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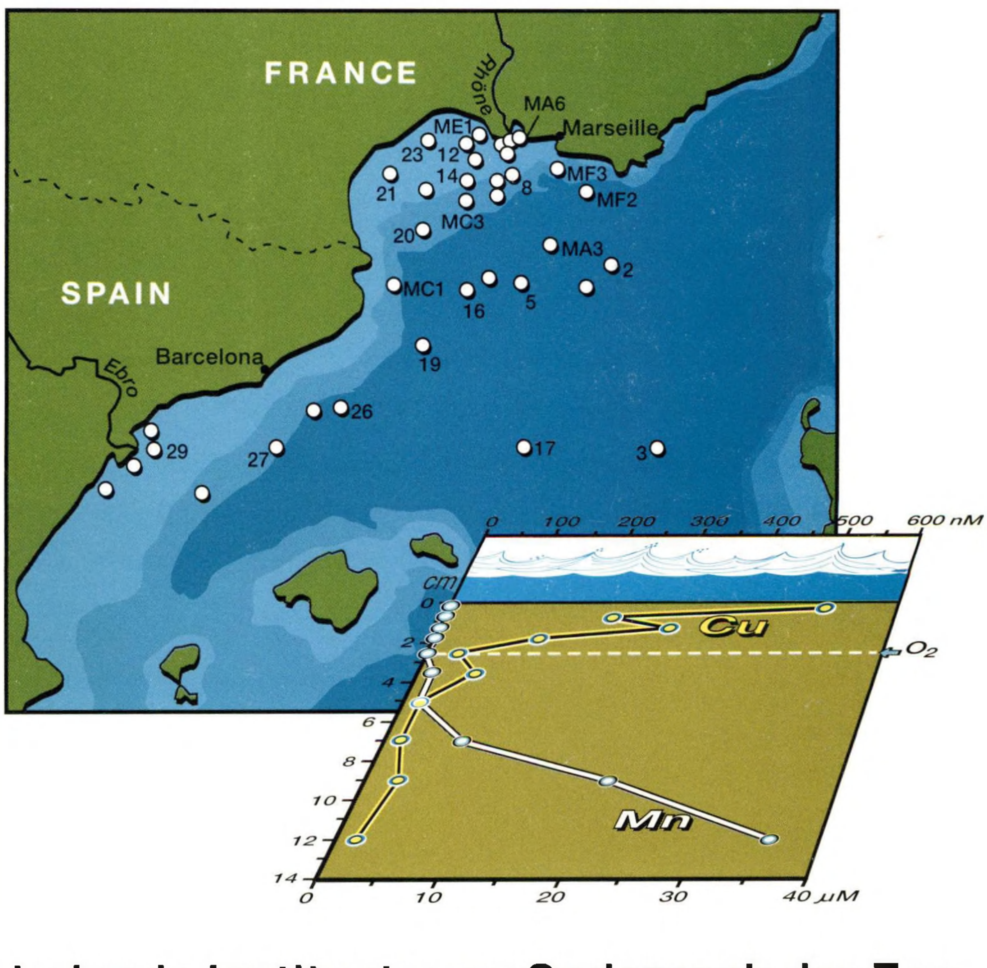

Nederlands Instituut voor Onderzoek der Zee

EROS-2000 Project

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DISTRIBUTION OF TRACE METALS IN SEDIMENTS AND POREWATERS IN THE N.W. MEDITERRANEAN SEA

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This research was carried out as part of an, environmental chemistry, students project for the Hogeschool Alkmaar

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ABSTRACT

As part of the on-going EROS 2000 project sediment samples which were collected in 1988 and 1991 in the North Western Mediterranean Sea were analyzed for trace- and major elements to construct both horizontal and vertical profiles of these elements. In the sediment both the loosely bound or leachable fraction and the residual fraction were determined. Porewater samples were analyzed for redox- and trace metals to determine the redox conditions in the sediments and the response of trace metals to these conditions. Horizontal, calcium carbonate corrected, profiles of solid phase trace metals indicate that the influence of the river Rhône on the concentrations of cadmium, copper, lead and zinc in the shallow sediments of the North Western Mediterranean Sea is higher than that of the river Ebro. The influence of both rivers on sediments in deep open-sea stations is probably minimal. Concentrations of chromium and nickel in the sediments are probably not influenced by both rivers, but by the sedimentary composition. Vertical concentration-depth profiles of lead and zinc in deep-sea sediments indicate anthropogenic inputs of these metals during the last century. However, lead concentrations in recently sedimented material suggest a decrease or at least a stabilization in input during the last years. Porewater profiles show that suboxic diagenesis is occuring in shallow sediments, while in sediments of the deeper open-sea stations only aerobic degradation of organic matter takes place. Dissolved trace metals are responding to the diagenetic environment in both types of sediment.

SAMENVATTING

Als onderdeel van het nog lopende EROS 2000 project werden sediment monsters genomen in de noord westelijke Middelandse Zee die werden geanalyseerd voor spoor- en hoofdelementen. Deze data werd gebruikt om zowel horizontale- als verticale verspreidingsprofielen te construeren. In het sediment werden zowel de zwak gebonden of leachable fractie en de residuale fractie bepaald. In het poriewater werden zowel redox- als spoormetalen bepaald om de redoxomstandgheden in het sediment te bepalen en de reactie van spoormetalen op deze condities. Horizontale, calciumcarbonaat gecorrigeerde, profielen geven aan dat de rivier Rhône een grotere invloed heeft op de concentraties cadmium, koper, lood en zink in sedimenten dicht bij de kust dan de rivier Ebro. De invloed van beide rivieren op sedimenten ver van de kust is waarschijnlijk minimaal. De concentraties van nikkel en chroom in sedimenten worden waarschijnlijk bepaald door de samenstelling van het sediment en niet door de beide rivieren. Verticale concentratie-diepte profielen van lood en zink in sedimenten ver van de kust geven een anthropogene toevoer aan gedurende de laatste eeuw. Lood concentraties in recentelijk gesedimenteerd materiaal geven aan dat de toevoer van lood de laatste jaren is afgenomen of op zijn minst gestabiliseerd. Poriewater profielen geven aan dat suboxische diagenese plaatsvind in sedimenten dicht bij de kust, terwijl in dieper gelegen sedimenten alleen aërobe degradatie van organisch materiaal plaatsvind. In beide typen sedimenten reageren spoormetalen op de specifieke diagenetische omstandigheden.

1. INTRODUCTION

Between 1987 and 1991 the Netherlands Institute for Sea Research (NIOZ) participated in several expeditions to the North Western Mediterranean Sea as part of the on-going European River Ocean System project (EROS 2000). One of the goals of this project is, generally, to describe both the horizontal and vertical distribution of trace metals in an estuarine/shelf sea system and the processes that regulate these distribution. For this purpose the North Western Mediterranean Sea was chosen.

In such a coastal environment trace metals, from both natural and antropogenic sources, are transported from land by rivers and atmosphere and buried in the sediment. Sediments can act either as a sink or source for metals, which depends on biogeochemical processes. Concentration profiles of trace metals in sediments and porewaters can provide information about the biogeochemical processes that are occuring in sediment and so the fate of a metal that is deposited.

To describe the distribution of trace metals in sediment and porewater, samples were collected during four cruises in 1987, 1988, 1990 and 1991, respectively. The samples from the 1987 and 1990 cruise have already been analyzed and the results are published **[Nolting, 1989; Nolting and Helder, 1990; Nolting and Helder, 1991; van Hoogstraten and Nolting, 1991; Nolting and van Hoogstraten, 1992]**. In this research the sediment and porewater samples which were collected in December 1988 with R.V. *Discovery* and those collected in November/December 1991 with R.V. *Tyro* were analyzed for the trace metals Pb, Zn, Cd, Cu, Ni, Cr, Fe and Mn in the solid phase fraction. Also the trace metals Pb, Zn, Cd, Cu , Ni, Fe and Mn were determined in the porewater fraction of the 1991 samples. The major element composition of the sediment was determined by analyzing the elements Ca, Si, Al and Mg in the solid phase fraction. Organic carbon and organic nitrogen were determined in the sediment samples from the 1991 cruise. With the obtained results, combined with the results from the previous cruises, concentration profiles (both horizontal and vertical) for the trace metals Pb, Zn, Cd, Cu, Ni and Cr were made, which will be discussed in this report. Also (redox)processes in the sediments will be discussed and the response of the mentioned trace metals to these processes.

2. THEORY

Chemical compounds, including trace metals, are transported to sediments by rivers, atmosphere and the remains of organisms living in sea water. In coastal sediments the main input of trace metals comes from rivers and the atmosphere, while in deeper open-sea sediments biogene material is the main source of trace metals. Sediments play an important role in the recycling of organic matter and a corresponding role in the recycling of trace metals **[e.g. Klinkhammer, 1980; Sawlan and Murray, 1983; Shaw *et al.*, 1990]**. In coastal sediments oxygen depletion is often observed in the top centimetres of the sediment as a result of a large input of organic matter. In the anaerobic part of the sediment secondary oxidants (such as Mn-oxides and Fe-oxides) replace oxygen for the oxidation of organic matter. This process is called suboxic diagenesis **[Froelich *et al.*, 1979]**. The use of secondary electron acceptors has a great influence on the behaviour of trace metals which are incorporated in these compounds. In the next paragraph the behaviour of the trace metals Pb, Zn, Cd, Cu and Ni in sediment and porewater will be shortly discussed.

Distribution profiles of solid phase lead **[e.g. Ridgway and Price, 1987; Gobeil and Silverberg, 1989; Nolting and Helder, 1991]** and zinc **[Nolting and Helder, 1991]** in sediments often displays a historical record. An explanation for this phenomenon is the increased antropogenic inputs of these elements since the last century (for instance the increased use of leaded gasoline) and the fact that these elements are hardly affected by early diagenesis **[Gobeil and Silverberg, 1989]**. The behaviour of cadmium in coastal sediments is very complex. Cadmium is probably associated with organic matter, from which it is released to the pore waters during early diagenesis. Some of the dissolved cadmium is returned to the water column (bentic flux) and some migrates downward and is precipitated at depth (in the oxic zone). In the anoxic zone dissolution of Cd from Mn- and Fe-oxides can take place, resulting in increasing porewater concentrations **[Gobeil *et al.*, 1986]**. Copper is intimately related to the aerobic degradation of organic matter, which leads to a concentration maximum at the sediment-water interface. Deeper down the sediment copper is trapped by sediment particles, so the concentration of copper in the pore water is decreasing with depth **[Klinkhammer, 1980; Sawlan and Murray, 1983]**. In coastal sediments copper can dissolute from Mn-oxides during sub oxic diagenesis, resulting in increasing copper concentrations in the pore waters **[Sawlan and Murray, 1983; Shaw *et al.*, 1990]**. Nickel is one of the trace metals whose pore water profiles are dominated mainly by concentration gradients below the oxidized zone. The pore water profiles of nickel are directly coupled to Mn-oxide dissolution during suboxic diagenesis what means that nickel is bound to Mn-oxides **[e.g. Klinkhammer *et al.*, 1982]**. In strongly reducing sediments all of the mentioned trace metals can be precipitated by sulfides, which are formed during the oxidation of organic matter by sulphate **[e.g. Gaillard *et al.*, 1986]**.

From the above described processes it is clear that the input of organic matter is one of the main controlling factors in the reactions taking place in a sediment and so controls the distribution of trace metals between sediment and (pore)water.

3. SAMPLING AND ANALYSIS

3.1 Sampling

Sediment samples were collected by means of a cylindrical boxcorer with an internal diameter of 30 cm at the stations shown in figure 1. The locations of these stations are listed in table 1. With the cylindrical boxcorer undisturbed samples can be taken, thus without any exchange of porewater and the overlying water. On board of the research vessel the overlying water was carefully siphoned off from the sediment and thereafter the core was subsampled by means of three plastic subcorers with an internal diameter of 6 cm. These subcorers were closed with rubber stoppers and carefully removed from the boxcorer. Directly after subsampling, the cores were transported to a refrigerated container in which the temperature was kept at *in situ* bottomwater temperature. The subcores of the 1988 cruise were sliced in 1 cm thick slices down to 4 cm depth, and in slices of 2 or 4 cm deeper down the core till 22 cm. The subcores collected at stations in the deeper part of the area (waterdepth > 2000m; respectively stations 3, 5, 16, 17, 26 and 27) were sliced in 0.25 cm thick slices down to 1 cm, and in slices of respectively 0.5, 1, 2 or 4 cm deeper down the core till 14 cm. This was done to achieve a better resolution at the sediment-water interface, where the most important processes take place and because sedimentation is very low at these stations. The sediments from the stations at shallow water depth were sliced in 0.5 cm thick slices down to 2 cm depth, and in slices of 1, 2 or 4 cm deeper down the core

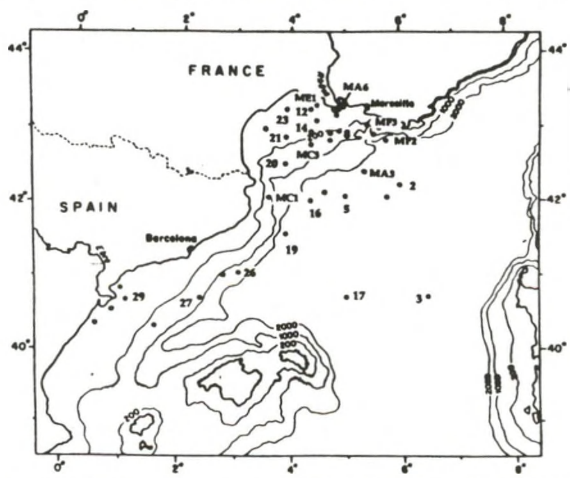

Figure 1: *Map of the North Western Mediterranean Sea showing sampling positions and depth profiles*

till 14 cm. The sliced sediment samples were transferred to all teflon squeezers and the interstitial water was squeezed off from the sediments over 0.2 µm cellulose-nitrate filters under nitrogen pressure (1-3.5 bar) and collected in polyethylene bottles. Slices of one depth were combined to obtain enough interstitial water for analysis. After squeezing the interstitial water was acidified to pH 2 with concentrated HCl and stored till analysis in a refrigerator. The sediment samples were stored in a deep freeze until analysis.

3.2 Sediment analysis

In the NIOZ laboratory about three grams of the squeezed sediment samples were dried in petri dishes at 60 ° C for at least 24 hours. The samples were then ground using a teflon mortar and pestle and about 0.1 grammes of ground sediment was quantitatively transferred into a 50 ml polypropylene volumetric flask and leached for at least 18 hours with 0.1 N HCL. After leaching the solution was filtered over a 0.45 µm cellulose nitrate filter (Sartorius) to seperate the residual fraction (on the filter) and the leachable fraction.

Station nr.	Position	depth (m)	Station nr.	Position	depth (m)
MA3	42 ° 20 N	2230	23	43 ° 13 N	81
1988	05 ° 19 E			03 ° 47 E	
MA6	43 ° 17 N	65	26	40 ° 60 N	1987
	04 ° 51 E			02 ° 60 E	
MC1	42 ° 00 N	910	27	40 ° 40 N	1774
	03 ° 37 E			02 ° 20 E	
MC3	42 ° 45 N	250	29	40 ° 40 N	60
	04 ° 20 E			01 ° 01 E	
ME1	43 ° 24 N	52	30	40 ° 50 N	59
	04 ° 01 E			00 ° 54 E	
MF2	42 ° 55 N	1140	1	43 ° 13 N	100
	05 ° 38 E		**1990**	04 ° 51 E	
MF3	43 ° 03 N	520	2A	43 ° 19 N	44
	05 ° 20 E			04 ° 51 E	
2	42 ° 17 N	2500	4	43 ° 09 N	101
1991	06 ° 00 E			04 ° 40 E	
3	40 ° 40 N	2765	6	42 ° 51 N	85
	06 ° 30 E			03 ° 25 E	
5	42 ° 05 N	2145	7	40 ° 46 N	11
	05 ° 00 E			00 ° 53 E	
8	42 ° 53 N	800	8A	40 ° 23 N	520
	04 ° 54 E			01 ° 23 E	
12	43 ° 16 N	63	10	40 ° 58 N	1080
	04 ° 19 E			02 ° 09 E	
14	42 ° 50 N	473	11	40 ° 30 N	30
	04 ° 20 E			00 ° 43 E	
16	41 ° 60 N	2257	13	40 ° 20 N	27
	04 ° 20 E			00 ° 28 E	
17	40 ° 40 N	2704	14A	42 ° 00 N	2390
	04 ° 60 E			04 ° 40 E	
19	41 ° 30 N	2289	15	41 ° 57 N	2500
	03 ° 50 E			05 ° 56 E	
20	42 ° 30 N	750	16A	42 ° 52 N	210
	03 ° 50 E			04 ° 43 E	
21	42 ° 45 N	329	19A	42 ° 50 N	513
	03 ° 50 E			00 ° 50 E	

Table 1: *Sampling positions with waterdepths during the three expeditions*

The filters were destroyed in a teflon bomb using 1 ml of aqua regia and 5 ml of HF at 120 ° C for 2 hours. After digestion the solution was quantitatively transferred into 50 ml polypropylene volumetric flasks, which contained 30 ml of saturated boric acid to complex the fluorides. Only three depths (at -0.25, -3.50 and -12 cm) from the shallow stations of the 1991 cruise were analyzed because already enough data was available from previous cruises in this area **[e.g. van Hoogstraten and Nolting, 1991]**.

All reagents used during the whole procedure were of Suprapure quality. The materials used were acid cleaned in 6 N HCl for at least 24 hours and then rinsed extensively with deionized water. The filters were soaked in dilute HCl for several days. Teflon materials were cleaned by putting them for at least 24 hours in hot (60 ° C) 7 N HNO_3 followed by rinsing with deionized water. All materials were stored in plastic bags until use.

From the major elements Ca was only determined in the leachable fraction. Si and Al were only determined in the residual fraction. The concentration of these elements in the other fraction is neglectable. Mg, Mn, Fe and Zn were analysed in both the leachable and the residual fraction. All these elements were analysed by Flame Atomic Absorption Spectrophotometry (FAAS) using a Perkin Elmer 2380. Si and Al were determined using a N_2O-acetylene flame, while for the other elements an air-acetylene flame was used. Concentrations were calculated using calibration curves obtained with standard additions, except for the elements Fe, Mn and Zn. The calibration curves of these elements obtained with standard additions and the curves obtained with external calibration standards were as good as equal, so external calibration curves were used. The trace metals Cd, Cu and Pb were analysed in both the leachable and residual fraction with the Stabilized Temperature Platform Furnace technique (STPF technique) using a Perkin Elmer 5000 equipped with deuterium background correction or a Perkin Elmer 5100 PC with Zeeman background correction. Cr and Ni were analysed using pyrolytically coated graphite tubes with the same instruments as described above. External calibration curves (0.1 N HNO_3 matrix) were used to calculate the concentrations of the trace metals in the samples. Used apparatus and the experimental conditions can be found in appendix 1, 2 and 3.

3.3 Porewater analysis

To determine the concentrations of Pb, Cd, Cu and Ni in the porewaters of the 1991 cruise, the porewaters were subjected to a preconcentration procedure using a modification of the method described by **Danielsson *et al.*, 1978**. In a clean 10 ml polypropylene vial up to 5 ml (depending on the amount of sample) of sample was buffered to a pH of 4-5 using 100 µl of an ammonium-acetate buffer. The metals were then complexed with 100 µl of a freon-cleaned 1 % solution of APDC/DDDC (ammoniumpyrrolydinine dithiocarbamate /

diethylammonium diethyldithiocarbamate) and extracted in 4 ml of quartz distiled freon-TF. After 3 minutes of vigorous shaking the water-phase was removed and stored in an acid-cleaned bottle. To the freon-phase 50 µl of concentrated HNO_3 (three times quartz distiled) was added to destroy the APDC/DDDC complex. Finally 0,95 ml of deionized water was added to obtain a final volume of 1.00 ml. In this way the samples were concentrated up to five times and interfering sea salts were removed. The trace metals were determined with flameless atomic absorption spectrophotometry using a Perkin Elmer 5000 with deuterium background correction (Cu and Ni) and a Perkin Elmer 5100 PC with Zeeman background correction (Cd and Pb). Three standard addition calibration curves were prepared using the stripped water from the freon extraction. In this way the recovery can be calculated for each metal. These recoveries were 72 % for Cu, 85 % for Ni, 92 % for Cd and 89 % for Pb. The recoveries of Cd and Pb are somewhat lower as described elsewhere **[Gerringa, 1990; Khan *et al.*, 1992]** but this can be attributed to differences in porewater composition. Five reagent blanks were run during the whole procedure and were 2.0 nM for Cu, 1.1 nM for Ni, 0.13 nM for Cd and 0.7 nM for Pb. Zinc was determined by direct aspiration in a flame AAS (Perkin Elmer model 2380) using calibration curves obtained with standard additions. Mn and Fe were determined directly with an auto analyser on board of the research vessel. Their concentrations were checked with flame AAS using the method of standard additions. Comparison of the results indicate that the uncertainty between the two techniques is less than ± 6 %, except for samples with very low concentrations.

3.4 Accuracy

Titrisol standards of 1000 ± 2 ppm were used for preparation of the range of standards. Only calibrations within the linear range of absorbance were used to calculate the concentrations in the samples. To validate the used analytical procedures several reference samples were analysed in parallel with the samples of both cruises for all the concerned elements. The reference samples used were BCR 142 (a light sandy soil) and BCR 143 (a sewage sludge amended soil) for the samples of the cruise and BCR 141 (a calcareous loam soil), BCR 142 and BCR 277 (a river estuarine soil) for the samples of the 1991 cruise. All of the used reference samples are from the Community Bureau of Reference in Brussels. In table 2 the found and the certified values for the BCR samples from the 1988 cruise are listed. In table 3 and 4 the found and certified values for the BCR samples from the 1991 cruise are listed. These tables show that the found and certified values are in good agreement with each other, which means that we obtained a good accuracy. Some elements are not determined in some of the BCR samples because of the relative high concentrations in the BCR samples compared to the Mediterranean samples. BCR 141 was analysed three times to determine the precision of the used procedure. The precision for all metals was better than 5

%. Blanks were run during the whole procedure and appeared to be neglectable compared to the concentrations in the samples, but were corrected for.

	BCR 142 (light sandy soil)		BCR 143 (sewage sludge)	
Element	determined	certified	determined	certified
Cd	0.22	0.25 ± 0.09	N.D.	31.1 ± 1.2
Cu	26.8	27.5 ± 0.6	227.3	236.5 ± 8.2
Ni	28.4	29.2 ± 2.5	82.5	99.5 ± 5.5
Pb	33.8	37.8 ± 1.9	N.D.	1333 ± 39
Zn	95.2	92.4 ± 4.4	N.D.	1272 ± 30
Cr	79.9	(74.9 ± 9.4)	232	(228 ± 19)
Mn	592	(569 ± 26)	N.D.	(999 ± 62)
MgO	0.91	(1.09)	4.93	(4.90)
Fe_2O_3	2.90	(2.80)	3.90	(3.75)
Al_2O_3	9.66	(9.48)	N.D.	(10.13)
CaO	5.34	(4.94)	10.86	(9.35)
SiO_2	69.30	(68.22)	N.D.	(42.72)

Table 2: *Found and certified values of trace- and major element concentrations in the BCR samples 142 and 143 (1988 cruise). Values between parenthesis are not certified. N.D. means not determined. Concentrations of the trace metals in $\mu g.g^{-1}$. Concentrations of the other (major) elements in %.*

	BCR 141 (calcareous loam)		BCR 142 (light sandy soil)	
Element	determined	certified	determined	certified
Cu	29.9 ± 0.4	32.6 ± 1.4	25.0	27.5 ± 0.6
Ni	31.8 ± 0.6	(30.9 ± 3.2)	27.5	29.2 ± 2.5
Pb	31.3 ± 0.2	29.4 ± 2.6	40.0	37.8 ± 1.9
Zn	81.3 ± 0.7	81.3 ± 3.7	95.1	92.4 ± 4.4
Cr	65.2 ± 2.7	(75.0 ± 10.4)	72.5	(74.9 ± 9.4)
Mn	522 ± 8	(547 ± 32)	533	(569 ± 26)
MgO	1.07	(1.19)	1.05	(1.09)
Fe_2O_3	3.87	(3.74)	2.92	(2.80)
Al_2O_3	11.99	(10.56)	9.55	(9.48)
CaO	19.8	(17.98)	4.88	(4.94)
SiO_2	44.0	(42.58)	65.9	(68.22)

Table 3 : *Found and certified values of trace- and major element concentrations in the BCR samples 141 and 142 (1991 cruise). Values between parenthesis are not certified. N.D. means not determined. Concentrations of the trace metals in $\mu g.g^{-1}$. Concentrations of the other (major) elements in %*

