DISTRIBUTION OF FIVE METALS IN SEDIMENTS FROM THE NEW YORK BIGHT

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ABSTRACT

Sediment samples from 107 stations located in the dumping areas of the New York Bight were analyzed for the metals Cu, Cr, Pb, Zn and Ni. Sampling at most of the stations was also done on a quarterly interval for possible variations of metal concentrations with time. The range of concentrations of the metals found in the area sampled (expressed as ppm on dry weight of the sediment) was as follo Cu - 215-0.8, Cr - 300-1.6, Pb - 266-0.9, Zn - 520-1.3, Ni - 38-0.8. The highest concentrations of metals were found in sediments at stations located in the dumpi areas. With a few notable exceptions, the concentrations of the metals did not vary greatly over the quarterly year sampling period.

INTRODUCTION

The following report consists of data on the concentrations and distribution of 5 metals (Cr, Cu, Ni, Zn, Pb) in sediments collected from 107 established stat in the apex of the New York Bight. The stations encompass the several dump sites (acid, dredge, sewage sludge) and peripheral areas in the Bight region. The stat were established by Marine Ecosystems Analysis (MESA) program of NOAA for periodi monitoring to develop baseline data for that geographical area.

For this study sediment sampling was conducted in August and October of 1973 and January and February of 1974 from the same established stations. In addition to determining the specific levels of metals in the sediments an attempt was made to determine variations in metal content in the sediments from the same station over a year sampling interval.

METHODS

Collection of Sediments

Bottom sediment samples were obtained with a Smith McIntyre grab sampler. Plastic tubes about 1-3/4 inches in diameter were inserted to the depth of the grab, the tubes were then capped and kept frozen until time for analysis. Chemical analyses of the samples were conducted during May-July 1974.

Metal Analyses

At the laboratory, the top 1-1/2 inches of sediment core were removed from the plastic tube and dried at 60°C. Where possible the dried sample was ground into a homogenous mass using a glass mortar and pestle. The metal analyses of the prepared sediments were conducted as follows: 2.5 g of sediment were placed in a 250 ml beaker and to this were added 10 ml of concentrated nitric acid and 0.5 ml of a 30% solution of hydrogen peroxide. The solution was evaporated to dryness by gentle boiling. The following were then added: 8 ml of 10% ammonium chloride, 0.4 ml of calcium nitrate (11.8 g/100 ml of $Ca(NO_3)_2 \cdot 4\ H_2O$) and 25 ml of a mixture of concentrated acids consisting of 80 ml of nitric acid, 20 ml of hydrochloric acid and 300 ml of distilled water. This mixture was gently boiled for five minutes or longer. The sample was then filtered through Whatman No. 2 filter paper and diluted to 100 ml with distilled water. All filtered samples were analyzed in a Perkin Elmer Model 403 atomic absorption spectrophotometer.

In addition to our in-house analysis and to expedite analysis and the need for collaborative data, a group of sediments from a duplicate core from each station sampled during March 1974 was analyzed for each metal by a consulting laboratory (Analytical Consulting Services, Inc., Kensington, Md.). Prior to the submission of these samples, some sediments previously analyzed by our laboratory were sent to the consulting laboratory for comparison of technique using our methodology.

The values obtained for copper, lead, nickel and zinc showed good agreement between the two laboratories. However, the value obtained for chromium by our laboratory was 100% lower than that obtained by the consulting laboratory. In order to resolve the difficulties, sediments were also sent to our Technology Laboratory at College Park, Maryland. Laboratory personnel were able to analyze the same sediment employing three different digestion methods as listed in Table 1. Two of the procedures resulted in chromium levels in the sediment similar to our laboratory findings. The third procedure resulted in chromium values which were significantly lower than obtained by our laboratory and the consulting laboratory. The results of this comparative study and the digestion and analytic procedures employed are presented in Table 1.

The conclusion reached by us was that the values for chromium initially obtained by Analytical Consulting Services were high.

Before the results from our Technology Laboratory were known to us, the duplicate cores were sent to the consulting laboratory for analysis for the five metals since there was urgency in completing the present work.

As it turned out, the chromium values generally agreed quite well for the samples analyzed for the present study by the two laboratories (Tables 2 and 3). Some exceptions were noted. Samples obtained at station 6 where the Milford laboratory found 100 ppm of chromium and the consulting laboratory found only 11.7 ppm of chromium and at station 85 where the Milford laboratory found 22 ppm of chromium while the private laboratory found only 1.9 ppm of this metal.

The values for copper, lead, nickel and zinc were generally quite similar for the data obtained by the two laboratories (Tables 2 and 3). However, there were again a few notable exceptions. Interestingly, if one metal value showed large disagreement, then generally all metals showed this disagreement and with the same order of magnitude. This would suggest that even though duplicate core samples

were analyzed, differences in sediment homogeneity can exist within the cores which resulted in these differences rather than disagreement in analytical techniques employed by the two laboratories. This spotty distribution of different sediment types in a dredge spoils area can be expected since the source of spoils can vary. This has been observed in a previous study on the New Haven, Connecticut, dump site by our laboratory.

RESULTS

For comparative purposes a series of isopleth drawings giving metal concentrations for each metal are presented in Figures 2 to 16. For this comparison, 4 isopleths for each metal have been prepared. These figures represent the metal concentrations obtained in the sediments during the four quarterly sampling periods. The latitude and longitude and the metal concentrations in the sediments from each station are listed in tabular form in the appendix.

