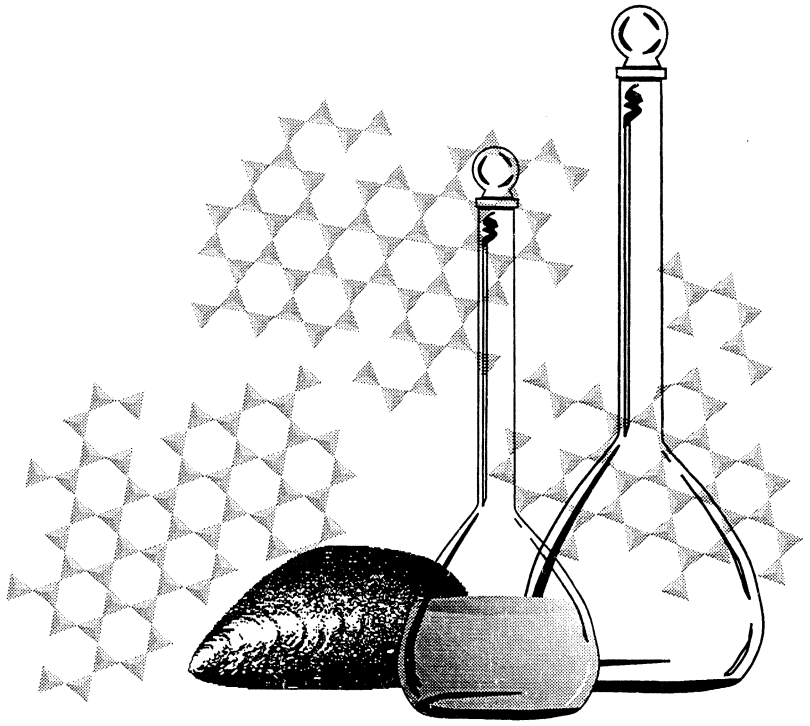
NOAA Technical Memorandum NOS NCCOS CCMA 142

National Status and Trends Program
for Marine Environmental Quality

NOAA National Status and Trends Program Thirteenth Round Intercomparison Exercise Results for Trace Metals in Marine Sediments and Biological Tissues



Silver Spring, Maryland
February 2000

US Department of Commerce

noaa NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Center for Coastal Monitoring and Assessment
National Centers for Coastal Ocean Science
National Ocean Service

NOAA Technical Memorandum NOS NCCOS CCMA 142

NOAA National Status and Trends Program Thirteenth Round Intercomparison Exercise Results for Trace Metals in Marine Sediments and Biological Tissues

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Abstract

This report, prepared by the National Research Council of Canada (NRC), summarizes the results of the *Thirteenth Round Intercomparison for Trace Metals in Marine Sediments and Biological Tissues* under the directive of the NOAA National Status and Trends Program. A total of thirty-six participants were included in the exercise, including NOAA, USEPA, state, Australian, Canadian, Mexican and Argentinean laboratories. Two samples were sent by NRC to each participant, a marine sediment from the Beaufort Sea and a freeze-dried mussel (*Mytilus edulis*) tissue. Laboratories were also asked to analyse two certified reference materials (CRMs) CRM 2976 and MESS-2. The elements to be determined were Al, Cr, Fe, Ni, Cu, Zn, As, Se, Ag, Cd, Sn, Hg and Pb for both matrices, plus Be, Si, Mn, Sb and Tl for the sediments. An accepted mean and confidence interval was calculated for each analyte in the two unknown samples, laboratory biases were identified and an overall rating of superior, good, fair or others were assigned to each laboratory. Sixty-three percent of the laboratories were rated in the superior or good category for the sediments. Eighty-four percent of the laboratories were rated superior or good for the biological tissues.

Silver Spring, Maryland
February 2000

United States Department of Commerce — William M. Daley, Secretary
National Oceanic and Atmospheric Administration — D. James Baker, Under Secretary
National Ocean Service — Nancy Foster, Assistant Administrator

INTRODUCTORY REMARKS

The National Oceanic and Atmospheric Administration's National Status and Trends (NS&T) Program measures levels of chemical contaminants in organisms and sediments from around the coasts of the United States. A number of different laboratories have participated in making there measurements. In order to help assure and document the intercomparability of the data from various participating laboratories, the NS&T Program has supported a series of intercomparison exercises. This has included providing support to the Institute of Environmental Chemistry, National Research Council (NRC) of Canada to conduct and evaluate the results from intercomparisons of analyses for trace metals in marine sediments and biological tissues. The following is a reproduction of a previously unpublished report provided to the NS&T Program by NRC Canada regarding one of these intercomparison. It is being reproduced here to provide a permanently available record of the exercise results.

National Research Council Canada
Conseil national de recherches Canada

Institute for National Measurement Standards
Institut des étalons nationaux de mesure

NRC · CNRC

NOAA/13

Thirteenth Round Intercomparison for Trace Metals in Marine Sediments and Biological Tissues

Scott Willie

Prepared for the
Coastal Monitoring and Bioeffects Assessment Division
Office of Ocean Resources Conservation and Assessment
National Oceanic and Atmospheric Administration

January 2000

Canada

TABLE OF CONTENTS

1. INTRODUCTION 2

2. RESULTS 3
- Beryllium 4
- Aluminum 6
- Silicon 8
- Chromium 10
- Manganese 12
- Iron 14
- Nickel 16
- Copper 18
- Zinc 20
- Arsenic 22
- Selenium 24
- Silver 26
- Cadmium 28
- Tin 30
- Antimony 32
- Mercury 34
- Thallium 36
- Lead 38

3. DISCUSSION 40

4. CONCLUSIONS 50

5. BIBLIOGRAPHY 51

6. ACKNOWLEDGEMENTS 51

APPENDICES

A. Participants

B. Data

C. Digestion Procedures for Sediments and Biological Tissues

D. Laboratory Evaluation (z and p scores)

1. INTRODUCTION

This is the thirteenth intercomparison exercise for trace metals organized by the National Research Council of Canada (NRC) on behalf of the Coastal Monitoring Branch of the National Oceanic and Atmospheric Administration (NOAA) Office of Ocean Resources, Conservation and Assessment (ORCA). The original purpose of this exercise was to assess the capabilities of a number of NOAA and other laboratories involved in the NOAA National Status and Trends program to analyse marine sediments and biological tissues for trace metals. Since 1990 external participation has expanded to include USEPA, state, Australian, Canadian, Mexican, Argentinean and Spanish laboratories.

Participating laboratories, meeting at the San Francisco Estuary Institute for the NOAA quality assurance workshop after the last intercomparison exercise, had agreed for this study to analyse one sediment and one biological tissue as well as to analyse the certified reference materials (CRMs) NRC sediment MESS-2 and mussel tissue CRM 2976. CRM 2976 has progressed through several identities, it was used as the unknown tissue in NOAA/7 and is now available from NIST as SRM 2976 or NRC as CRM 2976. For some elements only reference values are available for CRM 2976.

The test materials distributed by NRC were:

> **Sediment 99**, a freeze-dried marine sediment collected from the Beaufort Sea. This material was collected at the same location as MESS-2 and is intended to be a replacement CRM called MESS-3.
>
> **Tissue 99**, a freeze-dried mytlius edulis tissue supplied by the Canadian Institute of Fisheries Technology , Halifax, NS.

The participating laboratories were each sent an eight gram sample of each of the two unknowns with the understanding that each participating laboratory would be responsible for procuring its own samples of the recommended CRMs. The participants were also sent a data file on which to record their results and analytical procedures.

Following the protocol used for the previous NOAA exercises, each laboratory was requested to perform replicate analyses on each of the four samples. This year the number of replicates was reduced from five to three. The list of elements remained the same: Al, Cr, Fe, Ni, Cu, Zn, As, Se, Ag, Cd, Sn, Hg and Pb for both matrices, plus Be, Si, Mn, Sb and Tl for the sediments. The evaluation of the biological tissue would not be based on a hydrofluoric acid digestion.

In order to help provide benchmarks of accuracy for Sediment 99 and Tissue 99, NRC also analysed each of the samples for most of the analytes by two different analytical methods. Where possible, one set of results was produced using isotope dilution inductively coupled plasma mass spectrometry (IDICPMS). This technique, when used correctly, is capable of producing very reliable analytical values. This is not to infer that the NRC laboratory is infallible, however, it does have a long and successful record regarding analysis of marine samples and the production of certified reference materials for trace metal analysis. The replicates analysed by NRC were taken from four separate bottles. This was done in order to validate the interbottle homogeneity of the materials.

2. RESULTS

The prepared samples were mailed to the forty-four laboratories listed in Appendix A in June 1999 with the deadline for receipt of results set at November 22, 1999. Thirty-six sets of results were received. Sequential numbers were assigned to each responding laboratory upon receipt of its data. Laboratory numbers 37, 38 and 39 were assigned to NRC.

Of the thirty-six laboratories, six did not submit data for the sediments and six did not submit data for the biological tissues. Four laboratories submitted results for the first time. Eight laboratories which did not send results had participated in NOAA/12.

A copy of the tabulated raw data was sent to each participant that had submitted data by the deadline in order to verify that no errors had been made by us in the transposition of numbers. The data used for subsequent evaluation are listed in Appendix B. The data are listed as received with respect to significant figures.

If one or more "less than (<)" values were submitted in a set of replicate results the mean was not calculated and only the "less than" value was used for further data evaluation. To ensure that all laboratories are compared on a rather even basis, data sets containing less than three results were not evaluated. The number of results used for the evaluation is noted next to the laboratory number in Appendix B along with a calculated mean, standard deviation (SD) and relative standard deviation (RSD).

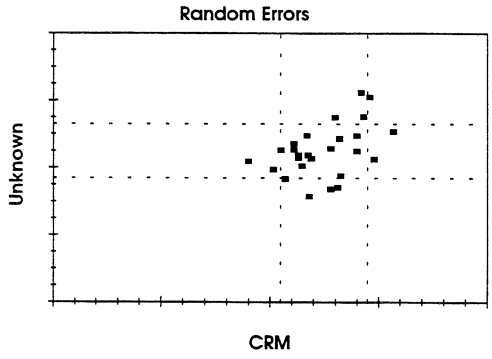
One purpose of the exercise was to arrive at an accepted value for each analyte concentration for each unknown sample in order to evaluate laboratory biases. An iterative procedure using the Cochran and Grubbs Tests was used to identify and remove specific results as outliers. The assigned values were then calculated from the remaining results using the analysis of variance technique (ANOVA). Laboratories that did not obtain acceptable results for the appropriate CRM were not included in this statistical procedure.

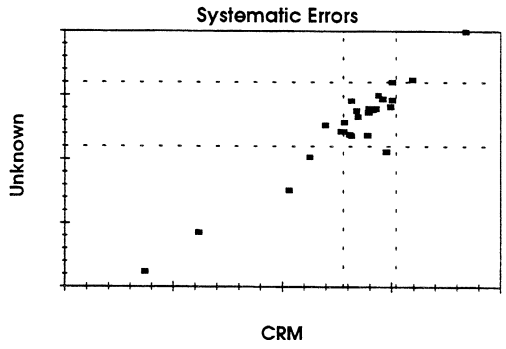
A minimum acceptable range for the analytes in the CRMs was set at either the certified range or ten percent of the certified value, whichever is larger (five percent for Al, Si and Fe in the sediments). Where this occurred, the certified value is listed is followed by the acceptable range used for evaluation in parentheses. In several cases, the calculated acceptable range for the unknown samples was also very small (an indication of good performance by the group as a whole), and the same criterion of a minimal acceptable range of ten percent was used.

The evaluated replicate data are plotted on the graphs where possible. Means that were outliers from the accepted or certified concentration are indicated by an asterisk following the laboratory number (e.g., 5*). "Less thans" are indicated by a downward arrow head and the reported value. A solid horizontal line represents the accepted mean for an unknown or the certified value of a CRM. The shaded area represents the 95% confidence intervals for these values. A short summary of results for each set of results is listed above the appropriate graph. All concentrations are expressed in mg/kg on a dry weight basis except for aluminum, iron and silicon in the sediments where the concentrations are in percent.

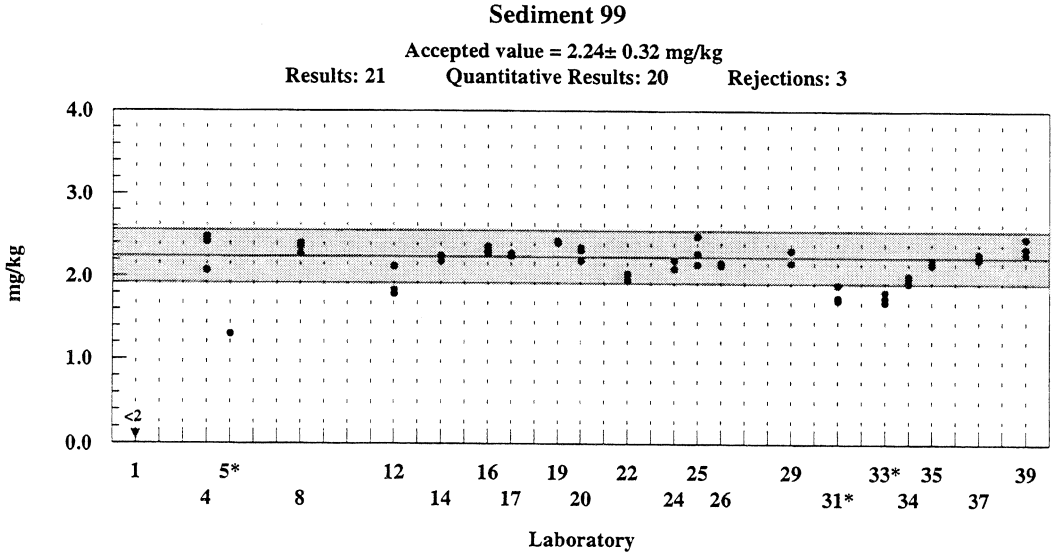
We have also included Youden (or two sample plots) for the sediment and the tissue samples. These plots of the overall mean for the CRM versus the mean for the unknown sample can give useful information when the analyte concentrations of the two samples are similar. If non-systematic or random errors are occurring,

the results would be expected to group at random about the intersection of the two means. If, however, systematic errors occur (e.g. a high or low result for both the CRM and the unknown) a predominance of points would be expected to group about a line running from the origin through the intersection of the two means. The latter case is common in intercomparison exercises due to calibration and blank errors. The laboratory number appears to the left of a marker if both of the laboratory results are rejected. Unfortunately, when a group of laboratories report similar rejected results the labels become illegible. The accepted confidence range is indicated by the dashed lines. Examples of Youden plots, demonstrating random and systematic errors respectively, are shown below.

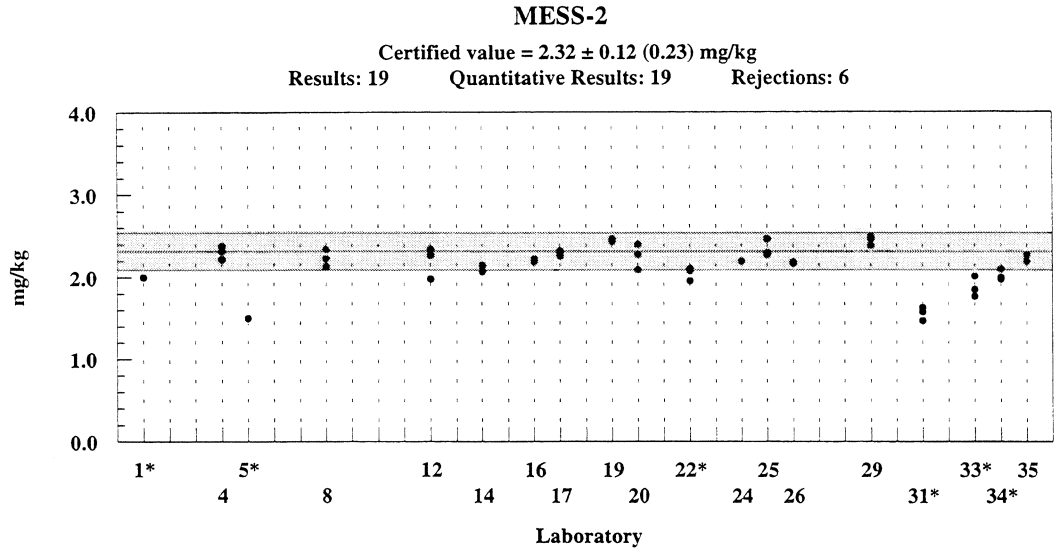


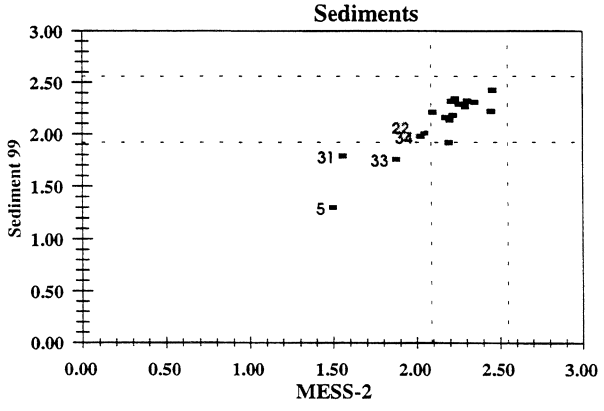


BERYLLIUM



BERYLLIUM





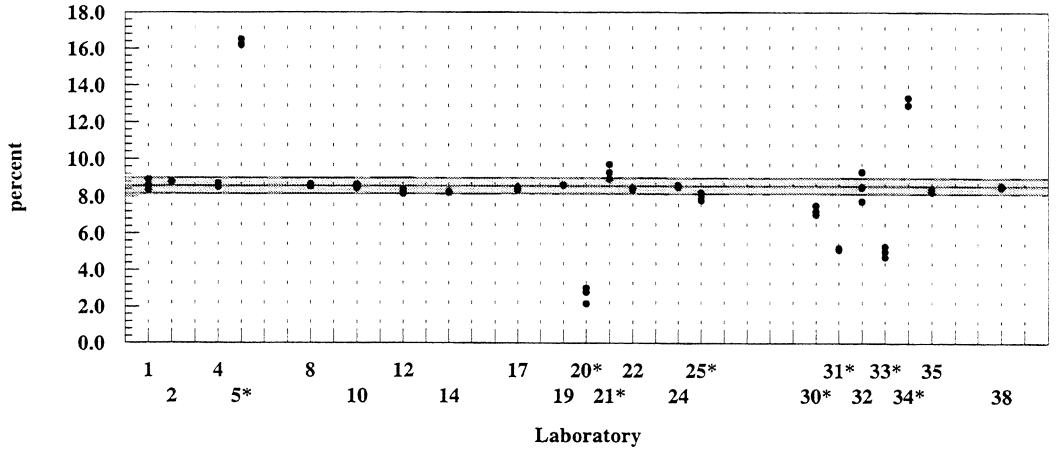
Unknown Sample	Instrumentation								NOAA/12	
	GFAAS		ICPMS		DCP		ICPAES			
	sets	rej	sets	rej	sets	rej	sets	rej	sets	rej
Sediment	2	0	6	0	1	0	10	3	23	5

The determination of Be was not required in the tissues.

ALUMINUM

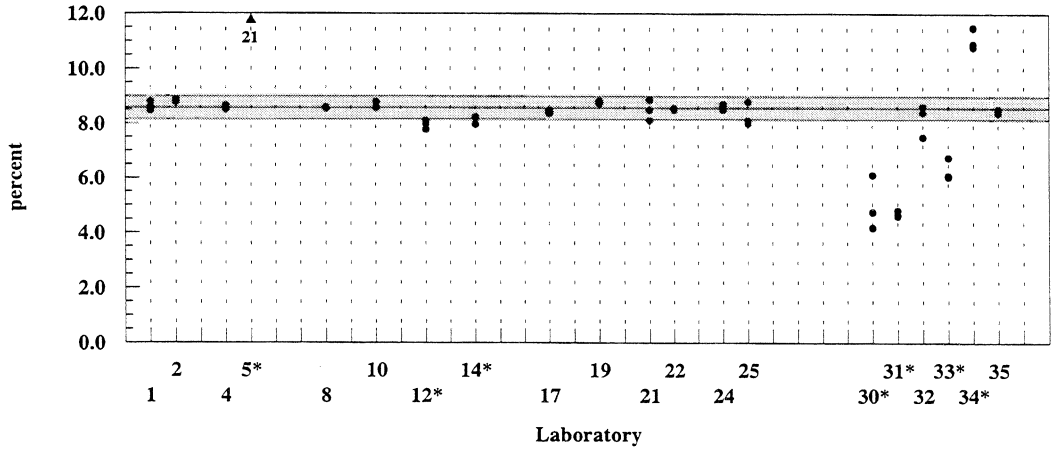
Sediment 99

Accepted value = 8.56 ± 0.38 (0.43) %
Results: 22 Quantitative Results: 22 Rejections: 8



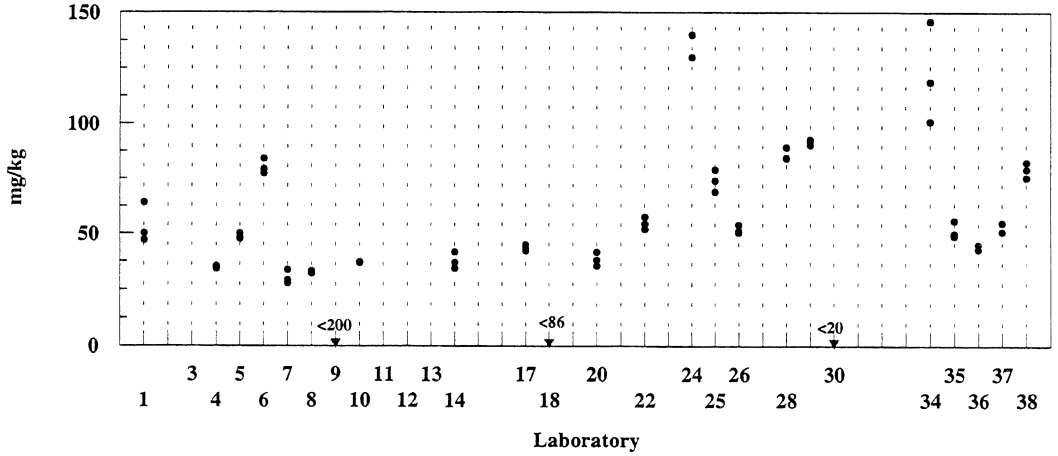
MESS-2

Certified value = 8.57 ± 0.26(0.43) %
Results: 20 Quantitative Results: 20 Rejections: 7

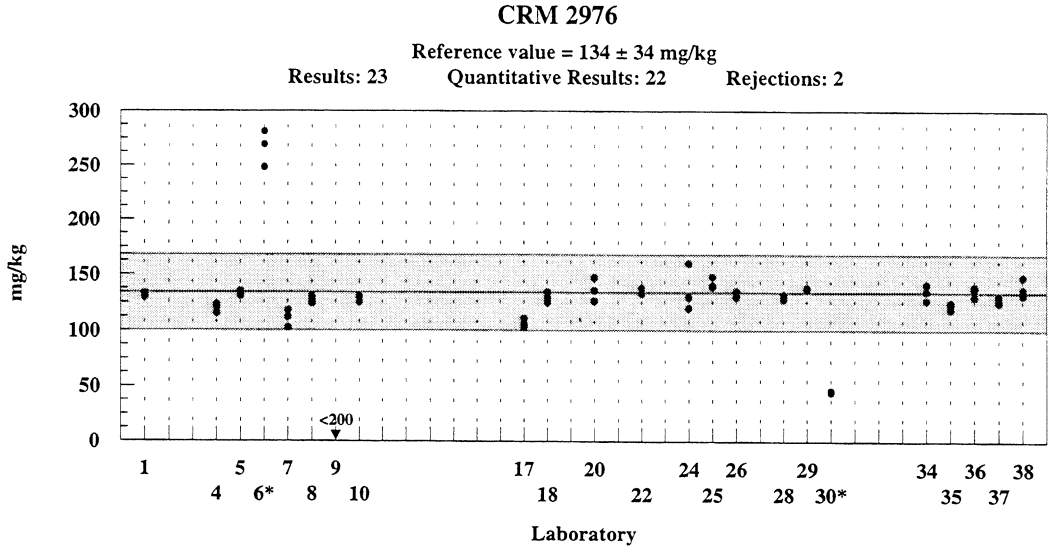


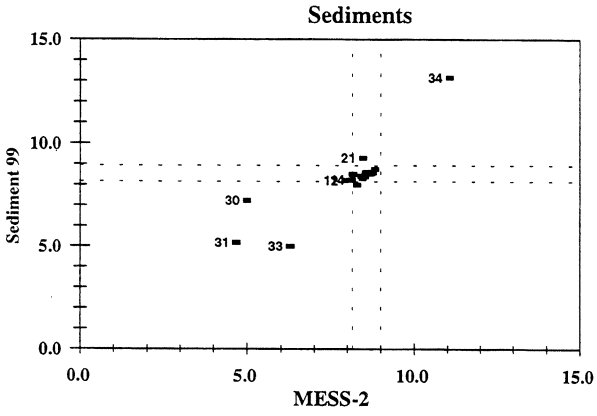
Tissue 99

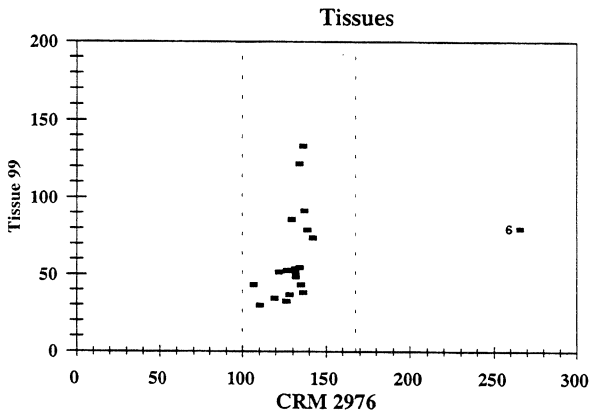
Accepted value = not determined
Results: 27 Quantitative Results: 24 Rejections: -



ALUMINUM







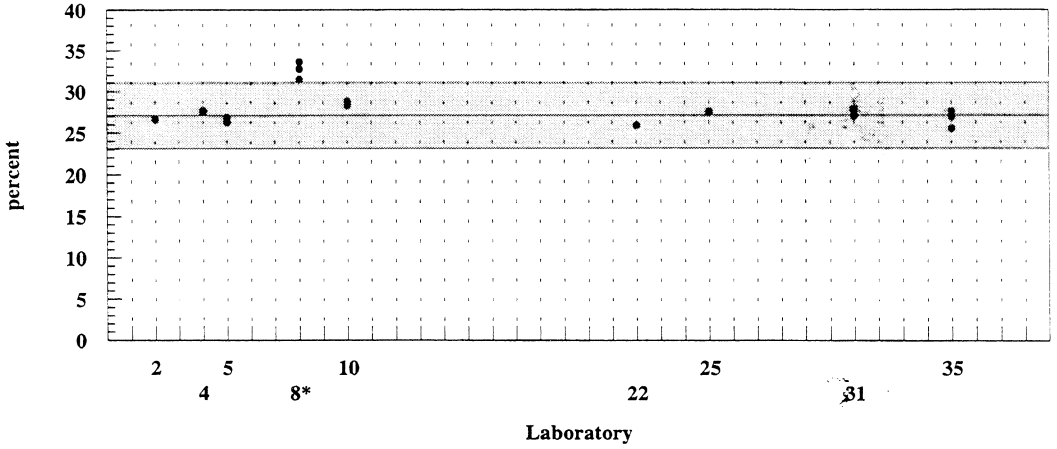
Unknown Sample	Digestion		Instrumentation						NOAA/12	
	HF		ICPMS		FAAS		ICPAES			
	yes	no	sets	rej	sets	rej	sets	rej	sets	rej
Sediment	20	2	2	1	3	1	14	4	26	11
Tissue	5	19	5	-	2	-	14	-	24	-

The results for Tissue 99 were not evaluated as NRC's results indicated the use of HF was required for complete recovery. Laboratories 37 and 38 are NRC results without HF and with HF, respectively.

SILICON

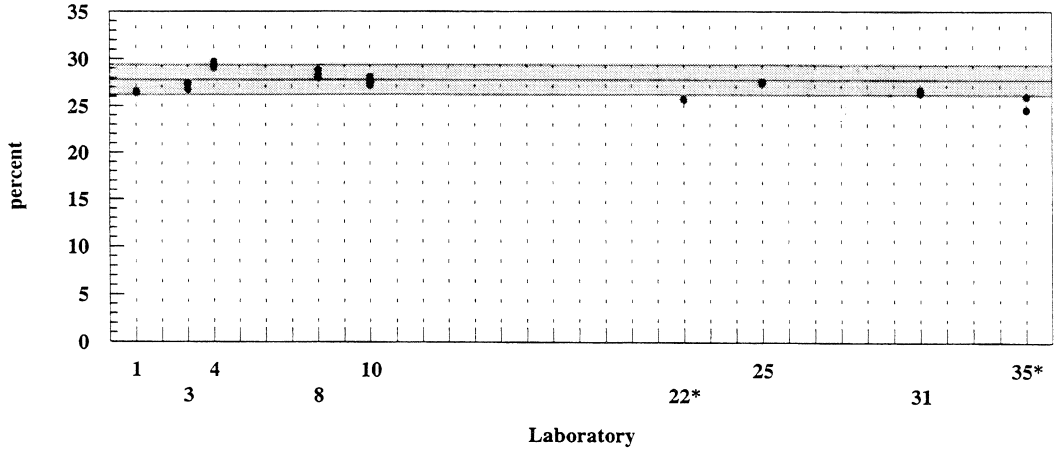
Sediment 99

Accepted value = 27.1 ± 4.0 %
Results: 9 Quantitative Results: 9 Rejections: 1

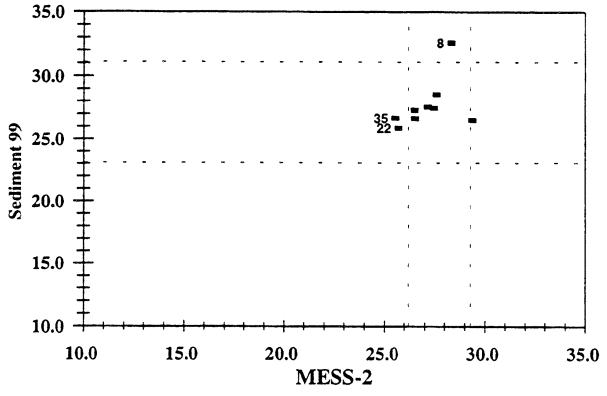


MESS-2

Certified value = 27.8 ± 1.1 (1.4) %
Results: 9 Quantitative Results: 9 Rejections: 1



Sediments



SILICON

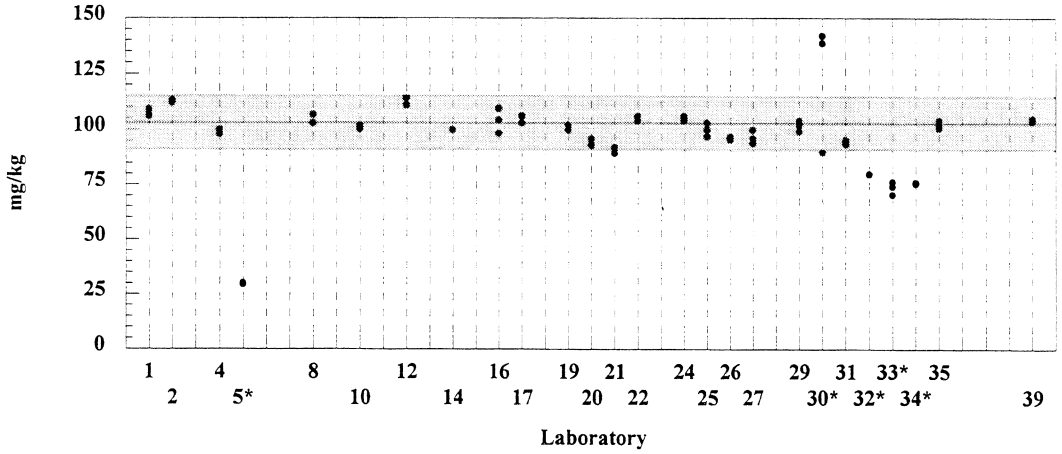
Unknown Sample	Instrumentation								NOAA/12	
	XRF		ICPMS		FAAS		ICPAES			
	sets	rej	sets	rej	sets	rej	sets	rej	sets	rej
Sediment	2	0	-	-	-	-	7	1	9	2

The determination of silicon was not required in the tissues.

CHROMIUM

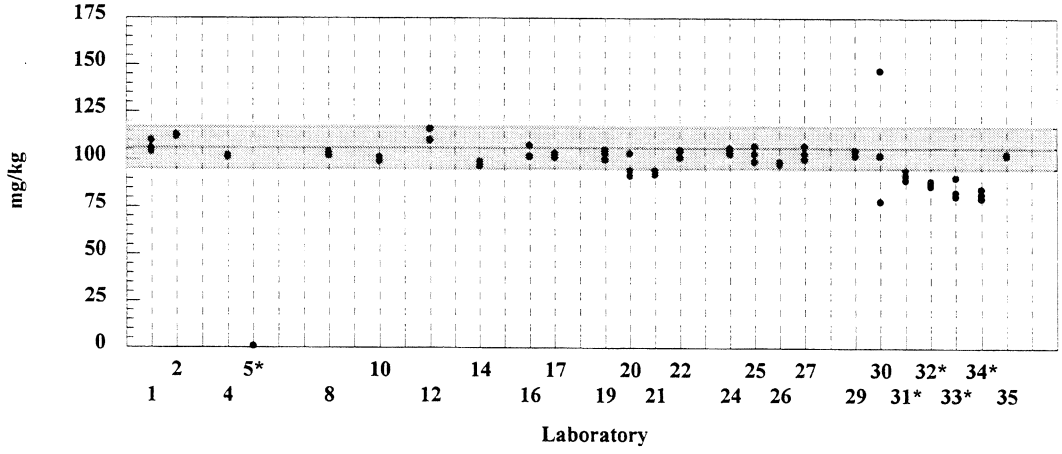
Sediment 99

Accepted value = 103 ± 12 mg/kg
Results: 26 Quantitative Results: 26 Rejections: 5



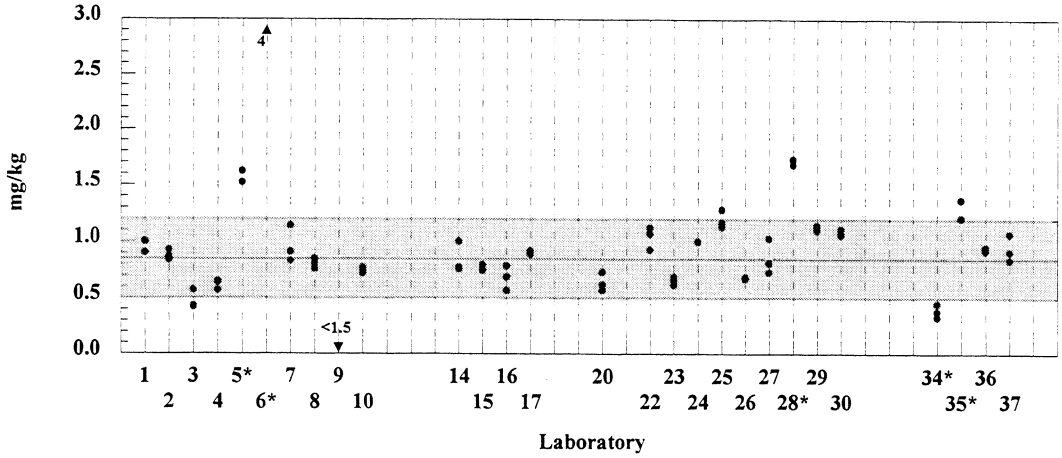
MESS-2

Certified value = 106 ± 8 (11) mg/kg
Results: 25 Quantitative Results: 25 Rejections: 5



Tissue 99

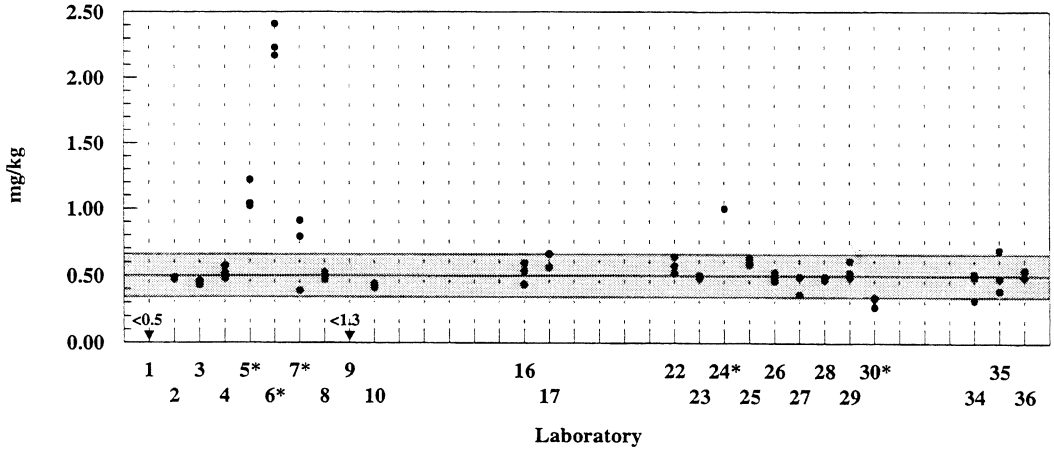
Accepted value = 0.85 ± 0.35 mg/kg
Results: 28 Quantitative Results: 27 Rejections: 5



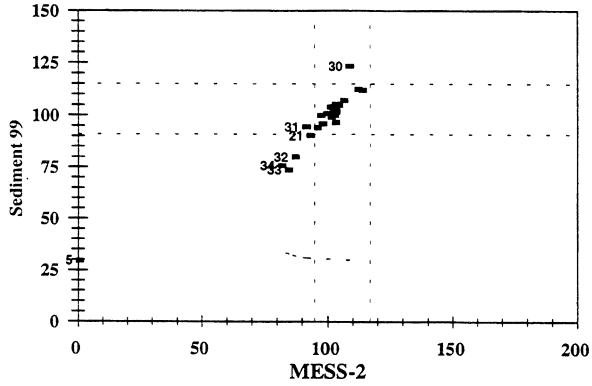
CHROMIUM

CRM 2976

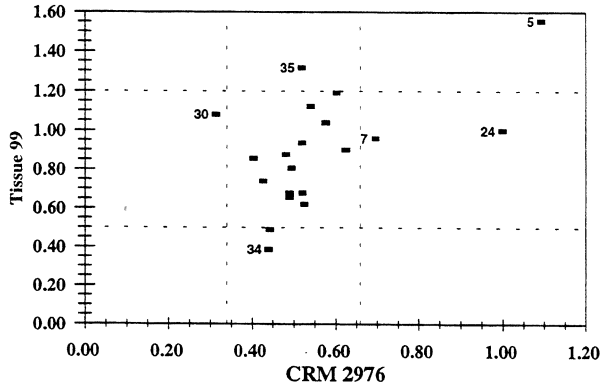
Reference value = 0.50 ± 0.16 mg/kg
Results: 24 Quantitative Results: 22 Rejections: 5



Sediments



Tissues

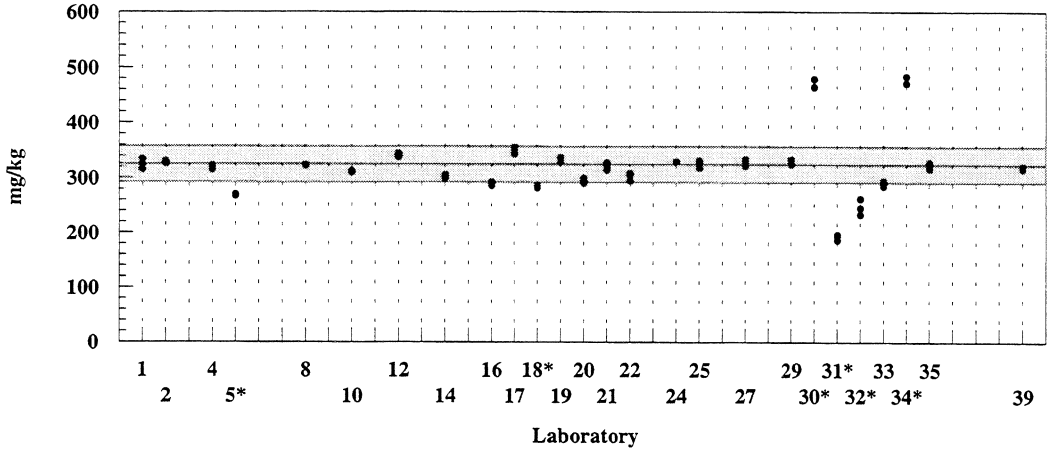


Unknown Sample	Instrumentation								NOAA/12	
	GFAAS		ICPMS		FAAS		ICPAES			
	sets	rej	sets	rej	sets	rej	sets	rej	sets	rej
Sediment	2	0	2	0	3	2	15	3	34	10
Tissue	11	2	7	1	-	-	8	2	31	6

MANGANESE

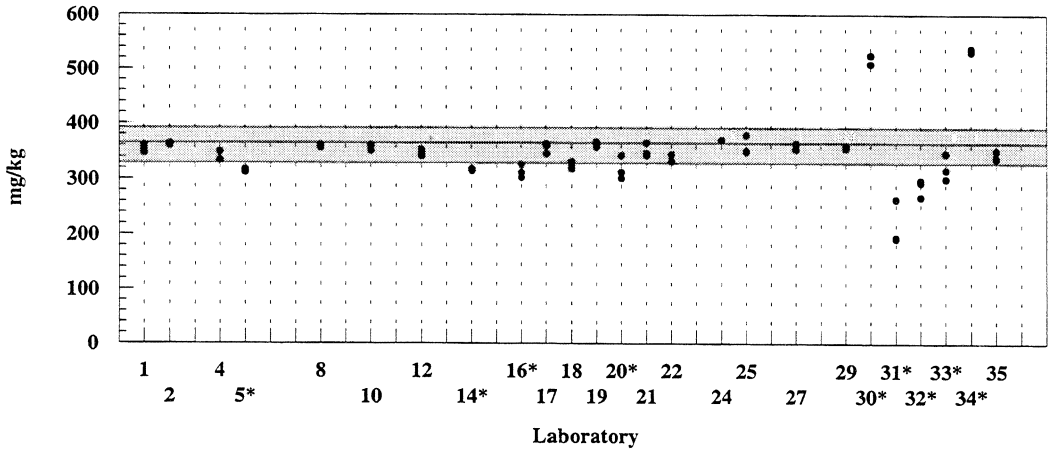
Sediment 99

Accepted value = 325 ± 33 mg/kg
Results: 26 Quantitative Results: 26 Rejections: 6

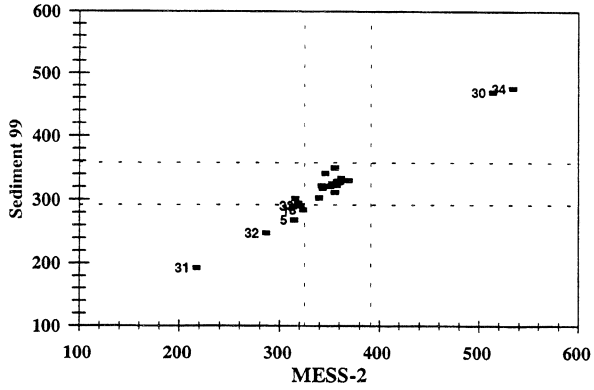


MESS-2

Certified value = 365 ± 21 (37) mg/kg
Results: 25 Quantitative Results: 25 Rejections: 9



Sediments



MANGANESE

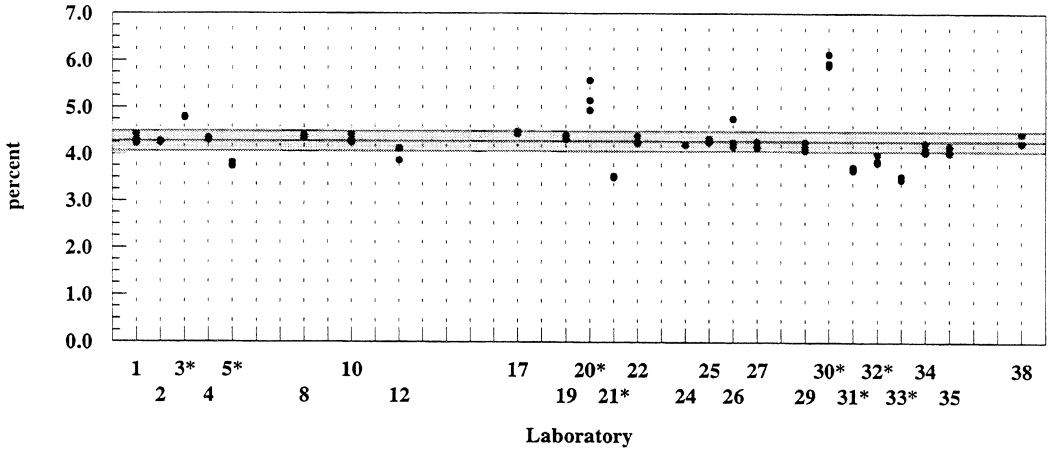
Unknown Sample	Instrumentation								NOAA/12	
	XRF		ICPMS		FAAS		ICPAES			
	sets	rej	sets	rej	sets	rej	sets	rej	sets	rej
Sediment	2	0	4	0	4	2	14	4	31	6

The determination of manganese was not required in the biological tissues.

