

**TRACE METALS IN CLAMS (*MACOMA BALTHICA*) AND SEDIMENTS AT THE PALO ALTO
MUDFLAT IN SOUTH SAN FRANCISCO BAY: JUNE, 1992 - MAY, 1993**

By Samuel N. Luoma, Daniel J. Cain, Cynthia Brown and Michelle Hornberger

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CONVERSION FACTORS

<i>Multiply</i>	<i>By</i>	<i>To obtain</i>
Micrometer	2.54×10^{-6}	Inch
Millimeter	2.54×10^{-3}	Inch
Centimeter	2.54×10^{-2}	Inch
Kilometer	1.609	Mile
Microgram	2.83×10^{-5}	Ounce
Milligram	2.83×10^{-2}	Ounce
Gram	28.3	Ounce
Millimeter	5.5×10^{-2}	pint

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ABSTRACT

This report presents trace element concentrations analyzed on samples of sediment and clams (*Macoma balthica*) collected from a mudflat one kilometer south of the discharge of the Palo Alto sewage treatment works. Samples were collected on ten occasions between June, 1992 and May 1993, at near monthly intervals. Previous reports compared concentrations of silver and copper from this mudflat with values observed at other stations in San Francisco Bay in earlier studies. Changes in concentrations of these metals were also compared from near monthly collections between 1977 and 1992. In this report we update this data set, emphasizing the recent data, changes observed between 1986 and 1993, and trends in copper and silver concentrations in the last three years.

INTRODUCTION

Sediments and benthic organisms are commonly employed to determine spatial distributions and temporal trends of trace metal contamination in estuarine waters. Sediments bind metals strongly, removing them from solution. The result is that sediments may retain the metals released to an environment. Thus concentrations of metals in sediments may be indicative of anthropogenic releases, with at least some integration over time.

Metals in sediments are also indicative of the exposure of animals in contact with benthic and suspended particulate materials. However, it is not well known what proportion of sediment-bound metal is passed on to living organisms. In order to better estimate bioavailable metal exposures, the tissues of the organisms themselves may be analyzed for trace metals. Biological species concentrate most metals to levels higher than occur in solution, and may even be more sensitive indicators of anthropogenic metal inputs than are sediments. Different species concentrate metals to different degrees. If one species is analyzed consistently the results can be successfully employed to indicate trace element exposures to the food web of the organism. For example, Ag, Cu and Se contamination originally observed in clams (*Macoma balthica*) at a Palo Alto mudflat was later also found in diving ducks, snails, and mussels from that area.

Purpose

The purpose of this study is to present trace metal concentrations observed in sediments and clams at a mudflat in south San Francisco Bay. The station, termed here the Palo Alto mudflat, is located one kilometer south of the intertidal discharge point of the Palo Alto publically-owned treatment works (POTW). The data reported here are from samples collected on eleven dates between June 1992 and May

1993. These data and data collected from earlier studies will be used to approach three questions:

1. What are concentrations of Ag, Cd, Cr, Cu, Ni, Pb, V and Zn in clams that reside in sediments at the Palo Alto mudflat and in sediments from that site?
2. How do concentrations and seasonal trends of metals in clams and sediments at Palo Alto in 1992-93 compare with concentrations observed in 1990-91 and 1991-92?
3. What are the trends in copper and silver concentrations at the Palo Alto mudflat between 1986 and 1993? Specifically, are concentrations of these elements in 1992-93 changing compared to concentrations observed at this locality in recent years?

Study Site

The data from this study were collected from site 3 of the transect conducted by Thomson and others (1984) along the Palo Alto shoreline, as reported by Luoma and others (1991; 1992). The highest concentrations of copper and silver were observed in clams and sediments adjacent to the Palo Alto POTW discharge by Thomson and others (1984). Contamination also was observed at the site that is being monitored by Luoma and others (1991; 1992). The influence of the POTW on metal concentrations at site 3 also was demonstrated by Cain and Luoma (1990), who showed a similarity in temporal trends at site 3 between metal discharge from the POTW and concentrations in clam tissues. Results from both studies thus indicated that environmental metal concentrations at site 3 were indicative of POTW metal discharges.

Another important conclusion from Cain and Luoma (1990) and Luoma and others (1985) was that concentrations of metals fluctuated on nearly monthly time scales in the Palo Alto mudflat environment. Thus frequent sampling within a year was necessary to characterize contamination for that year. The data presented in this report follow those procedures.

SAMPLING PROCEDURES

All samples were collected from the exposed mudflat at low tide. Sediment samples were scraped from the surface oxidized layers (1 -2 cm) of mudflat. Thus, these samples represent recently deposited sediments, or sediments affected by recent chemical reactions. Sediments were immediately returned to the laboratory in Menlo Park after collection. There they were sieved through 100 micrometer polyethylene mesh to remove large grains that might bias interpretation of concentrations. In previous years sieving was done with ocean water diluted to ambient salinities. In December 1992 we began sieving with distilled water after rigorous preliminary studies showed no difference between the two approaches. The mesh size was chosen by the largest grains typically found in the digestive tract of the indicator organism *Macoma balthica*. Previous studies have shown little difference between sieved and unsieved sediments in the silt-clay type sediment that predominates at this station, but sieving reduces the likelihood that changes are the result of sampling sediments of different character.

Before December 1992 the sieved slurry was subsampled using procedures reported by Luoma and others (1991; 1992). Beginning in December 1992, the mass of sediments that did not pass the sieve was weighed. Those that passed through the sieve were dried at room temperature, then 0.250 to 0.500 gram aliquots were collected in replicate for analysis. The greater weight enhanced detection limits for elements that occur in low concentrations. The subsamples were dried at 60° celsius before weighing and

extraction. The replicate subsamples were digested for "total" metal analysis by refluxing in 10 milliliters of concentrated nitric acid until the digest was clear. Samples were then evaporated to dryness and reconstituted in dilute (5 percent) hydrochloric acid for analysis. The hydrochloric acid matrix was specifically chosen because it mobilizes Ag into solution through creation of Ag-chloro complexes. Another set of replicate samples was subjected to a partial weak acid extraction, as a crude chemical estimate of bioavailable metal. These subsamples were extracted for 2 hours with 10 mL of five percent hydrochloric acid at room temperature. The extract was then pressure filtered through a 0.45 micrometer membrane filter.

The deposit feeding clam *Macoma balthica* was collected simultaneously with the sediment samples. More than 40 individuals were collected at each sampling, and the range of sizes (shell length) was maximized by intensive field sampling. Animals were returned to the laboratory and held for 48 hours in ocean water diluted to the ambient salinity at the time of sampling. This was done to depurate undigested material from their digestive tracts. After depuration the individual clams were separated into size classes (determined by differences of one millimeter shell length). Each size class was composited for a single sample, and soft tissues were removed for analysis. Samples for each date thus were composed of eight to twelve replicate composites, with each composite consisting of animals of a similar shell length. Animal samples were dried, weighed and refluxed in concentrated nitric acid until the digest was clear. Digests were then dried and reconstituted in dilute (5 percent) hydrochloric acid for analysis.

All metal analyses were conducted by Inductively Coupled Argon Plasma Emission Spectroscopy (ICAPES). Selected tissue samples were also analyzed by Atomic Absorption Spectroscopy to compare with the results of ICAPES analysis. Data from the two types of analyses were not significantly different ($p > 0.10$). Analyses of National Institute of Technical Standards (NITS) reference materials (bovine liver, oyster tissue) were also routinely conducted to assure adequate recovery and accurate analyses. Values were within the acceptable range reported by NITS. Peaks were censored from the data if they did not exceed 10 times the standard deviation of the background (this is termed the limit of quantification), with the exception of silver in sediments. Silver peaks were censored if they did not exceed 3 standard deviations (limit of detection). Most detectable silver concentrations from sediments fell between the limit of detection and limit of quantification.

RESULTS OF ANALYSES

Appendix 1 lists all sediment analyses, and Appendix 2 lists all metal analyses of clam tissues conducted from the June 1992 to May 1993 samples. Analytical data and detection limits also are given for each sample to aid in verification of peaks. Statistical data indicates size influences on tissue concentrations, and content calculations are reported with summary statistics in Appendix 2.

Table 1 lists monthly variability in mean silver and copper concentrations observed in clams and sediments from the study site between June 1992 and May 1993. Tables 2 and 3 compare the 1992 - 93 data to long-term temporal trends observed in the copper and silver concentrations of clams since 1977. These data are annual mean concentrations calculated from the 7 to 11 samples collected between May of one year and May of the next (for example the "1993" data represent collections from May 1992 through May 1993). Figures 1, 2 and 3 illustrate the trends in these data among recent years, so as to better put perspective on changes in 1993. From these figures and tables the data collected in 1993 can be compared with earlier levels of contamination at this station.

Seasonal trends in silver concentrations are compared between 1991, 1992 and 1993 data sets (figure 4). Figure 5 shows silver content in clams during the three years, a data manipulation that allows eliminating the effects of growth. This approach allows demonstration that the differences between the years were not the result of different biological processes.

Metal concentrations in sediments over the period May 1990 through May 1993 were compared with those in clams. The seasonal record allows detection of anomalous metal inputs to the sediments as observed in March 1992 (fig. 6; full data set reported in Luoma and others, 1992). Figure 7 shows the same data for additional metals such as chromium and vanadium, which were not heretofore contamination problems at the Palo Alto site. Silver concentrations in sediments are shown in figure 8. A number of values are missing from the figure for 1991, because concentrations during most of that year were below detection limits. After the March 1992 pulse of metal input, slightly higher silver concentrations were retained, thus making them detectable. The rapid decline in silver concentrations in February, March and May of 1993 was detectable because of the new approach of analyzing a larger mass of sediment. Copper and silver concentrations in clams are compared with concentrations in sediments in figures 6 and 8. The higher values in clams occur following the pulse of metal input and are retained until Spring 1993. Figure 9 compares total copper with hydrochloric acid-extractable, bioavailable copper, in order to further elucidate the nature of pulse metal input to the sediments.

Figure 10 shows the condition index for clams during the 1990 through 1993 period. Condition index is the tissue weight of a clam of a given length (the "fatness" index), and is an index of the clams well-being. *Macoma balthica* from San Francisco Bay typically show dual periods of growth in spring and fall, as observed in calendar year 1991 in figure 10. After the pulse of metal input to sediments, and during the 1992 and 1993 period of elevated tissue concentrations, those growth peaks were absent. Growth returned when tissue metal concentrations declined rapidly in March and May, 1993.

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LIST OF FIGURES

Figure 1. Annual mean concentrations of silver in clams (in micrograms per gram dry weight soft tissue) from May to May of each year from 1985-86 to 1992-93. Each annual mean is derived from seven to eleven collections at near-monthly intervals in each year. Vertical bars represent \pm one standard deviation from replicate composite samples.

Figure 2. Annual mean concentrations of silver in clams (in micrograms per gram dry weight soft tissue) from May to May of each year from 1988-89 to 1992-93. Each annual mean is derived from seven to eleven collections at near-monthly intervals in each year. Vertical bars represent \pm one standard deviation from replicate composite samples.

Figure 3. Annual mean concentrations of copper in clams (in micrograms per gram dry weight soft tissue) from May to May of each year from 1985-86 to 1992-93. Each annual mean is derived from seven to eleven collections at near-monthly intervals in each year. Vertical bars represent \pm one standard deviation from replicate composite samples.

Figure 4. Silver concentrations in *Macoma balthica* clams (in micrograms per gram dry weight of soft tissues) as observed at near-monthly intervals between May and May in 1990 through 1993. Vertical bars represent \pm one standard deviation from replicate composite samples. Some vertical bars are smaller than the symbol.

Figure 5. Silver content (in micrograms) of a *Macoma balthica* clam of 25 millimeter shell length as observed at near-monthly intervals between May and May in 1990 through 1993. This data is calculated from Figure 4 and the relationship in each collection between tissue weight and shell length for individual samples.

Figure 6. Copper concentrations in *Macoma balthica* clams (in micrograms per gram dry weight of soft tissues) as observed at near-monthly intervals between May 1990 and May 1993. The right Y axis show copper concentrations in sediments through the same time period. Vertical bars represent \pm one standard deviation from replicate composite clam samples. Values for replicate analysis of copper samples are shown in Appendix 1.

Figure 7. Concentrations of chromium, iron and vanadium in sediments (in micrograms per gram dry weight) as observed at near-monthly intervals between May 1990 and May 1993. Iron and chromium are hydrochloric acid extractable. Values for replicate analysis of samples are shown in Appendix 1.

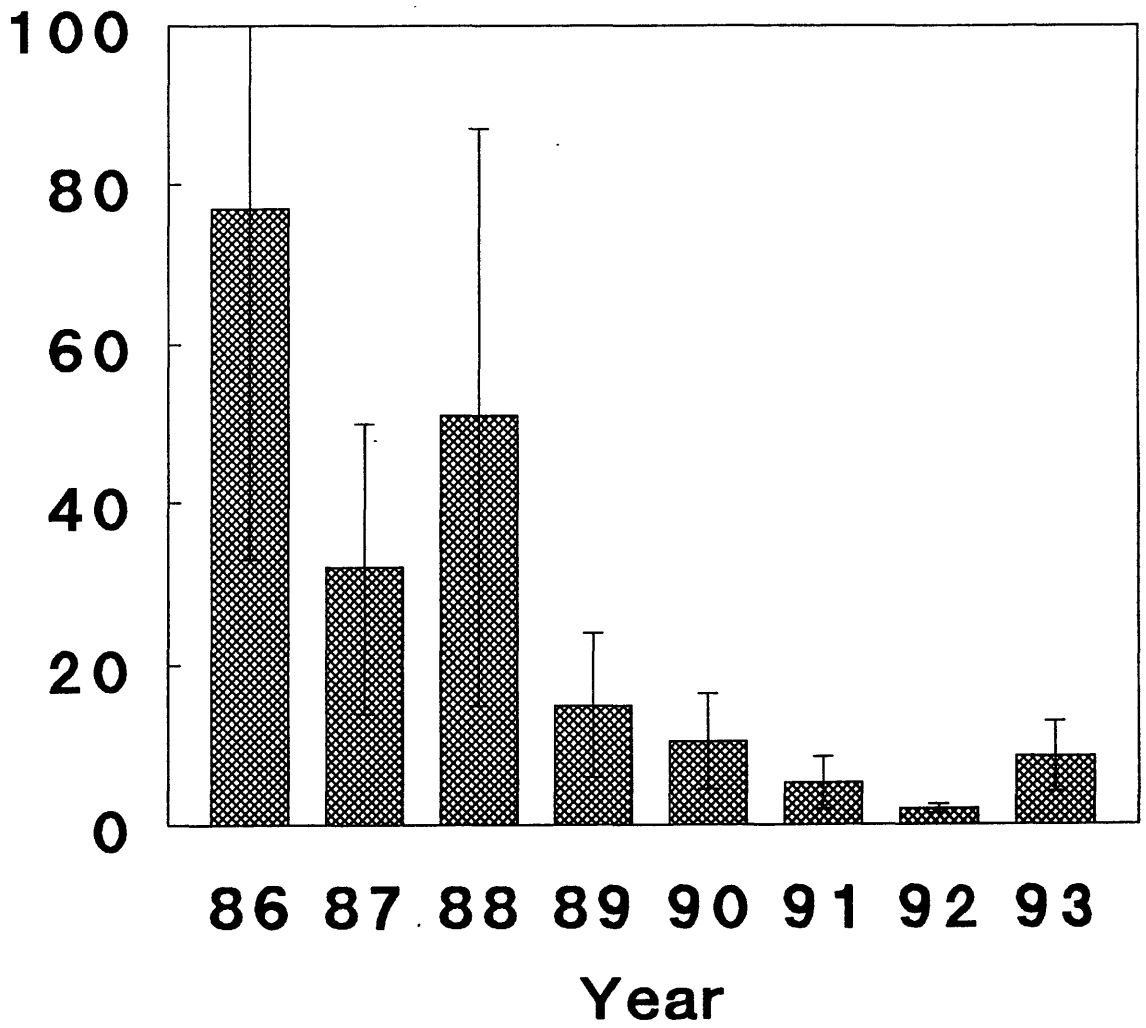
Figure 8. Silver concentrations in *Macoma balthica* clams (in micrograms per gram dry weight of soft tissues) as observed at near-monthly intervals between May 1990 and May 1993. The right Y axis show silver concentrations in sediments through the same time period. Vertical bars represent \pm one standard deviation from replicate composite clam samples. Values for replicate analysis of copper samples are shown in Appendix 1.