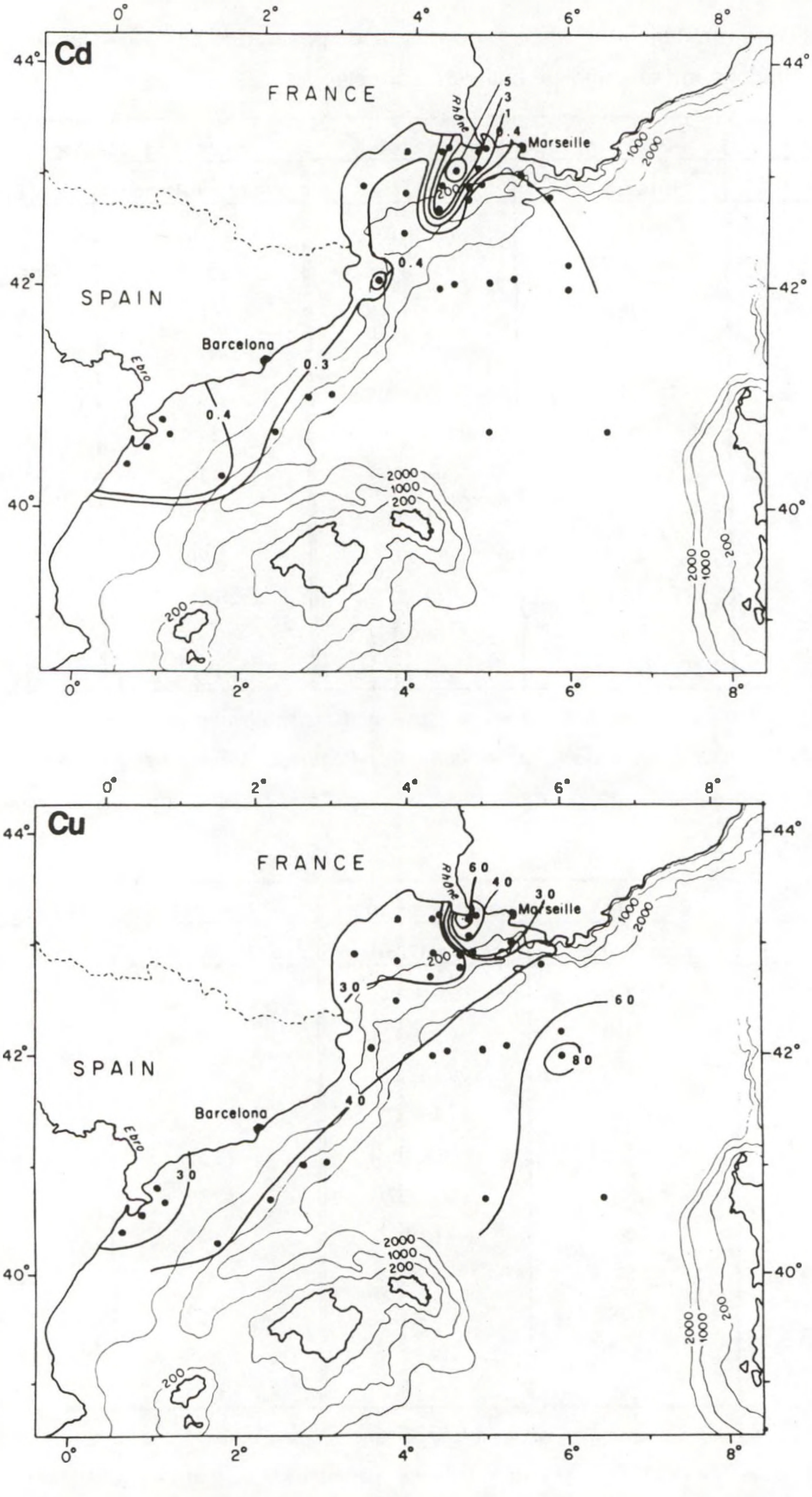

Figure 2: *Distribution of cadmium and copper in the upper 2 centimetres of sediment in the North Western Mediterranean Sea. Concentrations in $\mu g.g^{-1}$*

BCR 277 (river estuarine soil)		
Element	**determined**	**certified**
Cu	102.4	101.7 ± 1.6
Ni	41.6	43.4 ± 1.6
Pb	N.D.	146 ± 3
Zn	N.D.	547 ± 12
Cr	203	192 ± 7
Mn	1588	(1600)
MgO	1.31	(1.64)
Fe_2O_3	5.49	(6.52)
Al_2O_3	8.02	(8.73)
CaO	7.66	(7.55)
SiO_2	47.0	(49.2)

Table 4 : *Found and certified values of trace- and major element concentrations in BCR sample 277 (1991 cruise). Values between parenthesis are not certified. N.D. means not determined. Concentrations of the trace metals in $\mu g.g^{-1}$. Concentrations of the other (major) elements in %.*

4. RESULTS AND DISCUSSION

4.1 Horizontal distribution of trace metals

The horizontal distribution of the total content of trace metals in the top layer of sediments can indicate the source of these metals. One should however be very careful with calculating the average concentration of trace metals in this layer. In marine sediments the calcium carbonate content is usually increasing when moving from shallow waters to sediments situated in deeper waters, due to a change from fluviatile inputs to pelagic formed sediments. Regarding the fact that calcium carbonate contains a very little amount of trace metals, the used data have to be calculated on a calcium carbonate free basis to correct for this so called dilution effect. In appendix 12 the calculated average trace metal content in the upper 2 centimetres of the samples from the 1988,1990 and the 1991 cruise are given. Combined with the data from the 1990 cruise **[van Hoogstraten and Nolting, 1991]** detailed horizontal distribution profiles of the trace metals Cd, Cu, Ni, Cr, Pb and Zn were constructed (see figure 2, 3 and 4 respectively), which will be discussed here.

Cadmium

Unfortunately, no data are available from the sediments of the 1991 cruise. This means that the distribution profiles are based on the data from the 1988 and 1990 cruise (figure 2).

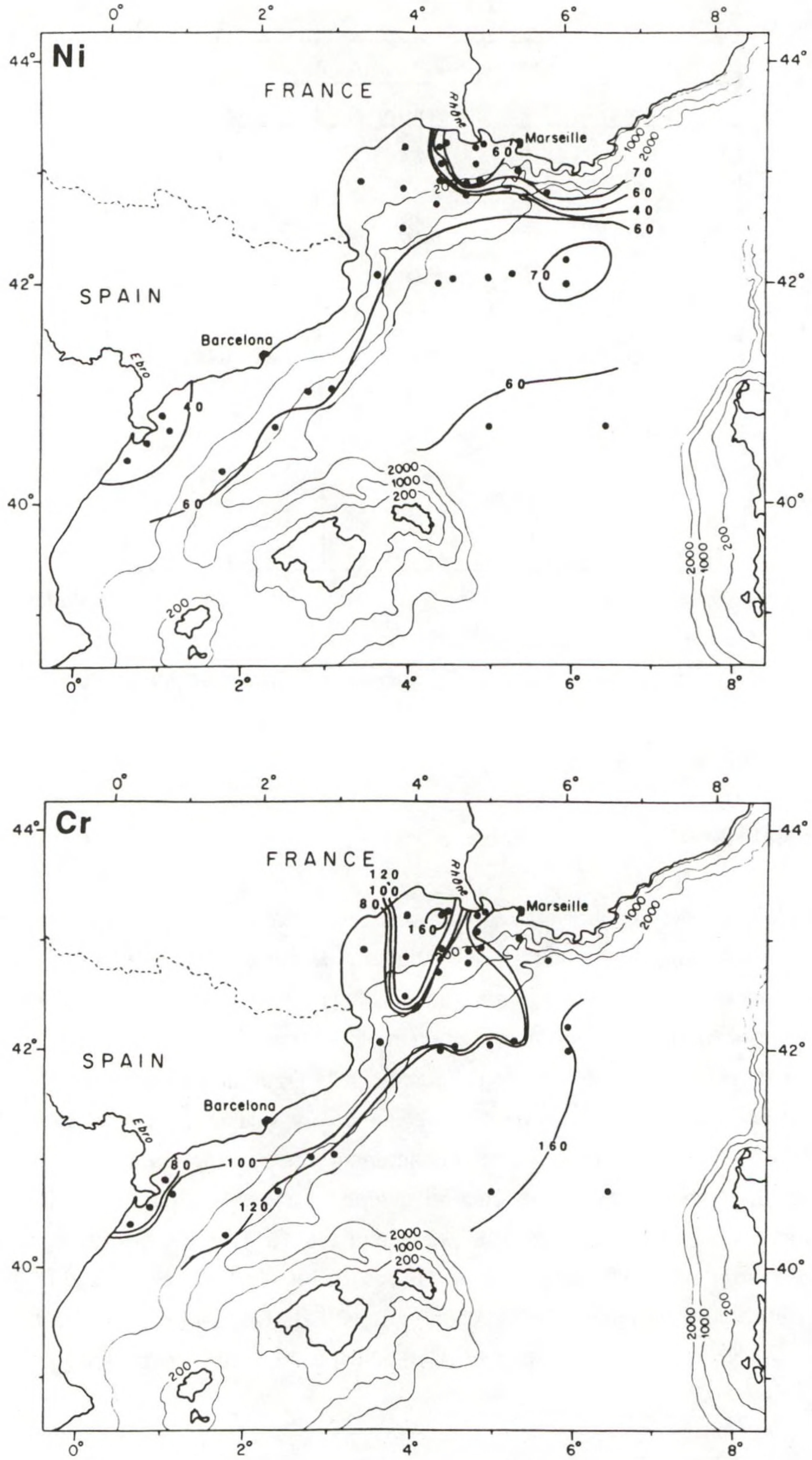

Figure 3: *Distribution of nickel and chromium in the upper 2 centimetres of sediment in the North Western Mediterranean Sea. Concentrations in* $\mu g.g^{-1}$

The highest concentrations of cadmium are found in sediments close to the river Rhône (3-5 $\mu g.g^{-1}$). These concentrations are decreasing with increasing distance from this river to a value of about 0.2 $\mu g.g^{-1}$ in the deeper parts of the area. Concentrations of cadmium in sediments close to the river Ebro are smaller (0.40 $\mu g.g^{-1}$) compared to those close to the river Rhône, but are significant higher compared to those found in the deeper parts of the area. It can be concluded that the influence of the river Rhône on the cadmium content in sediments of the North Western Mediterranean Sea is higher than that of the river Ebro.

Copper

Close to the river Rhône the copper concentration in the sediments is rapidly decreasing from >60 $\mu g.g^{-1}$ to <30 $\mu g.g^{-1}$ with increasing distance from this river (figure 2). This is probably due to a large input of copper from the Rhône, which is buried in sediments close to the river. When moving to sediments at greater water depth the copper concentration is increasing again to a maximum concentration of 86 $\mu g.g^{-1}$ at station 15. This is probably due to a change in sediment composition and not to a higher input of copper in this area. Sediments close to the river Ebro show no initial decrease in copper concentrations. Here concentrations are increasing directly with increasing distance from the river.

Nickel

The geographical distribution of nickel is very complex. With increasing distance from the river Rhône the nickel concentration is respectively increasing, decreasing, increasing and decreasing again (figure 3). Concentrations are increasing when moving from the river Ebro. It is obvious that the river Rhône has a bigger influence on the nickel concentrations in sediments of the North Western Mediterranean Sea than the Ebro, but this influence is of minor importance taken into account the rather patchy distribution pattern. Nickel contents in the top layer of the sediments in the North Western Mediterranean Sea are probably most dictated by the sedimentary composition and not by antropogenic inputs.

Chromium

Chromium concentrations are generally increasing with increasing distance from the rivers Rhône and Ebro (figure 3). Lowest concentrations are found in the direct vicinity of the Ebro (80 $\mu g.g^{-1}$), while the highest concentrations can be found at the stations far away from both rivers. The influence of the rivers Rhône and Ebro on the concentrations of chromium in sediments of the North Western Mediterranean Sea is probably minimal. So as by nickel the composition of the sediment dictates the chromium distribution in these sediments.

Lead

No data of total lead in the sediments from the samples from the 1990 cruise are available, so the distribution profiles are based on the data from the 1988 and 1991 cruise.

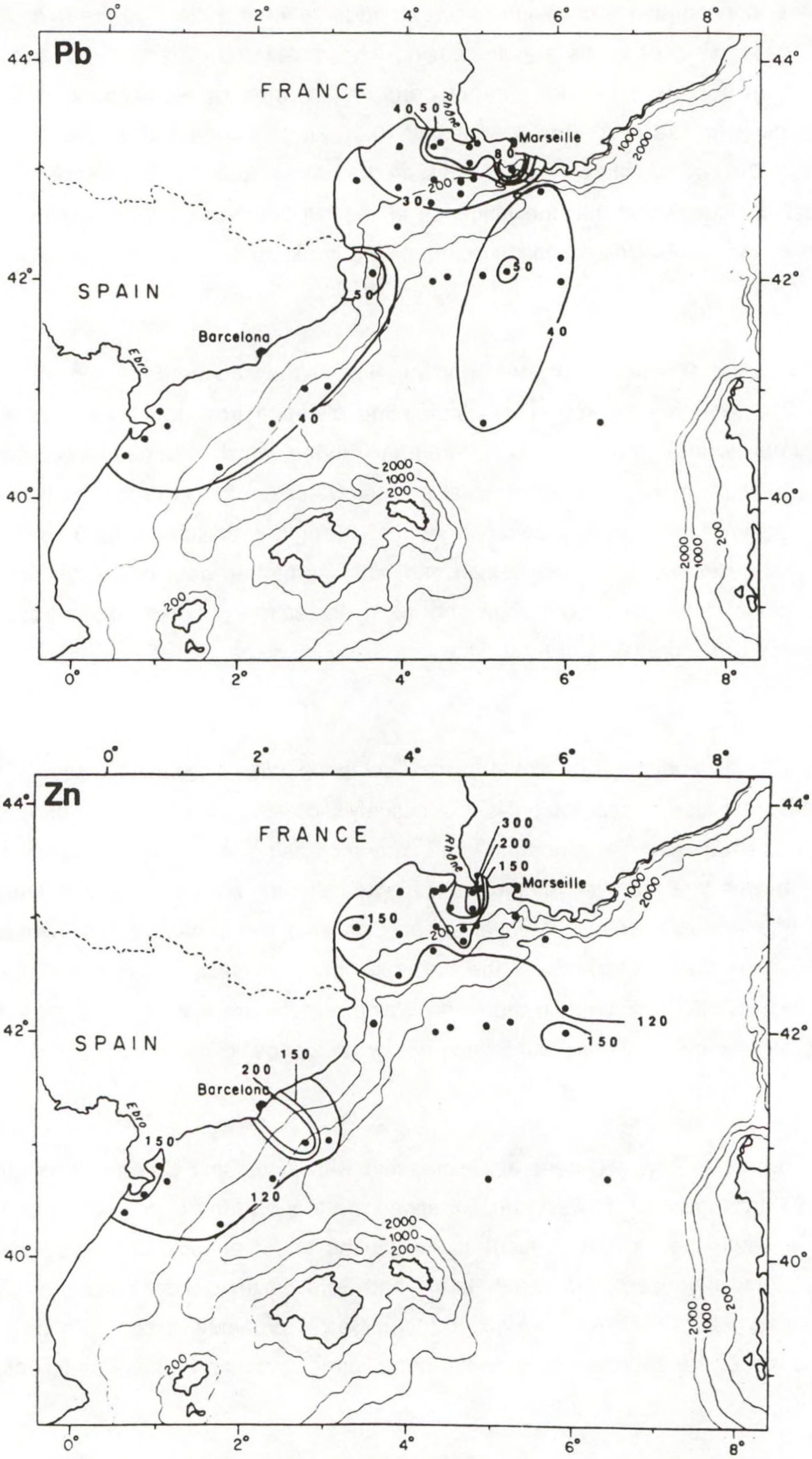

Figure 4: *Distribution of lead and zinc in the upper 2 centimetres of sediment in the North Western Mediterranean Sea. Concentrations in* $\mu g.g^{-1}$

Highest concentrations of lead are found in sediments close to the city of Marseille (figure 4). Concentrations are higher in sediments close to the Rhône compared to those in sediments close to the Ebro. The concentrations are decreasing with increasing distance from both rivers reaching a minimum concentration of 35 $\mu g.g^{-1}$ at station 3. It is obvious that the Rhône has some impact on the lead concentrations in sediments near the river outflow.

Zinc

The highest concentrations of zinc are found in the direct vicinity of the Rhône outflow (figure 4). The concentrations are decreasing with increasing distance from this river, except for a local rise at the stations 6 and 15. Concentrations in the direct vicinity of the Ebro are also higher compared to those in sediments at greater water depth, but lower than those in sediments near the Rhône outflow. A local area at the coast of Barcelona shows high concentrations of zinc in the sediment (> 200 $\mu g.g^{-1}$), probably due to industrial activities in this city or due to a different sediment composition at this station, although concentrations of the other trace metals did not show an enrichment at this site.

4.2 Sediment characteristics

4.2.1 Main element distribution

In this part the geographical distribution of the main elements Ca, Mg, Fe, Al and Si in the upper 2 centimetres of the sediment is discussed. The main elements are expressed in their carbonate or oxide form ($CaCO_3$, MgO, Fe_2O_3, Al_2O_3 and SiO_2, respectively) because these are the most important forms in which these elements occur in marine sediments. To describe the main element distribution a representative number of sampling stations was chosen; the stations MA6, 8, MA3, 2 and 3 to describe the distribution at increasing distance from the Rhône, and the stations 29, 27, 26, 17 and 3 to describe the distribution at increasing distance from the Ebro. The main element concentrations are shown in figure 5.

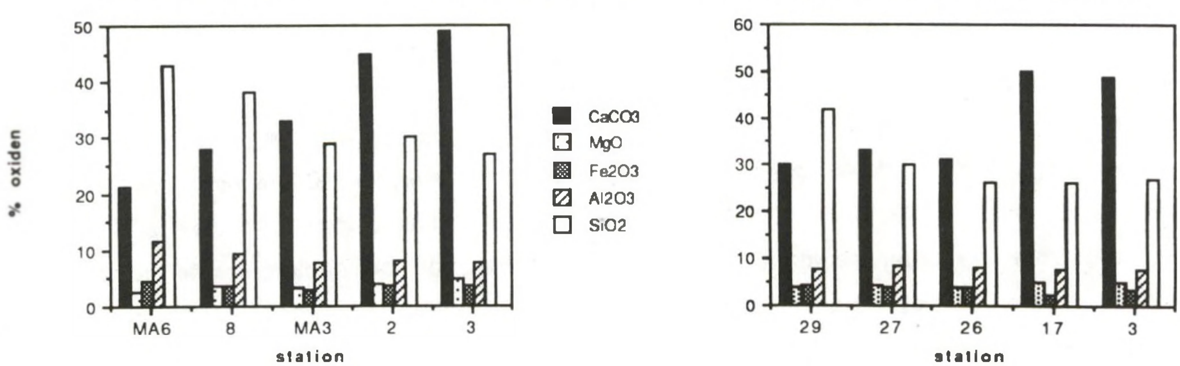

Figure 5: *Main element distribution in the upper 2 centimetres of sediments at increasing distance from the Rhône (left) and the Ebro (right)*

Iron oxide and magnesium oxide contents are generally uniform in both directions (5 % and 3 % respectively). The aluminium oxide content is slightly decreasing with increasing distance from the Rhône, but this is not observed at increasing distance from the Ebro. In both directions the content of calcium carbonate is increasing with increasing distance from the rivers. This phenomenon is very common in marine sediments and is due to the production of biogene calcium carbonate at open sea. The silicon oxide content show an opposite behaviour compared to that of calcium carbonate. The concentration is decreasing in both directions when moving from shallow to deep sea sediments, due to the supply of inorganic SiO_2, incorporated in land derived sediments. The total amount of oxides and carbonates range from 70-90 % at the stations described before (see figure 6). The residual 10-30 % is probably determined by other compounds like TiO_2, Na_2O, K_2O, P_2O_5, CO_2, NaCl and H_2O. There is no observable trend, which shows a decrease of total oxides and carbonate with increasing distance from the rivers Rhône and Ebro, as described by **van Hoogstraten and Nolting (1991)**.

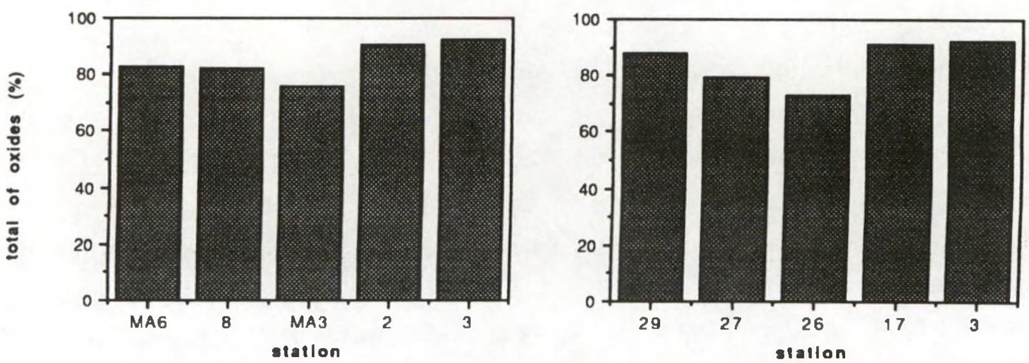

Figure 6: *Total oxides and carbonates in the upper 2 centimetres of sediments at increasing distance from the Rhône (left) and the Ebro (right)*

4.2.2 C/N ratio

In table 5 the content of organic carbon, nitrogen, $d^{13}C$ and the C/N ratio in sediments of the 1991 cruise are listed. The organic C content in sediments located at shallow water depths is rather high in the top surface sediment (~0.8%) compared to those at stations located in deeper waters (~0.5%). In these latter sediments the content of organic C subsequently decreases with depth.(St. 2, 3, 5, 16, 17, 26 and 27). This indicates the destruction of organic matter in the older sediment layer and that mixing of the sediment due to bioturbation is very small or not present at all. At the stations in shallow waters the organic C content is higher and rather constant with depth, due to high sedimentation rates and bioturbation. This results in a rather homogeneous sediment distribution, which is supported by the almost constant C/N ratio. This in contrast to the C/N ratio in sediments at the deep open-sea stations, which shows a decrease with depth. The C/N ratio reflects both the origin of the carbon and the degree of degradation of organic matter. Terrestrial material, rich in woody plant tissues has a high C/N ratio (50-100) whereas marine carbon has a much lower C/N ratio (5.4-8.3). Because marine formed material rich in nitrogen-containing compounds are less stable during diagenesis, it is expected that the C/N ration increases or remains nearly constant with age. The higher C/N ratio in the top centimetres of sediments located in the deeper parts of the area does not support this idea. So the lower C/N ratio in the older sediment layer cannot be explained by a loss of nitrogen, rather it indicates an increasing supply of terrestrial organic matter (high in C/N ratio) relative to marine organic matter with time. **Macdonald et al. (1991)** observed the same process, increasing C/N ratios to the top surface layer, in sediments from the Strait of Georgia, B.C., Canada and raised the explanation given above. Another observation that supports this explanation is the almost constant C/N ratio at the same detph in the cores at the deep open-sea stations. So at 12 cm the C/N ratio is ~4, at 5 cm ~5-6 and at the top ~8. This last ratio is almost the same as found in the sediments in the shallow part of the area. If a bigger part of the organic carbon in recently deposited sediment is from terrestrial origin it indicates an increase in riverine supply or an increase.in atmospheric transport. Indeed an four times increase in atmospheric transport of polycyclic aromatic hydrocarbons in the last hundred years, in the western Mediterranean Sea, is observed by **Lipiatou and Saliot (1991)**. If we take end-member compositions of terrestrial material with a C/N ratio of 90 and the marine ratio at C/N 6.2 we can calculate the contribution of the two sources **[Macdonald *et al.*, 1991]**. With this calculation we can explain the organic carbon content in the surface sediment at station 5 to be 73% from marine origin and for 23% terrigeen. For station 14 this ratio is 57% and 43% respectively.

Station nr.	Depth (cm)	org. C (%)	org. N (%)	$\delta^{13}C$	C/N mol
2	-0.25	0.97	0.09	-19.5	12.62
	-5.00	0.23	0.06	-18.7	5.06
	-10.00	0.15	0.04	-22.6	4.53
3	-0.25	0.56	0.08	-21.1	8.40
	-5.00	0.30	0.06	-22.2	5.97
	-12.00	0.24	0.07	-21.8	4.22
5	-0.25	0.44	0.06	-19.4	8.07
	-5.00	0.22	0.04	-21.5	5.72
	-12.00	0.20	0.06	-18.4	4.37
8	-0.25	0.85	0.13	-22.5	8.06
	-5.00	0.58	0.09	-22.0	8.06
	-12.00	0.57	0.09	-22.5	7.73
12	-0.25	0.83	0.11	-23.3	8.87
	-5.00	0.82	0.10	-23.2	9.20
	-12.00	0.70	0.09	-23.5	9.02

Table 4: *Organic carbon content, organic nitrogen content, $d^{13}C$ and the C/N ratio in sediment samples from the 1991 cruise*

Station nr.	Depth (cm)	org. C (%)	org. N (%)	$\delta^{13}C$	C/N mol
14	-0.25	0.83	0.10	-22.5	9.97
	-5.00	0.72	0.10	-23.2	8.67
	-12.00	0.57	0.08	-22.8	7.96
16	-0.25	0.41	0.06	-21.6	7.58
	-5.00	0.22	0.05	-22.3	5.08
	-12.00	0.18	0.04	-22.6	4.23
17	-0.25	0.47	0.07	-21.4	7.18
	-5.00	0.55	0.08	-21.6	7.82
	-12.00	0.24	0.05	-22.1	5.23
19	-0.25	0.56	0.10	-22.2	6.54
	-5.00	0.41	0.08	-22.4	6.10
	-12.00	0.35	0.07	-22.5	6.12
20	-0.25	0.69	0.10	-22.6	8.29
	-5.00	0.47	0.07	-22.9	7.87
	-12.00	0.42	0.06	-23.7	7.98
21	-0.25	0.69	0.09	-22.5	8.83
	-5.00	0.62	0.09	-22.6	8.02
	-12.00	0.47	0.08	-22.7	7.14
23	-0.50	0.72	0.11	-23.0	7.88
	-5.00	0.72	0.10	-23.0	8.59
	-16.00	0.60	0.09	-23.5	8.15
26	-0.25	0.78	0.11	-23.1	8.54
	-5.00	0.37	0.09	-22.6	4.93
	-12.00	0.23	0.05	-22.5	5.35
27	-0.25	0.58	0.09	-21.8	7.08
	-5.00	0.39	0.08	-22.2	6.12
	-12.00	0.33	0.07	-22.6	5.08
29	-0.25	0.73	0.11	-23.0	7.66
	-5.00	0.69	0.11	-23.3	7.25
	-12.00	0.56	0.10	-23.6	7.86
30	-0.25	0.86	0.11	-22.7	8.73
	-5.00	0.79	0.11	-23.0	8.22
	-9.00	0.77	0.11	-23.5	8.58

Table 4: *continued*

4.2.3 Sediment accumulation rates

Sediment accumulation rates are decreasing with increasing distance from the coast. Highest sedimentation rates are found in the direct vicinity of the river Rhône (e.g. 0.63 $cm.y^{-1}$ at station MA6), while lowest sedimentation rates are found at the deepest open-sea stations (e.g. 0.015 $cm.y^{-1}$ at station 3) **[Zuo *et al.*, 1990, 1992]**.

