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NOAA National Status and Trends Program Fifth 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, summarizes results of the NOAA National Status and Trends Program fifth round intercomparison exercise for trace metals in marine sediments and biological tissues. This exercise is one in a series of annual intercomparisons sponsored by NOAA and EPA doing agency-funded chemical analyses. In addition, the exercises have been opened to other laboratories resulting in forty laboratories receiving materials for analysis for the 1991 exercise. The exercise materials were a moderately contaminated sample of siliceous sediment collected from a Nova Scotia harbor, and a moderately contaminated tissue sample of *Mytilus edulis* collected off the Pacific Northwest coast of the US. Reference materials NIST SRM 1566a and NRC CRM BCSS-1 were also analyzed as part of the exercise. The elements determined were Al, Cr, Fe, Cu, Zn, As, Se, Cd, Sn, Hg and Pb for both matrices, plus Ag for the mussel tissue. The analysis of Si, Mn, Sb and Tl was optional. Twenty nine sets of results were received.

[Abstract by A. Cantillo, Quality Assurance Project Manager, NOAA National Status and Trends Program.]

Silver Spring, Maryland
May 1995

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 these 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 The following is a reproduction of a previously unpublished report provided to the NS&T Program by NRC Canada regarding one of these intercomparison.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.

Fifth Round Intercomparison

for Trace Metals

in Marine Sediments and Biological Tissues

NOAA/5

by

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TABLE OF CONTENTS

APPENDICES

1. INTRODUCTION

The purpose of this exercise is to assess the capabilities of a number of National Oceanic and Atmospheric Administration (NOAA) and other laboratories involved in NOAA's National Status and Trends program to analyze marine sediment and biological tissue for trace metals. This is the fifth intercomparison organized by the National Research Council of Canada (NRC) on behalf of NOAA. A small number of USEPA and state laboratories joined in the fourth exercise. This year the exercise was expanded to include forty laboratories, including four from Australia. The number of participants was limited only by the number of samples previously prepared by NRC before it was apparent that an even larger number of laboratories wished to participate.

Laboratories, meeting at the annual NOAA quality assurance workshop after the fourth exercise in Sequim, had agreed to analyze one sediment and one bivalve tissue as well as the certified reference materials (CRMs) NRC BCSS-1 and NIST SRM 1566a for the fifth study. The previous participants also requested that the samples be somewhat contaminated in contrast to the rather pristine materials that were issued for the fourth exercise. The materials prepared by NRC were:

> **Sediment N**, a moderately contaminated sample of siliceous sediment collected from a Nova Scotia harbour and
>
> **Mussel P**, a moderately contaminated tissue sample from *Mytilus edulis* collected off the northwest coast of the U.S. and donated by Eric Crecelius of Battelle Pacific Northwest.

Each participating laboratory was sent a ten gram sample of each of the "unknown" with the expectation that each participant would be responsible for procuring their own samples of the recommended CRMs. They were also sent data sheets on which to record their results, analytical procedures and methods for calculating limits of detection.

Each laboratory was requested to perform five replicate analyses of each of the samples and CRMs for eleven metals in the sediments: Al, Cr, Fe, Cu, Zn, As, Se, Cd, Sn, Hg and Pb (with Si, Mn, Sb and Tl optional). The same list of eleven plus Ag was requested for the biological tissues.

In order to help provide benchmarks of accuracy for Sediment N and Mussel P, NRC also analyzed each of the samples by two different analytical methods. Where possible, one set of results were 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.

2. RESULTS

The prepared samples were mailed to the forty laboratories listed in Appendix A on April 18, 1991, with the deadline for receipt of results set for September 13, 1991. It is very disappointing to report that results were received from only twenty-nine participants even after a two week extension of the deadline. Sequential numbers were assigned to each responding laboratory upon receipt of their data. Laboratory numbers 30 and 31 were assigned to NRC.

A copy of the tabulated raw results was sent to each participant that had submitted data before the September 13 deadline in order to verify that no errors had been made in the transposition of data. This was not possible for data received after the original deadline. A small number of mistakes were caught and changes were made only if NRC was at fault. The data used for subsequent evaluation are listed in Appendix B. With the exception of Al and Fe for the sediment samples, the data are listed as received with respect to significant figures.

Each set of replicate analyses was examined using the Q test (Dixon's test)[1] for outliers and, when warranted, the laboratory mean was recalculated excluding the outlier. There were 25 rejected results. These are marked by a "Q" in Appendix B. If two or more "less than (<)" values were submitted in a set of replicate results the mean was not calculated. However, all quantitative results are included in the graphs. Laboratory 26 submitted only two replicate analyses. The data were included in the graphs but not in the evaluation.

One purpose of the exercise was to arrive at an accepted value for each analyte concentration in order to evaluate laboratory biases. The overall mean concentration for each metal was calculated from the mean of laboratory replicates and NRC data. These means were assumed to be normally distributed, which may not be a valid assumption at very low concentrations, but for the purpose of this exercise is felt to be adequate. A successively applied Student *t* test[2] at the 95% confidence level was used to identify outliers. Some very obvious outliers were initially rejected before statistical evaluations.

All of the replicate data, including outliers, are plotted on the graphs where possible. Means that were outliers from the accepted or certified concentration are indicated by a "*" followed by the laboratory number. "Less thans" are indicated by a downward arrow head and the appropriate number. Some high results that would distort the clarity of the graphs are indicated by an upward arrow head with the mean of the replicates reported.

A solid horizontal line represents the accepted or certified value. The lines above and below represent the 95% confidence limits for these values. A short summary of results for each set of results is listed to the left of the appropriate graphs.

All concentrations are in mg/kg on a dry weight basis (except for aluminum, iron and silicon in the sediments where the concentrations are in percent).

ALUMINUM

Sediment N

Accepted Value:

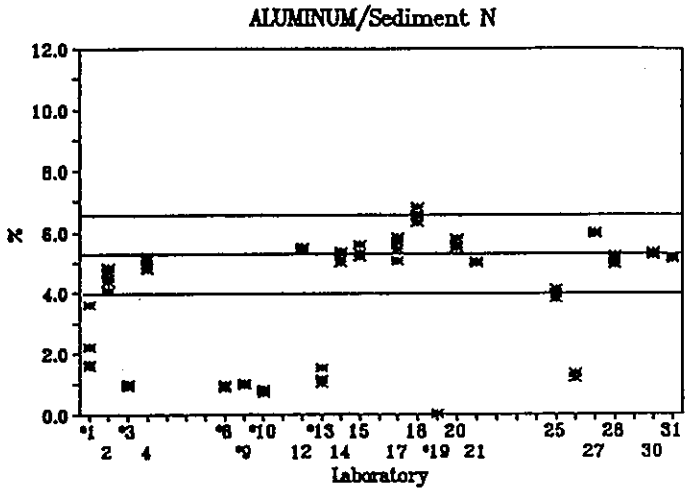
5.27 ± 1.30 %

Results: 21

Quantitative values: 21

Range: 0.009 to 6.8 %

Rejections: 7



BCSS-1

Certified value:

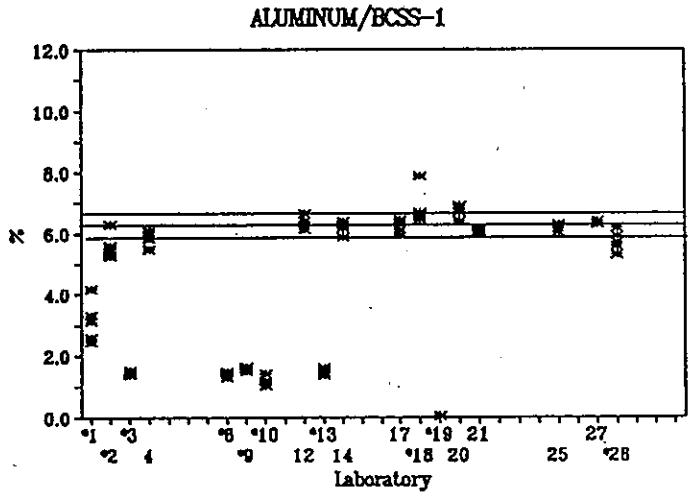
6.26 ± 0.41 %

Results: 18

Quantitative values: 18

Range: 0.035 to 7.9 %

Rejections: 10



Mussel P

Accepted value:

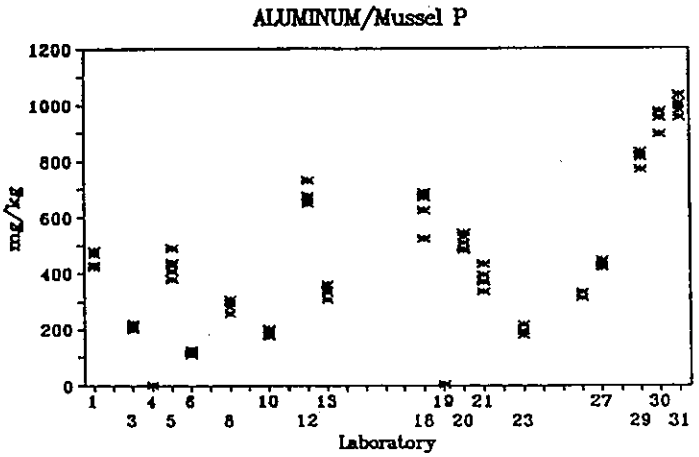
not determined

Results: 16

Quantitative values: 16

Range: 2.0 to 820 mg/kg

Rejections: -



ALUMINUM

SRM 1566a

Certified Value:

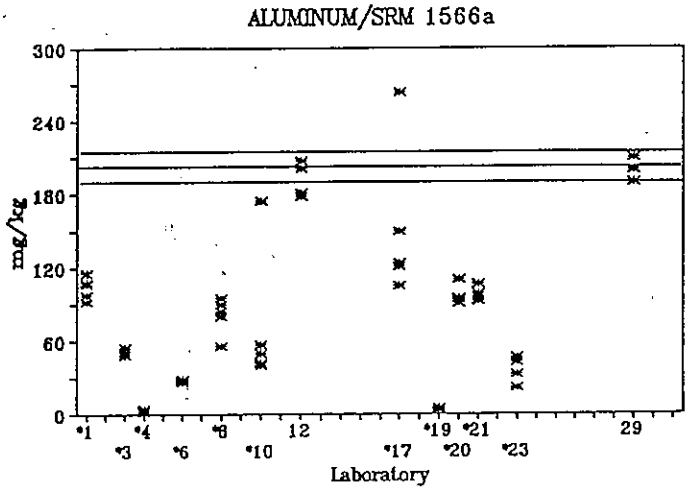
202.5 ± 12.5 mg/kg

Results: 13

Quantitative values: 13

Range: 1.6 to 263 mg/kg

Rejections: 11



Sediments

Nineteen participants submitted results for aluminum in Sediment N. Values ranged from 0.009 to 6.8 percent. Twelve of the laboratory means (2,4,12,14,15,17,18,20,21,25,27,28) were within the accepted confidence range of ± 25 percent. The other seven (1,3,8,9,10,13,19) were all low. This is most likely due to incomplete sample dissolution. Only one of these seven laboratories used hydrofluoric acid in their digestion procedure. By comparison, all the laboratories with results within the 95 percent confidence interval used hydrofluoric acid.

The same trend can be seen for BCSS-1. The laboratories that did not use hydrofluoric acid in their sample digestion reported results much lower than the certified value. Laboratory 18 reported a mean slightly higher than the confidence limit and Laboratory 28 slightly lower. The certified reference material has a tighter confidence interval of 7 percent and eight laboratories (4,12,14,17,20,21,25,27) were included.

Tissues

Eighteen laboratories reported results for Mussel P ranging between 1.99 and 830 mg/kg. A large discrepancy can be seen between the results of NRC (30,31) and Laboratory 29 and those of the other laboratories. This is probably due to fine sand or clay particles usually present in this type of sample. NRC's digestion procedure would have dissolved aluminum bearing materials. (We don't know Laboratory 29's procedure.) Laboratory 4 is the only other of record to have used hydrofluoric acid to decompose the sample but there are problems with the values, perhaps a couple of dropped decimal points. Leaving out Laboratories 29,30,31 yields a mean of 374 ± 374, an almost useless result. A less rigorous dissolution procedure by NRC resulted in a aluminum concentration of 425 ± 60 mg/kg. The degree of partial dissolution of the mineral content can not be well controlled on an interlaboratory basis. The results for aluminum in Mussel P were not included in the laboratory evaluations.

Thirteen laboratories reported results for SRM 1566a ranging between 1.6 and 263 mg/kg. Only Laboratories 12 and 29 produced means within the CRM's confidence interval. All others were low, presumably, for the same reasons as discussed above.

Precision is good for both samples.

SILICON

Sediment N

Accepted Value:

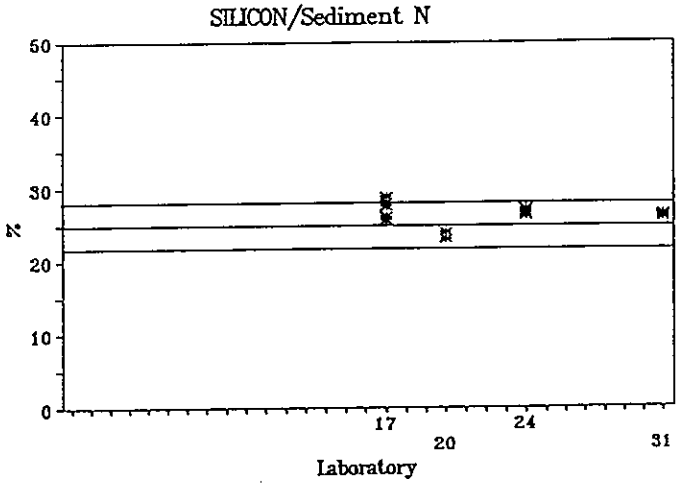
25.9 ± 4.1 %

Results: 3

Quantitative values: 3

Range: 23 to 28.9 %

Rejections: 0



BCSS-1

Certified value:

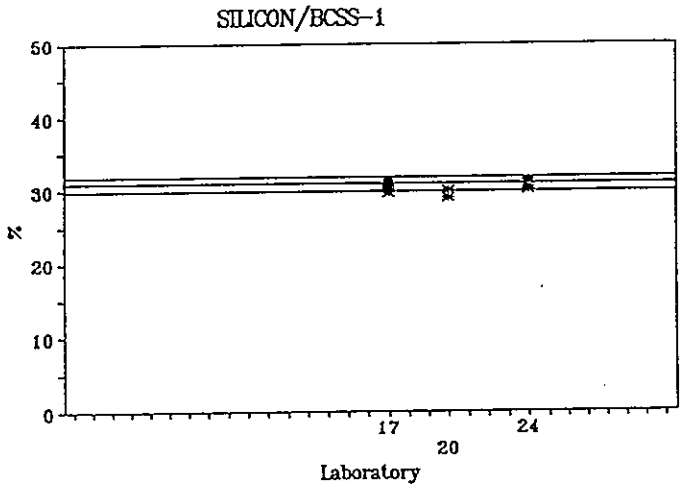
30.8 ± 1.0 %

Results:3

Quantitative values: 3

Range: 29 to 31.4 mg/kg

Rejections: 0



Sediments

Silicon in the sediments was an optional analyte.

Only three laboratories (17,20,24) other than NRC reported results for silicon. These laboratories were in good agreement, able to determine silicon with accuracy and precision in both Sediment N and the certified reference material.

SILICON

The determination of silicon was not required in the biological tissues

CHROMIUM

Sediment N

Accepted Value:

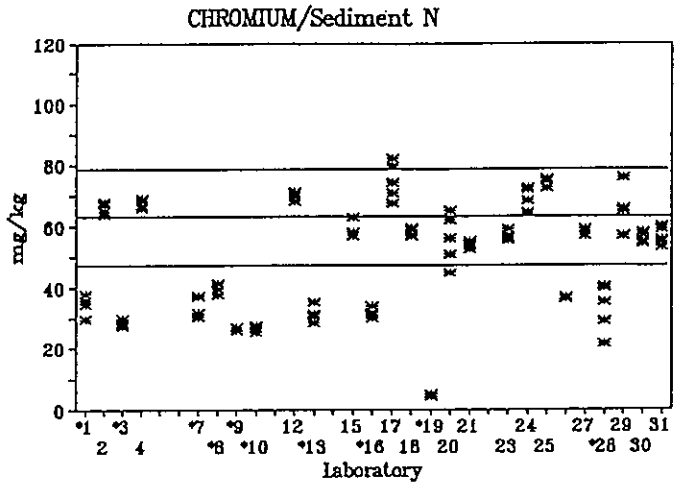
63.1 ± 15.7 mg/kg

Results: 25

Quantitative values: 25

Range: 4.0 to 82.2 mg/kg

Rejections: 10



BCSS-1

Certified value:

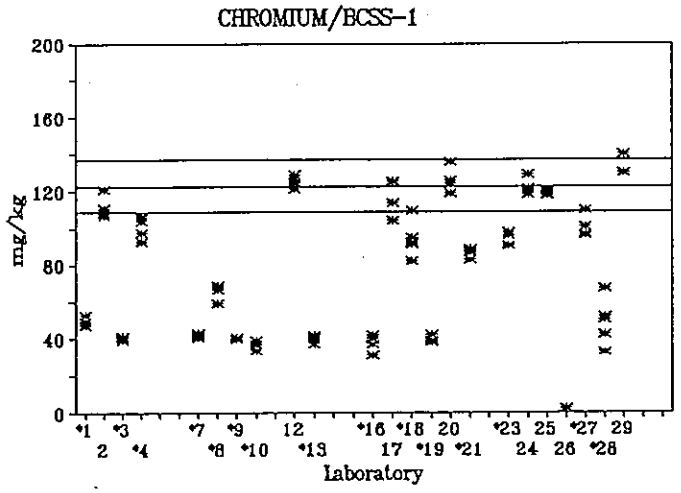
123 ± 14 mg/kg

Results: 22

Quantitative values: 22

Range: 31 to 140 mg/kg

Rejections: 15



Mussel P

Accepted value:

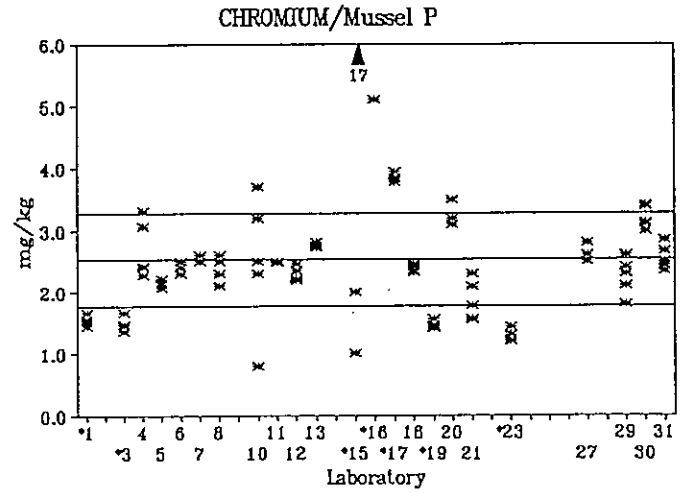
2.52 ± 0.75 mg/kg

Results: 23

Quantitative values: 23

Range: 0.8 to 17 mg/kg

Rejections: 7



CHROMIUM

SRM 1566a

Certified Value:

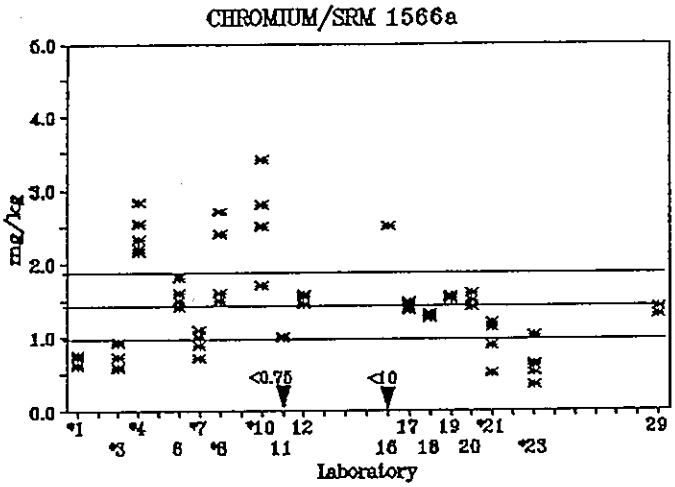
1.43 ± 0.46 mg/kg

Results: 17

Quantitative values: 15

Range: 0.35 to 9.8 mg/kg

Rejections: 8



Sediments

Twenty-three participants reported results for chromium in Sediment N ranging between 4 and 82.2 mg/kg. Ten laboratory means (1,3,7,8,9,10,13,16,19,26) were rejected. All were lower than the accepted ± 25 percent confidence limit. Only Laboratory 28 reported results with a precision poorer than 10 percent.

Twenty-two laboratories submitted results for BCSS-1 ranging from 2 to 140 mg/kg. Only seven means (2,12,17,20,24,25,29) were within the certified ± 11 percent confidence interval. Fifteen means were outside the confidence interval, all low.

Examination of the graphs reveals two sets of results for each sample. The same ten laboratories report means centring about the 30 mg/kg and 40 mg/kg levels for Sediment N and BCSS-1 respectively. This is a common problem in sediment analysis for chromium. It arises from the presence of the mineral chromite in these sediments which often resists dissolution. In general, laboratories that reported low results for aluminum also reported low results for chromium. Laboratories 2,12,17,20,24,25 and 29 produced good results for both samples.

Tissues

Twenty-one participants reported results for chromium in Mussel P ranging between 0.8 and 17 mg/kg. Seven of the means (1,3,15,16,17,19,23) outside the calculated ± 30 percent confidence interval. Only two of these (15,17) were higher than the upper confidence limit.

Seven (6,12,17,18,19,20,29) of fifteen laboratories reporting quantitative results for chromium in SRM 1566a had means within the ± 32 percent certified concentration range. Laboratories 4,8 and 10 reported high results and laboratories 1,3,7,21 and 23 were low. Laboratories 3,7,8,10,21 and 23 reported results with a precision worse than 15 percent. In general, intralaboratory precision for chromium was worse than for most analytes.

MANGANESE

Sediment N

Accepted Value:

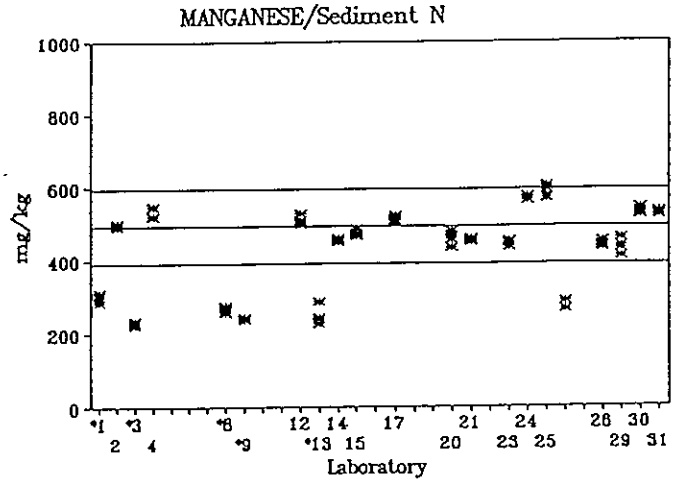
495 ± 103 mg/kg

Results: 20

Quantitative values: 20

Range: 222 to 606 mg/kg

Rejections: 5



BCSS-1

Certified value:

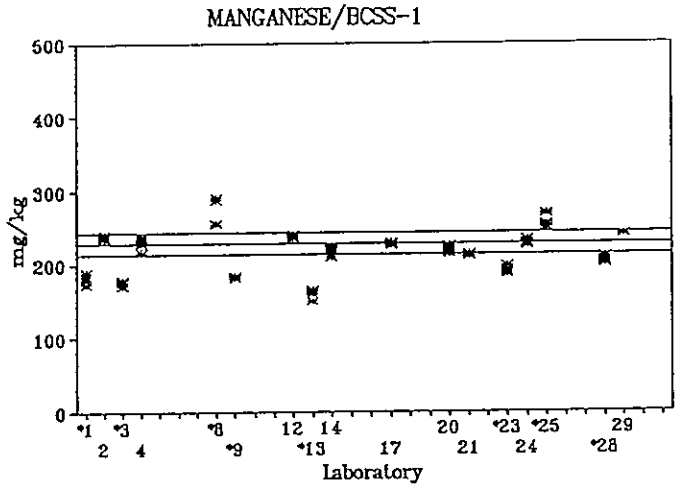
229 ± 15 mg/kg

Results: 17

Quantitative values: 17

Range: 150 to 291 mg/kg

Rejections: 8



Sediments

Manganese was an optional analyte but eighteen and seventeen participants reported results for Sediment N and BCSS-1 respectively. Thirteen means (2,4,12,14,15,17,20,21,23,24,25,28,29) were within the confidence interval of ± 21 percent calculated for Sediment N. A second set of data can be distinguished, probably due to dissolution procedures, with low means centring around about 250 mg/kg (1,3,8,9,13). Precision was good for all laboratories.

Results for BCSS-1 showed a similar trend, with eight laboratories (2,4,12,14,17,20,21,24,29) submitting means within the ± 7 percent certified confidence interval, six (1,3,9,13,23,28) reporting lower means and two (8,25) higher. Precision was again good for all laboratories.

MANGANESE

The determination of manganese was not required in the biological tissues

IRON

Sediment N

Accepted Value:

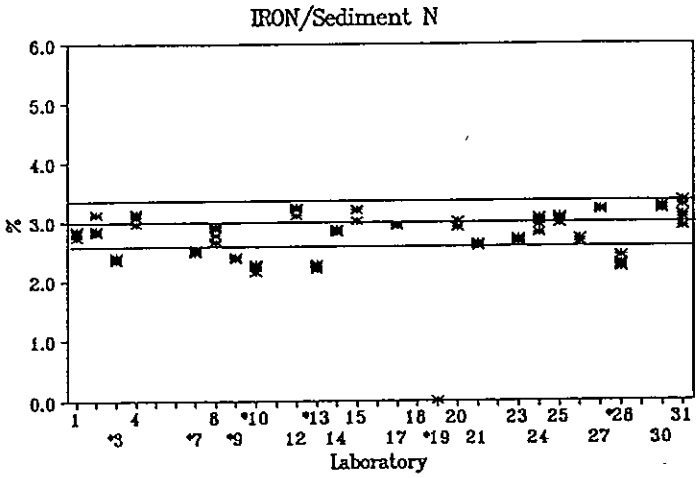
2.97 ± 0.40 %

Results: 23

Quantitative values: 23

Range:0.0002 to 3.2 %

Rejections: 7



BCSS-1

Certified value:

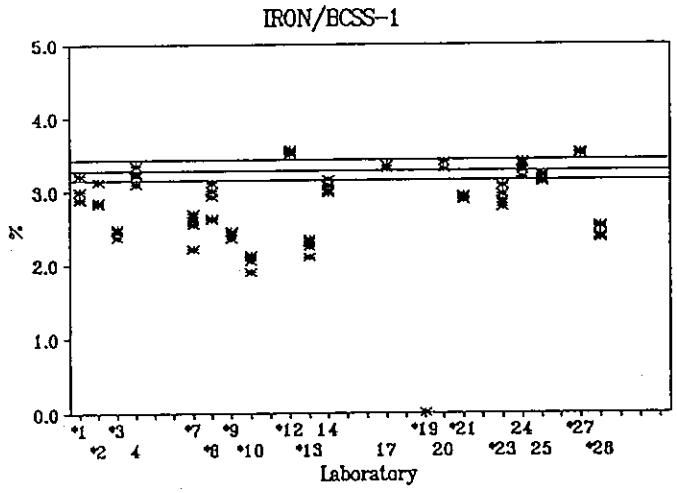
3.28 ± 0.14 %

Results: 20

Quantitative values: 20

Range: 0.002 to 3.5 %

Rejections: 14



Mussel P

Accepted value:

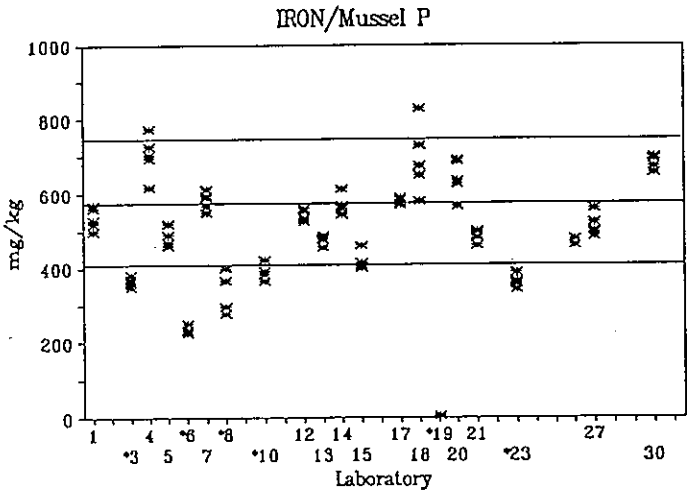
575 ± 172 mg/kg

Results: 20

Quantitative values: 20

Range: 3.6 to 773 mg/kg

Rejections: 6



IRON

SRM 1566a

Certified Value:

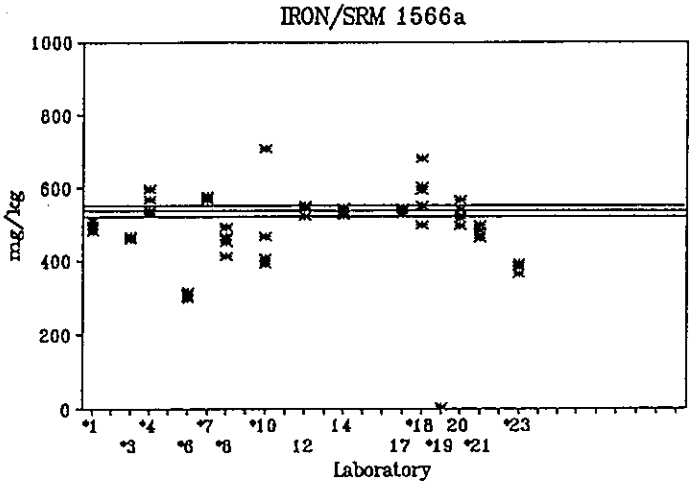
539 ± 15 mg/kg

Results: 15

Quantitative values: 15

Range: 4.19 to 6.80 mg/kg

Rejections: 11



Sediments

Twenty-one participants reported results for iron in Sediment N ranging between 0.0002 to 3.2 percent. (The former value is very difficult to comprehend.) Fourteen laboratories (1,2,4,8,12,14,15,17,20,21,23,24,25,27) had means within the accepted confidence interval of ± 13 percent. The means from seven laboratories (3,7,9,10,13,19, and 28) were rejected, all less than the lower confidence limit.

