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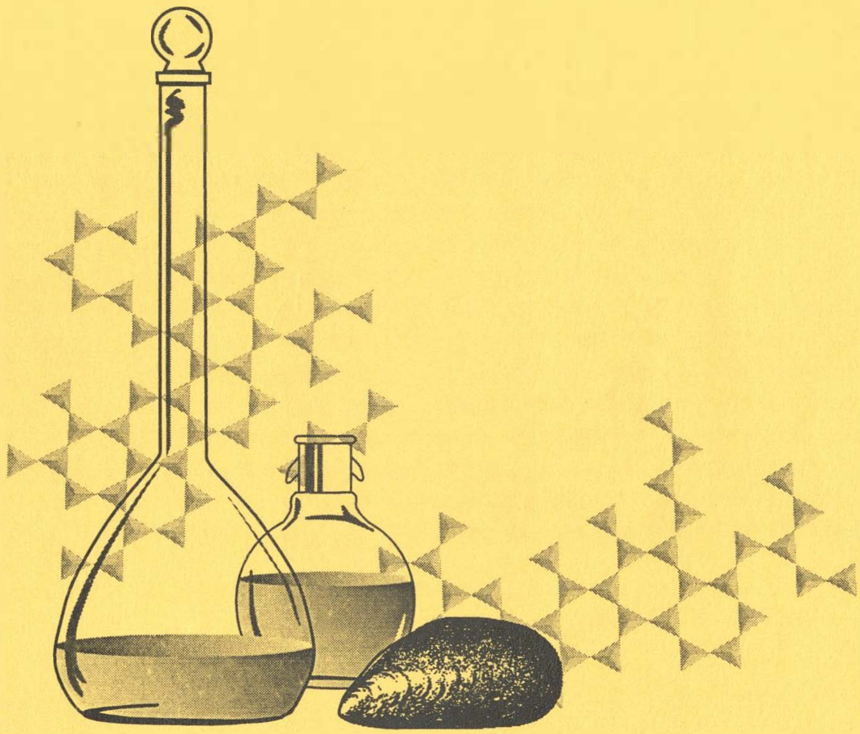
NOAA Technical Memorandum NOS ORCA 106

National Status and Trends Program
for Marine Environmental Quality

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



Silver Spring, Maryland
November 1996

US Department of Commerce

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Coastal Monitoring and Bioeffects Assessment Division
Office of Ocean Resources Conservation and Assessment
National Ocean Service

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Office of Ocean Resources Conservation and Assessment
National Ocean Service
National Oceanic and Atmospheric Administration
U.S. Department of Commerce
N/ORCA2, SSMC4
1305 East-West Highway
Silver Spring, MD 20910

Notice

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NOAA National Status and Trends Program Tenth Round Intercomparison 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 Tenth Round Intercomparison for Trace Metals in Marine Sediments and Biological Tissues under the directive of the NOAA National Status and Trends Program. A total of forty participants were included in the exercise, including NOAA, USEPA, state, Australian, Canadian, Mexican and Argentinean laboratories. Two samples were sent by NRC to each participant: a contaminated marine sediment from the vicinity of New York Bay and a freeze dried mussel (*Mytilus edulis*) from Charlottenlund, Denmark. Laboratories were also asked to analyze two certified reference materials NIST SRM 1566a and NRC BCSS-1. The elements to be determined were Al, Cr, Fe, Ni, Cu, Zn, As, Se, Ag, Cd, Sn, Hg and Pb for both matrices, plus Be, Si, Mn, Sb and Tl for the sediments. An accepted mean and confidence interval were calculated for each analyte in the two unknown samples. Laboratory biases were identified and an overall rating of superior, good, fair or others was assigned to each laboratory. Seventy-five percent of the laboratories were rated in the superior or good category for the sediments, an increase from sixty percent in last year's exercise. Seventy-seven percent of the laboratories were rated superior or good for the biological tissues. This also represented a slight increase over last year.

Silver Spring, Maryland
November 1996

United States Department of Commerce	National Oceanic and Atmospheric Administration	National Ocean Service
Michael Kantor Secretary	D. James Baker Under Secretary	W. Stanley Wilson Assistant Administrator

National Research Council Canada
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Institute for National Measurement Standards
Institut des étalons nationaux de mesure

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NOAA/10

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

Scott Willie and Shier Berman

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

November 1996

Canada

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APPENDICES

1. INTRODUCTION

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

Participating laboratories, meeting in Silver Spring at the annual NOAA quality assurance workshop after the ninth intercomparison exercise, had agreed for the tenth study to analyze one sediment and one biological tissue as well as to again analyze the certified reference materials (CRMs) NRC sediment BCSS-1 and NIST oyster tissue SRM 1566a. The test materials distributed by NRC were:

> **Sediment Y**, a freeze dried marine sediment collected by NIST in the vicinity of New York Bay and Newark Bay. This material is a proposed NIST SRM for organic contaminants.
>
> **Tissue Z**, a freeze dried mussel (*Mytilus edulis*) collected by the Marine Pollution Laboratory in Charlottenlund, Denmark.

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

Following a protocol used in previous NOAA exercises, each laboratory was requested to perform five replicate analyses on each of the four samples. Again, as last year, the evaluation of the biological tissue would not be based on a hydrofluoric acid digestion, although in order to obtain certified values for Al in NIST SRM 1566a it is required. The list of elements remained the same: Al, Cr, Fe, Ni, Cu, Zn, As, Se, Ag, Cd, Sn, Hg and Pb for both matrices, plus Be, Si, Mn, Sb and Tl for the sediments.

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

2. RESULTS

The prepared samples were mailed to the fifty laboratories listed in Appendix A in mid-April 1996 with the deadline for receipt of results set for the following September 9. Forty sets of results were received. Sequential numbers were assigned to each responding laboratory upon receipt of its data. Laboratory numbers 41 and 42 were assigned to NRC.

Of the forty laboratories, four did not submit data for the biological tissues and three did not submit data for the sediments. Three laboratories submitted results for the first time. Seven of the ten laboratories which did not send results had participated in NOAA/9.

A copy of the tabulated raw data was sent to each participant that had submitted data by the deadline in order to verify that no errors had been made by us in the transposition of numbers. This was not possible for data accepted from a few laboratories in the few days after the original deadline. Several mistakes were caught and changes were made only if NRC was at fault. The data used for subsequent evaluation are listed in Appendix B. The data are listed as received with respect to significant figures.

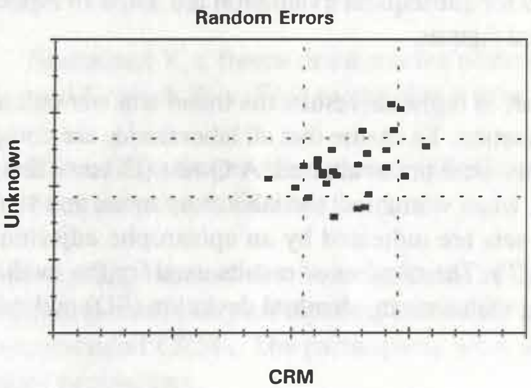
If two or more "less than (<)" values were submitted in a set of replicate results the mean was not calculated and only the "less than" value was used for further data evaluation. To ensure that all laboratories are compared on a rather even basis, sets containing less than four results were not evaluated. A Q test (Dixon's test) was used to determine outliers within a replicate set of data and, when warranted, the laboratory mean and standard deviation were recalculated excluding the outlier. These sets are indicated by an apostrophe adjoining the laboratory number on the graphs and in Appendix B (e.g., 7'). The number of results used for the evaluation is noted next to the laboratory number in Appendix B along with a mean, standard deviation (SD) and relative standard deviation (RSD) calculated by us.

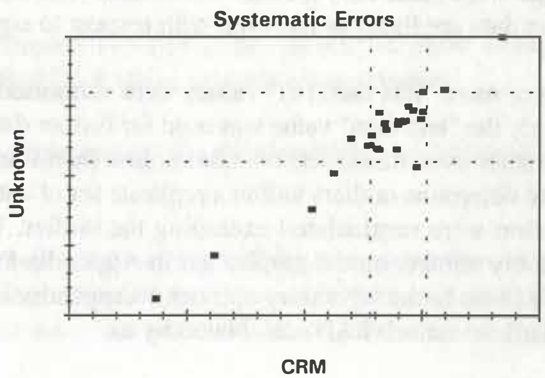
One purpose of the exercise was to arrive at an accepted value for each analyte concentration for each unknown sample in order to evaluate laboratory biases. The overall mean concentration for each metal was calculated from the mean of laboratory replicates and the NRC data. These means were assumed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

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

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

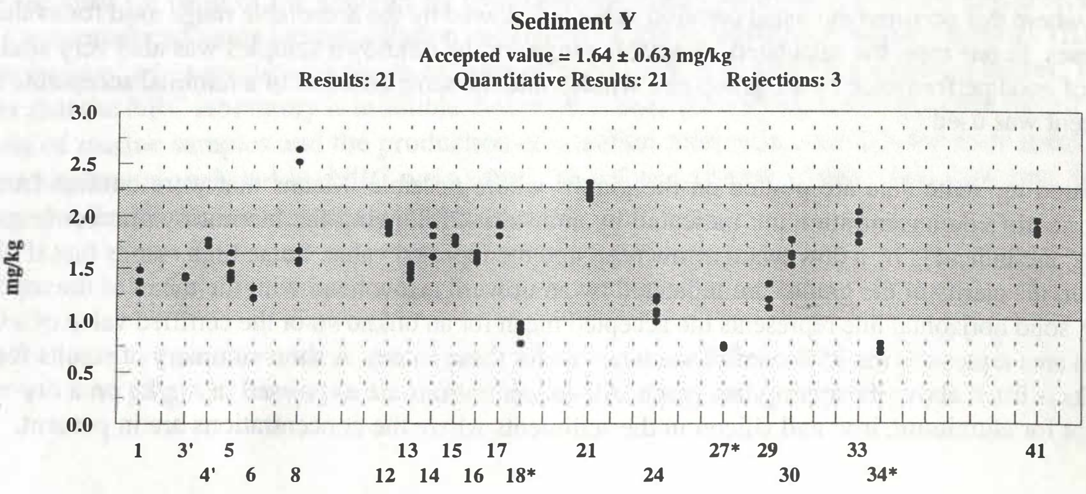
We have also included Youden (or two sample plots) for the sediment and the tissue samples when the concentration between the unknown sample and the CRM were similar. These plots of the overall mean for the CRM versus the mean for the unknown sample can give useful information when the analyte concentrations of the two samples are similar. If non-systematic or random errors are occurring, the results would be expected to group at random about the intersection of the two means. If, however, systematic errors occur (e.g. a high or low result for both the CRM and the unknown) a predominance of points would be expected to group about a line running from the origin through the intersection of the two means. The latter case is common in intercomparison exercises due to calibration and blank errors. The laboratory number appears to the left of a marker if both of the laboratory results are rejected. Unfortunately, when a group of laboratories report similar rejected results the labels become illegible. The accepted confidence range is indicated by the dashed lines. Examples of Youden plots, demonstrating random and systematic errors respectively, are shown below.



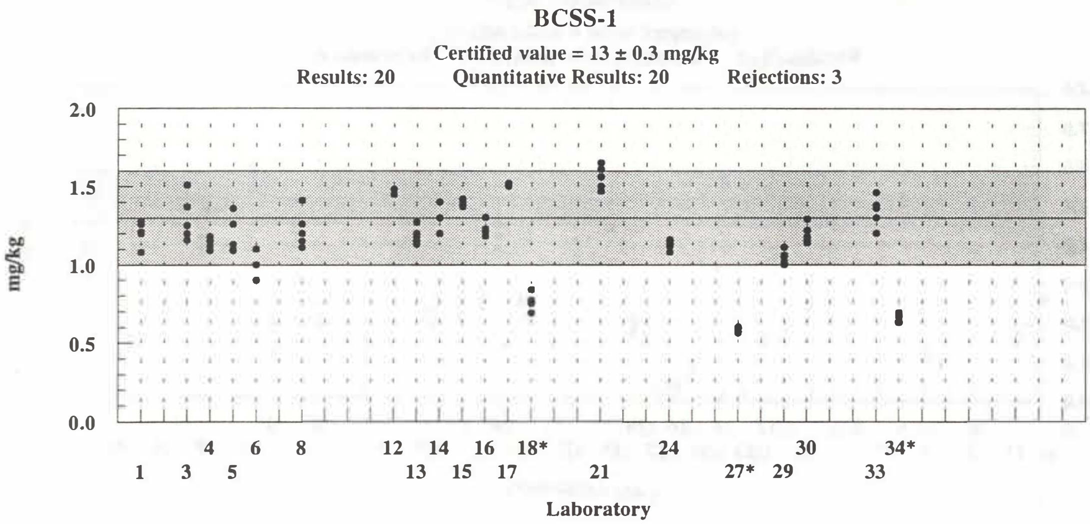


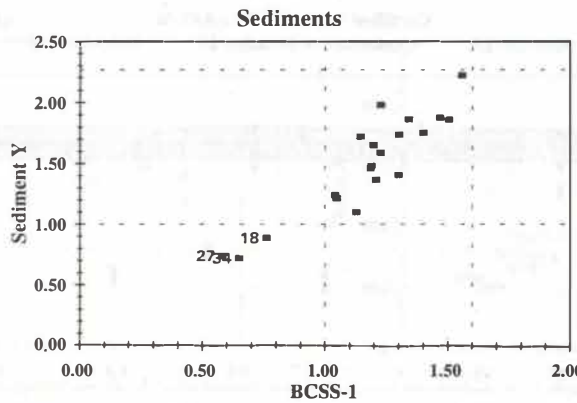
In the following discussions the term "significant" is only used if an appropriate F-test or *t*-test has been carried out.

BERYLLIUM



BERYLLIUM





This is the fourth year that the determination of Be has been included in the exercise. Twenty-one labs submitted results for Be, about the same number as in the last two years. The accepted concentration of Be in all four sediments has been between 1.6 and 2.1 mg/kg. The calculated confidence interval for Sediment Y is ± 38 percent, about the same as last year's ± 36 percent. Thirteen means (65%) were within ± 20 percent of the accepted value. Five labs that did not use hydrofluoric acid (HF) in the digestion procedure submitted results for Be. Three of these, all with low results, were rejected. The same three labs were the only ones outside the confidence interval for Be in the CRM (± 23 percent). The Youden plot displays a great tendency towards systematic errors, and an indication, which we will see repeated with other analytes, that for some reason it is easier to get better values for the 'unknown' sample than for the CRM, the same as last year.

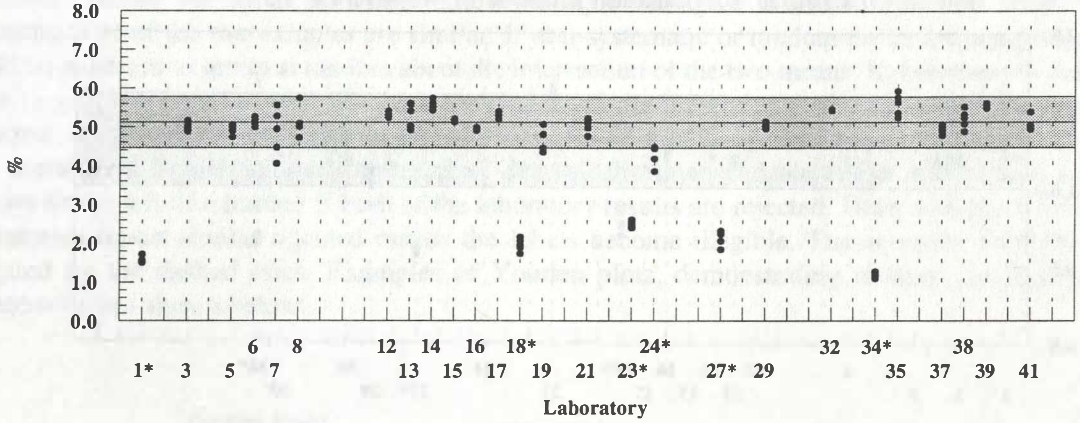
The determination of beryllium was not required in Tissue Z.

ALUMINUM

Sediment Y

Accepted value = 5.12 ± 0.67 %

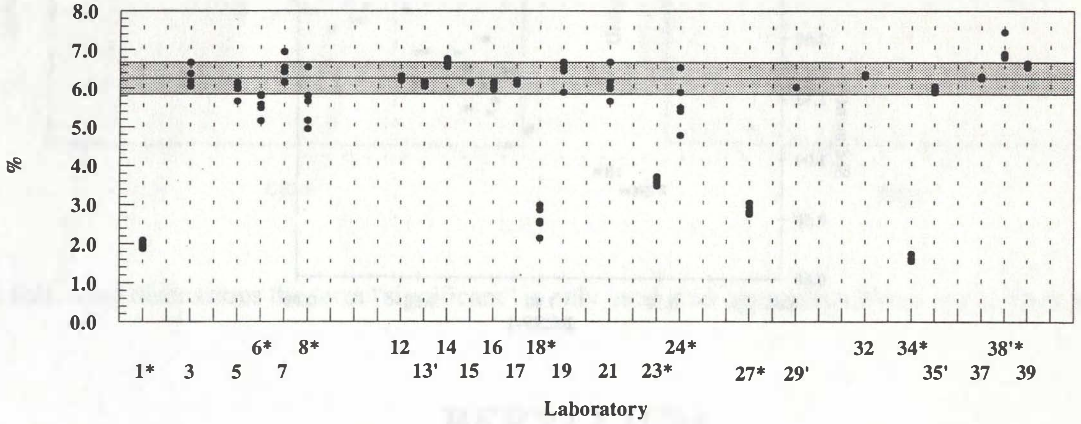
Results: 26 **Quantitative Results: 26** **Rejections: 6**



BCSS-1

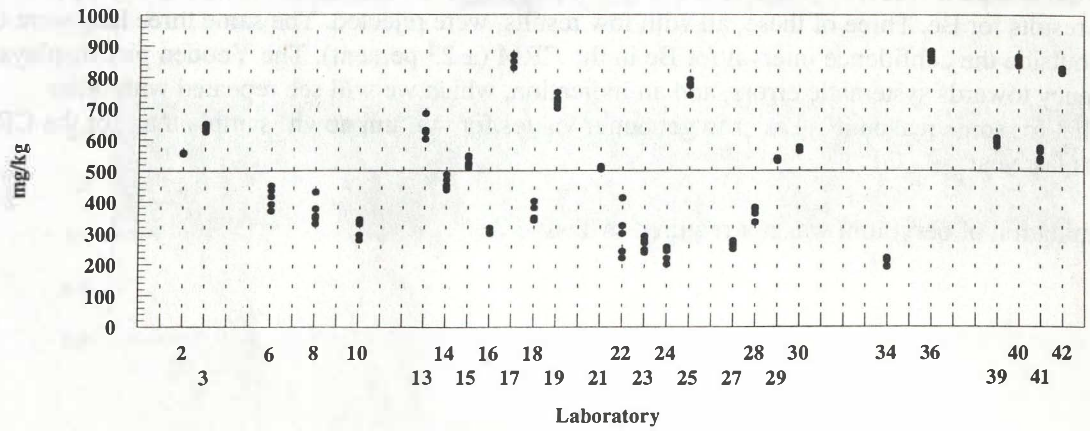
Certified value = 6.26 ± 0.41 %

Results: 25 **Quantitative Results: 25** **Rejections: 9**



Tissue Z

Results: 27 **Quantitative Results: 27** **Rejections: 0**

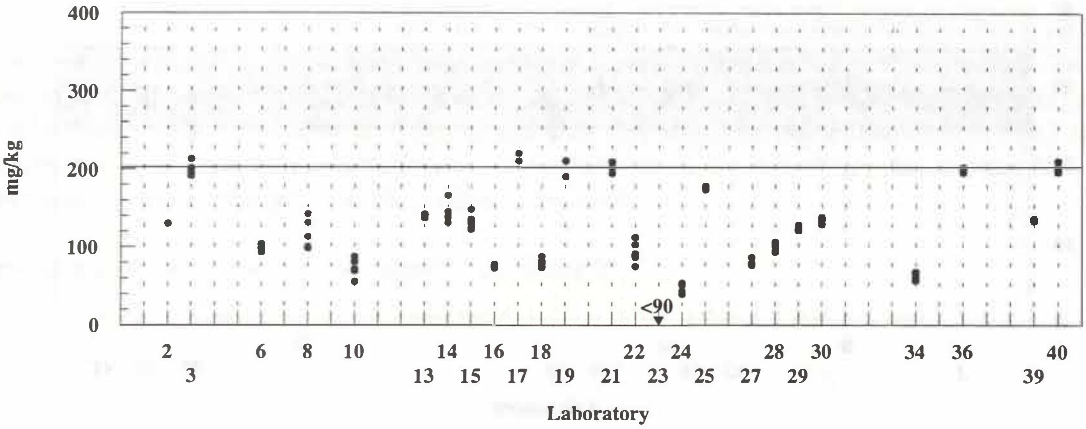


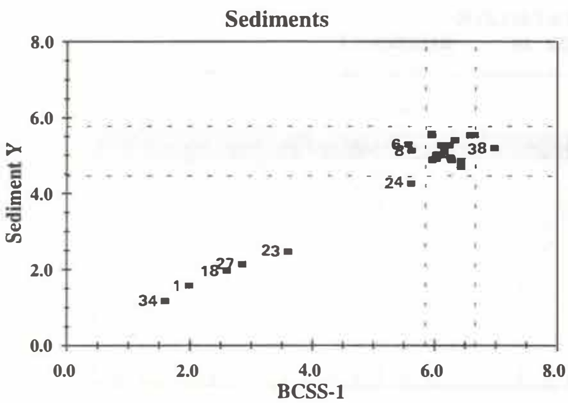
ALUMINUM

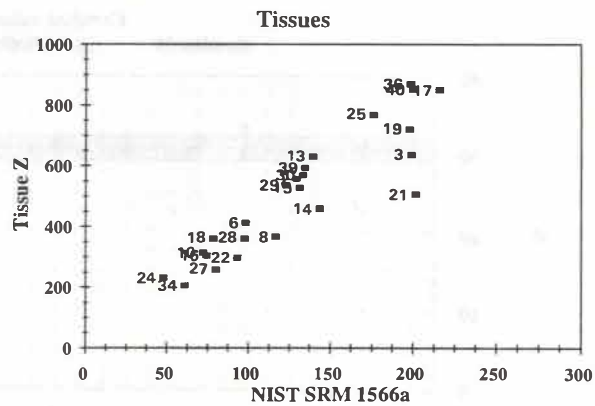
NIST SRM 1566a

Certified value = 202.5 ± 2.5 mg/kg

Results: 25 Quantitative Results: 24 Rejections: 0







The improvement noted last year for the determination of Al in sediments has been maintained, more or less. Twenty-six labs submitted results, a decrease from 28 last year. Some labs that do not use HF for the dissolution of the sample are apparently no longer reporting Al results. The accepted confidence interval (CI) which decreased from ± 25 to ± 8 percent from 1991 to 1995 has risen to ± 13 percent, but only six sets of results were rejected as opposed to 12 sets last year. Fourteen of the means (56%) were within ± 5 percent of the accepted value. Five of the labs did not use HF and all of their results were among the 6 rejected. All rejected sets were low. Results for BCSS-1 were equivalent to last year's. Of the 25 sets of results received for Al in BCSS-1, 15 labs used HF, five did not and 4 used non-destructive methods (Lab 8 did not tell us what they did). Eight of the 9 outliers were low. In both sediment samples the majority of the rejected results can probably be attributed to incomplete dissolution of the sediment. The use of HF is obviously beneficial but not always sufficient. All values from non-destructive methods (XRF, INAA) were within the CI. The Youden plot shows pronounced systematic errors.

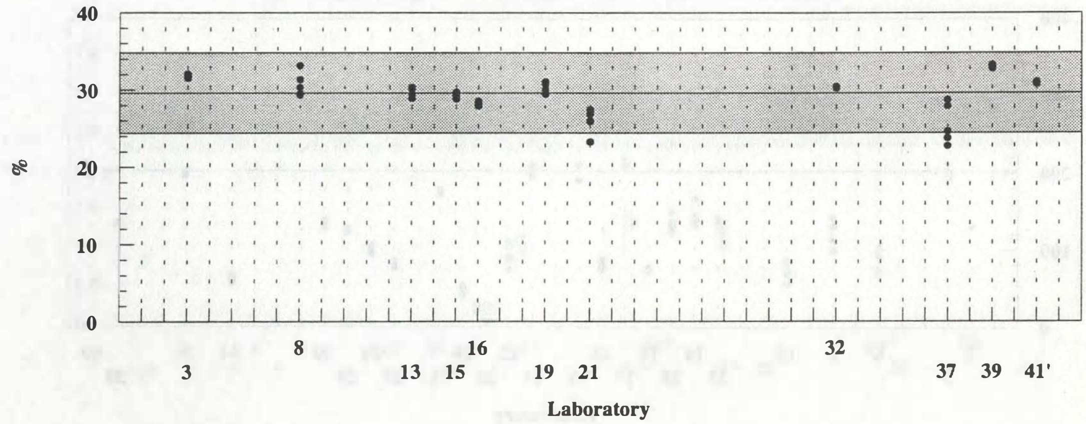
Performance for the determination of Al in the tissues is always difficult to evaluate and we have again not attempted to do so this year. We had earlier noted that the labs would not be evaluated for this analyte because HF is not routinely used by most labs for the dissolution of tissues. Our own results (41,42), without and with HF respectively, show dramatically different values. Labs 3, 17 and 42 used HF in the digestion and Lab 40 used INAA. These 4 labs yielded a mean value of about 790 mg/kg as opposed to a consensus value of about 500 mg/kg. Likewise, for SRM 1566a, it has been shown in previous exercises that HF is necessary to completely recover all the Al. Only 6 labs (3,17,19,21,36,40) produced means within ± 10 percent of the certified value. Again the Youden plot shows pronounced systematic errors.

SILICON

Sediment Y

Accepted value = 29.6 ± 5.2 %

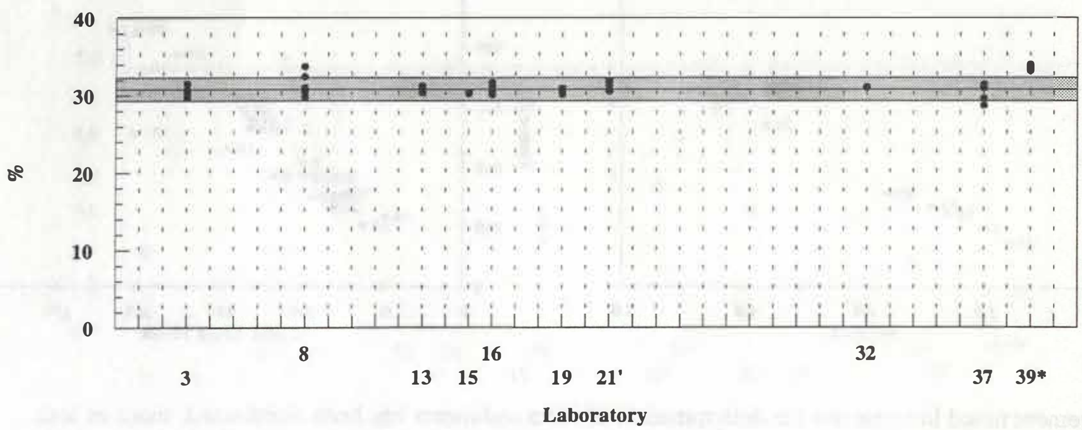
Results: 11 Quantitative Results: 11 Rejections: 0



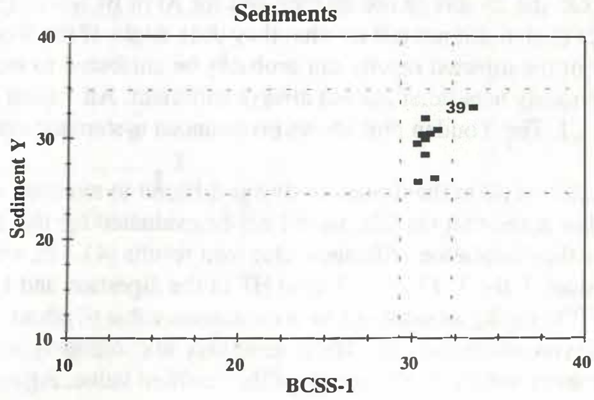
BCSS-1

Certified value = 30.8 ± 1.0(1.5) %

Results: 10 Quantitative Results: 10 Rejections: 1



Sediments



SILICON

The CI for Si in Sediment Y was ± 18 percent, not significantly different from NOAA/9's ± 13 percent. There were no rejected results. All the labs used HF or a non-destructive method of analysis. Six of the 10 submissions (60%) were within ± 5 percent of the accepted value. Results for BCSS-1 are equivalent to those of last year. With the exception of one outlier (Lab 39) all the submitted data for BCSS-1 were within less than ± 5 percent the certified value. It appears that most laboratories that attempt Si determinations in sediments perform the analysis very well.

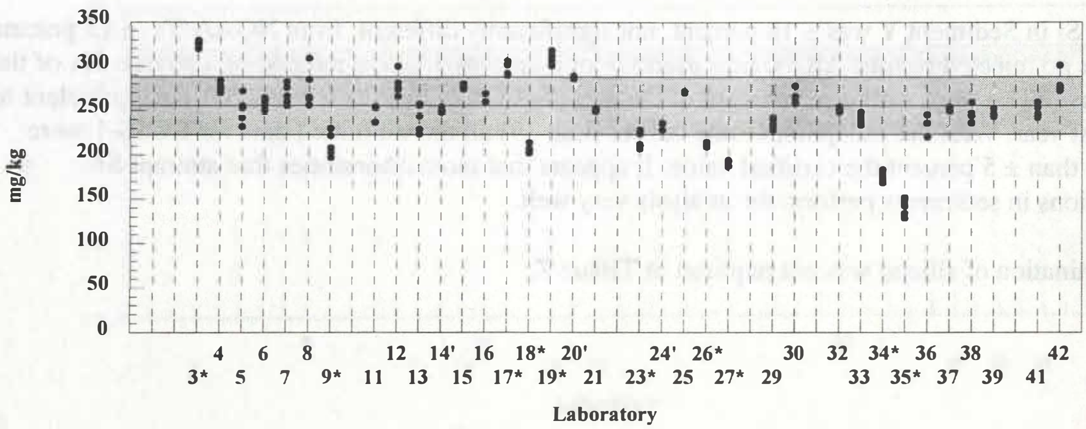
The determination of silicon was not required in Tissue Z.

CHROMIUM

Sediment Y

Accepted value = 256 ± 33 mg/kg

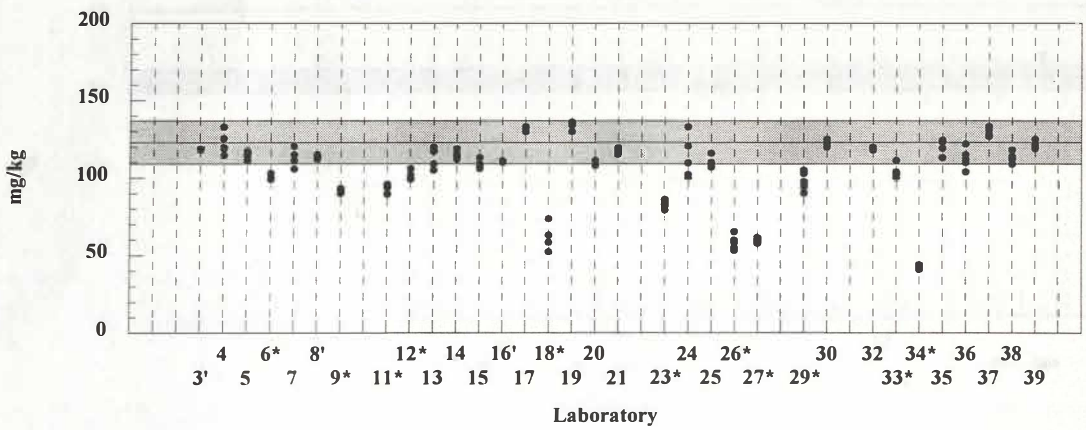
Results: 35 Quantitative Results: 35 Rejections: 10



BCSS-1

Certified value = 123 ± 14 mg/kg

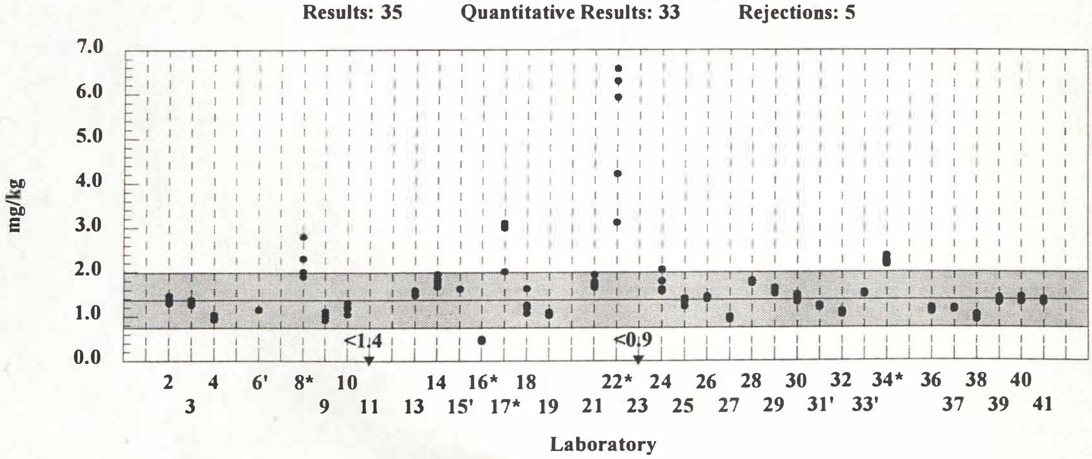
Results: 33 Quantitative Results: 33 Rejections: 11



Tissue Z

Accepted value = 1.37 ± 0.62 mg/kg

Results: 35 Quantitative Results: 33 Rejections: 5

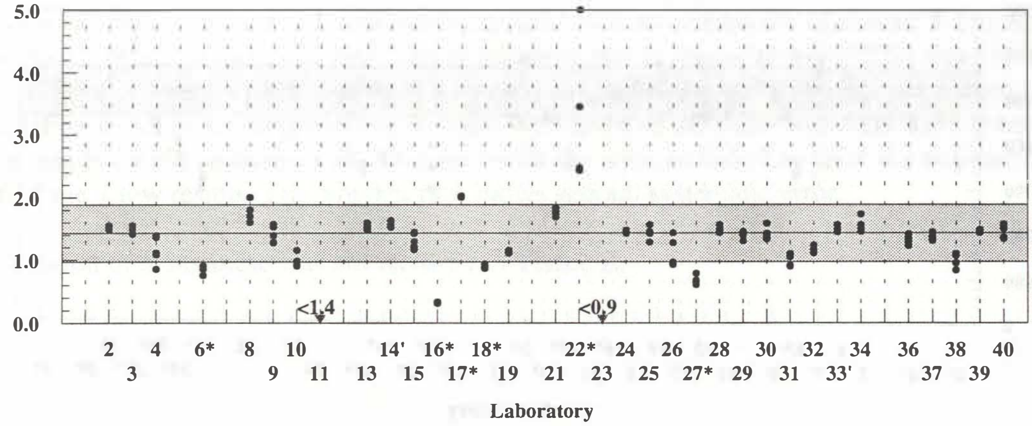


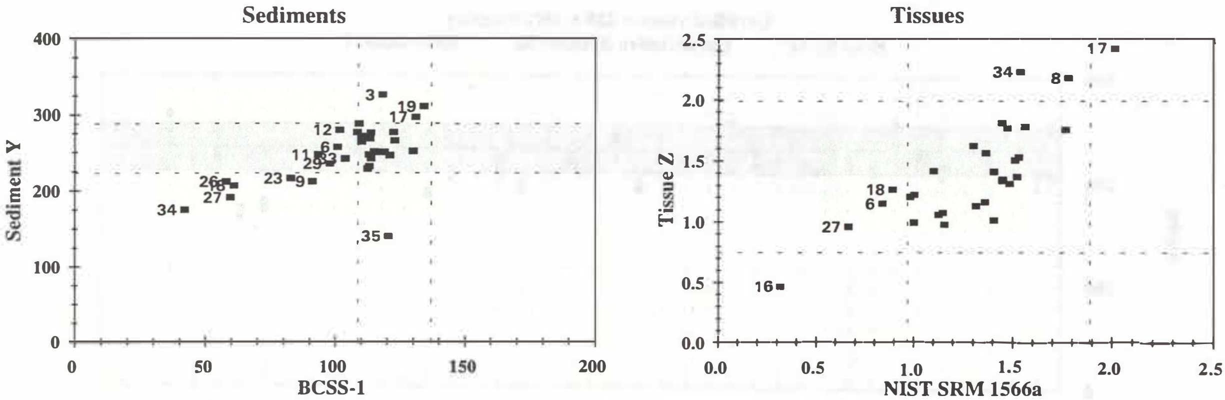
CHROMIUM

NIST SRM 1566a

Certified value = 1.43 ± 0.46 mg/kg

Results: 34 Quantitative Results: 32 Rejections: 6





The improvement shown last year for the determination of Cr in the sediment samples has been retained. The CI for Sediment Y is only ± 13 percent but the Cr concentration is 4 times that of last year's sample. The rejection rate increased to 29 percent from 19 percent this time. However, 28 of the 33 sets of results (85%) were within ± 20 percent of the accepted value. Seven of the 10 outliers were low and 5 of these did not use HF in the digestion procedure. Results from four of the other 5 outliers were obtained using FAAS. The situation is more marked with BCSS-1 where experience has shown that complete digestion is required to get within the certified interval. All 11 outliers were low. The results of 5 of the 6 labs which didn't use HF were rejected, but so were those of 6 labs that did. The use of HF is mandatory but not always sufficient. The Youden plot indicates systematic errors and reflects the difficulty in totally dissolving BCSS-1 which contains some chromite.

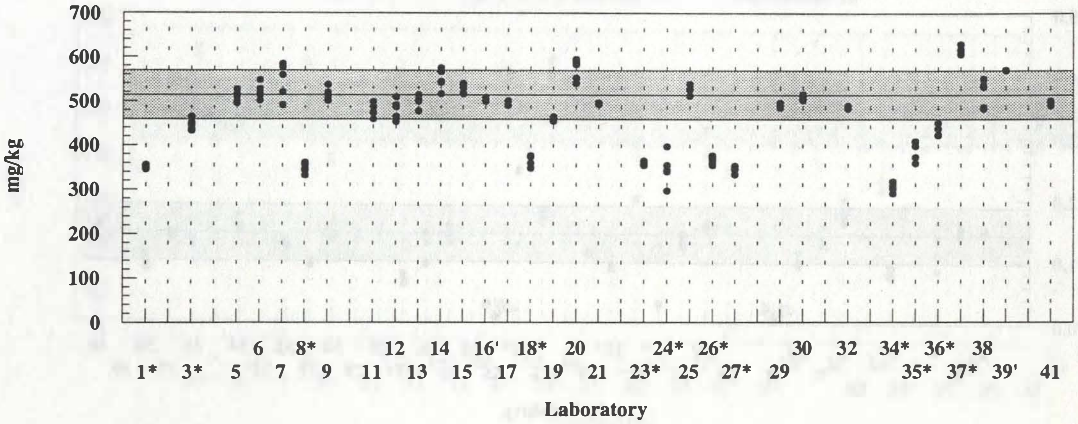
The improvement seen last year for the determination of Cr in the tissues is gone. The CI which had dropped from ± 60 to ± 40 to ± 27 percent in the last 3 years has significantly risen to ± 45 percent. The rejection rate of 15 percent is equivalent to last year. Seventeen of the 32 sets of results (59%) were within ± 20 percent of the accepted value. There is no apparent relationship between "success" and dissolution or measuring systems. The results for Cr in SRM 1566a are similar with the rejection rate increasing from 7 to 19 percent. The determination of Cr in tissues remains a challenge for some labs. The Youden plot shows some systematic errors.

MANGANESE

Sediment Y

Accepted value = 514 ± 55 mg/kg

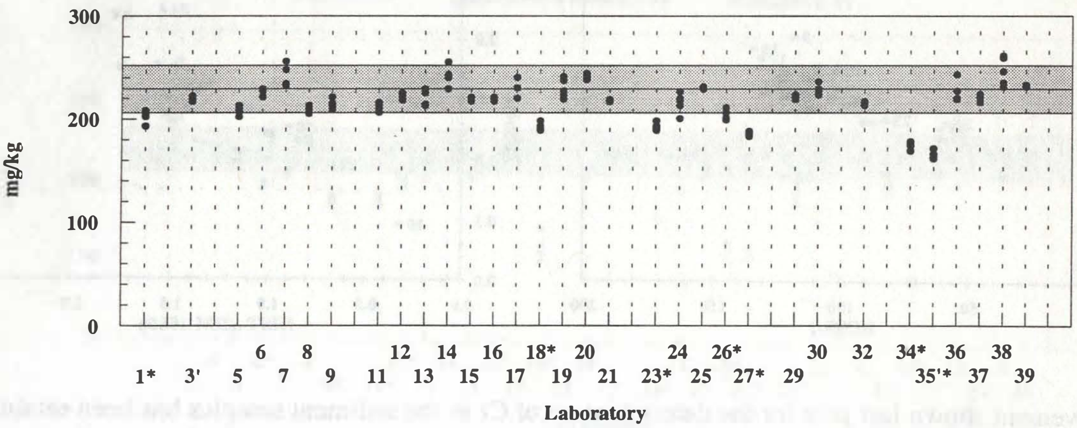
Results: 33 Quantitative Results: 33 Rejections: 12



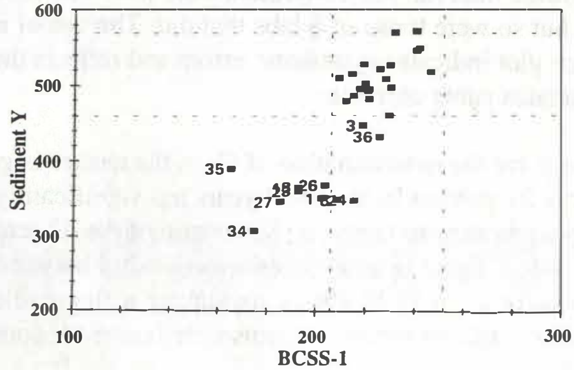
BCSS-1

Certified value = 229 ± 15(23) mg/kg

Results: 32 Quantitative Results: 32 Rejections: 7



Sediments



MANGANESE

The results for Mn this year are good with a calculated CI of ± 11 percent for Sediment Y but significantly higher than the CI of ± 5 percent last year. Twenty-three of the 32 sets of results (72%) were within ± 20 percent of the accepted value. Eleven of the 12 rejected sets were low and 7 of these were from labs that did not use HF in the dissolution procedure. Results from three of the other 5 outliers were obtained using FAAS. The results for the analysis of BCSS-1 are much the same as last year. Here the non-use of HF results in 6 of the 7 low results. The Youden plot shows general systematic error.

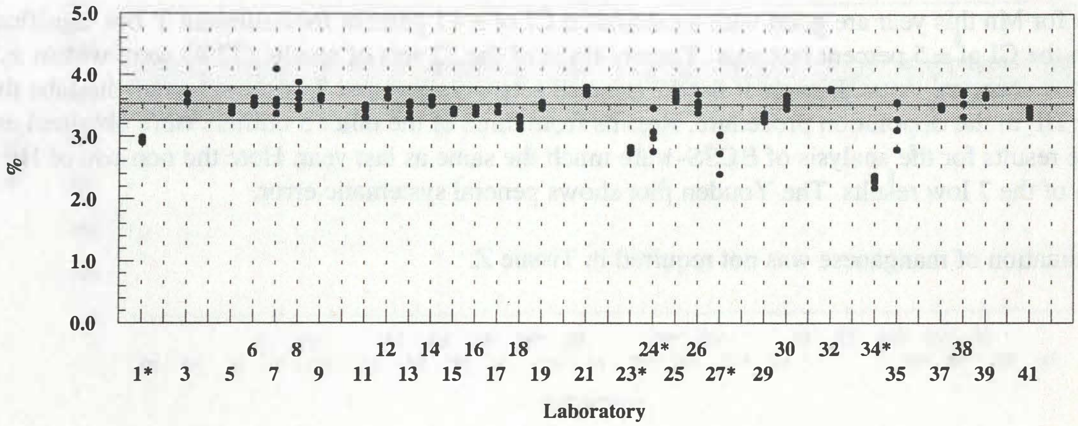
The determination of manganese was not required in Tissue Z.