Copper

The distribution of this metal in sediments was similar for the four different sampling periods (Figures 2 through 5). The highest levels of this metal, with one exception, were found at latitude 40°25'N and between longitudes of 73°46' to 73°54'W. The one exceptional case was for a sample obtained from a station at coordinates 40°22'N and 73°48'W. The copper level in sediment at this location was 215 ppm which was the highest level of copper found in any sediment collected.

Although the distribution pattern of copper levels in sediments was quite similar for the four quarterly sampling periods, certain individual areas were observed to have significant variations in copper levels as related to the sampling time. For example, at the station with coordinates 40°25'N and 73°52'W the copper levels were 18, 6, 114 and 170 ppm for the months of August and October

(1973), January and March (1974), respectively. This station is near the center of the dredge spoils dumping. These variations probably relate to the differences introduced by the frequency of dumping the spoils.

Chromium

The levels of this metal were similar in magnitude to the copper levels. The highest level found in sediments, however, was 300 ppm for a sample taken at coordinates 40°25'N and 73°52'W which is near the center of the dredge spoils dumping.

The distribution of this metal in sediments followed a pattern similar to that of copper - that is, the stations at 40°25'N and between 73°46' to 73°54'W generally had sediments with the highest levels of this metal (Figures 6 through 9). Also, the distribution pattern in sediments for this metal did not vary significantly for the four temporal sampling periods.

Lead

The levels of this metal were of the same order of magnitude as for copper and chromium. The highest level (266 ppm) of this metal was found in sediment at a station with the coordinates of 40°22'N and 73°48'W (obtained October 1973).

The distribution pattern of lead in sediments for all stations sampled was fairly similar to the copper and chromium distribution patterns (Figures 10 through 13). Also, the distributions of lead in sediments were fairly similar for the four seasonal samplings.

Zinc

The levels of this metal generally were greater in magnitude than the levels of the other three metals cited above. The highest level of zinc found in sediments was 520 ppm for a sample obtained in March 1974 at a station with the coordinates of 40°22'N and 73°48'W. A level of 440 ppm was found, however, for a sample obtained in October 1973 at a station with coordinates of 40°22'N and 73°54'W.

Like the three metals cited above, the zinc distribution pattern in sediments for all stations was fairly similar for the four temporal sampling periods (Figures 14 through 17).

Noted exceptions to this, however, were evident for the October 1973 sample collections. Sediments collected at this time at stations with coordinates of 40°16'N and 73°44'W and 40°13'N and 73°44'W had zinc levels of 275 and 154 ppm, respectively, while samples collected from these stations in January and March 1974 had zinc levels less than 40 ppm.

Nickel

Isopleths were not drawn for this metal because of the relatively low values obtained for most sediments. The highest level of nickel was found at station 31 obtained in January 1974 where the level of this metal in sediment was 38 ppm. Most other sediment samples contained less than 10 ppm of this metal.

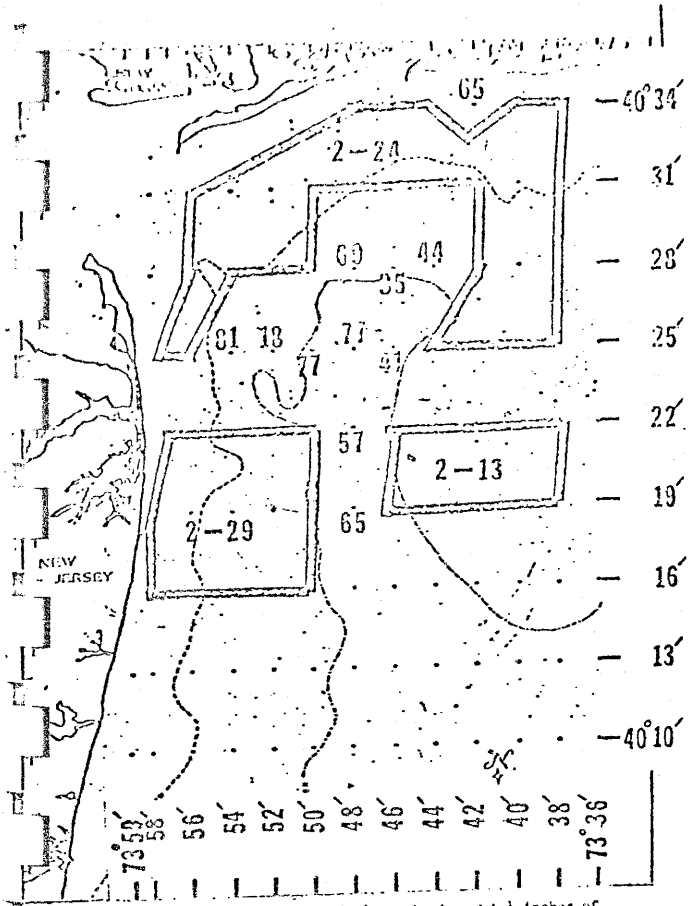

Figure 2. Copper levels(ppm, dry wt.) in the top 1-1½ inches of sediments collected from the New York Bight August, 1973.

