

INTERNAL REPORT 48

CHEMICAL ANALYSIS OF FINDLEY LAKE SNOWPACK

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ABSTRACT

On 20 March 1972 three snow cores and one surface snow sample were taken on the Findley Lake watershed to obtain a preliminary estimate of the elemental composition of the snowpack. Variation in chemical composition with depth and between forested and open areas was also investigated. Data from Ca^{2+} , Mg^{2+} , Na^+ , K^+ , $\text{Fe}^{2+,3+}$, Al^{3+} , Si^{4+} , and $(\text{PO}_4)^{3-}$ analyses are reported.

PROCEDURE

Sampling

Snow samples were taken at four locations on the Findley Lake watershed for chemical analysis. The first was a surface sample collected from under the tree canopy 15-30 m upslope from the southern shore of Findley Lake. The sample was a composite from several areas, but none of the sample was taken from more than 5 cm below the snow surface. Three samples were taken using a 4.12-cm-diameter Mount Rose snow tube. Cores one and three were taken under forest canopy and core two was from an open meadow, all on the east side of Findley Lake. No samples were taken from the floating snow on the lake surface. All samples were wrapped in plastic and aluminum foil in the field and transported to the laboratory frozen. If future Al analysis is contemplated, the samples should be placed in the bags, then wrapped in foil, whereas most of these samples were wrapped in foil, then placed in plastic bags.

Laboratory

All samples were kept in a walk-in freezer until they were analyzed. When they were removed from the freezer and unwrapped, they were placed in covered liter volumetric cylinders and allowed to melt at room temperature. Each sample was then filtered through a tarred Whatman 24 filter paper which was subsequently oven-dried and weighed. Several "blank" filter papers were also dried to test for weight loss upon drying.

An Instrumentation Lab. 320 atomic absorption spectrophotometer was employed for analysis of Ca^{2+} , Mg^{2+} , Na^+ , and K^+ , and a Bausch and Lomb Spectronic 70 spectrophotometer was employed for $\text{Fe}^{3+,2+}$, Al^{3+} , Si^{4+} , and P^{3-} analyses. Snow sample aliquots of 20 ml, plus 1 ml each of 4000 ppm La and Cs made to a volume of 25 ml, were used for the AA analysis. Iron, Al^{3+} , and Si^{4+} were determined on 30-ml aliquots in 50-ml volumes, and P^{3-} on a 20-ml aliquot in 25 ml final volume. The orthophenanthroline method of Jackson (1956) was used for Fe at 530 μm , Al was determined by the aluminon method of McLean (1965) at 530 μm , and Si was determined by the molybdosilicate yellow method of Jackson (1958) at 400 μm . Phosphorus was determined by the sulfomolybdic stannous chloride method of Jackson (1956) at 730 μm .

RESULTS AND DISCUSSION

Table 1 is a summary of the data by snow core. Each 76-cm (30-in.) increment was analyzed separately. Snow density was uniform throughout the cores, with the exception of the lowermost segment of core two. This may be an artifact produced by compaction when the core was taken. At the time the cores were taken, the precipitation in the area was mixed rain and snow. The rainfall as well as natural settling caused the high snow density.

Only core three and the grab sample showed a significantly higher surface concentration of solids than did cores one and two. There were no trends in the solids concentration with depth in the three cores. Solids in snow are from two sources, dust carried down with the precipitation and litterfall from trees. Higher concentrations of solids were expected under the forest canopy but, except for the grab sample, such higher concentrations were not consistently shown by these data. The grab sample had the highest concentration of solids because it was a surface sample and the solids were not diluted by "clean" snow from below the surface. Snow cores one and three from under the forest canopy had a higher concentration in the surface segments than did core two from the meadow. In all three cores higher solids concentrations were found in the deepest segment. This was probably caused by contamination of the sample with surface litter at the base of the snowpack. Cores one and three from the woods had higher overall sediment concentration than did core two.

Eight elements were found to occur in the following order of abundance: Na^+ > Si^{4+} = K^+ >> $(\text{PO}_4)^{3-}$ > Ca^{2+} > Al^{3+} = Mg^{2+} > $\text{Fe}^{3+,2+}$. Table 2 shows the means and standard deviation for each segment and for the total of all segments for each element. It is not surprising to note the wide variation within the cores and between cores. There was no apparent relationship between the elemental concentration of the surface segment or total core and the solids concentration. Thus it appears that the influx of these elements is a function of the elemental composition of the precipitation rather than the presence or absence of canopy at the collection site.

