MESA NEW YORK BIGHT PROJECT WATER COLUMN CHEMISTRY DATA
CRUISES #6-12 OF THE NOAA SHIP FERREL
APRIL - NOVEMBER 1974

A. Y. Cantillo
G. A. Berberian

Atlantic Oceanographic and Meteorological Laboratory
Miami, Florida
November 1997
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October 1997
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ABSTRACT

During the period April - November 1974, seven oceanographic cruises, denoted WCC 6-12, were conducted by NOAA Ship FERREL to obtain samples of sea water and suspended particulates from the New York Bight Apex for chemical analyses. This report presents the chemical data obtained from these samples.

1. INTRODUCTION

During 1973, the National Oceanic and Atmospheric Administration (NOAA) began an intensive investigation of the marine ecosystem of the continental shelf off New Jersey and New York, the area known as the New York Bight. This project is the first regional study of the Marine EcoSystem Analysis (MESA) Program. Detailed serial studies of the water chemistry in the New York Bight have not previously been performed. Therefore, the initial phase of investigations in the Bight has included an extensive physical, chemical, and oceanographic program to provide basic information concerning the geographical distribution and temporal variability of some representative chemical parameters of the sea water and its suspended particulate load.

The major contaminant sources, ocean dumping of sewage sludge, dredge spoil and acid waste, and outflow from the New York/New Jersey estuarine system, are all located in the Apex of the New York Bight. The initial phase of the marine chemistry observations was restricted to an area of approximately 40 km square in the Apex of the region (Fig. 1). From April to November, 1974, seven cruises were conducted in the New York Bight Apex covering a 26-station grid (Fig. 1) aboard NOAA Ship FERREL. These cruises were designated Water Column Characterization (WCC) cruise numbers 6 through 12 (Table 1). Cruises (1 through 5) had previously been conducted covering the same 26 stations during the period August to November 1973. However, these earlier cruises included only a very limited chemistry sampling program. Some of the resultant chemical data for WCC 1 through 5 have been reported by Hazelworth et al. (1974).

On cruises WCC 6 through 12, water column sampling was performed simultaneously with physical oceanographic data collection to define the density structure of the water column. Physical characterization of the collected suspended particulates is part of an investigation of suspended sediment transport processes. The physical oceanographic data from these cruises have been reported elsewhere (Hazelworth et al., 1975a, 1975b). The water column chemistry data is listed in Appendix I.

* Current address: NOAA/NOS, 1305 East West Hwy., Silver Spring, MD.
2. FIELD PROCEDURES

The 26-station Apex grid was occupied during daylight hours over a period of four to five days. The sequence of station occupation was modified on each cruise in response to weather, day length, and ship operational constraints. The sequence of occupation is shown in Figures 2 through 8 for cruises 6 through 12 respectively. On each of these cruises, except WCC 11, station 7 was occupied twice on separate days in order to investigate the gross temporal variability of the water column chemistry. On cruise WCC 8, station 3 was also occupied twice. Stations 16, 21, 22, and 23 could not be occupied on cruise WCC 7 due to adverse weather conditions. Station 26 was occupied on cruises WCC 11 and 12 only.

At each WCC station sampled, vertical profiles of temperature, salinity, conductivity, light transmissivity, dissolved oxygen, pH and Eh were measured using an Inter-Ocean model 513-10 CSTD. Equipment malfunction offer precluded investigation of several of the parameters on a number of WCC cruises. The vertical profiles of the data obtained with the CSTD have been reported by Hazelworth et al. (1975a, 1975b). Water samples were collected at several depths with Niskin water sampling bottles. Standard 10-L Niskin bottles were used for sampling from a hydrowire for cruises WCC 6 through 9. On cruises 10, 11, and 12, samples were collected with 10-L, top-drop Niskin samplers mounted on a rosette multi-bottle
### Table 1. MESA New York Bight Water Column Chemistry cruises, April - November, 1974.

<table>
<thead>
<tr>
<th>Cruise</th>
<th>Date</th>
<th>AOML Personnel</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Apr. 16-20, 1974</td>
<td>R. Starr, G. Berberian, D. Segar</td>
<td>Station 7 occupied twice. Station 26 not occupied</td>
</tr>
<tr>
<td>7</td>
<td>May 06-09, 1974</td>
<td>R. Starr, G. Berberian, L. Keister</td>
<td>Station 7 occupied twice. Stations 16, 21, 22, and 23 not occupied, due to inclement weather. Station 26 not occupied.</td>
</tr>
<tr>
<td>8</td>
<td>June 10-13, 1974</td>
<td>J. Hazelworth, D. Segar, M. Weiselberg</td>
<td>Stations 3 and 7 occupied twice. Station 26 not occupied</td>
</tr>
<tr>
<td>9</td>
<td>July 16-19, 1974</td>
<td>B. Kolitz, P. Hatcher, E. Forde</td>
<td>Station 7 occupied twice. Station 26 not occupied</td>
</tr>
<tr>
<td>10</td>
<td>Aug. 21-24, 1974</td>
<td>J. Hazelworth, D. Drake</td>
<td>Station 7 occupied twice. Station 26 not occupied</td>
</tr>
<tr>
<td>12</td>
<td>Nov. 4-7, 1974</td>
<td>B. Kolitz, D. Segar, M. McGrenra*</td>
<td>Station 7 occupied twice.</td>
</tr>
</tbody>
</table>

* From MESA New York Bight Project Office.

The multi-bottle array was mounted immediately above the sensors of the InterOcean CSTD system, so that the bottom of the Niskin samplers were approximately level with the sensors.