IRON

Sediment Y

Accepted value = 3.53 ± 0.27 %

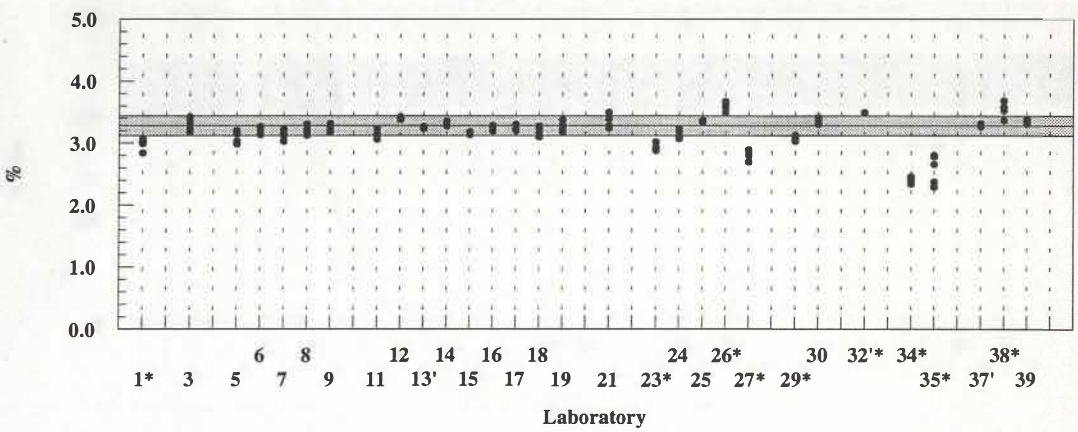
Results: 31 Quantitative Results: 31 Rejections: 5



BCSS-1

Certified value = 3.28 ± 0.14(0.16) %

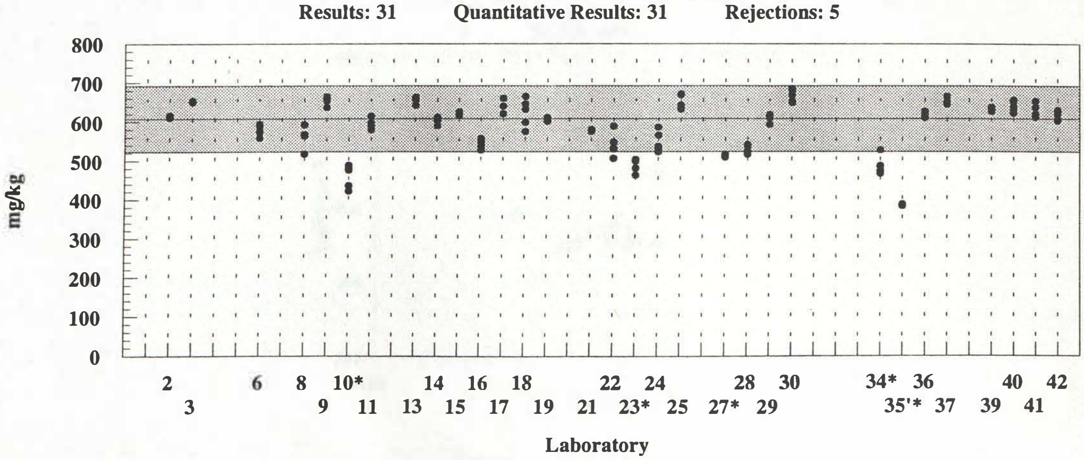
Results: 30 Quantitative Results: 30 Rejections: 9



Tissue Z

Accepted value = 608 ± 84 mg/kg

Results: 31 Quantitative Results: 31 Rejections: 5

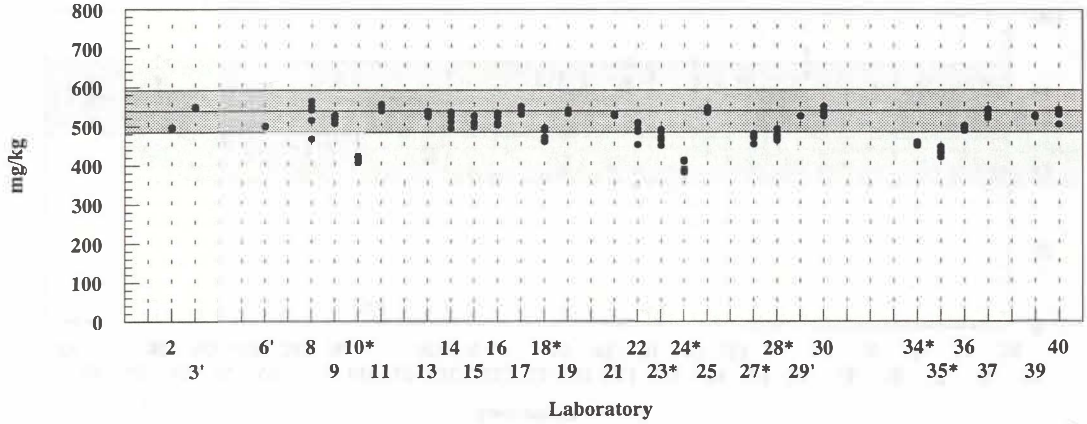


IRON

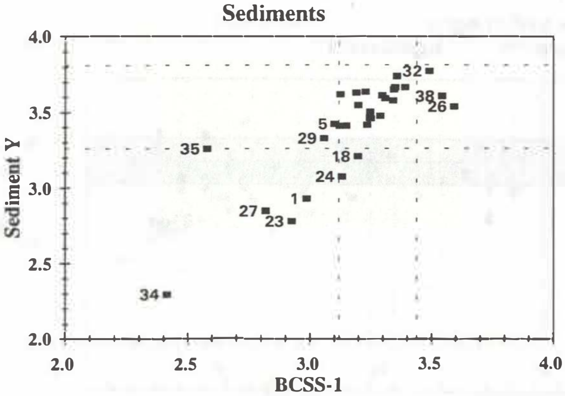
NIST SRM 1566a

Certified value = 539 ± 15(54) mg/kg

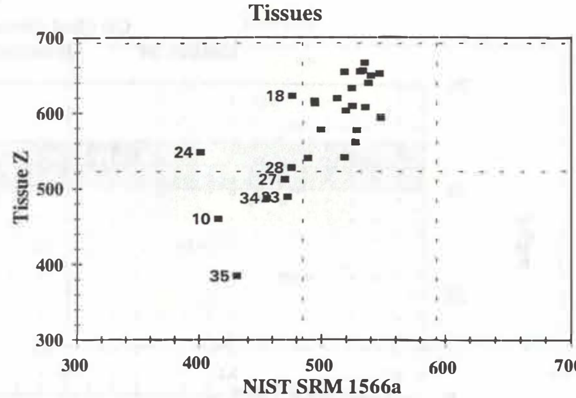
Results: 29 Quantitative Results: 29 Rejections: 8



Sediments



Tissues



Results for Fe in the sediments show some improvement compared to previous years. The calculated CI for Sediment Y is ± 8 percent, the same as in NOAA/9. But 21 of the 30 sets of results (70%) were within 5 percent of the accepted value compared to 56% last year. All 5 of the rejected sets were low. Four of these were from laboratories which did not use HF. For BCSS-1, the certified confidence range was increased to ± 5 percent from ± 4.3 percent for evaluation purposes. Results for BCSS-1 were much like last year. Of the 9 outliers, five didn't use HF, two others were measured using FAAS. Aside from the HF issue, the largest apparent single common factor among labs with poor results for the analytes Be to Fe is the use of FAAS. The Youden plot reflects systematic errors.

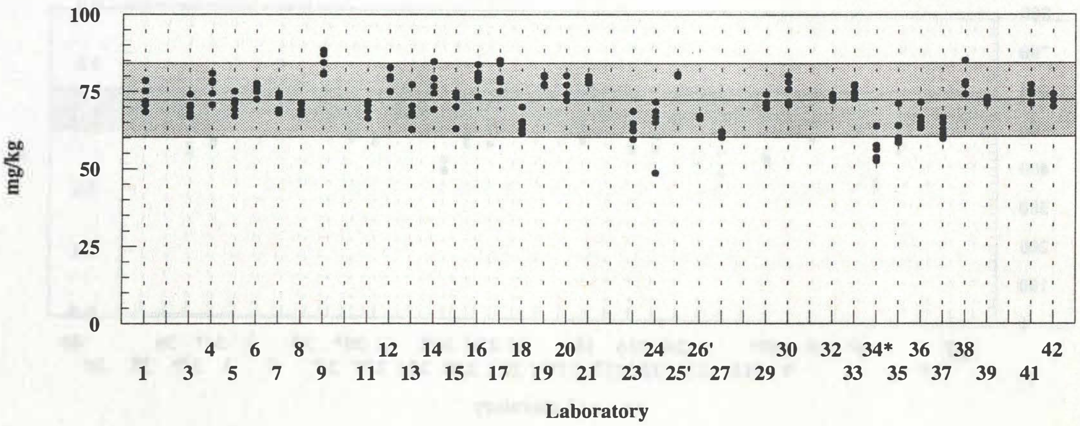
The results for the analysis of the tissue sample are comparable to last year. The CI of ± 14 percent and the acceptance ratios (86% vs 90%) are essentially the same. Twenty-seven of the 29 (93%) sets are within 20 percent of the accepted value. There are 5 rejected sets, all low. Four of these sets are from the 17 labs that used ICPAES. The acceptable confidence range for SRM 1566a has been increased to ± 10 percent and the rejection rate of 28 percent is rather larger than last year's 16 percent. All 8 outliers are low, and 7 of these were determined by ICPAES. The Youden plot again displays systematic errors.

NICKEL

Sediment Y

Accepted value = 72.2 ± 12.0 mg/kg

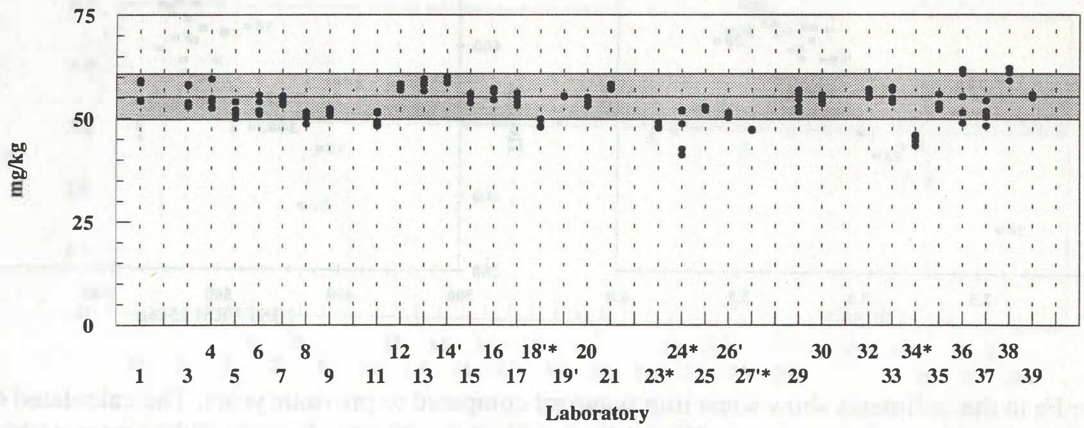
Results: 36 Quantitative Results: 36 Rejections: 1



BCSS-1

Certified value = 55.3 ± 3.6(5.5) mg/kg

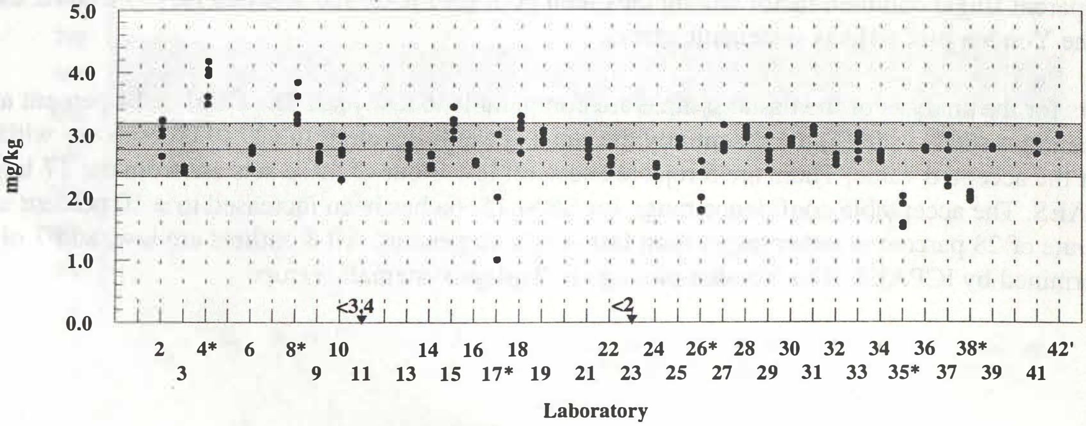
Results: 34 Quantitative Results: 34 Rejections: 4



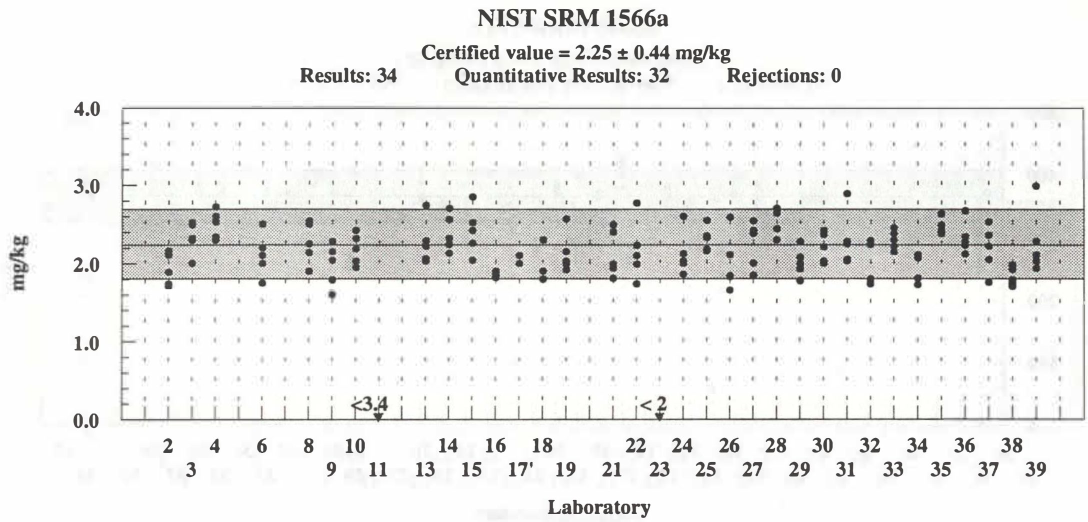
Tissue Z

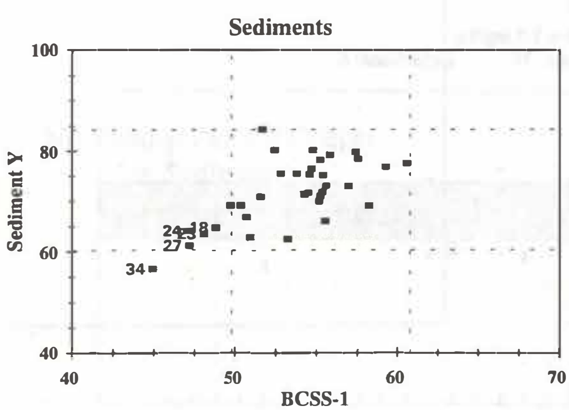
Accepted value = 2.77 ± 0.42 mg/kg

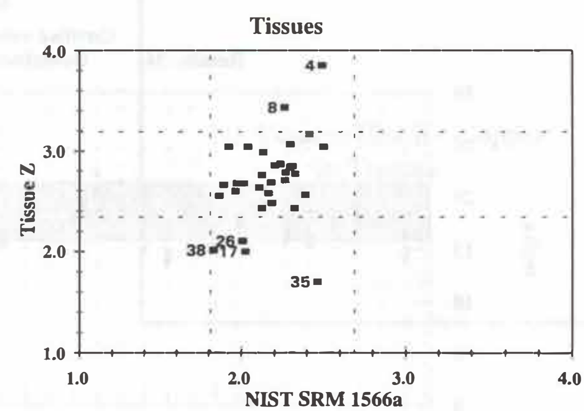
Results: 36 Quantitative Results: 34 Rejections: 6



NICKEL







Results for Ni in the sediments have not changed significantly. The accepted CI was ± 17 percent with 34 sets (97%) within 20 percent of the accepted value. The rejection rate is 3 percent (only 1 rejection). The use of HF does not seem to be a large factor with this sample, but 6 of the 7 labs that did not use HF had means lower than the accepted value. The acceptable confidence range for BCSS-1 was increased from ± 6.5 to ± 10 percent for the evaluation. There were 4 outliers in 34 submissions, all low. Two of these labs did not use HF. The Youden plot shows an obvious difference between the two sediments. The use of HF is more necessary for the CRM but not for Sediment Y.

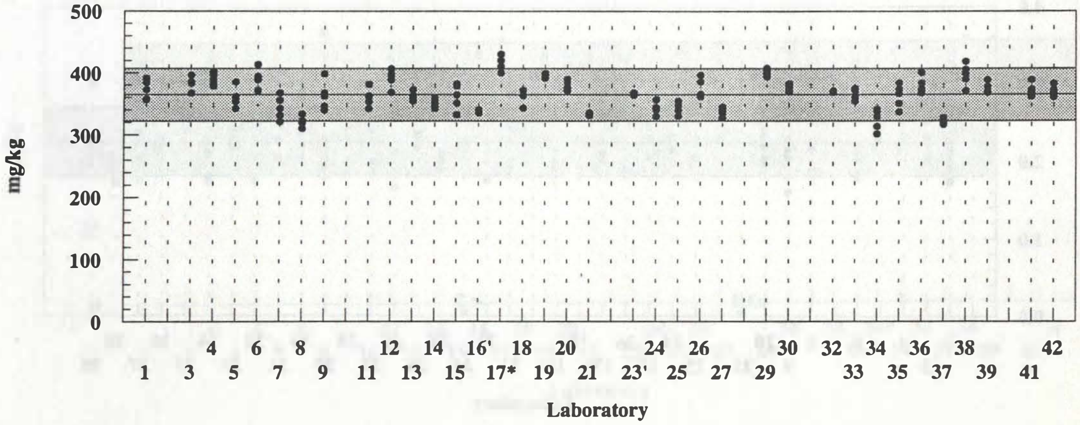
The decrease in the CI this year to ± 15 percent from ± 35 percent is probably due to the 3.6 times higher Ni concentration in Tissue Z compared to that of Tissue X. Twenty-six of the 32 sets (76%) were within 20 percent of the accepted value. Four of the six rejected sets were low. There is no apparent relationship between "success" and methodology. Results for Ni in SRM 1566a are improved. There were no outliers. The Youden plot shows systematic errors.

COPPER

Sediment Y

Accepted value = 365 ± 43 mg/kg

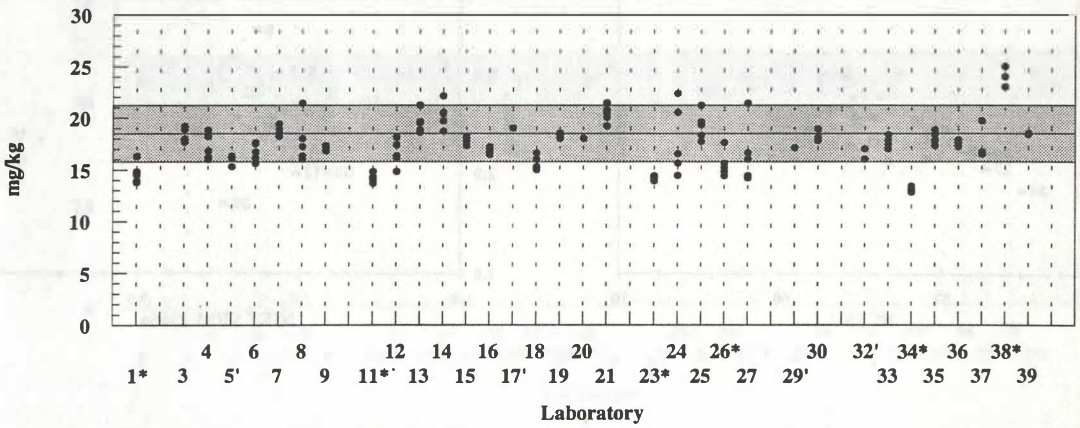
Results: 35 Quantitative Results: 35 Rejections: 1



BCSS-1

Certified value = 18.5 ± 2.7 mg/kg

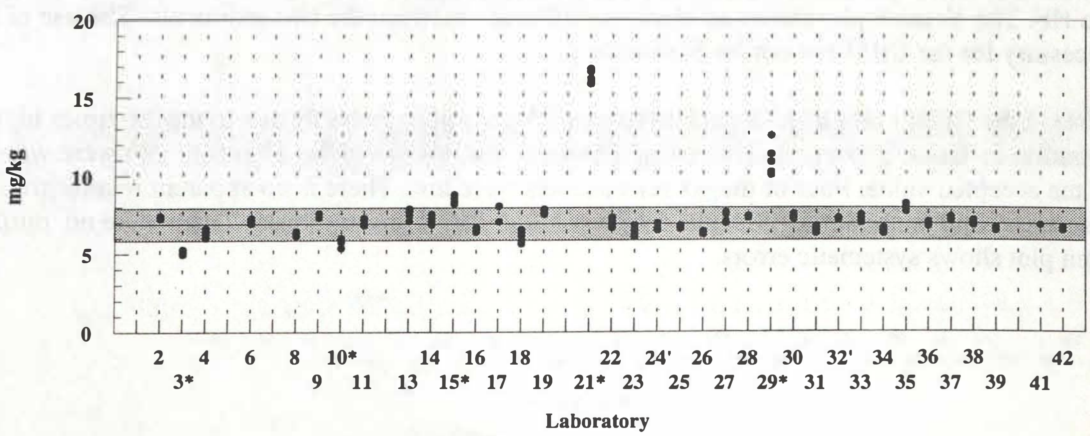
Results: 34 Quantitative Results: 34 Rejections: 6



Tissue Z

Accepted value = 6.88 ± 1.05 mg/kg

Results: 36 Quantitative Results: 36 Rejections: 5

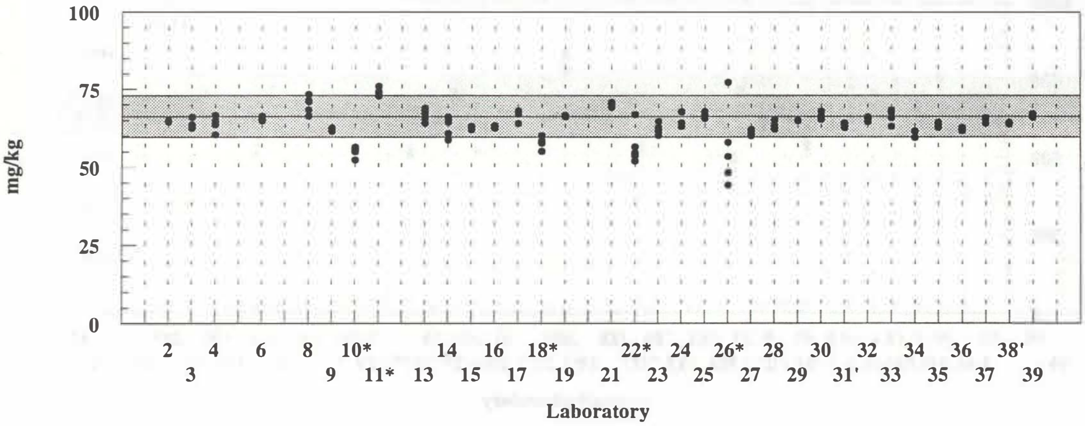


COPPER

NIST SRM 1566a

Certified value = 66.3 ± 4.3(6.6) mg/kg

Results: 34 Quantitative Results: 34 Rejections: 5



No Youden Plot for Copper in Sediments

No Youden Plot for Copper in Tissues

Results for Cu in the sediment sample are comparable to the good performance of last year. An apparent improvement may only be due to the increased Cu concentration. The calculated CI is ± 12 percent and the rejection rate is 3 percent. There was only 1 outlier, high. All 34 of the sets are within 20 percent of the accepted value. Results for Cu in BCSS-1 are also similar to last year. There are 6 rejections, 5 low. Four of these were from labs which did not use HF.

Results for Cu in the tissue sample are also comparable to the good performance of last year. The CI is ± 15 percent with 30 labs (89%) yielding results within 20 percent of the accepted value. There were only 5 rejected sets, 3 high, with no apparent relationship between "success" and methodology. Results for SRM 1566a are again similar to last year's.

We probably can not expect much better performance for the analysis for Cu in the future.

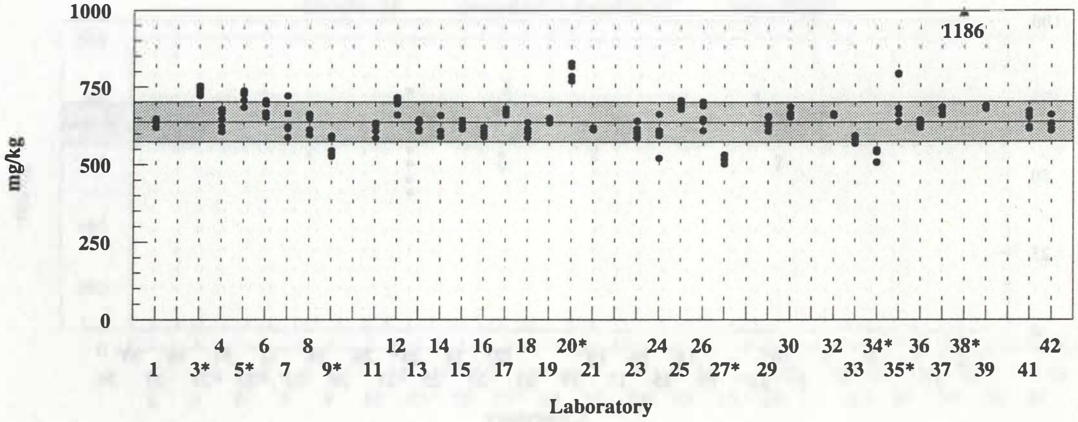
There are no Youden plots because of the disparities in the concentrations of the samples and the CRMs.

ZINC

Sediment Y

Accepted value = 638 ± 48(64) mg/kg

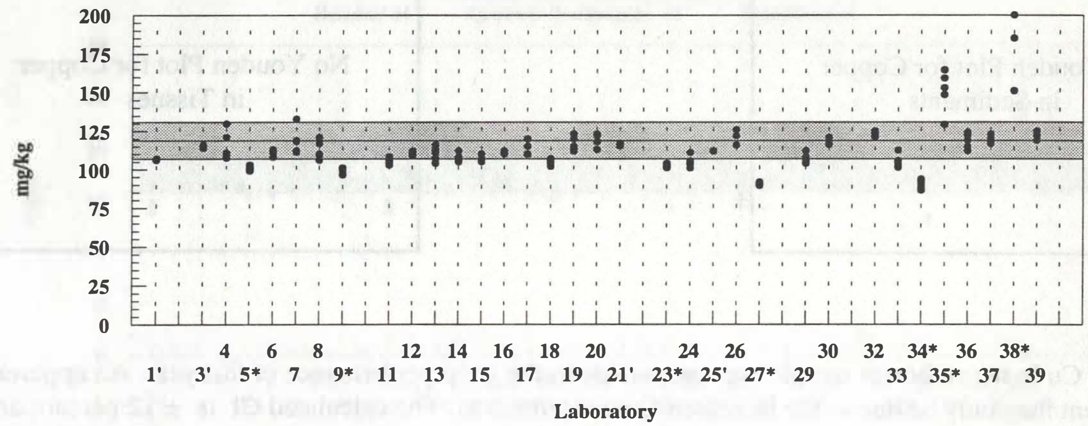
Results: 36 Quantitative Results: 36 Rejections: 8



BCSS-1

Certified value = 119 ± 12 mg/kg

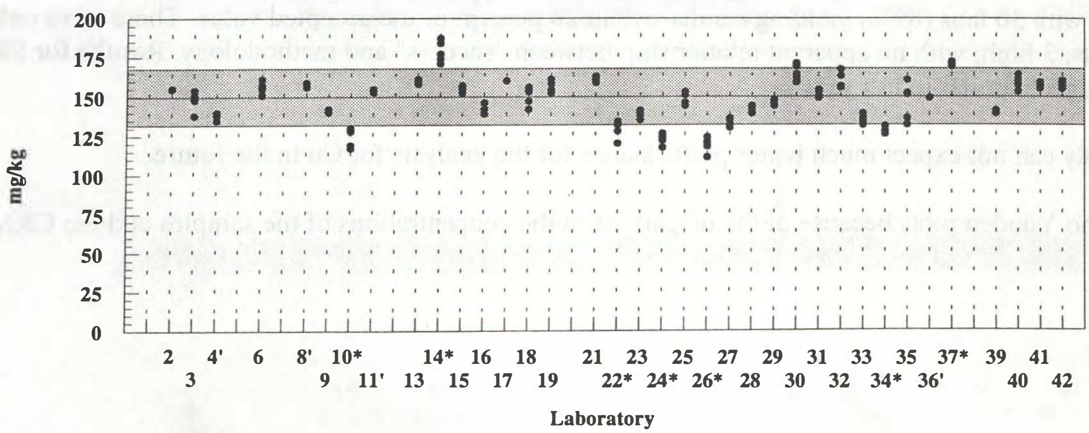
Results: 34 Quantitative Results: 34 Rejections: 7



Tissue Z

Accepted value = 150 ± 18 mg/kg

Results: 36 Quantitative Results: 36 Rejections: 7

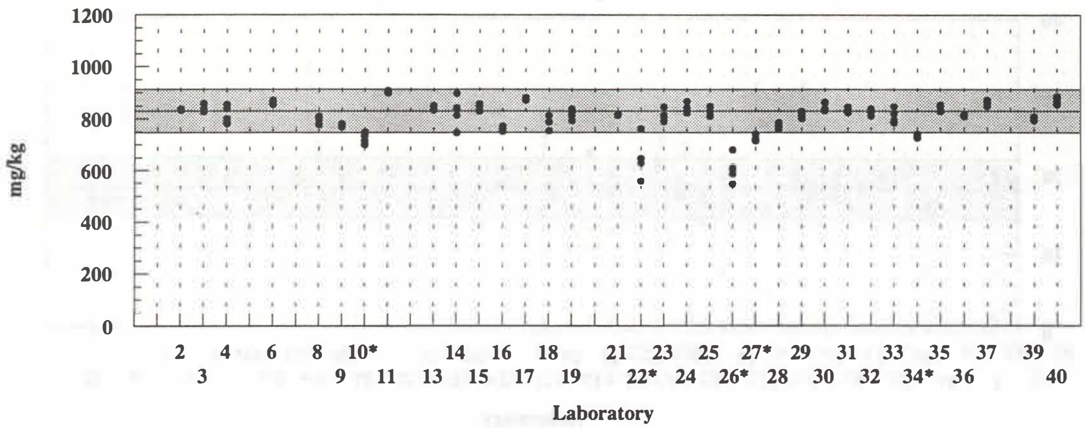


ZINC

NIST SRM 1566a

Certified value = 830 ± 57(83) mg/kg

Results: 34 Quantitative Results: 34 Rejections: 5



No Youden Plot for Zinc in Sediments

No Youden Plot for Zinc in Tissues

The previous improvement for zinc in the sediment samples is apparently maintained in NOAA/10. The calculated CI for Zn in Sediment Y is ± 8 percent with 32 sets (94%) within 20 percent of the accepted value. There were 8 outliers from 34 submissions, 4 high, 4 low. Seven sets were rejected for BCSS-1. Three of these labs did not use HF.

Also, the significant improvement in the determination of Zn in the tissues was again maintained. The calculated CI is ± 12 percent. Seven of 34 submitted results were rejected for Tissue Z, 6 low. Of the 7 rejections 4 measurements were made by ICPAES, 2 by ICPMS and 1 by FAAS. All 34 sets were within 20 percent of the accepted value. The acceptable range for Zn in SRM 1566a has been increased to ± 10 percent from the certified range of ± 7 percent. Five of the 34 results were rejected.

As with Cu, we probably can not expect much better performance for the analysis for Zn in the future.

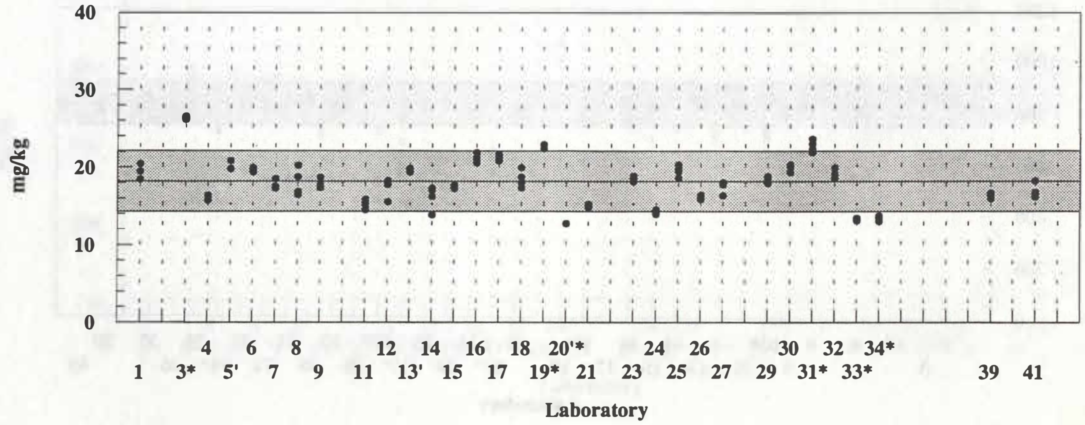
There are no Youden plots because of the disparities in the concentrations of the samples and the CRMs.

ARSENIC

Sediment Y

Accepted value = 18.2 ± 3.9 mg/kg

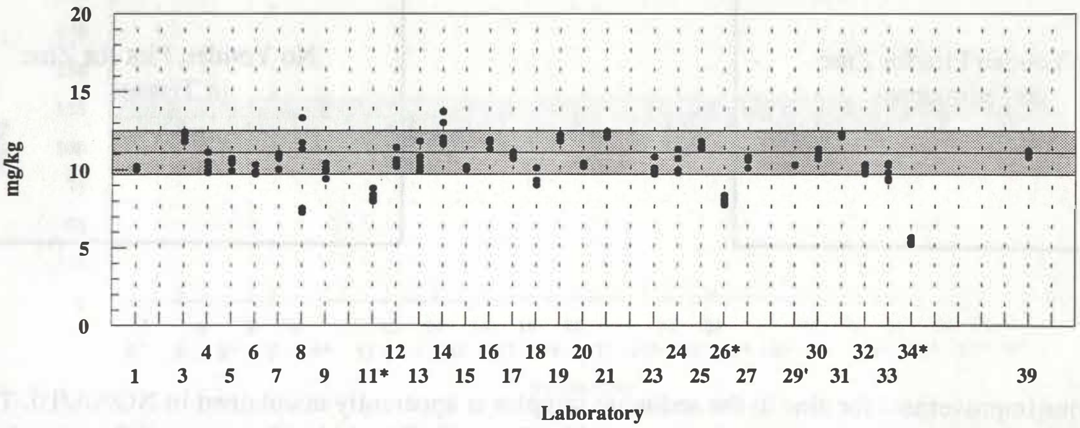
Results: 32 Quantitative Results: 32 Rejections: 6



BCSS-1

Certified value = 11.1 ± 1.4 mg/kg

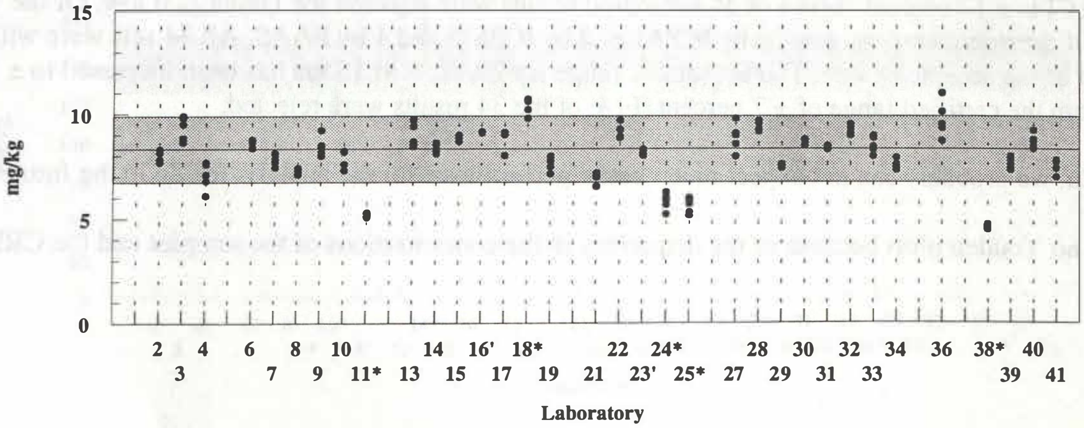
Results: 31 Quantitative Results: 31 Rejections: 3



Tissue Z

Accepted value = 8.31 ± 1.58 mg/kg

Results: 34 Quantitative Results: 34 Rejections: 5

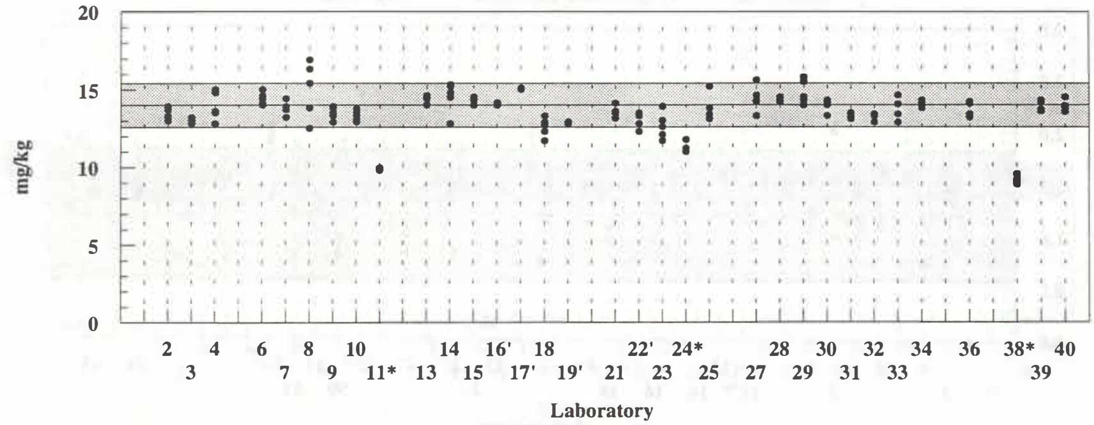


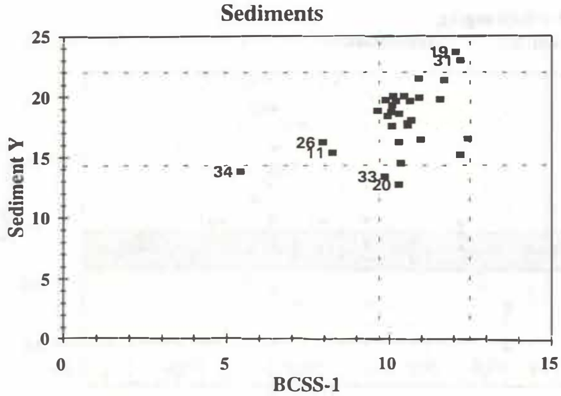
ARSENIC

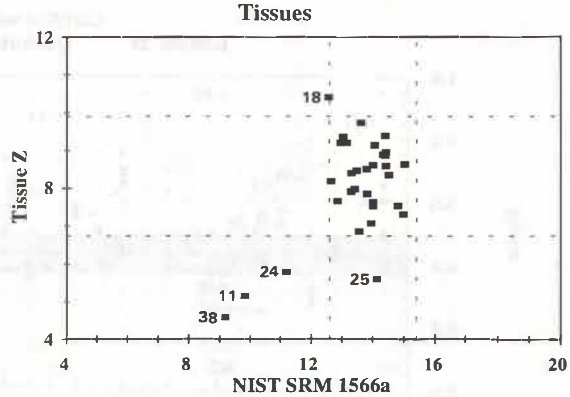
NIST SRM 1566a

Certified value = 14.0 ± 1.2(1.4) mg/kg

Results: 33 Quantitative Results: 33 Rejections: 3







The improvement of last year for As in sediments has continued. The calculated CI for arsenic in Sediment Y is ± 21 percent. Twenty-five sets (80%) were within 20 percent of the accepted value. There were only 6 outliers from 31 submissions. Of the 6, 3 used HGAAS. Performance for the CRM BCSS-1 was good. There were only 3 outliers. The Youden plot displays a tendency to systematic errors. The small but steady improvement since NOAA/5 continues but the group accuracy remains disappointingly low when compared to other common trace metals.

There is apparent improvement regarding the analysis of tissues for As. The CI is ± 19 percent with 28 of sets of results (85%) within 20 percent of the accepted value. There were only 5 outliers, 4 low. Of these, 3 were measured by GFAAS and 2 by ICPAES. These low results are probably due to either incomplete digestion of the organoarsenic species, calibration difficulties, or the As may be lost in the their digestion procedure. Results for SRM 1566a are improved with only 3 of 33 results (9%) rejected. The Youden plot displays a tendency to systematic errors for those with low results (incomplete digestion, analyte loss, calibration).

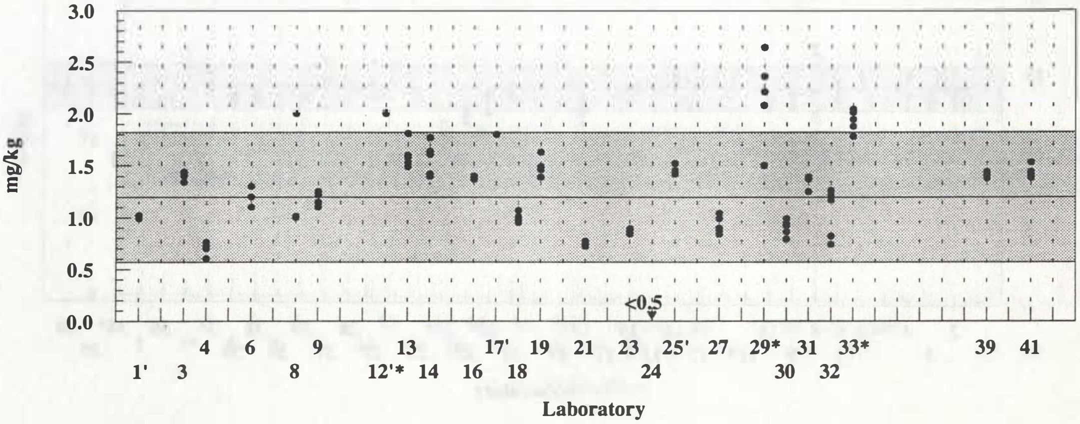
Arsenic is an analyte which requires attention in both biologicals and sediments.

SELENIUM

Sediment Y

Accepted value = 1.20 ± 0.63 mg/kg

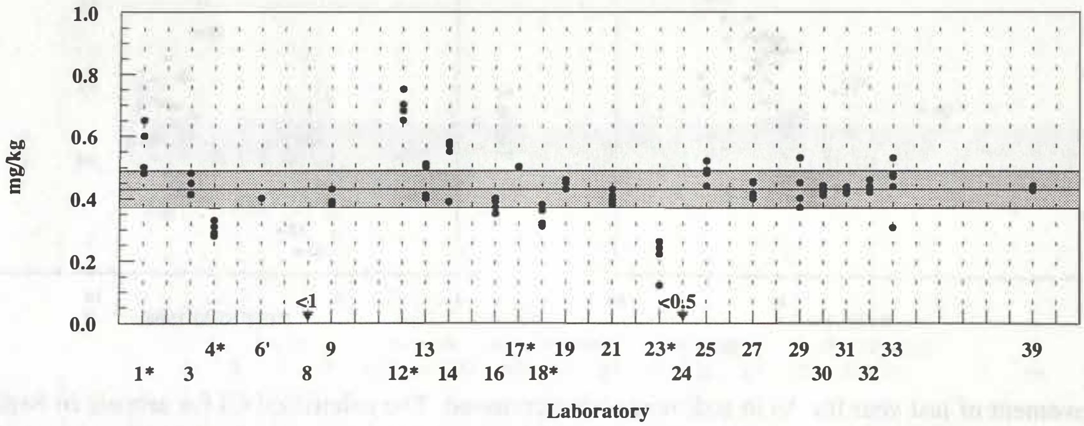
Results: 25 Quantitative Results:24 Rejections: 3



BCSS-1

Certified value = 0.43 ± 0.06 mg/kg

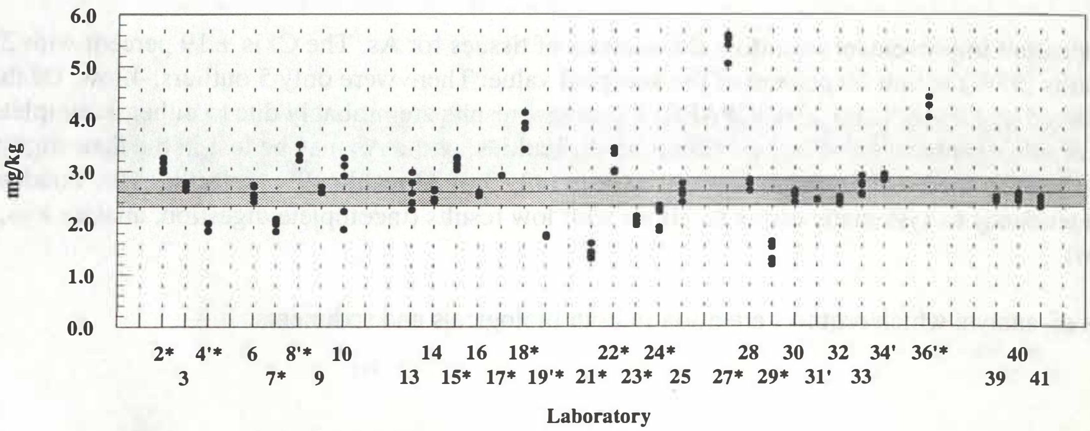
Results: 24 Quantitative Results: 22 Rejections: 6



Tissue Z

Accepted value = 2.59 ± 0.26 mg/kg

Results: 32 Quantitative Results: 32 Rejections: 15

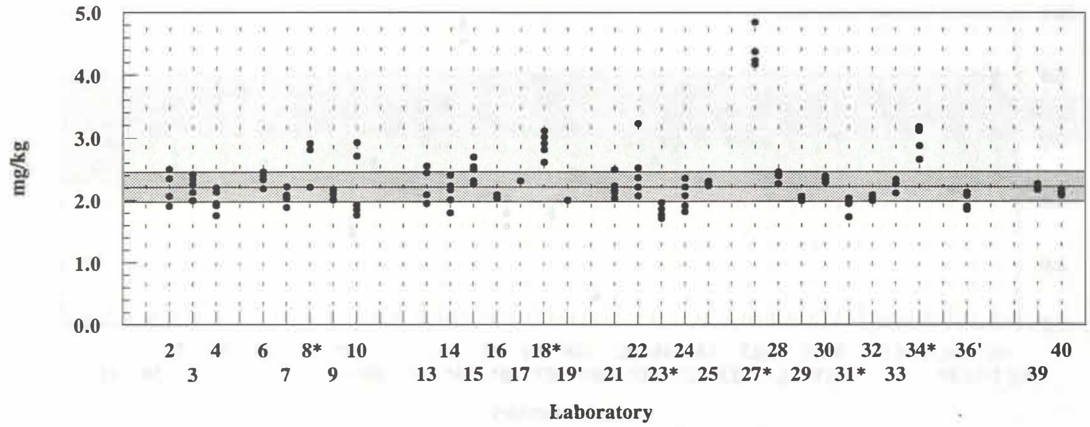


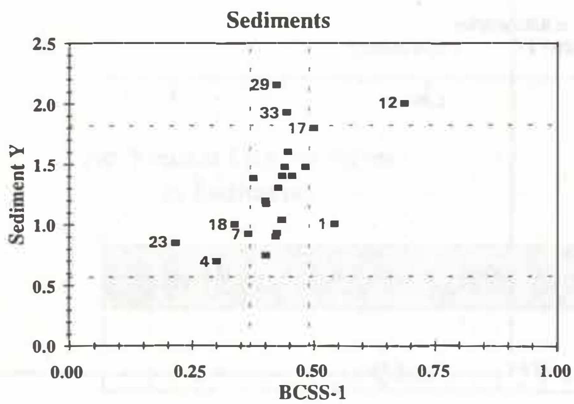
SELENIUM

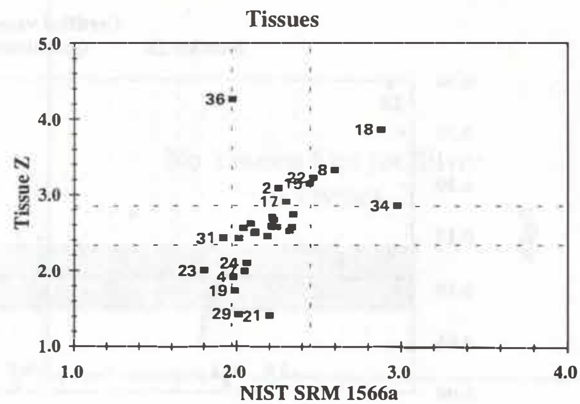
NIST SRM 1566a

Certified value = 2.21 ± 0.24 mg/kg

Results: 31 Quantitative Results: 31 Rejections: 6







The analysis of sediments for Se remains difficult for a large number of labs. The improvement noted last year has apparently disappeared. The calculated CI for Se in Sediment Y has significantly increased to ± 53 percent this year from ± 35 percent last year. Only 10 sets from 24 submissions (42%) were within 20 percent of the accepted value (down from 70%). There is no apparent relationship between "success" and methodology. Lab 29 possibly has a mathematical problem. Results for BCSS-1 are comparable to those of previous years with 6 of 22 results rejected. The Youden plot displays a tendency to random errors.