4.2 Vertical distribution of trace metals in sediment

In this paragraph the vertical distribution of metals Mn, Fe, Cu, Ni, Cr, Pb and Zn in sediments will be discussed. There will be looked at the residual fraction and the total fraction of these metals. The leachable fraction is loosely bound to the sediment and can reflect the (anthropogenic) source of an element **[e.g. Nolting and Helder, 1991]**. When the residual and the total fraction are plotted in one graph a variation in the leachable fraction can easily be observed. The main accent in this paragraph will be put to stations in the deeper part of the area, sampled during the 1991 cruise (station 2, 3 and 26), since not many data are available for this area. As a contrast, also the sediment at station MA6 (near the river Rhône) will be discussed. Concentration-depth profiles for all of the concerned metals are shown in figure 7, 8, 9 and10. Used data can be found in appendices 4 to 8.

Manganese and iron

The leachable fraction at all four stations is relative high compared to the total manganese content. At station MA6 manganese concentrations are lower than in sediments at the three deeper stations. The concentration-depth profile is very constant, indicating a high sedimentation rate and strong bioturbation at this site. At station 2 the total manganese concentration is relative constant in the top of the core (800 $\mu g.g^{-1}$), but increases downwards from 7 centimetres to a concentration of 1200 $\mu g.g^{-1}$at 12 cm depth. The same phenomenon is observed in the sediment at station 26, with an increase of the manganese concentration from 1000 $\mu g.g^{-1}$ in the top of the core to a concentration of 1800 $\mu g.g^{-1}$ at 12 cm depth. The manganese concentration-depth profile at station 3 shows a decrease in the top centimetre of the sediment. The reason for the observed variations in the concentration-depth profiles at the deeper stations will be discussed later. Iron concentration-depth profiles are relative constant at all four stations (2-3 %).The observed differences in the leachable content between the shallow station MA6 (1988 cruise) and the deeper stations 2, 26 and 3 (1991 cruise) are probably caused by differences in sample preparation (the samples from the 1988 cruise have been leached for a longer time or are leached with a stronger acid). As with manganese the iron concentration is decreasing in the surface layer of the sediment at station 3.

Copper, nickel and chromium

The concentrations of these metals at all four discussed stations are uniform with depth. At the stations 2 and 3 a decrease in concentration of all metals is observed in the surface layer of the sediment. The leachable content of the discussed metals does not show a variation with depth at all stations, which means that variations in the total metal content are a function of the texture of the sediment. The leachable fraction is however dependent on the position of the station, as discussed for iron and manganese.

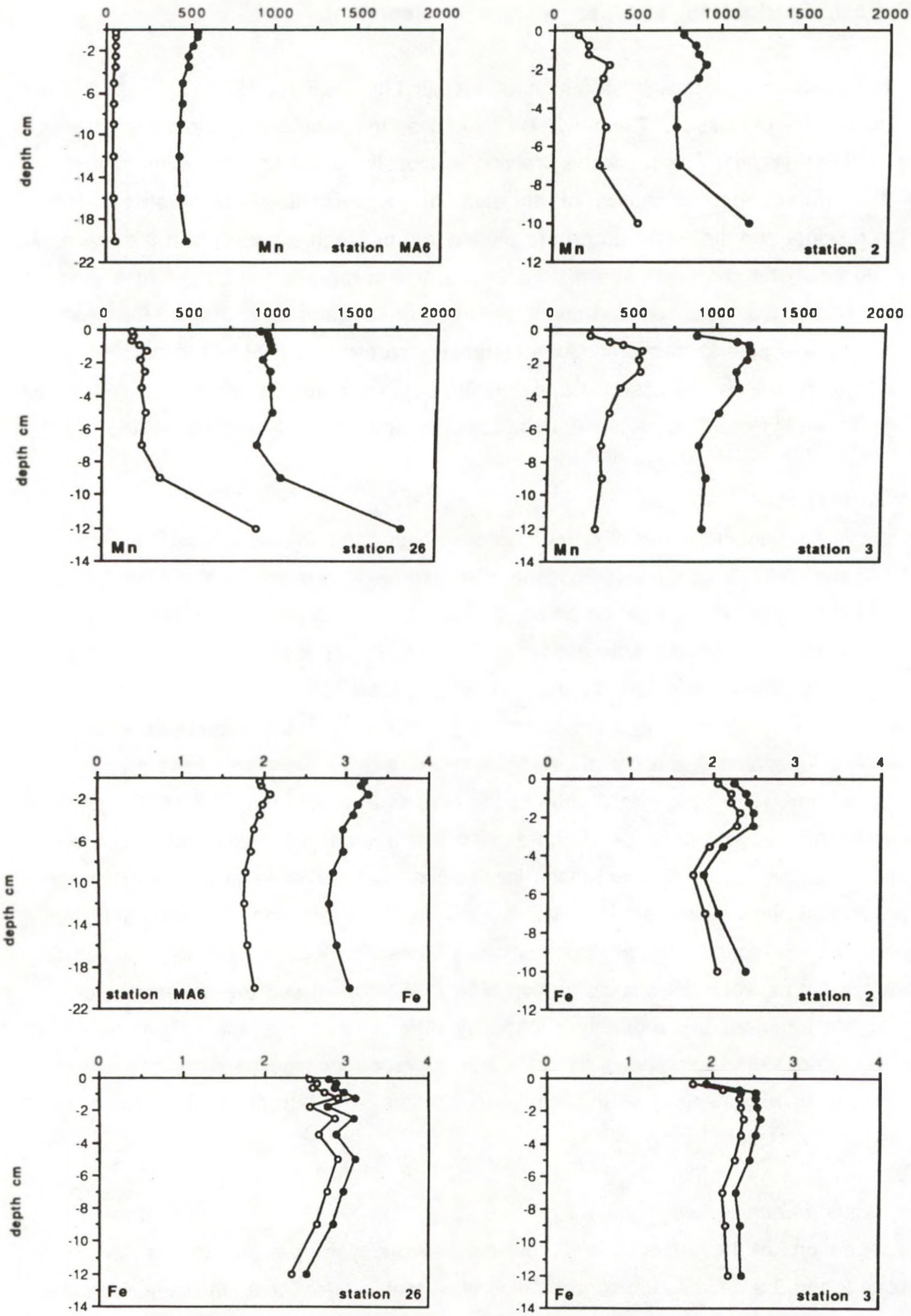

Figure 7: *Concentration-depth profiles of residual (open dots) and total (black dots) manganese and iron in sediments at the stations MA6, 2, 26 and 3. Concentrations in µg.g-1 for manganese and in % for iron*

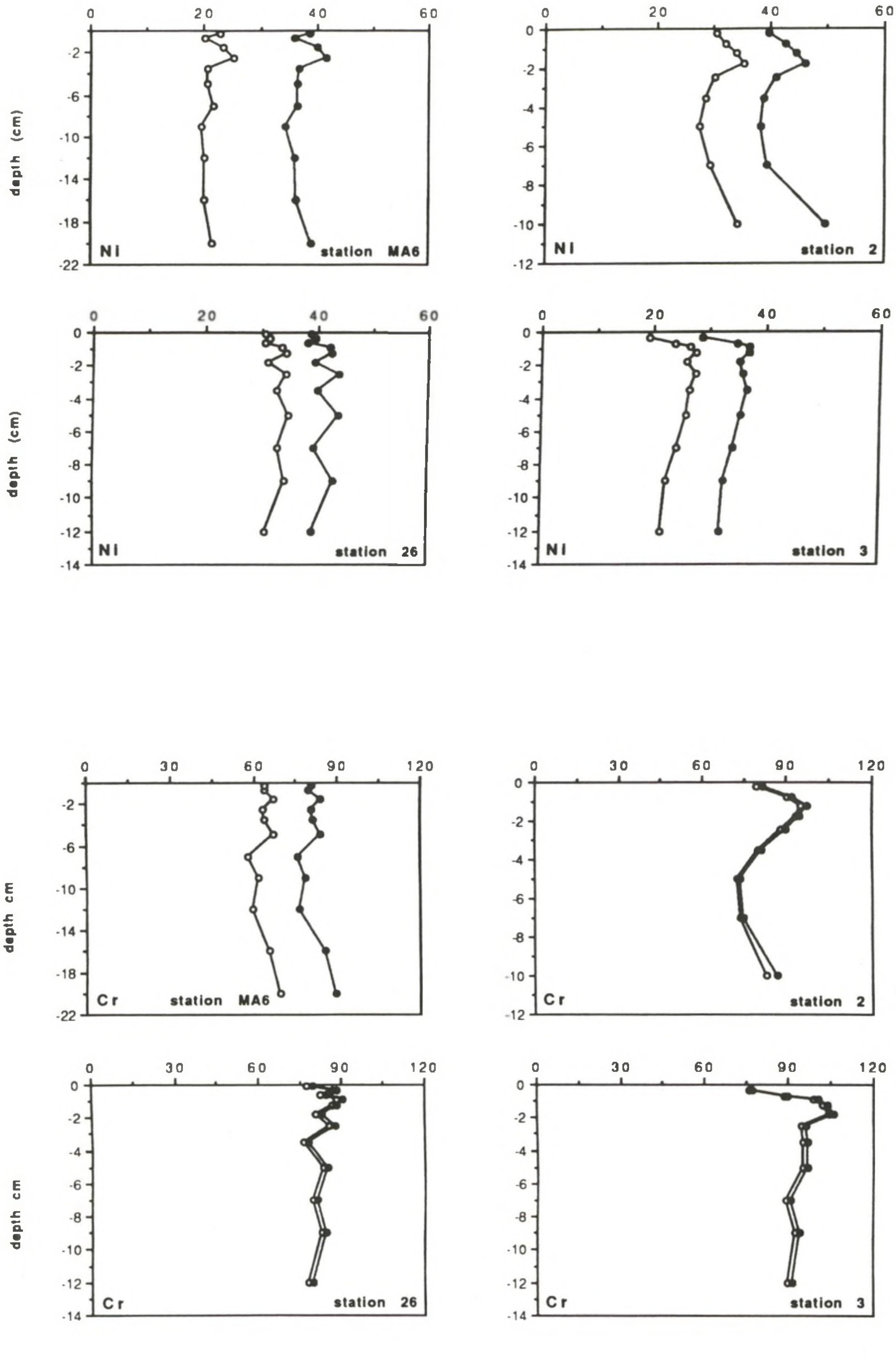

Figure 8: *Concentration-depth profiles of residual (open dots) and total (black dots) nickel and chromium in sediments at the stations MA6, 2, 26 and 3. Concentrations in µg.g-1*

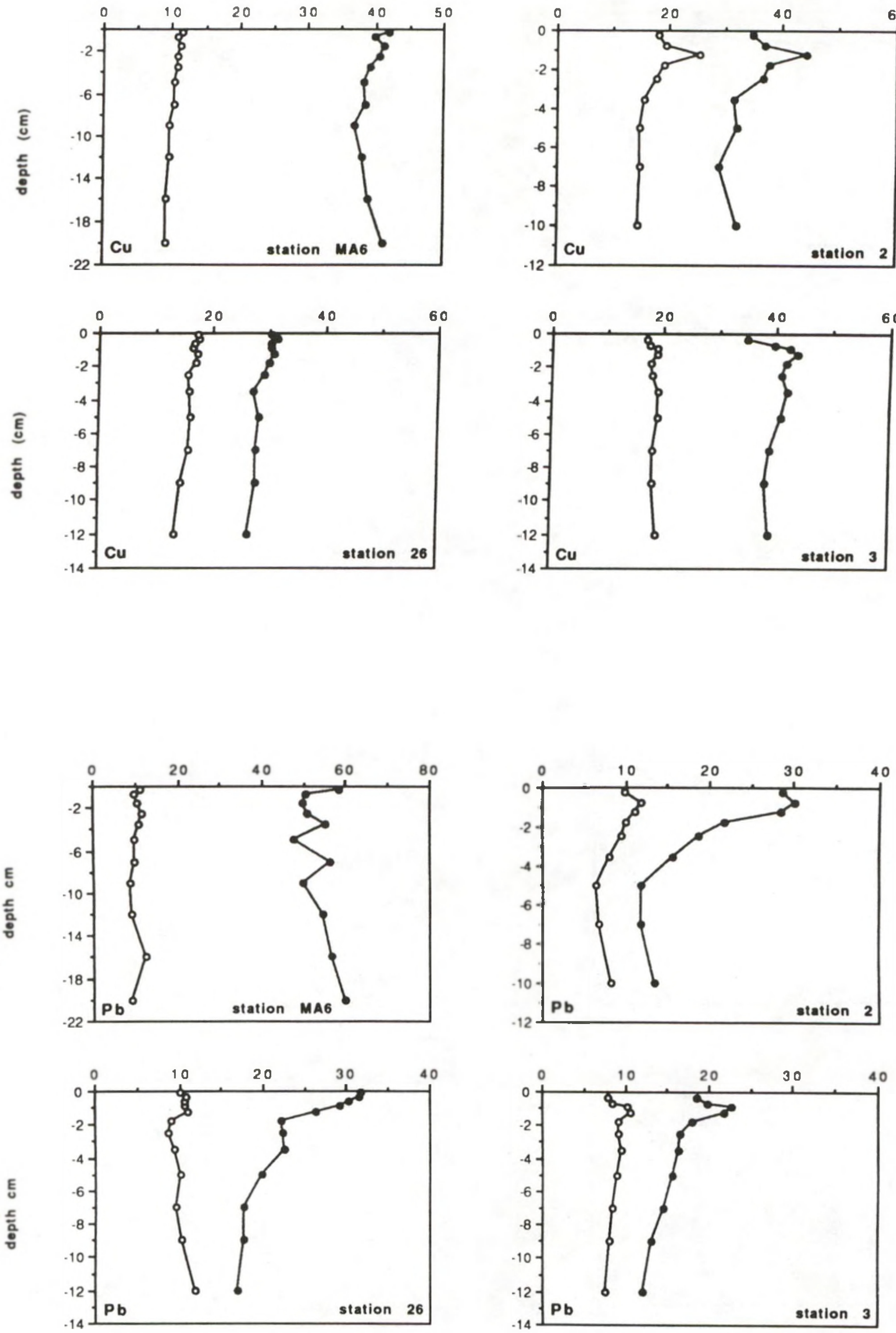

Figure 9: *Concentration-depth profiles of residual (open dots) and total (black dots) copper and lead in sediments at the stations MA6, 2, 26 and 3. Concentrations in µg.g-1*

Lead and zinc

Lead profiles at all three deep stations show an enrichment of the leachable fraction in the surface layer of the sediments, resulting in an increase in the amount of total lead in this layer. This is in contrast with the profile at station MA6; the concentration-depth profile of lead is rather constant at this station. At stations 2 and 3 the concentration of lead at the sediment-water interface is decreasing as discussed for the previously mentioned metals after a first increase at 2-3 cm depth in the same way as the previously discussed metals. This increase in lead concentration at the deep stations is due to the increased atmospheric lead input since the last century (leaded gasoline), and described before in various types of sediments **[e.g. Skei and Paus, 1979; Ridgway and Price, 1987; MacDonald *et al.*, 1991]**. The profiles of leachable lead at the stations located in deep waters are in good agreement with the profiles obtained by **Nolting and Helder (1991)** in sediments from the deeper parts of the North Western Mediterranean Sea (1987 cruise). Unfortunately they did not determine the total content of lead. The reported background value of the total lead content of ~15 $\mu g.g^{-1}$ agrees well with the world averaged values of 12-13 $\mu g.g^{-1}$ **[Taylor, 1964; Thompson, 1972]**. Compared to background values the lead concentration is about twofold enriched in the surface layer of the sediments, the same enrichments factor was also found by **Nolting and Helder (1991)**. With the known sediment accumulation rates of 0.015 and 0.030 $cm.y^{-1}$ at station 3 and 26 respectively (^{210}Pb data from **Zuo *et al.*, 1991**) the enrichment of lead in sediments at these stations started about 130 years ago (beginning of the industrial revolution). At station MA6 no historical record in lead concentrations can be calculated due to the high sediment accumultion rate and the high bioturbation at this station.

The concentration-depth profiles of zinc also suggest a twofold enrichment in the surface sediment layer at station 2, compared to a background value of ~40 $\mu g.g^{-1}$. At station 3 the zinc profile shows an enrichment in the surface layer of 20 $\mu g.g^{-1}$ compared to the background value of 60 $\mu g.g^{-1}$ at this station. As for lead the enrichment started about 130 years ago. In the top of the sediment at the stations 2 and 3 the zinc concentration is also decreasing, as described for all of the discussed metals. At station 26 the concentration-depth profile of zinc is rather 'patchy', but shows an enrichment of about 20 $\mu g.g^{-1}$ compared to the background value of ~80 $\mu g.g^{-1}$ at this station. The concentration-depth profile at station MA6 is uniform with depth, for the same reason as for lead.

All profiles of the previously discussed trace metals at the stations 2 and 3 show a decrease in concentration in the surface layer of the sediment. This phenomenon has also been observed at station 17 This could suggest a recent (~10-15 years) decrease in input of these metals. However, this is a misleading conclusion because the concentration of biogene calcium carbonate in the upper surface layer of the sediment is higher than deeper into the

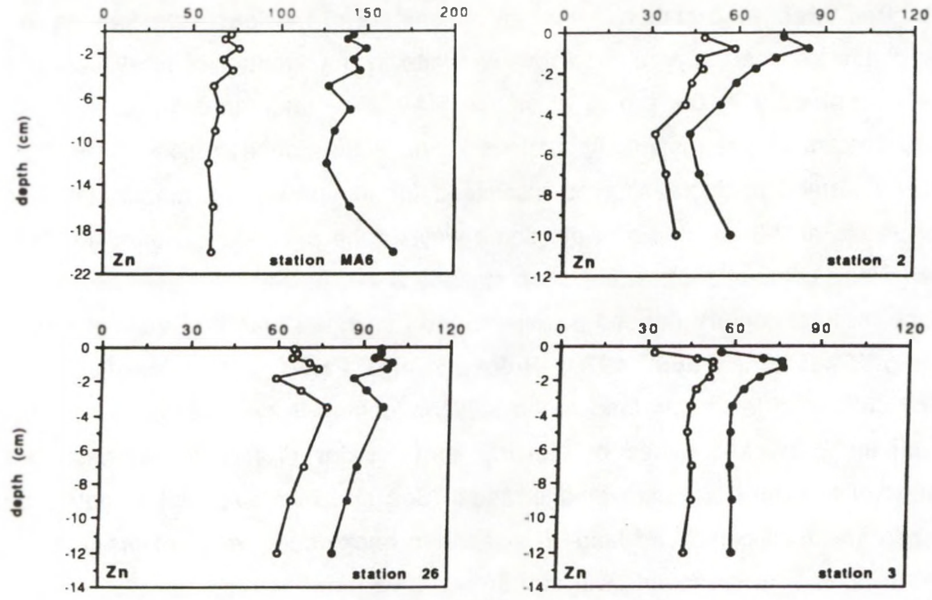

Figure 10: *Concentration-depth profiles of residual (open dots) and total (black dots) zinc in sediments at the stations MA6, 2, 26 and 3. Concentrations in µg.g-1*

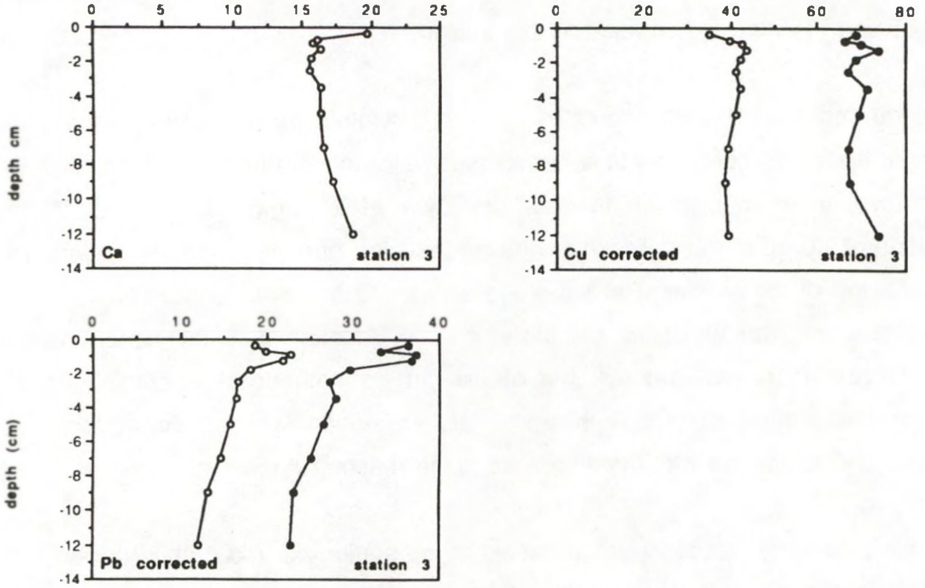

Figure 11: *Concentration-depth profile of leachable calcium at station 3 (concentrations in %) and concentration-depth profiles of calcium carbonate corrected residual (open dots) and total (black dots) copper and lead in sediments at station 3. Concentrations for these metals in µg.g-1*

sediment due to the sedimentation of *coccolites* . This means that we have to be very careful by interpreting data from this type of sediment. The concentrations have to be calculated on a calcium carbonate free basis to provide reliable profiles. This is illustrated for the trace metals lead and copper in the sediment at station 3 (see figure 11). The , corrected, profile of lead does not show a decrease in the top surface layer of the sediment but a stabilization. The concentration of copper on the other hand is rather constant with depth. The stabilization of the lead concentration can possibly be explained by a recent decrease in atmospheric lead deposition due to an increasing use of un-leaded gasoline.

Summarizing, it can be concluded that in sediments in the deeper parts of the N.W. Mediterranean Sea only lead and zinc are the only elements that give a clear signal of anthropogenic input, reflected by an increase in the leachable fraction of both metals. The occurence of the other trace metals is more or less dictated by natural sources, except for stations located in very shallow waters (e.g. station MA6), where high leachable metal concentrations are found in the sediment, indicating antropogenic inputs of all trace metals.

4.4 Porewater distribution of trace metals

In this paragraph some interesting trace element distribution in porewaters from the 1991 cruise will be discussed. For this purpose three stations were chosen with different diagenetic environments, which are representative for the North Western Mediterranean Sea. Station 21 is located near the coast of France (see figure 1) and the sediments of this station are mainly influenced by the river Rhône, which means that the supply of organic matter and trace metals to the sediment from this river is high. The relative high input of organic matter results in an oxygen penetration depth of about 2 cm (all oxygen data from **Lohse, 1991**). Station 29 is located in the plume of the river Ebro and the oxic layer is as a result of a high input of organic matter about 0.9 cm thick. The two stations described above represent the sediments in the shallow waters of the North Western Mediterranean Sea. Station 3 was chosen to represent the sediments located in the deep waters of the North Western Mediterranean Sea. These sediments have a low organic matter input (carbon limited) and the oxygen penetration depth in this area is usually more than 8 centimetres.