When recovered, the Niskin bottles were immediately transferred to the ship's laboratory where the samples of water were drawn as shown in Table 2. The samples for dissolved oxygen analysis were obtained immediately in order to minimize atmospheric contamination and any temperature-induced changes. These samples were preserved with manganous sulfate and alkaline iodide reagents and later analyzed by the modified Winkler titration method of Strickland and Parsons (1968). The next samples drawn were those for dissolved trace metal and particulate concentration analyses. The samples for dissolved trace metal analysis were filtered through pre-weighed 47 mm Nuclepore (0.45 µ pore size) filters on all cruises except WCC 6. The filtered sea water, usually 1 L, was stored in an acid-cleaned, 1-L linear-polyethylene bottle and acidified with 1 mL of silicate distilled, concentrated nitric acid.
Figure 2. Track line of NOAA ship FERREL for WCC 6, April 1974.

Figure 3. Track line of NOAA ship FERREL for WCC 7, May 1974.
Figure 4. Track line of NOAA ship FERREL for WCC 8, June 1974.

Figure 5. Track line of NOAA ship FERREL for WCC 9, July 1974.
Figure 6. Track line of NOAA ship FERREL for WCC 10, August 1974.

Figure 7. Track line of NOAA ship FERREL for WCC 11, September - October 1974.
Figure 8. Track line of NOAA ship FERREL for WCC 12, November 1974.

Table 2. Samples drawn from Niskin bottles.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Volume</th>
<th>Treatment</th>
<th>Container</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxygen</td>
<td>250 mL</td>
<td>Manganese sulfate and alkali iodide reagents</td>
<td>Amber glass bottle with ground glass stopper</td>
</tr>
<tr>
<td>Trace metals</td>
<td>1000 mL</td>
<td>Filtered through Nuclepore filter and acidified with nitric acid</td>
<td>Acid cleaned 1-L linear-polyethylene bottles. Filter was frozen.</td>
</tr>
<tr>
<td>Nutrients</td>
<td>100 mL</td>
<td>Frozen</td>
<td>&quot;Aged&quot; 250-mL polyethylene bottles</td>
</tr>
<tr>
<td>Particulate organics</td>
<td>2 x 2000 mL</td>
<td>Frozen</td>
<td>Duplicate glass fiber filters</td>
</tr>
<tr>
<td>pH</td>
<td>100 mL</td>
<td>On-board measurement</td>
<td>Beaker</td>
</tr>
<tr>
<td>Salinity</td>
<td>500 mL</td>
<td>None</td>
<td>500-mL glass</td>
</tr>
<tr>
<td>Particulates</td>
<td>50 mL</td>
<td>Frozen</td>
<td>Millipore filters</td>
</tr>
</tbody>
</table>
The Nuclepore filters were stored frozen for analysis of total suspended sediment loads and elemental metal composition. The nutrient samples were collected in aged 125-mL polyethylene bottles and frozen immediately. Approximately 1 to 2 L of sea water were filtered through a glass-fiber filter to collect suspended particulates for organic analysis. Two such filters were obtained, one for analysis of particular organic carbon and the other for analysis of particulate carbohydrates and proteins. Both filters were frozen immediately after collection. A sample of sea water was drawn and its pH obtained on board using a Orion-Model 701 pH meter standardized with Beckman pH 7 and 10 buffers. Samples for salinity determinations were collected in glass bottles and stored. One hundred mL of sea water were filtered through a Millipore filter for microscopic examination.

3. LABORATORY ANALYSES

3.1. Salinity

The samples for salinity determination were also analyzed onshore, using a Plessey 6220 salinometer. The salinity values presented here are those derived from the salinity analysis of the water samples; they are sometimes in disagreement with the salinities obtained with the Inter-Ocean model 513-10 CSTD (and corrected by the Plessey 6220 salinity values) as reported by Hazelworth et al. (1975a, 1975b).

All other samples collected were shipped, frozen when necessary, to the NOAA Atlantic Oceanographic and Meteorological Laboratories (AOML) in Miami, Florida, for analyses, or analyzed on shore.

3.2. Dissolved oxygen

The analysis of the samples preserved for oxygen determination (by the modified Winkler method) was carried out on shore immediately after each of the FERREL cruises, WCC 6 through 12. Calculation of the percent saturation of oxygen was performed using the results of the modified Winkler oxygen analysis, the salinity values obtained with the salinometer, and the temperature recorded by the CSTD system, by using the equation of Weiss (1970).

3.3. Total dissolved trace metals

The sea water samples were analyzed for total dissolved Fe, Mn, Cu, and Cd by the method of Segar and Cantillo (1976), using a Perkin-Elmer Atomic Absorption Spectrophotometer Model 503 equipped with a Heated Graphite Atomizer (HGA 2100). The analysis was generally completed within three months after collection of the samples. The samples collected on WCC 6 were not filtered, and the results obtained are a measure of the total metal in the sea water. The samples for cruises WCC 10, 11, and 12 were also analyzed for total dissolved Zn by the method of Segar and Cantillo (1976). The approximate detection limits of the dissolved trace metal analyses are as follows: Fe, 0.4 µg/kg; Mn, 0.3 µg/kg; Cu, 0.5 µg/kg; Cd, 0.01 µg/kg; and Zn, 0.01 µg/kg. The precision of trace metal analysis varied, but it was always better than ±15% for concentrations in excess of 10 times the detection limit.

3.4. Dissolved nutrients

Water samples were analyzed for dissolved nitrate (NO$_3^-$-N), nitrite (NO$_2^-$-N), orthophosphate (PO$_4^{3-}$-P), and silicate (SiO$_2$-Si) with a fourchannel Technicon Autoanalyzer, generally within a period of six weeks after their collection.
Table 3. Operational characteristics of the nutrient analysis system.

