

Glaciological Studies in Schirmacher Oasis Cdml, East Antarctica, During 21st Indian Antarctic Expedition

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Abstract

Studies on the Ice shelf, polar ice and monitoring of the ice bergs have been a part of long-term glaciological data acquisition programme of Geological Survey of India ever since India launched her First Antarctic expedition in 1981. Observations made on the ice berg distribution in Antarctic waters, snow accumulation/ablation on the ice shelf and fluctuations in the polar ice margin are in agreement with the broad conclusions drawn using data accumulated over two decades.

Keywords: Ice bergs, Ice shelf, polar ice front, snow accumulation/ablation.

Introduction

The Antarctic Ices sheet and the Ice shelves which cling on to the continent represent a perpetual dynamic ice field and even slight shift global temperatures cause perceptible changes in the various parameters like snow accumulation/ablation, advance/retreat of the ice front and calving of ice shelf and generation of icebergs. In other words, such parameters are indicators of global warming phenomenon. Thus any amount of data acquired about changes in these parameters is useful, given the vastness of this icy continent.

Glaciological studies carried out by Antarctica Division of Geological Survey of India in the austral summer of 21st Indian Antarctic Expedition included a) ice berg monitoring during onward and return voyages, b) monitoring of the fluctuation of polar ice front, c) monitoring of ice shelf for snow Accumulation/Ablation studies and d) palaeo-shoreline studies.

Iceberg Monitoring

This ongoing assignment was taken-up on board-ship during voyage to Antarctica and back. The icebergs encountered during the onward and

return journeys were systematically monitored as to their locations, dimensions and morphological characteristics. This was done using visual means as well as radar of the ship. The first iceberg was sighted at $47^{\circ}47.8'$ South latitude and $16^{\circ}21.95'$ East longitude on 11th January 2002 in the Atlantic Ocean sector. This is the lowest southern latitude of iceberg sighting in last three expeditions. A total number of 310 icebergs of size ranging from 50m to more than 1000m were recorded. During return voyage the number of iceberg recorded was 196. The last iceberg sighted was at $48^{\circ}55.73'$ South latitude on 22nd March 2002. Size-wise distribution of the icebergs observed during onward and return voyages is given in Fig. 1. It has been observed that the icebergs' distribution in the Antarctic waters distinctly falls in two zones with an iceberg-free zone in between.

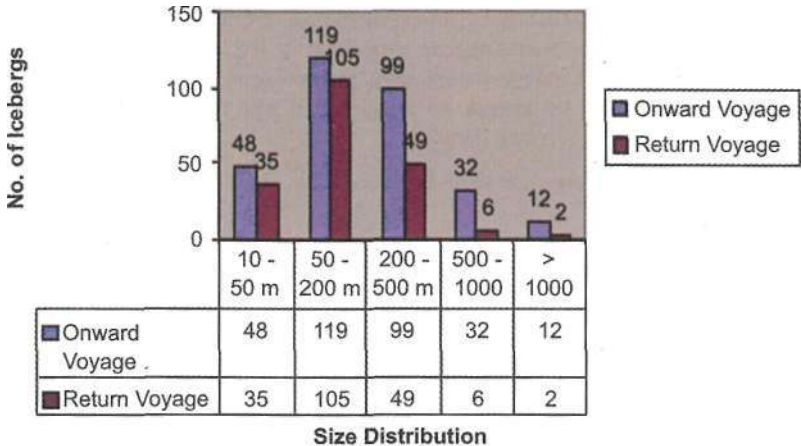


Fig. 1: Size-wise distribution of Icebergs during onward and return voyages

Monitoring of the Fluctuation of Polar Ice Margin

Since 1983, the polar ice tongue of Dakshin Gangotri Glacier Snout' in the central part of Schirmacher Oasis is being monitored to study nature of its fluctuation under a programme of global climatic change. Generally the retreat of the ice front occurs by way of melting of the ice front or by calving of the unstable portion of the ice front. Plotting the data against last year's observations on the snout suggests recession with varying magnitude at all reference points in one year. When compared with the data collected in 1996, the over all recession is of the order of m (Fig. 2 and Table 1).