Only six laboratories (4,14,17,20,24,25) of twenty which submitted results produced means within the ± 4 percent confidence interval of the certified reference material BCSS-1. The concentration of iron in both samples is similar but the confidence interval for the reference material is much smaller, resulting in a higher number of rejections. The laboratories that reported low results for Sediment N also submitted low results for BCSS-1. Laboratories 12 and 27 reported slightly high results. Laboratories 7 and 8 reported results with a precision greater than 5 percent.

Tissues

Nineteen participants reported results for iron in Mussel P ranging from 3.6 to 828 mg/kg. Six of the means were lower than the accepted ± 30 percent confidence interval. Two laboratories (8,18) submitted results with a precision worse than 10 percent.

Fifteen laboratories submitted results for iron in SRM 1566a. Only four laboratories (12,14,17,20) reported means within the ± 3 percent confidence interval. The remaining eleven means were beyond the certified concentration range. The precision was good for all laboratories.

Laboratories 12,14,17 and 20 reported good results for both biological tissues.

COPPER

Sediment N

Accepted Value:

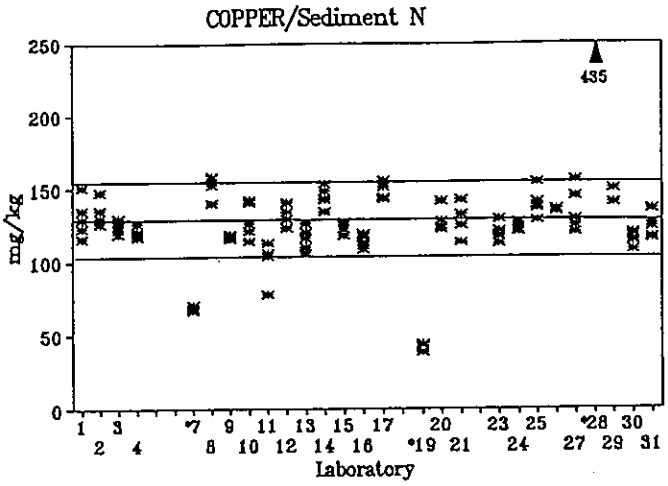
129 ± 26 mg/kg

Results: 27

Quantitative values: 27

Range: 40.5 to 435 mg/kg

Rejections: 3



BCSS-1

Certified value:

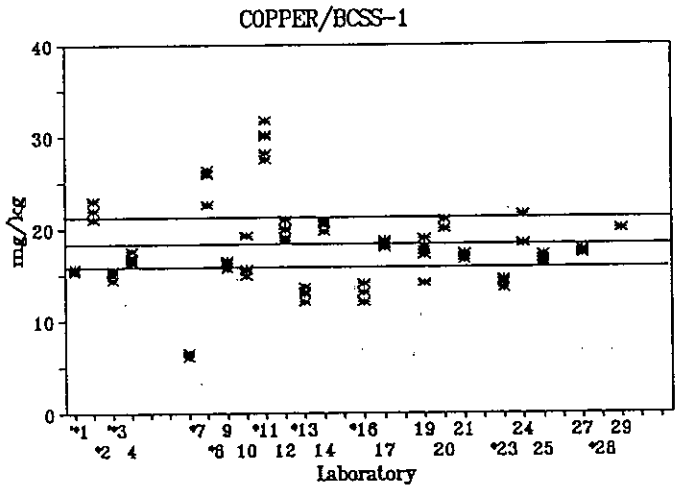
18.5 ± 2.7 mg/kg

Results: 23

Quantitative values: 23

Range: 2.0 to 305 mg/kg

Rejections: 10



Mussel P

Accepted value:

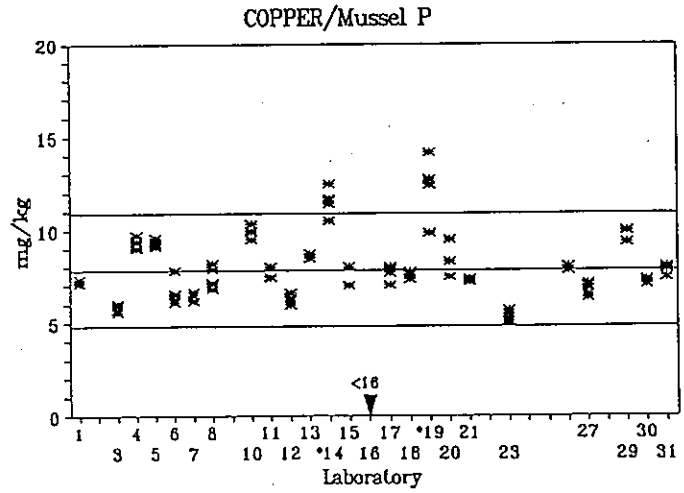
7.81 ± 3.07 mg/kg

Results: 24

Quantitative values: 24

Range: 5.03 to 14.16 mg/kg

Rejections: 2



COPPER

SRM 1566a

Certified Value:

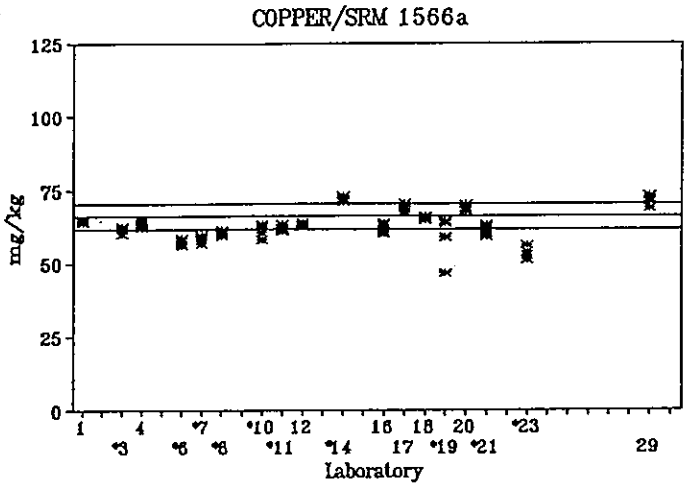
66.3 ± 4.3 mg/kg

Results: 18

Quantitative values: 18

Range: 46.7 to 73 mg/kg

Rejections: 10



Sediments

Twenty-seven laboratories reported results for Sediment N ranging between 38 and 435 mg/kg. Only 3 laboratories (7,19,28) reported means outside the confidence interval. The former two were low and the latter very high (arithmetic?). Precision was good for all laboratories.

Twenty-three laboratories reported results for BCSS-1. Ten of these failed to produce means within the confidence interval for this CRM. The concentration of copper in BCSS-1 is an order of magnitude less than that in Sediment N and the proportion of laboratories outside the acceptable range reflects the increased difficultly to determine copper at the lower level. Laboratories 1,3,7,13,16 and 23 reported low results and Laboratories 2,7,11 and 28 reported high results. Intralaboratory precision for all laboratories was good.

Tissues

Twenty-four laboratories reported quantitative results for Mussel P ranging between 5 and 14 mg/kg. Laboratories 3,6,7,12 and 23 reported low results while laboratories 4,5,10,14,19 and 29 reported high results.

Eighteen laboratories submitted results for SRM 1566a ranging between 47 and 73 mg/kg. The means of only half of these (1,4,12,14,16,17,18,20,29) were within the confidence interval of the CRM. The copper concentration of this sample is an order of magnitude higher than of Mussel P but the confidence interval of the CRM is quite tight (± 6 percent). All results outside the confidence interval were low. With the exception of laboratory 19 for SRM 1566a, precision was good for both biological tissues.

ZINC

Sediment N

Accepted Value:

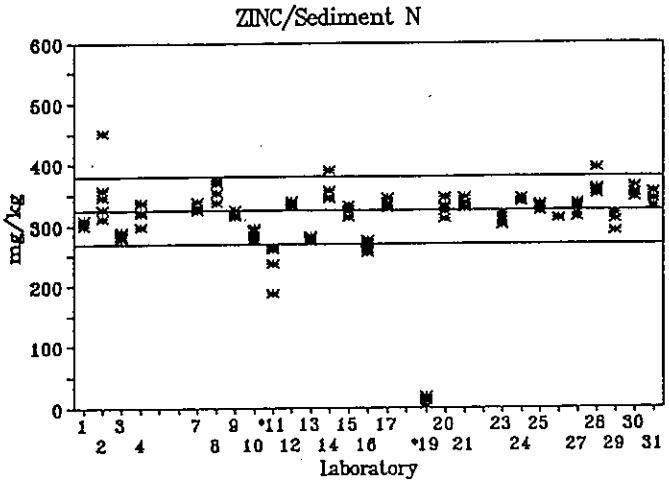
325 ± 55 mg/kg

Results: 26

Quantitative values: 26

Range: 2.99 to 452 mg/kg

Rejections: 2



BCSS-1

Certified value:

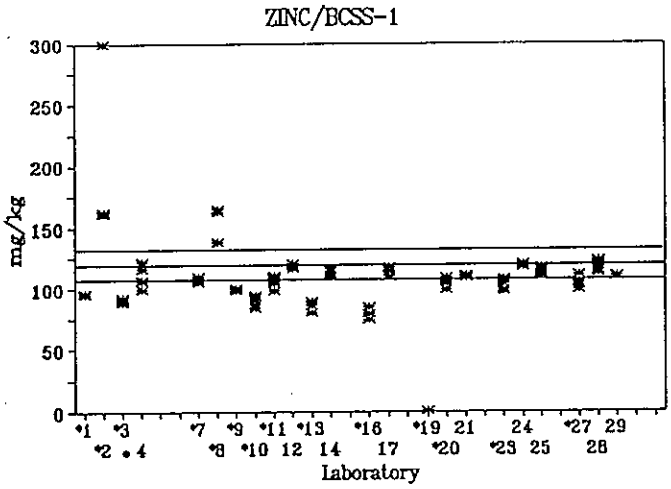
119 ± 12 mg/kg

Results: 23

Quantitative values: 23

Range: 1.0 to 422 mg/kg

Rejections: 14



Mussel P

Accepted value:

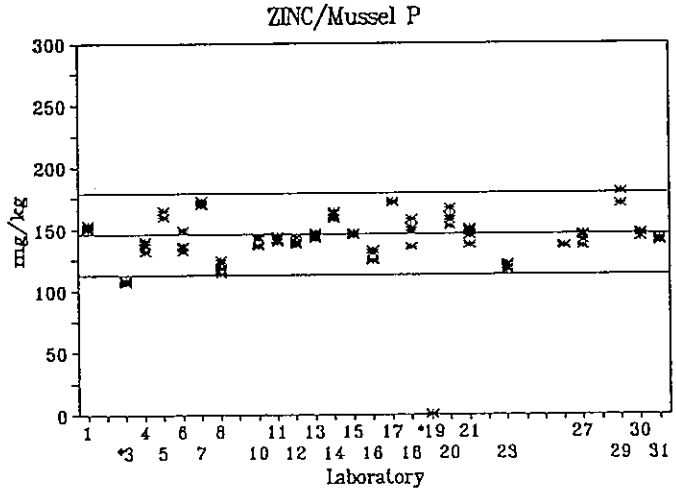
146 ± 19 mg/kg

Results: 24

Quantitative values: 24

Range: 0.213 to 180 mg/kg

Rejections: 2



ZINC

SRM 1566a

Certified Value:

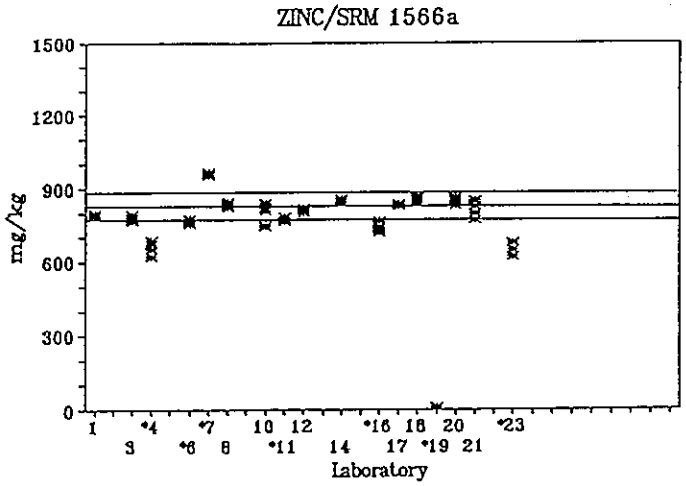
830 ± 57 mg/kg

Results: 17

Quantitative values: 17

Range: 8.5 to 968 mg/kg

Rejections: 7



Sediments

Twenty-four participants reported results for zinc in Sediment N ranging from 3 to 452 mg/kg. The means of only two laboratories (11,19) were rejected from the ± 17 percent calculated confidence interval. However, the concentration of zinc in this sediment is quite high.

Twenty-three laboratories submitted results for zinc in BCSS-1 ranging between 1 and 422 mg/kg. Fourteen of the means were outside the ± 10 percent certified confidence interval which represents about 10 percent of the concentration. Again, the tendency is towards low values for thirteen of the fourteen rejected sets. Laboratories 4,12,14,17,21,24,25,28 and 29 had good accuracy and precision for both sediment samples. Laboratory 2 had precision problems (greater than 10 percent) with both samples.

Tissues

Results for zinc in Mussel P are quite good with only two laboratory means (3,19) of twenty-two participants rejected from the ± 13 percent calculated confidence interval. If the results for laboratory 19 are omitted the results ranged between 106 and 180 mg/kg.

Seventeen laboratories reported results for SRM 1566a. Although the zinc concentration is six times that of Mussel P, seven means were outside the ± 7 percent certified confidence interval. Six of the seven (4,6,11,16,23) reported low means. Precision was good for all laboratories for both biological samples.

Nine laboratories (1,8,10,12,14,17,18,20,21) had good results for zinc in both samples.

Laboratory 19 had severe problems with zinc in both the biological and sediment samples.

ARSENIC

Sediment N

Accepted Value:

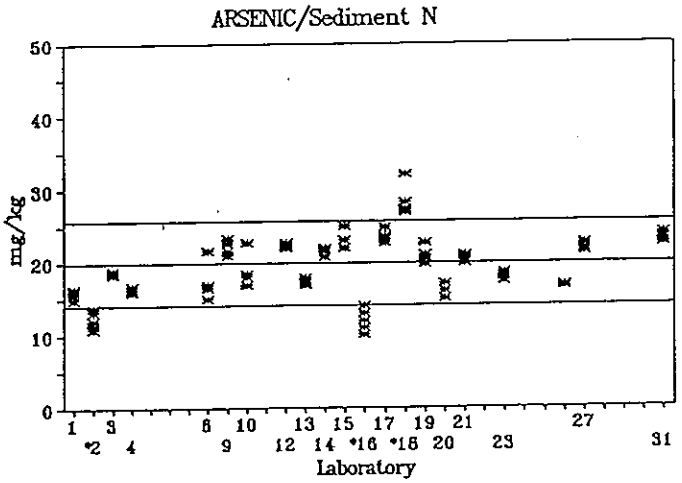
19.8 ± 5.8 mg/kg

Results: 19

Quantitative values: 19

Range: 10 to 32.1 mg/kg

Rejections: 3



BCSS-1

Certified value:

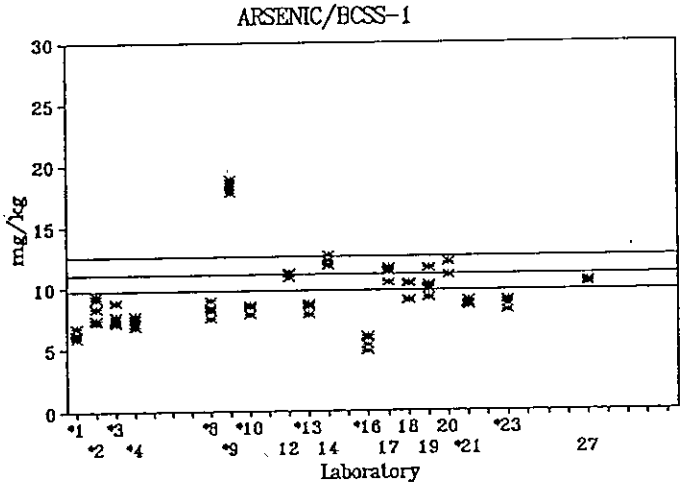
11.1 ± 1.4 mg/kg

Results: 18

Quantitative values: 18

Range: 4.8 to 18.9 mg/kg

Rejections: 11



Mussel P

Accepted value:

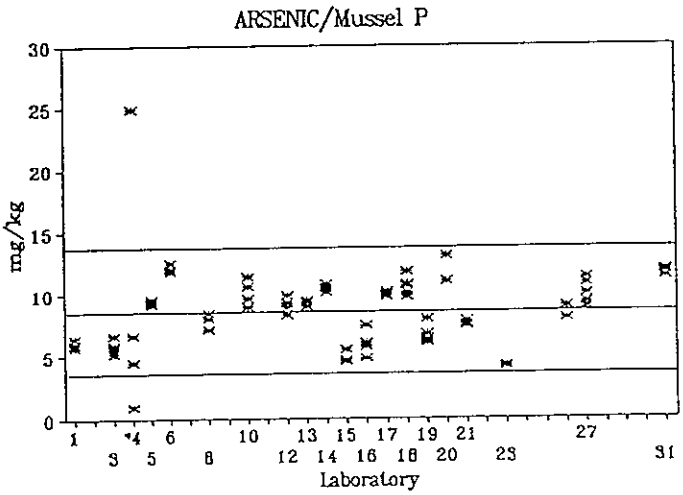
8.56 ± 5.0 mg/kg

Results: 20

Quantitative values: 20

Range: 0.99 to 43.2 mg/kg

Rejections: 1



ARSENIC

SRM 1566a

Certified Value:

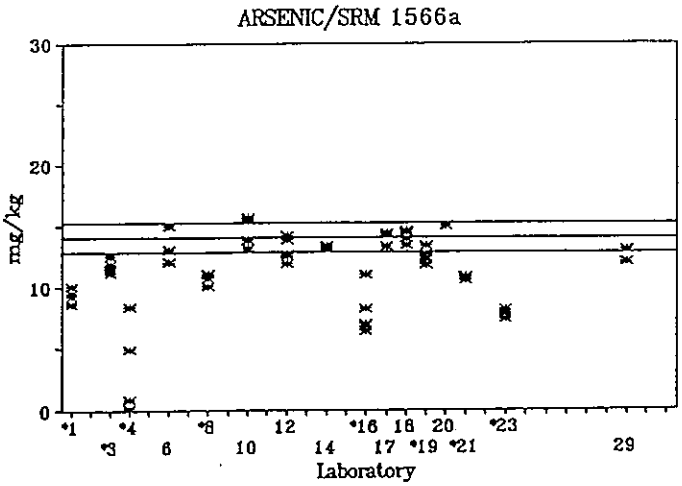
14 ± 1.2 mg/kg

Results: 16

Quantitative values: 16

Range: 0.13 to 43.2 mg/kg

Rejections: 8



Sediments

Nineteen participants reported arsenic results for Sediment N ranging from 10.8 to 32 mg/kg. Only Laboratory 18 reported high results while Laboratories 2 and 16 reported low results. However the defined confidence interval was a moderate ± 29 percent. Precision was good for all laboratories.

Eleven of the eighteen laboratories submitting results for arsenic in BCSS-1 had means outside of the ± 13 percent certified confidence interval. Ten of these (1,2,3,4,8,10,13,16,21,23) were lower than the lower confidence limit and only Laboratory 9 produced high results. The concentration of arsenic in BCSS-1 is one half that of Sediment N. A trend between results for the two samples can be discerned. Almost all the laboratories that report means near the lower confidence limit for Sediment N are rejected for BCSS-1. Laboratory 9 is an anomaly, reporting good results for Sediment N but high values for BCSS-1 (arithmetic?). Precision for all laboratories was again good.

Only six laboratories (12,14,17,19,20,27) produced means within both confidence intervals.

Tissues

Nineteen participants reported results for Mussel P ranging between 0.99 and 43.2 mg/kg. Only one mean (4) was rejected but the calculated confidence interval is a very large ± 59 percent.

Sixteen laboratories reported results for SRM 1566a ranging between 0.86 and 43.2 mg/kg. SRM 1566a has an arsenic concentration similar to that of Mussel P with a certified confidence interval of ± 9 percent. Only eight (6,10,12,14,17,18,20,29) had means within the confidence interval. All others were low. Laboratories 10,12,14,17,18 and 20 also did well with respect to the CRM BCSS-1.

Precision was good for both samples with the exception of Laboratory 19 for SRM 1566a and Laboratory 4 for both biological samples.

SELENIUM

Sediment N

Accepted Value:

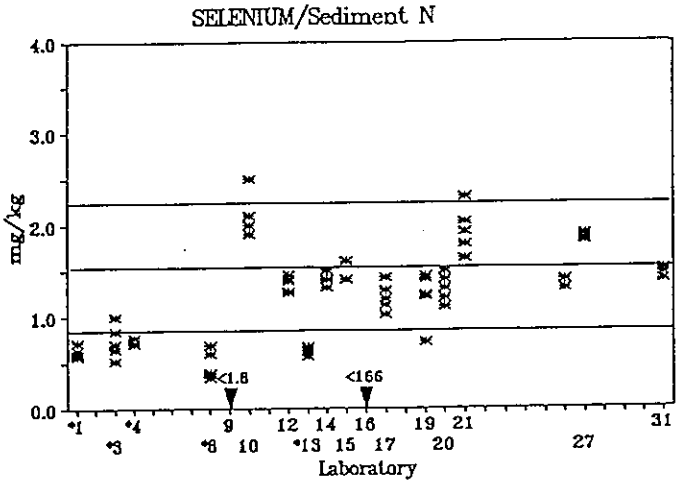
1.54 ± 0.70 mg/kg

Results: 17

Quantitative values: 15

Range: 0.33 to 2.5 mg/kg

Rejections: 5



BCSS-1

Certified value:

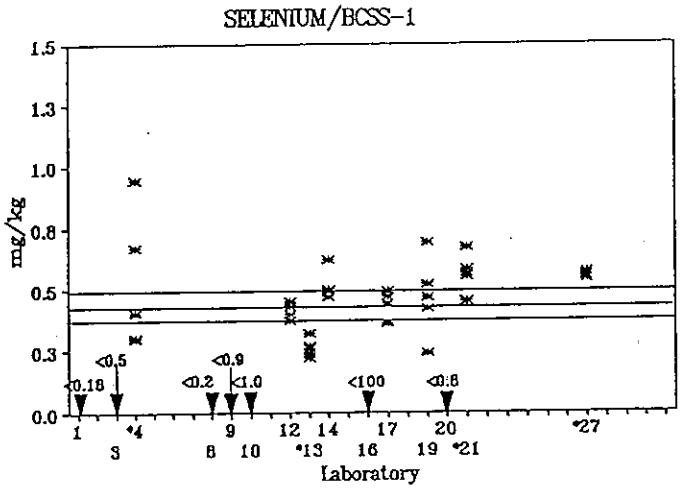
0.43 ± 0.06 mg/kg

Results: 15

Quantitative values: 8

Range: 0.22 to 3.0 mg/kg

Rejections: 4



Mussel P

Accepted value:

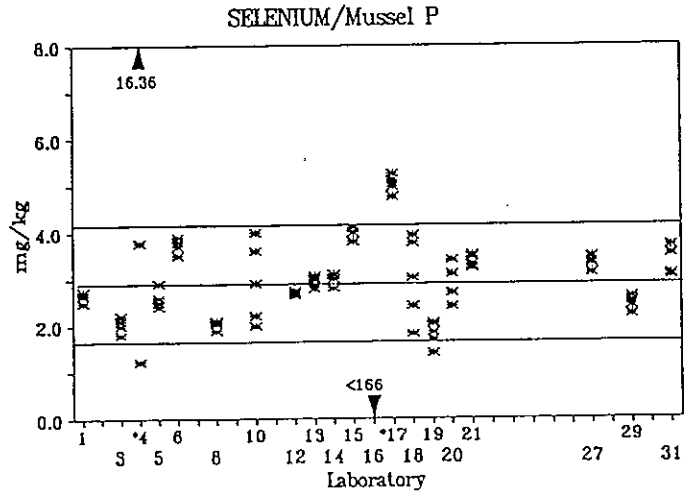
2.86 ± 1.20 mg/kg

Results: 19

Quantitative values: 18

Range: 1.21 to 16.4 mg/kg

Rejections: 2



SELENIUM

SRM 1566a

Certified Value:

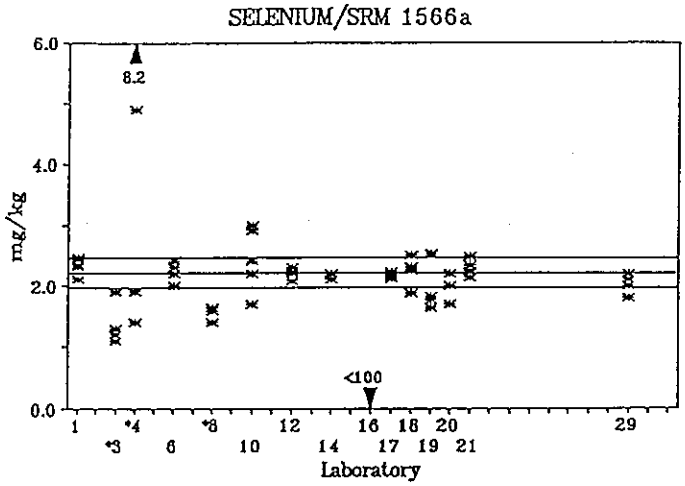
2.21 ± 0.24 mg/kg

Results: 15

Quantitative values: 14

Range: 1.1 to 20.2 mg/kg

Rejections: 3



Sediments

Fourteen participants reported quantitative results for selenium in Sediment N ranging between 0.33 and 2.5 mg/kg. Nine laboratories (10,12,14,15,17,19,20,21,27) had means within the large ± 45 percent calculated confidence interval. Five of the means (1,3,4,8,13) were outside and all were low.