On the other hand, the CI for Se in tissues has dropped continuously over the last 6 years but the analysis still remains a problem for many labs. The calculated CI for Se in Tissue Z has dropped to ± 10 percent this year from ± 27 percent last year and ± 42 percent in 1991. Twenty sets from 31 submissions (65%) were within 20 percent of the accepted value. There were 15 outliers, 7 high. Lab 27 possibly has a arithmetical problem. There is no apparent relationship between "success" and methodology. Results for SRM 1566a are somewhat better than in previous years. The proportion of acceptable results increased to 87 percent of the 31 submitted results. The Youden plot indicates systematic errors.

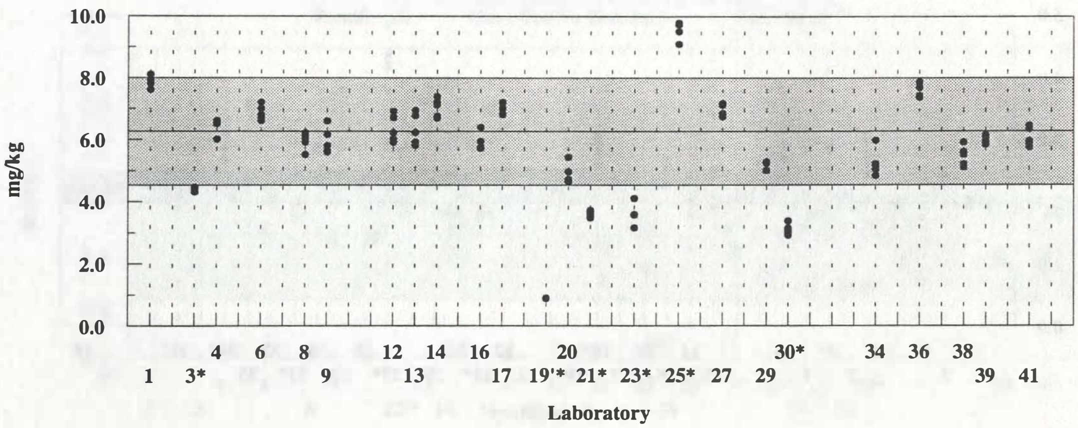
Selenium, like arsenic, is an analyte which requires attention.

SILVER

Sediment Y

Accepted value = 6.26 ± 1.72 mg/kg

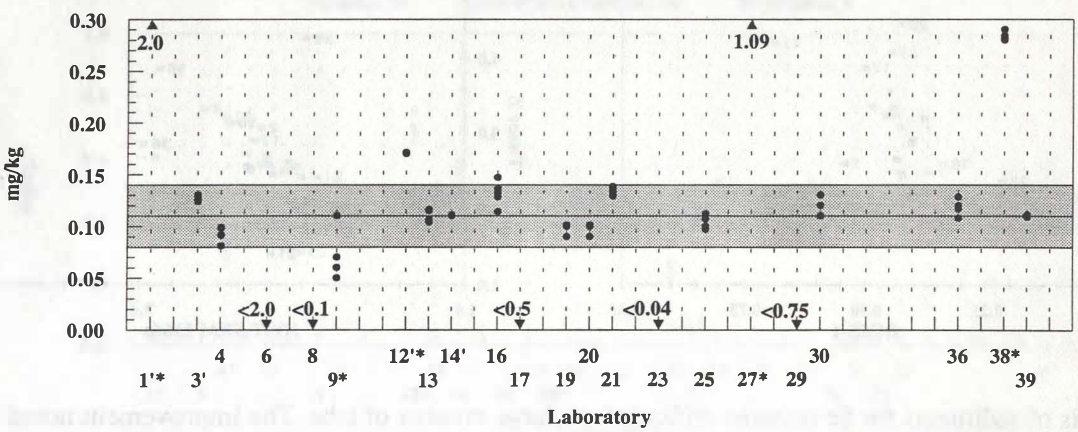
Results: 24 Quantitative Results: 24 Rejections: 6



BCSS-1

Certified value = 0.11 ± 0.03 mg/kg

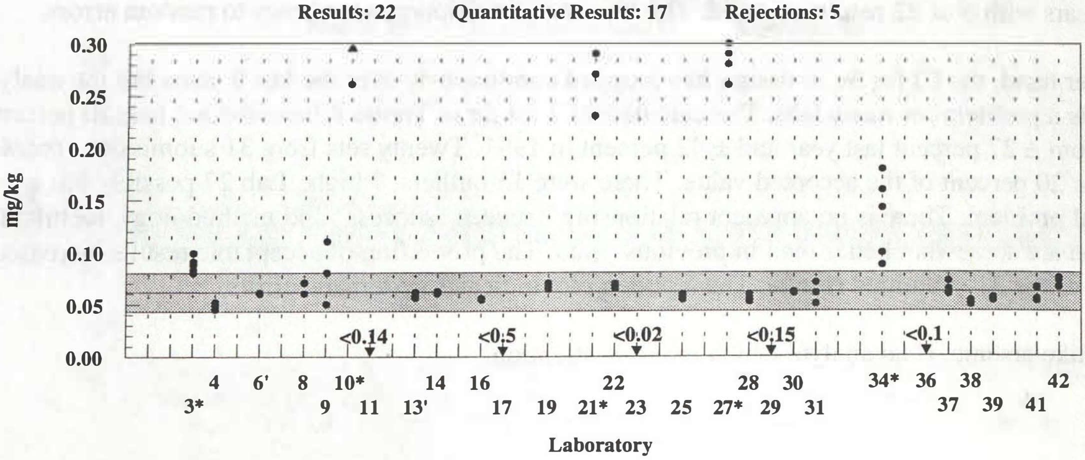
Results: 22 Quantitative Results: 17 Rejections: 5



Tissue Z

Accepted value = 0.062 ± 0.018 mg/kg

Results: 22 Quantitative Results: 17 Rejections: 5

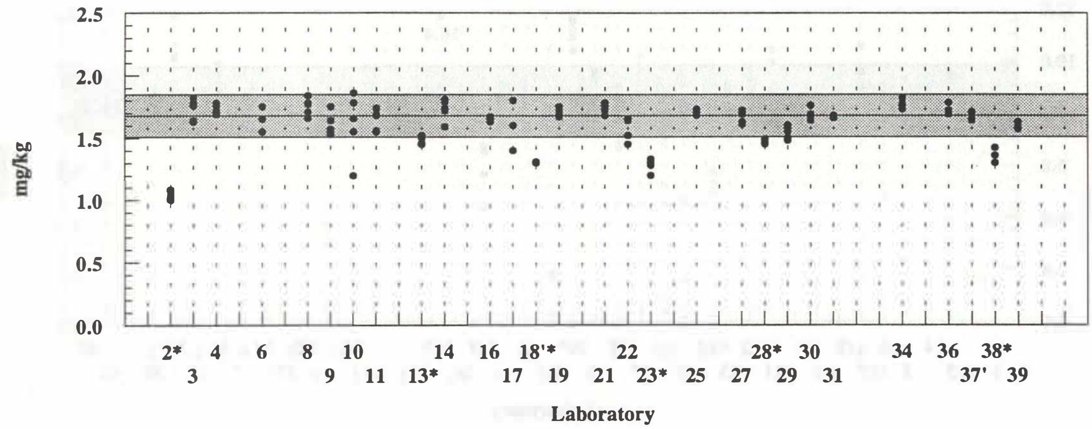


SILVER

NIST SRM 1566a

Certified value = 1.68 ± 0.15(0.17) mg/kg

Results: 28 Quantitative Results: 28 Rejections: 6



No Youden Plot for Silver in Sediments

No Youden Plot for Silver in Tissues

There is apparent improvement for the determination of Ag in sediments but it may only be due to the its relatively high concentration in Sediment Y. The calculated CI for Ag in Sediment Y is ± 27 percent. Fifteen sets from 23 submissions (65%) were within 20 percent of the accepted value. There is no apparent relation between measurement method and performance. The results for BCSS-1 are comparable to those of earlier years.

The results for Ag in Tissue Z are very good considering the low concentration of Ag. The calculated CI is ± 29 percent with sixteen sets from 21 submissions (76%) within 20 percent of the accepted value. There were 5 outliers, all high. There is no apparent relation between measurement method and performance. Results for the analysis of Ag in SRM 1566a have deteriorated. The rejection rate has risen to 21 percent from 11 percent last year.

The determination of silver in both matrices remains a problem for many labs.

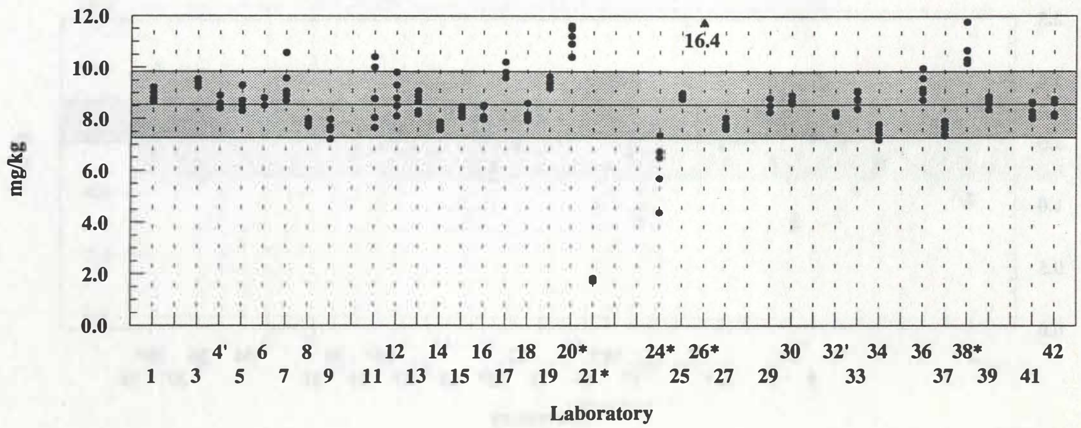
There are no Youden plots because of the disparities in the concentrations of the samples and the CRMs.

CADMIUM

Sediment Y

Accepted value = 8.55 ± 1.29 mg/kg

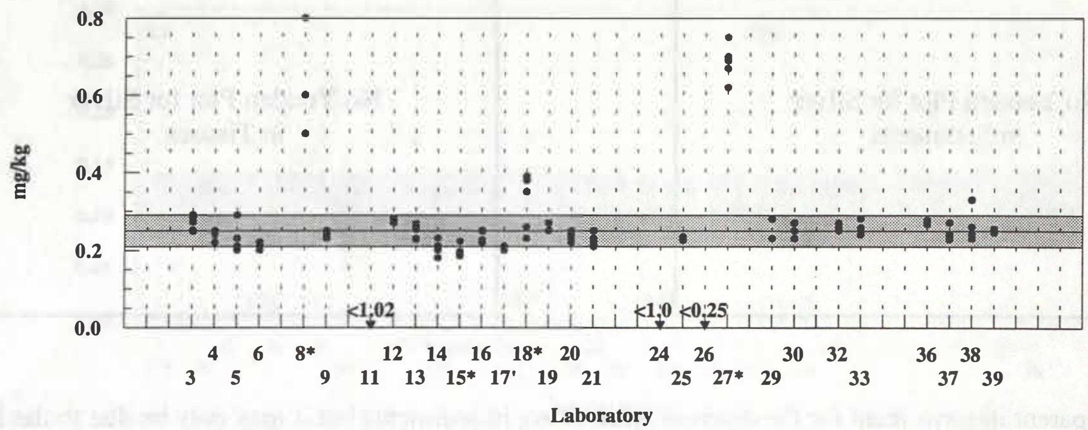
Results: 34 Quantitative Results: 34 Rejections: 5



BCSS-1

Certified value = 0.25 ± 0.04 mg/kg

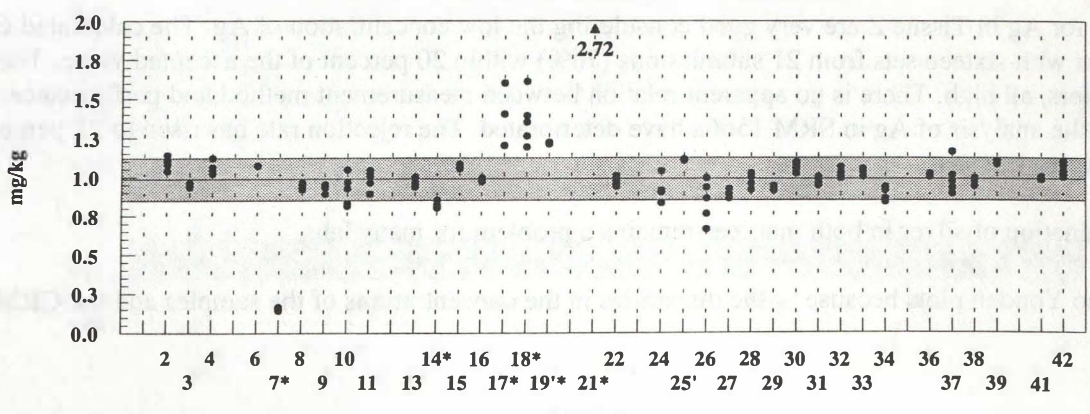
Results: 29 Quantitative Results: 29 Rejections: 4



Tissue Z

Accepted value = 0.99 ± 0.14 mg/kg

Results: 35 Quantitative Results: 35 Rejections: 6

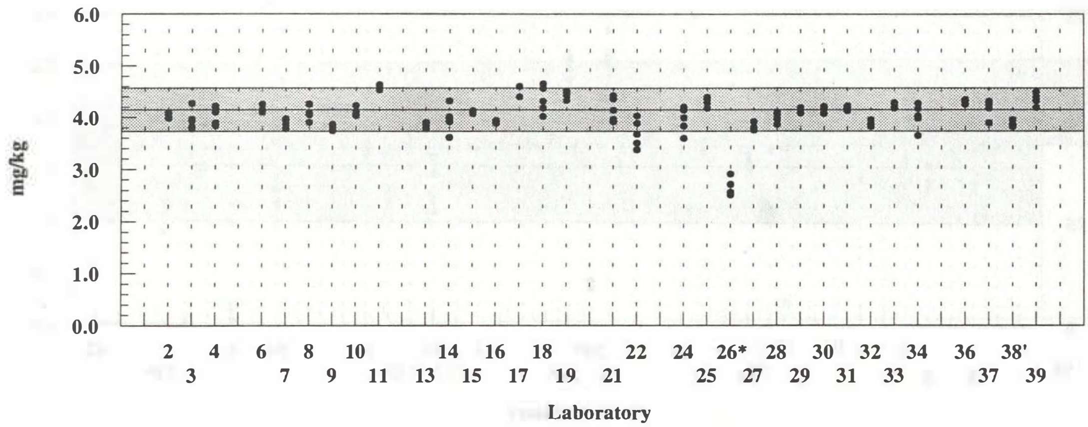


CADMIUM

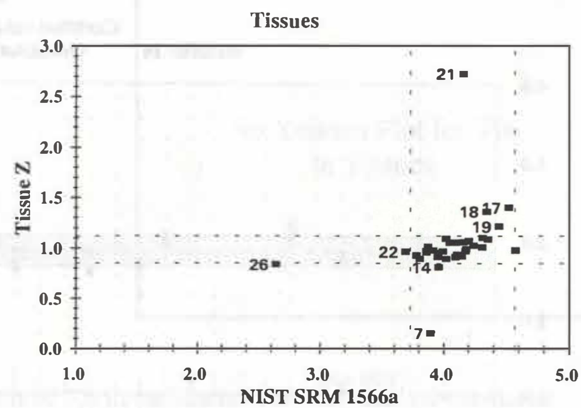
NIST 1566a

Certified value = 4.15 ± 0.38(0.42) mg/kg

Results: 33 Quantitative Results: 33 Rejections: 1



No Youden Plot for Cadmium in Sediments



The improvement of NOAA/8 and /9 results over earlier years for the determination of Cd in sediments has been maintained. The calculated CI for Cd in Sediment Y is ± 15 percent with 27 of the sets (84%) within 20 percent of the accepted value. There were only 5 outliers from 32 submissions, 3 high and 2 low. One-third of the accepted results were determined by GFAAS and all of the others almost equally by ICPMS, ICPAES and FAAS. Results for Cd in BCSS-1 are also improved. The proportion of acceptable results has risen to 84 percent from 79 percent last year. All but three of the 29 submissions are within 20 percent of the certified value.

Results for Cd in Tissue Z are somewhat improved over those of the past few years. The calculated CI for Cd is ± 14 percent with 28 of the sets (84%) within 20 percent of the accepted value. There were only 6 outliers in 33 submissions, 3 high and 2 low. The acceptance rate for SRM 1566a was 97 percent rising from 94 percent last year. Only one of the 34 submitted values was greater than 10 percent from the certified value. The Youden plot shows a tendency to systematic errors.

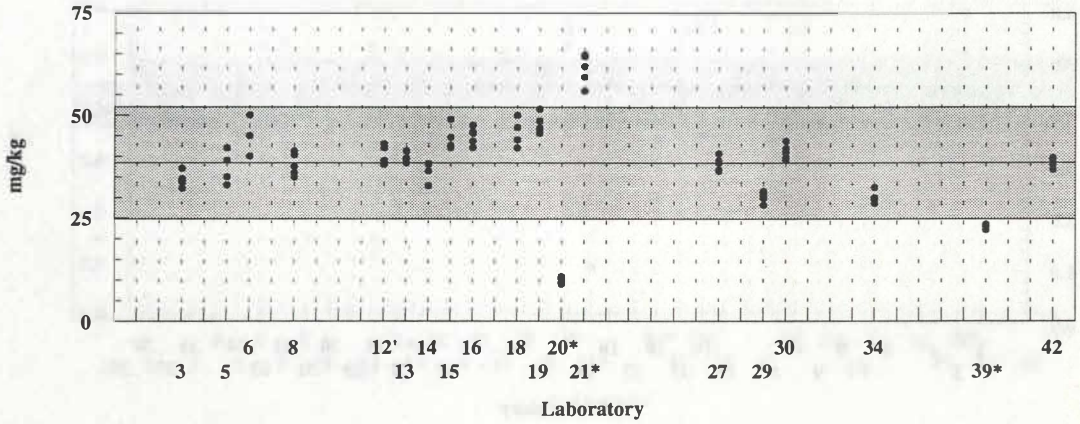
As with Cu and Zn, we probably can not expect much better performance for the analysis for Cd in the future.

TIN

Sediment Y

Accepted value = 38.4 ± 13.5 mg/kg

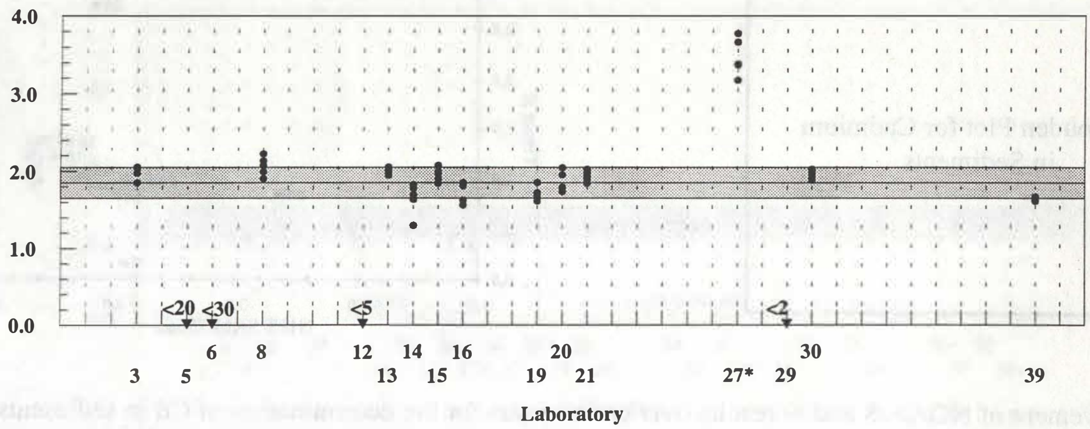
Results: 19 Quantitative Results: 19 Rejections: 3



BCSS-1

Certified value = 1.85 ± 0.20 mg/kg

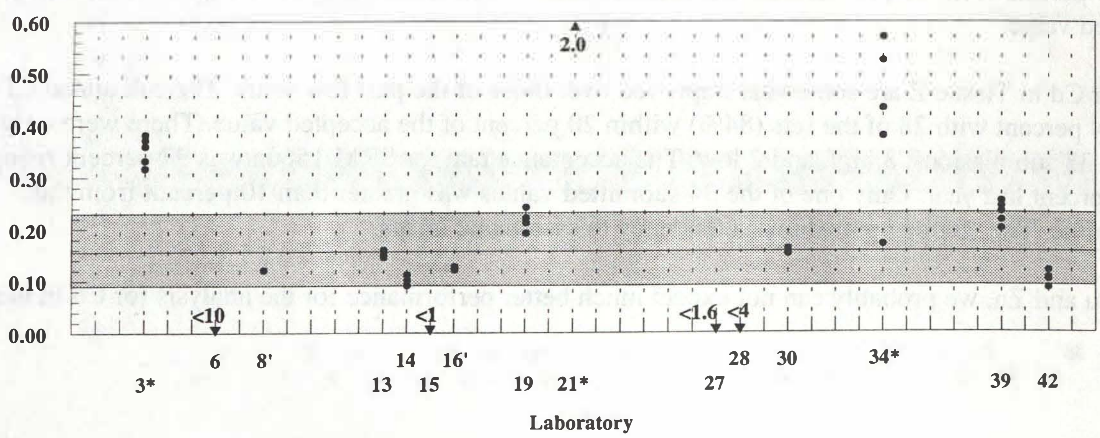
Results: 16 Quantitative Results: 12 Rejections: 1



Tissue Z

Accepted value = 0.16 ± 0.07 mg/kg

Results: 15 Quantitative Results: 11 Rejections: 3

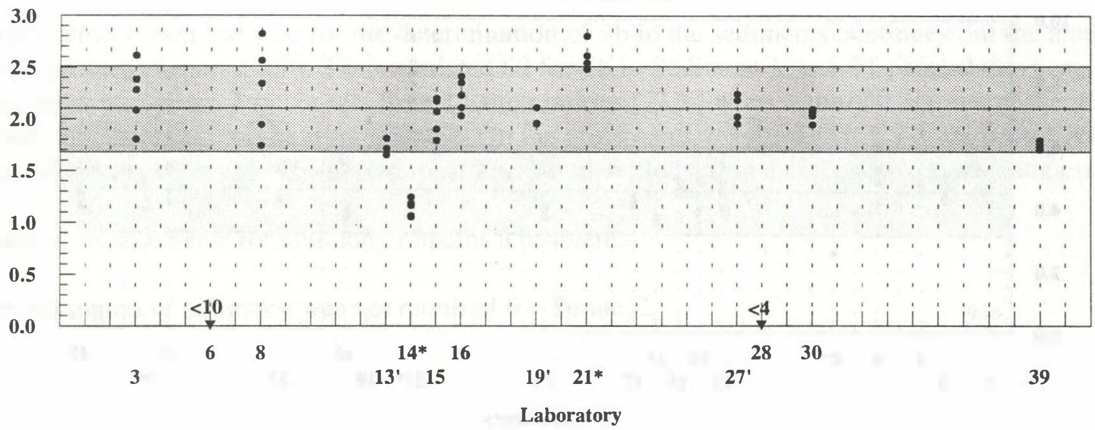


TIN

NIST SRM 1566a

Accepted value = 2.10 ± 0.42 mg/kg

Results: 13 Quantitative Results: 11 Rejections: 2



No Youden Plot for Tin in Sediments

No Youden Plot for Tin in Tissues

There was no apparent improvement for the determination of Sn in sediments and the analysis remains difficult for may labs. Less than half the participants attempt the analysis. The calculated CI for Sn in Sediment Y has risen to ± 35 percent this year from ± 26 percent last year, but the concentration of Sn is lower. Twelve sets from 18 submissions (61%) were within 20 percent of the accepted value. Three sets of results were rejected, 1 high, 2 low. Only 12 laboratories submitted quantitative results for Sn in BCSS-1 and all but 1 of them was within 11 percent of the certified value.

Neither was there improvement for the determination of Sn in the tissues. Only 10 laboratories submitted quantitative values for Sn in Tissue Z. The calculated CI for Sn in tissue was ± 44 percent this year from ± 37 percent last year but the concentration of the Sn was lower this year. Only 2 sets from the 10 submissions (20%) were within 20 percent of the accepted value. Three sets were rejected, all high. Six of the 8 acceptable results were obtained using ICPMS for the determination. The other 2 labs used GFAAS. There is a problem with inhomogeneity of Sn in SRM 1566a which NIST recognizes. SRM 1566a was treated as an unknown to obtain an accepted value. Eleven laboratories submitted quantitative values. There were 2 outliers. Nine of the submitted sets were within 20 percent of the accepted value. The predominant method of measurement was ICPMS.

Performance for Sn in the SRM 1566a is not included in the evaluation.

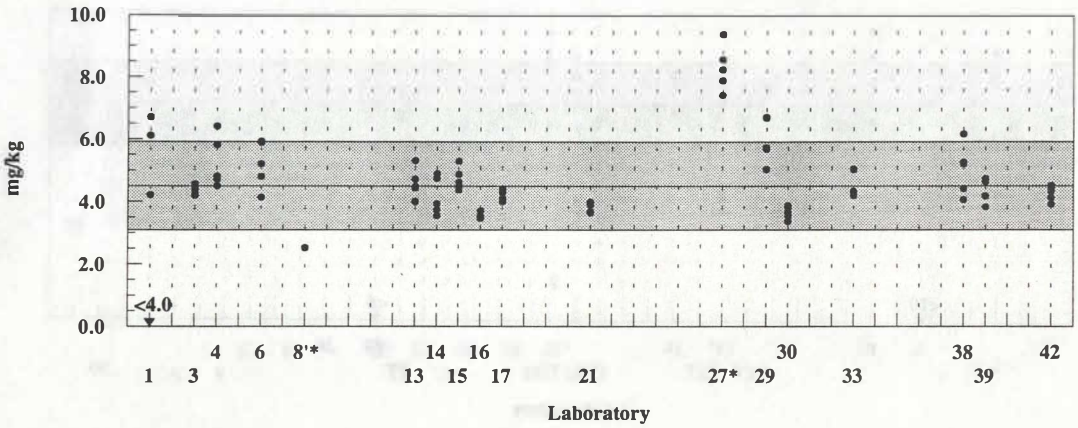
There are no Youden plots because of the disparities in the concentrations of the samples and the CRMs.

ANTIMONY

Sediment Y

Accepted value = 4.50 ± 1.40 mg/kg

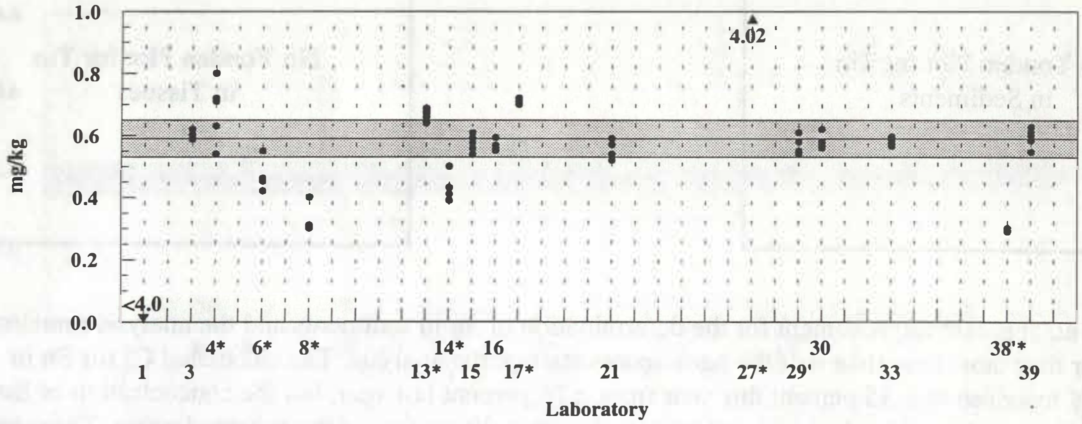
Results: 18 Quantitative Results: 17 Rejections: 2



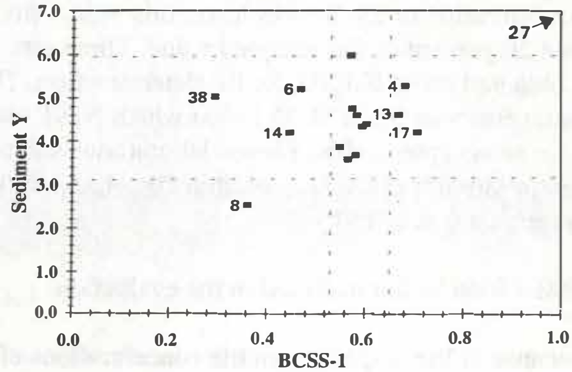
BCSS-1

Certified value = 0.59 ± 0.06 mg/kg

Results: 17 Quantitative Results: 16 Rejections: 8



Sediments



ANTIMONY

The improvement seen last year for the determination of Sb in the sediments continues but the analysis still remains a problem for most labs. The calculated CI for Sb in Sediment Y is ± 31 percent this year, about the same as in past years. Twelve sets from 17 submissions (71%) were within 20 percent of the accepted value and only 2 sets of results were rejected. On the other hand, results for BCSS-1 are not as good as last year with 8 rejections for 16 submissions. The Youden plot shows a tendency to systematic errors.

The analysis of sediments for antimony remains a problem.

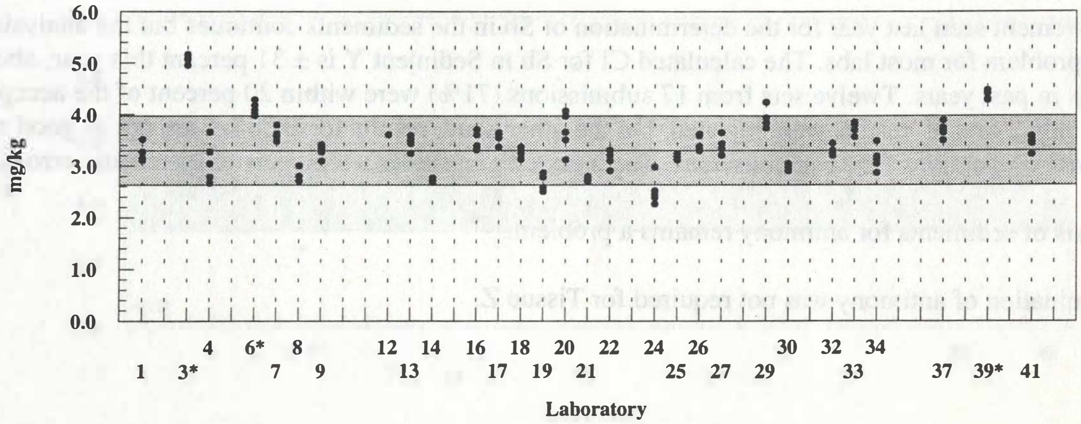
The determination of antimony was not required for Tissue Z.

MERCURY

Sediment Y

Accepted value = 3.30 ± 0.67 mg/kg

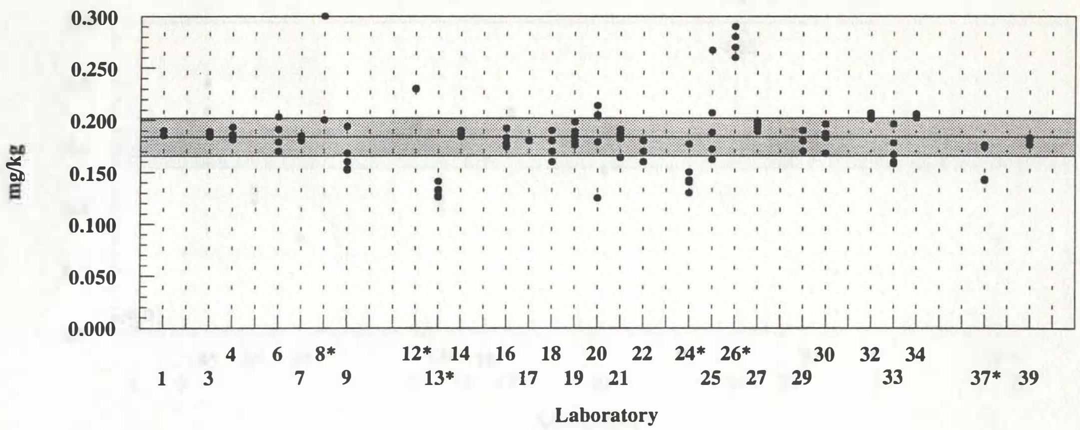
Results: 29 Quantitative Results: 29 Rejections: 3



BCSS-1

Accepted value = 0.184 ± 0.009(0.018) mg/kg

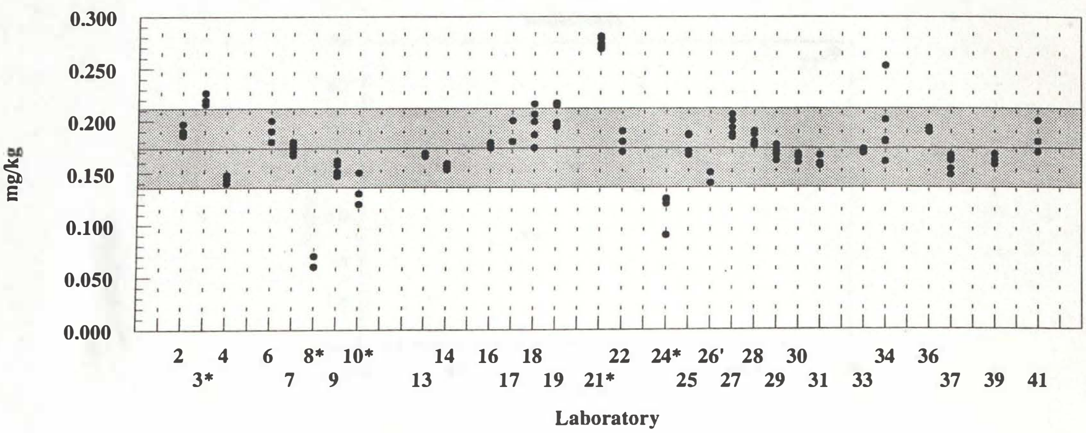
Results: 28 Quantitative Results: 28 Rejections: 6



Tissue Z

Accepted value = 0.174 ± 0.038 mg/kg

Results: 30 Quantitative Results: 30 Rejections: 5

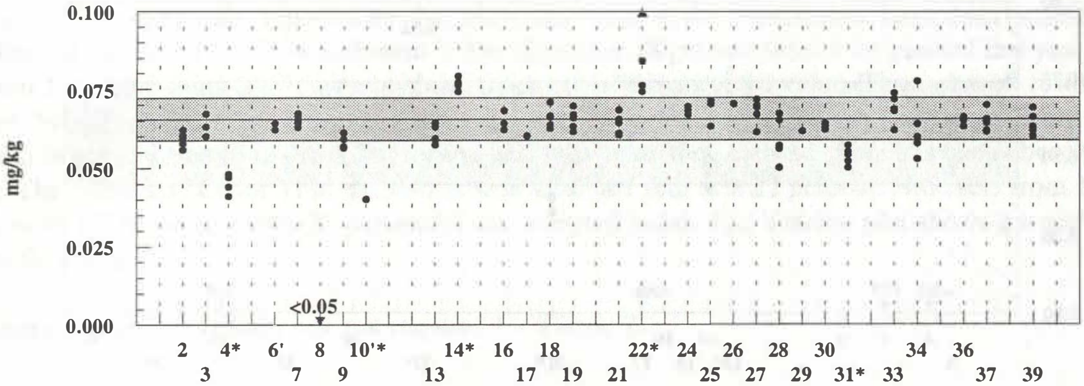


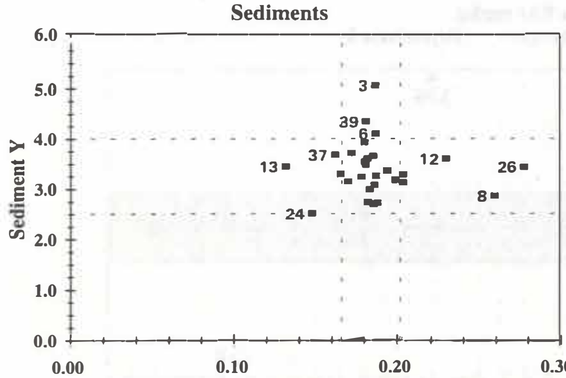
MERCURY

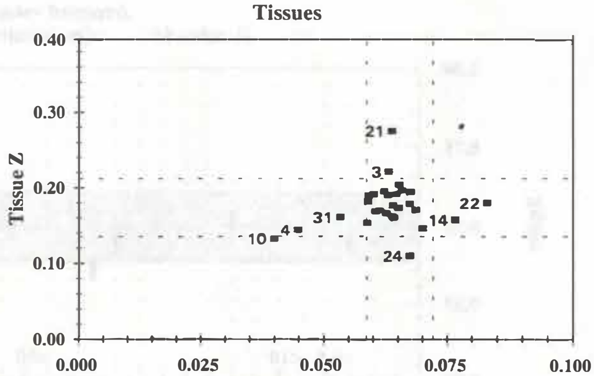
NIST SRM 1566a

Certified value = 0.0654 ± 0.0067 mg/kg

Results: 29 Quantitative Results: 28 Rejections: 5







The improvement in the determination of Hg in the sediments has again been maintained. The calculated CI for Hg in Sediment Y is ± 20 percent this year compared to ± 26 percent last year. Twenty-four sets from 28 submissions (86%) were within 20 percent of the accepted value. Only 3 sets of results were rejected, all high. Results for BCSS-1 also show improvement. The calculated CI for Hg in BCSS-1 is ± 5 percent this year, down from ± 13 percent last year. This was broadened to ± 10 percent for the evaluation. Twenty-three sets from 28 submissions (82%) were within 20 percent of the accepted value. There were 6 outliers, 3 high, 3 low. BCSS-1 is no longer certified for Hg, however, the accepted value has been close to 0.18 mg/kg for the past several years. The Youden plot shows a tendency to random errors.

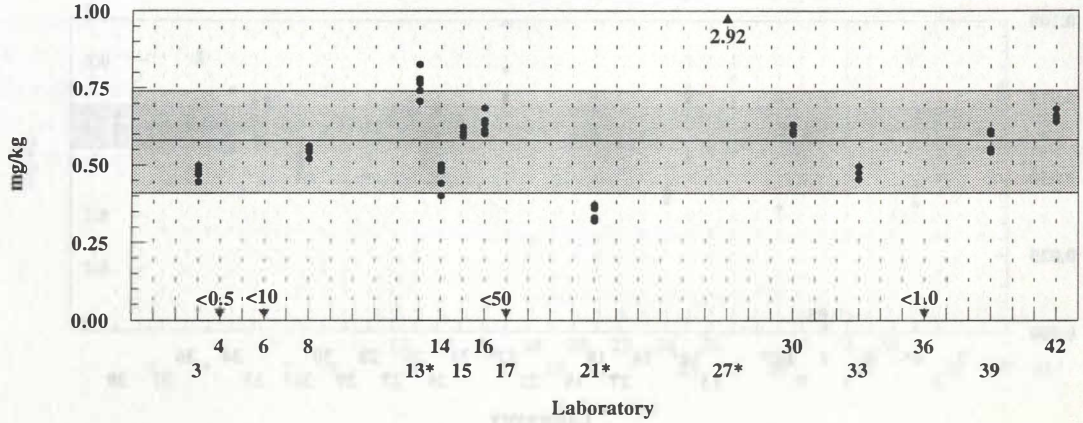
Results for the determination of Hg in the tissues are similar to last year. The calculated CI for Hg in Tissue Z is ± 22 percent, the same as last year. Twenty-five of the sets (86%) are within 20 percent of the accepted value. There were 5 outliers in 30 submissions. Performance for SRM 1566a also remains about the same. The Youden plot shows that random errors predominate.

THALLIUM

Sediment Y

Accepted value = 0.58 ± 0.16 mg/kg

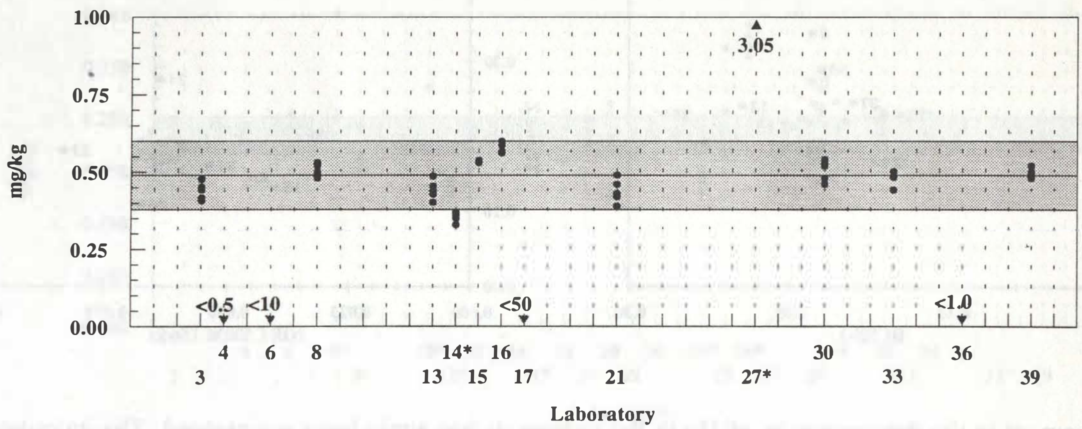
Results: 16 Quantitative Results: 12 Rejections: 3



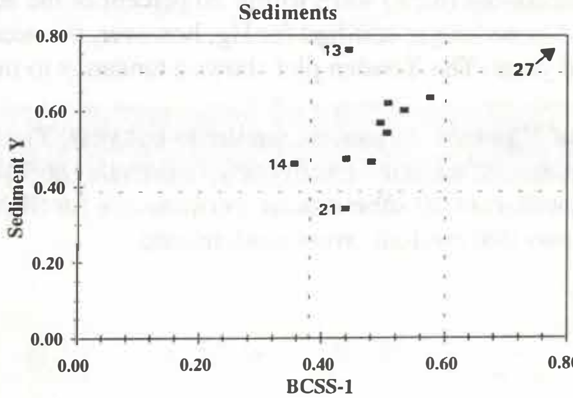
BCSS-1

Accepted value = 0.49 ± 0.11 mg/kg

Results: 15 Quantitative Results: 11 Rejections: 2



Sediments



THALLIUM

Results for Tl in sediments, reported by only about one-third of the participants, have deteriorated this year. The calculated CI for Tl in Sediment Y has risen to ± 28 percent from ± 16 percent last year. Eight sets from 12 submissions (72%) were within 20 percent of the accepted value. Three sets of results were rejected. Seven sets from the 9 accepted labs used ICPMS for the measurement. The other 2 used GFAAS. Thallium is not certified in BCSS-1 but for the past four years the accepted value has been about 0.5 mg/kg. The calculated CI for Tl in BCSS-1 is similar to last year at ± 22 percent. Nine sets from 11 submissions (81%) were within 20 percent of the accepted value. The Youden plot shows a tendency to systematic errors.

