Flow of Glaciers in Hidden Valley, Mukut Himal*

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Abstract

Surface flow velocities of three glaciers in Hidden Valley, Nepal were measured from the end of July to the end of August, 1974. The Rikha Samba glacier, the largest one, moved 1-2 m/month and an unnamed glacier near Tukche Peak, the only debris-covered type glacier, showed movements of 0-0.5 m/month. But no movement was observed at all on a glacier-like ice mass close to the Rikha Samba glacier.

1. Introduction

A first look of Hidden Valley gives a strong impression that it is a dried area. It is thought that the reason for this dryness is the relatively small effect of the monsoon on the region. Glaciers lying in a dried area like Hidden Valley must show a different behavior from those in the Khumbu region where a larger effect of the monsoon is expected. For the purpose of comparing the glaciers in Hidden Valley with those in the Khumbu region where some glaciological studies had already been made, the glaciers in Hidden Valley were investigated as a part of the

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* Glaciological Expedition to Nepal, Contribution No. 12
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Surface flow velocity is one of the most important properties of a glacier. In this paper, the surface flow velocities of glaciers in Hidden Valley are discussed.

2. Glaciers in Hidden Valley

In Hidden Valley, there are eleven glaciers which are shown as G 1, G 2, ⋯, G 11 in Fig. 1. Although the number of debris-covered type glaciers, of which ablation areas are almost covered by debris, are one third of the total number of the glaciers in the Khumbu region (Moribayashi, 1974), most of the glaciers in Hidden Valley are of the clean type, of which the ablation area is not covered by debris. One exception is the unnamed glacier shown as G 2 in Fig. 1: most of the ablation area is covered by debris.

The altitudes of the snouts of the glaciers measured by the “Thommen Everest Pocket Altimeter” were corrected by using the equation obtained by Ageta and Higuchi (1975). Table 1 shows the corrected altitude of the snout and the area of each glacier in Hidden Valley. Even the largest glacier, the Rikha Samba glacier (shown as G 5) has only about 5 km² in area and the others are considerably smaller than those in the Khumbu region. The altitude of the glacier snout of the G 2 glacier, which is the only one of the dirty type, has the lowest altitude of 5043 m. This is also the case of glaciers in the Khumbu region where the height of the terminus of the dirty type glaciers is relatively lower than that of clean type glaciers. Generally speaking, the altitudes of the glaciers in Hidden Valley are relatively high compared with those in the Khumbu region.

There exist many snow patches around the glaciers. Some of them seem to be connected with a glacier and look like a kind of glacier.

3. Structure of the Rikha Samba glacier

The Rikha Samba glacier (Fig. 2) slightly curves convex westward and the marginal zone of the concave side was almost covered by debris. At the concave side of the glacier where debris did not cover the ice surface, there could be found many crevasses which cross each other orthogonally and terminate at the glacial margin at angles of around 45° and 135°. There were crevasses of another type in two areas slightly down-glacier from C line and D line (Fig. 4): transverse crevasses convex up-stream; this type of crevasses usually shows tensile flow (Nye, 1952).

Table 1. Glaciers in Hidden Valley

<table>
<thead>
<tr>
<th>name</th>
<th>type</th>
<th>altitude of the terminus (m above sea level)</th>
<th>area (km²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>G 1</td>
<td>clean</td>
<td></td>
<td>1.2</td>
</tr>
<tr>
<td>G 2</td>
<td>dirty</td>
<td>5043</td>
<td>2.2</td>
</tr>
<tr>
<td>G 3</td>
<td>clean</td>
<td>5292</td>
<td>0.6</td>
</tr>
<tr>
<td>G 4</td>
<td></td>
<td>5350</td>
<td>1.9</td>
</tr>
<tr>
<td>G 5</td>
<td></td>
<td>5245</td>
<td>4.8</td>
</tr>
<tr>
<td>G 6</td>
<td></td>
<td></td>
<td>2.4</td>
</tr>
<tr>
<td>G 7</td>
<td></td>
<td>5505</td>
<td>3.7</td>
</tr>
<tr>
<td>G 8</td>
<td></td>
<td>5527</td>
<td></td>
</tr>
<tr>
<td>G 9</td>
<td></td>
<td>5499</td>
<td>1.7</td>
</tr>
<tr>
<td>G 10</td>
<td></td>
<td>5421</td>
<td>0.2</td>
</tr>
<tr>
<td>G 11</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The cracks and crevasses found near the terminus of the glacier are shown in Fig. 3, which was made by the same method which had been used to map the unnamed glacier (Nakawo, 1976). The cracks and crevasses in Fig. 3 are similar to those of the spray type often found near the terminus of a glacier (Allen et al. 1960). The transverse cracks convex down-stream in the figure were not found at the end of July and was found at the end of August: they are considered to be formed in the period between the two observational times.