Only eight laboratories reported quantitative results for selenium in BCSS-1. Of these, only four means (12,14,17,19) were within the ± 14 percent certified confidence interval of the CRM. Three of the remaining four were high. Seven laboratories reported "less than" values, some of which were rather puzzling. Two laboratories (1,8) reported "less than" values at one-half the certified concentration. Laboratory 16 reported a "less than" value approximately 200 times the certified concentration.

Tissues

Seventeen participants reported quantitative values for selenium in Mussel P. Only two of the means (4,17) were outside the large ± 42 percent calculated confidence interval and both were high.

However, eleven (1,6,10,12,14,17,18,19,20,21,29) of the fourteen laboratories submitting quantitative results for selenium in SRM 1566a were within the small ± 11 percent certified confidence interval. All eleven also had good results for Mussel P. It appears easier to get good values for selenium in a tissue sample than in a sediment.

Laboratory 16 obviously has a sensitivity (or arithmetic) problem. The reason is not evident. Laboratories 4 and 10 have precision problems.

In the past, many laboratories have demonstrated difficulties with the determination of selenium in marine samples. The above results are encouraging.

SILVER

The determination of silver was not required
in the sediment samples

SILVER

Mussel P

Accepted Value:

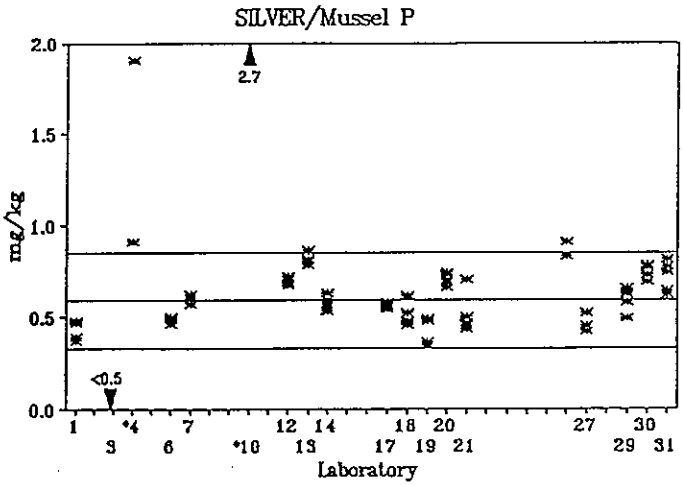
0.587 ± 0.257 mg/kg

Results: 18

Quantitative values: 17

Range: 0.35 to 2.95 mg/kg

Rejections: 2



SRM 1566a

Certified value:

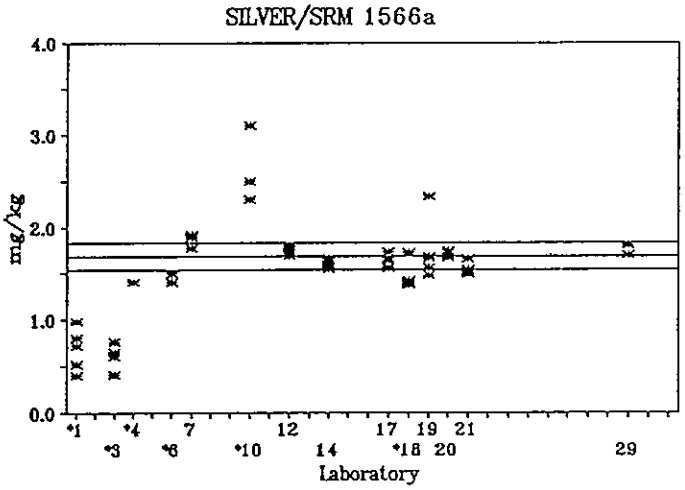
1.68 ± 0.15 mg/kg

Results: 14

Quantitative values: 14

Range: 0.40 to 3.1 mg/kg

Rejections: 6



Tissues

Fifteen participants reported quantitative results for silver in Mussel P ranging between 0.35 to 2.95 mg/kg. Only two of the means (4,10) were rejected, but the calculated confidence interval was a quite large ± 44 percent.

However, only eight (7,12,14,17,19,20,21,29) of fourteen laboratories submitting results for silver in SRM 1566a produced means within the certified confidence interval of ± 9 percent. The eight laboratories reported good results for both samples.

Intralaboratory precision was good for both samples with the exception of Laboratory 4.

CADMIUM

Sediment N

Accepted Value:

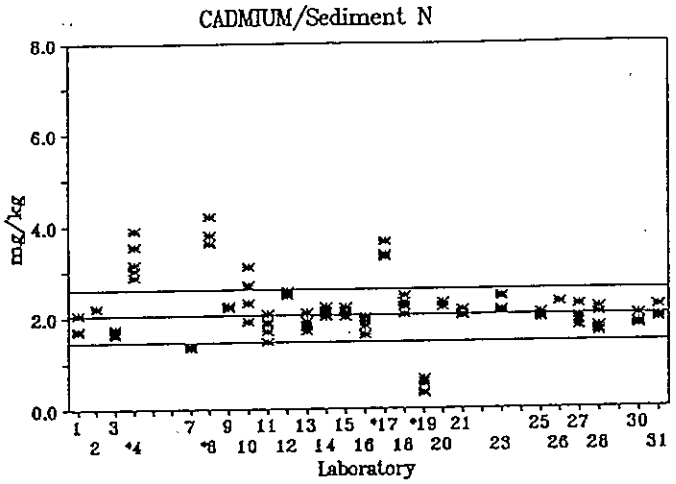
2.03 ± 0.58 mg/kg

Results: 25

Quantitative values: 25

Range: 0.30 to 3.6 mg/kg

Rejections: 4



BCSS-1

Certified value:

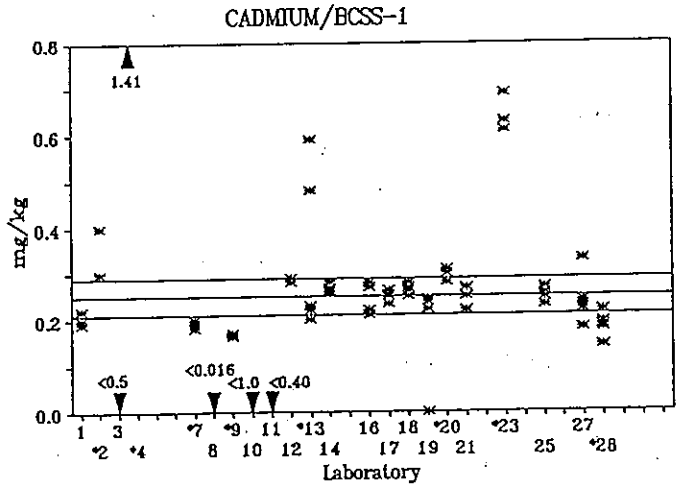
0.25 ± 0.04 mg/kg

Results: 22

Quantitative values: 18

Range: 0.14 to 1.41 mg/kg

Rejections: 8



Mussel P

Accepted value:

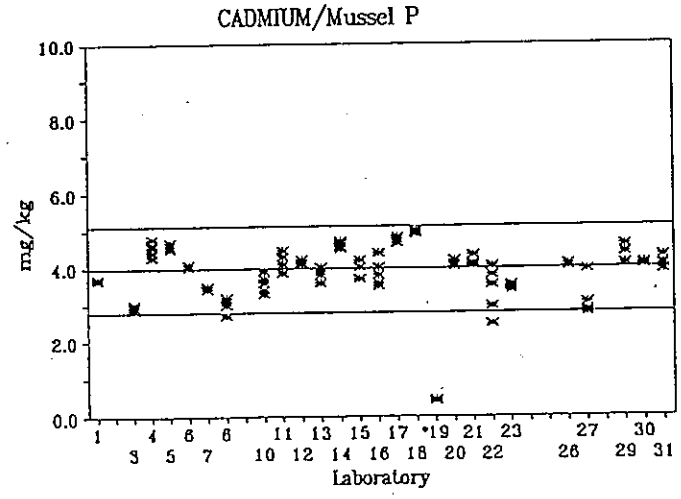
3.96 ± 1.14 mg/kg

Results: 25

Quantitative values: 25

Range: 0.39 to 5.01 mg/kg

Rejections: 1



CADMIUM

SRM 1566a

Certified Value:

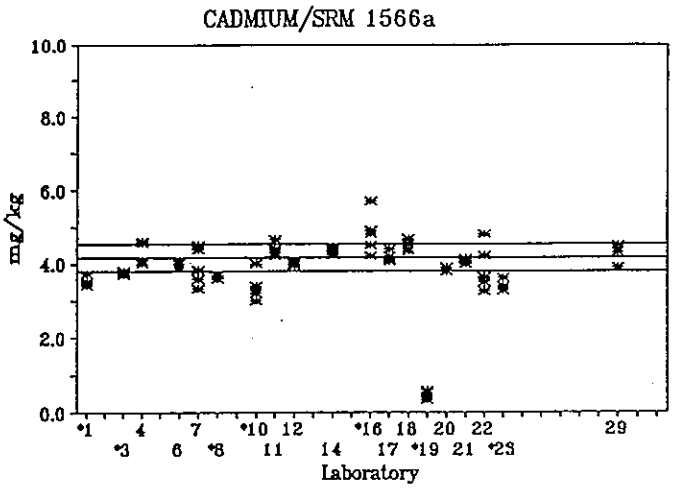
4.15 ± 0.38 mg/kg

Results: 24

Quantitative values: 24

Range: 0.307 to 5.7 mg/kg

Rejections: 7



Sediments

Twenty-three participants reported results for cadmium in Sediment N. Four of the means were outside the calculated confidence interval of ± 29 percent. Three of the four were high. Laboratory 10 reported results with a precision greater than 15 percent.

The certified concentration of cadmium in BCSS-1 is an order of magnitude lower than Sediment N. Eighteen of twenty-two laboratories submitting results reported quantitative values ranging between 0.14 to 1.4 mg/kg. Ten laboratories (1,12,14,16,17,18,19,21,25,27) had means within the confidence interval of ± 16 percent. For most analytes in this exercise rejected means are usually lower than the confidence limit. However, for cadmium there are an equal number of rejected means above and below the confidence interval. Laboratories 2,4,13 and 20 reported high results for BCSS-1 and Laboratories 1,7,8 and 28 reported low results. Precision was good for all laboratories with the exceptions of Laboratory 10 for Sediment N and Laboratory 13 for BCSS-1.

Tissues

Twenty-three and twenty-four participants reported results for Mussel P and SRM 1566a, respectively. The cadmium concentration of both samples is similar. Only one of the twenty-three was outside the calculated confidence interval for Mussel P of ± 29 percent, which was the same as for Sediment N.

However, due to a smaller confidence interval of the CRM (± 9 percent) there were seven rejections for SRM 1566a, six of which were due to low means. Twelve laboratories (4,6,7,11,12,14,17,18,20,21,22,29) did well for both tissue samples. Laboratory 19 reports low results for both tissue samples. Precision was good for both samples with the exceptions of laboratory 22 (Mussel P) and laboratory 17 (SRM1566a).

In general, the best performance in this exercise appears to be for cadmium.

TIN

Sediment N

Accepted Value:

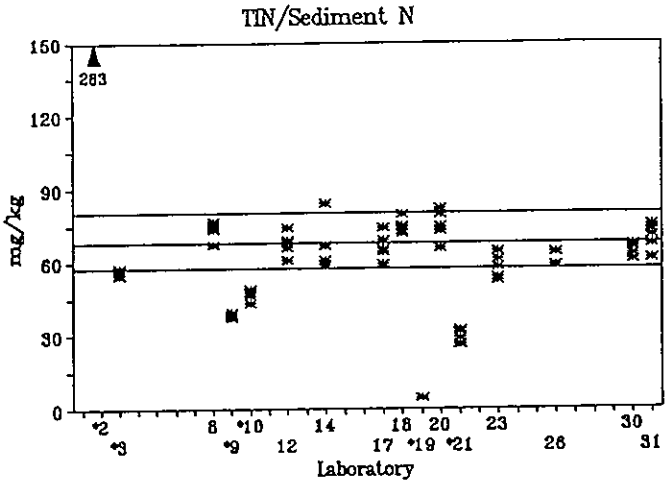
68.7 ± 11.2 mg/Kg

Results: 15

Quantitative values: 15

Range: 4.52 to 283 mg/Kg

Rejections: 4



BCSS-1

Certified value:

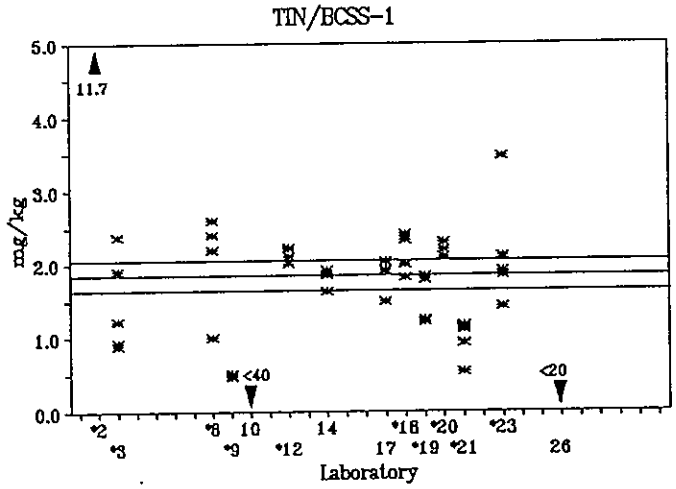
1.85 ± 0.20 mg/Kg

Results: 14

Quantitative values: 12

Range: 0.48 to 11.7 mg/Kg

Rejections: 10



Mussel P

Accepted value:

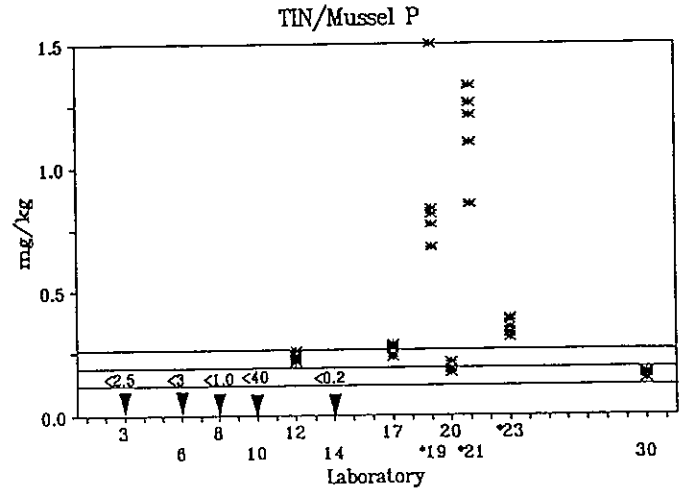
0.192 ± 0.072 mg/Kg

Results: 11

Quantitative values: 6

Range: 0.142 to 1.5 mg/Kg

Rejections: 3



TIN

SRM 1566a

Accepted Value:

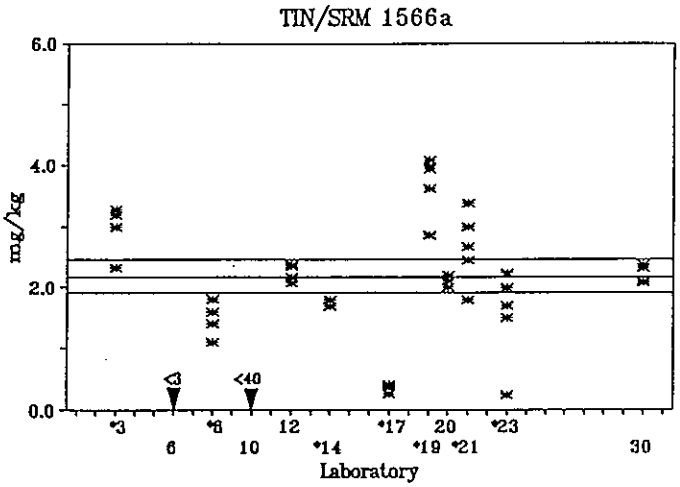
2.18 ± 0.27 mg/kg

Results: 12

Quantitative values: 10

Range: 0.50 to 2.84 mg/kg

Rejections: 7



Sediments

Nine (3,8,10,12,14,17,18,20,23) of thirteen participants reported means for tin in Sediment N within the calculated confidence interval of ± 29 percent. Four laboratories (2,9,19,21) had means outside The latter three were low. Precision was good except for Laboratory 14.

Only two (14,17) of twelve laboratories reporting quantitative results for tin in BCSS-1 had means within the ± 11 percent confidence interval for this CRM. The tin concentration is approximately a fifth of that in Sediment N. Laboratories 2,8,12,20 and 23 reported high means and 3,9,19 and 21 low results. Six laboratories (3,8,18,19,21,23) reported results with a precision worse than 15 percent.

Tissues

The concentration of tin in Mussel P is quite low at 0.2 mg/kg and only six sets of quantitative results submitted by participants. Of these, only three (12,17,20) had means within the calculated confidence interval of ± 38 percent, a wide interval. The rejected laboratories (19,21,23) were all high, with poor precision reported by Laboratories 19 and 21. Five laboratories (3,6,8,10,14) reported "less than" values.

SRM 1566a is not certified for tin by NIST, supposedly due to heterogeneity of the sample with respect to this metal. The sample has a tin concentration an order of magnitude high than that of Mussel P. The confidence interval (± 12 percent) of the calculated mean included only means from two laboratories (12,20). Laboratory 17 is a factor of 10 low (arithmetic?).

The reliable analysis of marine samples, especially biological tissues, for tin is apparently possible by only a small number of experienced laboratories.

ANTIMONY

Sediment N

Accepted Value:

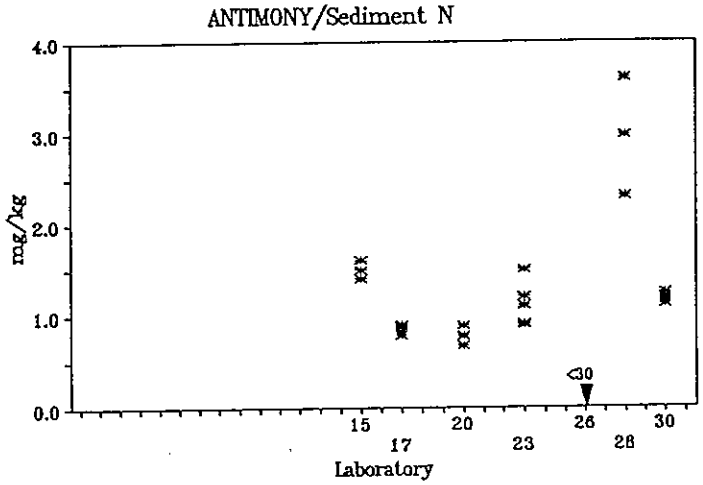
not determined

Results: 7

Quantitative values: 6

Range: 0.67 to 10.7 mg/kg

Rejections: -



BCSS-1

Certified value:

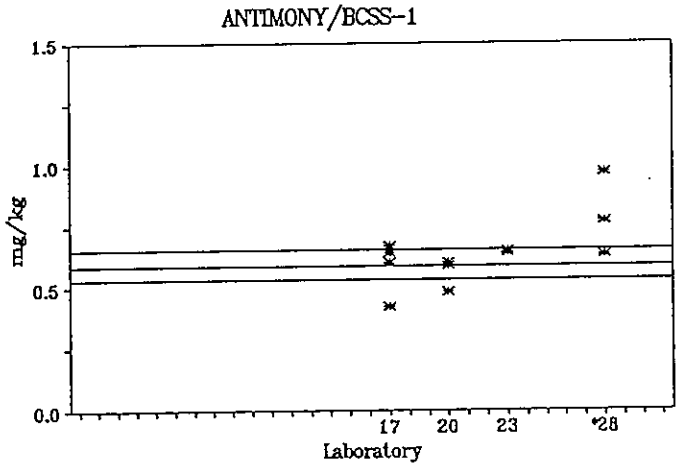
0.59 ± 0.06 mg/kg

Results: 4

Quantitative values: 4

Range:0.42 to 2.26 mg/kg

Rejections: 1



Sediments

Antimony was an optional analyte. A mean and confidence interval were not calculted from the six available sets of results. The interval would have been greater than ± 75 percent with a mean around 1.1 mg/kg. Laboratories 15,17,20 and 23 would have been included. Laboratory 28 submitted high results with poor precision.

Only four laboratories (17,20,23,28) submitted results for antimony in BCSS-1. The means of three of these (17,20,23) were within the ± 10 percent certified confidence interval. Laboratory 28 was again high.

ANTIMONY

The determination of antimony was not required in the biological tissues

MERCURY

Sediment N

Accepted Value:

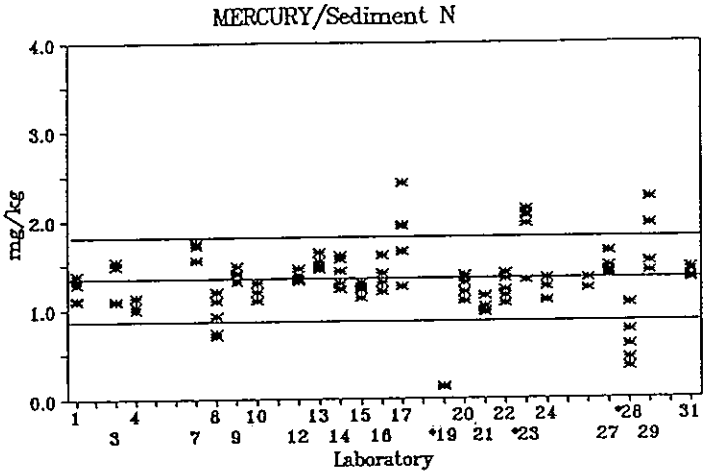
1.34 ± 0.47 mg/kg

Results: 23

Quantitative values: 23

Range: 0.13 to 2.41 mg/kg

Rejections: 4



BCSS-1

Accepted value:

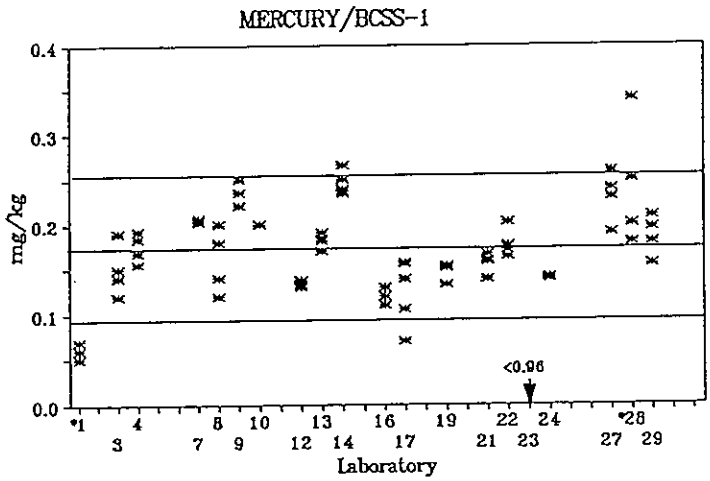
0.174 ± 0.081 mg/kg

Results: 20

Quantitative values: 19

Range: 0.05 to 0.26 mg/kg

Rejections: 2



Mussel P

Accepted value:

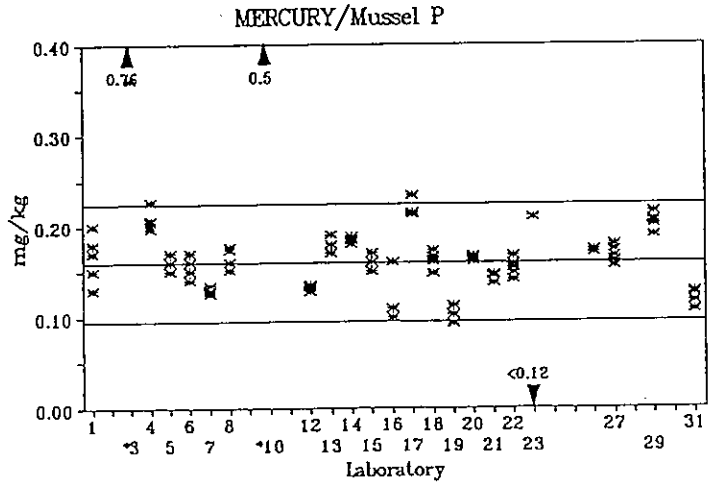
0.159 ± 0.065 mg/kg

Results: 23

Quantitative values: 22

Range: 0.10 to 1.0 mg/kg

Rejections: 2



MERCURY

SRM 1566a

Certified Value:

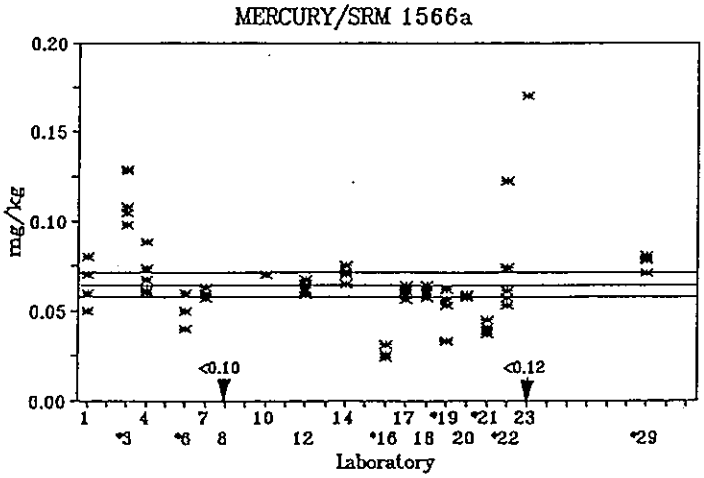
0.0642 ± 0.0067 mg/kg

Results: 18

Quantitative values: 16

Range: 0.03 to 0.17 mg/kg

Rejections: 7



Sediments

Twenty-two participants reported results for mercury in Sediment N ranging between 0.13 and 2.41 mg/kg. Eighteen participants (1,3,4,7,8,9,10,12,13,14,15,16,20,21,22,24,27,29) reported means within the calculated confidence interval of ± 35 percent. Two laboratories (17,23) were high and two (19,28) were low. Intralaboratory precision was not as good as for most other elements in this study as laboratories 3,8,17,22,28 and 29 reported results with a precision worse than 15 percent.

Seventeen of nineteen laboratories had means within the calculated confidence interval of ± 47 percent for BCSS-1. BCSS-1 is no longer certified for mercury and the accepted concentration was calculated in the same manner as for Sediment N. The large confidence interval is not surprising considering the fact that the mercury concentration in BCSS-1 is almost an order of magnitude less than that in Sediment N. There were two rejections (1,28).

Tissues

Twenty-three laboratories also reported results for mercury in Mussel P. The confidence interval was ± 41 percent and only two laboratories (3,10) were rejected.

Sixteen laboratories reported quantitative results for SRM 1566a ranging between 0.03 and 0.17 mg/kg. The confidence interval for the CRM is small (± 10 percent) and seven means were outliers. Laboratories 3,22 and 29 reported high results and Laboratories 6,16,19 and 21 were low. Intralaboratory precision was good for both tissue samples with only Laboratories 19 and 22 reporting a precision worse than 20 percent for SRM 1566a.

Nine laboratories (1,4,7,8,12,14,17,18,20) had means within the confidence intervals for both biological tissues.

