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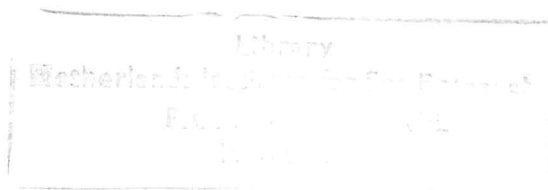
TRACE AND MAJOR ELEMENTS IN SEDIMENTS AND IN POREWATERS FROM THE NORTH WESTERN BASIN OF THE MEDITERRANEAN SEA

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This research was carried out as part of an 'environmental chemistry'
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ABSTRACT

As part of the EROS-2000 project (European River Ocean Systems), which is an international and interdisciplinary research programme of the European Community, sediment samples were collected in the North Western basin of the Mediterranean Sea in May 1990. In these samples trace and/or major elements were determined to advance the knowledge about the manifestation, sources and cycles of natural and anthropogenic constituents in coastal areas. Three fractions were determined: the porewater fraction which contains all dissolved elements, the leachable fraction which contains all easily exchangeable elements and the residual fraction which contains the not exchangeable elements in the sediments. The results show that the investigated area can be separated into five "sub-areas" which are different in element concentration, leachable fraction and sedimentary composition. Highest concentrations of trace elements are found in sediments closest to the Rhône delta. In this area several diagenetic processes are observable.

In summary the Rhône is probably the major source for several (trace-) elements to the Gulf of Lions which is located close to the river mouth of the Rhône. The influence of the Ebro on (trace-) element concentrations in the sediments close to the river mouth is probably minimal.

SAMENVATTING

Als onderdeel van het internationale en interdisciplinaire EROS-2000 project (European River Ocean Systems) van de Europese Gemeenschap, werden er sediment monsters verzameld in de Noordwestelijke Middellandse Zee in Mei 1990. In deze monsters werden spoor- en/of hoofdelementen bepaald om zodoende de kennis omtrent de verschijningsvormen, de bronnen en de cyclus van natuurlijke en anthropogene bestanddelen te vergroten. Er werden drie fracties bepaald: de poriewaterfractie die alle opgeloste elementen bevat, de uitwisselbare fractie die alle makkelijk uitwisselbare elementen bevat en de residuale fractie die de niet-uitwisselbare elementen bevat. Gebleken is dat het onderzochte gebied verdeeld kan worden in vijf gebieden die allen min of meer verschillen in element concentratie, in uitwisselbare fractie en in sediment samenstelling. De hoogste concentraties spoormetalen werden gevonden in de sedimenten vlak bij de monding van de Rhône. In dit gebied waren ook verschillende diagenetische processen waarneembaar.

Er kan dan ook geconcludeerd worden dat de Rhône waarschijnlijk de belangrijkste bron is van verschillende (spoor-) elementen in de Golf van Lion, die vlak bij de monding van de Rhône ligt. De invloed van de Ebro op de element concentraties is waarschijnlijk minimaal.

1. INTRODUCTION

1.1 Rationale

The manifestation of materials discharged from the continents depends to a large extent on biogeochemical processes. These processes occur in estuaries and in shelf seas. It is necessary to advance the knowledge about these processes because it can help with the interpretation of the consequences of anthropogenic modifications of discharges. Furthermore, an evaluation of the capacity of estuaries and shelf seas to accept wastes without detrimental effects is possible [Anonymous, 1986]. The rivers and the atmosphere are transporting pollutants to estuaries and shelf seas. This means that these areas are a kind of rallying place for pollutants resulting from human and industrial activities on land. Some of these pollutants have already established effects (e.g. eutrophication and anoxia through nutrients and organics respectively) but others have still an unknown impact on the marine environment (e.g. insecticides, etc). The basic processes which are important to the abundance and manifestation of pollutants are common in all coastal areas. Differences can occur through the differences in material input, through the differences in times-scales of mixing and transport and through the differences in biological productivity [Anonymous, 1986].

The capacity of coastal areas to receive pollutants without undue detrimental effects is of main economic importance. However, the exploration may not conflict with the demands of other uses such as fisheries and recreation. Therefore, and as well as for defending a coastal area against remaining detriment, a better understanding of the source and sink functions of these areas is needed.

After coastal areas have already received (and still receive) an increased attention because of their possible role in climate control [e.g. Whitfield and Turner, 1986; Codispoti, 1982; Hoppema, 1991], the European Community started in 1986 the interdisciplinary research programme EROS-2000 (European River Ocean System). This project consists of research on biogeochemical interactions in European coastal waters and is proposed by 25 institutes from 11 European countries. Financially it is supported by the European commission and by agencies from participating countries [Martin, 1989]. Such an international collaboration is required because of the

international character of coastal water pollutions. The aims of the EROS-2000 project are [Martin, 1989]:

- 1) To specify the sources and pathways of natural and anthropogenic compounds (organic and inorganic) in the European coastal environment.
- 2) To identify the mechanisms and to quantify rates of processes which control the river/coastal, air/sea and sediment/water exchanges as well as the internal cycling and fluxes of these compounds.
- 3) To develop process-specific (e.g. eutrophication) and regional biogeochemical models to predict the long term consequences of man-made changes of estuarine/coastal ecosystem functions.

In the EROS-2000 project, field investigations are carried out on estuary and shelf seas systems. The areas on which this research will be concentrated has to be characteristic for most of the European coastal waters. Therefore, two contrasting areas were found: the North Western basin of the Mediterranean Sea and the Southern bight of the North Sea (see appendix 1). These two areas represent two major contrasting situations. Low discharge of less polluted water into a deeper basin where tidal effects are minimal and where nutrient concentrations are low for the Mediterranean Sea and an eutrophic shallow region with large tidal effects for the North Sea [Anonymous, 1986]

1.2 Site selection

This report discusses data from samples collected in the North Western basin of the Mediterranean Sea. Therefore this paragraph in particular and this report in general will not deal with the Southern bight of the North Sea.

The North Western basin of the Mediterranean Sea has been selected as a representative area with minimal tidal effect and with demonstrable land derived

inputs of chemical constituents, both natural and anthropogenic [Anonymous, 1986]. After the construction of the Aswan High Dam in the river Nile, the Rhône became the most important river entering the Mediterranean Sea. The water and sediment input by the Rhône into the area are $1712 \text{ m}^3 \cdot \text{sec}^{-1}$ and $3.45 \cdot 10^8 \text{ kg} \cdot \text{year}^{-1}$ respectively [Martin et al, 1989]. The river is the major source of river water, nutrients and organics to the area. The deposition rates in the North Western basin of the Mediterranean Sea are highest near the river mouth of the Rhône ($0.63 \text{ cm} \cdot \text{year}^{-1}$) and decrease with increasing water depth and increasing distance from the river mouth (down to $0.02 \text{ cm} \cdot \text{year}^{-1}$) [Zuo et al, 1989]. The same profile occurs for the total organic carbon content. (2.17 % near the river and decreasing down to 0.35 % far away from the river mouth) [Lipiatou and Saliot, 1991]. The influence of the Ebro on deposition rates and total organic carbon content is still unknown.

The atmosphere is also an important route for materials to enter the Mediterranean Sea. This is shown by the fact that about 50 percent of the water and almost 100 percent of the dissolved and particulate lead, entering the Western Mediterranean, originates from the atmosphere [Martin et al, 1989]. The "Gulfe du Lion" consists of quasi permanent thermocline stratified situations in the river mouth. Seasonally such a situation occurs also in the whole area [Anonymous, 1986]. Thermocline stratification is the phenomenon which provides two water layers from different temperature: the upper layer and the substratum. While tidal effects became more important or when the meteorological situation is changing (e.g. summer ---> winter), a transposing of the two water layers is possible. The abundance of two layers with different temperature (or salinity) can influence the abundance and manifestation of several materials.

The Western Mediterranean is bordered on the Northern shoreline by industrialized nations (France, Italy and Spain). Aerosols transported from this region originate mainly in the "European pollution belt". On the southern shore the region is bordered by the "North African desert belt". This is one of the most important reservoirs of natural aerosols in the world [Anonymous, 1986]. The North Western basin of the Mediterranean Sea was poorly studied until the starting of the EROS-2000 project.

1.3 Objective

EROS-2000 is planned around five sub-programmes. The Netherlands Institute of Sea Research (NIOZ) participates in two of these sub programmes. The sub programme "particles" is investigated by the department of Marine Geology and Geochemistry. Research in relation to suspended particles in coastal seas is done. It includes the determination of source, transport and sedimentation, particle sizes and rates of deposition [Anonymous, 1986]. The second sub programme named "inorganic processes" is investigated at the department of Chemical Oceanography and Marine Pollution. Early diagenetic processes are studied here. This includes the investigation of sediment/water exchanges and the research on fluxes of trace and major elements, organics and nutrients [Anonymous, 1986]. Other institutes in Europe are also working on these subprograms. The three programmes which are not investigated at NIOZ are "integration", "bio-organic processes" and "air/sea exchanges" [Anonymous, 1986]. According to the subprograms "particles" and "inorganic processes", several NIOZ scientists took part in three EROS-2000 cruises in the Mediterranean Sea during August 1987, December 1988 and May 1990. Some of the collected samples were already analysed. The data of these samples have been published [e.g. Helder, 1989; Nolting, 1989; Nolting and Helder, 1991; Zuo et al, 1989]. During the last cruise with the French "R.V. Marion Dufresne", sediment cores were collected in the North Western basin of the Mediterranean Sea. The chosen sample stations (see appendix 2 and appendix 3) are closely linked to the sample stations of the cruises 1987 and 1988.

In order to advance the knowledge about the manifestation, the sources and the cycles of natural and anthropogenic compounds in estuaries and in shelf seas, this report discusses the data obtained from trace and major element analysis in sediments and in porewaters of the North Western basin of the Mediterranean Sea collected during the EROS-2000 cruise in the year 1990. Beside the interpretations which are done in this report, the obtained data can be used for more interpretations in relation to trace and major elements in sediments and in porewaters (e.g. historical records of the sediments can be made using the leachable concentrations of several elements to identify the increase of anthropogenic constituents by human activities

[e.g. Nolting and Helder, 1991]) This report was written in order to answer the following questions:

- 1) What is the geographical distribution of certain trace and major elements in the investigated area ?
- 2) Is there any increase or decrease of the leachable fraction of trace and major elements and what influence do the two rivers have on this transport ?
- 3) Which processes occur in the sediments closest to the Rhône and the Ebro and in sediments far away from these rivers ?
- 4) Are changes in the sedimentary composition observable in the area ?

2. BACKGROUND THEORY

2.1 *Processes in estuaries*

This chapter will discuss in short the main processes which are important to the abundance and manifestation of trace and major elements in estuaries and in shelf seas.

The main processes in these areas can be separated in (A) boundary processes and in (B) internal processes. Figure 2.1 shows the four boundary processes and the internal processes in estuaries and in shelf seas.

1) **River Inputs.** Rivers are one of the main routes for discharges from the continents to enter estuaries or shelf seas. The chemical composition of river water is closely correlated to the amount of water transported by the river. This correlation provides a variation in input of discharges to the coastal zone during events and seasons. Furthermore the manifestation of several materials in the estuary depends on the freshwater input of the river. Differences in salinity can change the ion-

strength of several materials. These differences are mostly influencing the manifestation of several elements [e.g. Stumm and Morgan, 1981; Nelson et al, 1981].

2,3) Air/sea exchange. Recently it has been recognized that various materials are transported to marine waters by the deposition of aerosols resulting from natural sources and from man's activities on land. This means that the atmosphere is another main route for discharges to enter a coastal zone [Martin et al, 1989]. Beside airborne input, several constituents leave the coastal zone by the atmosphere. Air/sea exchange is a two way process which includes both organic and inorganic compounds.

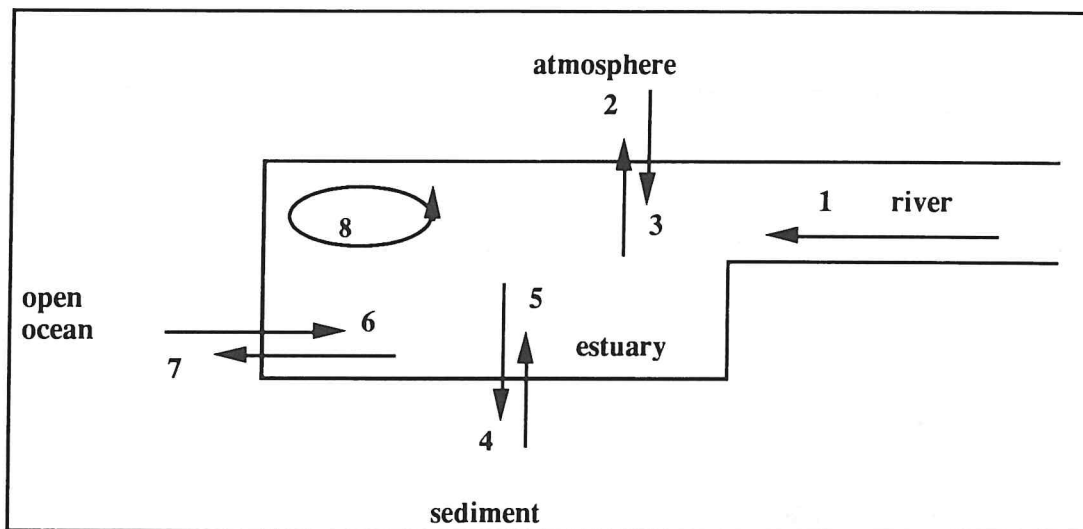


Figure 2.1: Major fluxes and processes in estuaries [Anonymous, 1986]

4,5) Sediment/water exchange. Reactions in sediments differ from those in the water column. Diagenesis refers to the sum total of processes that brings about changes in a sediment or sedimentary rock [Berner, 1980]. Early diagenesis is largely driven by the supply of organic matter. The oxidation of organic matter by oxygen, manganese oxides, nitrate, iron oxides and sulphate respectively is named the early diagenetic sequence. This sequence occurs frequently as a function of depth. The oxidizable compounds (O_2 , MnO_2 , NO_3 , Fe_2O_3 , SO_4) and the organic carbon of this sequence are influencing the abundance, manifestation and concentration of several trace elements in sediments and in the water column [e.g. Balistrieri and Murray, 1986; Davidson, 1985; Balzer, 1982].

6,7) The ocean boundary. Beside the input by rivers and the atmosphere, oceanic boundaries are also a route for chemicals to enter a coastal zone. The selection and defining of oceanic boundaries is still poorly studied. There is a need to establish criteria which includes (A) the boundaries set by the immediate influence of river inputs and (B) the physiographic constraint [Anonymous, 1986].

8) Internal processes. The distributions of constituents in estuaries and in shelf seas are dependent on the exchange of materials between particles and water. Especially physicochemical factors such as salinity, pH and Eh have a great influence on this exchange. Primary production also exerts influence on the distribution. The removal of dissolved constituents can occur by two possible ways. Primary by electrostatic interactions between dissolved constituents and reactive sites (e.g. available on hydrous manganese- and iron oxides and on organic matter). Secondary by covalent binding between dissolved constituents and available reactive elements (e.g. CdCl^+). The release of materials and elements into solution can occur by desorption and through the oxidation of organic matter (early diagenesis).

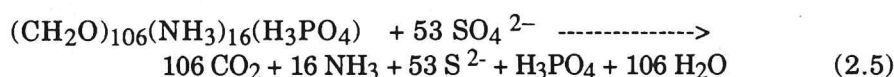
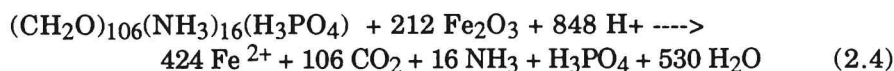
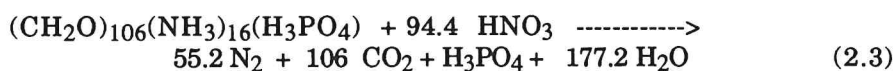
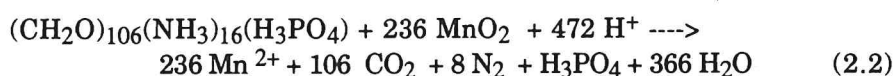
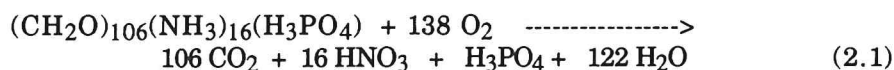


Table 2.1 : *The early diagenetic sequence [Bender and Heggie, 1984]*

3. METHODS

3.1 *Sampling*

In may 1990, 13 boxcores were taken in the North Western basin of the Mediterranean Sea. The used boxcorer ($\varnothing = 30$ cm, $L = 50$ cm) was specially designed by the technical department of the Netherlands Institute of Sea Research. With this special boxcorer, undisturbed sediment cores could be taken. This means that during the upcast no exchange of overlying water and porewater occurred [Personal communication, Nolting, 1991, NIOZ]. On board, the overlying water was carefully removed by syphoning off. A part of the overlying water was sampled and acidified to $\text{pH} = 2$ with hydrochloric acid (supra pur). After removing almost all the overlying water, three subsamples were taken by inserting plastic pipes ($\varnothing = 6$ cm, $L = 30$ cm) into the sediment core. Then the plastic pipes were carefully removed from the boxcore and were closed with rubber stoppers. In a cooled laboratory container the first 14 cm of the subsamples were divided into ten slices each. Slices were made with a thickness of 0.5 cm at the top of the core up to 4.0 cm at the end. Slices of the same depth were combined and were collected in clean teflon squeezers which were described by Reeburgh [1967]. Porewaters were collected in acid cleaned poly-ethylene bottles by squeezing the sediment-slices over a $0.2 \mu\text{m}$ cellulose-acetate filter under nitrogen pressure of 1.5-2.0 bar. Directly after squeezing the porewaters were acidified to $\text{pH} = 2$ with concentrated hydrochloric acid (supra pur). Until analysis the sediments were stored in a freezer in clean plastic bags and the porewaters were stored in a refrigerator.

3.2 *Sediment analysis*

After thawing, about three grammes of sediment was transferred into petri-dishes. Then the sediments were dried at 60°C for at least 24 hours. To grind the sediments after drying, an acid cleaned teflon mortar was used. To determine the leachable fraction, which contains the easily exchangeable metals [Duinker and Nolting, 1976], about 0.1 grammes of dry ground sediment was quantitatively transferred into acid cleaned 50 millilitre polypropylene volumetric flasks. The sediment was leached with 0.1 N hydrochloric acid (supra pur). After 18 hours, the leachable fraction was filtered over a pre acid cleaned $0.45 \mu\text{m}$ cellulose nitrate Sartorius[®] filter.

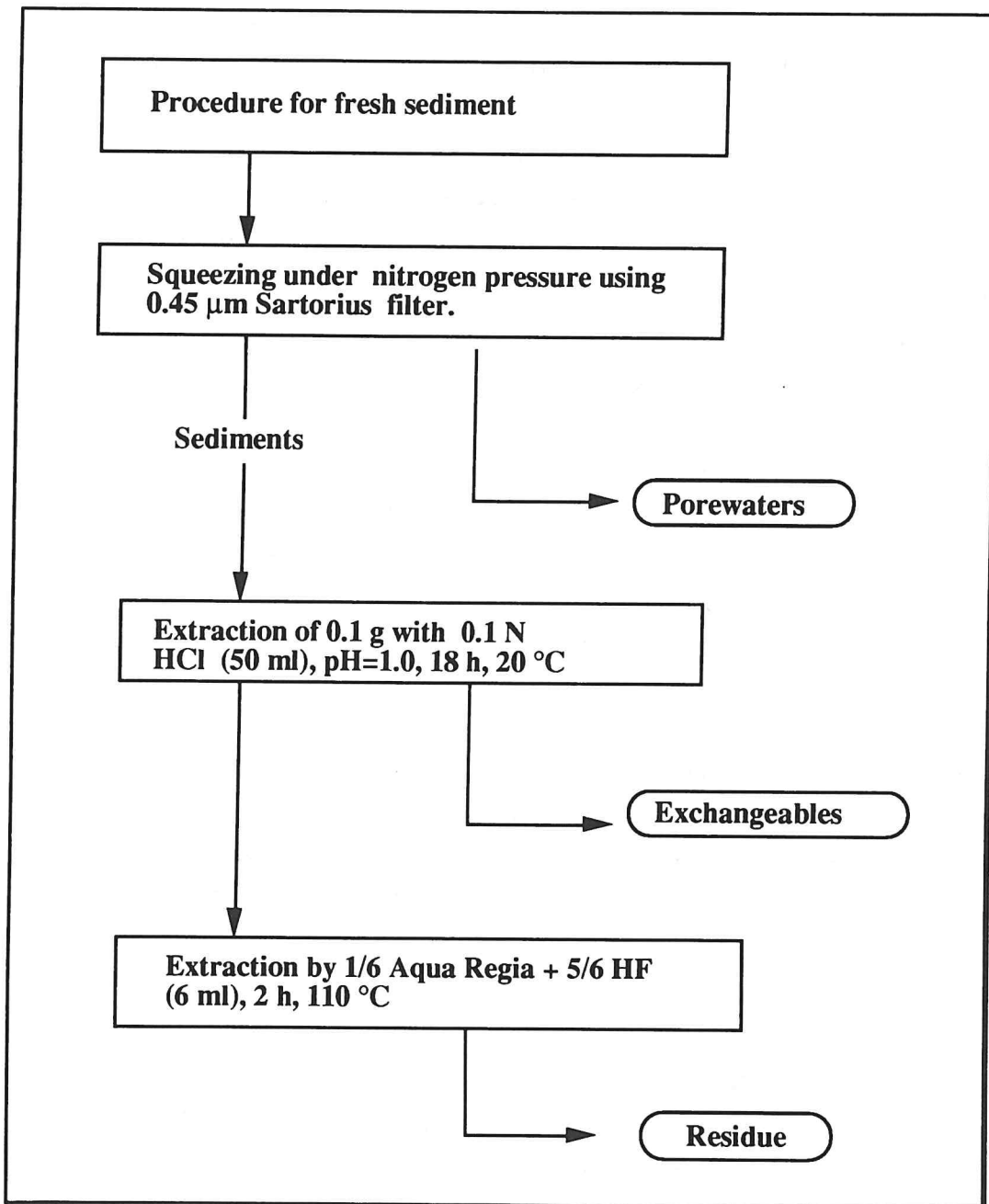


Figure 3.1: *Sequential determination procedure for sediments*

The residual fraction was determined by the use of teflon bombs which have been described by Rantala and Loring [1977a]. To exclude contamination from earlier use, the bombs were hot acid cleaned by storing them for 24 hours or longer in 60 ° C nitric acid (7 N). Before use the bombs were stored in 1 N hydrochloric acid (supra pur). Destruction of the residual material was done by placing the bombs (with filters, hydrofluoric acid and aqua regia) into a furnace for two hours at 110 ° C [Rantala and Loring, 1977b]. After cooling, the residual fraction was quantitatively transferred into acid cleaned 50 millilitre volumetric flasks by rinsing the bombs three times with a total volume of 30 millilitre saturated boric acid (supra pur).

Certain trace and major elements were determined for both the leachable and residual fraction. Major elements (Ca, Mg, Fe, Al, Si, Zn) by using Flame Atomic Absorption Spectrophotometry (FAAS). Trace elements (Cd, Cu, Pb, Ni) by using the Stabilized Temperature Platform Furnace technique (STPF-technique) on a flameless atomic spectrophotometer. Chromium was determined by Flame AAS and Flameless AAS for the leachable fraction and the residual fraction respectively. Furnace programmes and flame conditions can be found in appendix 4 and appendix 5 respectively.

