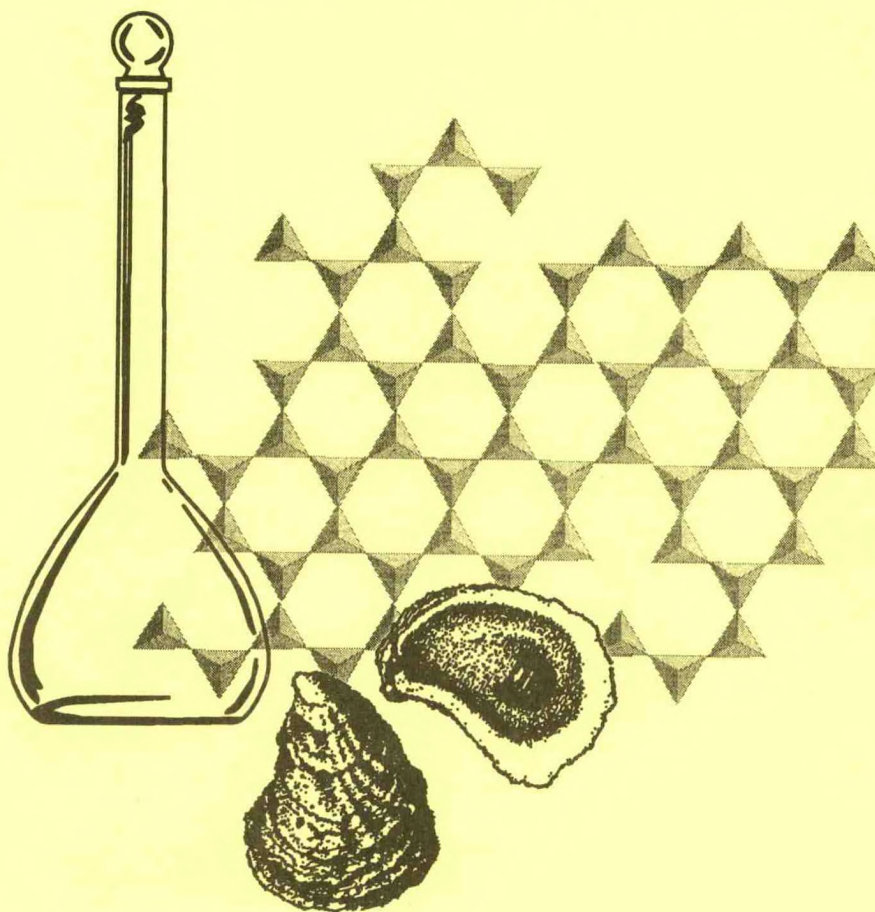


National Status and Trends Program
for Marine Environmental Quality

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



Silver Spring, Maryland
March 1995

US Department of Commerce

noaa NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

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

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Notice

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

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Abstract

This report, prepared by the National Research Council of Canada, summarizes results of the NOAA National Status and Trends Program eighth round intercomparison exercise for trace metals in marine sediments and biological tissues. This exercise is one in a series of annual intercomparisons sponsored by NOAA and EPA for laboratories doing agency-funded chemical analyses. In addition, the exercises have been opened to other laboratories resulting in fifty-six laboratories receiving materials for analysis for the 1994 exercise. The exercise materials were a freeze dried Pacific oyster tissue and a freeze dried marine sediment collected in Nova Scotia. Reference materials NRC CRM BCSS-1 and NIST SRM 1566a were also analyzed as part of the exercise. The elements 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 sediments. Forty-six sets of results were received.

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



Silver Spring, Maryland
March 1995

United States
Department of Commerce

Ronald H. Brown
Secretary

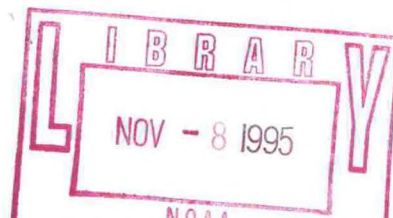
National Oceanic and
Atmospheric Administration

D. James Baker
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National Ocean Service

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INTRODUCTORY REMARKS

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



National Research Conseil national
Council Canada de recherches Canada

Institute for Environmental Institut de technologie
Research and Technology et de recherche environnementales

NRC · CNRC

NOAA/8

***Eighth Round Intercomparison
for Trace Metals
in Marine Sediments
and Biological Tissues***

Scott Willie and Shier Berman

Prepared for the
Oceans Assessments Division
National Oceanic and Atmospheric Administration

December 1994

Canada

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1. INTRODUCTION

This is the eighth intercomparison exercise for trace metals organized by the National Research Council of Canada (NRC) on behalf of the Ocean Assessments Division of the National Oceanic and Atmospheric Administration (NOAA). The original purpose of this exercise was to assess the capabilities of a number of NOAA and other laboratories involved in the Ocean Assessments Division's National Status and Trends program to analyze marine sediments and biological tissues for trace metals. In 1990 a small number of USEPA and state laboratories was allowed to join the fourth exercise. External participation was further expanded in 1991 with 29 laboratories, including four from Australia, submitting results. In 1992 the number was further expanded to 35 laboratories. Last year sixteen Canadian laboratories whose participation was supported by NRC joined the group bringing to fifty-nine the total number of laboratories in NOAA/7. This year, fifty-six sets of samples were sent to NOAA, USEPA, state, Australian and Canadian laboratories.

Participating laboratories, meeting in Miami at the annual NOAA quality assurance workshop after the seventh intercomparison exercise, had agreed for the eighth 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:

Tissue V, a freeze dried Pacific oyster tissue mixture donated by Eric Crecelius, Battelle Pacific Northwest.

Sediment U, a freeze dried marine sediment collected for NRC from a Nova Scotian harbour.

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.

This year a significant change was adopted. Each laboratory was requested to perform only four replicate analyses, but these were to be done on non-consecutive days for each of the samples and CRMs. It was hoped this protocol would lead to a better evaluation of the intralaboratory precision. Also, this 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 obviously 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 Tissue V and Sediment U, 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 eight 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-six laboratories listed in Appendix A in mid-April 1994 with the deadline for receipt of results set at September 6. Forty-six sets of results were received. Sequential numbers were assigned to each responding laboratory upon receipt of its data. Laboratory numbers 47 and 48 were assigned to NRC.

Seven laboratories submitted results for the first time. Nine of the ten laboratories which did not send results had participated in NOAA/7. Of the forty-six laboratories, four did not submit data for the biological tissues and six did not submit data for the sediments.

A copy of the tabulated raw data was sent to each participant that had submitted data before 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. A few 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 three results were not evaluated. In previous exercises a Q test (Dixon's test) was used to determine outliers within a replicate set of data, this practice was abandoned this year because of the very large rejection criterion for four replicates. 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* test² at the 95 percent confidence level was used to identify outliers. Some very obvious outliers were initially rejected before statistical evaluations.

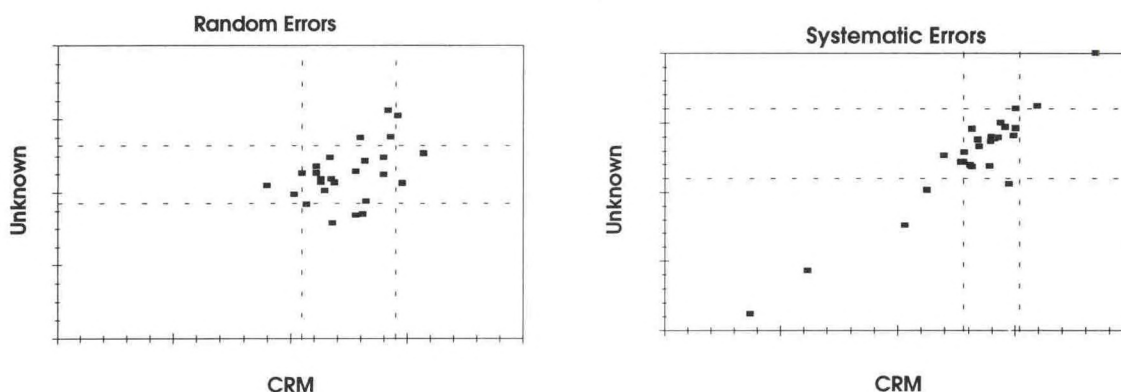
It was decided at last year's NOAA QA meeting to set the minimum acceptable range for the analytes in the CRMs at either the certified range or ten percent of the certified value, whichever is larger (five percent for Al, Si and Fe in the sediments). In Appendix B and the graphs where this occurred the listed certified value is followed by the acceptable range used for evaluation in parentheses. In a few cases, the calculated acceptable range for the unknown samples was also very small (an indication of good performance by the group as a whole), and the same criterion of a minimal acceptable range of ten percent was used. This change from previous practice results in a small discontinuity in the year to year evaluation of the exercise.

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. 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 one or both of the laboratory results are rejected. Unfortunately, when a group of laboratories report similar rejected results the labels become illegible. The accepted confidence range is indicated by the dashed lines.

Examples of Youden plots, demonstrating random and systematic errors respectively, are shown below.



BERYLLIUM

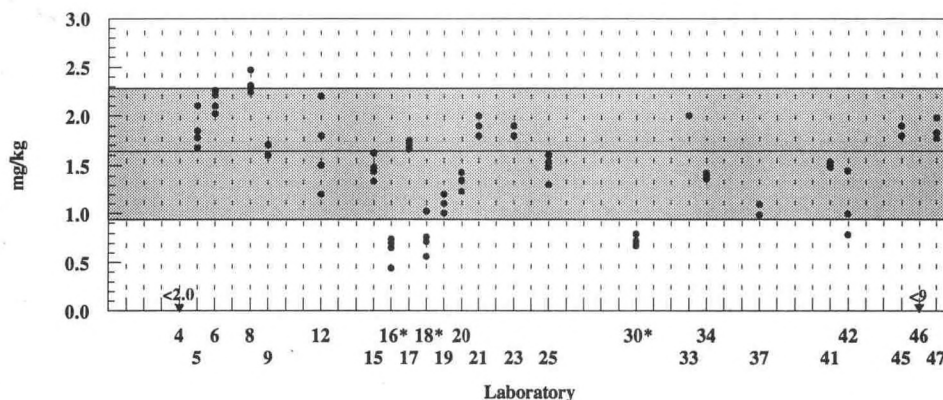
Sediment U

Accepted value = 1.61 ± 0.67 mg/kg

Results: 24

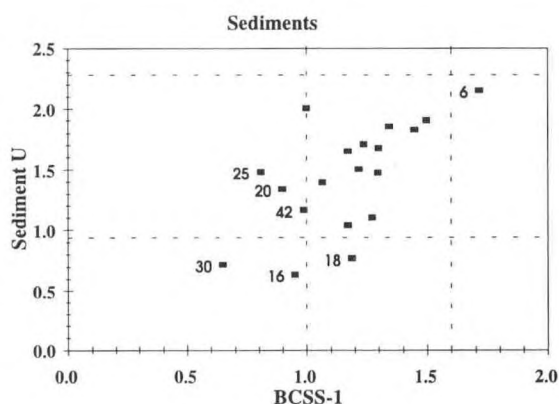
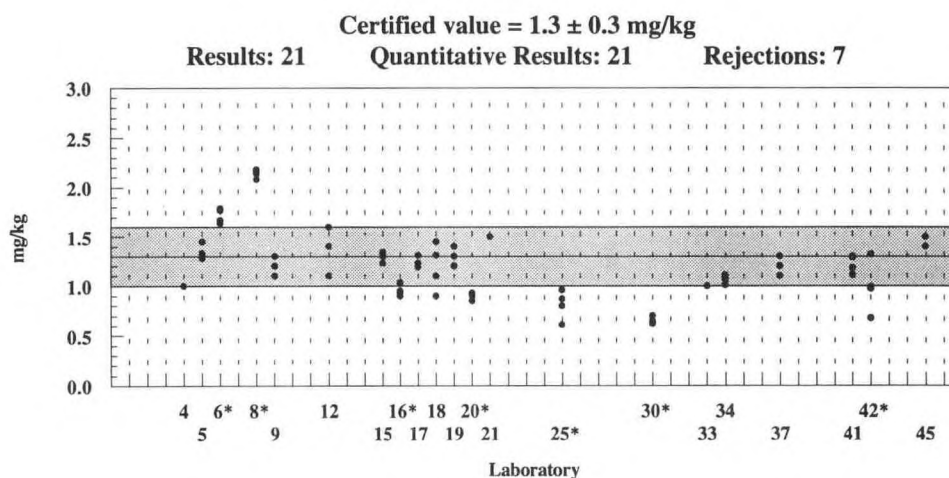
Quantitative Results: 22

Rejections: 3



BERYLLIUM

BCSS-1



This is the second year the determination of Be has been included in the exercise. The calculated confidence interval for Sediment U is ± 41 percent. This is larger than the calculated value in NOAA/7 (± 27 percent) and as a result there is a higher proportion of acceptable results compared to last year. Six laboratories submitted results for Be that did not use hydrofluoric acid (HF) in the digestion procedure. Three of these were rejected and the other three submitted results within the confidence interval, making it difficult to unequivocally conclude that the use of HF is essential in obtaining attaining good Be results. Twenty-one labs submitted results for Be in BCSS-1, an increase from fifteen last year. The tighter specification for the CRM (± 23 percent) resulted in seven rejected sets of results. Three of these laboratories did not use HF in their digestion procedure. The Youden plot displays a tendency towards systematic errors.

The determination of beryllium was not required in Tissue V.

