FINAL DATA REPORT TO

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David Rockwell, Project Officer

DATA REPORT ON TRACE ELEMENTS IN THE WATERS OF LAKE ONTARIO DURING AUGUST 1985

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INTRODUCTION

Between 1980 and 1985, the epilimnion of each of the Great Lakes was sampled during the period of summer thermal stratification or, in the case of Lake Erie, just after the fall return to isothermal conditions. As part of the United States Environmental Protection Agency, Great Lakes National Program Office's desire to develop a data base for the Great Lakes, samples were analyzed for trace elements. As part of the development of this data base, assessments of the quality of historical trace element data were made for each lake. For Lakes Superior, Huron, Erie, and Michigan, results are reported in Rossmann (1982), Rossmann (1984), and Rossmann (1986).

During 1985, water and particulate samples were collected from the epilimnion (1 m water depth) of Lake Ontario using the sampler described by Rossmann (1982, 1984, 1986). A total of 20 stations were sampled between August 9 and August 11 (FIG. 1). The locations of the stations conformed to those recommended by the International Joint Commission (IJC) Lake Ontario Task Force (Draft 1984.09.28).

Samples were analyzed for dissolved and particulate silver, aluminum, arsenic, boron, barium, beryllium, bismuth, cadmium, cobalt, chromium, copper, iron, lithium, manganese, molybdenum, nickel, lead, antimony, selenium, tin, strontium, vanadium, and zinc. Dissolved and total mercury analyses were also done. Dissolved and particulate concentrations were summed to obtain total element concentrations. For mercury, dissolved concentrations were subtracted from total concentrations to obtain an estimate of particulate concentrations. This report contains the results of analyses of the Lake Ontario water and particulate samples, quality control data, a summary of the historical element data, and comments regarding the quality of the historical data base. With this report, development of the new Great Lakes trace element data base is complete.

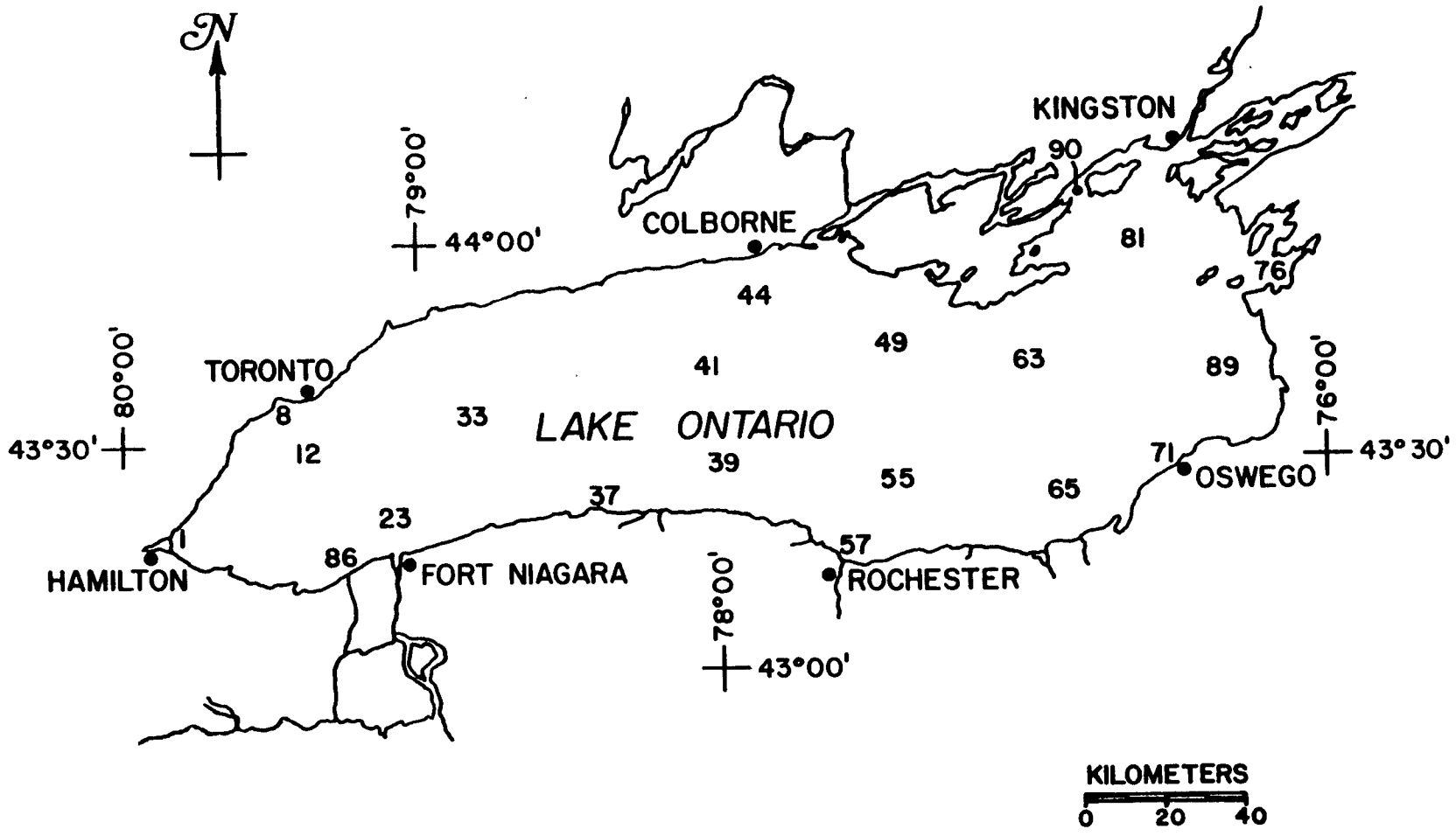

Figure 1. Lake Ontario stations sampled for water during 1985.

METHODS

COLLECTION

Samples were collected from a water depth of 1 m using a trace element-free polyethylene sampling system. The system used was capable of being rinsed with lake water at the sampling depth prior to collection of the sample. Details of the sampling procedure and sampler used are described in Rossmann (1982, 1984). Sampling was replicated at two of the twenty stations.

All samples to be filtered were passed through Millipore Fluoropore filters (FEP teflon) having a pore size of 0.5 um. One-liter filtered and total element samples were stored in precleaned polyethylene bottles containing 5 mL of concentrated Ultrex nitric acid as a preservative. Filtered and total mercury samples were stored in one-liter precleaned glass bottles containing 10 mL of concentrated sulfuric acid and 10 mL of 5% potassium dichromate as a preservative. Filters containing particulate matter were stored in precleaned polyethylene vials in a freezer until extraction with Ultrex nitric acid and hydrogen peroxide. Details of the extraction procedure are discussed by Rossmann (1982).

ANALYSES

All element analyses, excluding mercury and strontium, were done by flameless atomic absorption spectrophyotometry using a graphite furnace (Perkin-Elmer 1977, Rossmann 1982). For most elements, the sample was injected into the furnace. For many of the elements, the method of standard additions was used. Unlike samples from the other Great Lakes (Rossmann 1982, 1984, 1986), a considerable matrix effect was noted. Elements for which the method of standard additions was used included strontium, etc. Mercury analyses were done using the gold-amalgam technique (Perkin-Elmer 1981). Quantitation was with a

standard curve. All concentrations were calculated in the same manner as described by Rossmann (1982).

Limit of Detection

For each run consisting of standards, blanks, and samples, the limit of detection (minimum instrument response level) was determined by calculating the standard deviation of readings for multiple atomizations of air or distilled-deionized water. The standard deviations obtained from each of these blanks were then averaged, multiplied by 1.96 to provide for the 95% level of confidence (Hoel 1967), and divided by the slope of the regression line for the standards to convert to a concentration. Elements with a concentration below the limit of detection (W) are identified in the Appendices. At the 95% level of confidence, the average limits of detection for all runs of each element are listed in Table 1.

Criterion of Detection

For all water analyses, a criterion of detection, minimum concentration that can be detected as being significantly different from a blank, was calculated for each element. The criterion of detection was obtained by calculating the standard deviation of the appropriate field blank concentrations and then multiplying by 1.96 to provide for the 95% level of confidence (Hoel 1967). The criterion of detection for each element is listed in Table 1. Results below the criterion of detection (T) are identified in the Appendices.

Blanks

For each element analyzed, sample blanks were analyzed. The total element blank consisted of a bottle containing the appropriate preservative, to which

Table 1. Limits (LD) and criterions (CD) of detection for the analysis of 1985 Lake Ontario waters (ppb).