THALLIUM

Sediment N

Accepted Value:

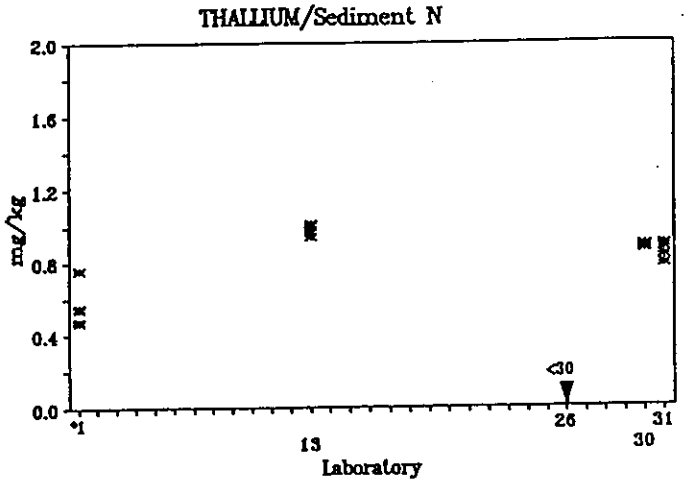
not determined

Results: 5

Quantitative values: 4

Range: 0.47 to 1.01 mg/kg

Rejections: -



BCSS-1

Certified value:

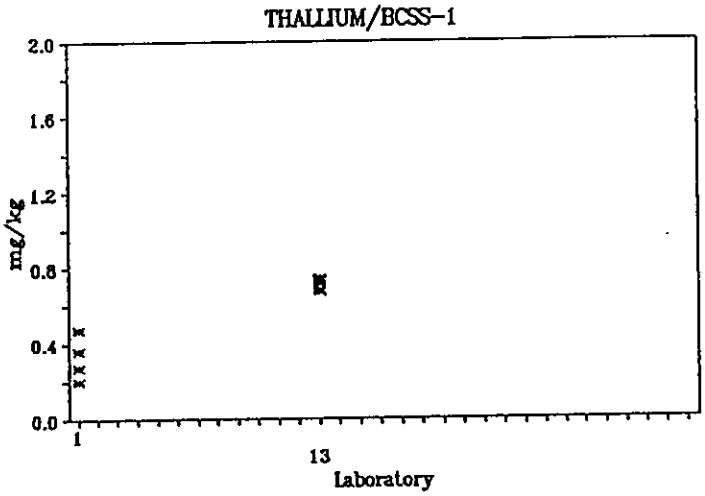
not determined

Results: 2

Quantitative values: 2

Range: 0.27 to 0.47 mg/kg

Rejections: -



Sediments

Thallium was an optional element for this exercise.

Since only two participants reported quantitative values for thallium in sediment N a mean value was not calculated. Laboratory 26 reported a "less than" value 30 times the NRC values.

BCSS-1 is not certified for Tl and no evaluation was performed for this sample due to the poor response.

THALLIUM

The determination of thallium was not required in the biological tissues

LEAD

Sediment N

Accepted Value:

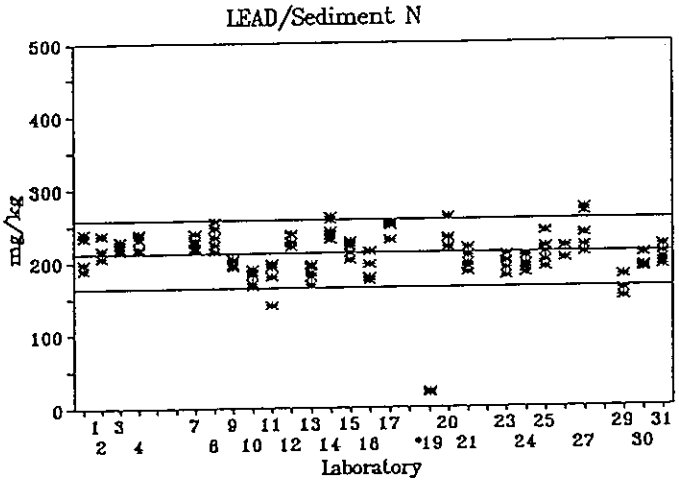
211 ± 46 mg/kg

Results: 25

Quantitative values: 25

Range: 18 to 272 mg/kg

Rejections: 1



BCSS-1

Certified value:

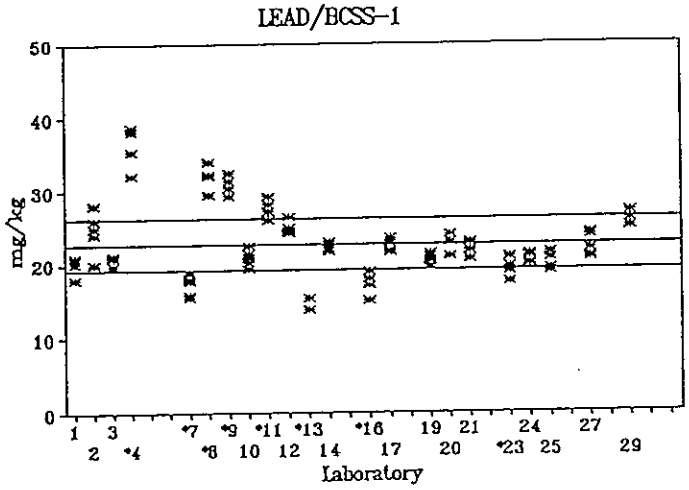
22.7 ± 3.4 mg/kg

Results: 22

Quantitative values: 22

Range: 15 to 38.7 mg/kg

Rejections: 8



Mussel P

Accepted value:

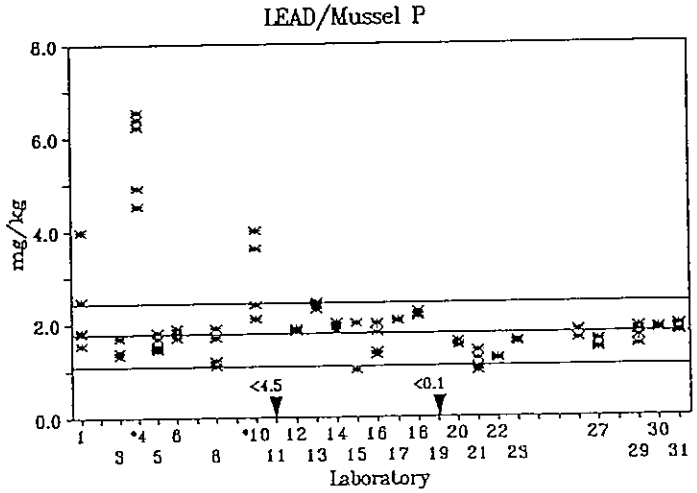
1.75 ± 0.67 mg/kg

Results: 24

Quantitative values: 22

Range: 0.97 to 6.5 mg/kg

Rejections: 2



LEAD

SRM 1566a

Certified Value:

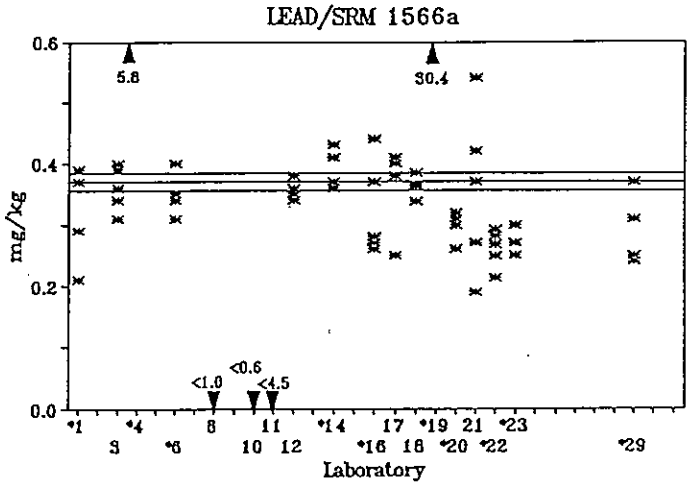
0.371 ± 0.014 mg/kg

Results: 18

Quantitative values: 15

Range:0.19 to 31.2 mg/kg

Rejections: 10



Sediments

Twenty-three participants reported results for lead in Sediment N ranging between 18 and 272 mg/kg. The results for lead in this sample are very good with only one laboratory (19) outside the calculated ± 22 percent confidence interval. The precision is also quite good with only three laboratories (1,11,27) reporting a standard deviation worse than 10 percent.

BCSS-1 has a ten-fold lower concentration and a confidence interval of ± 15 percent. The results are more scattered, but fourteen means (1,2,3,10,12,14,17,19,20,21,24,25,27,29) of twenty-two were within that range. Laboratories 4,8,9 and 11 reported high results and laboratories 7,13,16 and 19 reported low results. The precision for all laboratories is good for BCSS-1.

Tissues

Twenty participants reported quantitative results for lead in Mussel P with only two laboratories (4,10) higher than the calculated large ± 54 percent confidence interval. Laboratory 19 reported a "less than" value ten times lower than the accepted concentration. Laboratories 1,4,8,10 and 16 reported results with a precision greater than 15 percent.

The certified confidence interval for lead in SRM 1566a is very small (± 4 percent) and no laboratory had all its values within the interval. Five laboratories (3,12,17,18,21) had means within the confidence interval. Laboratories 4 and 19 reported very high results and Laboratory 11 reported a "less than" value at ten times the certified concentration. Laboratories 1,6,16,20,22,26 and 28 reported means slightly low, while laboratory 14 was slightly high. Laboratories 4,16,21 and 29 reported results with a precision greater than 20 percent.

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 precision. Of the four samples, one sample of each type was a certified reference material (CRM). For these, (except for mercury in BCSS-1 and tin in SRM 1566a) accurate means and confidence intervals are known. This, however, is an inherent difficulty with using CRMs in intercomparison studies. The answers are known to the participants and there is often a inclination to tend towards "the right answer". But the combination of CRMs and unknowns are a powerful tool in discerning competence provided there is a built in mechanism for obtaining reliable values for the concentrations of the analytes in the unknowns.

For each of the two unknown samples an excluded mean and confidence interval for each analyte were calculated from the submitted data, using the method outlined in the Introduction. 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. And, we get an indication of the type of reproducibility we may expect if the accepted group were to analyze similar materials. In almost all cases the calculated mean was not much different from the NRC means. The only exception was for aluminum in Mussel P.

If, for whatever reasons, we assume that NRC is competent, there appears also to always be a group of participating laboratories that are equally competent for various analytes in the two matrices and an accurate mean can be established along with an appropriate confidence interval with 95 percent confidence. The mean and confidence interval will be somewhat degraded by other results but there is no definitive way of separating the wheat from the chaff.

Table I

Criteria for Intralaboratory Precision Evaluation

Analyte Concentration	Expected RSD
$\geq$10 mg/kg	$\pm$ 10 percent*
$\geq$1 and $<$10 mg/kg	$\pm$ 15 percent
$<$1 mg/kg	$\pm$ 20 percent

* - $\pm$ 5 percent for aluminum and iron in sediments

The use of the CRMs is a great aid in this respect because their confidence intervals are generally much narrower than those defined for the unknowns. Laboratories which produce results within the confidence intervals of both the CRM and the unknown are obvious demonstrators of reliability.

A system to evaluate laboratory performance for individual elements in sediments and biological tissues was established using the following criteria:

- **E** - **Excellent accuracy**: all replicate values are within the established confidence interval.
- **G** - **Good accuracy**: the mean of the replicates is within the established confidence interval but one or more replicates is outside.
- **L** - **Low results**: the mean of the replicates is less than the lower confidence limit.
- **H** - **High results**: the mean of the replicates is greater than the upper confidence limit.
- **?** - Accuracy can not be established.
- **G** - **Good precision**: the intralaboratory precision is within the criteria for precision listed in Table I.
- **X** - **Poor precision**: the intralaboratory precision is not within the criteria for precision listed in Table I.
- **-** - No results or a "less than" value submitted.

Results for antimony and thallium were not included in this performance evaluation nor were those for aluminum in Mussel P. The results from Laboratory 26 which submitted only duplicate vales for the analyses have not been evaluated here.

Detailed charts of this assessment are tabulated in Appendix C.

The overall assessment based on the above criteria allowed four distinct categories of performance to be discernible. These are shown in Tables II and III. In general, **Superior** laboratories submitted results for most elements within the 95% 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 high proportion of outliers or "less thans" were categorized as having **Many Problems**.

The four laboratories rated "superior" and one of those rated "good" in the Accuracy column in Table II are the five veterans which have analyzed sediments in all five NOAA exercises in this series. Two more "goods" and two of the "fairs" joined the studies last year.

Two of the three laboratories rated "superior" and three of those rated "good" in the Accuracy column in Table III are the five veterans which have analyzed biological tissues in five

NOAA exercises in this series. (The five mentioned with respect to Table II and the five here are not all the same laboratories.) The other "superior" in Table III joined the study last year.

Table II

Accuracy and Precision Evaluation for Sediment Analysis*

	Accuracy	Precision
Superior	12,14,17,20	9,12,15,16,20,22,24,25
Good	4,15,18,21,24,25,27,29	4,13,14,23,27,29
Fair	1,2,3,10,11,16,22,23,28	1,3,7,11,17,18,19,21
Many Problems	7,8,9,13,19	2,8,10,28

* - Laboratories 5 and 6 did not submit results for the sediments.

Table III

Accuracy and Precision Evaluation for Biological Tissue*

	Accuracy	Precision
Superior	12,18,20	5,6,11,12,13,14,15,20,27
Good	5,13,14,15,17,27,29	1,3,7,18,29
Fair	1,6,7,8,10,11,21	16,17,19,21,22,23
Many Problems	3,4,16,19,22,23	4,8,10

* - Laboratories 2,9,24,25 and 28 did not submit results for the tissues.

Ten of the twelve laboratories which were rated "superior" or "good" accuracy for sediments (Table II) also analyzed the tissues. Eight of these ten were also rated "superior" or "good" of the ten laboratories so rated for tissues (Table III). In general, a laboratory with capabilities for one matrix will probably do well for another.

It can be seen from both Tables II and III that it is obviously easier to get superior or good precision than superior or good accuracy. While it is apparent that it is necessary to have acceptable precision in order to have good accuracy the converse does not hold. Good precision is attainable without respect to accuracy.

Nine of the twelve laboratories which were rated "superior" or "good" accuracy for sediments also were rated "superior" or "good" for precision (Table II). Also, nine of the ten laboratories which were rated "superior" or "good" accuracy for tissues were rated "superior" or "good" for precision (Table III). An accurate laboratory is usually a precise laboratory. One of the major requirements of any study is to define the tolerable uncertainty which can be associated with an analysis.

There is an apparent correlation between performance and previous experience in this type of intercomparison study. A comparison was made of the results of those laboratories which had participated in one or more of the four former NOAA exercises with those of the new participants. Means and standard deviations for the two groups were calculated and the results are tabulated in the tables in Appendix E. Conspicuous outliers were not included in these calculations in order to mitigate the effects of obvious poor performance. The number of means used in the calculations is noted in parentheses. The accepted or certified concentration is also shown. A *t* test and *F* test[3] were used to determine if there was a significant difference between the mean and standard deviations, respectively.

An examination of Table E-1 for sediments shows that the new participants produced lower means than the others in twenty-two of twenty-four instances and worse interlaboratory precision twenty-three of these times. Their means for the analyses of the CRM are more biased in eight out of eleven cases. This can probably be explained by poorer dissolution procedures used by many of the new participants (Appendix D). It is essential to incorporate hydrofluoric acid into the dissolution procedure.

Table E-2 for tissues shows that the new participants produced lower means than the others in twenty of twenty-two instances and worse interlaboratory precision fifteen of these times. Their means for the analyses of the CRM are more biased in ten out of twelve cases. The reason for the tendency towards lower values for the metals in the tissues is not apparent. An examination of the procedures listed in Appendix D led to no conclusions in this respect.

The final table in Appendix E (E-3) contains the summary of the statistical comparison of the means and intralaboratory precision between the two groups at the 95 percent confidence level. While comparisons at this confidence level do not yield as many differences as stated in the above two paragraphs the distinct tendencies must be taken into account.

It should be remembered that, according to plan, the two unknowns used in this study were moderately contaminated materials which are presumably easier to analyze than samples coming from uncontaminated areas. It would be a mistake to attempt to extrapolate to lower concentration levels without some further indication of abilities. The two CRMs, in most cases, had lower concentrations of analytes and are obviously relatively uncontaminated samples. The ability to analyze the CRMs with competence must be taken into account in this study. There were a large number of disappointing instances where poor performances were noted with the CRMs (e.g., aluminum, chromium, iron, zinc, arsenic and tin in BCSS-1; aluminum, chromium, iron, copper, arsenic, mercury and lead in SRM 1566a).

4. BIBLIOGRAPHY

1. J.C. Miller and J.N. Miller, *Statistics for Analytical Chemistry*, Ellis Horwood, 2nd Edition, 1988. pg. 62

2. ibid. pg. 54

3. ibid. pg. 60

APPENDIX A

Data was received from the following laboratories:

Alabama Department of Environmental Management
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Environmental Chemistry
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Menai, N.S.W. 2234 Australia
Dr. David Waite

Australian Government Analytical Laboratories
PO Box 385
Pymble, N.S.W. 2073 Australia
Mr. John Dalins

Battelle Pacific Northwest
439 W. Sequim Bay Road
Sequim, WA 98382
Dr. E. Crecelius

Battelle Ocean Science
397 Washington St.
Duxbury, MA 02332
Dr. D. Shea

California Department of Fish and Game
2201 Garden Road
Monteray, CA 93940
Dr. M. Stephenson

Cat Cove Lab. - Marine Fisheries
Commonwealth of Massachusetts
92 Fort Ave.
Salem, MA 01970
Dr. Jack Schwartz

Central Regional Lab.
EPA
839 Bestgate Rd.
Annapolis, MD 21401
Mr. Rich Dreisch

Department of Oceanography
Texas A. & M.
College Station, TX 77843
Dr. R.J. Taylor

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211 West Flagler St.
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Mrs. Jana Bares

EPA
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Mr. William McDaniel

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Tallahassee, FL 32399-2400
Dr. Bill Coppenger

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PO Box 594
Archerfield, Queensland 4108 Australia
Dr. Des Connell

Laboratory for Inorganic and Nuclear Chemistry
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Empire State Plaza
Albany, NY 12201
Dr. Edmond Canelli

New York State Dept. of Environment Conservation
Hale Creek Field Station
7235 Steele Ave. Extension
Gloversville, NY 12078
Mr. Samuel Jackling

NOAA/NMFS
212 Rogers Ave.
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Mr. George Sennefelder

Northeast Fisheries Center
Sandy Hook Laboratory
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Dr. V.S. Zdanowicz

Northwest Fisheries Science Center
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Seattle, WA 98112-2097
Dr. R.C. Clark, Jr.

Patuxent Wildlife Research Ctr.
Stickel Laboratory. Rm A-6
Laurel, MD 20708
Dr. John Moore

Queensland Department of Primary Industries
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Mr. George Rayment

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1217 Pearl St.
Jacksonville, FL 32202
Ms. Tammie Stouter

Technical Service Division
State of Louisiana
8618 GSRI Road
Baton Rouge, LA 70810
Ms. Elaine Sorbet

U. Massachusetts at Boston
Environmental Science Program
Harbor Campus
Boston, MA 02125
Dr. Gordon Wallace

USEPA
Environmental Monitoring Systems Laboratory
26 W. Martin Luther King Dr.
Cincinnati, OH 45268
Dr. R.F. Thomas

USEPA
Environmental Research Laboratory
South Ferry Road
Narragansett, RI 02882
Dr. W.S. Boothman

USGS
6481-B Peachtree Blvd.
Doraville, GA 30360
Dr. Arthur Horowitz

Water Pollution Control- 3rd Floor Lab
515 West 6th St.
Jacksonville, FL 32206
Mr. Roger Baskin

Data was not received from the following laboratories:

The Academy of Natural Sciences
Benedict Estuarine Research Laboratory
Benedict, MD 20612
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Division of Laboratories
Office of Public Health
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Ms. Lee Ruggles

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Mr. Al Bober

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Mr. Ted Groun

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Dr. James Stuart

Appendix B

DATA

ALUMINUM
Sediment N 5.27 +/- 1.30 %

							Mean	Std. Dev.
LAB	1	3.63	2.21	1.58	2.24	1.66	*2.26	0.82
LAB	2	4.06	4.70	4.85	4.39	4.53	4.51	0.30
LAB	3	0.947	0.918	0.984	0.953	1.010	*0.962	0.035
LAB	4	4.780	5.110	5.120	4.950	5.230	5.038	0.175
LAB	5							
LAB	6							
LAB	7							
LAB	8	0.897	0.883	0.979	0.946	0.949	*0.931	0.040
LAB	9	0.97432	0.98513	1.05326	0.99871	1.02014	*1.00631	0.03133
LAB	10	0.796	0.852	0.822	0.708	0.840	*0.804	0.057
LAB	11							
LAB	12	5.44	5.52	5.49	5.48	5.43	5.47	0.04
LAB	13	1.15	1.18	1.53	1.17	1.03	*1.21	0.19
LAB	14	5.12	4.99	4.99	5.37	5.31	5.16	0.18
LAB	15	5.2	5.6	5.2	5.6	5.3	5.4	0.2
LAB	16							
LAB	17	5.05	5.85	5.7	5.47	5.66	5.55	0.31
LAB	18	6.83	6.51	6.31	6.60	6.55	6.56	0.17
LAB	19	0.00964	0.0116	0.0177	0.0166	0.0169	*0.0017	0.0036
LAB	20	5.8	5.6	5.6	5.6	5.5	5.6	0.1
LAB	21	5.04	4.97	5.03	5.03	5.02	5.02	0.03
LAB	22							
LAB	23							
LAB	24							
LAB	25	4.107	3.968	3.809	3.934	4.111	3.986	0.127
LAB	26	1.18	1.35					
LAB	27	5.99	5.97	5.95	5.93	5.93	5.95	0.03
LAB	28	5.075	4.931	5.111	4.946	5.263	5.065	0.136
LAB	29							
LAB	30	5.31	5.35	5.25	5.36	5.23	5.30	0.06
LAB	31	5.16	5.11	5.11	5.15	5.14	5.13	0.02

ALUMINUM
BCSS-1 6.26 +/- 0.41 %

							Mean	Std. De
LAB	1	2.59	2.45	3.32	4.18	3.13	*3.1	0.7
LAB	2	5.295	5.5	5.61	5.27	6.3	*5.595	0.419
LAB	3	1.450	1.420	1.440	1.380	1.540	*1.446	0.059
LAB	4	5.490	5.860	6.040	6.100	5.810	5.860	0.239
LAB	5							
LAB	6							
LAB	7							
LAB	8	1.41	1.45	1.49	1.28	1.40	*1.41	0.08
LAB	9	1.57277	1.58627	1.51496	1.64540	1.62029	*1.58794	0.04977
LAB	10	1.17	1.19	1.15	1.42	1.03	*1.19	0.14
LAB	11							
LAB	12	6.41	6.25	6.13	6.25	6.64	6.34	0.20
LAB	13	1.43	1.53	1.48	1.36	1.60	*1.48	0.09
LAB	14	6.4	6.31	6.24	5.89	6.17	6.202	0.194
LAB	15							
LAB	16							
LAB	17	6.11	5.93	6.30	6.35	6.45	6.23	0.21
LAB	18	7.89	6.54	6.70	6.47	6.62	*6.84	0.53
LAB	19	0.0473	0.0368	0.0345	0.0382	0.0482	*0.0410	0.0063
LAB	20	6.7	6.4	6.9	6.9	6.8	6.7	0.2
LAB	21	6.15	6.1	6.08	6.04	6.01	6.08	0.05
LAB	22							
LAB	23							
LAB	24							
LAB	25	6.308	6.285	6.244	6.052	6.146	6.207	0.107
LAB	26							
LAB	27	6.41	6.31	6.31	6.29	6.31	6.33	0.05
LAB	28	6.179	5.675	5.564	5.278	5.915	*5.722	0.343
LAB	29							

ALUMINUM
Mussel P, mg/kg

						Mean	Std. Dev.
LAB 1	425	431	482	432	471	448	26
LAB 2							
LAB 3	201	208	218	223	209	212	9
LAB 4	2.080	2.220	2.450	1.990	3.560	2.460	0.639
LAB 5	380	490	410	440	430	430	41
LAB 6	109	121	115	121	132	120	9
LAB 7							
LAB 8	281	259	297	308	294	288	19
LAB 9							
LAB 10	196	200	176	182	204	192	12
LAB 11							
LAB 12	649	732	664	679	678	680	31
LAB 13	341	345	330	362	307	337	20
LAB 14							
LAB 15							
LAB 16							
LAB 17							
LAB 18	689.8	668.9	623.7	679.5	524.5	637.3	67.9
LAB 19	4.61	4.64	3.95	3.61	4.80	4.32	0.51
LAB 20	486	481	531	508	543	510	27
LAB 21	373	336	370	393	434	381	36
LAB 22							
LAB 23	216.1	181.0	192.3	191.7	195.3	195.3	12.8
LAB 24							
LAB 25							
LAB 26	332	312					
LAB 27	427	448	418	439	436	434	12
LAB 28							
LAB 29	820	820	770	830	810	810	23
LAB 30	955	974	953	976	894	950	33
LAB 31							

ALUMINUM
SRM 1566a 202.5 +/- 12.5 mg/kg

						Mean	Std. De
LAB 1	108	106	92	98	116	*104	9
LAB 2							
LAB 3	48.4	47.7	51.2	48.0	54.5	*50.0	2.9
LAB 4	2.100	1.611	4.515	3.656	3.380	*3.052	1.183
LAB 5							
LAB 6	27	29	26	28	28	*28	1
LAB 7							
LAB 8	84.4	90.1	80.0	55.8	95.2	*81.1	15.3
LAB 9							
LAB 10	39.5	49.8	41.8	Q174	56.8	*47.0	7.9
LAB 11							
LAB 12	181	181	178	201	207	190	13
LAB 13							
LAB 14							
LAB 15							
LAB 16							
LAB 17	Q263.7	120.9	105.3	123.4	149.3	*124.7	18.1
LAB 18							
LAB 19	5.54	3.64	3.61	4.00	4.94	*4.345	0.86
LAB 20	110	110	91	94	95	*100	9
LAB 21	98.9	92.8	96.0	107.0	92.5	*97.4	5.9
LAB 22							
LAB 23	42.8	46.2	32.3	42.5	21.4	*37.0	10.2
LAB 24							
LAB 25							
LAB 26							
LAB 27							
LAB 28							
LAB 29	210	200	190	200	200	200	7

SILICON
Sediment N 25.9 +/- 4.1 %

						Mean	Std. Dev.
LAB 1							
LAB 2							
LAB 3							
LAB 4							
LAB 5							
LAB 6							
LAB 7							
LAB 8							
LAB 9							
LAB 10							
LAB 11							
LAB 12							
LAB 13							
LAB 14							
LAB 15							
LAB 16							
LAB 17	27.5	28.9	28.0	25.6	26.2	27.2	1.3
LAB 18							
LAB 19							
LAB 20	24	24	24	23	23	24	1
LAB 21							
LAB 22							
LAB 23							
LAB 24	27.1	26.2	26.3	27.2	26.6	26.7	0.5
LAB 25							
LAB 26							
LAB 27							
LAB 28							
LAB 29							
LAB 30							
LAB 31	26.2	25.9	26.2	26.5	26.4	26.2	0.2

SILICON
BCSS-1 30.8 +/- 1.0 %

						Mean	Std. De
LAB 1							
LAB 2							
LAB 3							
LAB 4							
LAB 5							
LAB 6							
LAB 7							
LAB 8							
LAB 9							
LAB 10							
LAB 11							
LAB 12							
LAB 13							
LAB 14							
LAB 15							
LAB 16							
LAB 17	30.2	30.4	29.5	30.8	31.4	30.5	0.7
LAB 18							
LAB 19							
LAB 20	30	29	30	29	29	29	1
LAB 21							
LAB 22							
LAB 23							
LAB 24	30.0	31.3	29.9	31.4	30.5	30.6	0.7
LAB 25							
LAB 26							
LAB 27							
LAB 28							
LAB 29							