ALUMINUM

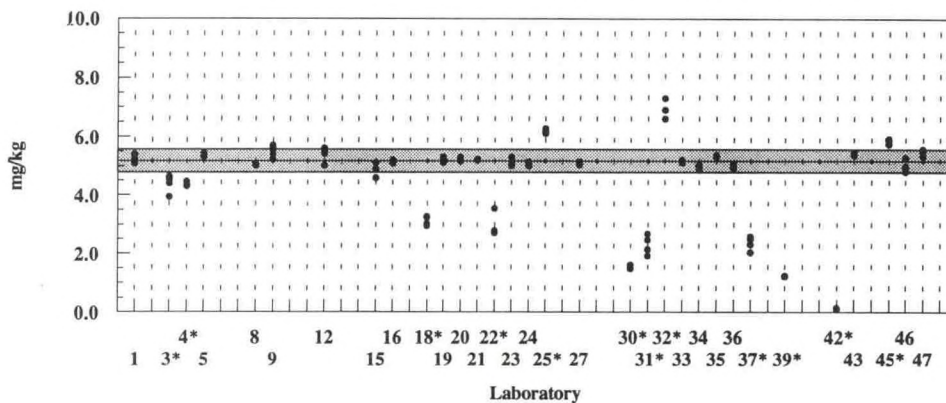
Sediment U

Accepted value = 5.16 ± 0.39 %

Results: 32

Quantitative Results: 32

Rejections: 12



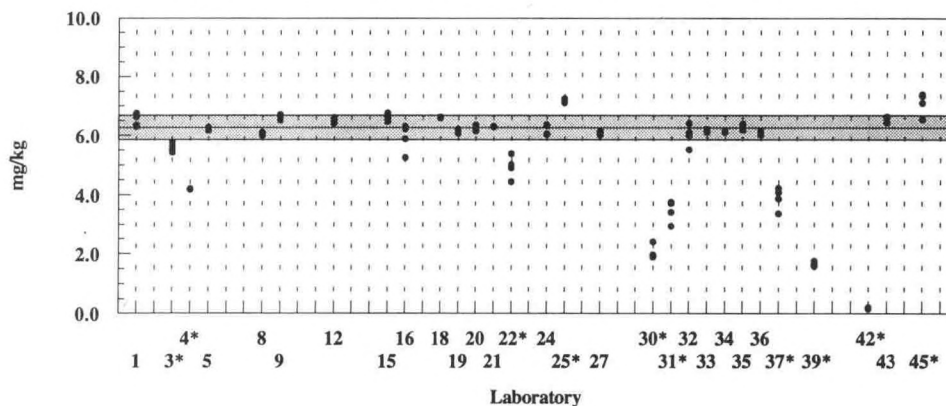
BCSS-1

Certified value = 6.26 ± 0.41 %

Results: 29

Quantitative Results: 29

Rejections: 10

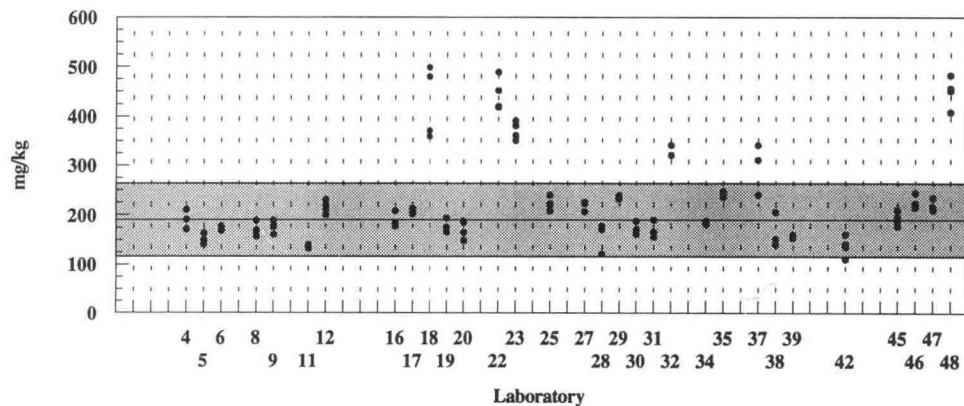


Tissue V

Results: 31

Quantitative Results: 31

Rejections: 0



ALUMINUM

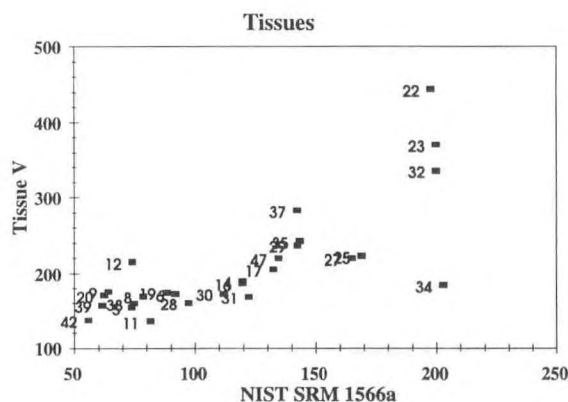
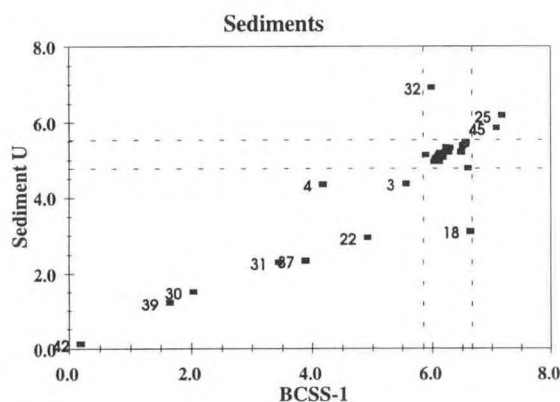
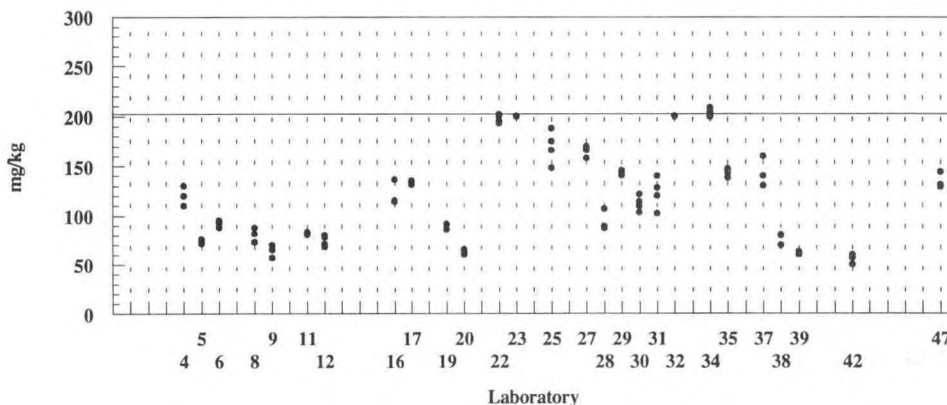
NIST SRM 1566a

Certified value = 202.5 ± 12.5 mg/kg

Results: 28

Quantitative Results: 28

Rejections: 0



In general, data has improved for the determination of Al in sediments and the accepted confidence interval has decreased from ± 25 , ± 20 , ± 12 to ± 8 percent from NOAA/5 to NOAA/8. Six laboratories did not use HF to help dissolve the Sample U. Five of these were among the nine rejected with low results for Sediment U. Results for BCSS-1 have also improved. Of the twenty-nine sets of results received for Al in BCSS-1, twenty-two used HF, five did not use HF and two used non-destructive methods. Eight of the ten outliers were low. Four of these did not use HF. 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.

Performance for the determination of Al in the tissues is difficult to evaluate this year. We stated in the letter accompanying the samples that evaluation would not be based on total digestion with HF as this acid is not routinely used by most laboratories for the dissolution of tissues. Our own results (47,48), respectively without and with HF, show dramatically different values. Laboratories 17, 22 and 23 used HF in the digestion and the other labs with high results (18,32,37) used HClO_4 . Statistical evaluation of the data (no HF, HClO_4) results in a value of 190 ± 74 mg/kg for Tissue V. Likewise for SRM 1566a it as been shown in previous exercises that HF is necessary to completely recover all the Al. Laboratory 47 is NRC's analysis without using HF. The results for Al in either Tissue V or SRM 1566a are not included in the final evaluation.

SILICON

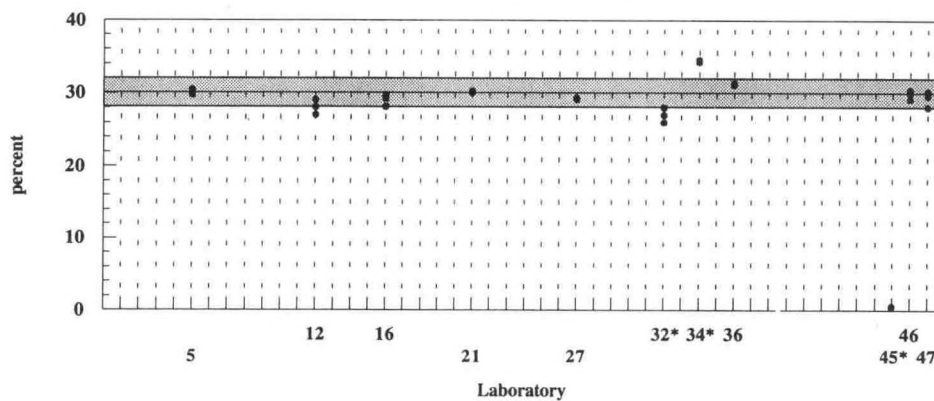
Sediment U

Accepted value = 30.1 ± 2.0 %

Results: 11

Quantitative Results: 11

Rejections: 3



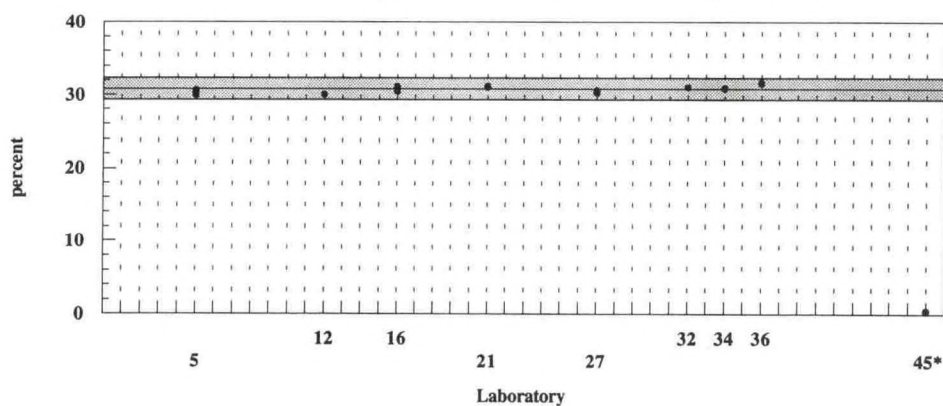
BCSS-1

Certified value = $30.8 \pm 1.0(1.5)$ %

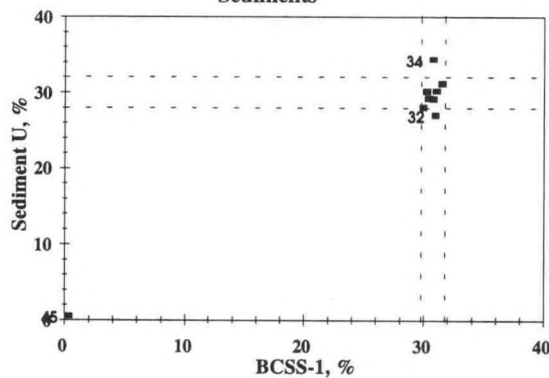
Results: 9

Quantitative Results: 9

Rejections: 1



Sediments



SILICON

NOAA/7, last year, was the first exercise where sufficient data were submitted to perform meaningful calculations for Si in sediments (14 data sets in NOAA/7 compared to 3 sets in NOAA/6) and the confidence interval decreased from ± 12 to ± 7 percent. Participation dropped this year with 11 data sets submitted. Laboratory 45 has submitted weird results considering that the material is an aluminum silicate. The other two Sediment U rejections were the only results based on measurements by flame atomic absorption (FAAS). Although a minimum value of ± 5 percent had been set for Si data in the CRM, except for the one obvious outlier, all the submitted data for BCSS-1 were within the certified range of ± 3.2 percent. 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 V.

CHROMIUM

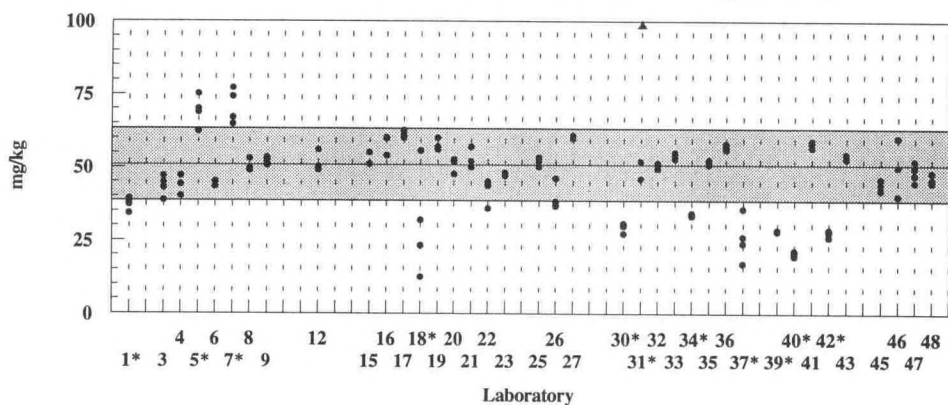
Sediment U

Accepted value = 50.8 ± 12.3 mg/kg

Results: 38

Quantitative Results: 38

Rejections: 11



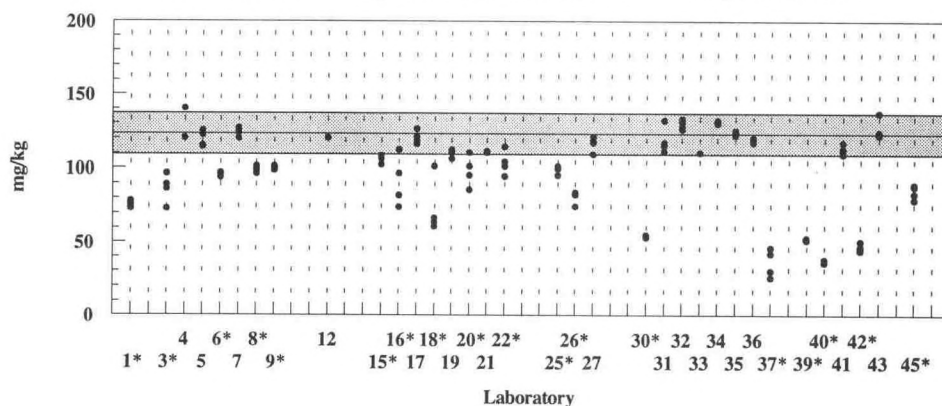
BCSS-1

Certified value = 123 ± 14 mg/kg

Results: 34

Quantitative Results: 34

Rejections: 18



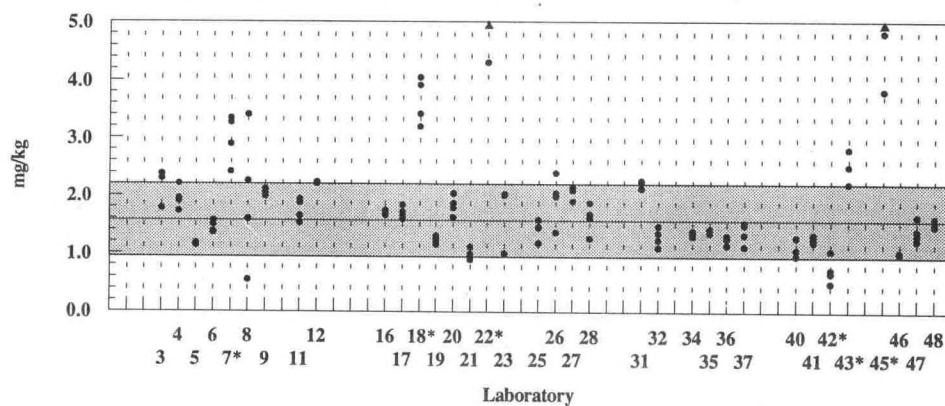
Tissue V

Accepted value = 1.57 ± 0.63 mg/kg

Results: 35

Quantitative Results: 35

Rejections: 6



CHROMIUM

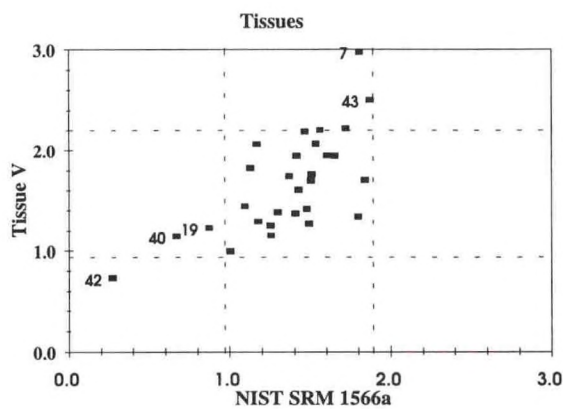
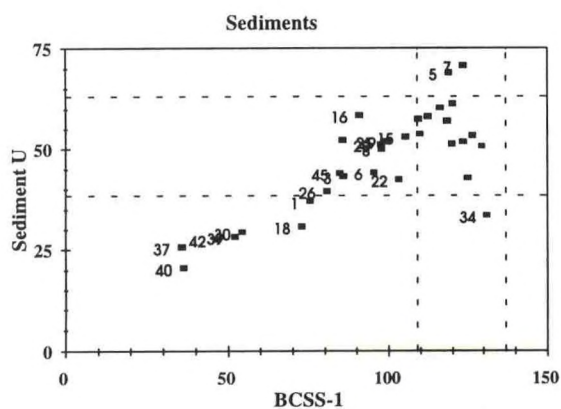
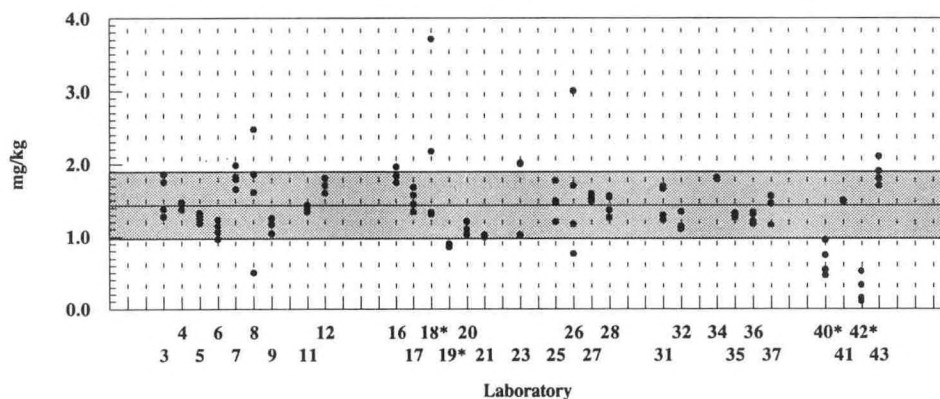
NIST SRM 1566a

