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THE LRTAP MONITOR RIVERS IN NEWFOUNDLAND: CHEMICAL STATUS DURING 1984, 1985 AND 1986

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MANAGEMENT PERSPECTIVE

Nine rivers on the Island of Newfoundland are sampled several times a year as part of the LRTAP monitor program.

Over the years 1984, 1985 and 1986, no trends are observable in weathering rates, pH, DOC, or excess sulfate concentrations.

PERSPECTIVES-GESTION

Tous les ans, dans le cadre du programme de surveillance du TGDPA, des échantillons sont prélevés à plusieurs reprises dans neuf rivières de Terre-Neuve.

En 1984, 1985 et 1986, aucune tendance n'a été relevée en ce qui a trait au taux de dégradation, au pH, à la DCO et à la concentration de sulfate en excès.

ABSTRACT

Nine rivers on the Island of Newfoundland are sampled several times a year. Evaluation of the data for 1984, 1985 and 1986 shows no significant trends in weathering rates or in pH.

The pHs of these rivers are generally higher than those of the LRTAP monitor rivers in Nova Scotia, and the sulfate and DOC concentrations lower.

RESUMÉ

Chaque année, des échantillons sont prélevés à plusieurs reprises dans neuf rivières de Terre-Neuve. Les données recueillies en 1984, 1985 et 1986 ne montrent aucune tendance significative du taux de dégradation ou du pH.

Le pH de ces rivières est généralement plus élevé que celui des rivières néo-écossaises jaugées dans le cadre du programme de surveillance du TGDPA, tandis que les concentrations de sulfate et la DCO sont plus faibles.

INTRODUCTION

There are nine LRTAP monitor rivers on the Island of Newfoundland. These rivers, their Water Survey of Canada (WSC) station codes, the locations of the gauges, annual runoff for 1984, 1985 and 1986, and the sizes of their drainage areas are shown in Table 1.

These rivers are sampled less frequently than those in Nova Scotia, probably mainly because of difficulty of access.

Chemical analyses are performed at the Moncton, N.B. laboratory of the Water Quality Branch, Atlantic Region. The analytical methods used are state of the art, and are briefly described as follows: pH is measured with a glass electrode in the laboratory; Ca^{++} and Mg^{++} are done by automated atomic absorption spectrophotometry; Na^{+} and K^{+} are done by automated flame photometry with internal standards: Cl^{-} was measured with a specific ion electrode until mid 1985 when a shift was made to ion chromatography. Sulfate is measured by ion chromatography (IC) and also by the colorimetric methyl thymol blue (MTB) indicator method which is positively biased by organic matter and is considered to incorporate some organic matter at a pH of 12 reached during the procedure. Dissolved organic carbon (DOC) is measured colorimetrically (NAQUADAT Code: 06107); extractable Fe is done by atomic absorption by direct aspriation; and extractable Al is done by atomic absorption with solvent extraction.

For each year (1984-1986), the number of samples, the mean annual discharge weighted sum of cations ($Ca^{++} + Mg^{++} + Na^{+} + K^{+}$, corrected for seasalt) (DWSU+), the mean annual pH, and excess SO_4^{--}, DOC, Al, and Fe concentrations are shown in Tables 2, 3 and 4.

DISCUSSION

The nine LRTAP monitor rivers on the Island of Newfoundland range from those with very soft water such as the Isle aux Morte (DWSU+ ranges from 65.7 to 92.8 μeq L^{-1} over the three years) and the Grey (DWSU+ ranges from 42.9 to 96.7 μeq L^{-1}) to the very hard water Harrys River (DWSU+ ranges from 1180 to 1510 μeq L^{-1}). The pHs of all of these rivers are generally higher than those of the LRTAP monitor rivers in Nova Scotia (Thompson, 1988), and their mean sulfate concentrations are generally lower because of their more remote location. The rivers that drain the Long Range Mountains along the northwest coast receive both higher amounts of precipitation and higher rates of sulfate deposition due to orographic effects (Thompson, 1987). These are the Torrent, Harrys and the Isle aux Morte Rivers. The rivers along the southern coast, the Grey, Garnish, Pipers Hole, and Rocky, also receive high amounts of precipitation as evidenced by their high runoffs (Table 1), but lower rates of sulfate deposition either because they lie in the lee of the Long Range Mountains or because most of the precipitation events reaching their watersheds have a maritime origin.

The DOC, extractable Al, and extractable Fe concentrations are also generally lower (Tables 2, 3 and 4) than in the Nova Scotia rivers (Thompson, 1988). If complexing by organic matter is most responsible for transportation of Al, Fe, and perhaps other metals, then the lower Al and Fe concentrations are in accord with the lower DOC concentrations.

The apparent CO_2 pressures, calculated from pH and alkalinity (not shown) are also lower than in the Nova Scotia rivers, although they are still higher than atmospheric CO_2 pressures. The lower CO_2 pressures may be due to longer travel times for the samples from Newfoundland, but the lower DOC concentrations may also be partly responsible. It has been shown (Thompson, 1988) for organic rich waters in Nova Scotia, that titratable organic matter may be included in the alkalinity titration, and that if all such alkalinity is assumed to be bicarbonate ion, the calculated CO_2 pressure will be high. The lack of this effect in the Newfoundland rivers may explain the lower calculated CO_2 pressures.

