

## IONIC CONTENT OF ANTARCTIC ICE SAMPLES

BY ERNEST E. ANGINO,\* KENNETH B. ARMITAGE† AND  
JERRY C. TASH†

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During the past few years, interest in the physicochemical properties of ice has expanded considerably (Gorham, 1958; Sugawara, 1961; Coachman, Hemmingsen & Scholander, 1956; Langway, 1962). Little, however, is known of the chemical composition of precipitation in the polar regions or of the chemical composition of different types of ice. Consequently, it is thought that the following information, compiled as a part of a much larger chemical study of several Antarctic lakes, might be of some interest to students of chemical meteorology and to those workers investigating the physical properties of ice.

*Sampling and methods.* The samples of glacier ice were chipped from the face of both the Taylor Glacier and Wilson Piedmont Glacier, situated in Taylor Glacier Dry Valley and Wright Valley respectively. Melt water samples were collected from small streams draining away from the face of these glaciers. Data from Lakes Bonney (B1, B2, B3) and Vanda (V) and Fryxell (F) are from cores cut in the 4.2 m ice cover of the respective lakes and later melted down (Angino, Armitage and Tash, 1962, 1964). Analytical methods employed in the chemical analyses are described in Angino, Armitage and Tash (1964). Data on the melt water samples from Wright and Taylor Glaciers are from Keller and Reesman (1963). The data, when expressed as equivalent parts per million (epm), do not sum to zero because all samples were not analysed completely and some major ions probably present were not determined in some samples.

*Results.* All the data are presented in Table 1. The pH of the melted ice samples was measured in the field as soon as possible after sampling, and ranged from 6.4 to 7.2. The dominant ion present in all instances, with the exception of the Taylor Glacier melt water sample, was chloride. Sodium was the predominant cation in the ice of Taylor Glacier. Calcium was the predominant cation in the other sample from Lake Bonney, from the melt water of Taylor Glacier and from the ice of Wilson Piedmont Glacier. Curiously, calcium was not detected in the run off from Wilson Piedmont Glacier and sodium was the predominant cation. In general, there is a marked decrease in ionic content of run off in comparison to the ionic content of melted ice.

Although little correlation exists between the ratios of NaCl, MgCl, CaCl and KCl for sea water and the included salts in the ice, a marine origin for part of the included salts is considered likely (Hamilton, Frost and Hays, 1962). Most of the other constituents probably came from soil dust blown to the site of deposition or, in the case of lake-ice samples, from salts thrown down and incorporated

\* Department of Oceanography and Meteorology, Texas A & M University.

† Department of Zoology, University of Kansas.

Table 1. *Chemical analyses of Antarctic ice samples*

Sample ... ..	*F	*V	*B1	*B2	*B3	TGI	TGM	WPI	WPM
Date ... ..	19 Nov. 61	18 Nov. 61	29 Oct. 61	2 Nov. 61	3 Nov. 61	2 Dec. 61	2 Dec. 61	8 Jan. 62	8 Jan. 62
	Content (ppm)								
PO <sub>4</sub>	0	0	0	0	0	16	0	0	0
NO <sub>3</sub>	0	0.04	0.01	0	0	0	0	0	0
HCO <sub>3</sub>	0	10	4	0	0	50	ND	12	ND
SO <sub>4</sub>	0	0	0	0	0	38	ND	0	ND
Cl	40	400	1000	ND	< 35	561	5-10	< 14	ND
SiO <sub>2</sub>	0	0	0	ND	0	4	0.4	0	ND
B	0	0	0	0	0	0	0	< 0.5	< 0.5
Al	0	ND	ND	ND	ND	ND	0.09	0	0.03
Fe	0	0	0	0	0	0	0	0	0
K	0	ND	< 1	~1.0	< 1	0	1.1	4	0.4
Na	0	ND	2	14	14	0	7.0	6	2
Ca	0	ND	6	8	2	20	18	7	0
MG	0	ND	1	6	10	104	1	< 1	< 1
pH		7.15	ND	7.2	6.4	7.1	7.0	7.0	7.0
Conductivity	230	1543	200	ND	200	2200	ND	76	ND

\* Ice core from 4.5 m ice cover on the lakes ND = Not determined.

F = Lake Fryxell—77° 38' S, 163° 04' E; V = Lake Vanda—77° 32' S, 161° 30' E; B = Lake Bonney—77° 43' S, 162° 25' E; TGI = Taylor Glacier Ice (melted down); TGM = Taylor Glacier Melt (runoff at foot of glacier); WPI = Wilson Piedmont Glacier Ice (melted down from Wright Valley tongue of Wilson Piedmont Glacier); WPM = Wilson Piedmont Glacier (run off at foot of glacier).

into the ice during rapid-freezing of the lake water. The rather high value of orthophosphate ( $\text{PO}_4$ ) in one sample (TGI) tends to support the anomalous phosphate values reported for Antarctic ice samples from the "Syowa" area (Sugawara, 1961). Two widely distributed anions, nitrate and carbonate, were not detected in any sample. Likewise the deficiency of  $\text{SO}_4$  is striking. The mechanisms controlling the distribution and presence of the respective ionic species in the different types of ice are still obscure. It is not our purpose here to discuss the mechanisms controlling the distribution and presence of specific elemental species in different types of ice. We wish only to present these data which in the hands of the appropriate investigators may furnish a clue to those mechanisms.

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