Certified value = 1.43 ± 0.46 mg/kg

Results: 30

Quantitative Results: 30

Rejections: 4



Results for the determination of Cr in the sediment samples have not changed significantly over the past two exercises. Nine of the twelve outliers for Sediment U were low and six of these did not use HF in the digestion procedure. Laboratory 46 is the only one which apparently can produce good values for both Al and Cr in the sediment without using HF in the dissolution process. Experience has shown that complete digestion is required to get within the certified interval for Cr in BCSS-1. All eighteen outliers were low even though twelve of the laboratories used HF. 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 chromite.

The Cr content in Tissue V is a factor of three higher than that in the tissue used in NOAA/7 which may well account for the smaller calculated confidence interval (± 40 percent compared to ± 60 percent in NOAA/7). Five of the six outliers are high for this sample possibly indicating contamination or calibration problems. There is no apparent relationship between "success" and dissolution or measuring systems. A comparison of the rejected results identified two rejections (18,22) out of the seven ICPMS results, two rejections (7,45) of the ten GFAAS results and one rejection (42) of the thirteen ICPAES results. The only INAA result (43) was high. The results for Cr in SRM 1566a have improved with the rejection rate decreasing from 17 to 13 percent from NOAA/7 to NOAA/8. The Youden plot gives us no clues.

MANGANESE

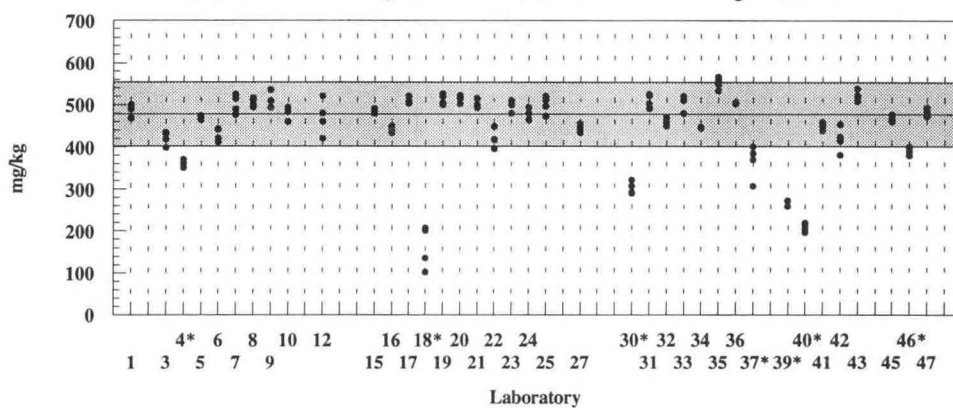
Sediment U

Accepted value = 478 ± 76 mg/kg

Results: 38

Quantitative Results: 38

Rejections: 7



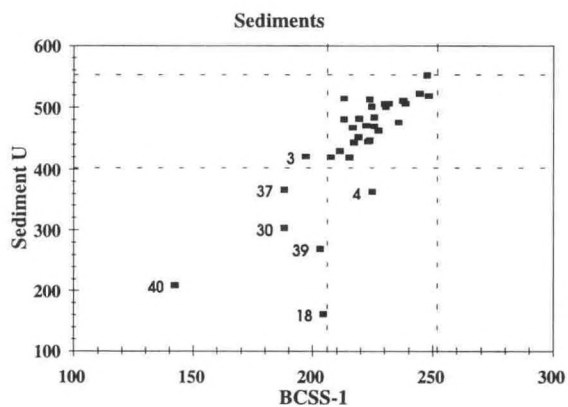
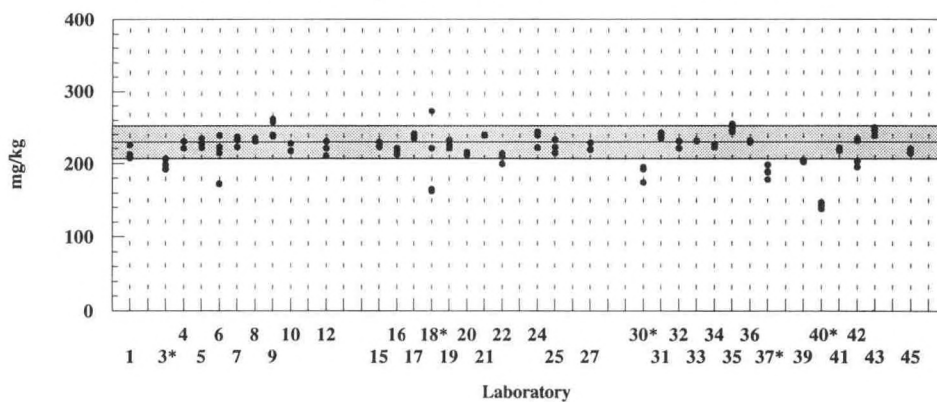
BCSS-1

Certified value = $229 \pm 15(23)$ mg/kg

Results: 35

Quantitative Results: 35

Rejections: 5



MANGANESE

This year's results for Mn in the sediment samples showed some improvement for BCSS-1 but were worse for the unknown sample. The ± 16 percent confidence range for Sediment U is similar to that of the sediment sample used in NOAA/7 but the proportion of rejected results has increased from ten to eighteen percent. All rejected values were low and six of these seven laboratories did not employ HF. The proportion of acceptable results based on the certified confidence interval of ± 6.6 percent for Mn in BCSS-1 has risen steadily from 53, 55, 60 to 65 percent of the reported results for NOAA/5 to NOAA/8 respectively. This year, expanding the acceptable range to ± 10 percent elevates the proportion of acceptable results to 86 percent. All of the outliers are low. Five of the six low sets of results for BCSS-1 were from laboratories that did not use HF in the digestion procedure. This is reflected in the Youden plot.

The determination of manganese was not required in Tissue V.

IRON

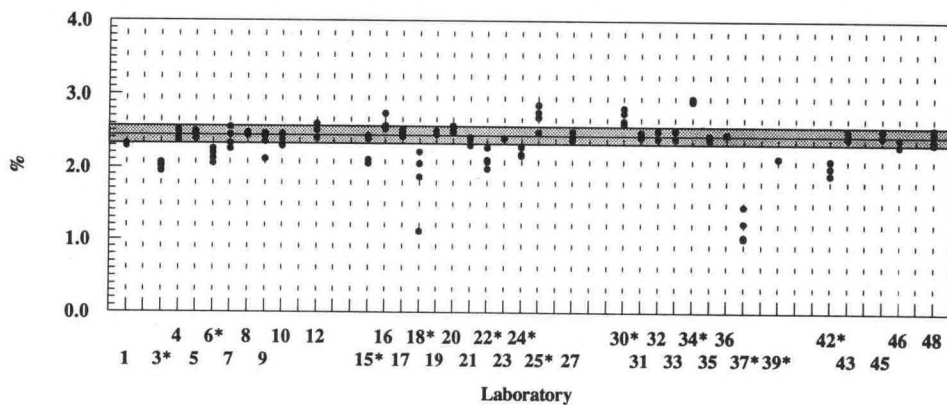
Sediment U

Accepted value = $2.44 \pm 0.11(0.12)\%$

Results: 36

Quantitative Results: 36

Rejections: 12



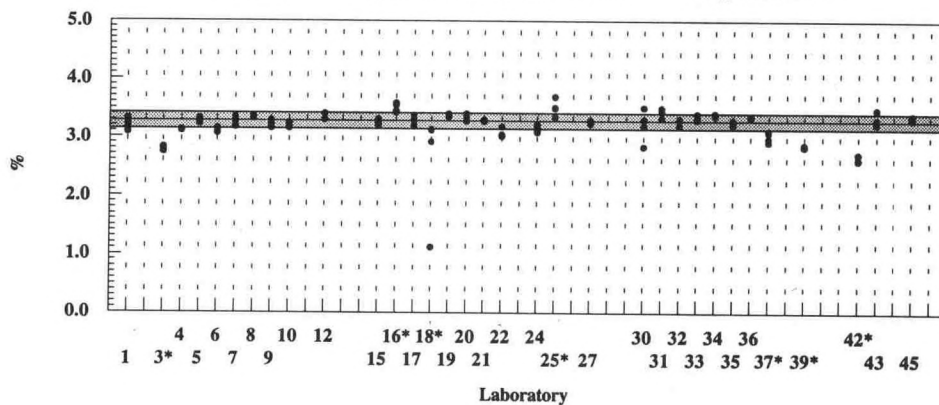
BCSS-1

Certified value = $3.28 \pm 0.14(0.16)\%$

Results: 33

Quantitative Results: 33

Rejections: 7



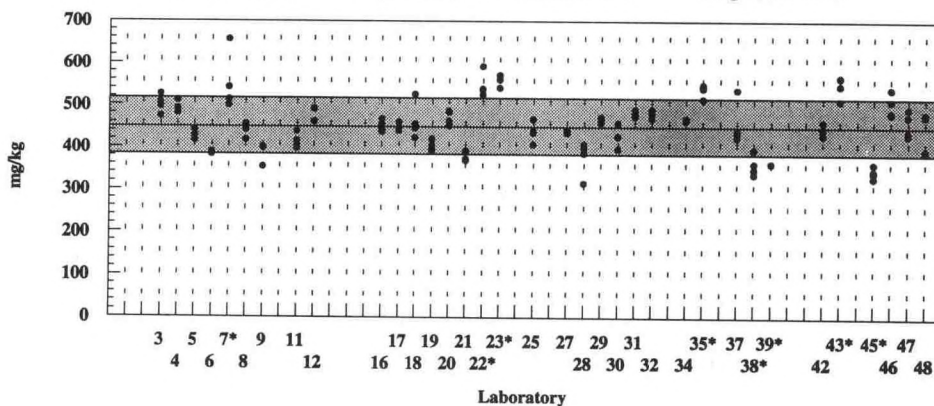
Tissue V

Accepted value = $449 \pm 66 \text{ mg/kg}$

Results: 35

Quantitative Results: 35

Rejections: 8



IRON

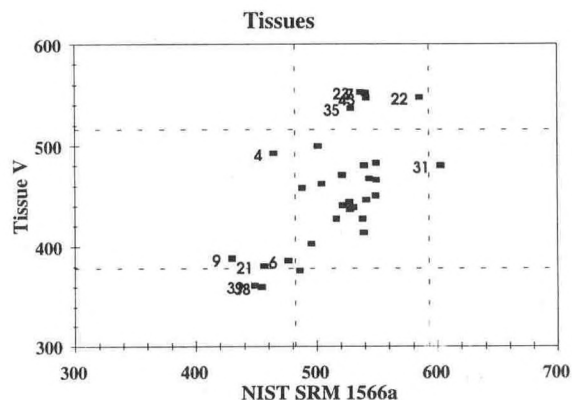
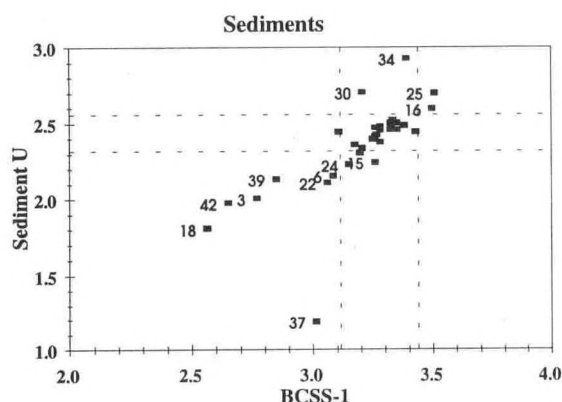
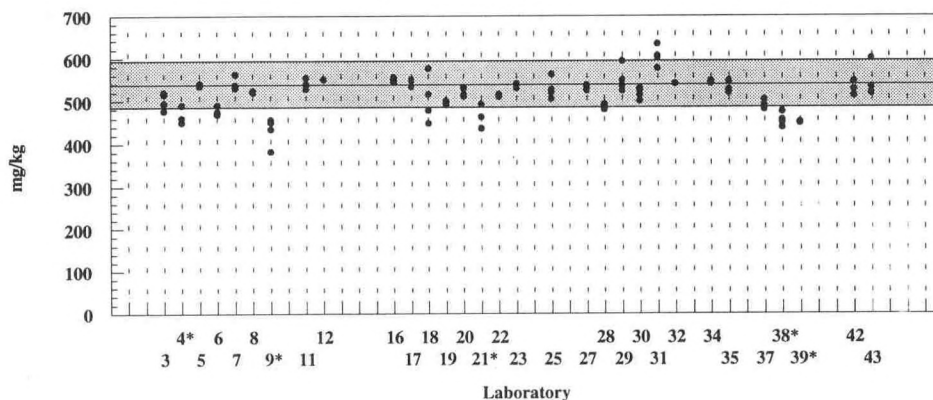
NIST SRM 1566a

Certified value = $539 \pm 15(54)$ mg/kg

Results: 31

Quantitative Results: 31

Rejections: 5



Results for Fe in the sediments have improved over those of previous years. The calculated confidence interval for Sediment U is ± 4.5 percent compared to values of between 13 and 15 percent for the three previous exercises. For data evaluation the acceptable confidence interval was marginally increased to ± 5 percent. Only three of the 12 rejected sets were high. Of the nine low values, only three were from laboratories which did not use HF. As we proceed to analytes of higher atomic number other dissolution and/or interference problems begin to predominate. For example, seven of 11 laboratories using FAAS (64 percent) produced unacceptable results for Sediment U while only four of 19 ICPAES values (21 percent) were rejected. For BCSS-1, the certified confidence range was increased to ± 5 percent from ± 4.3 percent for evaluation purposes. Results for BCSS-1 show good improvement with rejection rates of 70, 38, 46 and 21 percent from NOAA/5 to NOAA/8. Of the seven outliers, four were measured by FAAS and three by ICPAES. The Youden plot reflects systematic errors, most probably related to calibration and interference problems.