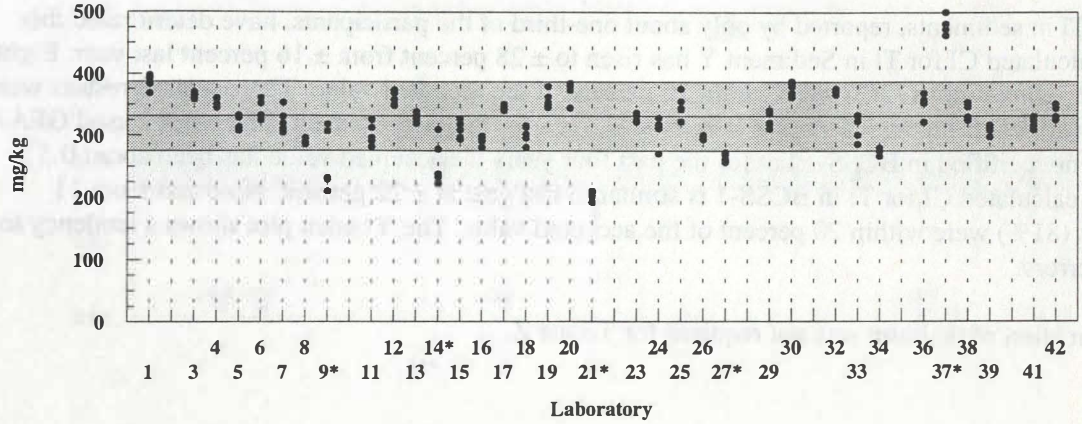
The determination of thallium was not required for Tissue Z.

LEAD

Sediment Y

Accepted value = 331 ± 56 mg/kg

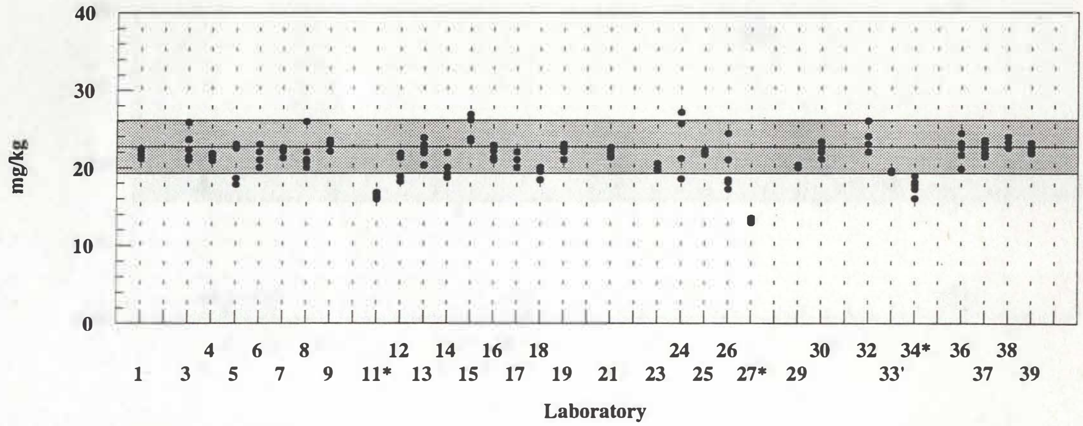
Results: 35 Quantitative Results: 35 Rejections: 5



BCSS-1

Certified value = 22.7 ± 3.4 mg/kg

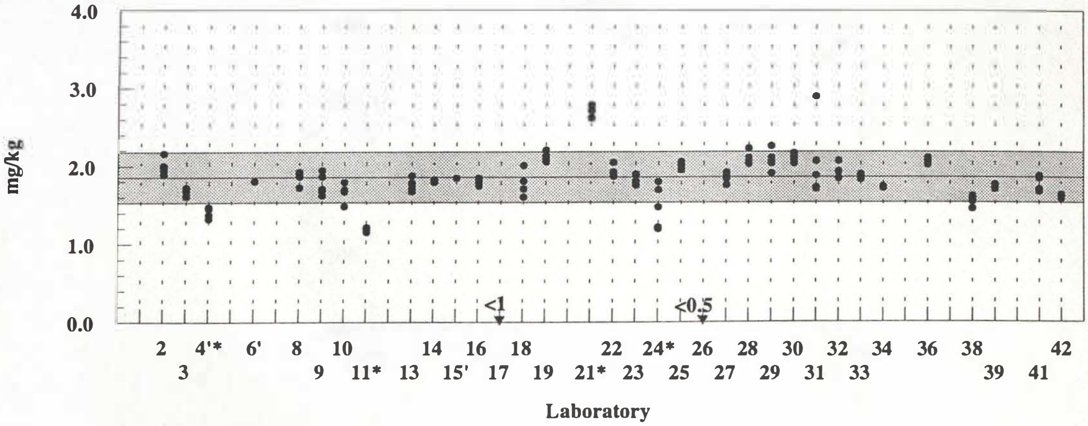
Results: 32 Quantitative Results: 32 Rejections: 3



Tissue Z

Accepted value = 1.85 ± 0.33 mg/kg

Results: 34 Quantitative Results: 32 Rejections: 4

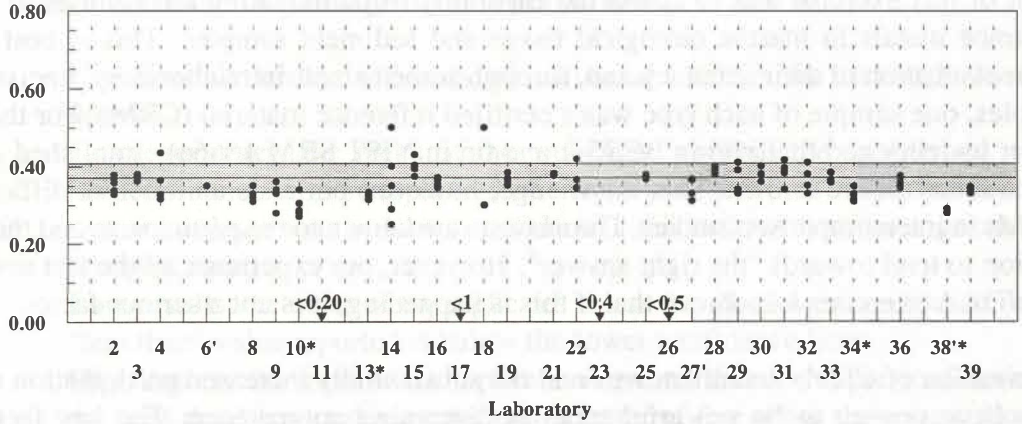


LEAD

NIST SRM 1566a

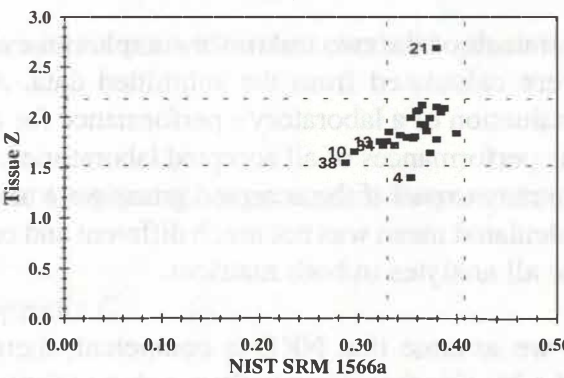
Certified value = 0.371 ± 0.014(0.037) mg/kg

Results: 31 Quantitative Results: 27 Rejections: 4



No Youden Plot for Lead in Sediments

Tissues



Performance for the determination of Pb in the sediments is not much different from last year. The calculated CI for Pb in Sediment Y is ± 17 percent with 28 of the sets (85%) within 20 percent of the accepted value. There were 5 outliers from 33 submissions, 1 high and 4 low. Performance for BCSS-1 is somewhat improved. Eighty-one percent of the submissions were within 15 percent of the certified value. There is still room for improvement.

The calculated CI for Pb in Tissue Z is ± 18 percent with 28 of the sets (93%) within 20 percent of the accepted value. This is down 2 percent from last year in spite of the lower concentration of Pb in Tissue Z. There were only 4 outliers, (1 high, 3 low) all from labs which used GFAAS to measure the Pb. The acceptable CI for Pb in SRM 1566a was increased to ± 10 percent for the evaluation. The performance was similar to last year's. There were 4 outliers for the CRM. All but 2 of the submissions were within 18 percent of the certified value.

3. DISCUSSION

The intent of this exercise was to assess the capability of participating laboratories to determine selected trace metals in marine biological tissue and sediment samples. This is best measured through an evaluation of their accuracy and, through some extent, intralaboratory precision. Of the four samples, one sample of each type was a certified reference material (CRM). For these CRMs (except for mercury and thallium in BCSS-1 and tin in NIST SRM 1566a) established means and confidence intervals are known. This knowledge, however, portends an inherent difficulty when using CRMs in intercomparison studies. The answers are known to the participants and there is often a inclination to tend towards "the right answer". However, our experience of the last several years with the NOAA exercises has shown that if this is happening, it is not a serious factor.

The combination of CRMs and unknowns and the substantially increased participation of the last few years have proven to be powerful tools in discerning competence. The key factor, which characterizes and is almost unique to the NOAA exercises, is the provision of 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. An implication of this approach is that the accuracy evaluation of a laboratory's performance for a particular analyte in a particular matrix is relative to the performances of all accepted laboratories. Thus we get an indication of the type of comparability we may expect if the accepted group were to analyze similar materials. In all cases in this study the calculated mean was not much different and certainly not significantly different from the NRC means for all analytes in both matrices.

If we assume that NRC is competent, there also appears to always be a group of participating laboratories that are equally competent for various analytes in the particular matrices and, if there are sufficient data, an accurate mean can be established along with an appropriate 95 percent confidence interval. There was no instance where a mean could be calculated that the mean was significantly different from the NRC result.

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

A system to evaluate laboratory performance for the individual elements in the 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, or a "less than" value has been reported that is not less than the lower confidence limit and not five times greater than the accepted mean.
- **L** - **Low results**: the mean of the replicates is less than the lower confidence limit or the "less than" value reported is below the lower confidence limit.
- **H** - **High results**: the mean of the replicates is greater than the upper confidence limit or the "less than" reported is greater than a factor of five above the accepted or certified value.
- **G** - **Good precision**: the intralaboratory precision is within the criteria for precision listed below in Table I.
- **X** - **Poor precision**: the intralaboratory precision is not within the criteria for precision listed below in Table I.
- **-** - No results.

Results from laboratories which did not submit at least 4 replicates for an analyte have not been evaluated.

Detailed charts of this assessment are tabulated in Appendix C.

The overall assessment is based on the number of sets rejected compared to the number of sets submitted. This evaluation allowed four distinct categories of accuracy performance to be discernible. These are shown in Table II (page 43) for the sediments and in Table VI (page 48) for the biological tissues. In general, **Superior** laboratories submitted results for most analytes within the 95 percent confidence intervals; **Good** laboratories submitted many results within the accepted range with a minimum number of outliers; **Fair** laboratories had some problems with certain elements or did not report results for a number of elements. Laboratories with a higher proportion of outliers or "less thans" compared to the number of acceptable results were categorized as **Others**. It should be noted that the dividing lines between the categories, especially between good and fair, are somewhat diffuse. The last three columns in Tables II and VI compare the number of laboratories in each category for the last five exercises.

An indication of the overall laboratory improvement that has occurred since these studies began was our decision to tighten the criteria used to evaluate intralaboratory precision (Table I) at the time of the NOAA/7 study in 1993. This more demanding standard reflected an improvement of procedures and instrumentation compared to the previous NOAA exercises.

Table I

Criteria for Intralaboratory Precision Evaluation

Sample	Expected RSD
Tissues	± 10 percent
Sediments	± 10 percent*

* ± 5 percent for aluminum, silicon and iron in sediments

When evaluating precision we cannot ignore that there is some probability that the sample is inhomogeneous. We assume that this would generally be more prevalent in the unknown samples which are not as rigorously processed as the CRMs. The certificate for NIST SRM 1566a acknowledges evidence of tin inhomogeneity in this CRM, which appears to be confirmed by the data (pp 30-31). The overall rating for the laboratories shown in Table VIII ignores the results for tin in SRM 1566a.

A similar evaluation for intralaboratory precision based on the criteria of Table I produced two categories: **Good** and **Fair** (Tables III and VIII).

Sediments

Table II shows the overall assessment for the sediments based on the number of quantitative results submitted and the number of rejected means. A listing of this evaluation over the past six years (using this years laboratory designation) is tabulated in Table IV on page 44. BCSS-1 has been used as the sediment CRM since NOAA/5 and Table V (page 45) lists the performance of the individual laboratories for this CRM over six years.

Only two laboratories reported sediment results for the first time, unlike previous years when typically eight or ten new laboratories participated. Of the thirty-three laboratories that submitted sediment data for both NOAA/9 and NOAA/10, fourteen (1,6,8,11,12,14,15,21,24,25,32,35,36,38) improved their ratings and the remaining nineteen stayed the same. Of these nineteen laboratories, fourteen of were in either the superior or good category. Remember that the rating is relative, and as the group as a whole improves the individual laboratory also must improve in order to retain its former position. Three of the laboratories in the superior category (13,19,39) are veterans which have analyzed biological tissues and sediments in at least six previous NOAA exercises.

Table II

Accuracy Evaluation for the Sediments*

	Laboratory Number	NOAA Intercomparison					
		/10	/9	/8	/7	/6	/5
Superior	3,6,8,12,13,14,15,16, 17,19,21,29,30,32,39	15	8	11	8	5	3
Good	1,4,5,7,9,11,20,24, 25,33,36,37	12	15	13	12	11	7
Fair	18,22,26,31,35,38	6	10	8	12	5	7
Others	23,27,34	3	7	8	10	7	6
Total		36	40	40	42	28	23

*Laboratories 2, 10 and 28 did not report results for the sediments

Table III

Intralaboratory Precision Evaluation for the Sediments

	Laboratory Number
Good	1,3,4,5,6,7,9,11,12,13,14,15,16,17, 18,19,20,21,22,23,25,26,29,30,31, 32,33,34,35,36,37,38,39
Fair	8,24,27

There were 922 sets of results evaluated for the sediments for NOAA/10 compared 974 for NOAA/9, 991 sets for NOAA/8, 1004 sets for NOAA/7, 511 sets for NOAA/6 and 407 sets for NOAA/5. The rejection rates were respectively 185 (20%), 260 (27%), 264 (27%), 322 (32%), 125 (24%) and 128 (31%) sets.

There is still a good number of problems concerning the analysis of marine sediments for trace metals. At least twenty-five percent of the participants who analyzed the sample for the analyte produced a value more than ± 20% (5% for Al, Si and Fe) from the accepted value for following ten analytes: beryllium, aluminum, silicon, manganese, iron, arsenic, selenium, silver, tin and thallium. Part of this problem, especially with aluminum, silicon, manganese and iron is due to the fact that

Table IV

Comparison of Laboratory Performance for Sediments In Previous NOAA Intercomparisons

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

LAB	NOAA/10		NOAA/9		NOAA/8		NOAA/7		NOAA/6		NOAA/5	
	Sets	Rej	Sets	Rej	Sets	Rej	Sets	Rej	Sets	Rej	Sets	Rej
21	36	5	36	9	36	9	34	7	30	8	22	14
22	2	0	2	0					26	7	22	15
23	22	14	24	16								
24	26	8	28	15	28	6	24	18	26	13	25	14
25	24	1	18	7								
26	20	9	14	6	14	10	20	8	12	7		
27	34	22	32	21	24	14	24	13				
29	32	3	32	6	36	10	24	3				
30	32	1	32	1	32	0	30	3				
31	4	1	4	1	4	0	6	0				
32	26	1	26	3	26	1	24	3	26	2	20	4
33	24	3	20	4	14	9	2	0	16	7	16	7
34	25	18										
35	14	6	7	2								
36	18	1	22	8								
37	22	3							28	2	24	0
38	22	8	18	10								
39	34	3	34	3	30	2	30	2	28	1	24	2

SUPERIOR | GOOD | FAIR | OTHERS

Table V

Comparison of Laboratory Performance for BCSS-1 In Previous NOAA Intercomparisons

LAB	NOAA/10		NOAA/9		NOAA/8		NOAA/7		NOAA/6		NOAA/5	
	Sets	Rej	Sets	Rej	Sets	Rej	Sets	Rej	Sets	Rej	Sets	Rej
1	12	6	16	10								
3	18	0	18	1	9	2	14	0	14	0		
4	13	2	11	3	14	5	-	-				
5	15	1	12	2	9	4						
6	17	4	17	6	16	1	9	2				
7	10	0										
8	18	4	17	2	18	1	17	3				
9	12	4	12	2	11	2	11	0	9	4		
11	9	5	8	3	13	9	12	7	9	3	10	9
12	15	4	15	6	16	3						
13	18	2	18	2	18	0	18	1	15	2	12	3
14	17	2	17	2	15	3						
15	14	1	10	0	15	7	16	2	15	1	9	8
16	18	0	18	1	15	5	16	13	12	8		
17	16	2	16	1	0	-	3	2	0	-	0	-
18	13	7	18	9								
19	15	0	17	3	16	1	16	1	9	1	6	0
20	10	0	11	1	14	3	12	1	13	2	10	7

LAB	NOAA/10		NOAA/9		NOAA/8		NOAA/7		NOAA/6		NOAA/5	
	Sets	Rej	Sets	Rej	Sets	Rej	Sets	Rej	Sets	Rej	Sets	Rej
21	18	0	18	1	18	1	17	1	15	3	11	5
22	1	0	1	0								
23	11	7	12	11								
24	13	3	14	7	14	2	11	8	11	9	10	9
25	12	0	9	3								
26	10	6	7	3	7	5	10	7	6	6		
27	17	12	16	13	12	9	12	8				
29	16	2	16	5	18	6	12	2				
30	16	0	16	0	16	0	15	1				
31	2	0	2	0	2	0	3	0				
32	13	1	13	3	13	1	12	1	13	1	10	3
33	12	2	10	2	7	6	1	0	6	3	7	5
34	11	10										
35	7	3	0	0								
36	9	0	11	4								
37	11	1										
38	11	6	9	5								
39	17	1	17	1	15	0	15	0	14	0	12	1

Figure 1

Analytical Capability for Sediment Y

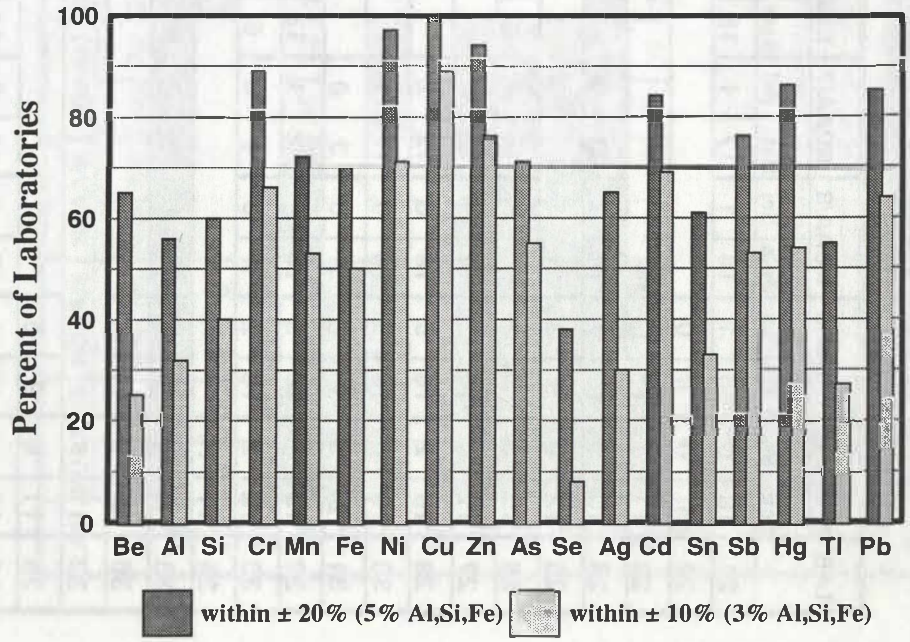
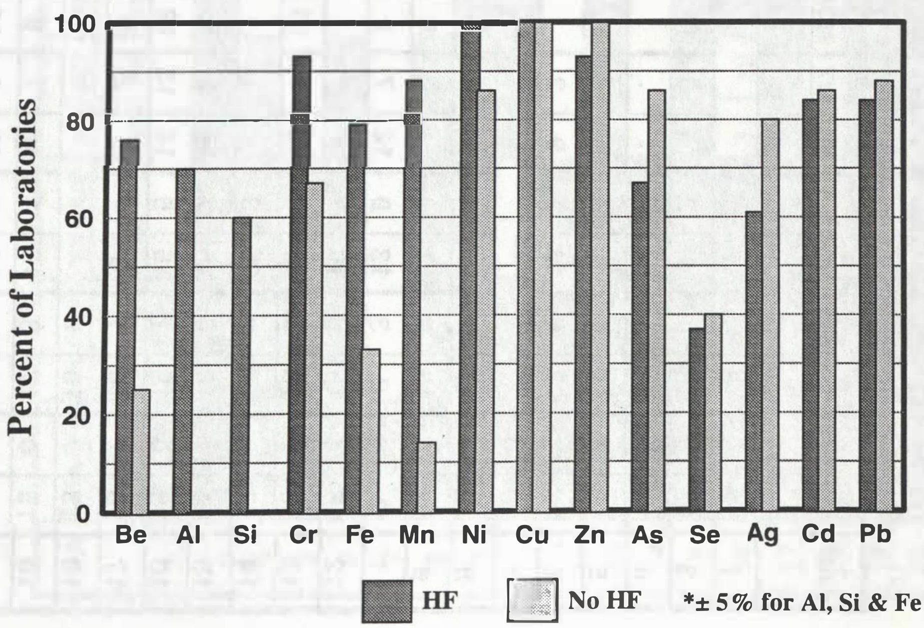


Figure 2

Use of HF in Sediment Y Decomposition
Laboratories Within ± 20%*



seven of the participants did not use hydrofluoric acid in their sediment decomposition procedures. Five of these laboratories ended up in either the fair or other categories. The other two were "good".

However, even for the group which uses hydrofluoric acid there are difficulties with seven analytes: aluminum, silicon, arsenic, selenium, silver, tin and thallium

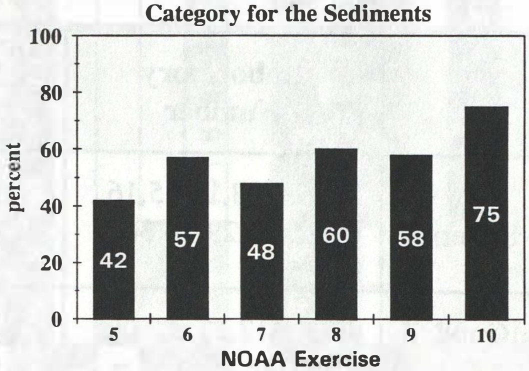
The analytical capability of the group as demonstrated in this exercise is shown in Figure 1 on page 46. This diagram shows the percentage of laboratories reporting values within 20 and 10 percent (5 and 3 percent for Al, Si and Fe) respectively of the accepted value for the analyte in Sediment Y. There is improvement for eleven of the eighteen (Be,Al,Cr,Fe,Ni,Cu,Zn,As,Ag,Sn,Hg) analytes.

The use of hydrofluoric acid in the sediment decomposition procedure has always been a topic of interest. Figure 2 is a comparison of the percent of laboratories using hydrofluoric acid within twenty percent of the accepted analyte value with those that did not. It is clearly evident that hydrofluoric acid is necessary for all analytes from beryllium to manganese. For analytes of higher atomic weight it doesn't seem to matter except in the case of arsenic and silver where the non-use of hydrofluoric acid appears to be beneficial. The latter results were also noted in last year's exercise but were only reported at the Quality Assurance Workshop in Silver Spring but not in the report for NOAA/9.

The overall categorization for the past six exercises is indicated in Figure 3. Relatively consistent performance occurred between NOAA/6 to NOAA/9. However, this year a sharp improvement is observed. Several factors could account for this. Hopefully, a major factor is an improvement in performance. The percentage of rejected results has decreased from 27 to 20 percent over the past year. Another consideration could be the fewer number of new participants which often end up in the lower categories. These, combined with the high trace metal content of Sediment Y resulted in three quarters of the laboratories rated in the superior or good categories.

Figure 3

Laboratories in the Superior and Good Category for the Sediments



Biological Tissues

Twenty-eight of the thirty-eight laboratories which submitted data for the tissues are in the superior and good categories. And, like last year, there were no laboratories in the "other" category. Four laboratories reported tissue data for the first time. Two of these were rated "good" and two were "fair".

Table VII (page 49) shows the number of submitted sets and the number of rejected means for the biological tissue samples over the six exercises from NOAA/5 to NOAA/10. Of the thirty-one laboratories that submitted tissue data for both NOAA/9 and NOAA/10 seven improved their ratings (all from good to superior) and two have slightly worse ratings (superior to good). Particular notice should go to laboratories 13, 30 and 39 with a consistently superior record over at least the last five years. Laboratories 2, 3, 8, 9, 19, 21, 25, 28 and 30 have been in the good or superior group for the past four years.

There were 712 sets of results evaluated for the tissues for NOAA/10, compared to 699 for NOAA/9, 771 for NOAA/8, 699 for NOAA/7, 368 for NOAA/6 and 317 sets for NOAA/5. The rejection rates were respectively 118(17%), 152 (17%), 143 (19%), 208 (30%), 99 (27%) and 93 (29%) sets.

Table VI
Accuracy Evaluation for the Biological Tissues*

	Laboratory Number	NOAA Intercomparison					
		/10	/9	/8	/7	/6	/5
Superior	2,3,6,9,13,14,15,16, 19,25,28,29,30,31, 33,36,39	17	13	15	8	7	4
Good	4,8,11,17,21,22,27, 32,37,38,40	11	15	13	14	9	8
Fair	7,10,18,23,24,26,34, 35	8	10	8	8	9	9
Others		0	0	6	8	5	5
Total		36	38	42	38	30	26

*Laboratories 1, 5, 12 and 20 did not report results for the tissues.

Table VII

Comparison of Laboratory Performance for Tissues In Previous NOAA Intercomparisons

LAB	NOAA/10		NOAA/9		NOAA/8		NOAA/7		NOAA/6		NOAA/5	
	Sets	Rej	Sets	Rej	Sets	Rej	Sets	Rej	Sets	Rej	Sets	Rej
2	21	2	20	4	18	5	20	4	22	6	23	14
3	23	3	23	3	10	1	20	7	24	8		
4	20	4	20	2	22	9	8	2				
6	23	2	23	3	22	1	8	1				
7	8	2										
8	23	6	23	4	24	1	26	8				
9	22	0	22	5	19	3	19	5	16	1		
10	22	10	22	9	18	1	19	7				
11	18	5	14	4	22	16	20	6	18	6	19	13
13	23	2	23	2	24	0	25	3	26	5	23	2
14	23	3	23	2	22	3						
15	19	2	12	4	18	11	21	7				
16	23	2	23	7	22	3	21	9				
17	22	6	22	1	22	2	13	6	10	5	9	1
18	21	8	23	8								
19	23	2	23	7	24	3	24	4	20	2	17	1
21	23	7	23	4	24	6	26	5	26	9	23	15
22	22	7	-	-	18	5	-	-	23	9	10	0
23	18	7	14	5								
24	19	7	20	8	22	7	21	11	24	5	21	9
25	22	1	22	1	16	0	21	3	21	6	23	3
26	14	5	8	3	14	6	20	12	4	2		
27	23	7	16	4	10	4	12	3				
28	23	2	23	2	24	2	23	4	26	7		
29	22	2	22	4	23	5						
30	23	0	23	2	24	0	26	1	26	4	10	0
31	20	2	18	3	4	0	19	1				
32	16	0	16	1	14	0						
33	18	0	18	1	12	1	2	1	16	6	16	7
34	23	9										
35	8	3	3	1								
36	22	1	19	0								
37	16	1	16	5					24	0		
38	14	5										
39	23	0	23	1	24	1	26	5	24	1	23	0
40	10	0										

SUPERIOR GOOD FAIR OTHERS

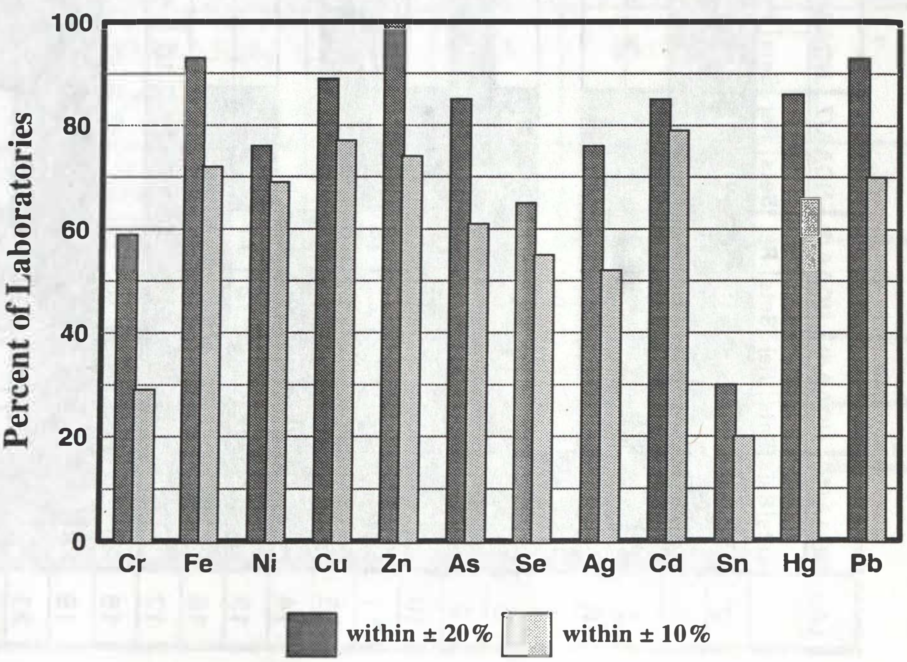
Table VIII
Intralaboratory Precision Evaluation for the Biological Tissues

	Laboratory Number
Good	2,3,4,6,7,8,9,10,11,13,14,15,16,17, 18,19,21,23,24,25,27,28,29,30,31, 32,33,34,35,36,37,38,39,40
Fair	22,26

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

The analytical capability of the group for the analysis of Tissue Z as demonstrated in this exercise is shown below in Figure 4. This diagram shows the percentage of laboratories reporting values within 20 and 10 percent respectively of the accepted value for the analyte. An asterisk beside the analyte symbol denotes an improvement at the 20 percent level over last year. There is improvement for nine of the twelve analytes (Fe,Ni,Cu,Zn,As,Se,Cd,Hg,Pb).

Figure 4
Analytical Capability for Tissue Z

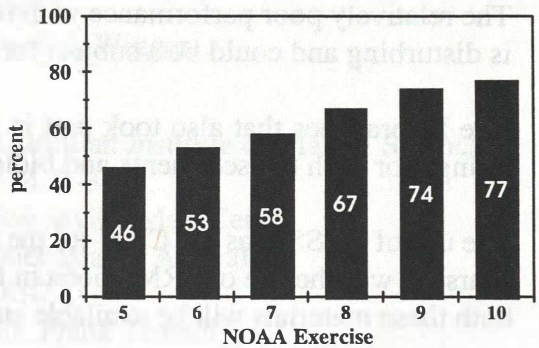


A number of problems remain concerning the analysis of marine tissues for trace metals. The following three analytes in Tissue Z presented difficulties to at least twenty-five percent of the participants that submitted results: chromium, selenium and tin. Many of the problems are generally related to the low levels of some of these analytes.

Figure 5 shows that more than three-quarters of the participants are in the superior and good categories this year, a continuation of the steady increase of laboratories into these categories of the last six years.

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

Figure 5
Laboratories in the Superior and Good Category for the Biologicals



Appendix D summarizes the digestion methods and instrumental techniques used for the determination of the metals. Graphite furnace atomic absorption spectrometry (GFAAS) and inductively coupled plasma (ICPAES) are the most frequently used with flame atomic absorption (FAAS) third. The use of inductively coupled plasma mass spectrometry (ICPMS) is increasing rapidly, overtaking GFAAS for analytes of low concentration in the tissues, and is responsible for the improvement for some of the analytes like silver, tin, antimony and thallium. The great majority of laboratories used more than one instrumental method for this exercise. The importance of using the right tool for the job is being more and more recognized by the participants.

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

However, a few laboratories still do not understand the concept of significant figures. We still continue to see trace analysis results reported to 4 and 5 significant figures.

4. CONCLUSIONS

In general, we continue to see the overall performance improve for both matrices. In particular the analysis of the sediments showed marked improvement, although significant changes could not be attributed to a particular element. Although conspicuous changes are not always evident on a year to year basis, over the past six years we have seen the percentage of laboratories in the top groups almost double.

Improvements could be noted for the determination of iron, arsenic and silver in the sediments, and for nickel, arsenic and lead in the biological tissues. Performance was worse for selenium and thallium in the sediments and for chromium and tin in the tissues. The performance for copper, zinc and cadmium in both matrices has reached a level where, aside from improvements in some individual laboratories, we can not expect much more general improvement from the superior and good performers as a group.

The relatively poor performance with regard to the analysis for arsenic and selenium in the tissues is disturbing and could be a subject for special investigation.

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

The use of BCSS-1 as the CRM for the last six years is a great help in comparing progress over the years, as was the use of SRM 1566a in five of the six years. Unfortunately this will be the final year both these materials will be available and new CRM's will have to be chosen for the next exercises.

Kudos go to laboratories 3,6,13,14,15,16,19,29,30 and 39 for achieving a superior rating for both matrices this year and to laboratories 13 and 39 for the best continual superior performance. Another fifteen laboratories (1,4,8,9,11,17,21,25,32,33,36,37) were in the superior or good category for both tissues and sediments.

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Appendix A

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Appendix B

DATA

BERYLLIUM
Sediment Y
1.64 ± 0.63 mg/kg

Lab							Mean	SD	RSD
1	5	1.26	1.36	1.48	1.37	1.37	1.37	0.08	5.7
2	0								
3'	5	1.40	1.33	1.42	1.42	1.40	1.39	0.04	2.7
4'	5	1.76	1.71	1.48	1.71	1.72	1.68	0.11	6.7
5	5	1.38	1.64	1.54	1.41	1.45	1.48	0.11	7.1
6	5	1.3	1.3	1.2	1.2	1.2	1.2	0.1	4.4
7	0								
8	5	1.57	2.51	2.63	1.54	1.66	1.98	0.54	27.3
9	0								
10	0								
11	0								
12	5	1.88	1.82	1.93	1.87	1.89	1.88	0.04	2.1
13	5	1.44	1.53	1.450	1.390	1.490	1.46	0.05	3.6
14	5	1.6	1.6	1.9	1.8	1.8	1.7	0.1	7.7
15	5	1.73	1.77	1.72	1.79	1.77	1.76	0.03	1.7
16	5	1.638	1.598	1.554	1.596	1.577	1.593	0.031	1.9
17	5	1.9	1.8	1.9	1.9	1.8	1.9	0.1	2.9
18*	5	0.91	0.91	0.77	0.96	0.88	0.89	0.07	8.0
19	0								
20	0								
21	5	2.31	2.15	2.21	2.26	2.18	2.22	0.06	2.9
22	0								
23	0								
24	5	1.22	1.05	0.98	1.18	1.08	1.10	0.10	8.9
25	0								
26	0								
27*	5	0.75	0.75	0.74	0.75	0.72	0.74	0.01	1.8
28	0								
29	5	1.34	1.34	1.11	1.19	1.11	1.22	0.12	9.5
30	5	1.76	1.76	1.52	1.63	1.6	1.65	0.10	6.3
31	0								
32	0								
33	5	1.81	2.03	1.74	1.81	1.94	1.87	0.12	6.3
34*	5	0.681	0.764	0.765	0.719	0.681	0.722	0.042	5.8
35	0								
36	0								
37	0								
38	0								
39	0								
40	0								
41	5	1.87	1.87	1.95	1.85	1.82	1.87	0.05	2.6
42	0								

BERYLLIUM
BCSS-1
1.3 ± 0.3 mg/kg

Lab							Mean	SD	RSD
1	5	1.20	1.08	1.21	1.28	1.26	1.21	0.08	6.5
2	0								
3	5	1.25	1.20	1.16	1.37	1.51	1.30	0.14	11.0
4	5	1.18	1.18	1.15	1.12	1.09	1.14	0.04	3.4
5	5	1.09	1.36	1.13	1.26	1.1	1.18	0.12	10.3
6	5	0.9	1.0	1.1	1.1	1.1	1.0	0.1	8.6
7	0								
8	5	1.11	1.41	1.15	1.26	1.20	1.23	0.12	9.6
9	0								
10	0								
11	0								
12	5	1.48	1.48	1.45	1.45	1.48	1.47	0.02	1.1
13	5	1.15	1.18	1.13	1.20	1.27	1.19	0.05	4.6
14	5	1.3	1.3	1.4	1.2	1.3	1.3	0.1	5.4
15	5	1.41	1.39	1.41	1.42	1.37	1.40	0.02	1.4
16	5	1.303	1.209	1.183	1.228	1.206	1.226	0.046	3.8
17	5	1.5	1.5	1.5	1.5	1.5	1.5	0.0	0.0
18*	5	0.69	0.76	0.77	0.75	0.84	0.76	0.05	7.0
19	0								
20	0								
21	5	1.56	1.5	1.65	1.61	1.47	1.56	0.07	4.8
22	0								
23	0								
24	5	1.15	1.13	1.08	1.12	1.16	1.13	0.03	2.8
25	0								
26	0								
27*	5	0.6	0.59	0.57	0.56	0.60	0.58	0.02	3.1
28	0								
29	5	1.00	1.02	1.11	1.06	1.05	1.05	0.04	4.0
30	5	1.14	1.22	1.18	1.29	1.16	1.20	0.06	5.0
31	0								
32	0								
33	5	1.20	1.30	1.36	1.46	1.38	1.34	0.10	7.2
34*	5	0.665	0.629	0.634	0.691	0.632	0.650	0.027	4.2
35	0								
36	0								
37	0								
38	0								
39	0								
40	0								

The determination of beryllium was not required in the biologicals

ALUMINUM
Sediment Y
5.12 ± 0.67 %

Lab							Mean	SD	RSD
1*	5	1.50	1.53	1.71	1.56	1.56	1.57	0.08	5.2
2	0								
3	5	4.88	5.16	4.93	4.96	5.04	4.99	0.11	2.2
4	0								
5	5	5.05	4.94	4.89	5.00	4.73	4.92	0.12	2.5
6	5	4.99	5.15	5.26	5.08	5.18	5.13	0.10	2.0
7	5	5.556	4.462	5.282	4.946	4.045	4.858	0.611	12.6
8	5	4.72	5.08	5.74	5.08	5.00	5.12	0.37	7.3
9	0								
10	0								
11	0								
12	5	5.24	5.30	5.41	5.32	5.32	5.32	0.06	1.1
13	5	4.92	5.02	5.61	5.58	5.41	5.31	0.32	6.0
14	5	5.43	5.52	5.61	5.49	5.74	5.56	0.12	2.2
15	5	5.13	5.17	5.14	5.21	5.17	5.16	0.03	0.6
16	5	4.92	4.96	4.97	4.98	4.91	4.95	0.03	0.6
17	5	5.4	5.3	5.2	5.3	5.2	5.3	0.1	1.6
18*	5	1.9624	1.8866	1.732	2.1585	2.0514	1.9582	0.1621	8.3
19	5	4.80	5.07	4.35	4.81	4.45	4.70	0.29	6.2
20	0								
21	5	4.98	4.76	5.18	5.11	5.22	5.05	0.19	3.7
22	0								
23*	5	2.44	2.60	2.53	2.40	2.48	2.49	0.08	3.1
24*	5	4.47	4.18	3.85	4.44	4.45	4.28	0.27	6.2
25	0								
26	0								
27*	5	1.84	2.32	2.26	2.06	2.24	2.14	0.20	9.1
28	0								
29	5	5.05	5.14	5.14	4.96	5.02	5.06	0.08	1.5
30	0								
31	0								
32	5	5.45	5.45	5.44	5.43	5.44	5.44	0.01	0.2
33	0								
34*	5	1.11	1.27	1.25	1.18	1.09	1.18	0.08	6.8
35	5	5.7548	5.6373	5.2361	5.3583	5.9216	5.5816	0.2819	5.1
36	0								
37	5	4.77	4.99	5.05	4.93	4.88	4.92	0.11	2.2
38	5	4.87	5.51	5.31	5.22	5.07	5.20	0.24	4.7
39	5	5.5543	5.5788	5.4790	5.5076	5.6007	5.5441	0.0502	0.9
40	2	5.39	5.28						
41	5	5.08	5.12	5.13	5.48	5.03	5.17	0.18	3.5
42	0								

ALUMINUM
BCSS-1
6.26 ± 0.41 %

Lab							Mean	SD	RSD
1*	5	2.05	1.87	1.97	2.08	1.94	1.98	0.08	4.3
2	0								
3	5	6.37	6.05	6.17	6.04	6.66	6.26	0.26	4.2
4	0								
5	5	5.66	6.14	6.00	5.98	6.03	5.96	0.18	3.0
6*	5	5.82	5.80	5.49	5.15	5.58	5.57	0.27	4.9
7	5	6.534	6.936	6.139	6.417	6.155	6.436	0.327	5.1
8*	5	4.94	5.16	6.54	5.66	5.80	5.62	0.62	11.1
9	0								
10	0								
11	0								
12	5	6.23	6.31	6.20	6.25	6.22	6.24	0.04	0.7
13	5	6.11	6.04	6.12	5.56	6.17	6.00	0.25	4.2
13'	5	6.62	6.68	6.63	6.56	6.76	6.65	0.07	1.1
15	5	6.17	6.13	6.14	6.17	6.18	6.16	0.02	0.4
16	5	5.97	6.16	5.99	5.96	6.08	6.03	0.09	1.4
17	5	6.2	6.2	6.1	6.2	6.1	6.2	0.1	0.9
18*	5	2.1354	2.5646	2.511	2.9751	2.8599	2.6092	0.3290	12.6
19	5	5.89	6.63	6.67	6.53	6.44	6.43	0.32	4.9
20	0								
21	5	6.67	6.04	5.66	5.99	6.17	6.11	0.37	6.0
22	0								
23*	5	3.70	3.55	3.68	3.60	3.47	3.60	0.09	2.6
24*	5	5.89	5.4	5.49	6.53	4.77	5.62	0.65	11.6
25	0								
26	0								
27*	5	3.03	2.83	2.77	2.75	2.92	2.86	0.12	4.0
28	0								
29'	5	6.03	6.02	6.03	6.09	6.03	6.04	0.03	0.5
30	0								
31	0								
32	5	6.35	6.36	6.36	6.30	6.30	6.33	0.03	0.5
33	0								
34*	5	1.62	1.54	1.54	1.73	1.55	1.60	0.08	5.1
35'	5	6.0424	5.9188	6.5307	5.9625	5.8872	6.0683	0.2650	4.4
36	0								
37	5	6.27	6.25	6.29	6.30	6.29	6.28	0.02	0.3
38**	5	6.88	5.11	6.79	7.44	6.806	6.61	0.88	13.3
39	5	6.5314	6.6138	6.5784	6.6369	6.5460	6.5813	0.0444	0.7
40	2	6.32	6.18						

ALUMINUM
Tissue Z
mg/kg

Lab							Mean	SD	RSD
1	0								
2	5	554	556	554	557	557	556	2	0.3
3	5	625	637	647	627	649	637	11	1.7
4	0								
5	0								
6	5	435	370	450	391	416	412	32	7.9
7	0								
8	5	346	376	430	329	353	367	39	10.7
9	0								
10	5	341.14	328.12	331.55	276.280	292.000	313.82	28.07	8.9
11	0								
12	0								
13	5	623	623	683	629	601	632	31	4.8
14	5	486	452	469	438	447	458	19	4.2
15	5	509	517	540	523	547	527	16	3.0
16	5	298	302	304	315	302	304	6	2.1
17	5	870	850	850	830	850	850	14	1.7
18	5	347	347	340	401	380	363	26	7.3
19	5	720	700	710	730	750	722	19	2.7
20	0								
21	5	511.38	509.4	504.6	503.67	507.29	507.27	3.22	0.6
22	5	322	219	240	297	411	298	76	25.4
23	5	267	245	237	276	288	263	21	8.1
24	5	248.77	253.34	241.41	198.87	217.36	231.95	23.11	10.0
25	5	791	774	741	777	771	771	18	2.4
26	0								
27	5	273	248	263	263	259	261	9	3.4
28	5	375	379	361	333	380	366	20	5.4
29	5	535	535	538	530	538	535	3	0.6
30	5	564	563	574	573	573	569	5	1.0
31	0								
32	0								
33	0								
34	5	219	214	211	191	193	206	13	6.2
35	0								
36	5	852	881	873	864	883	871	13	1.5
37	0								
38	0								
39	5	592	605	600	588	578	593	11	1.8
40	5	859.3	841.8	854.8	838.4	866.4	852.1	11.8	1.4
41	5	565	540	562	531	573	554	18	3.2
42	5	848	841	847	862	868	853	11	1.3