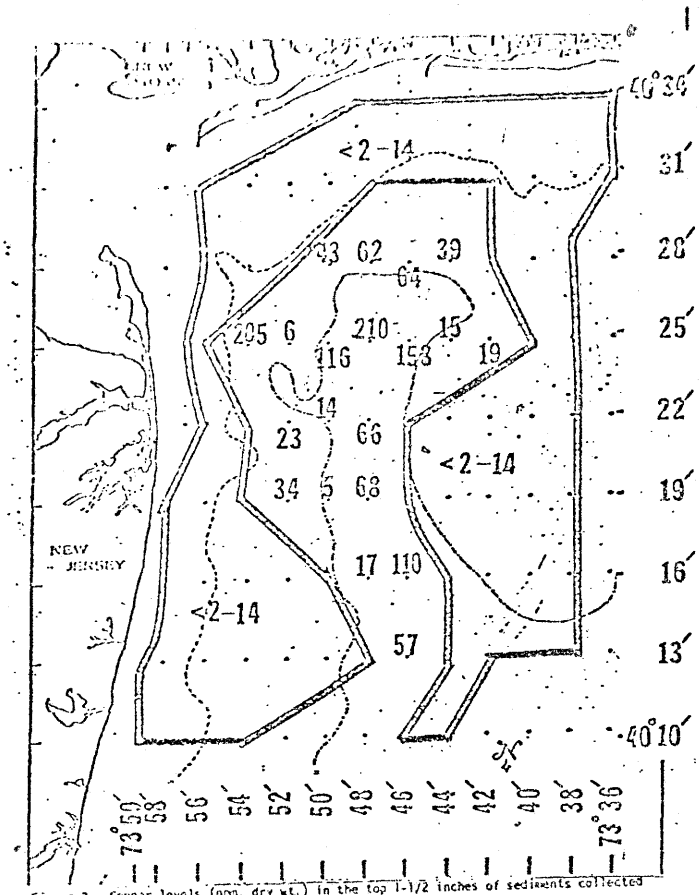

Figure 3. Copper levels (ppm, dry wt.) in the top 1-1/2 inches of sediments collected from the New York Bight October, 1973.

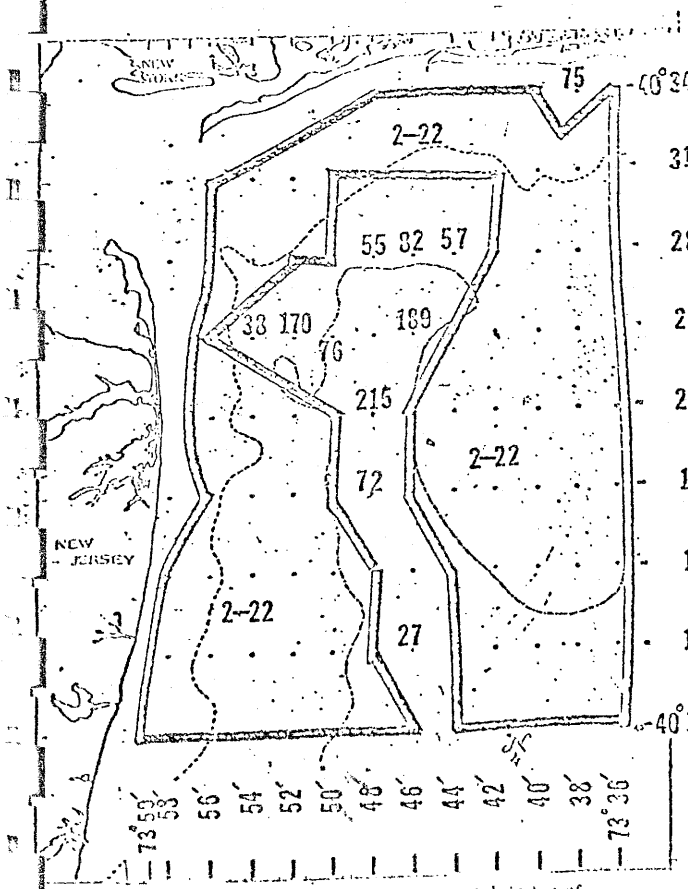

Figure 5. Copper levels (ppm, dry wt.) in the top 1-½ inches of sediments collected from the New York Bight March, 1974.

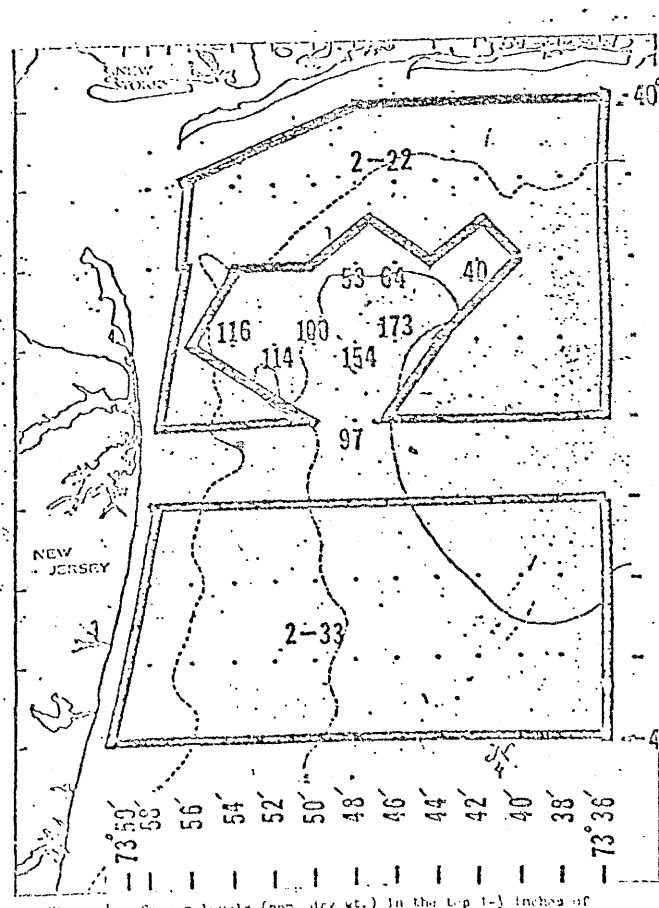

Figure 4. Copper levels (ppm, dry wt.) in the top 1-½ inches of sediments collected from the New York Bight January, 1974.

