during the last 20 years. Other objective was to obtain an ice core to study the past few decadal climatic change. We herewith report the field work done in Hidden Valley and show preliminary results.

1. Introduction

Glaciological research works were extensively carried out in Hidden Valley, Mukut Himal in 1974 as a part of Glaciological Expedition of Nepal (Higuchi, 1976 ; Nakawo *et al.*, 1976 ; Fujii *et al.*, 1976 ; Shrestha *et al.*, 1976). Prime objectives of the present glaciological research program in Hidden Valley are to clarify glacier fluctuations during the last 20 years and to obtain an ice core to reveal past several decadal climatic change for the evaluation of global change in high Nepal Himalayas. Particularly the present study focuses on global warming, paleo-ENSO/monsoon episodes and their relation to glacier fluctuation. Atmospheric acidification is to be studied as well from a view point of recent environmental change in the Himalayas.

2. Field Works

2.1. Research area

Present study was carried out in Hidden Valley, Mukut Himal in the arid northern side of the Dhaulagiri Himal. Hidden Valley is located in the area that is less affected by summer monsoon. Glaciers investigated are the Rikha Samba Glacier, the largest glacier in Hidden Valley, and other small glaciers in the valley (Fig. 1) as in 1974 to clarify changes of glaciers during the last 20 years. Ground tempera-

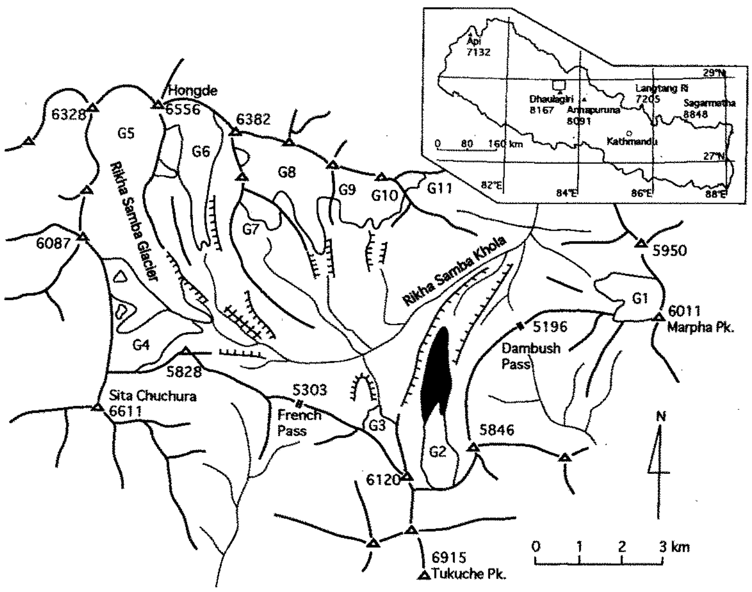

Fig. 1. Map of Hidden Valley showing locations of glaciers.

ture was measured in Hidden Valley and on the eastern slope of Dambush Pass.

2.2. Members

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Koji FUJITA (Glaciology) :
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2.3. Itinerary

September	30	lv. Kathmandu
October	5	ar. Tukuche
	6	lv. Tukuche
	8	ar. Hidden Valley
	9 to 25	research work in Hidden Valley
	26	lv. Hidden Valley
	27	ar. Tukuche
	29	lv. Tukuche
November	30	ar. Kathmandu

2.4. Field work and the preliminary results

Research works done in Hidden Valley are summarized as follows. The preliminary results are briefly noted as well. Further detailed results will be presented elsewhere.

2.4.1. Survey of glacier fluctuation since 1974

Termini of the glaciers, G2, G4, G5, G9, G10 and G11 in Hidden Valley were investigated by means of measuring the altitude with an altimeter and of photographing. Particularly the terminus area of the Rikha Samba Glacier (G5) was surveyed with the laser distance meter, Wild-T1600. Surface profiles along the lines of the Rikha Samba Glacier, C, D and E, were surveyed as shown in Fig. 2.

All the glaciers investigated in Hidden Valley have considerably retreated during the last 20 years. The Rikha Samba Glacier, the largest glacier in Hidden Valley, has retreated about 200 m since 1974 (Fig. 3). The surface lowering occurred in the last 20 years. A small snow patch located in the east of the Rikha Samba Glacier in 1974 disappeared. The other glaciers also retreated and new bedrock appeared in the accumulation basins due to the thinning of glacier surface.