Elongated bubbles were not found in the glacier except at B 5, where the bubbles were elongated (0.5 × 0.5 × 4 mm) in the direction of the dirty line formed by debris along the boundary between G 4 and G 5. At A 4, however, the bubbles were circular (about 2 mm in diameter) though
the ice surface was also covered by debris there.

4. Flow of glaciers

Flow measurements were carried out on three glaciers. One is the Rikha Samba glacier (G 5), which is a clean type glacier and another is the unnamed glacier near Tukche Peak (G 2), which is a dirty type glacier. The other is a snow patch shown as S.G. in Fig. 1, which is located close to the Rikha Samba glacier and seemed to be connected with it as shown in the figure.

4.1 Method

A theodolite (GT-60 Theodolite, Sokki-sha) was usually set in such a way that the direction of the sighting was normal to the flow direction. Every several hundred meters along the line of sighting of the theodolite, stakes were set on the glacier surface: the distance and the inclination between them were measured by a measure tape and a clinometer respectively. After about one month, the theodolite was set at the same position as in the previous survey with the same direction of sighting. The distance and the inclination between stake which had been set the first time and a sighting line the second time were measured.

Since the exact location of the stake at first was not determined by this method, flow directions could not be obtained.

4.2 The Rikha Samba glacier

Five lines of stakes were set in the Rikha Samba glacier for flow measurements as shown in Figs. 3 and 4. A, B and C lines were located...
on the ablation area of the glacier and D and E lines are on the accumulation area. The stakes of each line were surveyed from the survey position with the same of the line, though the stakes of D line and E line were lined up from the same theodolite position D for operational reasons. As a result of this, the stakes of E line were lined at an angle of about 50° to the flow direction. The results of flow measurements of the glacier from 10 July to 25 August are shown in Figs. 3 and 4. The values in Fig. 4 show the monthly horizontal velocity along the assumed flow direction.

The surface flow velocity increases progressively down-glacier from around 100 cm/month at E line to around 180 cm/month at C line which was set near the firn line and decreases again down-glacier: it is about 80 cm/month at A line which was set near the terminus of the glacier. It is notable that the stake of B 5 which was set on the boundary between G 4 glacier and the Rikha Samba glacier (G 5) moved down about 40 cm/month.

4.3 The unnamed glacier near Tukche Peak

Two lines, H and I, were set on the ablation area of the unnamed glacier (G 2) near Tukche Peak (Fig. 5). Both H and I lines were located about 300 m and about 1200 m down-stream from the firn line respectively. The results estimated from the data of 18 July and of 19 August are shown in Fig. 5. Flow velocities of about 40 cm/month were observed in I line which was set up-stream while the stakes of H line down-stream moved little; H 2 showed a few meters backward movement. The relation between the flow and

Fig. 5. Flow velocity of G 2 glacier

Fig. 6. The snow patch near the Rikha Samba glacier
the structure of the glacier will be given in a following paper (Nakawo, 1976).

4.4. The snow patch

Four stakes were set about 20 m apart like a grid on the snow patch (Fig. 6) and two of them were surveyed twice. No movement was observed in the period from 10 July to 25 August at all. The distances between the four stakes had not changed in the duration either. It is said, therefore, that the snow patch is not a kind of a glacier but only a snow patch. The snout of this ice mass is closely connected under debris with the margin of the Rikha Samba glacier which was observed to flow. This might mean that the flow near the margin of the Rikha Samba glacier is almost zero or it is possible that there exists marginal dead ice in the Rikha Samba glacier.

References