Element	Filtered LD	Filtered CD	Particulate LD	Particulate CD	Total LD	Total CD
Ag	0.0021	0.00034	0.00050	0.00010	---	---
Al	0.51	1.0	0.088	0.38	---	---
As	0.21	0.21	0.034	0.034	---	---
B	5.0	38.	1.1	0.80	---	---
Ba	0.58	0.58	0.078	0.078	---	---
Be	0.0018	0.0028	0.00020	0.0021	---	---
Bi	0.099	0.093	0.0054	0.010	---	---
Cd	0.012	0.020	0.00028	0.0066	---	---
Co	0.0035	0.0076	0.0014	0.0015	---	---
Cr	0.031	0.080	0.054	0.042	---	---
Cu	0.019	0.048	0.0033	0.0086	---	---
Fe	0.18	0.32	0.44	0.98	---	---
Hg	0.013	0.018	---	---	0.013	0.017
Li	0.14	0.037	0.0012	0.0035	---	---
Mn	0.026	0.045	0.045	0.0051	---	---
Mo	0.078	0.11	0.0060	0.0058	---	---
Ni	0.18	0.25	0.0056	0.016	---	---
Pb	0.033	0.064	0.013	0.020	---	---
Sb	0.056	0.062	0.0069	0.0096	---	---
Se	0.11	0.15	0.0075	0.11	---	---
Sn	0.17	0.10	0.027	1.8	---	---
Sr	8.4	6.8	0.016	0.026	---	---
V	0.16	0.16	0.012	0.012	---	---
Zn	0.072	0.12	0.052	0.090	---	---

one liter of distilled-deionized water was added. The filtered element blank consisted of a bottle containing the appropriate preservative, into which one liter of distilled-deionized water was filtered. This served not only to provide a blank but also further to clean the filter prior to filtration of the lake water sample. Total and filtered element blanks were collected at every station. Because both the sampler bottle and storage bottles were polyethylene and cleaned in the same manner, the blanks represented not only handling and storage contamination but also sampler contamination. If any median blank concentration was appreciabley large relative to measured sample concentrations, sub-samples of the distilled-deionized water transported to the ship and utilized to prepare the blanks were analyzed. After correction for the distilled-deionized water blanks, medians of the total and dissolved blanks were used to correct sample results. Medians were used as representative of the most likely blank concentration to occur for the period of sample collection. Even blanks can become contaminated and often the blank concentrations for a station were greater than the measured sample concentrations. Thus median blank concentrations were used so that each station's data could be corrected. The blank corrections used are listed in Table 2.

Quality Control Samples

In addition to our normal quality control procedures (Rossmann 1982), samples provided by the Data Quality Work Group of the International Joint Commission (Inter-laboratory Study No. 46, Trace Metals in Water) were analyzed at the same time as the Lake Ontario water samples. Our laboratory had analyzed the same samples as part of our analysis of Lake Superior water samples (Rossmann 1986). We only analyzed those samples that were within or slightly above our normal working range. In Table 3, results of our previous analysis of these samples are compared with those obtained during our Lake Ontario analyses

Table 2. Blank corrections applied to the analyses of 1985 Lake Ontario water (ppb).

Element	Filtered	Particulate	Total
Ag	0.0012	0.0	---
Al	1.32	0.62	---
As	0.0	0.0	---
B	0.0	4.6	---
Ba	0.0	0.0	---
Be	0.0	0.0	---
Bi	0.0	0.0	---
Cd	0.026	0.020	---
Co	0.0	0.0	---
Cr	0.0	0.0058	---
Cu	0.062	0.012	---
Fe	0.36	0.35	---
Hg	0.023	---	0.022
Li	0.0	0.0	---
Mn	0.0	0.0	---
Mo	0.0	0.0058	---
Ni	0.0	0.0	---
Pb	0.056	0.035	---
Sb	0.0	0.0036	---
Se	0.0	0.0	---
Sn	0.0	3.0	---
Sr	0.0	0.024	---
V	0.0	0.0	---
Zn	0.17	0.088	---

Table 3. Results of Great Lakes Research Division (GLRD) trace metal laboratory results for Interlaboratory Comparability Study No. 46 administered by the Data Quality Work Group of the International Joint Commission (IJC). Results are compared to GLRD previous results (Rossmann 1986) and IJC reported medians (concentrations in ppb). Samples 1and 2 were taken from the same bulk, unfiltered Lake Superior water sample.

	1			2			3			4		
		Previous			Previous			Previous			Previous	
Metal	GLRD	GLRD	Median	GLRD	GLRD	Median	GLRD	GLRD	Median	GLRD	GLRD	Median
Al	9.2	5.8	6.6	7.5	5.9	7.0	13.	7.0	12.	13.	9.5	16.
Cd	0.034	0.026	0.15	0.036	0.029	0.10	0.12	0.12	0.15	----	----	----
Co	0.020W	0.21W	0.50	-0.0021W	0.21W	0.50	0.24	0.24	0.37	0.51	0.39	1.2
Cr	0.31	0.38	0.50	0.22	0.31	0.70	1.3	>1.0	1.0	----	----	----
Cu	3.8	>1.5	4.0	3.9	>1.5	4.6	3.2	>1.5	2.8	3.4	>1.5	3.4
Fe	6.5	4.1	8.2	5.8	4.1	6.0	11.	>5.0	13.	9.8	>5.0	13.
Mn	0.24	0.24	0.34	0.22	0.25	0.50	>0.80	>0.40	1.3	----	----	----
Mo	----	0.20	1.0	0.22	0.16	0.20	1.7	1.4	1.2	2.8	----	2.0
Ni	----	0.14	1.0	----	0.056	0.95	----	0.33	1.0	----	0.38	1.0
Pb	0.47	0.52	1.0	0.44	0.49	1.0	>1.0	1.3	2.0	>1.0	1.7	3.0
V	0.33	0.62	0.26	0.33	0.33	0.30	0.87	1.4	1.0	----	----	----
Zn	2.4	----	3.0	2.0	----	2.5	2.6	----	3.6	3.4	----	3.7

Table 3. Continued.

	5			6			7			8		
		Previous			Previous			Previous			Previous	
Metal	GLRD	GLRD	Median	GLRD	GLRD	Median	GLRD	GLRD	Median	GLRD	GLRD	Median
Al	----	----	----	----	----	----	----	----	----	----	----	----
Cd	----	----	----	----	----	----	----	----	----	----	----	----
Co	0.93	0.92	1.2	4.4	4.9	4.9	----	----	----	----	----	----
Cr	----	----	----	----	----	----	----	----	----	----	----	----
Cu	----	----	----	----	----	----	----	----	----	----	----	----
Fe	----	----	----	----	----	----	----	----	----	----	----	----
Mn	----	----	----	----	----	----	----	----	----	----	----	----
Mo	----	----	----	----	----	----	----	----	----	----	----	----
Ni	1.6	1.5	2.0	5.4	4.8	6.0	3.7	3.6	4.2	2.3	2.1	2.7
Pb	----	----	----	----	----	----	----	----	----	----	----	----
V	1.2	1.3	1.1	----	----	----	----	----	----	----	----	----
Zn	----	----	----	----	----	----	----	----	----	----	----	----

and with the medians for the IJC Interlaboratory Study. With the exception of nickel and zinc, all results obtained during analysis of the Lake Ontario water samples were satisfactory. For these, a low bias may exist; however, no individual analysis for nickel and zinc or any of the other elements was at a concentration that would have been flagged as being either low or high.

Coefficient of Variation (Relative Deviation)

Samples were collected in replicate at two stations to provide an estimate of the coefficient of variation of the sampling and analysis of Lake Ontario waters (Table 4). Elements which have high coefficients of variation include boron, bismuth, dissolved iron, tin, and zinc. For the dissolved iron, tin, and zinc, high coefficients were at least in part due to limit or criterion of detection problems. For iron and zinc contamination problems also contributed to the high coefficients. I consider the results quite good for a coefficient of variation representing both sampling and analysis of trace elements in water.

RESULTS AND COMPARISON TO HISTORICAL DATA

Within this section, the 1985 lake water element concentrations as well as summarized historical data are presented. The historical data were summarized by year. Other than the STORET data, the data could not be sorted for nearshore and offshore stations. Only offshore data were selected from the STORET data base. All historical data must be used with caution. At the time of their generation, they may or may not have represented high quality data for the state-of-the-art methodology used. All results of the current study are summarized in the Appendices. Data are reported in the manner recommended by the International Joint Commission, including results below the limit or criterion of detection and including negative results (ASTM 1980). Because

Table 4. Coefficient of variation for sampling and analysis of water samples collected from Lake Ontario during 1985.

Element	Coefficent of Variation (%)		
	Dissolved	Particulate#	Total#
Ag	12	12	13
Al	6	11	10
As	12	**	12
B	54	42	46
Ba	9	31	9
Be	13	**	14
Bi	52	**	33
Cd	**	28	39
Co	7	1*	9
Cr	9	**	9
Cu	4	30	2
Fe	66*	8	9
Hg	**	--	**
Li	4	9	4
Mn	5	7	8
Mo	8	**	8
Ni	11	4	11
Pb	**	**	--
Sb	7	**	7
Se	19	**	20
Sn	65*	**	65
Sr	5	9	4
V	11	**	12
Zn	58*	59	45

Particulate mercury is calculated from total and dissolved concentrations. All but total mercury are calculated from particulate and dissolved concentrations.

* Only one of two replicated samples used due to one or both of the replicates for one sample being below the limit or criterion of detection.

**Both replicated samples had one or both of its replicates below the limit or criterion of detection.

historical data represent samples taken at different times of the year, in different places, and analyzed or collected by different procedures, trends inferred from use of the historical data must be used with caution. The trends are presented to illustrate what can be done with the available data. For quite a few of the elements, many of 1985 data were below the limit of detection (Table 5). The very low concentrations of these elements are hypothesized to be related to the time of the year the samples were collected. For dissolved element concentrations, this was a severe problem for silver, mercury, and lead. It was less of a problem for beryllium, cadmium, iron, and zinc. For particulate element concentrations the 1985, a high fraction of the results for arsenic, beryllium, bismuth, chromium, lead, molybdenum, selenium, tin, and vanadium were below the criterion or limit of detection.

SILVER (Ag)

No historical dissolved or particuate silver data were found. Only the 1985 data are presented (Tables 6-7). Greater than 60% of the analyses were below the limit or criterion of detection. Including the current study, three years of total silver data are available (Table 8). The 1979 data appear to be bad because the minimum and median are the same; suggesting a limit of detection problem skewing the data to the high side. No trends could be calculated for the few data points available.