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Lower Limit (µg-at/L)</th>
<th>Upper Limit (µg-at/L)</th>
<th>(95% confidence level)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO₃-N</td>
<td>0.0</td>
<td>50.0</td>
<td>0.5</td>
</tr>
<tr>
<td>NO₂-N</td>
<td>0.0</td>
<td>20.0</td>
<td>0.1</td>
</tr>
<tr>
<td>PO₄-P</td>
<td>0.0</td>
<td>20.0</td>
<td>0.05</td>
</tr>
<tr>
<td>SiO₃-Si</td>
<td>0.0</td>
<td>50.0</td>
<td>0.5</td>
</tr>
</tbody>
</table>

The analytical procedures used in the analyses for nitrate and nitrite are described by Armstrong et al. (1967). The orthophosphate procedure is described by Grasshoff (1965), and the silicate procedure is described by Strickland and Parsons (1968). The water used for standardization, blank determinations, and wash between samples is filtered Gulf Stream sea water obtained from the surface of the Straits of Florida. The detection limits and accuracies of analysis for the four nutrients are listed in Table 3.

3.5. Particulate organics

Suspended sediments were collected on glass-fiber filters and analyzed for particulate organic carbon by combustion in the presence of oxygen at 650°C. The CO₂ resulting from the combustion was measured by using thermal conductivity detectors on a Perkin-Elmer 240 Elemental Analyzer. The amount of carbon present in the total filter is calculated from the amount of CO₂ produced. This method is a modification of the methods proposed by Konrad et al. (1970) and by Hatcher (1974) for the analysis of total organic carbon in sediments. Analyses were performed under contract by Galbraith Laboratories, Knoxville, Tennessee. Precision of the method is usually ±1%; however, if sampling errors are considered, the total analytical precision is generally ±10%. Detection limits are 10 pg/L.

Suspended sediments collected on glass-fiber filters were analyzed for particulate carbohydrates and proteins, using the same filter. The freeze dried filter was homogenized by ultrasonification in 10 mL distilled water. Two aliquots were then taken for particulate carbohydrate analysis by the phenol sulfuric acid method of Gerchakov and Hatcher (1972). The remaining homogenate was treated with sodium hydroxide and allowed to stand overnight to solubilize proteins. Subsequently, the homogenate was centrifuged and aliquots were taken for particulate protein analysis by the Biuret method (Ellman, 1962). The relative standard deviation for both methods is roughly 8%; however, if sampling errors are considered, the total relative standard deviations are generally ±15%. Detection limits for particulate carbohydrates and proteins are 5 and 10 pg/L, respectively.

4. DISCUSSION

The data generated during the MESA New York Project cruises has been discussed in numerous publications (e.g., Atwood et al., 1979; Segar and Berberian, 1976; Segar and Cantillo, 1976; and others). This data report was originally written in 1977 and remained unpublished. Publication at this time is part of an effort to document the chemistry data in a form accessible to future investigators in the Bight.
5. ACKNOWLEDGMENTS

The authors wish to acknowledge P. G. Hatcher, L. E. Keister and D. A. Segar who worked on the original version of this document. They also express their thanks to the officers and crew of the NOAA Ship FERREL under CDR. Philip Johnson, for the long and patient hours they dedicated to collecting the data. Thanks are also expressed to Maxine Weiselberg, Karen Jamruz, and Nereyda Galceran for their assistance in the sample analyses, and to Mike Darnell and Walter Manning for their assistance in computer programming. The effort was sponsored by NOAA and funded in part by NOAA Environmental Research Laboratories and the MESA New York Bight Project.

6. REFERENCES


### APPENDIX I

**Chemistry data**

**Parameters and units**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>Depth (meters)</td>
</tr>
<tr>
<td>SAL</td>
<td>Salinity (‰)</td>
</tr>
<tr>
<td>O₂</td>
<td>Oxygen (mL/L)</td>
</tr>
<tr>
<td>%O₂</td>
<td>Percent saturation of oxygen</td>
</tr>
<tr>
<td>pH</td>
<td>pH</td>
</tr>
<tr>
<td>PCH</td>
<td>Particulate carbohydrates (µg/L)</td>
</tr>
<tr>
<td>PPRO</td>
<td>Particulate proteins (µg/L)</td>
</tr>
<tr>
<td>POC</td>
<td>Particulate organic carbon (µg/L)</td>
</tr>
<tr>
<td>Fe</td>
<td>Total dissolved iron (µg/L)</td>
</tr>
<tr>
<td>Mn</td>
<td>Total dissolved manganese (µg/L)</td>
</tr>
<tr>
<td>Cu</td>
<td>Total dissolved copper (µg/L)</td>
</tr>
<tr>
<td>Cd</td>
<td>Total dissolved cadmium (µg/L)</td>
</tr>
<tr>
<td>Zn</td>
<td>Total dissolved zinc (µg/L)</td>
</tr>
<tr>
<td>NO₂⁻</td>
<td>Dissolved nitrite (µg-at/L)</td>
</tr>
<tr>
<td>NO₃⁻</td>
<td>Dissolved nitrate (µg-at/L)</td>
</tr>
<tr>
<td>PO₄³⁻</td>
<td>Dissolved phosphate (µg-at/L)</td>
</tr>
<tr>
<td>Dissolved silicate (µg-at/L)</td>
<td></td>
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</tbody>
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Table I.1. Water chemistry characterization cruise WCC 6 data.