ALUMINUM
SRM 1566a
202.5 ± 2.5 mg/kg

Lab							Mean	SD	RSD
1	0								
2	5	130	130	130	130	131	130	0.4	0.3
3	5	194	201	213	191	197	199	9	4.3
4	0								
5	0								
6	5	93	104	98	97	101	99	4	4.2
7	0								
8	5	100	113	131	98	142.00	117	19	16.5
9	0								
10	5	80.79	87.09	55.39	71.50	68.87	72.73	12.13	16.7
11	0								
12	0								
13	5	139	142	140	141	137	140	2	1.4
14	5	139	166	145	131	138	144	13	9.3
15	5	148	124	129	122	135	132	10	7.9
16	5	73.75	77.08	73.19	76.26	72.38	74.53	2.03	2.7
17	5	210	220	220	220	210	216	5	2.5
18	5	87.4	77.8	81.4	74.5	73.6	78.9	5.6	7.1
19	5	190	190	210	210	190	198	11	5.5
20	0								
21	5	202.24	201.11	194.11	208.90	201.90	201.65	5.25	2.6
22	5	86.8	103	91.2	74.7	112	93.5	14.5	15.5
23	5	<90	<90	<90	<90	<90			
24	5	39.39	51.12	52.87	53.62	43.42	48.08	6.33	13.2
25	5	178	178	176	176	173	176	2	1.2
26	0								
27	5	144	79.2	78.2	86.5	76.7	92.9	28.8	31.0
28	5	93.6	94.6	94.1	102	106	98	6	5.7
29	5	124	123	128	121	121	123	3	2.3
30	5	134	136	138	130	129	133	4	2.9
31	0								
32	0								
33	0								
34	5	60.2	56.9	56.6	64.2	67.7	61.1	4.8	7.8
35	0								
36	5	195	198	199	199	202	199	3	1.3
37	0								
38	0								
39	5	136	134	136	133	136	135	1	1.0
40	5	195.6	196.0	209.5	202.2	197.6	200.2	5.8	2.9

SILICON
Sediment Y
29.6 ± 5.2 %

Lab							Mean	SD	RSD
1	0								
2	0								
3	5	32.0	32.0	31.8	31.9	31.5	31.8	0.2	0.7
4	0								
5	0								
6	0								
7	0								
8	5	33.1	31.3	29.5	30.3	29.3	30.7	1.6	5.1
9	0								
10	0								
11	0								
12	0								
13	5	30.1	30.2	29.4	30.3	28.9	29.8	0.6	2.0
14	0								
15	5	29.7	29.6	29.4	29.2	28.8	29.3	0.4	1.2
16	5	28.54	28.38	28.29	28.13	27.87	28.24	0.26	0.9
17	0								
18	0								
19	5	31.0	30.0	30.0	29.4	30.8	30.2	0.7	2.2
20	0								
21	5	27.42	23.22	25.88	25.96	26.82	25.86	1.61	6.2
22	0								
23	0								
24	0								
25	0								
26	0								
27	0								
28	0								
29	0								
30	0								
31	0								
32	5	30.4	30.3	30.2	30.3	30.3	30.3	0.1	0.2
33	0								
34	0								
35	0								
36	0								
37	5	22.7	24.6	28.7	23.7	27.9	25.5	2.6	10.3
38	0								
39	5	33.041	33.2142	32.702	32.8105	32.8191	32.9174	0.2067	0.6
40	0								
41'	5	33.2	30.9	30.9	31.0	30.7	31.3	1.0	3.3
42	0								

SILICON
BCSS-1
30.8 ± 1.0(1.5)%

Lab							Mean	SD	RSD
1	0								
2	0								
3	5	30.2	30.7	31.5	29.8	31.5	30.7	0.8	2.5
4	0								
5	0								
6	0								
7	0								
8	5	32.4	33.7	31.0	29.8	30.4	31.5	1.6	5.0
9	0								
10	0								
11	0								
12	0								
13	5	30.3	30.8	30.6	30.8	31.2	30.7	0.3	1.1
14	0								
15	5	30.3	30.2	30.2	30.3	30.4	30.3	0.1	0.3
16	5	30.12	31.21	31.66	30.08	30.61	30.74	0.69	2.2
17	0								
18	0								
19	5	30.9	30.4	30.7	30.1	30.7	30.6	0.3	1.0
20	0								
21'	5	31.88	31.51	26.16	30.54	31.24	30.27	2.35	7.8
22	0								
23	0								
24	0								
25	0								
26	0								
27	0								
28	0								
29	0								
30	0								
31	0								
32	5	31.1	31.0	31.0	31.0	31.1	31.0	0.1	0.2
33	0								
34	0								
35	0								
36	0								
37	5	31.4	28.7	30.9	29.6	31.0	30.3	1.1	3.7
38	0								
39*	5	33.1838	33.5109	33.6417	33.3237	33.9017	33.5124	0.2792	0.8
40	0								

The determination of silicon was not required in the biologicals

CHROMIUM
Sediment Y
256 ± 33 mg/kg

Lab							Mean	SD	RSD
1	0								
2	0								
3*	5	327	329	325	320	326	325	3	1.0
4	5	284	270	278	274	275	276	5	1.9
5	5	272	253	255	232	242	251	15	6.0
6	5	261	251	257	264	250	257	6	2.4
7	5	276.01	259.67	282.36	255.41	266.29	267.95	11.19	4.2
8	5	285	309	263	265	256	276	22	7.8
9*	5	230	203	222	208	197	212	14	6.4
10	0								
11	5	254.20	236.70	254.20	253.00	236.80	246.98	9.35	3.8
12	5	266	281	300	275	274	279	13	4.6
13	5	229	224	244	257	256	242	15	6.3
14'	5	254	249	250	248	271	254	10	3.8
15	5	276	275	276	280	274	276	2	0.8
16	5	260	269	260	260	269	264	5	1.9
17*	5	306	292	290	302	292	296	7	2.4
18*	5	214	202	206	205	207	207	4	2.1
19*	5	312	301	312	318	307	310	6	2.1
20'	5	289	288	287	299	286	290	5	1.8
21	5	249.05	252.61	248.92	250.69	249.89	250.23	1.51	0.6
22	0								
23*	5	210	228	224	207	212	216	9	4.3
24'	5	235.29	228.0	198.0	236.0	228.0	225.07	15.59	6.9
25	5	272	272	271	270	271	271	1	0.3
26*	5	214	209	209	214	214	212	3	1.3
27*	5	193	194	190	192	187	191	3	1.5
28	0								
29	5	240	235	242	232	228	235	6	2.4
30	5	278	265	266	258	259	265	8	3.0
31	0								
32	5	254	250	249	251	248	250	2	0.9
33	5	236.6	248.2	242.1	233.6	248.0	241.7	6.6	2.7
34*	5	175	179	183	171	168	175	6	3.4
35*	5	151.5	145.8	134.0	128.7	142.12	140.4	9.1	6.5
36	5	236	245	221	220	220	228	12	5.0
37	5	249	254	253	250	251	251	2	0.8
38	5	247	259	244	247	236	247	8	3.4
39	5	246	243	245	252	244	246	4	1.4
40	2	260	275						
41	5	251	258	248	264	247	254	7	2.9
42	5	278	301	272	275	276	280	12	4.2

CHROMIUM
BCSS-1
123 ± 14 mg/kg

Lab							Mean	SD	RSD
1	0								
2	0								
3'	5	122	118	118	118	119	119	2	1.5
4	5	132.9	119.0	114.5	120.0	125.6	122.4	7.1	5.8
5	5	117	116	111	114	117	115	3	2.2
6*	5	103	100	103	100	99	101	2	1.9
7	5	120.33	115.01	110.97	114.97	105.79	113.41	5.41	4.8
8'	5	115	115	112	113	103	112	5	4.5
9*	5	93	91.4	91.4	90.8	89.9	91.3	1.1	1.2
10	0								
11*	5	95.31	89.39	95.6	93.6	93.5	93.5	2.5	2.7
12*	5	102	102	106	99.6	99	102	3	2.8
13	5	117	118	120	105	109	114	6	5.7
14	5	114	112	119	115	116	115	3	2.2
15	5	113	109	106	107	108	109	3	2.5
16'	5	110	110	110	104	110	109	3	2.5
17	5	130	132	130	130	132	131	1	0.8
18*	5	52.3	58.5	58.4	63	73.6	61.2	7.9	13.0
19	5	135	136	135	134	130	134	2	1.8
20	5	111	108	108	111	108	109	2	1.5
21	5	117.45	118.92	115.31	118.62	119.41	117.94	1.64	1.4
22	0								
23*	5	84.9	82.0	86.0	82.8	79.3	83.0	2.6	3.1
24	5	120.71	102.25	133.03	109.80	100.00	113.16	13.74	12.1
25	5	110	110	108	116	107	110	3	3.2
26*	5	57.9	65.2	59.8	55.0	53.2	58.2	4.7	8.0
27*	5	61.4	60.2	59.2	57.7	60.4	59.8	1.4	2.3
28	0								
29*	5	103	105	90.1	94.4	97.5	98.0	6.1	6.2
30	5	125	123	122	125	120	123	2	1.7
31	0								
32	5	118	119	119	119	120	120	0.7	0.6
33*	5	102.1	99.8	102.7	111.2	103.9	103.9	4.3	4.2
34*	5	42.9	41.6	42.0	43.8	40.9	42.2	1.1	2.7
35	5	123.2	113.1	123.6	119.2	124.4	120.7	4.7	3.9
36	5	104	110	115	122	112	113	7	5.9
37	5	131	128	127	131	133	130	2	1.9
38	5	112	112	109	118	114	113	3	2.9
39	5	122	119	125	120	119	121	3	2.1
40	2	123	125						

CHROMIUM
Tissue Z
1.37 ± 0.62 mg/kg

Lab							Mean	SD	RSD
1	0								
2	5	1.37	1.39	1.30	1.32	1.46	1.37	0.06	4.6
3	5	1.34	1.3	1.37	1.29	1.26	1.31	0.04	3.3
4	5	0.97	0.93	0.93	1.02	1.04	0.98	0.05	5.2
5	0								
6'	5	1.15	1.15	1.25	1.15	1.15	1.17	0.04	3.8
7	0								
8*	5	1.9	1.9	2.3	2.8	2.0	2.2	0.4	17.6
9	5	1.11	1.02	0.92	1.04	0.97	1.01	0.07	7.1
10	5	1.20	1.18	1.30	1.30	1.05	1.21	0.10	8.6
11	5	<1.37	<1.27	<1.39	<1.33	<1.36			
12	0								
13	5	1.58	1.53	1.47	1.48	1.58	1.53	0.05	3.4
14	5	1.68	1.67	1.77	1.94	1.83	1.78	0.11	6.3
15'	5	1.62	1.63	1.62	1.62	1.62	1.62	0.00	0.3
16*	5	0.491	0.473	0.449	0.452	0.460	0.465	0.017	3.7
17*	5	3	2	2	2	3	2	1	22.8
18	5	1.62	1.19	1.25	1.19	1.07	1.26	0.21	16.6
19	5	1.02	1.06	1.07	1.05	1.09	1.06	0.03	2.4
20	0								
21	5	1.77	1.93	1.65	1.72	1.7	1.75	0.11	6.1
22*	5	6.29	6.56	5.92	4.21	3.11	5.22	1.49	28.6
23	5	<0.8	<0.7	<0.7	<0.7	<0.9			
24	5	1.56	1.79	1.61	2.04	2.05	1.81	0.23	12.8
25	5	1.35	1.39	1.22	1.32	1.40	1.34	0.07	5.4
26	5	1.43	1.44	1.38	1.39	1.44	1.42	0.03	2.0
27	5	0.97	0.99	0.92	0.99	0.93	0.96	0.03	3.5
28	5	1.76	1.80	1.78	1.74	1.75	1.77	0.02	1.4
29	5	1.50	1.58	1.50	1.60	1.63	1.56	0.06	3.8
30	5	1.44	1.41	1.48	1.32	1.40	1.41	0.06	4.2
31'	5	1.23	1.23	1.40	1.24	1.19	1.26	0.08	6.5
32	5	1.10	1.07	1.05	1.11	1.04	1.07	0.03	2.8
33	5	1.53	1.48	1.48	1.80	1.52	1.56	0.13	8.6
34*	5	2.22	2.24	2.16	2.18	2.35	2.23	0.07	3.3
35	0								
36	5	1.09	1.19	1.15	1.11	1.10	1.13	0.04	3.7
37	5	1.16	1.16	1.14	1.18	1.17	1.16	0.01	1.3
38	5	1.01	1.02	1.00	1.04	0.91	1.00	0.05	5.1
39	5	1.38	1.31	1.33	1.30	1.41	1.35	0.05	3.5
40	5	1.33	1.32	1.34	1.31	1.43	1.35	0.05	3.6
41	5	1.33	1.33	1.38	1.38	1.30	1.34	0.04	2.6
42	0								

CHROMIUM
SRM 1566a
1.43 ± 0.46 mg/kg

Lab							Mean	SD	RSD
1	0								
2	5	1.53	1.55	1.54	1.51	1.48	1.52	0.03	1.8
3	5	1.49	1.49	1.55	1.49	1.41	1.49	0.05	3.4
4	5	1.36	0.85	1.08	1.11	1.39	1.16	0.22	19.2
5	0								
6*	5	0.75	0.90	0.85	0.85	0.85	0.84	0.05	6.5
7	0								
8	5	1.8	1.8	2.0	1.6	1.7	1.8	0.1	8.3
9	5	1.57	1.39	1.28	1.53	1.27	1.41	0.14	9.8
10	5	0.98	1.15	0.90	0.97	0.92	0.98	0.10	10.0
11	5	<1.34	<1.36	<1.36	<1.40	<1.35			
12	0								
13	5	1.48	1.54	1.59	1.54	1.51	1.53	0.04	2.7
14'	5	1.56	1.54	1.52	1.63	2.09	1.67	0.24	14.4
15	5	1.21	1.29	1.42	1.16	1.44	1.30	0.12	9.5
16*	5	0.314	0.305	0.328	0.323	0.326	0.319	0.010	3.0
17*	5	2	2	2	2	2	2	0.0	0.0
18*	5	0.93	0.86	0.92	0.88	0.88	0.89	0.03	3.3
19	5	1.10	1.15	1.11	1.15	1.13	1.13	0.02	2.0
20	0								
21	5	1.83	1.78	1.69	1.74	1.79	1.77	0.05	3.0
22*	5	2.47	2.43	5.03	5.37	3.45	3.75	1.39	37.1
23	5	<0.6	<0.8	<0.7	<0.6	<0.7			
24	5	1.47	1.453	1.474	1.42	1.43	1.45	0.02	1.6
25	5	1.56	1.56	1.42	1.45	1.28	1.45	0.12	8.0
26	5	0.93	0.96	0.92	1.27	1.43	1.10	0.23	21.2
27*	5	0.78	0.63	0.60	0.66	0.67	0.67	0.07	10.2
28	5	1.56	1.46	1.43	1.43	1.49	1.47	0.05	3.7
29	5	1.30	1.45	1.38	1.40	1.30	1.37	0.07	4.8
30	5	1.37	1.58	1.33	1.34	1.42	1.41	0.10	7.3
31	5	1.04	1.09	1.09	0.904	0.892	1.00	0.10	9.8
32	5	1.11	1.10	1.15	1.23	1.16	1.15	0.05	4.5
33'	5	1.13	1.44	1.56	1.49	1.56	1.44	0.18	12.4
34	5	1.56	1.45	1.73	1.45	1.50	1.54	0.12	7.6
35	0								
36	5	1.35	1.32	1.41	1.22	1.28	1.32	0.07	5.4
37	5	1.38	1.30	1.37	1.44	1.32	1.36	0.05	4.0
38	5	1.06	1.09	1.09	0.83	0.94	1.00	0.11	11.4
39	5	1.43	1.48	1.45	1.44	1.46	1.45	0.02	1.3
40	5	1.49	1.57	1.33	1.52	1.36	1.45	0.10	7.2

MANGANESE
Sediment Y
514 ± 55 mg/kg

Lab							Mean	SD	RSD
1*	5	347	345	355	350	352	350	4	1.1
2	0								
3'	5	446	464	451	433	436	446	12	2.8
4	0								
5	5	526	516	498	510	495	509	13	2.5
6	5	512	518	547	501	527	521	17	3.3
7	5	576.04	519.4	583.36	558.58	490.55	545.59	39.49	7.2
8*	5	331	346	360	355	342	347	11	3.3
9	5	504	536	500	513	519	514	14	2.8
10	0								
11	5	459.00	475.00	487.40	498.00	473.00	478.48	14.85	3.1
12	5	491	453	509	486	465	481	22	4.6
13	5	477	477	503	513	499	494	16	3.3
14	5	544	516	541	566	574	548	23	4.2
15	5	516	539	534	518	529	527	10	1.9
16'	5	499	499	508	544	501	510	19	3.8
17	5	490	500	500	500	490	496	5	1.1
18*	5	359	359	347	376	373	363	12	3.3
19	5	464	458	454	458	461	459	4	0.8
20	5	588	540	552	582	594	571	24	4.2
21	5	494.63	494.14	492.63	496.12	494.83	494.47	1.26	0.3
22	0								
23*	5	354	358	359	357	364	358	4	1.0
24*	5	396.61	354.13	296.36	343.43	339.57	346.02	35.85	10.4
25	5	512	525	526	528	538	526	9	1.8
26*	5	375	376	359	368	354	366	10	2.7
27*	5	353	344	347	345	333	344	7	2.1
28	0								
29	5	496	493	494	485	489	491	4	0.9
30	5	504	506	515	511	502	508	5	1.0
31	0								
32	5	486	489	487	484	483	486	2	0.5
33	0								
34*	5	308	317	316	301	290	306	11	3.7
35*	5	358.4	408.3	372.4	397.4	407.3	388.8	22.3	5.7
36*	4	450	423	437	422		433	13	3.1
37*	5	617	629	617	606	615	617	8	1.3
38	5	486	531	550	536	482	517	31	6.0
39"	5	570	563	569	570	569	568	3	0.5
40	2	530	531						
41	0	506	506	499	507	507	505	3	0.7
42	0								

MANGANESE
BCSS-1
229 ± 15(23) mg/kg

Lab							Mean	SD	RSD
1*	5	202	193	203	208	205	202	6	2.8
2	0								
3'	5	219	222	217	217	255	226	16	7.2
4	0								
5	5	202	207	210	213	213	209	5	2.2
6	5	229	227	229	222	221	226	4	1.7
7	5	255.81	247.56	233.52	234.26	231.94	240.62	10.55	4.4
8	5	206	209	213	205	210	209	3	1.5
9	5	221	215	212	209	214	214	4	2.1
10	0								
11	5	215.7	209.8	214.2	213.5	206.1	211.86	3.88	1.8
12	5	218	225	224	218	221	221	3	1.5
13	5	225	214	213	229	225	221	7	3.3
14	5	229	243	255	242	240	242	9	3.8
15	5	220	217	220	217	221	219	2	0.9
16	5	217	221	221	219	220	220	2	0.8
17	5	240	230	230	230	220	230	7	3.1
18*	5	189	190	193	198	193	193	4	1.8
19	5	219	227	237	241	223	229	9	4.1
20	5	241	240	238	244	240	241	2	0.9
21	5	218.76	217.05	217.28	216.68	217.14	217.38	0.80	0.4
22	0								
23*	5	198	189	193	191	192	193	3	1.7
24	5	212.8	217.5	200.36	219.98	226.35	215.40	9.72	4.5
25	5	230	230	229	229	231	230	1	0.4
26*	5	206	211	201	199	200	203	5	2.5
27*	5	186	188	183	183	186	185	2	1.2
28	0								
29	5	223	219	221	221	219	221	2	0.8
30	5	223	227	236	229	225	228	5	2.2
31	0								
32	5	215	216	217	213	214	215	2	0.7
33	0								
34*	5	175	174	178	178	169	175	4	2.1
35'*	5	165.8	161.5	196.9	162.5	171.2	171.6	14.7	8.5
36	5	220	219	219	227	243	226	10	4.6
37	5	224	220	216	220	221	220	3	1.3
38	5	261	235	246	231	259	246	14	5.5
39	5	232	231	231	232	233	232	1	0.4
40	2	228.1	226.4						

The determination of manganese was not required in the biologicals

IRON
Sediment Y
3.53 ± 0.27 %

Lab							Mean	SD	RSD
1*	5	2.92	2.91	2.98	2.93	2.90	2.93	0.03	1.1
2	0								
3	5	3.55	3.67	3.69	3.57	3.57	3.61	0.06	1.8
4	0								
5	5	3.48	3.45	3.41	3.40	3.37	3.42	0.04	1.3
6	5	3.56	3.54	3.62	3.51	3.50	3.55	0.05	1.3
7	5	3.59	3.367	4.091	3.502	3.539	3.618	0.277	7.7
8	5	3.70	3.88	3.50	3.61	3.44	3.63	0.17	4.8
9	5	3.66	3.64	3.63	3.59	3.65	3.63	0.03	0.7
10	0								
11	5	3.4253	3.3026	3.4736	3.5121	3.3270	3.4081	0.0910	2.7
12	5	3.63	3.62	3.76	3.66	3.65	3.66	0.06	1.5
13	5	3.39	3.30	3.49	3.55	3.56	3.46	0.11	3.2
14	5	3.62	3.59	3.51	3.64	3.60	3.59	0.05	1.4
15	5	3.42	3.38	3.43	3.45	3.37	3.41	0.03	1.0
16	5	3.36	3.48	3.43	3.43	3.38	3.42	0.05	1.4
17	5	3.5	3.5	3.4	3.5	3.4	3.5	0.1	1.6
18	5	3.3284	3.2065	3.2419	3.1329	3.1233	3.2066	0.0843	2.6
19	5	3.56	3.46	3.49	3.47	3.53	3.50	0.04	1.2
20	0								
21	5	3.75	3.81	3.72	3.69	3.71	3.74	0.05	1.2
22	0								
23*	5	2.76	2.82	2.74	2.75	2.83	2.78	0.04	1.5
24*	5	3.466	2.98	2.765	3.089	3.07	3.074	0.254	8.3
25	5	3.68	3.75	3.60	3.58	3.63	3.65	0.07	1.9
26	5	3.5769	3.5283	3.4883	3.6957	3.3946	3.5368	0.1112	3.1
27*	5	2.4	3.03	3.04	2.73	3.04	2.85	0.28	10.0
28	0								
29	5	3.34	3.35	3.38	3.25	3.31	3.33	0.05	1.5
30	5	3.68	3.53	3.63	3.46	3.58	3.58	0.09	2.4
31	0								
32	5	3.77	3.77	3.77	3.76	3.78	3.77	0.01	0.2
33	0								
34*	5	2.31	2.34	2.37	2.27	2.18	2.29	0.07	3.2
35	5	3.1091	3.5439	2.7903	3.2881	3.5644	3.2592	0.3230	9.9
36	0								
37	5	3.46	3.49	3.45	3.46	3.51	3.47	0.03	0.7
38	5	3.33	3.68	3.74	3.74	3.54	3.61	0.17	4.8
39	5	3.6555	3.6363	3.6829	3.6499	3.6936	3.6636	0.0238	0.7
40	2	3.57	3.74						
41	5	3.41	3.32	3.37	3.45	3.47	3.40	0.06	1.8
42	0								

IRON
BCSS-1
3.28 ± 0.14(0.16) %

Lab							Mean	SD	RSD
1*	5	3.04	2.84	2.99	3.06	3.01	2.99	0.09	2.9
2	0								
3	5	3.22	3.35	3.32	3.18	3.42	3.30	0.10	3.0
4	0								
5	5	3.03	3.14	2.98	3.16	3.20	3.10	0.09	3.0
6	5	3.26	3.23	3.22	3.13	3.16	3.20	0.05	1.7
7	5	3.217	3.026	3.135	3.109	3.144	3.126	0.069	2.2
8	5	3.12	3.22	3.30	3.18	3.14	3.19	0.07	2.2
9	5	3.31	3.20	3.17	3.20	3.27	3.23	0.06	1.8
10	0								
11	5	3.1365	3.0738	3.2210	3.1297	3.0539	3.1230	0.0652	2.1
12	5	3.37	3.42	3.37	3.40	3.40	3.39	0.02	0.6
13'	5	3.37	3.26	3.23	3.25	3.26	3.27	0.06	1.7
14	5	3.3	3.35	3.29	3.27	3.34	3.31	0.03	1.0
15	5	3.13	3.13	3.13	3.18	3.18	3.15	0.03	0.9
16	5	3.19	3.26	3.19	3.26	3.28	3.24	0.04	1.3
17	5	3.3	3.3	3.2	3.2	3.2	3.2	0.1	1.7
18	5	3.233	3.1629	3.2307	3.2694	3.0952	3.1982	0.0693	2.2
19	5	3.37	3.17	3.29	3.18	3.23	3.25	0.08	2.6
20	0								
21	5	3.39	3.24	3.49	3.39	3.28	3.36	0.10	3.0
22	0								
23*	5	2.94	3.02	2.90	2.88	2.89	2.93	0.06	2.0
24	5	3.068	3.089	3.231	3.104	3.176	3.134	0.068	2.2
25	5	3.36	3.34	3.33	3.34	3.36	3.35	0.01	0.4
26*	5	3.6355	3.6000	3.569	3.487	3.6715	3.5926	0.0704	2.0
27*	5	2.89	2.80	2.70	2.83	2.88	2.82	0.08	2.7
28	0								
29*	5	3.12	3.03	3.04	3.07	3.03	3.06	0.04	1.3
30	5	3.32	3.41	3.36	3.32	3.30	3.34	0.04	1.3
31	0								
32*'	5	3.50	3.49	3.49	3.49	3.49	3.49	0.00	0.1
33	0								
34*	5	2.42	2.40	2.45	2.46	2.34	2.41	0.05	2.0
35*	5	2.3727	2.7818	2.2900	2.8037	2.6596	2.5816	0.2367	9.2
36	0								
37'	5	3.26	3.31	3.12	3.29	3.3	3.26	0.08	2.4
38*	5	3.58	3.57	3.52	3.68	3.36	3.54	0.12	3.3
39	5	3.3724	3.3856	3.3557	3.3063	3.3337	3.3507	0.0315	0.9
40	2	3.28	3.34						

IRON
Tissue Z
608 ± 84 mg/kg

Lab							Mean	SD	RSD
1	0								
2	5	611	613	611	616	614	613	2	0.3
3	5	654	651	654	650	652	652	2	0.3
4	0								
5	0								
6	5	588	559	594	576	572	578	14	2.4
7	0								
8	5	564	567	592	517	567	561	27	4.9
9	5	637	664	654	657	660	654	10	1.6
10*	5	481.41	488.26	475.78	421.950	435.900	460.66	29.72	6.5
11	5	614.55	597.52	589.51	579.2	588.94	593.94	13.22	2.2
12	0								
13	5	663	661	642	659	656	656	8	1.3
14	5	603	610	612	602	590	603	9	1.4
15	5	617	621	625	620	616	620	4	0.6
16	5	557	548	537	538	527	541	11	2.1
17	5	620	660	640	660	620	640	20	3.1
18	5	665	632	645	598	575	623	36	5.8
19	5	601	607	611	610	611	608	4	0.7
20	0								
21	5	574.93	578.62	576.79	578.44	579.77	577.71	1.88	0.3
22	5	588	547	532	506	530	541	30	5.6
23*	5	501	481	463	499	503	489	17	3.5
24	5	585.84	565.43	522.26	536.68	529.86	548.01	26.72	4.9
25	5	671	669	634	642	632	650	19	2.9
26	0								
27*	5	515	509	514	510	516	513	3	0.6
28	5	516	541	524	523	536	528	10	1.9
29	5	618	610	613	593	615	610	10	1.6
30	5	684	668	680	649	652	667	16	2.4
31	0								
32	0								
33	0								
34*	5	485	527	487	474	467	488	23	4.8
35**	5	383.4	387.1	383.9	385.7	371.5	382.3	6.2	1.6
36	5	610	627	620	614	611	616	7	1.2
37	5	645	664	665	652	649	655	9	1.4
38	0								
39	5	633	633	635	627	637	633	4	0.6
40	5	628	622	652	638	656	639	15	2.3
41	5	653	637	637	612	620	632	16	2.5
42	5	630	603	620	627	607	617	12	1.9

IRON
SRM 1566a
539 ± 15(54) mg/kg

Lab							Mean	SD	RSD
1	0								
2	5	497	495	494	494	495	495	1	0.2
3'	5	546	546	547	549	531	544	7	1.3
4	0								
5	0								
6'	5	499	489	501	498	501	498	5	1.0
7	0								
8	5	515	563	468	551	541	528	38	7.1
9	5	518	507	521	528	520	519	8	1.5
10*	5	422.26	419.29	408.14	407.370	424.000	416.21	7.91	1.9
11	5	540.05	549.02	555.17	555.66	539.33	547.85	7.90	1.4
12	0								
13	5	524	538	531	538	537	534	6	1.1
14	5	495	536	535	523	511	520	17	3.3
15	5	527	498	506	510	524	513	12	2.4
16	5	534	503	522	508	525	518	13	2.4
17	5	530	540	540	530	550	538	8	1.6
18*	5	464	472	461	495	490	476	15	3.2
19	5	540	532	541	532	532	535	5	0.9
20	0								
21	5	529.24	526.14	530.68	527.91	529.02	528.60	1.69	0.3
22	5	505	453	509	486	492	489	22	4.5
23*	5	472	484	451	464	491	472	16	3.4
24*	5	414.03	381.41	410.5	413.18	388.72	401.57	15.34	3.8
25	5	543	547	534	540	536	540	5	1.0
26	0								
27*	5	473	474	480	454	470	470	10	2.1
28*	5	464	472	477	473	492	476	10	2.2
29'	5	523	525	525	525	525	525	1	0.2
30	5	550	526	525	534	539	535	10	1.9
31	0								
32	0								
33	0								
34*	5	451	454	456	459	458	456	3	0.7
35*	5	447	420.9	430.5	436.4	421.5	431.3	10.9	2.5
36	5	488	496	494	494	501	495	5	0.9
37	5	527	521	543	539	528	532	9	1.7
38	0								
39	5	527	525	524	523	524	525	2	0.3
40	0	542	532	530	529	504	527	14	2.7

NICKEL
Sediment Y
72.2 ± 12.0 mg/kg

Lab							Mean	SD	RSD
1	5	70.6	68.4	78.2	71.8	75.1	72.8	3.9	5.3
2	0								
3	5	74	69.8	70.5	68.2	66.9	69.9	2.7	3.9
4	5	78.4	70.6	74.3	80.8	77.8	76.4	4.0	5.2
5	5	71	72	69	75	67	71	3	4.3
6	5	74.9	76.1	72.4	77.4	76.8	75.5	2.0	2.6
7	5	73.57	67.96	74.3	73.04	68.99	71.57	2.89	4.0
8	5	67.4	71.3	68.9	70.7	67.6	69.2	1.8	2.6
9	5	80.9	88.3	84.3	87.0	80.5	84.2	3.5	4.2
10	0								
11	5	70.40	68.57	68.6	71.63	66.27	69.09	2.04	3.0
12	5	74.9	82.6	82.6	79.7	79.0	79.8	3.2	4.0
13	5	62.6	70.2	67.2	68.2	77.1	69.1	5.3	7.7
14	5	69.2	74.4	76.6	79.1	84.6	76.8	5.7	7.4
15	5	62.9	74.5	70.0	73.0	74.2	70.9	4.8	6.8
16	5	79.68	83.62	73.2	80.88	78.47	79.17	3.84	4.9
17	5	78	84	79	85	75	80	4	5.2
18	5	64.4	62.8	65.2	61.4	69.9	64.7	3.2	5.0
19	5	77.2	77.3	80.2	76.8	79.6	78.2	1.6	2.0
20	5	72	74	77	74	80	75	3	4.2
21	5	78.08	77.87	79.72	78.98	77.68	78.47	0.86	1.1
22	0								
23	5	68.6	64.6	62.2	59.4	62.7	63.5	3.4	5.4
24	5	71.56	68.51	48.49	65.03	66.71	64.06	9.03	14.1
25'	5	79.9	79.9	82.7	80.6	80.2	80.7	1.2	1.5
26'	5	67.1	63.6	66.8	66.2	67.1	66.2	1.5	2.2
27	5	61.6	61.9	62.0	60.1	60.0	61.1	1.0	1.6
28	0								
29	5	70.8	71.4	74.0	70.8	69.6	71.3	1.6	2.3
30	5	71.5	75.7	78.0	80.1	70.7	75.2	4.1	5.4
31	0								
32	5	74	73	73	72	73	73	1	1.0
33	5	74.7	76.6	77.2	73.9	72.6	75.0	1.9	2.5
34*	5	63.7	56.1	57.4	53.5	52.5	56.6	4.4	7.8
35	5	71.01	63.86	59.81	58.22	58.88	62.36	5.31	8.5
36	5	71.4	65.1	66.5	63.8	63.1	66.0	3.3	5.0
37	5	64.5	62.6	59.6	61.2	66.4	62.9	2.7	4.3
38	5	77	85	78	74	74	78	5	5.8
39	5	71.2	70.9	71.5	72.3	72.9	71.8	0.8	1.1
40	0								
41	5	77	74	74	75	71	74	2	2.9
42	5	77	77	70	74	75	75	3	3.9

NICKEL
BCSS-1
55.3 ± 3.6(5.5) mg/kg

Lab							Mean	SD	RSD
1	5	58.6	54.1	54.4	59.2	58.7	57.0	2.5	4.4
2	0								
3	5	53.0	52.9	53.8	58.0	58.2	55.2	2.69	4.9
4	5	54.8	54.1	52.7	52.4	59.5	54.7	2.9	5.2
5	5	50	52	51	51	54	52	2	2.9
6	5	51.0	54.0	55.6	51.6	51.9	52.8	1.9	3.6
7	5	54.0	55.4	54.6	53.2	55.3	54.5	0.9	1.7
8	5	50.1	51.5	51.1	50.5	48.60	50.4	1.1	2.2
9	5	52.3	51.4	50.6	52.1	52.1	51.7	0.7	1.4
10	0								
11	5	51.63	49.18	51.20	48.57	48.16	49.75	1.57	3.2
12	5	57.4	57.8	56.9	56.8	58.3	57.4	0.6	1.1
13	5	59.5	58.7	56.6	58.5	58.0	58.3	1.1	1.8
14'	5	59.7	58.8	60.1	58.5	64.2	60.3	2.3	3.8
15	5	55.0	53.7	55.7	56.0	55.9	55.3	1.0	1.7
16	5	54.55	56.24	54.43	56.83	57.17	55.84	1.28	2.3
17	5	54	56	55	53	56	55	1	2.4
18''	5	48.1	47.8	49.6	49.8	55.3	50.1	3.0	6.0
19'	5	56.5	55.2	55.2	55.4	55.2	55.5	0.6	1.0
20	5	54	53	54	53	55	54	1	1.6
21	5	58.22	57.19	58.03	56.97	57.52	57.59	0.53	0.9
22	0								
23*	5	49.0	47.6	48.1	47.7	48.0	48.1	0.6	1.2
24*	5	51.96	51.69	42.5	41.06	48.62	47.17	5.11	10.8
25	5	52.7	51.9	52.8	52.0	52.8	52.4	0.5	0.9
26'	5	54.6	50.1	51.3	51.1	50.4	51.5	1.8	3.5
27''	5	47.0	47.2	45.8	47.3	47.3	46.9	0.6	1.4
28	0								
29	5	54.5	55.7	51.6	52.7	56.8	54.3	2.1	3.9
30	5	54.5	55.2	55.6	54.1	53.5	54.6	0.8	1.5
31	0								
32	5	55	55	55	57	56	56	1	1.6
33	5	57.5	54.8	56.7	54.3	53.8	55.4	1.6	2.9
34*	5	44.4	45.4	45.8	45.9	43.3	45.0	1.1	2.4
35	5	52.42	52.52	53.51	55.77	52.14	53.27	1.49	2.8
36	5	51.3	55.2	61.7	48.8	60.8	55.6	5.7	10.2
37	5	50.3	48.1	54.2	50.5	51.6	50.9	2.2	4.4
38	5	62	59	62	59	61	61	2	2.5
39	5	55.5	54.9	55.2	55.5	55.7	55.4	0.3	0.6
40	0								

NICKEL
Tissue Z
2.77 ± 0.42 mg/kg

Lab							Mean	SD	RSD
1	0								
2	5	3.24	2.66	2.99	3.09	3.22	3.04	0.24	7.7
3	5	2.39	2.49	2.43	2.42	2.43	2.43	0.04	1.5
4*	5	3.61	3.49	4.04	4.17	3.95	3.85	0.29	7.5
5	0								
6	5	2.70	2.45	2.45	2.80	2.75	2.63	0.17	6.4
7	0								
8*	5	3.83	3.32	3.24	3.18	3.61	3.44	0.28	8.0
9	5	2.82	2.70	2.62	2.58	2.65	2.67	0.09	3.5
10	5	2.979	2.755	2.677	2.276	2.728	2.683	0.255	9.5
11	5	<3.4	<3.1	<3.4	<3.3	<3.3			
12	0								
13	5	2.75	2.84	2.62	2.65	2.66	2.70	0.09	3.3
14	5	2.47	2.46	2.51	2.69	2.66	2.56	0.11	4.3
15	5	3.18	3.44	2.93	3.24	3.06	3.17	0.19	6.1
16	5	2.53	2.52	2.55	2.57	2.58	2.55	0.03	1.0
17*	5	2	3	1	2	2	2	1	35.4
18	5	3.3	3.1	3.2	2.7	2.9	3.0	0.2	7.9
19	5	2.87	2.92	3.02	3.07	3.06	2.99	0.09	3.0
20	0								
21	5	2.76	2.85	2.63	2.91	2.65	2.76	0.12	4.4
22	5	2.81	2.51	2.54	2.63	2.38	2.57	0.16	6.2
23	5	<2	<3	<2	<2	<2			
24	5	2.49	2.32	2.53	2.47	2.33	2.43	0.10	4.0
25	5	2.93	2.91	2.81	2.81	2.80	2.85	0.06	2.2
26*	5	2.39	2.57	1.99	1.77	1.79	2.10	0.36	17.2
27	5	2.83	2.80	2.85	2.73	3.15	2.87	0.16	5.6
28	5	3.10	3.12	3.00	3.04	2.94	3.04	0.07	2.4
29	5	2.98	2.42	2.58	2.65	2.73	2.67	0.21	7.7
30	5	2.86	2.93	2.82	2.86	2.82	2.86	0.04	1.6
31	5	3.07	3.07	3.00	3.12	3.07	3.07	0.04	1.4
32	5	2.59	2.68	2.51	2.61	2.58	2.59	0.06	2.4
33	5	2.88	2.60	3.02	2.97	2.73	2.84	0.17	6.1
34	5	2.57	2.69	2.66	2.73	2.63	2.66	0.06	2.3
35*	5	1.51	1.57	1.51	1.89	2.01	1.70	0.24	13.9
36	5	2.77	2.78	2.77	2.74	2.80	2.77	0.02	0.8
37	5	2.75	2.17	2.99	2.18	2.30	2.48	0.37	15.0
38*	5	2.08	1.95	2.00	2.02	2.02	2.01	0.05	2.3
39	5	2.77	2.81	2.77	2.79	2.79	2.79	0.02	0.6
40	0								
41	5	2.9	2.9	2.9	2.7	2.7	2.8	0.1	3.9
42'	5	3.02	3.09	3.02	3.01	3.00	3.03	0.04	1.2

NICKEL
SRM 1566a
2.25 ± 0.44 mg/kg

Lab							Mean	SD	RSD
1	0								
2	5	2.11	1.89	2.16	1.74	1.71	1.92	0.21	10.8
3	5	2.49	2.3	2.32	2.00	2.52	2.33	0.21	8.9
4	5	2.60	2.72	2.34	2.53	2.30	2.50	0.18	7.1
5	0								
6	5	2.20	2.10	2.50	1.75	2.00	2.11	0.27	13.0
7	0								
8	5	2.25	1.90	2.14	2.54	2.50	2.27	0.26	11.7
9	5	1.6	1.79	2.15	2.04	2.28	1.97	0.28	13.9
10	5	2.421	2.187	2.029	2.320	1.949	2.181	0.196	9.0
11	5	<3.3	<3.3	<3.4	<3.5	<3.3			
12	0								
13	5	2.22	2.06	2.03	2.29	2.74	2.27	0.29	12.6
14	5	2.13	2.56	2.32	2.70	2.24	2.39	0.23	9.8
15	5	2.26	2.52	2.42	2.04	2.85	2.42	0.30	12.5
16	5	1.90	1.90	1.82	1.84	1.87	1.87	0.04	1.9
17	5	2	2	2	1	2	2	0.4	24.8
18	5	1.9	2.3	1.8	2.3	1.9	2.0	0.2	11.8
19	5	1.92	2.03	2.15	1.99	2.57	2.13	0.26	12.1
20	0								
21	5	2.4	2.49	1.94	1.81	1.99	2.13	0.30	14.1
22	5	2.23	1.99	2.77	2.10	1.74	2.17	0.38	17.7
23	5	<2	<2	<2	<2	<2			
24	5	2.6	2.125	2.035	1.86	2.00	2.12	0.28	13.3
25	5	2.55	2.35	2.16	2.18	2.33	2.31	0.16	6.8
26	5	2.59	1.83	1.84	1.66	2.11	2.01	0.36	18.1
27	5	2.54	2.38	1.85	2.42	2.00	2.24	0.30	13.2
28	5	2.30	2.44	2.44	2.64	2.70	2.50	0.16	6.5
29	5	1.78	2.28	1.93	2.08	2.00	2.01	0.19	9.2
30	5	2.03	2.21	2.37	2.42	2.00	2.21	0.19	8.7
31	5	2.03	2.05	2.25	2.28	2.89	2.30	0.35	15.2
32	5	1.75	1.80	1.74	2.29	2.24	1.96	0.28	14.1
33	5	2.30	2.38	2.22	2.45	2.15	2.30	0.12	5.2
34	5	1.73	1.73	2.07	1.81	2.11	1.89	0.19	9.8
35	5	2.38	2.49	2.63	2.41	2.42	2.47	0.10	4.1
36	5	2.12	2.67	2.34	2.28	2.23	2.33	0.21	8.9
37	5	2.36	2.05	1.76	2.53	2.22	2.18	0.30	13.5
38	5	1.92	1.75	1.98	1.79	1.71	1.83	0.12	6.3
39	5	2.11	2.28	1.94	2.03	2.99	2.27	0.42	18.6
40	0								

COPPER
Sediment Y
365 ± 43 mg/kg

Lab							Mean	SD	RSD
1	5	372	384	357	356	391	372	16	4.2
2	0								
3	5	396	383	385	367	385	383	10	2.7
4	5	382	401	378	389	396	389	10	2.4
5	5	361	358	353	385	342	360	16	4.4
6	5	388	371	413	394	391	391	15	3.8
7	5	342.03	320.77	355.37	330.69	366.77	343.13	18.47	5.4
8*	5	320	322	319	333	310	321	8	2.6
9	5	367	346	398	362	339	362	23	6.3
10	0								
11	5	381	353.39	362.4	360.82	341.76	359.87	14.35	4.0
12	5	368	406	397	388	395	391	14	3.7
13	5	363	360	354	372	359	362	7	1.8
14	5	342	351	353	346	358	350	6	1.8
15	5	332	364	351	378	382	361	20	5.7
16'	5	335	335	320	340	335	333	8	2.3
17*	5	420	400	410	420	430	416	11	2.7
18	5	371	363	363	343	363	361	10	2.9
19	5	399	391	396	398	392	395	4	0.9
20	5	389	370	375	383	372	378	8	2.1
21	5	331.18	334.59	332.2	334.55	335.01	333.51	1.71	0.5
22	0								
23'	5	367	367	387	365	364	370	10	2.6
24	5	356.86	344	329.44	356	340	345.26	11.50	3.3
25	5	354	339	354	347	330	345	10	3.0
26	5	361	364	365	396	385	374	15	4.1
27	5	344	339	336	335	327	336	6	1.9
28	0								
29	5	393	402	399	397	407	400	5	1.3
30	5	382	369	375	370	379	375	6	1.5
31	0								
32	5	370	369	368	368	368	369	1	0.2
33	5	374.1	360.0	353.7	370.4	372.0	366.0	8.8	2.4
34	5	329	337	340	313	301	324	17	5.1
35	5	382.8	365.8	336.1	349.9	372.9	361.5	18.6	5.1
36	5	400	373	371	383	367	379	13	3.5
37*	5	327	319	316	326	320	322	5	1.5
38	5	370	418	405	398	389	396	18	4.5
39	5	388	367	367	377	370	374	9	2.4
40	0								
41	5	368	388	361	372	365	371	10	2.8
42	5	368	372	382	360	365	369	8	2.2

COPPER
BCSS-1
18.5 ± 2.7 mg/kg

Lab							Mean	SD	RSD
1*	5	14.8	14.5	13.9	16.3	13.8	14.7	1.0	6.9
2	0								
3	5	17.9	17.7	18.0	18.9	19.2	18.3	0.7	3.6
4	5	18.8	16.2	16.0	16.8	18.2	17.2	1.2	7.2
5'	5	16.3	16.3	15.3	22.8	16.1	17.4	3.1	17.7
6	5	15.6	16.7	17.6	16.1	17.5	16.7	0.9	5.2
7	5	18.2	19.4	18.5	18.9	18.9	18.8	0.5	2.4
8	5	21.4	18.0	17.2	16.3	16.0	17.8	2.2	12.2
9	5	17.3	17.1	16.8	16.8	17.1	17.0	0.2	1.3
10	0								
11*	5	14.29	14.29	14.8	14.08	13.67	14.23	0.41	2.9
12	5	18.1	16.3	14.8	17.4	16.2	16.6	1.3	7.6
13	5	21.2	19.6	18.8	19.5	18.6	19.5	1.0	5.2
14	5	20.5	18.7	20.4	19.7	22.1	20.3	1.2	6.1
15	5	18.1	17.3	17.8	18.2	17.6	17.8	0.4	2.1
16	5	16.45	16.53	16.7	16.92	17.19	16.76	0.30	1.8
17'	5	19	19	18	19	19	19	0.4	2.4
18	5	16.0	15.3	16.6	16.6	15.0	15.9	0.7	4.6
19	5	18.3	18	18.2	18.2	18.5	18.2	0.2	1.0
20	5	18	18	18	18	18	18	0.0	0.0
21	5	20.03	20.76	21.43	19.22	20.5	20.39	0.83	4.1
22	0								
23*	5	14.3	14.0	14.4	14.0	13.9	14.1	0.2	1.5
24	5	20.52	16.54	22.36	14.42	15.63	17.89	3.39	18.9
25	5	17.7	21.2	18.3	19.3	19.6	19.2	1.3	7.0
26*	5	17.6	15.6	14.4	15.2	14.8	15.5	1.2	8.0
27	5	14.2	16.0	16.6	21.4	14.4	16.5	2.9	17.6
28	0								
29'	5	17.6	17.1	17.1	17.1	17.1	17.2	0.2	1.3
30	5	18.1	17.8	18.1	18.9	18.9	18.4	0.5	2.8
31	0								
32'	5	17	17	16	20	17	17	2	8.7
33	5	18.35	17.40	17.87	18.36	17.00	17.80	0.60	3.3
34*	5	13.4	13.1	13.1	13.4	12.8	13.2	0.3	1.9
35	5	17.78	17.88	18.85	17.31	18.41	18.05	0.60	3.3
36	5	17.7	17.2	17.6	17.9	17.4	17.6	0.3	1.5
37	5	19.7	16.6	16.5	19.7	16.7	17.8	1.7	9.5
38*	5	25	24	25	25	23	24	1	3.7
39	5	18.5	18.5	18.5	18.4	18.4	18.5	0.1	0.3
40	0								

