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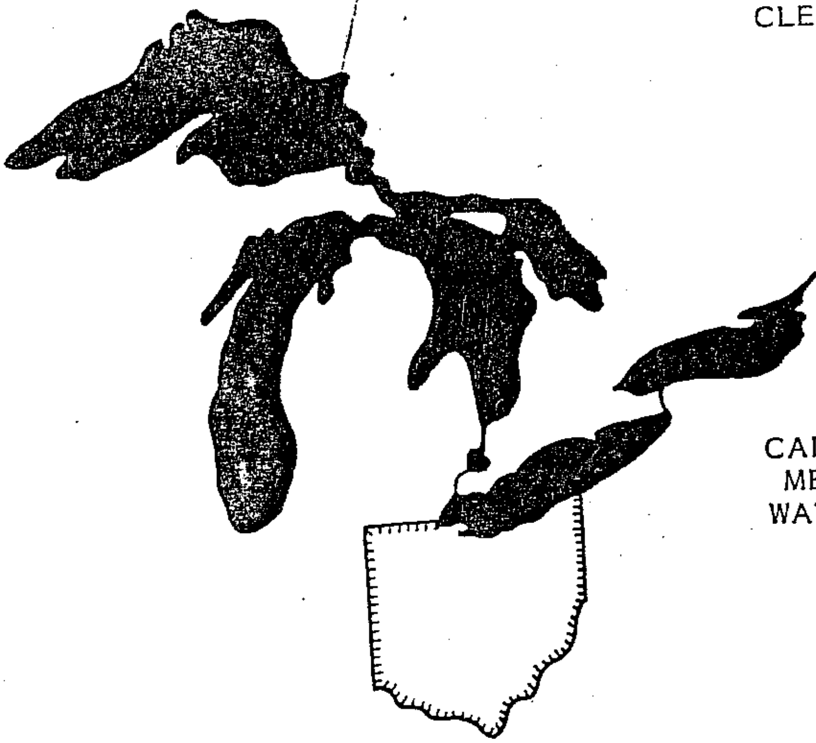

CADMIUM, CHROMIUM, COPPER, MERCURY AND ZINC IN THE WATERS OF MAUMEE BAY AND WESTERN LAKE ERIE

Prepared by

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CENTER FOR LAKE ERIE AREA RESEARCH

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Project Completion Report

Submitted to

Center for Lake Erie Area Research
The Ohio State University

PROJECT PERSONNEL

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METHODS

The Center for Lake Erie Area Research supplied 166 samples of water collected at 59 different stations in western Lake Erie and Maumee Bay. The period of collection was March 18-28, 1975. Most of these samples were collected March 18-23, 1975 from stations in the southwestern portion of the western basin of Lake Erie surrounding Maumee Bay. After the samples arrived in our laboratory, they were preserved with 0.5 ml redistilled HNO_3 until the heavy metal analyses could be completed.

The samples were analyzed for mercury using the cold vapor flameless atomic absorption procedure of Hatch and Ott (1968) and conforms to the modification of EPA (1974). The results for mercury were checked against standard samples of sediment and mercury loaded gelatin and were found to agree within ±5 percent. The overall uncertainty associated with our mercury results in the 0.03 to 10 ppb range is the greater of ±10 percent of the reported value or 0.015 ppb, based on replicate determinations and the determinations of standard samples.

Cadmium, chromium, copper, and zinc were determined using the standard atomic absorption procedure and machine settings for a PE-303 AA described in Perkin-Elmer (1964). A Boling 3-slot burner was used for greater sensitivity. Prior to the atomic absorption analysis, 100 ml of the water samples was digested according to the procedure for total metals analysis in EPA (1974). Following digestion with

HNO_3, the samples were filtered using pre-washed and weighed glass fiber filter paper. The filter paper and particulate residue were dried under vacuum and weighed to give an estimate of the suspended sediment in the water samples. Cd, Cr, Co, and Zn were measured on the filtrate from the acid digestion.