IRON

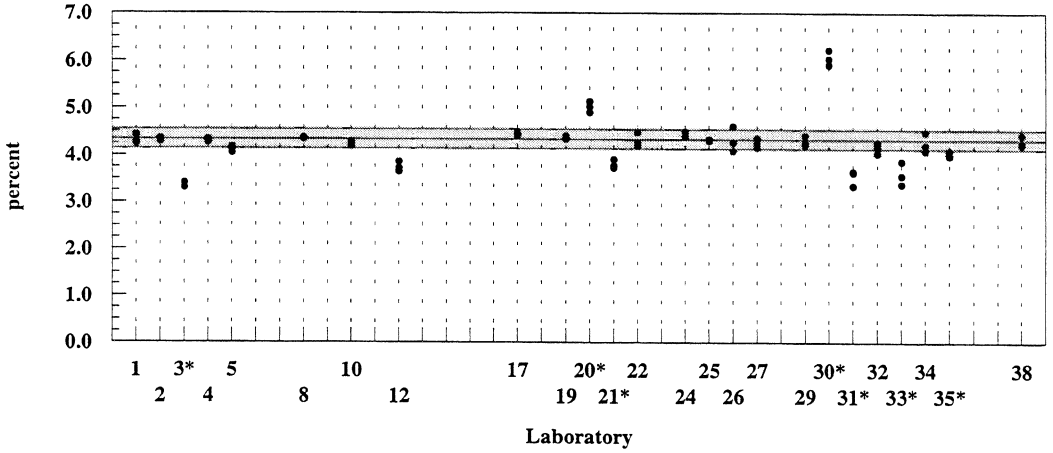
Sediment 99

Accepted value = 4.28 ± 0.22 %
Results: 25 Quantitative Results: 25 Rejections: 8



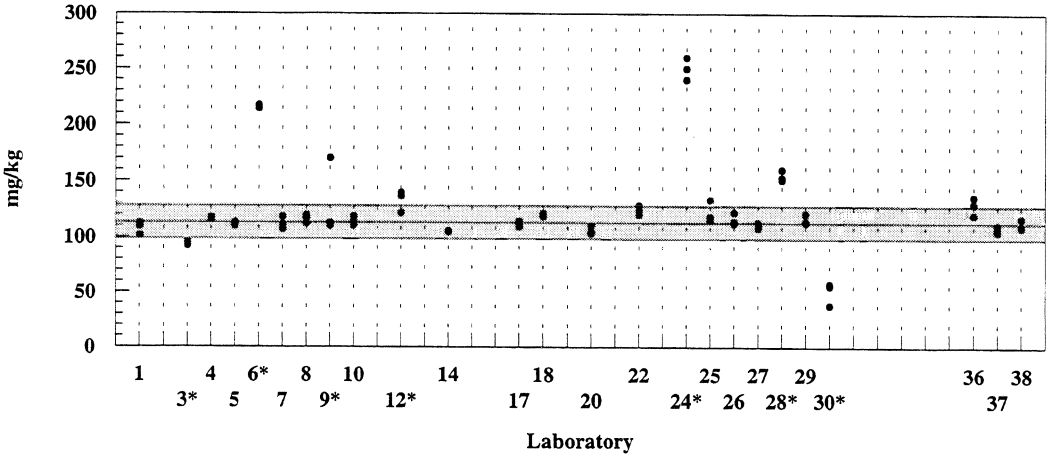
MESS-2

Certified value = 4.34 ± 0.21 %
Results: 25 Quantitative Results: 25 Rejections: 7



Tissue 99

Accepted value = 113 ± 15 mg/kg
Results: 25 Quantitative Results: 25 Rejections: 7

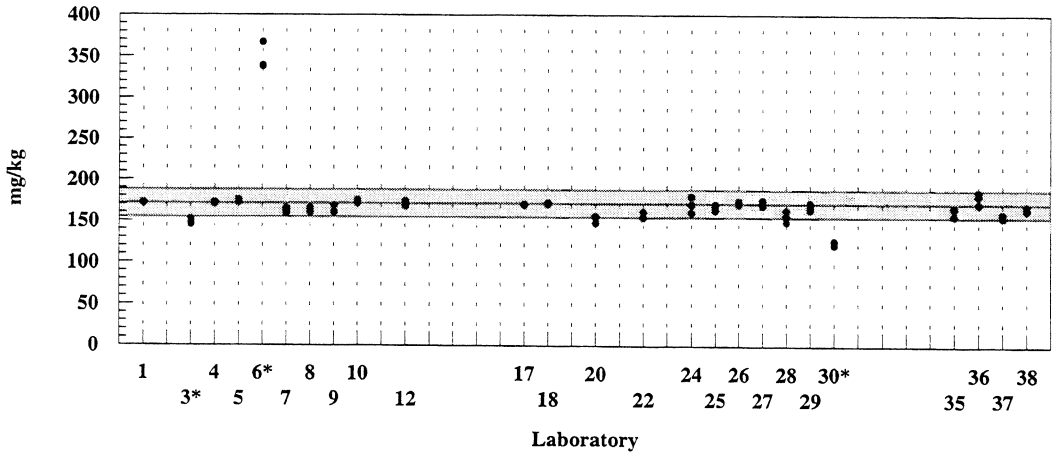


IRON

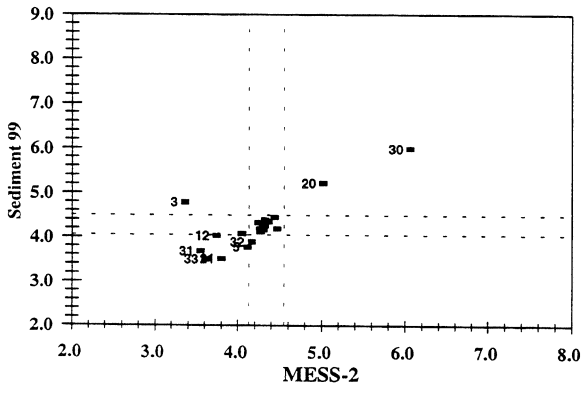
CRM 2976

Accepted value = 171 ± 5(17) mg/kg

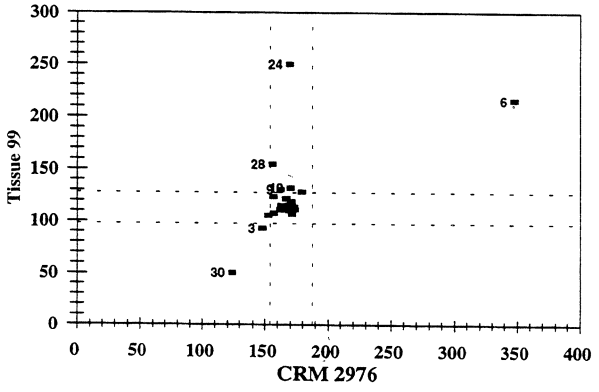
Results: 25 Quantitative Results: 25 Rejections: 3



Sediments



Tissues

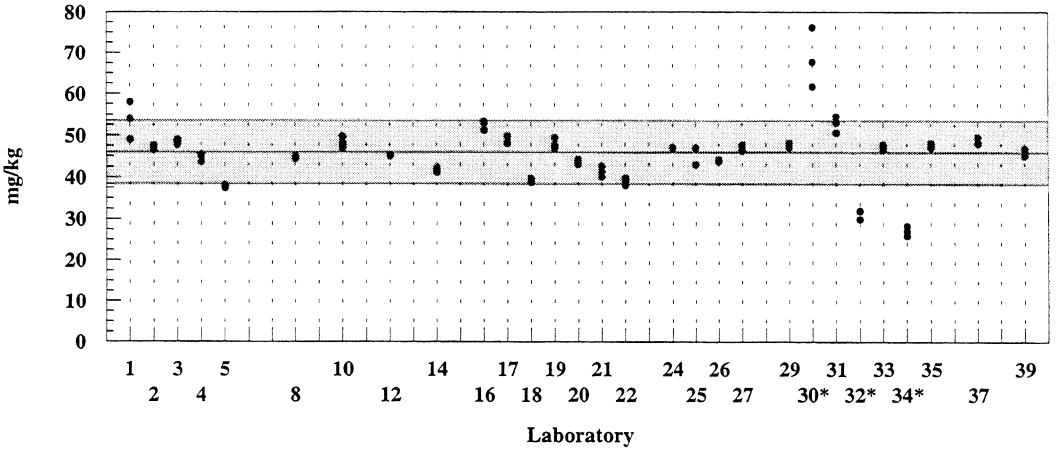


Unknown Sample	Instrumentation								NOAA/12	
	XRF		ICPMS		FAAS		ICPAES			
	sets	rej	sets	rej	sets	rej	sets	rej	sets	rej
Sediment	4	2	-	-	5	1	16	5	31	6
Tissue	2	1	1	1	3	0	19	5	33	2

NICKEL

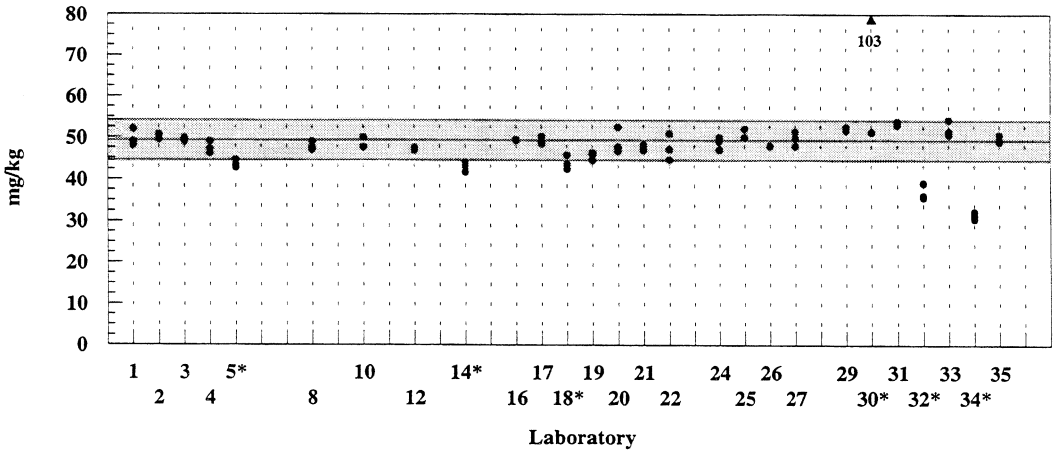
Sediment 99

Accepted value = 46.0 ± 7.6 mg/kg
Results: 29 Quantitative Results: 29 Rejections: 3



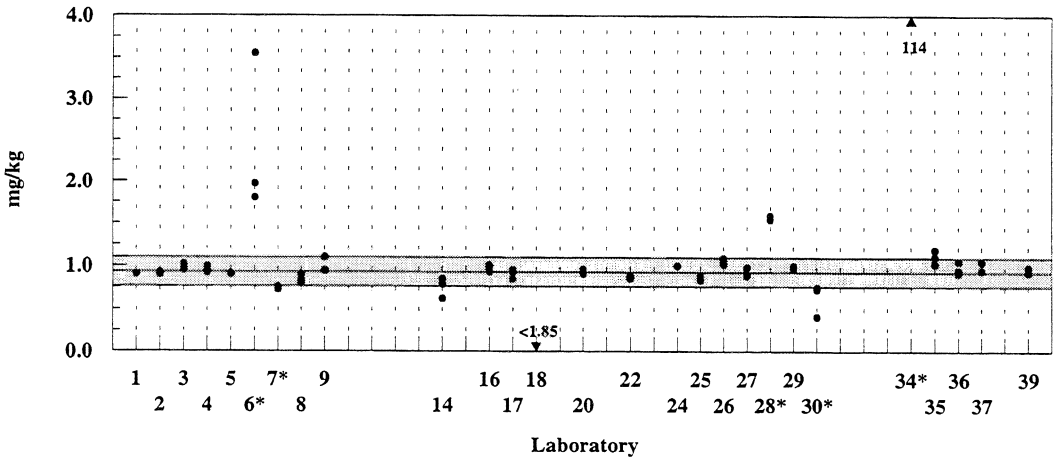
MESS-2

Certified value = 49.3 ± 3.8 (4.9) mg/kg
Results: 27 Quantitative Results: 27 Rejections: 6



Tissue 99

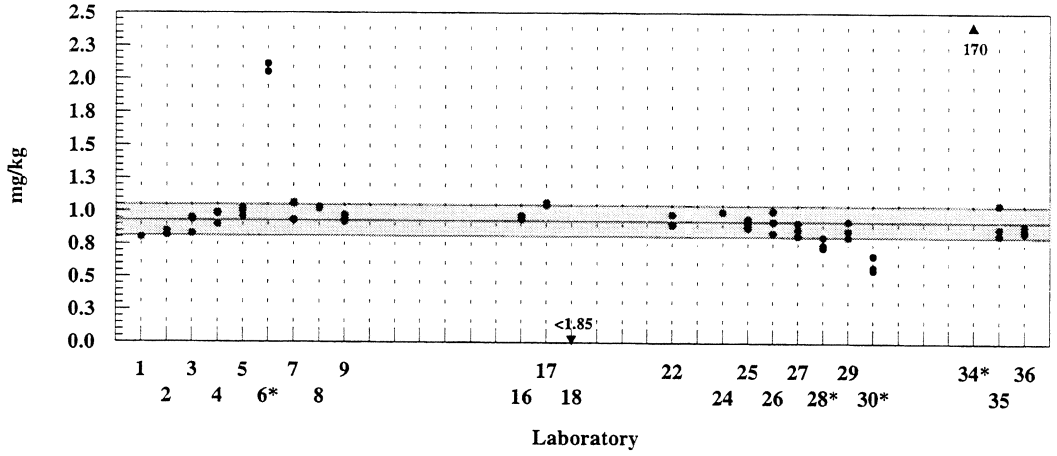
Accepted value = 0.93 ± 0.17 mg/kg
Results: 27 Quantitative Results: 26 Rejections: 5

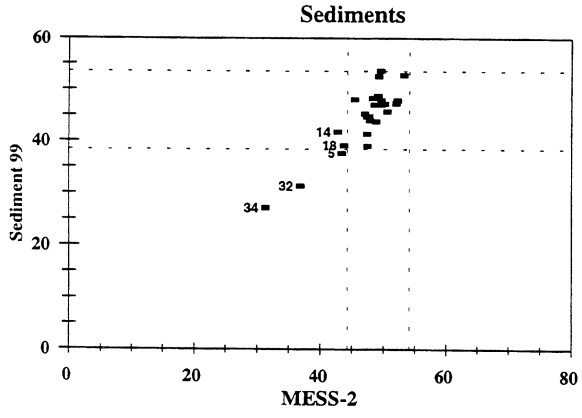


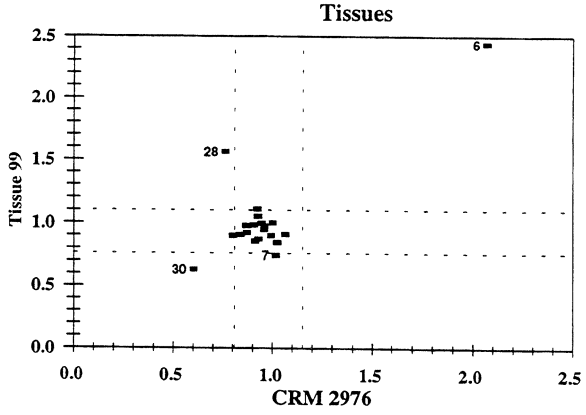
NICKEL

CRM 2976

Reference value = 0.93 ± 0.12 mg/kg
Results: 23 Quantitative Results: 22 Rejections: 4





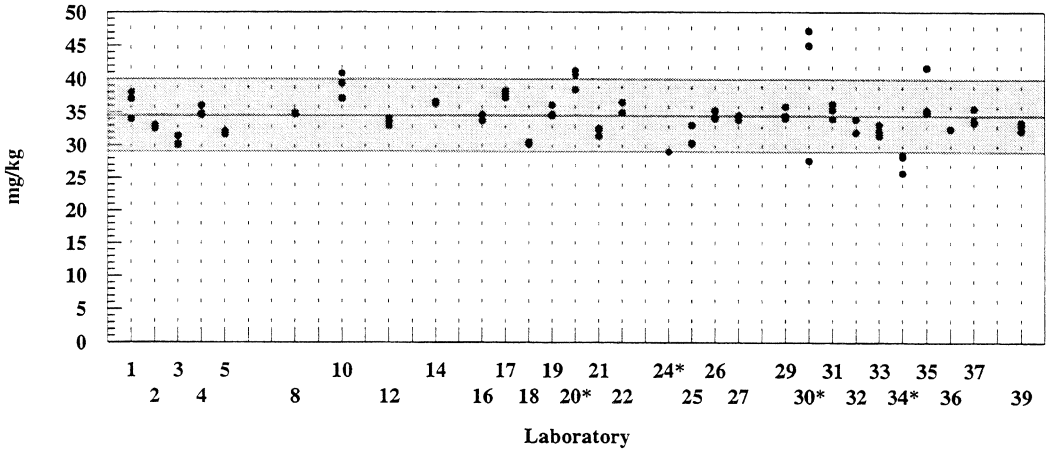


Unknown Sample	Instrumentation								NOAA/12	
	GFAAS		ICPMS		FAAS		ICPAES			
	sets	rej	sets	rej	sets	rej	sets	rej	sets	rej
Sediment	5	1	11	0	3	2	9	0	34	5
Tissue	9	2	12	3	0	-	4	0	33	3

COPPER

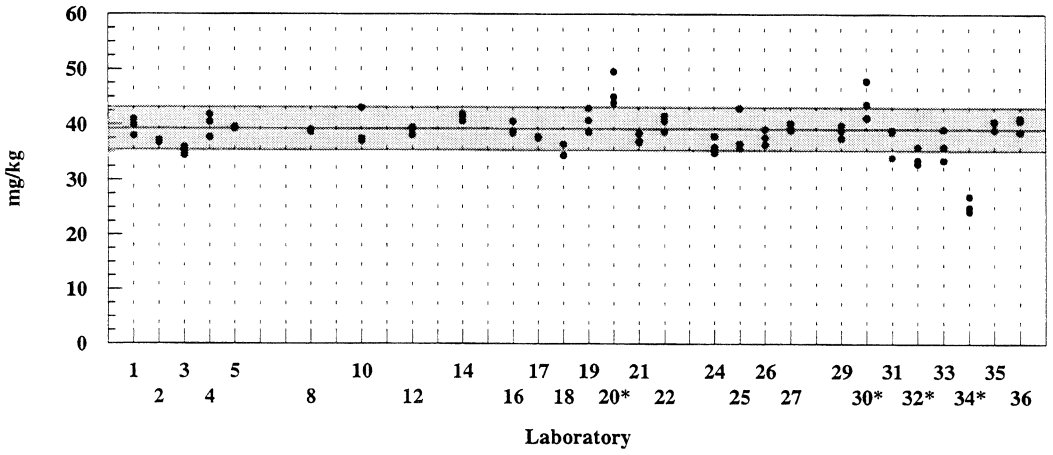
Sediment 99

Accepted value = 34.5 ± 5.1 mg/kg
Results: 30 Quantitative Results: 30 Rejections: 4



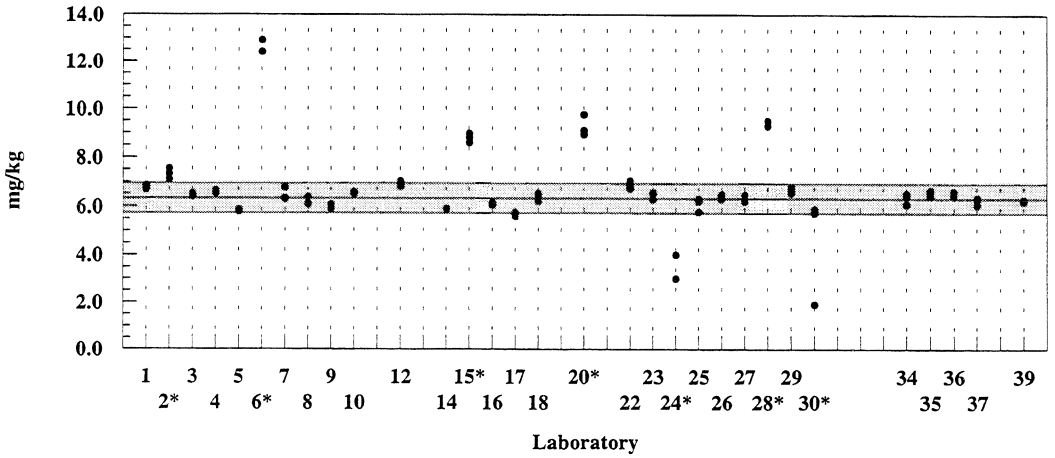
MESS-2

Certified value = 39.3 ± 2.0 (3.9) mg/kg
Results: 28 Quantitative Results: 28 Rejections: 4



Tissue 99

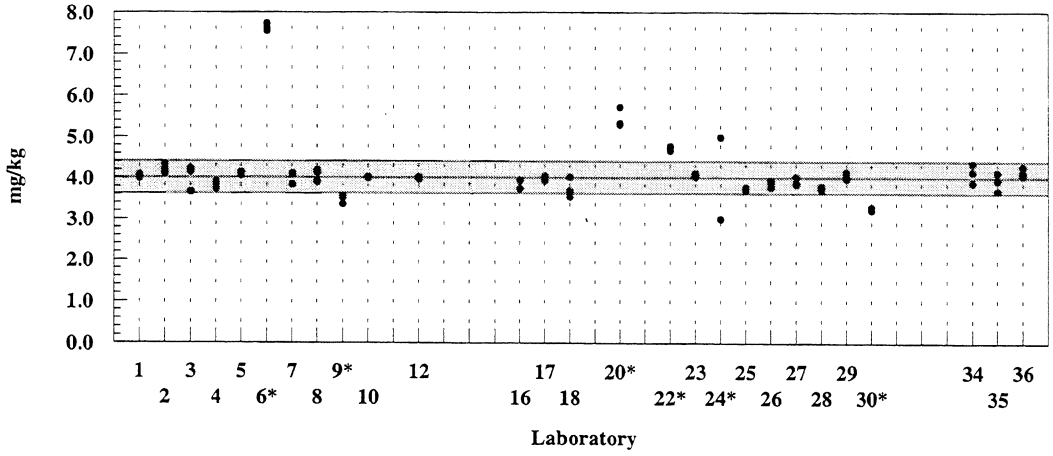
Accepted value = 6.33 ± 0.63 mg/kg
Results: 31 Quantitative Results: 31 Rejections: 7

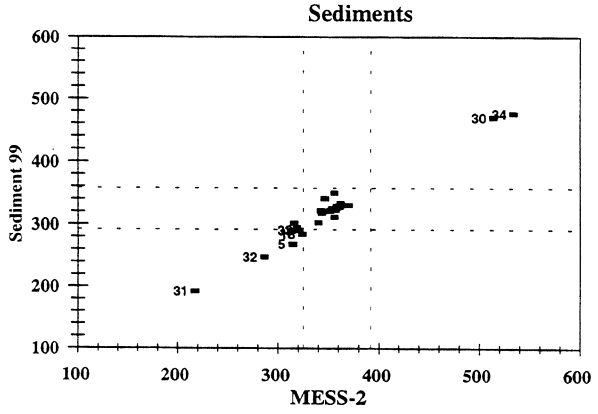


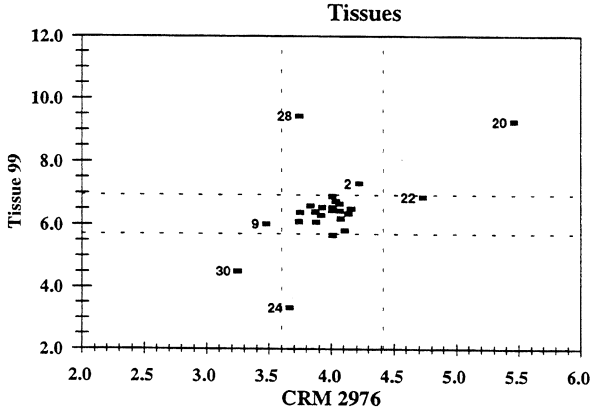
COPPER

CRM 2976

Certified value = 4.02 ± 0.33 (0.40) mg/kg
Results: 27 Quantitative Results: 27 Rejections: 6





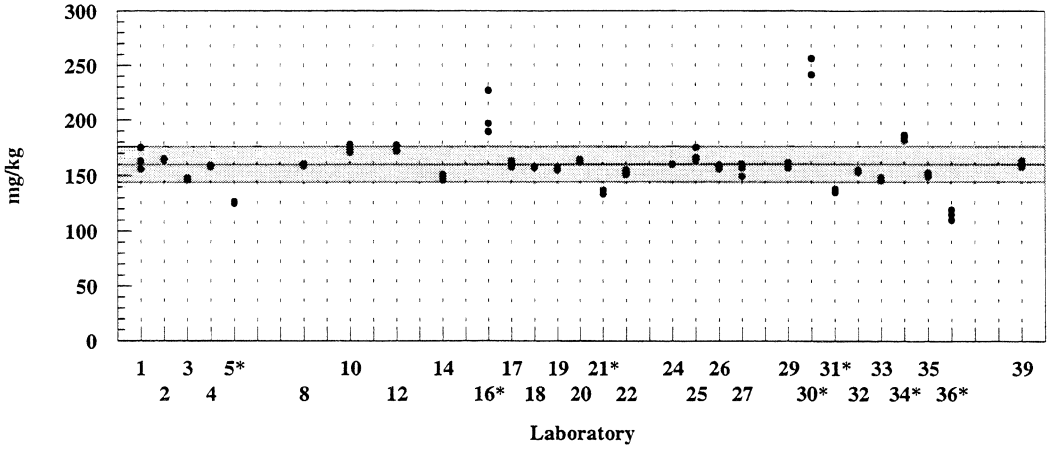


Unknown Sample	Instrumentation								NOAA/12	
	GFAAS		ICPMS		FAAS		ICPAES			
	sets	rej	sets	rej	sets	rej	sets	rej	sets	rej
Sediment	2	1	9	1	6	1	13	1	35	4
Tissue	5	3	11	2	2	0	13	1	36	2

ZINC

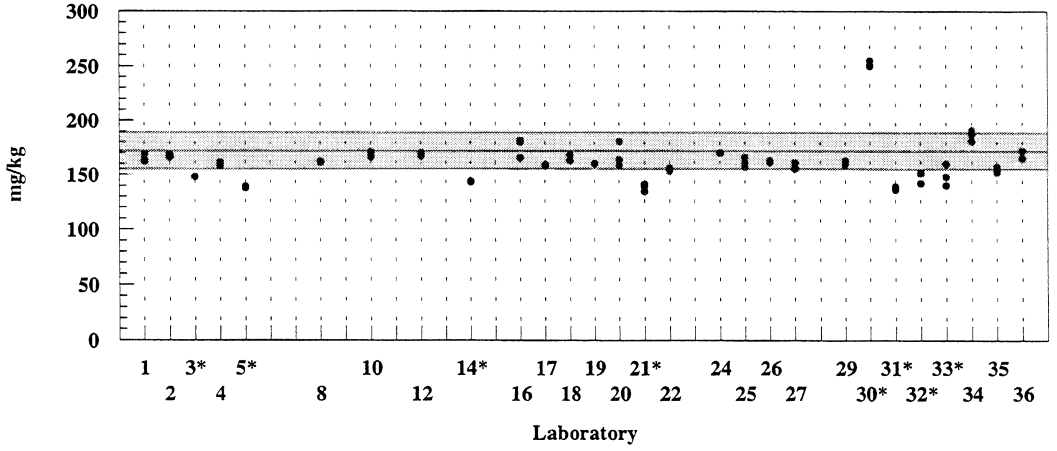
Sediment 99

Accepted value = 160 ± 7 (16) mg/kg
Results: 29 Quantitative Results: 29 Rejections: 7



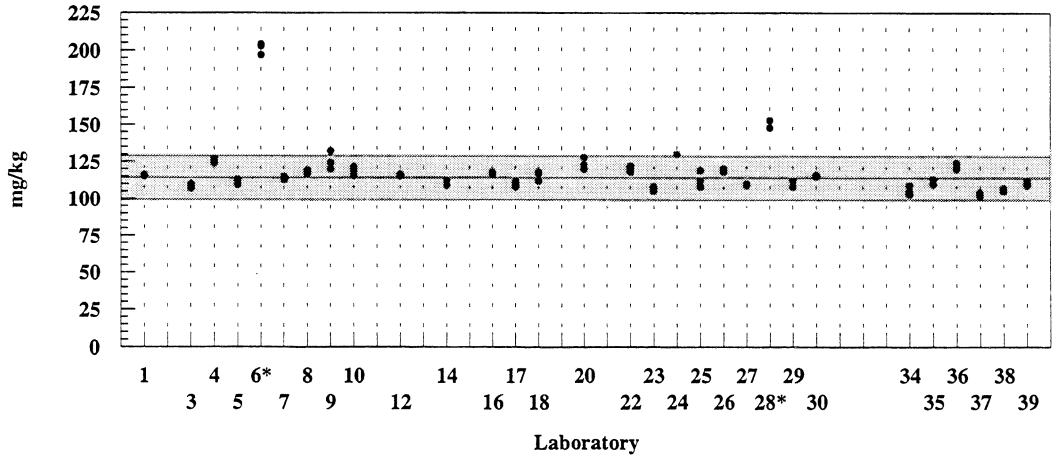
MESS-2

Certified value = 172 ± 16 (17) mg/kg
Results: 28 Quantitative Results: 28 Rejections:8



Tissue 99

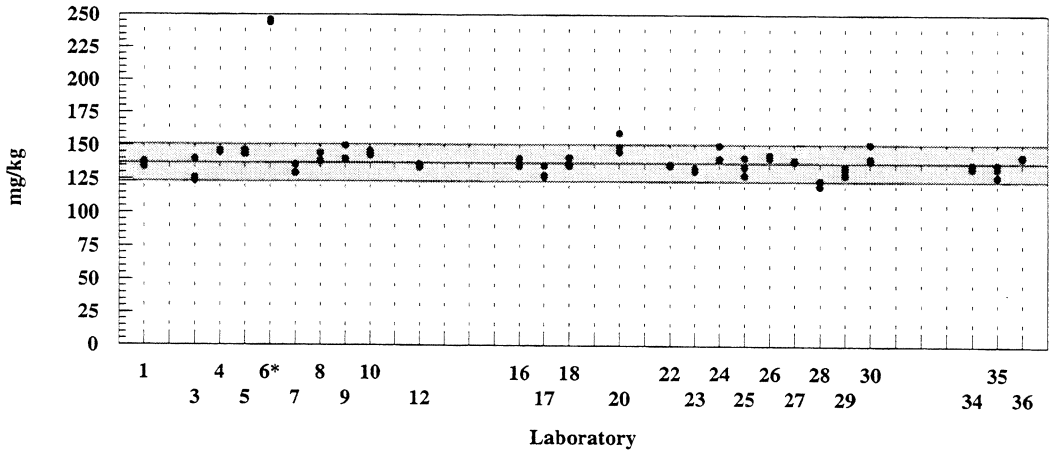
Accepted value = 114 ± 15 mg/kg
Results: 30 Quantitative Results: 30 Rejections: 2



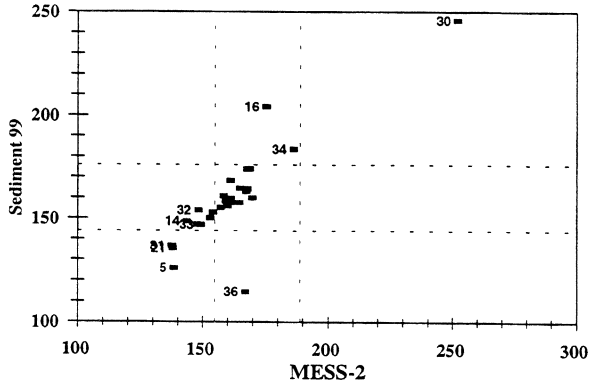
ZINC

CRM 2976

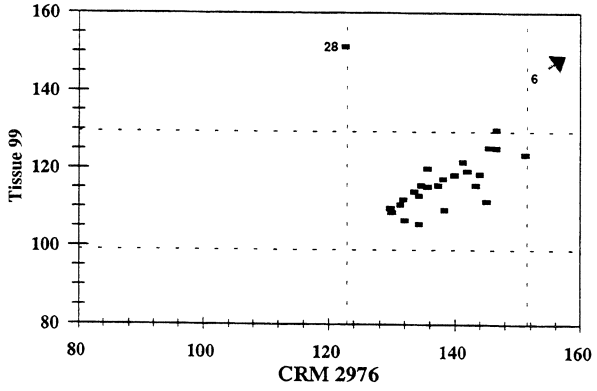
Certified value = 137 ± 13 (14) mg/kg
Results: 26 Quantitative Results: 26 Rejections: 1



Sediments



Tissues

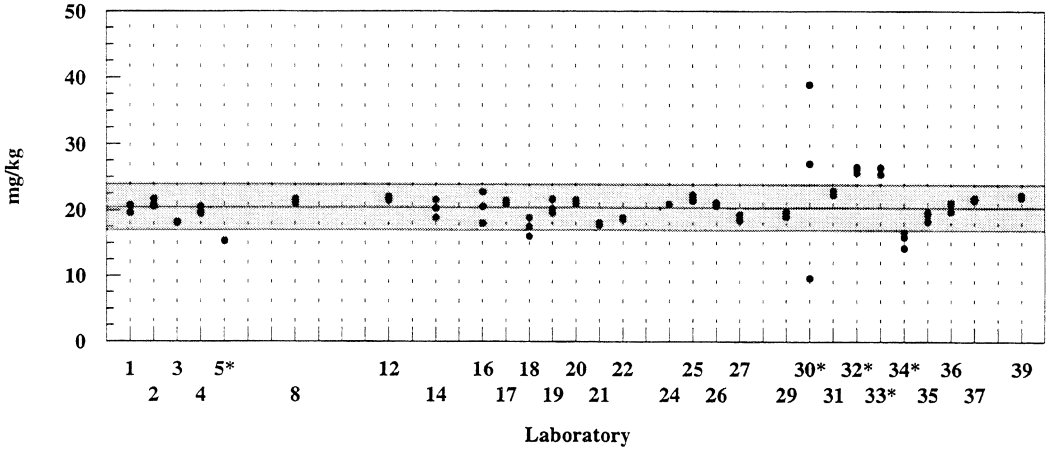


Unknown Sample	Instrumentation								NOAA/12	
	XRF		ICPMS		FAAS		ICPAES			
	sets	rej	sets	rej	sets	rej	sets	rej	sets	rej
Sediment	1	0	7	1	4	1	17	5	35	2
Tissue	-	-	6	2	4	0	19	0	36	6

ARSENIC

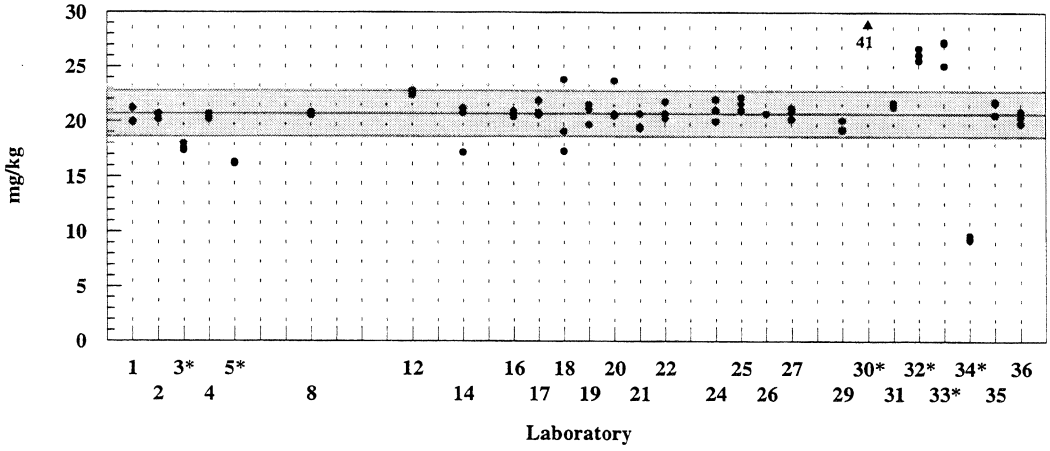
Sediment 99

Accepted value = 20.5 ± 3.5 mg/kg
Results: 29 Quantitative Results: 29 Rejections: 5