COPPER
Tissue Z
6.88 ± 1.05 mg/kg

Lab							Mean	SD	RSD
1	0								
2	5	7.35	7.37	7.27	7.23	7.41	7.33	0.07	1.0
3*	5	5.08	5.04	5.26	5.23	4.95	5.11	0.13	2.6
4	5	6.2	6.4	6.6	6.3	6.0	6.3	0.2	3.5
5	0								
6	5	7.09	6.90	7.19	7.24	6.90	7.06	0.16	2.3
7	0								
8	5	6.1	6.4	6.2	6.3	6.1	6.2	0.1	2.1
9	5	7.51	7.55	7.27	7.38	7.27	7.40	0.13	1.8
10*	5	5.87	5.97	5.71	5.32	5.35	5.64	0.30	5.3
11	5	7.24	6.88	6.88	7.13	6.78	6.98	0.19	2.8
12	0								
13	5	7.40	7.70	7.06	7.63	7.82	7.52	0.30	4.0
14	5	7.5	7.5	7.2	6.8	7.0	7.2	0.3	4.3
15*	5	8.15	8.52	8.75	8.29	8.51	8.44	0.23	2.7
16	5	6.62	6.65	6.36	6.35	6.43	6.48	0.14	2.2
17	5	7	8	8	7	7	7	1	7.8
18	5	5.8	6.3	5.6	6.5	6.1	6.0	0.4	6.1
19	5	7.63	7.80	7.52	7.48	7.8	7.65	0.15	2.0
20	0								
21*	5	15.81	16.03	16.19	16.81	16.59	16.29	0.41	2.5
22	5	7.28	7.14	6.92	6.82	6.61	6.95	0.26	3.8
23	5	6.52	6.76	6.08	6.12	6.33	6.36	0.28	4.5
24*	5	8.45	6.54	6.53	6.91	6.46	6.98	0.84	12.1
25	5	6.70	6.76	6.61	6.58	6.55	6.64	0.09	1.3
26	5	6.24	6.38	6.38	6.36	6.18	6.31	0.09	1.5
27	5	6.98	7.02	7.46	6.89	7.62	7.19	0.32	4.5
28	5	7.33	7.38	7.24	7.38	7.32	7.33	0.06	0.8
29*	5	10	10.2	12.5	10.8	11.3	11.0	1.0	9.1
30	5	7.15	7.34	7.26	7.49	7.32	7.31	0.12	1.7
31	5	6.57	6.38	6.71	6.51	6.26	6.49	0.17	2.7
32*	5	7.24	7.13	7.13	7.24	6.78	7.10	0.19	2.7
33	5	7.43	7.22	7.25	6.93	7.02	7.17	0.20	2.8
34	5	6.59	6.32	6.25	6.49	6.45	6.42	0.14	2.1
35	5	8.15	8.14	7.92	7.86	7.65	7.94	0.21	2.6
36	5	7.00	6.91	6.89	6.96	6.70	6.89	0.12	1.7
37	5	7.18	7.32	7.05	7.30	7.08	7.19	0.12	1.7
38	5	7.1	6.9	6.9	7.0	6.8	6.9	0.1	1.6
39	5	6.56	6.48	6.65	6.45	6.44	6.52	0.09	1.4
40	0								
41	5	6.8	6.8	6.8	6.8	6.8	6.8	0.0	0.0
42	5	6.70	6.68	6.52	6.49	6.59	6.60	0.09	1.4

COPPER
SRM 1566a
66.3 ± 4.3 (6.6) mg/kg

Lab							Mean	SD	RSD
1	0								
2	5	64.9	64.6	64.5	64.4	64.6	64.6	0.2	0.3
3	5	62.9	63.6	66.0	63.3	62.5	63.7	1.4	2.2
4	5	63.6	64.7	65.0	66.6	60.4	64.1	2.3	3.6
5	0								
6	5	66.3	64.8	65.3	65.7	65.4	65.5	0.6	0.8
7	0								
8	5	66.3	70.9	73.3	71.3	68.3	70.0	2.7	3.9
9	5	61.5	62.1	62.0	62.6	62.0	62.0	0.4	0.6
10*	5	56.42	55.81	52.40	54.96	55.22	54.96	1.54	2.8
11*	5	74.17	72.64	75.83	74.04	73.47	74.03	1.17	1.6
12	0								
13	5	67.0	65.5	64.1	68.8	68.1	66.7	1.9	2.9
14	5	64.4	66.0	58.7	65.3	60.7	63.0	3.2	5.0
15	5	63.1	62.7	62.0	62.9	63.0	62.7	0.4	0.7
16	5	63.31	62.70	63.00	62.60	62.50	62.82	0.33	0.5
17	5	68	67	64	64	68	66	2	3.1
18*	5	55.1	57.7	60.1	58.5	57.9	57.9	1.8	3.1
19	5	66.6	66.4	66.1	66.1	66.3	66.3	0.2	0.3
20	0								
21	5	70.08	70.02	69.11	70.7	70.46	70.07	0.61	0.9
22*	5	53.7	56.5	66.8	54.6	52.0	56.7	5.9	10.3
23	5	60.1	61.9	61.3	62.7	64.6	62.1	1.7	2.7
24	5	64.17	64.22	67.57	67.81	62.95	65.34	2.20	3.4
25	5	67.8	66.6	66.5	65.5	66.8	66.6	0.8	1.2
26*	5	77.1	57.9	53.4	48.1	44.1	56.12	12.84	22.9
27	5	60.9	62.0	61.7	60.0	60.9	61.1	0.8	1.3
28	5	63.0	62.6	63.4	62.2	65.0	63.2	1.1	1.7
29	5	64.8	64.8	64.8	64.8	64.8	64.8	0.0	0.0
30	5	67.8	66.3	66.1	65.3	66.0	66.3	0.9	1.4
31*	5	63.6	63.4	68.3	64.1	62.6	64.4	2.2	3.5
32	5	64.4	66.0	66.0	65.7	65.2	65.5	0.7	1.0
33	5	68.22	67.27	67.89	65.78	63.00	66.43	2.13	3.2
34	5	61.5	61.5	59.4	59.5	61.3	60.6	1.1	1.8
35	5	63.9	64.1	62.7	64.3	63.0	63.6	0.7	1.1
36	5	61.6	61.6	61.9	62.6	62.4	62.0	0.5	0.7
37	5	65.3	65.1	63.9	65.7	65.3	65.1	0.7	1.1
38*	5	59.7	63.7	63.8	64.3	63.7	63.0	1.9	3.0
39	5	65.9	66.8	66.4	67.0	66.2	66.5	0.4	0.7
40	0								

ZINC
Sediment Y
638 ± 48(64) mg/kg

Lab							Mean	SD	RSD
1	5	622	619	639	647	639	633	12	1.9
2	0								
3*	5	724	744	753	722	734	735	13	1.8
4	5	666	678	606	647	623	644	30	4.6
5*	5	737	727	731	707	684	717	22	3.0
6	5	667	652	662	706	695	676	23	3.4
7	5	664.1	588.2	720.8	615.8	621.7	642.12	51.70	8.1
8	5	653	612	662	650	596	635	29	4.5
9*	5	545	526	587	593	533	557	31	5.6
10	0								
11	5	624.2	585.89	634.2	626.73	608.24	615.85	19.24	3.1
12	5	660	697	716	706	710	698	22	3.2
13	5	609	613	635	645	639	628	16	2.6
14	5	591	607	608	659	658	625	32	5.1
15	5	643	619	615	632	619	626	12	1.9
16	5	590	610	600	620	620	608	13	2.1
17	5	680	670	660	680	670	672	8	1.2
18	5	636	607	603	588	616	610	18	2.9
19	5	635	638	638	650	647	642	7	1.0
20*	5	770	770	828	817	785	794	27	3.4
21	5	614.57	612.44	617.97	617.92	615.84	615.75	2.34	0.4
22	0								
23	5	590	641	615	587	604	607	22	3.6
24	5	662.39	603.61	521.22	610.51	594.69	598.48	50.59	8.5
25	5	705	696	692	679	708	696	12	1.7
26	5	610	640	647	703	690	658	38	5.8
27*	5	516	532	518	518	502	517	11	2.1
28	0								
29	5	631	651	656	626	608	634	20	3.1
30	5	654	665	655	686	657	663	13	2.0
31	0								
32	5	662	664	662	658	663	662	2	0.3
33	5	570	594	591	568	583	581	12	2.0
34*	5	542	540	548	506	508	529	20	3.8
35*	5	794.9	637.5	662.2	681.2	790.8	713.32	74.25	10.4
36	5	632	628	643	619	631	631	9	1.4
37	5	659	684	662	678	661	669	11	1.7
38*	5	1140	1240	1120	1280	1150	1186	70	5.9
39	5	679	680	682	688	689	684	5	0.7
40	2	616	667						
41	5	685	674	664	632	627	656	26	3.9
42	5	643	649	657	645	653	649	6	0.9

ZINC
BCSS-1
119 ± 12 mg/kg

Lab							Mean	SD	RSD
1'	5	106	102	106	107	106	105	2	1.8
2	0								
3'	5	115	116	115	114	122	116	3	2.8
4	5	129.8	120.9	107.5	108.6	110.7	115.50	9.60	8.3
5*	5	101	103	100	99	101	101	1	1.5
6	5	108	108	111	111	113	110	2	2.0
7	5	111.3	132.8	118.2	112.4	119	118.74	8.57	7.2
8	5	121	117	109	106	110	113	6	5.5
9*	5	99.7	100.3	101	96.8	96.4	98.8	2.1	2.1
10	0								
11	5	105.71	102.86	108.20	104.90	103.27	104.99	2.14	2.0
12	5	110	111	112	109	109	110	1	1.2
13	5	116	111	113	104	107	110	5	4.3
14	5	106	105	112	108	112	109	3	3.0
15	5	110	105	106	110	107	108	2	2.1
16	5	110	110	111	112	110	111	1	0.8
17	5	110	120	115	110	110	113	4	4.0
18	5	106	104	102	107	105	105	2	1.8
19	5	112	123	115	120	113	117	5	4.0
20	5	122	123	118	113	118	119	4	3.3
21'	5	122.02	115.42	116.13	117.02	115.85	117.29	2.71	2.3
22	0								
23*	5	104	104	102	103	101	103	1	1.3
24	5	100.85	103.25	105.51	104.23	110.99	104.97	3.78	3.6
25'	5	112	112	112	113	112	112	0.4	0.4
26	5	126	122	116	122	116	120	4	3.6
27*	5	89.9	91.5	89.4	90.0	90.5	90.3	0.8	0.9
28	0								
29	5	112	108	104	106	106	107	3	2.8
30	5	121	119	116	117	119	118	2	1.6
31	0								
32	5	125	121	123	122	124	123	2	1.3
33	5	104.5	105.8	103.1	112.5	101.2	105.4	4.3	4.1
34*	5	88.2	90.9	93.5	91.6	86.4	90.1	2.8	3.1
35*	5	129.3	148.5	152.9	164.4	159.2	150.9	13.5	8.9
36	5	112	124	119	115	122	118	5	4.2
37	5	119	120	117	118	123	119	2	1.9
38*	5	185	151	200	185	205	185	21	11.4
39	5	122	122	122	119	125	122	2	1.7
40	2	128	122						

ZINC
Tissue Z
150 ± 18 mg/kg

Lab							Mean	SD	RSD
1	0								
2	5	155	155	155	155	155	155	0.0	0.0
3	5	151	138	154	149	148	148	6	4.1
4'	5	135	120	138	140	135	134	8	5.9
5	0								
6	5	161	151	157	156	155	156	4	2.3
7	0								
8'	5	159	159	158	156	142	155	7	4.7
9	5	142	142	140	140	141	141	1	0.7
10*	5	128.01	129.54	129.81	117.830	118.880	124.81	5.95	4.8
11'	5	153.96	147.39	153.96	154.73	152.71	152.55	2.97	1.9
12	0								
13	5	161	158	158	158	159	159	1	0.8
14*	5	184	177	187	174	171	179	7	3.8
15	5	153	155	152	156	157	155	2	1.3
16	5	146	142	142	139	146	143	3	2.1
17	5	160	160	160	160	160	160	0.0	0.0
18	5	156	154	153	142	147	150	6	3.8
19	5	154	158	152	158	161	157	4	2.3
20	0								
21	5	159.61	159.92	158.84	162.75	161.57	160.54	1.59	1.0
22*	5	134	132	132	128	120	129	6	4.3
23	5	141	140	135	138	138	138	2	1.7
24*	5	124.43	117.4	123.685	126.48	121.86	122.77	3.43	2.8
25	5	153	151	146	146	144	148	4	2.6
26*	5	124	118	120	111	121	119	5	4.1
27	5	132	136	132	130	135	133	2	1.8
28	5	139	144	140	143	142	142	2	1.5
29	5	148	146	147	144	146	146	1	1.0
30	5	169	162	171	159	164	165	5	3.0
31	5	154	150	153	150	149	151	2	1.4
32	5	156.5	156.5	167.2	162.9	155.6	159.7	5.1	3.2
33	5	133.4	136.2	139.1	135.1	131.7	135.1	2.8	2.1
34*	5	126	128	128	131	128	128	2	1.4
35	5	160.4	151.2	136.1	152.1	131.9	146.3	11.9	8.1
36'	5	149	151	149	149	149	149	1	0.6
37*	5	170	169	170	169	172	170	1	0.7
38	0								
39	5	140	139	141	139	139	140	1	0.6
40	5	153	159	161	164	157	159	4	2.6
41	5	159	159	157	155	158	158	2	1.1
42	5	157	159	160	159	155	158	2	1.3

ZINC
SRM 1566a
830 ± 57(83) mg/kg

Lab							Mean	SD	RSD
1	0								
2	5	837	835	833	832	835	834	2	0.2
3	5	826	826	837	858	828	835	14	1.6
4	5	800	781	838	854	786	812	32	4.0
5	0								
6	5	871	854	864	861	865	863	6	0.7
7	0								
8	5	776	796	809	803	779	793	15	1.8
9	5	775	770	768	770	780	773	5	0.6
10*	5	737.43	732.37	715.58	699.860	748.600	726.77	19.18	2.6
11	5	897.45	900.04	906.5	898.34	899.29	900.32	3.59	0.4
12	0								
13	5	833	838	832	851	847	840	8	1.0
14	5	813	836	745	841	895	826	54	6.6
15	5	856	851	844	827	833	842	12	1.4
16	5	770	760	760	750	760	760	7	0.9
17	5	870	870	880	880	880	876	5	0.6
18	5	753	787	753	811	786	778	25	3.2
19	5	814	812	827	837	792	816	17	2.1
20	0								
21	5	817.49	814.58	814.27	812.07	815.28	814.74	1.95	0.2
22*	5	627	761	761	646	557	670	89	13.3
23	5	788	812	807	811	845	813	21	2.5
24	5	830.67	865.16	821.91	834.05	842.7	838.90	16.46	2.0
25	5	845	847	828	809	811	828	18	2.2
26*	5	604	607	585	679	546	604	48	8.0
27*	5	720	722	739	714	720	723	9	1.3
28	5	759	774	784	770	774	772	9	1.2
29	5	813	800	825	828	805	814	12	1.5
30	5	863	860	833	838	830	845	16	1.8
31	5	834	827	829	844	822	831	8	1.0
32	5	809.5	834.9	838.1	825.4	827.5	827.1	11.1	1.3
33	5	818	783	845	784	793	805	27	3.3
34*	5	730	736	725	738	740	734	6	0.8
35	5	852.7	845.2	852.2	844.1	827.8	844.4	10.1	1.2
36	5	808	810	809	815	812	811	3	0.3
37	5	867	871	848	861	869	863	9	1.1
38	0								
39	5	797	794	808	792	800	798	6	0.8
40	5	884	880	858	868	854	869	13	1.5

ARSENIC
Sediment Y
18.2 ± 3.9 mg/kg

Lab							Mean	SD	RSD
1	5	18.4	19.4	20.4	20.4	21.4	20.0	1.1	5.7
2	0								
3*	5	26.5	26.7	26.1	26.1	26.3	26.3	0.3	1.0
4	5	15.7	16.3	16.2	16.2	16.7	16.2	0.4	2.2
5*	4	19.8	16.5	20.8	19.7		19.2	1.9	9.7
6	5	19.3	19.6	20.1	19.9	19.5	19.7	0.3	1.6
7	4	17.24	18.47	17.47	18.45		17.91	0.64	3.6
8	5	18.7	20.2	16.8	25.9	16.4	19.6	3.8	19.6
9	5	17.3	17.7	17.3	18.6	21.0	18.4	1.6	8.5
10	0								
11	5	15.80	14.46	15.40	15.92	15.10	15.34	0.59	3.8
12	5	17.7	18.7	18.0	15.5	18.2	17.6	1.24	7.0
13*	5	19.8	19.6	16.3	19.7	19.3	18.9	1.5	7.9
14	5	13.8	18.3	16.2	17.2	17.0	16.5	1.7	10.2
15	5	17.4	17.2	17.9	17.6	17.6	17.5	0.3	1.5
16	5	20.8	20.53	21.22	21.86	22.22	21.33	0.71	3.3
17	5	21.6	21.2	20.8	21.6	22.3	21.5	0.6	2.6
18	5	18.7	20.1	18.0	17.3	19.9	18.8	1.2	6.4
19*	5	22.9	23.6	22.9	22.4	22.9	22.9	0.4	1.9
20**	5	12.7	12.7	12.7	12.7	12.8	12.7	0.0	0.4
21	5	15.73	14.82	15.21	15.08	14.99	15.17	0.35	2.3
22	0								
23	5	18.1	18.8	18.5	19.7	18.5	18.7	0.6	3.2
24	5	15.80	14.50	14.30	13.90	13.90	14.48	0.78	5.4
25	5	20.6	19.8	20.3	19.4	18.6	19.7	0.8	4.0
26	5	16.0	16.0	16.4	16.7	15.8	16.2	0.4	2.2
27	5	17.7	18.9	18	17.9	16.3	17.8	0.9	5.3
28	0								
29	5	19.1	18.5	18.8	17.9	18.5	18.6	0.4	2.4
30	5	20.4	19.3	20.3	19.3	20.0	19.9	0.5	2.7
31*	5	22.3	24.1	23.6	23.0	21.9	23.0	0.9	3.9
32	5	20.2	19.1	19.9	18.5	18.6	19.3	0.8	4.0
33*	5	13.93	13.17	13.40	13.23	13.08	13.36	0.34	2.5
34*	5	15.3	13.4	13.7	13.0	13.5	13.8	0.9	6.4
35	0								
36	0								
37	0								
38	0								
39	5	15.9	16.6	16.5	16.8	16.4	16.4	0.3	2.0
40	2	19.7	18.8						
41	5	16.7	16.5	16.1	18.2	16.8	16.9	0.8	4.7
42	0								

ARSENIC
BCSS-1
11.1 ± 1.4 mg/kg

Lab							Mean	SD	RSD
1	5	10.2	10.0	10.2	10.2	10.2	10.2	0.1	0.9
2	0								
3	5	12.2	12.2	11.8	11.9	12.4	12.1	0.2	2.0
4	5	10.2	9.9	9.8	10.5	11.1	10.3	0.5	5.1
5	5	9.9	10.7	10.7	10.6	10.4	10.5	0.3	3.2
6	5	9.70	9.84	9.80	10.30	9.87	9.90	0.23	2.3
7	5	10.0	11.0	10.9	10.7	10.8	10.7	0.4	3.7
8	5	11.7	13.3	7.48	7.25	11.3	10.21	2.70	26.5
9	5	10.1	10.0	9.4	10.4	9.9	10.0	0.4	3.7
10	0								
11*	5	8.16	8.37	8.00	7.96	8.78	8.25	0.34	4.1
12	5	10.2	10.2	10.4	10.6	11.4	10.6	0.5	4.7
13	5	9.9	10.5	11.8	10.2	10.8	10.6	0.7	6.9
14	5	11.8	11.6	13.7	12.0	13.0	12.4	0.90	7.2
15	5	10.1	10.0	10.2	10.1	10.0	10.1	0.1	0.8
16	5	11.89	11.74	11.72	11.85	11.31	11.70	0.23	2.0
17	5	11.1	10.9	10.8	10.7	11.0	10.9	0.2	1.5
18	5	10.1	9.0	9.3	10.1	9.3	9.6	0.5	5.3
19	5	11.8	11.9	12.2	12.1	12.2	12.0	0.2	1.5
20	5	10.3	10.2	10.2	10.4	10.3	10.3	0.1	0.8
21	5	12.09	12.16	12.42	12.06	12.19	12.18	0.14	1.2
22	0								
23	5	10.8	9.8	9.9	9.7	10.1	10.1	0.4	4.4
24	5	9.79	9.95	10.7	9.95	11.30	10.34	0.64	6.2
25	5	11.8	11.8	11.5	11.3	11.4	11.6	0.2	2.0
26*	5	7.72	7.90	7.74	8.34	8.10	7.96	0.26	3.3
27	5	10.8	10.7	10.6	10.1	10.6	10.6	0.3	2.6
28	0								
29*	5	10.3	10.3	10.3	10.3	11.3	10.5	0.4	4.3
30	5	10.9	11.3	10.8	10.7	10.9	10.9	0.2	2.1
31	5	12.3	12.2	12.2	12.1	12.2	12.2	0.1	0.6
32	5	9.73	9.93	10.34	10.34	10.14	10.10	0.27	2.6
33	5	9.45	9.30	9.83	10.41	10.28	9.85	0.49	5.0
34*	4	5.21	5.31	5.61	5.38		5.38	0.17	3.2
35	0								
36	0								
37	0								
38	0								
39	5	11.1	10.8	11.2	10.9	10.8	11.0	0.2	1.7
40	2	9.56	9.59						

ARSENIC
Tissue Z
8.31 ± 1.58 mg/kg

Lab							Mean	SD	RSD
1	0								
2	5	8.15	7.84	7.84	7.68	8.31	7.96	0.26	3.2
3	5	9.90	9.50	9.80	8.66	8.84	9.34	0.56	6.0
4	5	7.7	7.1	7.6	6.1	6.8	7.1	0.7	9.2
5	0								
6	5	8.71	8.66	8.38	8.78	8.36	8.58	0.19	2.3
7	5	7.44	7.86	7.70	8.07	8.13	7.84	0.28	3.6
8	5	7.4	7.4	7.1	7.3	7.3	7.3	0.1	1.7
9	5	8.49	9.21	8.40	7.99	8.16	8.45	0.47	5.5
10	5	8.227	8.215	8.177	7.296	7.592	7.901	0.431	5.5
11*	5	5.12	5.22	5.28	5.07	5.09	5.16	0.09	1.7
12	0								
13	5	8.66	8.52	8.440	9.390	9.690	8.94	0.56	6.3
14	5	8.2	8.1	8.3	8.6	8.5	8.3	0.2	2.5
15	5	8.69	8.87	8.95	8.88	8.98	8.87	0.11	1.3
16'	5	9.55	9.09	9.13	9.11	9.15	9.21	0.19	2.1
17	5	9	8	8	9	9	9	1	6.4
18*	5	10.7	10.7	10.6	9.8	10.2	10.4	0.4	3.8
19	5	7.13	7.73	7.94	7.47	7.98	7.65	0.35	4.6
20	0								
21	5	7.05	6.54	6.52	7.16	6.97	6.85	0.30	4.4
22	5	9.68	9.25	9.23	8.90	8.85	9.18	0.33	3.6
23'	4	9.5	8.1	8.3	8.0		8.48	0.69	8.2
24*	5	6.001	6.250	5.200	5.876	5.650	5.795	0.397	6.9
25*	5	5.68	5.13	5.89	5.28	5.98	5.59	0.37	6.7
26	0								
27	5	9.76	9.05	8.97	7.95	8.54	8.85	0.67	7.6
28	5	9.27	9.66	9.53	9.15	9.25	9.37	0.21	2.3
29	5	7.58	7.58	7.48	7.55	7.40	7.52	0.08	1.0
30	5	8.5	8.51	8.70	8.48	8.78	8.59	0.14	1.6
31	5	8.41	8.38	8.29	8.41	8.45	8.39	0.06	0.7
32	5	9.33	8.96	9.49	9.12	9.02	9.18	0.22	2.4
33	5	8.43	8.84	8.94	8.29	7.97	8.49	0.40	4.7
34	5	7.31	7.32	7.45	7.58	7.90	7.51	0.24	3.2
35	0								
36	5	10.1	11	9.5	8.71	9.31	9.72	0.87	8.9
37	0								
38*	5	4.61	4.52	4.65	4.70	4.46	4.59	0.10	2.1
39	5	7.97	7.6	7.81	7.33	7.42	7.63	0.27	3.5
40	5	8.33	8.70	8.46	9.21	8.35	8.61	0.37	4.3
41	5	7.7	8.1	7.7	8.0	7.3	7.8	0.3	4.0
42	0								

ARSENIC
SRM 1566a
14.0 ± 1.2(1.4) mg/kg

Lab							Mean	SD	RSD
1	0								
2	5	13.9	13.0	13.2	13.7	13.3	13.4	0.4	2.8
3	5	13.1	13.2	13.0	12.8	13.2	13.1	0.2	1.3
4	5	14.8	15.0	12.8	13.5	13.6	13.9	0.9	6.7
5	0								
6	5	15.0	14.4	14.1	14.0	14.6	14.4	0.4	2.8
7	5	13.2	13.9	13.9	14.4	13.7	13.8	0.4	3.1
8	5	12.5	13.8	16.9	16.3	15.4	15.0	1.8	12.1
9	5	12.9	13.3	13.8	13.5	13.9	13.5	0.4	3.0
10	5	13.49	13.315	12.935	13.036	13.771	13.309	0.339	2.5
11*	5	9.83	9.83	9.78	9.82	9.94	9.84	0.06	0.6
12	0								
13	5	14.6	14.6	14.5	14.4	14.0	14.4	0.2	1.7
14	5	14.5	15.3	12.8	14.8	15.2	14.5	1.0	7.0
15	5	14.4	14.5	14.5	14.3	14.0	14.3	0.2	1.4
16'	5	13.47	13.99	14.16	14.05	14.07	13.95	0.27	2.0
17'	5	15	13	15	15	15	15	1	6.1
18	5	12.3	12.7	11.7	13.3	12.9	12.6	0.6	4.8
19'	5	13.4	12.9	12.9	12.8	12.9	13.0	0.2	1.8
20	0								
21	5	13.5	13.15	13.45	13.59	14.12	13.56	0.35	2.6
22'	5	12.8	13.5	16.7	13.3	12.3	13.7	1.7	12.6
23	5	13.9	12.6	12.1	11.7	13.0	12.7	0.9	6.7
24*	5	11.77	11.22	11.00	11.00	11.00	11.20	0.33	3.0
25	5	15.2	15.2	13.1	13.8	13.4	14.1	1.0	7.1
26	0								
27	5	13.3	14.3	14.2	15.6	14.6	14.4	0.8	5.7
28	5	14.5	14.5	14.3	14.5	14.2	14.4	0.1	1.0
29	5	15.5	15.8	14.5	14.0	14.3	14.8	0.8	5.3
30	5	14.2	14.0	14.2	13.3	14.3	14.0	0.4	2.9
31	5	13.4	13.5	13.4	13.1	13.2	13.3	0.2	1.2
32	5	13.3	12.9	13.3	12.9	13.4	13.2	0.2	1.8
33	5	14.63	14.06	14.05	13.40	12.88	13.80	0.68	4.9
34	5	13.8	14.3	13.8	14.1	14.0	14.0	0.2	1.5
35	0								
36	5	14.1	14.2	13.2	13.4	13.2	13.6	0.5	3.7
37	0								
38*	5	9.48	9.53	9.02	8.86	9.18	9.21	0.29	3.1
39	5	14.2	14.3	13.7	14.2	13.6	14.0	0.3	2.3
40	5	13.92	14.51	13.56	13.85	13.95	13.96	0.35	2.5

SELENIUM
Sediment Y
1.20 ± 0.63 mg/kg

Lab							Mean	SD	RSD
1'	5	1.02	1.02	0.99	0.99	1.33	1.07	0.15	13.7
2	0								
3	5	1.40	1.40	1.43	1.44	1.34	1.40	0.04	2.8
4	5	0.76	0.70	0.72	0.71	0.60	0.70	0.06	8.5
5	0								
6	5	1.2	1.3	1.3	1.1	1.1	1.2	0.1	8.3
7'	3	0.924	0.921	0.921			0.922	0.002	0.2
8	5	2	2	1	<1	1	2	1	50.0
9	5	1.14	1.1	1.15	1.25	1.22	1.17	0.06	5.2
10	0								
11	0								
12'*	5	2.0	2.2	2.0	2.0	2.0	2.0	0.1	4.5
13	5	1.58	1.53	1.81	1.60	1.49	1.60	0.12	7.7
14	5	1.40	1.77	1.64	1.42	1.61	1.57	0.16	10.0
15	0								
16	5	1.39	1.37	1.4	1.39	1.37	1.38	0.01	1.0
17'	5	1.8	1.8	1.8	1.8	1.9	1.8	0.0	2.5
18	5	1.01	0.95	0.98	1.01	1.07	1.00	0.04	4.4
19	5	1.49	1.39	1.39	1.46	1.63	1.47	0.10	6.7
20	0								
21	5	0.75	0.74	0.72	0.77	0.75	0.75	0.02	2.4
22	0								
23	4	0.88	0.84	0.84	0.89		0.86	0.03	3.0
24	5	<0.500	<0.500	<0.500	<0.500	<0.500			
25'	5	1.52	1.52	1.79	1.42	1.45	1.54	0.15	9.5
26	0								
27	5	1.04	0.990	0.897	0.837	0.876	0.928	0.084	9.1
28	0								
29*	5	1.50	2.64	2.36	2.08	2.21	2.16	0.42	19.6
30	5	0.79	0.86	0.99	0.92	0.94	0.90	0.08	8.6
31	5	1.37	1.25	1.25	1.25	1.39	1.30	0.07	5.5
32	5	0.82	1.26	1.17	1.21	0.74	1.04	0.24	23.2
33*	5	1.877	2.040	2.010	1.781	1.943	1.930	0.104	5.4
34	0								
35	0								
36	0								
37	0								
38	0								
39	5	1.38	1.40	1.40	1.42	1.44	1.41	0.02	1.6
40	0	1.43	1.67						
41	5	1.43	1.56	1.46	1.41	1.47	1.47	0.06	3.9
42	0								

SELENIUM
BCSS-1
0.43 ± 0.06 mg/kg

Lab							Mean	SD	RSD
1*	5	0.48	0.65	0.48	0.50	0.60	0.54	0.08	14.4
2	0								
3	5	0.413	0.45	0.449	0.481	0.481	0.455	0.028	6.2
4*	5	0.33	0.28	0.29	0.29	0.31	0.30	0.02	6.7
5	0								
6'	5	0.4	0.4	0.4	0.5	0.4	0.4	0.0	10.6
7	3	0.37	0.35	0.47			0.40	0.06	16.2
8	5	<1	1	<1	<1	<1			
9	5	0.43	0.38	0.39	0.38	0.43	0.40	0.03	6.4
10	0								
11	0								
12*	5	0.70	0.68	0.65	0.65	0.75	0.69	0.04	6.1
13	5	0.41	0.51	0.41	0.40	0.50	0.45	0.05	12.1
14	5	0.55	0.58	0.39	0.57	0.57	0.53	0.08	15.1
15	0								
16	5	0.35	0.37	0.4	0.37	0.39	0.38	0.02	5.2
17*	5	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0
18*	5	0.36	0.38	0.31	0.32	0.32	0.34	0.03	9.0
19	5	0.43	0.43	0.43	0.45	0.46	0.44	0.01	3.2
20	0								
21	5	0.39	0.38	0.40	0.43	0.41	0.40	0.02	4.8
22	0								
23*	4	0.24	0.26	0.22	0.12		0.21	0.06	29.6
24	5	<0.500	<0.500	<0.500	<0.500	<0.500			
25	5	0.49	0.44	0.48	0.48	0.52	0.48	0.03	5.9
26	0								
27	5	0.454	0.405	0.399	0.414	0.451	0.425	0.026	6.1
28	0								
29	5	0.45	0.53	0.40	0.37	0.37	0.42	0.07	16.0
30	5	0.41	0.44	0.41	0.43	0.42	0.42	0.01	3.1
31	5	0.429	0.425	0.425	0.437	0.416	0.426	0.008	1.8
32	5	0.42	0.43	0.46	0.42	0.44	0.43	0.02	3.9
33	5	0.438	0.470	0.306	0.478	0.530	0.444	0.084	18.9
34	0								
35	0								
36	0								
37	0								
38	0								
39	5	0.434	0.441	0.430	0.426	0.441	0.434	0.007	1.5
40	0	0.47	0.52						

SELENIUM
Tissue Z
2.59 ± 0.26 mg/kg

Lab							Mean	SD	RSD
1	0								
2*	5	3.16	3.05	2.98	3.25	2.98	3.08	0.12	3.8
3	5	2.63	2.78	2.70	2.71	2.71	2.71	0.05	2.0
4'*	5	1.85	1.45	1.98	1.99	1.84	1.82	0.22	12.0
5	0								
6	5	2.54	2.40	2.69	2.72	2.48	2.57	0.14	5.3
7*	5	1.97	2.06	2.07	1.83	2.03	1.99	0.10	4.9
8'*	5	3.3	3.3	3.2	4.7	3.5	3.6	0.6	17.3
9	5	2.68	2.57	2.68	2.57	2.59	2.62	0.06	2.2
10	5	1.863	2.900	3.245	2.211	3.095	2.663	0.597	22.4
11	0								
12	0								
13	5	2.56	2.24	2.380	2.760	2.960	2.58	0.29	11.2
14	5	2.61	2.63	2.43	2.40	2.45	2.50	0.11	4.3
15*	5	3.13	3.02	3.09	3.22	3.25	3.14	0.09	3.0
16	5	2.57	2.58	2.58	2.55	2.51	2.56	0.03	1.2
17*	5	2.9	2.9	2.9	2.9	2.9	2.9	0.0	0.0
18*	5	3.9	4.1	3.4	3.8	4.1	3.9	0.3	7.5
19'*	5	1.72	1.76	2.07	1.73	1.73	1.80	0.15	8.4
20	0								
21*	5	1.30	1.33	1.40	1.59	1.42	1.41	0.11	8.0
22*	5	3.41	3.43	3.32	2.96	2.99	3.22	0.23	7.1
23*	5	2.03	1.96	2.11	1.96	1.94	2.00	0.07	3.5
24*	5	1.900	2.313	1.824	2.258	2.200	2.099	0.22	10.6
25	5	2.74	2.38	2.61	2.53	2.60	2.57	0.13	5.1
26	0								
27*	5	5.40	5.59	5.51	6.08	5.04	5.52	0.38	6.8
28	5	2.60	2.81	2.78	2.73	2.74	2.73	0.08	2.9
29*	5	1.17	1.28	1.61	1.6	1.51	1.43	0.20	13.8
30	5	2.56	2.59	2.56	2.50	2.38	2.52	0.08	3.3
31'	5	2.43	2.42	2.43	2.47	2.43	2.44	0.02	0.8
32	5	2.43	2.34	2.47	2.48	2.38	2.42	0.06	2.5
33	5	2.89	2.75	2.71	2.51	2.55	2.68	0.15	5.8
34'	5	2.83	2.8	2.92	2.43	2.87	2.77	0.20	7.1
35	0								
36'*	4	4.24	5.90	4.40	4.01		4.64	0.86	18.5
37	0								
38	0								
39	5	2.44	2.49	2.45	2.46	2.40	2.45	0.03	1.3
40	5	2.41	2.46	2.51	2.54	2.57	2.50	0.06	2.6
41	5	2.4	2.3	2.5	2.4	1.8	2.3	0.3	12.2
42	0								

SELENIUM
NIST SRM 1566a
2.21 ± 0.24 mg/kg

Lab							Mean	SD	RSD
1	0								
2	5	2.06	1.90	2.34	2.49	2.49	2.26	0.27	11.8
3	5	2.33	2.41	2.24	2.12	1.99	2.22	0.17	7.5
4	5	1.91	2.12	1.94	2.19	1.75	1.98	0.18	8.9
5	0								
6	5	2.34	2.18	2.32	2.39	2.45	2.34	0.10	4.3
7	5	2.05	2.08	2.02	2.21	1.88	2.05	0.12	5.8
8	5	2.2	2.9	2.9	2.8	2.2	2.6	0.4	14.1
9	5	2.00	2.09	2.01	2.16	2.17	2.09	0.08	3.8
10	5	2.916	1.916	2.700	1.757	1.844	2.227	0.539	24.2
11	0								
12	0								
13	5	2.08	2.43	2.080	1.940	2.540	2.21	0.26	11.6
14	5	2.16	2.39	2.00	2.22	1.79	2.11	0.23	10.8
15	5	2.68	2.30	2.25	2.53	2.48	2.45	0.18	7.2
16	5	2.08	2.03	2.04	2.02	2.04	2.04	0.02	1.1
17	5	2.3	2.3	2.3	2.3	2.3	2.3	0.0	0.0
18	5	2.8	3.1	2.6	3.0	2.9	2.9	0.2	6.7
19	5	1.99	1.99	1.99	1.99	2.18	2.03	0.08	4.2
20	0								
21	5	2.02	2.48	2.22	2.12	2.16	2.20	0.17	7.8
22	5	2.20	2.35	3.22	2.51	2.06	2.47	0.45	18.3
23	5	1.85	1.76	1.75	1.95	1.7	1.80	0.10	5.5
24	5	2.060	1.900	1.806	2.200	2.340	2.061	0.217	10.5
25	5	2.24	2.23	2.22	2.29	2.24	2.24	0.03	1.2
26	0								
27	5	4.37	4.17	4.84	4.23	5.32	4.59	0.49	10.6
28	5	2.25	2.40	2.25	2.44	2.38	2.34	0.09	3.8
29	5	2.03	2.00	2.00	1.98	2.05	2.01	0.03	1.4
30	5	2.34	2.37	2.27	2.33	2.31	2.32	0.04	1.6
31	5	2.02	1.96	1.93	1.72	1.97	1.92	0.12	6.1
32	5	2.00	1.99	2.07	1.98	2.02	2.01	0.04	1.8
33	5	2.25	2.32	2.32	2.10	2.10	2.22	0.11	5.0
34	5	2.64	2.86	3.10	3.12	3.16	2.98	0.22	7.4
35	0								
36	5	2.11	2.06	2.81	1.89	1.84	2.14	0.39	18.2
37	0								
38	0								
39	5	2.25	2.16	2.15	2.21	2.17	2.19	0.04	1.9
40	5	2.16	2.16	2.06	2.08	2.11	2.11	0.05	2.2

SILVER
Sediment Y
6.26 ± 1.72 mg/kg

Lab							Mean	SD	RSD
1	5	8.1	7.6	7.8	7.9	7.8	7.8	0.2	2.3
2	0								
3*	5	4.31	4.42	4.46	4.31	4.31	4.36	0.07	1.7
4	5	6.5	6.0	6.0	6.6	6.0	6.2	0.3	4.9
5	0								
6	5	7.2	6.6	6.8	6.7	7.0	6.9	0.2	3.5
7	0								
8	5	6.0	6.2	5.9	6.1	5.5	5.9	0.3	4.5
9	5	6.59	5.79	6.15	5.59	5.63	5.95	0.42	7.1
10	0								
11	0								
12	5	6.2	5.9	6.7	6.0	6.9	6.3	0.4	6.9
13	5	6.77	6.93	5.80	5.90	6.21	6.32	0.51	8.0
14	5	7.12	7.38	6.69	7.21	6.74	7.03	0.30	4.3
15	0								
16	5	6.39	5.93	5.75	5.74	5.71	5.90	0.29	4.8
17	5	6.8	7.0	7.2	6.8	7.2	7.0	0.2	2.9
18	0								
19**	5	0.87	0.88	0.89	0.87	1.06	0.91	0.08	9.0
20	5	4.97	5.42	4.64	4.96	4.71	4.94	0.31	6.2
21*	5	3.52	3.68	3.47	3.71	3.62	3.60	0.10	2.9
22	0								
23*	5	3.15	3.58	3.58	4.10	3.56	3.59	0.34	9.4
24	0								
25*	5	9.78	9.72	9.50	9.09	10.2	9.66	0.41	4.2
26	0								
27	5	7.15	7.17	7.11	6.73	6.84	7.00	0.20	2.9
28	0								
29	5	5.28	5.00	5.28	5.23	5.00	5.16	0.15	2.8
30*	5	3.09	3.37	3.14	2.91	3.00	3.10	0.17	5.6
31	0								
32	0								
33	0								
34	5	5.96	5.14	5.21	4.83	5.03	5.23	0.43	8.2
35	0								
36	5	7.84	7.67	7.35	7.41	7.39	7.53	0.21	2.8
37	0								
38	5	5.1	5.9	5.2	5.6	5.5	5.5	0.3	5.9
39	5	6.13	6.06	5.82	5.88	5.93	5.96	. 0.13	2.1
40	0								
41	5	5.86	6.32	5.74	6.44	5.94	6.06	0.30	5.0
42	0								

SILVER
BCSS-1
0.11 ± 0.03 mg/kg

Lab							Mean	SD	RSD
1**	5	2.6	1.9	1.8	1.8	1.7	2.0	0.4	18.6
2	0								
3'	5	0.126	0.126	0.124	0.107	0.130	0.123	0.009	7.3
4	5	0.091	0.099	0.098	0.081	0.092	0.092	0.007	7.8
5	0								
6	5	<2.0	<2.0	<2.0	<2.0	<2.0			
7	0								
8	5	<0.1	<0.1	<0.1	<0.1	<0.1			
9*	5	0.06	0.11	0.07	0.06	0.05	0.07	0.02	33.5
10	0								
11	0								
12**	5	0.17	0.18	0.17	0.17	0.17	0.17	0.00	2.6
13	5	0.106	0.106	0.104	0.115	0.116	0.109	0.006	5.2
14'	5	0.11	0.11	0.11	0.12	0.11	0.11	0.00	4.0
15	0								
16	5	0.132	0.114	0.128	0.136	0.147	0.131	0.012	9.2
17	5	<0.5	<0.5	<0.5	<0.5	<0.5			
18	0								
19	5	0.10	0.10	0.09	0.09	0.09	0.09	0.01	5.8
20	5	0.10	0.10	0.09	0.09	0.09	0.09	0.01	5.8
21	5	0.132	0.138	0.129	0.134	0.137	0.134	0.004	2.7
22	0								
23	5	<0.04	<0.05	<0.04	<0.04	<0.04			
24	0								
25	5	0.107	0.107	0.097	0.100	0.112	0.105	0.006	5.8
26	0								
27*	5	1.10	1.09	1.08	1.05	1.12	1.09	0.03	2.4
28	0								
29	5	<0.75	<0.75	<0.75	<0.75	<0.75			
30	5	0.12	0.13	0.12	0.12	0.11	0.12	0.01	5.9
31	0								
32	0								
33	0								
34	0								
35	0								
36	5	0.108	0.128	0.128	0.117	0.120	0.120	0.008	7.0
37	0								
38*	5	0.28	0.28	0.29	0.28	0.29	0.28	0.01	1.9
39	5	0.110	0.110	0.109	0.110	0.111	0.110	0.001	0.6
40	0								

SILVER
Tissue Z
0.062 ± 0.018 mg/kg

Lab							Mean	SD	RSD
1	0								
2	5	<0.998	<0.998	<0.998	<0.998	<0.998			
3*	5	0.088	0.091	0.083	0.080	0.099	0.088	0.007	8.4
4	5	0.049	0.052	0.052	0.045	0.052	0.050	0.003	6.2
5	0								
6'	5	0.06	0.05	0.06	0.06	0.06	0.06	0.00	7.7
7	0								
8	5	0.07	0.07	0.06	0.06	0.06	0.06	0.01	8.6
9	5	0.11	0.08	0.05	0.05	0.05	0.07	0.03	39.5
10*	5	0.374	0.37	0.343	0.294	0.261	0.328	0.049	15.0
11	5	<0.14	<0.13	<0.14	<0.13	<0.14			
12	0								
13'	5	0.0612	0.0602	0.092	0.057	0.056	0.065	0.015	23.3
14	5	0.06	0.06	0.06	0.06	0.06	0.06	0.00	0.0
15	0								
16	5	0.055	0.054	0.054	0.055	0.054	0.054	0.001	1.0
17	5	<0.5	<0.5	<0.5	<0.5	<0.5			
18	0								
19	5	0.07	0.067	0.065	0.064	0.065	0.066	0.002	3.6
20	0								
21*	5	0.29	0.27	0.27	0.23	0.23	0.26	0.03	10.4
22	5	0.0692	0.0674	0.0649	0.0680	0.0666	0.0672	0.0016	2.4
23	5	<0.02	<0.02	<0.02	<0.02	<0.02			
24	0								
25	5	0.059	0.059	0.054	0.057	0.057	0.057	0.002	3.6
26	0								
27*	5	0.26	0.29	0.28	0.30	0.28	0.28	0.01	5.3
28	5	0.055	0.059	0.052	0.052	0.054	0.054	0.003	5.3
29	5	<0.15	<0.15	<0.15	<0.15	<0.15			
30	5	0.061	0.061	0.060	0.061	0.060	0.061	0.001	0.9
31	5	0.06	0.07	0.05	0.07	0.06	0.06	0.01	13.5
32	0								
33	0								
34*	5	0.179	0.142	0.159	0.0987	0.087	0.133	0.039	29.5
35	0								
36	5	<0.1	<0.1	<0.1	<0.1	<0.1			
37	5	0.0641	0.0638	0.0589	0.0603	0.0716	0.0637	0.0049	7.7
38	5	0.05	0.049	0.052	0.050	0.053	0.051	0.002	3.2
39	5	0.054	0.056	0.055	0.054	0.053	0.054	0.001	2.1
40	0								
41	5	0.065	0.066	0.053	0.053	0.055	0.058	0.007	11.2
42	5	0.073	0.075	0.067	0.075	0.066	0.071	0.004	6.2