Figure 9. Hydrochloric acid extractable and total copper concentrations in sediments (in micrograms per gram dry weight) as observed between May 1990 and May 1993 at Palo Alto. Values for replicate analysis of copper samples are shown in Appendix 1.

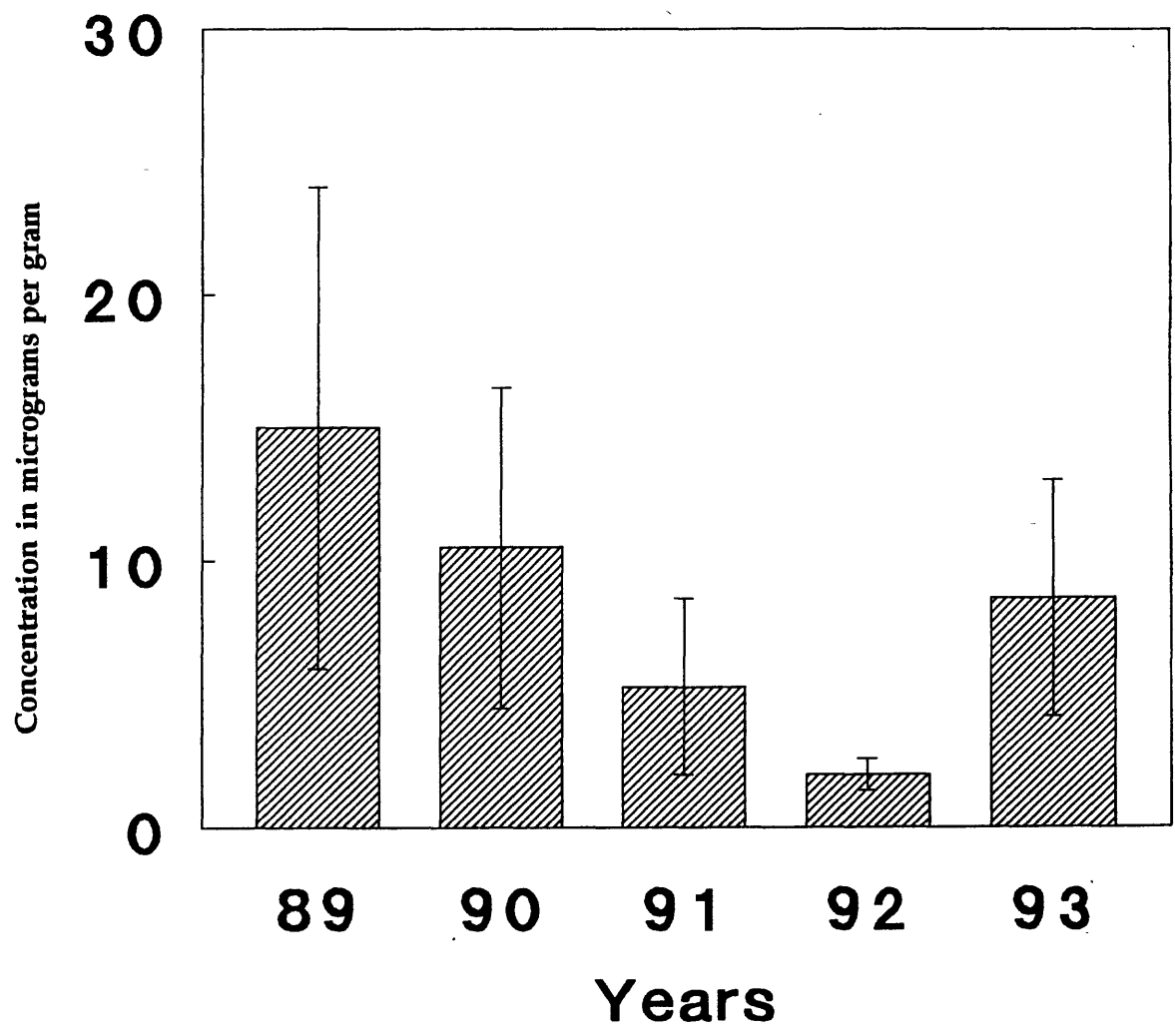
Figure 10. Weight of a *Macoma balthica* clam of 20 millimeter shell length between May 1990 and May 1993 at Palo Alto. Weights interpolated from regression of dry tissue weight against shell length for individual samples from each sample collection.