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Salinity (°/oo)</th>
<th>O₂ (mL/L)</th>
<th>%O₂</th>
<th>pH</th>
<th>Particulate organics (µg/L)</th>
<th>Dissolved trace metals (µg/L)</th>
<th>Dissolved nutrients (µg-at/L)</th>
</tr>
</thead>
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<td></td>
<td></td>
<td></td>
<td></td>
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<td>PCH</td>
<td>PPPO</td>
<td>POC</td>
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<td>GMT: 18.4 Date: 4/20/74</td>
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<td>790</td>
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<td>470</td>
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<td>Long (W): 73</td>
<td>GMT: 19.1 Date: 4/18/74</td>
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<td>GMT: 18.0 Date: 4/18/74</td>
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<tr>
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<td>109</td>
<td>7.82</td>
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<td>390</td>
<td>530</td>
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<td>7.76</td>
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<td>560</td>
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Table I.1. Water chemistry characterization cruise WCC 6 data (cont.).

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<tr>
<th>Station</th>
<th>Lat (N):</th>
<th>Long (W):</th>
<th>GMT:</th>
<th>Date:</th>
<th>Depth (m)</th>
<th>Salinity (‰)</th>
<th>O₂ (mL/L)</th>
<th>%O₂</th>
<th>pH</th>
<th>Particulate organic (µg/L)</th>
<th>Dissolved trace metals (µg/L)</th>
<th>Dissolved nutrients (µg-at/L)</th>
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Table I.2. Water chemistry characterization cruise WCC 7 data (cont.).

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<th>SiO(_2)^{-2} (µg-at/L)</th>
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**Station 6**
Lat (N): 40 26.3
Long (W): 73 57.0
GMT: 13.8
Date: 5/8/74

| 1  | 27.77 | 6.46 | 99 | 8.08 | 170 | 220 | 550 | 16 | 20 | 4.4 | 0.58 | - | 0.74 | 8.79 | 1.12 | 1.04 |
| 9  | 30.03 | 5.90 | 88 | 8.07 | 290 | 490 | 520 | 8.8 | 8.1 | 1.1 | 0.29 | - | 0.30 | 1.78 | 0.69 | 0.64 |

**Station 7**
Lat (N): 40 26.8
Long (W): 73 53.2
GMT: 22.5
Date: 5/6/74

| 1  | 29.59 | - | - | 8.22 | 240 | 420 | 460 | 11 | 14 | 3.8 | 0.41 | - | 0.22 | 1.91 | 0.99 | 0.37 |
| 10 | 32.39 | - | - | 8.20 | 120 | 220 | 320 | 6.4 | 3.5 | 0.95 | 0.25 | - | 0.25 | 0.13 | <0.40 | 0.28 |
| 18 | 32.82 | - | - | 8.16 | 230 | 290 | 420 | 15 | 8.9 | 2.3 | 0.37 | - | 0.13 | 1.44 | 1.74 | 0.70 |

**Station 8**
Lat (N): 40 27.4
Long (W): 73 47.6
GMT: 16.2
Date: 5/8/74

| 1  | 31.38 | 6.65 | 105 | 8.20 | 180 | 120 | 220 | 1.6 | 1.3 | 3.9 | 0.29 | - | <0.01 | <0.10 | <0.40 | 0.10 |
| 10 | 31.49 | 6.50 | 102 | 8.23 | 490 | 360 | 500 | 0.93 | 3.1 | 1.6 | 0.25 | - | <0.01 | <0.10 | <0.40 | 0.16 |
| 20 | 32.54 | 5.15 | 74 | 8.05 | 110 | 110 | 210 | 2.7 | 4.1 | - | 0.33 | - | 0.14 | 2.02 | 2.69 | 0.69 |
| 25 | 32.57 | 5.15 | 74 | 8.03 | 130 | 90 | 220 | 1.4 | 4.5 | <0.50 | 0.16 | - | 0.16 | 1.61 | 2.01 | 0.66 |
Table I.2. Water chemistry characterization cruise WCC 7 data (cont.).

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<th>pH</th>
<th>PCH</th>
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<th>Dissolved trace metals (µg/L)</th>
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<th>Fe</th>
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<th>Zn</th>
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Table I.2. Water chemistry characterization cruise WCC 7 data (cont.).

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GMT: 15.6  
Date: 6/11/74

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Table I.3. Water chemistry characterization cruise WCC 8 data (cont.).