Silicon in Biological Tissue Not Required

CHROMIUM
Sediment N 63.1 +/- 15.7 mg/kg

							Mean	Std. Dev.
LAB	1	29.7	34.5	35.6	36.0	37.9	*34.7	3.1
LAB	2	67	67	68	65	64	66	2
LAB	3	27.4	27.2	28.6	28.0	29.9	*28.2	1.1
LAB	4	66.0	66.8	68.3	69.4	68.6	67.8	1.4
LAB	5							
LAB	6							
LAB	7	37.5	37.1	30.4	30.5	32.0	*33.5	3.5
LAB	8	39.6	37.8	41.6	39.6	41.2	*40.0	1.5
LAB	9	26.97	25.87	25.87	26.93	25.86	*26.30	0.59
LAB	10	27.0	27.7	27.7	25.3	26.3	*26.8	1.0
LAB	11							
LAB	12	71.1	71.2	69.8	70.9	68.2	70.2	1.3
LAB	13	30.5	30.5	35.3	31.4	28.6	*31.3	2.5
LAB	14							
LAB	15	57	58	57	58	63	59	3
LAB	16	32	34	30	32	31	*32	1
LAB	17	74.2	79.8	67.4	70.9	82.2	74.9	6.125
LAB	18	58.8	57.1	56.7	59.5	57.0	57.8	1.1
LAB	19	4.935	4.243	4.179	4.151	4.075	*4.317	0.351
LAB	20	65	51	45	56	62	56	8
LAB	21	54.7	52.5	55.5	54.1	53.6	54.1	1.1
LAB	22							
LAB	23	57.0	58.9	55.5	56.4	55.6	56.7	1.4
LAB	24	64.4	64.5	68.5	72.6	72.0	68.4	3.9
LAB	25	72.7	74.59	72.70	75.55	75.47	74.20	1.42
LAB	26	36.2	37.1					
LAB	27	59	57	58	58	57	58	1
LAB	28	39.91	35.27	40.71	21.64	29.32	*33.37	7.97
LAB	29	76	65	57	65	66	66	7
LAB	30	58.2	54.4	57.2	55.2	55.0	56.0	1.6
LAB	31	55.6	54.9	60.2	53.5	59.0	56.6	2.8

CHROMIUM
BCSS-1 123 +/- 14 mg/kg

							Mean	Std. De
LAB	1	47.6	53.3	49.5	50.0	47.2	*49.5	2.4
LAB	2	121	111	111	108	107	112	6
LAB	3	40.8	40.7	40.5	39.0	41.6	*40.5	0.9
LAB	4	92.8	97.7	107	106	104	*101.5	6.1
LAB	5							
LAB	6							
LAB	7	41.4	41.9	43.3	42.3	40.5	*41.9	1.0
LAB	8	59.2	69.4	66.6	69		*66.1	4.7
LAB	9	39.79	40.81	39.76	39.75	39.75	*39.97	0.47
LAB	10	39.1	37.1	37.1	36.9	33.3	*36.7	2.1
LAB	11							
LAB	12	127	121	125	124	129	125	3
LAB	13	39.2	41.4	40.6	37.1	42.0	*40.1	2.0
LAB	14							
LAB	15							
LAB	16	31	42	40	37	37	*37	4
LAB	17	125.3	125.3	125.6	104.4	113.8	118.9	9.5
LAB	18	109.7	91.9	91.3	94.9	82.1	*94.0	9.0
LAB	19	42.37	39.12	38.4	37.92	37.91	*39.14	1.87
LAB	20	119	126	124	136	126	126	6
LAB	21	86.9	87.3	89	87.4	82.9	*86.7	2.3
LAB	22							
LAB	23	97.9	96.2	90.3	90.8	97.6	*94.6	3.7
LAB	24	122	121	118	121	129	122	4
LAB	25	117.79	120.8	119.69	118.11	117.29	118.74	1.46
LAB	26	2.14	1.91					
LAB	27	101	110	96	101	97	*101	6
LAB	28	32.78	50.06	51.96	67.33	42.42	*48.91	12.77
LAB	29	140	130	130	140	140	136	5

CHROMIUM
Mussel P 2.52 +/- 0.75 mg/kg

							Mean	Std. Dev.
LAB	1	1.51	1.45	1.57	1.54	1.66	*1.55	0.08
LAB	2							
LAB	3	1.66	1.46	1.46	1.48	1.36	*1.48	0.11
LAB	4	2.42	3.06	2.4	2.28	3.32	2.70	0.46
LAB	5	2.17	2.22	2.07	2.17	2.12	2.15	0.06
LAB	6	2.5	2.4	2.3	2.3	2.4	2.4	0.1
LAB	7	2.6	2.6	2.5	2.5	2.6	2.6	0.1
LAB	8	2.6	2.5	2.3	6.5	2.1	3.2	1.9
LAB	9							
LAB	10	3.2	3.7	2.3	0.8	2.5	2.5	1.1
LAB	11	2.50	2.50	2.50	2.50	2.48	2.50	0.01
LAB	12	2.22	2.19	2.21	2.36	2.46	2.29	0.12
LAB	13	2.74	2.77	2.72	2.76	2.81	2.76	0.03
LAB	14							
LAB	15	2	2	2	1	1	*2	1
LAB	16	5.1	17	25	17	19	*17	7
LAB	17	3.82	3.85	3.95	3.84	3.78	*3.85	0.06
LAB	18	2.35	2.46	2.44	2.312	2.41	2.39	0.06
LAB	19	1.421	1.405	1.467	1.451	1.560	*1.461	0.061
LAB	20	3.5	3.5	3.1	3.1	3.2	3.3	0.2
LAB	21	1.55	1.77	2.09	1.57	2.30	1.86	0.33
LAB	22							
LAB	23	1.44	1.33	1.22	1.19	1.30	*1.3	0.099
LAB	24							
LAB	25							
LAB	26							
LAB	27	2.5	2.6	2.8	2.6	2.6	2.6	0.1
LAB	28							
LAB	29	1.8	2.4	2.3	2.6	2.1	2.2	0.3
LAB	30	2.99	3.37	3.13	3.41	3.1	3.20	0.18
LAB	31	2.67	2.35	2.42	2.5	2.85	2.56	0.20

CHROMIUM
SRM 1566a 1.43 +/- 0.46 mg/kg

							Mean	Std. De
LAB	1	0.75	0.76	0.73	0.61	0.62	*0.69	0.07
LAB	2							
LAB	3	0.935	0.726	0.92	0.57	0.581	*0.746	0.176
LAB	4	2.33	2.15	2.21	2.84	2.53	*2.41	0.28
LAB	5							
LAB	6	1.6	1.6	1.5	1.4	1.8	1.6	0.1
LAB	7	1.1	1.0	0.89	1.0	0.70	*0.94	0.15
LAB	8	2.7	2.4	1.6	1.5	2.4	*2.1	0.5
LAB	9							
LAB	10	2.8	9.8	2.5	3.4	1.7	*2.6	3.3
LAB	11	<0.75	0.98	0.99	1.00	<0.75		
LAB	12	1.45	1.57	1.44	1.45	1.54	1.49	0.060
LAB	13							
LAB	14							
LAB	15							
LAB	16	2.5	<10	<10	<10	<10		
LAB	17	1.37	1.47	1.35	1.45	1.35	1.398	0.058
LAB	18	1.33	1.31	1.25	1.28	1.33	1.3	0.035
LAB	19	1.549	1.525	1.562	1.510	1.519	1.533	0.022
LAB	20	1.4	1.4	1.4	1.5	1.6	1.46	0.089
LAB	21	0.89	1.12	0.50	1.19	0.51	*0.84	0.33
LAB	22							
LAB	23	0.60	0.65	1.02	0.35	0.51	0.63	0.25
LAB	24							
LAB	25							
LAB	26							
LAB	27							
LAB	28							
LAB	29	1.3	1.3	1.3	1.3	1.4	1.3	0.0

MANGANESE
Sediment N 495 +/- 103 mg/kg

							Mean	Std. Dev.
LAB	1	315	286	301	293	310	*301	12
LAB	2	498	498	491	502	497	497	4
LAB	3	224	222	233	228	237	*229	6
LAB	4	522	548	519	522	522	527	12
LAB	5							
LAB	6							
LAB	7							
LAB	8	256.6	259.4	276.8	269.6	274.2	*267.3	8.9
LAB	9	241.7	242.5	238.1	244.6	241.3	*241.6	2.4
LAB	10							
LAB	11							
LAB	12	500	502	528	511	512	511	11
LAB	13	241	245	289	246	226	*249	24
LAB	14	455	457	457	462	448	456	5
LAB	15	470	466	472	486	474	474	8
LAB	16							
LAB	17	520	523	520	508	503	515	9
LAB	18							
LAB	19							
LAB	20	434	481	467	481	456	464	20
LAB	21	460	448	455	452	453	454	4
LAB	22							
LAB	23	435	447	448	446	454	446	7
LAB	24	562	575	575	574	575	572	6
LAB	25	600.86	606.23	593.23	568.92	579.98	589.84	15.30
LAB	26	265	288					
LAB	27							
LAB	28	438.19	436.36	432.43	443.19	452.44	440.52	7.70
LAB	29	440	460	440	430	410	436	18
LAB	30	524	534	530	525	544	531	8
LAB	31	524	532	535	523	526	528	5

MANGANESE
BCSS-1 229 +/- 15 mg/kg

							Mean	Std. De
LAB	1	173	184	184	180	190	*182	6
LAB	2	237	236	242	242	238	239	3
LAB	3	177	177	177	171	180	*176	3
LAB	4	216	228	234	238	230	229	8
LAB	5							
LAB	6							
LAB	7							
LAB	8	255	291.6	286.6	291.6	-	*277.7	19.8
LAB	9	184.3	185.2	181	184.1	184.1	*183.7	1.6
LAB	10							
LAB	11							
LAB	12	241	236	237	241	238	239	2
LAB	13	159	165	163	150	166	*161	7
LAB	14	221	224	209	218	223	219	6
LAB	15							
LAB	16							
LAB	17	228	231	227	225	226	227	2
LAB	18							
LAB	19							
LAB	20	224	226	216	213	220	220	5
LAB	21	214	214	214	211	210	213	2
LAB	22							
LAB	23	193	190	185	187	198	*191	5
LAB	24	229	228	234	225	224	228	4
LAB	25	253.01	267.9	256.32	249.36	269.31	*259.18	8.96
LAB	26							
LAB	27							
LAB	28	202.67	204.43	198.82	202.03	210.52	*203.69	4.32
LAB	29	240	240	240	240	240	240	0

Manganese in Biological Tissue Not Required

IRON

Sediment N 2.97 +/- 0.40 %

							Mean	Std. Dev.
LAB	1	2.84	2.74	2.81	2.79	2.86	2.81	0.05
LAB	2	2.83	3.13	2.81	2.86	2.85	2.90	0.13
LAB	3	2.33	2.34	2.41	2.38	2.42	*2.38	0.04
LAB	4	2.96	3.07	3.14	3.09	3.15	3.08	0.08
LAB	5							
LAB	6							
LAB	7	2.5	2.48	2.48	2.53	2.47	*2.49	0.02
LAB	8	2.669	2.657	2.913	2.877	2.765	2.776	0.117
LAB	9	2.36416	2.40267	2.37298	2.39086	2.38608	*2.38335	0.01511
LAB	10	2.25	2.25	2.29	2.15	2.23	*2.23	0.05
LAB	11							
LAB	12	3.10	3.21	3.22	3.24	3.21	3.20	0.06
LAB	13	2.23	2.24	2.29	2.26	2.19	*2.24	0.04
LAB	14	2.83	2.81	2.84	2.87	2.85	2.84	0.02
LAB	15	3.2	3.2	3.0	3.0	3.0	3.1	0.1
LAB	16							
LAB	17	2.93	2.94	2.92	2.92	2.94	2.93	0.01
LAB	18							
LAB	19	0.00026	0.0002	0.00026	0.00025	0.0003	*0.00025	0.00004
LAB	20	Q2.9	3.0	3.0	3.0	3.0	3.0	0.0
LAB	21	2.64	2.58	2.62	2.61	2.61	*2.61	0.02
LAB	22							
LAB	23	2.6955	2.7168	2.7049	2.6603	2.6624	2.6880	0.0255
LAB	24	2.94	3.07	3.02	2.99	2.81	2.97	0.10
LAB	25	2.968	3.096	3.028	3.025	3.054	3.034	0.047
LAB	26	2.66	2.71					
LAB	27	3.22	3.19	3.19	3.18	3.19	3.19	0.02
LAB	28	2.422	2.274	2.208	2.260	2.313	*2.295	0.080
LAB	29							
LAB	30	3.21	3.26	3.26	3.19	3.25	3.23	0.03
LAB	31	3.35	3.27	3.12	3.06	2.91	3.14	0.17

IRON

BCSS-1 3.28 +/- 0.14 %

							Mean	Std. De
LAB	1	3.00	2.89	2.88	3.21	2.88	*2.97	0.14
LAB	2	2.83	3.13	2.81	2.86	2.85	*2.90	0.13
LAB	3	2.46	2.46	2.45	2.37	2.5	*2.45	0.05
LAB	4	3.09	3.21	3.24	3.34	3.24	3.22	0.09
LAB	5							
LAB	6							
LAB	7	2.65	2.22	2.69	2.54	2.61	*2.54	0.19
LAB	8	3.112	2.928	3.013	2.621	2.634	*2.862	0.223
LAB	9	2.39937	2.44888	2.45366	2.44289	2.35171	*2.41930	0.04352
LAB	10	2.12	2.13	2.05	2.13	1.90	*2.07	0.10
LAB	11							
LAB	12	3.57	3.56	3.50	3.54	3.53	*3.54	0.03
LAB	13	2.24	2.32	2.3	2.1	2.36	*2.26	0.10
LAB	14	3.01	3.08	2.97	3.07	3.16	3.06	0.07
LAB	15							
LAB	16							
LAB	17	3.34	3.34	3.34	3.30	3.30	3.32	0.022
LAB	18							
LAB	19	0.0026	0.0028	0.0027	0.0026	0.0024	*0.0026	0.0001
LAB	20	3.4	3.4	3.4	3.3	3.3	3.4	0.1
LAB	21	2.94	2.93	2.92	2.89	2.87	*2.91	0.03
LAB	22							
LAB	23	3.0721	2.8655	2.7779	2.8239	2.9492	*2.8977	0.1161
LAB	24	3.28	3.31	3.41	3.19	3.35	3.31	0.08
LAB	25	3.113	3.146	3.202	3.219	3.126	3.161	0.047
LAB	26							
LAB	27	3.53	3.52	3.51	3.52	3.50	*3.52	0.01
LAB	28	2.514	2.360	2.388	2.393	2.533	*2.438	0.080
LAB	29							

IRON

Mussel P 575 +/- 172 mg/kg

						Mean	Std. Dev.
LAB 1	500	520	560	530	570	536	29
LAB 2							
LAB 3	348	361	364	382	371	*365	13
LAB 4	705	693	727	773	616	703	57
LAB 5	470	490	460	520	520	492	28
LAB 6	224	236	233	235	251	*236	10
LAB 7	595	589	613	550	567	583	25
LAB 8	295	277	367	399	367	*341	52
LAB 9							
LAB 10	393	422	364	382	422	*397	25
LAB 11							
LAB 12	526	536	533	558	554	541	14
LAB 13	479	488	483	477	456	477	12
LAB 14	545	543	613	568	559	566	28
LAB 15	416	398	462	415	400	418	26
LAB 16							
LAB 17	573	568	582	574	588	577	8
LAB 18	728	828	649	674	579	692	93
LAB 19	3.69	4.21	4.48	4.48	3.96	*4.16	0.34
LAB 20	567	636	685	626	691	641	50
LAB 21	484	459	498	480	501	484	17
LAB 22							
LAB 23	388	342	359	356	365	*362	17
LAB 24							
LAB 25							
LAB 26	461	479					
LAB 27	523.91	559.61	495.99	484.44	500.80	512.95	29.77
LAB 28							
LAB 29							
LAB 30	458	473	461	466	462	464	6
LAB 31							

IRON

SRM 1566a 539 +/- 15 mg/kg

						Mean	Std. De
LAB 1	480	500	510	490	510	*498	13
LAB 2							
LAB 3	469	461	462	458	465	*463	4
LAB 4	533	538	596	568	598	*567	31
LAB 5							
LAB 6	302	296	319	312	308	*307	9
LAB 7	577	570	571	566	579	*573	5
LAB 8	450	467	459	413	493	*456	29
LAB 9							
LAB 10	391	468	398	Q708	408	*416	189
LAB 11							
LAB 12	523	546	523	524	551	533	14
LAB 13							
LAB 14	527	535	546	526	524	532	9
LAB 15							
LAB 16							
LAB 17	528	542	543	540	538	538	6
LAB 18	500	592	603	551	680	*585	67
LAB 19	4.51	4.61	4.8	5.24	4.19	*4.67	0.39
LAB 20	526	497	515	540	566	529	26
LAB 21	471	499	484	461	484	*480	14
LAB 22							
LAB 23	395	382	388	365	-	*383	13
LAB 24							
LAB 25							
LAB 26							
LAB 27							
LAB 28							
LAB 29							

COPPER
Sediment N 129 +/- 26 mg/kg

							Mean	Std. Dev.
LAB	1	151	116	135	123	129	131	13
LAB	2	147	147	126	135	130	137	10
LAB	3	122	119	130	128	125	125	4
LAB	4	120	118	121	126	117	120	4
LAB	5							
LAB	6							
LAB	7	68.3	67.2	66.5	70.8	68.2	*68.2	1.6
LAB	8	139.6	154.6	151.8	157.2	158.6	152.4	7.6
LAB	9	116.43	118.51	115.28	116.34	117.51	116.81	1.23
LAB	10	140	121	126	142	114	129	12
LAB	11	106.0	Q77.5	106.0	104.0	112.8	107.2	3.9
LAB	12	123	129	129	140	134	131	6
LAB	13	126	106	110	120	116	116	8
LAB	14	143	142	153	148	134	144	7
LAB	15	125	127	125	122	118	123	4
LAB	16	108	117	119	111	113	114	4
LAB	17	144.1	151.1	155.6	142.7	152.8	149.3	5.6
LAB	18	138	143	150	146	150	145	5
LAB	19	38.52	42.52	38.88	38.22	43.95	*40.42	2.63
LAB	20	128	122	128	141	124	129	7
LAB	21	142	113	125	132	132	129	11
LAB	22							
LAB	23	129	118	121	117	112	119	6
LAB	24	121	127	124	127	120	124	3
LAB	25	138.11	136.27	128.28	154.37	140.59	139.52	9.49
LAB	26	136	134					
LAB	27	156	125	129	145	120	135	15
LAB	28	427	444	471	413	421	*435	23
LAB	29	150	150	150	140	140	146	5
LAB	30	108	120	115	114	119	115	5
LAB	31	126	124	116	117	136	124	8

COPPER
BCSS-1 18.5 +/- 2.7 mg/kg

							Mean	Std. De
LAB	1	15.3	15.4	15.8	15.5	15.2	*15.4	0.2
LAB	2	23	21	21	22	22	*22	1
LAB	3	15.3	15.5	15.0	14.4	15.0	*15.0	0.4
LAB	4	16.2	17.6	16.6	17.0	16.4	16.8	0.6
LAB	5							
LAB	6							
LAB	7	6.45	5.99	6.51	6.59	5.98	*6.30	0.30
LAB	8	22.6	26.0	25.8	26.4	-	*25.2	1.8
LAB	9	15.69	16.16	16.32	16.53	15.64	16.07	0.39
LAB	10	15.6	14.9	15.5	Q19.2	14.9	12.2	6.8
LAB	11	30.2	28.2	30.0	27.5	31.7	*29.5	1.7
LAB	12	19.1	18.7	20	19.9	20.9	19.7	0.9
LAB	13	13.6	13	13	12	12.8	*12.9	0.6
LAB	14	19.7	20.8	20.6	20.3	20.8	20.4	0.5
LAB	15							
LAB	16	12	14	14	12	13	*13	1
LAB	17	18.3	18.7	17.9	18.4	18.1	18.3	0.3
LAB	18	23.4	22.0	21.1	21.5	21.0	21.8	0.9
LAB	19	17.54	17.98	17.04	18.91	14.07	17.11	1.83
LAB	20	19	19	20	19	20	19	1
LAB	21	16.8	16.9	17.3	16.8	16.5	16.9	0.3
LAB	22							
LAB	23	14.5	14.4	13.5	13.5	14.1	*14.0	0.5
LAB	24	18.3	Q21.5	18.5	18.4	18.4	14.7	8.2
LAB	25	16.30	16.50	17.15	16.64	16.10	16.54	0.40
LAB	26							
LAB	27	17.2	17.7	17.1	17.1	17.4	17.3	0.3
LAB	28	305	312	302	Q826	296	*303	136
LAB	29	20	20	20	20	20	20	0

COPPER
Mussel P 7.81 +/- 3.07 mg/kg

							Mean	Std. Dev.
LAB	1	7.15	7.1	7.15	7.16	7.37	7.14	0.11
LAB	2							
LAB	3	6.05	5.92	6.00	5.54	5.68	5.84	0.22
LAB	4	9.71	9.42	8.97	9.35	9.05	9.30	0.30
LAB	5	9.6	9.1	9.2	9.3	9.4	9.3	0.2
LAB	6	7.8	6.6	6.5	6.1	6.3	6.7	0.7
LAB	7	6.22	6.67	6.23	6.17	6.47	6.35	0.21
LAB	8	8.2	7.9	7.1	7.2	6.8	7.4	0.6
LAB	9							
LAB	10	9.9	9.9	10.3	10.0	9.5	9.9	0.3
LAB	11	8.00	8.00	8.00	7.50	7.43	7.79	0.29
LAB	12	5.97	6.64	6.19	6.36	6.34	6.30	0.25
LAB	13	8.7	8.7	8.7	8.7	8.5	8.7	0.1
LAB	14	11.6	11.4	11.7	12.5	10.5	11.54	0.716
LAB	15	7	7	8	8	7	7	1
LAB	16	<7.5	<16	<16	<16	<16		
LAB	17	7.65	8.02	7.90	7.94	7.02	7.71	0.41
LAB	18	7.35	7.73	7.54	7.71	7.70	7.61	0.16
LAB	19	9.85	12.76	12.7	12.42	14.16	*12.38	1.57
LAB	20	7.5	8.3	9.5	9.5	9.5	8.9	0.9
LAB	21	7.3	7.4	7.3	7.2	7.4	7.3	0.1
LAB	22							
LAB	23	5.70	5.47	5.26	5.03	5.10	5.31	0.28
LAB	24							
LAB	25							
LAB	26	7.8	8.0					
LAB	27	6.81	6.97	6.34	6.51	7.09	6.74	0.31
LAB	28							
LAB	29	9.3	9.9	9.3	10	9.3	9.56	0.36
LAB	30	7.33	7.29	7.26	7.03	7.34	7.25	0.13
LAB	31	7.84	7.90	8.00	7.46	7.93	7.83	0.21

COPPER
SRM 1566a 66.3 +/- 4.3 mg/kg

							Mean	Std. De
LAB	1	64.0	64.6	65.1	64.5	64.9	64.6	0.4
LAB	2							
LAB	3	62.8	61.8	61.7	60.4	62.5	*61.8	0.9
LAB	4	63.0	63.7	65.2	65.0	62.5	63.9	1.2
LAB	5							
LAB	6	56	59	58	58	57	*58	1
LAB	7	56.7	58.1	59.9	59.1	59.9	*58.7	1.4
LAB	8	61.0	60.4	61.5	59.7	60.5	*60.6	0.7
LAB	9							
LAB	10	63.5	63.0	58.2	63.2	60.6	*61.7	2.3
LAB	11	60.95	61.76	61.88	63.5	61.65	*61.65	0.94
LAB	12	62.8	64.1	63.2	64.3	63.7	63.6	0.6
LAB	13							
LAB	14	72	73	71	71	71	72	1
LAB	15							
LAB	16	64	60	62	61	63	62	2
LAB	17	69.6	68.9	70.5	67.2	67.4	68.72	1.42
LAB	18	65	66.4	66.2	66.4	65.9	66.0	0.6
LAB	19	64.54	59.21	63.77	59.18	46.65	*58.67	7.168
LAB	20	69	67	68	69	69	68	1
LAB	21	60.4	63.2	61.3	59.4	62.5	*61.4	1.5
LAB	22							
LAB	23	53.0	52.9	56.3	51.3	-	*53.4	2.4
LAB	24							
LAB	25							
LAB	26							
LAB	27							
LAB	28							
LAB	29	73	72	69	72	71	71	2

ZINC
Sediment N 325 +/- 55 mg/kg

							Mean	Std. Dev.
LAB	1	304	299	310	300	305	304	4
LAB	2	452	346	326	312	358	359	55
LAB	3	278	290	288	283	282	284	5
LAB	4	297	319	337	322	335	322	16
LAB	5							
LAB	6							
LAB	7	323	327	339	329	330	330	6
LAB	8	336	352.2	369.2	368.2	373.8	360	16
LAB	9	316.88	316.95	Q 325.36	314.59	314.55	315.74	1.35
LAB	10	277	292	285	282	295	286	7
LAB	11	263.5	187.0	237.0	260.5	258.8	*241.4	32.2
LAB	12	332	340	335	334	333	335	3
LAB	13	278	280	273	283	279	279	4
LAB	14	390	357	347	343	345	356	20
LAB	15	333	314	323	313	324	321	8
LAB	16	261	255	269	259	277	264	9
LAB	17	334	336	333	327	345	335	7
LAB	18							
LAB	19	10.28	2.99	19.95	12.97	13.91	*12.02	6.16
LAB	20	311	322	346	333	328	328	13
LAB	21	336	327	346	336	328	335	8
LAB	22							
LAB	23	306	319	300	321	313	312	9
LAB	24	339	340	345	336	339	340	3
LAB	25	334.68	330.33	330.79	322.34	334.80	331	5
LAB	26	311	312					
LAB	27	336	313	319	333	330	326	10
LAB	28	360.99	356.47	394.10	354.08	350.18	363.16	17.73
LAB	29	310	310	310	320	290	308	11
LAB	30	354	364	345	352	354	354	7
LAB	31	342	332	354	342	344	343	8

ZINC
BCSS-1 119 +/- 12 mg/kg

							Mean	Std. De
LAB	1	94.9	95.3	96.4	95.2	95.5	*95.5	0.6
LAB	2	400	422	161	162	300	*289	125
LAB	3	90.4	92.6	92.8	87.9	89.9	*90.7	2.0
LAB	4	99.2	106	116	122	107	110	9
LAB	5							
LAB	6							
LAB	7	107	110	105	105	105	*106	2
LAB	8	138.2	164.8	162.6	162.4	-	*157.0	12.6
LAB	9	99.48	100.44	100.42	100.42	98.34	*99.82	0.92
LAB	10	87.0	95.0	93.8	91.0	84.4	*90.2	4.5
LAB	11	106.4	104.4	109.1	98.0	110.4	*105.7	4.9
LAB	12	120	118	116	116	120	118	2
LAB	13	85.8	89.2	88.6	80.3	88.6	*86.5	3.7
LAB	14	110	116	114	110	111	112	3
LAB	15							
LAB	16	74	85	85	79	80	*81	5
LAB	17	110	118	114	110	110	112	4
LAB	18							
LAB	19	1.025	1.017	1.0005	1.027	1.011	*1.016	0.011
LAB	20	104	109	106	105	99	*105	4
LAB	21	109	111	109	110	109	110	1
LAB	22							
LAB	23	108	103	97	99	106	*103	5
LAB	24	120	118	117	119	119	119	1
LAB	25	112.2	110.37	117.76	114.94	113.96	113.85	2.80
LAB	26							
LAB	27	104	111	102	99	105	*104	4
LAB	28	112.03	121.52	113.74	117.59	122.93	117.56	4.74
LAB	29	110	110	110	110	110	110	0

ZINC

Mussel P 146 +/- 19 mg/kg

							Mean	Std. Dev.
LAB	1	151	152	150	154	154	152	2
LAB	2							
LAB	3	108	109	107	106	108	*108	1
LAB	4	136	140	131	136	138	136	3
LAB	5	160	160	165	165	165	163	3
LAB	6	149	137	135	132	137	138	6
LAB	7	174	173	169	174	170	172	2
LAB	8	113.2	117.7	125.0	118.2	122.2	119.3	4.5
LAB	9							
LAB	10	136	136	143	142	137	139	3
LAB	11	141.5	141.5	144.0	139.0	144.5	142.1	2.2
LAB	12	143	137	139	138	138	139	2
LAB	13	147	145	144	143	142	144	2
LAB	14	162	158	159	164	162	161	2
LAB	15	145	147	145	146	144	145	1
LAB	16	133	130	125	124	133	129	4
LAB	17	171	171	172	172	172	172	1
LAB	18	151	158	148	148	135	148	8
LAB	19	0.599	1.069	0.599	0.699	0.2134	*0.636	0.305
LAB	20	152	160	167	157	167	161	7
LAB	21	144	148	151	137	149	146	6
LAB	22							
LAB	23	122	122	118	116	120	120	3
LAB	24							
LAB	25							
LAB	26	136	137					
LAB	27	140	146	144	145	136	142	4
LAB	28							
LAB	29	180	180	Q 170	180	180	180	0
LAB	30	146	147	143	143	143	144	2
LAB	31	142	142	139	141	142	141	1