It is difficult to compare results for the unknown tissue sample over the past few exercises as the mean Fe concentration has varied from 42 and 449 mg/kg. Five of the eight rejected values for Tissue V are high. There is no apparent relation between methodologies and results other than both INAA values (35,43) being high. The acceptable confidence range for SRM 1566a has been increased this year to ± 10 percent resulting in a drop in the rejection rate to 16 percent. The Youden plot displays systematic errors for low results only.

NICKEL

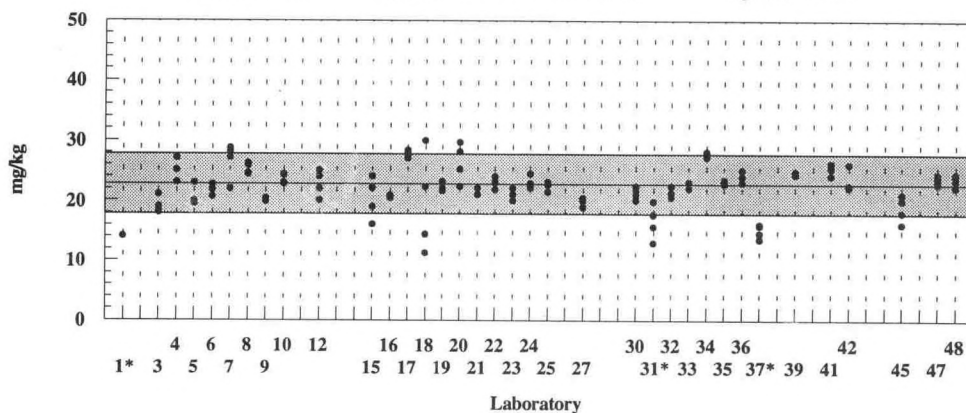
Sediment U

Accepted value = 22.8 ± 5.0 mg/kg

Results: 36

Quantitative Results: 36

Rejections: 3



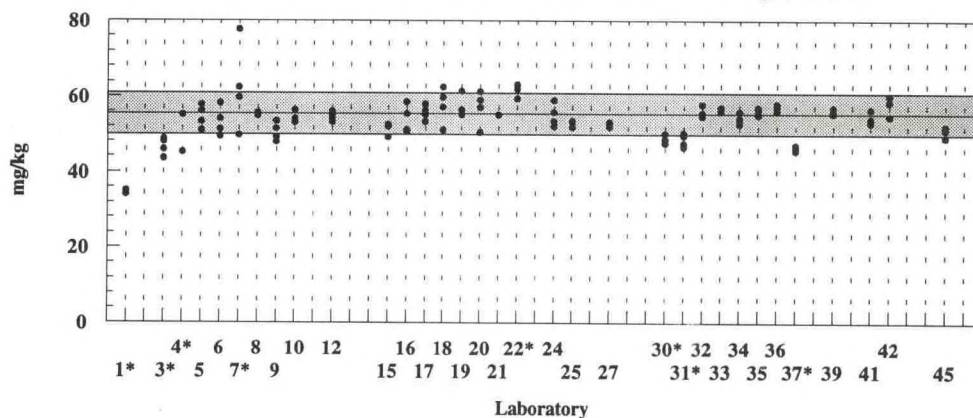
BCSS-1

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

Results: 33

Quantitative Results: 33

Rejections: 8



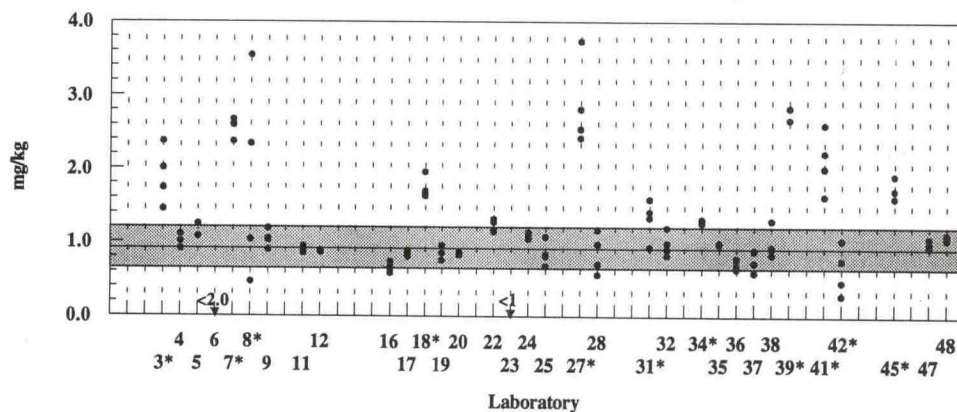
Tissue V

Accepted value = 0.92 ± 0.28 mg/kg

Results: 33

Quantitative Results: 31

Rejections: 11



NICKEL

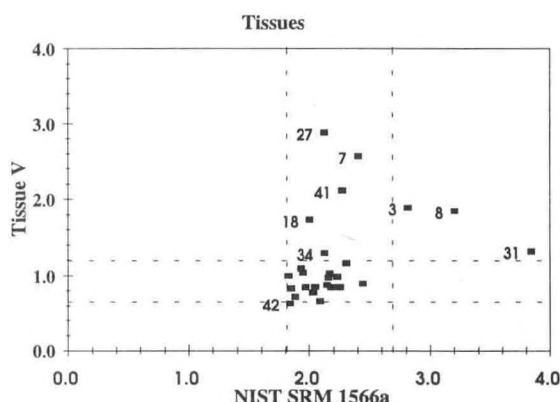
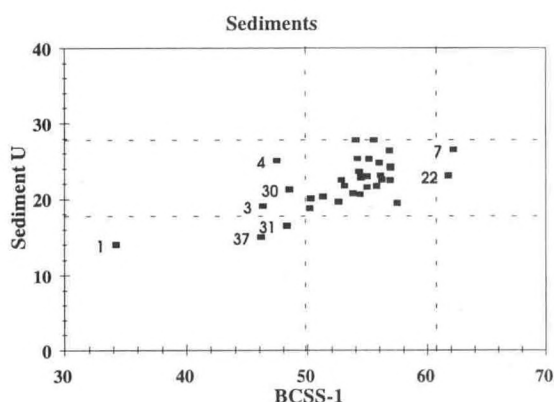
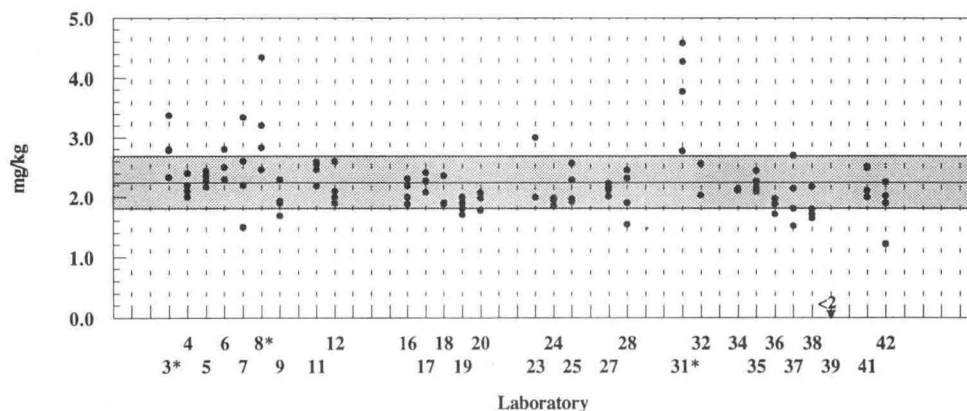
NIST SRM 1566a

Certified value = 2.25 ± 0.44 mg/kg

Results: 29

Quantitative Results: 28

Rejections: 3



Results for Ni in the sediments have not changed significantly. The rejection rate has decreased from 14 to 8 percent, but this is partially due the increase of the calculated confidence interval from 15 to 22 percent. Thirty-six laboratories submitted results for Sediment U with only 3 rejections, all low. HF was not used for 2 of the 3 outliers. The acceptable confidence range for BCSS-1 was increased from ± 6.5 to ± 10 percent for the evaluation. There were eight outliers in thirty-three submissions. Only three of the eight did not use HF. There is no apparent relation between methodologies and results. The Youden plot shows some tendency to systematic errors and also the tendency to low values.

The concentration of Ni in Tissue V is similar to Tissue S used in NOAA/7, but this year's results are somewhat worse. The rejection rate increased from 26 to 35 percent with ten of the eleven rejected results high. An examination of the instrumentation used reveals four of the six quantitative ICPAES results, four of the twelve GFAAS results, the only FAAS result, but only one of the eleven ICPMS results rejected. By contrast, results for Ni in SRM 1566a are significantly improved. The rejection rate decreased from 31 to 11 percent from NOAA/7 to NOAA/8. There were only three outliers, all high, two using ICPAES. The Youden plot shows the tendency to high results, especially for Tissue V.

COPPER

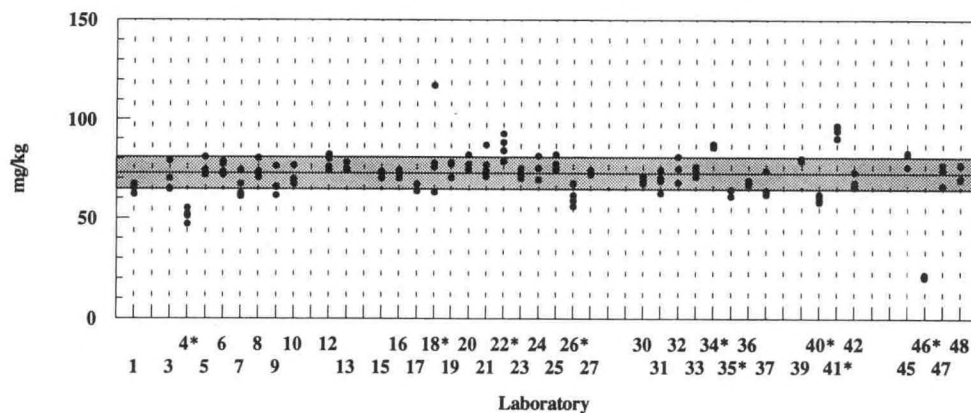
Sediment U

Accepted value = 72.7 ± 8.1 mg/kg

Results: 40

Quantitative Results: 40

Rejections: 9



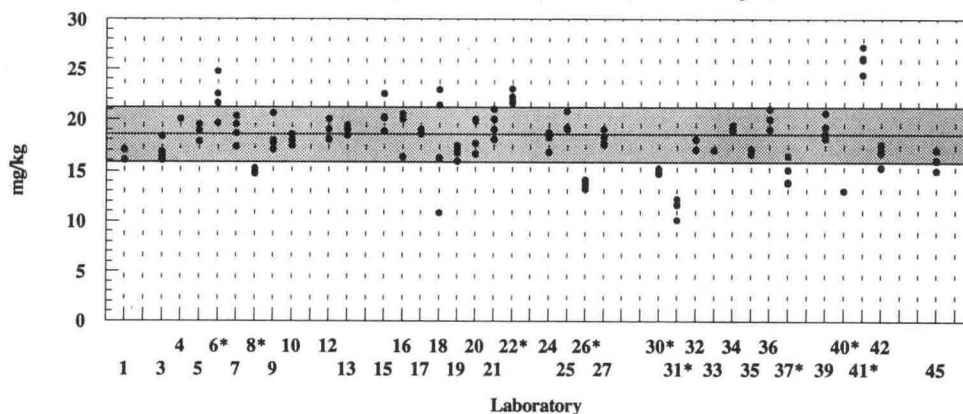
BCSS-1

Certified value = 18.5 ± 2.7 mg/kg

Results: 36

Quantitative Results: 36

Rejections: 9



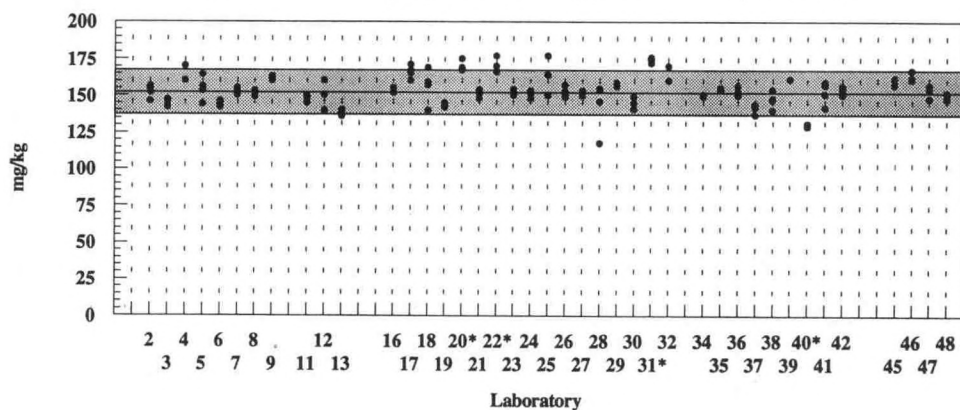
Tissue V

Accepted value = 152 ± 15 mg/kg

Results: 41

Quantitative Results: 41

Rejections: 4



COPPER

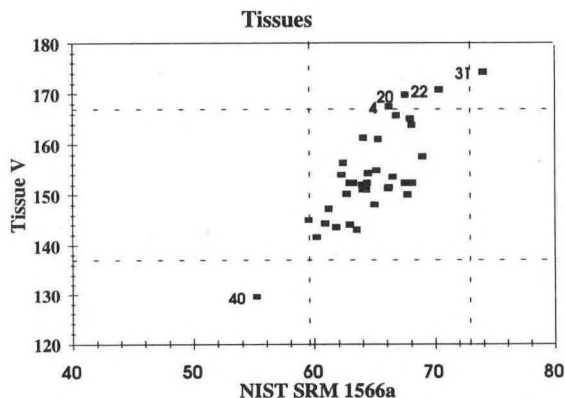
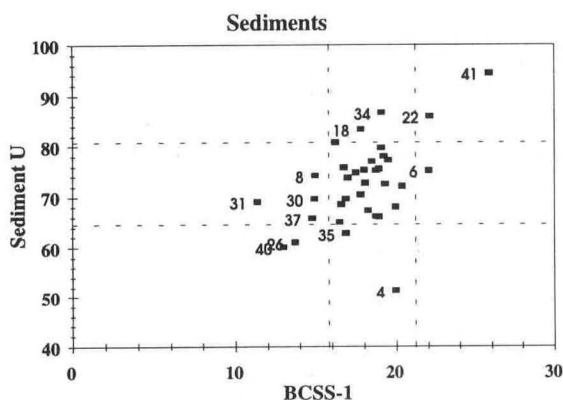
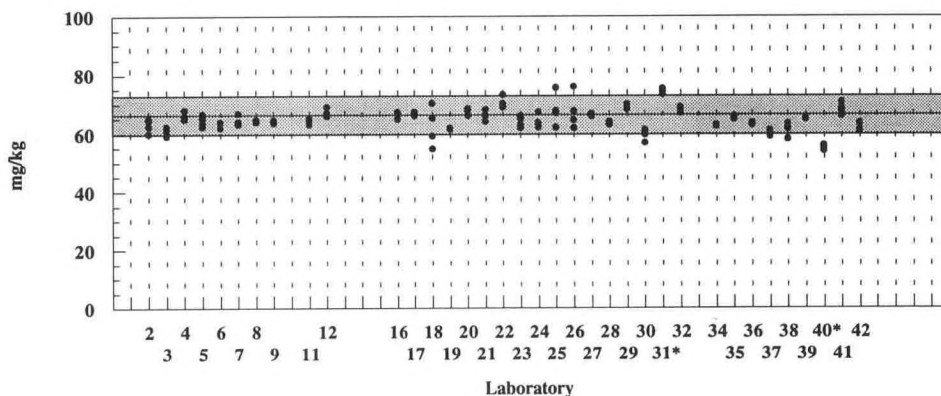
NIST SRM 1566a

Certified value = $66.3 \pm 4.3(6.6)$ mg/kg

Results: 36

Quantitative Results: 36

Rejections: 2



The significant improvement observed last year for the determination of Cu in the sediments has been maintained this year. The calculated confidence interval for Sediment U is ± 11 percent and the rejection rate is 22 percent. There were 9 outliers, 5 low (4,26,35,40,46) and 4 high (18,22,34,41). There is no apparent correlation between methodology and results. Laboratory 46 possibly has a problem with arithmetic. Results for Cu in BCSS-1 are also similar to last year, although, three of the nine rejected results are high whereas all of the rejected results in NOAA/7 were low. The disparity in Cu concentrations between the two samples makes insights from the Youden plot difficult.