| Station | Lat (N): | Long (W): | GMT: | Date: | Depth (m) | Salinity (‰) | O₂ (mL/L) | %O₂ | pH | PCH | PPOR | POC | Fe (µg/L) | Mn (µg/L) | Cu (µg-at/L) | Cd (µg-at/L) | Zn (µg-at/L) | NO₂⁻ (µg/L) | NO₃⁻ (µg/L) | SiO₃²⁻ (µg/L) | PO₄³⁻ (µg/L) |
|---------|----------|-----------|------|-------|----------|-------------|-----------|-----|----|-----|------|-----|---------|---------|----------------|----------------|-------------|-------------|-------------|-------------|----------------|-------------|----------------|----------------|
| 1       | 40 21.1  | 73 29.3   | 20.3 | 6/10/74 | 31.32      | 6.31         | 110       | 8.26 | 160 | 170 | 220 | 8.8 | 3.0 | 2.3 | 0.20 | <0.01 | <0.10 | <0.40 | 0.06 |
| 10      | 31.20    | 6.41      | 109  | 8.28  | 340 | 30 | 340 | 15 | 2.9 | 14 | 0.20 | <0.01 | <0.10 | <0.40 | 0.16 |
| 20      | 31.38    | 5.91      | 48   | 8.22  | 170 | 60 | 240 | 8.3 | 2.4 | 3.1 | 0.79 | <0.01 | <0.10 | <0.40 | 0.16 |
| 25      | 31.49    | 5.63      | 92   | 8.19  | 90  | 90 | 140 | 4.2 | 3.5 | 3.2 | 0.12 | <0.01 | 0.12 | 1.00 | 0.23 |
| 2       | 40 13.4  | 73 56.0   | 15.7 | 6/10/74 | 28.23      | 8.40         | 151       | 8.45 | 1230 | 1240 | 1090 | 10 | 2.9 | 9.8 | 0.38 | 0.14 | <0.10 | <0.40 | 0.42 |
| 9       | 30.25    | 5.90      | 102  | 8.42  | 400 | 420 | 590 | 7.9 | 3.3 | 2.8 | 1.4 | 0.13 | <0.10 | <0.40 | 0.12 |
| 19      | 30.92    | 5.69      | 96   | 8.35  | -   | -  | -  | -  | -  | -  | -  | -  | -  | 0.06 | <0.10 | <0.40 | 0.29 |
| 3       | 40 14.1  | 73 51.1   | 16.5 | 6/10/74 | 29.72      | 7.25         | 132       | 8.39 | 670  | 670  | 700  | 10 | 6.9 | 2.8 | 0.38 | 0.05 | <0.10 | <0.40 | 0.12 |
| 5       | 30.97    | 6.30      | 110  | 8.34  | 200 | 120 | 270 | 6.9 | 1.7 | 2.3 | 0.28 | 0.01 | <0.10 | <0.40 | <0.01 |
| 15      | 31.37    | 4.49      | 76   | 8.16  | 150 | 40 | 180 | 4.9 | 5.2 | 4.2 | 0.86 | 0.07 | 0.16 | 2.01 | 0.24 |
| 25      | 31.58    | 3.68      | 59   | 8.05  | 110 | 100 | 180 | 25 | 12  | 2.8 | 0.28 | 0.12 | 0.70 | 7.56 | 0.50 |
| 4       | 40 14.1  | 73 45.6   | 17.4 | 6/10/74 | 31.05      | 6.18         | 109       | 8.32 | 160  | 320  | 390  | 6.7 | 2.0 | 1.4 | 0.23 | <0.01 | <0.10 | <0.40 | 0.16 |
| 10      | 31.39    | 6.21      | 105  | 8.36  | 200 | 80 | 220 | 21 | 2.2 | 1.8 | 0.19 | 0.02 | 0.12 | <0.40 | 0.11 |
| 20      | 31.70    | 4.94      | 78   | 8.15  | 90  | 20 | 160 | 10 | 7.6 | 3.7 | 0.48 | 0.15 | 0.66 | 5.78 | 0.50 |
| 35      | 32.05    | 4.70      | 71   | 8.06  | 70  | 100 | 160 | 7.9 | 1.8 | 2.8 | 0.86 | 0.16 | 0.71 | 3.54 | 0.41 |
Table I.3. Water chemistry characterization cruise WCC 8 data (cont.).

| Depth (m) | Salinity (‰) | O₂ (mL/L) | %O₂ | pH | PCH | PPRO | POC | Fe (µg/L) | Mn (µg/L) | Cu (µg/L) | Cd (µg/L) | Zn (µg/L) | NO₂⁻ (µg-at/L) | NO₃⁻ (µg-at/L) | SiO₃²⁻ (µg-at/L) | PO₄³⁻ (µg-at/L) |
|-----------|--------------|-----------|-----|----|-----|-------|-----|----------|-----------|----------|-----------|-----------|-----------|----------------|----------------|----------------|----------------|
| Station 24 Lat (N): 40 15.7 Long (W): 73 37.0 GMT: 18.5 Date: 6/10/74 |
| 1 | 31.51 | 6.16 | 110 | 8.23 | 180 | 190 | 170 | 5.4 | 2.0 | 2.3 | 0.29 | <0.01 | <0.10 | <0.40 | 0.03 |
| 10 | 31.61 | 6.54 | 111 | 8.27 | 290 | 80 | 270 | 4.9 | 1.4 | 10 | 0.28 | <0.01 | <0.10 | <0.40 | <0.01 |
| 20 | 31.69 | 5.55 | 89 | 8.19 | - | 60 | 170 | 9.3 | 2.1 | 4.6 | 0.19 | <0.01 | 0.18 | 0.49 | 0.17 |
| 25 | 31.68 | 5.27 | 83 | 8.16 | 90 | 140 | 160 | 8.5 | 4.1 | 2.8 | 0.28 | 0.04 | 0.30 | 1.87 | 0.26 |
| Station 25 Lat (N): 40 16.9 Long (W): 73 28.3 GMT: 19.5 Date: 6/10/74 |
| 1 | 31.13 | 6.18 | 108 | 8.23 | 190 | 230 | 210 | 5.1 | 1.5 | 1.4 | 0.35 | - | 0.14 | 0.12 | <0.40 | 0.10 |
| 10 | 31.69 | 6.36 | 109 | 8.27 | 190 | 90 | 270 | 6.4 | 1.8 | 2.8 | 0.24 | <0.01 | <0.10 | <0.40 | 0.06 |
| 20 | 31.73 | 5.58 | 88 | 8.20 | 250 | 40 | 260 | 5.3 | 3.1 | 1.8 | 0.38 | <0.01 | 0.16 | 0.95 | 0.23 |
| 30 | 31.82 | 5.44 | 85 | 8.14 | 70 | 80 | 100 | 3.6 | 5.4 | 1.8 | 0.28 | <0.01 | 0.37 | 2.07 | 0.29 |
Table I.4. Water chemistry characterization cruise WCC 9 data.