Annual Mean Silver in Clams

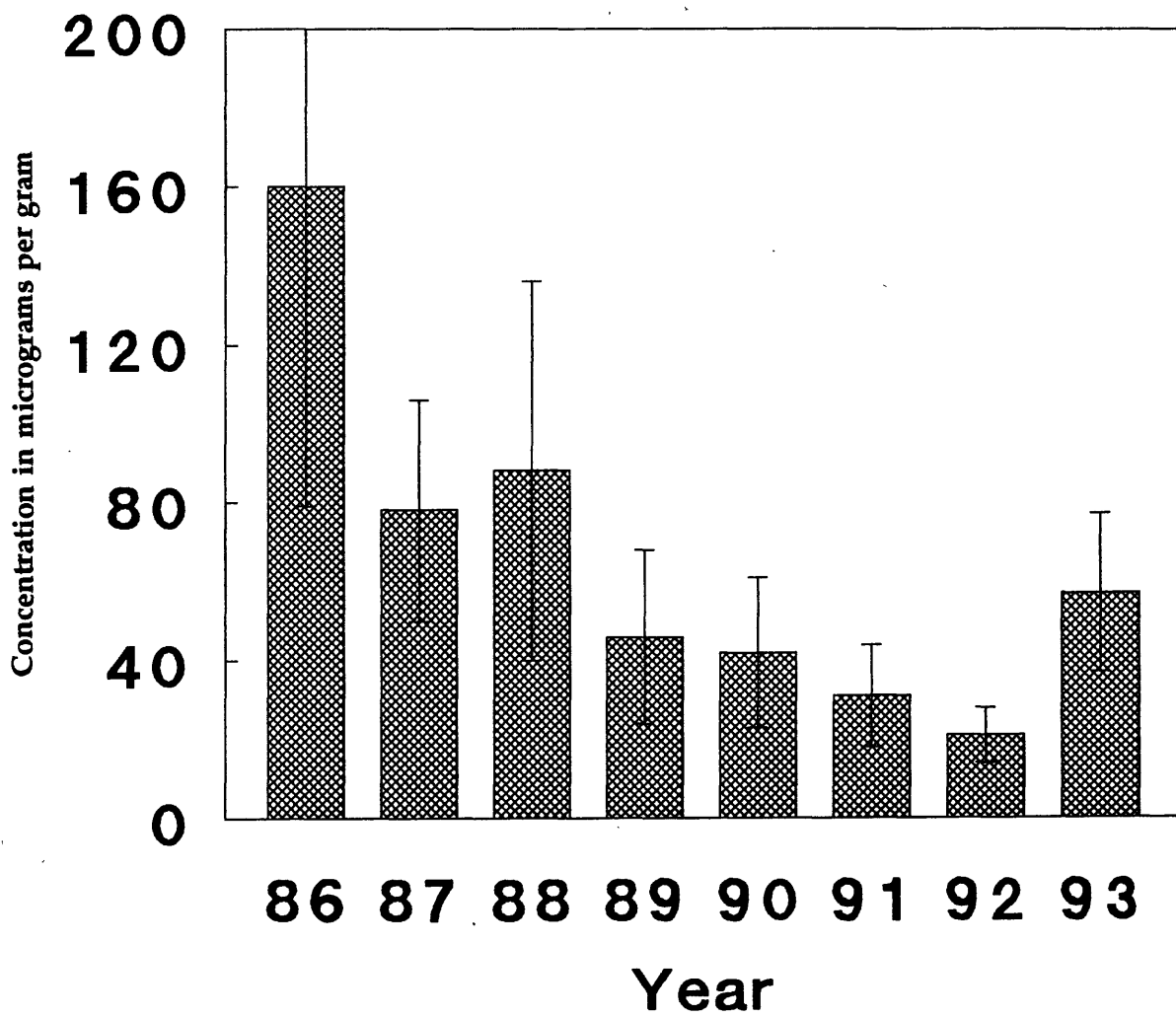
Concentration in micrograms per gram



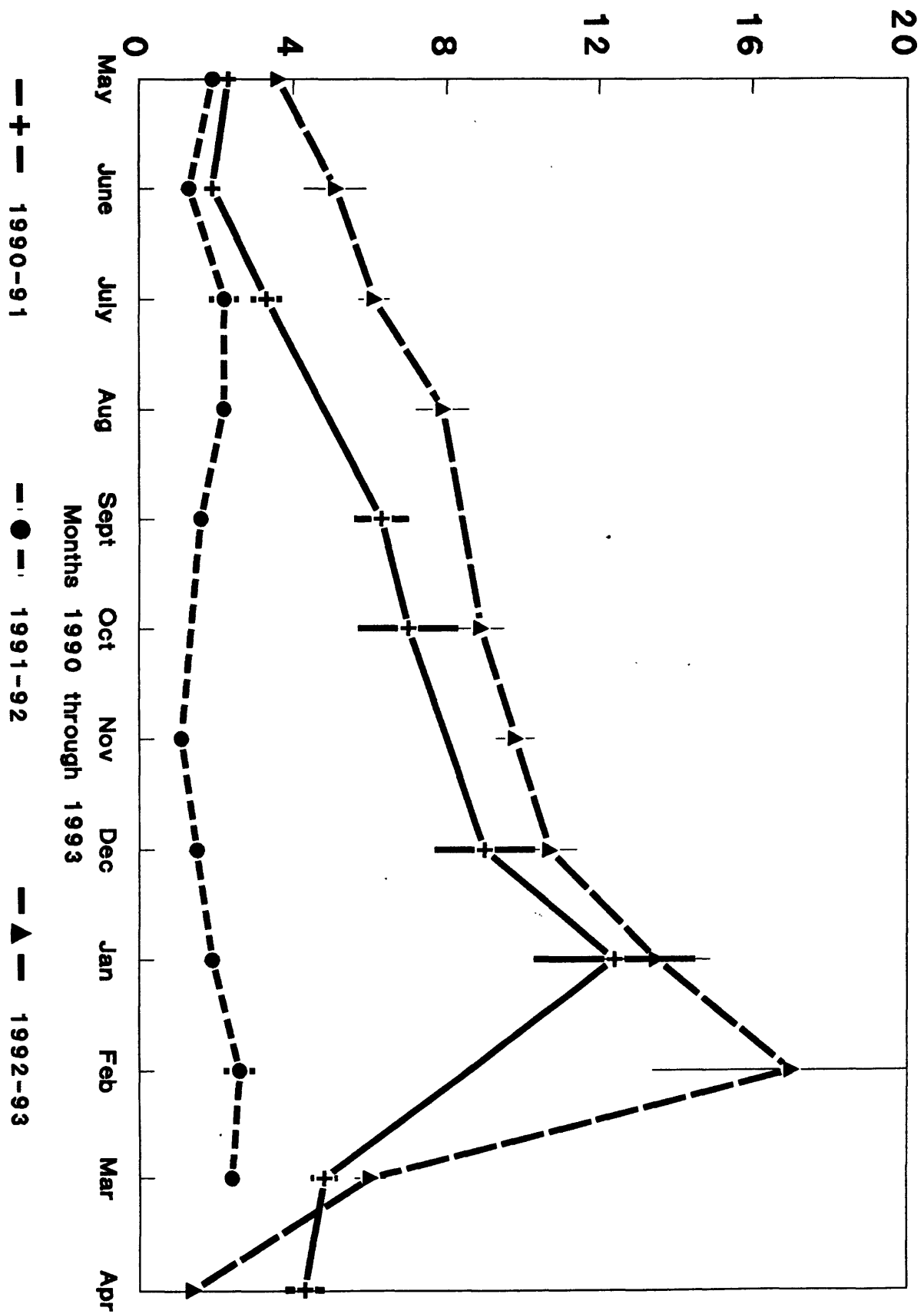
Annual Mean Silver in Clams



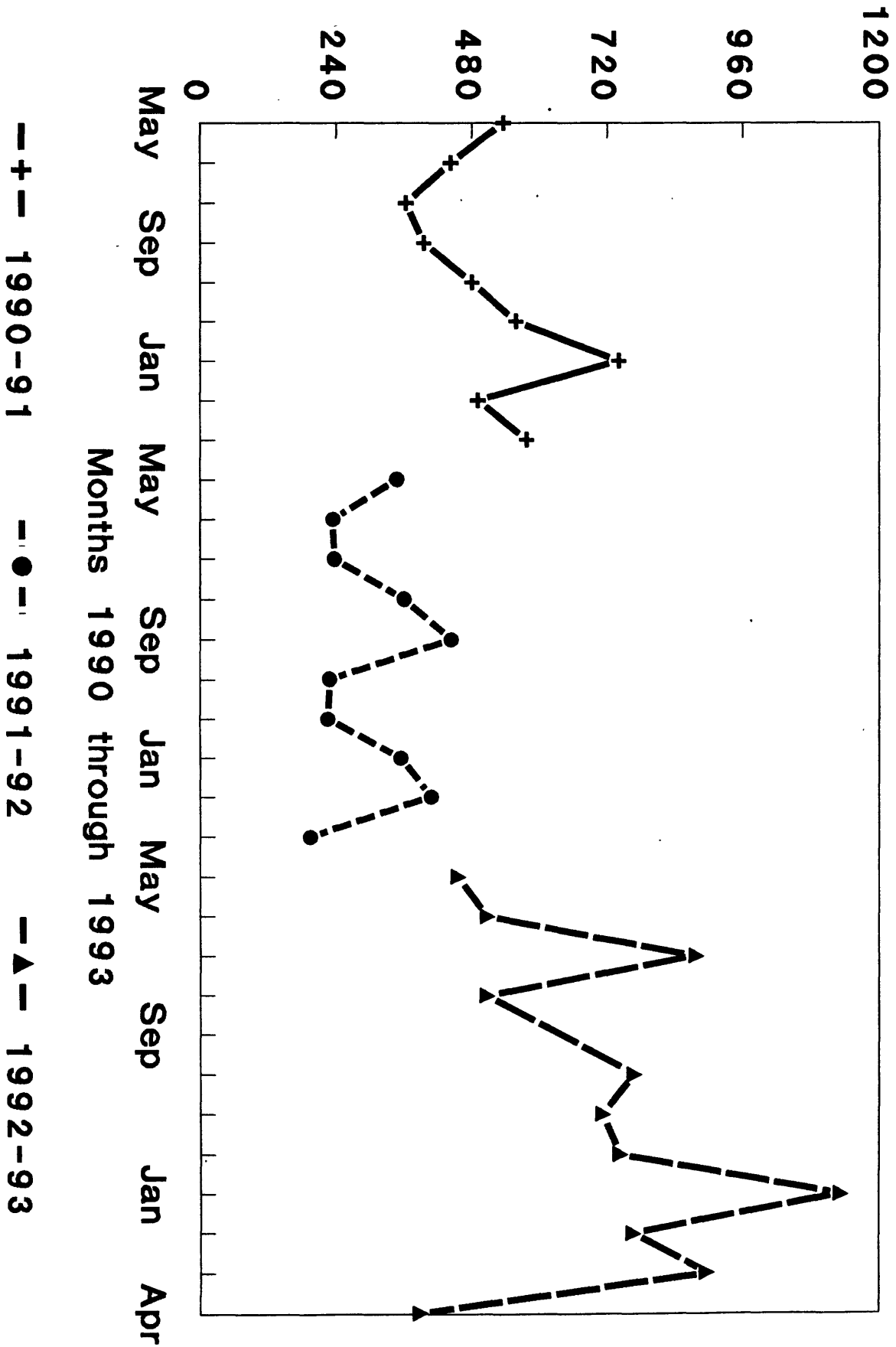
Annual Mean Copper in Clams



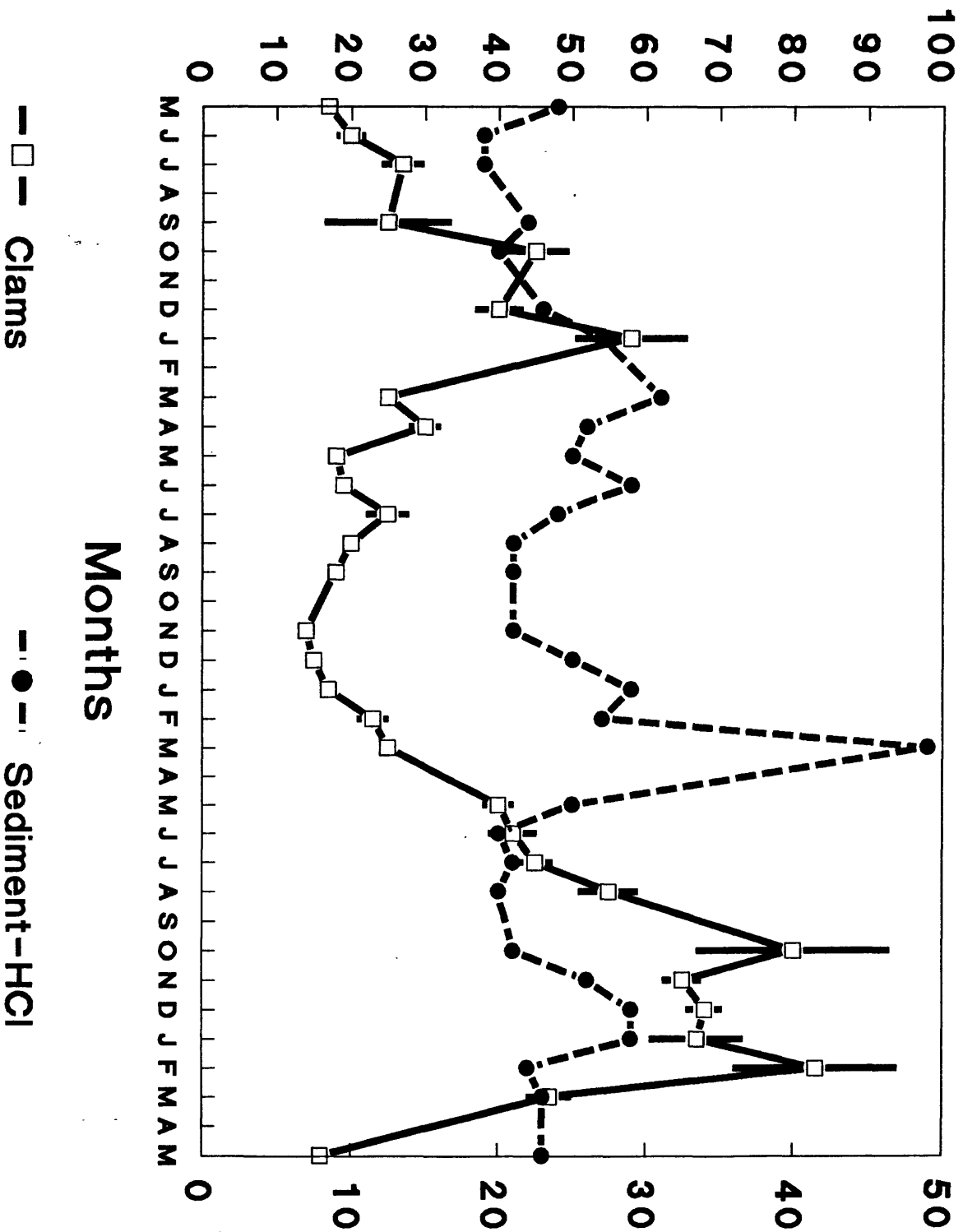
Silver in Clams (micrograms per gram)



nanograms silver in 25mm clam



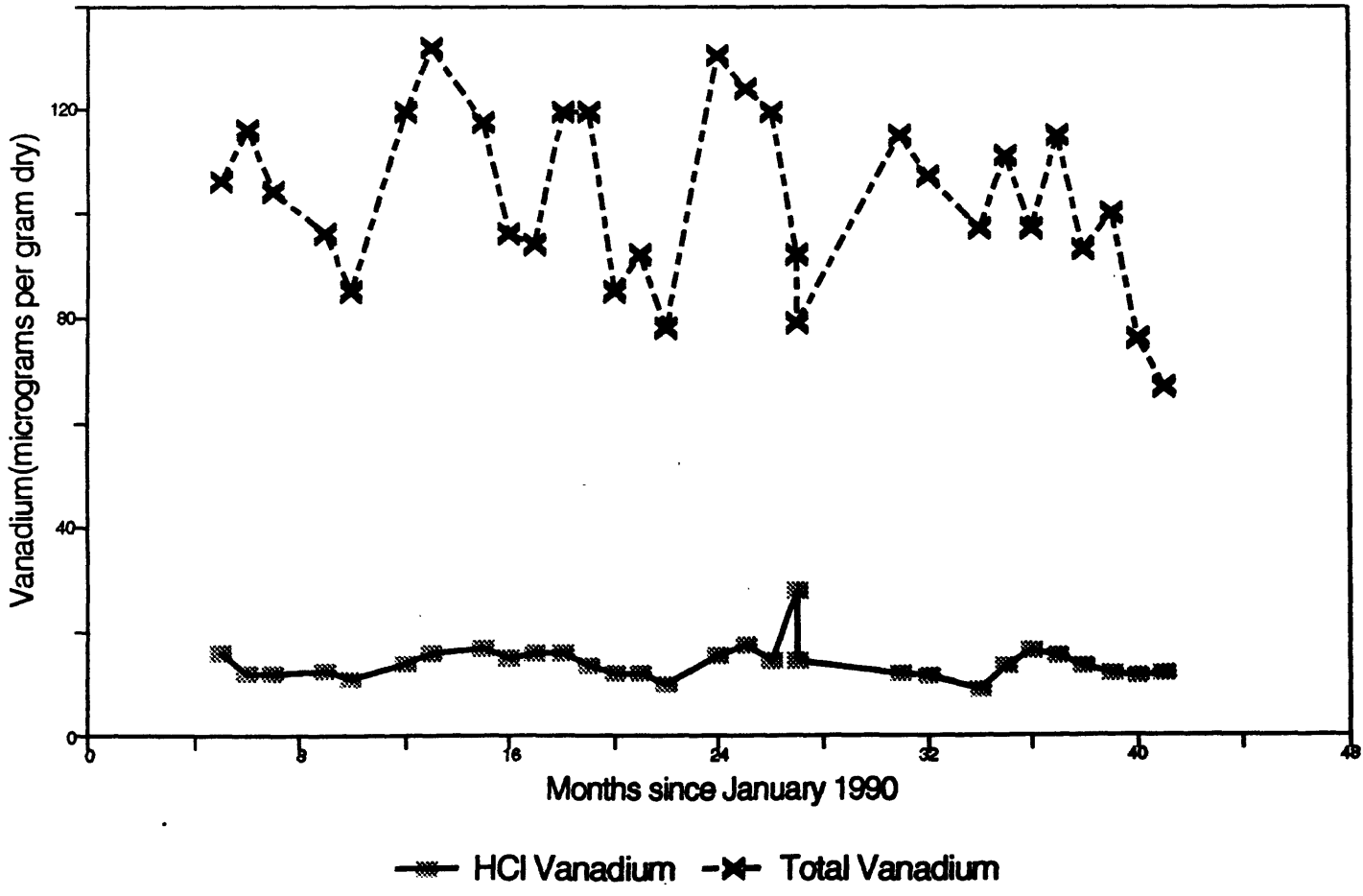
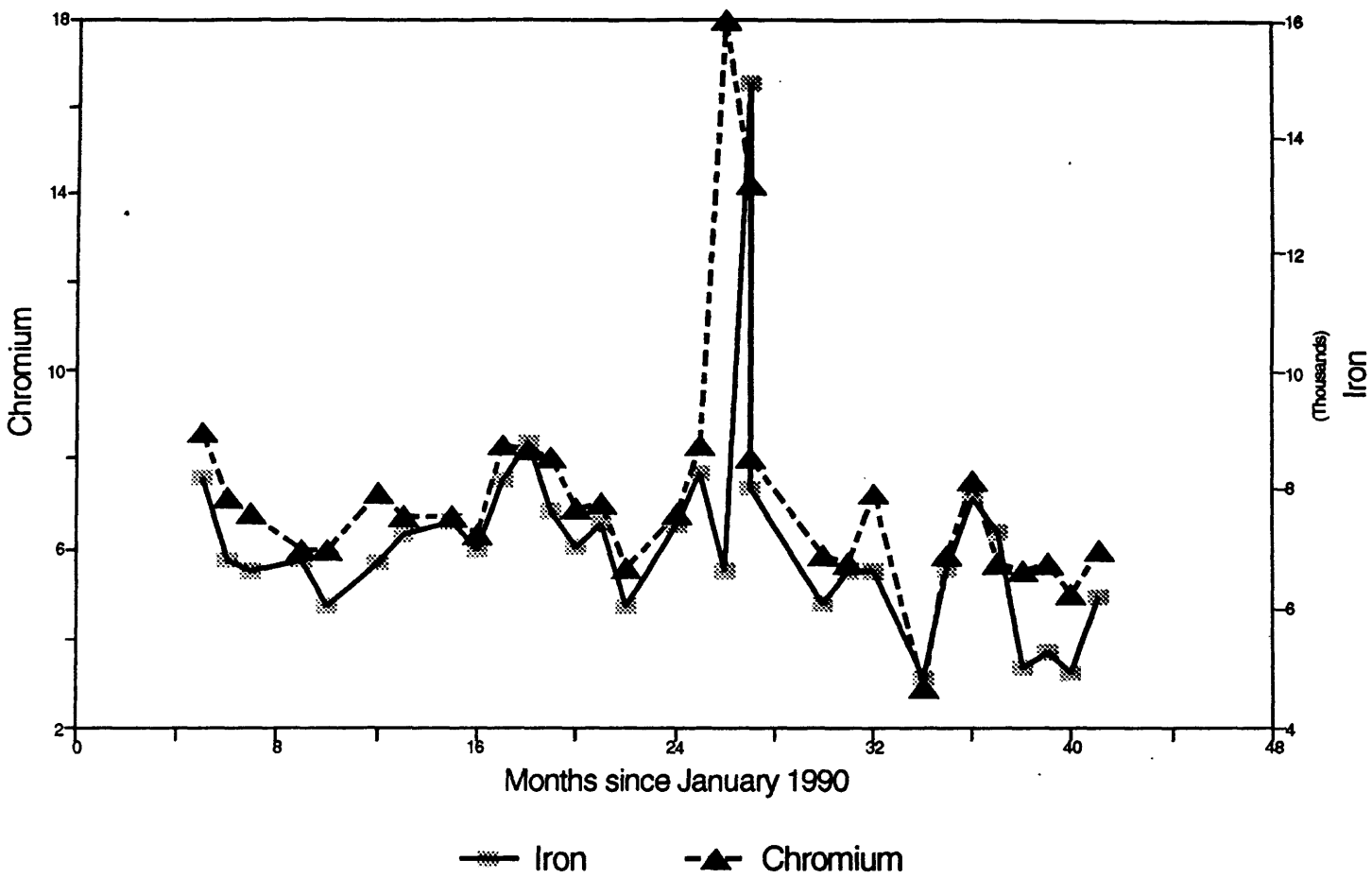
Micrograms per gram copper in clams



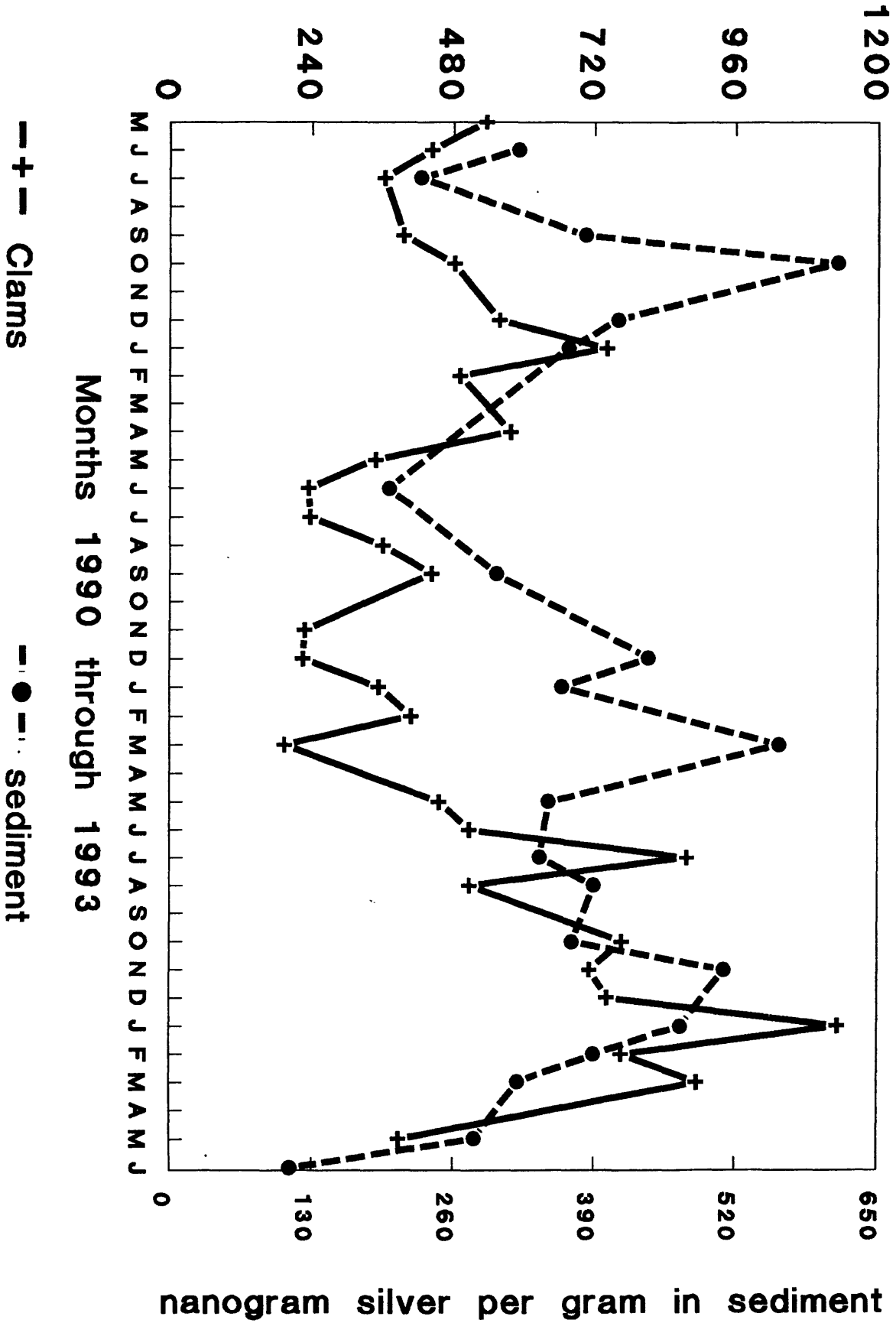
Micrograms per gram copper in sediment

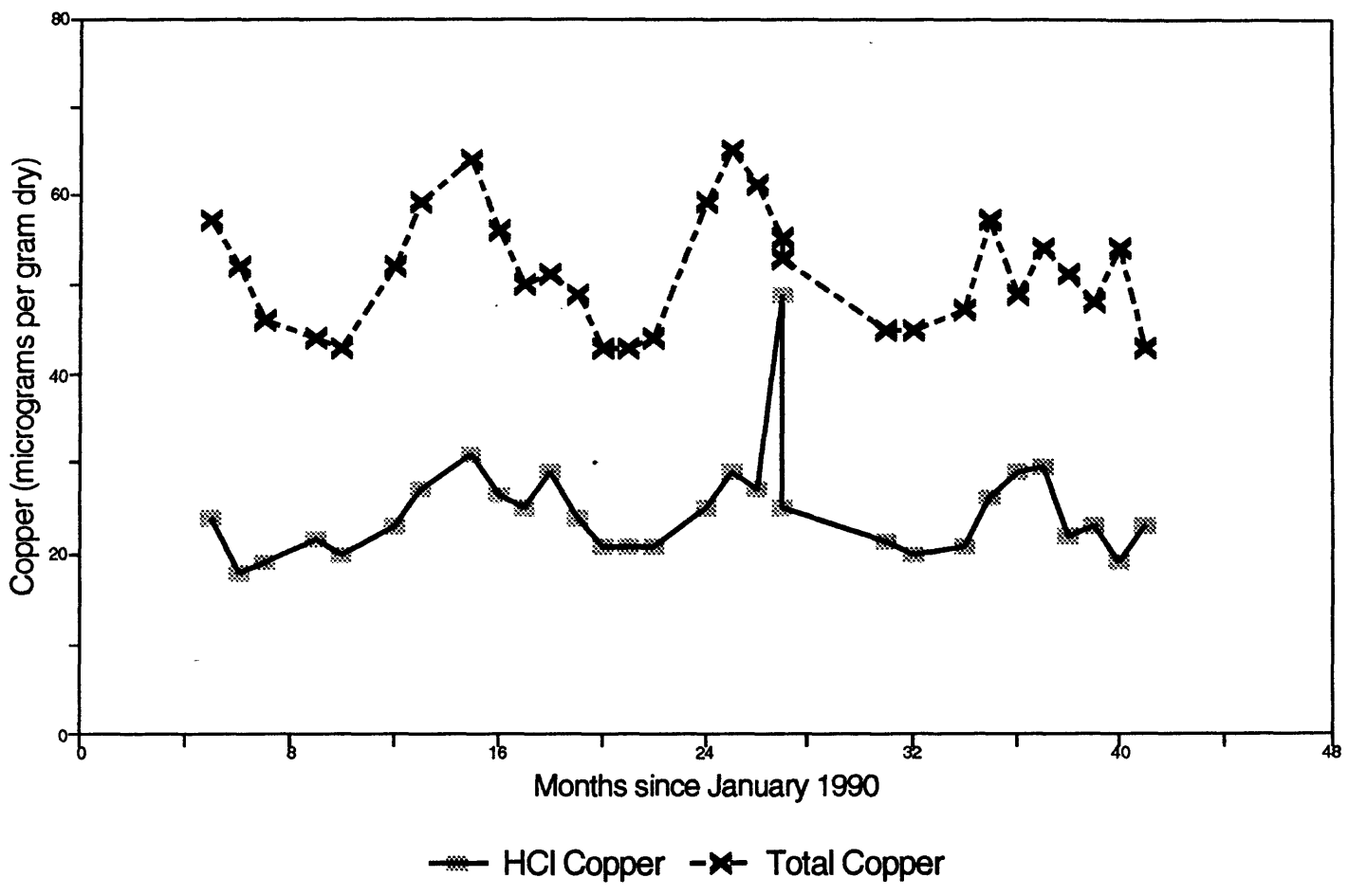
Metals in Sediments

Micrograms per gram dry weight



nanograms silver in 25 millimeter clam





Weight of standard clam (milligrams)

