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SHORT CONTRIBUTION

Oxygen isotopic ratios of some Himalayan glaciers

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ABSTRACT

$\delta^{18}O$ in ice cores taken from two temperate glaciers, Changme-Khangpu (CK) and Nehnar, located in the eastern and the western Himalayas respectively, and in fresh precipitation and surface ice at different altitudes on the Changme-Khangpu glacier has been measured. The fresh precipitation in CK has $\delta^{18}O$ in the narrow range of $-19 \pm 2‰$ which is similar to the ice core values. $\delta^{18}O$ and dust concentration in Nehnar core is found to be variable. The $\delta^{18}O$ values lie in the narrow range of $-9.5 \pm 1‰$ in the upper 46 m section and the fluctuations increase in the 66–102 m section of the ice core.

1. Introduction

We report here $\delta^{18}O$ measurements in ice cores taken from two Himalayan glaciers. Nehnar, located in the Kashmir Valley (34°09′ N, 75°31′ E) in the western Himalayas is a small (3.4 km long and 0.35 km wide at the maximum) valley glacier extending over the altitude range of 3900–4700 m. Changme-Khangpu (CK) is another young and small valley type glacier located in the Sikkim valley (27°58′ N, 88°42′ E) in the altitude range of 4800–5500 m. It is 5.8 km long and drains into Tista river. The chronology and ice dynamics of these glaciers have been studied earlier (Bhandari et al., 1983; Nijampurkar et al., 1982).

2. Experimental details

In August 1979, a long ice core of 102 m was drilled at an altitude of 4170 m in the ablation zone of the Nehnar glacier by the Glaciology Division, Geological Survey of India, Lucknow. The main accumulation area of the glacier is situated at an altitude of 4480 to 4700 m, ending about 1 km upstream of the core site. The core was divided into 2 m sections and the samples were melted at the site, sealed in plastic bottles and brought to the laboratory.

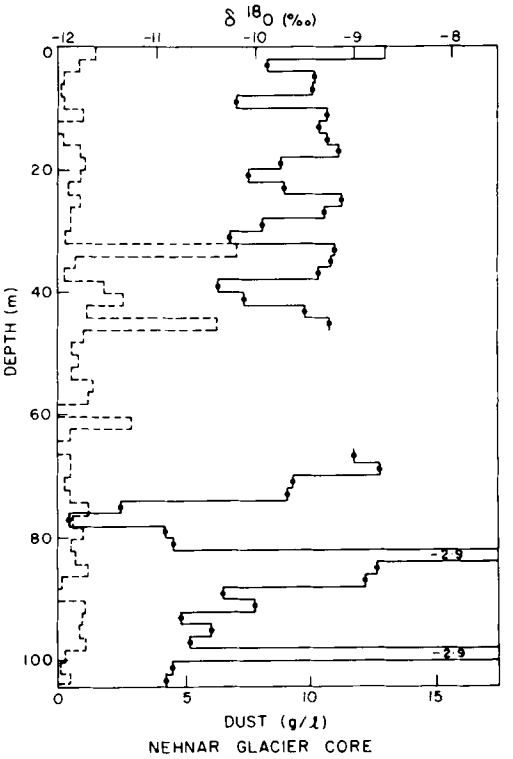

Fig. 1. $\delta^{18}O$ (solid line) and suspended dust (dotted line) as a function of depth in a 102 m core taken from the ablation zone of the Nehnar glacier. The snout ice value is $-8‰$.

A 12 m long ice core at an altitude of 5040 m was taken from the ablation zone of the CK glacier and 1 m sections of this core were melted in separate plastic bottles. 8 surface ice samples (each about 1 l) along the glacier axis were collected to cover the altitude range of 4950 to 5400 m. On August 28, 1978, there was a heavy snow fall all along the glacier. Within a day, 10 samples of this fresh snow were also collected at various altitudes on this glacier. The oxygen isotope analysis was performed from aliquots taken from these samples, in Copenhagen, Denmark. The values reported here are with reference to SMOW standard.

3. Results and discussions

The results of the $\delta^{18}O$ measurements in the 102 m core from the Nehnar glacier are shown in Fig. 1. The values in the upper strata (above 46 m) fluctuate within a narrow range of -9 and $-11‰$. The values below 60 m show larger fluctuations