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| Depth (m) | Salinity (‰) | O₂ (mL/L) | %O₂ | pH | PCH | PPRO | POC | Fe (µg/L) | Mn (µg/L) | Cu (µg/L) | Cd (µg/L) | Zn (µg/L) | NO₂⁻ (µg-at/L) | NO₃⁻ (µg-at/L) | SiO₃²⁻ (µg-at/L) | PO₄³⁻ (µg-at/L) |
|-----------|---------------|------------|-----|----|-----|------|-----|----------|----------|-----------|-----------|-----------|-------------|----------------|----------------|------------------|------------------|
| 1         | 27.76         | -          | -   | 8.21 | 440 | 870 | 1010 | 27 | 27 | 5.8 | 10 | -          | 0.57            | 1.73            | <0.40            | 1.19            |
| 10        | 31.04         | -          | -   | 8.03 | 170 | 220 | 360 | 28 | 12 | 14 | 1.9 | -          | 0.19            | 0.56            | 3.95             | 0.83             |
| 1         | 30.36         | -          | -   | 7.97 | 520 | 690 | 810 | 22 | 27 | 15 | 4.7 | -          | 0.43            | 1.37            | 2.50             | 1.24             |
| 10        | 31.52         | -          | -   | 7.95 | 140 | 30  | 410 | 47 | 19 | 5.4 | 4.9 | -          | 0.10            | 0.35            | 3.56             | 0.65             |
| 1         | 30.15         | -          | -   | 8.15 | 310 | 710 | 680 | 17 | 5.6 | 3.4 | 0.20 | -          | 0.09            | <0.10           | <0.40            | 0.52             |
| 13        | 31.80         | -          | -   | 7.89 | 140 | 200 | 290 | 25 | 15 | 8.3 | 2.7 | -          | 0.06            | 0.12            | 3.24             | 0.59             |
| 1         | 31.42         | -          | -   | 8.16 | 270 | 280 | 350 | 25 | 11 | 18 | 1.4 | -          | 0.06            | <0.10           | <0.40            | 0.48             |
| 10        | 31.46         | -          | -   | 8.13 | 460 | 130 | 480 | 12 | 7.0 | 10 | 0.58 | -          | <0.01           | <0.10           | <0.40            | 0.53             |
| 15        | 31.86         | -          | -   | 7.90 | 150 | 150 | 240 | 14 | 21 | 11 | 1.3 | -          | 0.08            | 0.12            | 2.33             | 0.84             |
| 1         | 31.58         | -          | -   | 8.18 | 170 | 170 | 230 | 23 | 4.8 | 4.9 | 0.86 | -          | 0.17            | <0.10           | <0.40            | 3.21             |
| 10        | 31.83         | -          | -   | 8.09 | 450 | 420 | 480 | 48 | 11 | 9.3 | 4.3 | -          | 0.27            | 2.29            | 2.62             | 5.34             |
| 15        | 31.93         | -          | -   | 8.08 | 200 | 250 | 340 | 18 | 6.5 | 3.9 | 0.71 | -          | <0.01           | <0.10           | 7.37             | 1.36             |
Table I.4. Water chemistry characterization cruise WCC 9 data (cont.).

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Table I.4. Water chemistry characterization cruise WCC 9 data (cont.).

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Table I.5. Water chemistry characterization cruise WCC 10 data (cont).

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Table I.5. Water chemistry characterization cruise WCC 10 data (cont.).

| Depth (m) | Salinity (°/oo) | O₂ (mL/L) | %O₂ | pH | PCH | PPRO | POC | Fe (µg/L) | Mn (µg/L) | Cu (µg-at/L) | Cd (µg-at/L) | Zn (µg-at/L) | NO₂⁻ (µg/L) | NO₃⁻ (µg/L) | SiO₃²⁻ (µg/L) | PO₄³⁻ (µg/L) |
|-----------|-----------------|-----------|-----|----|-----|------|-----|----------|---------|-------------|-------------|-------------|----------|---------|-----------|-------------|-------------|
| **Station 9** | Lat (N): 40 28.4 | Long (W): 73 39.8 | GMT: 21.5 | Date: 8/21/74 |
| 1 | 30.88 | 5.68 | 114 | 8.02 | 50 | 30 | 130 | 6.5 | 2.9 | 1.7 | 1.0 | 27 | <0.01 | <0.10 | <0.40 | 0.16 |
| 10 | 31.12 | 5.35 | 105 | 7.98 | 80 | 70 | 140 | 16 | 4.8 | 1.1 | 0.53 | 19 | <0.01 | <0.10 | <0.40 | 0.19 |
| 21 | 31.88 | 3.00 | 53 | 7.78 | 160 | 350 | 510 | 8.1 | 5.5 | 2.0 | 0.91 | 48 | 0.52 | 1.86 | 6.65 | 0.94 |
| **Station 10** | Lat (N): 40 29.3 | Long (W): 73 31.7 | GMT: 19.8 | Date: 8/22/74 |
| 1 | 31.17 | 5.40 | 108 | 8.13 | 60 | 80 | 140 | 15 | 2.9 | 2.0 | 1.1 | 42 | <0.01 | <0.10 | <0.40 | 0.20 |
| 10 | 31.15 | 5.08 | 100 | 8.08 | 90 | 120 | 200 | 10 | 3.1 | 3.2 | 0.86 | 48 | <0.01 | <0.10 | <0.40 | 0.26 |
| 20 | 31.57 | 3.71 | 68 | 7.92 | 230 | 490 | 600 | 19 | 2.6 | 2.0 | 1.3 | 54 | 0.13 | 0.30 | <0.40 | 0.65 |
| **Station 11** | Lat (N): 40 22.2 | Long (W): 73 56.8 | GMT: 14.6 | Date: 8/24/74 |
| 1 | 38.83 | 5.74 | 113 | 8.13 | 250 | 930 | 1080 | 6.4 | 3.3 | 1.9 | 0.27 | 13 | 0.94 | 2.58 | <0.40 | 1.3 |
| 11 | 30.54 | 4.31 | 83 | 8.03 | 210 | 260 | 400 | 13 | 2.8 | 3.2 | 1.5 | 28 | 0.22 | 0.53 | <0.40 | 0.64 |
| **Station 12** | Lat (N): 40 22.6 | Long (W): 73 52.4 | GMT: 14.3 | Date: 8/23/74 |
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| 10 | 30.94 | 4.07 | 77 | 7.99 | <5 | <10 | 260 | 9.1 | 3.0 | 6.3 | 0.46 | 50 | 0.34 | 1.05 | 1.93 | 0.85 |
| 20 | 31.97 | 1.75 | 31 | 7.80 | 130 | 170 | 310 | 14 | 43 | 6.0 | 0.31 | 28 | 0.71 | 1.11 | 11.05 | 1.45 |
Table I.5. Water chemistry characterization cruise WCC 10 data (cont.).