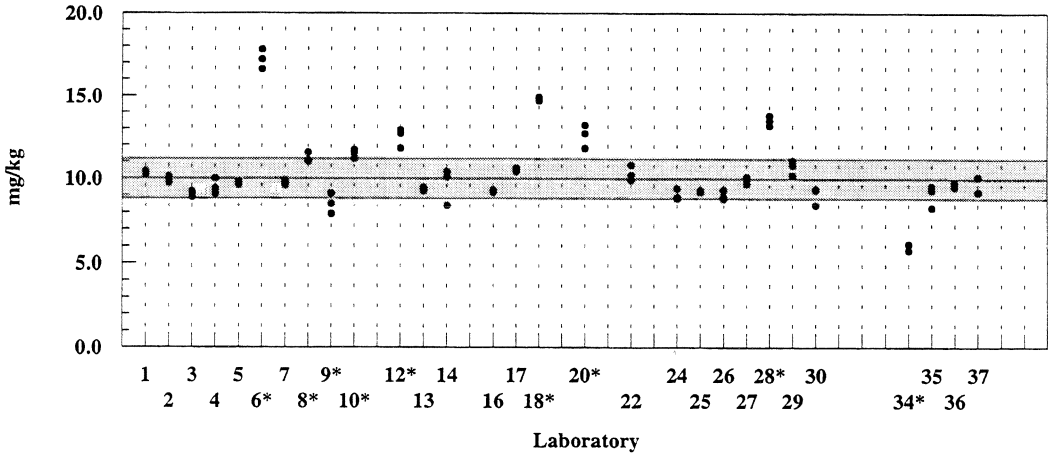
MESS-2

Certified value = 20.7 ± 0.8 (2.1) mg/kg
Results: 27 Quantitative Results: 27 Rejections: 6



Tissue 99

Accepted value = 10.0 ± 1.2 mg/kg
Results: 29 Quantitative Results: 29 Rejections: 9

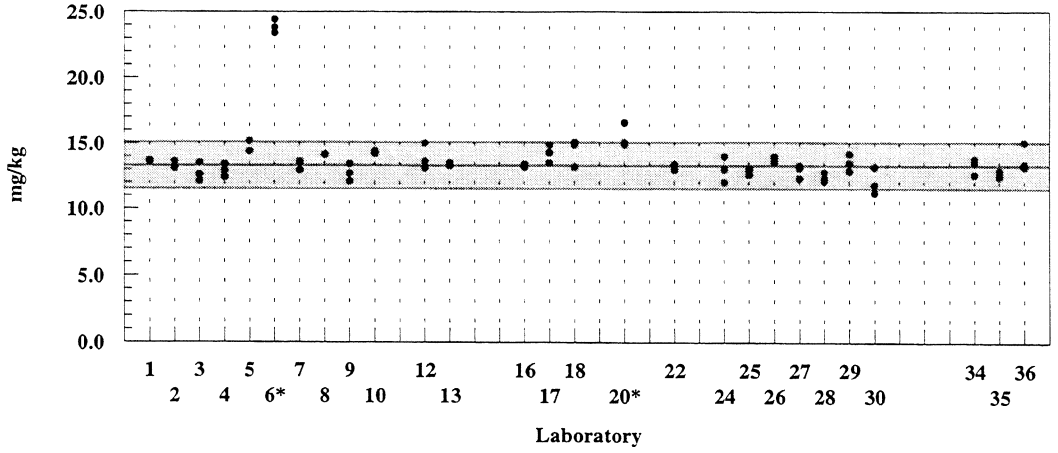


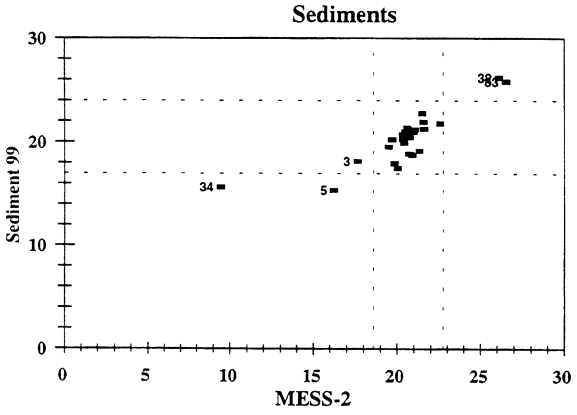
ARSENIC

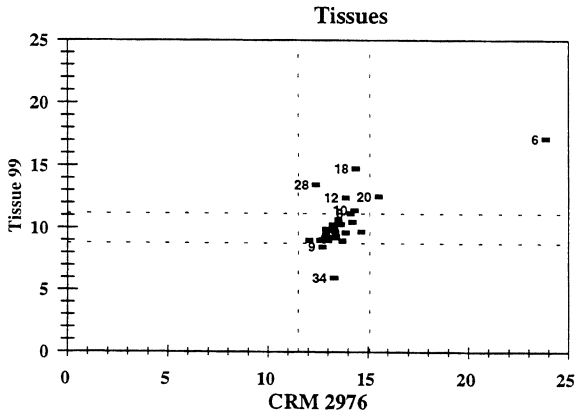
CRM 2976

Certified value = 13.3 ± 1.8 mg/kg

Results: 27 Quantitative Results: 27 Rejections: 2





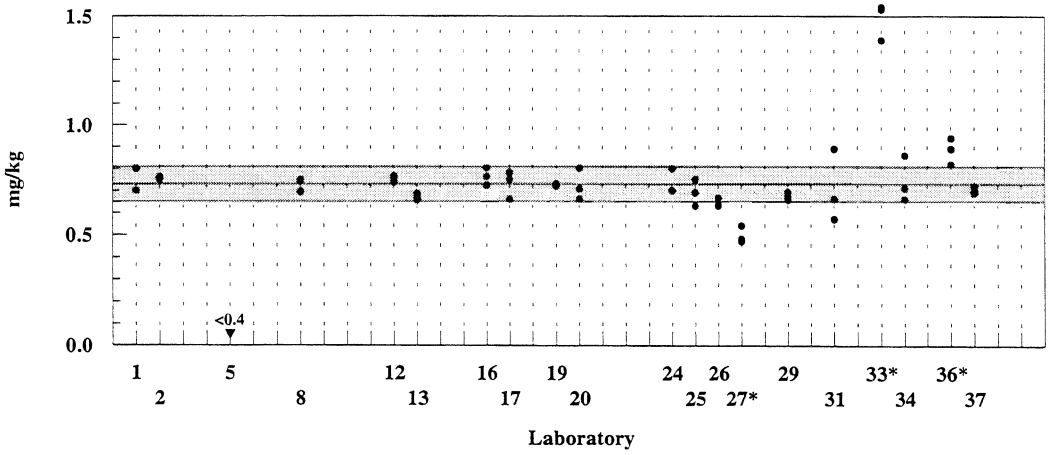


Unknown Sample	Instrumentation								NOAA/12	
	GFAAS		ICPMS		HG		ICPAES			
	sets	rej	sets	rej	sets	rej	sets	rej	sets	rej
Sediment	11	3	9	1	8	1	1	0	32	2
Tissue	5	1	13	4	5	2	4	2	33	12

SELENIUM

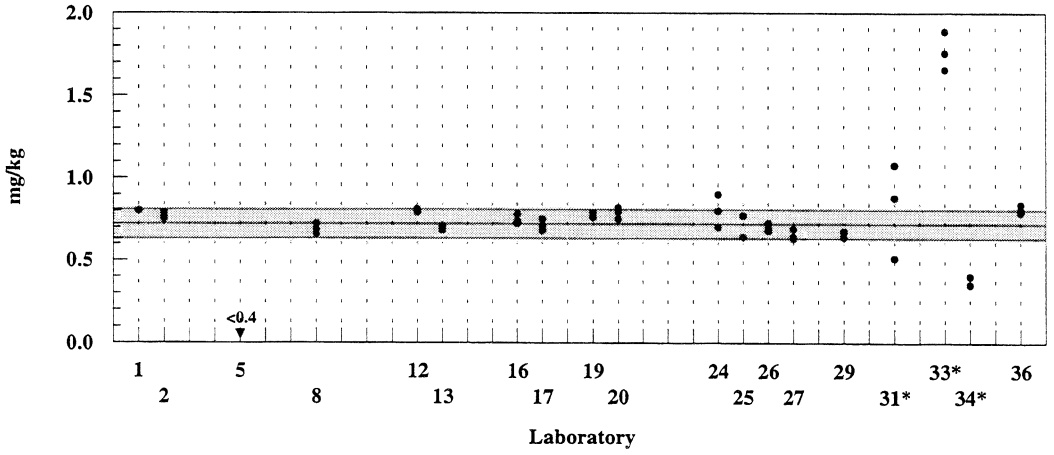
Sediment 99

Accepted value = 0.73 ± 0.08 mg/kg
Results: 20 Quantitative Results: 19 Rejections: 3



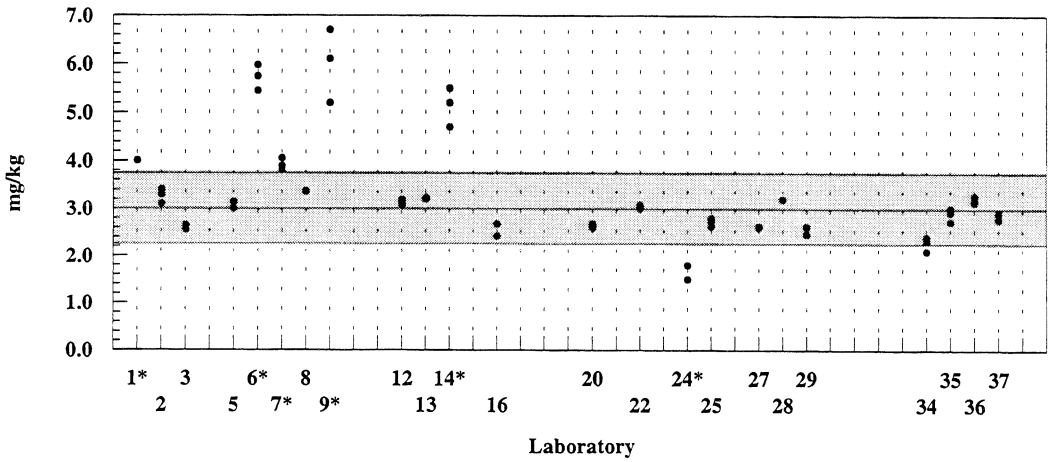
MESS-2

Certified value = 0.72 ± 0.09 mg/kg
Results: 19 Quantitative Results: 18 Rejections: 3



Tissue 99

Accepted value = 3.00 ± 0.75 mg/kg
Results: 23 Quantitative Results: 23 Rejections: 6

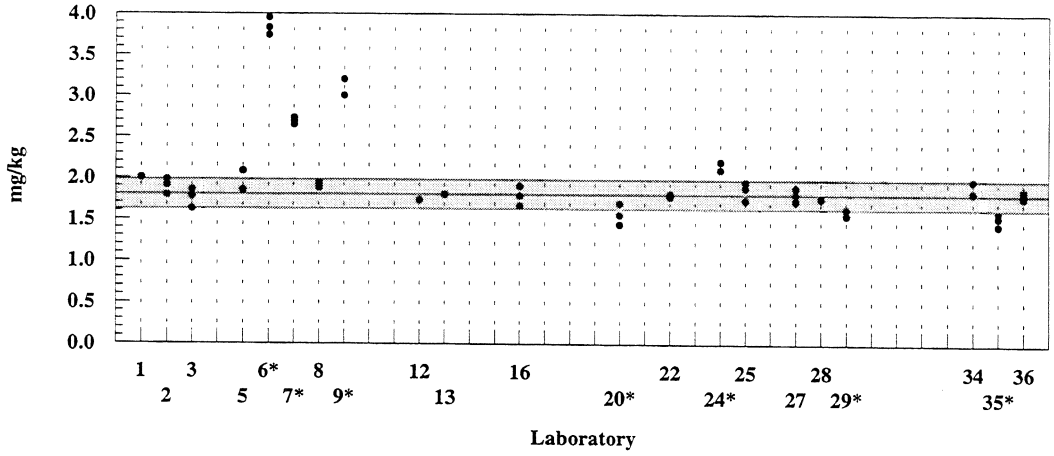


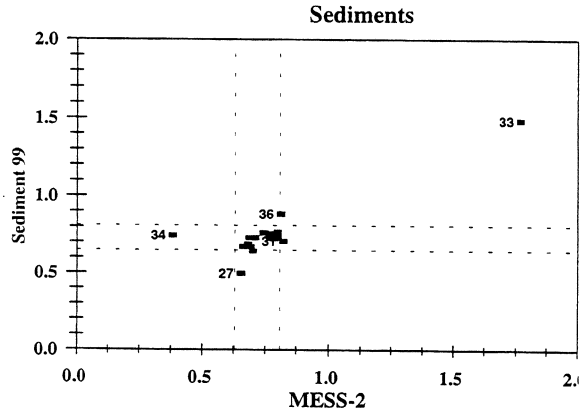
SELENIUM

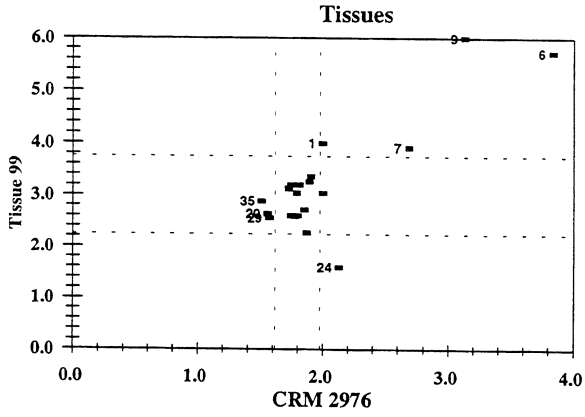
CRM 2976

Certified value = 1.80 ± 0.15 (0.18) mg/kg

Results: 21 Quantitative Results: 21 Rejections: 7





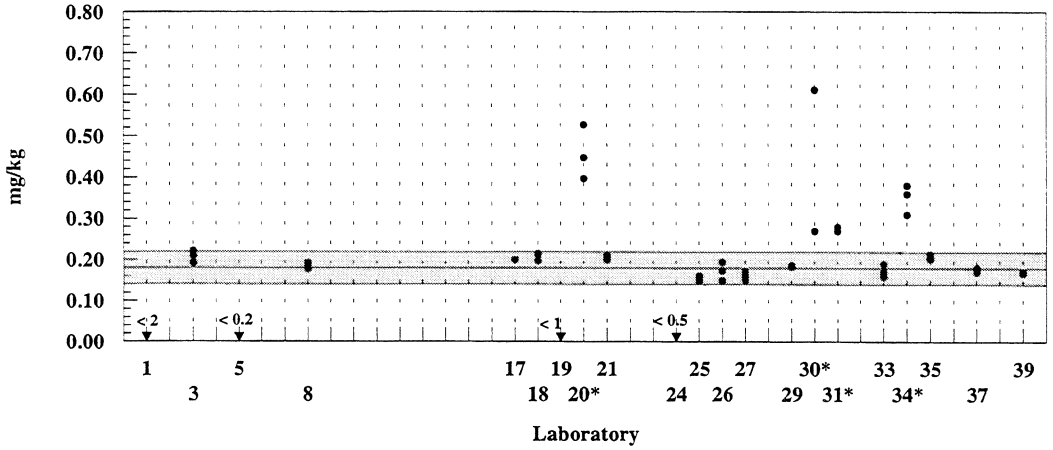


Unknown Sample	Instrumentation								NOAA/12	
	GFAAS		ICPMS		HGAS		ICPAES			
	sets	rej	sets	rej	sets	rej	sets	rej	sets	rej
Sediment	6	1	5	1	9	1	-	-	27	4
Tissue	3	0	9	3	8	0	2	2	27	4

SILVER

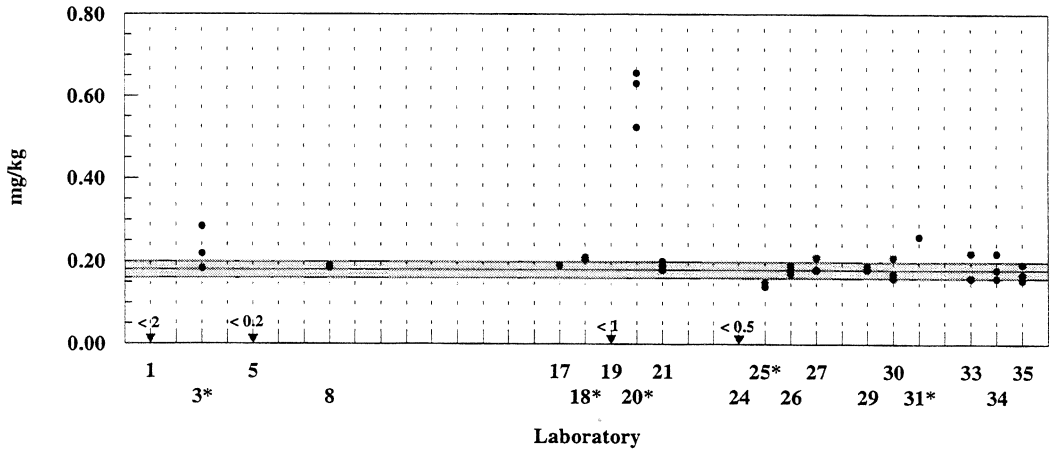
Sediment 99

Accepted value = 0.18 ± 0.04 mg/kg
Results: 21 Quantitative Results: 17 Rejections: 4



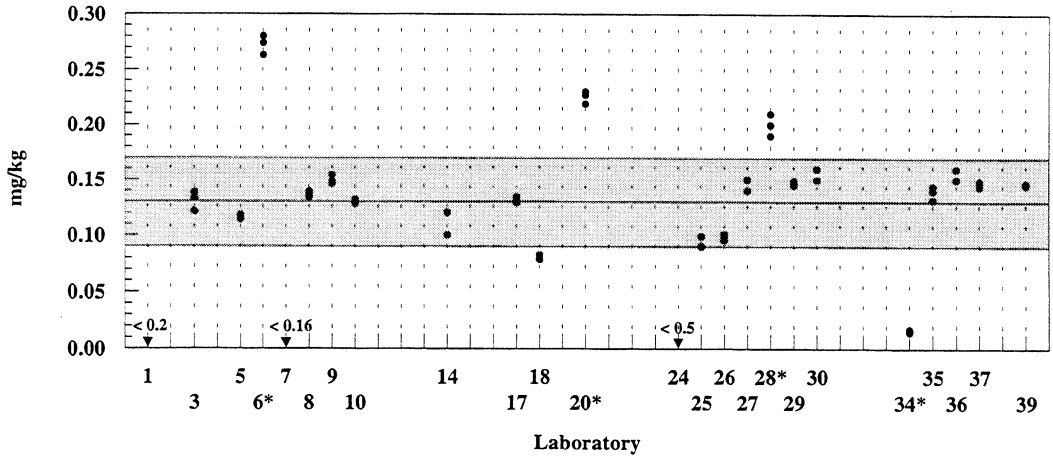
MESS-2

Certified value = 0.18 ± 0.02 mg/kg
Results: 19 Quantitative Results: 15 Rejections: 5



Tissue 99

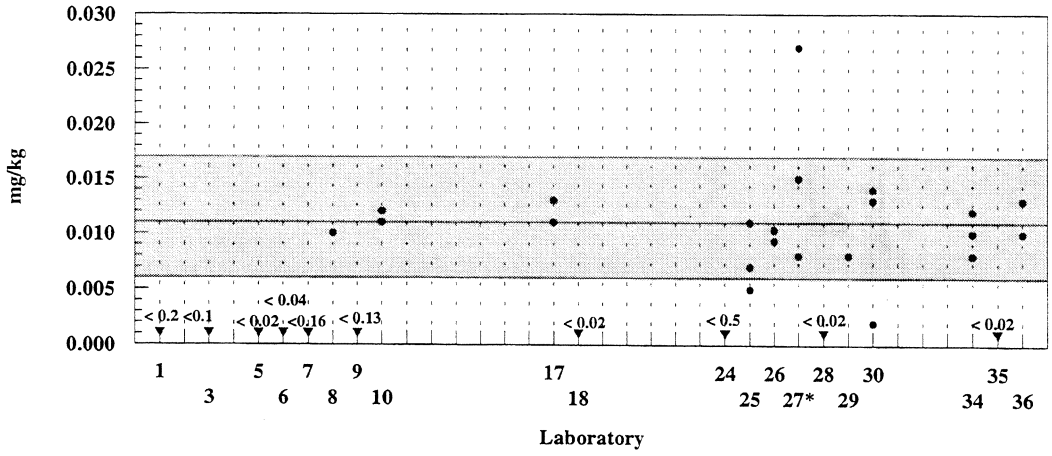
Accepted value = 0.13 ± 0.04 mg/kg
Results: 24 Quantitative Results: 21 Rejections: 3



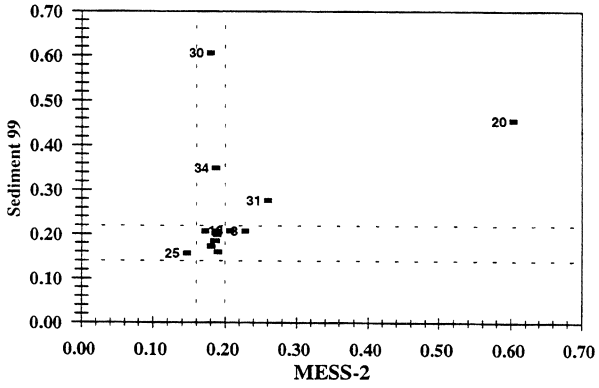
SILVER

CRM 2976

Reference value = 0.011 ± 0.005 mg/kg
Results: 20 Quantitative Results: 10 Rejections: 1



Sediments



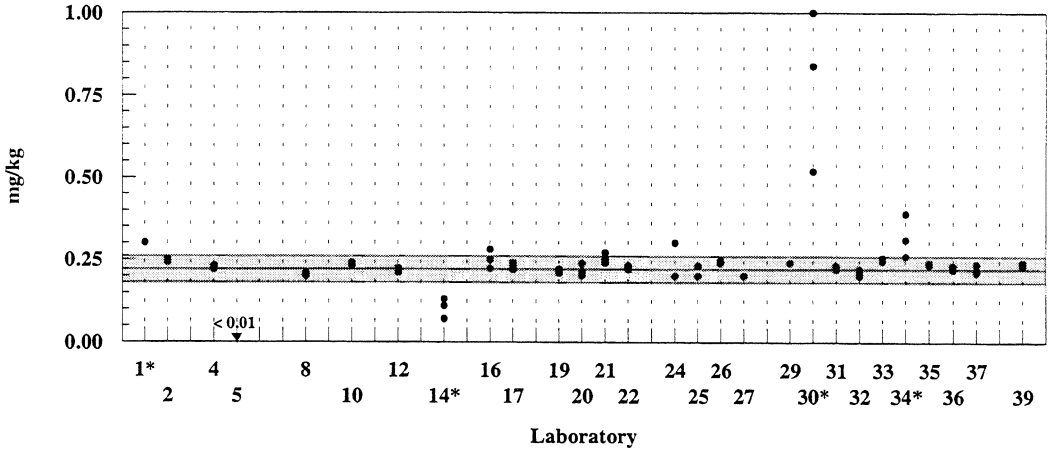
No Youden Plot
for Ag in Tissues

Unknown Sample	Instrumentation								NOAA/12	
	GFAAS		ICPMS		FAAS		ICPAES			
	sets	rej	sets	rej	sets	rej	sets	rej	sets	rej
Sediment	12	2	6	2	2	0	1	0	24	7
Tissue	9	1	9	2	-	-	2	1	27	8

CADMIUM

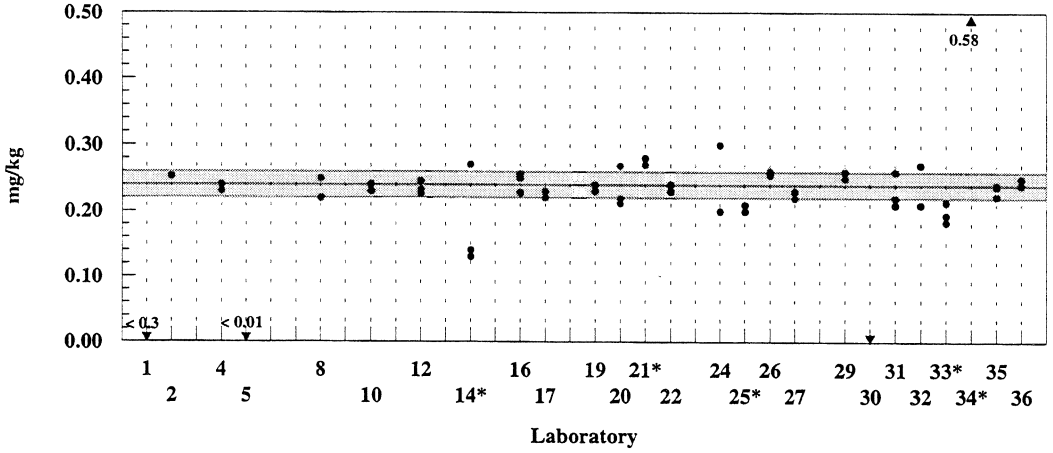
Sediment 99

Accepted value = 0.22 ± 0.04 mg/kg
Results: 28 Quantitative Results: 27 Rejections: 4



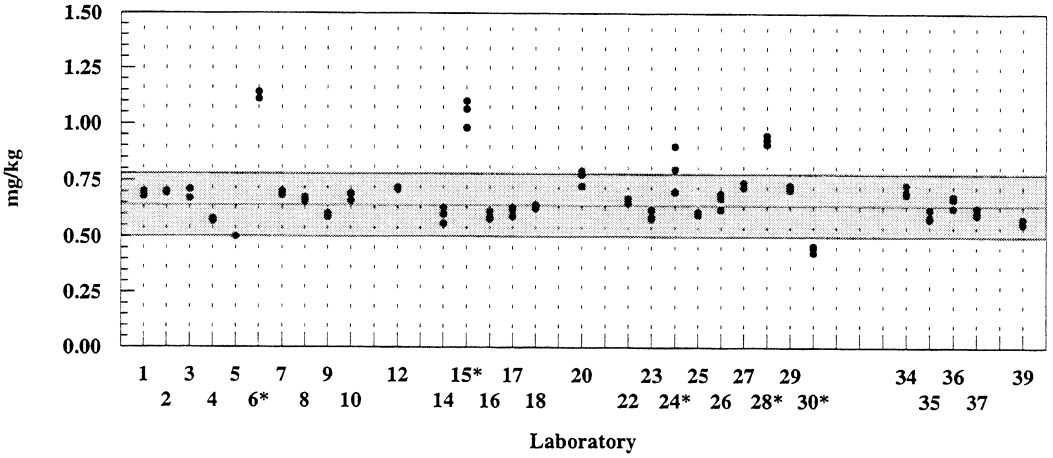
MESS-2

Certified value = 0.24 ± 0.01(0.02) mg/kg
Results: 26 Quantitative Results: 24 Rejections: 4



Tissue 99

Accepted value = 0.64 ± 0.14 mg/kg
Results: 31 Quantitative Results: 31 Rejections: 5

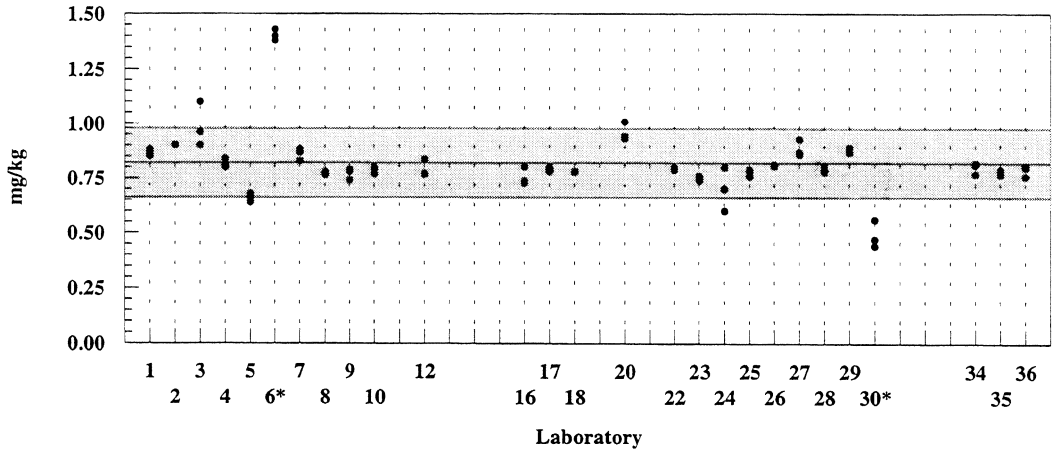


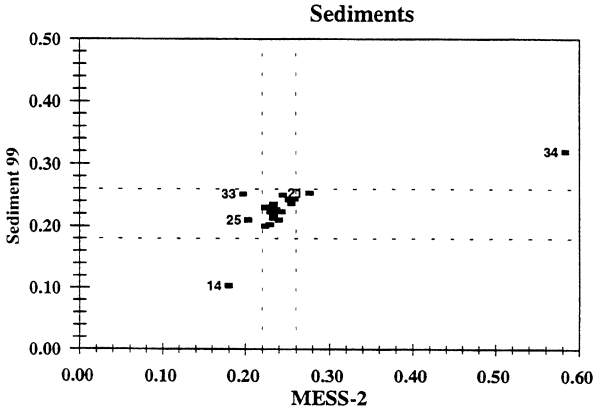
CADMIUM

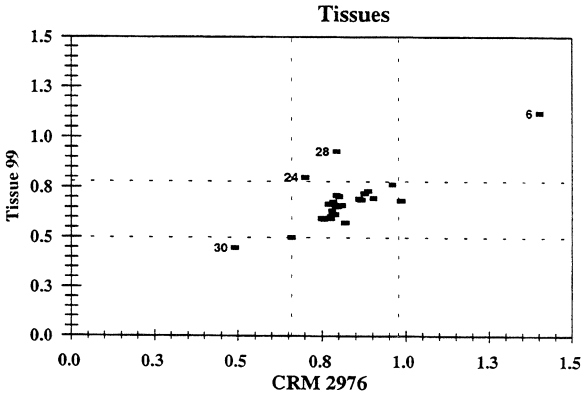
CRM 2976

Certified value = 0.82 ± 0.16 mg/kg

Results: 27 Quantitative Results: 27 Rejections: 2





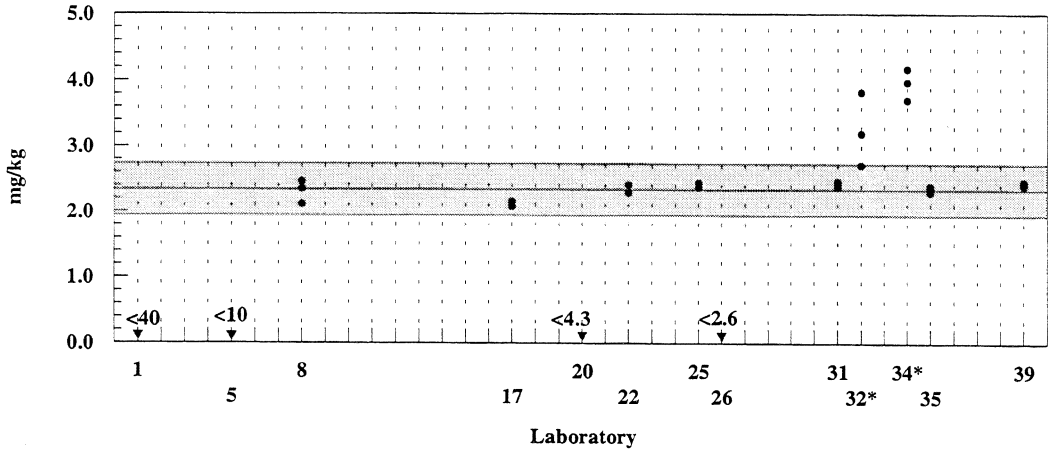


Unknown Sample	Instrumentation								NOAA/12	
	GFAAS		ICPMS		FAAS		ICPAES			
	sets	rej	sets	rej	sets	rej	sets	rej	sets	rej
Sediment	13	2	12	0	2	1	1	1	33	7
Tissue	12	3	14	2	-	-	4	0	35	6

TIN

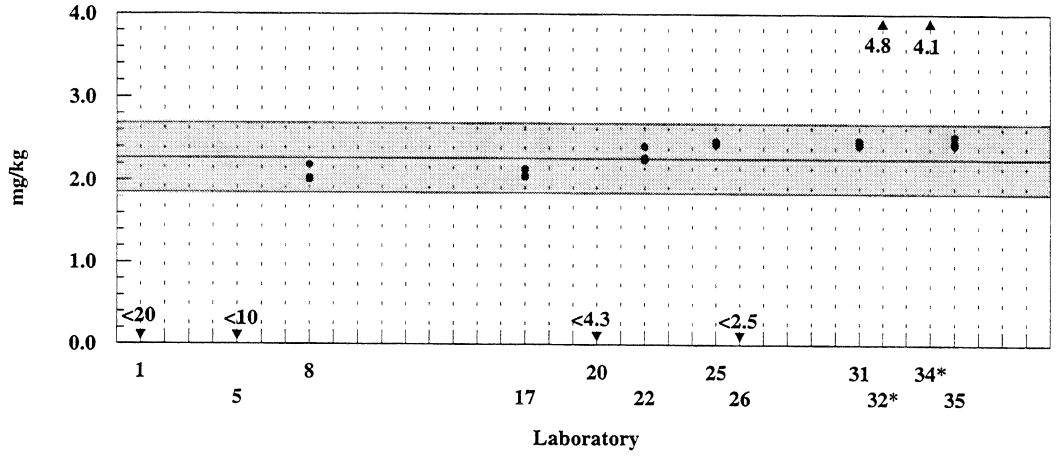
Sediment 99

Accepted value = 2.34 ± 0.4 mg/kg
Results: 13 Quantitative Results: 8 Rejections: 2



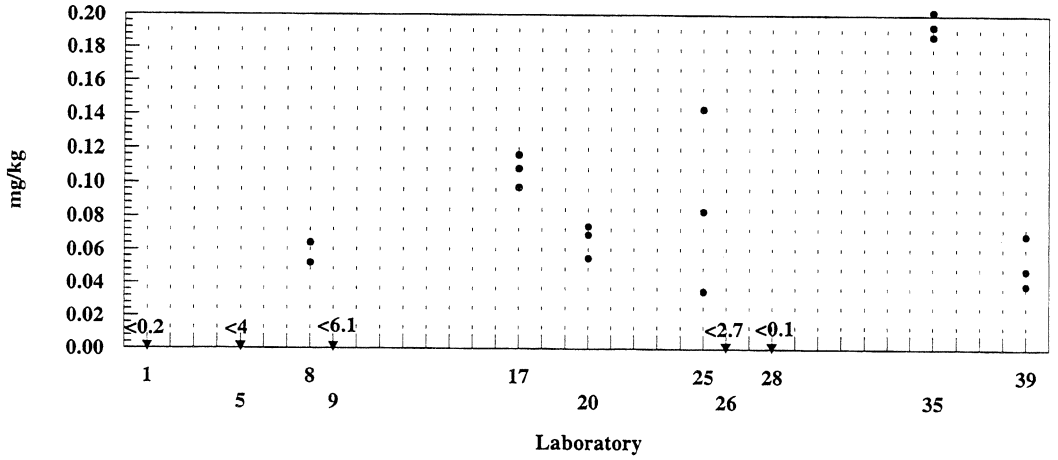
MESS-2

Certified value = 2.27 ± 0.42 mg/kg
Results: 12 Quantitative Results: 8 Rejections: 2



Tissue 99

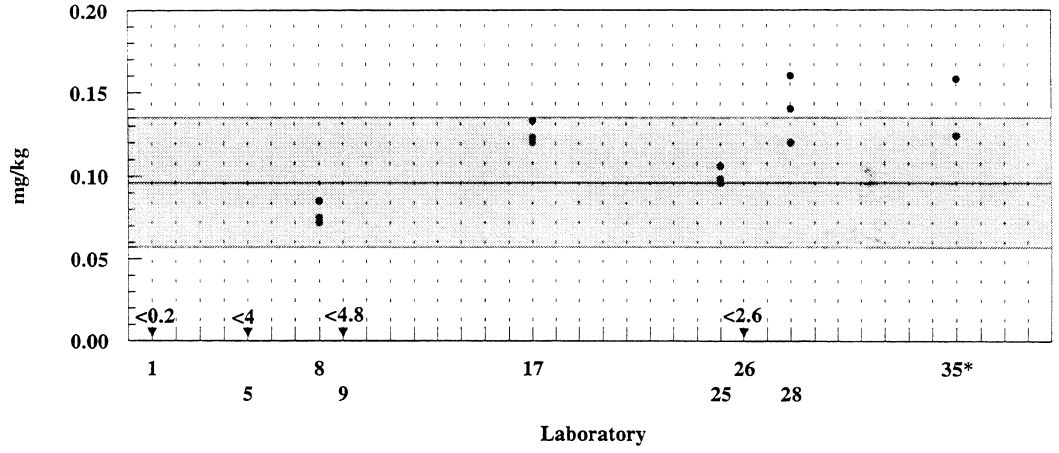
Accepted value = not determined
Results: 11 Quantitative Results: 6 Rejections: 0

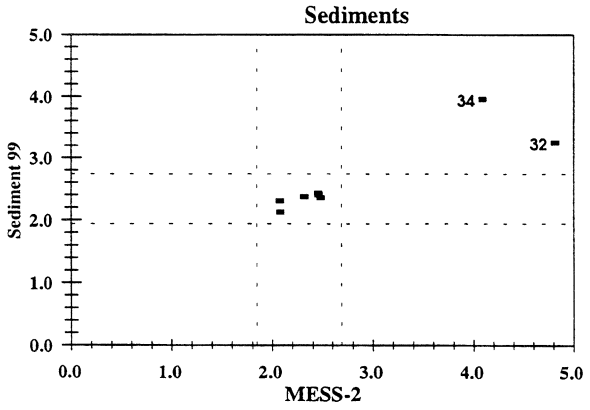


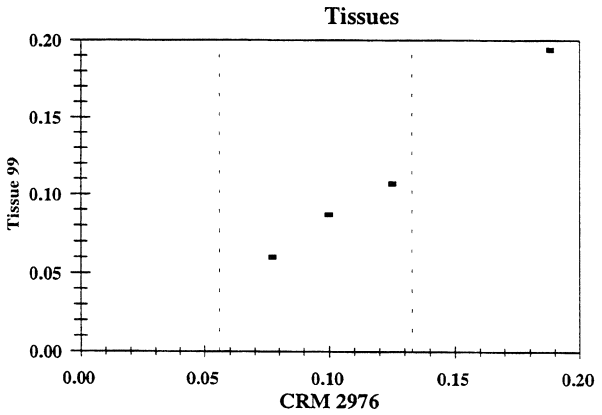
TIN

CRM 2976

Reference value = 0.096 ± 0.039 mg/kg
Results: 9 Quantitative Results: 5 Rejections: 1







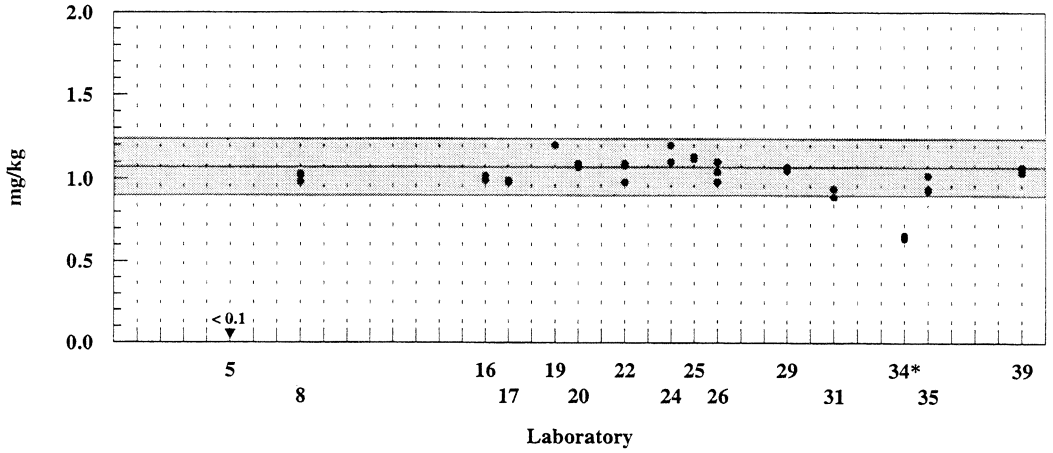
Unknown Sample	Instrumentation								NOAA/12	
	GFAAS		ICPMS		other		ICPAES			
	sets	rej	sets	rej	sets	rej	sets	rej	sets	rej
Sediment	3	2	6	0	-	-	-	-	13	3
Tissue	1	-	4	-	-	-	1	-	10	2

There was indication of inhomogeneity for Sn in Tissue 99, consequently an accepted value was not calculated.