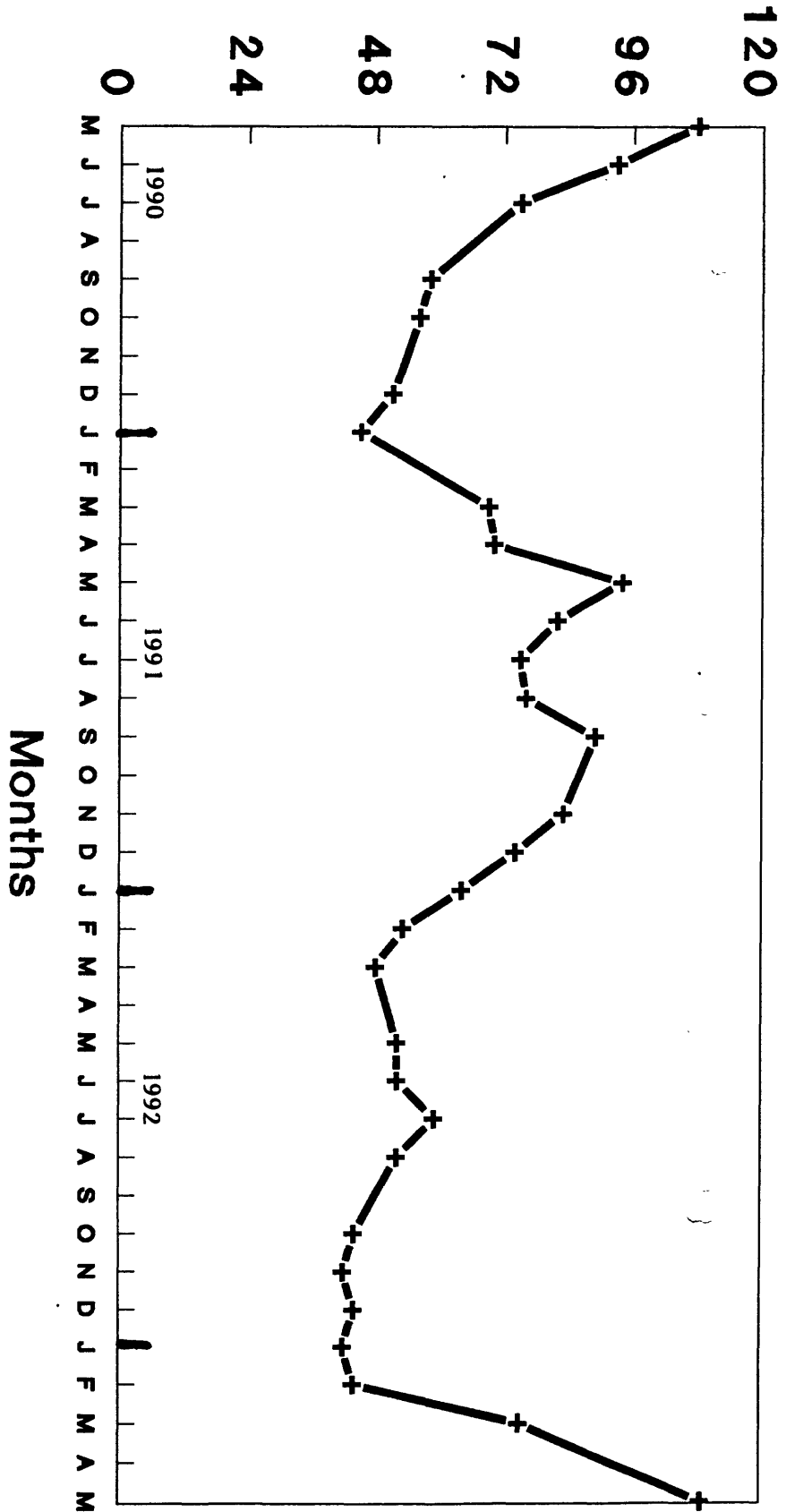


Table 1.—Concentrations of silver and copper in clams and sediments from the Palo Alto mudflat observed between May 1992 and May 1993. [Values are concentrations in micrograms per gram dry weight and represent the mean of replicates shown in appendices and the standard error of the mean for clam samples. Sediment concentrations are for the hydrochloric acid extracts of sediments, which encompasses the bioavailable form of the metals.]

Date	Silver in Sediment (HCl)	Silver in Clams		Copper in Sediment (HCL)	Copper in Clams	
		mean	SEM		mean	SEM
6/92	<0.22	5.1	0.8	20	42	3.3
7/92	0.34	6.1	0.4	21	45	2.4
8/92	0.39	7.9	0.7	20	55	4.0
10/92	0.37	8.8	0.6	21	80	1.3
11/92	0.51	9.8	0.5	26	65	2.6
12/92	0.42	10.7	0.7	29	68	2.4
1/93	0.47	13.5	1.4	29	67	6.3
2/93	0.39	17.0	3.6	22	83	11.0
3/93	0.32	6.0	0.4	23	47	3.0
4/93	0.28			19		
5/93	0.11	1.4	0.2	23	15.7	1.2
Annual Mean						
	0.36 \pm .11	8.6	4.4	23 \pm 3.5	5	20

Table 2. Annual mean copper concentrations in clams and sediments: 1977 to 1993.

[Values are annual means from 7 to 12 collections per year and standard deviations. Units are microgram per gram dry weight of soft tissue for clams (*Macoma balthica*) and microgram per gram dry weight for sediment.]

Year (May to April)	Copper in sediment (micrograms per gram)		Copper in clams (micrograms per gram)
	HCl	Total	
1977 to 1978	38 ± 16	56 ± 20	151 ± 24
1978 to 1979	51 ± 20	70 ± 19	378 ± 104
1979 to 1980	50 ± 8	84 ± 25	255 ± 124
1980 to 1981	46 ± 9	63 ± 11	267 ± 107
1981 to 1982	43 ± 8	71 ± 11	173 ± 63
1982 to 1983	31 ± 7	64 ± 11	158 ± 62
1983 to 1984	29 ± 7	58 ± 8	156 ± 62
1984 to 1985	32 ± 11	52 ± 8	141 ± 81
1985 to 1986	26 ± 4	51 ± 12	160 ± 81
1986 to 1987	22 ± 4	48 ± 9	78 ± 28
1987 to 1988	23 ± 7	48 ± 10	88 ± 48
1988 to 1989	27 ± 5	54 ± 6	46 ± 22
1989 to 1990	24 ± 3	47 ± 12	42 ± 19
1990 to 1991	23 ± 4	53 ± 7	31 ± 13
1991 to 1992	27 ± 8	51 ± 7	21 ± 7
1992 to 1993	23 ± 4	50 ± 5	57 ± 20

Table 3. Annual mean silver concentrations in clams and sediments from Palo Alto mudflat: 1977 to 1993.

[Values are annual means from 7 to 12 collections per year and standard deviations. Units are microgram per gram dry weight of soft tissue for clams (*Macoma balthica*) and microgram per gram dry weight for sediment. Silver in sediment is from the hydrochloric acid extract. Mean for 1992 to 1993 silver in sediment was calculated from 10 of 11 values where silver was above the instrumental level of detection. Most values were below the limit of quantification.]

Year (May to April)	Silver in sediment (micrograms per gram)	Silver in clams (micrograms per gram)
1977 to 1978	1.44 ± 0.92	102 ± 47
1978 to 1979	1.44 ± 0.51	125 ± 49
1979 to 1980	1.58 ± 0.30	75 ± 51
1980 to 1981	1.27 ± 0.21	90 ± 41
1981 to 1982	1.29 ± 0.36	45 ± 24
1982 to 1983	0.82 ± 0.14	42 ± 26
1983 to 1984	0.73 ± 0.22	54 ± 26
1984 to 1985	0.75 ± 0.13	53 ± 24
1985 to 1986	0.71 ± 0.24	77 ± 44
1986 to 1987	0.62 ± 0.21	32 ± 18
1987 to 1988		51 ± 36
1988 to 1989		15 ± 9
1989 to 1990		10.5 ± 6
1990 to 1991	0.38 ± 0.12	5.3 ± 3.3
1991 to 1992	<0.5	2.0 ± 0.6
1992 to 1993	0.36 ± 0.11	8.6 ± 4.4

APPENDIX 1. Metal concentrations in sediments collected at the Palo Alto mudflat. Each monthly collection is reported on a separate page. Concentrations observed in the reconstituted samples or extracts (in micrograms per milliliter or ug/ml) are reported at the top of each page, along with the sediment weight and dilution factor. The latter are employed to determine concentrations in sediments (reported as microgram per gram dry sediment or $\mu\text{g/g}$). Replicate subsamples were analyzed from each collection. Mean and standard deviation for the replicate samples are reported for the total and hydrochloric acid extracts.

Sed Wt (g)	Dilution(ml)	Extractant	Ag	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn	
0.1457	10.50	HCl	ug/ml	0.003	0.005	0.074	0.256	77.76	10.470	0.110	0.338	0.148	0.663
				0.003	0.005	0.090	0.294	90.90	11.950	0.133	0.404	0.171	0.771
11.00		Total		0.003	0.005	0.838	0.465	372.00	11.680	0.933	0.344	0.860	1.394
				0.003	0.005	1.820	0.940	764.28	22.370	1.752	0.595	1.609	2.736
		HCl	ug/g	0.223	0.324	5.35	18.41	5603.8	754.53	7.95	24.36	10.65	47.79
				0.223	0.324	6.49	21.21	6550.8	861.19	9.56	29.11	12.35	55.56
		Total		0.117	0.170	68.70	35.49	28850.7	844.44	66.14	22.47	60.74	103.28

HCl	MEAN	bd	5.92	19.81	6077.3	807.86	8.76	26.73	11.50	51.68
	STD		0.81	1.98	669.6	75.42	1.14	3.36	1.20	5.49

* Total 1 is almost half of Total 2. Average weight of sediment (sed wt. (g)) may not reflect actual wt in each vial.

Sed Wt (g)	Dilution(ml)	Extractant	Ag	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn
0.1442	10.50	HCl	ug/ml	0.005	0.084	0.311	95.28	9.471	0.125	0.457	0.170	0.792
				0.004	0.072	0.272	87.31	8.764	0.110	0.386	0.155	0.707
11.00		Total		0.003	3.014	1.303	1095.50	23.530	2.440	0.892	2.777	3.786
				0.003	3.251	1.367	1130.50	26.080	2.862	0.905	3.228	3.910
		HCl	ug/g	0.371	6.12	22.62	6937.9	689.64	9.13	33.30	12.36	57.67
				0.306	5.27	19.77	6357.5	638.16	8.02	28.12	11.27	51.47
		Total		0.118	114.96	49.68	41784.0	897.47	93.07	34.02	105.92	144.40
				0.118	124.00	52.14	43118.9	994.73	109.16	34.50	123.12	149.13

HCl	MEAN	0.339	bd	5.70	21.19	6647.7	663.90	8.57	30.71	11.82	54.57
	STD	0.046		0.60	2.01	410.4	36.40	0.79	3.66	0.77	4.38
Total	MEAN	bd	bd	119.48	50.91	42451.5	946.10	101.11	34.26	114.52	146.77
	STD			6.39	1.74	944.0	68.77	11.38	0.34	12.16	3.34

Sed Wt (g)	Dilution(ml)	Extractant	Ag	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn	
0.1531	10.50	HCl	ug/ml	0.006	0.005	0.108	0.292	99.08	10.840	0.148	0.396	0.170	0.760
				0.006	0.005	0.102	0.279	94.85	10.390	0.138	0.360	0.164	0.705
11.00		Total		0.003	0.005	2.962	1.249	1035.50	26.290	2.248	0.837	2.915	3.575
				0.003	0.005	3.081	1.277	1020.00	26.740	2.278	0.831	3.016	3.485
		HCl	ug/g	0.405	0.309	7.42	20.05	6795.2	743.44	10.17	27.19	11.63	52.11
				0.377	0.309	7.02	19.13	6505.1	712.57	9.48	24.66	11.24	48.36
		Total		0.111	0.162	106.41	44.87	37199.5	944.45	80.76	30.07	104.72	128.43
				0.111	0.162	110.68	45.88	36642.7	960.61	81.84	29.85	108.35	125.20

HCl	MEAN	0.391	bd	7.22	19.59	6650.1	728.00	9.82	25.92	11.44	50.24
	STD	0.019		0.28	0.65	205.1	21.82	0.49	1.78	0.28	2.65
Total	MEAN	bd	bd	108.55	45.37	36921.1	952.53	81.30	29.96	106.53	126.81
	STD			3.02	0.71	393.7	11.43	0.76	0.15	2.57	2.29

Sed Wt (g)	Dilution(ml)	Extractant	Ag	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn	
0.1388	10.50	HCl	ug/ml										
			0.005	0.005	0.040	0.282	66.12	17.290	0.081	0.379	0.122	0.599	
			0.005	0.005	0.038	0.276	62.99	16.430	0.081	0.377	0.117	0.575	
11.00		Total	0.003	0.005	3.087	1.209	1009.50	42.580	2.397	0.769	2.152	3.631	
			0.003	0.005	2.907	1.179	986.50	39.830	2.192	0.711	2.751	3.101	
		HCl	ug/g	0.356	0.340	2.99	21.35	5001.9	1307.96	6.13	28.67	9.22	45.34
				0.393	0.340	2.84	20.85	4765.1	1242.90	6.15	28.52	8.83	43.48
		Total	0.123	0.178	122.32	47.89	40001.8	1687.25	94.98	30.47	85.27	143.88	
			0.123	0.178	115.19	46.72	39090.4	1578.28	86.86	28.15	109.01	122.88	

HCl	MEAN	0.374	bd	2.91	21.10	4883.5	1275.43	6.14	28.60	9.02	44.41
	STD	0.027		0.11	0.35	167.4	46.00	0.02	0.11	0.28	1.32
Total	MEAN	bd	bd	118.76	47.30	39546.1	1632.76	90.92	29.31	97.14	133.38
	STD			5.04	0.83	644.4	77.05	5.74	1.64	16.78	14.85