Station 21

Profiles of the concerned trace metals are shown in figure 12 and 13. The profile of dissolved Mn suggest suboxic conditions from ~3 cm en deeper down the sediment. The profile of dissolved Fe indicates that the supply of organic matter is not sufficient to start the reduction of iron oxides. The profiles of Cu, Cd and Zn look very similar to each other, indicating oxidative regeneration of these metals in the top layer of the sediment as described by for instance **Klinkhammer, 1980** for Cu and Cd. This means that in this type of

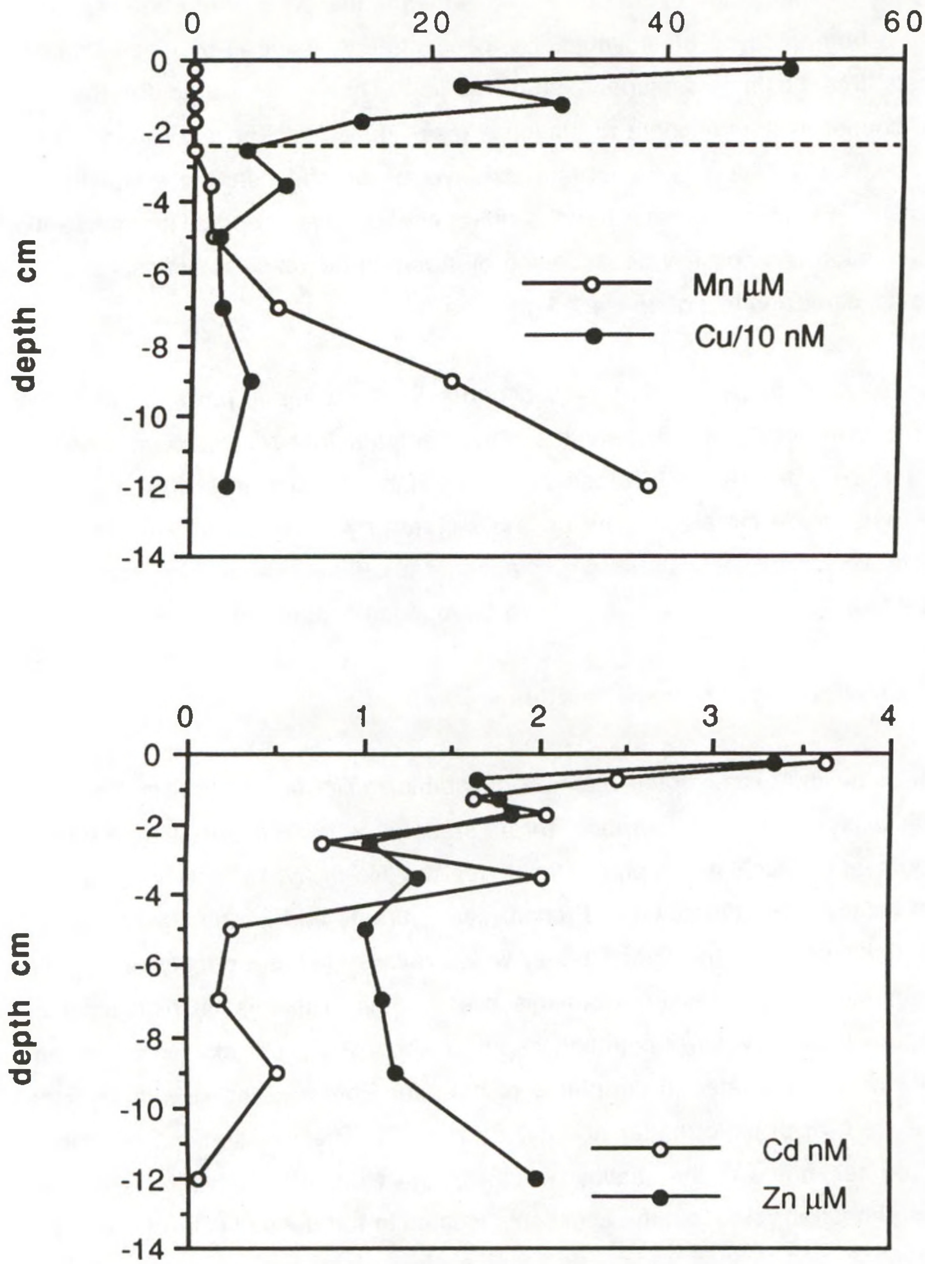

Figure 12: *Concentration-depth profiles of dissolved Mn, Cu, Cd and Zn at station 21. In the upper graph the oxygen penetration depth is shown (dashed line)*

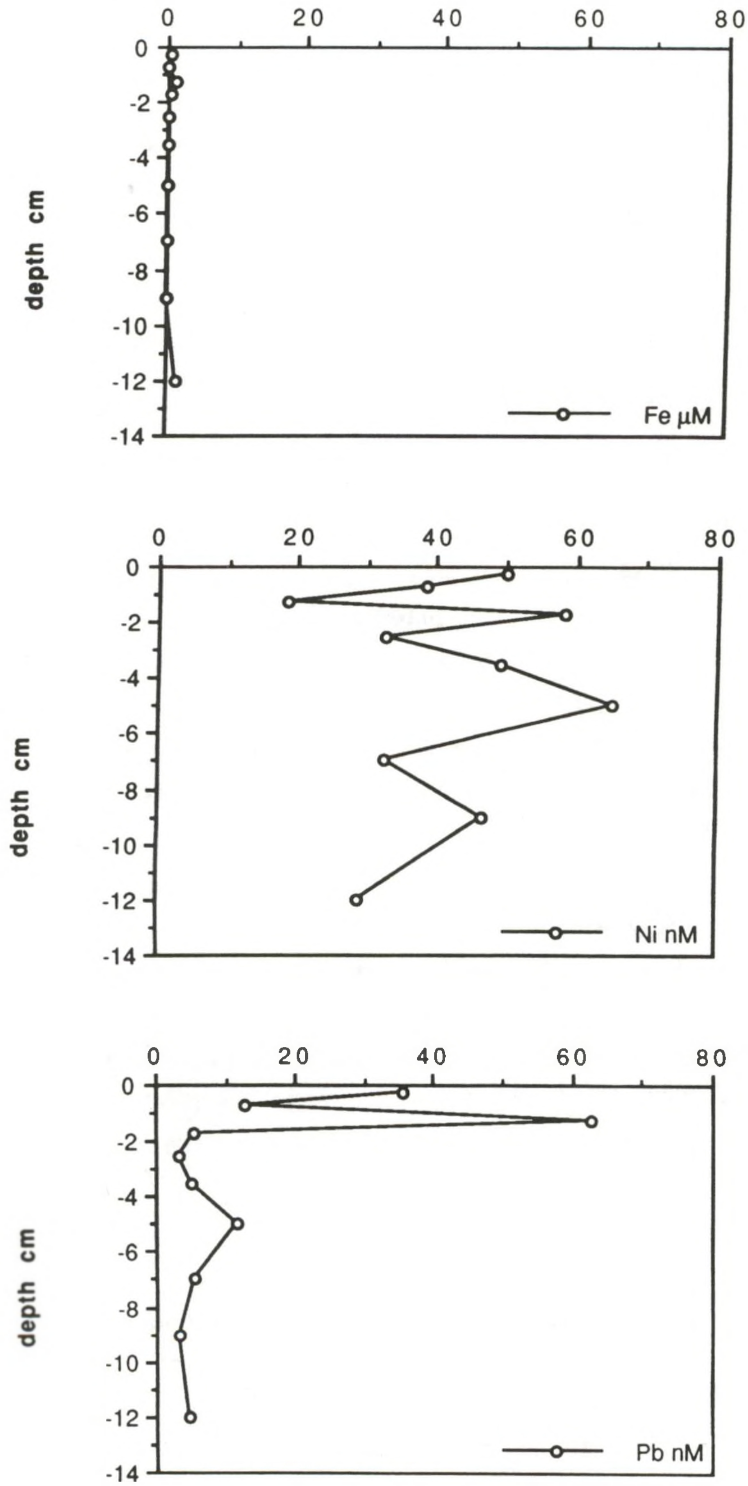

Figure 13: *Concentration-depth profiles of dissolved Fe, Pb and Ni at station 21*

sediment these metals are bound to labile organic carriers, which are destructed at the sediment-water interface, resulting in the burial of the trace metals in the sediment and a subsequent flux of these metals out of the sediment (bentic flux). The profile of dissolved Pb shows also some evidence for oxidative regeneration, with the highest concentrations at the sediment-water interface. The profile of Ni is patchy but relative constant, indicating no involvement of this metal in the diagenetic processes occuring in this type of sediment.

Station 29

The high input of organic matter in the sediment at this station results in the reduction of both manganese and iron oxides, resulting in the formation of dissolved Mn and Fe (see figure 14). The concentration of dissolved Mn increases directly beneath the oxic zone (1 cm), reaching a maximum concentration of 40 μM at 3 cm depth. Deeper down the sediment the concentration starts to decrease again, reaching a constant value of about 20 μM from 5 cm depth and deeper. The reduction of organic matter with Fe oxides starts from 2 cm depth, reaching a maximum concentration of 10 μM at 2.5 cm depth. Deeper down the sediment the concentration is relative constant (15-20 μM). All other trace metals show a peak at the sediment-water interface, probably due to the aerobic degredation of organic matter, from which these metals are released into the pore waters. In the anoxic zone the profiles of both Cd and Pb are very similar to the profile of dissolved Fe, indicating that in this type of sediment the prior mentioned metals are probably associated with iron oxides. This phenomenon has also been observed in other parts of the world **[Gobeil *et al.*, 1987; Gobeil and Silverberg, 1989]**. The profile of dissolved Ni is mimicing the profile of dissolved Mn, so in this type of sediment Ni is probably bound to Mn oxides, from which it is released during suboxic diagenesis. **Nolting and Helder, 1989** also observed this phenenmenon in the same area. Deeper down the sediment the profile of dissolved Zn is rather constant, indicating no involvement of this metal in early diagenesis in this type of sediment. This was also observed by **Nolting and Helder, 1991**.

Station 3

The concentrations of all of the discussed metals are lower than in the sediments described above (figure 15). The concentration-depth profiles of the redox elements Mn and Fe indicate that suboxic diagenesis is not taking place in the sediment at this site, which means that there is enough oxygen available for the oxidation of the deposited organic matter. The profile of Ni show a sharp peak (24 nM) at 1.25 cm depth and low concentrations at the sediment-water interface and deeper down the sediment. Probably this peak is caused by a slowly oxidative destruction of organic matter. The copper profile is typical for pelagic formed sediments **[e.g. Klinkhammer *et al.*, 1982]**, with relative high concentrations (300 nM) at the sediment-water interface (degradation of labile organic copper carriers) and an exponential decrease deeper down in the sediment due to the burial of copper in the

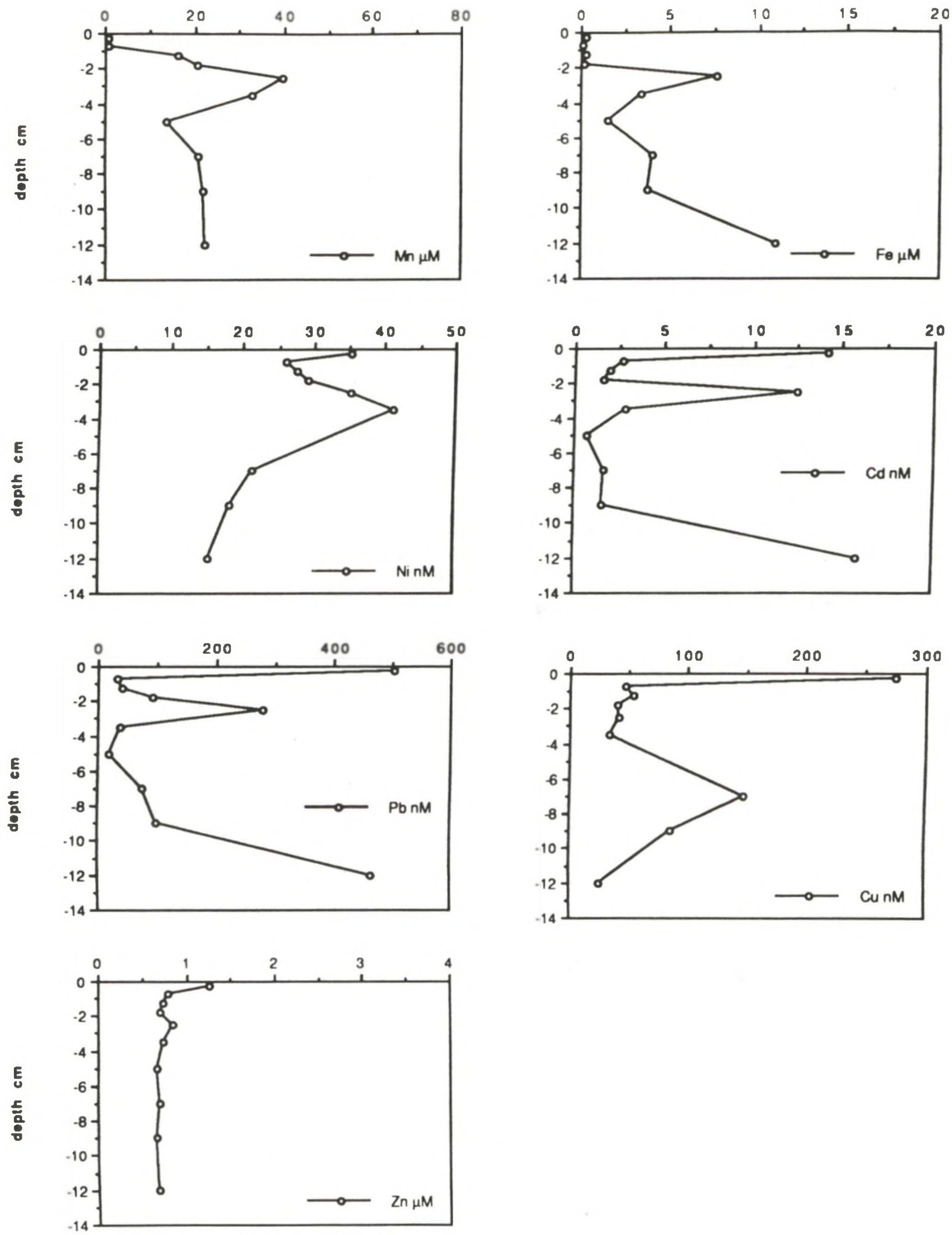

Figure 14: *Concentration-depth profiles of dissolved Mn, Fe, Ni, Cd, Pb, Cu and Zn at station 29*

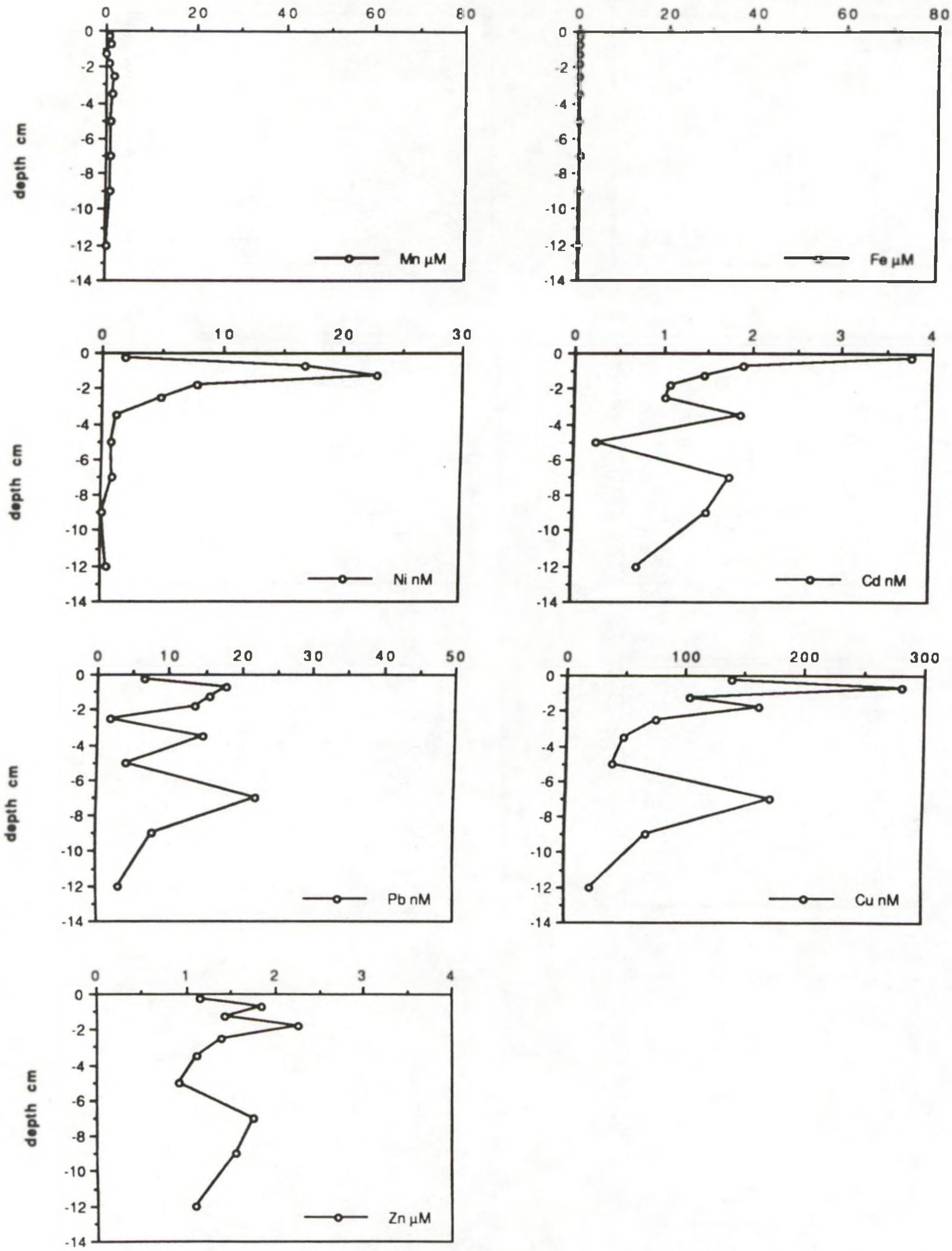

Figure 15: *Concentration-depth profiles of dissolved Mn, Fe, Ni, Cd, Pb, Cu and Zn at station 3*

sediment, reaching concentrations of <50 nM at 12 cm depth. The cadmium profile mimics the profile of copper with concentrations decreasing from 4 nM at the sediment-water interface to ~1 nM at 12 cm depth. Lead and zinc profiles are rather patchy but constant with depth (concentrations of ~10 nM and ~1.5 μM respectively), indicating that these metals are hardly affected by early diagenesis in this type of sediment.

CONCLUSIONS

With respect to the horizontal distribution of solid phase trace metals in the upper layer of the sediment the earlier presented division of the North Western Mediterranean Sea in 5 different areas has proven to be correct. Sediments close to the river Rhône reflect input of cadmium, copper, zinc and lead by this river. Sediments further away from the river Rhône still reflect the influence of this river on the distribution of trace metals, but to a lesser extend as in sediments close to the river Rhône. Sediments close to the river Ebro show the same trend as described above, but trace metal concentrations in these sediments are significantly lower as those close to the river Rhône, which means that the influence of the river Rhône on the North Western Mediterranean Sea is higher than the river Ebro. Sediments far away from both rivers are probably not influenced by these rivers, but atmospheric input of trace metals can contribute considerably, as vertical profiles of elements in the sediments indicate. Changes in the horizontal distribution of trace metals are due to changes in sedimentary composition, which is confirmed by the major element composition of the sediment, showing higher contents of calcium carbonate and lower contents of silicon oxide when moving from shallow to deeper open-sea stations. For this reason the trace metal concentrations in sediments have to be corrected and presented on a calcium carbonate free basis.

The vertical concentration-depth profiles of the trace metals lead and zinc at the deeper open-sea stations reflect anthropogenic inputs of these metals since the last century. This is not observed for the other investigated trace metals. At the deepest stations high calcium carbonate concentrations are found in the surface layer of the sediment, due to the sinking of biogene material. At these stations the concentration-depth profiles have to be corrected for the calcium carbonate content to obtain reliable profiles. Stabilization of the corrected lead content in the surface layer suggest a reduced anthropogenic input during the last years.

Porewater profiles of the redox elements manganese and iron suggest suboxic conditions in shallow sediments with a high input of organic matter. The porewater profiles of the investigated trace metals respond to the diagenetic environment in the sediment. Porewater profiles of trace metals at the deeper stations suggest that only oxic degradation of organic matter is taking place in the sediment. The profiles are different from those at the shallow stations.

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APPENDIX 1: Used apparatus for analysis of trace- and major metals in sediments and porewaters

Flameless Absorption Spectrophotometry

(1)
* Perkin Elmer 5100 PC Atomic Absorption Spectrophotometer
* Perkin Elmer HGA-600 graphite furnace
* Perkin Elmer AS-60 autosampler
* Zephyr watercooling Unit ZEM 750
* Epson PC-AX2 Personal computer
* Epson EX-80 printer

(2)
* Perkin Elmer 5000 Atomic Absorption Spectrophotometer
* Perkin Elmer HGA-500 graphite furnace
* Perkin Elmer AS-40 autosampler
* Zephyr watercooling Unit ZEM 750
* Perkin Elmer PRS-10 Printer Sequencer
* Perkin Elmer Recorder 56

Flame Absorption Spectrophotometry

(1)
* Perkin Elmer 2380 Atomic Absorption Spectrophotometer
* Perkin Elmer PRS-10 Printer Sequencer
* Perkin Elmer Recorder 56

Lamps

(1)
* Perkin Elmer Hollow Cathode Lamps (HCL) for Cu, Ni, Cr, Zn, Mn, Fe, Mg, Ca, Al and Si

(2)
* Perkin Elmer Electrodeless Discharge Lamp (EDL) for Cd and Pb (including the Perkin Elmer EDL Power Supply)

APPENDIX 2: Experimental conditions and temperature programs for the analysis of trace metals in porewaters and sediments (de Jong, personal communication)

Parameters		Cd	Pb	Cr	Cu	Ni
Wave-length (nm) 228.8		283.8	357.9	324.8	232.0	
Split setting (nm) 0.7		0.7	0.7	0.7	0.2	
Injection volume (µl)		20	10/20	20	20	10
Measurement type		area	area	area	area	area
Step 1 :	Temperature (°C)	180	160	180	180	150
	Ramp time (sec)	1	1	1	1	1
	Hold time (sec)	40	30	50	40	30
	Internal Flow (ml/min)	300	300	300	300	300
Step 2:	Temperature (°C)	700	750	1650	1300	1400
	Ramp time (sec)	10	10	10	10	10
	Hold time (sec)	15	15	10	15	15
	Internal Flow (ml/min)	50	50	50	50	50
Step 3:	Temperature (°C)	1800	1800	2500	2400	2500
	Ramp time (sec)	0	0	0	0	0
	Hold time (sec)	5	5	3	5	5
	Internal Flow (ml/min)	0	0	0	0	0
	Integration time (sec)	5	5	3	5	5
	Read delay (sec)	0	0	0	0	0
	Baseline offset corr. (sec)	-2	-2	-2	-2	-2
Step 4:	Temperature (°C)	2300	2500	2600	2500	2600
	Ramp time (sec)	1	1	1	1	1
	Hold time (sec)	3	3	3	3	3
	Internal Flow (ml/min)	300	300	300	300	300

Step 1: dry

Step 2: ash

Step 3: atomize

Step 4: burn out

APPENDIX 3: Flame conditions for analysis of major elements in sediments and porewaters (de Jong, personal communication)

Element	Wave-length (nm)	Split setting (nm)	Oxidant [1]	Reducing flame
Ca	422.7	0.7	Air	
Mg	485.2	0.7	Air	
Fe	248.3	0.2	Air	
Mn	279.5	0.2	Air	
Zn	213.9	0.7	Air	
Al	309.3	0.7	N_2O	√
Si	251.6	0.2	N_2O	

[1]: The fuel for all analysis was C_2H_2

APPENDIX 4: Cadmium and copper concentrations in sediments from the 1988 and 1991 cruise. BC= boxcore; D= mean depth; L= leachable; R= residual; T= total; L'= percent leachable. (N.D. means not determined)

	CADMIUM						COPPER				
BC #	D (cm)	L (µg/g)	R (µg/g)	T (µg/g)	L' (%)	BC #	D (cm)	L (µg/g)	R (µg/g)	T (µg/g)	L' (%)
MA3	-0.50	0.08	0.01	0.10	86.6	MA3	-0.50	16.9	7.4	24.3	69.5
	-1.50	0.07	0.03	0.10	72.7		-1.50	17.7	14.1	31.8	55.6
	-2.50	0.09	0.03	0.12	72.5		-2.50	17.8	9.6	27.4	64.9
	-3.50	0.07	0.02	0.09	75.8		-3.50	16.8	12.0	28.8	58.4
	-5.00	0.08	0.02	0.10	76.8		-5.00	15.2	12.5	27.7	54.8
	-7.00	0.09	0.03	0.12	76.7		-7.00	15.8	8.8	24.6	64.4
	-9.00	0.13	0.06	0.19	67.5		-9.00	16.1	11.4	27.5	58.5
	-12.00	0.09	0.10	0.18	47.5		-12.00	16.6	8.8	25.4	65.4
	-16.00	0.22	0.02	0.25	90.2		-16.00	9.9	8.0	17.9	55.3
MA6	-0.25	0.66	0.15	0.81	81.9	MA6	-0.25	30.4	11.4	41.8	72.7
	-0.75	0.58	0.14	0.72	80.4		-0.75	29.1	10.9	40.0	72.8
	-1.50	0.68	0.09	0.77	88.0		-1.50	29.8	11.4	41.2	72.4
	-2.50	0.65	0.13	0.78	83.2		-2.50	29.9	10.7	40.6	73.6
	-3.50	0.64	0.29	0.94	68.4		-3.50	28.3	10.9	39.2	72.2
	-5.00	0.57	0.17	0.74	77.0		-5.00	28.0	10.3	38.3	73.2
	-7.00	0.55	0.10	0.65	84.1		-7.00	28.2	10.3	38.5	73.3
	-9.00	0.64	0.10	0.74	86.3		-9.00	27.1	9.8	36.9	73.5
	-12.00	0.69	0.21	0.90	77.0		-12.00	28.4	9.6	38.0	74.7
	-16.00	0.75	0.11	0.86	87.4		-16.00	29.7	9.3	39.0	76.1
	-20.00	1.03	0.17	1.20	85.5		-20.00	31.9	9.3	41.2	77.4
MC1	-0.50	0.26	0.07	0.33	79.3	MC1	-0.50	12.7	11.1	23.8	53.4
	-1.50	0.45	0.14	0.59	75.9		-1.50	11.6	10.9	22.5	51.7
	-2.50	0.17	0.23	0.40	42.1		-2.50	10.4	9.4	19.8	52.6
	-3.50	0.40	0.08	0.48	83.0		-3.50	9.5	8.8	18.3	51.9
	-5.00	0.29	0.13	0.42	68.7		-5.00	8.2	9.3	17.5	46.9
	-7.00	0.27	0.12	0.39	68.9		-7.00	8.5	6.9	15.4	55.1
	-9.00	0.33	0.23	0.56	58.6		-9.00	7.8	6.8	14.6	53.5
	-12.00	1.15	0.08	1.23	93.3		-12.00	8.3	5.4	13.7	60.4
	-16.00	0.28	0.04	0.32	86.4		-16.00	9.4	4.4	13.8	68.1
	-20.00	0.29	1.12	1.41	20.6		-20.00	8.1	3.4	11.5	70.3
MC3	-0.50	0.64	N.D.	-	-	MC3	-0.50	5.7	N.D.	-	-
	-1.50	0.33	1.83	2.17	15.2		-1.50	6.2	6.8	13.0	47.9
	-2.50	0.90	1.64	2.54	35.4		-2.50	5.3	6.3	11.6	45.7
	-3.50	0.47	0.09	0.56	84.7		-3.50	4.7	2.9	7.6	61.6
	-5.00	0.46	1.03	1.49	30.9		-5.00	5.0	5.4	10.4	48.3
	-7.00	0.34	1.14	1.48	23.0		-7.00	6.3	5.1	11.4	55.5
	-9.00	0.18	0.02	0.20	88.7		-9.00	5.3	5.1	10.4	50.8
	-12.00	0.35	0.04	0.39	90.0		-12.00	5.3	5.6	10.9	48.7
	-16.00	0.21	0.06	0.27	78.1		-16.00	5.3	5.1	10.4	50.9
	-20.00	0.20	N.D.	-	-		-20.00	5.1	N.D.	-	-
ME1	-0.50	0.32	0.03	0.35	92.2	ME1	-0.50	4.6	4.0	8.6	53.2
	-1.50	0.12	0.02	0.14	84.5		-1.50	3.7	3.6	7.3	51.0
	-2.50	0.14	0.01	0.15	90.9		-2.50	3.5	3.7	7.2	48.6
	-3.50	0.12	0.03	0.15	82.2		-3.50	3.5	3.8	7.3	48.1
	-5.00	0.11	0.09	0.20	55.3		-5.00	4.3	4.5	8.8	49.1
	-7.00	0.16	0.02	0.18	89.9		-7.00	4.0	4.0	8.0	49.9
	-9.00	0.10	0.02	0.12	85.5		-9.00	3.7	3.6	7.3	50.8
	-12.00	0.32	0.03	0.35	92.5		-12.00	4.2	4.2	8.4	50.2
	-16.00	0.11	0.01	0.12	90.9		-16.00	4.1	4.2	8.3	49.3
	-20.00	0.12	0.01	0.14	88.9		-20.00	4.2	4.1	8.3	50.4