ANTIMONY

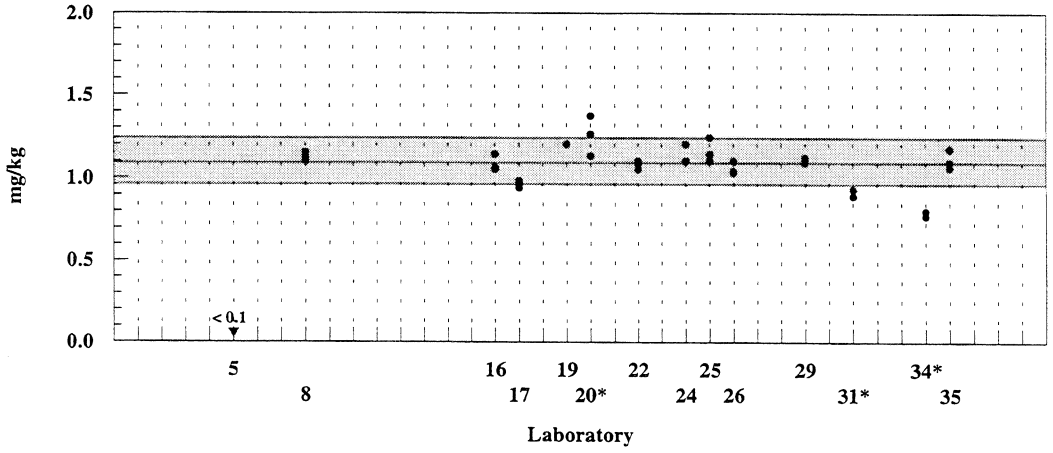
Sediment 99

Accepted value = 1.07 ± 0.17 mg/kg
Results: 15 Quantitative Results: 14 Rejections: 1

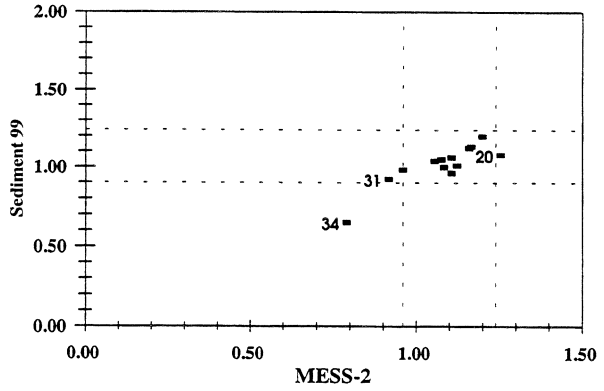


MESS-2

Certified value = 1.09 ± 0.13 mg/kg
Results: 14 Quantitative Results: 13 Rejections: 3



Sediments



ANTIMONY

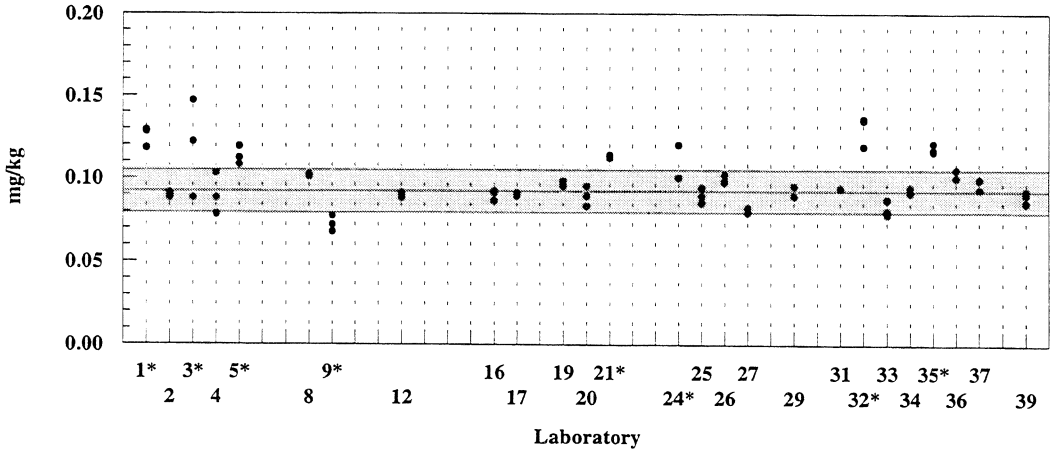
Unknown Sample	Instrumentation								NOAA/12	
	GFAAS		ICPMS		HGAS		ICPAES			
	sets	rej	sets	rej	sets	rej	sets	rej	sets	rej
Sediment	4	1	10	0	1	0	-	-	17	1

The determination of antimony was not required in the biologicals.

MERCURY

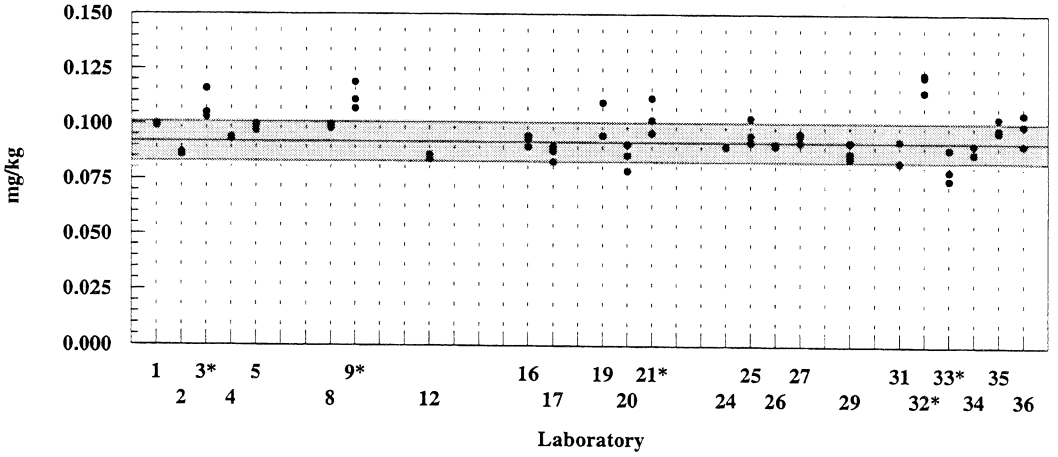
Sediment 99

Accepted value = 0.092 ± 0.013 mg/kg
Results: 26 Quantitative Results: 26 Rejections: 8



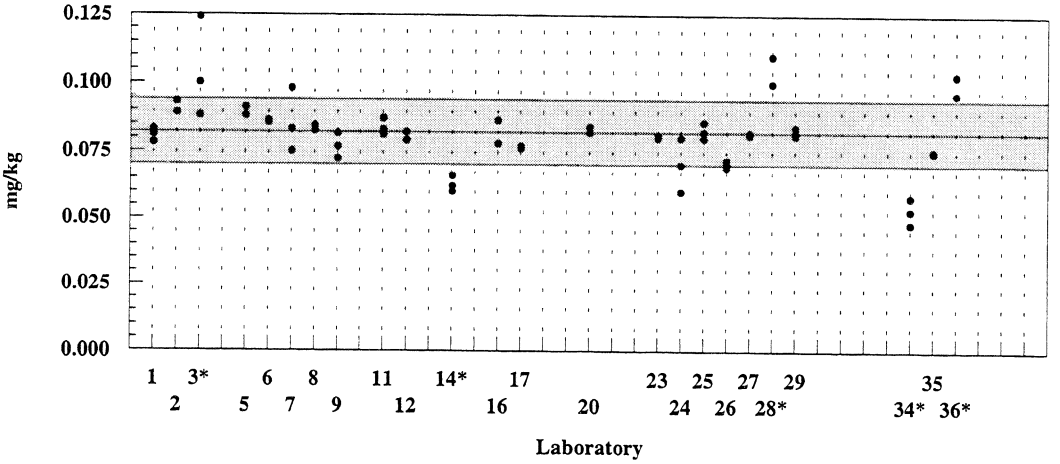
MESS-2

Certified value = 0.092 ± 0.009 mg/kg
Results: 24 Quantitative Results: 24 Rejections: 5



Tissue 99

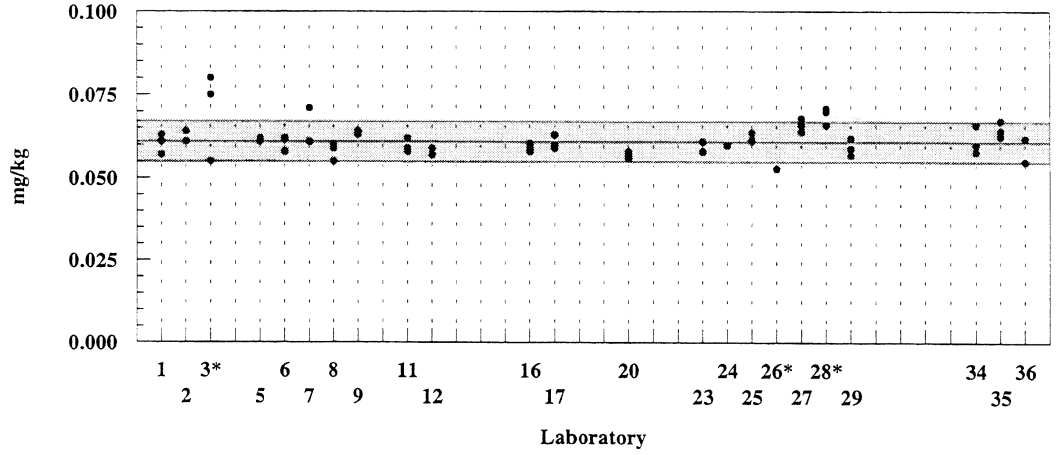
Accepted value = 0.082 ± 0.012 mg/kg
Results: 24 Quantitative Results: 24 Rejections: 5



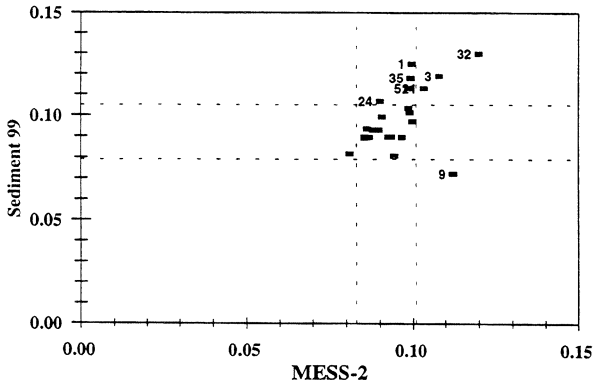
MERCURY

CRM 2976

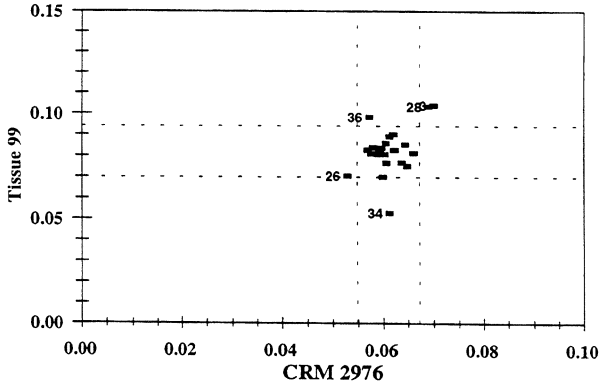
Certified value = 0.061 ± 0.0036 (0.0061) mg/kg
Results: 23 Quantitative Results: 23 Rejections: 3



Sediments



Tissues

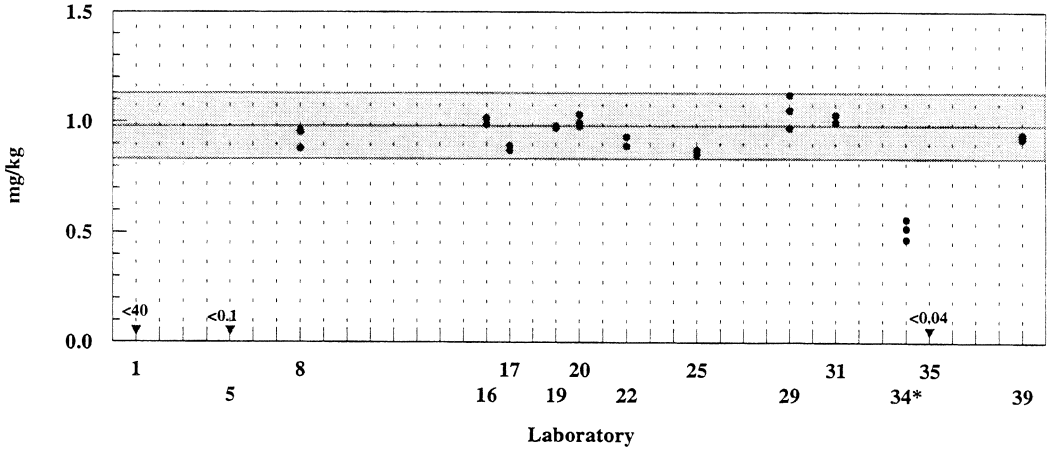


Unknown Sample	Same digest as for other elements		Instrumentation						NOAA/12	
			ICPMS		CVAAS		other			
	sets	rej	sets	rej	sets	rej	sets	rej	sets	rej
Sediment	11	3	4	0	21	8	2	0	29	10
Tissue	9	2	3	0	22	5	-	-	31	10

THALLIUM

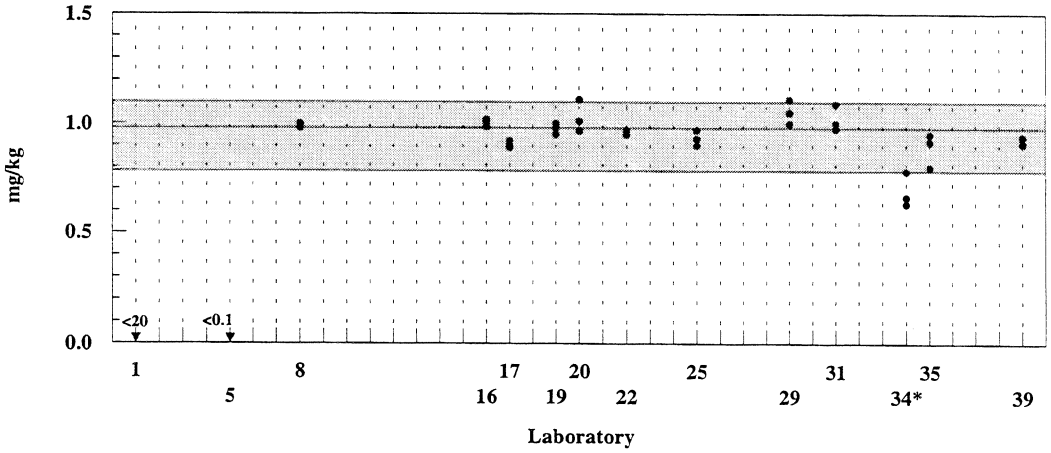
Sediment 99

Accepted value = 0.98 ± 0.15 mg/kg
Results: 14 Quantitative Results: 11 Rejections: 1

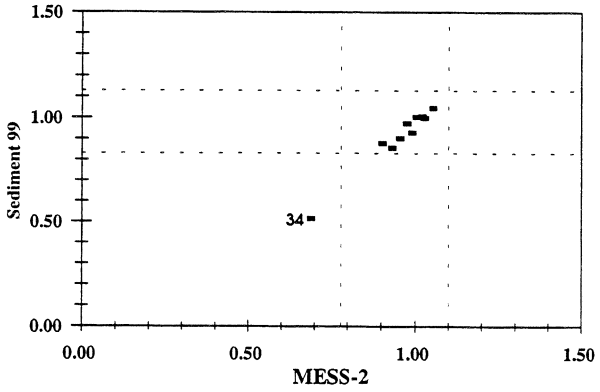


MESS-2

Accepted value = 0.98 ± 0.15 mg/kg
Results: 14 Quantitative Results: 12 Rejections: 1



Sediments



THALLIUM

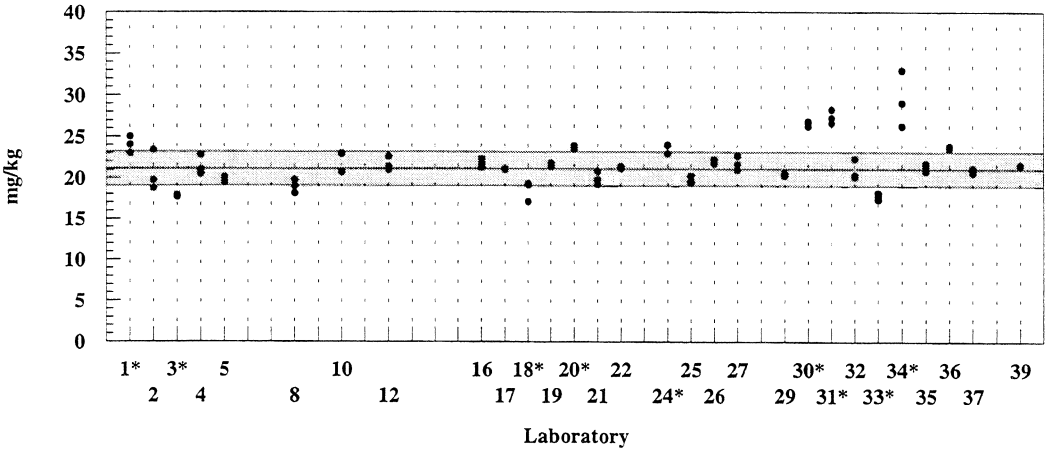
Unknown Sample	Instrumentation								NOAA/12	
	GFAAS		ICPMS		FAAS		ICPAES			
	sets	rej	sets	rej	sets	rej	sets	rej	sets	rej
Sediment	3	1	10	0	-	-	-	-	13	4

The determination of thallium was not required in the biological tissues.

LEAD

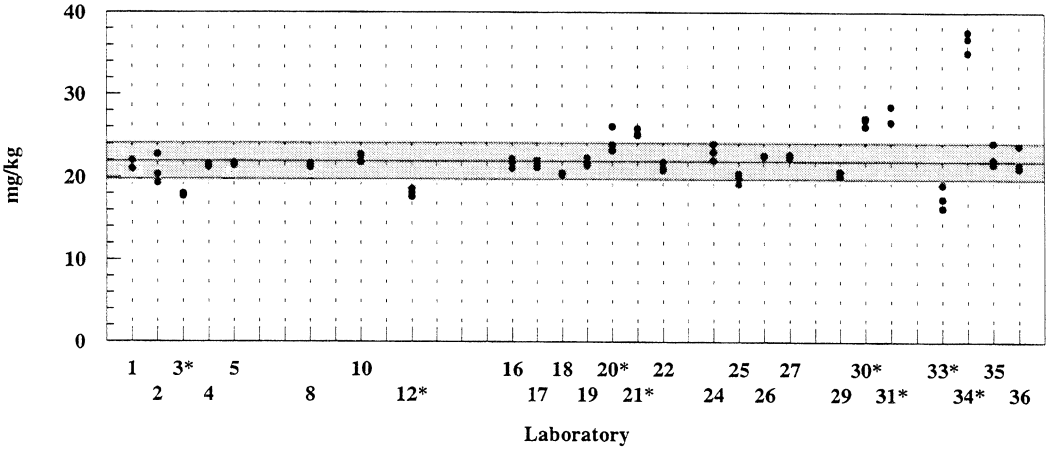
Sediment 99

Accepted value = 21.1 ± 2.1 mg/kg
Results: 29 Quantitative Results: 29 Rejections: 10



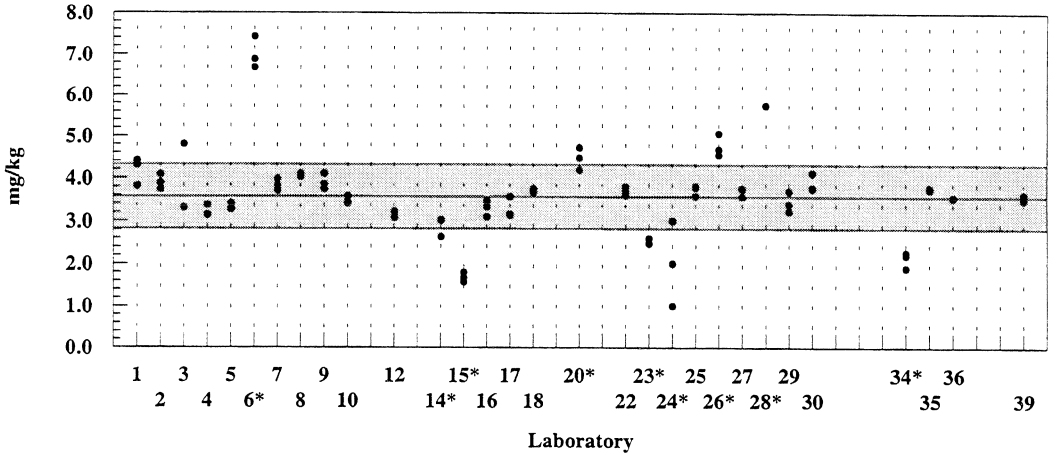
MESS-2

Certified value = 21.9 ± 1.2 (2.2) mg/kg
Results: 26 Quantitative Results: 26 Rejections: 8



Tissue 99

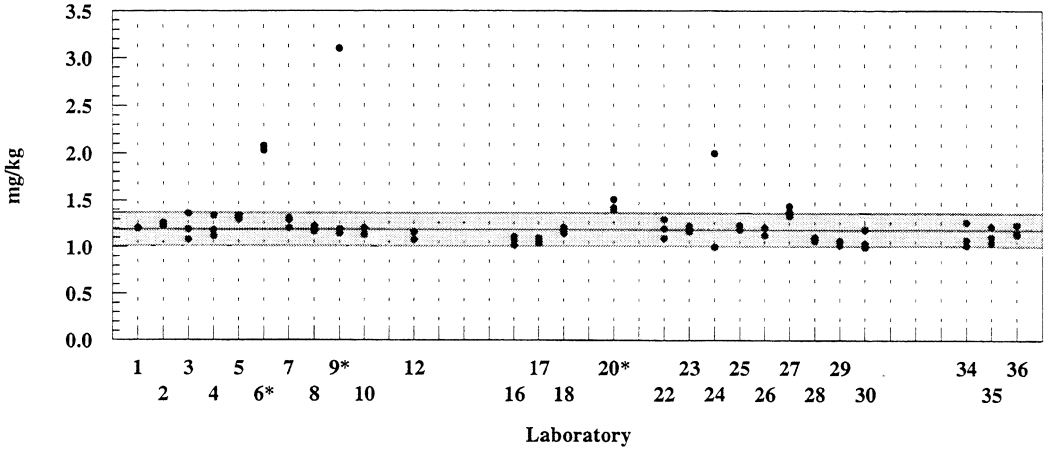
Accepted value = 3.57 ± 0.76 mg/kg
Results: 30 Quantitative Results: 30 Rejections: 9

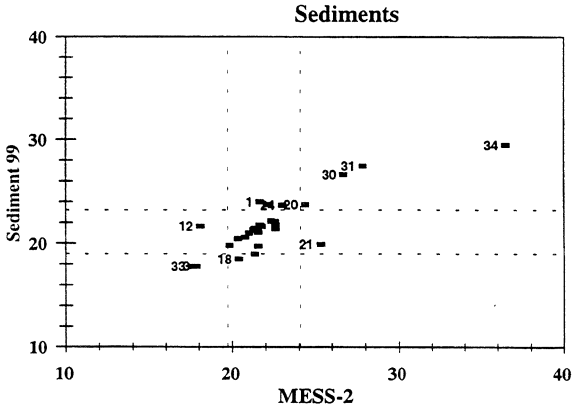


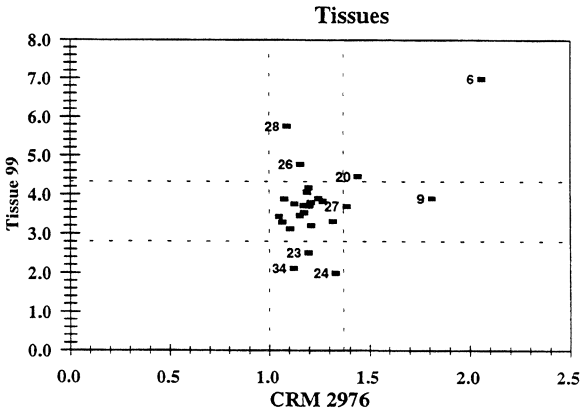
LEAD

CRM 2976

Certified value = 1.19 ± 0.18 mg/kg
Results: 27 Quantitative Results: 27 Rejections: 3







Unknown Sample	Instrumentation								NOAA/12	
	GFAAS		ICPMS		FAAS		ICPAES			
	sets	rej	sets	rej	sets	rej	sets	rej	sets	rej
Sediment	12	4	12	2	2	2	2	1	34	10
Tissue	12	3	13	2	-	-	4	3	33	6

3. DISCUSSION

The intent of this exercise was to assess the capability of participating laboratories to determine selected trace metals in marine biological tissue and sediment samples. This is best measured through an evaluation of their accuracy and, through some extent, intralaboratory precision. Of the four samples, one sample of each type was a certified reference material (CRM). This knowledge, however, portends an inherent difficulty when using CRMs in intercomparison studies. The answers are known to the participants and there is often an inclination to tend towards "the right answer." However, our experience with the NOAA exercises has shown that if this is happening, it is not a serious factor.

For each of the two unknown samples an excluded mean and confidence interval for each analyte were calculated from the submitted data. An implication of this approach is that the accuracy evaluation of a laboratory's performance for a particular analyte in a particular matrix is relative to the performances of all accepted laboratories. Thus we get an indication of the type of comparability we may expect if the accepted group were to analyse similar materials. In all cases in this study the calculated mean was not much different and certainly not significantly different from the NRC means for all analytes in both matrices.

If we assume that NRC is competent, there also appears to always be a group of participating laboratories that are equally competent for various analytes in the particular matrices and, if there are sufficient data, an accurate mean can be established along with an appropriate 95 percent confidence interval.

The use of the CRMs is a great aid in this type of exercise because their 95 percent confidence intervals are generally much narrower than those defined in the exercise for the unknowns. Laboratories which produce results within the confidence intervals of both the CRM and the unknown are obvious demonstrators of reliability and comparability for that analyte in the particular matrix at the concentration range in question. Of equal importance is the ability to use the CRMs to discern general trends which might otherwise be lost in the relatively wider confidence intervals calculated for the unknowns.

The overall assessment is based on the total number of data sets submitted to the number of sets outside the acceptable ranges. This evaluation allowed four categories of accuracy performance to be discernible. These are shown in Table II (page 42) for the sediments and in Table IV (page 46) for the biological tissues. In general, **Superior** laboratories submitted results for most analytes within the 95 percent confidence intervals; **Good** laboratories submitted many results within the accepted range with a minimum number of outliers; **Fair** laboratories had some problems with certain elements or did not report results for a number of elements. Laboratories with a higher proportion of outliers or "less thans" compared to the number of acceptable results were categorized as **Others**. It should be noted that the dividing lines between the categories, especially between good and fair, are somewhat diffuse. The last three columns in Tables II and IV compare the number of laboratories in each category for the last eight exercises.

We have also adopted the IUPAC guidelines for assessing accuracy in intercomparison exercises. This is accomplished by comparing the bias estimate for each analyte with a target value for standard deviation. The bias estimate is calculated from the difference between the laboratory mean (x) and the accepted (or assigned) mean (X). The z-score is calculated by dividing the bias estimate by the target value for standard deviation (σ), these scores are listed in Appendix D.

$$z = \frac{(x - X)}{\sigma_{target}}$$

For this NOAA exercise the target value for the standard deviation is set at ± 10% (± 5 % for Al, Si and Fe in the sediments). Using these criteria, z-scores can be classified into three categories.

$\|z\| \leq 2$	satisfactory
$2 \leq \|z\| \leq 3$	questionable
$\|z\| \geq 3$	unsatisfactory

An assessment for intralaboratory precision (p-score) is based on the criteria of Table 1 and listed in Appendix D.

$$p = \frac{\sigma_{lab}}{\sigma_{target}}$$

Table I
Criteria for Intralaboratory Precision Evaluation

Sample	Target RSD
Tissues	± 10 percent
Sediments	± 10 percent (± 5 percent Al, Si and Fe)

When evaluating precision we cannot ignore that there is some probability that the sample is inhomogeneous. We assume that this would generally be more prevalent in the unknown samples which are not as rigorously processed as the CRMs.

Sediments

Table II shows the overall assessment for the sediments based on the number of quantitative results submitted and the number of rejected means. A listing of this evaluation over the past seven years (using this years laboratory designation) is tabulated in Table III on page 43.

Four laboratories reported sediment results for the first time. Of the twenty-six laboratories that submitted sediment data for both NOAA/13 and NOAA/12, three improved their ratings and six slipped to a lower rating. Remember that the rating is relative, and as the group as a whole improves, an individual laboratory also must improve in order to retain its former position.

Table II

Accuracy Evaluation for the Sediments*

	Laboratory Number	NOAA Intercomparison								
		/13	/12	/11	/10	/9	/8	/7	/6	/5
Superior	1,2,4,8,12,16,17, 19,22,24,25,26, 27,29,35	15	19	15	15	8	11	8	5	3
Good	10,14,18,20,	4	7	10	12	15	13	12	11	7
Fair	3,13,21,31,36	5	6	7	6	10	8	12	5	7
Others	5,9,30,32,33,34	6	4	3	3	7	8	10	7	6
Total		30	36	34	36	40	40	42	28	23

*Laboratories 6,7,11,15,23 and 28 did not report results for the sediments

There were 798 sets of results evaluated for the sediments for NOAA/13 compared to 942 for NOAA/13, 865 for NOAA/11 and 922 sets for NOAA/10. The rejection rates were respectively 175 (22), 168 (18%), 202 (23%) and 185 (20%) sets.

Table III

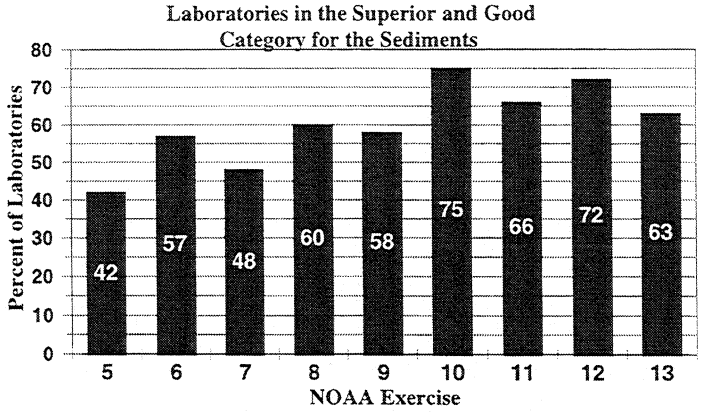
Comparison of Laboratory Performance for Sediments In Previous NOAA Intercomparisons

LAB	NOAA/13		NOAA/12		NOAA/11		NOAA/10		NOAA/9		NOAA/8		NOAA/7		NOAA/7	
	Sets	Out	Sets	Out	Sets	Out	Sets	Out	Sets	Out	Sets	Out	Sets	Out	Sets	Out
1	33	5	38	3	34	2	34	6	34	9	31	3	18	4		
2	25	0	26	2	26	2	26	1	26	3	26	1	24	3	26	2
3	17	9	18	5	18	5	26	2	22	6	28	11	10	4		
4	26	0	26	1	26	5	24	3	24	3	18	8				
5	35	21	26	10												
8	36	1	36	2	36	0	36	0	36	1	30	7	32	19	30	10
9	2	2	2	0	2	0	2	0	2	0					26	7
10	20	0														
12	26	3	26	1	26	5	21	0								
13	2	0														
14	18	6	16	7			27	11	36	18						
16	26	2	26	2	24	12	24	3	20	4	14	9	2	0	16	7
17	34	0	32	4	32	4	34	3	34	7	30	5				
18	14	4	15	3	20	16	22	14	24	16						
19	32	0	32	7	30	5	30	5	30	7	32	5				
20	33	11	26	11	16	5										
21	25	10														
22	29	1	30	3	20	1	30	1	20	1	30	13	32	4	32	6
24	31	3	31	5	32	4	32	6	30	2	15	0	15	2	14	1
25	35	3	36	6	36	5	36	3	36	2	36	0	36	1	31	2
26	28	0	28	4	28	5	34	22	32	21	24	14	24	13		
27	24	1	22	4	24	9	24	6	24	3	22	4	22	4	18	4
29	30	0	32	1	17	5	18	1	22	8						
30	22	19	16	9	22	12	18	5	16	6	26	16	24	9	22	4
31	35	17	36	10	36	13										
32	23	15														
33	28	18	18	7	30	12	27	9	32	14						
34	34	26	28	4	28	8	36	6	36	3	18	4	28	6	28	4
35	33	4	36	4	34	4	34	3	34	3	30	2	30	2	28	1
36	7	3	30	3	30	3	32	3	32	6	36	10	24	3		

SUPERIOR	GOOD	FAIR	OTHERS

The overall categorization for the past eight exercises is indicated in Figure 1. Although it appears no significant change has occured over the past few years, again it must be stressed that there is a general improvement in performance. This is evident by the smaller confidence intervals that are calculated from the raw data making it more difficult for a laboratory to remain within the accepted limits.

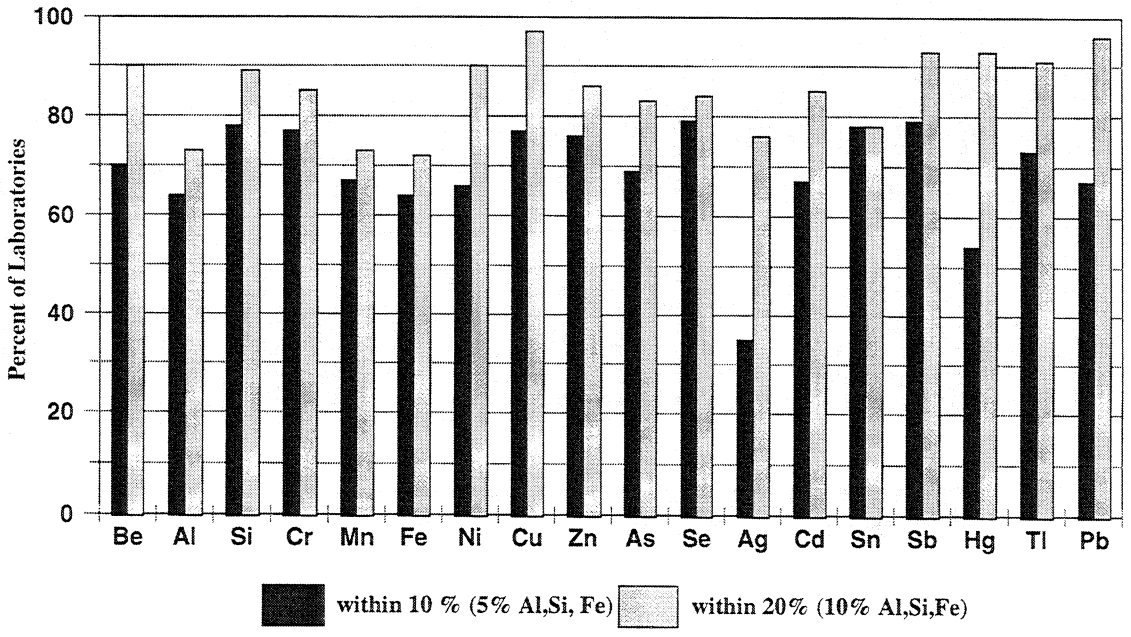
Figure 1



The analytical capability of the group as demonstrated in this exercise is shown in Figure 2 . This diagram shows the percentage of laboratories reporting values within 10 and 20 percent (5 and 10 percent for Al, Si and Fe)of the accepted value for each analyte in Sediment 99.

Figure 2

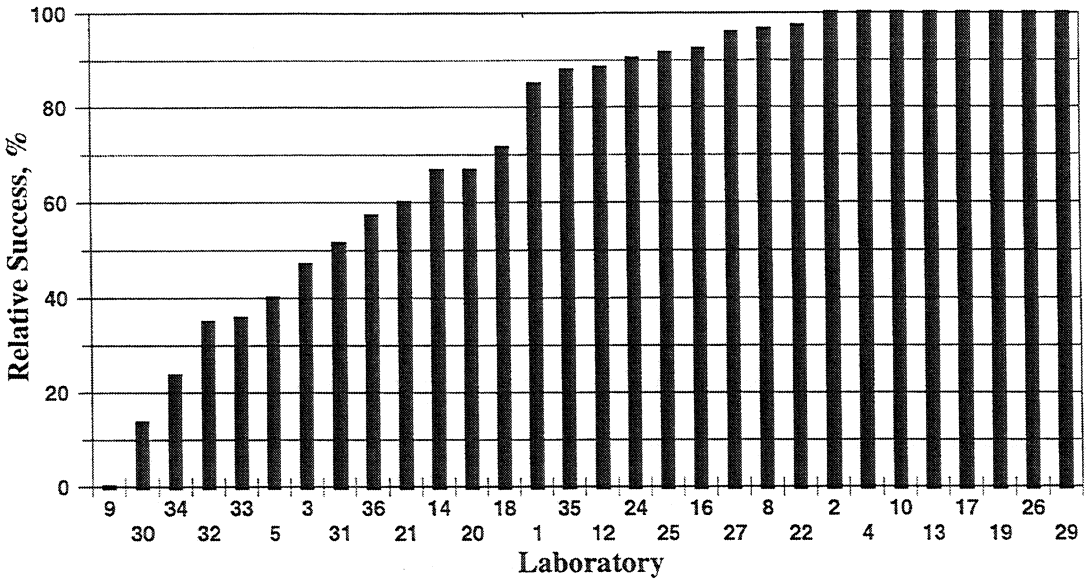
Analytical Capability for Sediment 99



It is acknowledged the evaluation criteria described on pages 40-41 is not representative for the laboratories that submit results for only a few elements. An alternative method of discerning competency in terms of analyses attempted is shown in Figure 3.

Figure 3

Laboratory Success



Thirteen laboratories (1,2,4,8,16,17,19,22,24,25,26,29 and 35) have performed well over the past five years.

There are still a few problems concerning the analysis of marine sediments for trace metals. But over seventy percent of the laboratories are able to get results within ± 20% of the accepted value.

It is difficult to state that for any one element there has been a noticeable improvement in performance for NOAA/13 compared to last year. Instead we must look over the past few years to see calculated confidence intervals for the unknowns decrease from ±27% (Cr NOAA/9) to ± 12% (Cr NOAA/13), ± 35% (Se NOAA/9) to ± 11% (Se NOAA/13) and ± 26% (Sn NOAA/9) to ±17% (Sn NOAA/13). This is another indication of general improvement and a good demonstration of the benefits of these exercises.

Biological Tissues

Twenty-six of the thirty-one laboratories which submitted data for the tissues are in the superior and good categories. Two of the laboratories were rated fair only because less that five sets of data were submitted. A listing of the overall assessment is shown in Table IV.

Table V (page 47) shows the number of submitted sets and the number of rejected means for the biological tissue samples over the eight exercises from NOAA/6 to NOAA/13. Of the thirty laboratories that submitted tissue data for both NOAA/12 and NOAA/13 six improved their ratings and six have worse ratings. Particular notice should go to laboratories 1,2,3,5,8,16,17,24,25,26, 27,28,2934,35 and 36 with a consistent superior or good record over the last five years.

There were 642 sets of results evaluated for the tissues for NOAA/13 compared to 769 for NOAA/12, 696 for NOAA/11 and 712 for NOAA/10. The rejection rates were respectively 103(16%), 118 (15%), (101 (15%) and 118(17%) sets.

Table IV
Accuracy Evaluation for the Biological Tissues*

	Laboratory Number	NOAA Intercomparison								
		/13	/12	/11	/10	/9	/8	/7	/6	/5
Superior	1,3,4,5,7,8,16,17, 18,22,25,26,27, 29,35	15	18	15	17	13	15	8	7	4
Good	2,9,10,12,14,20, 23,24,28,3436	11	16	14	11	15	13	14	9	8
Fair	11,13,30	3	5	5	8	10	8	8	9	9
Others	6,15	2	0	0	0	0	6	8	5	5
Total		31	39	34	36	38	42	38	30	26

*Laboratories 19,21,31,32 and 33 did not report results for the tissues.