The concentration of metals in the filtrate was determined by comparing the sample response on a model 165 recorder to that of calibration standards. The calibration curve was calculated using the IBM Scientific Subroutine Package Program POLRG to fit a 1 to 3 order power series to the absorbance corresponding to the chart responses using a least squares method. The following relationship was used to convert observed absorption values to absorbance:

absorbance = log [100/(100-% absorption)]

The uncertainty associated with the analyses of cadmium, copper, chromium and zinc is ±10% of the reported value, based on replicate determination.

RESULTS AND DISCUSSION

The results of the heavy metal analyses are given in Table 1. Two types of containers were used: 1) a screw cap wide mouth polyethylene jar (J) which was included in both the first and second set of samples to be received, and 2) a small mouth polyethylene bottle (B) which was included in only the second set of samples. Most of the polyethylene bottles were marked ELEC, but some were noted M or METALS. These samples are designated set 2M.

The estimate of suspended solids given in Table 1 contains a high degree of uncertainty. Due to the method that was used (described previously), solid organic material or solid metal oxides which were acid soluble would not have been detected. Therefore this is an estimate of suspended silicate mineral material.

The heavy metal analyses are difficult to interpret because they were obtained from samples collected at various times and places. Walters et al. (1972) defined two major water masses in western Lake Erie. The first was the Detroit River water mass that flowed southeast across the western basin toward the island area, and the second was a mixed water that was fairly uniform. These water masses move about in the lake as Kovacik (1972) established for Detroit River water moving to the Toledo Water Intake. He estimated that the water moved at 0.5 ft/sec. This movement can result in widely varying results for samples from the same station taken on different days.

Most of the results for samples in and near Maumee Bay show very little variability and represent a low or background level. In contrast, the samples from the eastern edge of the sample grid tend to show very high values of metals. These samples are at the western edge of the Detroit River water mass defined by Walters et al. (1972), and represent pollutants coming from the Detroit River.

The general levels observed for metals in the water samples near Maumee Bay were 0.03-0.2 ppb mercury, 120-300 ppb zinc, 1.5-4.5 ppb cadmium, 14-50 ppb copper, and 1.0-5.0 ppb chromium. Samples showing the effects of pollution ranged up to 5.9 ppb mercury, 820 ppb zinc, 5.7 ppb cadmium, 580 ppb copper, and 19 ppb chromium.

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Table 1. Results of Heavy Metal Analyses of Maumee Bay and Western Lake Erie Water Samples.

STATION	DATE	DEPTH	CONTAINER/ SAMPLE SET	SUSPENDED SOLIDS ppb	Hg ppb	Zn ppb	Cd ppb	Cu ppb	Cr ppb
55	87	001	B/2	<3	0.14	170	3.3	31	1.0
55	87	LE	B/2		0.27				
55	87	B	B/2		0.04				
57	82	S	J/2	<3	0.05	180	4.0	23	1.0
57	82	01	B/2		<0.03				
57	82	LE	B/2		0.16				
57	82	B			<0.03				
59	79	001	B/2	4	4.9	150	2.8	24	7.8
59	79	LE	B/2		2.2				
59	79	B	B/2		0.69				
60	82	S	J/2	<3	0.42	202	4.0	16	1.0
60	82	001	B/2		0.05				
60	82	LE	B/2		<0.03				
60	82	B	B/2		<0.03				
61	82	S	J/2	<3	0.05	160	3.3	12	1.4
61	82	01	B/2		0.06				
61	82	LE	B/2		0.04				
61	82	B	B/2		<0.03				
65	87	01	B/2	8	0.19	290	2.8	97	8.2
65	87	LE	B/2		0.11				
65	87	B	B/2		0.87				
67	86	01	B/2	3	0.21	570	4.0	26	15.
67	86	LE	B/2		0.20				
67	86	B	B/2		0.10				
68	86	001	B/2	4	0.31	400	3.7	30	13
68	86	LE	B/2		0.12				
68	86	B	B/2		0.45				