ZINC

SRM 1566a 830 +/- 57 mg/kg

							Mean	Std. De
LAB	1	797	802	792	787	795	795	6
LAB	2							
LAB	3	779	764	781	770	795	778	12
LAB	4	650	653	623	673	686	*657	24
LAB	5							
LAB	6	753	755	762	775	777	*764	11
LAB	7	961	955	968	962	953	*960	6
LAB	8	834	833	822	828	843	832	8
LAB	9							
LAB	10	744	808	750	838	818	792	42
LAB	11	763.8	771.6	765.8	786.0	770.9	*771.6	8.7
LAB	12	802	802	802	810	818	807	7
LAB	13							
LAB	14	840	853	859	858	840	850	9
LAB	15							
LAB	16	765	719	743	738	728	*739	17
LAB	17	832	830	835	833	826	831	3
LAB	18	849	868	860	857	837	854	12
LAB	19	8.642	8.658	8.504	8.597	8.67	*8.614	0.068
LAB	20	855	831	847	860	862	851	13
LAB	21	795	849	799	770	827	808	31
LAB	22							
LAB	23	649	644	679	624	-	*649	23
LAB	24							
LAB	25							
LAB	26							
LAB	27							
LAB	28							
LAB	29							
LAB	30							
LAB	31							

ARSENIC
Sediment N 19.8 +/- 5.8 mg/kg

							Mean	Std. Dev.
LAB	1	16.5	14.9	16.4	16.2	15.6	15.9	0.7
LAB	2	10.8	13.8	11.3	13.2	12.1	*12.2	1.3
LAB	3	18.9	18.3	18.4	18.5	18.6	18.5	0.2
LAB	4	15.8	15.8	16.3	16.2	16.7	16.2	0.38
LAB	5							
LAB	6							
LAB	7							
LAB	8	16.59	21.63	16.94	14.98	16.38	17.30	2.53
LAB	9	20.95	21.56	23.24	22.64	22.55	22.19	0.92
LAB	10	16.9	18.4	18.0	16.8	22.7	18.6	2.4
LAB	11							
LAB	12	22.2	22.7	22.6	22.0	22.3	22.4	0.3
LAB	13	17.4	17.9	17.1	17.3	16.8	17.3	0.4
LAB	14	21.5	21.9	22.0	21.8	20.8	21.6	0.5
LAB	15	23	25	22	23	22	23	1
LAB	16	10	14	12	11	13	*12	2
LAB	17	23.2	22.6	23.5	23.6	24.8	23.5	0.8
LAB	18	27.1	26.8	28.2	32.1	27.4	*28.3	1.9
LAB	19	20.34	19.7	20.51	22.65	21.05	20.85	1.12
LAB	20	15	17	16	16	15	16	1
LAB	21	19.8	20.3	19.9	20.8	21.0	20.4	0.5
LAB	22							
LAB	23	18.0	18.6	17.3	18.1	18.1	18.0	0.5
LAB	24							
LAB	25							
LAB	26	16.8	16.6					
LAB	27	21.3	22.6	21.9	21.7	22.4	22.0	0.5
LAB	28							
LAB	29							
LAB	30							
LAB	31	22.4	23.1	23.1	23.4	23.9	23.2	0.5

ARSENIC
BCSS-1 11.1 +/- 1.4 mg/kg

							Mean	Std. De
LAB	1	6.20	5.85	6.13	6.73	6.31	*6.24	0.32
LAB	2	9.1	9.4	7.4	7.2	8.3	*8.3	1.0
LAB	3	Q8.8	7.4	7.2	7.1	7.7	*7.4	0.3
LAB	4	7.77	7.41	7.07	7.50	6.82	*7.31	0.37
LAB	5							
LAB	6							
LAB	7							
LAB	8	8.95	8.45	8.30	8.10	7.47	*8.25	0.54
LAB	9	18.06	18.87	17.69	18.26	18.48	*18.27	0.44
LAB	10	8.5	8.4	7.8	8.6	8.4	*8.3	0.3
LAB	11							
LAB	12	10.8	11.1	11.2	10.8	10.8	10.9	0.2
LAB	13	7.8	8.4	8.7	8.4	8.6	*8.4	0.3
LAB	14	11.7	12.2	12.6	11.8	11.8	12.0	0.4
LAB	15							
LAB	16	5.8	6.0	6.0	4.8	5.3	*5.6	0.5
LAB	17	11.2	10.4	11.6	11.4	11.6	11.2	0.5
LAB	18	10.2	8.9	10.2	10.4	10.3	10.0	0.5
LAB	19	9.97	9.77	10.22	9.17	11.57	10.14	0.89
LAB	20	12	11	12	12	11	12	1
LAB	21	8.49	8.43	8.93	8.63	8.47	*8.59	0.20
LAB	22							
LAB	23	8.98	8.85	8.08	8.08	8.57	*8.51	0.42
LAB	24							
LAB	25							
LAB	26							
LAB	27	10.2	10.3	10.3	10.5	10.4	10.3	0.1
LAB	28							
LAB	29							

ARSENIC

Mussel P 8.56 +/- 5.0 mg/kg

							Mean	Std. Dev.
LAB	1	6.48	5.96	5.99	5.69	5.88	6.00	0.29
LAB	2							
LAB	3	6.7	5.9	5.5	5.8	5.2	5.8	0.6
LAB	4	0.99	4.52	6.7	43.2	24.9	*16.1	17.8
LAB	5	9.1	9.4	9.6	9.2	9.5	9.4	0.2
LAB	6	12.5	12.0	11.8	11.9	12.0	12.0	0.3
LAB	7							
LAB	8	8.46	8.05	8.05	7.17	7.14	7.77	0.59
LAB	9							
LAB	10	10.6	8.9	11.4	9.6	9.0	9.9	1.1
LAB	11							
LAB	12	9.24	8.89	8.26	9.34	9.90	9.13	0.60
LAB	13	9.5	8.9	9	9.4	9.3	9.2	0.3
LAB	14	10.4	10.1	10.5	10.5	10.8	10.5	0.3
LAB	15	4.5	5.5	4.7	4.6	5.5	5.0	0.5
LAB	16	6.1	6.0	5.7	7.4	4.8	6.0	0.9
LAB	17	10.1	10.0	10.2	9.8	9.7	10.0	0.2
LAB	18	9.7	10.1	11.8	10.8	10.6	10.6	0.8
LAB	19	6.00	6.19	6.73	6.33	7.96	6.64	0.78
LAB	20	11	11	11	11	Q13	9	5
LAB	21	7.37	7.45	7.49	7.54	7.80	7.53	0.16
LAB	22							
LAB	23	4.21	4.11	4.16	4.17	4.22	4.17	0.04
LAB	24							
LAB	25							
LAB	26	8.9	8					
LAB	27	10.8	11.3	9.28	9.93	8.86	10.00	1.02
LAB	28							
LAB	29							
LAB	30							
LAB	31	11.9	11.7	11.7	11.8	11.3	11.7	0.2

ARSENIC

NBS 1566a 14 +/- 1.2 mg/kg

							Mean	Std. De
LAB	1	9.55	8.52	10.05	8.62	9.19	*9.19	0.64
LAB	2							
LAB	3	12.5	11.1	11.4	11.5	11.9	*11.7	0.5
LAB	4	0.13	0.86	4.98	8.39	Q43.2	*11.51	3.70
LAB	5							
LAB	6	13	13	15	12	12	13	1
LAB	7							
LAB	8	10.74	10.10	11.04	10.02	11.09	*10.60	0.51
LAB	9							
LAB	10	15.4	15.7	13.8	13.1	15.6	14.7	1.2
LAB	11							
LAB	12	13.8	12.7	11.9	12.5	14.2	13.0	1.0
LAB	13							
LAB	14	13.4	13.1	13.3	13.2	13.3	13.3	0.1
LAB	15							
LAB	16	11	6.4	7.0	6.8	8.2	*7.9	1.9
LAB	17	13.3	14.3	14.3	14.4	14.4	14.1	0.5
LAB	18	14.6	13.9	13.4	14.5	14.4	14.2	0.5
LAB	19	11.79	12.35	12.17	13.35	12.74	*12.48	0.59
LAB	20	15	15	Q14	15	15	12	7
LAB	21	10.8	10.5	10.5	10.8	10.9	*10.7	0.2
LAB	22							
LAB	23	7.74	7.83	8.16	7.38	-	*7.78	0.32
LAB	24							
LAB	25							
LAB	26							
LAB	27							
LAB	28							
LAB	29	13	13	13	*12	13	10	6

SELENIUM
Sediment N 1.54 +/- 0.70 mg/kg

							Mean	Std. Dev.
LAB	1	0.56	0.59	0.64	0.72	0.58	*0.62	0.06
LAB	2							
LAB	3	1.0	0.84	0.70	0.64	0.52	*0.74	0.19
LAB	4	0.772	0.710	0.708	0.775	0.700	*0.733	0.037
LAB	5							
LAB	6							
LAB	7							
LAB	8	0.33	0.38	0.68	0.59	0.39	*0.47	0.15
LAB	9	<1.8	<1.8	<1.8	<1.8	<1.8		
LAB	10	2.1	2.0	1.9	2.1	2.5	2.1	0.2
LAB	11							
LAB	12	1.40	1.38	1.27	1.45	1.26	1.35	0.08
LAB	13	0.67	0.66	0.62	0.61	0.56	*0.62	0.04
LAB	14	1.31	1.5	1.41	1.4	1.39	1.40	0.07
LAB	15	Q1.4Q	1.6	1.6	1.6	1.6	1.6	0.0
LAB	16	<50	<166	<166	<166	<166		
LAB	17	1.42	1.19	1.02	1.12	1.29	1.21	0.15
LAB	18							
LAB	19	0.719	1.407	1.236	1.437	1.209	1.202	0.288
LAB	20	1.5	1.3	1.1	1.2	1.4	1.3	0.2
LAB	21	1.93	1.79	Q2.31Q	2.03	1.63	1.86	0.16
LAB	22							
LAB	23							
LAB	24							
LAB	25							
LAB	26	1.3	1.4					
LAB	27	1.83	1.91	1.82	1.9	1.84	1.86	0.04
LAB	28							
LAB	29							
LAB	30							
LAB	31	1.51	1.51	1.39	1.52	1.47	1.48	0.05

SELENIUM
BCSS-1 0.43 +/- 0.06 mg/kg

							Mean	Std. De
LAB	1	<0.18	<0.18	<0.18	<0.18	<0.18		
LAB	2							
LAB	3	<0.5	<0.5	<0.5	<0.5	<0.5		
LAB	4	0.405	0.299	0.944	0.670	0.304	*0.524	0.279
LAB	5							
LAB	6							
LAB	7							
LAB	8	<0.20	<0.20	<0.20	<0.20	<0.20		
LAB	9	<0.9	<0.9	<0.9	<0.9	<0.9		
LAB	10	<1.0	<1.0	<1.0	<1.0	<1.0		
LAB	11							
LAB	12	0.40	0.43	0.43	0.37	0.45	0.42	0.03
LAB	13	0.32	0.27	0.24	0.22	0.26	*0.26	0.04
LAB	14	Q0.62	0.49	0.49	0.50	0.47	0.49	0.01
LAB	15							
LAB	16	<25	<100	<100	<100	<100		
LAB	17	0.44	0.47	0.49	0.36	0.47	0.45	0.05
LAB	18							
LAB	19	0.518	0.239	0.690	0.465	0.420	0.466	0.163
LAB	20	<0.8	<0.8	<0.8	<0.8	<0.8		
LAB	21	0.67	0.56	0.45	0.58	0.55	*0.56	0.08
LAB	22							
LAB	23							
LAB	24							
LAB	25							
LAB	26	3.0	2.7					
LAB	27	0.57	0.56	0.55	0.56	0.54	*0.5	0.01
LAB	28							
LAB	29							

SELENIUM
Mussel P 2.86 +/- 1.20 mg/kg

							Mean	Std. Dev.
LAB	1	2.74	2.63	2.74	2.67	2.48	2.65	0.11
LAB	2							
LAB	3	2.1	2.2	2.0	1.8	1.8	2.0	0.2
LAB	4	20.6	21.1	35.1	3.77	1.21	*16.36	13.96
LAB	5	2.6	2.5	2.9	2.4	2.6	2.6	0.187
LAB	6	3.8	3.5	3.8	3.9	3.7	3.7	0.2
LAB	7							
LAB	8	2.09	2.06	2.02	2.11	1.89	2.03	0.09
LAB	9							
LAB	10	2.0	4.0	2.9	2.2	3.6	2.9	0.9
LAB	11							
LAB	12	2.76	2.66	2.64	2.64	2.71	2.68	0.05
LAB	13	3.02	3.06	2.98	2.87	2.79	2.94	0.11
LAB	14	3.0	2.8	3.1	2.8	2.8	2.9	0.1
LAB	15	4.1	4.1	4.0	3.8	4.0	4.0	0.1
LAB	16	<42	<166	<166	<166	<166		
LAB	17	4.76	5.13	5.24	4.96	5.03	*5.02	0.18
LAB	18	3.02	1.81	3.94	3.77	2.41	2.99	0.90
LAB	19	1.40	1.85	2.02	1.69	2.05	1.80	0.27
LAB	20	2.7	2.4	3.1	3.4	2.7	2.9	0.4
LAB	21	3.21	3.45	3.34	3.52	3.26	3.36	0.13
LAB	22							
LAB	23							
LAB	24							
LAB	25							
LAB	26							
LAB	27	3.31	3.11	3.35	3.44	3.48	3.34	0.14
LAB	28							
LAB	29	2.2	2.4	2.5	2.6	2.6	2.5	0.2
LAB	30							
LAB	31	3.08	3.70	3.51	3.04	3.10	3.29	0.30

SELENIUM
SRM 1566a 2.21 +/- 0.24 mg/kg

							Mean	Std. De
LAB	1	2.47	2.11	2.31	2.35	2.43	2.33	0.14
LAB	2							
LAB	3	1.3	Q1.9	1.1	1.2	1.2	*1.2	0.5
LAB	4	1.4	1.9	4.9	12.6	20.2	*8.2	8.1
LAB	5							
LAB	6	2.3	2.4	2.0	2.0	2.2	2.2	0.2
LAB	7							
LAB	8	1.59	1.59	1.40	1.59	1.64	*1.56	0.09
LAB	9							
LAB	10	2.4	2.9	2.2	1.7	3.0	2.4	0.5
LAB	11							
LAB	12	2.20	2.30	2.22	2.08	2.20	2.20	0.08
LAB	13							
LAB	14	2.1	2.2	2.1	2.1	2.1	2.1	0.0
LAB	15							
LAB	16	<25	<100	<100	<100	<100		
LAB	17	2.12	2.14	2.19	2.23	2.10	2.16	0.05
LAB	18	2.31	2.30	1.87	2.24	2.50	2.24	0.23
LAB	19	2.52	1.82	1.63	1.76	1.64	1.87	0.37
LAB	20	2.0	2.0	2.2	2.2	1.7	2.0	0.2
LAB	21	2.48	2.33	2.24	2.13	2.23	2.28	0.13
LAB	22							
LAB	23							
LAB	24							
LAB	25							
LAB	26							
LAB	27							
LAB	28							
LAB	29	1.8	2.0	2.1	2.2	2.2	2.1	0.2

Silver in Sediments Not Required

SILVER

Mussel P 0.587 +/- 0.257 mg/kg

							Mean	Std. Dev.
LAB	1	0.37	0.39	0.48	0.48	0.47	0.44	0.05
LAB	2							
LAB	3	<0.5	<0.5	<0.5	<0.5	<0.5		
LAB	4	1.9	2.16	2.95	0.907	2.42	*2.07	0.76
LAB	5							
LAB	6	0.5	0.49	0.49	0.46	0.48	0.48	0.02
LAB	7	0.62	0.57	0.62	0.57	0.6	0.60	0.03
LAB	8							
LAB	9							
LAB	10	2.5	2.3	3.1	<2.0	2.7	*2.7	0.3
LAB	11							
LAB	12	0.72	0.72	0.7	0.67	0.68	0.70	0.02
LAB	13	0.81	0.80	0.78	0.86	0.78	0.81	0.03
LAB	14	0.59	0.63	0.55	0.53	0.57	0.57	0.04
LAB	15							
LAB	16							
LAB	17	0.550	0.566	0.539	0.542	0.580	0.555	0.017
LAB	18	0.522	0.473	0.612	0.454	0.479	0.508	0.063
LAB	19	0.489	0.477	0.362	0.346	0.484	0.432	0.071
LAB	20	0.74	0.73	0.70	0.68	0.66	0.70	0.03
LAB	21	0.47	0.45	0.70	0.50	0.43	0.51	0.11
LAB	22							
LAB	23							
LAB	24							
LAB	25							
LAB	26	0.83	0.91					
LAB	27	0.42	0.45	0.52	0.42	0.45	0.45	0.04
LAB	28							
LAB	29	0.49	0.65	0.62	0.63	0.58	0.59	0.06
LAB	30	0.690	0.730	0.783	0.767	0.727	0.739	0.037
LAB	31	0.77	0.74	0.62	0.64	0.81	0.72	0.08

SILVER

SRM 1566a 1.68 +/- 0.15 mg/kg

							Mean	Std. De
LAB	1	0.40	0.52	0.80	0.98	0.72	*0.68	0.23
LAB	2							
LAB	3	0.41	0.41	0.65	0.6	0.76	*0.57	0.15
LAB	4	1.41	5.23	5.28	5.80	4.70	*4.48	1.76
LAB	5							
LAB	6	1.4	1.5	1.4	1.5	1.5	*1.5	0.1
LAB	7	1.77	1.89	1.92	1.9	1.89	1.87	0.06
LAB	8							
LAB	9							
LAB	10	2.3	2.5	<2.0	3.1	2.5	*2.08	1.201
LAB	11							
LAB	12	1.73	1.80	1.79	1.76	1.68	1.75	0.05
LAB	13							
LAB	14	1.66	1.59	1.62	1.57	1.54	1.60	0.05
LAB	15							
LAB	16							
LAB	17	1.56	1.55	1.73	1.66	1.63	1.63	0.07
LAB	18	1.38	1.37	1.42	1.39	Q1.72	*1.39	0.02
LAB	19	Q2.33	1.657	1.681	1.559	1.476	1.590	0.090
LAB	20	1.74	1.66	1.67	1.71	1.68	1.69	0.03
LAB	21	1.54	1.65	1.52	1.50	1.48	1.54	0.07
LAB	22							
LAB	23							
LAB	24							
LAB	25							
LAB	26							
LAB	27							
LAB	28							
LAB	29	Q1.7	1.8	1.8	1.8	1.8	1.8	0.0

CADMIUM
Sediment N 2.03 +/- 0.58 mg/kg

							Mean	Std. Dev.
LAB	1	1.73	2.05	2.07	1.70	1.74	1.86	0.19
LAB	2	2.2	2.2	2.2	2.2	2.2	2.2	0
LAB	3	1.65	1.77	1.61	1.72	1.66	1.68	0.06
LAB	4	3.89	3.55	2.87	3.02	3.15	*3.30	0.42
LAB	5							
LAB	6							
LAB	7	1.32	1.37	1.34	1.34	1.36	1.35	0.02
LAB	8	3.6	3.8	4.2	3.8	4.2	*3.9	0.3
LAB	9	2.21	2.24	2.20	2.18	2.20	2.21	0.02
LAB	10	2.7	3.1	2.7	2.3	1.9	2.5	0.5
LAB	11	1.90	1.45	1.70	1.85	2.06	1.79	0.23
LAB	12	2.57	2.54	2.55	2.45	2.51	2.52	0.05
LAB	13	1.9	1.7	1.8	2.1	1.9	1.9	0.1
LAB	14	2.22	2.13	2.09	2.00	2.02	2.09	0.09
LAB	15	2.0	2.1	2.1	2.0	2.2	2.1	0.1
LAB	16	2.0	1.9	1.8	1.6	1.8	1.8	0.1
LAB	17	3.33	3.29	3.63	3.36	3.65	*3.45	0.17
LAB	18	2.05	2.32	2.2	2.23	2.46	2.25	0.150
LAB	19	0.6423	0.3028	0.5089	0.3464	0.5766	*0.4754	0.1463
LAB	20	2.3	2.2	2.3	2.3	2.2	2.3	0.1
LAB	21	2.16	2.16	2.01	2.03	2.01	2.07	0.08
LAB	22							
LAB	23	2.16	2.45	2.45	2.41	2.12	2.32	0.16
LAB	24							
LAB	25	1.951	2.088	2.012	1.975	1.986	2.002	0.053
LAB	26	2.3	2.3					
LAB	27	2.25	1.99	1.92	1.77	1.86	1.96	0.18
LAB	28	1.79	1.64	1.68	2.06	2.18	1.87	0.24
LAB	29							
LAB	30	1.83	1.86	2.03	1.78	1.82	1.86	0.10
LAB	31	1.95	1.92	2.00	2.22	1.95	2.01	0.12

CADMIUM
BCSS-1 0.25 +/- 0.04 mg/kg

							Mean	Std. De
LAB	1	0.19	0.20	0.19	0.22	0.22	*0.20	0.02
LAB	2	0.40	0.40	0.30	0.30	0.30	*0.34	0.05
LAB	3	<0.5	<0.5	<0.5	<0.5	<0.5		
LAB	4	1.14	1.32	1.45	1.62	1.51	*1.41	0.18
LAB	5							
LAB	6							
LAB	7	0.18	0.2	0.19	0.18	0.19	*0.19	0.01
LAB	8	<0.016	<0.016	<0.016	<0.016	<0.016		
LAB	9	0.173	0.173	0.173	0.167	0.162	*0.170	0.005
LAB	10	<1.0	<1.0	3.5	<1.0	<1.0		
LAB	11	<0.40	<0.40	<0.40	<0.40	<0.40		
LAB	12	0.28	0.29	0.28	0.29	0.28	0.28	0.01
LAB	13	0.59	0.23	0.48	0.20	0.22	*0.34	0.18
LAB	14	0.282	0.27	0.266	0.261	0.255	0.267	0.010
LAB	15							
LAB	16	0.22	0.21	0.28	0.27	0.27	0.25	0.032
LAB	17	0.234	0.263	0.254	0.250	0.264	0.253	0.012
LAB	18	0.25	0.27	0.27	0.26	0.28	0.26	0.010
LAB	19	0.2454	0.2459	0.2219	0.2365	Q0.3808	0.2374	0.0112
LAB	20	0.30	0.31	0.28	0.30	0.30	*0.30	0.01
LAB	21	0.27	0.22	0.25	0.25	0.25	0.25	0.02
LAB	22							
LAB	23	0.69	0.63	0.63	0.61	0.61	0.63	0.03
LAB	24							
LAB	25	0.247	0.23	0.269	0.257	0.271	0.255	0.017
LAB	26							
LAB	27	0.33	0.22	0.18	0.24	0.23	0.24	0.06
LAB	28	0.185	0.219	0.195	0.179	0.142	*0.184	0.028
LAB	29							

CADMIUM
Mussel P 3.96 +/- 1.14 mg/kg

						Mean	Std. Dev.
LAB 1	3.72	3.67	3.75	3.67	3.70	3.70	0.03
LAB 2							
LAB 3	2.94	2.96	2.87	3.04	2.95	2.95	0.06
LAB 4	4.43	4.57	4.79	4.64	4.28	4.54	0.20
LAB 5	4.6	4.5	4.6	4.7	4.7	4.6	0.1
LAB 6	4.1	4.0	4.0	4.0	4.1	4.0	0.1
LAB 7	3.42	3.42	3.43	3.43	3.50	3.44	0.03
LAB 8	2.7	3.2	3.0	3.1	3.1	3.0	0.2
LAB 9							
LAB 10	3.6	3.7	3.9	3.4	3.3	3.6	0.2
LAB 11	4.10	4.30	4.30	3.85	4.46	4.20	0.23
LAB 12	4.14	4.11	4.23	4.1	4.12	4.14	0.052
LAB 13	4.0	3.9	3.8	4.0	3.6	3.9	0.2
LAB 14	4.49	4.55	4.58	4.73	4.68	4.61	0.10
LAB 15	4.2	4.2	3.7	4.0	4.0	4.0	0.2
LAB 16	3.8	4.0	4.4	3.5	3.6	3.9	0.4
LAB 17	4.85	4.77	4.65	4.75	4.65	4.73	0.09
LAB 18	4.96	5.01	4.90	4.95	4.93	4.95	0.04
LAB 19	0.3979	0.4556	0.3921	0.3996	0.4471	*0.4185	0.0303
LAB 20	4.2	4.0	4.1	4.0	4.0	4.1	0.1
LAB 21	4.33	4.04	4.14	4.06	4.10	4.13	0.12
LAB 22	4.031	3.53	2.476	3.789	2.962	3.358	0.633
LAB 23	3.53	3.55	3.49	3.38	3.45	3.48	0.07
LAB 24							
LAB 25							
LAB 26	4.0	4.1					
LAB 27	2.75	2.81	3.94	2.86	3.05	3.08	0.49
LAB 28							
LAB 29	4.1	4.6	4.6	4.6	4.4	4.5	0.2
LAB 30	4.02	4.12	4.07	4.07	4.04	4.06	0.04
LAB 31	4.11	4.04	4.12	4.30	3.90	4.09	0.14

CADMIUM
SRM 1566a 4.15 +/- 0.38 mg/kg

						Mean	Std. De
LAB 1	3.74	3.53	3.49	3.40	3.42	*3.52	0.14
LAB 2							
LAB 3	3.70	3.72	3.79	3.74	3.81	*3.72	0.05
LAB 4	4.10	4.00	4.08	4.59	4.57	4.27	0.29
LAB 5							
LAB 6	4.1	4.1	4.1	3.9	4.0	4.0	0.1
LAB 7	3.84	3.60	3.33	4.51	4.39	3.93	0.51
LAB 8	3.7	3.6	3.7	3.6	3.6	*3.6	0.1
LAB 9							
LAB 10	3.3	4.0	3.0	3.2	3.4	*3.4	0.4
LAB 11	4.29	4.41	4.21	4.65	4.37	4.386	0.166
LAB 12	4.08	3.96	4.01	4.06	4.01	4.02	0.05
LAB 13							
LAB 14	4.45	4.41	4.24	4.38	4.35	4.37	0.08
LAB 15							
LAB 16	4.5	4.9	5.7	4.8	4.2	*4.8	0.6
LAB 17	4.06	4.09	4.12	4.21	4.39	4.17	0.13
LAB 18	4.4	4.55	4.67	4.53	4.34	4.50	0.13
LAB 19	0.4239	0.6120	0.5315	0.3068	0.4003	*0.4549	0.1188
LAB 20	3.9	3.9	Q3.8	3.9	3.9	3.1	1.7
LAB 21	4.15	4.12	4.10	3.98	4.11	4.09	0.07
LAB 22	4.806	4.229	3.261	3.5	3.655	3.89	0.624
LAB 23	3.4	3.38	3.62	3.28	-	*3.42	0.14
LAB 24							
LAB 25							
LAB 26							
LAB 27							
LAB 28							
LAB 29	3.9	4.3	4.4	4.4	4.5	4.3	0.2

TIN

Sediment N 65.4 +/- 19.1 mg/kg

							Mean	Std. Dev.
LAB	1							
LAB	2	268	287	266	322	274	*283	23
LAB	3	56.7	54.7	54.9	57.9	57.7	56.4	1.5
LAB	4							
LAB	5							
LAB	6							
LAB	7							
LAB	8	74.4	67.4	73.4	77.0	75.4	73.5	3.7
LAB	9	38.84	37.4	37.79	39.92	38.51	*38.49	0.98
LAB	10	43.4	47.3	46.6	48.0	49.2	46.9	2.2
LAB	11							
LAB	12	68.4	74.2	60.8	66.2	69.3	67.8	4.9
LAB	13							
LAB	14	61	61	84	67	59	66	10
LAB	15							
LAB	16							
LAB	17	65.3	69.1	64.2	59.4	74.2	66.4	5.5
LAB	18	72.8	75.1	71.7	74.7	79.9	74.8	2.8
LAB	19	4.645	4.617	4.578	4.502	4.30	*4.528	0.139
LAB	20	82	73	80	66	75	75	6
LAB	21	31.6	32.6	26.2	29.1	26.4	*29.2	2.9
LAB	22							
LAB	23	64.53	58.14	61.14	52.39	53.81	58.00	5.04
LAB	24							
LAB	25							
LAB	26	59	64					
LAB	27							
LAB	28							
LAB	29							
LAB	30	60.8	66.6	65.9	63.4	67.4	64.8	2.7
LAB	31	73.1	70.9	67.4	61.3	75.4	69.6	5.5