More sampling is needed to verify these trends statistically. Two snow courses, one through the woods and one across the open lake, would be helpful in achieving this end. It is apparent that the snowpack contains a significant nutrient load, and that one of the major nutrient losses from the watershed may occur as snowmelt runoff.

REFERENCES

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- JACKSON, M. L. 1958. Soil chemical analysis. Prentice-Hall, Inc., Englewood Cliffs, N.J. 498 p.
- McCLEAN, E. O. 1965. Aluminum. C.67. IN: C. A. Black (ed.), Methods of soil analysis, Part 2. Monograph 9, American Society of Agronomy, Inc., Madison, Wisc.

Table 1. Chemical and physical characteristics of Findley Lake snow samples.

Sample No.	Depth (cm)	Solid	Liquid	Snow	Weight		Concentration							
		Volume (cm ³)	Volume (cm ³)	Density (g/cm ³)	of Solids (g)	of Solids (g/cm ³)	Na (µg/ml)	Si (µg/ml)	K (µg/ml)	P (µg/ml)	Ca (µg/ml)	Al (µg/ml)	Mg (µg/ml)	Fe (µg/ml)
SG-1	0-5	NM ^a	1510	NM ^a	0.5178	0.34	1.32	0.46	1.37	0.03	4.65	0.08	0.16	<0.10 ^b
SC-11	0-76	1013	430	0.42	0.0330	0.07	1.18	0.33	0.46	0.15	0.18	0.15	0.12	<0.10
SC-12	76-152	1013	480	0.47	0.0472	0.09	1.37	0.99	0.40	0.53	0.13	0.23	0.12	<0.10
SC-13	152-192	533	230	0.43	0.0705	0.30	0.65	0.16	0.56	0.03	0.36	0.03	0.21	<0.10
SC-21	0-76	1013	480	0.47	0.0178	0.03	1.97	0.99	0.65	0.97	0.18	0.25	0.21	<0.10
SC-22	76-152	1013	480	0.47	0.0210	0.04	1.10	0.33	0.77	0.06	0.13	0.00	0.08	<0.10
SC-23	152-228	1013	450	0.44	0.0168	0.03	0.37	0.26	0.28	0.02	0.11	0.18	0.15	<0.10
SC-24	228-261	440	290	0.65	0.0614	0.20	0.15	0.09	0.25	<0.01 ^c	0.16	0.03	0.07	<0.10
SC-31	0-76	1013	490	0.48	0.1227	0.25	0.18	0.43	0.36	0.01	0.12	0.12	0.07	<0.10
SC-32	76-152	1013	440	0.43	0.0374	0.08	0.23	0.53	0.25	0.01	0.10	0.18	0.07	<0.10
SC-33	152-250	1306	430	0.32	0.0456	0.10	0.21	0.19	0.27	0.10	0.08	0.12	0.07	<0.10

^aNM = not measured.

^bLower limit of detection = 0.10 µg/ml.

^cLower limit of detection = 0.01 µg/ml.

Table 2. Statistical analysis of Findley Lake snow core data.^a

Core No.	N ^b	Snow Density		Solids Conc. (g/l)		Na (µg/ml)		Si (µg/ml)		K (µg/ml)		P (µg/ml)		Ca (µg/ml)		Al (µg/ml)		Mg (µg/ml)	
		Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
1	3	0.05	0.02	0.15	0.13	1.06	0.37	0.49	0.47	0.47	0.08	0.24	0.31	0.22	0.12	0.13	0.10	0.15	0.05
2	4	0.03	0.02	0.07	0.08	0.89	0.82	0.41	0.55	0.48	0.26	0.26	0.53	0.14	0.03	0.11	0.14	0.12	0.06
3	3	0.07	0.04	0.14	0.09	0.20	0.02	0.38	0.70	0.29	0.05	0.04	0.65	0.10	0.02	0.14	0.18	0.07	0.0
All Seg-10 ments						0.74	0.71	0.43	0.86	0.42	0.73	0.18	0.80	0.15	0.07	0.12	0.80	0.11	0.71

^a Analyses were made for Fe in all cores, but amounts were too low to show measurable results.

N^b = number of core sections.