STATION	DATE	DEPTH	CONTAINER/ SAMPLE SET	SUSPENDED SOLIDS ppb	Hg ppb	Zn ppb	Cd ppb	Cu ppb	Cr ppb
70	77	S	J/1	47	0.11	160	3.1	22	10.
70	82	S	J/2		0.05				
70	82	01	B/2		0.08				
70	83	01	B/2		0.07				
70	79	001	B/2		0.14				
70	79	LE	B/2		0.07				
70	82	LE	B/2		0.08				
70	83	LE	B/2		<0.03				
70	79	B	B/2		0.09				
70	82	B	B/2		0.09				
70	83	B	B/2		0.06				
75	83	S	J/2	12	0.04	270	2.7	14	11.
75	83	01	B/2		0.99				
75	83	B	B/2		0.05				
76	83	001	B/2	11	0.09	560	3.6	60	18.
76	83	B	B/2		<0.03				
101	79	001	B/2	<3	5.2	310	<1.5	540	3.1
101	79	B	B/2		5.9				
102	79	S	J/1	<3	0.53	220	3.1	13.	2.7
102	79	S	B/2		0.03				
102	72	B	B/2		<0.03				
103	79	S	J/1	<3	0.11	340	3.9	15.	<1.0
104	79	S	B/2	<3	0.03	190	3.1	15.	4.7
104	79	B	B/2		0.03				
104	79	S	J/1		0.13				
105	79	001	B/2	<3	4.0	230	5.0	29.	5.2
105	79	B	B/2			240	3.4	100.	<1.0

STATION	DATE	DEPTH	CONTAINER/ SAMPLE SET	SUSPENDED SOLIDS ppb	Hg ppb	Zn ppb	Cd ppb	Cu ppb	Cr ppb
106	79	S	J/1	<3	0.11	200	3.6	18.	7.8
106	79	S	B/2		<0.03				
106	79	B	B/2		<0.03				
107	79	S	J/1	3	0.19	190	4.7	30.	6.8
107	79	B	B/2		<0.03				
108	79	S	J/1	17	0.22	160	5.9	17.	<1.0
108	79	S	B/2		0.04				
109	79	S	J/1	17	0.28	140	<1.5	70.	3.2
109	79	S	B/2		0.11				
110	78	S	J/1	7	0.34	280	4.3	180	8.4
111	78	S	J/1	<3	0.15	190	2.9	30.	<1.0
112	78	S	J/1	<3	0.09	330	<1.5	18.	2.4
113	77	S	J/1	9	0.23	430	3.8	500.	8.1
113	79	01	B/2		0.13				
113	79	B	B/2		<0.03				
114	79	S	J/1	3	0.09	150	5.6	19	4.8
114	79	S	B/2		<0.03				
114	79	B	B/2		0.04				
115	79	S	J/1	29	0.32	210	3.8	24	11.
115	79	S	B/2		2.5				
115	79	B	B/2		0.03				
116	79	S	J/1	34	0.48	140	7.3	25	10.
116	79	S	B/2		0.06				
116	79	B	B/2		0.40				
117	79	S	J/1	5	0.07	120	<1.5	52	<1.0
117	79	S	B/2		0.04				
117	79	B	B/2		0.09				

STATION	DATE	DEPTH	CONTAINER/ SAMPLE SET	SUSPENDED SOLIDS ppb	Hg ppb	Zn ppb	Cd ppb	Cu ppb	Cr ppb
118	78	S	J/1	5	0.07	820	4.4	41	13.
119	78	S	J/1	9	0.11	580	3.4	77	19.
120	77	S	J/1	38	0.19	380	4.2	83	15.
120	82	S	J/2		0.22				
120	79	001	B/2		<0.03				
120	82	01	B/2		0.03				
120	79	B	B/2		<0.03				
120	82	B	B/2		<0.03				
121	78	S	J/1	42	0.09	280	<1.5	28.	16.
122	79	S	J/1	29	0.56	240	<1.5	15	4.4
122	79	B	B/2		<0.03				
123	79	S	J/1	66	0.11	290	4.2	29	14.
123	79	S	B/2		0.06				
123	79	001	B/2		2.1				
123	79	B	B/2		2.4				
124	79	S	J/1	8	0.17	240	3.2	35	<1.0
124	79	001	B/2						
124	79	B	B/2						
125	78	S	J/1	10	0.10	180	<1.5	15	4.4
126	78	S	J/1	21	<0.03	170	<1.5	16	8.9
127	78	S	J/1	35	0.06	180	2.8	20	11.
127	82	S	J/2		0.05				
127	79	001	B/2		4.9				
127	82	01	B/2		0.08				
127	79	B	B/2		0.07				
127	79	B	B/2		0.09				
127	82	B	B/2		0.03				