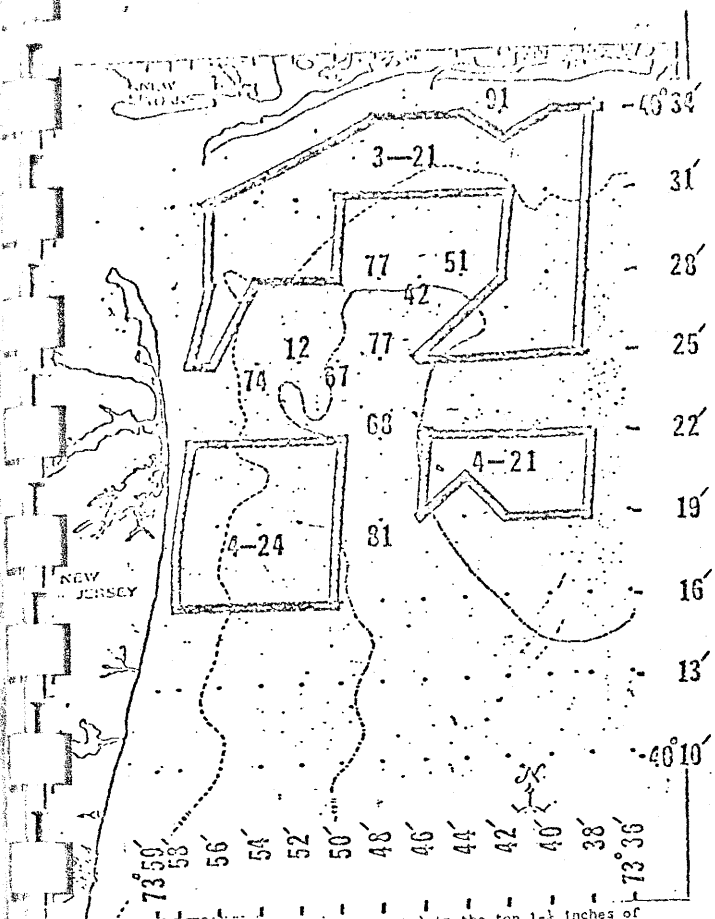

Figure 6. Chromium levels (ppm, dry wt.) in the top 1-½ inches of sediments collected from the New York Bight August, 1973.

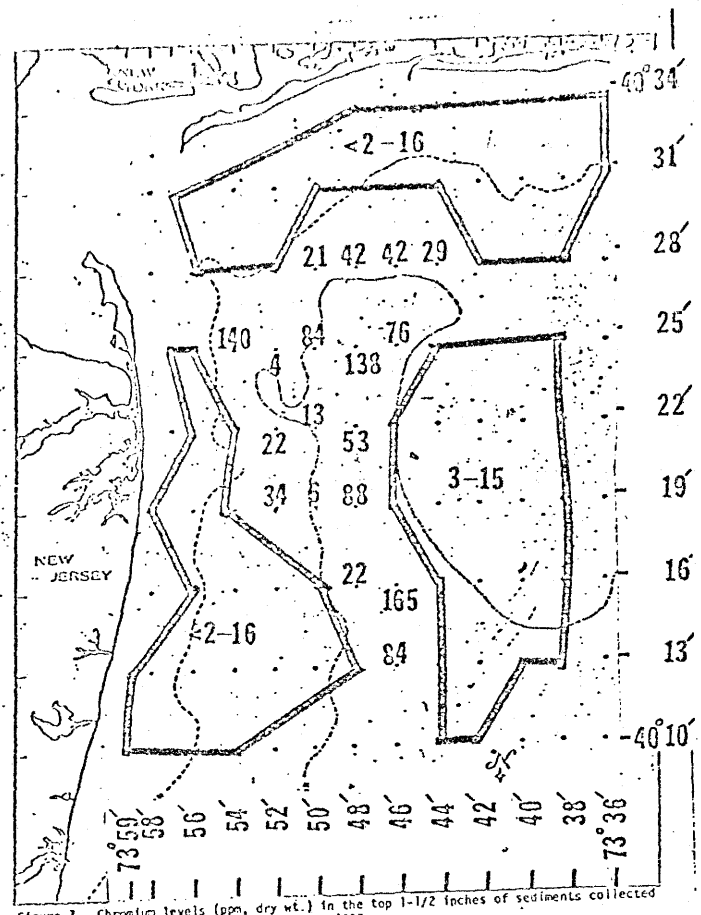

Figure 7. Chromium levels (ppm, dry wt.) in the top 1-1/2 inches of sediments collected from the New York Bight October, 1973.