Table V

Comparison of Laboratory Performance for Tissues In Previous NOAA Intercomparisons

LAB	NOAA/13		NOAA/12		NOAA/11		NOAA/10		NOAA/9		NOAA/8		NOAA/7		NOAA/6	
	Sets	Out	Sets	Out	Sets	Out	Sets	Out	Sets	Out	Sets	Out	Sets	Out	Sets	Out
1	26	1	26	0	24	0	23	2	23	3	22	1	8	1		
2	16	1	18	2	18	1	16	0	16	1	14	0				
3	22	4	22	5	20	2	20	4	20	2	22	9	8	2		
4	18	0	19	8	16	4										
5	26	2	23	4			23	2	23	2	24	2	23	4	26	7
6	24	20	26	6	24	9	23	9								
7	24	4	24	5	24	7	22	10	22	9	18	1	19	7		
8	26	1	26	3	24	3	23	2	23	7	22	3	21	9		
9	26	6	2	1	2	0	22	7	-	-	18	5	-	-	23	9
10	18	1														
11	2	0	2	0	2	0										
12	16	2	16	0	16	0	8	2								
13	4	0	2	1	20	1	20	2	18	3	4	0	19	1		
14	12	3	20	6												
15	4	3	4	1	3	0										
16	18	0	24	2	16	3	18	0	18	1	12	1	2	1	16	6
17	24	0	24	3	24	8	23	3	23	2	22	3				
18	18	1	23	8	16	6	18	7	14	5						
20	23	8	24	6	24	5										
22	20	1	16	3	18	7	19	2	12	4	18	11	21	7		
23	12	1	11	1												
24	24	8	24	7	22	5	22	6	22	1	22	2	13	6	10	5
25	26	0	25	0	20	1	23	2	23	2	24	0	25	3	26	5
26	24	2	26	1	22	2	23	7	16	4	10	4	12	3		
27	22	1	22	1	20	5	22	0	22	5	19	3	19	5	16	1
28	26	12	22	4	22	4	23	2	23	7	24	3	24	4	20	2
29	24	1	24	3	22	3	22	1	19	0						
30	20	10	16	5	16	3	18	5	14	4	22	16	20	6	18	6
34	20	6	24	6	19	4	23	3	23	3	10	1	20	7	24	8
35	24	3	26	1	24	0	23	0	23	1	24	1	26	5	24	1
36	10	1	24	0	22	1	22	2	22	4	23	5				

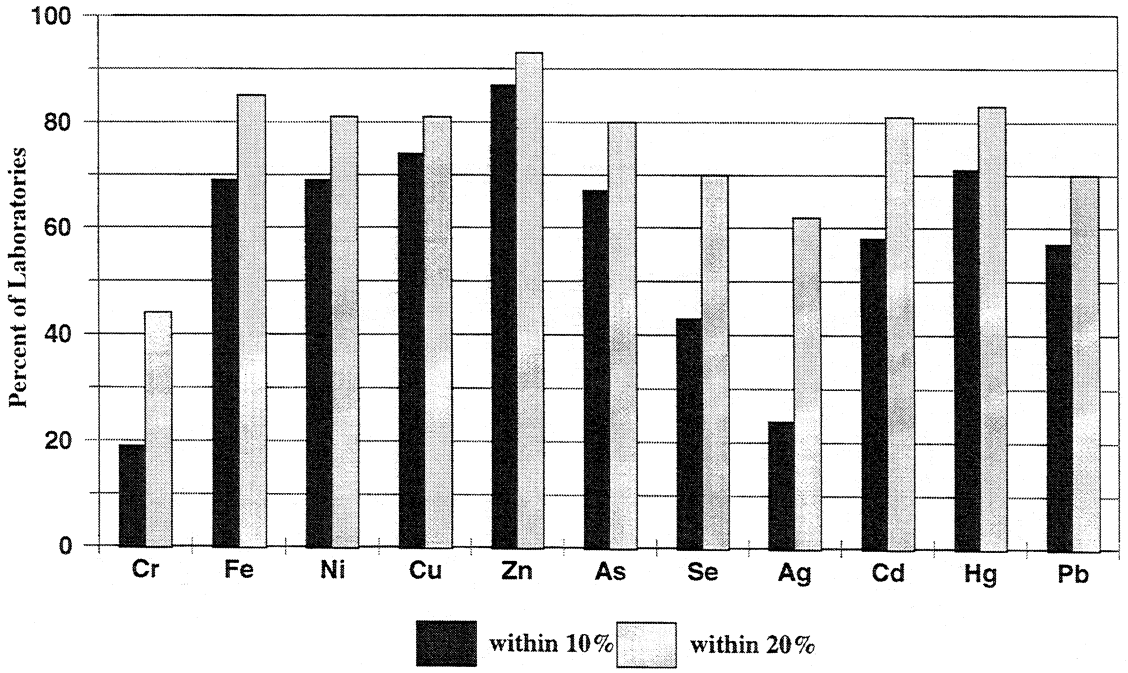
SUPERIOR	GOOD	FAIR	OTHERS

The majority of the laboratories satisfied the precision criteria of Table I. But while it is apparent that it is necessary to have acceptable precision in order to have good accuracy, it is obvious that even outstanding precision is not a guarantee of good accuracy.

The analytical capability of the group for the analysis of Tissue 99 as demonstrated in this exercise is shown below in Figure 4. This diagram shows the percentage of laboratories reporting values within 10 and 20 percent of the accepted value for the analyte. This year the performance for Cr has deteriorated compared to NOAA/12.

Figure 4

Analytical Capability for Tissue 99



A few problems remain concerning the analysis of marine tissues for trace metals. The following three analytes in Tissue 99 presented difficulties to at least twenty-five percent of the participants that submitted results: chromium, selenium, silver and lead. The percentage of accepted results submitted is presented in Figure 5. Eighteen of thirty-one laboratories had a success rate greater than 90%.

Figure 5

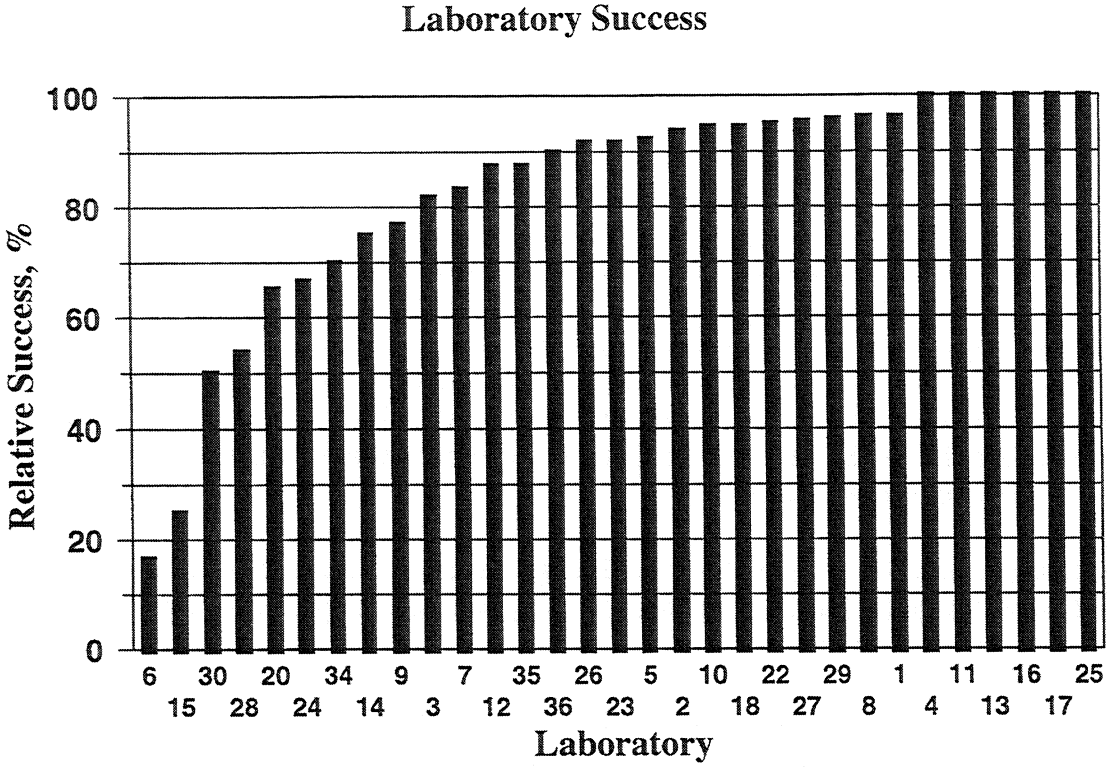


Figure 6

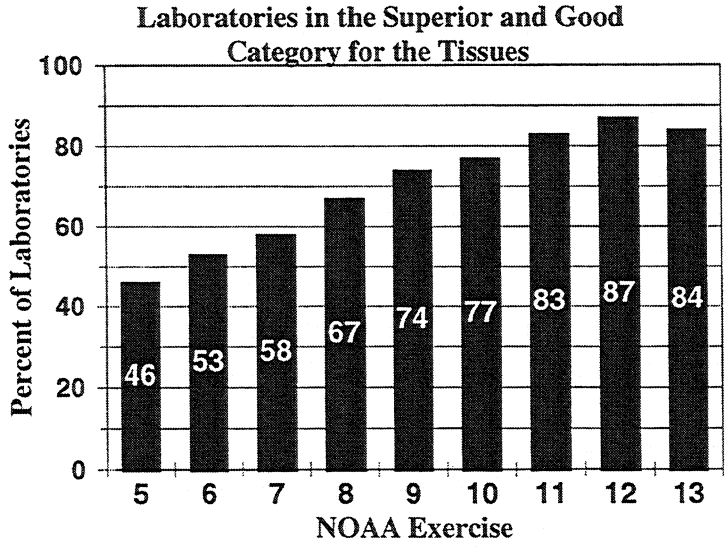


Figure 6 shows that eighty-four of the participants are in the superior and good categories this year. This is down slightly from last year but probably not a significant decrease.

Twenty-four laboratories that were in the good or superior category for the tissues also analyzed the sediments. All but four of these were also in the good or superior category for the sediments. In general, a laboratory with capabilities for one matrix appears to also do well for another.

Appendix C summarizes the digestion methods and instrumental techniques used for the determination of the metals. The great majority of laboratories used more than one instrumental method for this exercise. The importance of using the right tool for the job is obviously recognized by the participants. The use of inductively coupled plasma mass spectrometry (ICPMS) is increasing rapidly, and is responsible for the improvement for some of the analytes such as silver, tin, antimony and thallium. There were fourteen laboratories that used ICPMS in this study. Graphite furnace atomic absorption spectrometry (GFAAS) and inductively coupled plasma emission (ICPAES) are used slightly more frequently whereas flame atomic absorption (FAAS) is reported by only a few.

The predominate method of calibration was through the use of a calibration curve. One lab used standard additions for Cr and Cd in the tissues. Only one laboratory used standard additions for the As and Se in the sediments.

The majority of the laboratories also report using closed vessel digestion procedures with microwave heating. The popularity of this decomposition technique has risen steadily over the last few exercises and is certainly a partial cause for the continued improvements.

4. CONCLUSIONS

In general, we continue to see the overall performance improve for both matrices. Although conspicuous changes are not always evident on a year to year basis, over the past few years we have seen the percentage of laboratories in the top groups almost double.

The performance for copper, selenium and lead in both matrices has reached a level where we cannot expect to see more improvement. Silver is still problematic in the sediments; chromium selenium and tin in the tissues.

The laboratories that took part in previous exercises generally improved or maintained their ratings for both the sediments and biological tissues.

Kudos go to laboratories 1,4,8,16,17,22,25,26,27,29 and 35 for achieving a superior rating for both matrices this year. Another seven laboratories (2,10,12,14,18,20 and 24) were in the superior or good category for both tissues and sediments. Laboratories 4 and 17 reported 44 and 58 sets of data, respectively, all within the accepted limits.

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6. ACKNOWLEDGMENTS

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Appendix A
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Appendix B

Beryllium B-2
Aluminum B-4
Silicon B-6
Chromium B-8
Manganese B-10
Iron B-12
Nickel B-14
Copper B-16
Zinc B-18
Arsenic B-20
Selenium B-22
Silver B-24
Cadmium B-26
Tin B-28
Antimony B-30
Mercury B-32
Thallium B-34
Lead B-36

BERYLLIUM
Sediment 99
mg/kg

Lab					Mean	SD	RSD
1	3	<2	<2	<2			
2	0						
3	0						
4	3	2.07	2.47	2.42	2.32	0.22	9.4
5	3	1.3	1.3	1.3	1.3	0.0	0.0
6	0						
7	0						
8	3	2.36	2.40	2.27	2.34	0.07	2.8
9	0						
10	0						
11	0						
12	3	1.79	2.12	1.84	1.92	0.18	9.3
13	0						
14	3	2.19	2.19	2.25	2.21	0.03	1.6
15	0						
16	3	2.283	2.307	2.36	2.317	0.039	1.7
17	3	2.27	2.25	2.28	2.27	0.02	0.7
18	0						
19	3	2.41	2.43	2.43	2.42	0.01	0.5
20	3	2.2	2.32	2.35	2.29	0.08	3.5
21	0						
22	3	2.04	1.96	2.02	2.01	0.04	2.1
23	0						
24	3	2.1	2.1	2.2	2.1	0.1	2.7
25	3	2.28	2.49	2.15	2.31	0.17	7.4
26	3	2.14	2.17	2.16	2.16	0.02	0.7
27	0						
28	0						
29	3	2.32	2.17	2.17	2.22	0.09	3.9
30	0						
31	3	1.9	1.72	1.75	1.79	0.10	5.4
32	0						
33	3	1.70	1.82	1.75	1.76	0.06	3.4
34	3	1.98	1.93	2.02	1.98	0.05	2.3
35	3	2.15	2.18	2.21	2.18	0.03	1.6
36	0						
37	3	2.26	2.22	2.29	2.25	0.04	1.6
38	0						
39	3	2.35	2.47	2.28	2.37	0.10	4.1

BERYLLIUM
MESS-2
mg/kg

Lab					Mean	SD	RSD
1	3	2	2	2	2	0	0.0
2	0						
3	0						
4	3	2.22	2.38	2.32	2.31	0.08	3.5
5	3	1.5	1.5	1.5	1.5	0.0	0.0
6	0						
7	0						
8	3	2.34	2.23	2.13	2.23	0.11	4.7
9	0						
10	0						
11	0						
12	3	1.98	2.34	2.27	2.20	0.19	8.7
13	0						
14	3	2.08	2.07	2.15	2.10	0.04	2.1
15	0						
16	3	2.226	2.193	2.213	2.211	0.017	0.8
17	3	2.30	2.26	2.32	2.29	0.03	1.4
18	0						
19	3	2.47	2.46	2.44	2.46	0.02	0.6
20	3	2.09	2.28	2.4	2.26	0.16	6.9
21	0						
22	3	2.08	1.96	2.11	2.05	0.08	3.9
23	0						
24	3	2.2	2.2	2.2	2.2	0.0	0.0
25	3	2.47	2.28	2.30	2.35	0.10	4.4
26	3	2.17	2.17	2.19	2.18	0.01	0.5
27	0						
28	0						
29	3	2.49	2.47	2.39	2.45	0.05	2.2
30	0						
31	3	1.58	1.63	1.47	1.56	0.08	5.2
32	0						
33	3	2.02	1.77	1.85	1.88	0.13	6.8
34	3	2.10	1.98	2.00	2.03	0.06	3.2
35	3	2.19	2.20	2.28	2.22	0.05	2.3
36	0						

The determination of beryllium was not required in the biologicals

ALUMINUM
Sediment 99
%

Lab					Mean	SD	RSD
1	3	8.89	8.59	8.35	8.61	0.27	3.1
2	3	8.80	8.75	8.76	8.77	0.03	0.3
3	0						
4	3	8.52	8.69	8.52	8.58	0.10	1.1
5	3	16.2	16.25	16.5	16.32	0.16	1.0
6	0						
7	0						
8	3	8.53	8.59	8.64	8.59	0.06	0.6
9	0						
10	3	8.55	8.45	8.64	8.55	0.10	1.1
11	0						
12	3	8.15	8.15	8.36	8.22	0.12	1.5
13	0						
14	3	8.26	8.2	8.27	8.24	0.04	0.5
15	0						
16	0						
17	3	8.48	8.48	8.33	8.43	0.08	1.0
18	0						
19	3	8.59	8.60	8.58	8.59	0.01	0.1
20	3	2.8	2.16	3.01	2.66	0.44	16.7
21	3	9.71	9.27	8.93	9.30	0.39	4.2
22	3	8.38	8.43	8.44	8.42	0.03	0.4
23	0						
24	3	8.5	8.6	8.5	8.5	0.1	0.7
25	3	8.0	7.8	8.2	8.0	0.2	2.5
26	0						
27	0						
28	0						
29	0						
30	3	7.51	7.03	7.19	7.24	0.24	3.4
31	3	5.21	5.21	5.12	5.18	0.05	1.0
32	3	8.5	9.31	7.75	8.52	0.78	9.2
33	3	4.73	5.28	5.03	5.01	0.28	5.5
34	3	13.3	13.3	12.9	13.2	0.2	1.8
35	3	8.27	8.26	8.41	8.31	0.08	1.0
36	0						
37	0						
38	3	8.49	8.58	8.57	8.55	0.05	0.6
39	0						

ALUMINUM
MESS-2
%

Lab					Mean	SD	RSD
1	3	8.46	8.80	8.59	8.62	0.17	2.0
2	3	8.88	8.77	8.85	8.83	0.06	0.6
3	0						
4	3	8.51	8.64	8.65	8.60	0.08	0.9
5	3	20.9	21	21.1	21.00	0.10	0.5
6	0						
7	0						
8	3	8.54	8.56	8.58	8.56	0.02	0.2
9	0						
10	3	8.75	8.78	8.56	8.70	0.12	1.4
11	0						
12	3	7.97	8.09	7.77	7.94	0.16	2.0
13	0						
14	3	7.96	8.22	8.2	8.13	0.14	1.8
15	0						
16	0						
17	3	8.48	8.36	8.43	8.42	0.06	0.7
18	0						
19	3	8.81	8.76	8.74	8.77	0.04	0.4
20	0						
21	3	8.86	8.48	8.10	8.48	0.38	4.5
22	3	8.51	8.50	8.56	8.52	0.03	0.4
23	0						
24	3	8.7	8.5	8.6	8.6	0.1	1.2
25	3	8.0	8.8	8.1	8.3	0.4	5.3
26	0						
27	0						
28	0						
29	0						
30	3	4.18	4.74	6.10	5.01	0.99	19.7
31	3	4.8	4.61	4.65	4.69	0.10	2.1
32	3	8.62	8.4	7.49	8.17	0.60	7.3
33	3	6.74	6.03	6.07	6.28	0.40	6.4
34	3	11.5	10.8	10.9	11.1	0.4	3.4
35	3	8.39	8.53	8.48	8.47	0.07	0.9
36	0						

ALUMINUM
Tissue 99
mg/kg

Lab					Mean	SD	RSD
1	3	50	47	64	54	9	16.9
2	0						
3	0						
4	3	34.5	35.1	34.1	34.6	0.5	1.5
5	3	47.6	50	48.4	48.7	1.2	2.5
6	3	77.3	79.1	84	80.1	3.5	4.3
7	3	29.01	27.74	33.51	30.09	3.03	10.1
8	3	33	32	33	33	1	1.8
9	3	< 250	< 250	< 200			
10	3	36.8	37.1	36.9	36.9	0.1	0.4
11	0						
12	0						
13	0						
14	3	41.6	34.3	36.8	37.57	3.71	9.9
15	0						
16	0						
17	3	43.2	42.1	44.9	43.4	1.4	3.3
18	3	<86.9	<84.8	<86.0			
19	0						
20	3	41.6	38.0	35.5	38.4	3.1	8.0
21	0						
22	3	57.5	54.4	52.0	54.6	2.8	5.0
23	0						
24	3	130	140	130	133	6	4.3
25	3	74	79	69	74	5	6.8
26	3	51.1	53.9	50.5	51.8	1.8	3.5
27	0						
28	3	89.3	84.3	84.5	86.0	2.8	3.3
29	3	92.1	92.8	90.4	91.8	1.2	1.3
30	3	<20	<20	<20			
31	0						
32	0						
33	0						
34	3	119	146	101	122	23	18.6
35	3	49.2	55.8	50.0	51.7	3.6	7.0
36	3	42.8	44.6	42.8	43.4	1.0	2.4
37	3	51.9	54.7	51.2	52.6	1.9	3.5
38	3	79.3	82.5	75.6	79.13	3.45	4.4
39	0						

ALUMINUM
CRM 2976
mg/kg

Lab					Mean	SD	RSD
1	3	133	130	132	132	1.53	1.2
2	0						
3	0						
4	3	121	115	123	120	4	3.5
5	3	131	131.4	134.8	132	2	1.6
6	3	281	248	269	266	17	6.3
7	3	102.2	117.84	112.3	110.8	7.9	7.2
8	3	130	126	124	127	3	2.4
9	3	< 200	< 200	< 200			
10	3	125.2	129.6	130.3	128.4	2.7	2.1
11	0						
12	0						
13	0						
14	0						
15	0						
16	0						
17	3	111	106	103	107	4	3.9
18	3	134	125	129	129	5	3.5
19	0						
20	3	126.3	135.7	147.6	136.5	10.7	7.8
21	0						
22	3	138	133	133	135	3	2.1
23	0						
24	3	130	120	160	137	21	15.2
25	3	140	139	148	142	5	3.5
26	3	135	131	130	132	3	2.0
27	0						
28	3	129	132	128	130	2	1.6
29	3	138	137	137	137	1	0.4
30	3	45.1	44.9	46.2	45.4	0.7	1.6
31	0						
32	0						
33	0						
34	3	135	127	141	134	7	5.2
35	3	119	123	125	122	3	2.6
36	3	139	137	130	135	5	3.5
37	3	126	130	125	127	3	2.1
38	3	132	148	137	139	8	6.0
39	0						

SILICON
Sediment 99
%

Lab					Mean	SD	RSD
1	0						
2	3	26.7	26.6	26.7	26.7	0.1	0.2
3	0						
4	3	27.6	27.7	27.5	27.6	0.1	0.4
5	3	26.4	26.3	26.9	26.5	0.3	1.2
6	0						
7	0						
8	3	33.59	32.73	31.48	32.60	1.06	3.3
9	0						
10	3	28.7	28.8	28.3	28.6	0.3	0.9
11	0						
12	0						
13	0						
14	0						
15	0						
16	0						
17	0						
18	0						
19	0						
20	0						
21	0						
22	3	25.9	25.9	25.9	25.9	0.0	0.0
23	0						
24	0						
25	3	27.6	27.4	27.5	27.50	0.10	0.4
26	0						
27	0						
28	0						
29	0						
30	0						
31	3	26.95	27.89	27.16	27.33	0.49	1.8
32	0						
33	0						
34	0						
35	3	25.5	26.9	27.6	26.7	1.1	4.0
36	0						
37	0						
38	0						
39	0						

SILICON
MESS-2
%

Lab					Mean	SD	RSD
1	0						
2	3	26.6	26.4	26.6	26.5	0.1	0.4
3	0						
4	3	26.8	27.3	27.4	27.2	0.3	1.2
5	3	29.05	29.4	29.7	29.4	0.3	1.1
6	0						
7	0						
8	3	28.81	28.27	27.98	28.35	0.42	1.5
9	0						
10	3	27.2	28.1	27.5	27.6	0.4	1.6
11	0						
12	0						
13	0						
14	0						
15	0						
16	0						
17	0						
18	0						
19	0						
20	0						
21	0						
22	3	25.7	25.7	25.7	25.7	0.0	0.0
23	0						
24	0						
25	3	27.4	27.6	27.4	27.47	0.12	0.4
26	0						
27	0						
28	0						
29	0						
30	0						
31	3	26.72	26.49	26.32	26.51	0.20	0.8
32	0						
33	0						
34	0						
35	3	26.0	26.0	24.6	25.5	0.8	3.2
36	0						

The determination of silicon was not required in the biologicals

CHROMIUM
Sediment 99
mg/kg

Lab					Mean	SD	RSD
1	3	109	107	106	107	2	1.4
2	3	113	112	113	113	1	0.5
3	0						
4	3	98	100	100	99	1	1.2
5	3	29.4	29.4	29.8	29.5	0.2	0.8
6	0						
7	0						
8	3	106.6	102.9	102.9	104.1	2.1	2.1
9	0						
10	3	101.7	100.7	100.3	100.9	0.7	0.7
11	0						
12	3	111	114	111	112	2	1.5
13	0						
14	3	100	100	100	100	0	0.0
15	0						
16	3	98.31	109.4	104.3	104.0	5.6	5.3
17	3	103	103	106	104	2	1.7
18	0						
19	3	102	100	100	101	1	1.1
20	3	93.1	93.6	95.8	94.2	1.4	1.5
21	3	89.7	92.2	89.5	90.5	1.5	1.7
22	3	104	106	106	105	1	1.1
23	0						
24	3	104	105	106	105	1	1.0
25	3	97	103	100	100	3	3.0
26	3	96.9	95.7	95.7	96.1	0.7	0.7
27	3	100	96	94	97	3	3.2
28	0						
29	3	102	99.3	104	102	2	2.3
30	3	142	89.9	138.7	123.5	29.2	23.6
31	3	93.6	94.7	95.4	94.6	0.9	1.0
32	3	80	80	80	80	0	0.0
33	3	70.6	76.4	74.3	73.8	2.9	4.0
34	3	76.2	75.7	75.8	75.9	0.3	0.3
35	3	102	101	104	102	2	1.5
36	0						
37	0						
38	0						
39	3	105	104	105	104.67	0.58	0.6

CHROMIUM
MESS-2
mg/kg

Lab					Mean	SD	RSD
1	3	104	110	106	107	3.06	2.9
2	3	113	112	112	112	1	0.5
3	0						
4	3	101	102	102	102	0.58	0.6
5	3	0.712	0.707	0.718	0.712	0.006	0.8
6	0						
7	0						
8	3	103.8	101.9	101.9	102.5	1.1	1.1
9	0						
10	3	101.3	99.1	99.3	99.9	1.2	1.2
11	0						
12	3	116	110	116	114	3	3.0
13	0						
14	3	99.1	96.7	97.2	97.7	1.3	1.3
15	0						
16	3	101.4	101.8	107.4	103.5	3.4	3.2
17	3	101	103	101	102	1	0.9
18	0						
19	3	100	105	103	103	3	2.5
20	3	91.5	94.2	103.1	96.3	6.1	6.3
21	3	94.0	94.1	92.0	93.4	1.2	1.3
22	3	105	104	101	103	2	2.0
23	0						
24	3	106	103	105	105	2	1.5
25	3	107	99	103	103	4	3.9
26	3	98.5	97.6	98.9	98.3	0.7	0.7
27	3	103	107	100	103	4	3.4
28	0						
29	3	104	102	105	104	2	1.5
30	3	78	147	102	109	35	32.0
31	3	94.2	91.7	89.4	91.8	2.4	2.6
32	3	86.2	87.5	88.8	87.5	1.3	1.5
33	3	90.8	80.9	82.8	84.8	5.3	6.2
34	3	82.0	84.5	79.8	82.1	2.4	2.9
35	3	102	103	103	102	0	0.4
36	0						

CHROMIUM
Tissue 99
mg/kg

Lab					Mean	SD	RSD
1	3	1.0	0.9	1.0	1.0	0.1	6.0
2	3	0.839	0.926	0.866	0.88	0.04	5.1
3	3	0.57	0.43	0.42	0.47	0.08	17.7
4	3	0.57	0.64	0.65	0.62	0.05	7.3
5	3	1.52	1.62	1.52	1.55	0.06	3.7
6	3	3.18	5.5	3.37	4.02	1.29	32.1
7	3	0.91	0.83	1.14	0.96	0.16	16.8
8	3	0.85	0.811	0.76	0.81	0.05	5.6
9	3	< 1.5	< 1.5	2.2			
10	3	0.72	0.73	0.77	0.74	0.03	4.1
11	0						
12	0						
13	0						
14	3	0.76	0.77	1	0.84	0.14	16.1
15	3	0.746	0.758	0.796	0.767	0.026	3.4
16	3	0.786	0.688	0.567	0.680	0.110	16.1
17	3	0.92	0.89	0.90	0.90	0.02	1.7
18	0						
19	0						
20	3	0.73	0.57	0.62	0.64	0.08	12.8
21	0						
22	3	1.07	0.93	1.12	1.04	0.10	9.5
23	3	0.62	0.66	0.69	0.66	0.04	5.3
24	3	1	1	1	1	0	0.0
25	3	1.13	1.28	1.16	1.19	0.08	6.7
26	3	0.688	0.672	0.675	0.678	0.009	1.3
27	3	1.03	0.81	0.73	0.86	0.16	18.1
28	3	1.72	1.68	1.73	1.71	0.03	1.5
29	3	1.10	1.13	1.14	1.12	0.02	1.9
30	3	1.11	1.06	1.07	1.08	0.03	2.4
31	0						
32	0						
33	0						
34	3	0.38	0.45	0.33	0.39	0.06	15.6
35	3	1.37	1.21	1.37	1.32	0.09	7.0
36	3	0.95	0.94	0.92	0.94	0.02	1.6
37	3	0.84	0.91	1.07	0.94	0.12	12.5
38	0						
39	0						

CHROMIUM
CRM 2976
mg/kg

Lab					Mean	SD	RSD
1	3	<0.5	<0.5	<0.5			
2	3	0.485	0.484	0.474	0.48	0.01	1.2
3	3	0.44	0.43	0.46	0.44	0.02	3.4
4	3	0.57	0.52	0.48	0.52	0.05	9.3
5	3	1.02	1.04	1.22	1.09	0.11	10.1
6	3	2.23	2.41	2.17	2.27	0.12	5.5
7	3	0.39	0.79	0.91	0.70	0.27	39.1
8	3	0.489	0.524	0.471	0.495	0.027	5.4
9	3	< 1.3	< 1.3	< 1.3			
10	3	0.44	0.42	0.41	0.43	0.02	3.9
11	0						
12	0						
13	0						
14	0						
15	0						
16	3	0.535	0.594	0.434	0.521	0.081	15.5
17	3	0.56	0.66	0.66	0.63	0.06	9.2
18	0						
19	0						
20	0						
21	0						
22	3	0.64	0.57	0.52	0.58	0.06	10.5
23	3	0.50	0.49	0.48	0.49	0.01	2.0
24	3	1	1	1	1	0	0.0
25	3	0.58	0.63	0.60	0.60	0.03	4.2
26	3	0.462	0.524	0.483	0.490	0.032	6.4
27	3	0.36	0.36	0.49	0.40	0.08	18.6
28	3	0.47	0.49	0.48	0.48	0.01	2.1
29	3	0.61	0.52	0.49	0.54	0.06	11.6
30	3	0.34	0.33	0.27	0.31	0.04	12.1
31	0						
32	0						
33	0						
34	3	0.32	0.51	0.49	0.44	0.10	23.7
35	3	0.69	0.39	0.48	0.52	0.15	29.7
36	3	0.53	0.54	0.49	0.52	0.03	5.1

MANGANESE
Sediment 99
mg/kg

Lab					Mean	SD	RSD
1	3	334	324	316	325	9	2.8
2	3	328	326	330	328	2	0.6
3	0						
4	3	322	317	315	318	4	1.1
5	3	267.5	267.5	269.5	268.2	1.2	0.4
6	0						
7	0						
8	3	323	322	324	323	1	0.3
9	0						
10	3	312.0	312.8	310.3	311.7	1.2	0.4
11	0						
12	3	342	338	344	341	3	0.9
13	0						
14	3	302	299	305	302	3	1.0
15	0						
16	3	292.2	286.1	290.1	289.5	3.1	1.1
17	3	351	344	356	350	6	1.7
18	3	282	287	284	284	3	0.9
19	3	337	336	329	334	4	1.3
20	3	294	290	300	295	5	1.7
21	3	314.8	320.6	328.0	321.1	6.6	2.1
22	3	295	305	309	303	7	2.4
23	0						
24	3	330	330	330	330	0	0.0
25	3	329	332	319	327	7	2.1
26	0						
27	3	331	322	334	329	6	1.9
28	0						
29	3	326	326	334	329	5	1.4
30	3	479	465	465	470	8	1.7
31	3	194	197	187	193	5	2.7
32	3	263	234	246	248	15	5.9
33	3	295	290	286	290	5	1.6
34	3	472	472	484	476	7	1.5
35	3	318	320	329	322	6	1.8
36	0						
37	0						
38	0						
39	3	321	322	318	320	2.08	0.6

MANGANESE
MESS-2
mg/kg

Lab					Mean	SD	RSD
1	3	353	360	347	353	7	1.8
2	2	363	360	361	361	2	0.6
3	0						
4	3	333	348	349	343	9	2.6
5	3	315	312	317	315	3	0.8
6	0						
7	0						
8	3	356	356	361	358	3	0.8
9	0						
10	3	350.8	357.2	359.9	356.0	4.7	1.3
11	0						
12	3	346	352	341	346	6	1.6
13	0						
14	3	315	315	318	316	2	0.5
15	0						
16	3	325.3	311.2	302.8	313.1	11.4	3.6
17	3	345.6	359.4	362.9	356.0	9.1	2.6
18	3	318	331	323	324	7	2.0
19	3	357	367	363	362	5	1.4
20	3	301.7	311.9	342.1	318.6	21.0	6.6
21	3	365.0	346.6	342.4	351.3	12.0	3.4
22	3	344	344	332	340	7	2.0
23	0						
24	3	370	370	370	370	0	0.0
25	3	349	379	350	359	17	4.7
26	0						
27	3	364	363	354	360	6	1.5
28	0						
29	3	360	359	355	358	3	0.7
30	3	525	509	509	514	9	1.8
31	3	193	195	264	217	40	18.6
32	3	294	298	268	287	16	5.7
33	3	346	301	317	321	23	7.1
34	3	538	534	531	534	4	0.7
35	3	337	340	351	343	7	2.1
36	0						

The determination of manganese was not required in the biologicals

IRON
Sediment 99
%

Lab					Mean	SD	RSD
1	3	4.43	4.31	4.23	4.32	0.10	2.3
2	3	4.28	4.25	4.26	4.26	0.02	0.4
3	3	4.78	4.8	4.8	4.79	0.01	0.2
4	3	4.30	4.35	4.30	4.32	0.03	0.7
5	3	3.78	3.74	3.82	3.78	0.04	1.1
6	0						
7	0						
8	3	4.35	4.4	4.34	4.36	0.03	0.7
9	0						
10	3	4.25	4.31	4.43	4.33	0.09	2.1
11	0						
12	3	3.87	4.11	4.13	4.04	0.14	3.6
13	0						
14	0						
15	0						
16	0						
17	3	4.45	4.44	4.48	4.46	0.02	0.4
18	0						
19	3	4.32	4.40	4.34	4.35	0.04	1.0
20	3	4.940	5.580	5.150	5.223	0.326	6.2
21	3	3.50	3.52	3.53	3.52	0.02	0.4
22	3	4.23	4.39	4.26	4.29	0.09	2.0
23	0						
24	3	4.2	4.2	4.2	4.2	0.0	0.0
25	3	4.29	4.34	4.27	4.30	0.04	0.8
26	3	4.17	4.26	4.76	4.40	0.32	7.2
27	3	4.17	4.27	4.15	4.20	0.06	1.5
28	0						
29	3	4.27	4.08	4.16	4.17	0.10	2.3
30	3	6.14	5.9	5.95	6.00	0.13	2.1
31	3	3.66	3.72	3.7	3.69	0.03	0.8
32	3	3.83	3.86	4	3.90	0.09	2.3
33	3	3.53	3.53	3.46	3.51	0.04	1.2
34	3	4.24	4.04	4.11	4.13	0.10	2.5
35	3	4.06	4.03	4.17	4.09	0.07	1.8
36	0						
37	0						
38	3	4.24	4.44	4.25	4.31	0.11	2.6
39	0						

IRON
MESS-2
%

Lab					Mean	SD	RSD
1	3	4.24	4.42	4.26	4.31	0.10	2.3
2	3	4.34	4.29	4.32	4.32	0.03	0.6
3	3	3.4	3.4	3.3	3.4	0.1	1.7
4	3	4.27	4.30	4.33	4.30	0.03	0.7
5	3	4.12	4.05	4.17	4.11	0.06	1.5
6	0						
7	0						
8	3	4.35	4.36	4.34	4.35	0.01	0.2
9	0						
10	3	4.19	4.26	4.28	4.24	0.04	1.0
11	0						
12	3	3.86	3.72	3.65	3.74	0.11	2.9
13	0						
14	0						
15	0						
16	0						
17	3	4.41	4.45	4.46	4.44	0.03	0.6
18	0						
19	3	4.35	4.34	4.41	4.367	0.038	0.9
20	3	5.021	4.907	5.132	5.020	0.113	2.2
21	3	3.91	3.73	3.78	3.81	0.09	2.4
22	3	4.48	4.20	4.27	4.32	0.15	3.4
23	0						
24	3	4.5	4.4	4.5	4.5	0.1	1.3
25	3	4.32	4.32	4.33	4.32	0.01	0.1
26	3	4.61	4.09	4.27	4.32	0.26	6.1
27	3	4.36	4.17	4.26	4.26	0.10	2.2
28	0						
29	3	4.42	4.23	4.26	4.30	0.10	2.4
30	3	6.23	6.04	5.92	6.06	0.16	2.6
31	3	3.66	3.64	3.35	3.55	0.17	4.9
32	3	4.18	4.27	4.05	4.17	0.11	2.7
33	3	3.88	3.39	3.57	3.61	0.25	6.9
34	3	4.5	4.1	4.22	4.27	0.21	4.8
35	3	4.04	4.10	4.00	4.05	0.05	1.2
36	0						

IRON
Tissue 99
mg/kg

Lab					Mean	SD	RSD
1	3	112	109	101	107	6	5.3
2	0						
3	3	91.8	93.2	94.8	93.3	1.5	1.6
4	3	117	117	115	116	1	0.9
5	3	109.6	112.2	112.6	111.5	1.6	1.5
6	3	216	217	214	216	2	0.7
7	3	117.44	106.82	110.57	111.61	5.39	4.8
8	3	119	112	116	116	4	3.0
9	3	110	112	170	131	34	26.1
10	3	110.3	113.9	117.8	114.0	3.8	3.3
11	0						
12	3	121.2	136.1	139.2	132.2	9.6	7.3
13	0						
14	3	105	104	105	105	1	0.6
15	0						
16	0						
17	3	114	110	109	111	3	2.7
18	3	119	121	118	119	2	1.3
19	0						
20	3	103	110	105	106	4	3.4
21	0						
22	3	128	124	120	124	4	3.2
23	0						
24	3	240	250	260	250	10	4.0
25	3	133	115	118	122	10	7.9
26	3	122	112	114	116	5	4.6
27	3	113	108	110	110	3	2.3
28	3	153	151	160	155	5	3.1
29	3	113	114	121	116	4	3.8
30	3	55.7	57.6	38.1	50.5	10.8	21.3
31	0						
32	0						
33	0						
34	0						
35	3	107	113	114	111	4	3.4
36	3	130	136	120	129	8	6.3
37	3	111	107	105	108	3	2.8
38	3	109	110	117	112	4	3.9
39	0						

IRON
CRM 2976
mg/kg

Lab					Mean	SD	RSD
1	3	172	172	171	172	1	0.3
2	0						
3	3	151.3	147.1	145.3	147.9	3.1	2.1
4	3	170	172	170	171	1	0.7
5	3	175	172.2	174.4	173.9	1.5	0.8
6	3	367	339	338	348	16	4.7
7	3	159.01	164.04	165.02	162.69	3.22	2.0
8	3	165	165	160	163	3	1.8
9	3	160	160	168	163	5	2.8
10	3	174.7	173.6	171.3	173.2	1.7	1.0
11	0						
12	3	167.8	169.7	173.9	170.5	3.1	1.8
13	0						
14	0						
15	0						
16	0						
17	3	169	169	170	169	1	0.4
18	3	172	170	172	171	1	0.7
19	0						
20	3	147.8	154.5	155.7	152.7	4.3	2.8
21	0						
22	3	161	154	155	157	4	2.4
23	0						
24	3	160	170	180	170	10	5.9
25	3	163	170	168	167	4	2.2
26	3	174	171	170	172	2	1.2
27	3	169	172	175	172	3	1.7
28	3	156	163	149	156	7	4.5
29	3	164	168	172	168	4	2.4
30	3	126	125	121	124	3	2.1
31	0						
32	0						
33	0						
34	0						
35	3	156	165	166	162	6	3.4
36	3	186	181	171	179	8	4.3
37	3	158	159	154	157	3	1.6
38	3	164	163	168	165	3	1.8

NICKEL
Sediment 99
mg/kg

Lab					Mean	SD	RSD
1	3	58	54	49	54	5	8.4
2	3	47.4	47.6	46.5	47.2	0.6	1.2
3	3	49	48.5	47.7	48.4	0.7	1.4
4	3	45.1	45.4	43.7	44.7	0.9	2.0
5	3	38	37.4	37.4	37.6	0.3	0.9
6	0						
7	0						
8	3	44.93	44.78	44.42	44.71	0.26	0.6
9	0						
10	3	47.0	48.1	49.7	48.3	1.4	2.8
11	0						
12	3	45	45.3	45.4	45.2	0.2	0.5
13	0						
14	3	42.2	41.7	41.2	41.7	0.5	1.2
15	0						
16	3	51.25	53.39	52.95	52.53	1.13	2.2
17	3	48.1	49.8	48.3	48.7	0.9	1.9
18	3	39.7	38.9	38.7	39.1	0.5	1.4
19	3	47.0	47.7	49.4	48.0	1.2	2.6
20	3	43.2	43.9	44.2	43.8	0.5	1.2
21	3	40.1	41.2	42.6	41.3	1.3	3.0
22	3	39.8	39.1	38.1	39.0	0.9	2.2
23	0						
24	3	47	47	47	47	0	0.0
25	3	47	43	47	46	2	5.1
26	3	43.8	43.9	44.2	44.0	0.2	0.5
27	3	46.4	47.7	46.8	47.0	0.7	1.4
28	0						
29	3	48.1	48.2	47.1	47.8	0.6	1.3
30	3	76.2	61.7	67.7	68.5	7.3	10.6
31	3	54.5	50.7	53.1	52.8	1.9	3.6
32	3	30	32	32	31	1	3.7
33	3	47.8	47.4	46.6	47.3	0.6	1.3
34	3	27.1	28.3	26	27.1	1.2	4.2
35	3	47.2	48.2	48.0	47.8	0.5	1.1
36	0						
37	3	48.2	48.1	49.6	48.6	0.9	1.7
38	0						
39	3	46.8	46.7	45.2	46.2	0.9	1.9