ALUMINUM (Al)

As for silver, no dissolved or particulate historical aluminum data were found. The 1985 data are summarized in Tables 9-10. Total element data are available for three years (Table 11). All data appear to be of resonable quality. There is no total aluminum trend.

Table 5. Percent of analyses below the limit or criterion of detection for samples collected from Lake Ontario.

Element	1985 (n=22)		
	Dissolved	Particulate	Total
Ag	64	0	--
Al	4	0	--
As	9	86	--
B	36	0	--
Ba	0	14	--
Be	32	96	--
Bi	9	100	--
Cd	41	0	--
Co	0	9	--
Cr	0	77	--
Cu	0	0	--
Fe	32	0	--
Hg	96	--	73
Li	0	9	--
Mn	0	0	--
Mo	0	46	--
Ni	0	0	--
Pb	91	41	--
Sb	4	100	--
Se	0	100	--
Sn	18	100	--
Sr	0	0	--
V	27	59	--
Zn	41	0	--

Table 6. Statistical summary of dissolved silver data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1985[1]	22	-0.00055	0.0019	0.00088	0.00081	0.00072

[1] This study.

Table 7. Statistical summary of particulate silver data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1985[1]	22	0.00067	0.0039	0.0014	0.00064	0.0013

[1] This study.

Table 8. Statistical summary of total silver data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1979	10	0.10	0.30	0.13	0.067	0.10
1981	6	0.0	0.0080	0.0048	0.0032	0.0050
1985[1]	22	0.00058	0.0044	0.0023	0.00096	0.0023

[1] This study.

Table 9. Statistical summary of dissolved aluminum data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1985[1]	22	0.40	19.	5.4	4.2	4.1

[1] This study.

Table 10. Statistical summary of particulate aluminum data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1985[1]	22	1.4	62.	9.6	14.	4.3

[1] This study.

Table 11. Statistical summary of total aluminum data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1979	15	2.0	110.	22.	34.	6.0
1981	6	12.	36.	20.	8.4	18.
1985[1]	22	1.9	73.	15.	17.	8.1

[1] This study.

ARSENIC (As)

No historical dissolved and particulate data were found. The 1985 data are summarized in Tables 12-13. For the 1985 particulate data, 86% of the results were below the limit of detection (Table 5). Total arsenic data are available for four years (Table 14). The 1974 and 1981 concentrations are higher than those of 1979 and 1985. No trends could be calculated for the few data available.

BORON (B)

No dissolved and particulate boron data were found. Dissolved and particulate concentrations for 1985 are summarized in Tables 15 and 16, respectively. 36% of the dissolved concentrations were below the limit or criterion of detection (Table 5).

One year of historical total boron data was found (Table 17). The 1985 data are skewed to the high side; 1985 concentrations are higher than those of 1972.

BARIUM (Ba)

No historical data for barium were found. The 1985 data are summarized in Tables 18-20.

BERYLLIUM (Be)

As for barium, no historical beryllium data were found. The 1985 data are summarized in Tables 21-23. There were detection problems for this element. 32% of the dissolved and 96% of the particulate analyses were below the limit or criterion of detection (Table 5).

Table 12. Statistical summary of dissolved arsenic data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1985[1]	22	0.13	0.89	0.51	0.20	0.49

[1] This study.

Table 13. Statistical summary of particulate arsenic data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1985[1]	22	-0.016	0.066	0.023	0.019	0.024

[1] This study.

Table 14. Statistical summary of total arsenic data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1974[1]	23	0.60	1.2	0.90	0.16	0.90
1979	15	0.10	1.0	0.46	0.30	0.40
1981	5	0.83	1.1	1.0	0.11	0.98
1985[2]	22	0.16	0.92	0.53	0.20	0.50

[1] Traversy et al. 1975.
[2] This study.

Table 15. Statistical summary of dissolved boron data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1985[1]	22	5.4	210.	72.	55.	47.

[1] This study.

Table 16. Statistical summary of particulate boron data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1985[1]	22	0.94	22.	7.5	5.3	5.5

[1] This study.

Table 17. Statistical summary of total boron data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1972	13	14.	23.	20.	2.9	19.
1985[1]	22	9.8	213.	80.	54.	58.

[1] This study.

Table 18. Statistical summary of dissolved barium data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1985[1]	22	16.	20.	18.	1.0	18.

[1] This study.

Table 19. Statistical summary of particulate barium data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1985[1]	22	-0.0040	0.52	0.24	0.14	0.22

[1] This study.

Table 20. Statistical summary of total barium data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1985[1]	22	17.	21.	18.	1.1	18.

[1] This study.

Table 21. Statistical summary of dissolved beryllium data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1985[1]	22	0.0013	0.0076	0.0039	0.0017	0.0037

[1] This study.

Table 22. Statistical summary of particulate beryllium data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1985[1]	22	-0.000021	0.0024	0.00031	0.00054	0.000090

[1] This study.

Table 23. Statistical summary of total beryllium data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1985[1]	22	0.0019	0.0076	0.0042	0.0016	0.0039

[1] This study.

BISMUTH (Bi)

No historical bismuth data were found. The 1985 data are summarized in Tables 24-26. All of the particulate analyses were below the limit or criterion of detection (Table 5).

CADMIUM (Cd)

Five years of historical dissolved cadmium data were found (Table 27). All pre-1984 historical concentrations appear to be too high except the first entry for 1969. For the 1985 data, 41% of the analyses were below the limit or criterion of detection (Table 5).

Historical particulate cadmium data were available for one year (Table 28). The mean concentration in 1978 was nearly an order of magnitude less than that measured for 1985. Both data sets are believed to be of high quality.

In addition to the 1985 data, five years of total cadmium data were found (Table 29). Of these, the 1967, 1972, and second 1973 concentrations are too high. The first 1973, 1978, 1981, and 1985 data appear to be of reasonable quality. Too few data points preclude the calculation of any trend.

COBALT (Co)

All historical concentrations of dissolved cobalt appear to be too high (Table 30). No historical particulate concentrations were found (Table 31). The historical total cobalt concentration for 1981 seems to be too high (Table 32).

CHROMIUM (Cr)

Except for the second 1969 entry which appears to be a limit of detection problem, the 5 years of historical dissolved chromium data appear to be of high

Table 24. Statistical summary of dissolved bismuth data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1985[1]	22	0.035	0.72	0.28	0.18	0.27

[1] This study.

Table 25. Statistical summary of particulate bismuth data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1985[1]	22	-0.057	0.082	-0.0046	0.023	-0.0078

[1] This study.

Table 26. Statistical summary of total bismuth data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1985[1]	22	0.024	0.71	0.28	0.18	0.27

[1] This study.

Table 27. Statistical summary of dissolved cadmium data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1969[1]	--	---	---	0.09	---	---
1969	1	1.0	1.0	1.0	---	---
1971	14	0.10	0.50	0.21	0.12	0.20
1972	17	0.20	1.4	0.39	0.31	0.20
1973	14	0.20	0.40	0.26	0.065	0.20
1984[2]	57	---	---	0.010	0.005	---
1985[3]	22	-0.0030	0.47	0.053	0.099	0.024

1 Chau et al. 1970.
2 Lum and Callaghan 1986 and Lum 1987.
3 This study.

Table 28. Statistical summary of particulate cadmium data by year for Lake Ontario epilimnetic water (ppb).

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1978[1]	6	---	---	0.0086	0.0038	---
1985[2]	22	0.033	0.25	0.092	0.055	0.069

1 Nriagu et al. 1981.
2 This study.

Table 29. Statistical summary of total cadmium data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1967	2	1.0	2.0	1.5	0.71	---
1972 [1]	12	4.0	8.0	5.5	1.3	5.5
1973	1	0.16	0.16	0.16	---	---
1973 [2]	1	2.0	2.0	2.0	---	---
1978	4	---	---	0.046	0.0093	---
1981 [3]	7	0.009	0.33	0.12	0.12	0.086
1985	22	0.030	0.66	0.14	0.14	0.096

1 Elzerman and Armstrong 1979.
2 Nriagu et al. 1981.
3 This study.

Table 30. Statistical summary of dissolved cobalt data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1969 [1]	--	---	---	0.11	---	---
1969	1	5.0	5.0	5.0	---	---
1971	23	0.10	2.8	0.51	0.58	0.30
1972	18	0.20	1.0	0.49	0.22	0.40
1985 [2]	22	0.0087	0.037	0.021	0.0068	0.021

1 Chau et al. 1970.
2 This study.

Table 31. Statistical summary of particulate cobalt data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1985[1]	22	0.00045	0.018	0.0054	0.0044	0.0037

[1] This study.

Table 32. Statistical summary of total cobalt data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1981	7	0.060	0.16	0.12	0.041	0.12
1985[1]	22	0.011	0.051	0.027	0.0094	0.025

[1] This study.

quality (Table 33). Median and mean concentrations range between 0.5 and 0.77 ug/L. There is no trend in element concentration for the period of 1968 through 1985.

No historical particulate chromium data were found. The 1985 data are summarized in Table 34. 77% of these data were below the limit or criterion of detection.

Two years of historical total chromium data were found (Table 35). The 1972 concentrations are much too high. The mean and median concentrations for 1981 and 1985 are very similar.

COPPER (Cu)

Most of the historical dissolved copper data appear to be of poor quality (Table 36). The best of the pre-1984 data are those of 1972.