Dilutions for trace elements were obtained by the gravimetric method to achieve high accuracy. Volumetrically dilutions were used in the case of major elements. The leachable concentration plus the residual concentration yield the total content in the sediments, expressed in $\mu\text{g}\cdot\text{g}^{-1}$ dry sediment (ppm) for Cd, Cu, Pb, Ni, Cr, Zn and Mn and in % of dry sediment ($\text{cg}\cdot\text{g}^{-1}$) for Fe, Mg, Ca, Al and Si. More information about apparatus and expedients can be found in appendix 6.

3.3 Porewater analysis

The determined elements in the porewaters are Fe, Mn and Zn. The usual solvent extraction and preconcentration with APDC (AmmoniumPyrrolidineDithio-Carbamate) and freon was not necessary for these elements because a direct measurement with Flame AAS was possible. More information about flame conditions, apparatus and expedients can be found in appendix 5 and in appendix 6.

3.4 Analytical information

Calibration curves

Calibration curves for flame and furnace measurements (major and trace elements respectively) were obtained by gravimetric dilution of a 1000 mg·l⁻¹ titrisol[®] solution. The calibration solutions were stored in acid cleaned teflon bottles for the trace elements and in acid cleaned poly propylene bottles for major elements. Because the matrix effects were negligible using the STPF-technique, trace element concentrations in the samples were calculated using an external calibration curve [Personal communication, Nolting and De Jong, 1991, NIOZ]. The method of standard addition was used for all flame measurements.

With the exception of manganese and calcium, all calibration curves were within the theoretical linear range. The calibration curves for manganese and calcium were about ten times higher but linear curves were obtained by lowering the sensitivity with a factor 20 through turning the burnerhead for 90 °.

Blanks

All blanks were negligible with the exception of those which were obtained by the destruction of empty acid cleaned filters with hydrofluoric acid and aqua regia in hot acid cleaned teflon bombs (residual fraction). The blanks for Cd, Cu, Ni and Pb were 0.05 µg·l⁻¹, 1.15 µg·l⁻¹, 0.56 µg·l⁻¹, and 1.32 µg·l⁻¹, respectively. The blanks for other elements in this fraction were negligible.

Analytical Accuracy

To determine the analytical accuracy, a sediment sample was determined ten times. Because an analytical accuracy depends on the concentration, trace and major element concentrations in the used sample were an average of those which occur in the entire area. This means that this sample was representative for the investigated area. The ten samples were treated the same as the other samples (leachable fraction plus residual fraction). For each fraction a accuracy was calculated. The accuracy of the total content was calculated using the sum total of the leachable and residual fraction respectively. The confidence interval of 95 % obtained by this procedure is calculated using the Students T-test and is given in table 3.1.

Element	Leachable Content n = 10		Residual Content n = 10		Total Content n = 10	
	$\bar{a} \pm P$	R (%)	$\bar{a} \pm P$	R (%)	$\bar{a} \pm P$	R (%)
Cd	0.12 $\pm$ 0.04	33.3	0.03 $\pm$ 0.02 ¹	66.7	0.16 $\pm$ 0.05	31.3
Cu	5.7 $\pm$ 0.6	10.5	6.5 $\pm$ 0.2	3.1	12.3 $\pm$ 0.4	3.3
Ni	11.0 $\pm$ 0.3	2.7	24 $\pm$ 1	4.2	35 $\pm$ 1	2.9
Pb	11.1 $\pm$ 0.6	5.4	4.9 $\pm$ 0.5	10.2	16.0 $\pm$ 0.5	3.1
Cr	5.6 $\pm$ 0.6	10.7	49 $\pm$ 1	2.0	55 $\pm$ 2	3.6
Zn	44 $\pm$ 7	15.9	61 $\pm$ 5	8.2	108 $\pm$ 9	8.3
Mn	520 $\pm$ 20	3.8	110 $\pm$ 10	9.1	630 $\pm$ 20	3.2
Fe	0.60 $\pm$ 0.04	6.7	2.1 $\pm$ 0.2	9.5	2.8 $\pm$ 0.2	7.1
Mg	0.51 $\pm$ 0.03	5.9	0.69 $\pm$ 0.07	10.1	1.21 $\pm$ 0.06	5.0
Al	0.29 $\pm$ 0.02	6.9	5.1 $\pm$ 0.2	3.9	5.40 $\pm$ 0.3	5.6
Ca	13.7 $\pm$ 0.5	3.6			13.7 $\pm$ 0.5	3.6
Si			18 $\pm$ 2	11.1	18 $\pm$ 2	11.1

(1) Near calculated detection limit ($\sim 0.01 \mu\text{g}\cdot\text{g}^{-1}$ when using the follow method; 0.10 grammes sediment to 50 ml, 20 μl sample volume, stopped gas-flow during analysis)

(*) Concentrations were negligible using FAAS.

Table 3.1 : *The analytical accuracy determined for some elements found after analysis of sediments from the North Western basin of the Mediterranean Sea (concentrations for Cd, Cu, Ni, Pb, Cr, Zn and Mn in $\mu\text{g}\cdot\text{g}^{-1}$ and for Fe, Mg, Al, Ca and Si in %).; $\bar{a}$ = mean concentration; P = calculated standard deviation using the Students T-test assuming that 95 % of the determined values are within the reported range; R= calculated relative standard deviation using the Students T-test assuming that 95 % of the determined values are within the reported range*

The determination of the analytical accuracy for porewater analysis was difficult because of the small amount of sample. Therefore the analytical accuracy for these analysis is estimated. The precision of FAAS measurements is estimated to be ± 0.0005 Absorbance units. This means that the precision for porewaters analysis is :

Element	Porewaters
Fe	$\sim 5.00 \pm 0.2$ (4.0)
Mn	$\sim 3.00 \pm 0.1$ (3.3)
Zn	$\sim 1.00 \pm 0.03$ (3.3)

Table 3.2 :

The estimated analytical accuracy for some elements found for porewaters of the North Western basin of the Mediterranean Sea (concentrations are estimated averages of those which were found in the porewaters, concentrations in μM , values between parenthesis is the estimated precision in percents).

Reference samples

To test the quality of the obtained data, two contrasting reference samples were determined three times each. The used samples (from the Community Bureau of Reference- BCR, Brussels) were BCR No 142 which was a light sandy soil and BCR No. 143 which was a Sewage sludge amended soil. The BCR-reference samples were

	BCR 142		BCR 143	
element	determined	certified	determined	certified
Cd	0.27 ± 0.09	0.25 ± 0.09		31.1 ± 1.2
Cu	25.4 ± 0.8	27.6 ± 0.6	216	236.5 ± 8.2
Ni	27.4 ± 1.0	29.2 ± 2.5	101.3	99.5 ± 5.5
Pb	35.6 ± 1.2	37.8 ± 1.9		1333 ± 39
Zn	110.1 ± 8.8	92.4 ± 4.4		1272 ± 30
Cr	52.4 ± 1.5	(74.9)	221	(228)
Mn	529 ± 17	(569)	830	(999)
MgO	1.11 ± 0.05	(1.09)	5.18	(4.90)
Fe ₂ O ₃	2.60 ± 0.20	(2.80)	3.54 ± 0.26	(3.75)
Al ₂ O ₃	8.02 ± 0.55	(9.48)	9.00 ± 0.62	(10.13)
CaO	4.72 ± 0.17	(4.94)	9.10 ± 0.30	(9.35)
SiO ₂	70.8 ± 9	(68.22)	57.9 ± 7.4	(42.72)

Table 3.3 : *Determined BCR-reference samples. Values between parenthesis are not certified values (concentrations for Cd, Cu, Ni, Pb, Cr, Zn and Mn in $\mu\text{g}\cdot\text{g}^{-1}$ and for Fe₂O₃, MgO, Al₂O₃, CaO and SiO₂ in %).*

treated the same as the Mediterranean samples. Because the concentrations in BCR No 142 and those which are found in the Mediterranean samples were comparable, the analytical accuracy reported in table 3.1 is used for this reference sample. With the exception of the elements Si, Ca, Al and Fe, the analytical accuracy reported in table 3.1 is not used for BCR No 143 because of the uncomparable concentrations in this reference sample. Some trace elements are not determined in the BCR 143 reference sample because the concentrations are extreme high (~ 10 - 100 times higher than the obtained concentrations in Mediterranean sediments !!). Table 3.3 shows the obtained data from reference sample analysis. Almost all calculated and certified concentrations are comparable. This means that the analytical method, used for analysis of Mediterranean sediments is correct. The reported values are averages of three determined samples.

4. RESULTS AND DISCUSSIONS

4.1 *Geographical distribution*

This paragraph discusses the geographical distributions of trace and major elements in the North Western Mediterranean Sea. The used data can be found in appendix 7 to appendix 14. Element concentrations of Cd, Cu, Ni, Cr, Zn and Mn in this paragraph are expressed on a calciumcarbonate free basis (see appendix 15). Using this method, dilution effects through calciumcarbonate are excluded. Element concentrations of Fe, Mg, Ca, Al and Si in this paragraph are expressed as Fe_2O_3 , MgO , CaCO_3 , Al_2O_3 and SiO_2 respectively because these are the most important manifestations of these elements in a marine environment. All concentrations in this paragraph are an average of concentrations which are found in the upper layers of the sediments (0-2 cm).

Cd: Cadmium concentrations are high in sediments closest to the Rhône (~ $2 \mu\text{g}\cdot\text{g}^{-1}$). Sediments closest to the Ebro shows smaller concentrations of ~ $0.40 \mu\text{g}\cdot\text{g}^{-1}$. Cadmium concentrations decrease with increasing distance from the rivers. Lowest (~ $0.15 \mu\text{g}\cdot\text{g}^{-1}$) concentrations are found far from the two rivers at boxcore stations 10 and 16 (see figure 4.1). The decrease of

cadmium concentrations by a factor 10 (Rhône/ Mediterranean Sea) is comparable with results from Fernex et al [1986] however the decrease takes place over more than 10 km, as contrasted with these results. It is acceptable that the Rhône is influencing the cadmium concentrations in sediments near the river.

Cu : Copper concentrations are highest in sediments far away from the rivers (station 15: $\sim 85 \mu\text{g}\cdot\text{g}^{-1}$). High concentrations are also found close to the river mouth of the Rhône ($\sim 66 \mu\text{g}\cdot\text{g}^{-1}$). Sediments near the Ebro and in the middle of the investigated area (boxcore stations 4, 6, 7, 8, 10, 11, 13, 16 and 19) show lower concentrations ($\sim 30 \mu\text{g}\cdot\text{g}^{-1}$, see figure 4.1). Because dilution effects are negligible, it appears that adsorption and desorption effects are important in the area (In accordance to Fernex et al [1986])

Ni: Nickel concentrations are rather uniform in the area ($\sim 50 \mu\text{g}\cdot\text{g}^{-1}$). In sediments closets to the Ebro lower concentrations are found ($\sim 35 \mu\text{g}\cdot\text{g}^{-1}$, see figure 4.1) No large distribution profiles for nickel occurs. Probably the influence of the two rivers (Rhône and Ebro) on nickel concentrations in sediments from the North Western Mediterranean is minimal.

Cr : Chromium concentrations are generally uniform ($\sim 100 \mu\text{g}\cdot\text{g}^{-1}$). A small decrease is found in the sediments close to the Ebro ($\sim 70 \mu\text{g}\cdot\text{g}^{-1}$, see figure 4.1). Just like in the case of nickel, the influence of the Rhône and the Ebro on chromium concentrations in sediments from the North Western Mediterranean is probably minimal.

Zn : Zinc concentrations in the area decrease with increasing distance from the Rhône. The highest concentration is found in the sediments near the vicinity of the Rhône ($\sim 300 \mu\text{g}\cdot\text{g}^{-1}$). Stations far away from the river have concentrations which are lowered by a factor of two ($\sim 150 \mu\text{g}\cdot\text{g}^{-1}$, see figure 4.1). The influence of the Rhône on zinc concentrations is observable in sediments close to the river.

Mn: The geographical distribution of manganese is difficult to observe (see figure 4.1). The local situation in sediments is influencing the concentrations of manganese. Through early diagenesis, the reduction of Mn-oxides can take place which makes it difficult to deduce the influence of the Rhône and the Ebro on manganese concentrations. Manganese

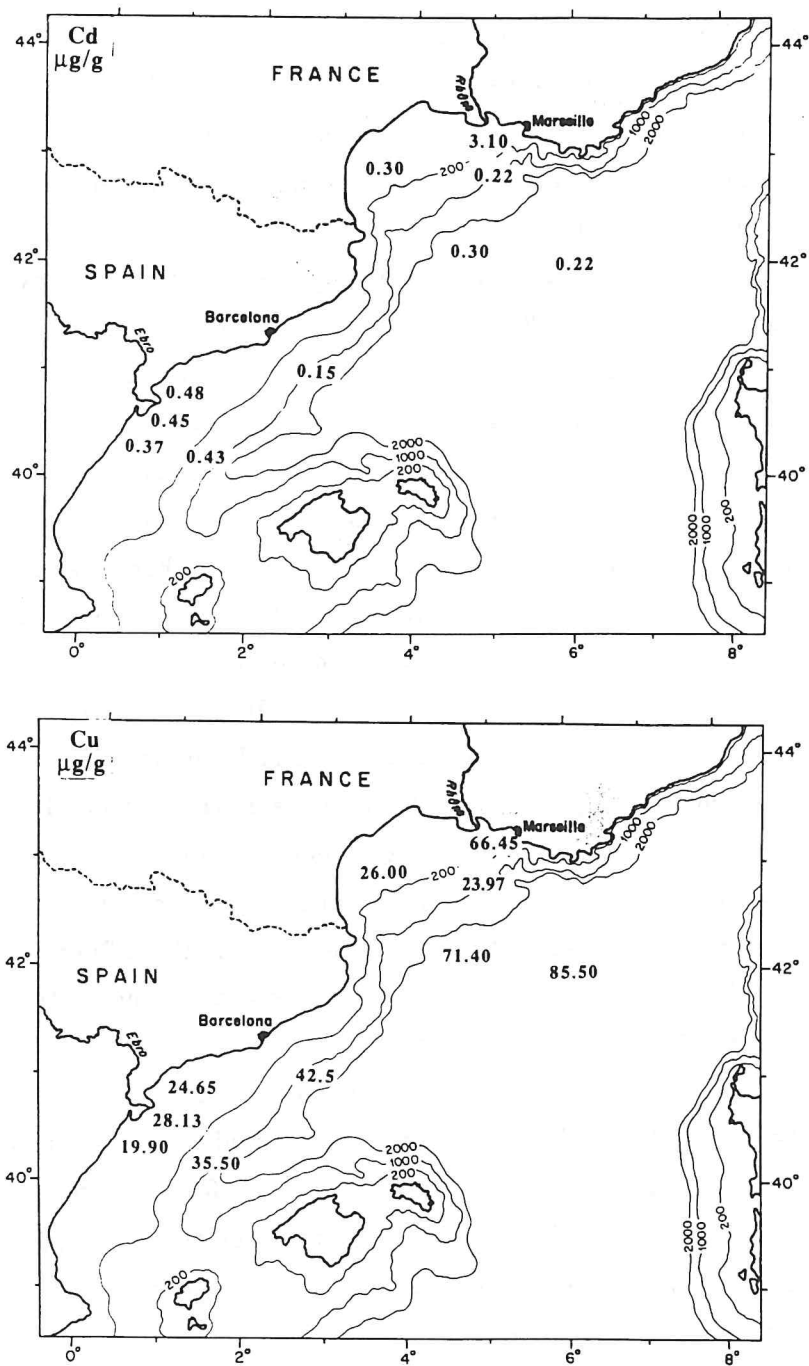


Figure 4.1 : Geographical distribution of Cd, Cu, Ni, Cr, Zn and Mn, calculated on a calciumcarbonate free basis, in the upperlayer of sediments (0-2 cm) of the North Western basin of the Mediterranean Sea (see also appendix 15)

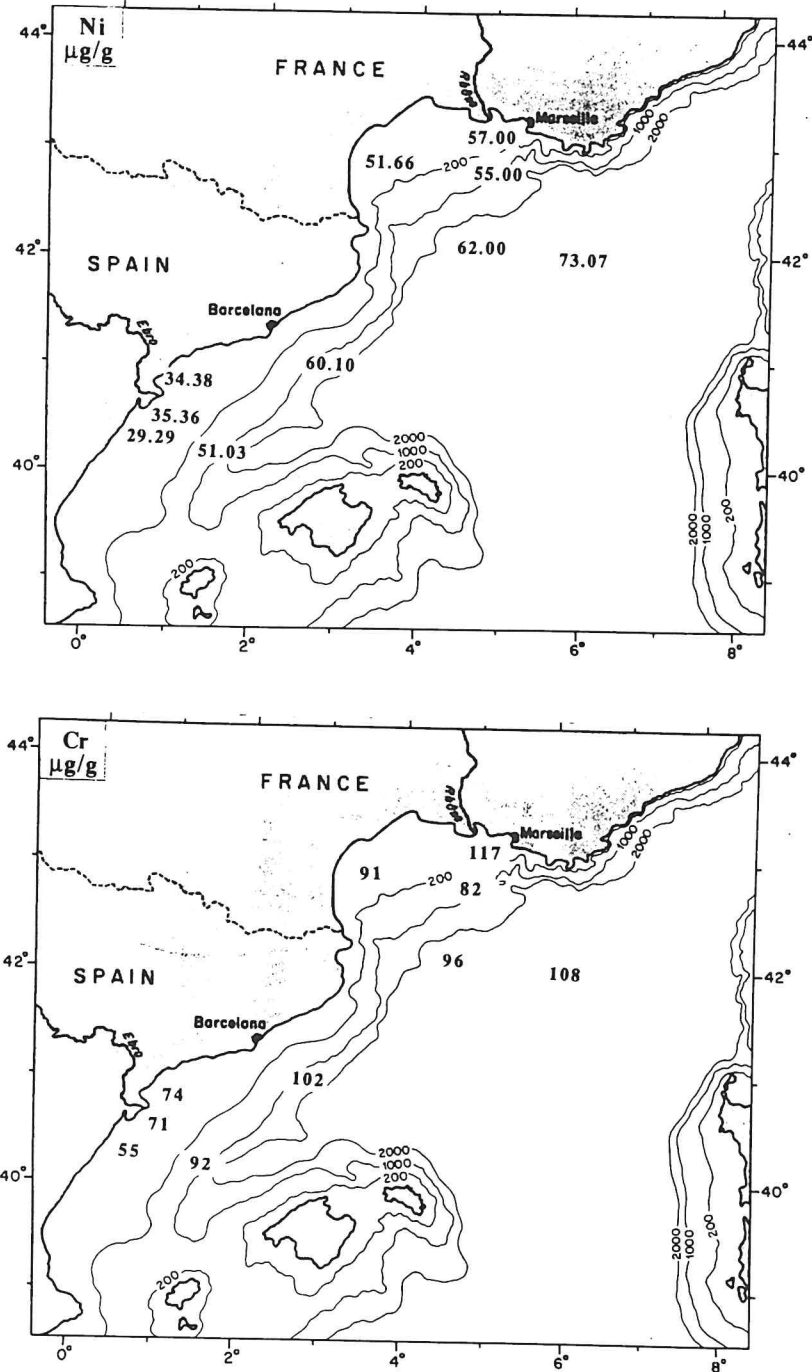


Figure 4.1: continued

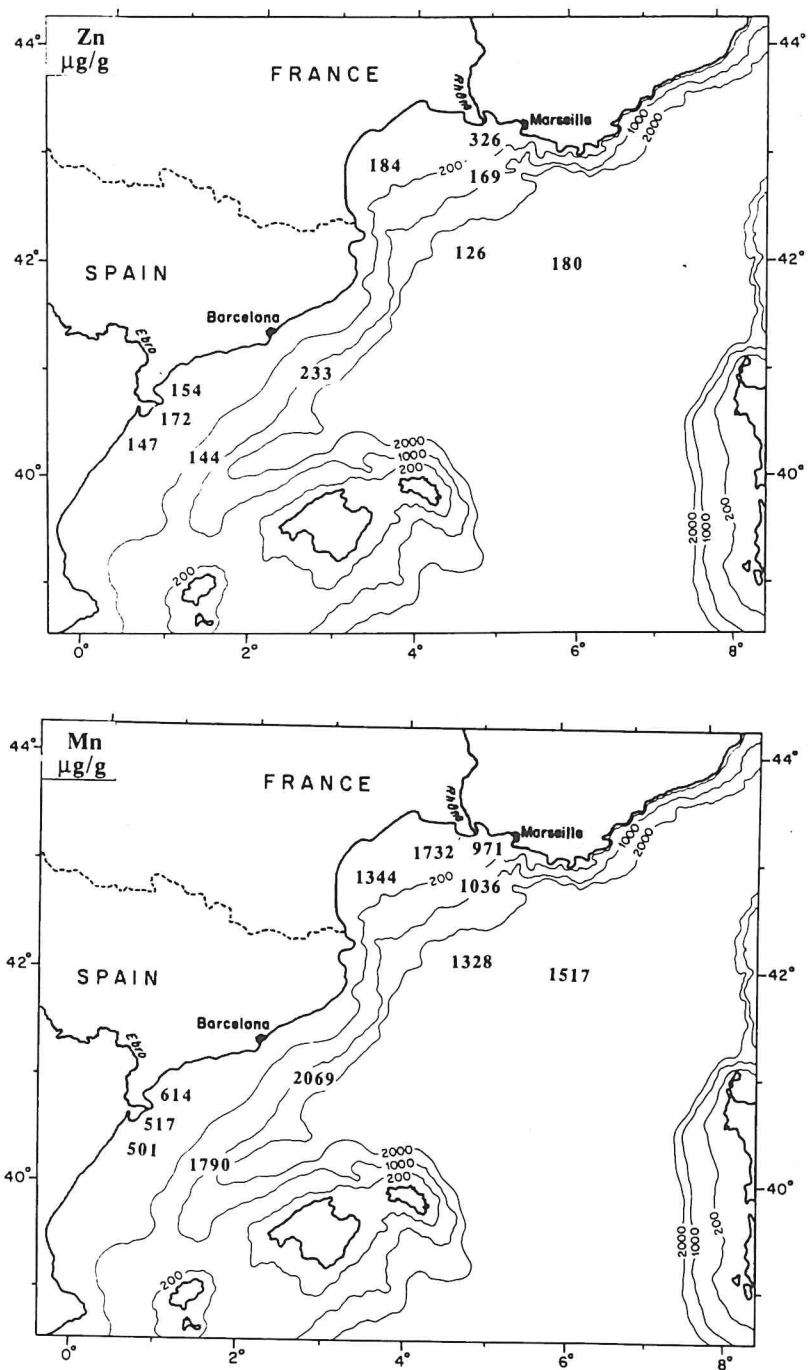


Figure 4.1 : continued

concentrations near the Rhône are $\sim 1000 \mu\text{g}\cdot\text{g}^{-1}$. Near the Ebro concentrations of $\sim 700 \mu\text{g}\cdot\text{g}^{-1}$ are found. Notable is the concentration at the stations 4, 8 and 10 ($\sim 1700 \mu\text{g}\cdot\text{g}^{-1}$)

Oxides: Distributions of oxides and carbonates shows the following profiles:

Rhône: The aluminium oxide, iron oxide and magnesium oxide contents in the sediments are generally uniform even with increasing distance from the river (10%, 5% and 3% respectively). Silicon-oxide decreases and calciumcarbonate increases with increasing distance from the river (see figure 4.2). The increase of calcium-carbonate is probably due to the production of biogenic calciumcarbonate in the deeper parts of the Mediterranean Sea (the abundance of biological material was observed by the use of a Scanning Electron Microscope). The total amount of oxides and carbonates show a decrease with increasing distance from the river mouth (see figure 4.3). Near the Rhône the sum of determined oxides reaches almost 100 % of the total dry sediment weight. In the deeper layers, only ~ 85 % was determined. Probably undetermined constituents like Ti, Na, K, CO_2 and H_2O play a more important role in sediments far away from the Rhône than in sediments close to the river mouth. **Ebro :** The distribution of the oxides and the carbonates at the area near the vicinity of the Ebro shows the same profiles as described above (see figure 4.2 and figure 4.3). Just as in the case of the Rhône, a decrease in the total amount of oxides occurs. Noticeable is the increase of aluminium-oxide at the stations half-way down the area (boxcore stations 8 and 10)

4.2 The leachable fraction

The leachable fraction gives information about manifestation of the elements in the sediments. Leachable contents depend mostly on the presence of exchangeable (weakly bounded) constituents, which are available on manganese-oxides, iron-oxides and on organic matter. Residual contents are mostly correlated to inorganic particles (e.g. clay minerals) which are descended from natural sources of the continents. Figure 4.4 and figure 4.5 shows the mean leachable contents and the mean residual contents in areas near the Rhône and the Ebro. The leachable and residual contents in these figures are averages of the contents of each boxcore station (0-15 cm).