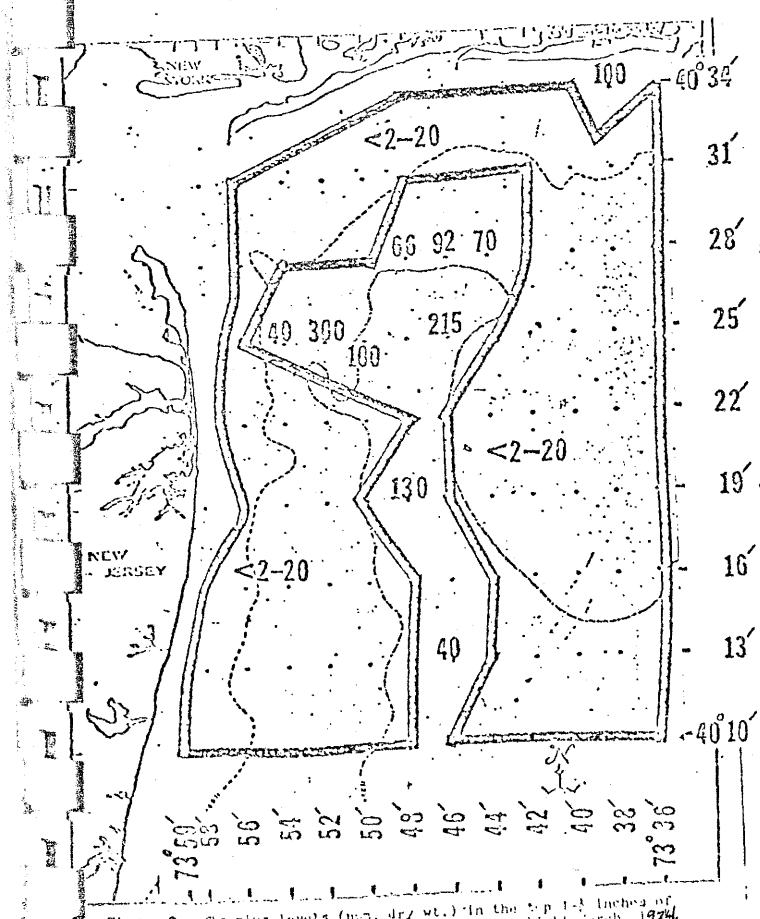

Figure 9. Chromium levels (ppm, dry wt.) in the top 1-½ inches of sediments collected from the New York Bight March, 1974.

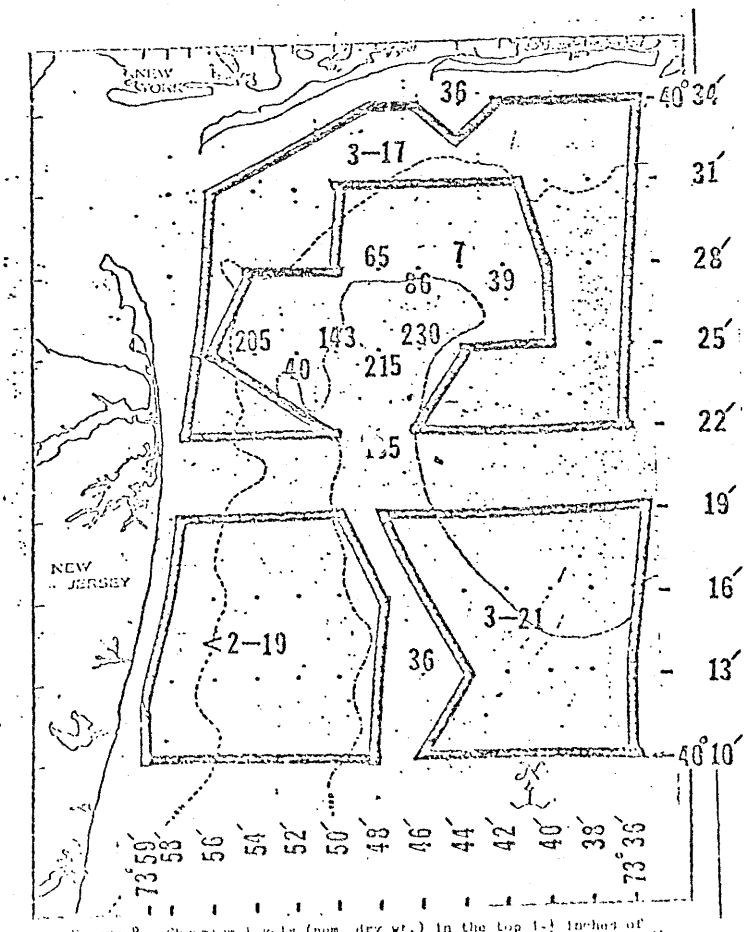

Figure 8. Chromium levels (ppm, dry wt.) in the top 1-½ inches of sediments collected from the New York Bight January, 1974.

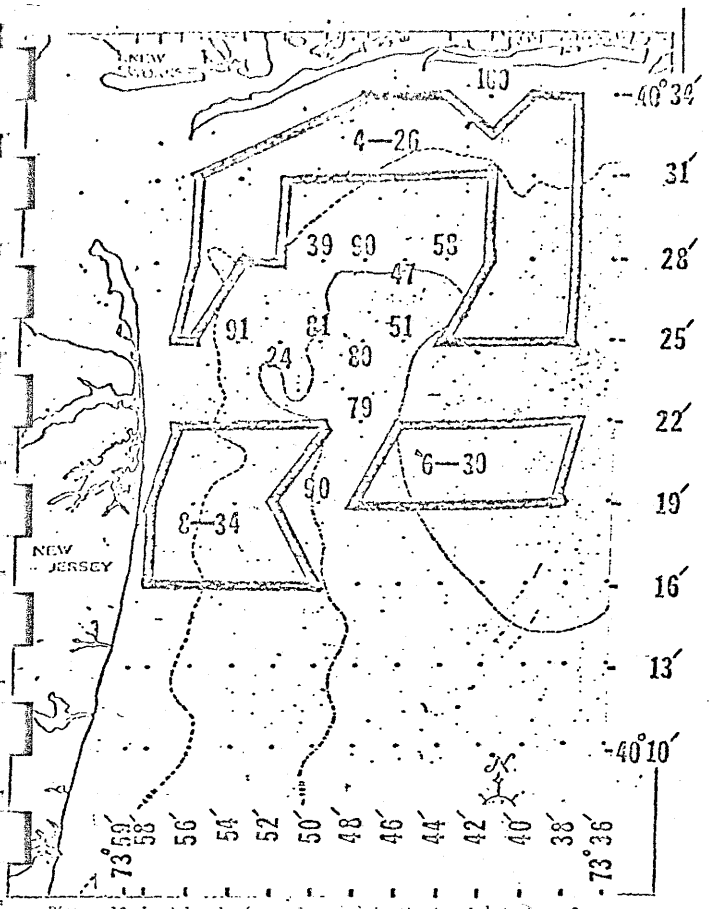

Figure 10. Lead levels (ppm, dry wt.) in the top 1-½ inches of sediments collected from the New York Bight August, 1973.