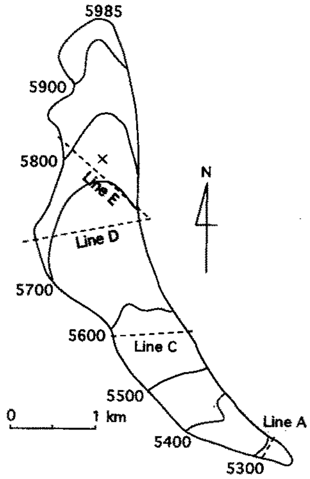

Fig. 2. Survey lines and the location of ice core drilling (cross) at the Rikha Samba Glacier.

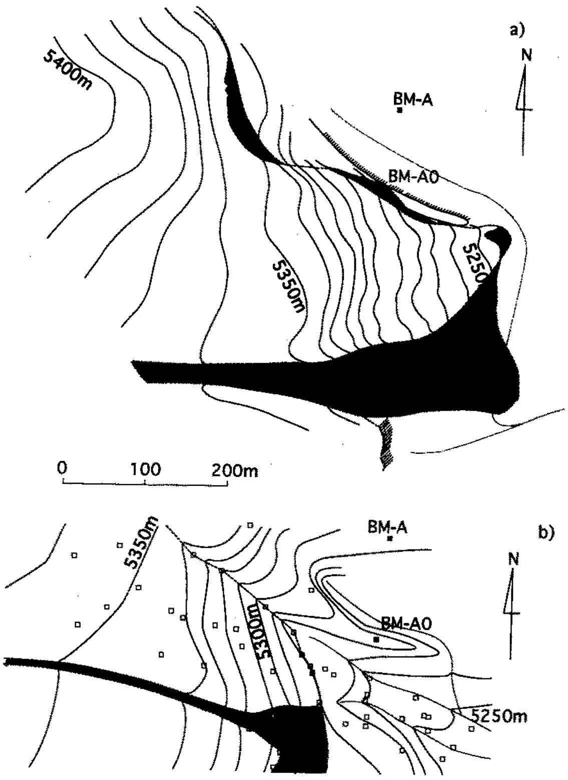

Fig. 3. Position of the terminus of the Rikha Samba Glacier in 1974 (a), after Nakawo *et al.* (1976), and in 1994 (b), present survey. Broken line and shaded area denotes the boundary of the glacier and debris-covered part respectively. Open squares in (b) and solid squares in both maps represent surveyed points and bench marks respectively.

2.4.2. Ice core drilling and in-situ core analyses

Ice core drilling was carried out to a depth of 23.25 m with the lightweighted PICO hand auger (Koci and Kuivinen, 1984) at the altitude of 5740 m a.s.l. in the accumulation area of the Rikha Samba Glacier (Fig. 2). Drilling site is located in the superimposed ice zone but ice core signals were well preserved. Core analyses were carried out in-situ as to dirt, microbial organisms, electrical conductivity and pH, and at laboratory as to oxygen isotope ratio, major chemical compounds and Tritium. As extremely high concentration of microbial organisms appears at a few layers, there is a possibility of disappearance of annual layers by unusual high ablation.

Tritium profile (Izumi, 1995 ; Fig. 4) indicates 1963 and 1958−59 peaks at 5.80−6.19 m and 7.10−7.34 m below the surface respectively. Mean annual accumulation rates are calculated as 18 cm in ice thickness from 1963 to 1994 and 25−30 cm in ice from 1958−59 to 1963. This indicates a decreased or negative balance after 1963 comparing with that before 1963. The 23.25 m deep ice core is expected to cover past 90 years if we take 30 cm of ice as a mean accumulation rate before 1963.

Bore hole temperature was measured at 1−4 meter interval with a Pt-100 resistance thermometer as well and the result is shown in Fig. 5.

2.4.3. Radio echo sounding

Ice thickness was measured at the Rikha Samba Glacier along the survey lines C and D (Fig. 2) with a handy radio echo sounder constructed by Ohio State

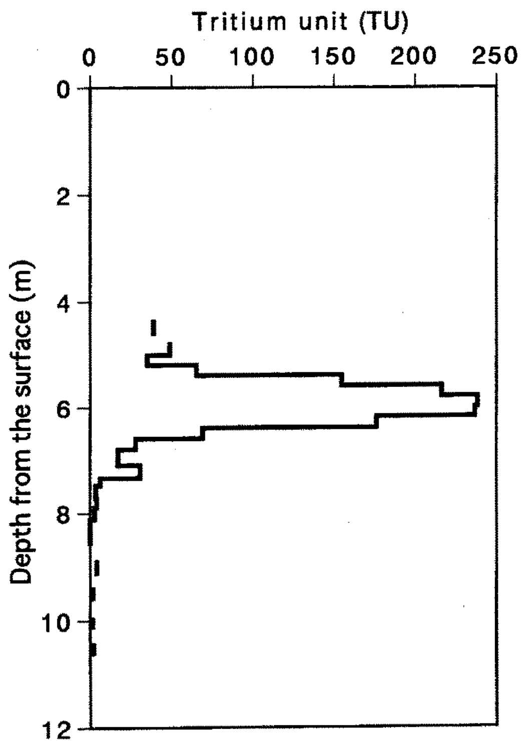

Fig. 4. Tritium profile of the core from the Rikha Samba Glacier (Izumi, 1995).