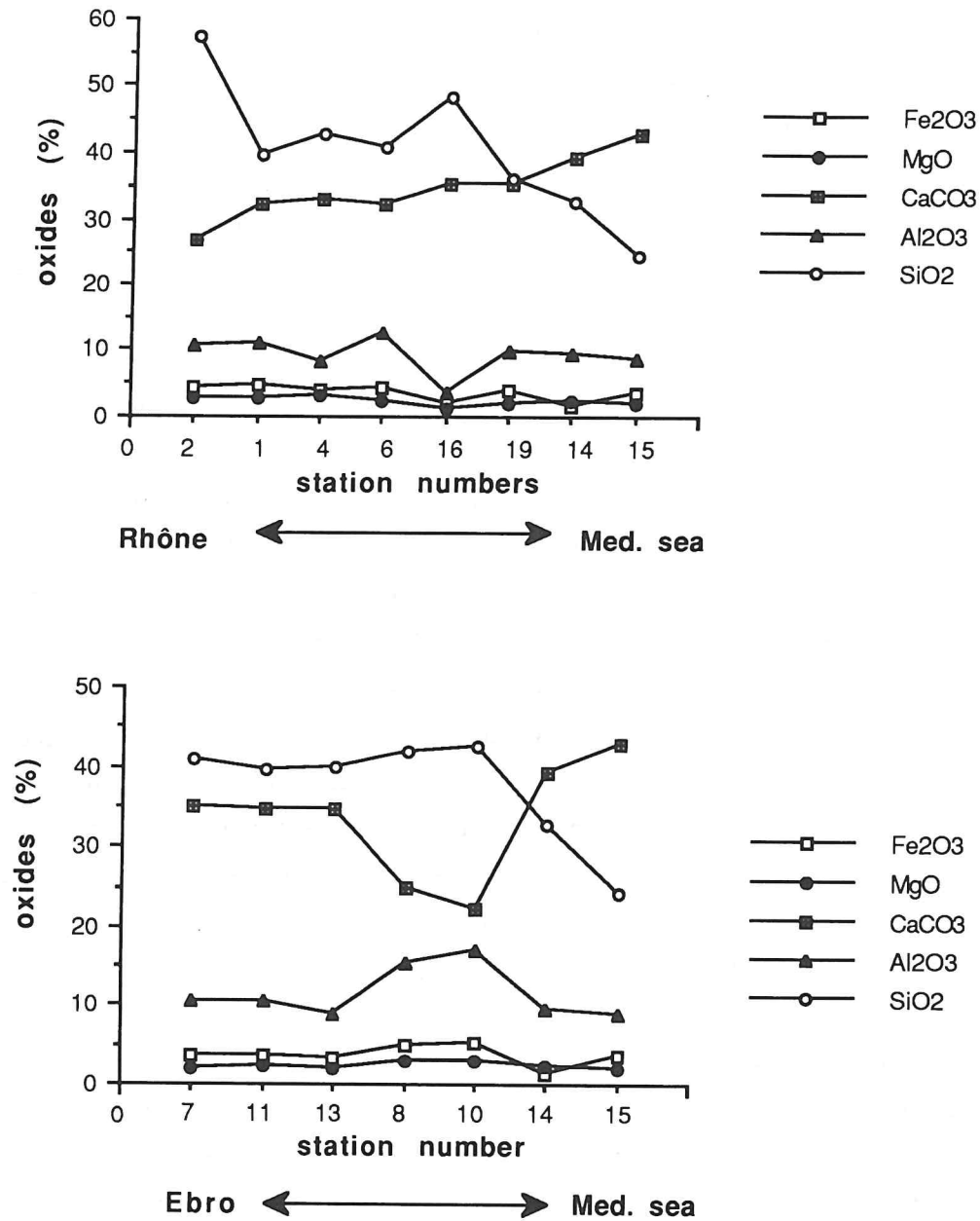


Figure 4.2 :The mean contents of element-oxides and element carbonates in the upperlayer (0-2 cm) of sediments in the vicinity of the Rhône (upper) and in the vicinity of the Ebro (lower)

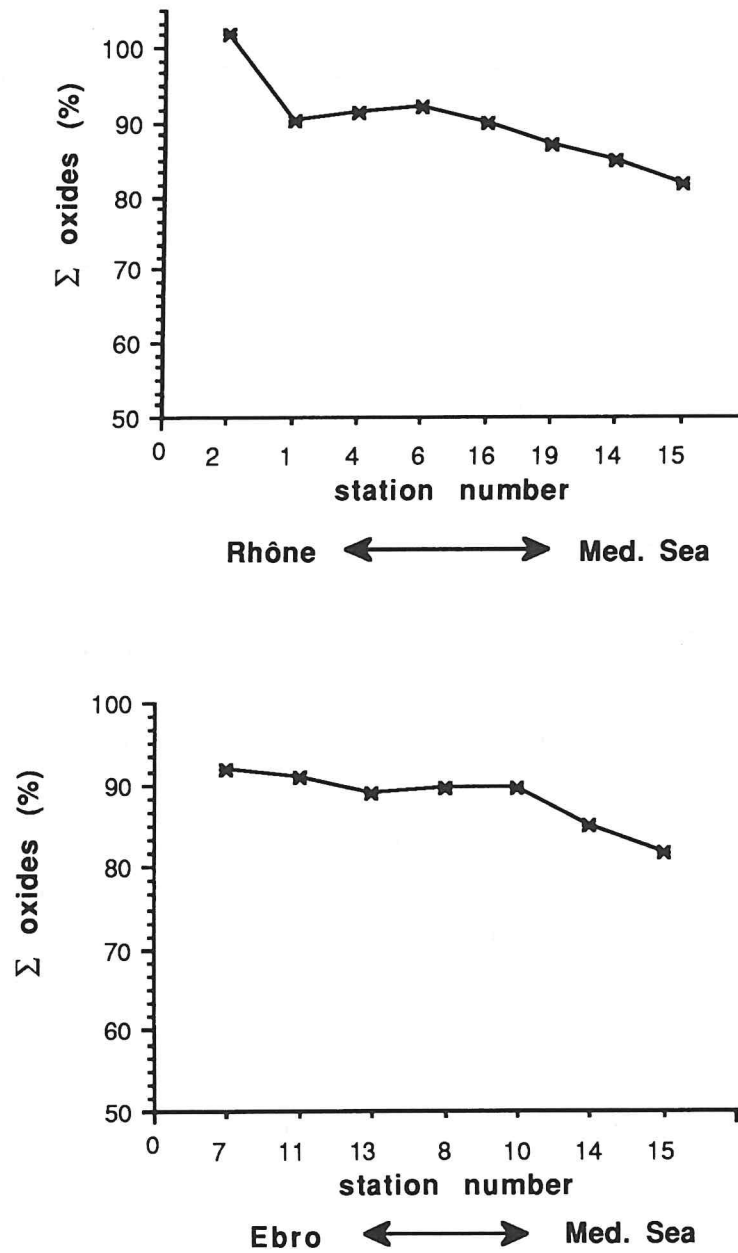


Figure 4.3 : The mean contents of the total amount of element-oxides and element carbonates in the upperlayer (0-2 cm) of sediments in the vicinity of the Rhône (upper) and in the vicinity of the Ebro (lower)

Rhône : High residual Cd-contents are found in the sediments close to the Rhône (> 80 %). High leachable Cd-contents are found in the other stations. In relation to high total cadmium concentrations which are described in the previous paragraph, it is likely that residual Cd which is transported by the Rhône is deposited in the areas near the river mouth. The leachable Cu-content varies from 60 % in the vicinity of the Rhône down to 25 % half-way the area, and again up to 55 % in the deeper layers of the Mediterranean Sea. Because the copper concentrations show the same curve (large concentrations- low concentrations - large concentrations) it is deducible that the investigated area can be separated into three different parts. This means that copper, resulting from the Rhône, is probably not transported to the deeper parts of the Mediterranean Sea, but is deposited (just as cadmium) in areas near the river mouth. In relation to the leachable Ni-contents, the investigated area can be separated into two different parts. One part with small leachable Ni-contents and another part with higher leachable Ni-contents (10 % and 50 % respectively). Because of the uniform concentrations of nickel in the area it is not likely that nickel from the Rhône is deposited in any of these areas. Thus the observed increase in the leachable fraction is probably not correlated to any influence of the Rhône. It is more likely that the observed increase occurs through differences in sedimentary composition. (see paragraph 4.2). Chromium and aluminium show very low leachable contents (< 10 %). Because the most important clay minerals in the North Western Mediterranean Sea are: [Rateyev et al, 1981] : Hydromicas ($\text{KAl}_4\text{Si}_7\text{AlO}_{20}(\text{OH})_4$) and Kaolinite ($\text{Al}_2\text{Si}_2\text{O}_5(\text{OH})_4$) the observed high residual Al-content was to be expected. The influence of the Rhône on the chromium and aluminium concentrations is not clearly demonstrable. Iron shows the same profile as nickel. Also two areas are found. Therefore the observed increase of the leachable Fe-content is also due to differences in sedimentary composition. The leachable Mn-content increases with increasing distance from the river. Such an increase can occur as a result of the formation of exchangeable Mn-oxides in the deeper oxic sediments of the Mediterranean Sea.

Ebro : The leachable Cd-content near the Ebro is relatively high (~ 80 %). Half-way the area, a decrease in the leachable content occurs but at the boxcore stations in the deeper parts of the Mediterranean Sea, the leachable Cd-content is seen to increase again.

This means that the investigated area can be separated into three different parts. Using the cadmium concentration profiles from the previous paragraph, it is acceptable to say that cadmium, transported by the Ebro is deposited in the first two areas and of which the first area is probably the most important. The influence of the Ebro on cadmium concentrations is not as high as the influence of the Rhône. Copper shows the same profile as cadmium. Three areas occurred so probably is copper, just like in the case of cadmium, deposited in areas near the river mouth. The increase of leachable Ni-content occurs in boxcore stations far from the river. Using the results of paragraph 4.1, two areas have been observed. Probably nickel, transported by the Ebro, is deposited in the first area. This means that the increase of the leachable fraction and the nickel concentration depend on differences in sedimentary composition. Chromium and aluminium show comparable results with those which were found in the "Rhône area". The residual content of these elements is generally high ($> 95\%$). Just as in the case of the "Rhône area" the influence of the river is not clearly demonstrated. The leachable iron content is relatively stable. However a small increase in the iron concentration occurs half-way to the area (see previous paragraph). It is not likely that the Ebro has a large influence on iron concentration and on the leachable iron content. Probably the differences in sedimentary composition are responsible for the observed increase of the iron concentrations. The results of manganese are comparable with those which were found near the Rhône.

4.3 Processes in sediments of the Mediterranean Sea.

The processes described in this paragraph occur in three different parts of the entire investigated area. These three areas are described because they represent the three major contrasting situations in the area. The first area (boxcore stations 1 and 2) has high deposition rates and a relatively large organic carbon content. The second part (boxcore stations 8 and 10) has probably lower deposition rates (no data yet available) and lower organic carbon contents. The third part (boxcore stations 14 and 15) has very low deposition rates and also very low organic carbon contents. Leachable concentrations are used in this paragraph because only these contents are available for diagenetic processes.

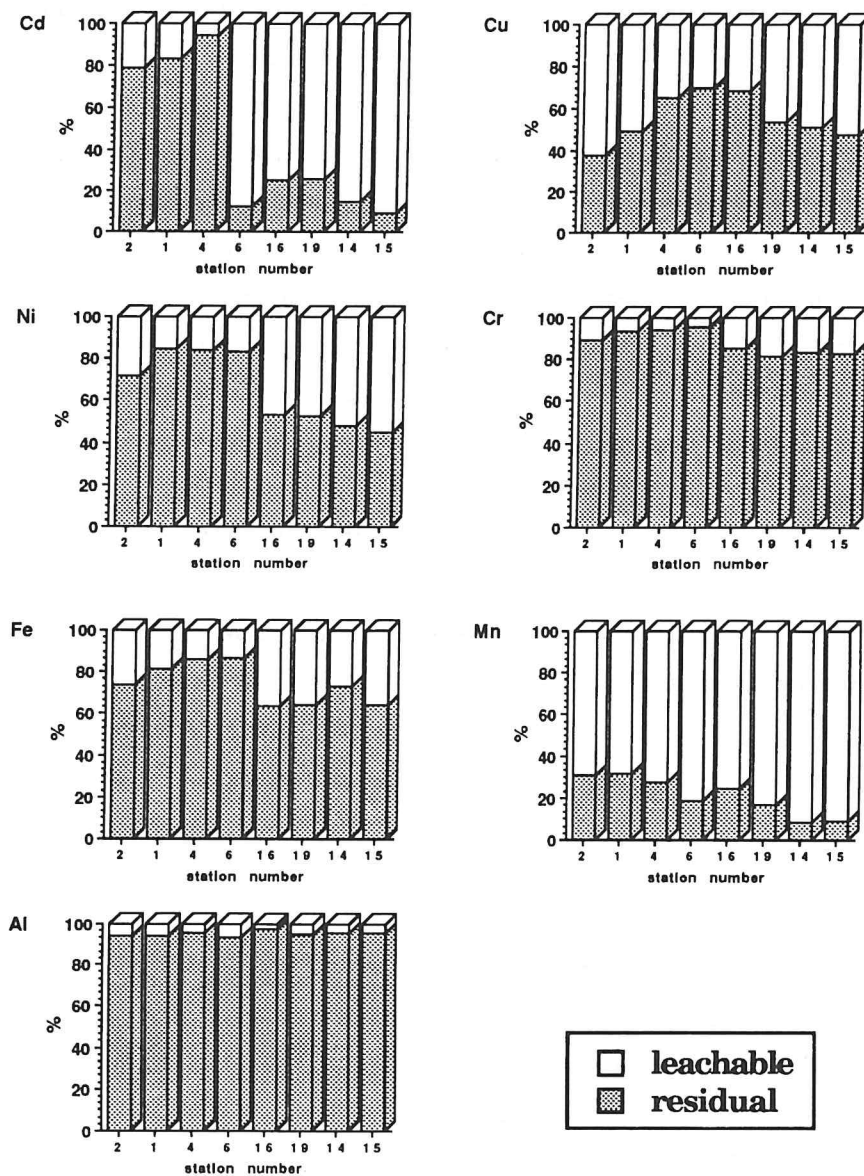


Figure 4.4 : *Leachable and the residual contents in sediments near the Rhône. Values are averages which occur in the upper 15 cm of the sediments*

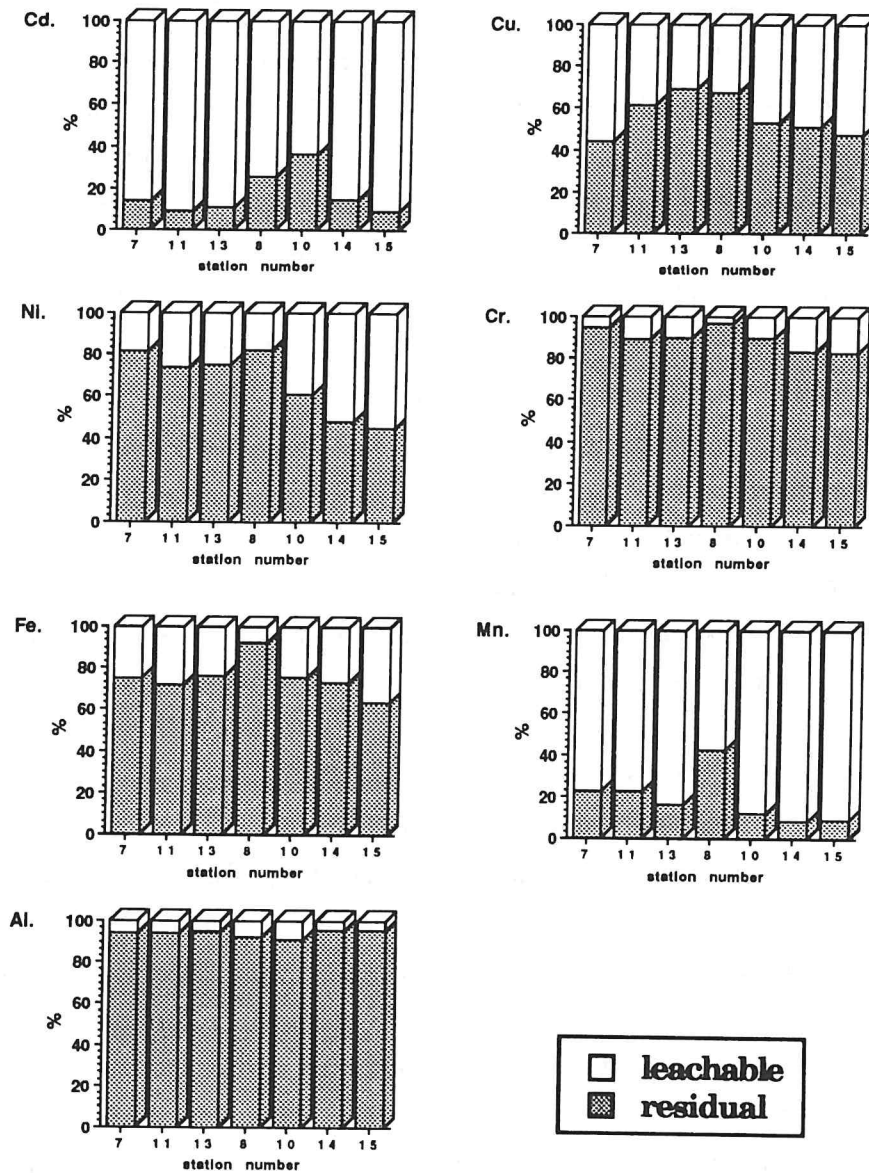


Figure 4.5 : Leachable and the residual contents in sediments near the Ebro. Values are the averages which occur in the upper 15 cm of the sediments

Manganese: At boxcore station two (close to the Rhône) the leachable manganese concentrations in the sediments are seen to increase slightly with depth (see figure 4.6). In the upper layers of the sediments the leachable concentrations are $\sim 500 \mu\text{g.g}^{-1}$. In the deeper layers leachable concentrations of $\sim 600 \mu\text{g.g}^{-1}$ are found. The manganese concentrations in the porewaters show a large increase indicating that reduction of manganese oxides is taking place (see also table 2.1). The concentrations in the porewaters varies from $\sim 8 \mu\text{M}$ at the top up to $\sim 90 \mu\text{M}$ in the deeper parts. The dotted line shows the proposed boundary between the oxic sediments and the anoxic sediments. Boxcore station 8, which is located near the Spanish coast, shows different profiles. The leachable manganese content in the sediments is seen to decrease slightly from $\sim 900 \mu\text{g.g}^{-1}$ in the top layers down to $\sim 400 \mu\text{g.g}^{-1}$ in the deeper parts of the sediments. The manganese concentration in the porewaters increases slightly. The concentration in the porewaters of the upper three cm of the sediments is generally stable. The concentrations change from $\sim 5 \mu\text{M}$ up to $\sim 25 \mu\text{M}$ in the deeper parts. The dotted line is the supposed border between the oxic and the anoxic layers. It is notable that the oxic layer at station 8 is much larger than the oxic layer from station 2. Probably the sedimentary composition is different in the area near boxcore station 8 (lower deposition rates and lower organic carbon contents). Boxcore station 15, again shows different profiles. The leachable concentrations in the sediments are $\sim 800 \mu\text{g.g}^{-1}$. A large increase occur at a depth of 9 cm ($\sim 2000 \mu\text{g.g}^{-1}$). The manganese concentrations in the porewaters is very stable ($< 5 \mu\text{M}$). Because no manganese oxide reduction occurs (no increase of dissolved Mn) it is probable that the organic carbon content in the first 15 cm of the sediments of boxcore station 15, is low enough to be oxidized by oxygen and nitrate alone.

Iron: At boxcore station 2 (close to the Ebro) the leachable iron concentrations in sediments show no large changes as a function of depth ($\sim 0.9 \%$). The iron concentration in the porewaters shows a large increase at the top layer. The concentrations are $\sim 20 \mu\text{M}$ at the top layer up to $\sim 275 \mu\text{M}$ in the deeper parts (see figure 4.7). This means that the reduction of iron oxides has taken place (see also table 2.1). The dotted line shows the supposed boundary between the oxic sediments and the anoxic sediments. At boxcore station 8 a different depth profile occurs. The leachable iron concentrations in the sediment are still stable but the concentrations are lower than in boxcore station 2 ($\sim 0.3 \%$). The iron concentration in

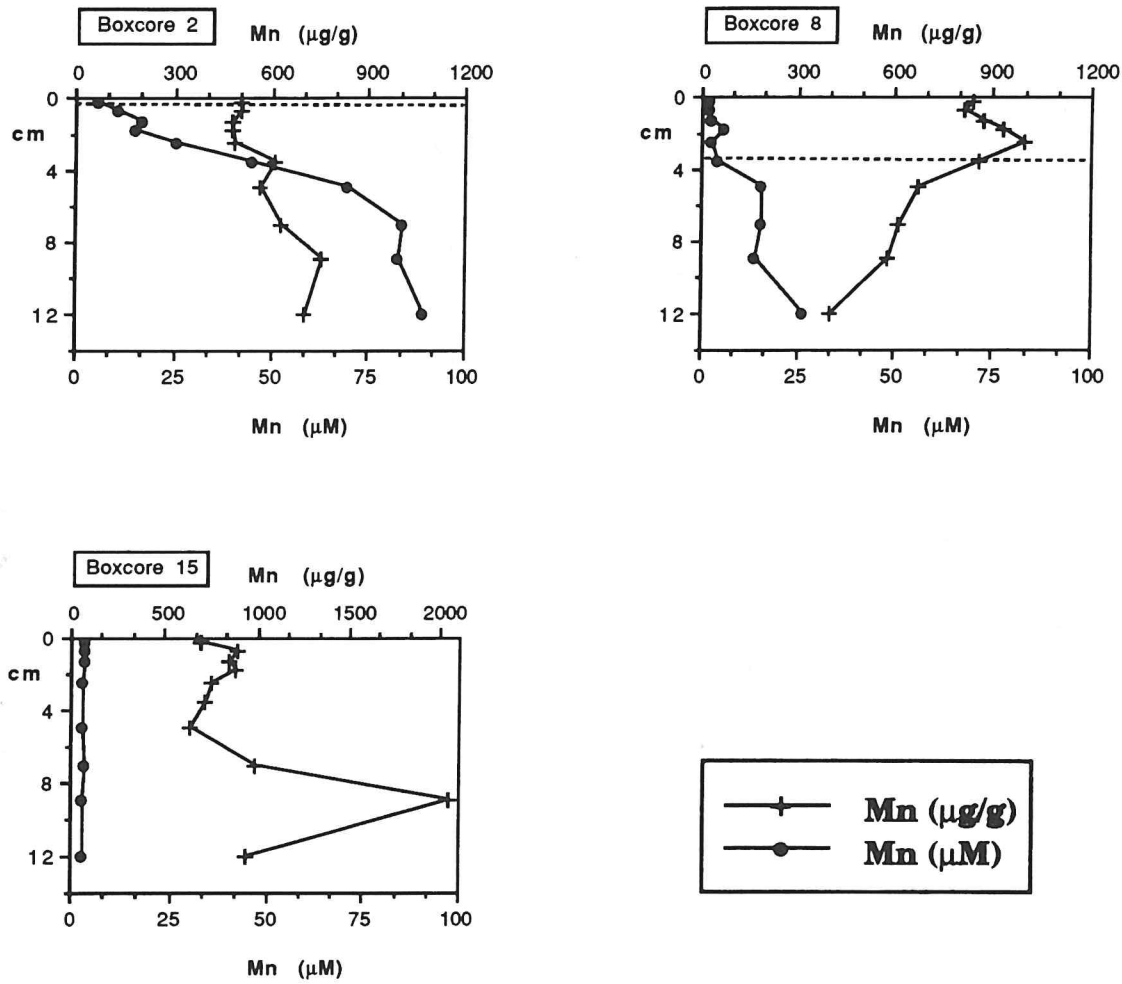


Figure 4.6 : Depth profiles of manganese in Mediterranean sediments. Crosses show the leachable Mn-content in $\mu\text{g.g}^{-1}$ dry sediment. The black dots show the dissolved manganese concentrations in the porewaters in μM .