The Cu concentration in Tissue V is forty times greater than in the unknowns used in NOAA/6 and NOAA/7 making performance comparisons difficult. But the results are good. The rejection rate from 41 submissions is less than ten percent, with three of the four outliers high. Also, no mean was more than 14 percent from the accepted value. There are similar results for SRM 1566a. With only two outliers, no result is more than 15 percent from the certified value. The Youden plot shows a tendency towards systematic errors.

ZINC

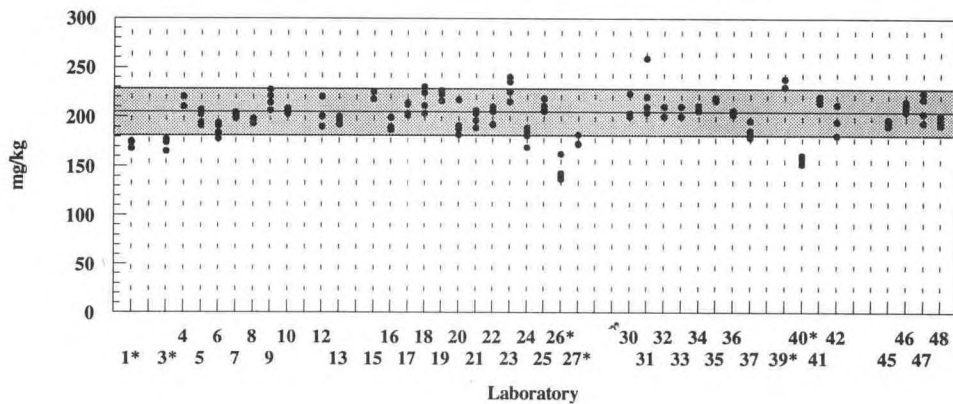
Sediment U

Accepted value = 205 ± 24 mg/kg

Results: 40

Quantitative Results: 40

Rejections: 6



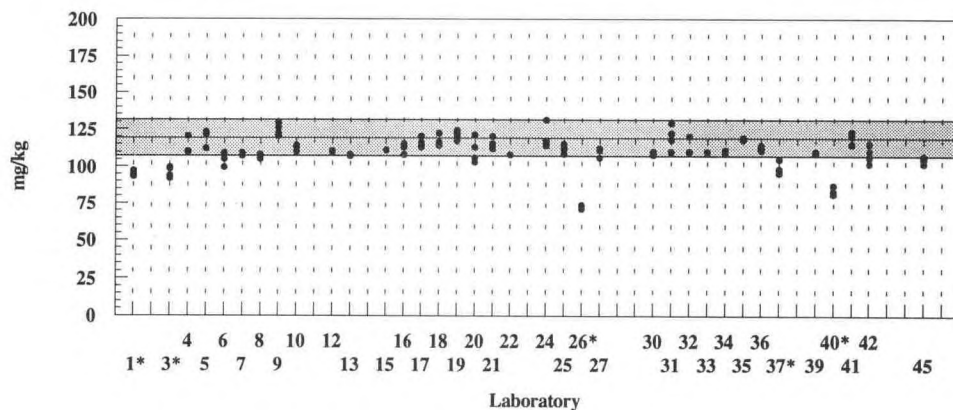
BCSS-1

Certified value = 119 ± 12 mg/kg

Results: 36

Quantitative Results: 36

Rejections: 5



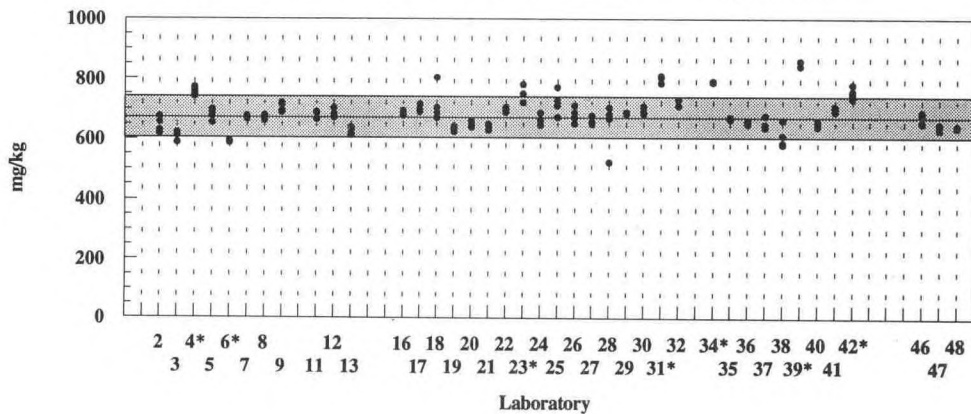
Tissue V

Accepted value = 672 ± 67 mg/kg

Results: 40

Quantitative Results: 40

Rejections: 7



ZINC

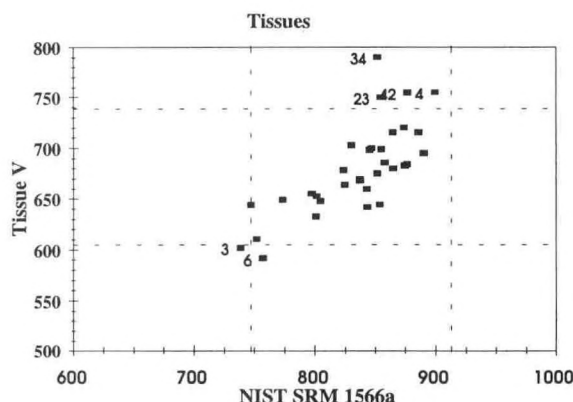
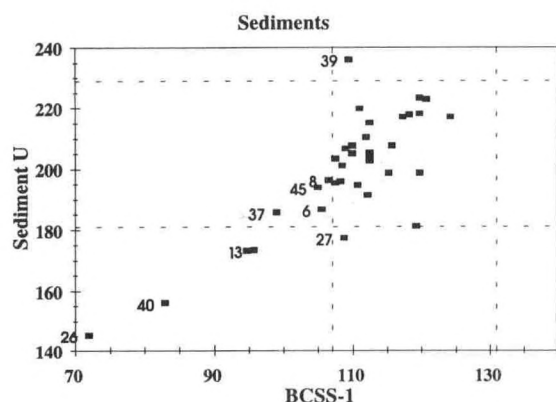
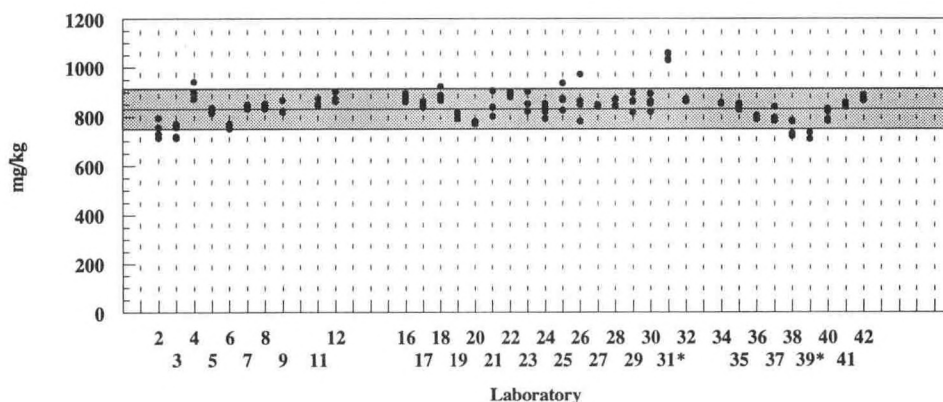
NIST SRM 1566a

Certified value = 830 ± 57 (83) mg/kg

Results: 36

Quantitative Results: 36

Rejections: 2



Results for zinc in the sediment samples have improved significantly from NOAA/7 with the proportion of rejected results decreasing from 24 to 15 percent. There were six outliers from 40 submissions, five of which were low but only one mean was greater than 20 percent from the accepted value. Likewise for BCSS-1, rejected results have decreased from 33 to 14 percent of the submitted values. Of the five outliers only two are greater than 20 percent from the certified value. There is no apparent correlation between methodology and results. The Youden plot displays systematic errors.

There is significant improvement also in the determination of Zn in the tissues. Seven of forty submitted results are (18 percent) rejected for Tissue V compared to twelve of forty results (30 percent) for the unknown tissue used last year. Six of the outliers are high but only one outlier is more than 20 percent from the accepted value. The acceptable range for Zn in SRM 1566a has been increased to ± 10 percent from the certified range of ± 7 percent. As a result only two of the thirty-six results were rejected but only one of these is more than 15 percent from the certified value. Again, there is no apparent correlation between methodology and results. The Youden plot displays a tendency to systematic errors, probably in calibration and for ubiquitous zinc, control of the blank.