Sed Wt (g)	Dilution(ml)	Extractant	Ag	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn	
0.0828	10.50	HCl	ug/ml	0.004	0.005	0.047	0.208	53.24	14.230	0.064	0.273	0.109	0.495
				0.004	0.005	0.046	0.202	52.60	13.950	0.067	0.259	0.106	0.464
11.00		Total		0.003	0.005	1.714	0.834	661.50	32.550	1.592	0.603	1.492	2.314
				0.003	0.005	1.940	0.897	695.50	32.970	1.632	0.647	1.838	3.519
		HCl	ug/g	0.457	0.571	5.91	26.43	6751.4	1804.53	8.10	34.63	13.77	62.73
				0.558	0.571	5.78	25.63	6670.3	1769.02	8.46	32.88	13.44	58.89
		Total		0.206	0.299	113.85	55.40	43940.2	2162.14	105.75	40.02	99.11	153.67
				0.206	0.299	128.86	59.55	46198.7	2190.04	108.41	42.94	122.09	233.75

HCl	MEAN	0.507	bd	5.85	26.03	6710.9	1786.78	8.28	33.76	13.61	60.81
	STD	0.072		0.09	0.56	57.4	25.11	0.25	1.24	0.23	2.72
Total	MEAN	bd	bd	121.36	57.47	45069.4	2176.09	107.08	41.48	110.60	193.71
	STD			10.62	2.94	1597.0	19.73	1.88	2.07	16.25	56.62

Sed Wt (g)	Dilution(ml)	Extractant	Ag	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn
0.0785	10.50	HCl	0.003	0.005	0.056	0.218	59.67	11.040	0.077	0.257	0.124	0.516
			0.003	0.005	0.056	0.213	57.66	10.650	0.076	0.250	0.120	0.500
0.2600	10.00	Total	0.003	0.005	3.059	1.281	1095.24	38.860	2.450	1.186	2.586	3.723
0.2546	10.00		0.003	0.005	2.846	1.225	1015.98	35.897	2.267	1.039	2.420	3.473
		HCl	0.415	0.602	7.54	29.17	7981.3	1476.69	10.25	34.35	16.60	69.07
			0.415	0.602	7.50	28.44	7712.5	1424.52	10.22	33.37	16.10	66.81
		Total	0.115	0.192	117.65	49.27	42124.6	1494.6	94.231	45.615	99.462	143.19
			0.118	0.196	111.78	48.11	39904.9	1409.9	89.042	40.809	95.051	136.41

HCl	MEAN	bd	bd	7.52	28.80	7846.9	1450.61	10.23	33.86	16.35	67.94
	STD			0.03	0.52	190.1	36.89	0.02	0.69	0.35	1.60
Total	MEAN	bd	bd	114.72	48.69	41014.8	1452.28	91.64	43.21	97.26	139.80
	STD			4.15	0.82	1569.5	59.88	3.67	3.40	3.12	4.80

Sed Wt (g)	Dilution(ml)	Extractant	Ag	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn	
0.0802	10.50	HCl	ug/ml	0.004	0.005	0.043	0.226	56.37	9.775	0.083	0.312	0.116	0.409
				0.004	0.005	0.044	0.225	55.02	9.494	0.080	0.280	0.116	0.527
0.2581	10.00	Total	0.003	0.005	3.296	1.380	1164.83	35.630	2.586	1.263	2.883	4.086	
0.2547	10.00		0.003	0.005	3.393	1.398	1164.17	35.430	2.591	1.273	3.014	3.952	
<hr/>													
		HCl	ug/g	0.484	0.589	5.56	29.54	7380.1	1279.77	10.91	40.87	15.16	53.57
				0.458	0.589	5.76	29.42	7203.4	1242.98	10.50	36.71	15.16	68.97
		Total	0.116	0.194	127.70	53.468	45131.0	1380.5	100.19	48.935	111.70	158.31	
			0.118	0.196	133.22	54.888	45707.5	1391.0	101.73	49.980	118.34	155.16	

HCl	MEAN	0.471	bd	5.66	29.48	7291.7	1261.37	10.70	38.79	15.16	61.27
	STD	0.019		0.14	0.08	125.0	26.01	0.29	2.94	0.00	10.89
Total	MEAN	bd	bd	130.46	54.18	45419.2	1385.76	100.96	49.46	115.02	156.74
	STD			3.90	1.00	407.7	7.48	1.08	0.74	4.69	2.23

Sed Wt (g)	Dilution(ml)	Extractant	Ag	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn
0.4962	10.00	HCl	0.016	0.012	0.278	1.134	253.80	53.580	0.410	1.566	0.660	2.366
0.5078	10.00		0.024	0.037	0.269	1.119	249.70	53.600	0.459	1.526	0.706	2.340
0.5349	10.00	Total	0.003	0.005	6.257	2.9265	2315.67	71.095	4.878	2.112	5.628	7.951
0.5507	10.00		0.003	0.005	5.518	2.5684	2197.78	73.892	4.972	1.639	4.399	7.615
		HCl	0.314	0.236	5.61	22.854	5114.9	1079.8	8.257	31.560	13.30	47.682
			0.473	0.725	5.29	22.036	4917.3	1055.5	9.031	30.051	13.899	46.081
		Total	0.056	0.093	116.98	54.711	43291.6	1329.1	91.195	39.480	105.22	148.64
			0.054	0.091	100.20	46.639	39908.8	1341.8	90.285	29.755	79.880	138.28
		HCl	0.394	0.480	5.45	22.44	5016.1	1067.67	8.64	30.81	13.60	46.88
		STD	0.112	0.346	0.23	0.58	139.7	17.16	0.55	1.07	0.43	1.13
		Total	bd	bd	108.59	50.67	41600.2	1335.46	90.74	34.62	92.55	143.46
		STD			11.86	5.71	2392.0	8.95	0.64	6.88	17.92	7.32

Sed Wt (g)	Dilution(ml)	Extractant	Ag	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn	
		ug/ml											
0.5140	10.00	HCl	0.017	0.013	0.279	1.185	263.10	66.590	0.466	1.576	0.622	2.603	
0.5005	10.00		0.016	0.011	0.295	1.180	272.30	64.420	0.473	1.541	0.631	2.644	
0.4999	10.00	Total	0.003	0.005	5.914	2.6055	2200.18	76.823	4.679	1.893	4.975	7.471	
0.5009	10.00		0.003	0.005	5.847	2.1605	1818.89	77.456	4.705	1.584	5.032	6.133	
HCl			0.335	0.249	5.42	23.054	5118.7	1295.5	9.060	30.661	12.11	50.642	
Total			0.312	0.212	5.89	23.576	5440.6	1287.1	9.449	30.789	12.599	52.827	
HCl			0.060	0.100	118.30	52.120	44012.4	1536.8	93.599	37.876	99.52	149.45	
Total			0.060	0.100	116.73	43.132	36312.5	1546.3	93.931	31.623	100.46	122.43	
HCl			MEAN	0.323	0.230	5.65	23.32	5279.6	1291.32	9.25	30.73	12.35	51.73
STD			0.016	0.026	0.33	0.37	227.6	5.95	0.27	0.09	0.35	1.55	
Total			MEAN	bd	bd	117.52	47.63	40162.4	1541.55	93.76	34.75	99.99	135.94
STD					1.11	6.36	5444.7	6.77	0.23	4.42	0.66	19.11	

4-8-93 (99% < 100u)

PALO ALTO

Sed Wt (g)	Dilution(ml)	Extractant	Ag	Al	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn
0.4768	10.00	HCL	0.01371	110.91778	-0.0034	0.24051	0.9097	237.765	52.55241	0.4053	1.38301	0.5587	2.71016
0.5053	10.00		0.0141	116.77372	-0.0041	0.25086	0.9692	247.6472	55.54609	0.4238	1.47492	0.58981	2.76918
			0.288	2326.296	-0.070	5.04	19.08	4986.7	1102.2	8.50	29.01	11.72	56.84
			0.279	2310.978	-0.081	4.96	19.18	4901.0	1099.3	8.39	29.19	11.67	54.80
		Mean	0.283	2318.637	-0.075	5.004	19.129	4943.84	1100.730	8.443	29.098	11.695	55.822
		Stdv	0.006	10.831	0.007	0.06	0.07	60.6	2.1	0.08	0.13	0.03	1.44

Sed Wt (g)	Dilution(ml)	Extractant	Ag	Al	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn
0.4986	10.00	2:8 TOT	-0.00731	369.91818	-0.0175	1.00298	0.6074	403.3837	14.55432	0.9659	0.39545	0.71329	1.50367
0.4953	10.00		-0.00697	410.43319	-0.0161	1.05415	0.476	407.0163	14.3404	0.961	0.39507	0.78923	1.48146
			-0.733	37095.686	-1.758	100.58	60.91	40451.6	1459.5	96.86	39.66	71.53	150.79
			-0.704	41432.787	-1.626	106.42	48.05	41087.9	1447.6	97.01	39.88	79.67	149.55
		Mean	bd	39264.237	bd	103.497	54.479	40769.7	1453.583	96.934	39.769	75.601	150.170
		Stdv		3066.794		4.13	9.10	449.9	8.4	0.11	0.16	5.76	0.87

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5-10-93 (89% < 100 u)

LO ALTO

Sed Wt (g)	Dilution(ml)	Extractant	Ag	Al	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn
0.5611	10.00	HCL	0.00889	130.03808	0.01195	0.32868	1.2932	346.0914	34.73313	0.5263	1.60675	0.68188	2.92705
0.5137	10.00		0.0035	121.83688	0.00853	0.31098	1.2002	323.3059	31.627	0.4934	1.49342	0.63255	2.72533
			0.158	2317.556	0.213	5.86	23.05	6168.1	619.0	9.38	28.64	12.15	52.17
			0.068	2371.752	0.166	6.05	23.36	6293.7	615.7	9.61	29.07	12.31	53.05
		Mean	0.113	2344.654	0.190	5.956	23.206	6230.9	617.345	9.492	28.854	12.233	52.610
		Stdv	0.064	38.322	0.033	0.14	0.22	88.8	2.4	0.16	0.31	0.11	0.63

Sed Wt (g)	Dilution(ml)	Extractant	Ag	Al	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn
0.4844	10.00	TOT 2:8	-0.00353	279.30545	0.00076	0.81239	0.3963	338.2188	7.42202	0.8043	0.36751	0.60238	1.13965
0.5154	10.00		-0.00606	362.1885	0.00499	0.95251	0.4603	385.8217	8.38095	0.9149	0.39309	0.73016	1.37995
			-0.073	28830.042	0.078	83.86	40.90	34911.1	766.1	83.02	37.93	62.18	117.64
			-0.118	35136.641	0.484	92.40	44.65	37429.3	813.1	88.76	38.13	70.83	133.87
		Mean	bd	31983.342	0.281	88.130	42.777	36170.2	789.579	85.887	38.035	66.506	125.753
		Stdv		4459.439	0.287	6.05	2.65	1780.7	33.2	4.06	0.14	6.12	11.48

APPENDIX 2. Metal concentrations in the clam *Macoma balthica* collected at the Palo Alto Mudflat. Each monthly collection is reported on two pages. The first page contains summary statistics:

Mean concentrations in microgram per gram dry tissue weight (ug/g).

STD is the standard deviation of the mean.

SEM is the standard error of the mean.

CV percent is the coefficient of variation.

$r_{wt \times []}$ is the correlation coefficient for the concentration versus weight correlation for each element.

X 100mg is the concentration interpolated from the above regression for a 100 mg animal.

$r_{l \times []}$ is the correlation coefficient for the concentration versus shell length regression.

X 20 mm and X 25 mm are concentrations interpolated from the regression for 20mm and 25 mm animals.

Content (a measure of metal bioaccumulation that is independent of mass) is also shown for 20 and 25 mm animals, as is the weight determined for animals of 15 mm and 20 mm shell length.

The second page for each month shows each analysis of each composite sample, the number of animals composited in each, concentration as calculated from sample dry weight and the dilution factor and the metal content for each sample.

Macoma balthica Palo Alto 6/2/92

	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
Mean(ug/g)	5.095	0.316	1.229	41.755	5.386	2.123	1.426	277.8
STD	2.676	0.031	0.395	11.090	0.661	0.384	0.355	81.3
SEM	0.807	0.010	0.119	3.344	0.199	0.122	0.107	24.5
CV%	52.519	9.677	32.156	26.559	12.272	18.109	24.870	29.2
r wt x []	0.763	0.000	0.319	0.685	0.719	0.000	0.485	0.052
X 100mg	7.188	0.000	1.358	49.537	5.873	0.000	1.602	273.516
r l x []	0.693	0.000	0.301	0.647	0.704	0.000	0.514	0.128
X 20mm	4.878	0.000	1.215	40.914	5.331	0.000	1.405	279.045
X 25mm	6.610	0.000	1.326	47.614	5.766	0.000	1.575	269.336

Estimated content (ug) for 20mm and 25mm clam

	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
20mm	0.2386	1.0000	0.0611	2.1022	0.2760	1.0000	0.0718	13.6370
25mm	0.5079	1.0000	0.1097	3.9901	0.5018	1.0000	0.1358	21.5710

Estimated weight for 15mm clam

0.026 gm
25.989 mg

Estimated weight for 20mm clam

0.052 gm
51.611 mg

Estimated weight for 25mm clam

87.874 mg.

Macoma balthica Palo Alto 6/2/92

Sample #-n	Average Length (mm)	Total Dry Wt (gm)	Average Dry Wt (gm)	Recon Amt (ml)	Concentration (ug/ml) - Blank Corrected from ICP-AES							
					Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
mb1	31.0	0.1400	0.1400	5	0.3316	0.01007	0.0242	2.05576	0.187	0.04832	0.03382	10.5662
mb2	28.1	0.1171	0.1171	5	0.12608	0.00852	0.05364	0.82274	0.14425	0.06784	0.05368	3.86986
mb3	23.4	0.1664	0.0832	5	0.2677	0.0093	0.04469	1.54182	0.1697	0.07075	0.05571	10.645
mb4	22.4	0.0625	0.0625	5	0.03219	0.00232	0.01188	0.49796	0.07142	0.01692	0.01622	1.46409
mb5	21.0	0.1086	0.0543	5	0.09365	0.00387	0.02294	0.93112	0.10587	0.05283	0.03788	4.9649
mb6	19.8	0.1464	0.0488	5	0.10689	0.0093	0.04301	0.98685	0.17195	0.05818	0.04367	10.4657
mb7	18.3	0.3664	0.0458	5	0.27505	0.0217	0.07196	2.78937	0.32676	0.12195	0.08255	17.8185
mb8	17.5	0.3492	0.0388	5	0.29668	0.02247	0.07798	2.66611	0.3404	0.12256	0.08866	23.7192
mb9	16.7	0.2188	0.0365	5	0.14377	0.0124	0.05493	1.54818	0.22271	0.09664	0.05333	13.7884
mb10	15.4	0.1680	0.0280	5	0.18134	0.01085	0.03971	1.2735	0.16619	0.08159	0.03909	9.88549
mb11	13.3	0.1047	0.0175	5	0.07448	0.0062	0.02116	0.80604	0.11473	0.04204	0.02515	6.24851
				Detection Lim	.003	.004	.005	.002	.01	.025	.001	.005
				Sample #								
		Concentration (ug/g) ==>		mb1	11.8429	0.3596	0.8643	73.4200	6.6786	1.7257	1.2079	377.366
				mb2	5.3834	0.3638	2.2904	35.1298	6.1593	2.8967	2.2921	165.237
				mb3	8.0439	0.2794	1.3428	46.3287	5.0992	2.1259	1.6740	319.860
				mb4	2.5752		0.9504	39.8368	5.7136		1.2976	117.127
				mb5	4.3117		1.0562	42.8692	4.8743	2.4323	1.7440	228.587
				mb6	3.6506	0.3176	1.4689	33.7039	5.8726	1.9870	1.4915	357.435
				mb7	3.7534	0.2961	0.9820	38.0645	4.4591	1.6642	1.1265	243.156
				mb8	4.2480	0.3217	1.1166	38.1745	4.8740	1.7549	1.2695	339.623
				mb9	3.2854	0.2834	1.2553	35.3789	5.0894	2.2084	1.2187	315.090
				mb10	5.3970	0.3229	1.1818	37.9018	4.9461	2.4283	1.1634	294.211
				mb11	3.5568	0.2961	1.0105	38.4928	5.4790	2.0076	1.2011	298.401
				Sample #								
		Content (ug) ==>		mb1	1.6580	0.0504	0.1210	10.2788	0.9350	0.2416	0.1691	52.8312
				mb2	0.6304	0.0426	0.2682	4.1137	0.7213	0.3392	0.2684	19.3493
				mb3	0.6693	0.0232	0.1117	3.8546	0.4243	0.1769	0.1393	26.6124
				mb4	0.1610	0.0000	0.0594	2.4898	0.3571	0.0000	0.0811	7.3205
				mb5	0.2341	0.0000	0.0574	2.3278	0.2647	0.1321	0.0947	12.4123
				mb6	0.1782	0.0155	0.0717	1.6448	0.2866	0.0970	0.0728	17.4428
				mb7	0.1719	0.0136	0.0450	1.7434	0.2042	0.0762	0.0516	11.1365
				mb8	0.1648	0.0125	0.0433	1.4812	0.1891	0.0681	0.0493	13.1774
				mb9	0.1199	0.0103	0.0458	1.2913	0.1858	0.0806	0.0445	11.5008
				mb10	0.1511	0.0090	0.0331	1.0613	0.1385	0.0680	0.0326	8.2379
				mb11	0.0622	0.0052	0.0177	0.6736	0.0959	0.0351	0.0210	5.2220