One year of historical particulate copper data was found (Table 37). The 1985 mean is almost twice that of 1978; however the 1978 mean is within the range of concentrations observed for 1985.

Five years of historical total copper data were found (Table 38). The 1967, 1972, and 1973 mean and median concentrations all appear to be much too high compared to those of 1978, 1981, and 1985. The 1985 median concentration is the lowest of the three years. No trend was found.

IRON (Fe)

Four years of historical dissolved iron data were found (Table 39). Mean and median concentrations appear to be slightly high for 1969, 1971, and 1972, though not unreasonably high. The 1973 mean concentration appears to be skewed to the high side. The 1985 median concentration is the lowest. No trend was found.

Table 33. Statistical summary of dissolved chromium data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1968[1]	38	0.0	12.	---	---	0.7
1969[2]	--	---	---	0.74	---	---
1969	26	1.0	3.0	1.2	0.51	1.0
1971	37	0.10	2.0	0.69	0.37	0.70
1972	18	0.20	2.4	0.67	0.54	0.50
1973	15	0.10	1.3	0.64	0.36	0.50
1985[3]	22	0.38	1.0	0.75	0.14	0.77

1 Weiler and Chawla 1969; all results for dissolved and total for various depths were combined.
2 Chau et al. 1970.
3 This study.

Table 34. Statistical summary of particulate chromium data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1985[1]	22	0.0056	0.18	0.041	0.041	0.025

1 This study.

Table 35. Statistical summary of total chromium data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1972	8	1.5	45.	17.	18.	7.5
1981	7	0.50	1.8	0.88	0.45	0.87
1985[1]	22	0.49	1.0	0.79	0.12	0.82

[1] This study.

Table 36. Statistical summary of dissolved copper data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1968[1]	38	5.0	175.	---	---	60.
1969[2]	--	---	---	6.4	---	---
1969	51	1.0	13.	3.3	2.4	3.0
1971	40	1.8	18.	4.6	3.2	3.5
1972	15	0.20	10.	2.0	2.4	1.6
1973	18	1.5	5.0	2.6	0.89	2.5
1984[3]	--	---	---	0.48	0.24	---
1984[3]	--	---	---	0.45	0.24	---
1985[4]	22	0.62	0.94	0.75	0.098	0.75

[1] Weiler and Chawla 1969; all results for dissolved and total for various depths were combined.

[2] Chau et al. 1970.

[3] Lum, K. R., Environmental Contaminants Division, National Water Research Institute, Burlington, Ontario, personal communication.

[4] This study.

Table 37. Statistical summary of particulate copper data by year for Lake Ontario epilimnetic water (ppb).

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1978[1]	6	---	---	0.14	0.043	---
1985[2]	22	0.13	1.3	0.24	0.24	0.17

[1] Nriagu et al. 1981.
[2] This study.

Table 38. Statistical summary of total copper data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1967	12	2.0	86.	24.	23.	15.
1972	78	1.0	160.	25.	32.	10.
1973	81	0.0030	200.	16.	27.	8.0
1978[1]	5	---	---	1.5	0.13	---
1981	7	0.90	2.5	1.6	0.54	1.6
1985[2]	22	0.78	2.0	0.99	0.26	0.92

[1] Nriagu et al. 1981.
[2] This study.

Table 39. Statistical summary of dissolved iron data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1969[1]	--	---	---	5.1	---	---
1969	54	1.0	30.	4.6	4.6	3.0
1971	40	0.60	4.1	1.6	0.94	1.2
1972	18	1.2	12.	4.3	2.7	4.0
1973	18	1.0	180.	36.	58.	4.0
1985[2]	22	-0.040	4.4	0.74	0.96	0.45

[1] Chau et al. 1970.
[2] This study.

Table 40. Statistical summary of particulate iron data by year for Lake Ontario epilimnetic water (ppb).

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1978[1]	4	---	---	9.4	2.4	---
1985[2]	22	2.2	64.	12.	14.	5.3

[1] Nriagu et al. 1981.
[2] This study.

Historical particulate iron data were found for only one year (Table 40). The 1978 and 1985 concentrations are the same within the variability of results observed.

Seven years of historical total iron data were found (Table 41). Of these the concentrations for 1967, the second 1968 entry, 1969, 1972, and 1973 are suspiciously high compared to those for the first 1968 entry, 1979, 1981, and 1985. The 1985 mean and median concentrations are lowest. No trend was found.

MERCURY (Hg)

Historical dissolved mercury data were found for only 1971 (Table 42). The 1971 mean and median concentrations are more than an order of magnitude higher than those for 1985. The maximum for 1985 is below the minimum for 1971. The 1971 should not be discarded, but they should be used with caution. 96% of the 1985 data were below the limit or criterion of detection (Table 5).

Like dissolved mercury data, only one, two year period of historical particulate mercury data were found (Table 43). The particulate mercury concentrations were considerably higher in 1970-1 than in 1985. The 1985 data are poor because they are the result of subtracting dissolved concentrations (96% below limit or criterion of detection) from total concentrations (73% below limit or criterion of detection) (Table 5).

Three years of historical total mercury data were found (Table 44). The 1979 concentrations appear to all be below the limit of detection. Lowest mean and median concentrations occurred in 1985. No trend could be calculated.

LITHIUM (Li)

One year of historical dissolved lithium data was found (Table 45). There is no significant difference between the 1971 and 1985 means or medians. No historical particulate data were found. The 1985 data are summarized in

Table 41. Statistical summary of total iron data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1967[1]	5	30.	300.	140.	110.	120.
1968	38	4.0	500.	---	---	8.
1968	14	20.	80.	56.	17.	60.
1969	14	20.	120.	48.	27.	40.
1972	95	1.5	1100.	87.	160.	33.
1973	82	0.070	780.	84.	120.	37.
1979	15	1.5	300.	57.	100.	13.
1981[2]	7	3.6	76.	22.	24.	14.
1985	22	2.6	66.	12.	15.	5.7

[1] Weiler and Chawla 1969; all results for various depths were combined.
[2] This study.

Table 42. Statistical summary of dissolved mercury data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1971[1]	39	0.050	0.60	0.16	0.098	0.15
1985	22	0.001	0.019	0.010	0.0053	0.011

[1] This study.

Table 43. Statistical summary of particulate mercury data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1970-1[1]	2	0.040	0.050	0.045	0.0071	---
1985[2]	22	-0.014	0.020	0.00018	0.0085	-0.002

[1] Chau and Saitoh 1973.
[2] This study.

Table 44. Statistical summary of total mercury data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1970-1[1]	132	0.0	0.30	0.13	0.07	---
1979	15	0.050	0.050	0.050	0.0	0.050
1985[2]	22	-0.005	0.026	0.011	0.0086	0.010

[1] Chau and Saitoh 1973; includes nearshore and samples from depths >5m.
[2] This study.

Table 45. Statistical summary of dissolved lithium data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1971	60	1.2	2.5	1.7	0.30	1.8
1985[1]	22	1.4	2.7	2.0	0.31	2.0

[1] This study.

Table 46. Only one year of historical total lithium data could be found (Table 47). The 1967 and 1985 medians are equal.

MANGANESE (Mn)

Including 1985, dissolved manganese data were found for 6 years (Table 48). The 1968 and second entry for 1969 represent concentrations at or near the limit of detection. The 1973 data are too high and should be ignored. The 1974 mean concentration is skewed to the very high side. The mean concentrations for the second entry of 1969, 1971, and 1985 and the median concentrations for 1971, 1972, 1985 are very similar to one another. There is no apparent trend in dissolved manganese concentrations between 1969 and 1985.

Only one year of historical particulate manganese data was found (Table 49). The mean for 1978 is lower than that for 1985. Both sets of data are considered to be of high quality.

Five years of historical total manganese data were found (Table 50). All historical data are suspiciously high compared to the 1985 data. They should be used with caution. The 1967 maximum is extremely high, and the 1973 minimum is very low. The 1973 minimum concentration is probably a STORET data entry error.

MOLYBDENUM (Mo)

Four years of historical dissolved molybdenum data were found (Table 51). No particulate or total historical molybdenum data were found. All historical data appear to be of high quality. Though the regression line is not statistically significant at the 0.05 level of significance, molybdenum increased between 1969 and 1985. The 1985 particulate and total data are summarized in Tables 52 and 53, respectively.

Table 46. Statistical summary of particulate lithium data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1985[1]	22	0.0028	0.066	0.011	0.014	0.0066

[1] This study.

Table 47. Statistical summary of total lithium data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1967	14	1.0	6.0	2.6	1.3	2.0
1985[1]	22	1.4	2.7	2.0	0.30	2.0

[1] This study.

Table 48. Statistical summary of dissolved manganese data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1968[1]	38	0.	44.	---	---	<1.
1969[2]	--	---	---	0.47	---	---
1969	10	1.0	3.0	1.2	0.63	1.0
1971	35	0.10	1.2	0.32	0.28	0.20
1972	18	0.20	240.	14.	56.	0.40
1973	18	0.70	20.	3.2	4.6	1.5
1985[3]	22	0.087	1.3	0.33	0.32	0.22

1 Weiler and Chawla 1969; all results for dissolved and total for various depths were combined.
2 Chau et al. 1970.
3 This study.

Table 49. Statistical summary of particulate manganese data by year for Lake Ontario epilimnetic water (ppb).