ARSENIC

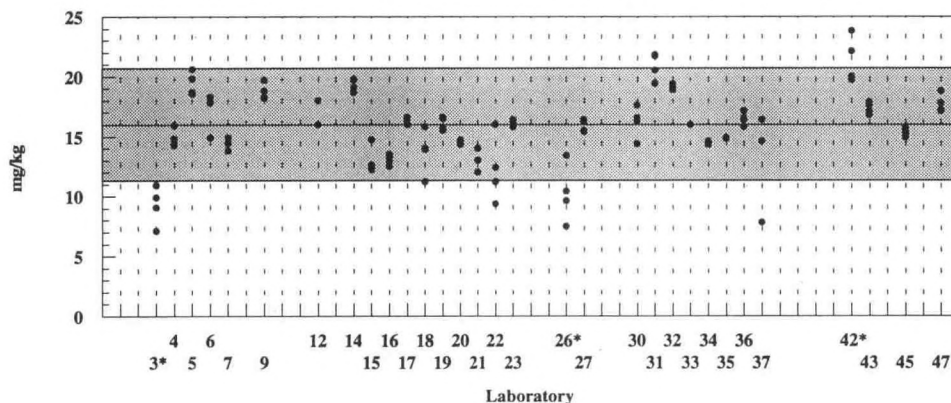
Sediment U

Accepted value = 16.0 ± 4.7 mg/kg

Results: 31

Quantitative Results: 31

Rejections: 3



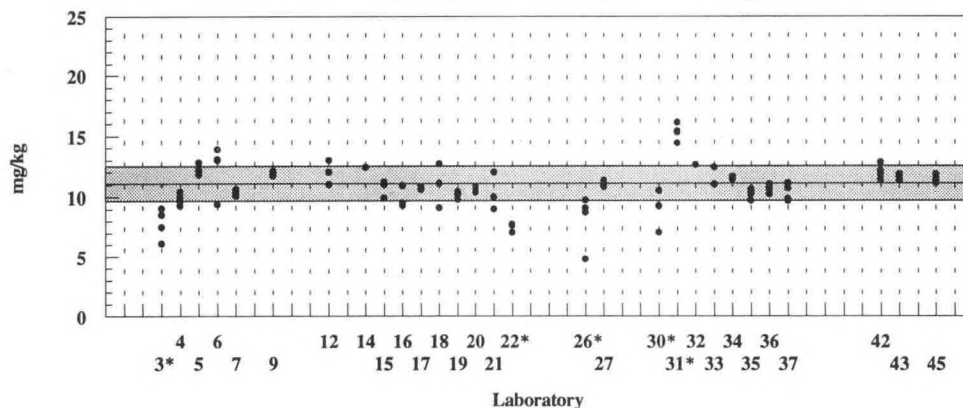
BCSS-1

Certified value = 11.1 ± 1.4 mg/kg

Results: 29

Quantitative Results: 29

Rejections: 5



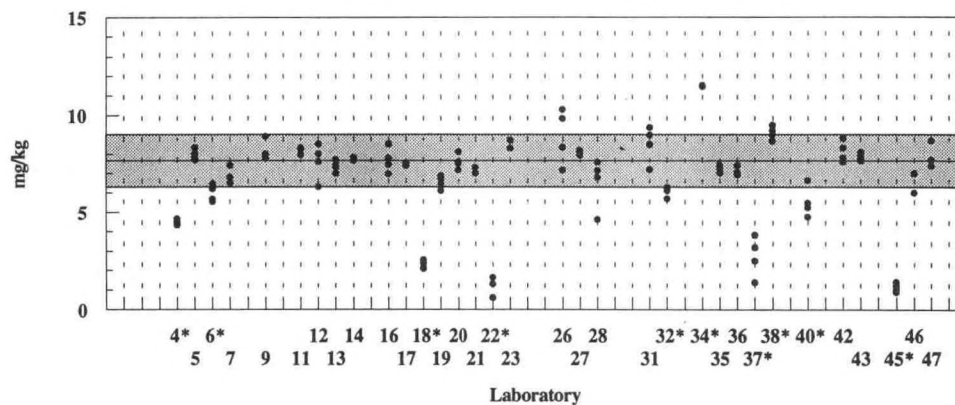
Tissue V

Accepted value = 7.65 ± 1.33 mg/kg

Results: 33

Quantitative Results: 33

Rejections: 10



ARSENIC

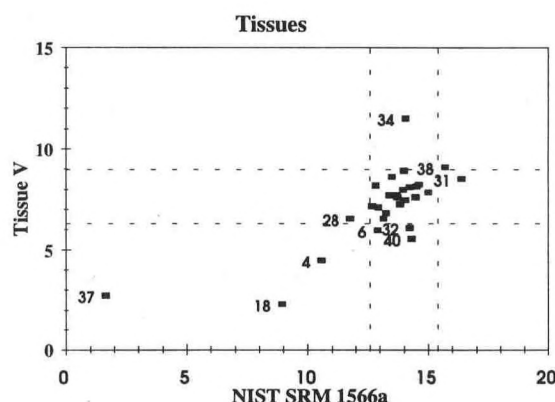
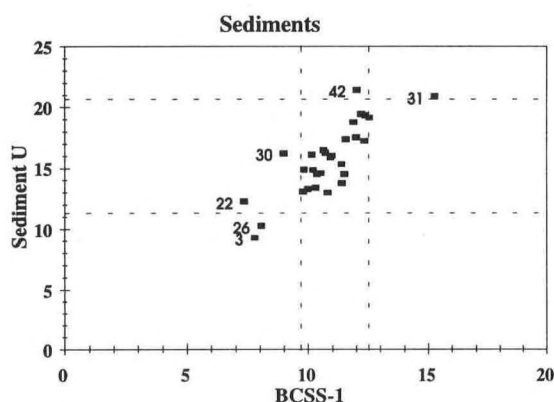
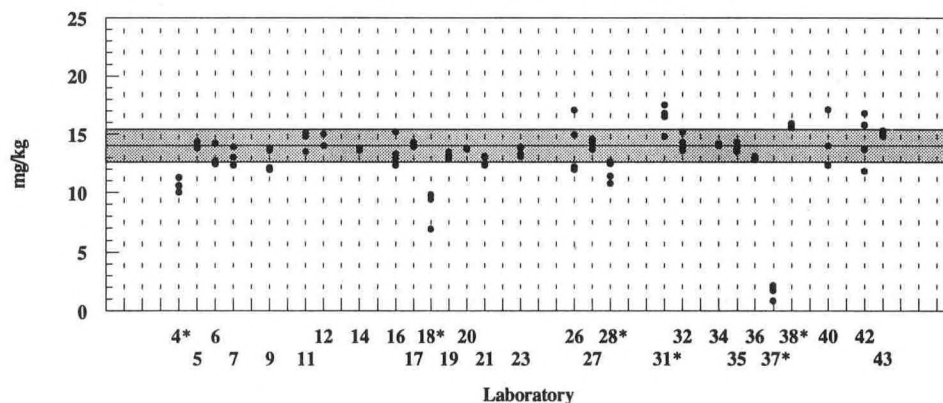
NIST SRM 1566a

Certified value = $14.0 \pm 1.2(1.4)$ mg/kg

Results: 28

Quantitative Results: 28

Rejections: 6



The calculated acceptable range for arsenic in Sediment U is larger than last year resulting in significantly fewer rejected results. There were three outliers, equally spread over HGAAS, GFAAS and ICPAES, in 31 submissions. Since NOAA/5, a small but steady improvement can be observed as the proportion of results rejected has decreased from 16 to 10 percent for NOAA/8. The improvement for the CRM BCSS-1 has been more marked over the four years, from 61 to 17 percent. Only four of 29 submitted results are more than 20 percent from the certified value. The Youden plot displays a tendency to systematic errors.

The results for As in Tissue V are disappointing. There were ten outliers in 30 submissions, nine low. Complete digestion of the tissues is indicated by the results for Fe, Cu and Zn as the results for these elements are almost all near the accepted mean yet a number of laboratories reported very low results for As. Perhaps calibration is more difficult for this element, or more likely the As may be lost in the digestion procedure. Results for As in the unknown tissue are similar to those in NOAA/7. Results for SRM 1566a are somewhat better and improved from last year with only six of twenty-eight results (21 percent) rejected this year versus ten of twenty-seven (37 percent) for NOAA/7. Of the six outliers, only two are greater than 19 percent from the certified value. The difference between the samples, other than concentration, is not readily evident. The Youden plot displays a tendency to systematic errors (analyte loss, calibration).

SELENIUM

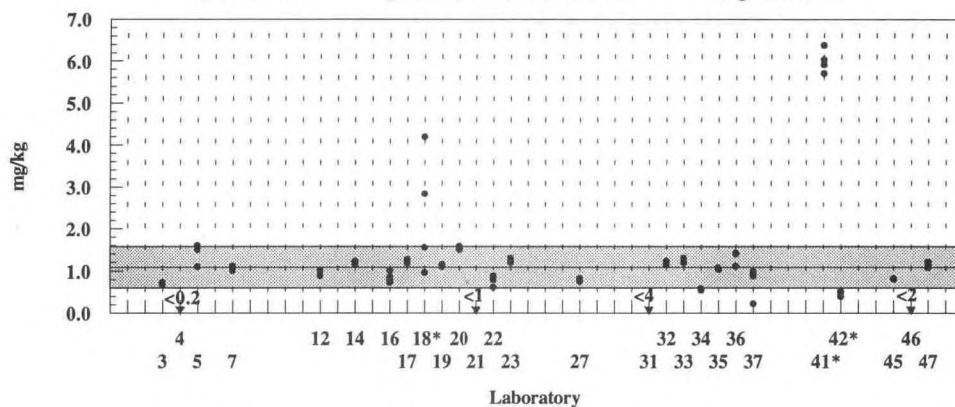
Sediment U

Accepted value = 1.09 ± 0.50 mg/kg

Results: 27

Quantitative Results: 23

Rejections: 3



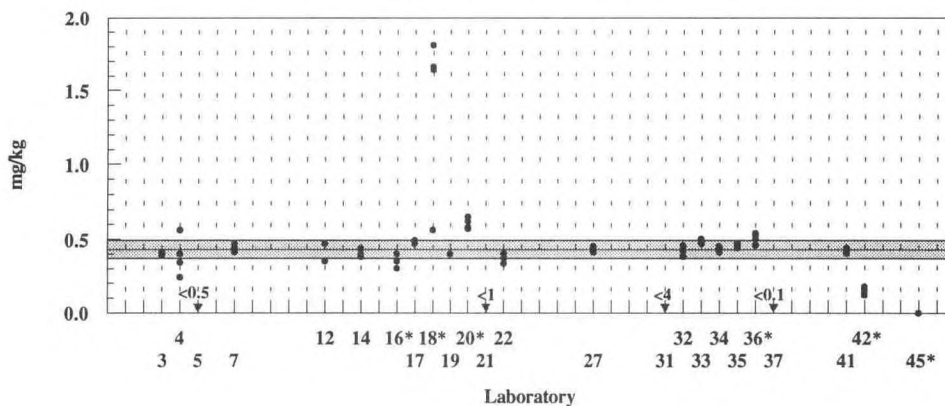
BCSS-1

Certified value = 0.43 ± 0.06 mg/kg

Results: 24

Quantitative Results: 20

Rejections: 6



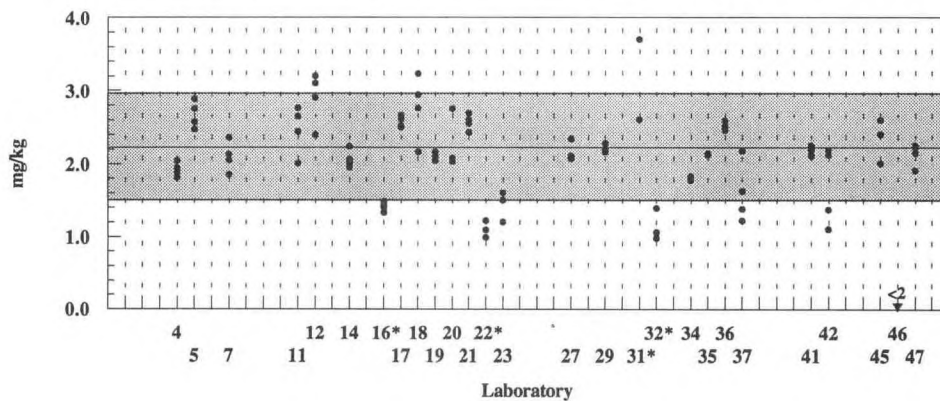
Tissue V

Accepted value = 2.23 ± 0.73 mg/kg

Results: 27

Quantitative Results: 26

Rejections: 4



SELENIUM

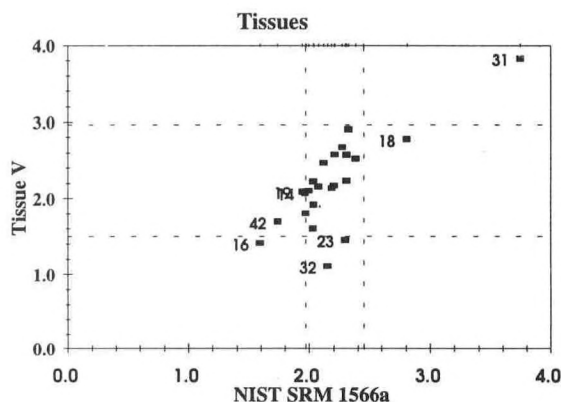
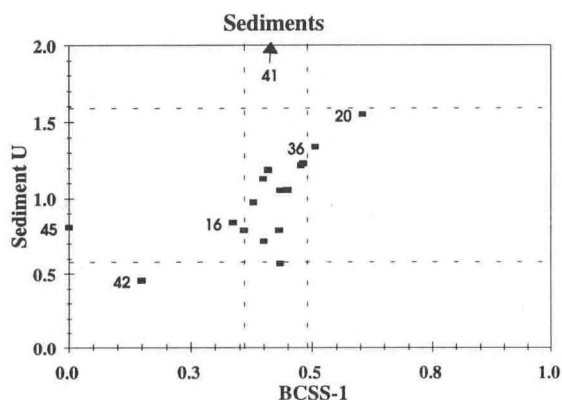
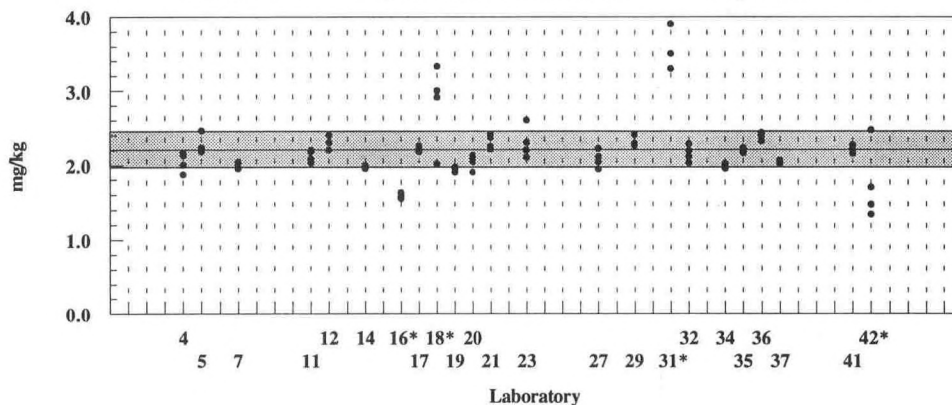
NIST SRM 1566a

Certified value = 2.21 ± 0.24 mg/kg

Results: 23

Quantitative Results: 23

Rejections: 4



The same number of quantitative results (23) were reported for Se in the unknown sediments for both NOAA/7 and NOAA/8. Only three rejections were found this year compared to five for NOAA/7, but the Se concentration in Sediment U is a factor of three higher. Laboratory 41 possibly has a mathematical problem. The determined confidence interval is a disappointing ± 46 percent. Results for BCSS-1 are identical and better for the past two years with six of twenty-six results rejected. Only four of the outliers are greater than 21 percent from the certified value. The Youden plot again displays a tendency to systematic errors

Twenty-seven submissions for Se in Tissues V resulted in four outliers, three low and one high. The acceptance ratio improved from 75 to 84 percent over the past year. The calculated confidence interval is ± 33 percent, a reasonable number for Se at this concentration. Likewise, for SRM 1566a, the proportion of acceptable results increased from 71 to 82 percent of the submitted results. Only two of the 23 submitted results are greater than 28 percent from the certified value. The Youden plot indicates systematic errors.