SILVER
SRM 1566a
1.68 ± 0.15 (0.17) mg/kg

Lab							Mean	SD	RSD
1	0								
2*	5	1.02	1.00	1.07	1.04	1.08	1.04	0.03	3.2
3	5	1.76	1.78	1.64	1.82	1.63	1.73	0.09	5.0
4	5	1.72	1.69	1.78	1.76	1.71	1.73	0.04	2.1
5	0								
6	5	1.65	1.55	1.55	1.55	1.75	1.61	0.09	5.6
7	0								
8	5	1.66	1.77	1.84	1.78	1.71	1.75	0.07	3.9
9	5	1.64	1.57	1.53	1.55	1.75	1.61	0.09	5.6
10	5	1.861	1.656	1.553	1.782	1.199	1.610	0.258	16.0
11	5	1.74	1.69	1.56	1.68	1.55	1.64	0.08	5.1
12	0								
13*	5	1.45	1.52	1.50	1.50	1.46	1.49	0.03	2.0
14	5	1.72	1.81	1.59	1.79	1.74	1.73	0.09	5.0
15	0								
16	5	1.66	1.67	1.65	1.66	1.63	1.65	0.02	0.9
17	5	1.8	1.8	1.6	1.4	1.6	1.6	0.2	10.2
18'*	5	1.3	1.3	1.3	1.3	1.2	1.3	0.0	3.5
19	5	1.69	1.68	1.72	1.67	1.75	1.70	0.03	1.9
20	0								
21	5	1.76	1.68	1.72	1.78	1.74	1.74	0.04	2.2
22	5	1.52	1.64	1.65	1.45	1.45	1.54	0.10	6.4
23*	5	1.3	1.28	1.33	1.20	1.31	1.28	0.05	3.9
24	0								
25	5	1.73	1.72	1.68	1.70	1.73	1.71	0.02	1.3
26	0								
27	5	1.63	1.70	1.72	1.61	1.69	1.67	0.05	2.8
28*	5	1.48	1.46	1.45	1.49	1.48	1.47	0.02	1.1
29	5	1.50	1.58	1.55	1.60	1.48	1.54	0.05	3.3
30	5	1.69	1.68	1.67	1.64	1.76	1.69	0.04	2.6
31	5	1.67	1.68	1.67	1.67	1.66	1.67	0.01	0.4
32	0								
33	0								
34	5	1.76	1.82	1.73	1.77	1.77	1.77	0.03	1.8
35	0								
36	5	1.72	1.72	1.78	1.69	1.72	1.73	0.03	1.9
37'	5	1.64	1.71	1.45	1.70	1.65	1.63	0.11	6.4
38*	5	1.36	1.42	1.36	1.30	1.36	1.36	0.04	3.1
39	5	1.57	1.58	1.63	1.62	1.59	1.60	0.03	1.6
40	0								
41	0								
42	0								

CADMIUM
Sediment Y
8.55 ± 1.29 mg/kg

Lab							Mean	SD	RSD
1	5	8.66	8.83	9.03	8.77	9.21	8.90	0.22	2.5
2	0								
3	5	9.25	9.53	9.41	9.25	9.54	9.40	0.14	1.5
4'	5	8.6	8.4	6.8	8.4	8.9	8.2	0.8	10.0
5	5	9.3	8.5	8.7	9.3	8.3	8.8	0.5	5.2
6	5	8.5	8.8	8.8	8.8	8.5	8.7	0.2	1.9
7	5	8.7	9.06	8.9	10.56	9.57	9.36	0.75	8.0
8	5	7.8	7.7	7.8	8.0	7.9	7.8	0.1	1.5
9	5	7.68	7.2	7.63	7.97	7.56	7.61	0.28	3.6
10	0								
11	5	10.00	8.04	10.40	8.78	7.65	8.97	1.20	13.4
12	5	8.8	8.5	9.3	8.1	9.8	8.9	0.7	7.5
13	5	8.18	8.66	9.07	8.29	8.88	8.62	0.38	4.4
14	5	7.64	7.86	7.58	7.67	7.70	7.69	0.10	1.4
15	5	8.46	8.22	8.08	8.07	8.33	8.23	0.17	2.0
16	5	8.02	7.98	8.08	8.48	8.52	8.22	0.26	3.2
17	5	9.8	10.2	10.2	9.8	9.6	9.9	0.3	2.7
18	5	8.60	8.03	8.16	8.01	7.94	8.15	0.26	3.3
19	5	9.19	9.34	9.65	9.45	9.36	9.40	0.17	1.8
20*	5	11.2	10.4	11.6	10.9	11.5	11.1	0.5	4.4
21*	5	1.715	1.82	1.813	1.733	1.815	1.779	0.051	2.9
22	0								
23	0								
24*	5	4.37	6.72	5.69	7.35	6.49	6.12	1.15	18.7
25	5	8.99	8.79	8.94	8.77	8.89	8.88	0.09	1.1
26*	5	21.0	13.6	14.0	14.0	19.2	16.4	3.5	21.3
27	5	7.79	8.03	7.68	7.64	7.60	7.75	0.17	2.2
28	5								
29	5	8.25	8.5	8.5	8.80	8.25	8.46	0.23	2.7
30	5	8.72	8.59	8.90	8.63	8.69	8.71	0.12	1.4
31	0								
32'	5	8.11	8.19	8.27	8.23	8.72	8.30	0.24	2.9
33	5	9.08	9.03	8.72	8.76	8.37	8.79	0.28	3.2
34	5	7.77	7.41	7.44	7.58	7.18	7.48	0.22	2.9
35	0								
36	5	9.95	8.73	9.01	9.15	9.57	9.28	0.48	5.2
37	5	7.70	7.33	7.90	7.38	7.60	7.58	0.23	3.1
38*	5	10.15	11.75	10.15	10.30	10.65	10.60	0.67	6.4
39	5	8.33	8.58	8.84	8.73	8.62	8.62	0.19	2.2
40	0								
41	5	8.00	8.63	8.09	8.26	8.57	8.31	0.28	3.4
42	0	8.17	8.71	8.60	8.08	8.16	8.34	0.29	3.5

CADMIUM
BCSS-1
0.25 ± 0.04 mg/kg

Lab							Mean	SD	RSD
1	5	<0.4	<0.4	<0.4	<0.4	<0.4			
2	0								
3	5	0.283	0.272	0.251	0.248	0.290	0.269	0.019	7.0
4	5	0.24	0.25	0.24	0.24	0.22	0.24	0.01	4.6
5	5	0.29	0.20	0.23	0.20	0.21	0.23	0.04	16.7
6	5	0.2	0.2	0.2	0.2	0.2	0.2	0.0	0.0
7	0								
8*	5	0.8	0.6	0.8	0.6	0.5	0.7	0.1	20.3
9	5	0.24	0.25	0.23	0.24	0.24	0.24	0.01	2.9
10	0								
11	5	<1.02	<1.02	<1.02	<1.02	<1.02			
12	5	0.28	0.28	0.27	0.27	0.27	0.27	0.01	2.0
13	5	0.253	0.268	0.229	0.227	0.260	0.247	0.019	7.5
14	5	0.23	0.18	0.21	0.20	0.21	0.21	0.02	8.8
15*	5	0.185	0.222	0.194	0.192	0.196	0.198	0.014	7.2
16	5	0.248	0.251	0.219	0.250	0.226	0.239	0.015	6.3
17'	5	0.2	0.2	0.2	0.3	0.2	0.2	0.0	20.3
18*	5	0.39	0.38	0.26	0.23	0.35	0.32	0.07	22.5
19	5	0.25	0.25	0.25	0.27	0.27	0.26	0.01	4.2
20	5	0.25	0.24	0.22	0.22	0.23	0.23	0.01	5.6
21	5	0.22	0.23	0.21	0.23	0.25	0.23	0.01	6.5
22	0								
23	0								
24	5	<1.0	<1.0	<1.0	<1.0	<1.0			
25	5	0.232	0.234	0.234	0.225	0.226	0.230	0.004	1.9
26	5	<0.25	<0.25	<0.25	<0.25	<0.25			
27*	5	0.75	0.69	0.62	0.67	0.70	0.69	0.05	6.9
28	5								
29	5	0.23	0.28	0.28	0.23	0.23	0.25	0.03	11.0
30	5	0.23	0.23	0.27	0.25	0.25	0.25	0.02	6.8
31	0								
32	5	0.26	0.27	0.26	0.26	0.25	0.26	0.01	2.7
33	5	0.258	0.257	0.240	0.256	0.281	0.258	0.015	5.7
34	0								
35	0								
36	4	0.277	0.269	0.275	0.267		0.272	0.005	1.8
37	5	0.228	0.271	0.241	0.235	0.239	0.243	0.017	6.8
38	5	0.26	0.23	0.23	0.24	0.33	0.26	0.04	16.3
39	5	0.249	0.254	0.251	0.246	0.255	0.251	0.004	1.5
40	0								

CADMIUM
Tissue Z
0.99 ± 0.14 mg/kg

Lab							Mean	SD	RSD
1	0								
2	5	1.10	1.11	1.14	1.08	1.04	1.09	0.04	3.4
3	5	0.934	0.951	0.959	0.962	0.960	0.953	0.012	1.2
4	5	1.06	1.04	1.12	1.04	1.02	1.06	0.04	3.6
5	0								
6	5	1.07	1.07	1.07	1.07	1.07	1.07	0.00	0.0
7*	5	0.156	0.157	0.145	0.156	0.165	0.156	0.007	4.6
8	5	0.96	0.92	0.95	0.92	0.94	0.94	0.02	1.9
9	5	0.95	0.95	0.93	0.89	0.94	0.93	0.02	2.7
10	5	0.966	1.045	0.926	0.812	0.829	0.916	0.097	10.6
11	5	0.89	0.96	1.04	1.00	1.02	0.98	0.06	6.0
12	0								
13	5	0.997	0.962	0.953	0.935	0.961	0.962	0.023	2.3
14*	5	0.80	0.80	0.80	0.85	0.82	0.81	0.02	2.7
15	5	1.06	1.05	1.05	1.05	1.08	1.06	0.01	1.2
16	5	0.990	0.967	0.981	0.980	0.978	0.979	0.008	0.8
17*	5	1.4	1.4	1.6	1.4	1.2	1.4	0.1	10.1
18*	5	1.61	1.35	1.39	1.19	1.26	1.36	0.16	11.8
19**	5	1.25	1.21	1.22	1.21	1.22	1.22	0.02	1.3
20	0								
21*	5	2.73	2.84	2.62	2.75	2.68	2.72	0.08	3.0
22	5	0.946	0.937	0.966	1.004	0.984	0.967	0.027	2.8
23	0								
24	5	1.035	0.91	0.91	0.83	0.90	0.92	0.07	8.1
25'	5	1.10	1.10	1.11	1.11	1.04	1.09	0.03	2.7
26	5	0.86	0.76	0.66	0.99	0.93	0.84	0.13	15.7
27	5	0.89	0.92	0.86	0.92	0.89	0.90	0.03	2.8
28	5	0.917	0.957	1.02	0.957	0.997	0.970	0.040	4.1
29	5	0.91	0.92	0.92	0.92	0.94	0.92	0.01	1.2
30	5	1.02	1.05	1.08	1.09	1.06	1.06	0.03	2.6
31	5	0.984	0.992	0.957	0.996	0.944	0.975	0.023	2.3
32	5	1.06	0.99	0.99	1.03	1.01	1.02	0.03	2.9
33	5	1.00	1.05	1.05	1.00	1.03	1.03	0.03	2.4
34	5	0.93	0.862	0.935	0.838	0.913	0.896	0.043	4.8
35	0								
36	5	1.01	1.00	1.00	1.02	1.02	1.01	0.01	1.0
37	5	1.16	0.893	0.930	1.01	0.970	0.993	0.103	10.4
38	5	0.97	0.94	0.97	0.99	0.99	0.97	0.02	2.1
39	5	1.08	1.08	1.09	1.10	1.10	1.09	0.01	0.9
40	0								
41	5	0.99	1.0	1.0	1.0	0.98	0.99	0.01	0.9
42	5	1.07	1.04	1.10	1.02	1.00	1.05	0.04	3.8

CADMIUM
SRM 1566a
4.15 ± 0.38(0.42) mg/kg

Lab							Mean	SD	RSD
1	0								
2	5	4.05	3.98	4.09	3.98	3.99	4.02	0.05	1.2
3	5	3.94	3.96	4.27	3.82	3.78	3.95	0.19	4.9
4	5	4.22	4.19	4.10	3.89	3.84	4.05	0.17	4.3
5	0								
6	5	4.25	4.10	4.25	4.25	4.15	4.20	0.07	1.7
7	5	3.78	3.86	3.97	3.94	3.94	3.90	0.08	2.0
8	5	3.9	4.26	4.08	4.25	4.05	4.11	0.15	3.7
9	5	3.74	3.81	3.75	3.86	3.75	3.78	0.05	1.4
10	5	4.062	4.053	4.028	4.112	4.227	4.096	0.079	1.9
11	5	4.55	4.61	4.55	4.63	4.53	4.57	0.04	0.9
12	0								
13	5	3.90	3.90	3.88	3.84	3.78	3.86	0.05	1.3
14	5	3.96	4.01	3.61	3.91	4.32	3.96	0.25	6.4
15	5	4.11	4.07	4.13	4.10	4.07	4.10	0.03	0.6
16	5	3.93	3.93	3.88	3.94	3.89	3.91	0.03	0.7
17	5	4.6	4.4	4.4	4.6	4.6	4.5	0.1	2.4
18	5	4.31	4.18	4.02	4.56	4.65	4.34	0.26	6.0
19	5	4.33	4.51	4.50	4.46	4.42	4.44	0.07	1.6
20	0								
21	5	4.42	4.36	3.91	3.96	4.14	4.16	0.23	5.5
22	5	3.67	3.88	4.03	3.37	3.5	3.69	0.27	7.3
23	0								
24	5	4.2	4.14	3.83	3.59	3.99	3.95	0.25	6.3
25	5	4.28	4.39	4.35	4.37	4.18	4.31	0.09	2.0
26*	5	2.70	2.50	2.55	2.90	2.55	2.64	0.16	6.2
27	5	3.8	3.78	3.91	3.75	3.79	3.81	0.06	1.6
28	5	3.86	4.06	3.98	3.96	4.10	3.99	0.09	2.3
29	5	4.18	4.18	4.18	4.08	4.10	4.14	0.05	1.2
30	5	4.17	4.19	4.07	4.16	4.21	4.16	0.05	1.3
31	5	4.13	4.17	4.15	4.22	4.20	4.17	0.04	0.9
32	5	3.95	3.86	3.88	3.86	3.82	3.87	0.05	1.2
33	5	4.27	4.28	4.18	4.27	4.20	4.24	0.05	1.1
34	5	3.98	4.17	3.64	4.03	4.27	4.02	0.24	6.0
35	0								
36	5	4.31	4.25	4.32	4.33	4.34	4.31	0.04	0.8
37	5	4.18	3.89	4.31	4.28	4.24	4.18	0.17	4.0
38'	5	3.85	3.95	3.82	3.82	4.31	3.95	0.21	5.3
39	5	4.39	4.32	4.39	4.49	4.19	4.36	0.11	2.5
40	0								

TIN
Sediment Y
38.4 ± 13.5 mg/kg

Lab							Mean	SD	RSD
1	0								
2	0								
3	5	32.2	33.6	34.0	34.5	37.0	34.3	1.8	5.1
4	0								
5	5	39	35	42	35	33	37	4	9.9
6	5	40	50	45	40	40	43	4	10.4
7	0								
8	5	37.5	41.2	34.9	40.3	36.0	38.0	2.7	7.1
9	0								
10	0								
11	0								
12'	5	39.0	38.0	43.0	76.0	42.0	47.6	16.0	33.6
13	5	38.4	41.3	39.6	39.3	39.4	39.6	1.1	2.7
14	5	38.16	32.82	36.44	38.12	38.25	36.76	2.33	6.3
15	5	49.0	42.7	44.6	42.1	42.4	44.2	2.9	6.5
16	5	43.7	45.6	47.53	42.13	45.94	44.98	2.10	4.7
17	0								
18	5	50	47	44	42	47	46	3	6.7
19	5	46.9	45.6	51.5	46.4	48.6	47.8	2.3	4.9
20*	5	10.7	8.96	10.30	9.52	10.80	10.06	0.79	7.9
21*	5	55.97	64.39	59.4	62.01	64.82	61.32	3.69	6.0
22	0								
23	0								
24	0								
25	0								
26	0								
27	5	40.7	36.7	39.0	36.4	38.4	38.24	1.76	4.6
28	0								
29	5	31.5	28.1	31	29.8	30.3	30.1	1.3	4.4
30	5	43.7	41.0	39.7	41.9	39.1	41.1	1.8	4.5
31	0								
32	0								
33	0								
34	5	28.5	32.4	32.4	29.9	29.5	30.5	1.8	5.8
35	0								
36	0								
37	0								
38	0								
39*	5	22.9	22.9	22.1	23.4	22.9	22.8	0.5	2.0
40	0								
41	0								
42	5	44.8	41.5	44.3	39.1	40.7	42.1	2.4	5.8

TIN
BCSS-1
1.85 ± 0.20 mg/kg

Lab							Mean	SD	RSD
1	0								
2	0								
3	5	2.03	1.85	2.04	1.97	2.05	1.99	0.08	4.2
4	0								
5	5	<20	<20	<20	<20	<20			
6	5	<30	<30	<30	<30	<30			
7	0								
8	5	2.22	2.13	2.07	1.90	1.99	2.06	0.12	6.0
9	0								
10	0								
11	0								
12	5	<5	<5	<5	<5	<5			
13	5	2.01	1.98	1.91	2.05	2.02	1.99	0.05	2.7
14	5	1.77	1.63	1.29	1.69	1.82	1.64	0.21	12.7
15	5	1.84	1.96	2.07	1.90	1.99	1.95	0.09	4.5
16	5	1.56	1.62	1.84	1.81	1.85	1.74	0.14	7.8
17	0								
18	0								
19	5	1.69	1.65	1.72	1.85	1.61	1.70	0.09	5.4
20	5	2.04	1.79	1.78	1.95	1.73	1.86	0.13	7.1
21	5	1.97	1.92	2.02	1.84	1.89	1.93	0.07	3.6
22	0								
23	0								
24	0								
25	0								
26	0								
27*	5	3.66	3.38	3.77	3.17	3.37	3.47	0.24	7.0
28	0								
29	5	<2	<2	<2	<2	<2			
30	5	1.88	1.96	2.02	1.99	1.91	1.95	0.06	2.9
31	0								
32	0								
33	0								
34	0								
35	0								
36	0								
37	0								
38	0								
39	5	1.63	1.67	1.61	1.63	1.62	1.63	0.02	1.4
40	0								

TIN
Tissue Z
0.16 ± 0.07 mg/kg

Lab							Mean	SD	RSD
1	0								
2	0								
3*	5	0.317	0.332	0.382	0.360	0.372	0.353	0.027	7.8
4	0								
5	0								
6	5	<10	<10	<10	<10	<10			
7	0								
8'	5	0.12	0.12	0.10	0.12	0.12	0.12	0.01	7.7
9	0								
10	0								
11	0								
12	0								
13	5	0.151	0.144	0.148	0.158	0.148	0.150	0.005	3.5
14	5	0.11	0.10	0.09	0.11	0.09	0.10	0.01	10.0
15	5	<1	<1	<1	<1	<1			
16'	5	0.154	0.126	0.121	0.121	0.120	0.128	0.015	11.3
17	0								
18	0								
19	5	0.22	0.24	0.19	0.21	0.21	0.21	0.02	8.5
20	0								
21*	5	2.33	2.84	2.66	2.51	2.36	2.54	0.21	8.4
22	0								
23	0								
24	0								
25	0								
26	0								
27	5	<1.61	<1.58	<1.51	<1.49	<1.60			
28	5	<4.0	<4.0	<4.0	<4.0	<4.0			
29	0								
30	5	0.16	0.16	0.15	0.16	0.15	0.16	0.01	3.5
31	0								
32	0								
33	0								
34*	5	0.524	0.57	0.432	0.168	0.378	0.414	0.157	37.9
35	0								
36	0								
37	0								
38	0								
39	5	0.232	0.199	0.252	0.215	0.242	0.228	0.021	9.3
40	0								
41	0								
42	0	0.101	0.095	0.103	0.104	0.118	0.104	0.008	8.1

TIN
SRM 1566a
2.10 ± 0.42 mg/kg

Lab							Mean	SD	RSD
1	0								
2	0								
3	5	2.28	2.08	2.38	1.80	2.61	2.23	0.31	13.8
4	0								
5	0								
6	5	<10	<10	<10	<10	<10			
7	0								
8	5	1.74	2.56	2.34	2.82	1.94	2.28	0.44	19.4
9	0								
10	0								
11	0								
12	0								
13'	5	1.71	2.36	1.81	1.65	1.71	1.85	0.29	15.8
14*	5	1.18	1.24	1.05	1.06	1.16	1.14	0.08	7.1
15	5	2.20	1.90	1.79	2.07	2.17	2.03	0.18	8.7
16	5	2.35	2.23	2.11	2.41	2.03	2.23	0.16	7.1
17	0								
18	0								
19'	5	2.84	1.96	1.95	1.95	2.11	2.16	0.39	17.8
20	0								
21*	5	2.54	2.80	2.61	2.54	2.48	2.59	0.12	4.8
22	0								
23	0								
24	0								
25	0								
26	0								
27'	5	2.18	2.02	1.95	2.24	<1.60	2.10	0.14	6.7
28	5	<4.0	<4.0	<4.0	<4.0	<4.0			
29	0								
30	5	2.06	1.94	2.04	2.03	2.09	2.03	0.06	2.8
31	0								
32	0								
33	0								
34	0								
35	0								
36	0								
37	0								
38	0								
39	5	1.74	1.71	1.79	1.78	1.7	1.74	0.04	2.3
40	0								

ANTIMONY
Sediment Y
4.50 ± 1.40 mg/kg

Lab							Mean	SD	RSD
1	5	<4	6.7	<4	6.1	4.2	5.00	1.30	26.0
2	0								
3	5	4.55	4.45	4.23	4.19	4.37	4.36	0.15	3.4
4	5	6.4	4.5	4.8	4.7	5.8	5.2	0.8	15.7
5	0								
6	5	5.92	4.79	5.20	5.88	4.13	5.18	0.76	14.6
7	0								
8'*	5	2.5	2.7	2.5	2.5	2.5	2.54	0.09	3.5
9	0								
10	0								
11	0								
12	0								
13	5	4.00	4.47	4.71	4.43	5.30	4.58	0.48	10.4
14	5	4.73	3.73	3.92	3.54	4.88	4.16	0.61	14.6
15	5	4.47	4.37	5.29	4.61	4.87	4.72	0.37	7.8
16	5	3.45	3.70	3.53	3.50	3.50	3.54	0.10	2.7
17	5	4.0	4.1	4.4	4.0	4.3	4.2	0.2	4.4
18	0								
19	0								
20	0								
21	5	3.64	3.92	3.89	3.68	3.98	3.82	0.15	4.0
22	0								
23	0								
24	0								
25	0								
26	0								
27*	5	8.24	9.38	7.42	7.89	8.57	8.30	0.74	8.9
28	0								
29	5	6.68	6.70	5.68	5.02	5.72	5.96	0.72	12.1
30	5	3.36	3.86	3.65	3.53	3.8	3.64	0.20	5.6
31	0								
32	0								
33	5	4.18	5.01	4.30	4.32	5.03	4.57	0.42	9.1
34	0								
35	0								
36	0								
37	0								
38	5	4.05	5.25	6.15	5.20	4.4	5.01	0.82	16.4
39	5	4.16	4.17	4.62	3.82	4.72	4.30	0.37	8.6
40	2	6.3	7.9						
41	0								
42	5	3.86	4.19	3.90	3.96	3.75	3.93	0.16	4.2

ANTIMONY
BCSS-1
0.59 ± 0.06 mg/kg

Lab							Mean	SD	RSD
1	5	<4	<4	<4	<4	<4			
2	0								
3	5	0.601	0.600	0.587	0.619	0.602	0.602	0.011	1.9
4*	5	0.63	0.54	0.80	0.72	0.71	0.68	0.10	14.5
5	0								
6*	5	0.42	0.46	0.45	0.55	0.46	0.47	0.05	10.4
7	0								
8*	5	0.3	0.4	0.4	0.4	0.30	0.36	0.05	15.2
9	0								
10	0								
11	0								
12	0								
13*	5	0.687	0.659	0.640	0.677	0.671	0.667	0.018	2.7
14*	5	0.50	0.43	0.39	0.50	0.41	0.45	0.05	11.5
15	5	0.591	0.576	0.608	0.557	0.538	0.574	0.028	4.8
16	5	0.559	0.551	0.568	0.593	0.551	0.564	0.017	3.1
17*	5	0.7	0.7	0.7	0.7	0.7	0.7	0.0	0.0
18	0								
19	0								
20	0								
21	5	0.59	0.52	0.54	0.57	0.52	0.55	0.03	5.7
22	0								
23	0								
24	0								
25	0								
26	0								
27*	5	4.1	3.83	3.35	3.84	4.98	4.02	0.60	15.0
28	0								
29'	5	0.61	0.97	0.54	0.55	0.58	0.65	0.18	27.8
30	5	0.57	0.56	0.58	0.62	0.57	0.58	0.02	4.0
31	0								
32	0								
33	5	0.575	0.591	0.566	0.596	0.586	0.583	0.012	2.1
34	0								
35	0								
36	0								
37	0								
38'*	5	0.29	0.29	0.30	0.37	0.29	0.31	0.03	11.3
39	5	0.600	0.547	0.610	0.584	0.627	0.594	0.030	5.1
40	2	0.646	0.673						

The determination of antimony was not required in the biologicals

MERCURY
Sediment Y
3.30 ± 0.67 mg/kg

Lab							Mean	SD	RSD
1	5	3.27	3.26	3.51	3.15	3.11	3.26	0.16	4.8
2	0								
3*	5	5.16	5.08	5.07	4.95	5.06	5.06	0.08	1.5
4	5	3.04	3.65	2.66	2.78	3.27	3.08	0.40	12.9
5	0								
6*	5	4.17	3.97	4.28	4.01	4.08	4.10	0.13	3.1
7	5	3.479	3.587	3.617	3.566	3.790	3.608	0.114	3.2
8	5	2.8	2.8	3.0	2.7	3.0	2.9	0.1	4.7
9	5	3.366	3.331	3.267	3.096	3.409	3.294	0.122	3.7
10	0								
11	5								
12	5	3.6	3.6	3.6	3.6	3.6	3.6	0.0	0.0
13	5	3.24	3.43	3.51	3.47	3.59	3.45	0.13	3.8
14	1	2.679	2.699	2.739	2.755	2.761	2.727	0.036	1.3
15	0								
16	5	3.70	3.60	3.31	3.38	3.39	3.48	0.17	4.8
17	5	3.36	3.64	3.54	3.62	3.54	3.54	0.11	3.1
18	5	3.32	3.13	3.24	3.15	3.36	3.24	0.10	3.1
19	5	2.5	2.79	2.78	2.86	2.58	2.70	0.15	5.7
20	5	3.50	4.06	3.65	3.96	3.12	3.66	0.38	10.3
21	5	2.691	2.794	2.728	2.744	2.753	2.742	0.038	1.4
22	4	2.9	3.1	3.3	3.2		3.1	0.2	5.5
23	0								
24	5	2.512	2.969	2.384	2.259	2.447	2.514	0.271	10.8
25	5	3.17	3.11	3.22	3.23	3.17	3.18	0.05	1.5
26	5	3.33	3.58	3.61	3.38	3.29	3.44	0.15	4.3
27	5	3.21	3.64	3.43	3.33	3.20	3.36	0.18	5.4
28	0								
29	5	3.73	4.23	3.93	3.83	3.93	3.93	0.19	4.8
30	5	2.90	3.04	3.04	3.00	2.98	2.99	0.06	1.9
31	0								
32	5	3.20	3.30	3.23	3.26	3.44	3.29	0.09	2.9
33	5	3.56	3.69	3.84	3.69	3.79	3.71	0.11	2.9
34	5	3.48	3.04	2.86	3.12	3.18	3.14	0.23	7.2
35	0								
36	0								
37	5	3.64	3.49	3.73	3.88	3.67	3.68	0.14	3.8
38	0								
39*	5	4.46	4.40	4.27	4.28	4.29	4.34	0.09	2.0
40	0								
41	5	3.55	3.43	3.22	3.47	3.57	3.45	0.14	4.1
42	0								

MERCURY
BCSS-1
0.184 ± 0.09(0.018) mg/kg

Lab							Mean	SD	RSD
1	5	0.190	0.185	0.185	0.185	0.190	0.187	0.003	1.5
2	0								
3	5	0.187	0.189	0.187	0.186	0.184	0.187	0.002	1.0
4	5	0.185	0.186	0.193	0.186	0.181	0.186	0.004	2.3
5	0								
6	5	0.203	0.191	0.191	0.170	0.179	0.187	0.013	6.8
7	5	0.182	0.182	0.180	0.180	0.185	0.182	0.002	1.1
8*	5	0.4	0.2	0.2	0.2	0.3	0.3	0.1	34.4
9	5	0.194	0.168	0.160	0.152	0.153	0.165	0.017	10.4
10	0								
11	5								
12*	5	0.23	0.23	0.23	0.23	0.23	0.23	0.00	0.0
13*	5	0.133	0.126	0.132	0.127	0.141	0.132	0.01	4.5
14	1	0.19	0.186	0.190	0.184	0.189	0.188	0.003	1.4
15	0								
16	5	0.178	0.174	0.183	0.177	0.192	0.181	0.007	3.9
17	5	0.18	0.18	0.18	0.18	0.18	0.18	0.00	0.0
18	5	0.19	0.18	0.17	0.19	0.16	0.18	0.01	7.3
19	5	0.198	0.189	0.185	0.176	0.180	0.186	0.009	4.6
20	5	0.205	0.204	0.214	0.179	0.125	0.185	0.036	19.5
21	5	0.188	0.191	0.182	0.164	0.186	0.182	0.011	5.9
22	4	0.17	0.18	0.17	0.16		0.17	0.01	4.8
23	0								
24*	5	0.1423	0.1500	0.1300	0.1769	0.1400	0.1478	0.0177	12.0
25	5	0.207	0.188	0.172	0.162	0.267	0.199	0.042	20.9
26*	5	0.29	0.29	0.27	0.28	0.26	0.28	0.01	4.7
27	5	0.196	0.199	0.194	0.189	0.192	0.194	0.004	2.0
28	0								
29	5	0.18	0.17	0.19	0.18	0.18	0.18	0.01	3.9
30	5	0.187	0.183	0.168	0.183	0.196	0.183	0.010	5.5
31	0								
32	5	0.205	0.207	0.204	0.201	0.202	0.204	0.002	1.2
33	5	0.196	0.178	0.158	0.160	0.167	0.172	0.016	9.1
34	5	0.188	0.202	0.205	0.206	0.202	0.201	0.007	3.6
35	0								
36	0								
37*	5	0.143	0.174	0.142	0.176	0.174	0.162	0.018	10.9
38	0								
39	5	0.181	0.183	0.176	0.182	0.183	0.181	0.003	1.6
40	0								

MERCURY
Tissue Z
0.174 ± 0.038 mg/kg

Lab							Mean	SD	RSD
1	0								
2	5	0.197	0.190	0.189	0.188	0.186	0.190	0.004	2.2
3*	5	0.227	0.227	0.216	0.220	0.216	0.221	0.006	2.5
4	5	0.144	0.147	0.140	0.147	0.148	0.145	0.003	2.3
5	0								
6	5	0.20	0.20	0.18	0.19	0.18	0.19	0.01	5.3
7	5	0.177	0.174	0.167	0.180	0.170	0.174	0.005	3.0
8*	5	0.06	<0.05	0.07	<0.05	0.06	0.06	0.01	9.1
9	5	0.147	0.162	0.151	0.158	0.147	0.153	0.007	4.4
10*	5	0.13	0.15	0.13	0.12	0.13	0.13	0.01	8.3
11	0								
12	0								
13	5	0.166	0.168	0.169	0.167	0.167	0.167	0.001	0.7
14	5	0.153	0.159	0.157	0.155	0.156	0.156	0.002	1.4
15	0								
16	5	0.179	0.177	0.177	0.174	0.174	0.176	0.002	1.2
17	5	0.20	0.20	0.18	0.20	0.18	0.19	0.01	5.7
18	5	0.2161	0.2062	0.1742	0.1864	0.1990	0.1964	0.0165	8.4
19	5	0.217	0.198	0.195	0.215	0.194	0.204	0.011	5.5
20	0								
21*	5	0.272	0.279	0.269	0.281	0.274	0.275	0.005	1.8
22	5	0.18	0.19	0.18	0.18	0.17	0.18	0.01	3.9
23	0								
24*	5	0.1202	0.125	0.0900	0.0900	0.1237	0.1098	0.0181	16.5
25	5	0.186	0.171	0.187	0.167	0.186	0.179	0.010	5.4
26'	5	0.14	0.15	0.15	0.14	0.19	0.15	0.02	13.5
27	5	0.187	0.184	0.206	0.200	0.193	0.194	0.009	4.7
28	5	0.176	0.190	0.177	0.180	0.187	0.182	0.006	3.4
29	5	0.177	0.169	0.172	0.167	0.162	0.169	0.006	3.3
30	5	0.165	0.168	0.168	0.165	0.160	0.165	0.003	2.0
31	5	0.167	0.157	0.167	0.157	0.159	0.161	0.005	3.2
32	0								
33	5	0.171	0.169	0.173	0.169	0.173	0.171	0.002	1.2
34	5	0.253	0.181	0.161	0.201	0.180	0.195	0.035	18.1
35	0								
36	5	0.189	0.193	0.193	0.192	0.190	0.191	0.002	0.9
37	5	0.162	0.167	0.148	0.165	0.154	0.159	0.008	5.0
38	0								
39	5	0.162	0.163	0.158	0.158	0.168	0.162	0.004	2.6
40	0								
41	5	0.18	0.20	0.20	0.17	0.18	0.19	0.01	7.2
42									

MERCURY
SRM 1566a
0.0654 ± 0.0067 mg/kg

Lab							Mean	SD	RSD
1	0								
2	5	0.0620	0.0558	0.0578	0.0603	0.0595	0.0591	0.0024	4.0
3	5	0.067	0.06	0.063	0.063	0.063	0.063	0.002	3.9
4*	5	0.044	0.044	0.048	0.041	0.047	0.045	0.003	6.2
5	0								
6'	5	0.064	0.054	0.064	0.064	0.062	0.062	0.004	7.0
7	5	0.0664	0.0643	0.0671	0.0628	0.0653	0.0652	0.0017	2.6
8	5	<0.05	<0.05	0.05	<0.05	<0.05			
9	5	0.061	0.0591	0.0612	0.0568	0.0563	0.0589	0.0023	3.9
10**	5	0.04	0.04	0.04	0.04	0.02	0.04	0.01	24.8
11	0								
12	0								
13	5	0.0643	0.0629	0.0593	0.0590	0.0573	0.0606	0.0029	4.8
14*	5	0.077	0.079	0.074	0.076	0.077	0.077	0.002	2.4
15	0								
16	5	0.068	0.064	0.064	0.062	0.062	0.064	0.002	3.8
17	5	0.06	0.06	0.06	0.06	0.06	0.06	0.00	0.0
18	5	0.0659	0.0636	0.0624	0.0707	0.0664	0.0658	0.0032	4.9
19	5	0.0657	0.0667	0.0630	0.0614	0.0695	0.0653	0.0032	4.9
20	0								
21	5	0.0604	0.0609	0.0682	0.0653	0.0642	0.0638	0.0032	5.1
22*	4	0.084	0.074	0.105	0.076		0.085	0.014	16.7
23	0								
24	5	0.0667	0.0693	0.0667	0.0667	0.0680	0.0675	0.0012	1.7
25	5	0.070	0.063	0.071	0.063	0.070	0.067	0.004	6.0
26	5	0.07	0.07	0.07	0.07	0.07	0.07	0.00	0.0
27	5	0.0612	0.0696	0.0668	0.069	0.0715	0.0676	0.0040	5.9
28	5	0.065	0.067	0.056	0.057	0.05	0.060	0.006	10.2
29	5	0.0615	0.0615	0.0615	0.0615	0.0615	0.0615	0.0000	0.0
30	5	0.063	0.063	0.064	0.062	0.062	0.063	0.001	1.3
31*	5	0.055	0.054	0.050	0.057	0.052	0.054	0.003	5.0
32	0								
33	5	0.0716	0.0618	0.0735	0.0684	0.0679	0.0686	0.0045	6.5
34	5	0.0773	0.0638	0.0597	0.0577	0.0527	0.0622	0.0093	15.0
35	0								
36	5	0.063	0.065	0.065	0.066	0.065	0.065	0.001	1.7
37	5	0.0697	0.0642	0.0618	0.0613	0.0653	0.0645	0.0034	5.2
38	0								
39	5	0.062	0.06	0.063	0.069	0.066	0.064	0.004	5.5
40	0								

THALLIUM
Sediment Y
0.55 ± 0.16 mg/kg

Lab							Mean	SD	RSD
1	0								
2	0								
3	5	0.478	0.469	0.445	0.496	0.484	0.474	0.019	4.0
4	5	<0.5	<0.5	<0.5	<0.5	<0.5			
5	0								
6	5	<10	<10	<10	<10	<10			
7	0								
8	5	0.55	0.56	0.52	0.54	0.54	0.54	0.01	2.7
9	0								
10	0								
11	0								
12	0								
13*	5	0.707	0.741	0.825	0.764	0.778	0.763	0.044	5.7
14	5	0.49	0.48	0.44	0.50	0.40	0.46	0.04	9.0
15	5	0.622	0.594	0.593	0.606	0.595	0.602	0.012	2.1
16	5	0.684	0.645	0.613	0.601	0.633	0.635	0.032	5.1
17	5	<50	<50	<50	<50	<50			
18	0								
19	0								
20	0								
21*	5	0.33	0.36	0.33	0.37	0.32	0.34	0.02	6.3
22	0								
23	0								
24	0								
25	0								
26	0								
27*	5	3.3	<1.86	1.93	3.75	2.68	2.92	0.79	27.1
28	0								
29	0								
30	5	0.63	0.61	0.63	0.63	0.60	0.62	0.01	2.3
31	0								
32	0								
33	5	0.455	0.453	0.494	0.474	0.454	0.466	0.018	3.8
34	0								
35	0								
36	5	<1.0	<1.0	<1.0	<1.0	<1.0			
37	0								
38	0								
39	5	0.60	0.61	0.54	0.54	0.55	0.57	0.03	6.0
40	0								
41	0								
42	5	0.66	0.68	0.68	0.64	0.65	0.66	0.02	2.7

THALLIUM
BCSS-1
0.49 ± 0.11 mg/kg

Lab							Mean	SD	RSD
1	0								
2	0								
3	5	0.442	0.452	0.407	0.416	0.476	0.439	0.028	6.3
4	5	<0.5	<0.5	<0.5	<0.5	<0.5			
5	0								
6	5	<10	<10	<10	<10	<10			
7	0								
8	5	0.49	0.52	0.50	0.53	0.48	0.50	0.02	4.1
9	0								
10	0								
11	0								
12	0								
13	5	0.402	0.427	0.454	0.439	0.486	0.442	0.031	7.1
14*	5	0.36	0.37	0.35	0.33	0.36	0.35	0.02	4.3
15	5	0.529	0.532	0.537	0.529	0.535	0.532	0.004	0.7
16	5	0.586	0.563	0.566	0.560	0.599	0.575	0.017	2.9
17	5	<50	<50	<50	<50	<50			
18	0								
19	0								
20	0								
21	5	0.49	0.39	0.42	0.46	0.43	0.44	0.04	8.8
22	0								
23	0								
24	0								
25	0								
26	0								
27*	5	2.73	2.56	3.74	3.57	2.66	3.05	0.56	18.3
28	0								
29	0								
30	5	0.48	0.52	0.53	0.54	0.46	0.51	0.03	6.8
31	0								
32	0								
33	5	0.502	0.483	0.486	0.485	0.442	0.480	0.022	4.7
34	0								
35	0								
36	5	<1.0	<1.0	<1.0	<1.0	<1.0			
37	0								
38	0								
39	5	0.48	0.48	0.52	0.50	0.49	0.49	0.02	3.4
40	0								

The determination of thallium was not required in the biologicals

LEAD
Sediment Y
331 ± 56 mg/kg

Lab							Mean	SD	RSD
1	5	383	391	368	393	397	386	11	3.0
2	0								
3	5	367	358	362	365	369	364	4	1.2
4	5	358	344	358	350	360	354	7	1.9
5	5	328	313	307	310	332	318	11	3.5
6	5	330	324	332	360	351	339	15	4.5
7	5	303.77	318.56	329.71	309.89	352.36	322.86	19.16	5.9
8	5	295	286	285	295	288	290	5	1.7
9*	5	317	231	228	209	306	258	50	19.2
10	0								
11	5	312.20	280.89	295.80	324.90	290.39	300.84	17.61	5.9
12	5	350	348	373	358	368	359	11	3.0
13	5	329	325	338	333	319	329	7	2.2
14*	5	222	277	237	232	309	255	37	14.3
15	5	296	293	317	308	327	308	14	4.6
16	5	294	298	280	290	280	288	8	2.8
17	5	345	342	350	346	340	345	4	1.1
18	5	313	280	302	295	315	301	14	4.8
19	5	353	345	349	362	379	358	14	3.8
20	5	379	380	384	344	373	372.00	16.00	4.3
21*	5	209.75	191.57	207.65	191.92	201.61	200.50	8.53	4.3
22	0								
23	5	336	332	332	322	324	329	6	1.8
24	5	317.64	328	313.73	270	310.55	307.98	22.23	7.2
25	5	322	355	375	342	344	348	19	5.6
26	5	300	293	296	294	297	296	3	0.9
27*	5	268	261	272	256	259	263	7	2.5
28	0								
29	5	318	320	310	340	335	325	12	3.8
30	5	379	384	387	362	368	376	11	2.8
31	0								
32	5	372	366	372	375	370	371	3	0.9
33	5	322.6	331.3	332.7	285.2	300.0	314.4	20.9	6.6
34	5	274	274	279	266	266	272	6	2.1
35	0								
36	5	368	321	357	353	352	350	18	5.0
37*	5	500	462	481	472	472	477	14	3.0
38	5	325	346	324	353	330	336	13	3.9
39	5	310	308	297	316	311	308	7	2.3
40	0								
41	5	330	308	330	323	315	321	10	3.0
42	5	330	350	343	324	325	334	12	3.5

LEAD
BCSS-1
22.7 ± 3.4 mg/kg

Lab							Mean	SD	RSD
1	5	22.2	21.7	22.4	21.6	21.1	21.8	0.5	2.4
2	0								
3	5	22.3	21.4	23.6	21.0	25.8	22.8	1.9	8.5
4	5	21.8	20.9	21.6	21.4	21.8	21.5	0.4	1.7
5	5	17.8	22.5	23.0	18.6	22.7	20.9	2.5	12.0
6	5	20	21	22	22	23	22	1	5.3
7	5	22.23	22.08	21.23	22.51	22.28	22.07	0.49	2.2
8	5	25.9	22.0	21.0	20.0	20.7	21.9	2.3	10.7
9	5	23.5	23.2	22.1	23.0	23.4	23.0	0.6	2.4
10	0								
11*	5	16.12	16.73	16.40	15.92	16.73	16.38	0.36	2.2
12	5	21.8	21.7	21.3	18.8	18.2	20.4	1.7	8.5
13	5	23.8	20.3	21.9	22.9	22.3	22.2	1.3	5.8
14	5	21.9	19.2	20.0	18.7	18.7	19.7	1.3	6.8
15	5	23.7	23.4	26.1	26.8	26.2	25.2	1.6	6.2
16	5	21.31	20.92	22.10	22.64	22.88	21.97	0.84	3.8
17	5	20	21	20	21	22	21	1	4.0
18	5	20.0	19.9	18.4	19.5	19.8	19.5	0.7	3.3
19	5	22.7	22.0	22.4	21.0	23.0	22.2	0.8	3.5
20	5								
21	5	22.11	21.34	21.62	22.57	22.42	22.01	0.52	2.4
22	0								
23	5	20.5	19.8	19.6	19.9	20.5	20.1	0.4	2.1
24	4	25.64	18.52	27.1	21.15		23.10	3.97	17.2
25	5	21.9	21.7	21.9	22.2	21.7	21.9	0.2	0.9
26	5	18.1	24.4	17.2	18.4	21.0	19.8	2.9	14.8
27*	5	12.9	13.1	12.9	13.5	12.9	13.1	0.3	2.0
28	0								
29	5	20.0	20.3	20.0	20.0	20.3	20.1	0.2	0.8
30	5	22.6	23.3	22.0	23.3	21.1	22.5	0.9	4.2
31	0								
32	5	23	22	26	24	24	24	1	6.2
33'	5	19.39	19.35	19.45	22.56	19.60	20.07	1.40	7.0
34*	5	18.1	17.2	18.9	17.7	16.0	17.6	1.1	6.1
35	0								
36	5	23.1	24.4	22.5	21.6	19.8	22.3	1.7	7.7
37	5	23.1	21.4	22.4	21.8	23.5	22.4	0.9	3.9
38	5	23.9	23.2	22.5	22.5	23.2	23.1	0.6	2.5
39	5	23.1	21.8	22.0	22.4	21.9	22.2	0.53	2.4
40	0								