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1978[1]	6	---	---	0.27	0.10	---
1985[2]	22	0.22	3.3	1.0	0.79	0.68

1 Nriagu et al. 1981.
2 This study.

Table 50. Statistical summary of total manganese data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1967	10	2.0	140.	38.	49.	5.0
1972	74	1.0	32.	6.7	5.3	5.0
1973	81	0.0040	51.	5.8	7.6	4.0
1979	15	0.40	7.4	2.2	1.9	1.4
1981	7	0.40	15.	4.6	5.0	3.0
1985[1]	22	0.47	3.9	1.3	0.98	0.88

[1] This study.

Table 51. Statistical summary of dissolved molybdenum data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1969[1]	--	---	---	1.1	---	---
1969	50	1.0	3.0	1.2	0.56	1.0
1971	40	0.90	1.7	1.2	0.18	1.1
1972	18	0.40	2.6	1.1	0.53	1.0
1973	18	0.50	2.0	1.4	0.36	1.4
1985[2]	22	1.3	1.9	1.5	0.18	1.5

[1] Chau et al. 1970.
[2] This study.

Table 52. Statistical summary of particulate molybdenum data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1985[1]	22	-0.068	0.034	0.016	0.030	0.0072

[1] This study.

Table 53. Statistical summary of total molybdenum data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1985[1]	22	1.3	1.9	1.5	0.18	1.5

[1] This study.

NICKEL (Ni)

The majority of the historical dissolved nickel data are of poor quality (Table 54). Only the 1973 mean and median concentrations are comparable to those of 1985.

Only one year of historical particulate nickel data were found (Table 55). The 1978 mean concentration is lower than that for 1985. Both data sets are believed to be of high quality.

Six years of historical total nickel were identified (Table 56). The 1972 and 1973 mean and median concentrations are much too high; consequently the data should be discarded. The 1985 mean and median concentrations are lowest of the remaining years. There is no statistically significant (0.05 level of significance) trend in total nickel concentration.

LEAD (Pb)

All pre-1984 dissolved lead data are bad (Table 57). Concentrations between 1968 and 1973 are much too high based on the 1985 concentrations. This is similar to what was observed for the other Great Lakes (Rossmann 1982, 1984, 1986). 91% of the 1985 results were below the limit or criterion of detection (Table 5).

Only one year of historical particulate lead data were found (Table 58). The 1978 mean concentration is three times that of the 1985 concentration. Both years of data appear to be of good quality. 41% of the 1985 particulate results were below the limit or criterion of detection (Table 5).

Five years of historical total lead data were found (Table 59). The 1967 through 1978 mean and median concentrations are all much too high, and those of 1981 also appear to be too high. The 1985 mean and median concentrations are

Table 54. Statistical summary of dissolved nickel data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1968[1]	38	2.	16.	---	---	5.6
1969[2]	--	---	---	2.3	---	---
1969	53	1.0	5.0	2.0	0.90	2.0
1971	40	0.20	12.	2.4	2.3	2.0
1972	18	1.5	6.5	4.0	1.7	4.0
1973	11	0.10	2.2	0.94	0.57	0.80
1985[3]	22	0.35	0.93	0.63	0.17	0.61

1 Weiler and Chawla 1969; all results for dissolved and total for various depths were combined.
2 Chau et al. 1970.
3 This study.

Table 55. Statistical summary of particulate nickel data by year for Lake Ontario epilimnetic water (ppb).

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1978[1]	5	---	---	0.044	0.024	---
1985[2]	22	0.054	0.30	0.095	0.052	0.082

1 Nriagu et al. 1981.
2 This study.

Table 56. Statistical summary of total nickel data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1967	14	1.0	4.0	2.4	0.85	2.0
1972	74	4.0	50.	16.	8.8	13.
1973	81	0.015	28.	11.	6.0	11.
[1]						
1978	6	---	---	1.0	0.11	---
1979	15	1.0	2.0	1.3	0.36	1.5
1981	6	1.3	3.1	2.0	0.82	1.5
[2]						
1985	22	0.46	1.0	0.72	0.18	0.71

[1] Nriagu et al. 1981.
[2] This study.

Table 57. Statistical summary of dissolved lead data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
[1]						
1968	38	2.	7.	---	---	3.3
[2]						
1969	--	---	---	0.83	---	---
1969	51	1.0	13.	3.3	2.4	1.0
1971	38	0.20	3.1	1.1	0.76	1.0
1972	15	0.40	2.0	1.2	0.37	1.0
1973	12	0.20	1.8	0.88	0.55	0.60
[3]						
1984	--	---	---	0.056	0.058	---
[4]						
1985	22	-0.052	0.14	-0.0013	0.047	-0.010

[1] Weiler and Chawla 1969; all results for dissolved and total for various depths were combined.
[2] Chau et al. 1970.
[3] Lum, K. R., Environmental Contaminants Division, National Water Research Institute, Burlington, Ontario, personal communication.
[4] This study.

Table 58. Statistical summary of particulate lead data by year for Lake Ontario epilimnetic water (ppb).

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1978 [1]	5	---	---	0.13	0.042	---
1985 [2]	22	-0.018	0.15	0.040	0.048	0.021

[1] Nriagu et al. 1981.
[2] This study.

Table 59. Statistical summary of total lead data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1967	14	2.0	48.	10.	13.	4.0
1972	4	1.0	58.	25.	28.	3.0
1973 [1]	1	1.6	1.6	1.6	---	---
1973 [1]	1	17.	17.	17.	---	---
1978 [2]	4	---	---	<0.41	---	---
1981 [2]	7	0.070	0.79	0.41	0.23	0.44
1985 [3]	22	-0.036	0.29	0.080	0.095	0.042

[1] Elzerman and Armstrong 1979.
[2] Nriagu et al. 1981.
[3] This study.

much lower than those for the other years. No trend was calculated because of the poor quality of the historical data.

ANTIMONY (Sb)

No historical dissolved, particulate, and total antimony data could be found. The 1985 data are summarized in Tables 60-62.

SELENIUM (Se)

No historical dissolved and particulate selenium data were found. The 1985 data are summarized in Tables 63 and 64, respectively. 100% of the 1985 particulate results were below the limit or criterion of detection (Table 5).

Three years of historical total selenium data were found (Table 65). The historical concentrations all appear to be too low. They could be too low if selenium was analyzed by the hydride technique. If selenium (VI) was not completely reduced to selenium (IV) prior to analysis, low results would be obtained (Sinemus et al. 1981). Thus the 1974, 1979, and 1981 results are either erroneously low or there was a drastic increase in selenium between 1981 and 1985. I believe the former to be the correct interpretation.

TIN (Sn)

No historical tin data could be found. The 1985 dissolved, particulate, and calculated total tin results are summarized in Tables 66-68, respectively. 100% of the particulate results were below the limit or criterion of detection (Table 5).

STRONTIUM (Sr)

Five years of historical dissolved strontium data were found (Table 69). All historical data are of high quality. For the period of 1968 to 1985, mean

Table 60. Statistical summary of dissolved antimony data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1985[1]	22	0.040	0.24	0.17	0.051	0.16

[1] This study.

Table 61. Statistical summary of particulate antimony data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1985[1]	22	-0.053	0.0091	-0.013	0.014	-0.010

[1] This study.

Table 62. Statistical summary of total antimony data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1985[1]	22	0.023	0.23	0.16	0.051	0.17

[1] This study.

Table 63. Statistical summary of dissolved selenium data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1985[1]	22	0.56	1.9	1.0	0.35	0.97

[1] This study.

Table 64. Statistical summary of particulate selenium data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1985[1]	22	-0.029	0.090	0.024	0.030	0.016

[1] This study.

Table 65. Statistical summary of total selenium data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1974[1]	23	<0.1	0.50	0.13	0.092	<0.1
1979	15	0.10	0.10	0.10	0.0	0.10
1981	5	0.080	0.32	0.21	0.11	0.27
1985[2]	22	0.56	2.0	1.0	0.36	0.99

[1] Traversy et al. 1975.
[2] This study.

Table 66. Statistical summary of dissolved tin data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1985[1]	22	0.040	1.1	0.41	0.32	0.23

[1] This study.

Table 67. Statistical summary of particulate tin data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1985[1]	22	0.	0.	0.	0.	0.

[1] This study. All results were within the range of the blanks.

Table 68. Statistical summary of total tin data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1985[1]	22	0.040	1.1	0.41	0.32	0.23

[1] This study.

Table 69. Statistical summary of dissolved strontium data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1968[1]	38	180.	200.	---	---	190.
1969[2]	--	---	---	180.	---	---
1969	54	150.	200.	180.	12.	180.
1971	60	170.	200.	180.	6.7	180.
1972	18	150.	180.	160.	12.	170.
1973	18	140.	170.	160.	9.0	160.
1985[3]	22	140.	200.	180.	16.	180.

1 Weiler and Chawla 1969; all results for dissolved and total for various depths were combined.
2 Chau et al. 1970.
3 This study.

Table 70. Statistical summary of particulate strontium data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1985[1]	22	0.22	0.96	0.56	0.20	0.50

1 This study.

concentrations varied between 160 and 180 ug/L, and median concentrations varied between 160 and 190 ug/L. There is no trend in concentration with time.

No historical particulate strontium data could be found. The 1985 data are summarized in Table 70.

One year of historical total strontium data were found (Table 71). The mean and median concentrations of 1967 and 1985 are equal.

VANADIUM (V)

Only one year of historical dissolved vanadium data was found (Table 72). The 1973 mean is an order of magnitude less than that for 1985.

No historical particulate vanadium data could be found. The 1985 data are summarized in Table 73. 59% of the particulate results were below the limit or criterion of detection (Table 5).