STATION	DATE	DEPTH	CONTAINER/ SAMPLE SET	SUSPENDED SOLIDS ppb	Hg ppb	Zn ppb	Cd ppb	Cu ppb	Cr ppb
128	79	S	J/1	39	0.13	170	<1.5	16	5.4
128	79	01	B/2		1.5				
128	79	B	B/2		3.4				
129	79	S	J/1	90	0.07	160	<1.5	13	13.
129	79	S	B/2		0.31				
129	79	B	B/2		0.19				
130	78	S	J/1	20	0.11	170	<1.5	53	8.1
131	78	S	J/1	45	0.25	240	2.5	21	6.8
132	77	S	J/1	76	0.04	160	4.8	24	11.
132	79	001	B/2		0.08				
132	82	01	B/2		0.06				
132	79	B	B/2		0.11				
132	82	B	B/2		0.04				
133	78	S	J/1	69	0.22	170	<1.5	18	12.
134	78	S	J/1	47	0.23	230	2.9	70	11.
135	77	S	J/1	68	<0.03	220	<1.5	64	14.
135	79	01	B/2		0.06				
135	82	S	B/2		0.98				
135	79	B	B/2		0.04				
135	82	B	B/2		3.3				
136	78	S	J/1	120	0.20	180	3.8	14	13.
137	78	S	J/1	52	0.15	170	4.8	21	8.0
138	78	S	J/1	39	0.28	120	<1.5	93	8.9
139	77	S	J/1	31	0.11	180	3.9	16	3.3
139	79	001	B/2		0.16				
139	80	001	B/2		0.21				
139	80	001	B/2M		0.11				

STATION	DATE	DEPTH	CONTAINER/ SAMPLE SET	SUSPENDED SOLIDS ppb	Hg ppb	Zn ppb	Cd ppb	Cu ppb	Cr ppb
139	82	S	B/2		0.10				
139	83	01	B/2		0.11				
139	79	B	B/2		0.04				
139	80	B	B/2M		0.09				
139	80	B	B/2		0.18				
139	82	B	B/2		0.76				
139	83	B	B/2		0.05				
140	77	S	J/1	39	0.12	120	<1.5	18	5.1
140	80	01	B/2		0.12				
140	80	01	B/2M		<0.03				
140	80	B	B/2		0.05				
140	80	B	B/2M		<0.03				
141	77	S	J/1	37	0.11	190	3.2	120	6.1
141	80	01	B/2M		0.04				
141	80	001	B/2		0.07				
141	80	B	B/2		0.16				
141	80	B	B/2M		0.07				
148	79	S	J/1	33	0.11	150	4.6	27	5.4
148	79	S	B/2		0.18				
148	79	B	B/2		1.5				
149	79	S	J/1	120	0.13	300	5.2	580	14.
149	79	S	B/2		0.37				
149	79	B	B/2		0.16				
150	80	S	J/1	75	0.15	170	3.2	47	12.
150	80	001	B/2		0.18				
151	80	S	J/1	32	0.16	170	5.1	85	8.0
151	80	001	B/2		0.15				
152	80	S	J/1	29	0.21	180	5.7	34	13.
152	80	001	B/2		0.14				
153	80	S	J/1	21	0.12	250	3.4	22	10.
153	80	001	B/2		0.10				