LEAD
Tissue Z
1.85 ± 0.33 mg/kg

Lab							Mean	SD	RSD
1	0								
2	5	2.00	2.16	1.94	1.89	1.98	1.99	0.10	5.1
3	5	1.72	1.62	1.62	1.68	1.61	1.65	0.05	2.9
4'*	5	1.37	1.32	1.47	1.45	2.03	1.53	0.29	18.8
5	0								
6'	5	1.80	1.80	1.80	1.80	1.90	1.82	0.04	2.5
7	0								
8	5	1.87	1.72	1.90	1.86	1.92	1.85	0.08	4.2
9	5	1.68	1.62	1.86	1.70	1.94	1.76	0.13	7.6
10	5	1.692	1.785	1.677	1.479	1.668	1.660	0.112	6.7
11*	5	1.16	1.15	1.19	1.19	1.21	1.18	0.02	2.1
12	0								
13	5	1.87	1.78	1.71	1.67	1.76	1.76	0.08	4.3
14	5	1.82	1.80	1.82	1.79	1.81	1.81	0.01	0.7
15'	5	1.84	1.84	1.84	1.84	1.80	1.83	0.02	1.0
16	5	1.77	1.74	1.84	1.78	1.82	1.79	0.04	2.2
17	5	<1	<1	<1	<1	<1			
18	5	1.8	1.8	2.0	1.7	1.6	1.8	0.1	8.2
19	1	2.13	2.09	2.13	2.20	2.05	2.12	0.06	2.6
20	0								
21*	5	2.619	2.612	2.725	2.707	2.781	2.689	0.072	2.7
22	5	2.04	1.91	1.92	1.89	1.86	1.92	0.07	3.6
23	5	1.89	1.88	1.89	1.80	1.75	1.84	0.06	3.5
24*	5	1.21	1.79	1.19	1.69	1.47	1.47	0.27	18.5
25	5	2.05	2.02	2.00	1.95	1.94	1.99	0.05	2.3
26	5	<0.5	<0.5	<0.5	<0.5	<0.5			
27	5	1.83	1.87	1.75	1.75	1.91	1.82	0.07	3.9
28	5	2.06	2.04	2.22	2.02	2.10	2.09	0.08	3.8
29	5	2.05	1.90	2.10	2.03	2.25	2.07	0.13	6.1
30	5	2.11	2.08	2.16	2.12	2.03	2.10	0.05	2.3
31	5	2.89	2.06	1.87	1.70	1.72	2.05	0.49	24.0
32	5	2.06	1.91	1.83	1.93	1.92	1.93	0.08	4.3
33	5	1.88	1.89	1.82	1.85	1.87	1.86	0.03	1.5
34	5	1.71	1.73	1.71	1.72	1.73	1.72	0.01	0.6
35	0								
36	5	2.05	2.1	2.01	2.06	2.07	2.06	0.03	1.6
37	0								
38	5	1.57	1.45	1.61	1.54	1.58	1.55	0.06	4.0
39	5	1.72	1.76	1.72	1.70	1.70	1.72	0.02	1.4
40	0								
41	5	1.67	1.87	1.84	1.69	1.70	1.75	0.09	5.3
42	5	1.63	1.58	1.62	1.61	1.58	1.60	0.02	1.4

LEAD
SRM 1566a
0.371 ± 0.014(0.037) mg/kg

Lab							Mean	SD	RSD
1	0								
2	5	0.378	0.338	0.328	0.368	0.358	0.354	0.021	5.9
3	5	0.379	0.362	0.376	0.378	0.372	0.373	0.007	1.9
4	5	0.316	0.326	0.328	0.364	0.435	0.354	0.049	13.8
5	0								
6'	5	0.35	0.35	0.35	0.40	0.35	0.36	0.02	6.2
7	0								
8	5	0.31	0.35	0.33	0.32	0.35	0.33	0.02	5.4
9	5	0.34	0.36	0.33	0.34	0.28	0.33	0.03	9.1
10*	5	0.305	0.34	0.271	0.287	0.280	0.297	0.027	9.2
11	5	<0.20	<0.21	<0.20	<0.21	<0.20			
12	0								
13*	5	0.314	0.333	0.325	0.327	0.316	0.323	0.008	2.4
14	5	0.40	0.29	0.35	0.25	0.50	0.36	0.10	27.3
15	5	0.403	0.374	0.430	0.399	0.393	0.400	0.020	5.1
16	5	0.365	0.371	0.354	0.347	0.345	0.356	0.011	3.2
17	5	<1	<1	<1	<1	<1			
18	5	0.3	0.5	0.3	0.5	0.3	0.4	0.1	28.8
19	1	0.365	0.369	0.383	0.358	0.351	0.365	0.012	3.3
20	0								
21	5	0.382	0.376	0.382	0.378	0.381	0.380	0.003	0.7
22	5	0.346	0.365	0.419	0.343	0.366	0.368	0.031	8.3
23	5	<0.4	<0.4	<0.4	<0.3	<0.4			
24	0								
25	5	0.378	0.373	0.367	0.372	0.376	0.373	0.004	1.1
26	5	<0.5	<0.5	<0.5	<0.5	<0.5			
27'	5	0.674	0.367	0.364	0.311	0.330	0.409	0.150	36.6
28	5	0.39	0.38	0.39	0.38	0.40	0.39	0.01	2.2
29	5	0.33	0.34	0.41	0.39	0.34	0.36	0.04	9.8
30	5	0.36	0.36	0.40	0.40	0.38	0.38	0.02	5.3
31	5	0.396	0.416	0.382	0.388	0.340	0.384	0.028	7.3
32	5	0.35	0.41	0.35	0.33	0.38	0.36	0.03	8.6
33	5	0.358	0.383	0.384	0.365	0.359	0.370	0.013	3.5
34*	5	0.315	0.310	0.349	0.326	0.329	0.326	0.015	4.6
35	0								
36	5	0.369	0.375	0.357	0.352	0.345	0.360	0.012	3.4
37	0								
38''	5	0.28	0.29	0.29	0.29	0.32	0.29	0.02	5.2
39	5	0.347	0.334	0.330	0.342	0.333	0.34	0.01	2.1
40	0								

APPENDIX C

Laboratory Evaluation for Sediments

		Lab 1	Lab 2	Lab 3	Lab 4	Lab 5	Lab 6	Lab 7	Lab 8	Lab 9	Lab 10
Be	Sed Y	EG		EG	EG	EG	EG		EX		
	BCSS-1	EG		EX	EG	EG	EG		EG		
Al	Sed Y	LG		EG		EG	EG	EX	EG		
	BCSS-1	LG		EG		EG	LG	EG	LX		
Si	Sed Y			EG					EG		
	BCSS-1			EG					EG		
Cr	Sed Y			HG	EG	EG	EG	EG	EG	LG	
	BCSS-1			EG	EG	EG	LG	EG	EG	LG	
Mn	Sed Y	LG		LG		EG	EG	EG	LG	EG	
	BCSS-1	LG		EG		EG	EG	EG	EG	EG	
Fe	Sed Y	LG		EG		EG	EG	EG	EG	EG	
	BCSS-1	LG		EG		GG	EG	EG	EG	EG	
Ni	Sed Y	EG		EG	EG	EG	EG	EG	EG	EG	
	BCSS-1	EG		EG	EG	EG	EG	EG	EG	EG	
Cu	Sed Y	EG		EG	EG	EG	EG	EG	GG	EG	
	BCSS-1	LG		EG	EG	GG	EG	EG	EX	EG	
Zn	Sed Y	EG		HG	EG	HG	EG	EG	EG	LG	
	BCSS-1	GG		EG	EG	LG	EG	EG	EG	LG	
As	Sed Y	EG		HG	EG	EG	EG	EG	EX	EG	
	BCSS-1	EG		EG	EG	EG	EG	EG	EX	EG	
Se	Sed Y	EG		EG	EG		EG		EX	EG	
	BCSS-1	HG		EG	LG		EG		G-	EG	
Ag	Sed Y	GG		LG	EG		EG		EG	EG	
	BCSS-1	HG		EG	EG		H-		G-	LX	
Cd	Sed Y	EG		EG	EG	EG	EG	GG	EG	EG	
	BCSS-1			EG	EG	EX	GG		HX	EG	
Sn	Sed Y			EG		EG	EX		EG		
	BCSS-1			EG		H-	H-		GG		
Sb	Sed Y	G-		EG	EX		EX		LG		
	BCSS-1	H-		EG	HX		LX		LX		
Hg	Sed Y	EG		HG	EX		HG	EG	EG	EG	
	BCSS-1	EG		EG	EG		EG	EG	HX	GX	
Tl	Sed Y			EG	G-		H-		EG		
	BCSS-1			EG	G-		H-		EG		
Pb	Sed Y	EG		EG	EG	EG	EG	EG	EG	LX	
	BCSS-1	EG		EG	EG	EX	EG	EG	EX	EG	

APPENDIX C

Laboratory Evaluation for Sediments

		Lab 11	Lab 12	Lab 13	Lab 14	Lab 15	Lab 16	Lab 17	Lab 18	Lab 19	Lab 20
Be	Sed Y		EG	EG	EG	EG	EG	EG	LG		
	BCSS-1		EG	EG	EG	EG	EG	EG	LG		
Al	Sed Y		EG	EG	EG	EG	EG	EG	LG	EG	
	BCSS-1		EG	EG	EG	EG	EG	EG	LX	EG	
Si	Sed Y			EG		EG	EG			EG	
	BCSS-1			EG		EG	EG			EG	
Cr	Sed Y	EG	GG	EG	EG	EG	EG	HG	LG	HG	EG
	BCSS-1	LG	LG	EG	EG	GG	EG	EG	LX	EG	LG
Mn	Sed Y	EG	EG	EG	EG	EG	EG	EG	LG	EG	HG
	BCSS-1	EG	EG	EG	EG	EG	EG	EG	LG	EG	EG
Fe	Sed Y	EG	EG	EG	EG	EG	EG	EG	GG	EG	
	BCSS-1	EG	EG	EG	EG	EG	EG	EG	GG	EG	
Ni	Sed Y	EG	EG	EG	EG	EG	EG	EG	EG	EG	EG
	BCSS-1	GG	EG	EG	EG	EG	EG	EG	LG	EG	EG
Cu	Sed Y	EG	EG	EG	EG	EG	EG	HG	EG	EG	EG
	BCSS-1	LG	EG	EG	EG	EG	EG	EG	GG	EG	EG
Zn	Sed Y	EG	EG	EG	EG	EG	EG	EG	EG	EG	HG
	BCSS-1	LG	EG	EG	EG	EG	EG	EG	GG	EG	EG
As	Sed Y	EG	EG	EG	GX	EG	EG	EG	EG	HG	LG
	BCSS-1	LG	EG	EG	EG	EG	EG	EG	GG	EG	EG
Se	Sed Y		HG	EG	EG		EG	EG	EG	EG	
	BCSS-1		HG	EX	EX		EG	HG	LG	EG	
Ag	Sed Y		EG	EG	EG		EG	EG		LG	EG
	BCSS-1		HG	EG	EG		GG	G-		EG	EG
Cd	Sed Y	GX	EG	EG	EG	EG	EG	GG	EG	EG	HG
	BCSS-1	G-	EG	EG	GG	LG	EG	GG	HG	EG	EG
Sn	Sed Y		EG	EG	EG	EG	EG		EG	EG	LG
	BCSS-1		G-	EG	GG	EG	GG			GG	EG
Sb	Sed Y			EX	EX	EG	EG	EG			
	BCSS-1			HG	LG	EG	EG	HG			
Hg	Sed Y		EG	EG	EG		EG	EG	EG	EG	EX
	BCSS-1		HG	LG	EG		EG	EG	EG	EG	GX
Tl	Sed Y			HG	EG	EG	EG	H-			
	BCSS-1			EG	LG	EG	EG	H-			
Pb	Sed Y	EG	EG	EG	LX	EG	EG	EG	EG	EG	EG
	BCSS-1	LG	GG	EG	EG	GG	EG	EG	GG	EG	

APPENDIX C

Laboratory Evaluation for Sediments

		Lab 21	Lab 22	Lab 23	Lab 24	Lab 25	Lab 26	Lab 27	Lab 28	Lab 29	Lab 30
Be	Sed Y	GG			EG			LG		EG	EG
	BCSS-1	EG			EG			LG		EG	EG
Al	Sed Y	EG		LG	LG			LG		EG	
	BCSS-1	EG		LG	LX			LG		EG	
Si	Sed Y	GG									
	BCSS-1	EG									
Cr	Sed Y	EG		LG	EG	EG	LG	LG		EG	EG
	BCSS-1	EG		LG	EX	EG	LG	LG		LG	EG
Mn	Sed Y	EG		LG	LG	EG	LG	LG		EG	EG
	BCSS-1	EG		LG	GG	EG	LG	LG		EG	EG
Fe	Sed Y	GG		LG	LG	EG	EG	LG		EG	EG
	BCSS-1	EG		LG	EG	EG	HG	LG		LG	EG
Ni	Sed Y	EG		EG	EX	EG	EG	EG		EG	EG
	BCSS-1	EG		LG	LX	EG	EG	LG		EG	EG
Cu	Sed Y	EG		EG	EG	EG	EG	EG		EG	EG
	BCSS-1	GG		LG	EX	EG	LG	EX		EG	EG
Zn	Sed Y	EG		EG	EG	EG	EG	LG		EG	EG
	BCSS-1	EG		LG	GG	EG	EG	LG		GG	EG
As	Sed Y	EG		EG	EG	EG	EG	EG		EG	EG
	BCSS-1	EG		EG	EG	EG	LG	EG		EG	EG
Se	Sed Y	EG		EG	L-	EG		EG		HX	EG
	BCSS-1	EG		LG	G-	GG		EG		GG	EG
Ag	Sed Y	LG		LG		HG		EG		EG	LG
	BCSS-1	EG		L-		EG		HG		G-	EG
Cd	Sed Y	LG			LX	EG	HG	EG		EG	EG
	BCSS-1	EG			G-	EG	G-	HG		EG	EG
Sn	Sed Y	HG						EG		EG	EG
	BCSS-1	EG						HG		G-	EG
Sb	Sed Y	EG						HG		GG	EG
	BCSS-1	EG						HX		EG	EG
Hg	Sed Y	EG	EG		GG	EG	EG	EG		GG	EG
	BCSS-1	GG	GG		LX	EX	HG	EG		EG	EG
Tl	Sed Y	LG						HX			EG
	BCSS-1	EG						HX			EG
Pb	Sed Y	LG		GG	EG	EG	EG	LG		EG	EG
	BCSS-1	EG		EG	GX	EG	EX	LG		EG	EG

APPENDIX C

Laboratory Evaluation for Sediments

		Lab 31	Lab 32	Lab 33	Lab 34	Lab 35	Lab 36	Lab 37	Lab 38	Lab 39	Lab 40
Be	Sed Y			EG	LG						
	BCSS-1			EG	LG						
Al	Sed Y		EG		LG	EG		EG	EG	EG	
	BCSS-1		EG		LG	EG		EG	HG	EG	
Si	Sed Y		EG					EX		EG	
	BCSS-1		EG					EG		HG	
Cr	Sed Y		EG	EG	LG	LG	EG	EG	EG	EG	
	BCSS-1		EG	LG	LG	EG	EG	EG	EG	EG	
Mn	Sed Y		EG		LG	LG	LG	HG	EG	EG	
	BCSS-1		EG		LG	LG	EG	EG	EG	EG	
Fe	Sed Y		EG		LG	EG		EG	EG	EG	
	BCSS-1		HG		LG	LG		EG	HG	EG	
Ni	Sed Y		EG	EG	LG	EG	EG	EG	EG	EG	
	BCSS-1		EG	EG	LG	EG	EG	EG	EG	EG	
Cu	Sed Y		EG	EG	GG	EG	EG	GG	EG	EG	
	BCSS-1		EG	EG	LG	EG	EG	EG	HG	EG	
Zn	Sed Y		EG	EG	LG	HX	EG	EG	HG	EG	
	BCSS-1		EG	GG	LG	HG	EG	EG	HX	EG	
As	Sed Y	HG	EG	LG	LG					EG	
	BCSS-1	EG	EG	GG	LG					EG	
Se	Sed Y	EG	EX	HX						EG	
	BCSS-1	EG	EG	GX						EG	
Ag	Sed Y				EG		EG		EG	EG	
	BCSS-1						EG		HG	EG	
Cd	Sed Y		EG	EG	EG		GG	EG	HG	EG	
	BCSS-1		EG	EG			EG	EG	GG	EG	
Sn	Sed Y				EG					LG	
	BCSS-1									EG	
Sb	Sed Y			EG					GG	EG	
	BCSS-1			EG					LG	EG	
Hg	Sed Y		EG	EG	EG			EG		HG	
	BCSS-1		EG	GG	EG			LX		EG	
Tl	Sed Y			EG			G-			EG	
	BCSS-1			EG			G-			EG	
Pb	Sed Y		EG	EG	EG		EG	HG	EG	EG	
	BCSS-1		EG	EG	LG		EG	EG	EG	EG	

APPENDIX C

Laboratory Evaluation for Tissues

		Lab 1	Lab 2	Lab 3	Lab 4	Lab 5	Lab 6	Lab 7	Lab 8	Lab 9	Lab 10
Cr	Tiss Z		EG	EG	EG		EG		HX	EG	EG
	1566a		EG	EG	GX		LG		GG	EG	GG
Fe	Tiss Z		EG	EG			EG		GG	EG	LG
	1566a		EG	EG			EG		EG	EG	LG
Ni	Tiss Z		GG	EG	HG		EG		HG	EG	EG
	1566a		GG	EG	GG		GX		EX	GX	EG
Cu	Tiss Z		EG	LG	EG		EG		EG	EG	LG
	1566a		EG	EG	EG		EG		GG	EG	LG
Zn	Tiss Z		EG	EG	EG		EG		EG	EG	LG
	1566a		EG	EG	EG		EG		EG	EG	LG
As	Tiss Z		EG	EG	GG		EG	EG	EG	EG	EG
	1566a		EG	EG	EG		EG	EG	GX	EG	EG
Se	Tiss Z		HG	EG	LG		EG	LG	HG	EG	GX
	1566a		GX	EG	GX		EG	GG	HX	EG	GX
Ag	Tiss Z			HG	EG		EG		EG	GX	HX
	1566a		LG	EG	EG		EG		EG	EG	GX
Cd	Tiss Z		GG	EG	EG		EG	LG	EG	EG	GG
	1566a		EG	EG	EG		EG	EG	EG	EG	EG
Sn	Tiss Z			HG			H-		EG		
	1566a			GX			G-		GX		
Hg	Tiss Z		EG	HG	EG		EG	EG	LG	EG	LG
	1566a		GG	EG	LG		EG	EG	L-	GG	LG
Pb	Tiss Z		EG	EG	LG		EG		EG	EG	GG
	1566a		GG	EG	GX		EG		GG	GG	LG

APPENDIX C

Laboratory Evaluation for Tissues

		Lab 11	Lab 12	Lab 13	Lab 14	Lab 15	Lab 16	Lab 17	Lab 18	Lab 19	Lab 20
Cr	Tiss Z	G-		EG	EG	EG	LG	HX	EX	EG	
	1566a	G-		EG	EG	EG	LG	HG	LG	EG	
Fe	Tiss Z	EG		EG	EG	EG	EG	EG	EG	EG	
	1566a	EG		EG	EG	EG	EG	EG	LG	EG	
Ni	Tiss Z	G-		EG	EG	GG	EG	LX	GG	EG	
	1566a	G-		GX	EG	GX	EG	EG	EX	EX	
Cu	Tiss Z	EG		EG	EG	HG	EG	GG	GG	EG	
	1566a	HG		EG	GG	EG	EG	EG	LG	EG	
Zn	Tiss Z	EG		EG	HG	EG	EG	EG	EG	EG	
	1566a	EG		EG	EG	EG	EG	EG	EG	EG	
As	Tiss Z	LG		EG	EG	EG	EG	EG	HG	EG	
	1566a	LG		EG	EG	EG	EG	EG	GG	EG	
Se	Tiss Z			GX	EG	HG	EG	HG	HG	LG	
	1566a			GX	GX	GG	EG	EG	HG	GX	
Ag	Tiss Z	G-		EG	EG		EG	G-		EG	
	1566a	EG		LG	EG		EG	EX	LG	EG	
Cd	Tiss Z	EG		EG	LG	EG	EG	HX	HX	HG	
	1566a	GG		EG	GG	EG	EG	EG	GG	EG	
Sn	Tiss Z			EG	EG	G-	EG			GG	
	1566a			EG	LG	EG	EG			EG	
Hg	Tiss Z			EG	EG		EG	EG	GG	GG	
	1566a			GG	HG		EG	EG	EG	EG	
Pb	Tiss Z	LG		EG	EG	EG	EG	L-	EG	GG	
	1566a	L-		LG	GX	GG	EG	G-	GX	EG	

APPENDIX C

Laboratory Evaluation for Tissues

		Lab 21	Lab 22	Lab 23	Lab 24	Lab 25	Lab 26	Lab 27	Lab 28	Lab 29	Lab 30
Cr	Tiss Z	EG	HX	G-	EX	EG	EG	EG	EG	EG	EG
	1566a	EG	HX	G-	EG	EG	GG	LG	EG	EG	EG
Fe	Tiss Z	EG	EG	LG	EG	EG		LG	EG	EG	EG
	1566a	EG	GG	LG	LG	EG		LG	LG	EG	EG
Ni	Tiss Z	EG	EG	L-	EG	EG	LX	EG	EG	EG	EG
	1566a	EX	EX	G-	EX	EG	EX	EX	EG	EG	EG
Cu	Tiss Z	HG	EG	EG	EG	EG	EG	EG	EG	HG	EG
	1566a	EG	LG	EG	EG	EG	LX	EG	EG	EG	EG
Zn	Tiss Z	EG	LG	EG	LG	EG	LG	GG	EG	EG	GG
	1566a	EG	LX	EG	EG	EG	LG	LG	EG	EG	EG
As	Tiss Z	EG	EG	EG	LG	LG		EG	EG	EG	EG
	1566a	EG	GG	GG	LG	EG		GG	EG	GG	EG
Se	Tiss Z	LG	HG	LG	LG	EG		HG	EG	LG	EG
	1566a	GG	GX	LG	GX	EG		HX	EG	EG	EG
Ag	Tiss Z	HG	EG	L-		EG		HG	EG	G-	EG
	1566a	EG	EG	LG		EG		EG	LG	GG	EG
Cd	Tiss Z	HG	EG		GG	EG	GG	EG	EG	EG	EG
	1566a	EG	GG		GG	EG	LG	EG	EG	EG	EG
Sn	Tiss Z	HG						H-	H-		EG
	1566a	HG						EG	G-		EG
Hg	Tiss Z	HG	EG		LX	EG	EG	EG	EG	EG	EG
	1566a	EG	HG		EG	EG	EG	EG	GG	EG	EG
Pb	Tiss Z	HG	EG	EG	LX	EG	L-	EG	GG	GG	EG
	1566a	EG	GG	G-		EG	G-	GG	EG	EG	EG

APPENDIX C

Laboratory Evaluation for Tissues

		Lab 31	Lab 32	Lab 33	Lab 34	Lab 35	Lab 36	Lab 37	Lab 38	Lab 39	Lab 40
Cr	Tiss Z	EG	EG	EG	HG		EG	EG	EG	EG	EG
	1566a	GG	EG	EG	EG		EG	EG	GG	EG	EG
Fe	Tiss Z				LG	LG	EG	EG		EG	EG
	1566a				LG	LG	EG	EG		EG	EG
Ni	Tiss Z	EG	EG	EG	EG	LX	EG	GG	LG	EG	
	1566a	GX	GX	EG	EG	EG	EG	GX	EG	GX	
Cu	Tiss Z	EG	EG	EG	EG	GG	EG	EG	EG	EG	
	1566a	EG	EG	EG	EG	EG	EG	EG	EG	EG	
Zn	Tiss Z	EG	EG	EG	LG	EG	EG	HG		EG	EG
	1566a	EG	EG	EG	LG	EG	EG	EG		EG	EG
As	Tiss Z	EG	EG	EG	EG		GG		LG	EG	EG
	1566a	EG	EG	EG	EG		EG		LG	EG	EG
Se	Tiss Z	EG	EG	GG	GG		HG			EG	EG
	1566a	LG	EG	EG	HG		GG			EG	EG
Ag	Tiss Z	EG			HX		G-	EG	EG	EG	
	1566a	EG			EG		EG	EG	LG	EG	
Cd	Tiss Z	EG	EG	EG	EG		EG	GG	EG	EG	
	1566a	EG	EG	EG	GG		EG	EG	EG	EG	
Sn	Tiss Z				HX					GG	
	1566a									EG	
Hg	Tiss Z	EG		EG	GX		EG	EG		EG	
	1566a	LG		GG	GX		EG	EG		EG	
Pb	Tiss Z	GX	EG	EG	EG		EG		GG	EG	
	1566a	GG	GG	EG	LG		EG		LG	GG	

APPENDIX D
Table D-1
Sediment Preparation Procedures

Lab No.	Sediment Preparation Procedure	Instrumentation
1	-0.5g -HNO_3, HCl -microwave heating	FAAS- As,Se ICPMS- Sb ICPAES- Cd,Mn,Ni,Fe,Cu,Zn,Ag,Be, Al,Pb
2	NA	
3	-0.5g -HNO_3, H_2O_2, HF -flask and hot plate	FAAS- Fe,Zn,Mn,Cu,Al,Ni,Si,Pb GFAAS- Be,Ni,Pb,Cr,Ag,Cd,Sn,Sb,Tl HGAAS- As,Se
4	-0.3-0.5g -HNO_3, HF -closed vessel, microwave heating	GFAAS- Ag,As,Be,Cd,Cr,Pb,Sb,Tl HGAAS- Se ICPAES- Cu,Ni,Zn
5	-0.5g -HNO_3, HF, $HClO_4$ -flask and hot plate -fusion (for Cr)	GFAAS- Cd(BCSS-1) ICPAES- Be,Al,Cr,Mn,Fe,Ni,Cu,Zn, Sn,Pb,Cd(Sed Y) HGICP- As
6	-1.00g -HNO_3, HF, (HCl alone for Sb) -flask and hot plate -teflon beaker(Fe,Mn,Al,Cr)	FAAS- Cd,Pb HGAAS- As,Se,Sb ICPAES-Be,Ni,Cu,Zn,Ag,Sn,Tl, Fe,Mn,Al,Cr
7	-0.5g -HNO_3, HF, $HClO_4$, H_2SO_4 -flask and hot plate	FAAS- Ni, Cu DCP-Mn,Al,Cr,Zn,Fe
	-0.25g -HNO_3, H_2SO_4, $HClO_4$ -flask and hot plate	HGAAS- Se,As
	-0.5g -HNO_3, HCl -flask and hot plate	FAAS- Cd DCP- Pb
8	NA	
9	-0.1-0.2g -HNO_3, HF, HCl, $HClO_4$ -flask and hot plate	FAAS- Cu,Cr,Fe,Mn,Zn GFAAS- Ag,Cd,Ni,Pb HGAAS- As,Se

Lab No.	Sediment Preparation Procedure	Instrumentation
10	NA	
11	-0.5g -HNO_3, HF, HCl -closed vessel -microwave heating	GFAAS- Pb,As ICPAES- Cu,Zn,Pb,Ni,Cd,Mn,Fe
12	-0.2g -HNO_3, HF, HCl, $HClO_4$ -teflon beaker	ICPAES- Be,Al,Cr,Mn,Fe,Ni,Cu Zn,Sn,Pb
	-0.5g -HF, HCl, H_2O_2 -Teflon beaker -acid digestion followed by solvent extraction	FAAS- Ag,Cd
	- 0.25g - HNO_3,HF, HCl, $HClO_4$ -Teflon beaker	HGAAS- As,Se
13	- 0.2g - HNO_3, HF, $HClO_4$ - closed vessel overnight at 130ºC	GFAAS- Ag,Cd,Se ICPMS- Be,Sb,Sn,Tl
	- 0.5g - pressed powder pellet	XRF- Al,As,Cr,Cu,Fe,Mn,Ni,Pb,Si,Zn
14	-0.25g -HNO_3, HF, $HClO_4$ -flask and hot plate	FAAS- Fe,Al GFAAS- Se, Ag ICPMS- Be,Al,Cr, Mn,Ni,Cu,Zn,As,Cd, Sn,Sb,Tl,Pb
15	-0.1g -HNO_3, HF, HCl -closed vessel, microwave heating	ICPMS- Cr,Sb
	-0.1g -HNO_3,HF -microwave heating -closed vessel	ICPMS- Ni,Cu,As,Cd,Sn,Tl,Pb ICPAES- Be,Mn,Zn
	-1.5g -fusion	XRF- Al,Fe,Si
16	-0.2g -HNO_3, HF, HCl -closed vessel	ICPAES- Si,Al,Cr,Zn,Mn,Ni,Fe,Cu,Pb ICPMS- Be,Cr,Zn,Ag,Ni,Cu,Cd,Sb, Hg,Tl,Pb

Lab No.	Sediment Preparation Procedure	Instrumentation
17	-0.25- 0.5g -HNO_3, HF, HCl, $HClO_4$ -flask and hot plate	FAAS- Al,Cd,Ag,Pb,Cr HGAAS- As,Sb,Se ICPAES-Be,Mn,Fe,Ni,Cu,Zn,Tl
18	-0.8g -HNO_3, HCl -flask and hot plate	ICPAES- Be,Al,Cr,Mn,Fe,Ni,Cu, Zn,As,Se,Cd,Sn,Pb
19	-0.5g -HNO_3, HF, HCl (Se,As), $HClO_4$ -closed vessel -dry ash (Se,As)	FAAS- Al,Cr,Cu,Fe,Mn,Si,Zn GFAAS- Ag,Sn,Pb,Ni,Cd HGAAS- Se,As
20	- 0.4g -HNO_3, HF, $HClO_4$ -teflon beaker and hot plate	FAAS- Al,Cr,Mn,Fe,Ni,Cu,Zn GFAAS- As,Se,Ag,Cd,Sn,Sb,Tl,Pb
21	- 0.35g -HNO_3, HF, HCl -microwave heating -closed vessel	FAAS- Be,Si,Mn,Fe,Cu,Zn GFAAS- Cr,Ni,As,Se,Ag,Cd,Sn, Sb,Tl,Pb
22	NA	
23	-0.5g -HNO_3, H_2O_2 - closed vessel - microwave heating	FAAS- Pb GFAAS- Pb,Ag,Se,As ICPAES- Al,Cr,Cu,Fe,Ni,Mn,Zn
24	- 0.5g -HNO_3, HF -flask and hot plate	GFAAS- As,Se ICPAES- Al,Cr,Mn,Fe,Cu,Zn,Ni
25	- 0.25g -HNO_3, HF, HCl - microwave heating -closed vessel	FAAS- Cr,Mn,Fe,Cu,Zn GFAAS- Ni,As,Se,Ag,Cd,Pb
26	- 0.5g -HNO_3, HCl - flask and hot plate	GFAAS- As ICPAES- Cr,Mn,Fe,Ni,Cu,Zn,Cd,Pb
27	- 1.0g - HNO_3, HCl - microwave heating	GFAAS- As,Se ICPAES- Be,Al,Mn,Fe,Cr,Ni,Cu,Zn,Ag Cd,Sn,Sb, Tl, Pb
28	NA	

Lab No.	Sediment Preparation Procedure	Instrumentation
29	- 0.5g - HNO_3, HF, HCl, $HClO_4$ - flask and hot plate	ICPAES- Fe,Al,Mn,Cr,Ni,Zn,Sn
	- HNO_3, HCl - flask and hot plate	FAAS- Cd,Pb GFAAS- As,Se ICPAES- Ag,Be, Cu
30	- HNO_3, HF, $HClO_4$ - closed vessel - microwave heating	ICPMS -Cr,Be,Fe,Mn,Ni,Cu,Zn, As,Se,Ag,Cd,Tl,Pb
31	- 0.25g - HCl - dry ash	HGAAS -As,Se
32	- 0.5g - HNO_3, H_2SO_4, $HClO_4$ - flask and hot plate	HGAAS- As, Se
	- 3 g - pressed powder pellet	XRF- Al,Cr,Cu,Fe,Mn,Ni,Pb,Si,Zn
33	- 0.5g -HNO_3, HF - microwave heating	ICPMS- Be,Cr,Ni,Cu,Zn,As,Se, Cd,Sb,Tl,Pb
34	- 0.40g - HNO_3, H_2O_2, HCl - flask and hot plate	ICPAES- Be,Al,Cr,Mn,Fe,Ni,Cu Zn,As,Ag,Cd,Sn,Pb
35	- 0.2g - HNO_3, HF, HCl - closed vessel - microwave heating	FAAS- Al,Cr,Mn,Fe,Ni,Cu,Zn
36	- 0.5 to 1g - HNO_3, HCl - flask and hot plate - microwave heating	FAAS- Cr,Cu,Ni,Zn,Pb,Cd GFAAS- Cd,Ag,Pb,Tl ICPAES- Mn
37	- 0.45g - HNO_3, HF, HCl - closed vessel	FAAS- Fe,Al,Si,Cu,Zn,Mn,Cr GFAAS- Pb,Ni,Cd

Lab No.	Sediment Preparation Procedure	Instrumentation
38	- 0.20g - HNO_3, HF, HCl - microwave heating - closed vessel	GFAAS- Pb,Ag ICPMS- Al,Cr,Fe,Mn,Ni,Cu,Zn, Cd,Ag,Sb
39	- 0.2g - HNO_3, HF - closed vessel	FAAS- Zn GFAAS- Pb,Sn,Ni,Ag,Cd,As,Cu INAA- Fe,Al,Cr,Mn,Sb
40	- 0.250g	INAA-Al,Cr,Mn,Fe,Zn,As,Se, Zn,As,Se,Sb
41	- 0.25g - HNO_3, HF, $HClO_4$ - closed vessel - microwave heating	GFAAS- Cr,Ni,Cu,Ag,Cd,Pb,As,Se ICPAES- Be,Al,Fe,Mn,Zn
42	- 0.25g - HNO_3,HF,$HClO_4$ - closed vessel - microwave heating	ICPAES- Cu ICPMS- Be IDICPMS- Cr,Ni,Cu,Zn,Sn,Sb,Cd,Tl,Pb

TABLE D-2
Tissue Dissolution Procedures

Lab No.	Tissue Preparation Procedure	Instrumentation
1	NA	
2	- 0.5g - HNO_3, HCl - closed vessel,microwave heating - followed by flask and hot plate	GFAAS- Pb,As,Se ICPAES- Ag,Cd,Cr,Cu,Ni,Zn,Al,Fe
3	- 0.5g - HNO_3, H_2O_2, HF - flask and hot plate	FAAS- Fe,Zn,Cu,Al,Ni GFAAS- Cu,Ni,Pb,Cr,Ag,Cd,Sn
4	- 2.0g - HNO_3, H_2O_2 - flask and hot plate	GFAAS- Ag,As,Cr,Pb,Ni,Se ICPAES- Cd,Cr,Cu,Zn
5	NA	
6	- 1.0g - HNO_3, H_2O_2 - flask and hot plate	GFAAS- Cd,Cr,Pb,Ni,Ag HGAAS- As,Se ICPAES- Al,Cu,Fe,Sn,Zn
7	- 0.1-0.5g - HNO_3, $HClO_4$ - flask and hot plate	FAAS- Zn GFAAS- Cd DCP -Fe HGAAS- As,Se
8		
9	- 0.1-0.2g - HNO_3, HF, HCl, $HClO_4$ - flask and hot plate	FAAS- Cu,Fe,Mn,Zn GFAAS- Ag,Cd,Cr,Ni,Pb
	- 0.1-0.2g - HNO_3, HCl - $Mg(NO_3)_2$ dry ash	HGAAS- As,Se
10	-1.0g - HNO_3, H_2O_2 - flask and hot plate	ICPMS- Ni,As,Se,Ag,Cd,Pb ICPAES- Al,Cr,Cu,Fe,Zn
11	- 0.75g - HNO_3, H_2O_2 - microwave heating,closed vessel	GFAAS- Pb,As,Ag ICPAES- Cu,Zn,Ni,Cd,Cr,Mn,Fe

Lab No.	Tissue Preparation Procedure	Instrumentation
12	NA	
13	- 0.3g - HNO_3, HCl - oven at 130°C	ICPMS- Ag,Al,Cd,Cr,Ni,Pb,Sn
	- 0.5g	XRF- As,Cu,Fe,Se,Zn
14	- 0.5g - HNO_3 - microwave heating	FAAS- Fe,Al ICPMS- Cr,Zn,As,Se,Ag,Cd,Sn,Pb
15	- 0.2g - HNO_3, H_2O_2 - microwave heating, closed vessel	FAAS- Cu(1566a) ICPMS- Cr,Ni,Cu, As,Se,Cd,Sn,Pb ICPAES- Al,Fe,Zn
16	- 0.5g - HNO_3 - closed vessel	ICPAES- Zn,Al,Fe,Cu ICPMS- Cr,Ni,Cu,As,Se,Ag,Cd,Sn,Pb
17	- 0.25-0.5g - HNO_3, HF, HCl, $HClO_4$ - flask and hot plate	FAAS- Al,Cd,Ag,Pb,Cr HGAAS- As,Se ICPAES- Fe,Cu,Zn
18	- 0.3g - HNO_3, H_2O_2 - flask and hot plate	ICPAES- Al,Cr,Fe,Ni,Cu,Zn, As,Se,Ag,Pb
19	- 0.5g - HNO_3, $HClO_4$ - closed vessel	FAAS- Al,Fe,Zn GFAAS- Ag,Sn,Pb,Cr,Ni,As,Se,Cd,Cu
20	NA	
21	-0.3-0.4g - HNO_3, H_2SO_4, HCl - microwave heating, closed vessel	FAAS- Al,Fe,Cu,Zn GFAAS- Cr,Ni,As,Se,Ag,Cd,Sn,Pb
22	- 0.5-0.7g - HNO_3 - closed vessel, microwave heating	ICPMS- Al,Cr,Ni,Cu,Zn,As,Se,Ag,Cd,Pb ICPAES -Fe
23	- 0.5g - HNO_3, H_2O_2 - microwave heating,closed vessel	FAAS- Pb GFAAS- Pb, Ag,Se,As ICPAES- Al,Cr,Cu,Fe,Ni,Mn,Zn

Lab No.	Tissue Preparation Procedure	Instrumentation
24	-0.5g - HNO_3, H_2O_2, HCl - dry ash	GFAAS- As,Se ICPAES- Al,Cr,Fe,Cu,Zn,Ni,Cd
25	- 0.5g - HNO_3, H_2O_2 - closed vessel - microwave heating	GFAAS- Cr,Ni,Se,Ag,Pb ICPAES- Al,Fe,Cu,Zn,As
26	- 1.0g - HNO_3 - flask and hot plate	GFAAS- As ICPAES- Cr,Ni,Cu,Zn,Cd,Pb
27	- 1.0g - HNO_3 - microwave heating	GFAAS- Pb ICPAES- As,Al,Fe,Ni,Cu,Zn,Sn, Cd,Ag,Se,Cr
28	- 0.5g - HNO_3 - microwave heating	ICPMS- As,Se,Pb ICPAES- Al,Cr,Fe,Ni,Cu,Zn,Ag,Sn
29	- 1.00g - HNO_3, H_2O_2 - flask and hot plate	GFAAS- Ni,As,Sr,Ag,Cd,Pb ICPAES- Al,Cr,Fe,Cu,Zn
30	- 0.2g - HNO_3 - microwave heating -closed vessel	ICPMS- Al,Cr,Fe,Ni,Cu,Cd,Sn,Zn As,Se,Ag,Pb
31	- 0.25g - HCl - dry ash	HGAAS- Se, As
	- 0.25g - HNO_3 - open tube/block digestion	FAAS- Zn, Cu GFAAS- Ag,Cd,Ni,Cr
32	- 0.5g - HNO_3, H_2O_2 - flask and hot plate	GFAAS- Cd,Cr,Ni,Pb
	- 1.0g - HNO_3, H_2SO_4, $HClO_4$ - flask and hot plate	HGAAS- As,Se ICPAES- Cu,Zn

Lab No.	Tissue Preparation Procedure	Instrumentation
33	-0.5g - HNO_3, HF - microwave heating	ICPMS- Cr,Ni,Cu,Zn,As,Se,Cd,Hg,Pb
34	- 0.20g - HNO_3, H_2O_2 - flask and hot plate	ICPMS- Cr,Ni,Cu,Se,Ag,Cd,Sn,Pb ICPAES- Al,Fe,Zn,As
35	- 0.5g - HNO_3 - flask and hot plate	FAAS- Fe,Ni,Cu,Zn
36	- HNO_3, H_2O_2 - microwave heating	GFAAS- As,Cd,Cr,Pb,Ni,Ag,Se ICPAES- As,Cd,Cr,Cu,Zn,Fe,Al
37	- 0.5g - HNO_3 - closed vessel	FAAS- Fe,Zn,Cu GFAAS- Cd,Cr,Ni,Ag
38	- 1.0g - HNO_3, H_2O_2 - flask and hot plate	GFAAS- Cr,Ni,Cu,As,Ag,Cd,Pb
39	- 0.2g - HNO_3 - closed vessel	GFAAS- Ag,Al,As,Cd,Cr,Cu,Ni,Pb,Se,Sn INAA- Fe,Zn
40	- 0.25g	INAA- Al,Cr,Fe,Zn,As,Se
41	- 0.25g - HNO_3, H_2O_2 - microwave heating -closed vessel	GFAAS- Cr,Fe,Ni,Cu,Ag,Cd,Pb HGAAS- As,Se ICPAES- Al,Zn,Fe
42	- 0.25g - HNO_3, H_2O_2 - microwave heating -closed vessel	IDICPMS- Ni, Cu,Zn,Ag,Cd,Sn,Pb
	- 0.25g - HNO_3, H_2O_2, HF -microwave heating -closed vessel	ICPAES- Al,Fe

TABLE D-3
Dissolution Procedures for the Determination of Mercury

Lab No.	Sediment Dissolution	Tissue Dissolution	Instrumentation
1	- 0.5g - HNO_3, HCl - microwave heating	NA	CVAAS
2	NA	- 0.1g - HNO_3, HCl - microwave heating - closed vessel	CVAFS
3	- 0.5g - HNO_3, H_2O_2, HF - flask and hot plate		CVAAS
4	- 0.5g - HNO_3, H_2SO_4 - BOD bottle and water bath		CVAAS
5	NA		
6	same as for other elements	post digestion on original extract by cold oxidation	CVAAS
7	- 0.5g - HNO_3, HCl - flask and hot plate	- 0.1g - HNO_3, H_2SO_4 - flask and hot plate	CVAAS
8			
9	- 0.06-0.4 g - HNO_3, H_2SO_4 - flask and hot plate	- 0.1-0.2g - HNO_3, H_2SO_4 - flask and hot plate	CVAFS
10	NA	same as for other elements	
11	NA		
12	- 0.1g - HNO_3 $NaCr_2O_7$ - flask and hot plate	NA	CVAAS
13	- 0.2g - HNO_3, HF, $HClO_4$ - closed vessel at 130°C	- 0.3g - HNO_3, HCl - closed vessel at 130°C	CVAAS

Lab No.	Sediment Dissolution	Tissue Dissolution	Instrumentation
14	- 0.25g - HNO_3 - microwave heating	same as for other elements	ID-ICPMS
15	NA		
16	same as for other elements	same as for other elements	CVAAS
17	same as for other elements		CVAAS
18	same as for other elements	same as for other elements	CVAAS
19	same as for other elements	same as for other elements	CVAAS
20	- 0.4g - HNO_3, HF, $HClO_4$ - teflon beaker and hot plate	NA	CVAAS
21	- 0.5g - HNO_3, HCl, H_2SO_4, - $KMnO_4$, $K_2S_2O_8$, NH_2OH HCl -closed vessel		CVAAS
22	- 0.25- 0.5g - HNO_3, H_2O_2 - $KMnO_4$, $K_2S_2O_8$ - heat on water bath	- 0.25g - HNO_3, H_2SO_4 - $KMnO_4$, $K_2S_2O_8$ - heat on water bath	CVAAS
23	NA		
24	- 0.25g - HNO_3, H_2SO_4 - closed vessel		CVAAS
25	same as for other elements		CVAAS
26	- 0.5g - HNO_3, HCl - flask and hot plate	- 1.0g - HNO_3 - flask and hot plate	CVAAS

Lab No.	Sediment Dissolution	Tissue Dissolution	Instrumentation
27	- 0.2g - HNO_3, H_2SO_4, HCl - $KMnO_4$, $K_2S_2O_8$ - heat on water bath	- 0.2g - HNO_3, H_2SO_4 - $KMnO_4$, $K_2S_2O_8$ - heat on water bath	CVAAS
28	NA	- 0.5g - HNO_3 - microwave heating	CVAAS
29	same as for other elements		CVAAS
30	same as for other elements		ICPMS
31	NA	- 0.25g - HNO_3 - open tube/ block	CVAAS
32	- 0.5g - HNO_3, HCl - flask and hot plate	NA	CVAAS
33	- 0.5g - HNO_3, H_2SO_4, $KMnO_4$ -heat on water bath	- 0.50 g - HNO_3, H_2SO_4, $KMnO_4$ - heat on water bath	CVAAS
34	- 0.2g - HNO_3, HCl - BOD bottle	- 0.5 g - HNO_3, H_2SO_4 - BOD bottle	CVAAS
35	NA		
36	NA	same as for other elements	CVAAS
37	same as for other elements		CVAAS
38	NA		
39	- 0.2g - HNO_3, H_2SO_4 - $KMnO_4$, $K_2S_2O_8$ - Heat on water bath		CVAAS
40	NA		
41	-0.25g - HNO_3, H_2SO_4, $HClO_4$ - flask and hot plate	same as for other elements	CVAAS- sediments IDICPMS - tissues