Three years of historical total vanadium data were found (Table 74). The 1969 and 1981 mean and median concentrations are much too high and should not be used for describing concentrations in Lake Ontario water. The 1985 mean and median concentrations are higher than those for 1971; however standard deviations are large enough to make the difference observed statistically insignificant.

ZINC (Zn)

Six years of historical dissolved zinc data were found (Table 75). All historical means and medians are much too high compared to the 1985 results. The pre-1984 data should not be used to describe the lake. 41% of the 1985 data were below the limit or criterion of detection (Table 5).

Only one year of historical particulate zinc data was found (Table 76). The 1985 mean and median concentrations are higher than the mean for 1978.

Table 71. Statistical summary of total strontium data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1967	14	160.	190.	180.	9.1	180.
1985[1]	22	140.	200.	180.	16.	180.

[1] This study.

Table 72. Statistical summary of dissolved vanadium data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1969[1]	--	---	---	0.03	---	---
1985[2]	22	0.072	0.69	0.33	0.17	0.29

[1] Chau et al. 1970.
[2] This study.

Table 73. Statistical summary of particulate vanadium data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1985[1]	22	-0.024	0.11	0.017	0.026	0.014

[1] This study.

Table 74. Statistical summary of total vanadium data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1969	1	1.0	1.0	1.0	---	---
1971	3	0.10	0.40	0.20	0.17	0.10
1981	7	0.11	4.9	2.2	2.2	1.1
1985[1]	22	0.091	0.70	0.34	0.17	0.33

[1] This study.

Table 75. Statistical summary of dissolved zinc data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1968[1]	38	18.	115.	---	---	71.
1969[2]	--	---	---	7.8	---	---
1969	44	1.0	44.	9.6	8.6	8.0
1971	40	2.5	54.	12.	11.	8.9
1972	17	0.50	56.	8.4	13.	4.0
1973	18	0.50	13.	4.5	3.0	4.0
1984[3]	--	---	---	0.82	0.55	---
1985[4]	22	-0.040	1.5	0.27	0.34	0.16

[1] Weiler and Chawla 1969; all results for dissolved and total for various depths were combined.

[2] Chau et al. 1970.

[3] Lum, K. R., Environmental Contaminants Division, National Water Research Institute, Burlington, Ontario, personal communication.

[4] This study.

Table 76. Statistical summary of particulate zinc data by year for Lake Ontario epilimnetic water (ppb).

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1978[1]	5	---	---	0.31	0.15	---
1985[2]	22	0.12	1.3	0.59	0.38	0.50

[1] Nriagu et al. 1981.
[2] This study.

Table 77. Statistical summary of total zinc data by year for Lake Ontario epilimnetic water (ppb). Unless noted, all data are from STORET.

Year	Number of Cases	Minimum	Maximum	Mean	Standard Deviation	Median
1967	14	2.0	48.	19.	13.	17.
1972	78	3.0	350.	40.	60.	19.
1973	81	0.041	190.	21.	25.	17.
1981	7	0.48	17.	5.9	5.5	3.8
1985[1]	22	0.21	2.6	0.87	0.59	0.68

[1] This study.

There is no statistically significant difference between the means for the two years.

Four years of historical total zinc data were found (Table 77). All the historical data are suspiciously high compared to those of 1985.

SUMMARY

Between 1980 and 1985, each of the Great Lakes was sampled either during summer thermal stratification or just after a return to isothermal conditions in early fall. With completion of the Lake Ontario work, the development of a new trace metal data base for each of the lakes is complete. Twenty Lake Ontario stations were occupied during 1985 for the collection of water samples from a depth of 1 m. Samples were analyzed for dissolved and particulated concentrations of Ag, Al, As, B, Ba, Be, Bi, Cd, Co, Cr, Cu, Fe, Li, Mn, Mo, Ni, Pb, Sb, Se, Sn, Sr, V, and Zn and total and dissolved Hg. Dissolved and particulate concentrations were summed to obtain total concentrations.

Historical data were summarized for each element analyzed. In general, historical data are of poor quality and are not useful for predicting trends or intercomparing concentrations for various years of collection. The historical data should be used with extreme caution or not used at all. Because of the sampling for the current work being confined to one cruise during summer thermal stratification and the poor quality of historical data, it is impossible to draw conclusions concerning seasonal and vertical variations of trace elements in the Great Lakes.

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Appendix 1. Measured dissolved element concentrations (ppb) in 1985 Lake Ontario waters.

Station	Depth m	Ag	Al	As	B	Ba	Be	Bi	Cd
LO-85-1	1.	0.00044W	7.4	0.55	47.	20.	0.0033	0.45	0.094
LO-85-8	1.	0.00055W	19.	0.39	9.9T	18.	0.0037	0.34	0.035
LO-85-12	1.	0.00051W	3.6	0.13W	21.T	19.	0.0038	0.035T	0.11
LO-85-23	1.	0.0017W	11.	0.59	30.T	20.	0.0013T	0.38	0.037
LO-85-33	1.	-0.00032W	4.1	0.19T	130.	19.	0.0039	0.32	0.031
LO-85-37	1.	-0.00055W	10.	0.27	76.	19.	0.0059	0.48	0.014T
LO-85-39	1.	0.0015	5.6	0.47	65.	17.	0.0030	0.45	0.010T
LO-85-41 #1	1.	0.0013	3.8	0.55	37.T	16.	0.0041	0.26	-0.0030T
LO-85-41 #2	1.	0.0016	4.3	0.71	5.3T	19.	0.0040	0.12	0.024
LO-85-44	1.	0.0017	1.1	0.79	18.T	18.	0.0050	0.71	0.044
LO-85-49	1.	0.00066W	1.5	0.41	76.	18.	0.0070	0.14	0.016T
LO-85-55 #1	1.	0.0016	3.2	0.50	170.	19.	0.0076	0.57	0.031
LO-85-55 #2	1.	0.0014W	3.3	0.46	160.	17.	0.0054	0.27	0.0030T
LO-85-57	1.	0.0016W	3.2	0.89	210.	17.	0.0024T	0.28	0.017T
LO-85-63	1.	0.0018	0.40T	0.49	37.T	18.	0.0028T	0.13	0.032
LO-85-65	1.	0.0015	1.9	0.24	47.	18.	0.0036	0.12	0.0040T
LO-85-71	1.	0.0019	2.9	0.35	47.	20.	0.0024T	0.45	0.T
LO-85-76	1.	0.00040W	9.3	0.57	30.T	17.	0.0038	0.27	0.0030T
LO-85-81	1.	-0.00054W	4.7	0.82	110.	17.	0.0019T	0.12	0.47
LO-85-86	1.	0.000030W	9.3	0.47	74.	18.	0.0025T	0.062T	0.072
LO-85-89	1.	-0.000030W	4.3	0.66	110.	18.	0.0027T	0.17	0.023
LO-85-90	1.	0.00072W	5.1	0.69	89.	18.	0.0065	0.11	0.094

W=below limit of detection.
T=below criterion of detection.
-0.=not analyzed.

Appendix 1. Continued.

Station	Depth m	Co	Cr	Cu	Fe	Hg	Li	Mn	Mo
LO-85-1	1.	0.022	0.77	0.94	0.94	0.013T	2.1	0.22	1.3
LO-85-8	1.	0.037	0.77	0.94	4.4	0.014T	2.1	0.57	1.3
LO-85-12	1.	0.013	0.65	0.81	0.19T	0.0090T	1.8	0.14	1.3
LO-85-23	1.	0.020	0.38	0.75	1.9	0.016T	1.6	1.3	1.4
LO-85-33	1.	0.012	0.69	0.68	0.38	0.014T	1.8	0.30	1.5
LO-85-37	1.	0.030	0.53	0.80	0.45	0.019	2.0	1.2	1.4
LO-85-39	1.	0.030	0.65	0.84	0.32T	0.0090T	2.1	0.55	1.3
LO-85-41 #1	1.	0.023	0.69	0.76	0.45	0.0010T	1.8	0.30	1.3
LO-85-41 #2	1.	0.021	0.74	0.84	0.23T	0.011T	1.8	0.27	1.6
LO-85-44	1.	0.024	0.66	0.73	0.45	0.0060T	2.1	0.087	1.7
LO-85-49	1.	0.0087	0.90	0.77	-0.040W	0.014T	2.1	0.12	1.6
LO-85-55 #1	1.	0.017	1.0	0.75	1.0	0.0070T	2.1	0.24	1.6
LO-85-55 #2	1.	0.015	0.87	0.76	0.38	0.0010T	2.0	0.25	1.6
LO-85-57	1.	0.031	0.80	0.69	0.84	0.0020T	1.7	0.23	1.5
LO-85-63	1.	0.021	0.81	0.62	0.16T	0.015T	1.6	0.10	1.8
LO-85-65	1.	0.019	0.80	0.66	0.51	0.017T	1.7	0.13	1.8
LO-85-71	1.	0.021	0.81	0.90	0.46	0.011T	1.8	0.15	1.9
LO-85-76	1.	0.027	0.70	0.66	0.63	0.010T	1.4	0.22	1.6
LO-85-81	1.	0.023	0.87	0.63	-0.020W	0.016T	2.7	0.12	1.6
LO-85-86	1.	0.015	0.79	0.65	1.7	0.0080T	2.4	0.38	1.6
LO-85-89	1.	0.016	0.83	0.64	0.54	0.013T	2.5	0.19	1.5
LO-85-90	1.	0.025	0.69	0.83	0.28T	0.0030T	2.2	0.21	1.4

W=below limit of detection.
T=below criterion of detection.
-0.=not analyzed.