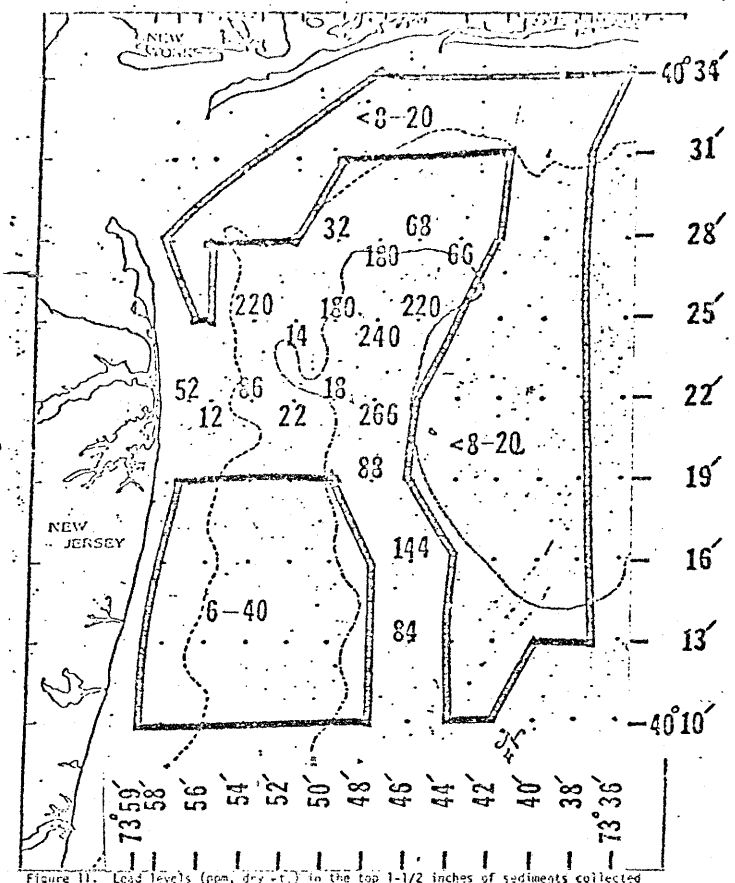

Figure 11. Lead levels (ppm, dry wt.) in the top 1-1/2 inches of sediments collected from the New York Bight October, 1973.

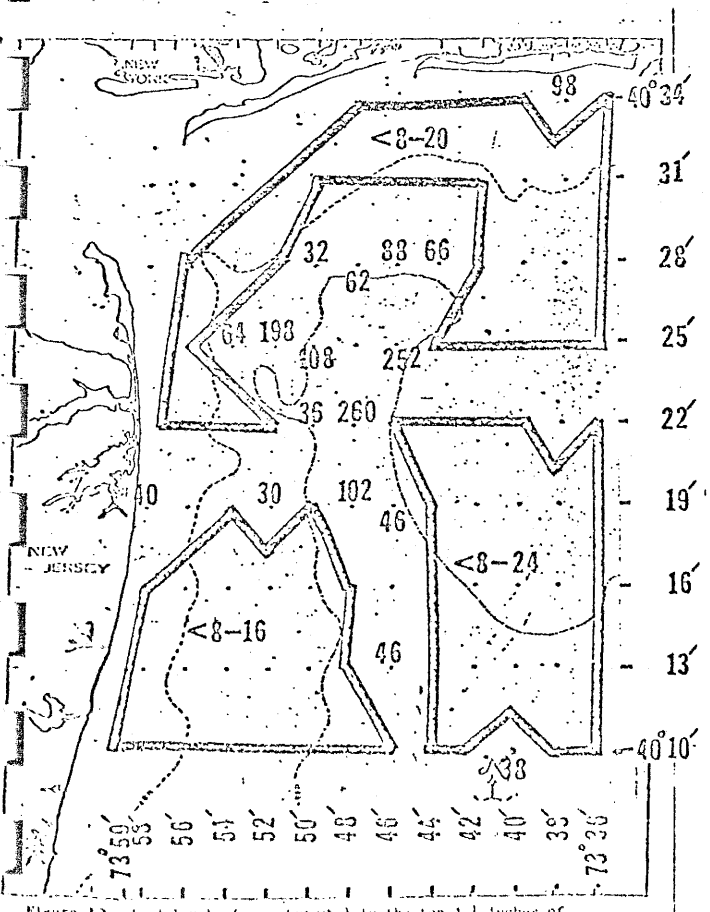

Figure 13. Lead levels (ppm, dry wt.) in the top 1-½ inches of sediments collected from the New York Bight March, 1974.