APPENDIX 4: Continued

CADMIUM

BC #	D (cm)	L (µg/g)	R (µg/g)	T (µg/g)	L' (%)
MF2	-0.50	0.18	0.05	0.23	78.3
	-1.50	0.16	0.05	0.21	76.6
	-2.50	0.10	0.08	0.18	56.2
	-3.50	0.10	0.02	0.12	82.6
	-5.00	0.19	0.02	0.21	90.0
	-7.00	0.09	0.05	0.14	62.6
	-9.00	0.08	0.03	0.11	71.0
	-12.00	0.08	0.02	0.10	77.9
	-16.00	0.09	0.05	0.14	66.7
	-20.00	0.08	0.04	0.12	65.6
MF3	-0.50	0.21	0.01	0.22	93.8
	-1.50	0.09	0.04	0.13	69.9
	-2.50	0.09	0.02	0.11	84.4
	-3.50	0.14	0.02	0.16	88.6
	-5.00	0.09	0.01	0.11	87.7
	-7.00	0.12	0.02	0.14	83.3
	-9.00	0.10	0.03	0.12	78.7
	-12.00	0.07	0.02	0.09	80.6
	-16.00	0.09	0.05	0.15	63.3
	-20.00	0.18	0.01	0.19	96.3
2	-0.25	N.D.	N.D.	-	-
	-0.75	N.D.	N.D.	-	-
	-1.25	N.D.	N.D.	-	-
	-1.75	N.D.	N.D.	-	-
	-2.50	N.D.	N.D.	-	-
	-3.50	N.D.	N.D.	-	-
	-5.00	N.D.	N.D.	-	-
	-7.00	N.D.	N.D.	-	-
	-9.00	N.D.	N.D.	-	-
3	-0.375	N.D.	N.D.	-	-
	-0.675	N.D.	N.D.	-	-
	-0.875	N.D.	N.D.	-	-
	-1.25	N.D.	N.D.	-	-
	-1.75	N.D.	N.D.	-	-
	-2.50	N.D.	N.D.	-	-
	-3.50	N.D.	N.D.	-	-
	-5.00	N.D.	N.D.	-	-
	-7.00	N.D.	N.D.	-	-
	-9.00	N.D.	N.D.	-	-
	-12.00	N.D.	N.D.	-	-
5	-0.125	N.D.	N.D.	-	-
	-0.375	N.D.	N.D.	-	-
	-0.675	N.D.	N.D.	-	-
	-0.875	N.D.	N.D.	-	-
	-1.25	N.D.	N.D.	-	-
	-1.75	N.D.	N.D.	-	-
	-2.50	N.D.	N.D.	-	-
	-3.50	N.D.	N.D.	-	-
	-5.00	N.D.	N.D.	-	-
	-7.00	N.D.	N.D.	-	-
	-9.00	N.D.	N.D.	-	-
	-12.00	N.D.	N.D.	-	-

COPPER

BC #	D (cm)	L (µg/g)	R (µg/g)	T (µg/g)	L' (%)
MF2	-0.50	16.8	16.5	33.3	50.5
	-1.50	15.9	14.9	30.8	51.6
	-2.50	15.1	15.5	30.6	49.4
	-3.50	15.2	13.8	29.0	52.4
	-5.00	15.8	14.7	30.5	51.8
	-7.00	10.9	18.0	28.9	37.8
	-9.00	10.4	18.0	28.5	36.5
	-12.00	9.9	17.0	26.9	36.8
	-16.00	13.0	13.8	26.8	48.4
	-20.00	12.3	15.2	27.5	44.7
MF3	-0.50	11.6	12.3	23.9	48.5
	-1.50	10.5	12.7	23.2	45.3
	-2.50	10.2	11.7	21.9	46.6
	-3.50	10.1	11.6	21.7	46.5
	-5.00	10.2	11.4	21.6	47.3
	-7.00	10.1	12.3	22.4	45.1
	-9.00	8.4	12.6	21.0	40.0
	-12.00	7.9	11.8	19.7	40.1
	-16.00	8.7	10.5	19.2	45.3
	-20.00	8.6	10.2	18.8	45.8
2	-0.25	16.9	18.1	35.0	48.3
	-0.75	17.6	19.4	37.0	47.4
	-1.25	18.7	25.5	44.2	42.3
	-1.75	18.6	19.2	37.8	49.2
	-2.50	18.9	17.9	36.8	51.3
	-3.50	16.0	15.7	31.7	50.6
	-5.00	17.2	14.9	32.1	53.5
	-7.00	14.3	14.8	29.0	49.1
	-9.00	17.6	14.6	32.2	54.7
3	-0.375	17.9	17.0	35.0	51.3
	-0.675	22.1	17.5	39.6	55.8
	-0.875	23.5	18.9	42.4	55.4
	-1.25	24.9	18.9	43.7	56.9
	-1.75	24.1	17.9	42.0	57.4
	-2.50	22.9	18.2	41.1	55.7
	-3.50	23.1	19.2	42.2	54.6
	-5.00	21.8	19.3	41.1	53.0
	-7.00	20.8	18.4	39.2	53.1
	-9.00	20.2	18.3	38.5	52.4
	-12.00	20.1	19.2	39.3	51.1
5	-0.125	13.4	12.8	26.2	51.2
	-0.375	12.9	12.9	25.8	49.8
	-0.675	14.1	16.2	30.3	46.4
	-0.875	16.5	16.7	33.2	49.8
	-1.25	14.4	13.8	28.3	51.1
	-1.75	13.3	13.3	26.6	50.1
	-2.50	15.3	14.4	29.7	51.5
	-3.50	15.5	12.8	28.3	54.9
	-5.00	15.0	15.0	30.1	50.1
	-7.00	14.5	14.6	29.1	49.8
	-9.00	13.0	14.2	27.2	47.6
	-12.00	12.0	13.2	25.1	47.6

APPENDIX 4: Continued

CADMIUM

BC #	D (cm)	L (µg/g)	R (µg/g)	T (µg/g)	L' (%)
16	-0.125	N.D.	N.D.	-	-
	-0.375	N.D.	N.D.	-	-
	-0.675	N.D.	N.D.	-	-
	-0.875	N.D.	N.D.	-	-
	-1.25	N.D.	N.D.	-	-
	-1.75	N.D.	N.D.	-	-
	-2.50	N.D.	N.D.	-	-
	-3.50	N.D.	N.D.	-	-
	-5.00	N.D.	N.D.	-	-
	-7.00	N.D.	N.D.	-	-
	-9.00	N.D.	N.D.	-	-
	-12.00	N.D.	N.D.	-	-
17	-0.125	N.D.	N.D.	-	-
	-0.375	N.D.	N.D.	-	-
	-0.675	N.D.	N.D.	-	-
	-0.875	N.D.	N.D.	-	-
	-1.25	N.D.	N.D.	-	-
	-1.75	N.D.	N.D.	-	-
	-2.50	N.D.	N.D.	-	-
	-3.50	N.D.	N.D.	-	-
	-5.00	N.D.	N.D.	-	-
	-7.00	N.D.	N.D.	-	-
	-9.00	N.D.	N.D.	-	-
	-12.00	N.D.	N.D.	-	-
26	-0.125	N.D.	N.D.	-	-
	-0.375	N.D.	N.D.	-	-
	-0.675	N.D.	N.D.	-	-
	-0.875	N.D.	N.D.	-	-
	-1.25	N.D.	N.D.	-	-
	-1.75	N.D.	N.D.	-	-
	-2.50	N.D.	N.D.	-	-
	-3.50	N.D.	N.D.	-	-
	-5.00	N.D.	N.D.	-	-
	-7.00	N.D.	N.D.	-	-
	-9.00	N.D.	N.D.	-	-
	-12.00	N.D.	N.D.	-	-
27	-0.125	N.D.	N.D.	-	-
	-0.375	N.D.	N.D.	-	-
	-0.675	N.D.	N.D.	-	-
	-0.875	N.D.	N.D.	-	-
	-1.25	N.D.	N.D.	-	-
	-1.75	N.D.	N.D.	-	-
	-2.50	N.D.	N.D.	-	-
	-3.50	N.D.	N.D.	-	-
	-5.00	N.D.	N.D.	-	-
	-7.00	N.D.	N.D.	-	-
	-9.00	N.D.	N.D.	-	-
	-12.00	N.D.	N.D.	-	-
8	-0.25	N.D.	N.D.	-	-
	-3.50	N.D.	N.D.	-	-
	-12.00	N.D.	N.D.	-	-

COPPER

BC #	D (cm)	L (µg/g)	R (µg/g)	T (µg/g)	L' (%)
16	-0.125	13.0	13.9	26.9	48.4
	-0.375	16.1	16.1	32.2	49.9
	-0.675	16.5	15.5	32.0	51.6
	-0.875	16.2	15.3	31.5	51.5
	-1.25	16.3	14.3	30.6	53.2
	-1.75	17.1	14.1	31.2	54.9
	-2.50	17.2	16.7	33.9	50.7
	-3.50	16.6	15.4	32.1	51.9
	-5.00	15.8	14.9	30.7	51.4
	-7.00	14.6	15.3	29.9	48.8
	-9.00	13.6	14.7	28.3	48.2
	-12.00	15.4	14.3	29.7	51.9
17	-0.125	9.7	7.9	17.6	55.3
	-0.375	14.6	8.4	23.0	63.4
	-0.675	18.1	13.6	31.7	57.1
	-0.875	20.5	15.9	36.4	56.4
	-1.25	18.7	14.8	33.5	55.7
	-1.75	20.3	16.2	36.5	55.6
	-2.50	20.1	14.9	35.1	57.4
	-3.50	18.8	15.6	34.4	54.6
	-5.00	19.3	11.2	30.5	63.3
	-7.00	19.1	15.7	34.8	54.9
	-9.00	18.6	14.1	32.6	56.9
	-12.00	17.3	16.7	34.1	50.9
26	-0.125	13.0	17.3	30.3	42.8
	-0.375	13.5	17.7	31.2	43.3
	-0.675	13.5	16.8	30.3	44.5
	-0.875	13.8	16.5	30.3	45.6
	-1.25	13.3	17.4	30.7	43.4
	-1.75	13.1	17.0	30.1	43.5
	-2.50	13.4	15.7	29.1	46.1
	-3.50	11.4	15.9	27.3	41.8
	-5.00	12.2	16.2	28.3	42.9
	-7.00	12.0	15.9	27.9	42.9
	-9.00	13.1	14.6	27.8	47.3
	-12.00	12.9	13.5	26.4	48.8
27	-0.125	13.0	13.6	26.6	49.0
	-0.375	13.9	17.3	31.2	44.6
	-0.675	12.7	18.5	31.2	40.6
	-0.875	14.3	19.1	33.3	42.9
	-1.25	15.0	19.1	34.1	44.0
	-1.75	15.4	19.0	34.3	44.8
	-2.50	14.5	18.4	32.9	43.9
	-3.50	13.6	18.1	31.7	42.9
	-5.00	14.0	18.1	32.1	43.7
	-7.00	12.6	17.5	30.1	42.0
	-9.00	13.5	18.7	32.2	41.9
	-12.00	13.7	18.2	31.9	43.0
8	-0.25	10.5	11.1	21.6	48.7
	-3.50	8.2	9.4	17.7	46.5
	-12.00	7.9	10.2	18.2	43.7

APPENDIX 4: Continued

CADMIUM

BC #	D (cm)	L (µg/g)	R (µg/g)	T (µg/g)	L' (%)
12	-0.25	N.D.	N.D.	-	-
	-3.50	N.D.	N.D.	-	-
	-12.00	N.D.	N.D.	-	-
14	-0.25	N.D.	N.D.	-	-
	-3.50	N.D.	N.D.	-	-
	-12.00	N.D.	N.D.	-	-
20	-0.25	N.D.	N.D.	-	-
	-3.50	N.D.	N.D.	-	-
	-12.00	N.D.	N.D.	-	-
21	-0.25	N.D.	N.D.	-	-
	-3.50	N.D.	N.D.	-	-
	-12.00	N.D.	N.D.	-	-
23	-0.50	N.D.	N.D.	-	-
	-3.50	N.D.	N.D.	-	-
	-16.00	N.D.	N.D.	-	-
29	-0.25	N.D.	N.D.	-	-
	-3.50	N.D.	N.D.	-	-
	-12.00	N.D.	N.D.	-	-

COPPER

BC #	D (cm)	L (µg/g)	R (µg/g)	T (µg/g)	L' (%)
12	-0.25	4.6	22.7	27.3	16.8
	-3.50	4.5	21.6	26.2	17.3
	-12.00	5.3	21.9	27.2	19.4
14	-0.25	5.2	12.8	18.0	28.7
	-3.50	4.5	13.7	18.2	24.6
	-12.00	5.2	13.3	18.5	28.2
20	-0.25	8.3	13.7	22.0	37.7
	-3.50	6.4	12.6	19.0	33.6
	-12.00	6.2	8.7	14.9	41.3
21	-0.25	3.9	12.6	16.5	23.8
	-3.50	4.3	13.1	17.4	24.7
	-12.00	3.2	11.4	14.6	21.8
23	-0.50	3.3	12.4	15.7	21.1
	-3.50	3.2	12.8	16.0	20.2
	-16.00	3.0	10.1	13.1	23.1
29	-0.25	3.7	13.1	16.8	22.0
	-3.50	3.9	13.9	17.8	21.8
	-12.00	5.2	12.2	17.4	29.8

APPENDIX 5: Nickel and chromium concentrations in sediments from the 1988 and 1991 cruise. BC= boxcore; D= mean depth; L= leachable; R= residual; T= total; L'= percent leachable. (N.D. means not determined)

NICKEL						CHROMIUM					
BC #	D (cm)	L (µg/g)	R (µg/g)	T (µg/g)	L' (%)	BC #	D (cm)	L (µg/g)	R (µg/g)	T (µg/g)	L' (%)
MA3	-0.50	22.2	18.6	40.8	54.4	MA3	-0.50	11.3	37.6	48.9	23.1
	-1.50	22.7	21.2	44.0	51.6		-1.50	10.7	46.7	57.4	18.6
	-2.50	24.6	20.3	44.9	54.7		-2.50	11.6	42.7	54.3	21.4
	-3.50	22.3	19.8	42.1	53.0		-3.50	10.6	44.8	55.4	19.1
	-5.00	21.3	19.4	40.7	52.3		-5.00	9.6	46.1	55.7	17.2
	-7.00	22.2	19.7	41.9	53.0		-7.00	11.2	38.9	50.1	22.4
	-9.00	23.7	20.9	44.6	53.2		-9.00	11.2	38.4	49.6	22.6
	-12.00	24.9	22.1	47.0	53.0		-12.00	9.8	37.7	47.5	20.6
	-16.00	17.2	24.9	42.1	40.9		-16.00	13.3	41.7	55.0	24.2
MA6	-0.25	16.0	22.9	38.9	41.2	MA6	-0.25	16.6	64.1	80.7	20.6
	-0.75	15.7	20.3	36.0	43.6		-0.75	15.7	63.8	79.5	19.7
	-1.50	16.7	23.3	40.0	41.7		-1.50	16.8	67.0	83.8	20.0
	-2.50	16.3	25.4	41.7	39.1		-2.50	17.0	63.5	80.5	21.1
	-3.50	16.0	20.8	36.8	43.5		-3.50	16.9	64.2	81.1	20.8
	-5.00	15.9	20.7	36.6	43.4		-5.00	17.1	67.0	84.1	20.3
	-7.00	14.8	21.7	36.5	40.5		-7.00	17.6	58.2	75.8	23.2
	-9.00	14.9	19.6	34.5	43.2		-9.00	16.5	61.9	78.4	21.0
	-12.00	16.0	20.1	36.1	44.4		-12.00	16.8	59.5	76.3	22.0
	-16.00	16.3	20.1	36.4	44.8		-16.00	19.9	65.7	85.6	23.2
	-20.00	17.4	21.6	39.0	44.6		-20.00	19.7	69.6	89.3	22.1
MC1	-0.50	19.7	22.0	41.7	47.3	MC1	-0.50	12.6	51.4	64.0	19.7
	-1.50	20.8	22.4	43.2	48.1		-1.50	11.1	58.2	69.3	16.0
	-2.50	20.1	21.7	41.8	48.1		-2.50	11.4	56.6	68.0	16.8
	-3.50	19.0	20.4	39.4	48.2		-3.50	10.4	50.0	60.4	17.2
	-5.00	15.9	20.4	36.3	43.8		-5.00	11.4	45.6	57.0	20.0
	-7.00	16.4	18.0	34.4	47.6		-7.00	11.4	49.5	60.9	18.7
	-9.00	17.7	19.1	36.8	48.2		-9.00	8.9	48.1	57.0	15.6
	-12.00	16.4	17.4	33.8	48.5		-12.00	7.1	38.5	45.6	15.6
	-16.00	17.0	16.6	33.6	50.7		-16.00	9.8	28.5	38.3	25.6
	-20.00	16.3	16.2	32.5	50.2		-20.00	9.4	33.5	42.9	21.9
MC3	-0.50	13.7	N.D.	-	-	MC3	-0.50	7.2	N.D.	-	-
	-1.50	14.0	24.1	38.0	36.8		-1.50	11.2	33.1	44.3	25.3
	-2.50	12.1	18.5	30.6	39.6		-2.50	6.7	33.3	40.0	26.8
	-3.50	12.2	8.1	20.2	60.2		-3.50	6.2	21.0	27.2	22.8
	-5.00	12.0	15.6	27.6	43.5		-5.00	9.8	28.2	38.0	25.8
	-7.00	12.6	17.4	30.0	41.9		-7.00	10.0	30.6	40.6	24.6
	-9.00	12.8	17.5	30.3	42.3		-9.00	9.9	33.4	43.3	22.9
	-12.00	12.7	19.1	31.8	40.0		-12.00	10.0	35.7	45.7	21.9
	-16.00	13.0	19.0	32.0	40.7		-16.00	10.2	36.2	46.4	22.0
	-20.00	12.9	N.D.	-	-		-20.00	10.2	N.D.	-	-
ME1	-0.50	7.3	15.4	22.7	32.2	ME1	-0.50	8.7	23.3	32.0	27.2
	-1.50	7.3	14.6	21.9	33.3		-1.50	7.5	31.4	38.9	19.3
	-2.50	7.0	15.5	22.5	31.2		-2.50	9.6	33.5	43.1	22.3
	-3.50	7.1	14.2	21.4	33.3		-3.50	8.3	34.7	43.0	19.3
	-5.00	7.7	15.9	23.6	32.6		-5.00	7.9	37.2	45.1	17.5
	-7.00	7.8	14.9	22.7	34.3		-7.00	8.8	32.3	41.1	21.4
	-9.00	7.0	13.8	20.8	33.6		-9.00	7.8	29.8	37.6	20.7
	-12.00	8.1	15.1	23.2	34.9		-12.00	8.2	31.0	39.2	20.9
	-16.00	8.5	14.1	22.6	37.7		-16.00	7.9	32.3	40.2	19.7
	-20.00	9.5	14.5	24.0	39.6		-20.00	8.5	35.3	43.8	19.4

APPENDIX 5: Continued

NICKEL

BC #	D (cm)	L (µg/g)	R (µg/g)	T (µg/g)	L' (%)
MF2	-0.50	36.8	33.3	70.1	52.5
	-1.50	35.7	32.7	68.4	52.2
	-2.50	34.8	32.6	67.4	51.6
	-3.50	36.2	30.5	66.7	54.3
	-5.00	43.3	34.5	77.8	55.7
	-7.00	31.5	31.7	63.2	49.8
	-9.00	32.6	32.7	65.3	49.9
	-12.00	31.8	29.8	61.6	51.7
	-16.00	33.6	28.5	62.1	54.1
	-20.00	33.6	30.7	64.3	52.2
MF3	-0.50	27.3	29.2	56.5	48.3
	-1.50	26.7	30.4	57.1	46.8
	-2.50	26.6	28.1	54.6	48.7
	-3.50	25.7	29.4	55.1	46.6
	-5.00	26.3	28.0	54.3	48.5
	-7.00	27.0	29.8	56.8	47.5
	-9.00	24.9	29.2	54.1	46.0
	-12.00	23.1	28.8	51.9	44.5
	-16.00	25.4	24.8	50.2	50.6
	-20.00	23.9	24.8	48.7	49.1
2	-0.25	9.4	30.4	39.8	23.6
	-0.75	10.5	32.1	42.6	24.7
	-1.25	10.6	34.0	44.7	23.8
	-1.75	10.8	35.4	46.1	23.3
	-2.50	10.8	30.4	41.2	26.2
	-3.50	10.3	28.5	38.8	26.5
	-5.00	10.8	27.7	38.5	28.1
	-7.00	10.1	29.5	39.6	25.5
	-10.00	15.4	34.3	49.6	30.9
3	-0.375	9.5	19.2	28.7	33.2
	-0.625	11.1	23.8	34.9	31.8
	-0.875	10.7	26.4	37.1	28.9
	-1.25	9.3	27.6	36.9	25.2
	-1.75	9.5	26.0	35.5	26.7
	-2.50	8.4	27.7	36.1	23.3
	-3.50	10.5	26.4	36.9	28.4
	-5.00	9.9	25.9	35.8	27.6
	-7.00	9.8	24.4	34.2	28.6
	-9.00	10.2	22.5	32.7	31.2
	-12.00	10.4	21.7	32.1	32.3
5	-0.125	8.7	17.7	26.4	32.8
	-0.375	7.8	21.9	29.7	26.3
	-0.625	9.8	27.0	36.7	26.6
	-0.875	10.1	28.3	38.4	26.2
	-1.25	8.7	26.1	34.7	24.9
	-1.75	8.2	24.9	33.1	24.8
	-2.50	9.3	27.6	36.8	25.2
	-3.50	11.9	22.8	34.7	34.3
	-5.00	10.3	27.2	37.5	27.4
	-7.00	8.4	26.1	34.6	24.4
	-9.00	7.2	24.2	31.4	22.8
	-12.00	7.3	20.6	28.0	26.2

CHROMIUM

BC #	D (cm)	L (µg/g)	R (µg/g)	T (µg/g)	L' (%)
MF2	-0.50	22.3	86.5	108.8	20.5
	-1.50	18.4	68.3	86.7	21.2
	-2.50	16.7	85.8	102.5	16.3
	-3.50	16.8	71.2	88.0	19.1
	-5.00	17.3	82.3	99.6	17.4
	-7.00	15.7	80.3	96.0	16.4
	-9.00	16.5	76.7	93.2	17.7
	-12.00	15.9	68.6	84.5	18.8
	-16.00	17.5	71.7	89.2	19.6
	-20.00	16.9	72.5	89.4	18.9
MF3	-0.50	17.8	61.3	79.1	22.5
	-1.50	17.6	75.8	93.4	18.8
	-2.50	16.4	63.6	80.0	20.5
	-3.50	15.9	67.5	83.4	19.1
	-5.00	15.5	58.3	73.8	21.0
	-7.00	16.0	68.6	84.6	18.9
	-9.00	14.3	70.6	84.9	16.8
	-12.00	13.9	58.0	71.9	19.3
	-16.00	14.6	61.8	76.4	19.1
	-20.00	14.0	56.8	70.8	19.8
2	-0.25	2.1	79.5	81.7	2.6
	-0.75	1.8	90.1	92.0	2.0
	-1.25	2.1	95.3	97.4	2.1
	-1.75	1.3	93.4	94.7	1.4
	-2.50	1.5	88.1	89.6	1.6
	-3.50	1.1	79.9	81.0	1.3
	-5.00	1.1	72.2	73.3	1.5
	-7.00	1.2	73.3	74.5	1.7
	-10.00	3.7	82.8	86.4	4.2
3	-0.375	1.4	76.1	77.5	1.8
	-0.625	1.5	88.4	89.9	1.6
	-0.875	1.5	98.8	100.3	1.5
	-1.25	1.5	102.3	103.8	1.5
	-1.75	1.8	104.1	105.9	1.7
	-2.50	1.6	94.4	96.0	1.7
	-3.50	1.7	95.3	97.0	1.8
	-5.00	1.6	95.2	96.7	1.6
	-7.00	1.6	89.2	90.8	1.7
	-9.00	1.8	92.5	94.3	1.9
	-12.00	1.7	89.7	91.4	1.9
5	-0.125	1.4	59.0	60.3	2.3
	-0.375	0.9	54.7	55.6	1.7
	-0.625	1.2	69.9	71.1	1.7
	-0.875	1.1	72.4	73.5	1.5
	-1.25	1.1	64.3	65.4	1.6
	-1.75	1.1	59.0	60.1	1.8
	-2.50	1.0	67.8	68.9	1.5
	-3.50	3.3	58.9	62.2	5.3
	-5.00	1.0	67.2	68.2	1.4
	-7.00	1.0	56.4	57.4	1.8
	-9.00	1.0	59.6	60.6	1.7
	-12.00	1.0	59.3	60.2	1.6

APPENDIX 5: Continued

NICKEL

BC #	D (cm)	L (µg/g)	R (µg/g)	T (µg/g)	L' (%)
16	-0.125	8.3	22.8	31.1	26.6
	-0.375	10.4	32.0	42.4	24.5
	-0.625	10.3	24.5	34.9	29.6
	-0.875	9.8	29.8	39.6	24.7
	-1.25	N.D.	25.0	-	-
	-1.75	10.3	23.6	33.9	30.3
	-2.50	10.4	26.8	37.2	27.9
	-3.50	10.5	26.8	37.3	28.2
	-5.00	10.3	32.4	42.7	24.1
	-7.00	11.2	25.4	36.6	30.7
	-9.00	9.9	27.6	37.5	26.5
	-12.00	10.3	29.9	40.2	25.6
17	-0.125	4.9	7.3	12.2	40.0
	-0.375	7.0	9.1	16.1	43.4
	-0.625	7.4	19.5	26.9	27.4
	-0.875	10.1	20.3	30.4	33.1
	-1.25	6.7	20.9	27.6	24.2
	-1.75	7.0	23.5	30.5	22.9
	-2.50	6.9	24.4	31.3	21.9
	-3.50	6.4	23.0	29.4	21.7
	-5.00	6.1	16.5	22.6	27.1
	-7.00	7.0	23.0	30.0	23.2
	-9.00	6.7	21.5	28.2	23.7
	-12.00	5.7	23.3	29.1	19.7
26	-0.125	7.9	30.6	38.5	20.4
	-0.375	8.2	31.3	39.6	20.8
	-0.625	7.4	30.6	38.0	19.4
	-0.875	8.7	33.5	42.2	20.6
	-1.25	8.1	34.3	42.5	19.1
	-1.75	8.2	31.2	39.4	20.8
	-2.50	9.3	34.3	43.6	21.3
	-3.50	7.3	32.6	39.9	18.3
	-5.00	8.7	35.0	43.6	19.8
	-7.00	6.5	33.0	39.5	16.6
	-9.00	8.6	34.2	42.9	20.1
	-12.00	8.2	30.9	39.1	21.0
27	-0.125	9.9	24.9	34.8	28.6
	-0.375	8.9	32.9	41.9	21.4
	-0.625	8.7	35.4	44.2	19.8
	-0.875	9.5	37.6	47.1	20.2
	-1.25	9.0	38.3	47.3	19.0
	-1.75	8.7	37.8	46.4	18.7
	-2.50	8.0	38.4	46.4	17.2
	-3.50	7.7	37.1	44.9	17.2
	-5.00	8.0	37.4	45.4	17.6
	-7.00	7.4	36.8	44.2	16.7
	-9.00	7.7	38.0	45.7	16.9
	-12.00	8.9	36.2	46.1	21.5
8	-0.25	11.8	20.7	32.4	36.3
	-3.50	11.1	18.9	29.9	37.1
	-12.00	9.6	21.9	31.5	30.5