NICKEL
MESS-2
mg/kg

Lab					Mean	SD	RSD
1	3	49	48	52	50	2	4.2
2	3	49.5	50.3	50.7	50.2	0.6	1.2
3	3	49.8	48.9	49.1	49.3	0.5	1.0
4	3	49.0	47.2	46.1	47.4	1.5	3.1
5	3	43.4	42.7	44.5	43.5	0.9	2.1
6	0						
7	0						
8	3	48.91	46.99	47.55	47.82	0.99	2.1
9	0						
10	3	49.9	47.6	47.6	48.4	1.3	2.7
11	0						
12	3	47.1	47.5	46.8	47.1	0.4	0.7
13	0						
14	3	43	43.9	41.6	42.8	1.2	2.7
15	0						
16	3	49.31	49.26	49.35	49.31	0.05	0.1
17	3	48.5	48.9	50.2	49.2	0.9	1.9
18	3	45.7	42.4	43.5	43.9	1.7	3.8
19	3	44.4	46.0	46.2	45.5	1.0	2.2
20	3	47.71	46.66	52.44	48.94	3.08	6.3
21	3	48.1	47.4	46.9	47.5	0.6	1.3
22	3	50.9	44.6	47.1	47.5	3.2	6.7
23	0						
24	3	50	47	49	49	2	3.1
25	3	50	52	50	51	1	2.3
26	3	47.8	48.0	47.8	47.9	0.1	0.2
27	3	51.4	49.8	47.9	49.7	1.8	3.5
28	0						
29	3	51.7	52.6	52.6	52.3	0.5	1.0
30	3	51.3	77.3	183	103.9	69.8	67.2
31	3	53	53.9	53	53	1	1.0
32	3	36	35.6	39	37	2	5.0
33	3	54.3	51.3	50.7	52.1	1.9	3.7
34	3	32.2	31.4	30.5	31.4	0.9	2.7
35	3	50.7	49.5	49.0	49.7	0.9	1.8
36	0						

NICKEL
Tissue 99
mg/kg

Lab					Mean	SD	RSD
1	3	0.9	0.9	0.9	0.9	0.0	0.0
2	3	0.897	0.919	0.908	0.908	0.011	1.2
3	3	0.95	0.98	1.02	0.98	0.04	3.6
4	3	0.99	0.94	0.92	0.95	0.04	3.8
5	3	0.9	0.9	0.9	0.9	0.0	0.0
6	3	1.8	3.55	1.97	2.44	0.97	39.6
7	3	0.749	0.723	0.756	0.743	0.017	2.3
8	3	0.895	0.839	0.804	0.846	0.046	5.4
9	3	0.944	1.1	0.947	0.997	0.089	8.9
10	0						
11	0						
12	0						
13	0						
14	3	0.79	0.62	0.85	0.75	0.12	15.8
15	0						
16	3	0.983	0.932	1.006	0.974	0.038	3.9
17	3	0.93	0.95	0.85	0.91	0.05	6.0
18	3	<1.87	<1.82	<1.85			
19	0						
20	3	0.96	0.91	0.96	0.94	0.03	3.1
21	0						
22	3	0.89	0.87	0.86	0.87	0.02	1.7
23	0						
24	3	1	1	1	1	0	0.0
25	3	0.89	0.84	0.84	0.86	0.03	3.4
26	3	1.09	1.02	1.05	1.05	0.04	3.3
27	3	0.98	0.90	0.89	0.92	0.05	5.3
28	3	1.59	1.56	1.54	1.56	0.03	1.6
29	3	1.00	0.97	0.97	0.98	0.02	1.7
30	3	0.75	0.73	0.41	0.63	0.19	30.3
31	0						
32	0						
33	0						
34	3	112	109	121	114	6	5.5
35	3	1.11	1.03	1.19	1.11	0.08	7.4
36	3	1.06	0.92	0.95	0.98	0.07	7.5
37	3	0.95	1.06	1.05	1.02	0.06	1.6
38	0						
39	3	0.93	0.98	0.99	0.97	0.03	3.5

NICKEL
CRM 2976
mg/kg

Lab					Mean	SD	RSD
1	3	0.8	0.8	0.8	0.8	0.0	0.0
2	3	0.848	0.848	0.815	0.837	0.02	2.2
3	3	0.95	0.94	0.83	0.91	0.07	7.3
4	3	0.98	0.99	0.90	0.96	0.05	4.9
5	3	0.96	1	1.02	0.99	0.03	3.1
6	3	2.05	2.05	2.11	2.07	0.03	1.7
7	3	0.932	1.067	1.056	1.018	0.075	7.4
8	3	1.02	1.02	1.03	1.02	0.01	0.6
9	3	0.971	0.923	0.941	0.945	0.024	2.6
10	0						
11	0						
12	0						
13	0						
14	0						
15	0						
16	3	0.961	0.971	0.942	0.958	0.015	1.5
17	3	1.05	1.07	1.07	1.07	0.01	1.3
18	3	<1.84	<1.87	<1.87			
19	0						
20	0						
21	0						
22	3	0.91	0.9	0.98	0.93	0.04	4.7
23	0						
24	3	1	1	1	1	0	0.0
25	3	0.88	0.91	0.95	0.91	0.04	3.8
26	3	0.843	1.01	0.93	0.93	0.08	9.0
27	3	0.82	0.87	0.92	0.87	0.05	5.7
28	3	0.75	0.81	0.73	0.76	0.04	5.5
29	3	0.93	0.81	0.86	0.87	0.06	6.8
30	3	0.56	0.58	0.67	0.60	0.06	9.7
31	0						
32	0						
33	0						
34	3	168	169	174	170	3	1.9
35	3	1.06	0.88	0.83	0.92	0.12	13.0
36	3	0.87	0.85	0.9	0.87	0.03	2.9

COPPER
Sediment 99
mg/kg

Lab					Mean	SD	RSD
1	3	38	37	34	36	2	5.7
2	3	32.6	33.1	32.5	32.7	0.3	1.0
3	3	31.4	30.2	30	30.5	0.8	2.5
4	3	36.0	34.8	34.6	35.1	0.8	2.2
5	3	32.1	31.7	31.7	31.8	0.2	0.7
6	0						
7	0						
8	3	34.69	34.9	34.79	34.79	0.11	0.3
9	0						
10	3	37.1	39.4	40.8	39.1	1.9	4.8
11	0						
12	3	33	34.1	33.6	33.6	0.6	1.6
13	0						
14	3	36.6	36.5	36.3	36.5	0.2	0.4
15	0						
16	3	33.73	34.59	34.64	34.32	0.51	1.5
17	3	38.2	37.2	37.7	37.7	0.5	1.4
18	3	30.2	30.2	30.5	30.3	0.2	0.6
19	3	36.1	34.7	34.5	35.1	0.9	2.5
20	3	38.4	41.2	40.6	40.1	1.5	3.7
21	3	32.6	32.4	31.4	32.1	0.6	2.0
22	3	35.0	35.0	36.5	35.5	0.9	2.4
23	0						
24	3	29	29	29	29	0	0.0
25	3	30.3	33.1	30.4	31.3	1.6	5.1
26	3	34.1	35.3	34.2	34.5	0.7	1.9
27	3	34.0	33.9	34.6	34.2	0.4	1.1
28	0						
29	3	35.9	34.1	34.5	34.8	0.9	2.7
30	3	47.2	27.7	45	40.0	10.7	26.7
31	3	36.3	34.1	35.4	35.3	1.1	3.1
32	3	34	32	32	33	1	3.5
33	3	33.2	32.2	31.5	32.3	0.9	2.6
34	3	28.3	25.8	28.6	27.6	1.5	5.6
35	3	41.7	35.0	35.3	37.3	3.8	10.1
36	3	32.5	32.6	32.5	32.5	0.1	0.2
37	3	35.6	33.8	33.5	34.3	1.2	3.4
38	0						
39	3	33.0	33.5	32.3	32.9	0.6	1.9

COPPER
MESS-2
mg/kg

Lab					Mean	SD	RSD
1	3	41	40	38	40	2	3.9
2	3	36.9	37.2	36.8	37.0	0.21	0.6
3	3	34.5	36	35.1	35.2	0.75	2.1
4	3	37.7	40.5	41.8	40.0	2.1	5.2
5	3	39.3	39.4	39.6	39.4	0.2	0.4
6	0						
7	0						
8	3	38.92	39.1	38.71	38.91	0.20	0.5
9	0						
10	3	43.1	37.1	37.5	39.2	3.3	8.5
11	0						
12	3	39.3	38.2	39.5	39.0	0.7	1.8
13	0						
14	3	40.7	41.9	41.5	41.4	0.6	1.5
15	0						
16	3	38.56	40.6	38.87	39.34	1.10	2.8
17	3	37.7	37.9	37.6	37.7	0.1	0.4
18	3	34.5	34.5	36.5	35.2	1.2	3.3
19	3	38.7	40.8	43.0	40.8	2.2	5.3
20	3	45.04	43.94	49.55	46.18	2.97	6.4
21	3	38.5	36.9	37.1	37.5	0.9	2.3
22	3	41.6	38.8	40.7	40.4	1.4	3.5
23	0						
24	3	35	36	38	36	2	4.2
25	3	43.0	35.8	36.6	38.5	3.9	10.3
26	3	39.3	37.8	36.5	37.9	1.4	3.7
27	3	40.3	39.1	39.4	39.6	0.6	1.6
28	0						
29	3	37.7	40.0	39.1	38.9	1.2	3.0
30	3	41.3	47.9	43.7	44.3	3.3	7.5
31	3	39.1	38.8	34.2	37.4	2.7	7.4
32	3	33.1	33.7	36.1	34.3	1.6	4.6
33	3	39.3	33.7	36.1	36.4	2.8	7.7
34	3	25.1	27.1	24.4	25.5	1.4	5.5
35	3	39.2	40.5	40.7	40.2	0.8	2.0
36	3	40.9	41.2	38.8	40.3	1.3	3.2

COPPER
Tissue 99
mg/kg

Lab					Mean	SD	RSD
1	3	6.71	6.83	6.68	6.74	0.08	1.2
2	3	7.09	7.31	7.52	7.31	0.22	2.9
3	3	6.5	6.4	6.5	6.5	0.1	0.9
4	3	6.65	6.53	6.61	6.60	0.06	0.9
5	3	5.86	5.8	5.78	5.81	0.04	0.7
6	3	12.9	12.4	12.4	12.6	0.3	2.3
7	3	6.29	6.32	6.76	6.46	0.26	4.1
8	3	6.38	6.12	6.07	6.19	0.17	2.7
9	3	6.08	6.08	5.9	6.02	0.10	1.7
10	3	6.54	6.57	6.51	6.54	0.03	0.4
11	0						
12	3	7.012	6.883	6.795	6.897	0.109	1.6
13	0						
14	3	5.9	5.9	5.9	5.9	0.0	0.0
15	3	8.96	8.80	8.60	8.79	0.18	2.1
16	3	6.035	6.137	6.056	6.076	0.054	0.9
17	3	5.69	5.58	5.73	5.67	0.08	1.4
18	3	6.20	6.43	6.53	6.39	0.17	2.6
19	0						
20	3	9.75	9.09	8.94	9.26	0.43	4.7
21	0						
22	3	7.04	6.85	6.72	6.87	0.16	2.3
23	3	6.50	6.28	6.55	6.44	0.14	2.2
24	3	3	3	4	3	1	17.3
25	3	6.31	6.21	5.77	6.10	0.29	4.7
26	3	6.30	6.44	6.47	6.40	0.09	1.4
27	3	6.46	6.21	6.22	6.30	0.14	2.2
28	3	9.5	9.5	9.3	9.4	0.1	1.2
29	3	6.65	6.76	6.55	6.65	0.11	1.6
30	3	5.73	5.88	1.91	4.51	2.25	49.9
31	0						
32	0						
33	0						
34	3	6.52	6.11	6.42	6.35	0.21	3.4
35	3	6.43	6.65	6.57	6.55	0.11	1.7
36	3	6.47	6.61	6.43	6.50	0.09	1.5
37	3	6.26	6.35	6.07	6.23	0.14	2.3
38	0						
39	3	6.28	6.21	6.28	6.26	0.04	0.6

COPPER
CRM 2976
mg/kg

Lab					Mean	SD	RSD
1	3	4.08	4.04	3.99	4.04	0.05	1.1
2	3	4.33	4.21	4.12	4.22	0.11	2.5
3	3	3.66	4.22	4.15	4.01	0.31	7.6
4	3	3.86	3.74	3.9	3.83	0.08	2.2
5	3	4.06	4.12	4.14	4.11	0.04	1.0
6	3	7.55	7.63	7.73	7.64	0.09	1.2
7	3	3.84	4.08	4.11	4.01	0.15	3.7
8	3	3.91	4.13	4.19	4.08	0.15	3.6
9	3	3.56	3.36	3.51	3.48	0.10	3.0
10	3	4.01	4.03	4.00	4.01	0.02	0.4
11	0						
12	3	4.014	3.98	4.032	4.009	0.026	0.7
13	0						
14	0						
15	0						
16	3	3.951	3.747	3.939	3.879	0.114	3.0
17	3	4.04	3.95	4.05	4.01	0.05	1.3
18	3	3.68	4.03	3.54	3.75	0.25	6.7
19	0						
20	3	5.34	5.31	5.73	5.46	0.23	4.3
21	0						
22	3	4.68	4.74	4.78	4.73	0.05	1.1
23	3	4.03	4.06	4.12	4.07	0.05	1.1
24	3	3	5	3	4	1	31.5
25	3	3.71	3.77	3.74	3.74	0.03	0.8
26	3	3.89	3.95	3.78	3.87	0.09	2.2
27	3	3.85	3.87	4.04	3.92	0.10	2.7
28	3	3.80	3.71	3.72	3.74	0.05	1.3
29	3	3.989	4.062	4.149	4.07	0.08	2.0
30	3	3.29	3.23	3.22	3.25	0.04	1.2
31	0						
32	0						
33	0						
34	3	4.37	4.16	3.89	4.14	0.24	5.8
35	3	3.69	4.14	3.95	3.93	0.22	5.7
36	3	4.13	4.07	4.28	4.16	0.11	2.6
37	0						
38	0						
39	0						

ZINC
Sediment 99
mg/kg

Lab					Mean	SD	RSD
1	3	175	163	156	165	10	5.8
2	3	164	165	164	164	1	0.4
3	3	146.1	147.9	147.2	147.1	0.9	0.6
4	3	158	158	159	158	1	0.4
5	3	125	126.5	126.5	126.0	0.9	0.7
6	0						
7	0						
8	3	159.6	160.5	158.8	159.6	0.9	0.5
9	0						
10	3	177.7	170.7	173.5	173.9	3.5	2.0
11	0						
12	3	173	172	177	174	3	1.5
13	0						
14	3	149	146	151	149	3	1.7
15	0						
16	3	226.7	196.5	189.2	204.1	19.9	9.7
17	3	158	163	162	161	3	1.8
18	3	158	157	158	158	1	0.4
19	3	155	157	156	156	1	0.6
20	3	163	162	164	163	1	0.6
21	3	133.3	136.3	136.9	135.5	1.9	1.4
22	3	153	151	155	153	2	1.3
23	0						
24	3	160	160	160	160	0	0.0
25	3	175	166	164	168	6	3.5
26	3	156	159	158	158	2	1.0
27	3	160	149	157	155	6	3.7
28	0						
29	3	159	161	157	159	2	1.3
30	3	256	241	241	246	9	3.5
31	3	137	135	138	137	2	1.1
32	3	153	155	154	154	1	0.6
33	3	148	148	145	147	2	1.2
34	3	181	186	184	184	3	1.4
35	3	150	149	152	150	1	0.9
36	3	119	110	115	115	5	3.9
37	0						
38	0						
39	3	158	163	160	160	3	1.6

ZINC
MESS-2
mg/kg

Lab					Mean	SD	RSD
1	3	164	169	162	165	4	2.2
2	3	169	166	169	168	2	1.0
3	3	147.8	148	148	147.9	0.1	0.1
4	3	158	161	159	159	2	1.0
5	3	139	137.5	139	138.5	0.9	0.6
6	0						
7	0						
8	3	162.3	161	161	161.4	0.8	0.5
9	0						
10	3	170.7	167.1	166.2	168.0	2.4	1.4
11	0						
12	3	170	167	170	169	2	1.0
13	0						
14	3	143	144	144	144	1	0.4
15	0						
16	3	181.3	165.3	180	175.5	8.9	5.1
17	3	158	159	159	158	0	0.3
18	3	168	163	163	165	3	1.8
19	3	160	160	160	160	0	0.0
20	3	158.5	163.6	180.5	167.5	11.5	6.9
21	3	134.4	138.8	141.1	138.1	3.4	2.5
22	3	156	153	154	154	2	1.0
23	0						
24	3	170	170	170	170	0	0.0
25	3	166	157	161	161	5	2.8
26	3	163	161	161	162	1	0.7
27	3	156	161	155	157	3	2.0
28	0						
29	3	159	163	159	160	2	1.4
30	3	250	255	251	252	3	1.0
31	3	138	139	136	138	2	1.1
32	3	142	152	151	148	6	3.7
33	3	160	140	148	149	10	6.7
34	3	191	181	187	186	5	2.7
35	3	149	154	157	153	4	2.7
36	3	165	172	165	167	4	2.4

ZINC
Tissue 99
mg/kg

Lab					Mean	SD	RSD
1	3	115	116	115	115	1	0.5
2	0						
3	3	110	109	107	109	2	1.4
4	3	125	127	124	125	2	1.3
5	3	109.6	112.2	113	111.6	1.8	1.6
6	3	204	203	197	201	4	1.9
7	3	114.91	112.55	114.89	114.12	1.36	1.2
8	3	119	117	119	118	1	1.0
9	3	124	132	120	125	6	4.9
10	3	118.7	121.6	115.4	118.6	3.1	2.6
11	0						
12	3	116.3	115.2	115.5	115.7	0.6	0.5
13	0						
14	3	112	109	109	110	2	1.6
15	0						
16	3	117.7	117.5	116.6	117.3	0.6	0.5
17	3	110	111	108	110	2	1.4
18	3	112	117	118	116	3	2.8
19	0						
20	3	123	120	128	124	4	3.3
21	0						
22	3	122	120	118	120	2	1.7
23	3	108	105	107	107	2	1.4
24	3	130	130	130	130	0	0.0
25	3	119	112	108	113	6	4.9
26	3	118	120	120	119	1	1.0
27	3	110	109	109	109	1	0.5
28	3	148	153	153	151	3	1.9
29	3	108	112	112	111	2	2.1
30	3	116	115	116	116	1	0.5
31	0						
32	0						
33	0						
34	3	103	105	109	106	3	2.9
35	3	113	113	110	112	2	1.5
36	3	121	120	124	122	2	1.7
37	3	104	102	104	103	1	1.1
38	3	105	107	105	106	1	1.1
39	3	112	109	110	110	2	1.4

ZINC
CRM 2976
mg/kg

Lab					Mean	SD	RSD
1	3	138	135	134	136	2.08	1.5
2	0						
3	3	140	126	124	130	9	6.7
4	3	146	146	145	146	1	0.6
5	3	145.6	143.6	146.2	145.1	1.4	0.9
6	3	258	246	244	249	8	3.0
7	3	129.54	135.6	135.53	133.56	3.48	2.6
8	3	138	144	138	140	3	2.5
9	3	150	140	150	147	6	3.9
10	3	143.7	142.6	145.9	144.1	1.7	1.2
11	0						
12	3	133.9	136	134.1	134.7	1.2	0.9
13	0						
14	0						
15	0						
16	3	139.3	134.8	140.3	138.1	2.9	2.1
17	3	128	127	135	130	4	3.4
18	3	141	135	136	137	3	2.3
19	0						
20	3	159.5	145.3	149.0	151.3	7.4	4.9
21	0						
22	3	136	135	136	136	1	0.4
23	3	131	133	132	132	1	0.8
24	3	150	150	140	147	6	3.9
25	3	128	141	134	134	7	4.8
26	3	141	143	142	142	1	0.7
27	3	139	138	138	138	1	0.4
28	3	124	124	120	123	2	1.9
29	3	128	132	134	131	3	2.3
30	3	140	151	139	143	7	4.6
31	0						
32	0						
33	0						
34	3	136	133	134	134	2	1.1
35	3	127	133	136	132	5	3.5
36	3	141	141	142	141	1	0.4

ARSENIC
Sediment 99
mg/kg

Lab					Mean	SD	RSD
1	3	20.6	20.8	19.6	20.3	0.6	3.2
2	3	20.54	20.94	21.66	21.05	0.57	2.7
3	3	18.1	18.2	18.2	18.2	0.1	0.3
4	3	20.5	19.5	19.8	19.9	0.5	2.6
5	3	15.4	15.4	15.3	15.4	0.1	0.4
6	0						
7	0						
8	3	21.07	21.7	21.38	21.38	0.32	1.5
9	0						
10	0						
11	0						
12	3	22.1	21.5	21.8	21.8	0.3	1.4
13	0						
14	3	20.3	21.6	18.9	20.3	1.4	6.7
15	0						
16	3	18.03	20.6	22.79	20.47	2.38	11.6
17	3	21.5	21.2	21.0	21.2	0.3	1.3
18	3	17.5	16.1	18.9	17.5	1.4	8.0
19	3	21.7	19.6	20.2	20.5	1.1	5.3
20	3	21.6	21.0	21.3	21.3	0.3	1.4
21	3	18.0	17.8	18.1	18.0	0.2	0.9
22	3	18.8	18.9	18.6	18.8	0.2	0.8
23	0						
24	3	21	21	21	21	0	0.0
25	3	21.5	22.4	22.0	22.0	0.5	2.1
26	3	20.8	21.2	20.7	20.9	0.3	1.3
27	3	19.4	18.5	18.8	18.9	0.5	2.4
28	0						
29	3	19.1	19.8	19.8	19.6	0.4	2.1
30	3	9.68	38.9	27.1	25.2	14.7	58.3
31	3	22.4	23	23	22.8	0.3	1.5
32	3	26.3	25.7	26.6	26.2	0.5	1.7
33	3	25.5	26.5	25.5	25.8	0.6	2.2
34	3	16.0	14.3	16.7	15.7	1.2	7.9
35	3	19.3	18.4	19.8	19.2	0.7	3.8
36	3	21.2	19.9	21.1	20.7	0.7	3.5
37	3	21.6	21.9	21.6	21.7	0.2	0.8
38	0						
39	3	22.0	22.3	22.4	22.2	0.2	0.9

ARSENIC
MESS-2
mg/kg

Lab					Mean	SD	RSD
1	3	21.2	19.9	20.0	20.4	0.7	3.6
2	3	20.68	20.7	20.19	20.52	0.29	1.4
3	3	17.6	17.4	18	17.7	0.3	1.7
4	3	20.4	20.7	20.2	20.4	0.3	1.2
5	3	16.3	16.2	16.2	16.2	0.1	0.4
6	0						
7	0						
8	3	20.82	20.58	20.55	20.65	0.15	0.7
9	0						
10	0						
11	0						
12	3	22.4	22.6	22.8	22.6	0.2	0.9
13	0						
14	3	21.2	20.8	17.2	19.7	2.2	11.2
15	0						
16	3	20.45	20.45	20.9	20.60	0.26	1.3
17	3	21.9	20.6	20.8	21.1	0.7	3.3
18	3	23.8	19.1	17.3	20.1	3.4	16.7
19	3	21.5	19.7	21.1	20.8	0.9	4.6
20	3	20.52	20.66	23.7	21.63	1.80	8.3
21	3	20.7	19.5	19.4	19.9	0.7	3.6
22	3	21.8	20.3	20.7	20.9	0.8	3.7
23	0						
24	3	21	22	20	21	1	4.8
25	3	22.2	21.0	21.6	21.6	0.6	2.8
26	3	20.7	20.7	20.7	20.7	0.0	0.0
27	3	21.2	20.9	20.2	20.8	0.5	2.5
28	0						
29	3	20.1	19.3	19.2	19.5	0.5	2.5
30	3	33	54.1	36.9	41.3	11.2	27.2
31	3	21.6	21.3	21.7	21.5	0.2	1.0
32	3	26.1	25.6	26.7	26.1	0.6	2.1
33	3	27.3	25.1	27.2	26.5	1.2	4.7
34	3	9.3	9.7	9.4	9.5	0.2	2.2
35	3	21.7	21.8	20.6	21.3	0.7	3.2
36	3	20.4	19.8	20.9	20.4	0.6	2.7

ARSENIC
Tissue 99
mg/kg

Lab					Mean	SD	RSD
1	3	10.2	10.4	10.4	10.3	0.1	1.1
2	3	9.82	10.11	9.72	9.89	0.20	2.0
3	3	8.9	9.2	9.1	9.1	0.2	1.7
4	3	9.1	10	9.4	9.5	0.5	4.8
5	3	9.8	9.78	9.6	9.73	0.11	1.1
6	3	17.8	17.2	16.6	17.2	0.6	3.5
7	3	9.584	9.883	9.765	9.744	0.151	1.5
8	3	11.55	11.09	11.02	11.22	0.29	2.6
9	3	7.9	8.5	9.1	8.5	0.6	7.1
10	3	11.2	11.7	11.5	11.5	0.3	2.4
11	0						
12	3	12.7	11.8	12.9	12.47	0.59	4.7
13	3	9.28	9.25	9.47	9.33	0.12	1.3
14	3	10.4	10.1	8.4	9.63	1.08	11.2
15	0						
16	3	9.156	9.28	9.308	9.25	0.08	0.9
17	3	10.6	10.4	10.5	10.5	0.1	0.7
18	3	14.9	14.7	14.8	14.8	0.1	0.7
19	0						
20	3	13.2	11.8	12.7	12.6	0.7	5.6
21	0						
22	3	10.8	10.2	9.9	10.3	0.5	4.4
23	0						
24	3	8.8	8.9	9.4	9.0	0.3	3.6
25	3	9.28	9.29	9.19	9.25	0.06	0.6
26	3	9.32	8.79	8.9	9.00	0.28	3.1
27	3	9.7	10.1	10.0	9.9	0.2	2.1
28	3	13.5	13.8	13.2	13.5	0.3	2.2
29	3	10.8	11.1	10.2	10.7	0.5	4.3
30	3	9.36	9.33	8.44	9.04	0.52	5.8
31	0						
32	0						
33	0						
34	3	6.13	5.76	6.09	5.99	0.20	3.4
35	3	8.27	9.31	9.55	9.04	0.68	7.5
36	3	9.52	9.69	9.77	9.66	0.13	1.3
37	3	10.1	10.1	9.2	9.80	0.52	5.3
38	0						
39	0						

ARSENIC
CRM 2976
mg/kg

Lab					Mean	SD	RSD
1	3	13.7	13.6	13.6	13.6	0.1	0.4
2	3	13.25	13.60	13.09	13.31	0.26	2.0
3	3	12.1	12.6	13.5	12.7	0.7	5.6
4	3	12.4	13.4	12.9	12.9	0.5	3.9
5	3	14.4	14.4	15.2	14.7	0.5	3.1
6	3	23.4	23.8	24.4	23.9	0.5	2.1
7	3	12.939	13.61	13.532	13.360	0.367	2.7
8	3	14.16	14.15	14.11	14.14	0.03	0.2
9	3	12.1	12.7	13.4	12.7	0.7	5.1
10	3	14.2	14.4	14.4	14.3	0.1	0.8
11	0						
12	3	13.1	15	13.6	13.90	0.98	7.1
13	3	13.3	13.4	13.5	13.40	0.10	0.7
14	0						
15	0						
16	3	13.38	13.27	13.17	13.27	0.11	0.8
17	3	14.9	14.3	13.5	14.2	0.7	4.7
18	3	13.2	14.9	15.1	14.4	1.0	7.3
19	0						
20	3	16.6	14.91	15.09	15.53	0.93	6.0
21	0						
22	3	13.0	13.3	13.4	13.2	0.2	1.6
23	0						
24	3	13	12	14	13	1	7.7
25	3	12.6	12.9	13.1	12.9	0.3	2.0
26	3	14	13.6	13.6	13.7	0.2	1.7
27	3	13.1	12.3	13.3	12.9	0.5	4.1
28	3	12.1	12.8	12.3	12.4	0.4	2.9
29	3	13.5	14.2	12.9	13.5	0.7	4.8
30	3	13.2	11.2	11.8	12.1	1.0	8.5
31	0						
32	0						
33	0						
34	3	12.6	13.8	13.5	13.3	0.6	4.7
35	3	12.45	12.50	12.90	12.62	0.24	1.9
36	3	13.4	13.2	15.1	13.9	1.0	7.5

SELENIUM
Sediment 99
mg/kg

Lab					Mean	SD	RSD
1	3	0.7	0.8	0.8	0.8	0.1	7.5
2	3	0.76	0.75	0.76	0.76	0.01	0.8
3	0						
4	0						
5	3	<0.4	<0.4	<0.4			
6	0						
7	0						
8	3	0.745	0.747	0.693	0.728	0.031	4.2
9	0						
10	0						
11	0						
12	3	0.756	0.765	0.738	0.753	0.014	1.8
13	3	0.685	0.656	0.67	0.670	0.015	2.2
14	0						
15	0						
16	3	0.723	0.763	0.802	0.763	0.040	5.2
17	3	0.75	0.78	0.66	0.73	0.07	8.9
18	0						
19	3	0.73	0.72	0.73	0.73	0.01	0.8
20	3	0.708	0.802	0.661	0.724	0.072	9.9
21	0						
22	0						
23	0						
24	3	0.7	0.8	0.7	0.7	0.1	7.9
25	3	0.75	0.69	0.63	0.69	0.06	8.7
26	3	0.631	0.635	0.665	0.644	0.019	2.9
27	3	0.48	0.54	0.47	0.50	0.04	7.6
28	0						
29	3	0.69	0.658	0.67	0.67	0.02	2.4
30	0						
31	3	0.66	0.57	0.89	0.71	0.17	23.4
32	0						
33	0	1.39	1.53	1.54	1.49	0.08	5.6
34	3	0.66	0.71	0.86	0.74	0.10	14.0
35	0						
36	3	0.94	0.89	0.82	0.88	0.06	6.8
37	3	0.70	0.69	0.72	0.70	0.02	2.2
38	0						
39	0						

SELENIUM
MESS-2
mg/kg

Lab					Mean	SD	RSD
1	3	0.8	0.8	0.8	0.8	0.0	0.0
2	3	0.76	0.79	0.75	0.77	0.02	2.7
3	0						
4	0						
5	3	<0.4	<0.4	<0.4			
6	0						
7	0						
8	3	0.659	0.72	0.685	0.688	0.031	4.4
9	0						
10	0						
11	0						
12	3	0.81	0.79	0.79	0.80	0.01	1.4
13	3	0.692	0.705	0.684	0.694	0.011	1.5
14	0						
15	0						
16	3	0.723	0.735	0.779	0.746	0.029	4.0
17	3	0.71	0.68	0.75	0.71	0.04	5.3
18	0						
19	3	0.76	0.79	0.76	0.77	0.02	2.2
20	3	0.819	0.794	0.749	0.787	0.035	4.5
21	0						
22	0						
23	0						
24	3	0.9	0.7	0.8	0.8	0.1	12.5
25	3	0.77	0.64	0.64	0.68	0.08	11.0
26	3	0.699	0.68	0.725	0.701	0.023	3.2
27	3	0.64	0.69	0.63	0.65	0.03	4.9
28	0						
29	3	0.671	0.675	0.639	0.66	0.02	3.0
30	0						
31	3	0.88	1.08	0.51	0.82	0.29	35.1
32	0						
33	0	1.89	1.76	1.66	1.77	0.12	6.5
34	3	0.40	0.40	0.35	0.38	0.03	7.5
35	0						
36	3	0.79	0.81	0.84	0.81	0.03	3.1

SELENIUM
Tissue 99
mg/kg

Lab					Mean	SD	RSD
1	3	4	4	4	4	0	0.0
2	3	3.29	3.10	3.40	3.27	0.15	4.7
3	3	2.63	2.55	2.64	2.61	0.05	1.9
4	0						
5	3	3.14	3	3	3.05	0.08	2.7
6	3	5.97	5.74	5.45	5.72	0.26	4.6
7	3	3.89	4.05	3.81	3.92	0.12	3.1
8	3	3.35	3.37	3.37	3.36	0.01	0.3
9	3	6.7	6.1	5.2	6.0	0.8	12.6
10	0						
11	0						
12	3	3.08	3.18	3.13	3.13	0.05	1.6
13	3	3.197	3.205	3.222	3.208	0.013	0.4
14	3	5.5	4.7	5.2	5.1	0.4	7.9
15	0						
16	3	2.672	2.676	2.419	2.589	0.147	5.7
17	0						
18	0						
19	0						
20	3	2.68	2.6	2.64	2.64	0.04	1.5
21	0						
22	3	3.08	3.01	3.04	3.04	0.04	1.2
23	0						
24	3	1.5	1.5	1.8	1.6	0.2	10.8
25	3	2.63	2.73	2.80	2.72	0.09	3.1
26	0						
27	3	2.60	2.60	2.63	2.61	0.02	0.7
28	3	3.20	3.20	3.20	3.20	0.00	0.0
29	3	2.46	2.62	2.60	2.56	0.09	3.4
30	0						
31	0						
32	0						
33	0						
34	3	2.32	2.10	2.40	2.27	0.16	6.8
35	3	3.01	2.73	2.92	2.89	0.14	4.9
36	3	3.14	3.19	3.27	3.20	0.07	2.0
37	3	2.88	2.78	2.92	2.86	0.07	2.5
38	0						
39	0						

SELENIUM
CRM 2976
mg/kg

Lab					Mean	SD	RSD
1	3	2	2	2	2	0	0.0
2	3	1.98	1.91	1.79	1.89	0.10	5.2
3	3	1.77	1.85	1.62	1.75	0.12	6.7
4	0						
5	3	2.08	1.85	2.08	2.00	0.13	6.6
6	3	3.74	3.83	3.95	3.84	0.11	2.7
7	3	2.69	2.65	2.73	2.69	0.04	1.5
8	3	1.88	1.94	1.91	1.91	0.03	1.6
9	3	3	3.2	3.2	3.1	0.1	3.7
10	0						
11	0						
12	3	1.73	1.73	1.73	1.73	0.00	0.0
13	3	1.795	1.795	1.800	1.797	0.003	0.2
14	0						
15	0						
16	3	1.78	1.9	1.66	1.78	0.12	6.7
17	0						
18	0						
19	0						
20	3	1.69	1.438	1.553	1.560	0.126	8.1
21	0						
22	3	1.8	1.81	1.77	1.79	0.02	1.2
23	0						
24	3	2.1	2.2	2.1	2.1	0.1	2.7
25	3	1.95	1.88	1.73	1.85	0.11	6.1
26	0						
27	3	1.88	1.72	1.80	1.80	0.08	4.4
28	3	1.75	1.75	1.75	1.75	0.00	0.0
29	3	1.55	1.62	1.55	1.57	0.04	2.6
30	0						
31	0						
32	0						
33	0						
34	3	1.83	1.82	1.97	1.87	0.08	4.5
35	3	1.58	1.53	1.43	1.51	0.08	5.3
36	3	1.82	1.85	1.77	1.81	0.04	2.2

SILVER
Sediment 99
mg/kg

Lab					Mean	SD	RSD
1	3	<0.2	<0.2	<0.2			
2	0						
3	3	0.209	0.192	0.221	0.207	0.015	7.0
4	0						
5	3	<0.02	<0.02	<0.02			
6	0						
7	0						
8	3	0.177	0.192	0.187	0.185	0.008	4.1
9	0						
10	0						
11	0						
12	0						
13	0						
14	0						
15	0						
16	0						
17	3	0.20	0.20	0.20	0.20	0.01	2.5
18	3	0.215	0.211	0.197	0.208	0.009	4.6
19	3	>1	>1	>1			
20	3	0.447	0.396	0.526	0.456	0.066	14.4
21	3	0.21	0.20	0.21	0.21	0.01	2.8
22	0						
23	0						
24	3	<0.5	<0.5	<0.5			
25	3	0.15	0.16	0.16	0.16	0.01	3.7
26	3	0.173	0.194	0.150	0.172	0.022	12.8
27	3	0.16	0.15	0.17	0.16	0.01	6.3
28	0						
29	3	0.183	0.186	0.186	0.185	0.002	0.9
30	3	0.94	0.61	0.27	0.61	0.34	55.2
31	3	0.28	0.27	0.28	0.28	0.01	2.1
32	0						
33	3	0.19	0.17	0.16	0.17	0.02	8.8
34	3	0.31	0.36	0.38	0.35	0.04	10.3
35	3	0.202	0.206	0.214	0.21	0.01	2.9
36	0						
37	3	0.175	0.181	0.171	0.176	0.005	2.9
38	0						
39	3	0.169	0.168	0.171	0.169	0.002	0.9

SILVER
MESS-2
mg/kg

Lab					Mean	SD	RSD
1	3	<0.2	<0.2	<0.2			
2	0						
3	3	0.218	0.183	0.284	0.228	0.051	22.5
4	0						
5	3	<0.02	<0.02	<0.02			
6	0						
7	0						
8	3	0.189	0.185	0.186	0.187	0.002	1.1
9	0						
10	0						
11	0						
12	0						
13	0						
14	0						
15	0						
16	0						
17	3	0.19	0.19	0.19	0.19	0.00	1.8
18	3	0.208	0.210	0.203	0.207	0.004	1.7
19	3	>1	>1	>1			
20	3	0.656	0.631	0.523	0.603	0.071	11.7
21	3	0.18	0.19	0.20	0.19	0.01	5.3
22	0						
23	0						
24	3	<0.5	<0.5	<0.5			
25	3	0.14	0.15	0.15	0.15	0.01	3.9
26	3	0.192	0.171	0.181	0.181	0.011	5.8
27	3	0.21	0.18	0.18	0.19	0.02	9.1
28	0						
29	3	0.181	0.185	0.189	0.185	0.004	2.2
30	3	0.16	0.17	0.21	0.18	0.03	14.7
31	3	0.26	0.26	0.26	0.26	0.00	0.0
32	0						
33	3	0.22	0.16	0.16	0.18	0.03	19.2
34	3	0.16	0.22	0.18	0.19	0.03	16.4
35	3	0.156	0.168	0.193	0.17	0.02	11.0
36	0						
37	0						
38	0						
39	0						

SILVER
Tissue 99
mg/kg

Lab					Mean	SD	RSD
1	3	<0.2	<0.2	<0.2			
2	0						
3	3	0.121	0.133	0.138	0.131	0.009	6.7
4	0						
5	3	0.118	0.114	0.116	0.116	0.002	1.7
6	3	0.28	0.274	0.263	0.272	0.009	3.2
7	3	<.16	<.16	<.16			
8	3	0.139	0.134	0.138	0.137	0.003	1.9
9	3	0.154	0.148	0.146	0.149	0.004	2.8
10	3	0.129	0.128	0.132	0.130	0.002	1.5
11	0						
12	0						
13	0						
14	3	0.1	0.1	0.12	0.11	0.01	10.8
15	0						
16	0						
17	3	0.130	0.129	0.134	0.131	0.003	2.0
18	3	0.0797	0.0787	0.0828	0.0804	0.0021	2.7
19	0						
20	3	0.230	0.227	0.219	0.23	0.01	2.5
21	0						
22	0						
23	0						
24	3	<0.5	<0.5	<0.5			
25	3	0.099	0.091	0.090	0.093	0.005	5.3
26	3	0.101	0.0988	0.0959	0.0986	0.0026	2.6
27	3	0.14	0.15	0.15	0.15	0.01	3.9
28	3	0.20	0.21	0.19	0.20	0.01	5.0
29	3	0.145	0.147	0.149	0.147	0.002	1.4
30	3	0.15	0.16	0.15	0.15	0.01	3.8
31	0						
32	0						
33	0						
34	3	0.017	0.016	0.015	0.016	0.001	6.2
35	3	0.144	0.140	0.132	0.139	0.006	4.4
36	3	0.16	0.15	0.16	0.16	0.01	3.7
37	3	0.149	0.144	0.147	0.147	0.003	1.7
38	0						
39	3	0.145	0.147	0.146	0.146	0.001	0.7