SILVER

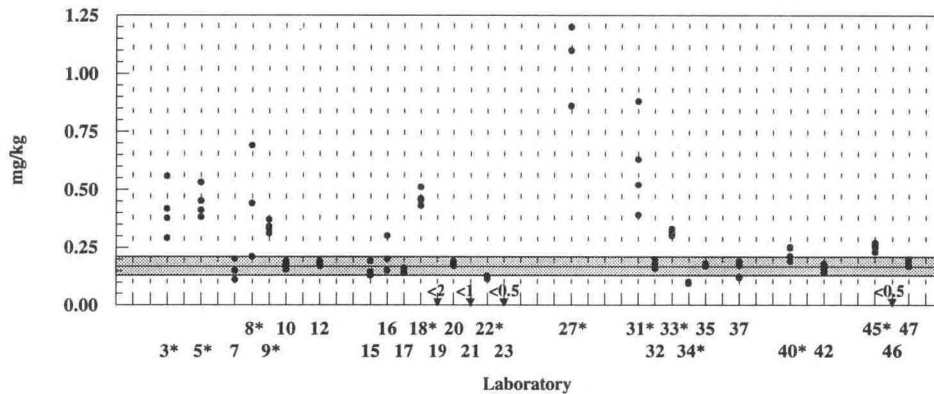
Sediment U

Accepted value = 0.17 ± 0.04 mg/kg

Results: 28

Quantitative Results: 24

Rejections: 12



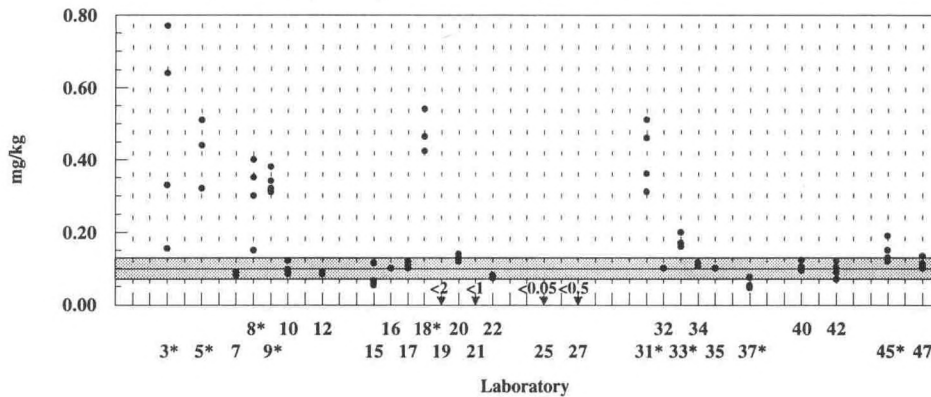
BCSS-1

Accepted value = 0.10 ± 0.03 mg/kg

Results: 27

Quantitative Results: 23

Rejections: 9



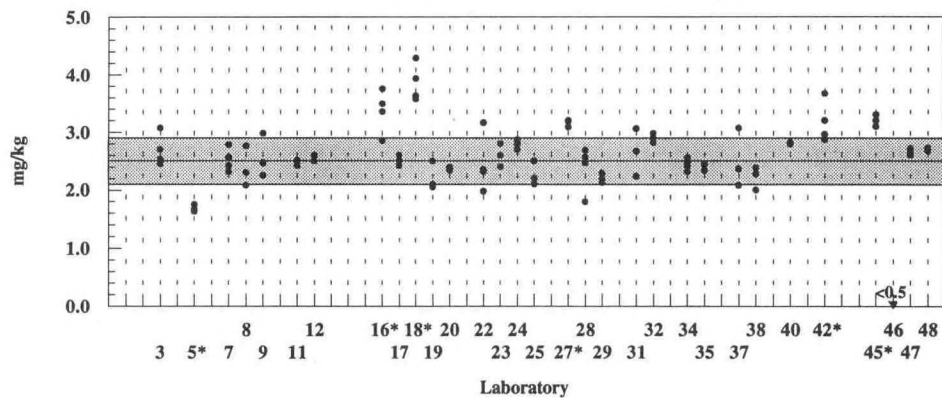
Tissue V

Accepted value = 2.51 ± 0.41 mg/kg

Results: 31

Quantitative Results: 30

Rejections: 6



SILVER

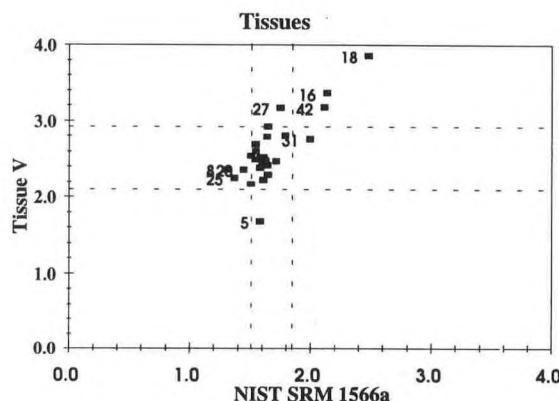
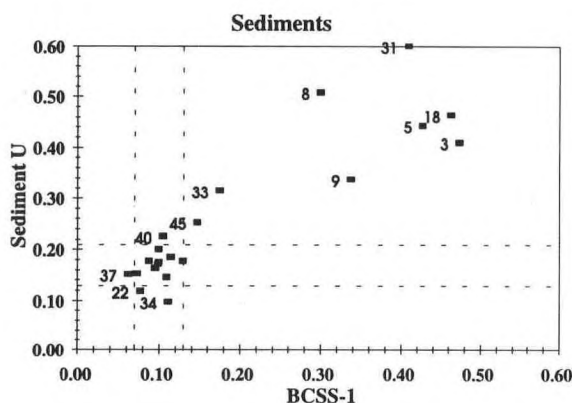
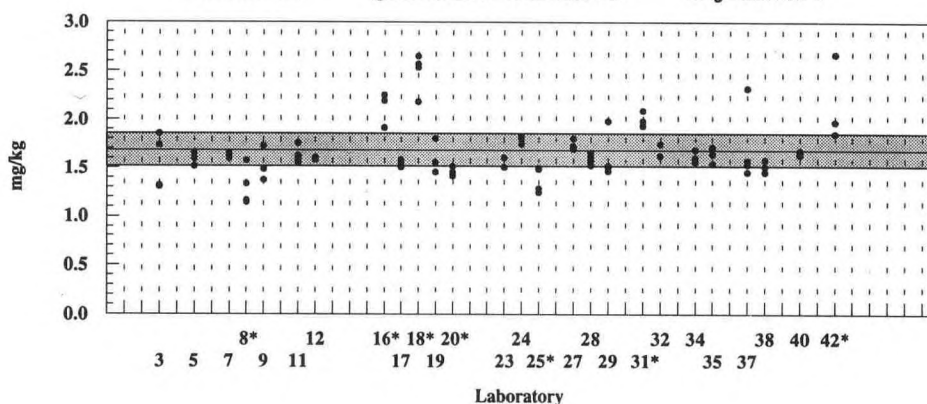
NIST SRM 1566a

Certified value = $1.68 \pm 0.15(0.17)$ mg/kg

Results: 26

Quantitative Results: 26

Rejections: 7



Although 50 percent of the quantitative submissions for Ag in Sediment U were rejected, the determination of Ag in the sediments has improved. The Ag concentration is very low and 12 laboratories are in good agreement. Two of three results obtained by ICPAES were outliers as were three of four ICPMS results and both FAAS results. GFAAS is apparently the most effective method of choice with fourteen results yielding three high outliers and the only low outlier. BCSS-1 is not certified for Ag, but the calculated value for the past two exercises is close to this year's accepted value of 0.10 mg/kg. Fourteen laboratories are in good agreement with this value. The Youden plot reveals a number of laboratories have either contamination or calibration problems indicated by the high results to the upper right of the acceptable area.

Considering the relatively high concentration of Ag in Tissue V compared to previous exercises results have not improved significantly. For NOAA/7 the Ag concentration in the tissue was very low and only a few laboratories reported results. In NOAA/6, ten percent of the laboratories were outliers on a sample with a confidence interval of ± 33 percent. This year, twenty percent of the laboratories were rejected at a confidence interval of ± 16 percent. But only three of the 30 submitted values are greater than 27 percent from the accepted value. As with the sediments, GFAAS appears to be the method of choice but there is also an increased number of ICPMS and ICPAES values. For the past two years results for Ag in SRM 1566a have been similar with seventy percent of the laboratories reporting acceptable results. The Youden plot for tissues reveals most outliers are high.

CADMIUM

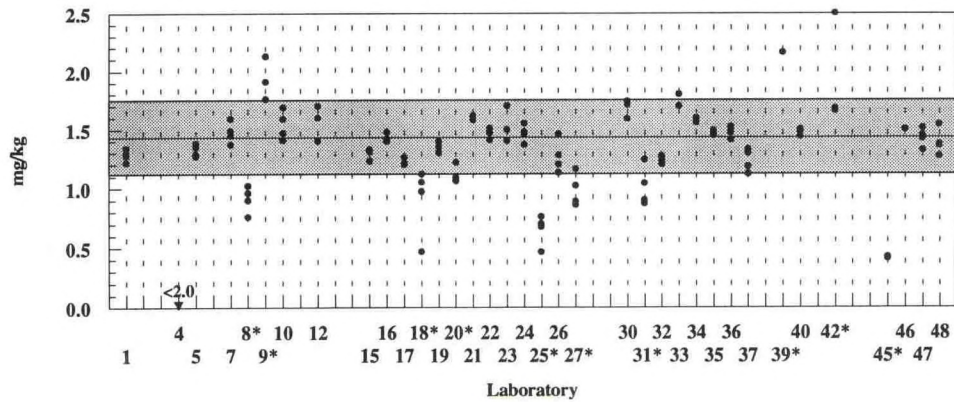
Sediment U

Accepted value = 1.44 ± 0.31 mg/kg

Results: 36

Quantitative Results: 35

Rejections: 10



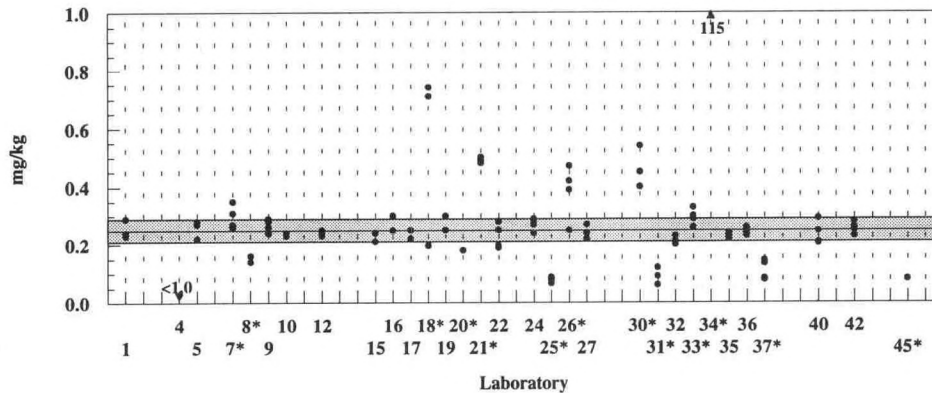
BCSS-1

Certified value = 0.25 ± 0.04 mg/kg

Results: 30

Quantitative Results: 29

Rejections: 13



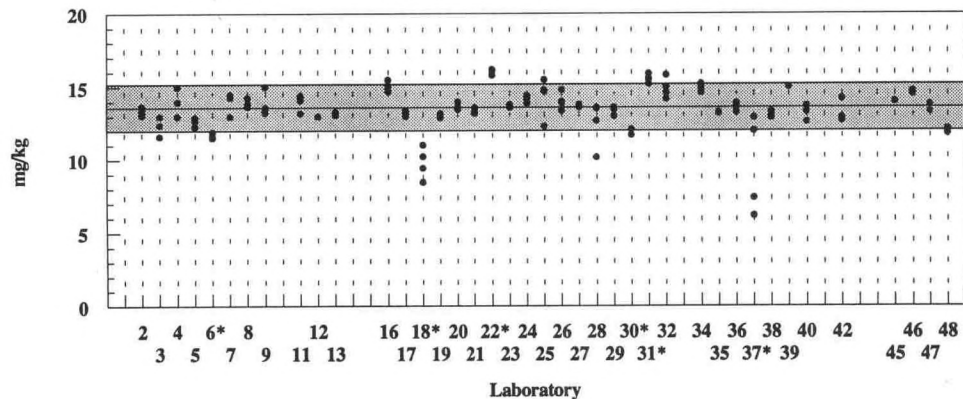
Tissue V

Accepted value = 13.6 ± 1.6 mg/kg

Results: 40

Quantitative Results: 40

Rejections: 6



CADMIUM

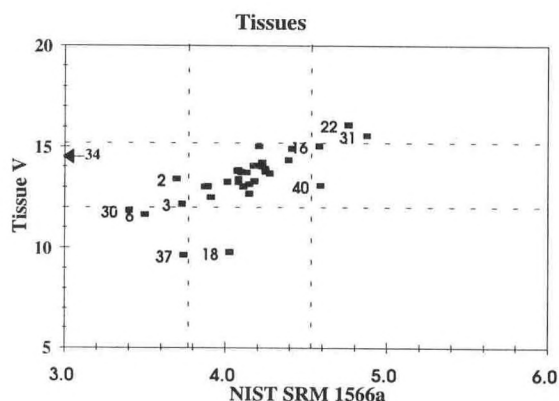
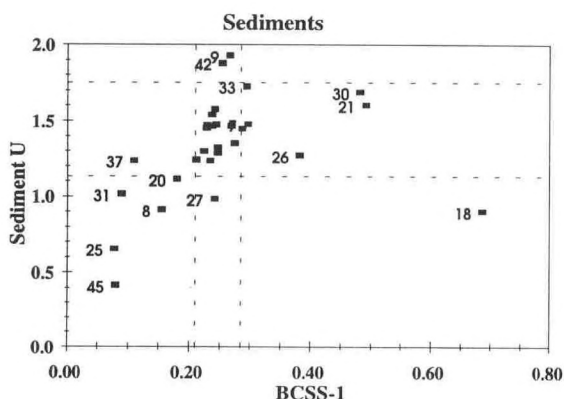
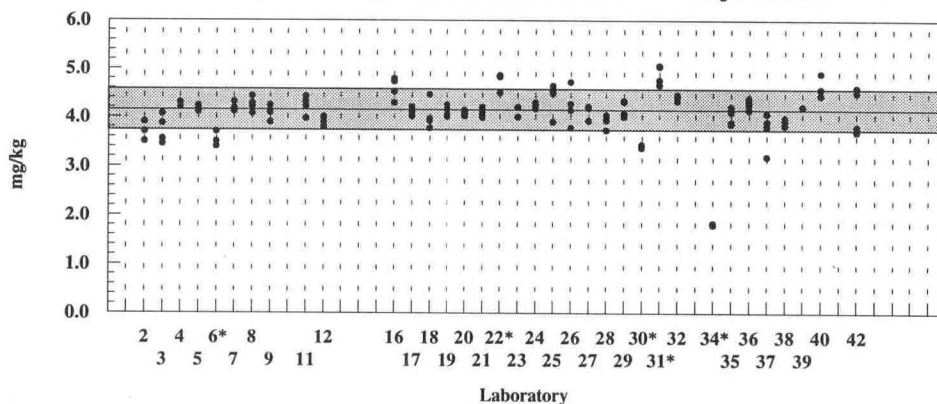
NIST SRM 1566a

Certified value = 4.15 ± 0.42 mg/kg

Results: 35

Quantitative Results: 35

Rejections: 5



An improvement over previous years results can be noted for the determination of Cd in Sediment U. The Cd concentration is a factor of three higher compared to NOAA/7 and the number of acceptable results increased from 57 to 71 percent. There were 10 outliers from 35 submissions, three high and seven low. Half of the accepted results were determined by GFAAS and most of the others almost equally by ICPMS, ICPAES and FAAS. By contrast, results for Cd in BCSS-1 show a regression. The proportion of acceptable results for NOAA/5 to NOAA/8 are 55, 71, 63, and 55 percent with 13 outliers out of 29 submissions for NOAA/8. This trend is contrary to results for all other elements and is hopefully an anomaly. The Youden plot indicates what looks like a mixture of systematic and random errors for these sediment samples.

Results for Cd in Tissue V show an improvement over last year and are very good but the Cd concentration is a factor of 15 higher. There were six outliers in 40 submissions yielding an acceptability rate of 85 percent and only four submitted values greater than 15 percent from the accepted value. The methods of choice are almost equally divided between ICPMS (11) and ICPAES (10). GFAAS and FAAS account almost equally for the rest. The acceptance rate for SRM 1566a was 86 percent. Only one of the 35 submitted values was greater than 18 percent from the certified value. The Youden plot displays the preponderance of systematic errors.