CHROMIUM

BC #	D (cm)	L (µg/g)	R (µg/g)	T (µg/g)	L' (%)
16	-0.125	1.1	37.2	38.4	2.9
	-0.375	1.9	83.1	85.1	2.3
	-0.625	1.4	82.0	83.5	1.7
	-0.875	1.3	82.2	83.5	1.6
	-1.25	1.5	76.5	78.0	2.0
	-1.75	1.5	65.8	67.3	2.2
	-2.50	1.2	84.1	85.3	1.4
	-3.50	1.7	83.6	85.2	1.9
	-5.00	1.2	78.1	79.3	1.5
	-7.00	1.2	86.8	88.0	1.4
	-9.00	1.3	82.2	83.5	1.5
	-12.00	1.6	87.6	89.3	1.8
17	-0.125	2.4	28.2	30.6	8.0
	-0.375	3.1	41.0	44.1	7.0
	-0.625	1.9	75.5	77.4	2.5
	-0.875	2.3	75.8	78.1	3.0
	-1.25	1.0	73.4	74.4	1.3
	-1.75	1.1	81.3	82.4	1.3
	-2.50	1.0	86.3	87.3	1.1
	-3.50	0.8	88.3	89.1	0.9
	-5.00	0.9	60.5	61.5	1.5
	-7.00	1.1	74.9	76.0	1.5
	-9.00	0.9	73.7	74.6	1.2
	-12.00	1.0	84.8	85.8	1.2
26	-0.125	2.2	77.1	79.3	2.8
	-0.375	2.0	86.3	88.3	2.2
	-0.625	2.0	82.1	84.1	2.4
	-0.875	2.3	87.9	90.2	2.5
	-1.25	1.8	86.3	88.2	2.1
	-1.75	2.2	80.6	82.8	2.6
	-2.50	2.2	85.4	87.5	2.5
	-3.50	1.6	76.4	78.0	2.1
	-5.00	1.6	83.1	84.7	1.9
	-7.00	1.5	79.5	81.0	1.8
	-9.00	1.9	82.7	84.6	2.2
	-12.00	1.7	77.7	79.4	2.1
27	-0.125	3.8	62.0	65.8	5.8
	-0.375	2.3	79.6	81.9	2.9
	-0.625	2.1	87.7	89.7	2.3
	-0.875	2.4	87.5	89.9	2.6
	-1.25	2.3	87.4	89.7	2.6
	-1.75	1.9	85.3	87.2	2.2
	-2.50	1.8	83.8	85.6	2.1
	-3.50	2.7	84.8	87.5	3.1
	-5.00	1.9	77.7	79.6	2.4
	-7.00	1.9	82.8	84.7	2.2
	-9.00	2.4	82.6	85.0	2.8
	-12.00	2.4	82.9	85.3	2.8
8	-0.25	3.7	72.6	76.3	4.8
	-3.50	2.5	65.7	68.1	3.6
	-12.00	2.7	71.6	74.2	3.6

APPENDIX 5: Continued

NICKEL

BC #	D (cm)	L (µg/g)	R (µg/g)	T (µg/g)	L' (%)
12	-0.25	3.3	50.3	53.6	6.2
	-3.50	3.7	51.1	54.9	6.8
	-12.00	3.4	46.6	50.0	6.8
14	-0.25	5.4	40.0	45.4	12.0
	-3.50	5.1	32.0	37.1	13.8
	-12.00	5.0	34.5	39.5	12.6
20	-0.25	8.7	31.5	40.2	21.7
	-3.50	7.5	33.3	40.8	18.4
	-12.00	7.3	27.4	34.7	21.0
21	-0.25	6.3	33.2	39.5	15.9
	-3.50	6.4	31.1	37.5	17.0
	-12.00	6.3	32.6	38.9	16.2
23	-0.50	3.6	28.5	32.1	11.1
	-3.50	3.1	30.4	33.5	9.3
	-16.00	3.0	22.4	25.4	12.0
29	-0.25	1.9	23.9	25.9	7.5
	-3.50	1.4	22.7	24.1	5.9
	-12.00	2.1	25.1	27.1	7.6

CHROMIUM

BC #	D (cm)	L (µg/g)	R (µg/g)	T (µg/g)	L' (%)
12	-0.25	2.7	127.0	129.8	2.1
	-3.50	4.1	122.4	126.5	3.3
	-12.00	2.7	118.0	120.8	2.2
14	-0.25	2.6	81.1	83.7	3.2
	-3.50	2.4	85.9	88.3	2.7
	-12.00	2.0	82.4	84.4	2.4
20	-0.25	2.6	86.0	88.6	3.0
	-3.50	1.8	84.8	86.6	2.0
	-12.00	2.6	79.9	82.5	3.1
21	-0.25	4.6	85.0	89.6	5.1
	-3.50	3.6	77.0	80.5	4.4
	-12.00	3.8	79.4	83.2	4.6
23	-0.50	3.2	85.7	88.9	3.6
	-3.50	2.9	82.1	85.0	3.4
	-16.00	2.6	72.1	74.7	3.5
29	-0.25	5.4	72.0	77.5	7.0
	-3.50	3.8	80.3	84.0	4.5
	-12.00	3.1	77.4	80.4	3.8

APPENDIX 6: Lead and zinc concentrations in sediments from the 1988 and 1991 cruise. BC= boxcore; D= mean depth; L= leachable; R= residual; T= total; L'= percent leachable. (N.D. means not determined)

LEAD

BC #	D (cm)	L (µg/g)	R (µg/g)	T (µg/g)	L' (%)
MA3	-0.50	22.8	13.2	36.0	63.3
	-1.50	20.0	14.7	34.7	57.7
	-2.50	15.4	13.4	28.9	53.4
	-3.50	12.7	13.3	26.0	48.8
	-5.00	11.5	13.0	24.5	46.9
	-7.00	10.0	12.6	22.6	44.2
	-9.00	9.4	12.2	21.6	43.5
	-12.00	9.5	12.4	21.9	43.4
	-16.00	8.9	13.3	22.2	40.2
MA6	-0.25	47.1	11.3	58.4	80.6
	-0.75	40.7	9.7	50.4	80.8
	-1.50	39.4	10.3	49.7	79.3
	-2.50	39.3	11.6	50.9	77.2
	-3.50	44.3	10.7	55.0	80.6
	-5.00	37.8	9.7	47.5	79.5
	-7.00	46.7	9.6	56.3	82.9
	-9.00	40.9	8.7	49.6	82.5
	-12.00	45.3	9.0	54.3	83.5
	-16.00	44.3	12.3	56.6	78.3
	-20.00	50.9	9.0	59.9	84.9
MC1	-0.50	32.1	10.2	42.3	75.9
	-1.50	26.5	9.1	35.5	74.5
	-2.50	20.1	9.5	29.6	67.9
	-3.50	18.3	8.4	26.7	68.5
	-5.00	17.3	9.5	26.8	64.5
	-7.00	12.9	5.5	18.4	70.2
	-9.00	11.7	5.6	17.3	67.8
	-12.00	11.4	4.4	15.8	72.3
	-16.00	13.9	4.8	18.6	74.5
	-20.00	10.9	4.2	15.1	72.4
MC3	-0.50	20.7	N.D.	-	-
	-1.50	23.3	11.5	34.8	67.0
	-2.50	21.8	109.8	131.6	16.6
	-3.50	19.2	3.8	23.0	83.6
	-5.00	18.3	7.3	25.6	71.4
	-7.00	14.1	7.3	21.4	65.7
	-9.00	12.8	5.5	18.3	70.1
	-12.00	13.6	5.8	19.4	70.0
	-16.00	10.8	6.2	17.1	63.3
	-20.00	10.5	N.D.	-	-
ME1	-0.50	31.1	6.8	37.9	82.1
	-1.50	35.2	7.0	42.1	83.5
	-2.50	36.8	6.6	43.4	84.8
	-3.50	28.5	6.9	35.4	80.6
	-5.00	30.2	7.4	37.6	80.4
	-7.00	35.9	8.7	44.6	80.4
	-9.00	29.2	6.9	36.1	80.8
	-12.00	18.3	6.9	25.2	72.6
	-16.00	13.4	6.5	19.9	67.5
	-20.00	15.3	6.0	21.3	71.8

ZINC

BC #	D (cm)	L (µg/g)	R (µg/g)	T (µg/g)	L' (%)
MA3	-0.50	30.1	16.4	46.5	64.8
	-1.50	19.0	60.9	79.9	23.8
	-2.50	21.1	40.2	61.3	34.4
	-3.50	18.2	45.4	63.6	28.6
	-5.00	15.9	48.1	64.0	24.8
	-7.00	19.3	44.6	63.9	30.2
	-9.00	26.7	40.6	67.3	39.7
	-12.00	24.8	82.0	106.8	23.2
	-16.00	23.8	45.3	69.1	34.5
MA6	-0.25	70.3	71.8	142.1	49.5
	-0.75	70.0	68.0	138.0	50.7
	-1.50	72.6	75.9	148.5	48.9
	-2.50	73.8	67.7	141.5	52.1
	-3.50	72.8	72.7	145.5	50.0
	-5.00	65.0	62.2	127.2	51.1
	-7.00	74.7	65.2	139.9	53.4
	-9.00	68.0	62.8	130.8	52.0
	-12.00	67.5	58.9	126.4	53.4
	-16.00	78.2	61.9	140.1	55.8
	-20.00	104.0	61.2	165.2	63.0
MC1	-0.50	35.9	49.3	85.2	42.1
	-1.50	32.5	52.4	84.9	38.3
	-2.50	31.1	52.9	84.0	37.0
	-3.50	27.9	53.7	81.6	34.2
	-5.00	37.5	45.3	82.8	45.3
	-7.00	38.2	41.7	79.9	47.8
	-9.00	35.4	40.1	75.5	46.9
	-12.00	26.8	37.0	63.8	42.0
	-16.00	28.5	25.0	53.5	53.3
	-20.00	30.5	37.9	68.4	44.6
MC3	-0.50	34.2	N.D.	-	-
	-1.50	31.4	40.9	72.3	43.4
	-2.50	27.4	34.6	62.0	44.2
	-3.50	27.6	15.9	43.5	63.5
	-5.00	23.2	34.8	58.0	40.0
	-7.00	25.1	46.8	72.0	35.0
	-9.00	19.6	38.0	57.6	34.0
	-12.00	29.9	39.9	69.8	42.9
	-16.00	26.8	37.8	64.6	41.5
	-20.00	23.1	N.D.	-	-
ME1	-0.50	36.9	33.6	70.5	52.4
	-1.50	50.4	35.7	86.0	58.5
	-2.50	37.9	31.5	69.3	54.6
	-3.50	37.1	30.8	67.9	54.6
	-5.00	36.1	41.6	77.7	46.4
	-7.00	40.1	46.3	86.4	46.4
	-9.00	37.0	33.9	70.9	52.2
	-12.00	35.0	38.3	73.3	47.7
	-16.00	19.4	36.1	55.5	34.9
	-20.00	37.7	34.1	71.8	52.5

APPENDIX 6: Continued

LEAD

BC #	D (cm)	L (μg/g)	R (μg/g)	T (μg/g)	L' (%)
MF2	-0.50	20.4	12.6	33.0	61.8
	-1.50	19.2	11.9	31.1	61.7
	-2.50	13.5	11.2	24.7	54.6
	-3.50	20.3	9.8	30.1	67.6
	-5.00	22.2	23.2	45.4	48.9
	-7.00	15.2	11.3	26.5	57.4
	-9.00	19.3	11.3	30.6	63.1
	-12.00	18.6	10.0	28.6	65.1
	-16.00	22.6	7.8	30.4	74.5
	-20.00	14.1	8.9	23.0	61.4
MF3	-0.50	48.5	18.4	66.9	72.5
	-1.50	35.5	13.4	48.9	72.6
	-2.50	40.1	11.9	52.0	77.1
	-3.50	29.2	12.6	41.8	69.9
	-5.00	18.8	11.0	29.8	63.2
	-7.00	23.3	12.1	35.4	65.9
	-9.00	14.4	12.1	26.6	54.1
	-12.00	14.0	9.4	23.4	59.8
	-16.00	10.9	7.5	18.4	59.2
	-20.00	12.3	7.0	19.3	63.8
2	-0.25	18.8	9.8	28.6	65.7
	-0.75	18.2	11.9	30.1	60.6
	-1.25	17.4	11.1	28.5	61.1
	-1.75	11.8	10.1	21.9	53.8
	-2.50	9.3	9.6	18.8	49.2
	-3.50	7.5	8.2	15.7	47.8
	-5.00	5.4	6.4	11.8	45.6
	-7.00	5.1	6.8	11.9	42.8
	-10.00	5.3	8.2	13.5	39.0
3	-0.375	10.7	7.8	18.5	57.6
	-0.675	11.2	8.5	19.8	56.9
	-0.875	12.3	10.3	22.6	54.4
	-1.25	11.2	10.6	21.8	51.5
	-1.75	8.8	9.2	18.0	48.8
	-2.50	7.5	9.2	16.6	44.9
	-3.50	7.0	9.5	16.5	42.5
	-5.00	6.7	9.0	15.7	42.9
	-7.00	6.2	8.5	14.7	42.0
	-9.00	4.9	8.2	13.1	37.6
	-12.00	4.5	7.6	12.1	37.1
5	-0.125	12.8	9.6	22.4	57.3
	-0.375	12.0	8.3	20.3	59.0
	-0.675	12.3	12.5	24.8	49.7
	-0.875	11.2	13.6	24.8	45.2
	-1.25	9.8	8.3	18.0	54.1
	-1.75	8.8	7.9	16.7	52.8
	-2.50	9.8	8.5	18.3	53.7
	-3.50	8.4	7.5	15.9	52.7
	-5.00	6.8	7.8	14.7	46.6
	-7.00	7.0	9.2	16.3	43.3
	-9.00	7.4	7.7	15.1	49.1
	-12.00	5.2	8.3	13.5	38.5

ZINC

BC #	D (cm)	L (μg/g)	R (μg/g)	T (μg/g)	L' (%)
MF2	-0.50	48.2	58.0	106.2	45.4
	-1.50	32.4	51.5	83.9	38.6
	-2.50	48.0	58.4	106.4	45.1
	-3.50	33.5	65.1	98.6	34.0
	-5.00	34.7	79.6	114.3	30.4
	-7.00	28.0	69.2	97.2	28.8
	-9.00	24.5	67.0	91.5	26.8
	-12.00	20.8	64.6	85.4	24.3
	-16.00	34.0	47.3	81.3	41.8
	-20.00	32.2	66.3	89.5	25.9
MF3	-0.50	41.4	49.9	91.3	45.3
	-1.50	47.1	56.7	103.8	45.4
	-2.50	33.9	50.9	84.8	40.0
	-3.50	36.0	60.3	96.3	37.4
	-5.00	35.8	41.2	77.0	46.5
	-7.00	28.7	48.5	77.2	37.2
	-9.00	29.9	63.1	93.0	32.1
	-12.00	24.2	50.4	74.6	32.4
	-16.00	29.1	41.2	70.3	41.4
	-20.00	32.4	51.9	84.3	38.4
2	-0.25	26.7	48.2	74.9	35.7
	-0.75	25.6	58.1	83.7	30.6
	-1.25	25.7	46.7	72.4	35.5
	-1.75	17.5	47.8	65.3	26.8
	-2.50	15.2	43.6	58.8	25.8
	-3.50	12.0	41.7	53.7	22.3
	-5.00	12.0	31.2	43.2	27.8
	-7.00	11.6	35.1	46.7	24.8
	-10.00	18.2	39.0	57.2	31.8
3	-0.375	22.7	32.5	55.2	41.2
	-0.675	22.6	47.2	69.8	32.4
	-0.875	23.7	52.3	76.0	31.2
	-1.25	24.2	52.6	76.8	31.5
	-1.75	17.4	51.3	68.7	25.3
	-2.50	16.0	47.2	63.2	25.3
	-3.50	14.4	45.2	59.6	24.2
	-5.00	14.4	44.5	59.0	24.4
	-7.00	12.9	46.2	59.1	21.8
	-9.00	14.2	46.0	60.1	23.6
	-12.00	16.0	43.7	59.7	26.8
5	-0.125	24.7	18.5	43.2	57.1
	-0.375	17.5	27.4	44.9	39.0
	-0.675	20.1	38.9	59.0	34.1
	-0.875	18.0	44.7	62.7	28.7
	-1.25	21.7	31.2	52.9	41.0
	-1.75	15.0	30.4	45.4	33.0
	-2.50	17.0	33.5	50.5	33.7
	-3.50	20.3	22.4	42.7	47.6
	-5.00	13.5	34.4	47.9	28.2
	-7.00	14.2	35.7	49.9	28.5
	-9.00	13.5	31.9	45.4	29.8
	-12.00	11.9	32.8	44.7	26.6

APPENDIX 6: Continued

LEAD						ZINC					
BC #	D (cm)	L (µg/g)	R (µg/g)	T (µg/g)	L' (%)	BC #	D (cm)	L (µg/g)	R (µg/g)	T (µg/g)	L' (%)
16	-0.125	11.9	7.3	19.2	61.9	16	-0.125	20.7	16.8	37.5	55.2
	-0.375	13.6	9.8	23.4	57.9		-0.375	22.0	56.5	78.5	28.0
	-0.675	13.4	8.6	22.0	60.8		-0.675	22.5	56.1	78.6	28.6
	-0.875	11.1	9.6	20.6	53.6		-0.875	20.8	53.3	74.1	28.1
	-1.25	11.7	6.3	18.1	65.0		-1.25	22.3	61.1	83.4	26.7
	-1.75	10.8	10.9	21.7	49.9		-1.75	20.2	48.0	68.2	29.6
	-2.50	9.5	9.3	18.8	50.5		-2.50	19.0	57.9	76.9	24.7
	-3.50	7.7	8.7	16.3	46.9		-3.50	16.7	57.4	74.1	22.5
	-5.00	6.4	4.6	11.0	58.2		-5.00	16.3	53.3	69.6	23.4
	-7.00	5.7	7.3	13.0	43.8		-7.00	15.9	50.8	66.7	23.8
	-9.00	9.4	19.0	28.4	33.2		-9.00	18.0	53.3	71.3	25.2
	-12.00	5.8	7.7	13.4	42.8		-12.00	16.8	53.4	70.2	23.9
17	-0.125	10.0	10.0	20.0	50.1	17	-0.125	23.0	19.2	42.2	54.5
	-0.375	11.2	6.1	17.3	64.9		-0.375	26.9	18.8	45.7	58.9
	-0.675	12.8	9.7	22.5	56.9		-0.675	26.3	58.5	84.8	31.0
	-0.875	12.8	10.3	23.1	55.5		-0.875	28.0	54.0	82.0	34.1
	-1.25	10.3	11.0	21.3	48.3		-1.25	24.1	47.5	71.6	33.6
	-1.75	9.2	10.8	20.0	46.1		-1.75	20.5	59.0	79.5	25.8
	-2.50	8.1	9.7	17.8	45.6		-2.50	18.8	62.7	81.5	23.1
	-3.50	7.8	10.2	18.0	43.4		-3.50	17.3	62.3	79.6	21.7
	-5.00	6.7	7.2	13.9	48.2		-5.00	18.6	36.9	55.5	33.5
	-7.00	7.6	10.3	17.9	42.4		-7.00	16.7	51.4	68.1	24.5
	-9.00	6.5	8.7	15.2	43.1		-9.00	17.3	51.5	68.8	25.1
	-12.00	5.0	10.5	15.6	32.5		-12.00	16.5	53.0	69.5	23.8
26	-0.125	21.6	10.2	31.8	68.0	26	-0.125	30.3	65.6	95.9	31.6
	-0.375	20.8	10.8	31.5	65.9		-0.375	29.0	66.6	95.6	30.3
	-0.675	19.7	10.6	30.3	64.9		-0.675	28.4	65.1	93.5	30.4
	-0.875	18.6	10.6	29.2	63.7		-0.875	28.6	70.8	99.5	28.8
	-1.25	15.3	11.0	26.2	58.2		-1.25	23.8	74.0	97.8	24.3
	-1.75	13.1	9.0	22.1	59.3		-1.75	26.8	59.6	86.4	31.0
	-2.50	13.6	8.7	22.3	61.0		-2.50	22.5	68.1	90.6	24.8
	-3.50	13.2	9.4	22.6	58.5		-3.50	19.7	77.2	96.9	20.3
	-5.00	9.9	10.0	19.9	49.7		-5.00	20.8	N.D.	-	-
	-7.00	8.1	9.6	17.6	45.7		-7.00	18.3	69.8	88.1	20.8
	-9.00	7.4	10.4	17.7	41.5		-9.00	19.4	65.3	84.7	22.9
	-12.00	5.1	11.8	16.9	30.0		-12.00	19.1	60.9	80.0	23.9
27	-0.125	18.7	11.2	29.8	62.6	27	-0.125	31.0	44.2	75.2	41.2
	-0.375	19.0	12.1	31.1	61.1		-0.375	28.4	70.3	98.7	28.8
	-0.675	14.8	12.1	26.9	55.1		-0.675	24.4	68.5	92.9	26.3
	-0.875	14.9	15.8	30.8	48.5		-0.875	27.2	74.6	101.8	26.7
	-1.25	13.7	12.2	25.9	52.9		-1.25	27.0	70.4	97.4	27.7
	-1.75	14.5	13.4	27.9	52.0		-1.75	23.0	79.6	102.6	22.4
	-2.50	11.4	12.5	23.9	47.8		-2.50	19.3	78.4	97.7	19.8
	-3.50	12.2	12.4	24.6	49.5		-3.50	18.5	73.3	91.8	20.2
	-5.00	10.9	17.4	28.2	38.4		-5.00	18.4	78.5	96.9	19.0
	-7.00	9.0	11.6	20.6	43.8		-7.00	15.6	73.5	89.1	17.5
	-9.00	9.5	11.6	21.1	44.9		-9.00	18.4	73.0	91.4	20.1
	-12.00	5.3	16.6	22.0	24.3		-12.00	17.8	68.2	86.0	20.7
8	-0.25	8.9	7.7	16.7	53.6	8	-0.25	34.3	59.6	93.9	36.5
	-3.50	9.5	7.1	16.5	57.3		-3.50	22.6	55.3	77.9	29.0
	-12.00	8.4	7.7	16.0	52.2		-12.00	18.0	56.9	74.9	24.0

APPENDIX 6: Continued

LEAD

BC #	D (cm)	L (μg/g)	R (μg/g)	T (μg/g)	L' (%)
12	-0.25	17.0	21.8	38.8	43.8
	-3.50	19.9	25.1	45.0	44.3
	-12.00	19.4	9.5	28.9	67.0
14	-0.25	18.4	10.0	28.4	64.9
	-3.50	10.3	9.4	19.7	52.4
	-12.00	6.5	7.8	14.3	45.5
20	-0.25	17.1	9.4	26.5	64.4
	-3.50	21.9	17.8	39.7	55.2
	-12.00	10.2	4.3	14.5	70.6
21	-0.25	19.2	9.5	28.7	66.9
	-3.50	17.7	10.8	28.6	62.1
	-12.00	15.0	8.2	23.2	64.5
23	-0.50	17.6	8.0	25.6	68.9
	-3.50	17.9	8.0	25.9	69.1
	-16.00	14.8	6.2	21.0	70.4
29	-0.25	17.9	11.5	29.4	60.8
	-3.50	17.9	12.9	30.8	58.3
	-12.00	14.4	11.4	25.8	55.8

ZINC

BC #	D (cm)	L (μg/g)	R (μg/g)	T (μg/g)	L' (%)
12	-0.25	35.5	91.9	127.4	27.9
	-3.50	39.6	87.2	126.8	31.2
	-12.00	37.4	90.4	127.8	29.3
14	-0.25	31.3	71.7	103.0	30.4
	-3.50	28.9	74.3	103.2	28.0
	-12.00	22.2	72.3	94.5	33.8
20	-0.25	28.8	68.8	97.6	30.3
	-3.50	17.4	69.1	86.5	33.8
	-12.00	25.6	50.1	75.7	26.8
21	-0.25	28.4	65.2	93.6	30.8
	-3.50	35.0	68.6	103.6	31.1
	-12.00	20.5	56.0	76.5	27.9
23	-0.50	31.4	70.5	101.9	31.8
	-3.50	31.1	71.1	103.2	28.6
	-16.00	23.9	61.7	85.6	25.7
29	-0.25	30.1	64.7	94.8	31.8
	-3.50	29.2	72.8	102.0	28.6
	-12.00	25.1	72.4	97.5	25.7

APPENDIX 7: Iron concentrations in sediments from the 1988 and 1991 cruise. BC= boxcore; D= mean depth; L= leachable; R= residual; T= total; L'= percent leachable. (N.D. means not determined)