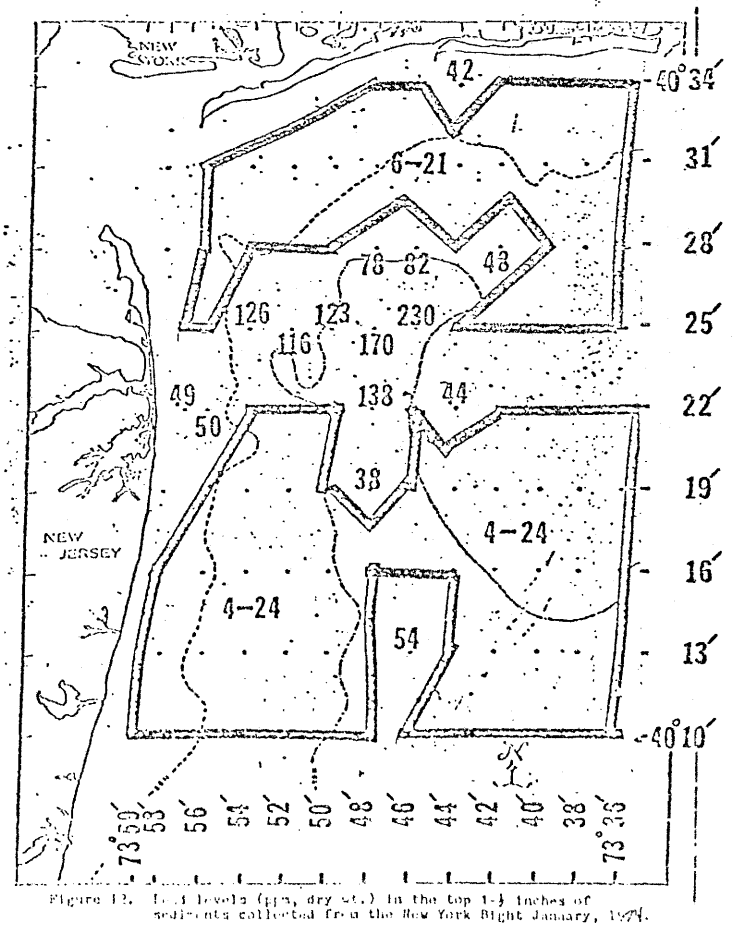

Figure 12. Lead levels (ppm, dry wt.) in the top 1-½ inches of sediments collected from the New York Bight January, 1974.

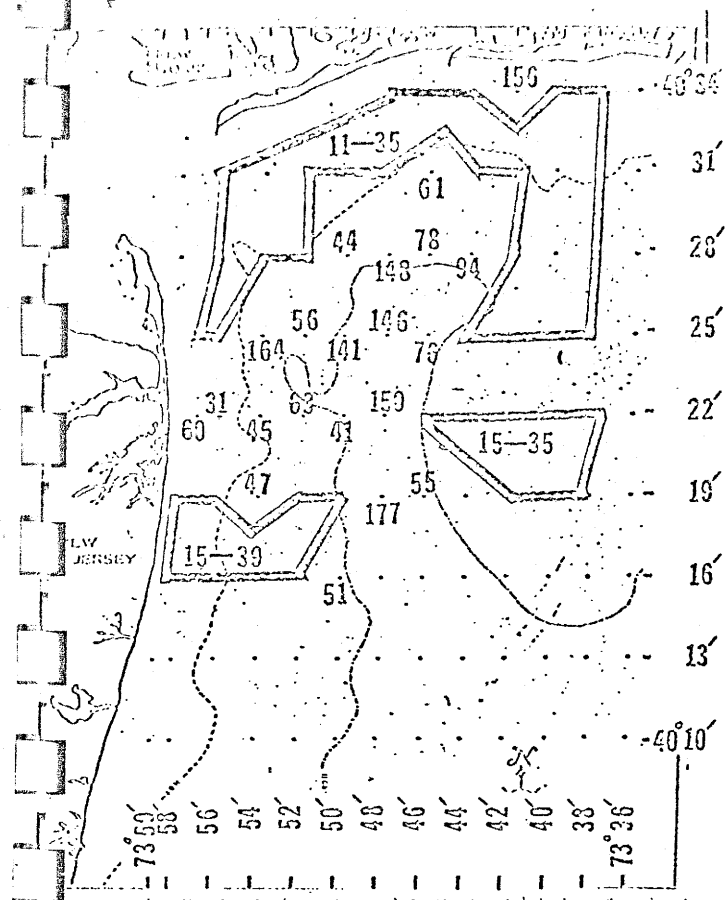

Figure 14. Zinc levels (ppm, dry wt.) in the top 1-1/2 inches of sediments collected from the New York Bight August, 1973.