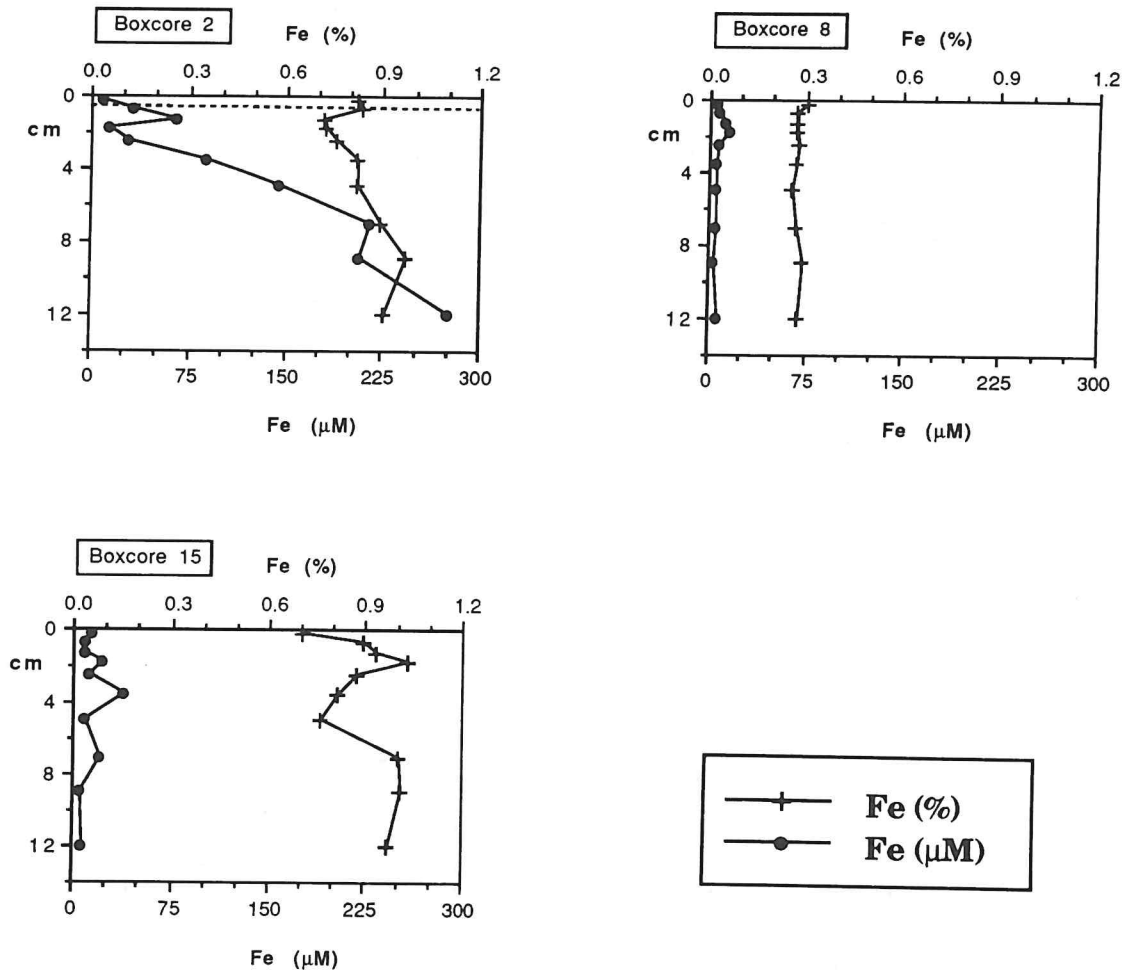


Figure 4.7 : Depth profiles of iron in Mediterranean sediments. Crosses show the leachable Fe-content in $\mu\text{g.g}^{-1}$ dry sediment. The black dots show the dissolved iron concentrations in the porewaters in μM .

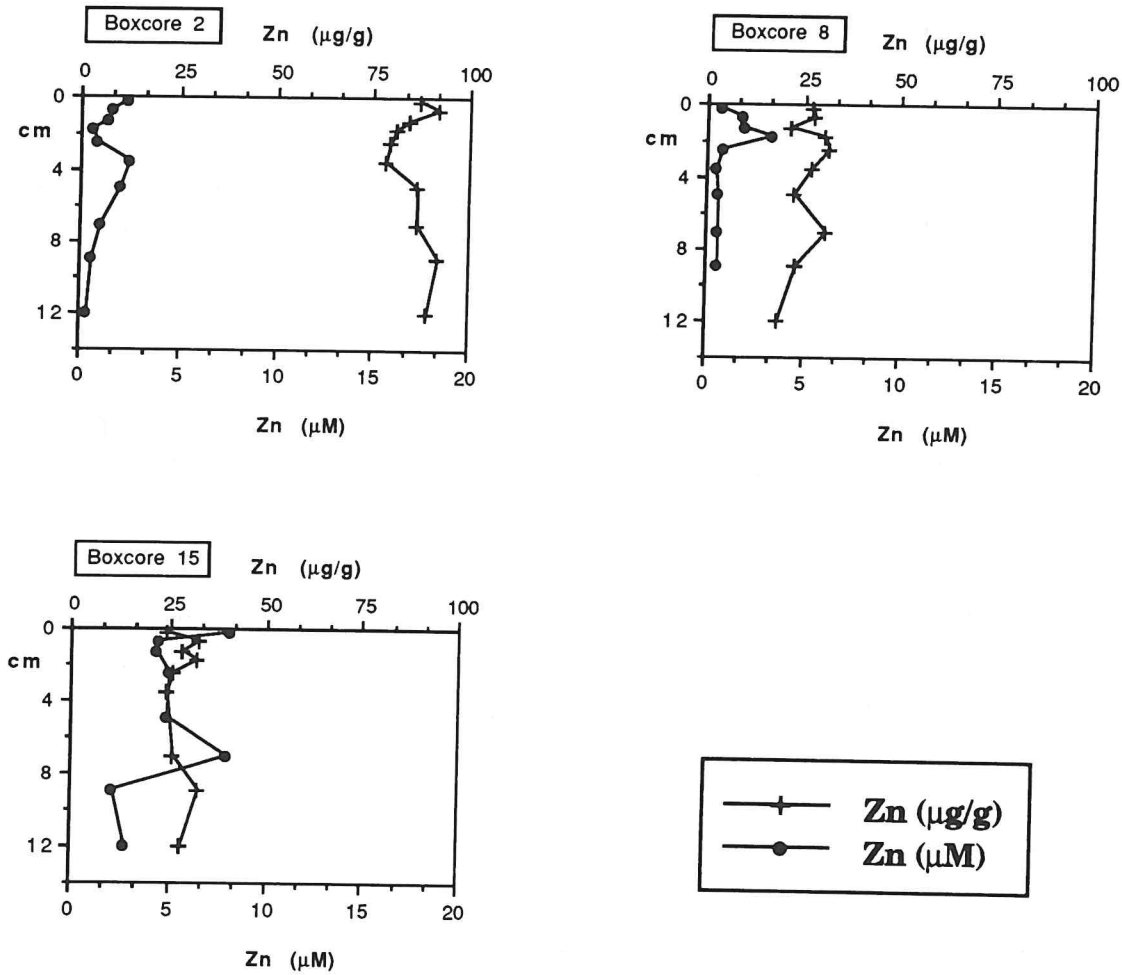


Figure 4.8 : Depth profiles of zinc in Mediterranean sediments. Crosses show the leachable Zn-content in $\mu\text{g.g}^{-1}$ dry sediment. The black dots show the dissolved zinc concentrations in the porewaters in μM .

the porewaters is very low because the reduction of iron oxides is of minor importance in this sediment. The iron depth profiles at boxcore station 15 are comparable with those which occur in boxcore station 8. Only higher leachable concentrations of iron in the sediments are found (~ 0.9 %). Reduction of iron oxides is probably not taking place in this sediment.

Zinc : Zinc is not acting as an oxidant for organic matter, in contrast to Fe and Mn. This means that increases or decreases can only be indirectly correlated to the oxidation of organic matter, namely that shifts in the organic carbon composition are changing the ratio of soluble to bound zinc. Changes in the leachable concentration or in the porewater concentration are probably depending upon changes in the sedimentary composition. At boxcore station 2 high leachable concentrations are found (~ 90 $\mu\text{g.g}^{-1}$) while the concentrations of zinc in the porewaters are low (~ 2 μM , see figure 4.8). At boxcore station 8 only changes in the leachable concentration are found (~ 25 $\mu\text{g.g}^{-1}$). Boxcore station 15 shows the same leachable concentration as in sediments of boxcore station 8 but larger concentrations in the porewaters are found (~ 5 μM). It is acceptable to say that the sedimentary composition in the areas is influencing the concentrations of Zn in the sediments.

4.4 The sedimentary composition

The usual element/aluminium ratio's can not be used in the North Western Mediterranean Sea because of the large atmospheric input of aluminium resulting from Sahara dust [e.g. Davies and Buat-Ménard, 1990; Hydes et al, 1988; Chester et al, 1989]. Thus changes in sedimentary composition can not be deduced from the element/aluminium ratio's. Therefore element/silicon ratio's are used in this paragraph.

The element/silicon ratio's can give information about the sedimentary composition. When all the element/silicon ratio's in the investigated area are constant, it can be concluded that the sedimentary composition in the area is not changing. When the ratio's are changing, differences appear in the composition. Probably because of a different origin of the deposited materials (e.g. rivers, atmosphere , biogenic).

Rhône : in sediments near the Rhône (see figure 4.9) there are changes in the element/silicon ratio's. Nearly all elements show a reduction of the ratio in the middle of a transect from rivermouth in seaward direction. This means that the sedimentary composition is changing. In relation to the obtained figures the investigated area near the Rhône can be separated in three different parts. The first area includes the boxcore stations 1, 2 and 4. Most of the element/silicon ratio's are relative high in this area (except Mn/Si and Ca/Si). The second area includes the boxcore stations 6,16 and 19. Here the element/silicon ratio's are a little lower (except for Mn/Si and Ca/Si, these ratio's are higher). The third area includes the boxcore stations 14 and 15. In this area the element/silicon ratio's are increasing again. It is acceptable that the first area and the second area are more or less influenced by the Rhône river whereas the first area is influenced more. The third area has probably a more "oceanological" composition.

Ebro : in the areas near the Ebro not all the element/silicon ratio's are comparable with those which were found near the Rhône (see figure 4.10) . The cadmium/silicon ratio is generally uniform and much lower than near the Rhône. Copper, nickel, zinc, manganese and calcium ratio's are all increasing. Probably there are in the areas near the Ebro also changes in the sedimentary composition. Just like the Rhône, three areas can be deduced. A first area near the vicinity of the Ebro. This area includes the boxcore stations 7, 11 and 13. A second area is found in the middle of a transect from rivermouth in seaward direction. The boxcore stations 8 and 10 belong to this area. The last area is comparable with the third area which was found at the previous description of the Rhône areas. This area is including the boxcore stations 14 and 15. The influence of the Ebro is probably limited to the first two areas. Figure 4.11 shows the investigated area with the obtained five areas with different sedimentary compositions.

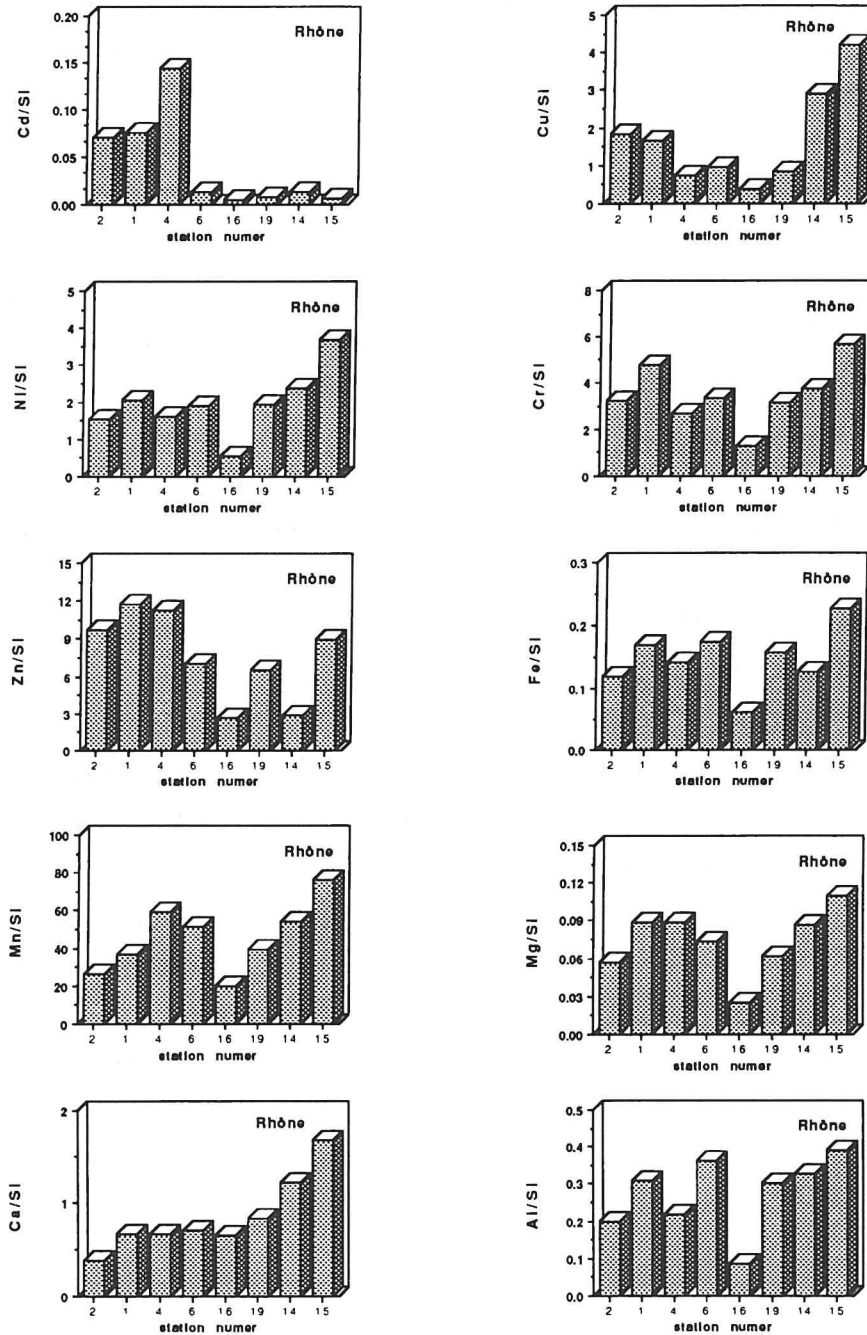


Figure 4.9 : The element/silicon ratios in the areas near the Rhône for several elements. The used concentrations for calculating these ratio's were averages of the concentrations in the upper two cm of the sediments

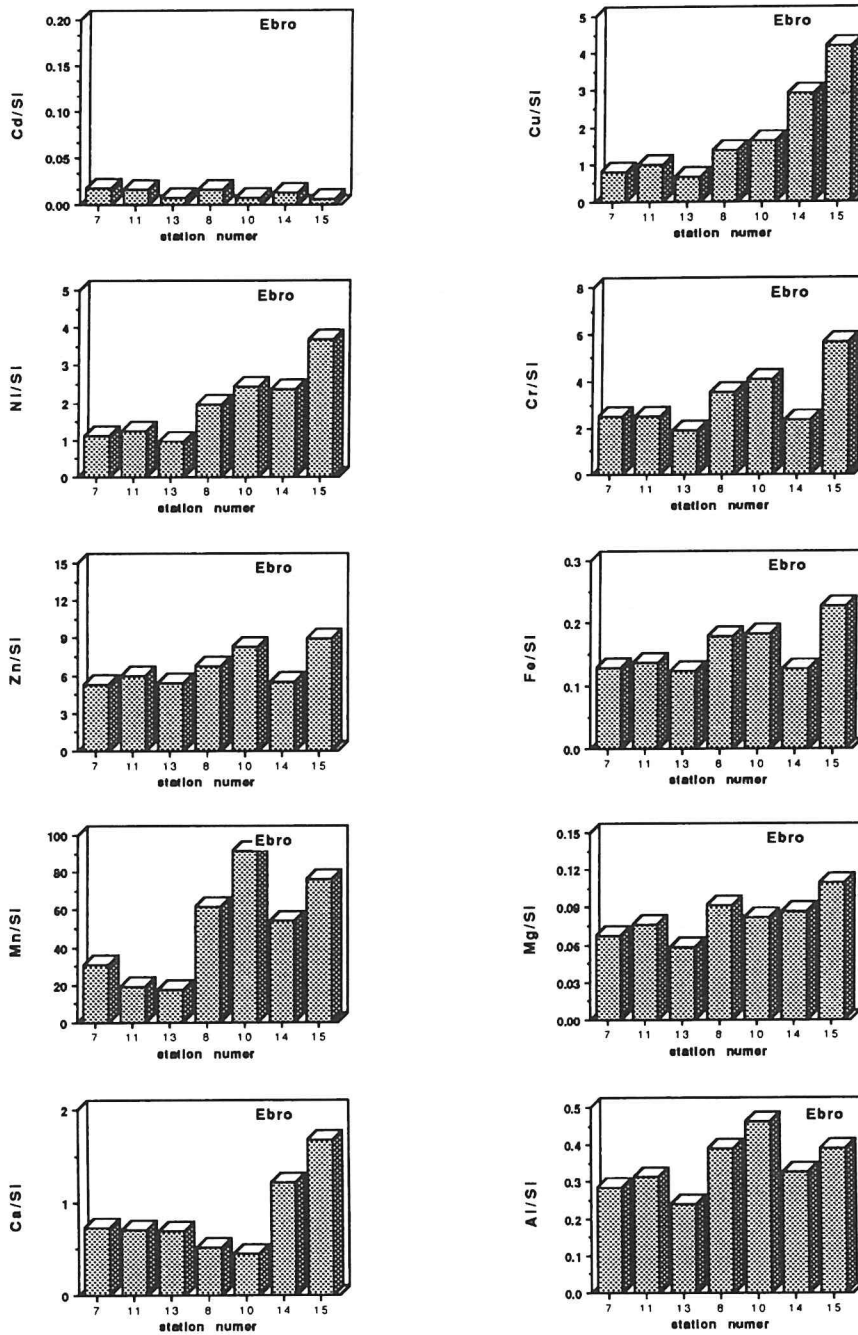


Figure 4.10 : The element/silicon ratios in the areas near the Ebro for several elements. The used concentrations for calculating these ratio's were averages of the concentrations found in the upper two cm of the sediments

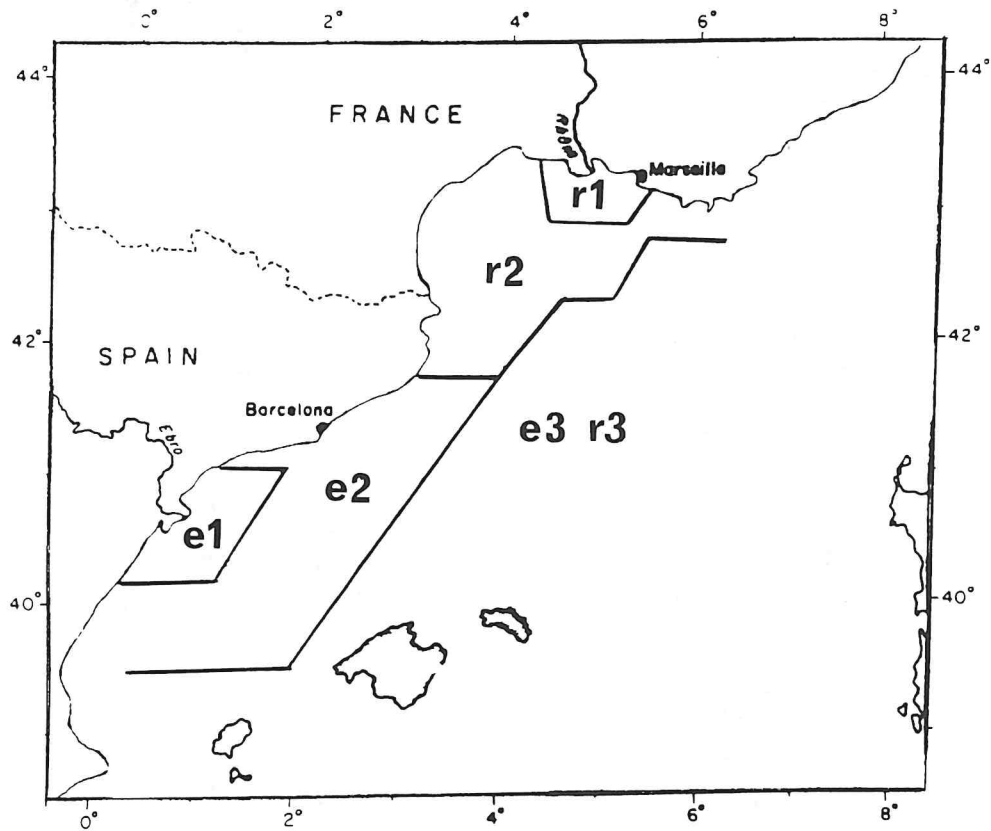


Figure 4.11 : *The investigated area with the proposed areas. R1, R2 and R3 are the first, the second and the third area described at page 33. E1, E2 and E3 are the first, the second and the third area described at page 33.*

CONCLUSIONS

The investigated area of the EROS-2000 cruise (1990) shows differences in (trace-) element composition and concentration levels, leachable content, processes and sedimentary composition. Five sub-areas can be deduced. In areas closest to the Rhône and the Ebro the highest (trace-) element concentrations are found but the concentrations near the Rhône are significantly higher than those which are found near the Ebro. In the area close to the river mouth of the Rhône, high leachable contents are found for copper and manganese while extreme low leachable contents are found for cadmium. Aluminium shows a high residual content. This is understandable because the clay minerals in these areas contain relative large amounts of aluminium. Also the atmospheric input of aluminium is of high importance. Processes are found in areas close to the two rivers. Reduction of manganese oxide and iron oxide occurs in the area close to the Rhône while only manganese reduction occurs close to the Ebro. Therefore, an increase in the concentration of dissolved manganese and/or iron in the porewaters is found in these areas. Because the concentration of certain elements in porewaters are correlated to the reduction of "hydrous" manganese or iron oxides it is likely that other element concentrations in the porewaters (e.g. copper or cadmium) are also increasing in these areas. The reduction of manganese and iron oxides far away from the two rivers has been not found. Probably the amount of oxidizable organic matter in the first 15 cm of the sediments, which are located far away from the rivers, is not large enough to start the manganese reduction. The element/silicon ratio's are changing in the area. This means that differences in sedimentary composition can be found in the area.