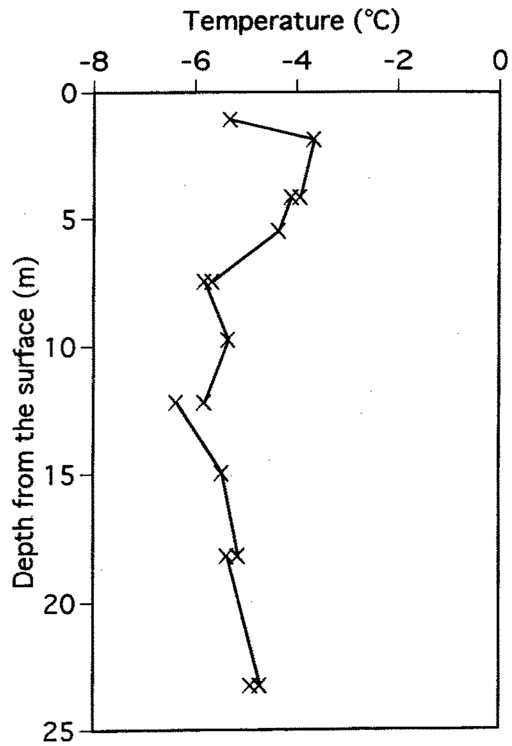

Fig. 5. Bore hole temperature profile in the accumulation area of the Rikha Samba Glacier.

University.

2.4.4. Glacier flow measurement

Glacier flow velocity was measured at two points of the Rikha Samba Glacier. As the duration of the measurement was limited, the flow velocity has to be carefully calculated and evaluated.

2.4.5. Ground temperature measurement

Ground temperature lapse rate in 1974 indicated the lower limit of permafrost distribution at 4900–5000 m a.s.l. Recent warming trend may have affected the permafrost distribution. If warming has occurred by more than 0.5 °C in the last 20 years, the change in permafrost distribution may be detectable. Ground temperature at 50 cm depth was measured with a thermistor thermometer after making a 50 cm deep hole with an iron bar. Figure 6 shows the result clearly indicating the lower limit of permafrost distribution at 4900–5000 m a.s.l. where the lapse rate changes as in 1974 (Fujii and Higuchi, 1976).

2.4.6. Surface meteorological observation

Meteorological observation was carried out at 08 : 45, 11 : 45, 14 : 45 and 17 : 45 Nepal Standard Time (GMT+5h45 m). Elements observed were air temperature, wind speed, wind direction, atmospheric pressure and weather. Air temperature and humidity were continuously measured with a thermo-hydro graph at Base Camp (5150 m a.s.l.) located near the terminus of the Rikha Samba Glacier.