Macoma balthica *Palo Alto 7-14-92*

	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
Mean(ug/g)	6.066	0.2171	2.234	44.94	4.314	1.651	1.185	293.0
STD	1.324	0.04481	1.541	7.04	0.652	0.273	0.220	66.6
SEM	0.441	0.016	0.514	2.35	0.217	0.096	0.073	22.2
CV%	21.825	20.642	68.955	15.67	15.109	16.515	18.573	22.7
r wt x []	0.832	0.004	0.684	0.148	0.497	0.706	0.162	0.009
X 100mg	8.755	0.218	-0.337	47.485	3.523	1.189	1.273	294.346
r l x []	0.826	0.039	0.712	0.146	0.509	0.695	0.153	0.018
X 20mm	6.778	0.218	1.520	45.615	4.098	1.552	1.207	292.160
X 25mm	8.456	0.221	-0.164	47.198	3.589	1.244	1.259	290.282

Estimated content (ug) for 20mm and 25mm clam

	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
20mm	0.3955	0.0127	0.0819	2.6476	0.2389	0.0901	0.0703	16.9246
25mm	0.8780	0.0228	0.0842	4.8519	0.3911	0.1359	0.1311	30.4396

Estimated weight for 15mm clam

0.028 gm
27.573 mg

Estimated weight for 20mm clam

0.059 gm
59.146 mg

Sample #	Average Length (mm)	Total Dry Wt (gm)	Average Dry Wt (gm)	Recon Amt (ml)	Concentration (ug/ml) - Blank Corrected from ICP-AES								
					Ag	Cd	Cr	Cu	Ni	Pb	V	Zn	
Mb1	23.7	0.2629	0.0876	5	0.47346	0.01162	0.08175	2.82828	0.21215	0.06735	0.0672	18.9723	
Mb2	21.3	0.2054	0.0685	5	0.27559	0.00677	0.04438	1.27821	0.19148	0.0703	0.0609	11.6825	
Mb3	19.6	0.3523	0.0587	5	0.36217	0.01452	0.09039	3.22814	0.24724	0.10083	0.0728	17.8541	
Mb4	18.5	0.2896	0.0483	5	0.36568	0.01743	0.07099	3.16225	0.23441	0.09634	0.0556	14.8777	
Mb5	17.6	0.3516	0.0440	5	0.42391	0.0184	0.09391	3.11304	0.26256	0.10693	0.0645	19.7923	
Mb6	16.4	0.2559	0.0366	5	0.32634	0.01065	0.10505	2.29353	0.20466	0.09771	0.0701	14.0975	
Mb7	15.5	0.2212	0.0316	5	0.24784	0.00774	0.10046	1.82381	0.18596	0.06869	0.0533	9.28437	
Mb8	14.5	0.1214	0.0243	5	0.1099	0.00484	0.08457	1.15295	0.12718	0.05193	0.0351	6.76734	
Mb9	13.8	0.0409	0.0205	5	0.04004	-0.001	0.04762	0.33843	0.04417	0.00778	0.008	3.5636	
				Detection Limit	.003	.004	.005	.002	.01	.025	.001	.005	
				Sample #									
				Concentration (ug/g) ==>	Mb1	9.0046	0.2210	1.5548	53.7900	4.0348	1.2809	1.2781	360.828
					Mb2	6.7086	0.1648	1.0803	31.1151	4.6611	1.7113	1.4825	284.385
					Mb3	5.1401	0.2061	1.2829	45.8152	3.5089	1.4310	1.0332	253.394
					Mb4	6.3135	0.3009	1.2257	54.5969	4.0471	1.6633	0.9599	256.866
					Mb5	6.0283	0.2617	1.3355	44.2696	3.7338	1.5206	0.9172	281.460
					Mb6	6.3763	0.2081	2.0526	44.8130	3.9988	1.9091	1.3697	275.449
					Mb7	5.6022	0.1750	2.2708	41.2254	4.2034	1.5527	1.2048	209.864
					Mb8	4.5264	0.1993	3.4831	47.4856	5.2381	2.1388	1.4456	278.721
					Mb9	4.8949		5.8215	41.3729	5.3998		0.9780	435.648
				Sample #									
				Content (ug) ==>	Mb1	0.7888	0.0194	0.1362	4.7120	0.3534	0.1122	0.1120	31.6085
					Mb2	0.4595	0.0113	0.0740	2.1314	0.3193	0.1172	0.1015	19.4804
					Mb3	0.3017	0.0121	0.0753	2.6894	0.2060	0.0840	0.0606	14.8742
					Mb4	0.3049	0.0145	0.0592	2.6370	0.1955	0.0803	0.0464	12.4066
					Mb5	0.2652	0.0115	0.0588	1.9479	0.1643	0.0669	0.0404	12.3842
					Mb6	0.2334	0.0076	0.0751	1.6402	0.1464	0.0699	0.0501	10.0814
					Mb7	0.1770	0.0055	0.0718	1.3027	0.1328	0.0491	0.0381	6.6317
					Mb8	0.1100	0.0048	0.0846	1.1539	0.1273	0.0520	0.0351	6.7729
					Mb9	0.1003		0.1193	0.8481	0.1107		0.0200	8.9308

Macoma balthica Palo Alto 8/12/92

	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
Mean(ug/g)	7.853	0.379	1.954	55.178	5.429	1.759	1.185	258.8
STD	2.327	0.097	0.881	13.314	0.603	0.487	0.162	72.4
SEM	0.702	0.029	0.266	4.014	0.182	0.154	0.049	21.8
CV%	29.638	25.489	45.069	24.129	11.102	27.712	13.658	28.0
r wt x []	0.763	0.000	0.319	0.685	0.719	0.000	0.485	0.052
X 100mg	7.188	0.000	1.358	49.537	5.873	0.000	1.602	273.516
r l x []	0.693	0.000	0.301	0.647	0.704	0.000	0.514	0.128
X 20mm	4.878	0.000	1.215	40.914	5.331	0.000	1.405	279.045
X 25mm	6.610	0.000	1.326	47.614	5.766	0.000	1.575	269.336

Estimated content (ug) for 20mm and 25mm clam

	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
20mm	0.2386	1.0000	0.0611	2.1022	0.2760	1.0000	0.0718	13.6370
25mm	0.5079	1.0000	0.1097	3.9901	0.5018	1.0000	0.1358	21.5710

Estimated weight for 15mm clam

0.026 gm
25.989 mg

Estimated weight for 20mm clam

0.052 gm
51.611 mg

Macoma balthica Palo Alto 8/12/92

Sample #-n	Average Length (mm)	Total Dry Wt (gm)	Average Dry Wt (gm)	Recon Amt (ml)	Concentration (ug/ml) - Blank Corrected from ICP-AES						
					Ag	Cd	Cr	Cu	Ni	Pb	V
mb1	13.1	0.0436	0.0145	5	0.07428	0.00395	0.03383	0.74567	0.04732	0.018	0.00876
mb2	14.3	0.0907	0.0227	5	0.07782	0.00494	0.05005	0.81399	0.10027	0.05126	0.02271
mb3	15.6	0.1785	0.0255	5	0.26865	0.01979	0.07902	1.59258	0.16953	0.05755	0.04117
mb4	16.5	0.2431	0.0304	5	0.3697	0.01781	0.06041	2.7352	0.23844	0.09376	0.05956
mb5	17.4	0.2122	0.0303	5	0.36625	0.0188	0.05414	2.38364	0.23554	0.07397	0.05665
mb6	18.7	0.1798	0.0450	5	0.3566	0.01187	0.05412	2.2982	0.18132	0.05548	0.03655
mb7	20.6	0.3294	0.0549	5	0.56602	0.0188	0.09446	3.3735	0.39039	0.11528	0.08064
mb8	21.4	0.1343	0.0672	5	0.23038	0.01088	0.06825	1.17253	0.16282	0.05386	0.02923
mb9	23.8	0.1797	0.0900	5	0.13008	0.0089	0.05319	1.52144	0.16663	0.04243	0.03708
mb10	26.5	0.2161	0.1080	5	0.48654	0.0188	0.05239	2.73404	0.2796	0.05359	0.0656
				Detection Li	0.0026	0.0033	0.0018	0.0054	0.0081	0.039	0.0015
				Sample #							
		Concentration (ug/g) ==>		mb1	8.5183	0.4530	3.8796	85.5126	5.4266		1.0046
				mb2	4.2900	0.2723	2.7591	44.8727	5.5276	2.8258	1.2519
				mb3	7.5252	0.5543	2.2134	44.6101	4.7487	1.6120	1.1532
				mb4	7.6039	0.3663	1.2425	56.2567	4.9042	1.9284	1.2250
				mb5	8.6298	0.4430	1.2757	56.1649	5.5500	1.7429	1.3348
				mb6	9.9166	0.3301	1.5050	63.9099	5.0423	1.5428	1.0164
				mb7	8.5917	0.2854	1.4338	51.2067	5.9258	1.7498	1.2240
				mb8	8.5771	0.4051	2.5410	43.6534	6.0618	2.0052	1.0882
				mb9	3.6194	0.2476	1.4800	42.3328	4.6363	1.1806	1.0317
				mb10	11.2573	0.4350	1.2122	63.2587	6.4692	1.2399	1.5178
				0	ERR	ERR	ERR	ERR	ERR	ERR	ERR
				Sample #							
		Content (ug) ==>		mb1	0.1235	0.0066	0.0563	1.2399	0.0787	0.0000	0.0146
				mb2	0.0974	0.0062	0.0626	1.0186	0.1255	0.0641	0.0284
				mb3	0.1919	0.0141	0.0564	1.1376	0.1211	0.0411	0.0294
				mb4	0.2312	0.0111	0.0378	1.7102	0.1491	0.0586	0.0372
				mb5	0.2615	0.0134	0.0387	1.7018	0.1682	0.0528	0.0404
				mb6	0.4462	0.0149	0.0677	2.8759	0.2269	0.0694	0.0457
				mb7	0.4717	0.0157	0.0787	2.8113	0.3253	0.0961	0.0672
				mb8	0.5764	0.0272	0.1708	2.9335	0.4074	0.1348	0.0731
				mb9	0.3257	0.0223	0.1332	3.8099	0.4173	0.1063	0.0929
				mb10	1.2158	0.0470	0.1309	6.8319	0.6987	0.1339	0.1639

Macoma balthica Palo Alto 10-23-92

	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
Mean(ug/g)	8.8192	0.2142	1.6107	79.5397	5.9598	1.3586	1.3546	203.3
STD	1.99845	0.05998	0.63373	43.5223	0.83195	0.40101	0.43731	59.2
SEM	0.603	0.021	0.191	13.122	0.251	0.179	0.132	17.9
CV%	22.660	28.002	39.344	54.718	13.959	29.516	32.283	29.1
r wt x []	0.345	0.397	0.219	0.545	0.315	0.000	0.414	0.190
X 100mg	11.195	0.129	2.090	-2.198	6.863	0.000	1.978	164.579
r l x []	0.348	0.277	0.260	0.649	0.330	0.000	0.457	0.194
X 20mm	9.235	0.211	1.709	62.672	6.124	0.000	1.474	196.421
X 25mm	10.097	0.182	1.913	27.689	6.464	0.000	1.722	182.163

Estimated content (ug) for 20mm and 25mm clam

	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
20mm	0.3970	0.0087	0.0695	2.6706	0.2656	1.0000	0.0613	8.1750
25mm	0.7682	0.0130	0.1330	3.7304	0.4951	1.0000	0.1225	13.7942

Estimated weight for 15mm clam

0.021 gm
20.536 mg

Estimated weight for 20mm clam

0.044 gm
43.968 mg

Estimated weight for 25mm clam

0.079 gm
79.356 mg

Macoma balthica Palo Alto 10-23-92

Sample #-n	Average Length (mm)	Total Dry Wt (gm)	Average Dry Wt (gm)	Recon Amt (ml)	Concentration (ug/ml) - Blank Corrected from ICP-AES							
					Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
mb1	10.4	0.0353	0.0071	5	0.0500	0.0012	0.0151	1.4096	0.0406	-0.0318	0.0107	1.5615
mb2	13.6	0.0685	0.0170	5	0.1423	-0.0015	0.0161	1.5201	0.0757	-0.0245	0.0134	2.4240
mb3	14.5	0.0728	0.0182	5	0.1570	0.0012	0.0132	1.1039	0.0870	-0.0099	0.0121	2.0987
mb4	15.5	0.1398	0.0233	5	0.1586	0.0038	0.0484	1.2134	0.1950	0.0095	0.0396	5.1009
mb5	16.7	0.2468	0.0308	5	0.4216	0.0125	0.0550	2.6727	0.2691	0.0487	0.0549	12.8083
mb6	17.7	0.1630	0.0326	5	0.2401	0.0085	0.0464	1.9741	0.1650	0.0286	0.0399	8.2389
mb7	18.6	0.2175	0.0311	5	0.3404	0.0105	0.0763	2.8760	0.2555	0.0539	0.0669	9.1839
mb8	19.6	0.2228	0.0446	5	0.3079	0.0105	0.0587	2.7063	0.2029	0.0135	0.0504	11.4032
mb9	20.3	0.1983	0.0496	5	0.4299	0.0091	0.0504	2.8382	0.2515	0.0525	0.0431	11.5639
mb10	22.2	0.2057	0.0514	5	0.4848	0.0105	0.1317	3.1621	0.3019	0.0840	0.0997	5.3331
mb11	24.4	0.2206	0.0735	5	0.4333	0.0045	0.0741	2.4323	0.2961	0.0531	0.0731	4.9021
Detection Limit					0.0026	0.0033	0.0018	0.0054	0.0081	0.0390	0.0015	0.0081
Sample #												
<u>Concentration (ug/g) ==></u>												
mb1					7.0819		2.1398	<i>Zoo</i>	5.7491		1.5085	221.178
mb2					10.3867		1.1757	<i>!!!</i>	5.5283		0.9752	176.937
mb3					10.7822		0.9077	75.8141	5.9724		0.8283	144.143
mb4					5.6720	0.1373	1.7320	43.3993	6.9742		1.4167	182.437
mb5					8.5405	0.2526	1.1148	54.1463	5.4522	0.9870	1.1122	259.488
mb6					7.3665	0.2604	1.4244	60.5562	5.0622		1.2236	252.727
mb7					7.8255	0.2409	1.7530	66.1141	5.8747	1.2388	1.5382	211.123
mb8					6.9095	0.2352	1.3181	60.7332	4.5531		1.1299	255.907
mb9					10.8393	0.2307	1.2715	71.5634	6.3409	1.3237	1.0877	291.577
mb10					11.7851	0.2547	3.2019	76.8630	7.3388	2.0408	2.4227	129.634
mb11					9.8216	0.1020	1.6792	55.1290	6.7119	1.2030	1.6575	111.108
Sample #												
<u>Content (ug) ==></u>												
mb1					0.0503		0.0152	1.4176	0.0408		0.0107	1.5704
mb2					0.1766		0.0200	1.8863	0.0940		0.0166	3.0079
mb3					0.1962		0.0165	1.3798	0.1087		0.0151	2.6234
mb4					0.1322	0.0032	0.0404	1.0112	0.1625		0.0330	4.2508
mb5					0.2630	0.0078	0.0343	1.6677	0.1679	0.0304	0.0343	7.9922
mb6					0.2401	0.0085	0.0464	1.9741	0.1650		0.0399	8.2389
mb7					0.2434	0.0075	0.0545	2.0561	0.1827	0.0385	0.0478	6.5659
mb8					0.3082	0.0105	0.0588	2.7087	0.2031		0.0504	11.4135
mb9					0.5376	0.0114	0.0631	3.5495	0.3145	0.0657	0.0540	14.4622
mb10					0.6058	0.0131	0.1646	3.9508	0.3772	0.1049	0.1245	6.6632
mb11					0.7219	0.0075	0.1234	4.0520	0.4933	0.0884	0.1218	8.1664