TIN

BCSS-1 1.85 +/- 0.20 mg/kg

								Mean	Std. De
LAB	1								
LAB	2	10.9	10.6	11.7	12.1	13.0		*11.7	1.0
LAB	3	1.23	2.38	0.89	1.91	0.94		*1.47	0.65
LAB	4								
LAB	5								
LAB	6								
LAB	7								
LAB	8	2.4	2.6	2.2	1.0			*2.1	0.7
LAB	9	0.52	0.48	0.46	0.48	0.46		*0.48	0.02
LAB	10	<40	<40	<40	<40	<40			
LAB	11								
LAB	12	2.23	2.10	2.22	2.00	2.11		*2.13	0.10
LAB	13								
LAB	14	1.92	1.84	Q 1.63	1.87	1.84		1.86	0.04
LAB	15								
LAB	16								
LAB	17	2.04	2.03	1.92	Q 1.49	1.91		1.98	0.07
LAB	18	1.82	1.99	2.37	2.33	2.42		2.19	0.24
LAB	19	1.84	1.79	1.25	1.786	1.22		*1.58	0.31
LAB	20	2.2	2.1	2.3	2.1	2.2		*2.2	0.1
LAB	21	1.14	0.93	1.11	0.54	1.17		*0.98	0.26
LAB	22								
LAB	23	3.47	1.84	2.11	1.91	1.42		*2.15	0.78
LAB	24								
LAB	25								
LAB	26	<20	<20						
LAB	27								
LAB	28								
LAB	29								

TIN

Mussel P 0.192 +/- 0.072 mg/kg

							Mean	Std. Dev.
LAB	1							
LAB	2							
LAB	3	<2.5	<2.5	<2.5	<2.5	<2.5		
LAB	4							
LAB	5							
LAB	6	<3	<3	<3	<3	<3		
LAB	7							
LAB	8	<1.0	<1.0	<1.0	<1.0	<1.0		
LAB	9							
LAB	10	<40	<40	<40	<40	<40		
LAB	11							
LAB	12	0.26	0.24	0.21	0.22	0.23	0.23	0.02
LAB	13							
LAB	14	<0.2	<0.2	<0.2	<0.2	<0.2		
LAB	15							
LAB	16							
LAB	17	0.268	0.232	0.275	0.241	0.283	0.260	0.022
LAB	18							
LAB	19	Q1.5	0.808	0.767	0.675	0.832	*0.771	0.069
LAB	20	0.21	0.18	0.17	0.19	0.17	0.18	0.02
LAB	21	0.85	1.21	1.10	1.26	1.33	*1.15	0.19
LAB	22							
LAB	23	0.35	0.31	0.38	0.33	0.39	*0.35	0.03
LAB	24							
LAB	25							
LAB	26							
LAB	27							
LAB	28							
LAB	29							
LAB	30	0.161	0.163	0.173	0.167	0.142	0.161	0.012
LAB	31							

TIN

SRM 1566a 2.18 +/- 0.27 mg/kg

							Mean	Std. De
LAB	1							
LAB	2							
LAB	3	3.00	3.20	3.28	3.00	2.32	*2.96	0.38
LAB	4							
LAB	5							
LAB	6	<3	<3	<3	<3	<3		
LAB	7							
LAB	8	1.1	1.4	1.6	1.8	1.6	*1.5	0.3
LAB	9							
LAB	10	<40	<40	<40	<40	<40		
LAB	11							
LAB	12	2.17	2.06	2.16	2.34	2.38	2.22	0.13
LAB	13							
LAB	14	1.68	1.69	1.79	1.69	1.68	*1.71	0.05
LAB	15							
LAB	16							
LAB	17	0.370	0.363	0.385	0.410	0.250	*0.356	0.062
LAB	18							
LAB	19	3.62	4.08	2.86	3.93	3.99	*3.70	0.50
LAB	20	2.1	2.2	2.1	2.0	2.1	2.1	0.1
LAB	21	2.45	3.37	2.67	1.78	2.99	*2.65	0.60
LAB	22							
LAB	23	2.23	0.24	1.99	1.49	1.70	*1.53	0.77
LAB	24							
LAB	25							
LAB	26							
LAB	27							
LAB	28							
LAB	29							
LAB	30	2.31	2.07	2.09	2.32	2.38	2.23	0.140

ANTIMONY
Sediment N, mg/kg

							Mean	Std. Dev.
LAB	1							
LAB	2							
LAB	3							
LAB	4							
LAB	5							
LAB	6							
LAB	7							
LAB	8							
LAB	9							
LAB	10							
LAB	11							
LAB	12							
LAB	13							
LAB	14							
LAB	15	1.5	1.6	1.4	1.6	1.6	1.5	0.1
LAB	16							
LAB	17	0.881	0.898	0.877	0.826	0.780	0.852	0.049
LAB	18							
LAB	19							
LAB	20	0.78	0.67	0.67	0.77	0.89	0.756	0.092
LAB	21							
LAB	22							
LAB	23	1.50	1.20	0.91	0.89	1.10	1.12	0.25
LAB	24							
LAB	25							
LAB	26	<30	<30					
LAB	27							
LAB	28	3.59	2.97	2.30	10.70	4.84	3.59	2.97
LAB	29							
LAB	30	1.15	1.17	1.11	1.19	1.24	1.17	0.05
LAB	31							

ANTIMONY
BCSS-1 0.59 +/- 0.06 mg/kg

								Mean	Std. De
LAB	1								
LAB	2								
LAB	3								
LAB	4								
LAB	5								
LAB	6								
LAB	7								
LAB	8								
LAB	9								
LAB	10								
LAB	11								
LAB	12								
LAB	13								
LAB	14								
LAB	15								
LAB	16								
LAB	17	0.60	0.64	0.42	0.67	0.64	0.59	0.10	
LAB	18								
LAB	19								
LAB	20	0.60	0.48	0.48	0.59	0.60	0.55	0.06	
LAB	21								
LAB	22								
LAB	23	0.65	<0.55	0.64	<0.55	<0.58			
LAB	24								
LAB	25								
LAB	26								
LAB	27								
LAB	28	0.97	0.77	0.97	0.63	2.26	*1.12	0.653	
LAB	29								

Antimony in Biological Tissue Not Required

MERCURY

Sediment N 1.34 +/- 0.47 mg/kg

							Mean	Std. Dev.
LAB	1	1.28	1.09	1.33	1.11	1.39	1.24	0.13
LAB	2							
LAB	3	1.54	1.54	1.49	1.10	1.08	1.35	0.24
LAB	4	1.03	1.03	1.03	0.989	1.13	1.04	0.05
LAB	5							
LAB	6							
LAB	7	1.56	1.74	1.71	1.75	1.55	1.66	0.10
LAB	8	0.70	1.20	1.10	0.92	0.74	0.93	0.22
LAB	9	1.31	1.418	1.402	1.395	1.485	1.402	0.063
LAB	10	1.3	1.2	1.1	1.3	1.1	1.2	0.1
LAB	11							
LAB	12	1.31	1.33	1.34	1.39	1.46	1.37	0.06
LAB	13	1.46	1.54	1.49	1.44	1.64	1.51	0.08
LAB	14	1.43	1.22	1.56	1.60	1.29	1.42	0.17
LAB	15	1.25	1.30	1.12	1.21	1.23	1.22	0.07
LAB	16	1.3	1.2	1.6	1.4	1.4	1.4	0.1
LAB	17	1.95	1.25	2.41	1.65	1.93	*1.84	0.43
LAB	18							
LAB	19	0.1296	0.1326	0.1416	0.1444	0.1298	*0.1356	0.0069
LAB	20	1.35	1.30	1.19	1.09	1.38	1.26	0.12
LAB	21	1.14	0.968	0.968	0.952	1.02	1.010	0.077
LAB	22	1.063	1.143	1.332	1.406	1.209	1.2306	0.139
LAB	23	1.96	2.04	1.32	2.07	2.12	*1.90	0.33
LAB	24	1.10	1.09	1.24	1.34	1.24	1.20	0.11
LAB	25							
LAB	26	1.23	1.34					
LAB	27	1.48	1.43	1.38	1.41	1.65	1.47	0.11
LAB	28	0.59	0.45	0.35	1.06	0.76	*0.64	0.28
LAB	29	1.96	1.53	2.25	1.42	1.42	1.72	0.37
LAB	30							
LAB	31	1.33	1.46	1.42	1.35	1.36	1.38	0.05

MERCURY

BCSS-1 0.174 +/- 0.081 mg/kg

							Mean	Std. De
LAB	1	0.05	0.06	0.07	0.05	-	*0.06	0.01
LAB	2							
LAB	3	0.12	0.14	0.15	0.19	0.15	0.15	0.03
LAB	4	0.192	0.184	0.156	0.168	0.184	0.177	0.015
LAB	5							
LAB	6							
LAB	7	0.202	0.207	0.204	0.207	0.204	0.205	0.002
LAB	8	0.2	0.120	0.180	0.120	0.140	0.152	0.036
LAB	9	0.235	0.235	0.235	0.250	0.221	0.235	0.010
LAB	10	0.2	0.2	0.2	0.2	0.2	*0.2	0.0
LAB	11							
LAB	12	0.130	0.132	0.133	0.137	0.138	0.134	0.003
LAB	13	0.191	0.182	0.170	0.182	0.185	0.182	0.008
LAB	14	0.24	0.234	0.250	0.237	0.266	0.245	0.013
LAB	15							
LAB	16	0.12	0.12	0.12	0.11	0.13	0.12	0.01
LAB	17	0.07	0.156	0.105	0.139	0.157	0.125	0.037
LAB	18							
LAB	19	0.151	0.153	0.152	0.154	0.133	0.149	0.009
LAB	20							
LAB	21	0.166	0.139	0.160	0.158	0.160	0.157	0.010
LAB	22	0.202	0.177	0.175	0.171	0.164	0.178	0.014
LAB	23	<1.02	<0.96	<0.96	<0.96	<1.02		
LAB	24	0.140	0.141	0.139	0.142	0.139	0.140	0.001
LAB	25							
LAB	26							
LAB	27	0.19	0.26	0.23	0.24	0.23	0.23	0.03
LAB	28	0.25	0.34	0.20	0.18	0.48	*0.29	0.12
LAB	29	0.180	0.196	0.155	0.209	0.155	0.179	0.024

MERCURY

Mussel P 0.159 +/- 0.065 mg/kg

							Mean	Std. Dev.
LAB	1	0.17	0.20	0.18	0.15	0.13	0.17	0.03
LAB	2							
LAB	3	0.75	0.79	0.91	0.36	1.0	*0.76	0.25
LAB	4	0.227	0.197	0.208	0.205	0.200	0.207	0.012
LAB	5	0.16	0.17	0.17	0.15	0.15	0.16	0.01
LAB	6	0.16	0.15	0.15	0.14	0.17	0.15	0.01
LAB	7	0.126	0.129	0.130	0.124	0.135	0.129	0.004
LAB	8	0.160	0.152	0.174	0.178	0.152	0.163	0.012
LAB	9							
LAB	10	0.5	0.5	0.5	0.5	0.5	*0.5	0.0
LAB	11							
LAB	12	0.127	0.128	0.133	0.134	0.136	0.132	0.004
LAB	13	0.17	0.19	0.17	0.18	0.17	0.18	0.01
LAB	14	0.184	0.186	0.185	0.189	0.180	0.185	0.003
LAB	15	0.16	0.15	0.17	0.16	0.15	0.16	0.01
LAB	16	0.10	0.10	0.11	Q0.16	0.10	0.08	0.05
LAB	17	0.234	0.213	0.215	0.212	0.214	0.218	0.009
LAB	18	0.166	0.148	0.173	0.162	0.160	0.162	0.009
LAB	19	0.1021	0.0925	0.0921	0.0921	0.1120	0.0982	0.0088
LAB	20	0.163	0.166	0.167	0.161	0.165	0.164	0.002
LAB	21	0.145	0.147	0.145	0.137	0.145	0.144	0.004
LAB	22	0.159	0.167	0.154	0.149	0.141	0.154	0.010
LAB	23	<0.12	<0.12	<0.13	<0.13	0.21		
LAB	24							
LAB	25							
LAB	26	0.170	0.174					
LAB	27	0.166	0.161	0.156	0.174	0.180	0.167	0.010
LAB	28							
LAB	29	0.207	0.201	0.189	0.204	0.215	0.203	0.009
LAB	30							
LAB	31	0.124	0.107	0.116	0.117	0.127	0.118	0.008

MERCURY

SRM 1566a 0.0642 +/- 0.0067 mg/kg

							Mean	Std. De
LAB	1	0.08	0.07	0.06	0.05	0.06	0.06	0.01
LAB	2							
LAB	3	0.105	0.108	0.129	0.128	0.098	*0.114	0.014
LAB	4	0.067	0.0613	0.0601	0.0887	0.0735	0.0701	0.0117
LAB	5							
LAB	6	0.06	0.05	0.05	0.04	0.06	*.05	0.01
LAB	7	0.0567	0.0600	0.0629	0.0596	0.0566	0.059	0.003
LAB	8	<0.10	<0.10	<0.10	<0.10	<0.10		
LAB	9							
LAB	10	0.07	0.07	0.07	0.07	0.07	0.07	0.00
LAB	11							
LAB	12	0.0587	0.0606	0.0619	0.0645	0.0670	0.0625	0.0033
LAB	13							
LAB	14	0.070	0.075	0.072	0.065	0.071	0.071	0.004
LAB	15							
LAB	16	0.026	0.026	0.031	0.026	0.024	*0.027	0.003
LAB	17	0.056	0.062	0.061	0.059	0.064	0.060	0.003
LAB	18	0.061	0.059	0.057	0.064	0.064	0.061	0.003
LAB	19	0.0619	0.0562	0.0328	0.0333	0.0529	*0.0474	0.0135
LAB	20	0.057	0.058	0.057	0.058	0.059	0.058	0.001
LAB	21	0.041	0.045	0.039	0.041	0.037	*0.041	0.003
LAB	22	0.122	0.053	0.074	0.061	0.057	*0.073	0.028
LAB	23	0.17	<0.13	<0.13	<0.12	<0.12		
LAB	24							
LAB	25							
LAB	26							
LAB	27							
LAB	28							
LAB	29	0.078	0.079	0.079	0.081	0.071	*0.078	0.004
LAB								
LAB								

THALLIUM
Sediment N 0.90 +/- 0.13 mg/kg

							Mean	Std. Dev.
LAB	1	0.55	0.48	0.47	0.54	0.76	*0.56	0.12
LAB	2							
LAB	3							
LAB	4							
LAB	5							
LAB	6							
LAB	7							
LAB	8							
LAB	9							
LAB	10							
LAB	11							
LAB	12							
LAB	13	0.94	1.01	1.00	0.97	0.94	0.97	0.03
LAB	14							
LAB	15							
LAB	16							
LAB	17							
LAB	18							
LAB	19							
LAB	20							
LAB	21							
LAB	22							
LAB	23							
LAB	24							
LAB	25							
LAB	26	<30	<30					
LAB	27							
LAB	28							
LAB	29							
LAB	30	0.869	0.875	0.864	0.888	0.870	0.873	0.009
LAB	31	0.78	0.87	0.89	0.83	0.89	0.85	0.05

THALLIUM
BCSS-1, mg/kg

							Mean	Std. De
LAB	1	0.36	0.27	0.36	0.47	0.20	0.33	0.10
LAB	2							
LAB	3							
LAB	4							
LAB	5							
LAB	6							
LAB	7							
LAB	8							
LAB	9							
LAB	10							
LAB	11							
LAB	12							
LAB	13	0.68	0.71	0.74	0.67	0.73	0.71	0.03
LAB	14							
LAB	15							
LAB	16							
LAB	17							
LAB	18							
LAB	19							
LAB	20							
LAB	21							
LAB	22							
LAB	23							
LAB	24							
LAB	25							
LAB	26							
LAB	27							
LAB	28							
LAB	29							

Thallium in Biological Tissue Not Required

LEAD
Sediment N 211 +/- 46 mg/kg

							Mean	Std. Dev.
LAB	1	198	198	240	234	189	212	23
LAB	2	216	237	216	237	206	222	14
LAB	3	229	220	223	219	214	221	6
LAB	4	237	215	219	232	240	229	11
LAB	5							
LAB	6							
LAB	7	220	239	230	226	216	226	9
LAB	8	213.8	223.6	247.0	233.6	255.6	234.7	17.0
LAB	9	201.77	203.71	192.85	196.08	203.60	199.60	4.89
LAB	10	182	166	190	185	170	179	10
LAB	11	197.5	140.0	180.0	192.5	198.5	181.7	24.4
LAB	12	227	221	227	238	227	227	6
LAB	13	196	180	168	185	193	184	11
LAB	14	242	257	230	262	236	245	14
LAB	15	202	212	221	224	228	217	10
LAB	16	178	213	173	179	196	188	17
LAB	17	248.3	252.9	250.5	228.7	251.2	246.3	10.0
LAB	18							
LAB	19	22.10	21.09	20.72	20.11	17.85	*20.37	1.59
LAB	20	220	219	232	262	233	233	17.370
LAB	21	184	219	192	198	208	200	13.682
LAB	22							
LAB	23	209	199	201	190	180	196	11
LAB	24	195	190	196	207	183	194	9
LAB	25	191.12	219.72	211.8	200.54	241.58	212.95	19.35
LAB	26	220	203					
LAB	27	237	272	267	211	221	241.6	27.162
LAB	28							
LAB	29	180	180	150	180	160	170	14
LAB	30	192	193	209	190	188	194	8
LAB	31	221	202	210	192	196	204	12

LEAD
BCSS-1 22.7 +/- 3.4 mg/kg

							Mean	Std. De
LAB	1	18.0	20.7	21.0	20.1	20.1	20.0	1.2
LAB	2	28	26	25	20	24	25	3
LAB	3	21.2	20.9	21.0	19.8	21.0	20.8	0.6
LAB	4	32.1	35.4	38.0	38.0	38.7	*36.4	2.7
LAB	5							
LAB	6							
LAB	7	15.4	17.7	18.0	15.8	18.8	*17.1	1.5
LAB	8	29.4	32.2	32.0	34.0	32.2	*32.0	1.6
LAB	9	30.37	32.44	29.29	29.29	31.38	*30.55	1.37
LAB	10	21.4	20.2	20.9	19.4	22.5	20.9	1.2
LAB	11	27.2	27.2	28.1	26.0	29.2	*27.5	1.2
LAB	12	24.5	26.4	24.4	25.0	24.2	24.9	0.9
LAB	13	13.8	15.3	15.3	13.8	13.8	*14.4	0.8
LAB	14	22.1	22.5	22.1	21.7	23.1	22.3	0.5
LAB	15							
LAB	16	17	18	19	17	15	*17	1
LAB	17	21.6	23.1	22.7	23.6	21.8	22.6	0.9
LAB	18							
LAB	19	21.41	19.70	20.54	20.38	21.08	20.62	0.66
LAB	20	24	24	21	23	24	23	1
LAB	21	22.9	23.1	21.8	20.7	21.9	22.1	1.0
LAB	22							
LAB	23	18.98	20.96	17.50	18.85	19.59	*19.18	1.26
LAB	24	21.0	21.3	19.9	21.3	20.1	20.7	0.7
LAB	25	20.75	21.48	20.76	19.37	18.90	20.25	1.07
LAB	26							
LAB	27	24.2	23.8	22.0	21.0	20.8	22.4	1.6
LAB	28							
LAB	29	26	27	25	26	27	26	1

LEAD

Mussel P 1.75 +/- 0.67 mg/kg

							Mean	Std. Dev.
LAB	1	1.78	1.83	3.98	1.54	2.48	2.32	0.99
LAB	2							
LAB	3	1.7	1.4	1.4	1.3	1.4	1.4	0.2
LAB	4	4.90	4.51	6.55	6.38	6.21	*5.71	0.94
LAB	5	1.47	1.42	1.70	1.51	1.81	1.58	0.17
LAB	6	1.7	1.7	1.8	1.7	1.9	1.8	0.1
LAB	7							
LAB	8	1.7	1.9	1.1	1.9	1.2	1.6	0.4
LAB	9							
LAB	10	3.6	3.6	2.4	4.0	2.1	*3.1	0.8
LAB	11	<4.5	<4.5	<4.5	<4.5	<4.5		
LAB	12	1.81	1.85	1.89	1.88	1.91	1.87	0.04
LAB	13	2.37	2.46	2.37	2.29	2.39	2.38	0.06
LAB	14	1.84	1.95	1.84	2.01	1.93	1.91	0.07
LAB	15	1	2	2	2	2	2	0
LAB	16	1.8	2.0	1.3	1.3	1.4	1.6	0.3
LAB	17	2.03	2.07	2.03	2.06	2.04	2.05	0.02
LAB	18	2.18	2.14	2.12	2.13	2.26	2.17	0.06
LAB	19	<0.1	<0.1	<0.1	<0.1	<0.1		
LAB	20	1.6	1.5	1.6	1.5	1.5	1.5	0.1
LAB	21	1.05	1.23	1.07	1.41	0.97	1.15	0.18
LAB	22	1.259	1.264	1.212	1.243	1.247	1.245	0.020
LAB	23	1.64	1.63	1.60	1.56	1.64	1.61	0.03
LAB	24							
LAB	25							
LAB	26	1.65	1.85					
LAB	27	1.42	1.64	1.60	1.64	1.46	1.55	0.10
LAB	28							
LAB	29	1.5	1.7	1.8	1.9	1.7	1.7	0.1
LAB	30	1.84	1.89	1.83	1.86	1.81	1.85	0.03
LAB	31	1.81	1.93	1.77	1.75	1.96	1.84	0.10

LEAD

SRM 1566a 0.371 +/- 0.014 mg/kg

							Mean	Std. De
LAB	1	Q1.02	0.37	0.39	0.29	0.21	*0.315	0.16
LAB	2							
LAB	3	0.40	0.34	0.39	0.31	0.36	0.36	0.04
LAB	4	9.60	3.50	4.13	4.93	6.85	*5.80	2.47
LAB	5							
LAB	6	0.34	0.40	0.35	0.31	0.31	*0.34	0.04
LAB	7							
LAB	8	<1.0	<1.0	<1.0	<1.0	<1.0		
LAB	9							
LAB	10	<0.6	<0.6	1.5	<0.6	1.3		
LAB	11	<4.5	<4.5	<4.5	<4.5	<4.5		
LAB	12	0.35	0.38	0.36	0.34	0.36	0.36	0.01
LAB	13							
LAB	14	0.37	0.36	0.41	0.43	0.41	*0.40	0.03
LAB	15							
LAB	16	0.26	0.27	0.37	0.44	0.28	*0.32	0.08
LAB	17	0.25	0.4	0.38	0.41	0.38	0.364	0.065
LAB	18	0.385	0.338	0.337	0.363	0.365	0.358	0.020
LAB	19	31.24	30.76	30.33	29.23	30.44	*30.40	0.74
LAB	20	0.30	0.26	0.32	0.31	0.30	*0.30	0.02
LAB	21	0.54	0.42	0.37	0.19	0.27	0.36	0.14
LAB	22	0.268	0.213	0.292	0.281	0.249	*0.261	0.031
LAB	23	0.30	0.25	0.27	0.25	0.25	*0.26	0.02
LAB	24							
LAB	25							
LAB	26							
LAB	27							
LAB	28							
LAB	29	0.25	0.31	0.37	0.25	0.24	*0.28	0.06

APPENDIX C
Laboratory Evaluation for Sediment Analysis

		Lab 1	Lab 2	Lab 3	Lab 4	Lab 5	Lab 6	Lab 7	Lab 8	Lab 9	Lab 10
Al	Sed N	L X	E X	L G	E G	--	--	--	L G	L G	L X
	BCSS	L X	L X	L G	G G	--	--	--	L X	L G	L X
*Si	Sed N	--	--	--	--	--	--	--	--	--	--
	BCSS	--	--	--	--	--	--	---	--	--	--
Cr	Sed N	L G	E G	L G	E G	--	--	L G	L G	L G	L X
	BCSS	L G	G G	L G	L G	--	--	L G	L G	L G	L G
*Mn	Sed N	L G	E G	L G	E G	--	--	--	L G	L G	--
	BCSS	L G	E G	L G	E G	--	--	--	H G	L G	--
Fe	Sed N	E G	E G	L G	E G	--	--	L G	E G	L G	L G
	BCSS	L G	L G	L G	G G	--	--	L X	L X	L G	L G
Cu	Sed N	E G	E G	E G	E G	--	--	L G	G G	E G	E G
	BCSS	L G	H G	L G	E G	--	--	L G	E G	G G	G G
Zn	Sed N	E G	G X	E L	E G	--	--	E G	E G	E G	E G
	BCSS	L G	H X	L G	G G	--	--	L G	H G	L G	L G
As	Sed N	E G	L G	E G	E G	--	--	--	E G	E G	E G
	BCSS	L G	L G	L G	L G	--	--	--	L G	H G	L G
Se	Sed N	L G	--	L X	L G	--	--	--	L X	L G	G G
	BCSS	--	--	--	H X	--	--	--	--	--	--
Cd	Sed N	E G	E G	E G	H G	--	--	L G	H G	E G	G X
	BCSS	G G	H G	--	H G	--	--	L G	--	L G	--
Sn	Sed N	--	H G	L G	--	--	--	--	E G	L G	L G
	BCSS	--	H G	L G	--	--	--	--	H G	L G	--
*Sb	BCSS	--	--	--	--	--	--	---	--	--	--
Hg	Sed N	E G	--	E X	E G	--	--	E G	G X	E G	E G
	BCSS	L G	--	E G	E G	--	--	E G	E G	E G	E G
Pb	Sed N	E X	E G	E G	E G	--	--	E G	E G	E G	E G
	BCSS	G G	G G	E G	H G	--	--	L G	H G	H G	E G

* optional element

Laboratory Evaluation for Sediments

		Lab 11	Lab 12	Lab 13	Lab 14	Lab 15	Lab 16	Lab 17	Lab 18	Lab 19	Lab 20
Al	Sed N	--	E G	L G	E G	E G	--	E X	G G	L G	E G
	BCSS	--	E G	L G	E G	--	--	E G	H X	L G	G G
*Si	Sed N	--	--	--	--	--	--	E G	--	--	E G
	BCSS	--	--	--	--	--	--	E G	--	--	G G
Cr	Sed N	--	E G	L G	--	E G	L G	G G	E G	L G	G G
	BCSS	--	E G	L G	--	--	L G	G G	L G	L G	E G
*Mn	Sed N	--	E G	L G	E G	E G	--	E G	--	--	E G
	BCSS	--	E G	L G	G G	--	--	E G	--	--	E G
Fe	Sed N	--	E G	L G	E G	E G	--	E G	--	L G	E G
	BCSS	--	H G	L G	L G	--	--	E G	--	L G	E G
Cu	Sed N	G G	E G	E G	E G	E G	E G	E G	--	L G	E G
	BCSS	H G	E G	L G	E G	--	L G	E G	--	G G	E G
Zn	Sed N	L G	E G	E G	G G	E G	G G	E G	--	E G	H G
	BCSS	L G	E G	L G	E G	--	L G	E G	--	L G	L G
As	Sed N	--	E G	E G	E G	E G	L G	E G	H G	E G	E G
	BCSS	--	E G	L G	G G	--	L G	E G	G G	G G	E G
Se	Sed N	--	E G	L G	E G	E G	--	E G	--	G X	E G
	BCSS	--	E G	L G	H G	--	--	G G	--	G X	--
Cd	Sed N	E G	E G	E G	E G	E G	E G	H G	E G	L G	E G
	BCSS	--	E G	G X	E G	--	E G	E G	E G	E G	H G
Sn	Sed N	--	E G	--	G X	--	--	E G	E G	L G	G G
	BCSS	--	H G	--	E G	--	--	G G	H X	L X	H G
*Sb	BCSS	--	--	--	--	--	--	G G	--	--	G G
Hg	Sed N	--	E G	E G	E G	E G	E G	H X	--	L G	E G
	BCSS	--	E G	E G	G G	--	E G	G G	--	E G	--
Pb	Sed N	G X	E G	E G	G G	E G	E G	E G	--	L G	G G
	BCSS	H G	G G	L G	E G	--	L G	E G	--	E G	E G