In conclusion one could say that the Rhône influences the North Western basin of the Mediterranean Sea more than the Ebro does. The area close to the river mouth of the Rhône in particular shows higher (trace-) element concentrations and more diagenetic features, because of higher organic carbon deposition.

ACKNOWLEDGEMENTS

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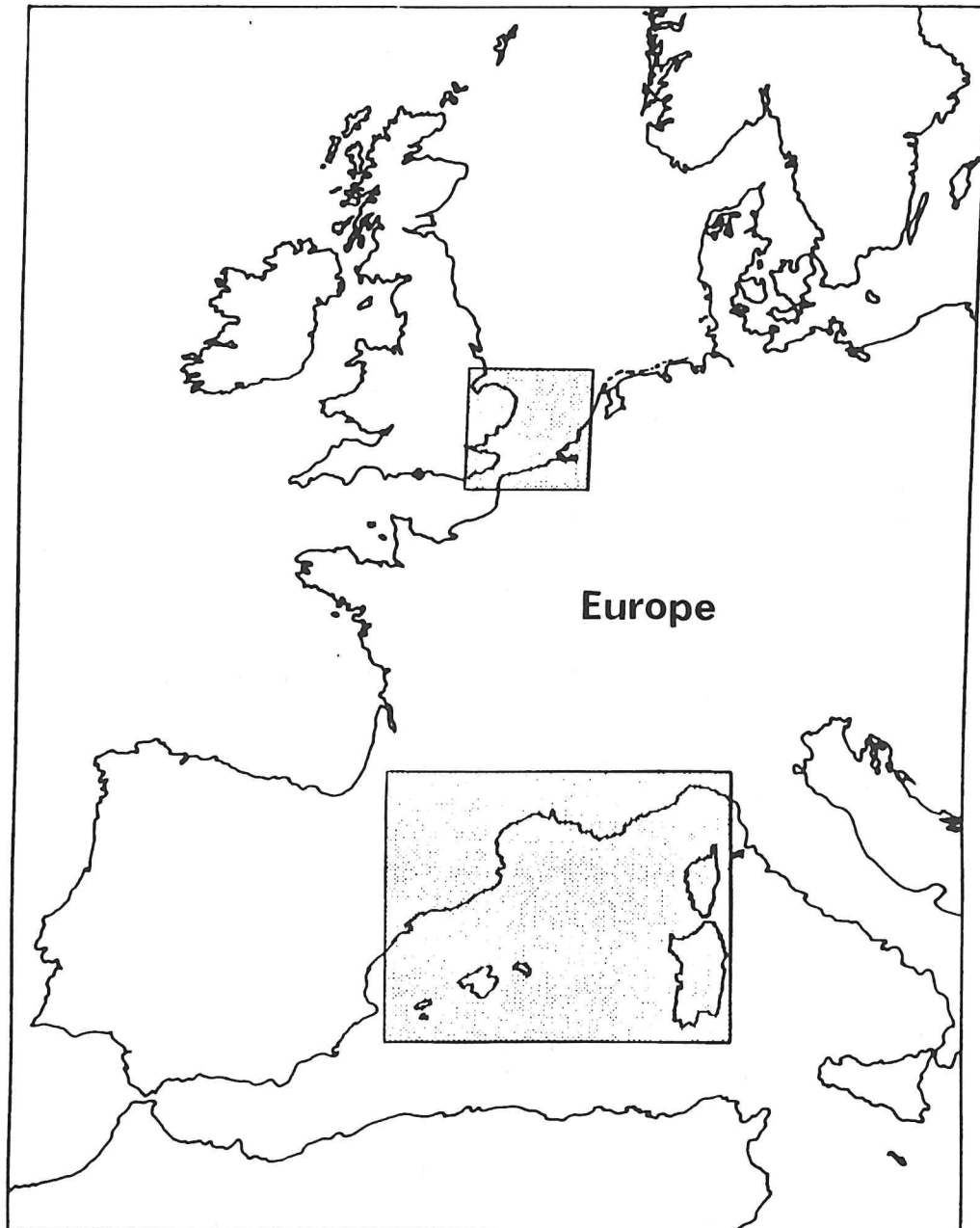
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TABLE OF APPENDICES

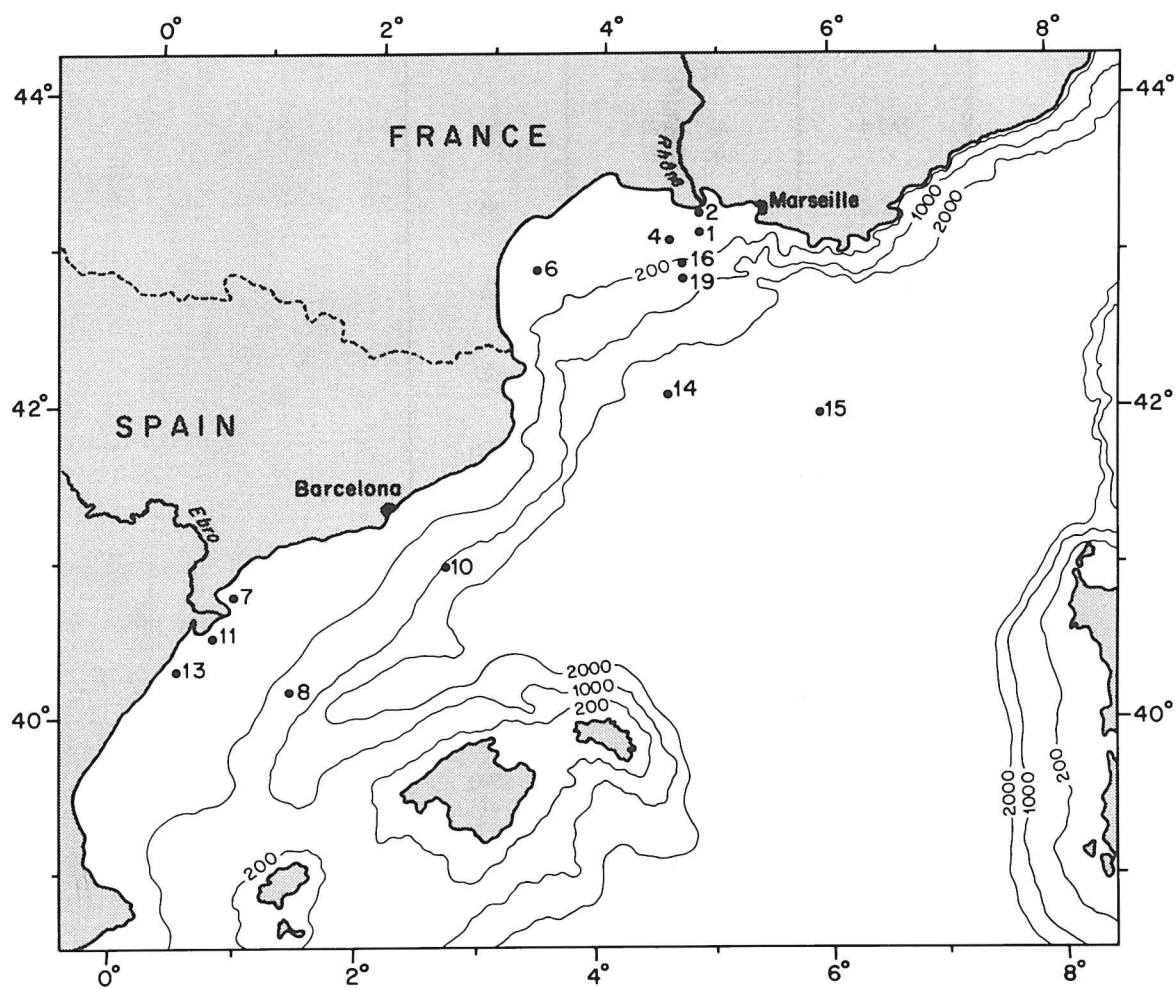
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13. Magnesium and calcium concentrations in sediments from the North Western basin of the Mediterranean Sea.
14. Aluminium and silicon concentrations in sediments from the North Western basin of the Mediterranean Sea.
15. Mean element concentrations in the upper layers of the sediments (0-2 cm) from the North Western basin of the Mediterranean Sea calculated on a calciumcarbonate free basis.

APPENDIX 1: Map of the studied areas in according to the EROS-2000 project.

APPENDIX 2: Description of the sample stations in the North Western basin of the Mediterranean Sea.

Station	Location	Water depth (m)
BC 1	43 ° 13 N 04 ° 51 E	100
BC 2	43 ° 19 N 04 ° 51 E	44
BC 4	43 ° 09 N 04 ° 40 E	101
BC 6	42 ° 51 N 03 ° 25 E	85
BC 7	40 ° 46 N 00 ° 53 E	11
BC 8	40 ° 23 N 01 ° 23 E	520
BC 10	40 ° 58 N 02 ° 09 E	1080
BC 11	40 ° 30 N 00 ° 43 E	30
BC 13	40 ° 20 N 00 ° 28 E	27
BC 14	42 ° 00 N 04 ° 40 E	2390
BC 15	41 ° 57 N 05 ° 56 E	2500
BC 16	42 ° 52 N 04 ° 43 E	210
BC 19	42 ° 50 N ° 50 E	513

APPENDIX 3: Map of the North Western basin of the Mediterranean Sea with depth profiles and sample stations.



APPENDIX 4: Used furnace programmes and measurement conditions for analysis of trace elements in sediments of the North Western basin of the Mediterranean Sea [Personal communication, De Jong, 1990, NIOZ].

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
Sample volume (µl)	20	10/20	20	20	10
Measurement type	area	area	area	area	area
Step I: 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 II: 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 III: 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 IV: 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

APPENDIX 5: Flame conditions during analysis of major elements in sediments and in porewaters from the North Western basin of the Mediterranean Sea [Personal communication, De Jong, 1990, NIOZ].

Element	Wave-length (nm)	Split setting (nm)	Oxidant ⁽¹⁾	Reducing flame
Calcium	422.7	0.7	Air	
Magnesium	485.2	0.7	Air	
Iron	248.3	0.2	Air	
Manganese	279.5	0.2	Air	
Zinc	213.9	0.7	Air	
Aluminium	309.3	0.7	N ₂ O	√
Silicon	251.6	0.2	N ₂ O	
Chromium	357.9	0.7	Air	√

⁽¹⁾ The fuel for all analysis was C₂H₂

APPENDIX 6: The used apparatus and expedients for analysis of the leachable, the residual and the porewater fraction of sediments of the North Western basin of the Mediterranean Sea.

Flameless Absorption Spectrophotometry

- (1)
 - * Perkin Elmer 5100 PC Atomic Absorption Spectrophotometer
 - * Perkin Elmer HGA-600 graphite furnace
 - * Perkin Elmer AS-60 sampling automat
 - * 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 sampling automat
 - * 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, Mn, Fe, Mg, Ca and Si

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

APPENDIX 7: Cadmium and copper concentrations in sediments from the North Western Mediterranean Sea. The table shows the boxcore station (BC, see also appendix 2 and appendix 3), the mean depth (D), the leachable fraction (L), the residual fraction (R) and the total fraction (T, expressed as the sum total of the leachable and residual fraction). The last column (L') gives the leachable fraction in percents of the total fraction. { n.d. means not determined, b.d means below detection limit ; values between parenthesis are probably contaminated}

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' (%)
1	-0.25	0.11	n.d.	1.29	8.5	1	-0.25	15.8	n.d.	29.7	53.2
	-0.75	0.21	n.d.	1.58	13.3		-0.75	13.9	n.d.	32.8	42.4
	-1.25	0.07	n.d.	0.22	32.2		-1.25	14.0	n.d.	27.7	50.6
	-1.75	0.23	n.d.	1.08	21.2		-1.75	13.4	n.d.	29.4	45.6
	-2.50	0.05	n.d.	0.67	7.5		-2.50	13.3	n.d.	29.4	45.3
	-3.50	0.05	n.d.	0.51	9.7		-3.50	14.0	n.d.	27.6	50.7
	-5.00	0.09	n.d.	1.34	6.7		-5.00	13.8	n.d.	27.1	51.0
	-7.00	0.07	n.d.	0.31	22.6		-7.00	14.9	n.d.	27.5	54.2
	-9.00	0.11	n.d.	0.51	21.7		-9.00	16.5	n.d.	28.5	57.9
	-11.00	0.16	n.d.	0.69	23.3		-11.00	16.3	n.d.	29.7	54.9
2	-0.25	0.62	n.d.	1.49	41.5	2	-0.25	31.3	n.d.	46.5	67.3
	-0.75	0.65	n.d.	2.26	28.7		-0.75	33.3	n.d.	51.0	65.3
	-1.25	0.62	n.d.	2.51	24.7		-1.25	28.7	n.d.	46.2	62.2
	-1.75	0.61	n.d.	2.84	21.5		-1.75	30.9	n.d.	53.0	58.4
	-2.50	0.55	n.d.	2.71	20.3		-2.50	27.8	n.d.	49.6	56.0
	-3.50	0.54	n.d.	9.74	5.5		-3.50	26.8	n.d.	55.0	48.7
	-5.00	0.71	n.d.	4.06	17.5		-5.00	31.1	n.d.	45.9	67.7
	-7.00	0.71	n.d.	6.17	11.5		-7.00	30.8	n.d.	59.0	52.2
	-9.00	0.61	n.d.	4.99	12.2		-9.00	29.1	n.d.	37.1	78.4
	-12.00	0.86	n.d.	2.88	29.9		-12.00	29.9	n.d.	45.6	65.5
4	-0.25	0.14	n.d.	2.21	6.3	4	-0.25	6.5	n.d.	15.2	42.7
	-0.75	0.11	n.d.	3.41	3.2		-0.75	4.8	n.d.	13.7	35.0
	-1.25	0.11	n.d.	5.11	2.1		-1.25	5.0	n.d.	14.4	34.6
	-1.75	0.10	n.d.	4.43	2.3		-1.75	5.0	n.d.	14.7	34.0
	-2.50	0.12	n.d.	1.79	6.7		-2.50	4.8	n.d.	15.2	31.6
	-3.50	0.18	n.d.	2.61	6.9		-3.50	5.1	n.d.	15.0	33.9
	-5.00	0.16	n.d.	4.70	3.4		-5.00	4.8	n.d.	14.0	34.3
	-7.00	0.16	n.d.	2.59	6.2		-7.00	4.9	n.d.	15.8	31.0
	-9.00	0.23	n.d.	9.21	2.5		-9.00	4.9	n.d.	13.9	35.3
	-12.00	0.19	n.d.	1.10	17.3		-12.00	4.6	n.d.	14.0	32.8
6	-0.25	0.14	0.07	0.21	67.8	6	-0.25	6.3	11.6	17.9	35.2
	-0.75	0.22	0.04	0.26	83.9		-0.75	5.6	12.0	17.6	31.9
	-1.25	0.15	0.01	0.16	95.4		-1.25	5.0	9.3	14.3	35.0
	-1.75	0.16	0.01	0.17	94.4		-1.75	5.3	15.3	20.6	25.8
	-2.50	0.13	0.01	0.14	91.9		-2.50	4.5	11.7	16.2	27.8
	-3.50	0.13	0.01	0.14	93.0		-3.50	4.5	10.9	15.4	29.2
	-5.00	0.14	0.02	0.16	89.4		-5.00	4.6	12.3	16.9	27.3
	-7.00	0.13	0.03	0.16	78.9		-7.00	5.2	11.6	16.8	31.0
	-9.00	0.13	b.d.	0.13	> 96.6		-9.00	4.7	11.7	16.4	28.6
	-12.00	0.13	0.02	0.15	88.5		-12.00	4.5	10.9	15.4	29.2

APPENDIX 7: Continued

CADMIUM

BC #	D (cm)	L (µg/g)	R (µg/g)	T (µg/g)	L' (%)
7	-0.25	0.28	0.15	0.43	65.3
	-0.75	0.25	0.02	0.27	92.6
	-1.25	0.25	0.03	0.28	89.6
	-1.75	0.25	0.03	0.28	88.7
	-2.50	0.40	0.01	0.41	96.6
	-3.50	0.27	0.07	0.34	80.3
	-5.00	0.27	0.01	0.28	95.0
	-7.00	0.40	0.04	0.44	90.0
	-9.00	0.33	0.06	0.39	85.2
	-12.00	0.68	0.25	0.93	73.1
8	-0.25	0.29	0.09	0.38	75.8
	-0.75	(8.14)	0.48	(8.62)	(94.4)
	-1.25	0.18	0.08	0.26	70.1
	-1.75	0.25	0.09	0.34	74.2
	-2.50	(1.70)	(1.51)	(3.21)	(53.0)
	-3.50	0.15	0.08	0.23	66.6
	-5.00	0.14	0.07	0.20	68.3
	-7.00	0.23	0.04	0.27	83.9
	-9.00	0.13	0.06	0.19	69.7
	-12.00	0.30	0.05	0.35	85.5
10	-0.25	0.09	0.06	0.15	60.1
	-0.75	0.08	0.04	0.12	67.4
	-1.25	(8.64)	0.03	(8.67)	(99.7)
	-1.75	0.04	0.05	0.09	43.7
	-2.50	0.04	0.06	0.10	38.6
	-3.50	0.04	0.04	0.08	49.3
	-5.00	0.04	0.03	0.07	55.5
	-7.00	0.05	0.02	0.07	74.8
	-9.00	0.05	0.01	0.06	80.9
	-12.00	0.05	0.03	0.08	63.8
11	-0.25	0.44	b.d.	0.44	> 97.9
	-0.75	0.20	b.d.	0.20	> 97.6
	-1.25	0.22	b.d.	0.22	> 97.8
	-1.75	0.29	0.02	0.31	94.1
	-2.50	0.19	b.d.	0.19	> 97.4
	-3.50	0.21	0.04	0.25	82.9
	-5.00	0.16	b.d.	0.16	> 97.0
	-7.00	0.15	b.d.	0.15	> 96.8
	-9.00	0.14	0.02	0.16	88.2
	-12.00	0.38	0.23	0.61	62.5
13	-0.25	0.13	b.d.	0.13	> 96.3
	-0.75	0.18	b.d.	0.18	> 97.3
	-1.25	0.30	b.d.	0.30	> 97.8
	-1.75	0.34	0.02	0.36	93.2
	-2.50	0.24	0.06	0.30	81.3
	-3.50	0.36	n.d.	n.d.	-
	-5.00	0.17	b.d.	0.17	> 97.1
	-7.00	0.23	0.02	0.25	90.8
	-9.00	0.20	0.11	0.31	64.3
	-12.00	0.14	0.02	0.16	85.8

COPPER

BC #	D (cm)	L (µg/g)	R (µg/g)	T (µg/g)	L' (%)
7	-0.25	8.5	7.3	15.8	53.9
	-0.75	8.6	6.7	15.3	56.4
	-1.25	9.5	7.4	16.9	56.2
	-1.75	8.8	7.3	16.1	54.6
	-2.50	8.3	7.3	15.6	53.2
	-3.50	10.4	6.9	17.3	60.3
	-5.00	10.1	8.0	18.1	55.6
	-7.00	10.0	8.0	18.0	55.7
	-9.00	10.9	7.8	18.7	58.3
	-12.00	9.4	8.2	17.6	53.5
8	-0.25	8.2	19.4	27.6	29.7
	-0.75	8.0	18.5	26.5	30.2
	-1.25	8.1	18.5	26.6	30.4
	-1.75	8.2	17.9	26.1	31.5
	-2.50	8.0	11.5	19.5	41.1
	-3.50	7.6	17.0	24.6	30.9
	-5.00	7.6	18.2	25.9	29.4
	-7.00	7.6	15.8	23.4	32.4
	-9.00	7.3	17.4	24.7	29.6
	-12.00	10.7	15.2	25.9	41.2
10	-0.25	15.4	16.3	31.7	48.6
	-0.75	16.3	14.6	30.9	52.8
	-1.25	17.9	18.4	36.3	49.3
	-1.75	16.4	17.0	33.4	49.0
	-2.50	16.7	16.1	32.8	50.9
	-3.50	16.6	16.8	33.4	49.7
	-5.00	15.0	16.8	31.8	47.2
	-7.00	12.3	17.0	29.3	42.0
	-9.00	11.5	15.6	27.1	42.4
	-12.00	10.7	17.4	28.1	38.1
11	-0.25	6.8	12.6	19.4	35.0
	-0.75	6.5	11.1	17.6	36.9
	-1.25	5.8	9.7	15.5	37.3
	-1.75	6.7	14.4	21.1	31.8
	-2.50	6.5	8.0	14.5	44.8
	-3.50	6.4	13.3	19.7	32.4
	-5.00	9.2	13.5	22.7	40.5
	-7.00	7.1	7.6	14.7	48.2
	-9.00	8.3	13.1	21.4	38.8
	-12.00	8.8	13.2	22.0	40.1
13	-0.25	3.9	9.3	13.2	29.5
	-0.75	3.8	10.0	13.8	27.6
	-1.25	3.5	8.4	11.9	29.4
	-1.75	4.0	9.0	13.0	30.9
	-2.50	3.5	8.3	11.8	29.7
	-3.50	4.2	n.d.	n.d.	-
	-5.00	4.5	9.5	14.0	32.1
	-7.00	4.4	11.6	16.0	27.5
	-9.00	4.4	8.1	12.5	35.2
	-12.00	4.9	9.5	14.4	34.0