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	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
Mean(ug/g)	9.8451	0.2230	3.8225	64.8191	7.8520	3.0052	2.8570	208.1
STD	1.59232	0.04032	1.02822	8.73903	1.86432	0.78469	0.84165	51.8
SEM	0.480	0.015	0.310	2.635	0.562	0.262	0.254	15.6
CV%	16.174	18.081	26.899	13.482	23.743	26.111	29.459	24.9
r wt x []	0.208	0.000	0.515	0.579	0.466	0.360	0.701	0.280
X 100mg	8.774	0.000	5.536	48.431	10.661	4.027	4.768	161.206
r l x []	0.059	0.000	0.549	0.490	0.531	0.408	0.755	0.357
X 20mm	9.814	0.000	4.009	63.402	8.179	3.007	3.067	201.951
X 25mm	9.709	0.000	4.641	58.598	9.289	3.497	3.779	181.216

Estimated content (ug) for 20mm and 25mm clam

	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
20mm	0.4050	1.0000	0.1631	2.6215	0.3363	0.1245	0.1254	8.1428
25mm	0.7125	1.0000	0.3216	4.4154	0.6545	0.2343	0.2657	13.4099

Estimated weight for 15mm clam

0.020 gm
19.900 mg

Estimated weight for 20mm clam

0.042 gm
41.891 mg

Estimated weight for 25mm clam

0.075 gm
74.624 mg

Macoma balthica Palo Alto 11-23-92

Sample #-n	Average Length (mm)	Total Dry Wt (gm)	Average Dry Wt (gm)	Recon Amt (ml)	Concentration (ug/ml) - Blank Corrected from ICP-AES							
					Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
mb1	9.9	0.0359	0.0060	5	0.0665	-0.0000	0.0241	0.5048	0.0467	-0.0122	0.0141	1.8373
mb2	14.1	0.0846	0.0169	5	0.1857	0.0007	0.0460	1.3146	0.1107	0.0340	0.0329	3.0529
mb3	15.8	0.1104	0.0221	5	0.2246	0.0034	0.0926	1.7249	0.1752	0.0453	0.0698	6.4116
mb4	16.7	0.1461	0.0292	5	0.2534	0.0041	0.0892	1.8196	0.2062	0.0786	0.0646	6.5061
mb5	17.7	0.0924	0.0308	5	0.1881	-0.0007	0.0760	1.1625	0.1484	0.0650	0.0517	2.3602
mb6	18.4	0.1823	0.0365	5	0.3782	0.0083	0.1355	2.4245	0.2699	0.1174	0.1041	7.7304
mb7	19.4	0.1154	0.0385	5	0.2536	0.0055	0.0649	1.1547	0.1677	0.0568	0.0504	4.1874
mb8	20.6	0.1569	0.0523	5	0.3055	0.0076	0.0948	1.9930	0.2036	0.0846	0.0788	8.1871
mb9	21.8	0.1300	0.0650	5	0.1874	0.0055	0.1185	1.3921	0.2186	0.0807	0.0894	4.9617
mb10	24.0	0.1145	0.0573	5	0.2958	0.0062	0.1433	1.3795	0.3005	0.1086	0.1076	5.3706
mb11	25.4	0.1222	0.0611	5	0.1907	0.0055	0.1039	1.6593	0.1858	0.0626	0.0895	3.2253
				Detection Lim	0.0026	0.0033	0.0018	0.0054	0.0081	0.0390	0.0015	0.0081
				Sample #								
		Concentration (ug/g) ==>		mb1	9.2686		3.3630	70.2999	6.5109		1.9694	255.886
				mb2	10.9780		2.7167	77.6946	6.5442		1.9450	180.432
				mb3	10.1720		4.1932	78.1202	7.9347	2.0537	3.1594	290.381
				mb4	8.6728	0.1416	3.0516	62.2732	7.0568	2.6888	2.2094	222.658
				mb5	10.1801		4.1113	62.9071	8.0324	3.5193	2.7976	127.718
				mb6	10.3724	0.2273	3.7160	66.4987	7.4034	3.2196	2.8544	212.025
				mb7	10.9878	0.2395	2.8101	50.0296	7.2673	2.4622	2.1846	181.430
				mb8	9.7361	0.2421	3.0219	63.5109	6.4875	2.6959	2.5099	260.902
				mb9	7.2080	0.2126	4.5579	53.5417	8.4092	3.1049	3.4373	190.836
				mb10	12.9161	0.2715	6.2562	60.2421	13.1244	4.7409	4.6996	234.526
				mb11	7.8044	0.2262	4.2495	67.8917	7.6014	2.5612	3.6604	131.969
				Sample #								
		Content (ug) ==>		mb1	0.0556		0.0202	0.4218	0.0391		0.0118	1.5353
				mb2	0.1855		0.0459	1.3130	0.1106		0.0329	3.0493
				mb3	0.2248		0.0927	1.7265	0.1754	0.0454	0.0698	6.4174
				mb4	0.2532	0.0041	0.0891	1.8184	0.2061	0.0785	0.0645	6.5016
				mb5	0.3135		0.1266	1.9375	0.2474	0.1084	0.0862	3.9337
				mb6	0.3786	0.0083	0.1356	2.4272	0.2702	0.1175	0.1042	7.7389
				mb7	0.4230	0.0092	0.1082	1.9261	0.2798	0.0948	0.0841	6.9850
				mb8	0.5092	0.0127	0.1580	3.3216	0.3393	0.1410	0.1313	13.6452
				mb9	0.4685	0.0138	0.2963	3.4802	0.5466	0.2018	0.2234	12.4044
				mb10	0.7401	0.0156	0.3585	3.4519	0.7520	0.2717	0.2693	13.4383
				mb11	0.4768	0.0138	0.2596	4.1482	0.4644	0.1565	0.2237	8.0633

Macoma balthica Palo Alto 12-21-92

	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
Mean(ug/g)	10.7411	0.2229	4.8888	67.6751	8.7283	3.4248	3.8651	316.6
STD	2.43313	0.09207	1.55238	7.97337	1.3186	0.93039	1.32841	55.0
SEM	0.734	0.035	0.468	2.404	0.398	0.380	0.401	16.6
CV%	22.653	41.309	31.753	11.782	15.107	27.167	34.370	17.4
r wt x []	0.609	0.181	0.083	0.550	0.056	0.000	0.136	0.247
X 100mg	7.567	0.251	4.612	58.273	8.885	0.000	4.252	287.508
r l x []	0.555	0.064	0.024	0.466	0.134	0.000	0.252	0.179
X 20mm	9.928	0.223	4.911	65.436	8.835	0.000	4.067	310.651
X 25mm	8.683	0.230	4.945	62.012	8.998	0.000	4.375	301.579

Estimated content (ug) for 20mm and 25mm clam

	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
20mm	0.4201	0.0091	0.2067	2.8506	0.3871	1.0000	0.1752	13.5378
25mm	0.7428	0.0171	0.4044	5.3125	0.7617	1.0000	0.3695	25.8075

Estimated weight for 15mm clam

0.019 gm
18.820 mg

Estimated weight for 20mm clam

0.044 gm
43.865 mg

Estimated weight for 25mm clam

0.085 gm
84.561 mg

Macoma balthica Palo Alto 12-21-92

Sample #-n	Average	Total	Average	Recon	Concentration (ug/ml) - Blank Corrected from ICP-AES								
	Length (mm)	Dry Wt (gm)	Dry Wt (gm)	Amt (ml)	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn	
mb1	9.2	0.0327	0.0047	5	0.06495	-1.2E-05	0.02073	0.47496	0.05135	-0.0153	0.01322	1.9313	
mb2	10.6	0.0394	0.0066	5	0.09713	-0.0014	0.03055	0.55089	0.05534	0.00051	0.01962	1.87707	
mb3	11.8	0.0458	0.0092	5	0.11627	-0.0007	0.04497	0.54103	0.08098	-0.0016	0.03431	3.54347	
mb4	14.5	0.0455	0.0152	5	0.10936	0.00068	0.06767	0.69355	0.10799	0.01806	0.05618	3.6907	
mb5	15.5	0.0839	0.0210	5	0.24036	0.00553	0.08068	1.25054	0.13786	0.04225	0.06159	5.54049	
mb6	16.4	0.0742	0.0247	5	0.17439	0.00414	0.0921	0.95469	0.13276	0.03229	0.07179	4.7783	
mb7	17.5	0.1432	0.0286	5	0.3546	0.00414	0.15849	2.3531	0.27354	0.12195	0.13404	8.16211	
mb8	18.4	0.1402	0.0351	5	0.24117	0.00345	0.18528	1.82679	0.25039	0.11593	0.13721	9.9681	
mb9	20.2	0.2565	0.0513	5	0.31028	0.01313	0.19035	3.19183	0.38955	0.16528	0.15306	17.3491	
mb10	22.2	0.1772	0.0591	5	0.35255	0.00414	0.07963	2.16766	0.27403	0.07677	0.07902	8.25819	
mb11	27.8	0.1108	0.1108	5	0.18018	0.00691	0.11688	1.26443	0.20968	0.0942	0.10615	6.48449	
Detection Lim					0.0026	0.0033	0.0018	0.0054	0.0081	0.0390	0.0015	0.0081	
Sample #													
Concentration (ug/g) ==>					mb1	9.9309	3.1692	72.6244	7.8514	2.0214	295.305		
					mb2	12.3259	3.8765	69.9103	7.0226	2.4898	238.206		
					mb3	12.6930	4.9090	59.0648	8.8404	3.7456	386.841		
					mb4	12.0174	7.4359	76.2147	11.8668	6.1736	405.571		
					mb5	14.3241	0.3295	4.8079	74.5258	8.2156	2.5177	3.6704	330.184
					mb6	11.7512	0.2789	6.2060	64.3324	8.9460	4.8376	321.988	
					mb7	12.3812	0.1445	5.5338	82.1614	9.5509	4.2579	4.6802	284.990
					mb8	8.6009	0.1230	6.6076	65.1495	8.9297	4.1343	4.8934	355.496
					mb9	6.0483	0.2559	3.7105	62.2190	7.5935	3.2218	2.9836	338.189
					mb10	9.9478	0.1168	2.2468	61.1643	7.7322	2.1661	2.2297	233.019
					mb11	8.1308	0.3117	5.2742	57.0593	9.4620	4.2508	4.7902	292.621
Sample #													
Content (ug) ==>					mb1	0.0467	0.0149	0.3413	0.0369	0.0095	1.3879		
					mb2	0.0814	0.0256	0.4614	0.0463	0.0164	1.5722		
					mb3	0.1168	0.0452	0.5434	0.0813	0.0345	3.5589		
					mb4	0.1827	0.1130	1.1585	0.1804	0.0938	6.1647		
					mb5	0.3008	0.0069	0.1010	1.5650	0.1725	0.0529	0.0771	6.9339
					mb6	0.2903	0.0069	0.1533	1.5890	0.2210	0.1195	7.9531	
					mb7	0.3541	0.0041	0.1583	2.3498	0.2732	0.1218	0.1339	8.1507
					mb8	0.3019	0.0043	0.2319	2.2867	0.3134	0.1451	0.1718	12.4779
					mb9	0.3103	0.0131	0.1903	3.1918	0.3895	0.1653	0.1531	17.3491
					mb10	0.5879	0.0069	0.1328	3.6148	0.4570	0.1280	0.1318	13.7714
					mb11	0.9009	0.0345	0.5844	6.3222	1.0484	0.4710	0.5308	32.4224

Macoma balthica Palo Alto 1-19-93

	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
Mean(ug/g)	13.4607	0.3870	3.7729	67.1220	7.4872	2.5567	3.1014	347.2
STD	4.49947	0.15617	2.05415	20.9727	2.71697	0.5734	1.65798	138.6
SEM	1.357	0.052	0.619	6.324	0.819	0.217	0.500	41.8
CV%	33.427	40.350	54.445	31.246	36.288	22.428	53.460	39.9
r wt x []	0.374	0.241	0.070	0.598	0.225	0.000	0.131	0.467
X 100mg	9.260	0.259	3.417	35.812	5.965	0.000	3.644	185.541
r l x []	0.547	0.372	0.469	0.377	0.629	0.000	0.733	0.238
X 20mm	14.799	0.370	4.297	71.420	8.417	0.000	3.762	365.098
X 25mm	17.474	0.291	5.344	80.009	10.274	0.000	5.083	400.962

Estimated content (ug) for 20mm and 25mm clam

	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
20mm	0.6013	0.0135	0.1587	2.9241	0.3419	1.0000	0.1440	14.3108
25mm	1.1333	0.0197	0.3146	5.3312	0.6810	1.0000	0.3210	24.7017

Estimated weight for 15mm clam

0.025 gm
25.313 mg

Estimated weight for 20mm clam

0.042 gm
41.636 mg

Estimated weight for 25mm clam

0.061 gm
61.251 mg

Macoma balthica Palo Alto 1-19-93

Sample #-n	Average Length (mm)	Total Dry Wt (gm)	Average Dry Wt (gm)	Recon Amt (ml)	Concentration (ug/ml) - Blank Corrected from ICP-AES								
					Ag	Cd	Cr	Cu	Ni	Pb	V	Zn	
mb1	10.0	0.0409	0.0058	5	0.1032	-0.0014	0.0247	0.5279	0.0461	-0.0075	0.0169	3.0105	
mb2	12.1	0.3430	0.0858	5	0.1314	0.0018	0.0307	0.5942	0.0611	0.0111	0.0232	3.6841	
mb3	13.8	0.0681	0.0170	5	0.1940	0.0082	0.0349	0.9536	0.1026	0.0146	0.0227	4.6858	
mb4	15.5	0.1110	0.0222	5	0.3509	0.0124	0.1516	1.9562	0.1910	0.0485	0.0796	9.5633	
mb5	16.5	0.0975	0.0244	5	0.1905	0.0103	0.0513	1.6092	0.1475	0.0411	0.0427	7.9987	
mb6	17.4	0.0803	0.0268	5	0.2403	0.0039	0.0633	1.1306	0.1434	0.0238	0.0575	6.5833	
mb7	18.3	0.0955	0.0318	5	0.3279	0.0039	0.0824	1.4236	0.1582	0.0436	0.0775	6.0840	
mb8	19.6	0.1056	0.0352	5	0.2670	0.0039	0.0267	1.3584	0.1217	0.0416	0.0386	4.5064	
mb9	21.5	0.1352	0.0451	5	0.4892	0.0103	0.1425	2.0046	0.2482	0.0793	0.1131	15.2056	
mb10	22.5	0.1248	0.0624	5	0.3551	0.0082	0.1698	1.5512	0.2869	0.0885	0.1571	11.6530	
mb11	25.3	0.1397	0.0699	5	0.4644	0.0124	0.1235	2.2066	0.2370	0.0802	0.1211	6.7310	
Detection Limit					0.0026	0.0033	0.0018	0.0054	0.0081	0.0390	0.0015	0.0081	
Sample #													
Concentration (ug/g) ==>					mb1	12.6220		3.0253	64.5297	5.6306		2.0660	368.028
					mb2	1.9148		0.4470	8.6616	0.8909		0.3380	53.704
					mb3	14.2451	0.6012	2.5600	70.0113	7.5307		1.6630	344.036
					mb4	15.8067	0.5598	6.8269	88.1159	8.6053	2.1850	3.5874	430.779
					mb5	9.7676	0.5286	2.6301	82.5212	7.5656	2.1101	2.1882	410.187
					mb6	14.9625	0.2458	3.9406	70.3968	8.9289		3.5778	409.920
					mb7	17.1669	0.2067	4.3140	74.5347	8.2853	2.2815	4.0560	318.536
					mb8	12.6434	0.1869	1.2626	64.3160	5.7646	1.9710	1.8272	213.373
					mb9	18.0924	0.3812	5.2698	74.1340	9.1778	2.9333	4.1827	562.339
					mb10	14.2255	0.3281	6.8040	62.1456	11.4959	3.5443	6.2933	466.868
					mb11	16.6209	0.4448	4.4215	78.9751	8.4835	2.8714	4.3354	240.909
Sample #													
Content (ug) ==>					mb1	0.0732		0.0175	0.3743	0.0327		0.0120	2.1346
					mb2	0.1643		0.0384	0.7432	0.0764		0.0290	4.6078
					mb3	0.2422	0.0102	0.0435	1.1902	0.1280		0.0283	5.8486
					mb4	0.3509	0.0124	0.1516	1.9562	0.1910	0.0485	0.0796	9.5633
					mb5	0.2383	0.0129	0.0642	2.0135	0.1846	0.0515	0.0534	10.0086
					mb6	0.4010	0.0066	0.1056	1.8866	0.2393		0.0959	10.9859
					mb7	0.5459	0.0066	0.1372	2.3702	0.2635	0.0726	0.1290	10.1294
					mb8	0.4450	0.0066	0.0444	2.2639	0.2029	0.0694	0.0643	7.5107
					mb9	0.8160	0.0172	0.2377	3.3434	0.4139	0.1323	0.1886	25.3615
					mb10	0.8877	0.0205	0.4246	3.8779	0.7173	0.2212	0.3927	29.1326
					mb11	1.1618	0.0311	0.3091	5.5204	0.5930	0.2007	0.3030	16.8395