SILVER
CRM 2976
mg/kg

Lab					Mean	SD	RSD
1	3	<0.2	<0.2	<0.2			
2	0						
3	3	<0.1	<0.1	<0.1			
4	0						
5	3	<0.02	<0.02	<0.02			
6	3	<0.04	<0.04	<0.04			
7	3	<.16	<.16	<.16			
8	3	0.01	0.01	0.01	0.01	0.00	0.0
9	3	0.0138	< 0.13	< 0.13			
10	3	0.012	0.011	0.011	0.011	0.001	5.0
11	0						
12	0						
13	0						
14	0						
15	0						
16	0						
17	3	0.011	0.013	0.013	0.013	0.001	8.8
18	3	<.0197	<.0201	<.0201			
19	0						
20	0						
21	0						
22	0						
23	0						
24	3	<0.5	<0.5	<0.5			
25	3	0.011	0.005	0.007	0.008	0.003	39.8
26	3	0.0103	0.0093	0.0104	0.0100	0.0006	5.8
27	3	0.015	0.027	0.008	0.017	0.010	57.7
28	3	<.02	<.02	<.02			
29	3	0.008	0.008	0.008	0.008	0.000	0.0
30	3	0.002	0.014	0.013	0.010	0.007	68.9
31	0						
32	0						
33	0						
34	3	0.012	0.008	0.01	0.010	0.002	20.0
35	3	<.02	<.02	<.02			
36	3	0.01	0.013	0.01	0.01	0.00	15.7

CADMIUM
Sediment 99
mg/kg

Lab					Mean	SD	RSD
1	3	0.3	0.3	0.3	0.3	0.0	0.0
2	3	0.248	0.24	0.242	0.243	0.004	1.7
3	0						
4	3	0.22	0.23	0.23	0.23	0.01	2.5
5	3	<0.01	<0.01	<0.01			
6	0						
7	0						
8	3	0.208	0.201	0.199	0.203	0.005	2.3
9	0						
10	3	0.23	0.23	0.24	0.23	0.01	2.3
11	0						
12	3	0.222	0.212	0.211	0.215	0.006	2.8
13	0						
14	3	0.07	0.13	0.11	0.10	0.03	29.6
15	0						
16	3	0.28	0.222	0.248	0.250	0.029	11.6
17	3	0.24	0.23	0.22	0.23	0.01	2.5
18	0						
19	3	0.21	0.22	0.21	0.21	0.01	2.7
20	3	0.202	0.215	0.238	0.218	0.018	8.3
21	3	0.27	0.24	0.25	0.25	0.02	6.0
22	3	0.22	0.23	0.23	0.23	0.01	2.5
23	0						
24	3	0.2	0.2	0.3	0.2	0.1	24.7
25	3	0.20	0.23	0.20	0.21	0.02	8.2
26	3	0.247	0.239	0.246	0.244	0.004	1.8
27	3	0.2	0.2	0.2	0.2	0.0	0.0
28	0						
29	3	0.24	0.24	0.24	0.24	0.00	0.5
30	3	1.04	0.52	0.84	0.80	0.26	32.8
31	3	0.22	0.22	0.23	0.22	0.01	2.6
32	3	0.20	0.21	0.22	0.21	0.01	4.8
33	3	0.255	0.255	0.245	0.252	0.006	2.3
34	3	0.31	0.39	0.26	0.32	0.07	20.5
35	3	0.239	0.234	0.234	0.236	0.003	1.2
36	3	0.23	0.22	0.22	0.22	0.01	2.6
37	3	0.21	0.22	0.235	0.22	0.01	5.7
38	0						
39	3	0.24	0.234	0.23	0.23	0.01	2.1

CADMIUM
MESS-2
mg/kg

Lab					Mean	SD	RSD
1	3	<0.3	<0.3	<0.3			
2	3	0.252	0.252	0.252	0.252	0.000	0.0
3	0						
4	3	0.23	0.24	0.24	0.24	0.01	2.4
5	3	<0.01	<0.01	<0.01			
6	0						
7	0						
8	3	0.249	0.219	0.22	0.229	0.017	7.4
9	0						
10	3	0.24	0.23	0.24	0.23	0.00	1.2
11	0						
12	3	0.226	0.232	0.245	0.234	0.010	4.1
13	0						
14	3	0.27	0.14	0.13	0.18	0.08	43.4
15	0						
16	3	0.25	0.228	0.256	0.245	0.015	6.0
17	3	0.23	0.22	0.22	0.22	0.00	2.2
18	0						
19	3	0.23	0.23	0.24	0.23	0.01	2.5
20	3	0.219	0.212	0.268	0.233	0.031	13.1
21	3	0.28	0.27	0.28	0.28	0.01	2.1
22	3	0.24	0.24	0.23	0.24	0.01	2.4
23	0						
24	3	0.2	0.2	0.3	0.2	0.1	24.7
25	3	0.21	0.20	0.20	0.20	0.01	2.8
26	3	0.255	0.261	0.259	0.258	0.003	1.2
27	3	0.23	0.22	0.22	0.22	0.01	2.6
28	0						
29	3	0.26	0.26	0.25	0.26	0.00	1.8
30	3	<0.2	<0.2	<0.2			
31	3	0.26	0.22	0.21	0.23	0.03	11.5
32	2	0.27	0.21		0.24	0.04	17.7
33	3	0.214	0.184	0.194	0.197	0.015	7.7
34	3	0.54	0.53	0.68	0.58	0.08	14.4
35	3	0.238	0.240	0.223	0.234	0.009	4.0
36	3	0.24	0.24	0.25	0.24	0.01	2.4

CADMIUM
Tissue 99
mg/kg

Lab					Mean	SD	RSD
1	3	0.70	0.68	0.69	0.69	0.01	1.4
2	3	0.696	0.700	0.694	0.697	0.003	0.4
3	3	0.67	0.67	0.71	0.68	0.02	3.4
4	3	0.58	0.58	0.57	0.58	0.00	0.5
5	3	0.5	0.5	0.5	0.5	0.0	0.0
6	3	1.14	1.11	1.11	1.12	0.02	1.5
7	3	0.683	0.701	0.699	0.694	0.010	1.4
8	3	0.666	0.676	0.659	0.667	0.009	1.3
9	3	0.598	0.604	0.589	0.597	0.008	1.3
10	3	0.66	0.69	0.69	0.68	0.02	2.2
11	0						
12	3	0.708	0.708	0.718	0.711	0.006	0.8
13	0						
14	3	0.63	0.56	0.6	0.60	0.04	5.9
15	3	0.981	1.099	1.064	1.048	0.061	5.8
16	3	0.612	0.579	0.588	0.593	0.017	2.9
17	3	0.62	0.63	0.59	0.62	0.02	3.4
18	3	0.634	0.643	0.626	0.634	0.009	1.3
19	0						
20	3	0.775	0.726	0.792	0.764	0.034	4.5
21	0						
22	3	0.65	0.67	0.65	0.66	0.01	1.8
23	3	0.59	0.58	0.62	0.60	0.02	3.5
24	3	0.8	0.9	0.7	0.8	0.1	12.5
25	3	0.60	0.61	0.61	0.61	0.01	1.0
26	3	0.691	0.622	0.671	0.661	0.036	5.4
27	3	0.72	0.74	0.74	0.73	0.01	1.6
28	3	0.93	0.95	0.91	0.93	0.02	2.2
29	3	0.72	0.71	0.73	0.72	0.01	1.4
30	3	0.46	0.43	0.45	0.45	0.02	3.4
31	0						
32	0						
33	0						
34	3	0.73	0.70	0.69	0.71	0.02	2.9
35	3	0.582	0.621	0.588	0.597	0.021	3.5
36	3	0.67	0.68	0.63	0.66	0.03	4.0
37	3	0.60	0.61	0.63	0.61	0.01	2.4
38	0						
39	3	0.56	0.56	0.58	0.57	0.01	2.0

CADMIUM
CRM 2976
mg/kg

Lab					Mean	SD	RSD
1	3	0.88	0.85	0.87	0.87	0.02	1.8
2	3	0.903	0.902	0.903	0.903	0.001	0.1
3	3	1.1	0.96	0.9	0.99	0.10	10.4
4	3	0.81	0.80	0.84	0.82	0.02	2.3
5	3	0.66	0.64	0.68	0.66	0.02	3.0
6	3	1.4	1.38	1.43	1.40	0.03	1.8
7	3	0.829	0.883	0.869	0.860	0.028	3.3
8	3	0.766	0.778	0.767	0.770	0.007	0.9
9	3	0.78	0.741	0.79	0.77	0.03	3.4
10	3	0.79	0.77	0.80	0.78	0.02	2.2
11	0						
12	3	0.772	0.838	0.769	0.793	0.039	4.9
13	0						
14	0						
15	0						
16	3	0.803	0.727	0.739	0.756	0.041	5.4
17	3	0.80	0.78	0.79	0.79	0.01	1.4
18	3	0.779	0.780	0.781	0.780	0.001	0.1
19	0						
20	3	1.008	0.932	0.942	0.961	0.041	4.3
21	0						
22	3	0.80	0.79	0.80	0.80	0.01	0.7
23	3	0.74	0.76	0.75	0.75	0.01	1.3
24	3	0.7	0.8	0.6	0.7	0.1	14.3
25	3	0.78	0.79	0.76	0.78	0.02	2.0
26	3	0.809	0.811	0.806	0.809	0.003	0.3
27	3	0.93	0.86	0.87	0.89	0.04	4.3
28	3	0.81	0.78	0.79	0.79	0.02	1.9
29	3	0.87	0.89	0.87	0.88	0.01	1.3
30	3	0.56	0.44	0.47	0.49	0.06	12.7
31	0						
32	0						
33	0						
34	3	0.81	0.77	0.82	0.80	0.03	3.3
35	3	0.769	0.773	0.789	0.777	0.011	1.4
36	3	0.81	0.8	0.76	0.79	0.03	3.3

TIN
Sediment 99
mg/kg

Lab					Mean	SD	RSD
1	3	<40	<40	<40			
2	0						
3	0						
4	0						
5	3	<10	<10	<10			
6	0						
7	0						
8	3	2.46	2.35	2.11	2.31	0.18	7.8
9	0						
10	0						
11	0						
12	0						
13	0						
14	0						
15	0						
16	0						
17	3	2.15	2.15	2.08	2.12	0.04	1.9
18	0						
19	0						
20	3	<4.35	<4.35	<4.35			
21	0						
22	3	2.29	2.41	2.41	2.37	0.07	2.9
23	0						
24	0						
25	3	2.38	2.44	2.38	2.40	0.03	1.4
26	3	<2.63	<2.56	<2.82			
27	0						
28	0						
29	0						
30	0						
31	3	2.38	2.47	2.44	2.43	0.05	1.9
32	3	3.2	3.83	2.72	3.25	0.56	17.1
33	0						
34	3	3.71	3.98	4.18	3.96	0.24	6.0
35	3	2.37	2.30	2.40	2.36	0.05	2.3
36	0						
37	0						
38	0						
39	3	2.43	2.47	2.41	2.44	0.03	1.3

TIN
MESS-2
mg/kg

Lab					Mean	SD	RSD
1	3	<20	<20	<20			
2	0						
3	0						
4	0						
5	3	<10	<10	<10			
6	0						
7	0						
8	3	2.19	2.03	2.01	2.08	0.10	4.8
9	0						
10	0						
11	0						
12	0						
13	0						
14	0						
15	0						
16	0						
17	3	2.14	2.06	2.05	2.08	0.05	2.3
18	0						
19	0						
20	3	<4.35	<4.35	<4.35			
21	0						
22	3	2.42	2.28	2.25	2.32	0.09	3.9
23	0						
24	0						
25	3	2.44	2.47	2.48	2.46	0.02	0.8
26	3	<2.56	<2.53	<2.60			
27	0						
28	0						
29	0						
30	0						
31	3	2.43	2.45	2.49	2.46	0.03	1.2
32	3	5.05	5.57	3.84	4.82	0.89	18.4
33	0						
34	3	3.83	4.4	4.04	4.09	0.29	7.0
35	3	2.47	2.54	2.44	2.48	0.05	2.0
36	0						

TIN
Tissue 99
mg/kg

Lab					Mean	SD	RSD
1	3	<0.2	<0.2	<0.2			
2	0						
3	0						
4	0						
5	3	<4	<4	<4			
6	0						
7	0						
8	3	0.064	0.052	0.064	0.060	0.007	11.5
9	3	< 6.1	< 6.1	< 4.9			
10	0						
11	0						
12	0						
13	0						
14	0						
15	0						
16	0						
17	3	0.116	0.097	0.108	0.107	0.009	8.6
18	0						
19	0						
20	3	0.074	0.055	0.069	0.066	0.010	14.9
21	0						
22	0						
23	0						
24	0						
25	3	0.035	0.143	0.083	0.087	0.054	62.2
26	3	<2.71	<2.28	<2.67			
27	0						
28	3	<.10	<.10	<.10			
29	0						
30	0						
31	0						
32	0						
33	0						
34	0						
35	3	0.187	0.193	0.202	0.194	0.008	4.1
36	0						
37	0						
38	0						
39	3	0.069	0.048	0.039	0.052	0.015	29.6

TIN
CRM 2976
mg/kg

Lab					Mean	SD	RSD
1	3	<0.2	<0.2	<0.2			
2	0						
3	0						
4	0						
5	3	<4	<4	<4			
6	0						
7	0						
8	3	0.085	0.072	0.075	0.077	0.007	8.8
9	3	< 4.8	< 5.3	< 4.2			
10	0						
11	0						
12	0						
13	0						
14	0						
15	0						
16	0						
17	3	0.133	0.123	0.120	0.125	0.007	5.4
18	0						
19	0						
20	0						
21	0						
22	0						
23	0						
24	0						
25	3	0.096	0.098	0.106	0.100	0.005	5.3
26	3	<2.64	<2.61	<2.63			
27	0						
28	3	0.16	0.12	0.14	0.14	0.02	14.3
29	0						
30	0						
31	0						
32	0						
33	0						
34	0						
35	3	0.283	0.124	0.158	0.188	0.084	44.6
36	0						

ANTIMONY
Sediment 99
mg/kg

Lab					Mean	SD	RSD
1	0						
2	0						
3	0						
4	0						
5	3	<0.1	<0.1	<0.1			
6	0						
7	0						
8	3	0.982	1.021	1.03	1.01	0.03	2.5
9	0						
10	0						
11	0						
12	0						
13	0						
14	0						
15	0						
16	3	1.018	0.991	0.992	1.000	0.015	1.5
17	3	0.99	0.98	0.99	0.98	0.01	0.5
18	0						
19	3	1.2	1.2	1.2	1.2	0.0	0.0
20	3	1.09	1.08	1.07	1.08	0.01	0.9
21	0						
22	3	0.98	1.08	1.09	1.05	0.06	5.8
23	0						
24	3	1.1	1.2	1.1	1.1	0.1	5.1
25	3	1.12	1.12	1.13	1.12	0.01	0.5
26	3	1.1	1.04	0.981	1.04	0.06	5.7
27	0						
28	0						
29	3	1.07	1.05	1.07	1.06	0.01	1.1
30	0						
31	3	0.94	0.89	0.94	0.92	0.03	3.1
32	0						
33	0						
34	3	0.66	0.64	0.65	0.65	0.01	1.5
35	3	0.93	1.02	0.94	0.96	0.05	5.1
36	0						
37	0						
38	0						
39	3	1.05	1.07	1.04	1.05	0.02	1.5

ANTIMONY
MESS-2
mg/kg

Lab					Mean	SD	RSD
1	0						
2	0						
3	0						
4	0						
5	3	<0.1	<0.1	<0.1			
6	0						
7	0						
8	3	1.15	1.1	1.12	1.12	0.03	2.2
9	0						
10	0						
11	0						
12	0						
13	0						
14	0						
15	0						
16	3	1.14	1.051	1.062	1.084	0.049	4.5
17	3	0.94	0.96	0.98	0.96	0.02	2.0
18	0						
19	3	1.2	1.2	1.2	1.2	0.0	0.0
20	3	1.26	1.13	1.37	1.25	0.12	9.6
21	0						
22	3	1.08	1.10	1.05	1.08	0.03	2.3
23	0						
24	3	1.2	1.1	1.2	1.2	0.1	4.9
25	3	1.24	1.10	1.14	1.16	0.07	6.2
26	3	1.1	1.04	1.03	1.06	0.04	3.6
27	0						
28	0						
29	3	1.09	1.11	1.12	1.11	0.02	1.4
30	0						
31	3	0.89	0.93	0.93	0.92	0.02	2.5
32	0						
33	0						
34	3	0.80	0.80	0.77	0.79	0.02	2.2
35	3	1.06	1.09	1.17	1.11	0.06	5.1
36	0						

The determination of antimony was not required in the biologicals

MERCURY
Sediment 99
mg/kg

Lab					Mean	SD	RSD
1	3	0.129	0.118	0.128	0.125	0.006	4.9
2	3	0.088	0.091	0.089	0.089	0.002	1.7
3	3	0.122	0.088	0.147	0.119	0.030	24.9
4	3	0.078	0.103	0.088	0.090	0.013	14.0
5	3	0.119	0.112	0.108	0.113	0.006	4.9
6	0						
7	0						
8	3	0.101	0.101	0.102	0.101	0.001	0.6
9	3	0.0771	0.0718	0.0677	0.0722	0.0047	6.5
10	0						
11	0						
12	3	0.088	0.091	0.09	0.090	0.002	1.7
13	0						
14	0						
15	0						
16	3	0.086	0.0918	0.0909	0.090	0.003	3.5
17	3	0.089	0.089	0.091	0.090	0.001	1.0
18	0						
19	3	0.098	0.098	0.095	0.097	0.002	1.8
20	3	0.095	0.083	0.089	0.089	0.006	6.7
21	3	0.114	0.113	0.112	0.113	0.001	0.9
22	0						
23	0						
24	3	0.1	0.1	0.12	0.11	0.01	10.8
25	3	0.085	0.089	0.094	0.089	0.005	5.0
26	3	0.102	0.0973	0.0984	0.0992	0.0025	2.5
27	3	0.082	0.079	0.081	0.081	0.002	1.9
28	0						
29	3	0.089	0.095	0.095	0.093	0.003	3.7
30	0						
31	3	0.0935	0.0934	0.0937	0.0935	0.0002	0.2
32	3	0.119	0.135	0.136	0.130	0.010	7.3
33	3	0.078	0.08	0.087	0.082	0.005	5.8
34	3	0.094	0.094	0.091	0.093	0.002	1.9
35	3	0.117	0.116	0.121	0.118	0.003	2.2
36	3	0.105	0.105	0.100	0.103	0.003	2.8
37	3	0.093	0.093	0.099	0.095	0.003	3.6
38	0						
39	3	0.092	0.085	0.090	0.089	0.004	4.1

MERCURY
MESS-2
mg/kg

Lab					Mean	SD	RSD
1	3	0.099	0.100	0.100	0.100	0.001	0.6
2	3	0.087	0.086	0.087	0.087	0.001	0.7
3	3	0.103	0.105	0.116	0.108	0.007	6.5
4	3	0.093	0.093	0.094	0.093	0.001	0.6
5	3	0.097	0.099	0.1	0.099	0.002	1.5
6	0						
7	0						
8	3	0.1	0.099	0.098	0.099	0.001	1.0
9	3	0.119	0.107	0.111	0.112	0.006	5.4
10	0						
11	0						
12	3	0.086	0.084	0.086	0.085	0.001	1.4
13	0						
14	0						
15	0						
16	3	0.0898	0.0949	0.0935	0.0927	0.0026	2.8
17	3	0.088	0.090	0.083	0.087	0.004	4.1
18	0						
19	3	0.095	0.095	0.110	0.100	0.009	8.7
20	3	0.079	0.091	0.086	0.085	0.006	7.1
21	3	0.096	0.102	0.112	0.103	0.008	7.8
22	0						
23	0						
24	3	0.09	0.09	0.09	0.09	0.00	0.0
25	3	0.095	0.103	0.092	0.097	0.006	5.9
26	3	0.0912	0.0904	0.0905	0.0907	0.0004	0.5
27	3	0.092	0.096	0.095	0.094	0.002	2.2
28	0						
29	3	0.085	0.092	0.087	0.088	0.004	4.1
30	0						
31	3	0.0827	0.083	0.0927	0.0861	0.0057	6.6
32	3	0.123	0.122	0.115	0.120	0.004	3.6
33	3	0.079	0.089	0.075	0.081	0.007	8.9
34	3	0.091	0.091	0.087	0.090	0.002	2.6
35	3	0.098	0.103	0.097	0.099	0.003	3.2
36	3	0.100	0.091	0.105	0.099	0.007	7.2

MERCURY
Tissue 99
mg/kg

Lab					Mean	SD	RSD
1	3	0.083	0.078	0.081	0.081	0.003	3.1
2	3	0.093	0.089	0.089	0.090	0.003	2.9
3	3	0.088	0.124	0.1	0.104	0.018	17.6
4	0						
5	3	0.091	0.088	0.088	0.089	0.002	1.9
6	3	0.086	0.0862	0.0855	0.086	0.000	0.4
7	3	0.075	0.098	0.083	0.085	0.012	13.7
8	3	0.0845	0.0844	0.0826	0.0838	0.0011	1.3
9	3	0.0816	0.0722	0.0766	0.0768	0.0047	6.1
10	0						
11	3	0.087	0.083	0.081	0.084	0.003	3.7
12	3	0.079	0.082	0.082	0.081	0.002	2.1
13	0						
14	3	0.062	0.06	0.066	0.063	0.003	4.9
15	0						
16	3	0.0779	0.0864	0.0779	0.0807	0.0049	6.1
17	3	0.077	0.077	0.076	0.077	0.001	1.3
18	0						
19	0						
20	3	0.084	0.082	0.082	0.083	0.001	1.4
21	0						
22	0						
23	3	0.081	0.081	0.080	0.081	0.001	0.7
24	3	0.07	0.06	0.08	0.07	0.01	14.3
25	3	0.0823	0.0799	0.0858	0.0827	0.0030	3.6
26	3	0.0692	0.0703	0.0718	0.0704	0.0013	1.9
27	3	0.082	0.081	0.081	0.081	0.001	0.7
28	3	0.11	0.1	0.10	0.10	0.01	5.6
29	3	0.082	0.084	0.081	0.082	0.002	1.9
30	0						
31	0						
32	0						
33	0						
34	3	0.048	0.058	0.053	0.05	0.00	9.4
35	3	0.0753	0.0753	0.0749	0.0752	0.0002	0.3
36	3	0.096	0.096	0.103	0.098	0.004	4.1
37	0						
38	0						
39	0						

MERCURY
CRM 2976
mg/kg

Lab					Mean	SD	RSD
1	3	0.057	0.061	0.063	0.060	0.003	5.1
2	3	0.064	0.061	0.061	0.062	0.002	3.0
3	3	0.08	0.055	0.075	0.070	0.013	18.9
4	0						
5	3	0.062	0.061	0.061	0.061	0.001	0.9
6	3	0.058	0.0616	0.062	0.061	0.002	3.6
7	3	0.071	0.061	0.061	0.064	0.006	9.0
8	3	0.0602	0.059	0.055	0.058	0.003	4.7
9	3	0.0630	0.0641	0.0640	0.0637	0.0006	1.0
10	0						
11	3	0.062	0.058	0.059	0.060	0.002	3.5
12	3	0.057	0.057	0.059	0.058	0.001	2.0
13	0						
14	0						
15	0						
16	3	0.0605	0.0581	0.0591	0.0592	0.0012	2.0
17	3	0.060	0.063	0.059	0.061	0.003	4.2
18	0						
19	0						
20	3	0.057	0.056	0.058	0.057	0.001	1.8
21	0						
22	0						
23	3	0.058	0.058	0.061	0.059	0.002	2.9
24	3	0.06	0.06	0.06	0.06	0.00	0.0
25	3	0.0637	0.0612	0.0618	0.0622	0.0013	2.1
26	3	0.053	0.0529	0.053	0.053	0.000	0.1
27	3	0.068	0.066	0.064	0.066	0.002	3.0
28	3	0.066	0.071	0.070	0.069	0.003	3.8
29	3	0.062	0.059	0.057	0.059	0.003	4.2
30	0						
31	0						
32	0						
33	0						
34	3	0.058	0.066	0.060	0.061	0.004	6.8
35	3	0.0627	0.0642	0.0674	0.0648	0.0024	3.7
36	3	0.055	0.055	0.062	0.057	0.004	7.0

THALLIUM
Sediment 99
mg/kg

Lab					Mean	SD	RSD
1	3	<40	<40	<40			
2	0						
3	0						
4	0						
5	3	<0.1	<0.1	<0.1			
6	0						
7	0						
8	3	0.879	0.953	0.959	0.930	0.045	4.8
9	0						
10	0						
11	0						
12	0						
13	0						
14	0						
15	0						
16	3	1.016	1.013	0.987	1.005	0.016	1.6
17	3	0.89	0.87	0.89	0.88	0.01	1.2
18	0						
19	3	0.98	0.97	0.97	0.97	0.01	0.6
20	3	1.03	0.978	0.994	1.001	0.027	2.7
21	0						
22	3	0.89	0.89	0.93	0.90	0.02	2.6
23	0						
24	0						
25	3	0.85	0.85	0.87	0.86	0.01	1.3
26	0						
27	0						
28	0						
29	3	1.12	1.05	0.97	1.05	0.08	7.2
30	0						
31	3	1.03	0.998	0.995	1.01	0.02	1.9
32	0						
33	0						
34	3	0.52	0.56	0.47	0.52	0.05	8.7
35	3	<0.04	<0.04	<0.04			
36	0						
37	0						
38	0						
39	3	0.92	0.93	0.94	0.93	0.01	1.1

THALLIUM
MESS-2
mg/kg

Lab					Mean	SD	RSD
1	3	<20	<20	<20			
2	0						
3	0						
4	0						
5	3	<0.1	<0.1	<0.1			
6	0						
7	0						
8	3	0.998	0.98	0.996	0.991	0.010	1.0
9	0						
10	0						
11	0						
12	0						
13	0						
14	0						
15	0						
16	3	1.018	0.986	1.008	1.004	0.016	1.6
17	3	0.92	0.89	0.90	0.90	0.01	1.3
18	0						
19	3	0.98	0.95	1.00	0.98	0.03	2.6
20	3	0.967	1.01	1.11	1.03	0.07	7.1
21	0						
22	3	0.95	0.95	0.97	0.96	0.01	1.2
23	0						
24	0						
25	3	0.97	0.93	0.90	0.93	0.04	3.8
26	0						
27	0						
28	0						
29	3	1.11	1.05	1.00	1.05	0.06	5.2
30	0						
31	3	0.976	1.00	1.09	1.02	0.06	5.9
32	0						
33	0						
34	3	0.78	0.63	0.66	0.69	0.08	11.5
35	3	0.919	0.799	0.951	0.890	0.080	9.0
36	0						
37	0						
38	0						
39	2	0.94	0.91				

The determination of thallium was not required in the biologicals

LEAD
Sediment 99
mg/kg

Lab					Mean	SD	RSD
1	3	24	23	25	24	1	4.2
2	3	23.4	19.7	18.7	20.6	2.5	12.0
3	3	17.7	17.9	17.9	17.83	0.12	0.6
4	3	20.5	22.8	21.0	21.4	1.2	5.6
5	3	20.1	19.6	19.5	19.7	0.3	1.6
6	0						
7	0						
8	3	18.11	18.97	19.76	18.95	0.83	4.4
9	0						
10	3	20.7	22.9	23.0	22.2	1.3	5.9
11	0						
12	3	21.4	21	22.6	21.7	0.8	3.8
13	0						
14	0						
15	0						
16	3	21.72	22.3	21.3	21.77	0.50	2.3
17	3	21.1	21.0	21.1	21.1	0.1	0.3
18	3	19.1	19.3	17.1	18.5	1.2	6.6
19	3	21.8	21.4	21.7	21.6	0.2	1.0
20	3	23.9	23.5	23.8	23.7	0.2	0.9
21	3	20.8	19.2	19.8	19.9	0.8	4.1
22	3	21.2	21.4	21.3	21.3	0.1	0.5
23	0						
24	3	24	23	24	24	1	2.4
25	3	19.5	20.3	19.6	19.8	0.4	2.2
26	3	22.3	22.3	21.8	22.1	0.3	1.3
27	3	22.7	21.7	21.0	21.8	0.9	3.9
28	0						
29	3	20.5	20.3	20.6	20.5	0.2	0.7
30	3	26.9	26.7	26.3	26.6	0.3	1.1
31	3	27.3	26.7	28.3	27.4	0.8	2.9
32	3	20.2	20.4	22.4	21.0	1.2	5.8
33	3	18.2	17.8	17.4	17.8	0.4	2.2
34	3	26.3	29.1	33.0	29.5	3.4	11.4
35	3	21.5	20.9	21.8	21.4	0.5	2.1
36	3	23.6	23.9	23.7	23.7	0.2	0.6
37	3	20.7	21.2	21.0	20.9	0.2	1.1
38	0						
39	3	21.5	21.7	21.7	21.6	0.1	0.5

LEAD
MESS-2
mg/kg

Lab					Mean	SD	RSD
1	3	21	22	22	22	1	2.7
2	3	20.3	22.7	19.3	20.8	1.7	8.4
3	3	17.9	18	17.7	17.87	0.15	0.9
4	3	21.2	21.2	21.6	21.3	0.2	1.1
5	3	21.6	21.4	21.7	21.6	0.2	0.7
6	0						
7	0						
8	3	21.63	21.26	21.19	21.36	0.24	1.1
9	0						
10	3	22.5	21.8	22.7	22.3	0.5	2.0
11	0						
12	3	18.1	18.6	17.6	18.1	0.5	2.8
13	0						
14	0						
15	0						
16	3	21.07	22.21	21.72	21.67	0.57	2.6
17	3	21.5	21.2	22.0	21.6	0.4	1.8
18	3	20.5	20.4	20.3	20.4	0.1	0.5
19	3	21.4	22.3	21.6	21.8	0.5	2.2
20	3	23.19	23.89	26.07	24.38	1.50	6.2
21	3	25.8	25.0	25.2	25.3	0.4	1.6
22	3	21.8	21.1	20.9	21.3	0.5	2.2
23	0						
24	3	24	23	22	23	1	4.3
25	3	20.4	19.2	19.9	19.8	0.6	3.0
26	3	22.5	22.6	22.6	22.6	0.1	0.3
27	3	22.7	22.7	22.4	22.6	0.2	0.8
28	0						
29	3	20.7	20.2	20.1	20.3	0.3	1.6
30	3	26.1	27.1	26.9	26.7	0.5	2.0
31	3	26.6	28.5	28.5	27.9	1.1	3.9
32	1	21			21		
33	3	19.1	16.3	17.4	17.6	1.4	8.0
34	3	35.1	37.6	36.8	36.5	1.3	3.5
35	3	22.1	21.6	24.1	22.6	1.3	5.9
36	3	21.1	21.4	23.8	22.1	1.5	6.7

LEAD
Tissue 99
mg/kg

Lab					Mean	SD	RSD
1	3	3.8	4.3	4.4	4.2	0.3	7.7
2	3	3.88	3.73	4.08	3.90	0.18	4.5
3	3	3.3	3.3	4.8	3.8	0.9	22.8
4	3	3.13	3.36	3.13	3.21	0.14	4.3
5	3	3.4	3.28	3.26	3.31	0.08	2.3
6	3	6.87	7.42	6.67	6.99	0.39	5.6
7	3	3.697	3.82	3.974	3.830	0.139	3.6
8	3	4.03	4.04	4.1	4.06	0.04	0.9
9	3	4.1	3.85	3.74	3.90	0.18	4.7
10	3	3.57	3.41	3.43	3.47	0.09	2.5
11	0						
12	3	3.07	3.09	3.21	3.12	0.08	2.4
13	0						
14	3	2.63	2.63	3.01	2.76	0.22	8.0
15	3	1.571	1.788	1.663	1.674	0.109	6.5
16	3	3.463	3.32	3.094	3.292	0.186	5.7
17	3	3.16	3.56	3.13	3.29	0.24	7.2
18	3	3.67	3.74	3.75	3.72	0.04	1.2
19	0						
20	3	4.47	4.19	4.72	4.46	0.27	5.9
21	0						
22	3	3.8	3.6	3.7	3.7	0.1	2.7
23	3	2.59	2.49	2.48	2.52	0.06	2.4
24	3	1	2	3	2	1	50.0
25	3	3.58	3.78	3.81	3.72	0.13	3.4
26	3	5.07	4.55	4.68	4.77	0.27	5.7
27	3	3.75	3.57	3.76	3.69	0.11	2.9
28	3	5.76	5.75	5.75	5.75	0.01	0.1
29	3	3.22	3.69	3.39	3.43	0.24	6.9
30	3	3.78	4.12	3.75	3.88	0.21	5.3
31	0						
32	0						
33	0						
34	3	2.20	1.90	2.26	2.12	0.19	9.1
35	3	3.77	3.76	3.74	3.76	0.02	0.5
36	3	3.54	3.54	3.55	3.54	0.01	0.2
37	0						
38	0						
39	3	3.62	3.5	3.58	3.57	0.06	1.7

LEAD
CRM 2976
mg/kg

Lab					Mean	SD	RSD
1	3	1.2	1.2	1.2	1.2	0.00	0.0
2	3	1.26	1.23	1.25	1.25	0.01	1.1
3	3	1.19	1.36	1.08	1.21	0.14	11.7
4	3	1.18	1.12	1.34	1.21	0.11	9.2
5	3	1.32	1.3	1.34	1.32	0.02	1.5
6	3	2.08	2.03	2.07	2.06	0.03	1.3
7	3	1.202	1.31	1.294	1.269	0.058	4.6
8	3	1.17	1.22	1.18	1.19	0.03	2.2
9	3	3.1	1.15	1.19	1.81	1.11	61.5
10	3	1.20	1.13	1.14	1.15	0.04	3.1
11	0						
12	3	1.16	1.08	1.08	1.11	0.05	4.2
13	0						
14	0						
15	0						
16	3	1.114	1.02	1.072	1.069	0.047	4.4
17	3	1.10	1.04	1.06	1.07	0.03	3.2
18	3	1.15	1.21	1.16	1.17	0.03	2.7
19	0						
20	3	1.512	1.396	1.423	1.444	0.061	4.2
21	0						
22	3	1.1	1.2	1.3	1.2	0.1	8.3
23	3	1.19	1.17	1.23	1.20	0.03	2.6
24	3	1	2	1	1	1	43.3
25	3	1.23	1.19	1.19	1.20	0.02	1.9
26	3	1.13	1.21	1.13	1.16	0.05	4.0
27	3	1.34	1.38	1.44	1.39	0.05	3.6
28	3	1.07	1.09	1.11	1.09	0.02	1.8
29	3	1.07	1.06	1.02	1.05	0.03	2.5
30	3	1.19	1	1.04	1.08	0.10	9.3
31	0						
32	0						
33	0						
34	3	1.08	1.27	1.02	1.12	0.13	11.6
35	3	1.11	1.05	1.22	1.13	0.09	7.8
36	3	1.24	1.15	1.14	1.18	0.06	4.7

APPENDIX C

Procedures for the Analysis of the Sediments

Lab	Sediment Digestion Procedure	Instrumentation
1	- 1 g - HNO_3, HCl, - open vessel	FAAS - Cd,Pb,Ag ICPAES - Be, Al, Si,Cr,Mn,Fe,Ni,Cu Zn,Sn,Sb,Tl,Pb
	- 0.5 g - HNO_3, HF, HCl, $HClO_4$ - open vesel	
2	- 0.3g - HNO_3, HF, HCl - closed vessel, microwave heating	ICPAES - Al,Si,Fe ICPMS- Be,Cr,Mn,Ni,Cu,Zn,As,Se, Ag,Cd,Sn,Sb,Tl,Pb
3	- 0.5 g - HNO_3, HCl - closed vessel microwave heating	GFAAS - Ag, Pb, As, Ni ICPAES - Zn,Fe,Cu
4	- 0.2g - HNO_3, HF, HCl, boric acid - closed vessel microwave heating	GFAAS-Cd,Pb,Cu ICPAES- Si,Al,Be,Fe,Ni,Zn,Mn,As
5	- 0.5 g - HNO_3 - closed vessel microwave heating	ICPMS - As,Se,Tl,Ag,Cd,Sb, ICPAES- Be,Al,Si,Cr,Mn,Fe,Ni,Cu, Zn,Sn,Pb
6	NA	
7	NA	
8	- 0.3 g - HF, HCl - closed vessel microwave heating	ICPMS- Be,Cr,Mn,Ni,Cu,Zn,As,Se,Ag, Cd,Sn,Tl,Sb ICPAES- Al,Si,Fe
9	NA	
10	- 0.3 g - HNO_3. HF, $HClO_4$ - open vessel, microwave heating	ICPMS- Pb,Cu,Cr,Zn,Ni ICPAES- Al,Fe,Mn
11	NA	

12	- 0.5g - HNO_3, HF,HCl, H_2SO_4, $HClO_4$ - open vessel	FAAS- Cu,Ni DCPAES- Be,Al,Cr,Mn,Fe,Zn
	- 0.4 g - HNO_3, H_2SO_4, $HClO_4$ - open vessel	HGAAS- As,Se
	- 0.4 g - HNO_3, HCl - open vessel	GFAAS - Cd DCP - Pb
13	- 0.25 g - dry ash	HGAAS- As,Se
14	- 0.2 g - HNO_3, HF, HCl, boric acid - closed vessel microwave heating	ICPAES - Be,Al,Cr,Mn,Ni,Cu,Zn,As,Cd
15	NA	
16	- 0.3 g - HNO_3, HF, boric acid - open vessel	ICPMS- Be,Cr,Mn,Ni,Cu,Zn,As,Se,Cd, Sb,Tl,Pb
17	- 0.25 g - HNO_3, HF, $HClO_4$ - open vessel	FAAS- Al,Fe,Mn GFAAS - Ag,Se ICPMS - Be,Cr,Ni,Cu,Zn,As,Cd,Sn, Sb,Tl,Pb
18	- 0.5 g - HNO_3, H_2O_2 - closed vessel microwave heating	GFAAS - As,Pb ICPAES - Cu,Mn,Ni,Zn
19	- 0.2 g - HNO_3, HF,HCl, $HClO_4$ - open vessel	HGAAS- As,Se ICPMS- Cr,Mn,Cu,Ag,Cd,Sb,Tl,Pb ICPAES- Al,Be,Fe,Ni,Zn
20	- 0.2 g - HNO_3, HF - closed vessel	ICPMS - Al,Cu,Ag,Mn,Zn,Cr,Ni,As, Cd,Sn,Sb,Tl,Pb,Be,Si HGAAS- As,Se color- Fe
21	- 0.2 g - HNO_3, HF, HCl, boric - closed vessel	GFAAS- Ag,Cd,Pb,Cr,Mn,As,Fe,Al ICPAES- Cu,Ni,Zn

22	- 0.2 g - HNO_3, HF, H_2SO_4 - closed vessel microwave heating	XRF- Al,Si ICPMS- Ni,As,Cd,Sn,Sb,Tl,Pb ICPAES- Be,Cr,Fe,Mn,Cu,Zn
23	NA	
24	- 0.5 g - HNO_3, HF, HCl, $HClO_4$ - open vessel	FAAS - Ag,Cd, and Pb HGAAS- ,As,Se,Sb ICPAES - Be,Al,Cr,Mn,Fe,Ni,Cu,Zn
25	- 0.25g - HNO_3, HF - closed vessel	GFAAS- Se,Ag,Cd XRF- Al,Si,Mn,Fe,Zn ICPMS- Be,Cr,Cu,As,Sn,Sb,Tl,Pb ICPAES- Ni
26	- 1 g - HNO_3, HF, HCl - closed vessel microwave heating	FAAS - Fe,Cu,Zn GFAAS- As,Se,Pb,Cd,Sb ICPAES- Be,Cr,Ni,Ag,Sn
27	- 0.1 - 0.25 g - HNO_3, HF, HCl - closed vessel microwave heating	FAAS- Cu,Mn,Zn,Fe GFAAS- Ag,Cd,Cr,Ni,Pb HGAAS- As,Se
28	- NA	
29	- 0.25g - HNO_3, HF, HCl - closed vessel microwave heating	GFAAS- Ni,As,Ag,Cd,Sb,Tl,Pb HGAAS- Se ICPAES- Be,Cr,Mn,Fe,Zn
30	- 0.25 g - HNO_3, HF, HCl - closed vessel microwave heating	GFAAS - Cu,Cr,Pb,Ni,Ag,As ICPAES - Zn,Mn,Fe,Al
31	- 0.5 g - HNO_3, HF, HCl - closed vessel microwave heating	GFAAS- As,Se ICPMS - Ag,Cd,Sn,Sb,Tl,Pb ICPAES - Be,Al,Si,Cr,Mn,Fe,Ni,Cu,Zn
32	- 0.2 - 0.4 g - HNO_3, HF, HCl - closed vessel, hot block	FAAS- Al,Cr,Cu,Ni,Zn,Fe GFAAS- Ag,Cd,Pb,As,Sn
33	- 0.5 g - HNO_3, Hcl - closed vessel, microwave heating	GFAAS- As,Cd,Pb,Se,Ag ICPAES- Al,Be,Cr,Mn,Fe,Ni,Cu,Zn
34	- 0.8 g - HNO_3, HF, boric acid - open vessel	FAAS- Al,Cu,Pb,Ni,Cr,Mn,Fe,Zn GFAAS - Ag,Tl,Be,Sn,Sb,Cd HGAAS- As,Se