BC #	D (cm)	L (µg/g)	R (µg/g)	T (µg/g)	L' (%)
MA3	-0.50	0.56	1.17	1.73	32.4
	-1.50	0.64	1.59	2.23	28.7
	-2.50	0.65	1.56	2.21	29.4
	-3.50	0.61	1.45	2.06	29.6
	-5.00	0.61	1.49	2.10	29.0
	-7.00	0.64	1.52	2.16	29.6
	-9.00	0.66	1.40	2.06	32.0
	-12.00	0.65	1.42	2.07	31.4
	-16.00	0.84	1.68	2.52	33.3
MA6	-0.25	1.25	1.95	3.20	39.1
	-0.75	1.21	1.96	3.17	38.2
	-1.50	1.19	2.08	3.27	36.4
	-2.50	1.15	1.99	3.14	36.6
	3.50	1.13	1.95	3.08	36.7
	-5.00	1.08	1.88	2.96	36.5
	-7.00	1.12	1.84	2.96	37.8
	-9.00	1.06	1.76	2.82	37.6
	-12.00	1.04	1.74	2.78	37.4
	-16.00	1.09	1.78	2.87	38.0
	-20.00	1.16	1.87	3.03	38.3
MC1	-0.50	0.85	2.14	2.99	28.4
	-1.50	0.89	2.14	3.03	29.4
	-2.50	0.82	2.11	2.93	28.0
	-3.50	0.81	2.03	2.84	28.5
	-5.00	0.92	1.88	2.80	32.9
	-7.00	0.93	1.69	2.62	35.5
	-9.00	0.89	1.70	2.59	34.4
	-12.00	0.90	1.56	2.46	36.6
	-16.00	0.87	1.27	2.14	40.7
	-20.00	0.95	1.33	2.28	41.7
MC3	-0.50	0.74	N.D.	-	-
	-1.50	0.73	1.66	2.39	30.5
	-2.50	0.72	1.63	2.35	30.6
	-3.50	0.70	1.06	1.76	39.8
	-5.00	0.68	1.64	2.32	29.3
	-7.00	0.66	1.70	2.36	28.0
	-9.00	0.68	1.72	2.40	28.3
	-12.00	0.66	1.77	2.43	27.2
	-16.00	0.66	1.74	2.40	27.5
	-20.00	0.70	N.D.	-	-
ME1	-0.50	0.89	1.55	2.44	36.5
	-1.50	0.91	1.56	2.47	36.8
	-2.50	0.89	1.58	2.47	36.0
	-3.50	0.85	1.59	2.44	34.8
	-5.00	0.89	1.74	2.63	33.8
	-7.00	0.90	1.70	2.60	34.6
	-9.00	0.87	1.55	2.42	36.0
	-12.00	0.87	1.61	2.48	35.1
	-16.00	0.27	1.64	1.91	14.1
	-20.00	0.90	1.63	2.53	35.6

APPENDIX 7: Continued

BC #	D (cm)	L (µg/g)	R (µg/g)	T (µg/g)	L' (%)
MF2	-0.50	0.91	2.50	3.41	26.7
	-1.50	0.85	2.32	3.17	26.8
	-2.50	0.76	2.45	3.21	23.7
	-3.50	0.78	2.35	3.13	24.9
	-5.00	0.74	2.56	3.30	22.4
	-7.00	0.84	2.55	3.39	24.8
	-9.00	0.90	2.62	3.52	25.6
	-12.00	0.86	2.58	3.44	25.0
	-16.00	0.80	2.36	3.16	25.3
	-20.00	0.81	2.53	3.34	24.3
MF3	-0.50	0.86	2.34	3.20	26.9
	-1.50	0.85	2.48	3.33	25.5
	-2.50	0.82	2.30	3.12	26.3
	-3.50	0.79	2.37	3.16	25.0
	-5.00	0.82	2.13	2.95	27.8
	-7.00	0.86	2.31	3.17	27.1
	-9.00	0.79	2.31	3.10	25.5
	-12.00	0.80	2.17	2.97	26.9
	-16.00	0.81	1.93	2.74	29.6
	-20.00	0.79	1.80	2.59	30.5
2	-0.25	0.20	2.06	2.26	8.8
	-0.75	0.19	2.21	2.40	7.9
	-1.25	0.22	2.22	2.44	9.0
	-1.75	0.17	2.32	2.49	6.8
	-2.50	0.20	2.28	2.48	8.1
	-3.50	0.16	1.96	2.12	7.5
	-5.00	0.14	1.76	1.90	7.4
	-7.00	0.16	1.91	2.07	7.7
	-10.00	0.35	2.05	2.40	14.6
3	-0.375	0.16	1.76	1.92	8.3
	-0.675	0.19	2.13	2.32	8.2
	-0.875	0.18	2.34	2.52	7.1
	-1.25	0.20	2.32	2.52	7.9
	-1.75	0.20	2.34	2.54	7.9
	-2.50	0.19	2.38	2.57	7.4
	-3.50	0.19	2.34	2.53	7.5
	-5.00	0.18	2.27	2.45	7.3
	-7.00	0.17	2.12	2.29	7.4
	-9.00	0.17	2.17	2.34	7.3
	-12.00	0.17	2.19	2.36	7.2
5	-0.125	0.16	1.40	1.56	10.3
	-0.375	0.14	1.55	1.69	8.3
	-0.675	0.16	2.24	2.40	6.7
	-0.875	0.15	2.05	2.20	6.8
	-1.25	0.15	1.82	1.97	7.6
	-1.75	0.15	1.71	1.86	8.1
	-2.50	0.15	1.88	2.03	7.4
	-3.50	0.32	1.69	2.01	15.9
	-5.00	0.15	1.96	2.11	7.1
	-7.00	0.15	1.84	1.99	7.5
	-9.00	0.13	1.81	1.94	6.7
	-12.00	0.15	1.82	1.97	7.6

APPENDIX 7: Continued

BC #	D (cm)	L (μg/g)	R (μg/g)	T (μg/g)	L' (%)
16	-0.125	0.16	0.68	0.84	19.0
	-0.375	0.20	2.08	2.28	8.8
	-0.675	0.19	1.95	2.14	8.9
	-0.875	0.19	2.08	2.27	8.4
	-1.25	0.18	1.95	2.13	8.5
	-1.75	0.19	1.70	1.89	10.1
	-2.50	0.19	2.04	2.23	8.5
	-3.50	0.18	2.00	2.18	8.3
	-5.00	0.18	1.94	2.12	8.5
	-7.00	0.18	1.96	2.14	8.4
	-9.00	0.18	2.02	2.20	8.2
	-12.00	0.17	2.06	2.23	7.6
17	-0.125	0.19	0.77	0.96	19.8
	-0.375	0.29	0.97	1.26	23.0
	-0.675	0.27	1.64	1.19	14.1
	-0.875	0.03	1.87	1.90	1.6
	-1.25	0.20	1.87	2.07	9.7
	-1.75	0.22	2.09	2.31	9.5
	-2.50	0.23	2.18	2.41	9.5
	-3.50	0.18	2.18	2.36	7.6
	-5.00	0.18	1.45	1.63	11.0
	-7.00	0.21	2.04	2.25	9.3
	-9.00	0.19	1.98	2.17	8.8
	-12.00	0.17	2.08	2.25	7.6
26	-0.125	0.24	2.54	2.78	8.6
	-0.375	0.24	2.63	2.87	8.4
	-0.675	0.26	2.58	2.84	9.2
	-0.875	0.23	2.72	2.95	7.8
	-1.25	0.21	2.89	3.10	6.8
	-1.75	0.21	2.54	2.75	7.6
	-2.50	0.23	2.85	3.08	7.5
	-3.50	0.22	2.64	2.86	7.7
	-5.00	0.22	2.88	3.10	7.1
	-7.00	0.20	2.75	2.95	6.8
	-9.00	0.20	2.63	2.83	7.1
	-12.00	0.17	2.33	2.50	6.8
27	-0.125	0.30	1.88	2.18	13.8
	-0.375	0.23	2.53	2.76	8.3
	-0.675	0.20	2.64	2.84	7.0
	-0.875	0.25	2.91	3.16	7.9
	-1.25	0.22	2.83	3.05	7.2
	-1.75	0.21	2.94	3.15	6.7
	-2.50	0.20	2.97	3.17	6.3
	-3.50	0.20	2.93	3.13	6.4
	-5.00	0.21	2.94	3.15	6.7
	-7.00	0.21	2.96	3.17	6.6
	-9.00	0.23	2.89	3.12	7.4
	-12.00	0.20	2.73	2.93	6.8
8	-0.25	0.26	2.10	2.36	11.0
	-3.50	0.22	1.88	2.10	10.5
	-12.00	0.27	2.04	2.31	11.7
12	-0.25	0.39	3.41	3.80	10.3
	-3.50	0.44	3.46	3.90	11.3
	-12.00	0.40	3.20	3.60	11.1

APPENDIX 7: Continued

BC #	D (cm)	L (μg/g)	R (μg/g)	T (μg/g)	L' (%)
14	-0.25	0.36	2.52	2.88	12.5
	-3.50	0.34	2.58	2.92	11.6
	-12.00	0.29	2.51	2.80	10.4
20	-0.25	0.25	2.48	2.73	9.2
	-3.50	0.21	2.40	2.61	8.0
	-12.00	0.39	2.04	2.43	16.0
21	-0.25	0.27	2.50	2.77	9.7
	-3.50	0.26	2.42	2.68	9.7
	-12.00	0.30	2.30	2.60	11.5
23	-0.50	0.31	2.55	2.86	10.8
	-3.50	0.32	2.32	2.64	12.1
	-16.00	0.28	2.07	2.35	11.9
29	-0.25	0.40	2.55	2.95	13.6
	-3.50	0.31	2.61	2.92	10.6
	-12.00	0.33	2.63	2.96	11.1

APPENDIX 8: **Manganese concentrations in sediments from the 1988 and 1991 cruise. BC= boxcore; D= mean depth; L= leachable; R= residual; T= total; L'= percent leachable. (N.D. means not determined)**

BC #	D (cm)	L (µg/g)	R (µg/g)	T (µg/g)	L' (%)
MA3	-0.50	727	17	744	97.7
	-1.50	773	46	819	94.3
	-2.50	752	43	795	94.6
	-3.50	663	43	706	93.9
	-5.00	647	45	692	93.5
	-7.00	638	46	684	93.3
	-9.00	693	48	740	93.6
	-12.00	1201	106	1307	91.9
	-16.00	376	53	429	87.6
MA6	-0.25	489	50	539	90.7
	-0.75	486	51	537	90.6
	-1.50	464	54	518	89.6
	-2.50	434	52	486	89.4
	3.50	433	50	483	89.7
	-5.00	404	49	453	89.2
	-7.00	398	48	446	89.2
	-9.00	393	49	442	88.9
	-12.00	386	44	430	89.9
	-16.00	397	47	444	89.4
	-20.00	430	51	481	89.4
MC1	-0.50	785	61	846	92.7
	-1.50	836	63	899	93.0
	-2.50	763	61	824	92.6
	-3.50	820	59	879	93.3
	-5.00	375	54	429	87.4
	-7.00	361	51	412	87.6
	-9.00	367	48	415	88.3
	-12.00	386	46	432	89.5
	-16.00	336	16	352	95.4
	-20.00	396	19	415	95.4
MC3	-0.50	506	N.D.	-	-
	-1.50	591	33	624	94.8
	-2.50	432	57	489	88.3
	-3.50	333	24	357	93.3
	-5.00	307	56	363	84.5
	-7.00	290	56	346	83.7
	-9.00	299	53	352	84.9
	-12.00	303	55	358	84.7
	-16.00	296	55	351	84.4
	-20.00	309	N.D.	-	-
ME1	-0.50	455	47	502	90.6
	-1.50	429	51	480	89.4
	-2.50	407	49	456	89.3
	-3.50	409	53	462	88.6
	-5.00	425	53	478	89.0
	-7.00	424	56	480	88.4
	-9.00	420	51	471	89.1
	-12.00	406	47	453	89.6
	-16.00	151	50	201	75.2
	-20.00	416	48	464	89.6

APPENDIX 9: Continued

BC #	D (cm)	L (μg/g)	R (μg/g)	T (μg/g)	L' (%)
MF2	-0.50	1108	69	1177	94.1
	-1.50	1214	45	1259	96.4
	-2.50	1413	70	1483	95.3
	-3.50	1974	68	2042	96.7
	-5.00	4760	1868	6628	71.8
	-7.00	612	70	682	89.7
	-9.00	482	67	549	87.7
	-12.00	411	66	477	86.2
	-16.00	444	58	502	88.5
	-20.00	413	66	479	86.3
MF3	-0.50	777	61	838	92.8
	-1.50	841	66	907	92.7
	-2.50	812	62	874	92.9
	-3.50	799	65	864	92.5
	-5.00	813	61	874	93.0
	-7.00	885	65	950	93.1
	-9.00	563	68	631	89.3
	-12.00	369	60	428	86.1
	-16.00	313	52	365	85.7
	-20.00	301	54	355	84.8
2	-0.25	632	146	778	81.2
	-0.75	635	211	846	75.1
	-1.25	661	208	869	76.1
	-1.75	576	336	912	63.2
	-2.50	569	296	865	65.8
	-3.50	475	261	736	64.5
	-5.00	428	313	741	57.8
	-7.00	479	278	757	63.3
	-10.00	671	512	1183	56.7
3	-0.375	639	244	883	72.4
	-0.675	767	363	1130	67.9
	-0.875	756	440	1196	63.2
	-1.25	648	562	1210	53.6
	-1.75	648	539	1187	54.6
	-2.50	574	550	1124	51.1
	-3.50	716	430	1146	62.5
	-5.00	652	373	1025	63.6
	-7.00	586	328	914	64.1
	-9.00	625	331	956	65.4
	-12.00	640	293	933	68.6
5	-0.125	554	69	623	88.9
	-0.375	536	91	627	85.5
	-0.675	673	149	822	81.9
	-0.875	666	204	870	76.6
	-1.25	590	165	755	78.1
	-1.75	558	161	719	77.6
	-2.50	683	165	848	80.5
	-3.50	675	139	814	82.9
	-5.00	623	163	786	79.3
	-7.00	595	147	742	80.2
	-9.00	531	106	637	83.4
	-12.00	536	127	663	80.8

APPENDIX 8: Continued

BC #	D (cm)	L (μg/g)	R (μg/g)	T (μg/g)	L' (%)
16	-0.125	545	21	566	96.3
	-0.375	691	136	827	83.6
	-0.675	665	117	782	85.0
	-0.875	631	125	756	83.5
	-1.25	651	164	815	79.9
	-1.75	672	75	747	90.0
	-2.50	646	142	788	82.0
	-3.50	653	108	761	85.8
	-5.00	631	156	787	80.2
	-7.00	573	117	690	83.0
	-9.00	517	122	639	80.9
	-12.00	585	263	848	69.0
17	-0.125	359	40	399	90.0
	-0.375	561	89	650	86.3
	-0.675	689	260	949	72.6
	-0.875	750	262	1012	74.1
	-1.25	622	318	940	66.2
	-1.75	699	396	1095	63.8
	-2.50	726	355	1081	67.2
	-3.50	672	324	996	67.5
	-5.00	650	184	834	77.9
	-7.00	603	252	855	70.5
	-9.00	604	233	837	72.2
	-12.00	549	260	809	67.9
26	-0.125	771	161	932	82.7
	-0.375	807	169	976	82.7
	-0.675	819	161	980	83.6
	-0.875	778	211	989	78.7
	-1.25	749	254	1003	74.7
	-1.75	736	212	948	77.6
	-2.50	749	239	988	75.8
	-3.50	780	221	1001	77.9
	-5.00	757	253	1010	75.0
	-7.00	688	234	922	74.6
	-9.00	729	338	1067	68.3
	-12.00	873	919	1792	48.7
27	-0.125	695	200	895	77.7
	-0.375	671	388	1059	63.4
	-0.675	575	397	972	59.2
	-0.875	676	436	1112	60.8
	-1.25	661	455	1116	59.2
	-1.75	688	497	1185	58.1
	-2.50	617	526	1143	54.0
	-3.50	623	524	1147	54.3
	-5.00	631	484	1115	56.6
	-7.00	569	519	1088	52.3
	-9.00	595	518	1113	53.5
	-12.00	983	1504	2487	39.5
8	-0.25	1128	99	1227	91.9
	-3.50	1368	83	1451	94.3
	-12.00	321	91	412	77.9
12	-0.25	617	569	1186	52.0
	-3.50	481	1560	2041	23.6
	-12.00	463	175	638	72.6

APPENDIX 8: Continued

BC #	D (cm)	L (μg/g)	R (μg/g)	T (μg/g)	L' (%)
14	-0.25	887	159	1046	84.8
	-3.50	657	164	821	80.0
	-12.00	443	152	595	74.5
20	-0.25	806	152	958	84.1
	-3.50	807	283	1090	74.0
	-12.00	436	127	563	77.4
21	-0.25	753	140	893	84.3
	-3.50	462	141	603	76.6
	-12.00	426	124	550	77.5
23	-0.50	606	130	736	82.3
	-3.50	604	120	724	83.4
	-16.00	442	105	547	80.8
29	-0.25	485	127	612	79.2
	-3.50	298	117	415	71.8
	-12.00	312	114	426	73.2

APPENDIX 9: **Magnesium and calcium concentrations in sediments from the 1988 and 1991 cruise. D= mean depth; L= leachable; R= residual; T= total; L'= percent leachable. (N.D. means not determined)**

MAGNESIUM

BC #	D (cm)	L (%)	R (%)	T (%)	L' (%)
MA3	-0.50	1.79	0.06	1.85	97.0
	-1.50	1.83	0.11	1.94	94.3
	-2.50	1.83	0.10	1.93	94.7
	-3.50	1.89	0.10	1.99	95.1
	-5.00	1.88	0.10	1.98	94.9
	-7.00	1.93	0.10	2.03	95.1
	-9.00	1.90	0.10	2.00	94.4
	-12.00	1.84	0.09	1.93	94.3
	-16.00	2.08	0.11	2.19	92.6
MA6	-0.25	1.44	0.11	1.55	94.2
	-0.75	1.40	0.11	1.51	94.4
	-1.50	1.45	0.12	1.56	94.3
	-2.50	1.45	0.11	1.56	92.6
	-3.50	1.39	0.11	1.50	94.2
	-5.00	1.40	0.11	1.51	94.4
	-7.00	1.42	0.10	1.52	94.3
	-9.00	1.34	0.10	1.44	92.6
	-12.00	1.37	0.10	1.47	94.2
	-16.00	1.44	0.10	1.54	94.4
	-20.00	1.49	0.11	1.60	94.3
MC1	-0.50	1.77	0.13	1.90	92.6
	-1.50	1.80	0.13	1.93	94.2
	-2.50	1.79	0.13	1.92	94.4
	-3.50	1.84	0.12	1.96	94.3
	-5.00	1.88	0.12	2.00	92.6
	-7.00	1.84	0.11	1.95	94.2
	-9.00	1.88	0.11	1.99	94.4
	-12.00	1.96	0.10	2.06	94.3
	-16.00	1.93	0.07	2.00	92.6
	-20.00	2.06	0.07	2.13	94.2
MC3	-0.50	1.67	N.D.	-	-
	-1.50	1.68	0.06	1.74	94.4
	-2.50	1.64	0.09	1.73	94.3
	-3.50	1.67	0.07	1.74	92.6
	-5.00	1.67	0.08	1.75	94.2
	-7.00	1.63	0.08	1.71	94.4
	-9.00	1.67	0.08	1.75	94.3
	-12.00	1.64	0.10	1.74	92.6
	-16.00	1.66	0.09	1.75	94.2
	-20.00	1.69	N.D.	-	-
ME1	-0.50	1.46	0.07	1.53	94.4
	-1.50	1.48	0.07	1.55	94.3
	-2.50	1.47	0.07	1.54	92.6
	-3.50	1.50	0.08	1.58	94.2
	-5.00	1.49	0.09	1.58	94.4
	-7.00	1.48	0.08	1.56	94.3
	-9.00	1.53	0.08	1.61	92.6
	-12.00	1.59	0.08	1.67	94.2
	-16.00	1.36	0.09	1.45	94.4
	-20.00	1.58	0.07	1.65	94.3

CALCIUM

BC #	D (cm)	L (%)
MA3	-0.50	14.9
	-1.50	14.2
	-2.50	11.3
	-3.50	16.1
	-5.00	13.0
	-7.00	13.6
	-9.00	14.5
	-12.00	14.4
	-16.00	12.0
MA6	-0.25	9.0
	-0.75	8.2
	-1.50	9.0
	-2.50	8.9
	-3.50	9.3
	-5.00	9.3
	-7.00	9.5
	-9.00	9.4
	-12.00	10.4
	-16.00	9.5
	-20.00	8.7
MC1	-0.50	11.1
	-1.50	10.9
	-2.50	11.3
	-3.50	12.2
	-5.00	13.2
	-7.00	12.8
	-9.00	13.2
	-12.00	13.5
	-16.00	12.3
	-20.00	13.8
MC3	-0.50	13.3
	-1.50	11.5
	-2.50	14.7
	-3.50	14.3
	-5.00	14.5
	-7.00	14.2
	-9.00	14.0
	-12.00	13.7
	-16.00	13.2
	-20.00	14.4
ME1	-0.50	16.1
	-1.50	14.9
	-2.50	15.1
	-3.50	14.2
	-5.00	13.8
	-7.00	13.8
	-9.00	12.8
	-12.00	14.0
	-16.00	14.9
	-20.00	14.1

APPENDIX 9: Continued

		MAGNESIUM					CALCIUM	
BC #	D (cm)	L (%)	R (%)	T (%)	L' (%)	BC #	D (cm)	L (%)
MF2	-0.50	2.19	0.17	2.10	92.6	MF2	-0.50	8.6
	-1.50	2.10	0.13	2.23	94.2		-1.50	7.8
	-2.50	2.06	0.16	2.22	94.4		-2.50	8.5
	-3.50	2.09	0.15	2.24	94.3		-3.50	8.2
	-5.00	2.25	0.16	2.41	92.6		-5.00	8.1
	-7.00	2.08	0.15	2.23	94.2		-7.00	8.4
	-9.00	2.08	0.16	2.24	94.4		-9.00	8.1
	-12.00	2.04	0.15	2.19	94.3		-12.00	8.2
	-16.00	2.13	0.14	2.27	92.6		-16.00	9.4
	-20.00	2.11	0.16	2.27	94.2		-20.00	9.1
MF3	-0.50	2.06	0.11	2.17	94.4	MF3	-0.50	11.4
	-1.50	2.07	0.14	2.21	94.3		-1.50	11.6
	-2.50	2.12	0.12	2.25	92.6		-2.50	12.2
	-3.50	2.09	0.13	2.22	94.2		-3.50	13.0
	-5.00	2.15	0.12	2.27	94.4		-5.00	12.9
	-7.00	2.08	0.14	2.22	94.3		-7.00	12.4
	-9.00	2.06	0.14	2.22	92.6		-9.00	12.8
	-12.00	1.98	0.12	2.10	94.2		-12.00	12.8
	-16.00	2.10	0.12	2.22	94.4		-16.00	14.5
	-20.00	2.08	0.13	2.21	94.3		-20.00	13.6
2	-0.25	2.17	0.35	2.52	86.1	2	-0.25	19.1
	-0.75	2.04	0.28	2.32	87.9		-0.75	17.4
	-1.25	1.93	0.22	2.15	89.8		-1.25	17.2
	-1.75	2.18	0.25	2.43	89.7		-1.75	16.6
	-2.50	2.16	0.25	2.41	89.6		-2.50	16.4
	-3.50	2.14	0.30	2.44	87.7		-3.50	18.1
	-5.00	2.31	0.18	2.49	92.8		-5.00	18.7
	-7.00	2.28	0.19	2.47	92.3		-7.00	19.7
	-10.00	2.11	0.22	2.33	90.6		-10.00	15.9
3	-0.375	3.01	0.17	3.18	94.7	3	-0.375	19.7
	-0.625	2.74	0.23	2.97	92.3		-0.625	16.1
	-0.875	2.51	0.28	2.79	90.0		-0.875	15.8
	-1.25	2.55	0.30	2.85	89.5		-1.25	16.3
	-1.75	2.31	0.27	2.58	89.5		-1.75	15.6
	-2.50	2.18	0.27	2.45	89.0		-2.50	15.5
	-3.50	2.19	0.33	2.52	86.9		-3.50	16.4
	-5.00	2.25	0.31	2.56	87.9		-5.00	16.4
	-7.00	2.28	0.27	2.55	89.4		-7.00	16.6
	-9.00	2.10	0.28	2.38	88.2		-9.00	17.2
	-12.00	3.00	0.22	3.22	93.2		-12.00	18.7
5	-0.125	3.11	0.11	3.22	96.6	5	-0.125	19.8
	-0.375	3.10	0.03	3.13	99.0		-0.375	21.1
	-0.625	2.55	0.15	2.70	94.4		-0.625	18.4
	-0.875	2.41	0.17	2.58	93.4		-0.875	18.6
	-1.25	2.18	0.33	2.51	86.9		-1.25	19.9
	-1.75	2.55	0.18	2.73	93.4		-1.75	19.6
	-2.50	2.98	0.19	3.17	86.9		-2.50	20.1
	-3.50	2.70	0.19	2.89	93.4		-3.50	19.6
	-5.00	2.38	0.16	2.54	94.0		-5.00	19.6
	-7.00	2.70	0.16	2.86	93.4		-7.00	20.0
	-9.00	2.77	0.15	2.92	93.7		-9.00	20.3
	-12.00	2.60	0.16	2.76	94.5		-12.00	20.8