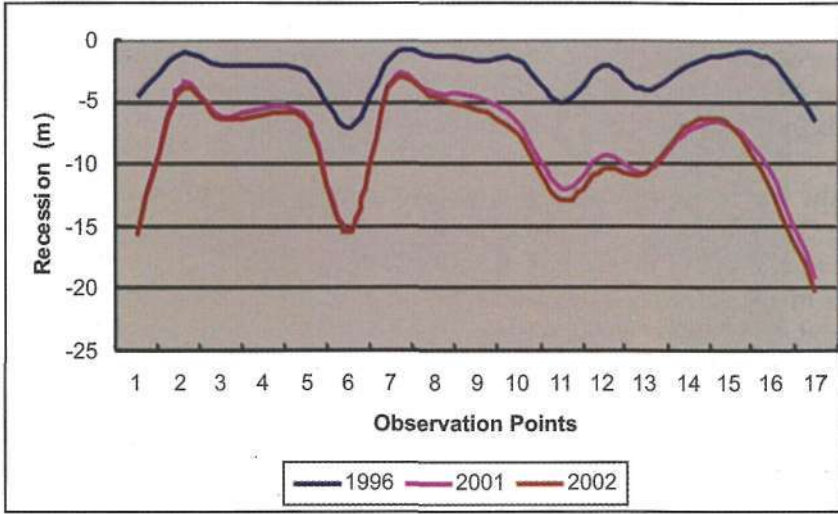


Fig. 2: Recession of Dakshin Gangotri glacial snout as compared to its position in 2001 and 1996

Table 1: Data on recession of DG glacial snout as observed in Feb. 2002

Observation Point	Recession (m)	Observation Point	Recession (m)
1	NA	7	6
2	11.25	8	7.96
3	3.1	9	8.35
4	4.35	10	6.59
4A	3.9	11	4.83
4B	4.05	12	NA
5	8.53	13	1
5A	2.3	14	10.77
5B	3.45	15	13.75
6	4.1		

In order to extend the monitoring of the polar ice front over a larger area, in the 20th IAE, observation points were marked along the southern margin of the Schirmacher for 9-line kilometers eastwards from western most point of Schirmacher and geographical co-ordinates for each of these points were recorded using a GPS. In all 18 observation points were fixed. The distances of the ice front from these observation points were then recorded to form the base-line data. During the present expedition,

observations could be made at only 9 points out of the above 18 points. However, these nine points were spread out more or less evenly over the 9 line-km of ice front (Table 2). Two new points of observation were added in the course of study. When this data was compared with the base line data collected in Feb. 2000, it was seen that there is general trend of retreat of the ice front by varying dimensions at all the points monitored (Fig. 3). At point no. 10, the unusual amount of 13.41 m retreat was largely due to collapse of the ice cliff (Fig. 4). Thus the conclusions drawn using data of the DG snout regarding the polar ice front's steady retreat is corroborated by the above observations.

Table 2: Data on recession of the polar IceFront as recorded in Feb. 2002

Observation Points	Recession (m)
XX2	1.06
XX3	0.95
XX4	0.78
XX7	2.53
XX8	2.50
XX9	1.72
XX10	3.30
XX11	1.84
XX13	1.58
XX14	1.02

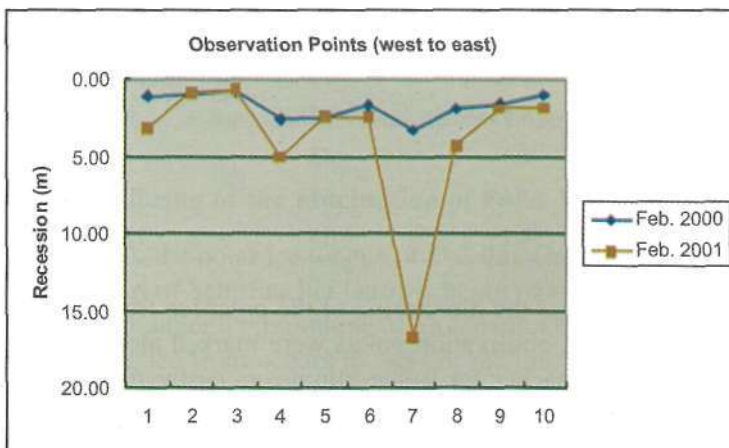


Fig. 3: Recession of Polar Ice Front as observed in the western part of Schumacher Oasis. Data of Feb. 2000 forms the base line