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Table I.5. Water chemistry characterization cruise WCC 10 data (cont.).

<p>| Depth (m) | Salinity (‰) | O₂ (mL/L) | %O₂ | pH  | PCH | PPRO | POC | Fe (µg/L) | Mn (µg/L) | Cu (µg/L) | Cd (µg/L) | Zn (µg/L) | NO₃⁻ (µg-at/L) | NO₂⁻ (µg-at/L) | SiO₃²⁻ (µg-at/L) | PO₄³⁺ (µg-at/L) |
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| Station 17 Lat (N): 40 18.5 Long (W): 73 51.9 GMT: 15.2 Date: 8/23/74 | 1 29.28 6.38 125 8.12 290 860 600 4.8 3.5 8.2 1.3 76 0.65 1.64 &lt;0.40 0.88 | 10 - 5.22 - 8.09 40 80 90 16 4.6 3.2 0.26 13 0.09 0.41 &lt;0.40 0.39 | 24 - 2.07 - 7.78 120 250 420 10 19 3.8 0.54 42 0.45 0.94 6.34 1.18 |
| Station 18 Lat (N): 40 19.1 Long (W): 73 46.5 GMT: 17.5 Date: 8/21/74 | 1 30.87 5.47 110 7.82 60 &lt;0.10 70 5.9 5.8 8.0 0.59 17 0.05 &lt;0.10 &lt;0.40 0.17 | 10 31.04 5.56 111 7.90 40 40 90 2.8 5.8 1.6 1.1 40 0.06 &lt;0.10 &lt;0.40 0.32 | 20 32.11 2.24 39 7.53 70 190 350 2.8 3.8 1.2 4.1 44 1.14 2.05 11.88 1.34 |
| Station 19 Lat (N): 40 20.3 Long (W): 73 37.7 GMT: 19.0 Date: 8/21/74 | 1 31.12 5.30 107 7.85 70 40 150 22 4.3 2.8 1.5 47 0.03 &lt;0.10 &lt;0.40 0.11 | 10 31.21 5.44 108 7.87 90 130 1950 18 4.6 1.1 0.72 31 &lt;0.01 &lt;0.10 &lt;0.40 0.15 | 20 31.97 3.56 65 7.63 110 80 240 16 7.3 1.1 0.47 44 0.18 0.70 3.27 0.64 |
| Station 20 Lat (N): 40 21.1 Long (W): 73 29.4 GMT: 17.8 Date: 8/22/74 | 1 31.14 5.46 109 8.12 80 100 160 11 4.1 1.4 0.66 19 &lt;0.01 &lt;0.10 &lt;0.40 0.24 | 10 31.22 5.62 109 8.12 50 110 420 12 1.7 1.4 1.4 15 &lt;0.01 &lt;0.10 &lt;0.40 0.60 | 20 31.80 5.55 103 8.13 120 40 200 5.2 2.1 0.85 0.46 36 &lt;0.01 &lt;0.10 0.50 0.25 |
| 28 31.88 3.72 65 7.93 90 130 300 12 11 0.85 0.46 11 0.27 1.60 10.01 1.02 |</p>
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Table I.6. Water chemistry characterization cruise WCC 11 data (cont.).

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Table I.6. Water chemistry characterization cruise WCC 11 data (cont.).

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<th>pH</th>
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<th>Dissolved trace metals (µg/L)</th>
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| 10 | 30.90 | 6.81 | 124 | 8.24 | 250 | 400 | 490 | 5.1 | 5.5 | 5.0 | 0.26 | 8.7 | 0.14 | 0.42 | <0.40 | 0.23 |
| 20 | 31.57 | 5.12 | 93 | 8.16 | 150 | 220 | 240 | 4.0 | 4.8 | 6.2 | 0.35 | 6.7 | 0.18 | 0.47 | <0.40 | 0.39 |
| 27 | 32.30 | 3.91 | 68 | 7.97 | 260 | 110 | 230 | 7.4 | 20 | 7.5 | 1.0 | 13 | 0.54 | 5.10 | 13.18 | 1.23 |

Station 21 | Lat (N): 40 13.5 | Long (W): 73 56.0 | GMT: 15.4 | Date: 10/1/74 |

| 1 | 31.44 | 5.89 | 108 | 8.10 | 100 | - | 170 | 11 | 5.7 | 4.6 | 0.33 | 7.8 | 0.18 | 0.45 | <0.40 | 0.68 |
| 11 | 31.70 | 3.49 | 64 | 7.88 | 120 | 130 | 310 | 12 | 16 | 3.1 | 2.8 | 15 | 0.63 | 2.73 | 6.28 | 1.61 |
| 18 | 31.98 | 3.13 | 56 | 7.82 | <5 | 50 | 200 | 9.0 | 17 | 4.6 | 0.53 | 25 | 0.35 | 2.69 | 6.80 | 1.05 |