APPENDIX 7: Continued

CADMIUM

BC #	D (cm)	L (µg/g)	R (µg/g)	T (µg/g)	L' (%)
14	-0.25	0.10	0.16	0.26	38.8
	-0.75	0.09	0.01	0.10	94.6
	-1.25	0.20	0.01	0.21	95.2
	-1.75	0.16	0.01	0.17	94.7
	-2.50	0.13	0.03	0.16	83.4
	-3.50	0.15	0.04	0.19	80.9
	-5.00	0.12	0.02	0.14	84.7
	-7.00	0.20	0.01	0.21	95.2
	-9.00	0.07	b.d.	0.07	> 95.5
	-12.00	0.11	0.02	0.13	87.5
15	-0.25	0.07	b.d.	0.07	> 93.3
	-0.75	0.07	b.d.	0.07	> 93.3
	-1.25	0.18	0.06	0.24	76.2
	-1.75	0.12	0.01	0.13	92.0
	-2.50	0.06	b.d.	0.06	> 92.3
	-3.50	0.07	b.d.	0.07	> 94.7
	-5.00	0.06	0.01	0.07	85.5
	-7.00	0.06	b.d.	0.06	> 92.7
	-9.00	0.06	b.d.	0.06	> 92.5
	-12.00	0.13	b.d.	0.13	> 96.3
16	-0.25	0.09	b.d.	0.09	> 96.9
	-0.75	0.06	(1.67)	(1.73)	(3.5)
	-1.25	0.12	0.02	0.14	83.1
	-1.75	0.05	0.01	0.06	78.1
	-2.50	0.08	0.02	0.10	82.7
	-3.50	0.22	0.02	0.24	91.5
	-5.00	0.21	0.79	1.00	21.1
	-7.00	0.09	0.03	0.12	72.9
	-9.00	0.12	0.04	0.16	76.8
	-12.00	0.10	0.04	0.14	73.8
19	-0.25	0.08	0.04	0.12	69.5
	-0.75	0.10	0.01	0.11	93.5
	-1.25	0.08	0.11	0.19	41.1
	-1.75	n.d.	n.d.	n.d.	-
	-2.50	n.d.	n.d.	n.d.	-
	-3.50	0.05	0.01	0.06	86.3
	-5.00	0.06	0.03	0.09	69.6
	-7.00	0.07	0.04	0.11	63.9
	-9.00	0.04	b.d.	0.04	> 88.9
	-12.00	0.13	0.03	0.16	> 81.6

COPPER

BC #	D (cm)	L (µg/g)	R (µg/g)	T (µg/g)	L' (%)
14	-0.25	18.5	18.8	37.3	49.6
	-0.75	21.7	24.4	46.1	47.0
	-1.25	22.8	23.5	46.3	49.2
	-1.75	20.9	22.9	43.8	47.8
	-2.50	19.4	19.9	39.3	49.3
	-3.50	15.1	17.9	33.0	45.7
	-5.00	12.6	15.9	28.5	44.1
	-7.00	17.8	15.1	32.9	54.0
	-9.00	14.8	17.0	31.8	46.5
	-12.00	21.0	16.3	37.3	56.3
15	-0.25	22.8	17.3	40.1	56.8
	-0.75	28.3	24.6	52.9	53.5
	-1.25	27.9	25.5	53.4	52.3
	-1.75	27.4	21.5	48.9	56.1
	-2.50	28.0	22.5	50.5	55.5
	-3.50	25.4	19.3	44.7	56.9
	-5.00	19.2	19.8	39.0	49.3
	-7.00	20.1	13.9	34.0	59.1
	-9.00	30.1	18.1	48.2	62.5
	-12.00	21.0	17.7	38.7	54.2
16	-0.25	1.7	8.6	10.3	16.5
	-0.75	1.7	5.1	6.8	24.8
	-1.25	5.1	7.0	12.1	42.1
	-1.75	1.8	7.7	9.5	18.9
	-2.50	1.8	8.0	9.8	18.3
	-3.50	4.3	10.7	15.0	28.6
	-5.00	5.5	11.0	16.5	33.3
	-7.00	6.7	9.4	16.1	41.6
	-9.00	5.4	5.9	11.3	47.9
	-12.00	8.0	10.4	18.4	43.5
19	-0.25	7.2	6.6	13.8	52.1
	-0.75	7.1	7.5	14.6	48.6
	-1.25	6.9	11.3	18.2	37.9
	-1.75	n.d.	n.d.	n.d.	-
	-2.50	n.d.	n.d.	n.d.	-
	-3.50	6.7	6.4	13.1	51.2
	-5.00	6.1	6.3	12.4	49.0
	-7.00	5.5	6.1	11.6	47.4
	-9.00	4.5	5.8	10.3	43.7
	-12.00	5.4	8.9	14.3	37.9

APPENDIX 8:

Nickel and chromium concentrations in sediments from the North Western Mediterranean Sea. The table shows the boxcore station (BC, see also appendix 2 and appendix 3), the mean depth (D), the leachable fraction (L), the residual fraction (R) and the total fraction (T, expressed as the sum total of the leachable and residual fraction). The last column (L') gives the leachable fraction in percents of the total fraction. { n.d. means not determined }

NICKELCHROMIUM

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' (%)
1	-0.25	6.9	n.d.	37.6	18.4	1	-0.25	5.9	n.d.	88.7	6.7
	-0.75	5.6	n.d.	39.5	14.2		-0.75	5.4	n.d.	91.6	5.9
	-1.25	5.7	n.d.	36.5	15.6		-1.25	5.4	n.d.	89.6	6.0
	-1.75	5.6	n.d.	37.8	14.8		-1.75	5.3	n.d.	86.5	6.1
	-2.50	5.5	n.d.	39.3	14.0		-2.50	5.5	n.d.	87.1	6.3
	-3.50	5.6	n.d.	36.7	15.2		-3.50	5.7	n.d.	90.3	6.3
	-5.00	5.7	n.d.	36.4	15.7		-5.00	5.7	n.d.	88.9	6.4
	-7.00	5.4	n.d.	35.8	15.1		-7.00	5.6	n.d.	90.7	6.2
	-9.00	5.4	n.d.	36.0	15.0		-9.00	6.2	n.d.	89.2	7.0
	-11.00	6.4	n.d.	38.6	16.6		-11.00	6.0	n.d.	89.9	6.7
2	-0.25	10.8	n.d.	n.d.	-	2	-0.25	9.7	n.d.	88.8	10.9
	-0.75	11.4	n.d.	43.0	26.5		-0.75	9.5	n.d.	84.6	11.2
	-1.25	10.3	n.d.	39.7	26.0		-1.25	8.3	n.d.	75.6	11.0
	-1.75	11.2	n.d.	44.2	25.4		-1.75	8.4	n.d.	95.9	8.8
	-2.50	11.9	n.d.	50.2	23.7		-2.50	8.0	n.d.	96.8	8.3
	-3.50	12.2	n.d.	49.8	24.5		-3.50	7.4	n.d.	93.8	7.9
	-5.00	12.6	n.d.	38.1	33.1		-5.00	9.0	n.d.	69.8	12.9
	-7.00	14.9	n.d.	49.7	30.0		-7.00	9.4	n.d.	84.6	11.1
	-9.00	14.0	n.d.	43.1	32.5		-9.00	8.8	n.d.	66.9	13.2
	-12.00	14.1	n.d.	43.3	32.5		-12.00	8.9	n.d.	73.1	12.2
4	-0.25	6.4	n.d.	31.0	20.7	4	-0.25	3.5	n.d.	58.6	6.0
	-0.75	5.8	n.d.	31.3	18.5		-0.75	2.8	n.d.	46.1	6.1
	-1.25	4.8	n.d.	31.2	15.4		-1.25	2.6	n.d.	40.0	6.5
	-1.75	4.7	n.d.	35.7	13.2		-1.75	2.6	n.d.	43.7	5.9
	-2.50	4.4	n.d.	30.6	14.4		-2.50	2.7	n.d.	64.0	4.2
	-3.50	4.7	n.d.	30.1	15.6		-3.50	2.7	n.d.	56.1	4.8
	-5.00	4.6	n.d.	31.8	14.4		-5.00	2.6	n.d.	32.7	7.9
	-7.00	4.7	n.d.	31.9	14.7		-7.00	2.6	n.d.	58.2	4.5
	-9.00	4.5	n.d.	29.3	15.4		-9.00	2.4	n.d.	45.8	5.2
	-12.00	4.5	n.d.	30.3	14.8		-12.00	2.4	n.d.	68.6	3.5
6	-0.25	5.8	28.6	34.4	16.9	6	-0.25	3.1	57.3	60.4	5.1
	-0.75	6.0	29.2	35.2	17.1		-0.75	2.7	60.3	63.0	4.3
	-1.25	5.5	22.1	27.6	20.0		-1.25	2.4	44.9	47.3	5.1
	-1.75	6.0	36.7	42.7	14.0		-1.75	2.5	72.3	74.8	3.3
	-2.50	5.6	27.6	33.2	16.9		-2.50	2.3	58.4	60.7	3.8
	-3.50	5.3	27.4	32.7	16.2		-3.50	2.4	55.6	58.0	4.1
	-5.00	5.8	28.5	34.3	16.9		-5.00	2.4	56.7	59.1	4.1
	-7.00	5.5	28.1	33.6	16.4		-7.00	2.5	59.6	62.1	4.0
	-9.00	5.4	28.4	33.8	16.0		-9.00	2.5	56.5	59.0	4.2
	-12.00	4.9	26.6	31.5	15.6		-12.00	2.2	54.5	56.7	3.9

APPENDIX 8: Continued

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' (%)
7	-0.25	3.5	17.3	20.8	16.8	7	-0.25	3.1	45.0	48.1	6.4
	-0.75	4.1	18.3	22.4	18.3		-0.75	2.4	45.3	47.7	5.0
	-1.25	4.4	19.4	23.8	18.5		-1.25	2.3	47.0	49.3	4.7
	-1.75	4.1	18.3	22.4	18.3		-1.75	2.4	44.1	46.5	5.2
	-2.50	4.1	18.7	22.8	18.0		-2.50	2.3	44.5	46.8	4.9
	-3.50	4.1	17.6	21.7	18.9		-3.50	2.4	45.0	47.4	5.1
	-5.00	4.0	21.1	25.1	15.9		-5.00	2.3	51.9	54.2	4.2
	-7.00	4.2	14.4	18.6	22.6		-7.00	2.3	49.0	51.3	4.5
	-9.00	5.6	21.1	26.7	21.0		-9.00	2.3	50.1	52.4	4.4
	-12.00	4.8	20.1	24.9	19.3		-12.00	2.2	49.6	51.8	4.2
8	-0.25	6.8	30.9	37.7	18.1	8	-0.25	3.2	69.1	72.3	4.4
	-0.75	6.7	31.4	38.1	17.6		-0.75	2.5	63.3	65.8	3.8
	-1.25	6.5	32.8	39.3	16.5		-1.25	2.4	66.6	69.0	3.5
	-1.75	6.7	31.7	38.4	17.4		-1.75	2.4	66.3	68.7	3.5
	-2.50	6.8	22.8	29.6	23.0		-2.50	2.5	41.7	44.2	5.7
	-3.50	6.4	29.0	35.4	18.1		-3.50	2.2	65.9	68.1	3.2
	-5.00	6.4	32.2	38.6	16.6		-5.00	2.0	62.5	64.5	3.1
	-7.00	6.6	30.9	37.5	17.6		-7.00	2.1	62.1	64.2	3.3
	-9.00	6.1	31.6	37.7	16.2		-9.00	1.6	66.2	67.8	2.4
	-12.00	6.8	31.5	38.3	17.8		-12.00	1.5	63.3	64.8	2.3
10	-0.25	18.8	28.3	47.1	39.9	10	-0.25	8.6	70.1	78.7	10.9
	-0.75	17.9	28.6	46.5	38.5		-0.75	8.4	70.7	79.1	10.6
	-1.25	21.1	27.0	48.1	43.8		-1.25	9.7	72.1	81.8	11.9
	-1.75	18.8	26.3	45.1	41.7		-1.75	9.1	71.1	80.2	11.3
	-2.50	18.3	27.9	46.2	39.6		-2.50	8.2	70.5	78.7	10.4
	-3.50	19.2	37.6	56.8	33.8		-3.50	6.2	65.7	71.9	8.6
	-5.00	19.2	28.4	47.6	40.4		-5.00	7.6	71.5	79.1	9.6
	-7.00	16.7	28.3	45.0	37.1		-7.00	7.3	67.2	74.5	9.8
	-9.00	16.1	27.0	43.1	37.4		-9.00	7.0	67.6	74.6	9.4
	-12.00	14.9	26.8	41.7	35.8		-12.00	6.6	62.5	69.1	9.6
11	-0.25	6.7	16.9	23.6	28.3	11	-0.25	6.0	43.9	49.9	12.0
	-0.75	5.9	17.0	22.9	25.8		-0.75	5.5	39.1	44.6	12.3
	-1.25	4.9	17.3	22.2	22.1		-1.25	5.0	41.0	46.0	10.9
	-1.75	6.0	17.8	23.8	25.2		-1.75	6.0	41.4	47.4	12.7
	-2.50	6.1	18.1	24.2	25.2		-2.50	5.6	42.7	48.3	11.6
	-3.50	6.2	17.4	23.6	26.3		-3.50	5.8	42.3	48.1	12.1
	-5.00	6.8	18.4	25.2	27.0		-5.00	5.0	40.9	45.9	10.9
	-7.00	6.0	19.5	25.5	23.6		-7.00	4.7	48.3	53.0	8.9
	-9.00	7.4	19.1	26.5	27.9		-9.00	4.7	44.9	49.6	9.5
	-12.00	7.2	14.4	21.6	33.4		-12.00	4.7	54.7	59.4	7.9
13	-0.25	4.8	14.1	18.9	25.4	13	-0.25	3.8	30.2	34.0	11.2
	-0.75	5.4	13.4	18.8	28.7		-0.75	4.0	36.0	40.0	10.0
	-1.25	4.5	15.7	20.2	22.3		-1.25	3.8	28.7	32.5	11.7
	-1.75	4.7	13.8	18.5	25.4		-1.75	3.9	31.8	35.7	10.9
	-2.50	4.4	13.4	17.8	24.7		-2.50	3.8	33.7	37.5	10.1
	-3.50	4.9	n.d.	n.d.	-		-3.50	4.2	39.5	43.7	9.6
	-5.00	4.6	14.3	18.9	24.3		-5.00	4.1	37.0	41.1	10.0
	-7.00	5.1	14.8	19.9	25.7		-7.00	4.1	32.1	36.2	11.3
	-9.00	4.7	15.3	20.0	23.5		-9.00	4.1	36.1	40.2	10.2
	-12.00	5.1	16.3	21.4	23.8		-12.00	3.8	39.3	43.1	8.8

APPENDIX 8: Continued

NICKEL

BC #	D (cm)	L (µg/g)	R (µg/g)	T (µg/g)	L' (%)
14	-0.25	15.4	16.3	31.7	48.5
	-0.75	19.0	18.0	37.0	51.4
	-1.25	20.0	19.2	39.2	51.0
	-1.75	24.5	20.1	44.6	54.9
	-2.50	19.4	20.7	40.1	48.4
	-3.50	17.2	19.4	36.6	47.0
	-5.00	17.7	13.6	31.3	56.6
	-7.00	19.4	18.1	37.5	51.7
	-9.00	18.5	17.5	36.0	51.4
	-12.00	23.1	18.6	41.7	55.4
15	-0.25	20.4	16.3	36.7	55.5
	-0.75	22.1	22.7	44.8	49.4
	-1.25	22.1	19.1	41.2	53.6
	-1.75	26.4	17.8	44.2	59.7
	-2.50	24.4	18.9	43.3	56.3
	-3.50	24.7	19.3	44.0	56.2
	-5.00	19.8	19.0	38.8	51.0
	-7.00	28.0	20.6	48.6	57.6
	-9.00	36.3	22.8	59.1	61.4
	-12.00	22.8	21.4	44.2	51.6
16	-0.25	5.7	6.7	12.4	46.1
	-0.75	5.5	5.5	11.0	50.0
	-1.25	7.1	6.9	14.0	50.9
	-1.75	6.9	6.3	13.2	52.1
	-2.50	5.4	6.4	11.8	45.8
	-3.50	8.1	10.0	18.1	44.8
	-5.00	9.2	11.5	20.7	44.4
	-7.00	10.3	11.6	21.9	47.1
	-9.00	8.9	11.4	20.3	43.9
	-12.00	9.8	13.1	22.9	42.8
19	-0.25	14.8	17.2	32.0	46.3
	-0.75	16.6	17.1	33.7	49.3
	-1.25	21.2	20.5	41.7	50.8
	-1.75	n.d.	n.d.	n.d.	-
	-2.50	n.d.	n.d.	n.d.	-
	-3.50	15.0	18.3	33.3	45.1
	-5.00	16.4	17.2	33.6	48.8
	-7.00	15.7	17.3	33.0	47.6
	-9.00	14.2	16.4	30.6	46.4
	-12.00	15.1	17.0	32.1	47.1

CHROMIUM

BC #	D (cm)	L (µg/g)	R (µg/g)	T (µg/g)	L' (%)
14	-0.25	8.8	40.5	49.3	17.8
	-0.75	10.6	48.6	59.2	17.9
	-1.25	10.1	45.7	55.8	18.1
	-1.75	10.1	59.0	69.1	14.6
	-2.50	9.8	49.7	59.5	16.5
	-3.50	10.4	45.1	55.5	18.8
	-5.00	7.8	35.2	43.0	18.1
	-7.00	10.2	70.1	80.3	12.7
	-9.00	8.7	43.7	52.4	16.6
	-12.00	9.7	47.0	56.7	17.1
15	-0.25	8.8	48.8	57.6	15.3
	-0.75	11.0	57.6	68.6	16.0
	-1.25	11.3	49.2	60.5	18.7
	-1.75	13.8	52.0	65.8	21.0
	-2.50	11.0	51.8	62.8	17.5
	-3.50	9.9	49.9	59.8	16.6
	-5.00	8.7	50.4	59.1	14.7
	-7.00	12.6	58.6	71.2	17.7
	-9.00	12.6	60.0	72.6	17.4
	-12.00	12.2	58.3	70.5	17.3
16	-0.25	4.1	27.1	31.2	13.2
	-0.75	3.9	20.1	24.0	16.3
	-1.25	4.3	23.1	27.4	15.7
	-1.75	4.4	20.4	24.8	17.8
	-2.50	3.9	24.2	28.1	13.9
	-3.50	5.4	33.8	39.2	13.8
	-5.00	5.4	33.1	38.5	14.0
	-7.00	6.6	35.4	42.0	15.7
	-9.00	5.5	35.9	41.4	13.3
	-12.00	6.4	41.4	47.8	13.4
19	-0.25	10.1	42.5	52.6	19.2
	-0.75	10.9	43.2	54.1	20.1
	-1.25	10.4	42.6	53.0	19.6
	-1.75	n.d.	n.d.	n.d.	-
	-2.50	n.d.	n.d.	n.d.	-
	-3.50	9.3	38.5	47.8	19.4
	-5.00	9.8	42.4	52.2	18.8
	-7.00	9.3	39.9	49.2	18.9
	-9.00	8.6	41.2	49.8	17.3
	-12.00	8.4	40.0	48.4	17.3

APPENDIX 9: Lead concentrations in sediments from the North Western Mediterranean Sea. The table shows the boxcore station (BC, see also appendix 2 and appendix 3), the mean depth (D) and the leachable fraction (L),

BC #	D (cm)	L (µg/g)
1	-0.25	23.20
	-0.75	19.20
	-1.25	20.80
	-1.75	19.40
	-2.50	23.70
	-3.50	25.00
	-5.00	24.50
	-7.00	20.90
	-9.00	20.50
	-11.00	22.40
2	-0.25	22.30
	-0.75	21.80
	-1.25	20.00
	-1.75	20.40
	-2.50	19.90
	-3.50	20.70
	-5.00	21.70
	-7.00	24.80
	-9.00	24.70
	-12.00	24.40
4	-0.25	16.20
	-0.75	16.30
	-1.25	16.50
	-1.75	17.00
	-2.50	16.70
	-3.50	17.10
	-5.00	15.50
	-7.00	17.10
	-9.00	16.20
	-12.00	14.30
6	-0.25	19.30
	-0.75	18.50
	-1.25	17.40
	-1.75	17.90
	-2.50	16.80
	-3.50	17.20
	-5.00	17.40
	-7.00	16.60
	-9.00	16.10
	-12.00	14.50
7	-0.25	10.90
	-0.75	10.70
	-1.25	11.60
	-1.75	10.80
	-2.50	11.50
	-3.50	11.60
	-5.00	11.60
	-7.00	8.70
	-9.00	12.90
	-12.00	13.00

APPENDIX 9 : Continued

B C #	D (cm)	L ($\mu\text{g/g}$)
8	-0.25	20.50
	-0.75	19.90
	-1.25	18.40
	-1.75	18.60
	-2.50	18.90
	-3.50	18.80
	-5.00	19.70
	-7.00	20.00
	-9.00	16.80
	-12.00	15.70
10	-0.25	19.60
	-0.75	15.70
	-1.25	18.50
	-1.75	18.70
	-2.50	16.30
	-3.50	14.00
	-5.00	12.00
	-7.00	11.50
	-9.00	11.00
	-12.00	7.90
11	-0.25	12.80
	-0.75	11.70
	-1.25	10.70
	-1.75	12.70
	-2.50	11.70
	-3.50	12.20
	-5.00	11.70
	-7.00	11.30
	-9.00	11.10
	-12.00	11.00
13	-0.25	8.80
	-0.75	9.00
	-1.25	8.00
	-1.75	8.30
	-2.50	8.30
	-3.50	8.50
	-5.00	8.70
	-7.00	9.00
	-9.00	8.50
	-12.00	5.60
14	-0.25	11.70
	-0.75	11.70
	-1.25	10.30
	-1.75	8.30
	-2.50	7.00
	-3.50	5.40
	-5.00	4.90
	-7.00	6.40
	-9.00	5.60
	-12.00	6.20

APPENDIX 9 : Continued

B C #	D (cm)	L (µg/g)
15	-0.25	11.50
	-0.75	12.00
	-1.25	9.30
	-1.75	9.00
	-2.50	6.80
	-3.50	4.50
	-5.00	3.90
	-7.00	4.90
	-9.00	6.10
	-12.00	5.50
16	-0.25	5.20
	-0.75	5.10
	-1.25	6.10
	-1.75	6.60
	-2.50	5.20
	-3.50	4.70
	-5.00	4.20
	-7.00	4.50
	-9.00	4.00
	-12.00	4.70
19	-0.25	9.30
	-0.75	9.20
	-1.25	10.10
	-1.75	
	-2.50	
	-3.50	10.10
	-5.00	9.10
	-7.00	6.70
	-9.00	6.70
	-12.00	5.90

APPENDIX 10: Zinc concentrations in sediments from the North Western Mediterranean Sea. The table shows the boxcore station (BC, see also appendix 2 and appendix 3), the mean depth (D), the leachable fraction (L), the residual fraction (R) the total fraction (T, expressed as the sum total of the leachable and residual fraction) and the leachable fraction in percents of the total fraction (L'). The last column (P) gives the concentration in the porewaters. { n.d. means not determined and n.s. means no sample }