Fig. 4: Recession of Polar Ice Front by collapse of the ice cliff on the southern margin of Schirmacher Oasis

Snow Accumulation/Ablation Study on Ice Shelf

Monitoring of ice-shelf is being carried out by monitoring a network of stakes near Dakshin Gangotri station. Sixteen wooden stakes which were fixed during XVIII Indian Antarctic Expedition had got almost buried; hence in the month of November 2001, a new set of 16 - stakes network was fixed and initial measurements were recorded. The second observation of the stakes was done on 27th February of 2002; data on 13 stakes out of 16 could be recorded (Table 3). This data, when plotted against that of

Table 3: Data of Snow Accumulation/Ablation for the stake network on the Ice shelf

Stake No.	Height (m)	Height (m)
	on 27th Feb. 2002	on 18th Nov. 2001
2	2.32	2.35
3	2.355	2.45
4	2.375	2.4
5	2.355	2.3
6	2.355	2.35
7	1.79	1.85
8	1.54	1.68
9	2.51	2.5
10	2.56	2.45
11	1.905	1.85
12	1.82	1.9
13	1.73	1.7
14	1.66	1.75

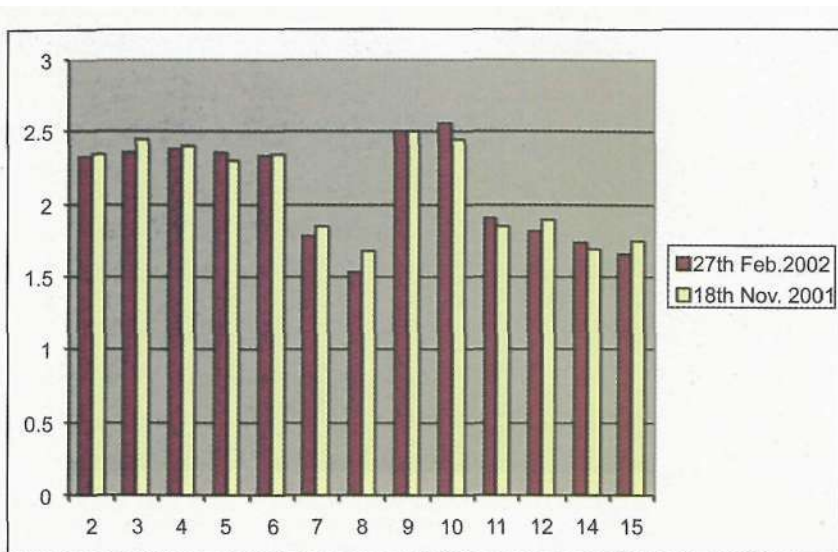


Fig. 5: Snow Accumulation/Ablation During Austral Summer of 2002 measured on the network of 16 stakes on the ice shelf. Data was available for only 13 stakes



Fig. 6: Ridge-like feature at the foot of cliff representing probable palaeo-shoreline, on the northern margin of Schirmacher Oasis

Nov. 2001, gives the pattern of snow accumulation/ablation on the ice shelf in the austral summer during the 21st Indian expedition. It is observed that out of 13 stakes for which data is available, snow accumulation is seen at 8 stakes; ablation is observed at rest of 5 stakes (Fig. 5).

Palaeo-shore line Studies

During the last glacial maximum (LGM), Schirmacher Oasis was under thick sheet of continental ice. This is evidenced by the presence of polished rock surfaces, striations and grooves throughout Schirmacher including the highest point 'Trishul' (212 m). At the end of last glacial epoch, when the glacial cover retreated, the Schirmacher started rising due to isostatic rebound and is continuing. This slow and steady rise has resulted in development of cliffs and parallel ridge-like features at many places at the base of the cliffs, along the northern margin of Schirmacher (Fig. 6). Detailed studies were carried out on these features which may represent palaeo-shore line.

The escarpments on the northern margin of Schirmacher generally rise to a height of 70-80 m above m.s.l. At the base of escarpment there are at least three discernable parallel ridges that run parallel to the coast. Each ridge is about 5 m high and is separated from other by a narrow depression. The ridges are made up of possible marine sand and glacial talus rolling down from the cliff tops. The glacial material is composed of angular blocks of size ranging from 10cm to 100 cm. The sediment fraction occupies the interstitial space between the angular fragments. The sediment fraction consists of both sand and clay sized particles.

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