35	- 0.2 g - HNO_3, HF, boric acid - closed vessel	GFAAS- Ag,As,Cd,Pb,Sb,Sn,Tl ICPAES -Be,Al,Si,Cr,Mn,Fe,Ni,Cu,Zn HGAFS- Se
36	- 1 g - HNO_3, HCl - open vessel	FAAS- Cu ICPMS- As,Cd,Pb,Se ICPAES- Zn
37	- 0.25 g - HNO_3, HF, $HClO_4$ - closed vessel, microwave heating	GFAAS - Be, Ni,Cu,As,Se,Ag,Cd,Pb
38	- 0.25g - HNO_3, HF, HCl - closed vessel, microwave heating	ICPAES- Al,Fe,
39	- 0.25 g - HNO_3, HF - closed vessel, microwave heating	ICPMS- Be,Cr,Mn,Ni,Cu,Zn,As,Ag, Cd,Sn,Sb,Tl,Pb

Procedures for the Analysis of the Tissues

Lab	Tissue Dissolution Procedure	Instrumentation
1	- 1g - HNO_3, H_2O_2 - open vessel	FAAS -Fe ICPMS- Al,Cr,Ni,Cu,Zn,As,Se, Ag,Cd,Sn,Pb
2	- 0.1 g - HNO_3, H_2SO_4, $HClO_4$ - open vessel	HGAAS -As,Se
	- 0.5 g - HNO_3, H_2O_2, HCl - closed vessel microwave heating	ICPAES- Fe,Zn GFAAS- Cr,Ni,Cu,Cd,Pb
3	- 0.5 g - HNO_3, H_2O_2 - open vessel	GFAAS- Ag,Pb,Se,Cu,Ni,Cr ICPAES - As,Zn,Fe,Cd
4	- 0.5 g - HNO_3 closed vessel microwave heating	GFAAS- Cd,,Cr,Ni,Pb ICPAES- Al,Cu,Fe,Zn

5	- 0.5 g - HNO_3 - closed vessel microwave heating	ICPMS - As,Se,Ag,Cd ICPAES Al,Cr,Mn,fe,Ni,Cu,Zn,Sn,Pb
6	- 0.25 g - HNO_3, H_2O_2 - closed vessel microwave heating	ICPMS- Al,As,Cd,Cr,Cu,Fe,Pb,Ni, Se,Ag,Zn
7	- 1g - HNO_3, H_2O_2 - open vessel	ICPMS- Ni, As,Ag,Se,Cd,Pb ICPAES- Fe,Cu,Zn,Cr,Al
8	- 0.5g - HNO_3 - closed vessel microwave heating	ICPMS - Ni, Cu,As,Se,Ag,Cd,Sn,Pb ICPAES - Al,Cr,Zn,Cu,Fe
9	- 0.2- 0.3g - HNO_3, HCl - closed vessel microwave heating	ICPMS- Ni,Cu,Ag,Cd,Pb ICPAES - Al,Cr,Fe,Zn,As,Se,Sn
10	- 0.3 g - HNO_3 - closed vessel microwave heating	ICPMS- Ag,Cd,Pb,Al,Cr,Cu,As ICPAES- Fe,Zn
11	NA	
12	- 0.45g - HNO_3, H_2O_2 - open vessel	FAAS- Cu,Zn GFAAS- Cd DCPAES- Fe
	-0.45 g - HNO_3, H_2O_2 - open vessel -DDDC extraction	GFAAS- Pb
	- 0.2 g - HNO_3, HCl, $HClO_4$, H_2SO_4 - open vessel	HGAAS- As, Se
13	- 0.25 g - dry ash	HGAAS- As,Se
14	- 1g - HNO_3, $HClO_4$ - open vessel	ICPAES - Al,Cr,Fe,Ni,Cu,Zn,As Se,Ag,Cd,Pb

15	- 0.2 g - HNO_3, H_2O_2 - closed vessel microwave heating	GFAAS- Cr,Cu,Cd,Pb
16	- 0.5g - HNO_3 - closed vessel microwave heating	ICPMS- Cr,Ni,Cu,Zn,As,Se,Cd,Pb
17	- 0.5 g - HNO_3, H_2O_2 - closed vessel microwave heating	FAAS- Al,Fe,Mn ICPMS- Cr,Ni,Cu,Zn,As,Cd,Sb,Pb
18	- 0.5 g - HNO_3, H_2O_2 - closed vessel microwave heating	GFAAS- As,Cd,Pb,Ag ICPAES- Al,Cr,Cu,Fe,Mn,Ni,Zn
19	NA	
20	- 0.2 g - HNO_3 - open vessel	ICPAES - Al,Cr,Ni,Cu,Zn,As,Ag,Cd,Sn,Pb HGAAS - Se
21		
22	- 0.2 g - HNO_3, H_2O_2, HCl - closed vessel microwave heating	ICPMS - Ni,Cu,As,Se,Cd,Pb ICPAES - Al,Cr,Fe,Zn
23	- 1.5 g - HNO_3, H_2O_2 - closed vessel microwave heating	ICPAES - Cr,Cu,Zn,Cd,Pb
24	- 0.5 g - HNO_3, HF, HCl, $HClO_4$ - open vessel	FAAS - HGAAS - ICPAES -
25	- 0.2 g - HNO_3, HF - closed vessel microwave heating	ICPMS- Al,Cr,Ni,As,Se,Ag,Cd,Sn,Pb ICPAES - Fe,Cu,Zn
26	- 1g - HNO_3 - closed vessel microwave heating	GFAAS - Cr,Pb,Ag ICPAES - Al,Fe,Ni,Cu,Zn,As,Cd,Sn
27	- 0.1 - 0.25 g - HNO_3, HF, HCl - closed vessel microwave heating	FAAS- Cu,Zn GFAAS- Ag,Cd,Cr,Ni,Pb,Fe

	- 0.1 -0.25 g - HNO_3, HCl - $Mg(NO_3)_2$ dry ash	HGAAS - As, Se
28	- 0.25g - closed vessel microwave heating	FAAS- Fe GFAAS- Cr ICPMS- Al,Ni,Cu,Zn,As,Ag,Cd,Sn,Pb HGAAS- Se
29	- 0.25g - HNO_3, H_2O_2 - closed vessel microwave heating	GFAAS- Cr,Ni,Ag,Cd,Pb HGAAS- Se ICPMS- As ICPAES- Al,Fe,Cu,Zn
30	- 0.5 g - HNO_3, H_2O_2 - closed vessel microwave heating	GFAAS- Cu, Cr,Pb,Ni,Cd,Ag,As ICPAES - Zn,Mn,Fe,Al
31	NA	
32	NA	
33	NA	
34	- 1.3 g - HNO_3, HF, H_2SO_4 - open vessel	FAAS- Al,Fe, Zn GFAAS- Cu,Pb,Ni,Cr,Sn,Ag,Tl,Cd HGAAS- As,Se
35	- 0.2 g - HNO_3 - closed vessel	GFAAS- Ag,As,Cd,Ni,Pb,Se,Sn ICPAES- Al,Cr,Fe,Cu,Zn
36	- 1 g - HNO_3, H_2O_2 - open vessel	FAAS- Zn ICPMS- As,Cd,Cr,Cu,Pb,Ni,Se,Ag ICPAES - Al,Fe
37	- 0.25g - HNO_3, H_2O_2 - closed vessel, microwave heating	GFAAS- Cr,Ni,Cu,As,Se,Ag,Cd ICPAES- Al,Fe,Zn
38	- 0.25g - HNO_3, HF - closed vessel, microwave heating	ICPAES- Al,Fe,Zn
39	- 0.25 g - HNO_3 - closed vessel, microwave heating	IDICPMS-Cu,Zn,Ag,Pb,Ni,Cd,Sn

Sample Preparation for Hg Determination

Lab	Sediment	Tissue	Instrumentation
1	same as for other elements	same as for other elements	CVAAS
2	same as for other elements	- 0.5g - HNO_3, H_2O_2, HCl - closed vessel microwave heating	ICPMS (sediment) CVAAS (tissue)
3	- 0.5 g - HNO_3, H_2SO_4 - open vessel	- 0.5 g - HNO_3, H_2SO_4 - open vessel	CVAAS
4	-1 g - HNO_3, HCl - open vessel	- 0.5 g - HNO_3, H_2SO_4 - open vessel	CVICP
5	same as for other elements	same as for other elements	CVAAS
6	NA	- 0.5 - 1 g - HNO_3, H_2SO_4, $KMnO_4$, $K_2S_2O_8$	CVAAS
7	NA	- 1 g - HNO_3, H_2O_2 - open vessel	CVAAS
8	same as for other elements	same as for other elements	
9	- 1 g - HNO_3, H_2O_2 - $KMnO_4$, $K_2S_2O_8$ - open vessel	- 0.2 -0.3 g - HNO_3, HCl - closed vessel microwave heating	CVAAS
10	NA	NA	ICPMS
11	NA	- 0.2 g - HNO_3, $HClO_4$ - open vessel	CVAAS
12	same as for Cd, Pb	- 0.1 g - HNO_3, H_2O_2, H_2SO_4, $KMnO_4$ - open vessel	CVAAS
13	NA	NA	

14	NA	same as for other elements	CVAAS
15	NA	NA	
16	- 0.5 g - HNO_3, H_2SO_4 - open vessel	- 0.5 g - HNO_3, H_2SO_4, $KMnO_4$ - water bath	CVAAS
17	- 0.25 g - HNO_3, $HClO_4$ - open vessel	same as for other elements	ICPMS
18	NA	NA	
19	- 0.1 g - HNO_3 - $Na_2Cr_2O_7$	NA	CVAAS
20	same as for other elements	same as for other elements	CVAFS
21	same as for other elements	NA	CVAAS
22	NA	NA	
23	NA	- 0.04 g - dry ash	CVAAS
24	- 0.5 g - HNO_3, HCl - open vessel	same as for other elements	CVAAS
25	same as for other elements	same as for other elements	CVAAS
26	- 1 g - HNO_3, HCl, H_2SO_4, $KMnO_4$ - open vessel, water bath	- 1 g - HNO_3, H_2SO_4 - open vessel, water bath	CVAAS
27	- 0.06 - 0.4 g - HNO_3, H_2SO_4 - open vessel	- 0.1 - 0.2 g - HNO_3, H_2SO_4 - open vessel	CVAAS
28	NA	same as for other elements	CVAAS
29	- 0.25 g - HNO_3, HF, HCl - closed vessel microwave heating	- 0.25 g - HNO_3, H_2O_2 - closed vessel microwave heating	CVAAS
30	NA	NA	

31	same as for other elemnts	NA	CVAAS
32	- 0.2 - 0.4 g - HNO_3, HF, HCl - closed vessel, hot block	NA	CVAAS
33	- 0.5 g - HNO_3, Hcl - closed vessel, microwave heating	NA	CVAAS
34	- 0.7 g - HNO_3, H_2SO_4 - $KMnO_4$, $K_2S_2O_8$ - closed vessel	- 1.6 g - HNO_3, H_2SO_4 - $KMnO_4$, $K_2S_2O_8$ - closed vessel	CVAAS
35	- 0.2 g - HNO_3, H_2SO_4 - $KMnO_4$, $K_2S_2O_8$ - closed vessel	- 0.2 g - HNO_3, H_2SO_4 - $KMnO_4$, $K_2S_2O_8$ - closed vessel	CVAAS
36	same as for other elements	same as for other elements	CVAAS
37	- 0.25g - HNO_3 - closed vessel, microwave		CVAAS
38	NA	NA	
39	as other elements	NA	ICPMS

Appendix D

Sediments
- Z- scores D-2
- p - scores D-4

Tissues
- Z - scores D-6
- p - scores D-7

Appendix D

Z- Scores for Sediments

LAB	Be		Al		Si		Cr		Mn		Fe		Ni		Cu		Zn	
	Sed 99	MESS-2	Sed 99	MESS-2	Sed 99	MESS-2	Sed 99	MESS-2	Sed 99	MESS-2	Sed 99	MESS-2	Sed 99	MESS-2	Sed 99	MESS-2	Sed 99	MESS-2
1		-1.4	0.1	0.1			0.4	0.1	-0.0	-0.3	0.2	-0.2	1.7	0.1	0.5	0.1	0.3	-0.4
2			0.5	0.6	-0.3	-0.9	0.9	0.6	0.1	-0.1	-0.1	-0.1	0.3	0.2	-0.5	-0.6	0.3	-0.2
3											2.4	-4.5	0.5	-0.0	-1.1	-1.0	-0.8	-1.4
4	0.4	-0.1	0.0	0.1	0.4	-0.5	-0.4	-0.4	-0.2	-0.6	0.2	-0.2	-0.3	-0.4	0.2	0.2	-0.1	-0.7
5	-4.2	-3.5	18.1	29.0	-0.4	1.1	-7.1	-9.9	-1.7	-1.4	-2.3	-1.0	-1.8	-1.2	-0.8	0.0	-2.1	-1.9
6																		
7																		
8	0.5	-0.4	0.1	-0.0	4.0	0.4	0.1	-0.3	-0.1	-0.2	0.4	0.0	-0.3	-0.3	0.1	-0.1	-0.0	-0.6
9																		
10			-0.0	0.3	1.1	-0.1	-0.2	-0.6	-0.4	-0.2	0.2	-0.4	0.5	-0.2	1.3	-0.0	0.9	-0.2
11																		
12	-1.4	-0.5	-0.8	-1.5			0.9	0.8	0.5	-0.5	-1.1	-2.7	-0.2	-0.4	-0.3	-0.1	0.9	-0.2
13																		
14	-0.1	-0.9	-0.7	-1.0			-0.3	-0.8	-0.7	-1.3			-0.9	-1.3	0.6	0.5	-0.7	-1.6
15																		
16	0.3	-0.5					0.1	-0.2	-1.1	-1.4			1.4	0.0	-0.1	0.0	2.8	0.2
17	0.1	-0.1	-0.3	-0.3			0.1	-0.4	0.8	-0.2	0.8	0.5	0.6	-0.0	0.9	-0.4	0.1	-0.8
18									-1.3	-1.1			-1.5	-1.1	-1.2	-1.1	-0.1	-0.4
19	0.8	0.6	0.1	0.5			-0.2	-0.3	0.3	-0.1	0.3	0.1	0.4	-0.8	0.2	0.4	-0.3	-0.7
20	0.2	-0.3	-13.8				-0.9	-0.9	-0.9	-1.3	4.4	3.1	-0.5	-0.1	1.6	1.7	0.2	-0.3
21			1.7	-0.2			-1.2	-1.2	-0.1	-0.4	-3.6	-2.5	-1.0	-0.4	-0.7	-0.5	-1.5	-2.0
22	-1.0	-1.2	-0.3	-0.1	-0.9	-1.5	0.2	-0.3	-0.7	-0.7	0.1	-0.1	-1.5	-0.4	0.3	0.3	-0.4	-1.0
23																		
24	-0.5	-0.5	-0.1	0.1			0.2	-0.1	0.2	0.1	-0.4	0.6	0.2	-0.1	-1.6	-0.8	0.0	-0.1
25	0.3	0.1	-1.3	-0.6	0.3	-0.2	-0.3	-0.3	0.1	-0.2	0.1	-0.1	-0.1	0.3	-0.9	-0.2	0.5	-0.6
26	-0.4	-0.6					-0.7	-0.7			0.5	-0.1	-0.4	-0.3	0.0	-0.4	-0.1	-0.6
27							-0.6	-0.3	0.1	-0.1	-0.4	-0.4	0.2	0.1	-0.1	0.1	-0.3	-0.9
28																		
29	-0.1	0.6					-0.1	-0.2	0.1	-0.2	-0.5	-0.2	0.4	0.6	0.1	-0.1	-0.1	-0.7
30			-3.1	-8.3			2.0	0.3	4.5	4.1	8.0	7.9	4.9	11.1	1.6	1.3	5.4	4.7
31	-2.0	-3.3	-7.9	-9.1	0.2	-0.9	-0.8	-1.3	-4.1	-4.0	-2.7	-3.6	1.5	0.8	0.2	-0.5	-1.5	-2.0
32			-0.1	-0.9			-2.2	-1.7	-2.4	-2.1	-1.8	-0.8	-3.2	-2.5	-0.5	-1.3	-0.4	-1.4
33	-2.2	-1.9	-8.3	-5.4			-2.8	-2.0	-1.1	-1.2	-3.6	-3.3	0.3	0.6	-0.6	-0.7	-0.8	-1.3
34	-1.2	-1.3	10.8	5.8			-2.6	-2.3	4.6	4.6	-0.7	-0.3	-4.1	-3.6	-2.0	-3.5	1.5	0.8
35	-0.3	-0.4	-0.6	-0.2	-0.3	-1.6	-0.1	-0.3	-0.1	-0.6	-0.9	-1.3	0.4	0.1	0.8	0.2	-0.6	-1.1
36															-0.6	0.3	-2.8	-0.3

Z- Scores for Sediments

LAB	As		Se		Ag		Cd		Sn		Sb		Hg		Tl		Pb	
	Sed 99	MESS-2	Sed 99	MESS-2	Sed 99	MESS-2	Sed 99	MESS-2	Sed 99	MESS-2	Sed 99	MESS-2	Sed 99	MESS-2	Sed 99	MESS-2	Sed 99	MESS-2
1	-0.1	-0.2	0.5	1.1			3.6						3.6	0.8			1.4	-0.1
2	0.3	-0.1	0.4	0.6			1.1	0.5					-0.3	-0.6			-0.2	-0.5
3	-1.1	-1.5			1.5	2.7							2.9	1.7			-1.5	-1.8
4	-0.3	-0.1					0.3	-0.1					-0.3	0.1			0.2	-0.3
5	-2.5	-2.2											2.3	0.7			-0.6	-0.2
6																		
7																		
8	0.4	-0.0	-0.0	-0.4	0.3	0.4	-0.8	-0.4	-0.1	-0.9	-0.6	0.3	1.0	0.8	-0.5	0.1	-1.0	-0.2
9													-2.2	2.2				
10							0.5	-0.3									0.5	0.2
11																		
12	0.6	0.9	0.3	1.1			-0.2	-0.2					-0.3	-0.7			0.3	-1.7
13			-0.8	-0.4														
14	-0.1	-0.5					-5.3	-2.5										
15																		
16	-0.0	-0.0	0.4	0.4			1.4	0.2			-0.7	-0.1	-0.3	0.1	0.3	0.2	0.3	-0.1
17	0.4	0.2	-0.0	-0.1	1.1	0.5	0.5	-0.7	-0.9	-0.8	-0.8	-1.2	-0.3	-0.5	-1.0	-0.8	-0.0	-0.2
18	-1.5	-0.3			1.5	1.5											-1.2	-0.7
19	0.0	0.0	-0.0	0.7			-0.3	-0.3			1.2	1.0	0.5	0.9	-0.1	-0.0	0.3	-0.1
20	0.4	0.4	-0.1	0.9	15.4	23.5	-0.1	-0.3			0.1	1.5	-0.3	-0.7	0.2	0.5	1.2	1.1
21	-1.2	-0.4			1.5	0.6	1.5	1.5					2.3	1.2			-0.6	1.6
22	-0.8	0.1					0.3	-0.1	0.1	0.2	-0.2	-0.1			-0.8	-0.2	0.1	-0.3
23																		
24	0.2	0.1	0.0	1.1			0.6	-0.3			0.6	0.7	1.6	-0.2			1.2	0.5
25	0.7	0.4	-0.5	-0.5	-1.3	-1.9	-0.5	-1.5	0.3	0.9	0.5	0.6	-0.3	0.5	-1.3	-0.5	-0.6	-0.9
26	0.2	0.0	-1.2	-0.3	-0.4	0.1	1.1	0.8			-0.3	-0.3	0.8	-0.1			0.5	0.3
27	-0.8	0.0	-3.2	-0.9	-1.1	0.6	-0.9	-0.7					-1.2	0.3			0.3	0.3
28																		
29	-0.5	-0.6	-0.8	-0.8	0.3	0.3	0.8	0.6			-0.1	0.2	0.1	-0.4	0.7	0.7	-0.3	-0.7
30	2.3	10.0			23.7	0.0	26.4										2.6	2.2
31	1.1	0.4	-0.3	1.4	5.4	4.4	0.2	-0.4	0.4	0.8	-1.4	-1.6	0.2	-0.6	0.3	0.4	3.0	2.7
32	2.8	2.6					-0.5	0.0	3.9	11.2			4.1	3.0			-0.0	-0.4
33	2.6	2.8	10.4	14.6	-0.4	0.0	1.4	-1.8					-1.1	-1.2			-1.6	-2.0
34	-2.4	-5.4	0.2	-4.7	9.4	0.4	4.5	14.3	6.9	8.0	-3.9	-2.8	0.1	-0.3	-4.7	-3.0	4.0	6.7
35	-0.7	0.3			1.5	-0.4	0.7	-0.3	0.1	0.9	-1.0	0.2	2.8	0.8		-0.9	0.1	0.3
36	0.1	-0.2	2.1	1.3			0.2	0.1					1.2	0.7			1.2	0.1

p- Scores for Sediments

LAB	Be		Al		Si		Cr		Mn		Fe		Ni		Cu		Zn	
	Sed 99	MESS-2	Sed 99	MESS-2	Sed 99	MESS-2	Sed 99	MESS-2	Sed 99	MESS-2	Sed 99	MESS-2	Sed 99	MESS-2	Sed 99	MESS-2	Sed 99	MESS-2
1		0.0	0.6	0.4			0.1	0.3	0.3	0.2	0.5	0.5	0.8	0.4	0.6	0.4	0.6	0.2
2			0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.1
3											0.0	0.3	0.1	0.1	0.2	0.2	0.1	0.0
4	0.9	0.4	0.2	0.2	0.1	0.2	0.1	0.1	0.1	0.3	0.1	0.1	0.2	0.3	0.2	0.5	0.0	0.1
5	0.0	0.0	0.2	0.1	0.2	0.2	0.1	0.1	0.0	0.1	0.2	0.3	0.1	0.2	0.1	0.0	0.1	0.1
6																		
7																		
8	0.3	0.5	0.1	0.0	0.7	0.3	0.2	0.1	0.0	0.1	0.1	0.0	0.1	0.2	0.0	0.1	0.1	0.0
9																		
10			0.2	0.3	0.2	0.3	0.1	0.1	0.0	0.1	0.4	0.2	0.3	0.3	0.5	0.8	0.2	0.1
11																		
12	0.9	0.9	0.3	0.4			0.2	0.3	0.1	0.2	0.7	0.6	0.0	0.1	0.2	0.2	0.2	0.1
13																		
14	0.2	0.2	0.1	0.4			0.0	0.1	0.1	0.1			0.1	0.3	0.0	0.1	0.2	0.0
15																		
16	0.2	0.1					0.5	0.3	0.1	0.4			0.2	0.0	0.1	0.3	1.0	0.5
17	0.1	0.1	0.2	0.1			0.2	0.1	0.2	0.3	0.1	0.1	0.2	0.2	0.1	0.0	0.2	0.0
18									0.1	0.2			0.1	0.4	0.1	0.3	0.0	0.2
19	0.0	0.1	0.0	0.1			0.1	0.2	0.1	0.1	0.2	0.2	0.3	0.2	0.2	0.5	0.1	0.0
20	0.3	0.7	3.3				0.2	0.6	0.2	0.7	1.2	0.4	0.1	0.6	0.4	0.6	0.1	0.7
21			0.8	0.9			0.2	0.1	0.2	0.3	0.1	0.5	0.3	0.1	0.2	0.2	0.1	0.2
22	0.2	0.4	0.1	0.1	0.0	0.0	0.1	0.2	0.2	0.2	0.4	0.7	0.2	0.7	0.2	0.4	0.1	0.1
23																		
24	0.3	0.0	0.1	0.2			0.1	0.1	0.0	0.0	0.0	0.3	0.0	0.3	0.0	0.4	0.0	0.0
25	0.7	0.4	0.5	1.1	0.1	0.1	0.3	0.4	0.2	0.5	0.2	0.0	0.5	0.2	0.5	1.0	0.3	0.3
26	0.1	0.1					0.1	0.1			1.4	1.2	0.0	0.0	0.2	0.4	0.1	0.1
27							0.3	0.3	0.2	0.2	0.3	0.4	0.1	0.4	0.1	0.2	0.4	0.2
28																		
29	0.4	0.2					0.2	0.1	0.1	0.1	0.5	0.5	0.1	0.1	0.3	0.3	0.1	0.1
30			0.7	3.9			2.4	3.2	0.2	0.2	0.4	0.5	1.1	6.7	2.7	0.8	0.4	0.1
31	0.5	0.5	0.2	0.4	0.4	0.2	0.1	0.3	0.3	1.9	0.2	1.0	0.4	0.1	0.3	0.7	0.1	0.1
32			1.8	1.5			0.0	0.1	0.6	0.6	0.5	0.5	0.4	0.5	0.4	0.5	0.1	0.4
33	0.3	0.7	1.1	1.3			0.4	0.6	0.2	0.7	0.2	1.4	0.1	0.4	0.3	0.8	0.1	0.7
34	0.2	0.3	0.4	0.7			0.0	0.3	0.1	0.1	0.5	1.0	0.4	0.3	0.6	0.5	0.1	0.3
35	0.2	0.2	0.2	0.2	0.8	0.6	0.2	0.0	0.2	0.2	0.4	0.2	0.1	0.2	1.0	0.2	0.1	0.3
36															0.0	0.3	0.4	0.2

p- Scores for Sediments

LAB	As		Se		Ag		Cd		Sn		Sb		Hg		Tl		Pb	
	Sed 99	MESS-2	Sed 99	MESS-2	Sed 99	MESS-2	Sed 99	MESS-2	Sed 99	MESS-2	Sed 99	MESS-2	Sed 99	MESS-2	Sed 99	MESS-2	Sed 99	MESS-2
1	0.3	0.4	0.8	0.0			0.0						0.5	0.1			0.4	0.3
2	0.3	0.1	0.1	0.3			0.2	0.0					0.2	0.1			1.2	0.8
3	0.0	0.2			0.7	2.2							2.5	0.6			0.1	0.1
4	0.3	0.1					0.3	0.2					1.4	0.1			0.6	0.1
5	0.0	0.0											0.5	0.2			0.2	0.1
6																		
7																		
8	0.1	0.1	0.4	0.4	0.4	0.1	0.2	0.7	0.8	0.5	0.3	0.2	0.1	0.1	0.5	0.1	0.4	0.1
9													0.7	0.5				
10							0.2	0.1									0.6	0.2
11																		
12	0.1	0.1	0.2	0.1			0.3	0.4					0.2	0.1			0.4	0.3
13			0.2	0.2														
14	0.7	1.1					3.0	4.3										
15																		
16	1.2	0.1	0.5	0.4			1.2	0.6			0.2	0.4	0.3	0.3	0.2	0.2	0.2	0.3
17	0.1	0.3	0.9	0.5	0.3	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.1	0.4	0.1	0.1	0.0	0.2
18	0.8	1.7			0.5	0.2											0.7	0.0
19	0.5	0.5	0.1	0.2			0.3	0.2			0.0	0.0	0.2	0.9	0.1	0.3	0.1	0.2
20	0.1	0.8	1.0	0.5	1.4	1.2	0.8	1.3			0.1	1.0	0.7	0.7	0.3	0.7	0.1	0.6
21	0.1	0.4			0.3	0.5	0.6	0.2					0.1	0.8			0.4	0.2
22	0.1	0.4					0.3	0.2	0.3	0.4	0.6	0.2			0.3	0.1	0.0	0.2
23																		
24	0.0	0.5	0.8	1.2			2.5	2.5			0.5	0.5	1.1	0.0			0.2	0.4
25	0.2	0.3	0.9	1.1	0.4	0.4	0.8	0.3	0.1	0.1	0.1	0.6	0.5	0.6	0.1	0.4	0.2	0.3
26	0.1	0.0	0.3	0.3	1.3	0.6	0.2	0.1			0.6	0.4	0.2	0.0			0.1	0.0
27	0.2	0.2	0.8	0.5	0.6	0.9	0.0	0.3					0.2	0.2			0.4	0.1
28																		
29	0.2	0.3	0.2	0.3	0.1	0.2	0.0	0.2			0.1	0.1	0.4	0.4	0.7	0.5	0.1	0.2
30	5.8	2.7			5.5	1.5	3.3										0.1	0.2
31	0.2	0.1	2.3	3.5	0.2	0.0	0.3	1.2	0.2	0.1	0.3	0.3	0.0	0.7	0.2	0.6	0.3	0.4
32	0.2	0.2					0.5	1.8	1.7	1.8			0.7	0.4			0.6	0.0
33	0.2	0.5	0.6	0.7	0.9	1.9	0.2	0.8					0.6	0.9			0.2	0.8
34	0.8	0.2	1.4	0.8	1.0	1.6	2.0	1.4	0.6	0.7	0.2	0.2	0.2	0.3	0.9	1.2	1.1	0.3
35	0.4	0.3			0.3	1.1	0.1	0.4	0.2	0.2	0.5	0.5	0.2	0.3		0.9	0.2	0.6
36	0.3	0.3	0.7	0.3			0.3	0.2					0.3	0.7			0.1	0.7

Z- Scores for Tissues

LAB	Cr		Fe		Ni		Cu		Zn		As		Se		Ag		Cd		Sn		Hg		Pb	
	Tiss 99	2976	Tiss 99	2976	Tiss 99	2976	Tiss 99	2976	Tiss 99	2976	Tiss 99	2976	Tiss 99	2976	Tiss 99	2976	Tiss 99	2976	Tiss 99	2976	Tiss 99	2976	Tiss 99	2976
1	1.4		-0.5	0.0	-0.3	-1.4	0.2	0.0	0.1	-0.1	0.3	0.3	3.3	1.1			0.8	0.6			-0.2	-0.1	1.7	0.1
2	0.3	-0.4			-0.2	-1.0	1.0	0.5			-0.1	0.0	0.9	0.5			0.9	1.0			1.0	0.2	0.9	0.5
3	-4.4	-1.1	-1.7	-1.4	0.6	-0.3	-0.2	-0.0	-0.5	-0.5	-0.9	-0.4	-1.3	-0.3	0.1	0.1	0.7	2.0			2.7	1.5	0.6	0.2
4	-2.7	0.5	0.3	-0.0	0.2	0.3	-0.1	-0.5	1.0	0.6	-0.5	-0.3					-1.0	-0.0					-1.0	0.2
5	8.3	11.9	-0.1	0.2	-0.3	0.7	-1.2	0.2	-0.2	0.6	-0.3	1.0	0.2	1.1	0.1	-1.1	-2.2	-2.0			0.9	0.1	-0.7	1.1
6	37.3	35.4	9.1	10.4	16.2	12.3	9.0	9.0	7.7	8.2	7.2	7.9	9.1	11.3	0.3	10.9	7.5	7.1			0.5	-0.1	9.6	7.3
7	1.3	3.9	-0.1	-0.5	-2.0	0.9	-0.3	-0.0	0.0	-0.3	-0.3	0.0	3.1	4.9			0.8	0.5			0.4	0.5	0.7	0.7
8	-0.5	-0.1	0.2	-0.4	-0.9	1.0	-0.7	0.1	0.4	0.2	1.2	0.6	1.2	0.6	0.1	0.5	0.4	-0.6	-	-1.9	0.2	-0.5	1.4	-0.0
9			1.6	-0.5	0.7	0.2	-0.9	-1.4	1.0	0.7	-1.5	-0.4	10.0	7.4	0.1	1.5	-0.7	-0.6			-0.6	0.4	0.9	5.2
10	-1.3	-1.5	0.1	0.1			-0.1	-0.0	0.4	0.5	1.5	0.8			0.1	-0.0	0.6	-0.4					-0.3	-0.3
11																					0.2	-0.2		
12			1.7	-0.0			0.4	-0.0	0.1	-0.2	2.5	0.5	0.4	-0.4			1.1	-0.3			-0.1	-0.5	-1.3	-0.7
13											-0.7	0.1	0.7	-0.0										
14	-0.1		-0.7		-1.9		-1.1		-0.4		-0.4		7.1		0.1	-1.8	-0.7				-2.4		-2.3	
15	-1.0						3.3										6.4						-5.3	
16	-2.0	0.4			0.5	0.3	-0.8	-0.4	0.3	0.1	-0.8	-0.0	-1.4	-0.1			-0.7	-0.8			-0.2	-0.3	-0.8	-1.0
17	0.6	2.5	-0.2	-0.1	-0.2	1.5	-1.5	-0.0	-0.4	-0.5	0.5	0.7			0.1	0.1	-0.4	-0.4	-	3.1	-0.7	-0.1	-0.8	-1.0
18			0.6	0.0			-0.4	-0.7	0.1	0.0	4.8	0.8			0.1	-3.8	-0.1	-0.5					0.4	-0.1
19																								
20	-2.5		-0.6	-1.1	0.1		4.0	3.6	0.8	1.0	2.6	1.7	-1.2	-1.3	0.2	7.3	1.9	1.7	-		0.1	-0.7	2.5	2.1
21																							0.4	0.1
22	2.2	1.5	1.0	-0.8	-0.6	0.0	0.4	1.8	0.5	-0.1	0.3	-0.1	0.1	-0.0			0.3	-0.3						
23	-2.3	-0.2					-0.3	0.1	-0.6	-0.4							-0.7	-0.9			-0.2	-0.3	-2.9	0.1
24	1.8	10.0	12.1	-0.1	0.8	0.8	-5.0	-0.9	1.4	0.7	-1.0	-0.2	-4.7	1.9			2.5	-1.5			-1.5	-0.2	-4.4	1.2
25	4.0	2.1	0.8	-0.2	-0.8	-0.2	-0.8	-0.7	-0.1	-0.2	-0.7	-0.3	-0.9	0.3	0.1	-2.8	-0.5	-0.5	-	0.4	0.1	0.2	0.4	0.1
26	-2.0	-0.2	0.3	0.0	1.3	-0.0	-0.3	-0.4	0.5	0.4	-1.0	0.3			0.1	-2.4	0.3	-0.1			-1.4	-1.3	3.4	-0.3
27	0.1	-1.9	-0.2	0.1	-0.1	-0.6	-0.5	-0.2	-0.4	0.1	-0.1	-0.3	-1.3	0.0	0.1	1.3	1.5	0.8			-0.1	0.8	0.3	1.7
28	10.1	-0.4	3.7	-0.9	6.8	-1.8	4.2	-0.7	3.3	-1.0	3.5	-0.7	0.7	-0.3	0.2	5.4	4.5	-0.3		4.6	2.6	1.3	6.1	-0.8
29	3.2	0.8	0.3	-0.2	0.5	-0.7	0.0	0.1	-0.3	-0.4	0.7	0.2	-1.5	-1.3	0.1	1.3	1.3	0.7			0.0	-0.3	-0.4	-1.2
30	2.7	-3.7	-5.5	-2.7	-3.2	-3.5	-3.2	-1.9	0.1	0.5	-1.0	-0.9			0.2	1.8	-3.0	-4.0					0.9	-1.0
31																								
32																								
33																								
34	-5.5	-1.2			>10	>10	-0.4	0.3	-0.7	-0.2	-4.0	-0.0	-2.4	0.4	0.0	-8.8	1.0	-0.2			-3.5	0.1	-4.1	-0.6
35	5.5	0.4	-0.1	-0.5	1.9	-0.1	-0.1	-0.2	-0.2	-0.4	-1.0	-0.5	-0.4	-1.6	0.1	0.7	-0.7	-0.5	-	9.6	-0.8	0.6	0.5	-0.5
36	1.0	0.4	1.4	0.5	0.5	-0.6	-0.2	0.3	0.7	0.3	-0.3	0.5	0.7	0.1	0.2	2.1	0.3	-0.4			2.0	-0.6	-0.1	-0.1

p- Scores for Tissues

LAB	Cr		Fe		Ni		Cu		Zn		As		Se		Ag		Cd		Sn		Hg		Pb	
	Tiss 99	2976	Tiss 99	2976	Tiss 99	2976	Tiss 99	2976	Tiss 99	2976	Tiss 99	2976	Tiss 99	2976	Tiss 99	2976	Tiss 99	2976	Tiss 99	2976	Tiss 99	2976	Tiss 99	2976
1	0.6		0.5	0.0	0.0	0.0	0.1	0.1	0.1	0.2	0.1	0.0	0.0	0.0			0.1	0.2			0.3	0.5	0.8	0.0
2	0.5	0.1			0.1	0.2	0.3	0.3			0.2	0.2	0.5	0.5			0.0	0.0			0.3	0.3	0.5	0.1
3	1.8	0.3	0.2	0.2	0.4	0.7	0.1	0.8	0.1	0.7	0.2	0.6	0.2	0.7	0.7		0.3	1.0			1.8	1.9	2.3	1.2
4	0.7	0.9	0.1	0.1	0.4	0.5	0.1	0.2	0.1	0.1	0.5	0.4					0.1	0.2					0.4	0.9
5	0.4	1.0	0.1	0.1	0.0	0.3	0.1	0.1	0.2	0.1	0.1	0.3	0.3	0.7	0.2		0.0	0.3			0.2	0.1	0.2	0.2
6	3.2	0.6	0.1	0.5	4.0	0.2	0.2	0.1	0.2	0.3	0.3	0.2	0.5	0.3	0.3		0.2	0.2			0.0	0.4	0.6	0.1
7	1.7	3.9	0.5	0.2	0.2	0.7	0.4	0.4	0.1	0.3	0.2	0.3	0.3	0.1			0.1	0.3			1.4	0.9	0.4	0.5
8	0.6	0.5	0.3	0.2	0.5	0.1	0.3	0.4	0.1	0.2	0.3	0.0	0.0	0.2	0.2	0.0	0.1	0.1	-	0.9	0.1	0.5	0.1	0.2
9			2.6	0.3	0.9	0.3	0.2	0.3	0.5	0.4	0.7	0.5	1.3	0.4	0.3		0.1	0.3			0.6	0.1	0.5	6.1
10	0.4	0.4	0.3	0.1			0.0	0.0	0.3	0.1	0.2	0.1			0.1	0.5	0.2	0.2					0.3	0.3
11																					0.4	0.3		
12			0.7	0.2			0.2	0.1	0.0	0.1	0.5	0.7	0.2	0.0			0.1	0.5			0.2	0.2	0.2	0.4
13											0.1	0.1	0.0	0.0										
14	1.6		0.6		1.6		0.0		0.2		1.1		0.8		1.1		0.6				0.5		0.8	
15	0.3						0.2										0.6						0.7	
16	1.6	1.6			0.4	0.2	0.1	0.3	0.0	0.2	0.1	0.1	0.6	0.7			0.3	0.5			0.6	0.2	0.6	0.4
17	0.2	0.9	0.3	0.0	0.6	0.1	0.1	0.1	0.1	0.3	0.1	0.5			0.2	0.9	0.3	0.1	-	0.5	0.1	0.4	0.7	0.3
18			0.1	0.1			0.3	0.7	0.3	0.2	0.1	0.7			0.3		0.1	0.0					0.1	0.3
19																								
20	1.3		0.3	0.3	0.3		0.5	0.4	0.3	0.5	0.6	0.6	0.2	0.8	0.3		0.4	0.4	-		0.1	0.2	0.6	0.4
21																								
22	0.9	1.0	0.3	0.2	0.2	0.5	0.2	0.1	0.2	0.0	0.4	0.2	0.1	0.1			0.2	0.1					0.3	0.8
23	0.5	0.2					0.2	0.1	0.1	0.1							0.3	0.1			0.1	0.3	0.2	0.3
24	0.0	0.0	0.4	0.6	0.0	0.0	1.7	3.1	0.0	0.4	0.4	0.8	1.1	0.3			1.2	1.4			1.4	0.0	5.0	4.3
25	0.7	0.4	0.8	0.2	0.3	0.4	0.5	0.1	0.5	0.5	0.1	0.2	0.3	0.6	0.5	4.0	0.1	0.2	-	0.5	0.4	0.2	0.3	0.2
26	0.1	0.6	0.5	0.1	0.3	0.9	0.1	0.2	0.1	0.1	0.3	0.2			0.3	0.6	0.5	0.0			0.2	0.0	0.6	0.4
27	1.8	1.9	0.2	0.2	0.5	0.6	0.2	0.3	0.1	0.0	0.2	0.4	0.1	0.4	0.4	5.8	0.2	0.4			0.1	0.3	0.3	0.4
28	0.2	0.2	0.3	0.4	0.2	0.5	0.1	0.1	0.2	0.2	0.2	0.3	0.0	0.0	0.5		0.2	0.2		1.4	0.6	0.4	0.0	0.2
29	0.2	1.2	0.4	0.2	0.2	0.7	0.2	0.2	0.2	0.2	0.4	0.5	0.3	0.3	0.1	0.0	0.1	0.1			0.2	0.4	0.7	0.3
30	0.2	1.2	2.1	0.2	3.0	1.0	5.0	0.1	0.0	0.5	0.6	0.9			0.4	6.9	0.3	1.3					0.5	0.9
31																								
32																								
33																								
34	1.6	2.4			0.5	0.2	0.3	0.6	0.3	0.1	0.3	0.5	0.7	0.4	0.6	2.0	0.3	0.3			0.9	0.7	0.9	1.2
35	0.7	3.0	0.3	0.3	0.7	1.3	0.2	0.6	0.2	0.4	0.8	0.2	0.5	0.5	0.4		0.4	0.1	-	4.5	0.0	0.4	0.0	0.8
36	0.2	0.5	0.6	0.4	0.8	0.3	0.1	0.3	0.2	0.0	0.1	0.8	0.2	0.2	0.4	1.6	0.4	0.3			0.4	0.7	0.0	0.5