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ABSTRACT

Shallow ice core samples near *Dakshin Gangotri* Station Antarctica from the transition zone between the inland polar ice and shelf ice were studied for ^2Pb , ^3Cs , ^8O and Thermoluminescence (TL) of trapped dust in ice layers. The total B activity shows a small peak around 15 m but ^{13}Cs activity is below the detection limit in all the samples. The lead 210 activity indicates an average fallout in the range 1.1 ± 0.3 dpm/L in various samples. The vertical profile of ^8O in 3 m ice core ranges between -17.2 to -21.5‰ indicating a mean annual surface air temperature of 9°C at the time of deposition. Natural thermoluminescence levels of the trapped dust are smaller than the geological levels consistent with data obtained earlier.

INTRODUCTION

Shallow ice core samples were collected near *Dakshin Gangotri* Station, from a location situated 40 km inside the shelf, by the second Indian Expedition to Antarctica during January-February 1983. The samples were brought in frozen condition to Goa and then air lifted to Physical Research Laboratory, Ahmedabad in specially fabricated boxes (cooled by dry ice) for analysis. The ice samples were studied for natural and artificial radio activity, ^3Cs , ^2Pb , Stable Isotope ^8O and Thermoluminescence (TL) of trapped dust in ice layers. These data are compared with the findings in samples collected by the first Indian Expedition to Antarctica (Bhandari *et al* 1984).

SAMPLE COLLECTION AND EXPERIMENTAL PROCEDURES

A 3 metre deep ice core was collected by Geological Survey of India team from the transition zone (70° 20' S, 12° E) between the inland polar ice and shelf ice. This sample represents an important physical form of ice in Antarctica which is expected to be different than the ice shelf samples collected during the first Indian Expedition at 70° S 12° E. The core raised using 'SIPRI' ice corer was cut into five samples and processed in a clean, dust free room for isotopic analysis. The procedures used have been described earlier (Nijampurkar *et al* 1982, Nijampurkar and Bhandari, 1984). The measurements were made using low background (1.2 cph) GM detectors with NaI (TI) anticoincidence shield (Bhandari, 1969) and high purity Ge detectors (Shukla *et al* 1983) with a view to identify the nuclear debris produced, if any, from the past nuclear explosions and to find the natural variation in ^2Pb fallout. The trapped dust separated using millipore filters was used for TL analysis (Bhandari *et al* 1983). One fraction of the ice core C2/1A, during processing is shown in Fig 1.

RESULTS AND DISCUSSIONS

Radioactivity in ice core samples

Total B activity and ^2Pb activity are good time markers for dating ice samples.

The total B activity ranges from 0.5 to 2.5 dpm/L (Table I) and a small peak was observed around 1.5 m depth (Fig 2a) which is higher by a factor of five than the deepest sample. This probably represents natural levels as is also supported by ^3Cs analysis which is below the detection levels (0.3 dpm/L) in the samples (Table I).

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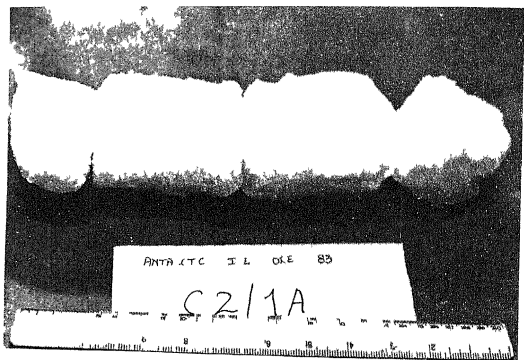
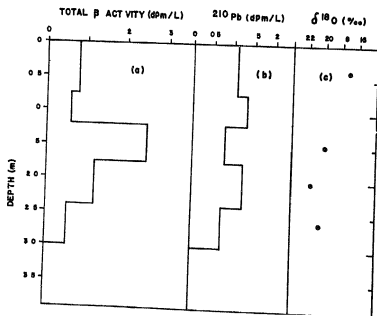


Fig J Antarctic ice core (C2/1A)



**2 VaanonfoaBacvy Pb and $\delta^{18}\text{O}$ with depth

Lead 210 activities in these samples (Tables I) ranged from 0.7 to 1.3 dpm/L indicating a fallout value in the range of 1.1 ± 0.3 dpm/L which is consistent with the earlier findings.

TABLE I
Radioactivity in ice core samples

Sample	Depth (m)	Water processed (L)	Total α -activity		^{137}Cs dpm/L	^{210}Pb activity	
			cpm	dpm/L		cpm	dpm/L
C2/1	0-0.75	0.895	0.08±0.10	0.79±0.10	ND	0.11±0.02	1.07±0.2
C2/1A	0.75-1.20	0.560	0.06±0.01	0.61±0.01	ND	0.08±0.02	1.33±0.24
C2/2	1.20-1.75	0.615	0.18±0.01	2.49±0.19	ND	0.08±0.04	0.79±0.43
C2/3	1.75-2.35	0.645	0.08±0.01	1.15±0.14	ND	0.10±0.04	1.26±0.49
C2/4	2.35-3.00	0.940	0.08±0.02	0.5 ±0.01	ND	0.08±0.01	0.72±0.08

ND Not Detectable

$\delta^{18}\text{O}$ in ice core samples

The isotopic composition ($\delta^{18}\text{O}$) was measured with reference to Standard Mean Ocean Water (SMOW) using a micromass spectrometer which ranged from -17 to -21.5‰ and does not show a systematic trend with depth (Fig. 2c). The surface sample, however, shows a less depleted value of $\delta^{18}\text{O}$ compared to the other samples. Oxygen isotope ratio is a good climatic indicator, particularly for the Polar Region and suggests that the mean annual surface air temperature (MASAT, Dansgaard, 1964) at the time of deposition could be around -9°C . This is consistent with the earlier findings on Antarctica (Bhandari *et al.*, 1984).

Thermoluminescence of dust in ice layers

Dust trapped in the ice layers of the core have been studied using sediment TL dating procedure (Bhandari *et al.*, 1983). These samples satisfy the basic criterion of predepositional sun bleaching and the good plateau characteristics. The preliminary observations on sediment equivalent dose D(Id) are found to be 490 and 600 rads (Table II). The results suggest that the values are much lower than geologic TL and confirms a recent TL bleaching event. The data can be used for dating the time of deposition when the dose rate and residual TL can be estimated accurately.

TABLE II
Thermoluminescence data on Antarctic dust samples

Sample No.	Plateau Region (C)	D (Inat) (rad)	R	D(Id) (rad)	D(Id) mean rad	Remarks
PRL.TL:G:ANC-1	340-400	1490	0.67	490	490 (120)	OW + HCl
PRL.TL:G:ANC-4	320-380	1540	0.57	615	600 (100)	OW + HCl

In view of the fact that in general a glow curve is a composite of many glow peaks - D (Inat), R and D (Id) refer to a particular glow curve temperature in the plateau region Mean D(Id) represents the average value over the plateau region. The estimates in parenthesis indicate the scatter around the mean in the plateau region. OW indicates organic wash.

R= Fraction of unbleachable to natural T.L. and D(Inat) is natural equivalent Dose,

SUGGESTIONS FOR FUTURE WORK

It is desirable to raise longer ice cores (atleast 30-50 metres in the beginning) in the future expeditions to understand past climatic records, accumulation rates and deposition of windborne as well as extra-terrestrial matter.

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