Macoma balthica Palo Alto 2-9-93

	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
Mean(ug/g)	16.9928	0.4063	5.3396	82.9822	10.1084	2.9310	4.8295	458.7
STD	10.0904	0.10768	1.35624	31.5475	1.22645	0.6545	1.38282	226.7
SEM	3.567	0.041	0.480	11.154	0.434	0.247	0.489	80.1
CV%	59.380	26.504	25.400	38.017	12.133	22.330	28.633	49.4
r wt x []	0.334	0.000	0.078	0.550	0.129	0.000	0.284	0.250
X 100mg	11.153	0.000	1.750	-3.598	6.592	0.000	1.877	158.361
r l x []	0.335	0.000	0.082	0.654	0.117	0.000	0.308	0.264
X 20mm	9.259	0.000	1.905	63.477	6.280	0.000	1.532	199.999
X 25mm	10.087	0.000	1.833	27.360	6.400	0.000	1.698	180.699

Estimated content (ug) for 20mm and 25mm clam

	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
20mm	0.3980	1.0000	0.0785	2.7054	0.2718	1.0000	0.0639	8.3332
25mm	0.7671	1.0000	0.1351	3.7633	0.4921	1.0000	0.1217	13.8171

Estimated weight for 15mm clam

0.021 gm
20.536 mg

Estimated weight for 20mm clam

0.044 gm
43.968 mg

Estimated weight for 25mm clam

0.079 gm
79.356 mg

Macoma balthica Palo Alto 2-9-93

Sample #-n	Average Length (mm)	Total Dry Wt (gm)	Average Dry Wt (gm)	Recon Amt (ml)	Concentration (ug/ml) - Blank Corrected from ICP-AES							
					Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
mb1	10.0	0.0339	0.0058	5	0.0742	0.0029	0.0297	0.4794	0.0642	0.0007	0.0229	2.4140
mb2	11.7	lost										
mb3	15.3	0.1078	0.0170	5	0.2691	0.0082	0.1459	1.3270	0.2504	0.0692	0.1154	9.3014
mb4	16.6	0.1321	0.0222	5	0.4258	0.0082	0.0895	2.4066	0.2119	0.0452	0.0802	10.1361
mb5	18.7	0.1766	0.0244	5	0.3853	0.0082	0.1261	2.3955	0.3228	0.0884	0.1218	12.6518
mb6	19.7	0.1382	0.0268	5	0.3505	0.0135	0.1776	1.9517	0.2873	0.0995	0.1634	9.0816
mb7	21.3	0.2170	0.0318	5	0.5896	0.0188	0.2460	3.5790	0.4290	0.1289	0.2141	19.9257
mb8	lost	0.1593		5	0.5734	0.0145	0.2014	1.9922	0.3649	0.1126	0.1857	10.9445
mb9	lost	0.1043		5	0.8598	0.0114	0.1291	3.2766	0.2271	0.0624	0.1409	21.0418
				Detection Lim	0.0026	0.0033	0.0018	0.0054	0.0081	0.0390	0.0015	0.0081
				Sample #								
		Concentration (ug/g) ==>		mb1	10.9511		4.3815	70.7129	9.4703		3.3746	356.051
				mb2								
				mb3	12.4828	0.3798	6.7693	61.5493	11.6154	3.2086	5.3539	431.420
				mb4	16.1173	0.3099	3.3875	91.0906	8.0192	1.7092	3.0356	383.653
				mb5	10.9082	0.2318	3.5715	67.8234	9.1398	2.5039	3.4490	358.205
				mb6	12.6805	0.4880	6.4261	70.6112	10.3961	3.5997	5.9099	328.568
				mb7	13.5854	0.4327	5.6693	82.4655	9.8854	2.9695	4.9334	459.117
				mb8	17.9990	0.4566	6.3219	62.5302	11.4529	3.5357	5.8271	343.518
				mb9	41.2180	0.5450	6.1897	157 *****	10.8882	2.9907	6.7522	***** 1007
				0								
				0								
				Sample #								
		Content (ug) ==>		mb1	0.0635	0.0000	0.0254	0.4101	0.0549		0.0196	2.0651
				mb2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
				mb3	0.2122	0.0065	0.1151	1.0463	0.1975	0.0545	0.0910	7.3341
				mb4	0.3578	0.0069	0.0752	2.0222	0.1780	0.0379	0.0674	8.5171
				mb5	0.2662	0.0057	0.0871	1.6549	0.2230	0.0611	0.0842	8.7402
				mb6	0.3398	0.0131	0.1722	1.8924	0.2786	0.0965	0.1584	8.8056
				mb7	0.4320	0.0138	0.1803	2.6224	0.3144	0.0944	0.1569	14.5999
				mb8								
				mb9								
				0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
				0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Macoma balthica: Palo Alto 3-16-93

	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
Mean(ug/g)	6.0221	0.3398	3.8393	47.3009	6.8132	1.7363	2.9416	328.82
STD	1.14559	0.03572	1.05019	9.13625	1.09263	0.45684	0.8389	54.9525
SEM	0.362	0.011	0.332	2.889	0.346	0.152	0.265	17.377
CV%	19.023	10.512	27.354	19.315	16.037	26.311	28.518	16.712
r wt x []	0.230	0.268	0.029	0.641	0.485	0.337	0.228	0.489
X 100mg	6.283	0.330	3.809	41.506	6.289	1.597	3.130	355.385
r l x []	0.256	0.350	0.038	0.699	0.547	0.416	0.218	0.487
X 20mm	6.144	0.335	3.823	44.646	6.565	1.686	3.018	339.946
X 25mm	6.507	0.319	3.773	36.705	5.821	1.404	3.245	373.210

Estimated content (ug) for 20mm and 25mm clam

	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
20mm	0.4559	0.0250	0.2747	3.2862	0.4840	0.1219	0.2177	25.3197
25mm	0.8962	0.0451	0.5048	5.4388	0.8306	0.2007	0.4278	51.0562

Estimated weight for 15mm clam

0.033 gm
33.454 mg

Estimated weight for 20mm clam

0.075 gm
75.072 mg

Macoma balthica: Palo Alto 3-16-93

Sample #-n	Average Length (mm)	Total Dry Wt (gm)	Average Dry Wt (gm)	Recon Amt (ml)	Concentration (ug/ml) - Blank Corrected from ICP-AES							
					Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
mb1	11.3	0.0611	0.0153	5	0.0663	0.0050	0.0397	0.7727	0.1051	0.0053	0.0279	3.5376
mb2	13.7	0.1045	0.0261	5	0.1128	0.0071	0.0964	1.2097	0.1575	0.0477	0.0601	5.7029
mb3	14.7	0.2502	0.0313	5	0.2375	0.0145	0.2581	2.1424	0.3561	0.1176	0.1985	14.7772
mb4	17.5	0.2530	0.0506	5	0.4085	0.0177	0.1628	2.9227	0.3350	0.0665	0.1269	18.0779
mb5	18.5	0.3003	0.0601	5	0.4184	0.0198	0.1684	2.6653	0.3445	0.0834	0.1238	25.2578
mb6	19.7	0.2612	0.0653	5	0.2465	0.0167	0.2163	2.1967	0.3745	0.0896	0.1664	14.3292
mb7	20.4	0.3334	0.0834	5	0.4285	0.0230	0.1313	2.4013	0.3427	0.0794	0.1139	20.6979
mb8	21.5	0.4772	0.0954	5	0.6600	0.0368	0.4701	3.8599	0.6179	0.1612	0.3662	31.3778
mb9	22.5	0.2130	0.1065	5	0.2084	0.0135	0.2042	1.7290	0.3421	0.0971	0.1773	13.5107
mb10	23.5	0.3541	0.1180	5	0.4714	0.0220	0.2494	3.3888	0.4044	0.1005	0.2004	29.8951
				Detection Limit	0.0026	0.0033	0.0018	0.0054	0.0081	0.0390	0.0015	0.0081
Sample #												
		Concentration (ug/g) ==>		mb1	5.4279	0.4098	3.2501	63.2319	8.5989		2.2848	289.489
				mb2	5.3980	0.3411	4.6108	57.8805	7.5363	2.2812	2.8756	272.864
				mb3	4.7456	0.2907	5.1586	42.8130	7.1171	2.3511	3.9676	295.307
				mb4	8.0733	0.3502	3.2173	57.7617	6.6199	1.3134	2.5069	357.270
				mb5	6.9670	0.3303	2.8046	44.3777	5.7354	1.3879	2.0614	420.542
				mb6	4.7190	0.3189	4.1414	42.0510	7.1696	1.7147	3.1851	274.295
				mb7	6.4268	0.3452	1.9685	36.0120	5.1393	1.1912	1.7082	310.407
				mb8	6.9156	0.3855	4.9260	40.4430	6.4741	1.6891	3.8364	328.770
				mb9	4.8920	0.3166	4.7945	40.5876	8.0305	2.2788	4.1613	317.153
				mb10	6.6557	0.3101	3.5213	47.8502	5.7105	1.4195	2.8291	422.128
Sample #												
		Content (ug) ==>		mb1	0.0830	0.0063	0.0497	0.9674	0.1316		0.0350	4.4292
				mb2	0.1409	0.0089	0.1203	1.5107	0.1967	0.0595	0.0751	7.1218
				mb3	0.1485	0.0091	0.1615	1.3400	0.2228	0.0736	0.1242	9.2431
				mb4	0.4085	0.0177	0.1628	2.9227	0.3350	0.0665	0.1269	18.0779
				mb5	0.4187	0.0199	0.1686	2.6671	0.3447	0.0834	0.1239	25.2746
				mb6	0.3081	0.0208	0.2704	2.7459	0.4682	0.1120	0.2080	17.9115
				mb7	0.5360	0.0288	0.1642	3.0034	0.4286	0.0993	0.1425	25.8879
				mb8	0.6398	0.0368	0.4699	3.8583	0.6176	0.1611	0.3660	31.3647
				mb9	0.5210	0.0337	0.5106	4.3226	0.8552	0.2427	0.4432	33.7768
				mb10	0.7854	0.0366	0.4155	5.6463	0.6738	0.1675	0.3338	49.8111

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	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
Mean(ug/g)	1.4324	0.2449	3.2902	15.6560	4.7053	2.1883	2.4548	183.80
STD	0.64188	0.0444	1.76713	3.65465	1.88134	0.82484	1.19413	28.9739
SEM	0.214	0.016	0.589	1.218	0.627	0.292	0.398	9.658
CV%	44.812	18.131	53.710	23.343	39.984	37.693	48.644	15.763
r wt x []	0.331	0.460	0.559	0.184	0.723	0.657	0.554	0.056
X 100mg	1.359	0.255	3.634	15.890	5.178	2.462	2.685	183.243
r l x []	0.565	0.377	0.719	0.267	0.854	0.715	0.667	0.306
X 20mm	1.428	0.251	3.306	15.668	4.725	2.386	2.465	183.693
X 25mm	1.768	0.229	2.114	14.753	3.217	1.646	1.717	192.000

Estimated content (ug) for 20mm and 25mm clam

	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
20mm	0.1473	0.0262	0.3033	1.6412	0.4604	0.2361	0.2287	19.9597
25mm	0.3879	0.0541	0.4916	3.2724	0.7648	0.3691	0.3797	44.1271

Estimated weight for 15mm clam

0.042 gm
41.507 mg

Estimated weight for 20mm clam

0.109 gm
108.994 mg

Estimated weight for 25mm clam

0.230 gm
230.477 mg

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Sample #-n	Average Length (mm)	Total Dry Wt (gm)	Average Dry Wt (gm)	Recon Amt (ml)	Concentration (ug/ml) - Blank Corrected from ICP-AES							
					Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
Mb1	9.9	0.0334	0.0111	5	0.0042	0.0027	0.0450	0.1252	0.0571	0.0350	0.0291	1.0071
Mb2	16.5	0.2245	0.0559	5	0.0612	0.0110	0.1104	0.6410	0.2176	0.1187	0.1024	8.0673
Mb3	17.3	0.2917	0.0581	5	0.0700	0.0121	0.1544	1.0498	0.2499	0.1292	0.1001	9.5799
Mb4	18.6	0.3308	0.0827	5	0.0811	0.0183	0.3524	0.9901	0.3856	0.2330	0.2558	13.8493
Mb5	20.1	0.3719	0.1240	5	0.0550	0.0224	0.2487	1.0451	0.3710	0.2004	0.2075	11.9621
Mb6	22.1	0.4347	0.1449	5	0.1900	0.0265	0.3300	1.8071	0.4734	0.2197	0.2811	20.7733
Mb7	23.1	0.8655	0.1731	5	0.3096	0.0369	0.1892	1.3751	0.4073	0.1966	0.1362	36.2036
Mb8	24.9	0.6498	0.2166	5	0.3351	0.0286	0.2754	2.1680	0.4480	0.1767	0.1926	22.5578
Mb9	28.1	0.7765	0.3883	5	0.1834	0.0296	0.3253	2.4010	0.4056	0.2187	0.2454	26.0546
				Detection Lim	0.0026	0.0033	0.0018	0.0054	0.0081	0.0390	0.0015	0.0081
Sample #												
		Concentration (ug/g) ==>		Mb1	0.6300		6.7315	18.7460	8.5432		4.3593	150.769
				Mb2	1.3623	0.2454	2.4594	14.2758	4.8470	2.6445	2.2804	179.673
				Mb3	1.1997	0.2067	2.6467	17.9946	4.2835	2.2152	1.7153	164.209
				Mb4	1.2259	0.2761	5.3272	14.9651	5.8287	3.5220	3.8661	209.330
				Mb5	0.7398	0.3013	3.3439	14.0511	4.9873	2.6949	2.7897	160.824
				Mb6	2.1853	0.3054	3.7956	20.7852	5.4456	2.5266	3.2336	238.939
				Mb7	1.7887	0.2132	1.0931	7.9438	2.3532	1.1355	0.7871	209.148
				Mb8	2.5787	0.2202	2.1194	16.6819	3.4473	1.3596	1.4818	173.575
				Mb9	1.1811	0.1909	2.0947	15.4605	2.6116	1.4081	1.5802	167.770
Sample #												
		Content (ug) ==>		Mb1	0.0070		0.0747	0.2081	0.0948		0.0484	1.6735
				Mb2	0.0762	0.0137	0.1375	0.7980	0.2709	0.1478	0.1275	10.0437
				Mb3	0.0697	0.0120	0.1538	1.0455	0.2489	0.1287	0.0997	9.5405
				Mb4	0.1014	0.0228	0.4406	1.2376	0.4820	0.2913	0.3197	17.3116
				Mb5	0.0917	0.0374	0.4146	1.7423	0.6184	0.3342	0.3499	19.9422
				Mb6	0.3166	0.0442	0.5500	3.0118	0.7891	0.3661	0.4686	34.6222
				Mb7	0.3096	0.0369	0.1892	1.3751	0.4073	0.1966	0.1362	36.2036
				Mb8	0.5585	0.0477	0.4591	3.6133	0.7467	0.2945	0.3210	37.5964
				Mb9	0.4586	0.0741	0.8134	6.0033	1.0141	0.5468	0.6136	65.1450