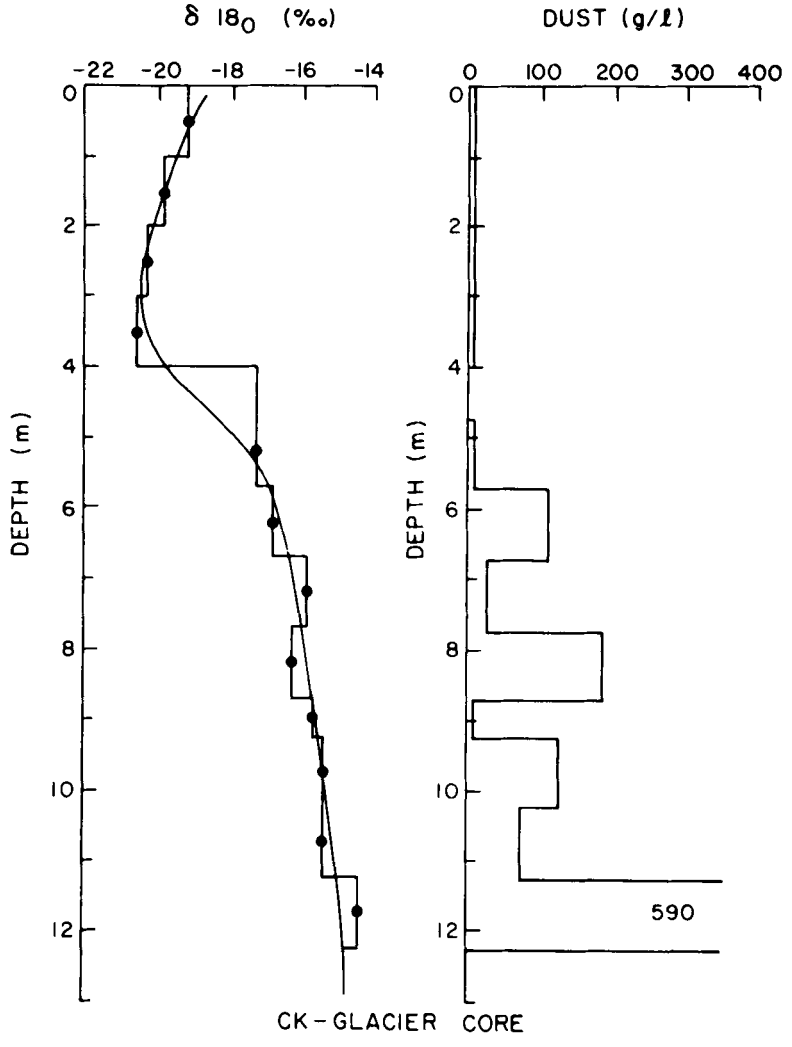

Fig. 2. $\delta^{18}O$ and suspended dust as a function of depth in the 12 m core taken from the ablation zone of the Changme-Khangpu glacier.

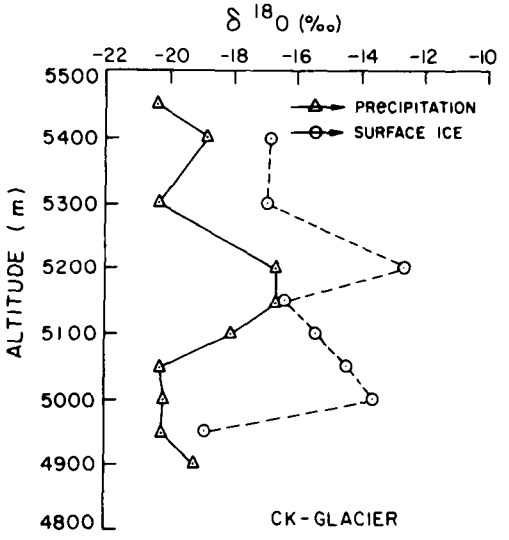

Fig. 3. $\delta^{18}O$ as a function of altitude in fresh snow and surface ice of the Changme-Khangpu glacier.

ranging between -3 and $-12‰$. There is no correlation of $\delta^{18}O$ with the dust content which is also shown in Fig. 1. The values in the upper strata (0–40 m) are significantly different from the snout ice value of $-8.5‰$ which is dated to be 500 years old (Bhandari et al., 1981). The values found in Alpine glaciers like Jungfraujoch ice cores (Schotterer et al., 1977) are similar to those observed in Nehnar.

The variation of $\delta^{18}O$ in the 12 m core of the CK glacier is shown in Fig. 2. The values in the 0–4 m section ($-20 \pm 1‰$) and in the 4–12 m section ($-16 \pm 2‰$) of the core appear to be different.

Fig. 3 shows the results of the analysis of the fresh snow and surface ice samples in the CK glacier. The fresh snow covering an altitude range of about 550 m shows $\delta^{18}O$ within a narrow range of $-19 \pm 2‰$. No systematic dependence of $\delta^{18}O$ on altitude is observed in the sampling range of 4900 to 5450 m, although some trends have been observed in the Alps and Greenland (Ambach et al., 1968, 1972). Our observations are consistent with those of Ambach et al. (1968) in the Alps and those of Wushiki (1977) on δD in the Himalayas, which do not indicate much altitude dependence in isotopic fractionation. The ice $\delta^{18}O$ values are somewhat higher at -12 to $-17‰$ compared to the values for fresh snow, but more observations are needed to establish such differences. The distribution of dust content in the cores of the Nehnar and CK glaciers is shown in Figs. 1 and 2. It is difficult to use these data, which mainly relate to the ablation zones, as climatic indicators because several complications like percolation and mixing of melt waters and ice erosion due to wind and rain occur in the temperate glaciers.

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