Figure 7 shows the air temperature, humidity and

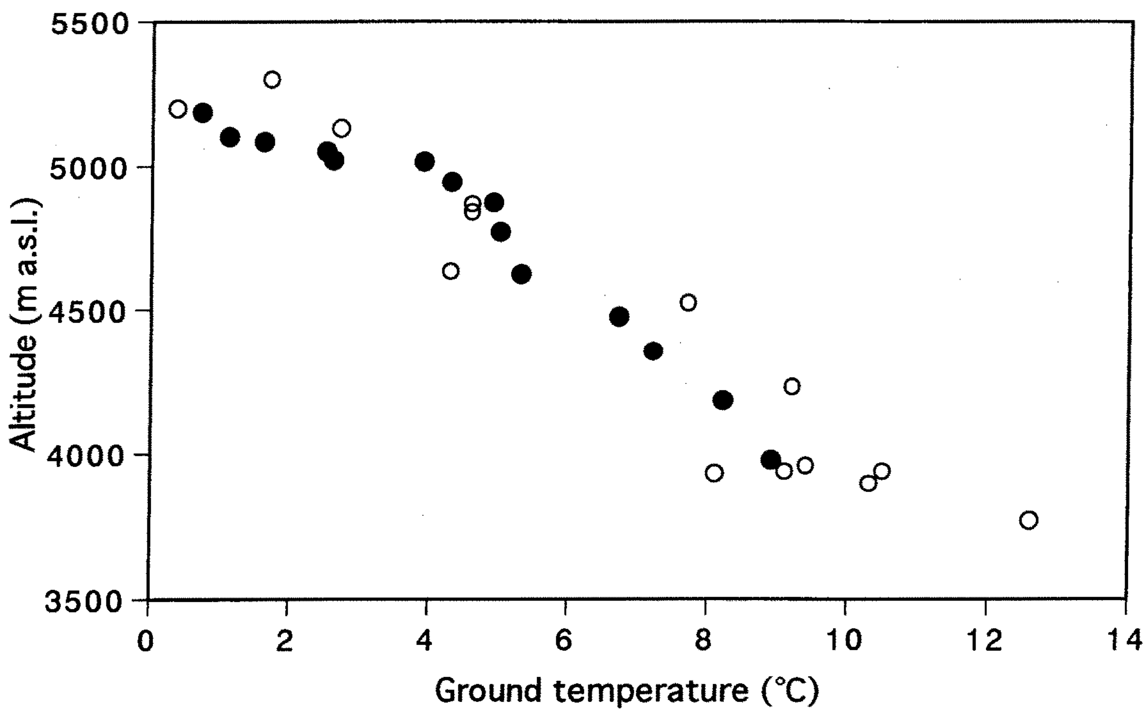

Fig. 6. Relation between ground temperature at 50 cm depth and altitude on eastern slope of the Dambush Pass (5196m a.s.l.) and in Hidden Valley ; solid circle for 1994 and open circle for 1974.

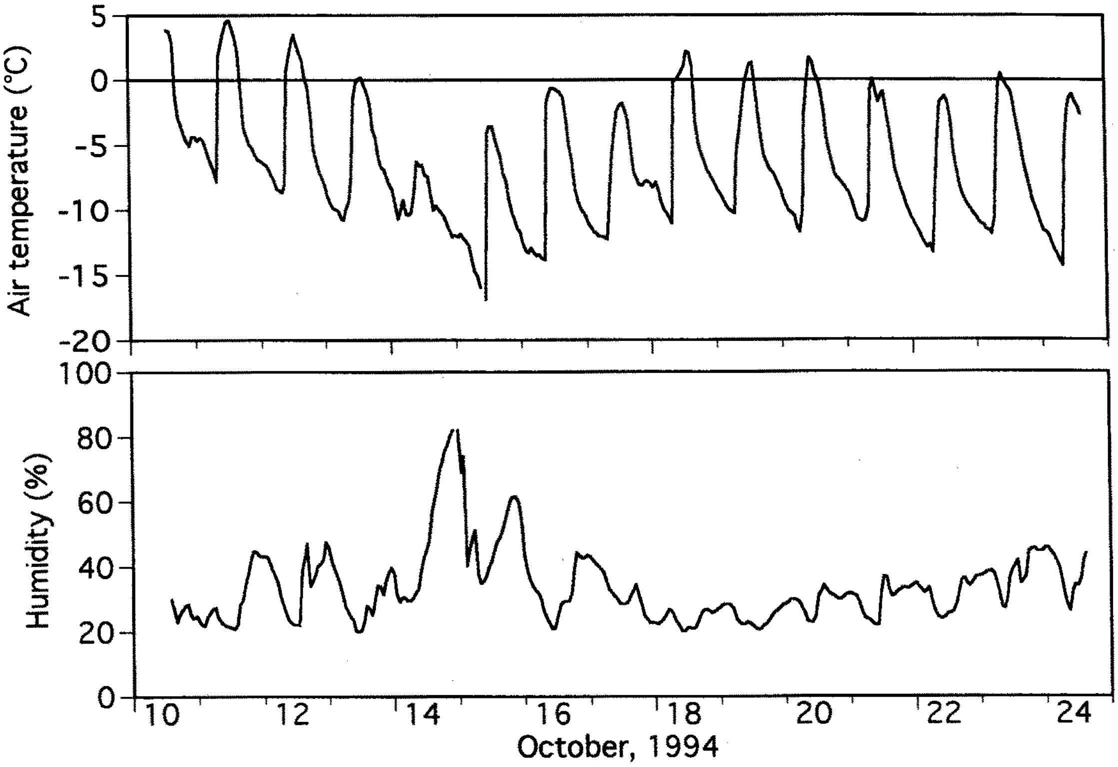

Fig. 7. Air temperature and humidity at Base Camp (5150 m a.s.l.) in October 1994.

weather observed at the Base Camp.

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