BC #	D (cm)	L (µg/g)	R (µg/g)	T (µg/g)	L' (%)	P (µM)
1	-0.25	56.7	n.d.	256.3	22.1	2.35
	-0.75	49.2	n.d.	189.1	26.0	3.64
	-1.25	51.0	n.d.	157.6	32.4	1.32
	-1.75	49.0	n.d.	241.2	20.3	n.s.
	-2.50	59.8	n.d.	227.3	26.3	3.77
	-3.50	50.0	n.d.	145.4	34.4	3.51
	-5.00	50.0	n.d.	160.3	31.2	1.07
	-7.00	50.3	n.d.	146.7	34.3	0.49
	-9.00	54.7	n.d.	152.6	35.9	2.16
	-11.00	53.5	n.d.	181.5	29.5	4.99
2	-0.25	86.7	n.d.	282.9	30.6	2.29
	-0.75	91.8	n.d.	237.4	38.7	1.58
	-1.25	84.3	n.d.	198.9	42.4	1.32
	-1.75	80.5	n.d.	239.9	33.6	0.55
	-2.50	78.9	n.d.	251.2	31.4	0.74
	-3.50	78.0	n.d.	240.3	32.5	2.42
	-5.00	86.5	n.d.	174.4	49.6	2.03
	-7.00	86.0	n.d.	221.4	38.9	1.00
	-9.00	91.7	n.d.	216.6	42.3	0.55
	-12.00	89.0	n.d.	185.9	47.9	0.36
4	-0.25	29.1	n.d.	185.5	15.7	0.67
	-0.75	25.2	n.d.	254.9	9.9	0.80
	-1.25	27.5	n.d.	157.8	17.4	0.47
	-1.75	25.9	n.d.	169.0	15.3	0.41
	-2.50	26.0	n.d.	116.9	22.2	0.34
	-3.50	26.3	n.d.	121.5	21.6	0.54
	-5.00	28.1	n.d.	119.0	23.6	1.07
	-7.00	27.3	n.d.	113.5	24.1	0.05
	-9.00	25.2	n.d.	97.2	25.9	0.54
	-12.00	25.7	n.d.	100.6	25.5	0.60
6	-0.25	28.9	104.3	133.2	21.7	0.80
	-0.75	36.5	88.9	125.4	29.1	0.67
	-1.25	30.9	71.8	102.7	30.1	1.27
	-1.75	25.1	113.4	138.5	18.1	1.40
	-2.50	26.7	87.8	114.5	23.3	1.00
	-3.50	30.0	78.7	108.7	27.6	0.94
	-5.00	35.6	86.9	122.5	29.1	1.20
	-7.00	30.4	126.1	156.5	19.4	0.74
	-9.00	27.6	81.4	109.0	25.3	1.47
	-12.00	28.8	104.4	133.2	21.6	2.26
7	-0.25	26.1	89.4	115.5	22.6	0.60
	-0.75	28.1	60.2	88.3	31.8	0.80
	-1.25	28.4	69.2	97.6	29.1	3.61
	-1.75	44.8	56.5	101.3	44.2	0.37
	-2.50	24.9	57.0	81.9	30.4	4.79
	-3.50	28.9	82.6	111.5	25.9	0.93
	-5.00	29.1	71.4	100.5	28.9	0.66
	-7.00	28.7	77.4	106.1	27.1	1.45
	-9.00	29.1	71.6	100.7	28.9	0.99
	-12.00	31.2	65.2	96.4	32.4	0.93

APPENDIX 10: Continued

B C #	D (cm)	L (µg/g)	R (µg/g)	T (µg/g)	L' (%)	P (µM)
8	-0.25	26.9	114.4	141.3	19.0	0.66
	-0.75	27.5	94.4	121.9	22.6	1.78
	-1.25	21.4	56.5	77.9	27.5	1.91
	-1.75	30.4	65.0	95.4	31.9	3.29
	-2.50	31.4	76.2	107.6	29.2	0.73
	-3.50	27.0	70.8	97.8	27.6	0.47
	-5.00	22.5	80.0	102.5	21.9	0.60
	-7.00	30.8	79.2	110.0	28.0	0.53
	-9.00	23.1	92.4	115.5	20.0	0.53
	-12.00	18.7	91.2	109.9	17.0	n.s.
10	-0.25	45.5	130.5	176.0	25.9	0.65
	-0.75	52.0	91.4	143.4	36.3	0.39
	-1.25	52.3	168.3	220.6	23.7	0.98
	-1.75	37.3	149.1	186.4	20.0	0.65
	-2.50	50.9	97.8	148.7	34.2	0.52
	-3.50	47.7	159.1	206.8	23.1	0.52
	-5.00	40.3	110.0	150.3	26.8	0.72
	-7.00	37.4	109.2	146.6	25.5	0.59
	-9.00	37.3	102.2	139.5	26.7	1.56
	-12.00	32.0	81.7	113.7	28.1	1.17
11	-0.25	37.1	78.5	115.6	32.1	n.s.
	-0.75	30.8	78.1	108.9	28.3	2.99
	-1.25	30.0	76.9	106.9	28.1	1.95
	-1.75	34.1	85.2	119.3	28.6	0.78
	-2.50	33.6	64.0	97.6	34.4	1.11
	-3.50	29.8	77.0	106.8	27.9	0.72
	-5.00	31.3	84.2	115.5	27.1	1.17
	-7.00	30.4	67.6	98.0	31.0	n.s.
	-9.00	28.7	87.3	116.0	24.8	0.65
	-12.00	31.9	84.6	116.5	27.4	1.11
13	-0.25	24.2	70.2	94.4	25.6	3.08
	-0.75	24.9	92.3	117.2	21.2	2.95
	-1.25	22.0	55.1	77.1	28.5	1.22
	-1.75	21.6	74.3	95.9	22.5	2.27
	-2.50	21.4	65.4	86.8	24.6	3.65
	-3.50	23.8	n.d.	n.d.	-	1.28
	-5.00	23.0	67.9	90.9	25.3	2.50
	-7.00	18.1	69.7	87.8	20.6	1.86
	-9.00	19.9	69.4	89.3	22.3	1.22
	-12.00	20.0	77.0	97.0	20.6	n.s.
14	-0.25	32.9	45.0	77.9	42.2	2.05
	-0.75	34.1	46.5	80.6	42.3	4.42
	-1.25	35.5	40.6	76.1	46.6	5.13
	-1.75	27.9	45.0	72.9	38.2	6.73
	-2.50	30.2	36.8	67.0	45.0	8.46
	-3.50	25.9	42.6	68.5	37.8	13.40
	-5.00	18.4	21.7	40.1	45.9	2.63
	-7.00	27.2	30.2	57.4	47.4	3.46
	-9.00	24.4	33.4	57.8	42.2	4.36
	-12.00	25.6	52.2	77.8	32.9	1.99

APPENDIX 10: Continued

BC #	D (cm)	L ($\mu\text{g/g}$)	R ($\mu\text{g/g}$)	T ($\mu\text{g/g}$)	L' (%)	P (μM)
15	-0.25	24.0	63.1	87.1	27.6	8.00
	-0.75	32.2	77.8	110.0	29.3	4.36
	-1.25	28.1	84.3	112.4	25.0	4.30
	-1.75	32.0	78.8	110.8	28.9	n.s.
	-2.50	25.6	68.3	93.9	27.2	4.94
	-3.50	24.2	54.6	78.8	30.7	n.s.
	-5.00	n.d.	n.d.	n.d.	-	4.81
	-7.00	26.0	61.4	87.4	29.7	7.95
	-9.00	32.4	72.5	104.9	30.9	2.06
	-12.00	28.2	68.3	96.5	29.2	2.70
16	-0.25	16.5	37.0	53.5	30.8	n.s.
	-0.75	16.9	44.1	61.0	27.7	6.41
	-1.25	22.7	38.4	61.1	37.1	5.00
	-1.75	23.2	35.1	58.3	39.8	2.12
	-2.50	21.7	33.4	55.1	39.4	3.79
	-3.50	24.8	36.6	61.4	40.4	3.02
	-5.00	24.2	35.8	60.0	40.3	6.22
	-7.00	26.8	28.7	55.5	48.3	2.44
	-9.00	23.2	21.8	45.0	51.6	4.62
	-12.00	26.5	29.1	55.6	47.7	1.55
19	-0.25	59.3	45.6	104.9	56.5	1.39
	-0.75	64.6	51.8	116.4	55.5	3.04
	-1.25	55.9	54.9	110.8	50.4	2.28
	-1.75	n.d.	n.d.	n.d.	-	5.52
	-2.50	n.d.	n.d.	n.d.	-	2.09
	-3.50	48.0	55.6	103.6	46.3	2.28
	-5.00	44.6	56.9	101.5	44.0	1.90
	-7.00	51.3	55.3	106.6	48.1	1.20
	-9.00	42.5	53.2	95.7	44.4	1.52
	-12.00	37.1	62.5	99.6	37.3	1.39

APPENDIX 11: Manganese concentrations in sediments from the North Western Mediterranean Sea. The table shows the boxcore station (BC, see also appendix 2 and appendix 3), the mean depth (D), the leachable fraction (L), the residual fraction (R) the total fraction (T, expressed as the sum total of the leachable and residual fraction) and the leachable fraction in percents of the total fraction (L'). The last column (P) gives the concentration in the porewaters. { n.d. means not determined and n.s. means no sample }

B C #	D (cm)	L ($\mu\text{g/g}$)	R ($\mu\text{g/g}$)	T ($\mu\text{g/g}$)	L' (%)	P (μM)
1	-0.25	527	n.d.	728	72.4	3.46
	-0.75	439	n.d.	664	66.1	12.10
	-1.25	446	n.d.	651	68.5	17.40
	-1.75	412	n.d.	618	66.7	n.s.
	-2.50	431	n.d.	648	66.5	36.40
	-3.50	405	n.d.	605	66.9	47.80
	-5.00	400	n.d.	583	68.6	42.50
	-7.00	399	n.d.	573	69.6	27.80
	-9.00	422	n.d.	587	71.8	30.30
	-11.00	408	n.d.	581	70.3	29.60
2	-0.25	502	n.d.	705	71.2	5.61
	-0.75	498	n.d.	705	70.7	10.30
	-1.25	473	n.d.	696	67.9	16.30
	-1.75	474	n.d.	747	63.4	14.60
	-2.50	482	n.d.	839	57.4	25.30
	-3.50	607	n.d.	961	63.2	44.30
	-5.00	558	n.d.	698	80.0	69.30
	-7.00	625	n.d.	964	64.9	83.40
	-9.00	752	n.d.	989	76.1	82.20
	-12.00	702	n.d.	923	76.0	88.80
4	-0.25	885	n.d.	1191	74.3	1.95
	-0.75	822	n.d.	1129	72.8	1.95
	-1.25	886	n.d.	1226	72.3	1.95
	-1.75	851	n.d.	1103	77.1	1.95
	-2.50	824	n.d.	1150	71.7	2.31
	-3.50	810	n.d.	1075	75.4	3.38
	-5.00	710	n.d.	1012	70.2	21.90
	-7.00	563	n.d.	816	69.0	36.60
	-9.00	544	n.d.	750	72.5	58.70
	-12.00	559	n.d.	811	68.9	57.30
6	-0.25	777	137	914	85.0	1.95
	-0.75	828	150	978	84.7	1.95
	-1.25	790	90	880	89.8	2.31
	-1.75	681	189	870	78.3	5.52
	-2.50	595	137	732	81.2	2.31
	-3.50	575	123	698	82.4	3.73
	-5.00	480	149	629	76.3	15.20
	-7.00	439	126	565	77.7	15.50
	-9.00	443	113	556	79.7	13.70
	-12.00	420	133	553	76.0	25.90
7	-0.25	316	82	398	79.4	12.10
	-0.75	293	88	381	76.8	17.00
	-1.25	310	106	416	74.6	17.70
	-1.75	300	102	402	74.5	17.70
	-2.50	310	89	399	77.7	20.00
	-3.50	322	91	413	78.0	19.60
	-5.00	338	86	424	79.8	15.50
	-7.00	332	92	424	78.3	11.70
	-9.00	334	86	420	79.5	8.74
	-12.00	330	91	421	78.5	5.74

APPENDIX 11: Continued

B C #	D (cm)	L ($\mu\text{g/g}$)	R ($\mu\text{g/g}$)	T ($\mu\text{g/g}$)	L' (%)	P (μM)
8	-0.25	836	335	1171	71.4	1.81
	-0.75	810	429	1239	65.4	1.81
	-1.25	868	557	1425	60.9	2.17
	-1.75	932	616	1548	60.2	5.44
	-2.50	996	520	1516	65.7	2.17
	-3.50	858	403	1261	68.1	3.62
	-5.00	675	220	895	75.4	15.20
	-7.00	612	207	819	74.7	15.60
	-9.00	580	205	785	73.8	13.80
	-12.00	400	203	603	66.4	26.10
10	-0.25	1633	160	1793	91.1	1.81
	-0.75	1572	165	1737	90.5	1.81
	-1.25	1556	150	1706	91.2	2.17
	-1.75	1095	126	1221	89.7	1.81
	-2.50	2339	157	2496	93.7	2.54
	-3.50	3121	441	3562	87.6	16.70
	-5.00	3368	674	4042	83.3	44.30
	-7.00	1471	164	1635	90.0	119.00
	-9.00	570	142	712	80.1	121.00
	-12.00	565	153	718	78.7	98.10
11	-0.25	319	73	392	81.3	n.s.
	-0.75	269	68	337	79.7	4.16
	-1.25	227	81	308	73.8	12.20
	-1.75	262	67	329	79.7	10.40
	-2.50	251	75	326	77.1	9.30
	-3.50	245	67	312	78.4	7.46
	-5.00	265	84	349	75.9	7.83
	-7.00	251	87	338	74.3	7.83
	-9.00	262	87	349	75.0	6.73
	-12.00	273	72	345	79.2	6.36
13	-0.25	291	63	354	82.2	2.69
	-0.75	277	51	328	84.5	3.79
	-1.25	261	40	301	86.6	7.83
	-1.75	272	53	325	83.7	6.73
	-2.50	275	52	327	84.2	8.57
	-3.50	270	n.d.	n.d.	-	4.16
	-5.00	279	68	347	80.4	6.36
	-7.00	274	51	325	84.3	5.63
	-9.00	273	51	324	84.3	4.16
	-12.00	277	58	335	82.7	n.s.
14	-0.25	649	50	699	92.9	1.98
	-0.75	759	93	852	89.1	2.72
	-1.25	797	56	853	93.5	3.46
	-1.75	770	68	838	91.9	3.83
	-2.50	789	66	855	92.2	2.35
	-3.50	600	78	678	88.5	5.68
	-5.00	520	38	558	93.2	3.46
	-7.00	565	35	600	94.1	3.46
	-9.00	701	73	774	90.5	2.72
	-12.00	799	57	856	93.3	n.s.

APPENDIX 11: Continued

BC #	D (cm)	L ($\mu\text{g/g}$)	R ($\mu\text{g/g}$)	T ($\mu\text{g/g}$)	L' (%)	P (μM)
15	-0.25	698	46	744	93.8	3.09
	-0.75	887	57	944	94.0	3.09
	-1.25	843	49	892	94.5	3.09
	-1.75	882	58	940	93.8	n.s.
	-2.50	746	63	809	92.2	2.72
	-3.50	710	59	769	92.4	n.s.
	-5.00	631	239	870	72.5	2.72
	-7.00	978	52	1030	95.0	3.46
	-9.00	2045	280	2325	87.9	2.72
	-12.00	934	82	1016	91.9	2.72
16	-0.25	316	114	430	73.5	n.s.
	-0.75	317	100	417	76.0	5.36
	-1.25	276	101	377	73.2	17.00
	-1.75	295	77	372	79.2	19.60
	-2.50	234	151	385	60.9	20.30
	-3.50	289	118	407	71.0	20.30
	-5.00	304	81	385	79.0	18.50
	-7.00	359	86	445	80.7	8.74
	-9.00	315	91	406	77.7	7.99
	-12.00	395	81	476	83.0	17.40
19	-0.25	548	102	650	84.3	2.74
	-0.75	591	76	667	88.6	2.74
	-1.25	623	82	705	88.3	2.74
	-1.75	n.d.	n.d.	n.d.	-	3.87
	-2.50	n.d.	n.d.	n.d.	-	2.74
	-3.50	544	87	631	86.2	3.49
	-5.00	389	79	468	83.2	11.40
	-7.00	316	87	403	78.4	12.50
	-9.00	297	80	377	78.8	n.s.
	-12.00	279	81	360	77.5	18.50

APPENDIX 12: Iron concentrations in sediments from the North Western Mediterranean Sea. The table shows the boxcore station (BC, see also appendix 2 and appendix 3), the mean depth (D), the leachable fraction (L), the residual fraction (R) the total fraction (T, expressed as the sum total of the leachable and residual fraction) and the leachable fraction in percents of the total fraction (L'). The last column (P) gives the concentration in the porewaters. { n.d. means not determined and n.s. means no sample }

BC #	D (cm)	L (%)	R (%)	T (%)	L' (%)	P (μM)
1	-0.25	0.62	n.d.	3.25	19.1	7.19
	-0.75	0.55	n.d.	3.19	17.2	5.96
	-1.25	0.60	n.d.	3.00	20.0	5.34
	-1.75	0.54	n.d.	3.89	13.9	n.s.
	-2.50	0.58	n.d.	3.08	18.9	7.80
	-3.50	0.57	n.d.	2.76	20.7	6.57
	-5.00	0.53	n.d.	2.95	18.0	26.90
	-7.00	0.54	n.d.	2.81	19.2	12.70
	-9.00	0.58	n.d.	2.89	20.0	15.20
	-11.00	0.57	n.d.	2.83	20.1	15.80
2	-0.25	0.82	n.d.	3.05	26.9	7.80
	-0.75	0.83	n.d.	3.34	24.9	30.50
	-1.25	0.71	n.d.	2.98	23.8	63.70
	-1.75	0.72	n.d.	3.25	22.2	13.30
	-2.50	0.75	n.d.	3.28	22.9	28.70
	-3.50	0.82	n.d.	3.87	21.2	87.70
	-5.00	0.82	n.d.	2.79	29.4	143.00
	-7.00	0.89	n.d.	2.94	30.2	215.00
	-9.00	0.97	n.d.	3.31	29.3	206.00
	-12.00	0.90	n.d.	3.06	29.4	276.00
4	-0.25	0.43	n.d.	3.02	14.2	6.21
	-0.75	0.41	n.d.	2.55	16.1	4.25
	-1.25	0.41	n.d.	3.24	12.7	5.96
	-1.75	0.40	n.d.	2.65	15.1	4.25
	-2.50	0.40	n.d.	2.77	14.4	3.60
	-3.50	0.42	n.d.	2.89	14.5	4.25
	-5.00	0.39	n.d.	3.33	11.7	5.56
	-7.00	0.37	n.d.	2.89	12.8	2.94
	-9.00	0.36	n.d.	2.53	14.2	4.25
	-12.00	0.36	n.d.	2.65	13.6	4.25
6	-0.25	0.45	2.81	3.26	13.8	4.90
	-0.75	0.44	2.77	3.21	13.7	4.25
	-1.25	0.40	1.82	2.22	18.0	8.83
	-1.75	0.43	3.60	4.03	10.7	6.86
	-2.50	0.43	2.85	3.28	13.1	4.90
	-3.50	0.46	2.70	3.16	14.5	4.90
	-5.00	0.41	2.63	3.04	13.5	7.52
	-7.00	0.41	3.00	3.41	12.0	11.40
	-9.00	0.44	2.81	3.25	13.6	17.30
	-12.00	0.37	2.71	3.08	12.0	20.60
7	-0.25	0.49	1.90	2.39	20.5	7.57
	-0.75	0.61	1.93	2.54	24.0	5.15
	-1.25	0.62	1.91	2.53	24.5	1.04
	-1.75	0.59	1.84	2.43	24.2	3.45
	-2.50	0.62	1.72	2.34	26.5	64.50
	-3.50	0.66	1.87	2.53	26.1	24.70
	-5.00	0.71	1.95	2.66	26.7	75.50
	-7.00	0.69	1.99	2.68	25.8	99.60
	-9.00	0.73	1.89	2.62	27.9	51.50
	-12.00	0.70	2.06	2.76	25.4	41.30

APPENDIX 12: Continued

B C #	D (cm)	L (%)	R (%)	T (%)	L' (%)	P (μ M)
8	-0.25	0.30	3.20	3.50	8.6	4.82
	-0.75	0.27	3.20	3.47	7.8	6.19
	-1.25	0.27	3.23	3.50	7.7	11.00
	-1.75	0.27	3.15	3.42	7.9	15.10
	-2.50	0.28	2.74	3.02	9.3	6.88
	-3.50	0.27	5.65	5.92	4.6	4.82
	-5.00	0.26	n.d.	n.d.	-	5.51
	-7.00	0.27	2.94	3.21	8.4	4.13
	-9.00	0.29	3.21	3.50	8.3	3.45
	-12.00	0.28	3.54	3.82	7.3	6.19
10	-0.25	0.82	2.69	3.51	23.4	5.39
	-0.75	0.81	2.74	3.55	22.8	3.95
	-1.25	0.98	2.71	3.69	26.6	4.67
	-1.75	0.93	2.59	3.52	26.4	4.67
	-2.50	0.91	2.62	3.53	25.8	3.95
	-3.50	0.88	2.83	3.71	23.7	3.23
	-5.00	0.87	2.59	3.46	25.1	2.51
	-7.00	0.90	2.79	3.69	24.4	3.95
	-9.00	0.91	2.84	3.75	24.3	8.27
	-12.00	0.74	2.46	3.20	23.1	4.67
11	-0.25	0.76	1.76	2.52	30.2	n.s.
	-0.75	0.69	1.92	2.61	26.4	8.99
	-1.25	0.61	1.75	2.36	25.8	24.10
	-1.75	0.71	1.87	2.58	27.5	23.40
	-2.50	0.71	1.79	2.50	28.4	21.20
	-3.50	0.70	1.76	2.46	28.5	21.20
	-5.00	0.78	1.94	2.72	28.7	9.71
	-7.00	0.67	2.04	2.71	24.7	10.40
	-9.00	0.77	2.09	2.86	26.9	6.83
	-12.00	0.76	1.45	2.21	34.5	9.71
13	-0.25	0.52	1.88	2.40	21.6	12.00
	-0.75	0.56	1.86	2.42	23.1	10.50
	-1.25	0.53	1.86	2.39	22.1	7.45
	-1.75	0.53	1.69	2.22	23.9	8.21
	-2.50	0.52	1.80	2.32	22.4	11.30
	-3.50	0.56	n.d.	n.d.	-	5.16
	-5.00	0.56	1.75	2.31	24.3	8.98
	-7.00	0.55	1.66	2.21	24.9	6.69
	-9.00	0.57	1.58	2.15	26.5	6.69
	-12.00	0.56	2.01	2.57	21.8	n.s.
14	-0.25	0.52	1.35	1.87	27.9	5.93
	-0.75	0.56	1.23	1.79	31.2	8.21
	-1.25	0.53	1.59	2.12	24.9	8.98
	-1.75	0.53	1.61	2.14	24.7	9.74
	-2.50	0.52	1.65	2.17	24.0	9.74
	-3.50	0.56	1.48	2.04	27.4	13.60
	-5.00	0.56	1.21	1.77	31.6	7.45
	-7.00	0.55	1.51	2.06	26.7	7.45
	-9.00	0.57	1.59	2.16	26.4	4.40
	-12.00	0.56	1.48	2.04	27.4	8.21

APPENDIX 12: Continued

B C #	D (cm)	L (%)	R (%)	T (%)	L' (%)	P (μ M)
15	-0.25	0.70	1.44	2.14	32.7	13.20
	-0.75	0.89	2.00	2.89	30.8	8.48
	-1.25	0.93	1.57	2.50	37.3	7.69
	-1.75	1.03	1.56	2.59	39.8	21.80
	-2.50	0.87	1.69	2.56	34.0	10.80
	-3.50	0.81	1.45	2.26	35.9	37.50
	-5.00	0.76	1.43	2.19	34.6	7.69
	-7.00	1.00	1.55	2.55	39.3	20.30
	-9.00	1.01	1.65	2.66	37.9	5.34
	-12.00	0.97	1.56	2.53	38.4	6.91
16	-0.25	0.43	0.93	1.36	31.6	n.s.
	-0.75	0.47	0.83	1.30	36.0	10.00
	-1.25	0.57	1.09	1.66	34.3	11.60
	-1.75	0.56	0.94	1.50	37.4	5.34
	-2.50	0.50	1.24	1.74	28.7	6.12
	-3.50	0.62	0.91	1.53	40.6	8.48
	-5.00	0.61	1.00	1.61	37.9	11.60
	-7.00	0.68	0.92	1.60	42.4	10.00
	-9.00	0.60	0.97	1.57	38.3	10.00
	-12.00	0.70	1.06	1.76	39.8	25.80
19	-0.25	0.91	1.80	2.71	33.5	8.32
	-0.75	0.97	1.68	2.65	36.7	7.49
	-1.25	0.98	1.76	2.74	35.8	7.49
	-1.75	n.d.	n.d.	n.d.	-	9.97
	-2.50	n.d.	n.d.	n.d.	-	5.84
	-3.50	0.91	1.64	2.55	35.7	6.67
	-5.00	0.98	1.55	2.53	38.7	5.84
	-7.00	0.95	1.58	2.53	37.6	5.01
	-9.00	0.96	1.64	2.60	36.9	5.84
	-12.00	0.84	1.57	2.41	34.8	5.84