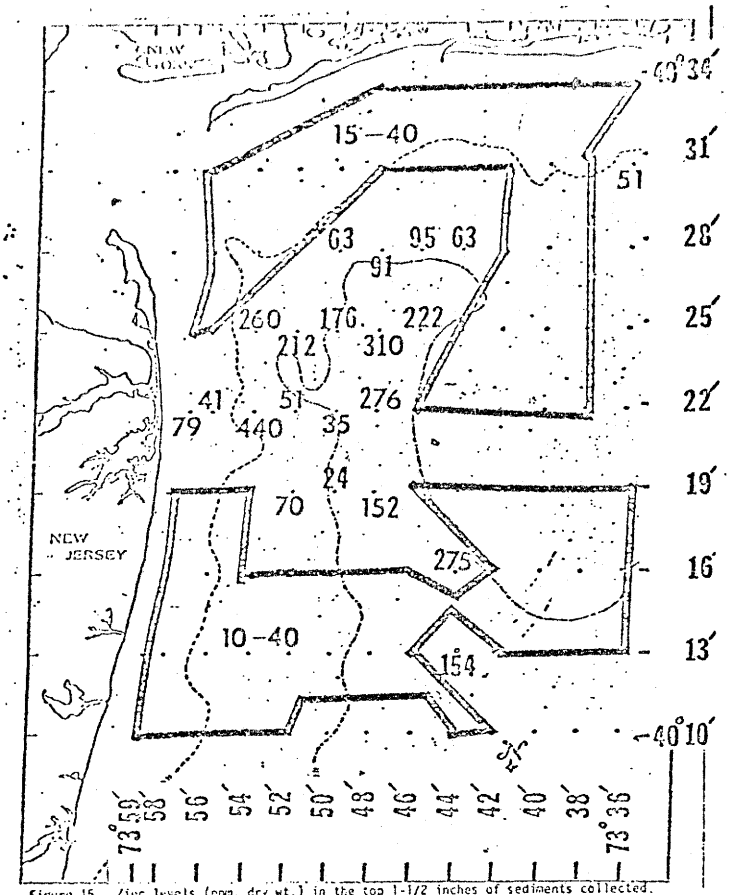

Figure 15. Zinc levels (ppm, dry wt.) in the top 1-1/2 inches of sediments collected from the New York Bight October, 1973.

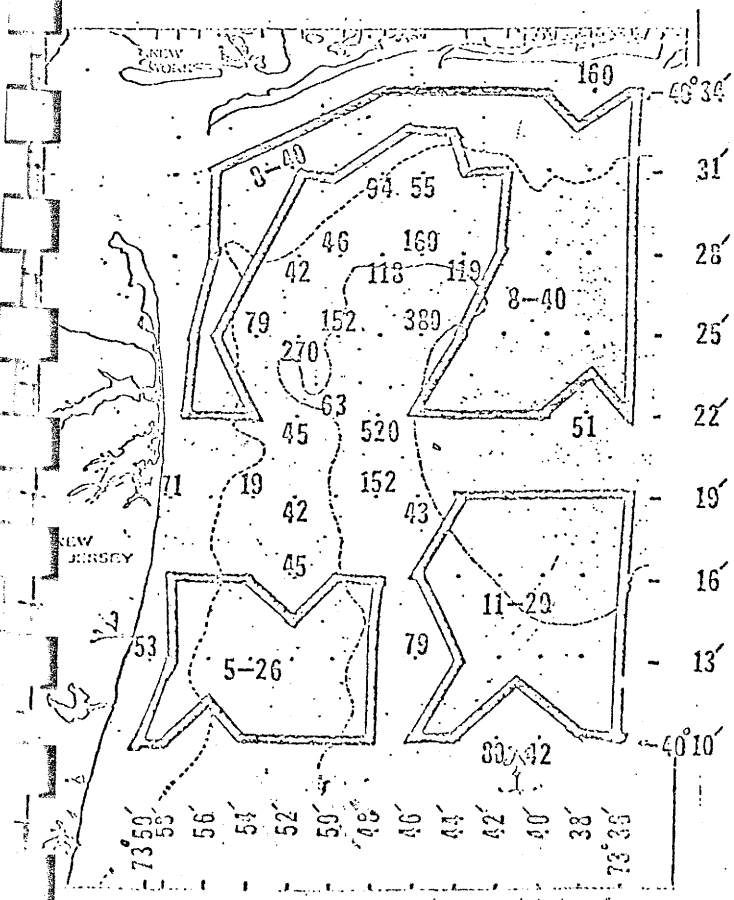

Figure 17. Zinc levels (ppm, dry wt.) in the top 1-1/2 inches of sediments collected from the New York Bight March, 1974

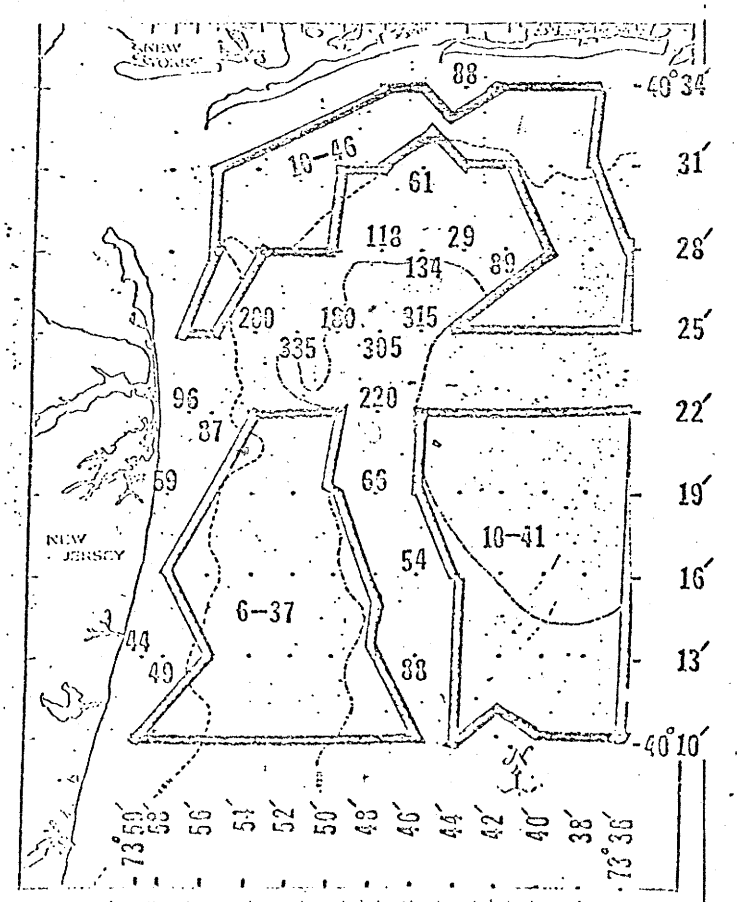

Figure 16. Zinc levels (ppm, dry wt.) in the top 1-1/2 inches of sediments collected from the New York Bight January, 1974.