In general, then, the chemistry of the rivers in Newfoundland is more nearly 'normal' than is that of the rivers in Nova Scotia whose water chemistry and several of the analytical procedures used are affected by organic matter.

SUMMARY AND CONCLUSIONS

Evaluation of the data for the nine LRTAP monitor rivers on the Island of Newfoundland for the years 1984, 1985 and 1986, reveals no significant trends in weathering rates, excess sulfate concentrations, or pH.

The rivers in Newfoundland contrast with those in Nova Scotia by having generally lower DOC and excess sulfate concentrations and higher pHs.

Table 1. The LRTAP Monitor Rivers in Newfoundland, their WSC Station Codes, the locations of the gauges, annual runoff in 1984, 1985 and 1986, and the size of the drainage areas.

River	WSC Station Code	Deg.Min.Sec Lat N	Lon W	1984 m yr^{-1}	1985 m yr^{-1}	1986 m yr^{-1}	Drainage Area km^2
Torrent	02YC001	50-36-27	57-09-04	1.38	1.23	0.879	624
Harrys	02YJ001	48-34-31	58-21-48	1.32	1.07	0.941	640
Indian Br.	02YM001	49-30-43	56-06-45	0.594*	0.440*	0.499*	974
Exploits	02YO001	48-55-50	55-40-07	1.11	0.619	0.660	8,460
Isle aux Morts	02ZB001	47-36-50	59-00-33	2.05	1.83	1.58	205
Grey	02ZD002	47-44-35	55-56-05	1.56	1.12	1.19	1,340
Garnish	02ZG001	47-12-50	55-19-45	1.40	1.16	1.54	205
Pipers Hole	02ZH001	47-56-49	54-17-08	1.24	0.764	1.02	764
Rocky	02ZK001	47-13-29	53-34-06	1.25	1.05	1.36	285

* Flow diverted

Table 2. Number of samples, mean sum of cations, pH, excess SO_4^{--}, DOC, Al, and Fe for the LRTAP monitor rivers in Newfoundland, 1984.

River	n	DWSU + $\mu eq\ L^{-1}$	pH	Ex.SO_4^{--} $\mu eq\ L^{-1}$	DOC $mg\ L^{-1}$	Al $\mu eq\ L^{-1}$	Fe $\mu eq\ L^{-1}$
Torrent	4	277.0	7.0	47.0	4.9	11.1	6.3
Harrys	10	1210.0	7.7	48.4	3.2	2.6	3.4
Indian Br.	10	197.0	6.9	26.5	6.1	9.9	8.5
Exploits	11	167.0	6.5	43.3	5.7	7.0	5.9
Isle aux Morts	5	65.7	6.0	31.9	5.0	11.0	6.4
Grey	7	96.7	6.3	28.9	4.9	11.2	8.0
Garnish	5	134.0	6.4	24.4	7.0	12.7	10.1
Pipers Hole	8	92.0	6.5	20.2	5.2	6.3	10.6
Rocky	10	100.0	6.3	17.6	7.7	8.7	13.2

Table 3. Number of samples, mean sum of cations, pH, excess SO_4^{--}, DOC, Al, and Fe for the LRTAP monitor rivers in Newfoundland, 1985.

River	n	DWSU + $\mu eq\ L^{-1}$	pH	Ex.SO_4^{--} $\mu eq\ L^{-1}$	DOC $mg\ L^{-1}$	Al $\mu eq\ L^{-1}$	Fe $\mu eq\ L^{-1}$
Torrent	3	356.0	7.1	65.6	6.0	11.9	8.2
Harrys	5	1510.0	7.9	56.8	2.5	1.8	2.7 - n=2
Indian Br.	8	245.0	6.9	33.1	5.9	10.6	8.6
Exploits	4	190.0	6.2	88.1	7.9	8.7	5.1
Isle aux Morts	5	92.8	6.1	42.9	5.0	11.0	6.6
Grey	4	52.1	6.2	36.0	5.2	11.0	7.4
Garnish	4	109.0	6.3	31.4	6.5	14.7	8.1
Pipers Hole	5	99.4	6.5	27.5	4.8	6.6	9.0
Rocky	7	113.0	6.1	20.0	7.6	9.9	12.9

Table 4. Number of samples, mean sum of cations, pH, excess SO_4^{--}, DOC, Al, and Fe for the LRTAP monitor rivers in Newfoundland, 1986.

River	n	DWSU + $\mu eq\ L^{-1}$	pH	Ex.SO_4^{--} $\mu eq\ L^{-1}$	DOC $mg\ L^{-1}$	Al $\mu eq\ L^{-1}$	Fe $\mu eq\ L^{-1}$
Torrent	7	317.0	7.0	55.6	4.8	9.9	5.4
Harrys	10	1180.0	7.8	48.3	3.5	4.3	5.8
Indian Br.	10	206.0	6.8	23.6	5.9	10.3	7.8
Exploits	9	144.0	6.5	42.6	4.8	5.9	6.0
Isle aux Morts	5	74.9	5.9	40.1	4.6	10.7	5.0
Grey	5	42.9	5.9	28.4	4.9	8.5	6.2
Garnish	6	93.8	6.1	22.6	7.0	16.1	9.6
Pipers Hole	10	79.1	6.5	23.5	4.7	5.7	9.9
Rocky	11	98.2	6.2	16.9	7.8	10.1	13.4