Station 22 | Lat (N): 40 14.1 | Long (W): 73 51.2 | GMT: 16.3 | Date: 10/1/74 |

| 1 | 31.45 | 6.26 | 116 | 8.16 | <5 | <10 | 130 | 5.9 | 5.5 | 3.8 | 0.21 | 13 | 0.07 | <0.10 | <0.40 | 0.42 |
| 10 | 31.46 | 6.09 | 113 | 8.15 | 60 | 200 | 190 | 9.7 | 6.7 | 4.6 | 1.3 | 21 | 0.06 | <0.10 | <0.40 | 0.44 |
| 20 | 31.88 | 4.56 | 82 | 7.97 | 50 | 30 | 140 | 15 | 28 | 6.9 | 0.57 | 49 | 0.15 | 1.29 | 1.53 | 0.67 |
| 22 | 32.12 | 3.48 | 60 | 7.83 | 100 | 160 | 150 | 11 | 13 | 8.5 | 1.4 | 31 | 0.14 | 1.66 | 2.51 | 0.72 |
Table I.6. Water chemistry characterization cruise WCC 11 data (cont.).

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<th>PCH</th>
<th>PPRO</th>
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<th>Particulate organics (µg/L)</th>
<th>Dissolved trace metals (µg/L)</th>
<th>Dissolved nutrients (µg-at/L)</th>
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Station 1 Lat (N): 40 30.0 Long (W): 73 57.5 GMT: 20.9 Date: 11/4/74

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Table I.7. Water chemistry characterization cruise WCC 12 data (cont.).

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### Table I.7. Water chemistry characterization cruise WCC 12 data (cont.).

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| Depth (m) | Salinity (%) | O₂ (µg/L) | %O₂ | pH | PCH | PPRO | POC | Particulate organics (µg/L) | Dissolved trace metals (µg/L) | Dissolved nutrients (µg-at/L) |
| 1 | 31.78 | 2.83 | 48 | 8.09 | 90 | 320 | 400 | 4.3 | 1.7 | 1.4 | 0.58 | 21 | 0.20 | 0.91 | 0.59 | 0.48 |
| 10 | 32.42 | 2.90 | 49 | 8.09 | 60 | 150 | 160 | 9.1 | 0.73 | 3.5 | 0.75 | 32 | 0.11 | <0.10 | <0.40 | 0.27 |
| 20 | 32.60 | 2.81 | 48 | 8.08 | 50 | 120 | 100 | 6.0 | 1.0 | 1.4 | 0.19 | 23 | 0.20 | <0.10 | <0.40 | 0.40 |
| 28 | 32.74 | 1.81 | 30 | 7.93 | 140 | 70 | 290 | 10 | 9.2 | 3.5 | 1.8 | 56 | 0.36 | 2.72 | 6.37 | 0.79 |

| Station 9 Lat (N): 40 28.2 Long (W): 73 39.7 GMT: 14.2 Date: 11/7/74 |
| Depth (m) | Salinity (%) | O₂ (µg/L) | %O₂ | pH | PCH | PPRO | POC | Particulate organics (µg/L) | Dissolved trace metals (µg/L) | Dissolved nutrients (µg-at/L) |
| 1 | 31.82 | 5.91 | 100 | 8.34 | 190 | 300 | 370 | 4.3 | 0.85 | 2.1 | 2.8 | 36 | 0.15 | 0.76 | <0.40 | 0.68 |
| 10 | 32.19 | 4.79 | 81 | 8.21 | 110 | 70 | 170 | 13 | 58 | 6.0 | 0.28 | 33 | 0.18 | 0.99 | <0.40 | 0.54 |
| 21 | 32.46 | 2.63 | 44 | 8.10 | 100 | 90 | 140 | 8.3 | 5.6 | 1.8 | 0.25 | 39 | 0.15 | 3.33 | 4.55 | 0.82 |

| Station 10 Lat (N): 40 29.2 Long (W): 73 31.6 GMT: 16.1 Date: 11/6/74 |
| Depth (m) | Salinity (%) | O₂ (µg/L) | %O₂ | pH | PCH | PPRO | POC | Particulate organics (µg/L) | Dissolved trace metals (µg/L) | Dissolved nutrients (µg-at/L) |
| 1 | 31.82 | 5.92 | 100 | 8.19 | 270 | 420 | 360 | 6.3 | 0.52 | 2.3 | 0.55 | 57 | 0.19 | 1.06 | 0.82 | 0.55 |
| 10 | 31.85 | 5.56 | 94 | 8.22 | 200 | 220 | 260 | 7.8 | 0.76 | 3.0 | 0.14 | 25 | 0.19 | 0.95 | 0.90 | 0.52 |
| 20 | 32.30 | 4.52 | 76 | 8.12 | 130 | 20 | 170 | 6.1 | 2.6 | 2.7 | 0.11 | 29 | 0.19 | 1.66 | 2.78 | 0.16 |

| Station 11 Lat (N): 40 22.2 Long (W): 73 56.8 GMT: 18.5 Date: 11/4/74 |
| Depth (m) | Salinity (%) | O₂ (µg/L) | %O₂ | pH | PCH | PPRO | POC | Particulate organics (µg/L) | Dissolved trace metals (µg/L) | Dissolved nutrients (µg-at/L) |
| 1 | 28.75 | 2.68 | 45 | 7.98 | 350 | 460 | - | 9.3 | 22 | 4.6 | 0.54 | 38 | 0.73 | 5.35 | 2.52 | 1.20 |
| 13 | 32.09 | 2.02 | 34 | 7.92 | 110 | 170 | 340 | 5.9 | 5.6 | 1.3 | 0.25 | 18 | 0.24 | 2.88 | 2.93 | 0.61 |
Table I.7. Water chemistry characterization cruise WCC 12 data (cont.).

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Table I.7. Water chemistry characterization cruise WCC 12 data (cont.).

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