Appendix 1. Continued.

Station	Depth m	Ni	Pb	Sb	Se	Sn	Sr	V	Zn
LO-85-1	1.	0.73	0.095	0.14	1.4	0.60	190.	0.20W	0.16
LO-85-8	1.	0.82	0.14	0.15	1.3	1.1	180.	0.13T	0.60
LO-85-12	1.	0.82	-0.038W	0.24	1.5	0.99	170.	0.25	0.11T
LO-85-23	1.	0.40	-0.019W	0.24	1.4	0.10	180.	0.26	1.5
LO-85-33	1.	0.60	-0.052W	0.24	1.9	0.31	170.	0.45	-0.040W
LO-85-37	1.	0.76	0.039T	0.22	1.1	0.18W	170.	0.15T	0.63
LO-85-39	1.	0.60	0.031T	0.14	1.3	0.23	170.	0.14T	0.050T
LO-85-41 #1	1.	0.44	-0.015W	0.24	0.96	0.23	170.	0.54	0.24
LO-85-41 #2	1.	0.44	-0.043W	0.20	0.62	0.63	160.	0.65	0.58
LO-85-44	1.	0.35	-0.0019W	0.15	1.0	0.040T	140.	0.23	0.33
LO-85-49	1.	0.42	-0.026W	0.20	0.83	0.30	140.	0.34	0.040T
LO-85-55 #1	1.	0.48	-0.044W	0.12	0.98	0.21W	190.	0.40	0.19
LO-85-55 #2	1.	0.67	0.020T	0.13	0.88	0.22W	190.	0.35	0.10T
LO-85-57	1.	0.74	0.019T	0.19	0.56	0.23	160.	0.45	0.18
LO-85-63	1.	0.68	-0.0093W	0.19	0.69	0.90	170.	0.28	0.W
LO-85-65	1.	0.66	-0.034W	0.10	0.58	0.80	200.	0.69	0.020T
LO-85-71	1.	0.76	-0.038W	0.16	0.56	0.82	200.	0.56	0.17
LO-85-76	1.	0.53	-0.0038W	0.21	0.68	0.47	190.	0.36	0.14
LO-85-81	1.	0.45	0.010T	0.15	1.1	0.11	190.	0.29	0.39
LO-85-86	1.	0.61	-0.043W	0.15	0.97	0.32	200.	0.072W	0.10T
LO-85-89	1.	0.93	-0.010W	0.17	0.90	0.17	180.	0.092T	0.42
LO-85-90	1.	0.93	-0.0053W	0.040T	1.0	0.12	190.	0.32	0.070T

W=below limit of detection.
T=below criterion of detection.
-0.=not analyzed.

Appendix 2. Measured particulate element concentrations (ppb) in 1985 Lake Ontario waters.

Station	Depth m	Ag	Al	As	B	Ba	Be	Bi	Cd
LO-85-1	1.	0.0015	11.	0.034W	4.7	0.063	0.00045W	0.0024T	0.25
LO-85-8	1.	0.0039	27.	0.035W	5.5	0.32	0.0010T	-0.0060W	0.059
LO-85-12	1.	0.0012	5.1	0.024W	11.	0.22	0.000074T	-0.011W	0.14
LO-85-23	1.	0.0015	62.	0.066	8.0	0.50	0.0024	-0.0089W	0.059
LO-85-33	1.	0.0010	4.3	0.045W	3.6	0.27	0.00016W	-0.0007W	0.080
LO-85-37	1.	0.0015	21.	0.036W	5.5	0.27	0.00087T	-0.057W	0.056
LO-85-39	1.	0.0011	2.0	0.029W	13.	0.10	0.000021T	-0.0018W	0.033
LO-85-41 #1	1.	0.00067	1.3	0.0085W	7.4	0.31	-0.000021W	-0.012W	0.033
LO-85-41 #2	1.	0.00074	1.4	0.0014W	4.5	0.17	0.00025W	0.082W	0.051
LO-85-44	1.	0.00073	1.7	0.016W	3.2	0.52	0.000005W	-0.0078W	0.064
LO-85-49	1.	0.0014	3.7	0.0042W	2.4	0.48	0.000047T	-0.014W	0.080
LO-85-55 #1	1.	0.0015	3.3	0.034T	0.94	0.19	-0.000006W	-0.0067W	0.035
LO-85-55 #2	1.	0.0012	4.3	0.035	2.0	0.26	-0.000006W	0.0011W	0.050
LO-85-57	1.	0.0017	12.	0.028W	7.2	0.19	0.00028T	-0.0080W	0.069
LO-85-63	1.	0.0013	1.5	-0.015W	5.8	0.072W	0.000007W	-0.0065W	0.16
LO-85-65	1.	0.0015	3.5	-0.013W	11.	0.20	0.00011W	-0.0086W	0.10
LO-85-71	1.	0.0015	7.9	0.023W	11.	0.42	0.00020W	0.0003W	0.066
LO-85-76	1.	0.0021	12.	0.038W	16.	0.23	0.00028T	0.0021W	0.12
LO-85-81	1.	0.0011	3.4	0.023W	2.2	0.14	0.000061W	-0.014W	0.19
LO-85-86	1.	0.0015	13.	0.0028W	22.	0.097W	0.00048T	-0.010W	0.12
LO-85-89	1.	0.0013	2.0	0.015W	13.	-0.0040	0.000007W	-0.0033W	0.12
LO-85-90	1.	0.0011	6.2	0.035W	4.2	0.36	0.000089T	-0.011W	0.080

W=below limit of detection.
T=below criterion of detection.
-0.=not analyzed.

Appendix 2. Continued.

Station	Depth m	Co	Cr	Cu	Fe	Hg(1)	Li	Mn	Mo
LO-85-1	1.	0.014	0.079	0.21	13.	0.0090	0.016	1.0	0.0065
LO-85-8	1.	0.014	0.18	0.22	31.	0.0060	0.024	1.8	0.0048T
LO-85-12	1.	0.0043	0.047T	0.19	7.0	-0.014	0.0075	0.66	0.011
LO-85-23	1.	0.018	0.11	0.17	64.	-0.0040	0.066	2.6	0.029
LO-85-33	1.	0.0018	0.026T	0.17	5.1	0.012	0.0077	0.53	0.0091
LO-85-37	1.	0.0080	0.050T	0.16	28.	-0.0090	0.023	1.5	0.022
LO-85-39	1.	0.0035	0.070	0.19	3.7	-0.0020	0.0062	0.33	-0.028W
LO-85-41 #1	1.	0.0023	0.011T	0.28	2.1	0.020	0.0056	0.22	0.0007W
LO-85-41 #2	1.	0.0023	0.021T	0.13	2.5	0.013	0.0047	0.22	-0.034W
LO-85-44	1.	0.0055	0.065	1.30	5.3	-0.0040	0.0049	0.43	-0.021W
LO-85-49	1.	0.0028	0.029T	0.38	7.4	-0.0040	0.0066	0.64	0.034
LO-85-55 #1	1.	0.0019	0.010T	0.14	4.5	0.0050	0.0061	0.71	-0.017W
LO-85-55 #2	1.	0.00045W	0.018T	0.13	4.2	0.	0.0066	0.86	-0.068W
LO-85-57	1.	0.0036	0.032T	0.13	13.	0.0010	0.014	0.88	-0.064W
LO-85-63	1.	0.0037	0.019T	0.24	4.1	-0.0040	0.0049	0.37	0.016
LO-85-65	1.	0.00093W	0.019T	0.16	4.1	0.0030	0.0036	0.68	0.0072
LO-85-71	1.	0.0069	0.015T	0.19	9.8	-0.0080	0.0067	1.5	-0.0053W
LO-85-76	1.	0.0058	0.025T	0.20	17.	-0.0070	0.0086	3.3	0.034
LO-85-81	1.	0.0041	0.015T	0.18	3.8	-0.0070	0.0031T	0.60	0.032
LO-85-86	1.	0.0059	0.027T	0.16	16.	0.0070	0.010	1.0	0.017
LO-85-89	1.	0.0035	0.0056T	0.14	3.2	-0.010	0.0028T	0.48	0.016W
LO-85-90	1.	0.0061	0.022T	0.14	8.5	0.0010	0.0046	1.6	0.033

W=below limit of detection.
T=below criterion of detection.
-0.=not analyzed.
(1) particulate mercury concentration calculated from total and dissolved concentrations; no T's or W's inferred.

Appendix 2. Continued.