Laboratory Evaluation for Sediments

		Lab 21	Lab 22	Lab 23	Lab 24	Lab 25	Lab 27	Lab 28	Lab 29
Al	Sed N	E G	--	--	--	G G	E G	E G	--
	BCSS	E G	--	--	--	E G	E G	L X	--
*Si	Sed N	--	--	--	E G	--	--	--	--
	BCSS	--	--	--	E G	--	--	--	--
Cr	Sed N	E G	--	E G	E G	E G	E G	L X	E G
	BCSS	L G	--	L G	E G	E G	L G	L X	G G
*Mn	Sed N	E G	--	E G	E G	G G	--	E G	E G
	BCSS	G G	--	L G	E G	H G	--	L G	E G
Fe	Sed N	L G	--	E G	E G	E G	E G	L G	--
	BCSS	L G	--	L G	E G	E G	H G	L G	--
Cu	Sed N	E G	--	E G	E G	E G	G G	H G	E G
	BCSS	E G	--	L G	G G	E G	E G	--	E G
Zn	Sed N	E G	--	E G	E G	E G	E G	G G	E G
	BCSS	E G	--	L G	E G	E G	L G	E G	E G
As	Sed N	E G	--	E G	--	--	E G	--	--
	BCSS	L G	--	L G	--	--	E G	--	--
Se	Sed N	G G	--	--	--	--	E G	--	--
	BCSS	H G	--	--	--	--	H G	--	--
Cd	Sed N	E G	--	E G	--	E G	E G	E G	--
	BCSS	E G	--	H G	--	E G	G G	L G	--
Sn	Sed N	L G	--	G G	--	--	--	--	--
	BCSS	L X	--	H X	--	--	--	--	--
*Sb	BCSS	--	--	E G	--	--	--	H X	--
Hg	Sed N	E G	E X	H G	E G	--	E G	L X	G X
	BCSS	E G	E G	--	E G	--	G G	H G	E G
Pb	Sed N	E G	--	E G	E G	E G	G X	--	G G
	BCSS	E E	--	L G	E G	E G	E G	--	G G

Laboratory Evaluation for Biological Tissue Analysis

		Lab 1	Lab 2	Lab 3	Lab 4	Lab 5	Lab 6	Lab 7	Lab 8	Lab 9	Lab 10
Al	MUSS P	? G	--	? G	? G	? G	? G	--	? G	--	? G
	SRM	L G	--	L G	L G	--	L G	--	L G	--	L G
Cr	MUSS P	L G	--	L G	G G	E G	E G	E G	E G	--	G G
	SRM	L G	--	L X	H G	--	E G	L X	H X	--	H X
Fe	MUSS P	E G	--	L G	G G	E G	L G	E G	L X	--	L G
	SRM	L G	--	L G	H G	--	L G	H G	L G	--	L G
Cu	MUSS P	E G	--	E G	E G	E G	E G	E G	E G	--	E G
	SRM	E G	--	L G	E G	--	L G	L G	L G	--	L G
Zn	MUSS P	E G	--	L G	E G	E G	E G	E G	E G	--	E G
	SRM	E G	--	E G	L G	--	L G	H G	E G	--	G G
As	MUSS P	E G	--	E G	H X	E G	E G	--	E G	--	E G
	SRM	L G	--	L G	L X	--	G G	--	L G	--	G G
Se	MUSS P	E G	--	E G	H X	E G	E G	--	E G	--	E G
	SRM	E G	--	L G	H X	--	E G	--	L G	--	G G
Ag	MUSS P	E G	--	--	H X	--	E G	E G	--	--	H G
	SRM	L G	--	L G	L G	--	L G	G G	--	--	H G
Cd	MUSS P	E G	--	E G	E G	E G	E G	E G	G G	--	E G
	SRM	L G	--	G G	G G	--	E G	G G	L G	--	L G
Sn	MUSS P	--	--	--	--	--	--	--	--	--	--
	SRM	--	--	H G	--	--	L G	--	--	--	--
Hg	MUSS P	E G	--	H G	G G	E G	E G	E G	E G	--	H G
	SRM	G G	--	H G	G G	--	L G	G G	--	--	E G
Pb	MUSS P	G X	--	E G	H X	E G	E G	--	E X	--	H X
	SRM	L G	--	G G	H X	--	L G	--	--	--	--

Laboratory Evaluation for Biological Tissue Analysis

		Lab 11	Lab 12	Lab 13	Lab 14	Lab 15	Lab 16	Lab 17	Lab 18	Lab 19	Lab 20
Al	MUSS P	--	? G	? G	--	--	--	--	? X	? G	? G
	BCSS	--	G G	--	--	--	--	L G	--	L G	L G
Cr	MUSS P	E G	E G	E G	--	L G	H G	H G	E G	L G	G G
	SRM	--	E G	--	--	--	--	E G	E G	E G	E G
Fe	MUSS P	--	E G	E G	E G	G G	--	E G	G X	L G	E G
	SRM	--	E G	--	E G	--	--	E G	H G	L G	G G
Cu	MUSS P	E G	E G	E G	H G	E G	--	E G	E G	H G	E G
	SRM	L G	E G	--	H G	--	G G	E G	E G	L X	E G
Zn	MUSS P	E G	E G	E G	E G	E G	E G	E G	E G	L G	E G
	SRM	L G	E G	--	E G	--	L G	E G	E G	L G	E G
As	MUSS P	--	E G	E G	E G	E G	E G	E G	E G	E G	E G
	SRM	--	G G	--	E G	--	L G	E G	E G	L X	E G
Se	MUSS P	--	E G	E G	E G	E G	--	H G	E X	G G	E G
	SRM	--	E G	--	E G	--	--	E G	G G	G G	G G
Ag	MUSS P	--	E G	G G	E G	--	--	E G	E G	E G	E G
	SRM	--	E G	--	E G	--	--	E G	G G	G G	E G
Cd	MUSS P	E G	E G	E G	E G	E G	E G	E X	E G	L G	E G
	SRM	G G	E G	--	E G	--	H G	E G	G G	L G	E G
Sn	MUSS P	--	E G	--	--	--	--	G G	--	H X	E G
	SRM	--	E G	--	L G	--	--	L G	--	H G	E G
Hg	MUSS P	--	E G	E G	E G	E G	E G	G G	E G	E G	E G
	SRM	--	E G	--	G G	--	L G	G G	E G	L X	E G
Pb	MUSS P	--	E G	E G	E G	G G	E X	E G	E G	--	E G
	SRM	--	G G	--	H G	--	L X	G G	G G	H G	L G

Laboratory Evaluation for Biological Tissue Analysis

		Lab 21	Lab 22	Lab 23	Lab 24	Lab 25	Lab 27	Lab 28	Lab 29
Al	MUSS P	? G	--	? G	--	--	? G	--	? G
	SRM	L G	--	L G	--	--	--	--	E G
Cr	MUSS P	G G	--	L G	--	--	E G	--	E G
	SRM	L X	--	L X	--	--	--	--	E G
Fe	MUSS P	E G	--	L G	--	--	E G	--	--
	SRM	L G	--	L G	--	--	--	--	--
Cu	MUSS P	E G	--	E G	--	--	E G	--	E G
	SRM	L G	--	L G	--	--	--	--	G G
Zn	MUSS P	E G	--	E G	--	--	E G	--	G G
	SRM	E G	--	L G	--	--	--	--	--
As	MUSS P	E G	--	E G	--	--	E G	--	--
	SRM	L G	--	L G	--	--	--	--	G G
Se	MUSS P	E G	--	--	--	--	E G	--	E G
	SRM	G G	--	--	--	--	--	--	G G
Ag	MUSS P	E G	--	--	--	--	E G	--	E G
	SRM	G G	--	--	--	--	--	--	E G
Cd	MUSS P	E G	G X	E G	--	--	E G	--	E G
	SRM	E G	G G	L G	--	--	--	--	E G
Sn	MUSS P	H X	--	H G	--	--	--	--	--
	SRM	H X	--	L X	--	--	--	--	--
Hg	MUSS P	E G	E G	--	--	--	E G	--	E G
	SRM	L G	H X	--	--	--	--	--	H G
Pb	MUSS P	G G	E G	E G	--	--	E G	--	E G
	SRM	G X	L G	L G	--	--	--	--	L X

APPENDIX D
Sediment Analysis Procedures

Lab. #	Sediment Dissolution Procedure	Instrumentation
1	-0.3 g -HNO_3 -closed vessel, microwave heating	GFAAS - As,Cd,Cr,Cu,Mn, Pb,Se,Tl FAAS - Al,Fe,Zn
2	-0.25 g -HNO_3/HF/$HCLO_4$ -open beaker	FAAS - Al,Cr,Cu,Fe,Mn,Zn GFAAS - As,Pb,Se
3	-1.0 g -HNO_3/H_2O_2/HCl -reflux	ICP - Al,Cd,Cr,Cu,Fe,Mn,Sn,Zn GFAAS - As,Pb,Se
4	-0.25 g -HNO_3/HF -microwave heating -transfer, HNO_3/HCl/H_2O_2 -open beaker	ICP - Al,Cr,Fe,Mn,Sn,Zn ICP (IC interface) - Cd,Cu,Pb HGICP - As,Se
5	-not determined	
6	-not determined	
7	-1.0 g -HNO_3 -closed vessel, microwave heating -filtered	GFAAS - Cd,Cr,Cu,Fe,Pb FAAS - Zn
8	-1.0 g -HNO_3/HCl -open beaker	ICP - Al,Cd,Cr,Cu,Fe,Mn, Pb,Sn,Zn GFAAS - As,Se
9	-1.0 g -HNO_3/H_2O_2 -open beaker -filtered	
10	-0.5 g -HNO_3/H_2O reflux -H_2O_2 -HCl reflux -filtered	ICP - Al,Cd,Cu,Cr,Fe,Sn,Zn GFAAS - As,Pb,Se

Lab. #	Sediment Dissolution Procedure	Instrumentation
11	-1.0 g -HNO_3/H_2O_2 -open beaker -filtered	FAAS - Cd,Cr,Cu,Pb,Zn
12	-0.2 g -HNO_3/HF -closed vessel	GFAAS - As,Cd,Cr,Pb,Se,Sn FAAS - Al,Fe,Mn,Zn
13	-0.75 g -HNO_3/HF or HNO_3/HCl -closed vessel, microwave heating	GFAAS - As,Cd,Tl ICP - Al,Cr,Cu,Fe,Mn,Pb,Zn HGAAS - Se
14	-0.12 g -HNO_3/HF/HCl -closed vessel, microwave heating	GFAAS - As,Cd,Pb,Sn FAAS - Al,Cu,Fe,Mn,Zn HGAAS - Se
15	-HNO_3/HF/$HCLO_4$	FAAS - Cu,Pb,Cd,Cr,Fe,Mn,Al HGAAS - As,Se,Sb
16	-0.5 g -HNO_3 reflux -H_2O_2 -HCl	ICP - Cr,Cu,Pb,Zn GFAAS - As,Cd,Se
17	-0.5 g -HNO_3/HF/HCl -closed vessel, microwave heating	GFAAS - Cr,Cu,As,Se,Cd,Pb HGAAS - Sn FAAS - Al,Fe,Zn
18	-0.25 g -HNO_3/HF/$HCLO_4$ -closed vessel, microwave heating	
19	-1.0 g -$HNO_3/H_2O/H_2O_2$	FAAS - Al,Fe GFAAS - As,Cd,Cr,Pb,Se,Sn
20	-0.2 g -HNO_3/$HCLO_4$/HF -closed vessel	GFAAS - Cd,Se,Sb XRF - Al,As,Cr,Cu,Fe,Mn, Pb,Si,Zn ICPMS - Sn
21	-0.5 g -HNO_3/HF/$HCLO_4$ -open beaker	ICP - Al,Cr,Cu,Fe,Mn,Zn,Pb GFAAS - As,Cd,Se,Sn

Lab. #	Sediment Dissolution Procedure	Instrumentation
22	-0.5 g -HNO_3/H_2O_2 -open beaker	GFAAS - Cd,Pb
23	-0.5 g -HNO_3/HF -closed vessel, microwave heating -HCl/HNO_3	
24	-0.45 g -HNO_3/HCl/HF -closed vessel	FAAS - Al,Cr,Cu,Fe,Mn,Si,Zn GFAAS - Pb
25	-0.2 g -HNO_3/HCl/HF -closed vesssel, microwave heating	GFAAS -Al,Cd,Cr,Cu,Mn,Pb FAAS - Fe,Zn
26	-1.0 g -HNO_3/H_2O_2 --open vessel	GFAAS - As,Cd,Pb,Se,Sn,Tl ICP - Al,Sb
27	-$HNO_3/HCLO_4/H_2SO_4$ or HNO_3/HCL (Hg,Pb) -pelleting (XRF)	ICP - Cr,Cu,Zn HGICP - As,Se DPASV - Cd,Pb XRF - Al,Fe
28		
29		
30	-0.5 g -HNO_3/HF/$HCLO_4$ -closed vessel, microwave heating	IDICPMS - Cr,Cu,Pb,Zn,Cd,Sn, Tl,Sb ICP - Al,Fe,Mn
31	-0.25 g -HNO_3/HF/$HCLO_4$ -closed vessel, microwave heating	GFAAS - Cr,Cu,Pb,As,Se FAAS - Fe,Mn XRF - Al, Si

Appendix D

Biological Analysis Procedures

Lab. #	Biological Dissolution Procedure	Instrumentation
1	-0.3 g -HNO_3 -closed vessel, microwavve heating	GFAAS - As,Cd,Cr,Cu,Mn, Pb,Se,Tl FAAS - Al,Fe,Zn
2	-not determined	
3	-1.0 g -$HNO_3/H_2O_2/HCl$ -reflux	ICP - Ag,Al,Cd,Cr,Cu, Fe,Sn,Zn GFAAS - As,Pb,Se
4	-0.25 g -HNO_3/HF -microwave heating -transfer, $HNO_3/HCl/H_2O_2$ -open beaker	ICP - Al,Cr,Fe,Zn ICP (IC interface) - Cd,Cu,Pb HGICP - As,Se
5	-0.5 g -HNO_3 (Cr,Zn,Cu,Cd,Pb,Fe) -$HNO_3/HCLO_4/H_2SO_4$ (Se, As) -open beaker -ashing 450°C /HNO_3 (Al)	FAAS - Al,Cd,Cu,Fe,Sn,Zn GFAAS - Cr,Pb HGAAS - AS,Se
6	-0.4 g -HNO_3 closed vessel, microwave heating	ICPAES - Al,CD,CU,Fe,Sn,Zn ICPMS - As,Cr,Hg,Pb,Se
7	-0.5 g -HNO_3 -closed vessel, microwave heating	GFAAS - Ag,Cd,Cr,Cu,Fe,Pb FAAS - Zn
8	-1.0 g -ash 550 °C -HNO_3/HCl -0.25 g -HNO_3/H_2O_2 (As,Se)	ICP - Al,Cd,Cr,Cu,Fe, Pb,Sn,Zn GFAAS - As,Se
9	-not determined	

Lab. #	Biological Dissolution Procedure	Instrumentation
10	-0.5 g -HNO_3 reflux -H_2O_2 -HCl reflux -filtered	ICP - Al,Cd,Cu,Cr,Fe,Sn,Zn GFAAS - As,Pb,Se
11	-1.0 g -HNO_3 -open beaker -HNO_3/H_2O_2 -filtered	FAAS - Cd,Cr,Cu,Pb,Zn
12	-0.2 g -HNO_3 -closed vessel	GFAAS - Ag,Al,As,Cd,Cr, Pb,Se,Sn FAAS - Fe,Zn
13	-0.75 g -HNO_3 -closed vessel, microwave heating	GFAAS - Ag,Cr,Pb ICP - As,Al,Cu,Cd,Fe,Zn HGAAS - Se
14	-0.3 g -HNO_3 -closed vessel, microwave heating	GFAAS - Ag,As,Cd,Pb,Sn,Se FAAS - Al,Cu,Fe,Zn
15	-HNO_3/HF/$HCLO_4$	FAAS - Cu,Pb,Cd,Cr,Fe,Mn,Al HGAAS - As,Se,Sb
16	-0.5 g -HNO_3 reflux -H_2O_2 -HCl	ICP - Cr,Cu,Zn GFAAS - As,Cd,Se,Pb
17	-0.5 g -HNO_3/H_2O_2 -closed vessel, microwave heating	GFAAS - Ag,Cr,Cu,As, Se,Cd,Pb HGAAS - Sn FAAS - Al,Fe,Zn
18	-0.25 g -$HNO_3/HCLO_4$ -closed vessel, microwave heating	GFAAS - Ag,Al,As,Cd,Cr,Cu, Fe,Pb,Se,Zn
19	-1.0 g -$HNO_3/H_2O/H_2O_2$	FAAS - Al,Fe GFAAS - As,Cd,Cr,Pb,Se,Sn

Lab. #	Biological Dissolution Procedure	Instrumentation
20	-0.3 g -HNO_3 -closed vessel, microwave heating	GFAAS - Ag XRF - As,Cu,Fe,Se,Zn ICPMS - Sn,Al,Cd,Cr,Pb
21	-0.5 g -HNO_3/H_2O_2 -open beaker	ICP - Al,Cr,Cu,Fe,Zn, GFAAS - As,Cd,Se,Sn,Pb
22	-0.5 g -HNO_3/H_2O_2 -open beaker	GFAAS - Cd,Pb
23	-0.2 g -HNO_3 -open vessel, microwave heating -H_2O_2 -closed vessel, microwave heating	
24	-not determined	
25	-not determined	
26	-1.0 g -HNO_3/H_2O_2 --open vessel	GFAAS - As,Cd,Pb,Se,Sn,Ag ICP - Al,Sb
27	-HNO_3 (Se), $HNO_3/HCLO_4$ (As) or HNO_3 -closed vessel, microwave heating	ICPMS - Al,Fe,Cu,Zn,Ag,Cd,Pb HGAAS - As,Se GFAAS - Cr
28		
29		
30	-0.25 g -$HNO_3/HF/HCLO_4$ -closed vessel, microwave heating	IDICPMS - Ag,Cr,Cu,Pb, Zn,Cd,Sn, ICP - Al,Fe
31	-0.25 g -$HNO_3/HF/HCLO_4$ -closed vessel, microwave heating	GFAAS - Ag,Cr,Cu,Pb,As,Se FAAS - Al,Fe ICP - Zn

Digestion Procedures for Mercury Determination

Lab. #	Sediment Analysis	Biological Analysis
1	-0.4 g -10 mL HNO_3 -closed vessel, microwave heating -$KMNO_4$,$K_2S_2O_8$	-4:1 H_2SO_4:HNO_3 -$K_2S_2O_8$
2	-not determined	
3	-0.2 g -HNO_3,/H_2SO_4, $KMNO_4$ -autoclaved 121 °C	-0.5 g -HNO_3, H_2SO_4 -waterbath 60°C for 2 hr.
4		
5	-not determined	-HNO_3/HCl/H_2SO_4
6	-not determined	
7	-1.0 g -HNO_3 -closed vessel, microwave heating	-0.5 g -same as sediment
8	-0.25 g -HNO_3 reflux	-same as sediment
9	-0.2 g -HNO_3/HCl/H_2O -$KMnO_4$	-not determined
10	-0.2 g -H_2SO_4, HNO_3, $KMNO_4$,$K_2S_2O_8$	-same as sediment
11	-not determined	-2.0 g -HNO_3, H_2SO_4 -waterbath 70°C, filter -$KMNO_4$, $K_2S_2O_8$
12	-0.4 -HNO_3,H_2SO_4,$KMNO_4$,$K_2S_2O_8$	-0.2 g -same as sediment
13	-0.5 g -HNO_3, H_2O_2 -$KMNO_4$,$K_2S_2O_8$	-same as sediment

Lab. #	Sediment Analysis	Biological Analysis
14	-HF,HCl,HNO_3	-same as sediment
15	-HCl,HNO_3	-not determined
16	-0.3 g -H_2SO_4,HNO_3 -waterbath 30 min @ 60°C -$KMNO_4$	-same as sediment
17		
18	-not determined	-0.3 g -HNO_3, $HClO_4$ -closed vessel.microwave heating
19	-$KMNO_4$,$K_2S_2O_8$	-same as sediment
20	-0.2 g -HNO_3, HF, $HClO_4$	-0.3 g -HNO_3 -microwave heating
21	-0.5 g -V_2O_5 catalysed HNO_3	-same as sediment
22	-0.5 g -H_2SO_4, H_2O_2, $KMNO_4$	
23		
24		-not determined
25	-not determined	-not determined
26	-1.0 g -HNO_3 -hot plate, open vessel	-not determined
27	-0.7 g -HNO_3,HCl -2 hr. steam bath	-not determined
28		-not determined
29		
31	-0.25 g -$HNO_3/HCLO_4/H_2SO_4$	-1.0 g -$HNO_3/HCLO_4/H_2SO_4$

APPENDIX E

TABLE E-1

Comparison of Previous Participants to New Participants

Sediments

Element	Sample	Previous Participants, mg/kg	New Participants, mg/kg	Accepted or Certified value, mg/kg
Al(%)	Sediment N	5.37 ± 0.56 (9)	2.72 ± 2.19 (12)	5.27 ± 1.30
	BCSS-1	6.28 ± 0.41 (7)	3.12 ± 2.41 (11)	6.26 ± 0.41
Cr	Sediment N	62.1 ± 7.2 (11)	41.9 ± 16.7 (13)	63.1 ± 15.7
	BCSS-1	115 ± 17 (8)	59 ± 29 (13)	123 ± 14
Mn	Sediment N	491 ± 43 (11)	369 ± 139 (9)	495 ± 103
	BCSS-1	228 ± 10 (8)	201 ± 31 (9)	229 ± 15
Fe(%)	Sediment N	2.95 ± 0.21 (10)	2.67 ± 0.37 (12)	2.97 ± 0.40
	BCSS-1	3.04 ± 0.44 (9)	2.74 ± 0.47 (10)	3.28 ± 0.14
Cu	Sediment N	132 ± 11 (11)	115 ± 28 (15)	129 ± 26
	BCSS-1	18.8 ± 2.3 (9)	16.8 ± 5.4 (14)	18.5 ± 2.7
Zn	Sediment N	336 ± 16 (11)	311 ± 35 (12)	325 ± 55
	BCSS-1	131 ± 60 (9)	105 ± 19 (13)	119 ± 12
As	Sediment N	21.2 ± 4.4 (9)	18.5 ± 3.1 (11)	19.8 ± 5.8
	BCSS-1	10.4 ± 1.5 (7)	9.02 ± 3.57 (10)	11.1 ± 1.4
Se	Sediment N	1.47 ± 0.23 (6)	1.10 ± 0.61 (9)	1.54 ± 0.70
	BCSS-1	0.48 ± 0.06 (4)	0.45 ± 0.13 (4)	0.43 ± 0.06
Cd	Sediment N	2.31 ± 0.44 (10)	2.16 ± 0.67 (14)	2.03 ± 0.58
	BCSS-1	0.279 ± 0.128 (8)	0.269 ± 0.129 (11)	0.25 ± 0.04
Sn	Sediment N	63 ± 14 (9)	54 ± 15 (4)	65.4 ± 19.1
	BCSS-1	1.93 ± 0.44 (7)	1.41 ± 0.67 (7)	1.85 ± 0.20
Hg	Sediment N	1.47 ± 1.32 (8)	1.24 ± 0.26 (14)	1.34 ± 0.47
	BCSS-1	0.163 ± 0.044 (7)	0.179 ± 0.057 (13)	0.174 ± 0.081
Pb	Sediment N	193 ± 69 (9)	196 ± 55 (14)	211 ± 46
	BCSS-1	22.9 ± 2.1 (9)	22.8 ± 6.4 (14)	22.7 ± 3.4

TABLE E-2
Comparison of Previous Participants to New Participants
Biological Tissues

Element	Sample	Previous Participants, mg/kg	New Participants, mg/kg	Accepted or Certified value, mg/kg
Al	Mussel P	645 ± 276 (8)	307 ± 125 (8)	-
	SRM 1566a	95 ± 62 (6)	62 ± 30 (6)	202.5 ± 12.5
Cr	Mussel P	2.55 ± 0.79 (9)	1.20 ± 0.33 (7)	2.52 ± 0.75
	SRM -1566a	2.24 ± 0.47 (9)	1.58 ± 0.75 (13)	1.43 ± 0.46
Fe	Mussel P	567 ± 109 (8)	460 ± 127 (11)	575 ± 172
	SRM 1566a	511 ± 64 (7)	464 ± 96 (7)	539 ± 15
Cu	Mussel P	6.93 ± 2.24(10)	8.02 ± 1.91 (11)	7.81 ± 3.07
	SRM 1566a	65.5 ± 6.1 (8)	61.5 ± 2.0 (9)	66.3 ± 4.3
Zn	Mussel P	151 ± 17.5 (10)	140 ± 16 (14)	146 ± 19
	SRM 1566a	807 ± 72 (7)	787 ± 81 (9)	830 ± 55.7
As	Mussel P	9.33 ± 2.45 (8)	8.79 ± 3.06 (13)	8.56 ± 5.0
	SRM 1566a	12.6 ± 2.3 (8)	11.4 ± 2.2 (8)	14 ± 1.2
Se	Mussel P	3.21 ± 0.78 (8)	2.79 ± 0.74 (10)	2.86 ± 1.20
	SRM 1566a	2.16 ± 0.10 (6)	1.93 ± 0.48 (6)	2.21 ± 0.24
Ag	Mussel P	0.621 ± 0.093 (9)	0.535 ± 0.15 (6)	0.587 ± 0.257
	SRM 1566a	1.64 ± 0.11 (7)	1.38 ± 0.62 (6)	1.68 ± 0.15
Cd	Mussel P	4.30 ± 0.44 (9)	3.73 ± 0.53 (14)	3.96 ± 1.14
	SRM 1566a	4.10 ± 0.34 (8)	4.01 ± 0.40 (10)	4.15 ± 0.38
Sn	SRM 1566a	1.82 ± 0.74 (7)	2.72 ± 1.12 (3)	2.18 ± 0.27
Hg	Mussel P	0.165 ± 0.075 (8)	0.222 ± 0.182 (14)	0.159 ± 0.065
	SRM 1566a	0.0616 ± 0.0115 (7)	0.0634 ± 0.0238 (9)	0.0642 ± .0067
Pb	Mussel P	1.77 ± 0.29 (10)	1.87 ± 0.54 (11)	1.75 ± 0.67
	SRM 1566a	0.335 ± 0.049 (8)	0.318 ± 0.041 (5)	0.371 ± 0.014

TABLE E-3
Summary of Statistical Comparison of Means
Between Previous and New Participants

Element	Sediment Evaluation			Biological Evaluation		
	Sample	*t* test	*F* test	Sample	*t* test	*F* test
Al	Sediment N	Y	Y	Mussel P	-	-
	BCSS-1	Y	Y	SRM 1566a	N	N
Cr	Sediment N	Y	Y	Mussel P	N	N
	BCSS-1	Y	N	SRM 1566a	N	Y
Fe	Sediment N	Y	N	Mussel P	N	N
	BCSS-1	N	N	SRM 1566a	N	N
Cu	Sediment N	N	Y	Mussel P	N	N
	BCSS-1	N	Y	SRM 1566a	N	Y
Zn	Sediment N	Y	Y	Mussel P	N	N
	BCSS-1	N	Y	SRM 1566a	N	N
As	Sediment N	N	N	Mussel P	N	N
	BCSS-1	N	Y	SRM 1566a	N	N
Se	Sediment N	N	Y	Mussel P	N	N
	BCSS-1	N	N	SRM 1566a	N	Y
Cd	Sediment N	N	N	Mussel P	Y	N
	BCSS-1	N	N	SRM 1566a	N	N
Sn	Sediment N	N	N	Mussel P	-	-
	BCSS-1	N	N	SRM 1566a	N	N
Hg	Sediment N	N	N	Mussel P	N	Y
	BCSS-1	N	N	SRM 1566a	N	Y
Pb	Sediment N	N	N	Mussel P	N	Y
	BCSS-1	N	Y	SRM 1566a	N	N
Mn (sed) Ag (bio)	Sediment N	Y	Y	Mussel P	N	N
	BCSS-1	Y	Y	SRM 1566a	N	Y

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