APPENDIX 9: Continued

		MAGNESIUM					CALCIUM	
BC #	D (cm)	L (%)	R (%)	T (%)	L' (%)	BC #	D (cm)	L (%)
16	-0.125	2.00	0.06	2.06	97.1	16	-0.125	18.5
	-0.375	2.21	0.18	2.39	92.5		-0.375	16.5
	-0.625	2.98	0.15	3.13	95.2		-0.625	15.9
	-0.875	2.44	0.30	2.74	89.1		-0.875	15.9
	-1.25	2.37	0.35	2.72	87.1		-1.25	16.4
	-1.75	3.10	0.33	3.43	90.4		-1.75	15.8
	-2.50	2.51	0.31	2.82	89.0		-2.50	16.5
	-3.50	2.45	0.27	2.72	90.1		-3.50	16.4
	-5.00	2.33	0.25	2.58	90.3		-5.00	16.7
	-7.00	2.55	0.27	2.82	90.4		-7.00	16.4
	-9.00	2.50	0.21	2.71	92.3		-9.00	16.4
	-12.00	2.68	0.25	2.93	91.5		-12.00	16.4
17	-0.125	3.70	0.25	3.95	93.7	17	-0.125	25.6
	-0.375	2.54	0.18	2.72	93.4		-0.375	19.6
	-0.625	3.16	0.27	3.43	92.1		-0.625	17.4
	-0.875	3.02	0.24	3.26	92.6		-0.875	16.7
	-1.25	2.48	0.25	2.73	90.8		-1.25	18.2
	-1.75	3.02	0.40	3.42	88.3		-1.75	20.1
	-2.50	2.54	0.28	2.82	90.1		-2.50	17.3
	-3.50	2.18	0.31	2.49	87.6		-3.50	14.6
	-5.00	2.68	0.23	2.91	92.1		-5.00	16.4
	-7.00	2.55	0.25	2.80	91.1		-7.00	17.0
	-9.00	2.71	0.28	2.99	90.6		-9.00	17.0
	-12.00	2.70	0.24	2.94	91.8		-12.00	17.8
26	-0.125	2.03	0.11	2.14	94.6	26	-0.125	12.3
	-0.375	2.11	0.17	2.28	92.5		-0.375	12.2
	-0.625	2.25	0.15	2.40	93.8		-0.625	11.7
	-0.875	2.15	0.15	2.30	93.4		-0.875	11.8
	-1.25	2.12	0.15	2.27	92.9		-1.25	12.3
	-1.75	2.23	0.17	2.40	94.6		-1.75	12.6
	-2.50	2.11	0.12	2.23	93.1		-2.50	12.3
	-3.50	2.16	0.16	2.32	93.5		-3.50	11.9
	-5.00	2.30	0.16	2.46	92.4		-5.00	12.3
	-7.00	2.18	0.18	2.36	93.1		-7.00	12.1
	-9.00	2.15	0.16	2.31	93.1		-9.00	13.5
	-12.00	2.16	0.16	2.32	92.4		-12.00	15.2
27	-0.125	2.54	0.13	2.67	95.1	27	-0.125	14.7
	-0.375	2.23	0.19	2.42	92.1		-0.375	13.1
	-0.625	2.18	0.22	2.40	90.8		-0.625	10.4
	-0.875	2.02	0.25	2.27	89.0		-0.875	11.3
	-1.25	2.17	0.14	2.31	93.9		-1.25	11.9
	-1.75	2.21	0.15	2.36	93.6		-1.75	12.0
	-2.50	2.01	0.15	2.16	93.1		-2.50	12.4
	-3.50	2.00	0.12	2.12	94.3		-3.50	10.4
	-5.00	2.50	0.33	2.83	88.3		-5.00	12.2
	-7.00	2.38	0.18	2.56	93.0		-7.00	12.4
	-9.00	2.30	0.15	2.45	93.9		-9.00	12.0
	-12.00	2.18	0.17	2.35	92.8		-12.00	13.0
8	-0.25	1.70	0.45	2.15	79.1	8	-0.25	11.1
	-3.50	1.70	0.33	2.03	83.7		-3.50	10.9
	-12.00	1.72	0.35	2.07	83.1		-12.00	10.9

APPENDIX 9: Continued

		MAGNESIUM					CALCIUM	
BC #	D (cm)	L (%)	R (%)	T (%)	L' (%)	BC #	D (cm)	L (%)
12	-0.25	2.10	0.30	2.40	87.5	12	-0.25	12.5
	-3.50	2.15	0.20	2.35	91.5		-3.50	12.6
	-12.00	2.17	0.18	2.35	92.3		-12.00	13.1
14	-0.25	3.15	0.40	3.55	88.7	14	-0.25	11.4
	-3.50	2.10	0.23	2.33	90.1		-3.50	11.3
	-12.00	2.33	0.40	2.73	85.3		-12.00	10.8
20	-0.25	2.10	0.24	2.34	89.7	20	-0.25	11.9
	-3.50	1.98	0.14	2.12	93.4		-3.50	10.7
	-12.00	2.78	0.25	3.03	91.7		-12.00	12.4
21	-0.25	2.27	0.33	2.60	87.3	21	-0.25	12.5
	-3.50	2.18	0.18	2.36	92.4		-3.50	10.4
	-12.00	2.30	0.19	2.49	92.4		-12.00	12.4
23	-0.50	2.30	0.28	2.58	89.1	23	-0.50	11.5
	-3.50	3.00	0.18	3.18	94.3		-3.50	11.9
	-16.00	2.75	0.23	2.98	92.3		-16.00	10.7
29	-0.25	2.03	0.30	2.33	87.1	29	-0.25	12.4
	-3.50	2.15	0.20	2.35	91.5		-3.50	11.3
	-12.00	2.17	0.18	2.35	92.3		-12.00	11.2

APPENDIX 10: **Silicon and aluminium concentrations in sediments from the 1988 and 1991 cruise. D= mean depth; L= leachable; R= residual; T= total; L'= percent leachable. (N.D. means not determined)**

SILICON

BC #	D (cm)	R (%)
MA3	-0.50	8.2
	-1.50	13.6
	-2.50	13.6
	-3.50	13.4
	-5.00	14.4
	-7.00	14.8
	-9.00	14.2
	-12.00	14.6
	-16.00	15.8
MA6	-0.25	20.2
	-0.75	19.5
	-1.50	20.3
	-2.50	20.3
	-3.50	19.9
	-5.00	20.0
	-7.00	20.0
	-9.00	20.4
	-12.00	19.8
	-16.00	19.3
	-20.00	22.3
MC1	-0.50	16.8
	-1.50	16.3
	-2.50	16.7
	-3.50	16.4
	-5.00	16.1
	-7.00	15.2
	-9.00	16.0
	-12.00	15.5
	-16.00	4.3
	-20.00	5.5
MC3	-0.50	N.D.
	-1.50	15.6
	-2.50	17.2
	-3.50	N.D.
	-5.00	15.9
	-7.00	17.2
	-9.00	17.1
	-12.00	19.9
	-16.00	17.8
	-20.00	N.D.
ME1	-0.50	17.1
	-1.50	17.5
	-2.50	17.8
	-3.50	17.4
	-5.00	18.3
	-7.00	14.1
	-9.00	17.8
	-12.00	17.6
	-16.00	17.9
	-20.00	18.6

ALUMINIUM

BC #	D (cm)	R (%)
MA3	-0.50	3.5
	-1.50	4.2
	-2.50	4.3
	-3.50	4.2
	-5.00	4.2
	-7.00	4.3
	-9.00	4.0
	-12.00	3.9
	-16.00	4.8
MA6	-0.25	5.8
	-0.75	5.9
	-1.50	6.1
	-2.50	6.0
	-3.50	5.8
	-5.00	5.9
	-7.00	5.8
	-9.00	5.7
	-12.00	5.5
	-16.00	5.7
	-20.00	6.0
MC1	-0.50	6.6
	-1.50	6.5
	-2.50	6.7
	-3.50	6.4
	-5.00	6.2
	-7.00	5.9
	-9.00	5.8
	-12.00	5.7
	-16.00	4.6
	-20.00	4.7
MC3	-0.50	N.D.
	-1.50	4.7
	-2.50	4.4
	-3.50	2.8
	-5.00	4.0
	-7.00	4.2
	-9.00	4.4
	-12.00	4.4
	-16.00	4.3
	-20.00	N.D.
ME1	-0.50	3.4
	-1.50	3.5
	-2.50	3.7
	-3.50	3.9
	-5.00	4.3
	-7.00	4.2
	-9.00	3.7
	-12.00	4.1
	-16.00	4.2
	-20.00	4.3

APPENDIX 10: Continued

SILICON

BC #	D (cm)	R (%)
MF2	-0.50	18.5
	-1.50	15.5
	-2.50	16.8
	-3.50	15.5
	-5.00	17.3
	-7.00	17.4
	-9.00	17.2
	-12.00	16.5
	-16.00	17.2
	-20.00	17.9
MF3	-0.50	15.8
	-1.50	16.3
	-2.50	15.7
	-3.50	15.6
	-5.00	14.2
	-7.00	17.3
	-9.00	16.7
	-12.00	16.3
	-16.00	16.5
	-20.00	16.3
2	-0.25	12.1
	-0.75	14.1
	-1.25	14.0
	-1.75	14.0
	-2.50	15.1
	-3.50	13.2
	-5.00	13.8
	-7.00	13.6
	-10.00	13.6
3	-0.375	9.9
	-0.625	10.1
	-0.875	14.2
	-1.25	14.1
	-1.75	15.1
	-2.50	14.7
	-3.50	14.8
	-5.00	14.7
	-7.00	14.7
	-9.00	14.6
	-12.00	14.4
5	-0.125	12.0
	-0.375	12.2
	-0.625	12.1
	-0.875	12.0
	-1.25	13.0
	-1.75	12.1
	-2.50	12.0
	-3.50	12.5
	-5.00	12.2
	-7.00	12.1
	-9.00	12.8
	-12.00	12.3

ALUMINIUM

BC #	D (cm)	R (%)
MF2	-0.50	6.5
	-1.50	6.4
	-2.50	6.7
	-3.50	6.1
	-5.00	6.6
	-7.00	6.6
	-9.00	6.5
	-12.00	6.2
	-16.00	5.9
	-20.00	6.4
MF3	-0.50	5.2
	-1.50	5.4
	-2.50	5.4
	-3.50	5.0
	-5.00	4.7
	-7.00	5.3
	-9.00	5.3
	-12.00	5.2
	-16.00	5.2
	-20.00	5.1
2	-0.25	4.0
	-0.75	4.2
	-1.25	4.2
	-1.75	4.2
	-2.50	4.2
	-3.50	4.3
	-5.00	4.3
	-7.00	4.4
	-10.00	4.3
3	-0.375	4.4
	-0.625	4.3
	-0.875	5.0
	-1.25	4.3
	-1.75	4.3
	-2.50	4.2
	-3.50	4.0
	-5.00	4.2
	-7.00	4.4
	-9.00	4.5
	-12.00	4.4
5	-0.125	4.4
	-0.375	4.3
	-0.625	5.0
	-0.875	4.3
	-1.25	4.3
	-1.75	4.2
	-2.50	4.0
	-3.50	4.2
	-5.00	4.4
	-7.00	4.5
	-9.00	4.4
	-12.00	4.5

APPENDIX 11: Continued

SILICON

BC #	D (cm)	R (%)
16	-0.125	8.7
	-0.375	12.1
	-0.625	13.6
	-0.875	14.0
	-1.25	14.0
	-1.75	14.2
	-2.50	14.2
	-3.50	13.6
	-5.00	14.0
	-7.00	14.3
	-9.00	14.0
	-12.00	14.6
17	-0.125	7.3
	-0.375	12.2
	-0.625	11.9
	-0.875	13.3
	-1.25	13.6
	-1.75	12.8
	-2.50	11.8
	-3.50	12.0
	-5.00	14.3
	-7.00	11.3
	-9.00	12.2
	-12.00	12.2
26	-0.125	12.5
	-0.375	12.8
	-0.625	12.2
	-0.875	13.2
	-1.25	12.6
	-1.75	12.6
	-2.50	12.5
	-3.50	12.1
	-5.00	13.0
	-7.00	12.7
	-9.00	12.5
	-12.00	12.6
27	-0.125	11.4
	-0.375	14.2
	-0.625	14.1
	-0.875	14.2
	-1.25	12.2
	-1.75	12.2
	-2.50	13.0
	-3.50	13.4
	-5.00	14.4
	-7.00	11.9
	-9.00	13.6
	-12.00	12.5
8	-0.25	24.1
	-3.50	21.1
	-12.00	17.6

ALUMINIUM

BC #	D (cm)	R (%)
16	-0.125	3.1
	-0.375	3.6
	-0.625	4.1
	-0.875	4.2
	-1.25	4.3
	-1.75	6.1
	-2.50	4.2
	-3.50	5.0
	-5.00	5.2
	-7.00	4.3
	-9.00	2.0
	-12.00	3.6
17	-0.125	2.2
	-0.375	4.3
	-0.625	4.5
	-0.875	4.3
	-1.25	4.2
	-1.75	4.2
	-2.50	3.9
	-3.50	4.2
	-5.00	4.2
	-7.00	4.4
	-9.00	4.2
	-12.00	4.4
26	-0.125	4.3
	-0.375	4.3
	-0.625	4.3
	-0.875	5.2
	-1.25	4.5
	-1.75	4.2
	-2.50	4.2
	-3.50	4.3
	-5.00	4.2
	-7.00	4.2
	-9.00	4.3
	-12.00	3.1
27	-0.125	4.6
	-0.375	4.3
	-0.625	4.7
	-0.875	4.3
	-1.25	4.6
	-1.75	4.3
	-2.50	4.4
	-3.50	4.3
	-5.00	4.4
	-7.00	4.3
	-9.00	4.5
	-12.00	4.6
8	-0.25	4.9
	-3.50	3.2
	-12.00	3.9

APPENDIX 10: Continued

SILICON

BC #	D (cm)	R (%)
12	-0.25	19.1
	-3.50	16.1
	-12.00	15.9
14	-0.25	20.2
	-3.50	18.9
	-12.00	20.8
20	-0.25	20.0
	-3.50	19.1
	-12.00	18.0
21	-0.25	21.2
	-3.50	23.2
	-12.00	22.4
23	-0.50	19.2
	-3.50	17.5
	-16.00	18.2
29	-0.25	19.6
	-3.50	19.8
	-12.00	20.4

ALUMINIUM

BC #	D (cm)	R (%)
12	-0.25	4.1
	-3.50	4.1
	-12.00	4.1
14	-0.25	4.5
	-3.50	4.0
	-12.00	4.0
20	-0.25	4.2
	-3.50	4.2
	-12.00	4.2
21	-0.25	4.0
	-3.50	5.3
	-12.00	5.0
23	-0.50	5.2
	-3.50	5.2
	-16.00	5.1
29	-0.25	4.1
	-3.50	4.0
	-12.00	4.2

APPENDIX 11: **Concentrations of nickel, cadmium, lead, copper, zinc, iron and manganese in porewaters of the 1991 cruise. N.D. means not determined.**

BC #	D (cm)	Ni (nM)	Cd (nM)	Pb (nM)	Cu (nM)	Zn (μM)	Fe (μM)	Mn (μM)
2	-0.25	97.2	9.91	20.5	177.0	2.03	1.71	0.61
	-0.75	37.7	30.80	22.8	652.0	1.29	0.26	1.10
	-2.50	22.8	3.41	24.0	145.9	1.51	1.15	1.40
	-3.50	28.7	3.63	27.4	100.2	1.69	0.00	2.01
	-7.00	1.9	1.91	9.0	97.1	1.40	0.22	1.20
	-10.00	4.9	3.63	8.8	66.7	1.05	0.47	0.76
3	-0.25	1.9	3.76	6.5	139.2	1.16	0.00	0.75
	-0.75	16.8	1.89	17.8	281.3	1.84	0.00	1.05
	-1.25	22.8	1.46	15.5	104.4	1.42	0.00	0.00
	-1.75	7.9	1.09	13.6	161.8	2.25	0.01	0.79
	-2.50	4.9	1.03	1.8	75.8	1.38	0.03	1.70
	-3.50	~0	1.87	14.6	49.0	1.12	0.08	1.55
	-5.00	~0	0.26	4.1	38.6	0.92	0.00	1.05
	-7.00	~0	1.77	22.0	172.8	1.75	0.19	0.99
	-9.00	~0	1.52	7.9	68.5	1.55	0.00	0.97
	-12.00	~0	0.73	3.2	22.1	1.10	0.01	0.48
5	-0.25	39.6	3.03	5.9	169.5	1.49	0.30	2.18
	-0.75	28.6	0.67	12.5	76.1	1.29	0.18	4.46
	-1.25	15.9	2.35	5.4	39.3	1.40	0.20	0.98
	-1.75	12.2	1.54	3.6	47.7	1.36	0.62	0.43
	-2.50	6.7	0.55	3.1	55.6	1.66	0.10	0.16
	-3.50	12.2	4.03	5.0	71.9	1.07	0.17	0.33
	-5.00	8.6	0.90	30.3	122.5	1.71	0.12	0.62
	-7.00	19.5	2.58	6.8	69.5	1.23	0.03	0.23
	-9.00	15.9	0.84	38.7	68.9	1.42	0.16	0.52
	-12.00	12.2	0.22	4.5	21.9	1.73	0.27	0.35
8	-0.25	210.9	6.66	231.3	235.0	1.46	0.34	0.36
	-3.50	137.1	4.05	52.3	81.5	1.24	0.06	8.06
	-5.00	91.3	7.05	212.3	263.8	1.19	0.09	8.48
	-9.00	205.2	16.78	228.6	365.9	1.44	0.18	29.22
12	-0.25	120.1	6.59	83.0	175.8	2.39	1.18	0.25
	-0.75	83.6	6.72	96.8	102.4	1.71	0.11	8.02
	-1.25	281.5	56.04	1829.8	551.5	2.07	0.24	17.53
	-1.75	62.1	1.71	41.3	100.4	1.44	3.88	63.72
	-2.50	163.5	27.90	202.9	178.6	1.76	0.35	48.33
	-3.50	55.2	2.56	64.4	128.6	1.64	7.01	62.20
	-5.00	34.3	1.02	33.5	63.9	1.67	50.30	56.76
	-7.00	78.8	2.68	94.5	132.9	2.32	24.00	47.05
	-9.00	116.0	5.92	136.5	460.9	3.20	1.21	24.38
16	-0.25	56.3	1.94	7.0	175.0	1.51	0.00	0.43
	-0.75	113.0	1.79	18.1	184.0	1.21	0.10	0.38
	-1.75	44.5	0.58	8.0	82.2	1.15	0.16	0.50
	-5.00	59.6	6.29	18.4	83.0	1.21	0.80	0.24
	-7.00	54.4	0.73	8.9	1066.0	1.12	0.07	0.24
	-9.00	42.3	1.23	35.7	170.1	1.12	0.09	0.25
	-12.00	51.8	2.39	98.2	1232.0	1.21	0.08	0.03

APPENDIX 11: Continued

BC #	D (cm)	Ni (nM)	Cd (nM)	Pb (nM)	Cu (nM)	Zn (µM)	Fe (µM)	Mn (µM)
17	-0.25	77.8	5.50	26.1	352.8	1.97	0.36	0.44
	-0.75	14.0	0.49	4.2	85.1	1.01	0.25	0.00
	-1.25	84.0	17.49	32.8	451.4	2.34	0.09	0.88
	-1.75	~0	~0	0.1	107.1	1.76	0.10	0.08
	-2.50	32.3	1.52	19.4	69.5	1.71	0.10	0.00
	-3.50	12.2	25.69	12.1	60.4	1.44	0.13	0.08
	-5.00	14.0	4.28	9.3	72.5	1.56	0.01	0.00
	-7.00	15.9	0.51	18.1	131.5	1.18	0.68	0.01
	-9.00	45.0	2.04	41.4	563.1	1.53	0.10	0.00
	-12.00	148.9	5.33	51.6	486.6	1.79	0.06	0.06
19	-0.25	N.D.	0.45	27.9	366.1	1.66	0.17	0.00
	-0.75	N.D.	1.17	8.7	103.0	1.05	0.24	0.00
	-1.25	N.D.	1.17	13.1	110.8	1.54	0.16	0.04
	-1.75	N.D.	1.04	16.0	204.3	1.71	0.03	0.09
	-2.50	N.D.	~0	20.1	148.0	1.38	0.01	0.00
	-3.50	N.D.	0.57	35.9	168.3	1.54	0.12	0.00
	-5.00	N.D.	1.07	7.3	70.2	0.95	0.03	5.19
	-7.00	N.D.	1.07	11.6	87.7	1.28	0.07	26.51
	-9.00	N.D.	1.02	5.7	52.2	1.03	0.00	47.63
	-12.00	N.D.	1.40	22.4	76.3	1.03	0.09	55.17
20	-0.25	N.D.	2.33	13.0	111.7	1.19	0.04	0.00
	-0.75	N.D.	1.31	17.1	186.5	1.59	0.12	0.00
	-1.25	N.D.	1.36	18.9	248.1	1.50	0.20	0.22
	-1.75	N.D.	2.14	13.8	173.3	1.66	0.06	0.00
	-2.50	N.D.	0.24	16.7	64.9	0.98	0.22	0.00
	-3.50	N.D.	2.54	11.9	114.8	1.00	0.08	0.00
	-5.00	N.D.	0.78	9.9	94.6	1.14	0.03	0.03
	-7.00	N.D.	0.61	5.2	32.6	0.98	0.20	1.37
	-9.00	N.D.	0.96	8.6	85.9	0.98	0.03	4.49
	-12.00	N.D.	0.40	5.1	40.9	0.91	0.00	5.45
21	-0.25	50.0	3.63	35.3	503.8	3.35	0.20	0.10
	-0.75	38.4	2.45	12.8	224.5	1.64	0.11	0.00
	-1.25	18.6	1.63	62.5	310.5	1.78	1.12	0.00
	-1.75	58.2	2.05	5.6	139.4	1.85	0.19	0.09
	-2.50	32.6	0.76	3.4	44.5	1.05	0.11	0.00
	-3.50	49.3	2.02	5.1	77.2	1.31	0.06	1.32
	-5.00	65.1	0.26	11.6	23.2	1.03	0.14	1.64
	-7.00	32.6	0.18	5.5	24.7	1.12	0.04	7.04
	-9.00	46.7	0.51	3.4	50.5	1.19	0.08	21.96
	-12.00	29.1	0.05	4.8	29.2	1.99	1.62	39.04
23	-0.50	24.0	2.60	31.8	67.6	1.14	0.03	0.00
	-1.50	32.1	2.78	78.7	32.6	1.17	0.03	24.18
	-2.50	35.5	1.19	42.7	29.9	1.35	0.18	43.31
	-3.50	43.7	1.54	33.4	37.2	1.38	0.26	43.23
	-5.00	45.7	1.52	39.1	33.2	1.21	0.08	26.51
	-7.00	487.5	4.25	64.5	26.5	1.05	0.02	14.43
	-9.00	49.8	35.17	937.7	23.8	1.10	2.89	44.97
	-12.00	38.2	8.62	103.1	19.8	1.10	1.81	34.24
	-16.00	53.2	36.74	518.7	21.8	1.40	0.65	37.25

APPENDIX 11: Continued

BC #	D (cm)	Ni (nM)	Cd (nM)	Pb (nM)	Cu (nM)	Zn (µM)	Fe (µM)	Mn (µM)
26	-0.25	55.0	1.58	19.0	220.9	1.32	0.43	0.00
	-0.75	59.4	1.92	15.0	275.1	1.24	0.37	0.00
	-1.25	168.7	2.45	36.3	360.0	1.59	0.31	0.00
	-1.75	60.5	1.36	23.4	411.2	1.85	0.54	0.00
	-2.50	132.1	2.33	62.6	411.2	1.61	0.10	0.00
	-3.50	77.3	5.66	106.1	593.8	1.85	0.23	0.00
	-5.00	33.5	3.10	47.3	375.4	1.03	0.88	0.00
	-7.00	33.5	1.69	58.7	351.0	1.83	0.16	0.00
	-9.00	12.8	3.26	228.6	538.2	1.03	0.15	0.00
	-12.00	28.0	1.34	55.5	215.6	1.08	0.20	0.13
27	-0.75	23.2	1.23	30.7	230.7	0.98	0.33	0.48
	-1.25	139.2	19.00	453.8	1104.5	3.02	0.30	0.32
	-1.75	23.2	1.73	97.8	175.3	1.21	0.30	0.31
	-2.50	28.8	1.96	59.7	288.3	1.05	0.19	0.33
	-3.50	21.8	1.85	49.6	168.7	0.90	0.68	0.00
	-5.00	19.1	15.29	455.5	151.1	0.79	0.18	0.46
	-7.00	99.6	2.20	39.0	158.7	0.95	0.26	0.45
	-9.00	19.1	6.01	331.6	92.1	0.76	0.16	0.17
	-12.00	28.8	2.12	49.2	64.6	0.66	0.22	2.35
29	-0.25	35.1	14.19	502.2	274.3	1.27	0.27	0.59
	-0.75	26.0	2.66	31.9	47.0	0.79	0.12	0.57
	-1.25	27.5	1.96	39.7	53.5	0.74	0.25	16.19
	-1.75	29.1	1.61	91.1	40.0	0.71	0.17	20.65
	-2.50	35.1	12.47	277.7	41.6	0.84	7.60	39.58
	-3.50	41.2	2.87	38.6	33.5	0.74	3.42	32.37
	-5.00	~0	0.71	18.2	~0	0.66	1.51	13.66
	-7.00	21.5	1.73	76.7	146.7	0.71	4.02	20.86
	-9.00	18.4	1.60	100.1	86.2	0.66	3.76	21.94
	-12.00	15.4	15.89	465.8	25.7	0.68	10.94	22.26

APPENDIX 12: Calculated mean element concentrations in the upper 2 centimetres of sediments from the 1988 and 1991 cruise. Calculated on a calcium carbonate free basis (N.D. means not determined)

Station #	Cd (µg/g)	Cu (µg/g)	Ni (µg/g)	Cr (µg/g)	Pb (µg/g)	Zn (µg/g)
MA3	0.2	44	66	84	56	99
MA6	1.0	52	49	106	67	183
MC1	0.8	32	59	92	54	118
MC3	3.0	18	53	62	49	102
ME1	0.4	13	36	58	65	128
MF2	0.3	40	87	123	41	120
MF3	0.3	33	80	122	81	137
2	N.D.	69	77	163	49	133
3	N.D.	70	59	164	35	119
5	N.D.	55	65	126	41	100
8	N.D.	30	45	106	23	130
12	N.D.	40	78	189	57	185
14	N.D.	25	64	117	40	144
16	N.D.	52	64	123	36	119
17	N.D.	58	46	124	42	132
20	N.D.	31	57	126	38	139
21	N.D.	24	57	130	42	136
23	N.D.	22	45	125	36	143
26	N.D.	44	58	123	41	136
27	N.D.	46	63	121	41	136
29	N.D.	24	37	112	43	137
1	1.5	44	56	131	N.D.	310
2A	3.1	67	57	117	N.D.	326
4	5.7	21	48	70	N.D.	286
6	0.3	26	52	91	N.D.	184
7	0.5	25	34	74	N.D.	154
8	0.4	36	51	92	N.D.	144
10	0.2	43	60	102	N.D.	233
11	0.5	28	35	71	N.D.	172
13	0.4	20	29	55	N.D.	147
14	0.3	71	62	96	N.D.	126
15	0.2	86	73	108	N.D.	180
16A	0.2	15	20	41	N.D.	90
19	0.2	24	55	82	N.D.	169

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