Station	Depth m	Ni	Pb	Sb	Se	Sn	Sr	V	Zn
LO-85-1	1.	0.30	0.11	-0.028W	0.042T	0.W	0.73	0.017W	0.77
LO-85-8	1.	0.13	0.13	-0.038W	-0.029W	0.W	0.78	0.055	1.3
LO-85-12	1.	0.091	0.022	-0.020W	0.016T	0.W	0.80	0.0015W	0.19
LO-85-23	1.	0.14	0.15	-0.053W	0.0021W	0.W	0.22	0.11	1.1
LO-85-33	1.	0.077	0.016T	-0.0081W	0.082T	0.W	0.75	0.014	0.25
LO-85-37	1.	0.081	0.11	-0.017W	0.046T	0.W	0.25	0.027	0.55
LO-85-39	1.	0.060	0.020	-0.012W	0.023T	0.W	0.69	0.015	0.31
LO-85-41 #1	1.	0.059	0.0018T	-0.0048W	-0.013W	0.W	0.58	0.0070T	0.25
LO-85-41 #2	1.	0.062	-0.0017W	0.0056T	0.0041W	0.W	0.76	-0.0060W	0.12
LO-85-44	1.	0.11	0.066	-0.0054W	0.020T	0.W	0.62	0.012T	0.99
LO-85-49	1.	0.094	0.080	-0.0049W	0.011T	0.W	0.36	0.0078T	0.56
LO-85-55 #1	1.	0.068	-0.018W	0.0031T	0.052T	0.W	0.45	-0.0032W	0.75
LO-85-55 #2	1.	0.075	0.017T	-0.0078W	0.0079W	0.W	0.45	-0.024W	0.24
LO-85-57	1.	0.054	0.010T	-0.019W	0.013T	0.W	0.50	0.026	0.50
LO-85-63	1.	0.077	0.023	-0.0041W	0.041T	0.W	0.47	0.0039T	0.82
LO-85-65	1.	0.068	0.0081T	-0.0044W	0.0030W	0.W	0.36	0.015	0.21
LO-85-71	1.	0.093	0.024	0.0091T	0.0089W	0.W	0.45	0.018W	0.44
LO-85-76	1.	0.11	-0.0040W	-0.021W	-0.0039W	0.W	0.46	0.014W	1.3
LO-85-81	1.	0.084	-0.010W	-0.010W	0.064T	0.W	0.69	0.012W	0.20
LO-85-86	1.	0.10	0.077	-0.020W	0.024T	0.W	0.57	0.019	1.3
LO-85-89	1.	0.076	0.021	-0.0027W	0.090T	0.W	0.35	0.0066W	0.47
LO-85-90	1.	0.088	0.035	-0.017W	0.019T	0.W	0.96	0.017	0.50

W=below limit of detection.
T=below criterion of detection.
-0.=not analyzed.

Appendix 3. Calculated total element concentrations (ppb) in 1983 Lake Ontario waters.(1)

Station	Depth m	Ag	Al	As	B	Ba	Be	Bi	Cd
LO-85-1	1.	0.0019	19.	0.58	52.	20.	0.0038	0.45	0.34
LO-85-8	1.	0.0044	47.	0.43	15.	19.	0.0047	0.33	0.094
LO-85-12	1.	0.0017	8.8	0.16	32.	19.	0.0039	0.024	0.25
LO-85-23	1.	0.0032	73.	0.66	38.	21.	0.0037	0.37	0.096
LO-85-33	1.	0.00068	8.4	0.23	130.	20.	0.0041	0.32	0.11
LO-85-37	1.	0.00094	31.	0.31	81.	19.	0.0068	0.43	0.070
LO-85-39	1.	0.0026	7.6	0.50	78.	17.	0.0031	0.45	0.043
LO-85-41 #1	1.	0.0020	5.1	0.56	44.	17.	0.0041	0.25	0.030
LO-85-41 #2	1.	0.0023	5.7	0.72	9.8	19.	0.0042	0.20	0.075
LO-85-44	1.	0.0025	2.8	0.81	21.	19.	0.0050	0.71	0.11
LO-85-49	1.	0.0021	5.2	0.42	79.	19.	0.0070	0.12	0.096
LO-85-55 #1	1.	0.0031	6.5	0.54	170.	19.	0.0076	0.57	0.066
LO-85-55 #2	1.	0.0025	7.6	0.49	160.	17.	0.0054	0.27	0.053
LO-85-57	1.	0.0034	15.0	0.92	210.	17.	0.0026	0.27	0.086
LO-85-63	1.	0.0031	1.9	0.47	43.	18.	0.0028	0.12	0.190
LO-85-65	1.	0.0030	5.4	0.22	58.	18.	0.0037	0.11	0.10
LO-85-71	1.	0.0034	11.	0.37	58.	20.	0.0026	0.45	0.066
LO-85-76	1.	0.0025	21.	0.61	46.	17.	0.0041	0.28	0.12
LO-85-81	1.	0.00057	8.1	0.84	110.	17.	0.0019	0.10	0.66
LO-85-86	1.	0.0016	23.	0.47	96.	18.	0.0029	0.052	0.19
LO-85-89	1.	0.0013	6.3	0.67	130.	18.	0.0027	0.17	0.14
LO-85-90	1.	0.0018	11.	0.72	93.	19.	0.0066	0.10	0.17

-0.=not analyzed.
(1)no T's or W's inferred for calculated metal concentrations.

Appendix 3. Continued.(1)

Station	Depth m	Co	Cr	Cu	Fe	Hg(2)	Li	Mn	Mo
LO-85-1	1.	0.035	0.85	1.2	14.	0.022	2.1	1.2	1.3
LO-85-8	1.	0.051	0.95	1.2	36.	0.020	2.2	2.4	1.3
LO-85-12	1.	0.018	0.70	1.0	7.2	-0.0050W	1.8	0.79	1.3
LO-85-23	1.	0.038	0.49	0.92	66.	0.012T	1.7	3.9	1.4
LO-85-33	1.	0.014	0.71	0.85	5.5	0.026	1.8	0.83	1.5
LO-85-37	1.	0.038	0.58	0.96	28.	0.010T	2.0	2.7	1.4
LO-85-39	1.	0.033	0.72	1.0	4.0	0.0070T	2.1	0.88	1.3
LO-85-41 #1	1.	0.025	0.70	1.0	2.6	0.021	1.8	0.52	1.3
LO-85-41 #2	1.	0.024	0.76	0.97	2.7	0.024	1.9	0.49	1.6
LO-85-44	1.	0.030	0.73	2.0	5.7	0.0020T	2.1	0.51	1.6
LO-85-49	1.	0.011	0.93	1.1	7.4	0.010T	2.1	0.76	1.7
LO-85-55 #1	1.	0.019	1.1	0.89	5.5	0.012T	2.1	0.96	1.6
LO-85-55 #2	1.	0.016	0.88	0.89	4.5	0.0010T	2.0	1.1	1.6
LO-85-57	1.	0.035	0.83	0.81	14.	0.0030T	1.8	1.1	1.4
LO-85-63	1.	0.025	0.83	0.86	4.3	0.011T	1.6	0.47	1.8
LO-85-65	1.	0.020	0.82	0.82	4.6	0.020	1.7	0.81	1.8
LO-85-71	1.	0.028	0.82	1.1	10.	0.0030T	1.8	1.7	1.9
LO-85-76	1.	0.033	0.72	0.86	18.	0.0030T	1.4	3.5	1.7
LO-85-81	1.	0.027	0.89	0.80	3.8	0.0090T	2.7	0.72	1.6
LO-85-86	1.	0.021	0.82	0.81	18.	0.015T	2.5	1.4	1.6
LO-85-89	1.	0.020	0.83	0.78	3.7	0.0030T	2.5	0.67	1.5
LO-85-90	1.	0.031	0.71	0.97	8.8	0.0040T	2.2	1.8	1.5

W=below limit of detection.
T=below criterion of detection.
-0.=not analyzed.
(1)no T's or W's inferred for calculated metal concentrations.
(2)measured total mercury concentration.

Appendix 3. Continued.(1)

Station	Depth m	Ni	Pb	Sb	Se	Sn	Sr	V	Zn
LO-85-1	1.	1.0	0.22	0.11	1.5	0.60	190.	0.21	0.93
LO-85-8	1.	0.95	0.25	0.11	1.3	1.1	180.	0.19	1.9
LO-85-12	1.	0.91	0.044	0.22	1.6	0.99	170.	0.26	0.30
LO-85-23	1.	0.54	0.29	0.19	1.4	0.10	180.	0.37	2.6
LO-85-33	1.	0.68	0.031	0.23	2.0	0.31	170.	0.46	0.21
LO-85-37	1.	0.84	0.22	0.20	1.2	0.18	170.	0.18	1.2
LO-85-39	1.	0.66	0.041	0.13	1.3	0.23	170.	0.16	0.36
LO-85-41 #1	1.	0.50	0.0036	0.23	0.95	0.23	170.	0.54	0.49
LO-85-41 #2	1.	0.50	-0.0034	0.20	0.62	0.63	160.	0.64	0.70
LO-85-44	1.	0.46	0.13	0.14	1.0	0.040	140.	0.24	1.3
LO-85-49	1.	0.52	0.16	0.20	0.84	0.30	140.	0.35	0.60
LO-85-55 #1	1.	0.55	-0.036	0.13	1.0	0.21	190.	0.40	0.94
LO-85-55 #2	1.	0.74	0.033	0.12	0.89	0.22	190.	0.33	0.34
LO-85-57	1.	0.79	0.020	0.17	0.58	0.23	160.	0.47	0.68
LO-85-63	1.	0.75	0.047	0.19	0.73	0.90	170.	0.29	0.82
LO-85-65	1.	0.73	0.016	0.10	0.58	0.80	200.	0.70	0.23
LO-85-71	1.	0.85	0.048	0.17	0.56	0.82	200.	0.58	0.61
LO-85-76	1.	0.63	-0.0080	0.19	0.68	0.47	190.	0.37	1.4
LO-85-81	1.	0.53	-0.021	0.14	1.20	0.11	190.	0.30	0.59
LO-85-86	1.	0.71	0.15	0.13	0.99	0.32	200.	0.091	1.4
LO-85-89	1.	1.0	0.042	0.17	0.99	0.17	180.	0.099	0.89
LO-85-90	1.	1.0	0.070	0.023	1.0	0.12	190.	0.33	0.57

-0.=not analyzed.
(1)no T's or W's inferred for calculated metal concentrations.