APPENDIX 13: Magnesium and calcium concentrations in sediments from the North Western Mediterranean Sea. The table shows the boxcore station (BC, see also appendix 2 and appendix 3), the mean depth (D), the leachable fraction (L), the residual fraction (R) the total fraction (T, expressed as the sum total of the leachable and residual fraction) and the leachable fraction in percents of the total fraction (L'). Calcium is only expressed as the leachable fraction because the residual fraction was negligible { n.d. means not determined }

MAGNESIUMCALCIUM

BC #	D (cm)	L (%)	R (%)	T (%)	L' (%)	BC #	D (cm)	L (%)
1	-0.25	0.52	n.d.	1.63	32.0	1	-0.25	12.60
	-0.75	0.51	n.d.	1.70	30.0		-0.75	12.70
	-1.25	0.50	n.d.	1.52	33.0		-1.25	13.20
	-1.75	0.50	n.d.	1.87	26.7		-1.75	12.70
	-2.50	0.50	n.d.	1.55	32.3		-2.50	12.90
	-3.50	0.50	n.d.	1.49	33.5		-3.50	13.10
	-5.00	0.49	n.d.	1.41	34.8		-5.00	12.70
	-7.00	0.48	n.d.	1.44	33.3		-7.00	13.10
	-9.00	0.49	n.d.	1.51	32.4		-9.00	13.30
	-11.00	0.52	n.d.	1.58	33.0		-11.00	13.40
2	-0.25	0.50	n.d.	1.55	32.2	2	-0.25	10.40
	-0.75	0.52	n.d.	1.51	34.5		-0.75	10.50
	-1.25	0.50	n.d.	1.80	27.7		-1.25	10.70
	-1.75	0.49	n.d.	2.12	23.1		-1.75	10.90
	-2.50	0.49	n.d.	1.86	26.3		-2.50	11.00
	-3.50	0.54	n.d.	2.59	20.9		-3.50	10.40
	-5.00	0.55	n.d.	1.98	27.8		-5.00	10.80
	-7.00	0.54	n.d.	2.46	21.9		-7.00	10.70
	-9.00	0.55	n.d.	2.21	24.9		-9.00	10.20
	-12.00	0.54	n.d.	1.77	30.5		-12.00	10.50
4	-0.25	0.52	n.d.	1.89	27.4	4	-0.25	13.10
	-0.75	0.51	n.d.	1.58	32.3		-0.75	13.10
	-1.25	0.50	n.d.	1.89	26.4		-1.25	13.20
	-1.75	0.51	n.d.	1.76	29.0		-1.75	13.10
	-2.50	0.54	n.d.	1.57	34.4		-2.50	13.10
	-3.50	0.53	n.d.	1.86	28.5		-3.50	13.10
	-5.00	0.53	n.d.	2.05	25.8		-5.00	13.00
	-7.00	0.53	n.d.	1.62	32.6		-7.00	13.00
	-9.00	0.51	n.d.	1.92	26.6		-9.00	12.80
	-12.00	0.51	n.d.	1.52	33.5		-12.00	12.80
6	-0.25	0.58	0.80	1.38	42.1	6	-0.25	13.10
	-0.75	0.55	0.75	1.30	42.4		-0.75	13.00
	-1.25	0.54	0.57	1.11	48.4		-1.25	12.60
	-1.75	0.55	0.86	1.41	39.1		-1.75	12.90
	-2.50	0.55	0.68	1.23	44.9		-2.50	12.50
	-3.50	0.58	0.74	1.32	43.9		-3.50	12.60
	-5.00	0.55	0.70	1.25	44.2		-5.00	12.70
	-7.00	0.55	0.70	1.25	44.2		-7.00	12.40
	-9.00	0.56	0.76	1.32	42.4		-9.00	13.00
	-12.00	0.53	0.57	1.10	48.1		-12.00	13.30

APPENDIX 13: Continued

MAGNESIUMCALCIUM

BC #	D (cm)	L (%)	R (%)	T (%)	L' (%)	BC #	D (cm)	L (%)
7	-0.25	0.63	0.65	1.28	49.3	7	-0.25	14.10
	-0.75	0.62	0.68	1.30	47.8		-0.75	14.10
	-1.25	0.63	0.57	1.20	52.4		-1.25	13.90
	-1.75	0.63	0.55	1.18	53.2		-1.75	13.80
	-2.50	0.62	0.60	1.22	50.7		-2.50	13.80
	-3.50	0.63	0.67	1.30	48.6		-3.50	13.80
	-5.00	0.65	0.77	1.42	45.9		-5.00	13.70
	-7.00	0.62	0.72	1.34	46.3		-7.00	13.20
	-9.00	0.63	0.77	1.40	45.0		-9.00	13.30
	-12.00	0.76	0.77	1.53	49.7		-12.00	13.70
8	-0.25	0.87	0.95	1.82	47.8	8	-0.25	10.10
	-0.75	0.89	0.87	1.76	50.7		-0.75	9.90
	-1.25	0.87	0.87	1.74	50.0		-1.25	9.80
	-1.75	0.91	0.90	1.81	50.3		-1.75	9.80
	-2.50	0.92	1.27	2.19	41.9		-2.50	9.70
	-3.50	0.93	0.92	1.85	50.4		-3.50	9.70
	-5.00	0.75	0.95	1.70	44.1		-5.00	9.90
	-7.00	0.97	0.89	1.86	52.1		-7.00	9.70
	-9.00	0.74	0.93	1.67	44.2		-9.00	9.90
	-12.00	0.73	0.90	1.63	44.7		-12.00	9.70
10	-0.25	0.80	0.88	1.68	47.6	10	-0.25	8.60
	-0.75	0.80	0.66	1.46	54.6		-0.75	8.90
	-1.25	1.02	0.88	1.90	53.8		-1.25	9.10
	-1.75	0.80	0.84	1.64	48.9		-1.75	8.80
	-2.50	0.82	0.76	1.58	52.0		-2.50	8.80
	-3.50	0.80	0.82	1.62	49.5		-3.50	8.60
	-5.00	0.80	0.75	1.55	51.7		-5.00	8.50
	-7.00	0.78	0.72	1.50	51.9		-7.00	8.60
	-9.00	0.76	0.71	1.47	51.8		-9.00	8.80
	-12.00	0.75	0.64	1.39	54.0		-12.00	8.10
11	-0.25	0.84	0.63	1.47	57.2	11	-0.25	13.20
	-0.75	0.81	0.57	1.38	58.8		-0.75	13.40
	-1.25	0.71	0.49	1.20	59.3		-1.25	15.00
	-1.75	0.84	0.65	1.49	56.3		-1.75	13.70
	-2.50	0.80	0.57	1.37	58.4		-2.50	13.50
	-3.50	0.81	0.54	1.35	60.0		-3.50	13.30
	-5.00	0.81	0.64	1.45	55.7		-5.00	13.20
	-7.00	0.79	0.58	1.37	57.7		-7.00	13.00
	-9.00	0.83	0.70	1.53	54.3		-9.00	12.90
	-12.00	0.84	0.73	1.57	53.5		-12.00	13.10
13	-0.25	0.66	0.43	1.09	60.7	13	-0.25	13.40
	-0.75	0.69	0.50	1.19	57.8		-0.75	13.60
	-1.25	0.68	0.43	1.11	61.3		-1.25	14.00
	-1.75	0.67	0.40	1.07	62.6		-1.75	14.80
	-2.50	0.68	0.45	1.13	60.3		-2.50	14.00
	-3.50	0.72	n.d.	n.d.	-		-3.50	14.40
	-5.00	0.71	0.49	1.20	59.1		-5.00	13.80
	-7.00	0.72	0.51	1.23	58.7		-7.00	14.10
	-9.00	0.68	0.50	1.18	57.4		-9.00	13.90
	-12.00	0.69	0.49	1.18	58.7		-12.00	13.40

APPENDIX 13: Continued

MAGNESIUMCALCIUM

BC #	D (cm)	L (%)	R (%)	T (%)	L' (%)	BC #	D (cm)	L (%)
14	-0.25	0.64	0.51	1.15	55.7	14	-0.25	15.20
	-0.75	0.72	0.63	1.35	53.3		-0.75	20.00
	-1.25	0.75	0.59	1.34	55.8		-1.25	14.30
	-1.75	0.73	0.68	1.41	51.8		-1.75	13.30
	-2.50	0.72	0.51	1.23	58.6		-2.50	13.20
	-3.50	0.67	0.49	1.16	57.8		-3.50	12.50
	-5.00	0.56	0.48	1.04	54.0		-5.00	14.80
	-7.00	0.74	0.55	1.29	57.4		-7.00	15.70
	-9.00	0.72	0.48	1.20	60.1		-9.00	15.50
	-12.00	0.74	0.59	1.33	55.6		-12.00	16.10
15	-0.25	0.63	0.45	1.08	58.1	15	-0.25	20.60
	-0.75	0.75	0.58	1.33	56.4		-0.75	16.60
	-1.25	0.75	0.64	1.39	54.0		-1.25	16.00
	-1.75	0.78	0.50	1.28	60.7		-1.75	15.30
	-2.50	0.81	0.59	1.40	57.8		-2.50	16.10
	-3.50	0.76	0.57	1.33	57.2		-3.50	10.30
	-5.00	0.61	0.62	1.23	49.8		-5.00	13.40
	-7.00	0.76	0.57	1.33	57.1		-7.00	16.30
	-9.00	0.76	0.60	1.36	55.7		-9.00	16.10
	-12.00	0.68	0.61	1.29	52.9		-12.00	14.50
16	-0.25	0.30	0.24	0.54	55.9	16	-0.25	15.40
	-0.75	0.29	0.22	0.51	57.2		-0.75	12.90
	-1.25	0.42	0.23	0.65	64.2		-1.25	13.50
	-1.75	0.41	0.19	0.60	68.4		-1.75	14.40
	-2.50	0.27	0.24	0.51	52.7		-2.50	15.80
	-3.50	0.46	0.34	0.80	57.7		-3.50	14.40
	-5.00	0.47	0.39	0.86	54.7		-5.00	12.00
	-7.00	0.50	0.42	0.92	54.6		-7.00	12.70
	-9.00	0.47	0.36	0.83	56.5		-9.00	12.50
	-12.00	0.58	0.38	0.96	60.7		-12.00	13.60
19	-0.25	0.56	0.46	1.02	54.7	19	-0.25	13.80
	-0.75	0.60	0.48	1.08	55.4		-0.75	14.50
	-1.25	0.57	0.50	1.07	53.1		-1.25	14.00
	-1.75	n.d.	n.d.	n.d.	-		-1.75	n.d.
	-2.50	n.d.	n.d.	n.d.	-		-2.50	n.d.
	-3.50	0.53	0.47	1.00	52.9		-3.50	12.70
	-5.00	0.58	0.50	1.08	53.6		-5.00	14.30
	-7.00	0.57	0.47	1.04	54.8		-7.00	14.30
	-9.00	0.57	0.49	1.06	53.9		-9.00	14.70
	-12.00	0.52	0.45	0.97	53.5		-12.00	13.20

APPENDIX 14: Aluminium and silicon concentrations in sediments from the North Western Mediterranean Sea. The table shows the boxcore station (BC, see also appendix 2 and appendix 3), the mean depth (D), the leachable fraction (L), the residual fraction (R) the total fraction (T, expressed as the sum total of the leachable and residual fraction) and the leachable fraction in percents of the total fraction (L'). Silicon is only expressed as the residual fraction because the leachable fraction was negligible { n.d. means not determined }

ALUMINIUMSILICON

BC #	D (cm)	L (%)	R (%)	T (%)	L' (%)	BC #	D (cm)	R (%)
1	-0.25	0.17	n.d.	5.45	3.1	1	-0.25	19.57
	-0.75	0.15	n.d.	6.18	2.4		-0.75	18.32
	-1.25	0.16	n.d.	5.71	2.8		-1.25	17.47
	-1.75	0.15	n.d.	5.88	2.5		-1.75	18.88
	-2.50	0.16	n.d.	5.56	2.9		-2.50	17.80
	-3.50	0.16	n.d.	5.88	2.7		-3.50	18.15
	-5.00	0.15	n.d.	5.13	2.9		-5.00	16.76
	-7.00	0.15	n.d.	5.23	2.9		-7.00	17.77
	-9.00	0.15	n.d.	5.72	2.6		-9.00	18.08
	-11.00	0.14	n.d.	5.93	2.4		-11.00	18.59
2	-0.25	0.18	n.d.	5.62	3.2	2	-0.25	32.29
	-0.75	0.19	n.d.	5.04	3.8		-0.75	21.36
	-1.25	0.17	n.d.	5.44	3.1		-1.25	21.02
	-1.75	0.18	n.d.	6.09	3.0		-1.75	32.38
	-2.50	0.19	n.d.	7.11	2.7		-2.50	25.67
	-3.50	0.16	n.d.	6.64	2.4		-3.50	26.09
	-5.00	0.20	n.d.	5.23	3.8		-5.00	20.12
	-7.00	0.21	n.d.	6.51	3.2		-7.00	23.70
	-9.00	0.20	n.d.	5.74	3.5		-9.00	20.72
	-12.00	0.18	n.d.	6.09	3.0		-12.00	20.06
4	-0.25	0.13	n.d.	4.39	3.0	4	-0.25	20.21
	-0.75	0.13	n.d.	4.13	3.2		-0.75	18.93
	-1.25	0.15	n.d.	5.10	2.9		-1.25	21.60
	-1.75	0.15	n.d.	3.98	3.8		-1.75	19.38
	-2.50	0.15	n.d.	5.35	2.8		-2.50	17.96
	-3.50	0.14	n.d.	5.14	2.7		-3.50	18.60
	-5.00	0.15	n.d.	3.57	4.2		-5.00	20.83
	-7.00	0.15	n.d.	5.82	2.6		-7.00	18.58
	-9.00	0.15	n.d.	4.72	3.2		-9.00	20.00
	-12.00	0.14	n.d.	5.16	2.7		-12.00	19.12
6	-0.25	0.18	6.45	6.63	2.7	6	-0.25	17.73
	-0.75	0.16	6.50	6.66	2.4		-0.75	19.13
	-1.25	0.16	4.78	4.94	3.2		-1.25	14.98
	-1.75	0.16	8.13	8.29	1.9		-1.75	24.24
	-2.50	0.15	6.56	6.71	2.2		-2.50	18.40
	-3.50	0.17	5.95	6.12	2.8		-3.50	18.39
	-5.00	0.15	6.79	6.94	2.2		-5.00	19.62
	-7.00	0.17	6.43	6.60	2.6		-7.00	18.70
	-9.00	0.17	6.69	6.86	2.5		-9.00	17.90
	-12.00	0.15	6.15	6.30	2.4		-12.00	17.04

APPENDIX 14: Continued

ALUMINIUM						SILICON		
BC #	D (cm)	L (%)	R (%)	T (%)	L' (%)	BC #	D (cm)	R (%)
7	-0.25	0.10	5.06	5.16	1.9	7	-0.25	18.91
	-0.75	0.12	5.58	5.70	2.1		-0.75	19.34
	-1.25	0.12	5.86	5.98	2.0		-1.25	19.30
	-1.75	0.10	5.01	5.11	2.0		-1.75	18.57
	-2.50	0.10	4.95	5.05	2.0		-2.50	18.10
	-3.50	0.11	5.00	5.11	2.2		-3.50	17.98
	-5.00	0.13	5.90	6.03	2.2		-5.00	19.48
	-7.00	0.13	5.93	6.06	2.1		-7.00	17.13
	-9.00	0.13	5.78	5.91	2.2		-9.00	19.10
	-12.00	0.12	6.27	6.39	1.9		-12.00	17.79
8	-0.25	0.19	7.22	7.41	2.6	8	-0.25	20.16
	-0.75	0.19	7.63	7.82	2.4		-0.75	18.88
	-1.25	0.19	7.83	8.02	2.4		-1.25	19.37
	-1.75	0.18	8.80	8.98	2.0		-1.75	19.47
	-2.50	0.21	3.68	3.89	5.4		-2.50	n.d.
	-3.50	0.18	7.65	7.83	2.3		-3.50	17.30
	-5.00	0.19	8.05	8.24	2.3		-5.00	17.55
	-7.00	0.20	7.75	7.95	2.5		-7.00	17.43
	-9.00	0.19	7.80	7.99	2.4		-9.00	18.94
	-12.00	0.19	7.50	7.69	2.5		-12.00	19.15
10	-0.25	0.53	8.09	8.62	6.1	10	-0.25	19.05
	-0.75	0.54	8.68	9.22	5.9		-0.75	19.55
	-1.25	0.60	8.41	9.01	6.7		-1.25	20.55
	-1.75	0.60	8.43	9.03	6.6		-1.75	20.13
	-2.50	0.56	7.97	8.53	6.6		-2.50	19.37
	-3.50	0.57	8.21	8.78	6.5		-3.50	21.20
	-5.00	0.55	8.11	8.66	6.3		-5.00	21.17
	-7.00	0.56	8.82	9.38	6.0		-7.00	20.55
	-9.00	0.55	8.25	8.80	6.2		-9.00	18.87
	-12.00	0.51	7.92	8.43	6.0		-12.00	17.84
11	-0.25	0.31	5.39	5.70	5.4	11	-0.25	19.56
	-0.75	0.28	5.86	6.14	4.6		-0.75	18.02
	-1.25	0.24	5.02	5.26	4.6		-1.25	17.44
	-1.75	0.33	4.87	5.20	6.4		-1.75	19.10
	-2.50	0.30	5.87	6.17	4.9		-2.50	19.96
	-3.50	0.30	5.63	5.93	5.1		-3.50	19.78
	-5.00	0.31	5.60	5.91	5.2		-5.00	19.13
	-7.00	0.30	6.14	6.44	4.7		-7.00	18.74
	-9.00	0.34	5.80	6.14	5.5		-9.00	19.83
	-12.00	0.35	6.05	6.40	5.5		-12.00	20.44
13	-0.25	0.22	4.67	4.89	4.5	13	-0.25	19.79
	-0.75	0.23	4.29	4.52	5.1		-0.75	19.42
	-1.25	0.20	4.41	4.61	4.3		-1.25	18.19
	-1.75	0.22	4.60	4.82	4.6		-1.75	17.20
	-2.50	0.21	5.06	5.27	4.0		-2.50	18.15
	-3.50	0.24	n.d.	n.d.	-		-3.50	n.d.
	-5.00	0.23	5.17	5.40	4.3		-5.00	18.34
	-7.00	0.24	4.79	5.03	4.8		-7.00	17.61
	-9.00	0.24	4.95	5.19	4.6		-9.00	17.30
	-12.00	0.27	5.51	5.78	4.7		-12.00	17.26

APPENDIX 14: Continued

ALUMINIUM

BC #	D (cm)	L (%)	R (%)	T (%)	L' (%)
14	-0.25	0.22	3.83	4.05	5.4
	-0.75	0.23	5.17	5.40	4.3
	-1.25	0.20	5.23	5.43	3.7
	-1.75	0.22	5.05	5.27	4.2
	-2.50	0.21	4.46	4.67	4.5
	-3.50	0.24	4.72	4.96	4.8
	-5.00	0.23	n.d.	n.d.	-
	-7.00	0.24	4.89	5.13	4.7
	-9.00	0.24	2.64	2.88	8.3
	-12.00	0.27	3.81	4.08	6.6
15	-0.25	0.53	n.d.	n.d.	-
	-0.75	0.65	4.56	5.21	12.5
	-1.25	0.71	2.74	3.45	20.6
	-1.75	0.77	4.31	5.08	15.2
	-2.50	0.64	4.33	4.97	12.9
	-3.50	0.54	3.20	3.74	14.4
	-5.00	0.48	3.71	4.19	11.4
	-7.00	0.64	4.02	4.66	13.7
	-9.00	0.57	4.26	4.83	11.8
	-12.00	0.62	4.42	5.04	12.3
16	-0.25	0.15	1.82	1.97	7.6
	-0.75	0.17	1.57	1.74	9.8
	-1.25	0.18	1.61	1.79	10.1
	-1.75	0.17	1.83	2.00	8.5
	-2.50	0.16	1.38	1.54	10.4
	-3.50	0.27	2.73	3.00	9.0
	-5.00	0.30	3.00	3.30	9.1
	-7.00	0.35	2.92	3.27	10.7
	-9.00	0.28	3.30	3.58	7.8
	-12.00	0.33	3.82	4.15	8.0
19	-0.25	0.46	4.46	4.92	9.4
	-0.75	0.48	4.84	5.32	9.0
	-1.25	0.47	4.85	5.32	8.8
	-1.75	n.d.	n.d.	n.d.	-
	-2.50	n.d.	n.d.	n.d.	-
	-3.50	0.45	4.37	4.82	9.3
	-5.00	0.45	4.94	5.39	8.3
	-7.00	0.49	3.91	4.40	11.1
	-9.00	0.46	4.12	4.58	10.0
	-12.00	0.40	4.41	4.81	8.3

SILICON

BC #	D (cm)	R (%)
14	-0.25	16.13
	-0.75	12.71
	-1.25	16.35
	-1.75	15.68
	-2.50	16.36
	-3.50	19.38
	-5.00	16.63
	-7.00	13.66
	-9.00	14.15
	-12.00	13.36
15	-0.25	9.92
	-0.75	12.24
	-1.25	11.94
	-1.75	11.29
	-2.50	14.29
	-3.50	11.78
	-5.00	12.00
	-7.00	12.81
	-9.00	13.59
	-12.00	13.30
16	-0.25	21.10
	-0.75	21.47
	-1.25	24.77
	-1.75	22.51
	-2.50	22.78
	-3.50	22.42
	-5.00	23.46
	-7.00	22.04
	-9.00	22.66
	-12.00	20.38
19	-0.25	16.92
	-0.75	17.04
	-1.25	16.76
	-1.75	n.d.
	-2.50	n.d.
	-3.50	15.17
	-5.00	16.45
	-7.00	16.94
	-9.00	17.86
	-12.00	17.52

APPENDIX 15: Mean element concentrations in the upper layers of the sediments (0-2 cm) from the North Western basin of the Mediterranean Sea calculated on a calciumcarbonate free basis. BC means Boxcore station.

B C	Cd µg/g	Cu µg/g	Ni µg/g	Cr µg/g	Zn µg/g	Mn µg/g
1	1.53	43.97	55.60	131	310	978
2	3.10	66.45	57.00	117	326	971
4	5.65	21.45	47.78	70	286	1732
6	0.30	26.00	51.66	91	184	1344
7	0.48	24.65	34.38	74	154	614
8	0.43	35.50	51.03	92	144	1790
10	0.15	42.5	60.10	102	233	2069
11	0.45	28.13	35.36	71	172	517
13	0.37	19.90	29.29	55	147	501
14	0.30	71.40	62.00	96	126	1328
15	0.22	85.50	73.07	108	180	1517
16	0.15	14.93	19.52	41	90	613
19	0.22	23.97	55.00	82	169	1036

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