TIN

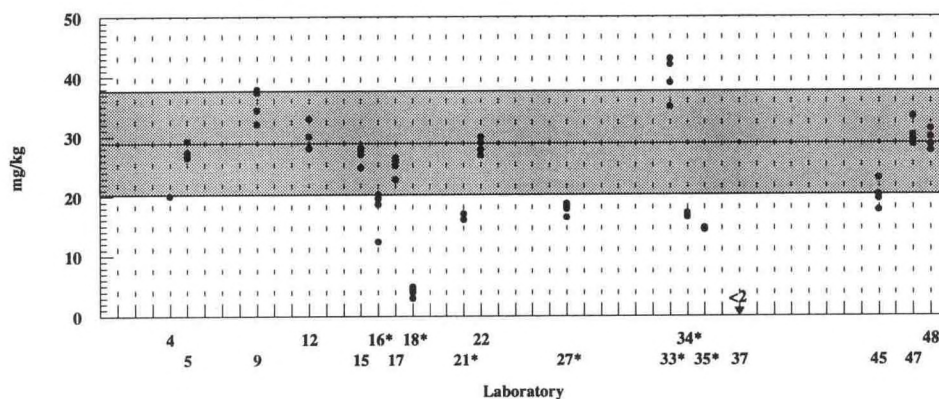
Sediment U

Accepted value = 28.9 ± 8.7 mg/kg

Results: 18

Quantitative Results: 17

Rejections: 7



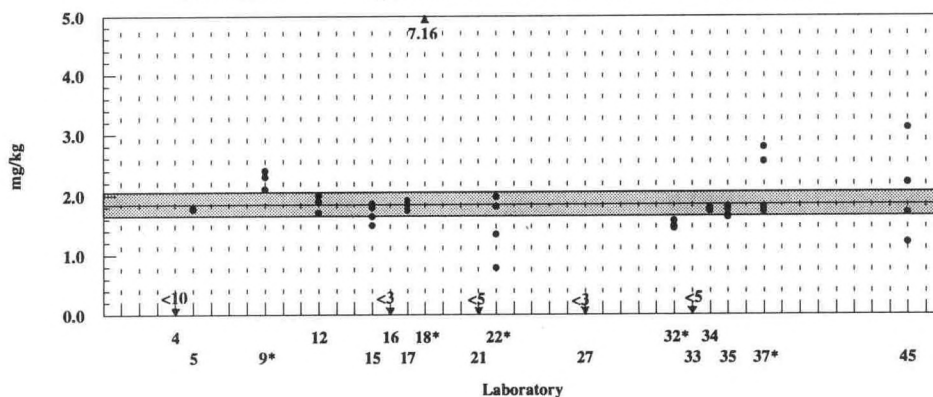
BCSS-1

Certified value = 1.85 ± 0.20 mg/kg

Results: 17

Quantitative Results: 12

Rejections: 5



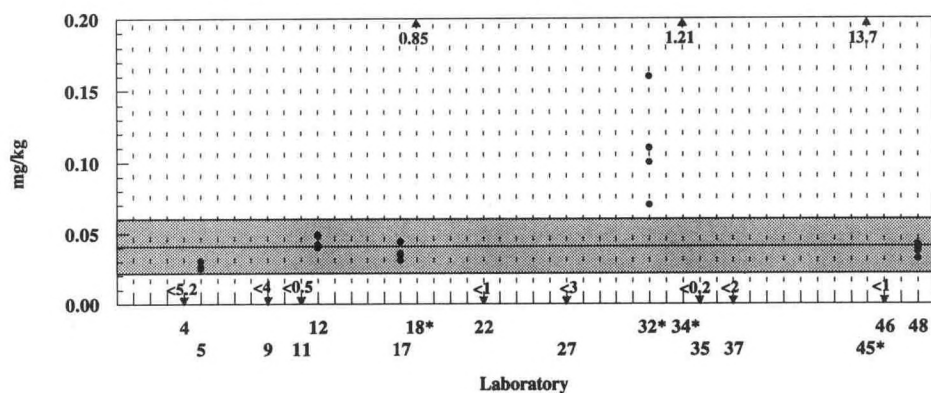
Tissue V

Accepted value = 0.041 ± 0.020 mg/kg

Results: 16

Quantitative Results: 8

Rejections: 4



TIN

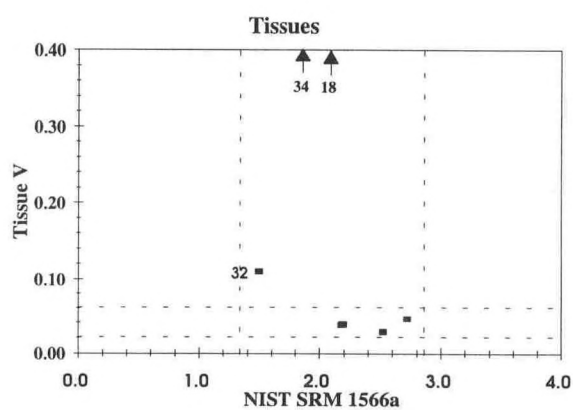
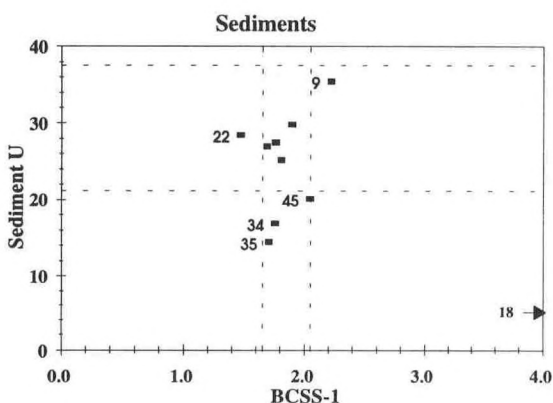
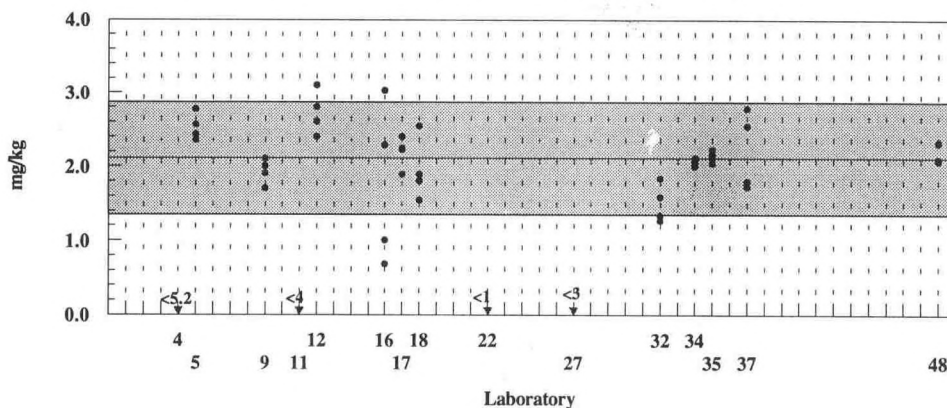
NIST SRM 1566a

Accepted value = 2.10 ± 0.76 mg/kg

Results: 15

Quantitative Results: 11

Rejections: 0



Results for the determination of Sn in Sediment U were worse than those for NOAA/7 which in turn were worse than for NOAA/6. This is in spite of the fact that the concentration of Sn in this year's sediment is almost an order of magnitude higher than that of last year. The acceptance rate has dropped from 80 to 59 percent. This year seven out of seventeen results were rejected for a sediment with a tin concentration near 30 mg/kg. All but one of the outliers were low. All laboratories whose values were within the calculated confidence interval use HF in the dissolution process and all but one employed either ICPMS or GFAAS for measurement. Only 12 laboratories submitted quantitative results for Sn in BCSS-1. Oddly enough, three laboratories which produced outliers for Sediment U performed well with the CRM with 1/15 the Sn Concentration. There were five outliers, about the same proportion as last year. The Youden plot tells us little.

Only four of eight laboratories submitted acceptable quantitative values for Sn in Tissue V. All of the acceptable results were obtained using ICPMS for the determination. The concentration is very low and difficult to achieve by any other technique. 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 no outliers. The Sn concentration was measured by ICPMS (6), GFAAS (4), ICPAES (1). Performance for Sn in SRM 1566a is not included in the evaluation.

ANTIMONY

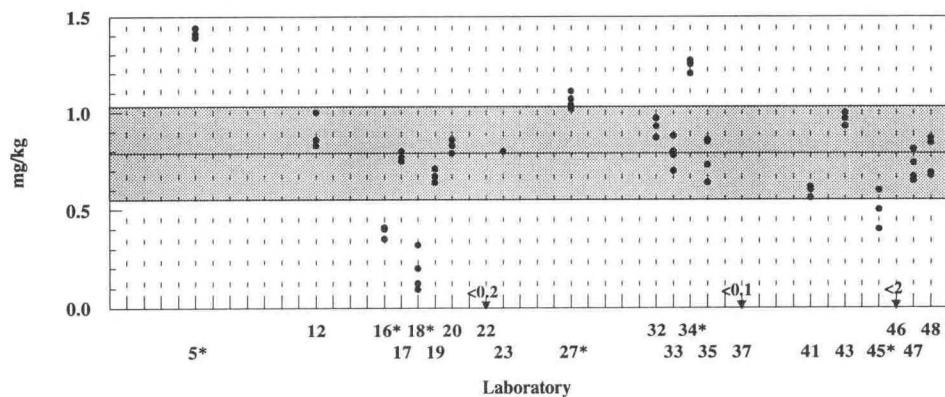
Sediment U

Accepted value = 0.79 ± 0.24 mg/kg

Results: 21

Quantitative Results: 18

Rejections: 6



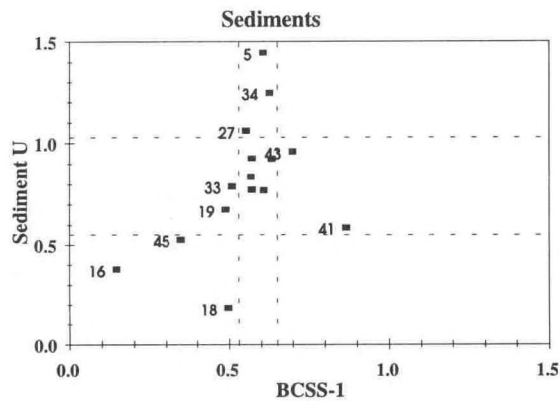
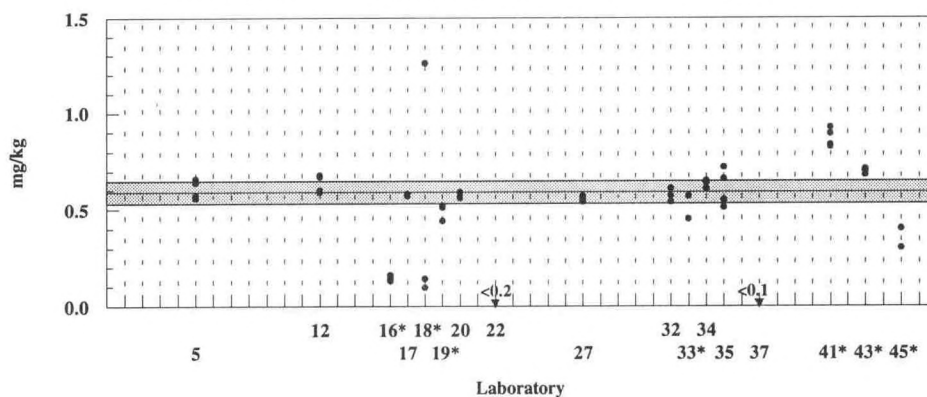
BCSS-1

Certified value = 0.59 ± 0.06 mg/kg

Results: 17

Quantitative Results: 15

Rejections: 7



ANTIMONY

The determination of Sb in the sediments remains a problem. The participation rate has increased but the percentage of acceptable results has not changed. The acceptance rates for Sediment U and the CRM are 67 and 53 percent, respectively. Overall for both Sediment U and BCSS-1, there was one rejection of six ICPMS results, eight rejections of twelve GFAAS results, three rejections of six HGAAS results, no rejections of two ICPAES results and one rejection of four INAA result. The Youden plot is a mess.

The determination of antimony was not required for Tissue V.

MERCURY

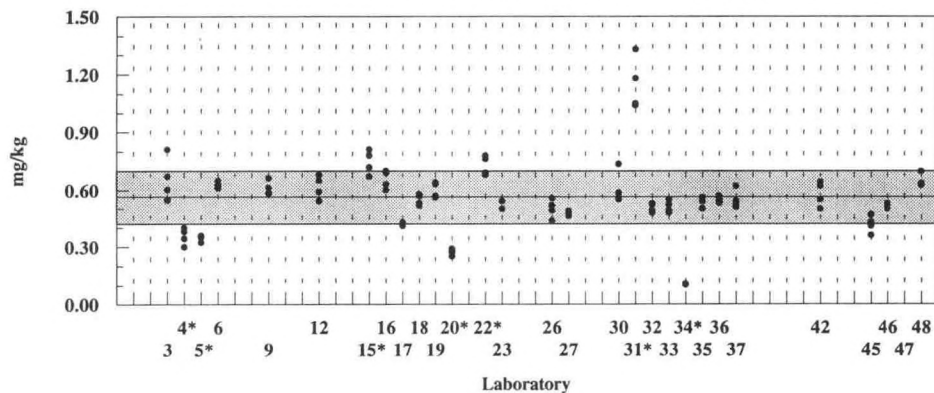
Sediment U

Accepted value = 0.56 ± 0.14 mg/kg

Results: 28

Quantitative Results: 28

Rejections: 6



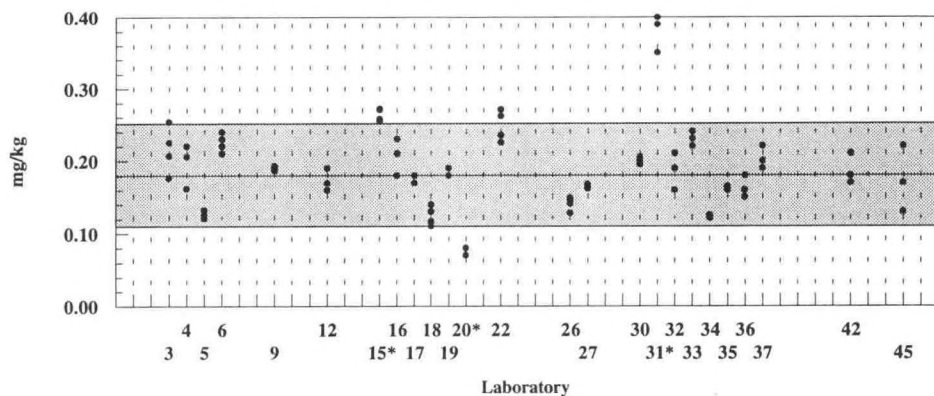
BCSS-1

Accepted value = 0.180 ± 0.071 mg/kg

Results: 25

Quantitative Results: 25

Rejections: 3



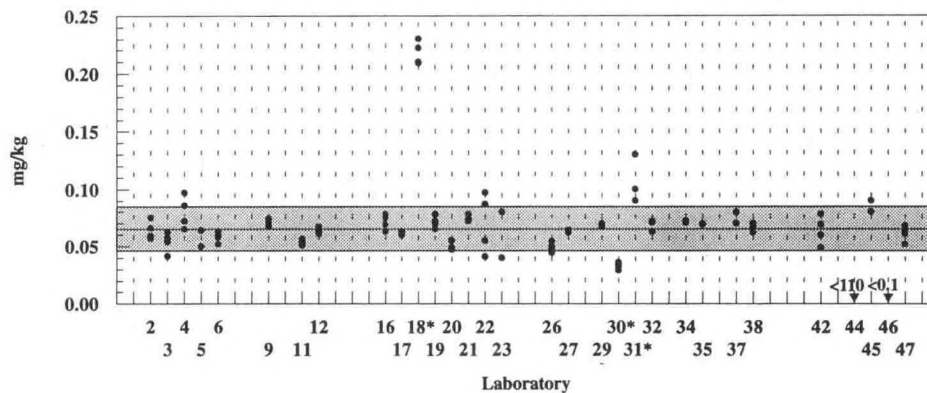
Tissue V

Accepted value = 0.0654 ± 0.0192 mg/kg

Results: 31

Quantitative Results: 29

Rejections: 3



MERCURY

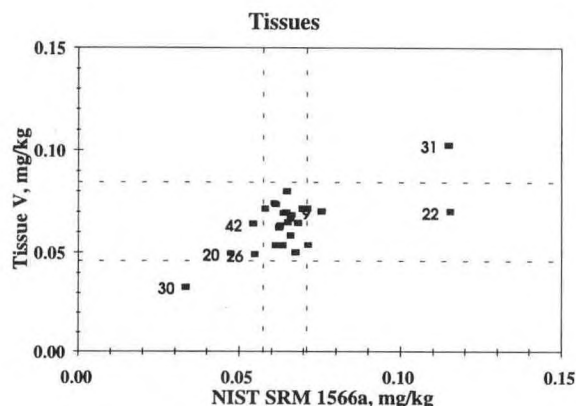
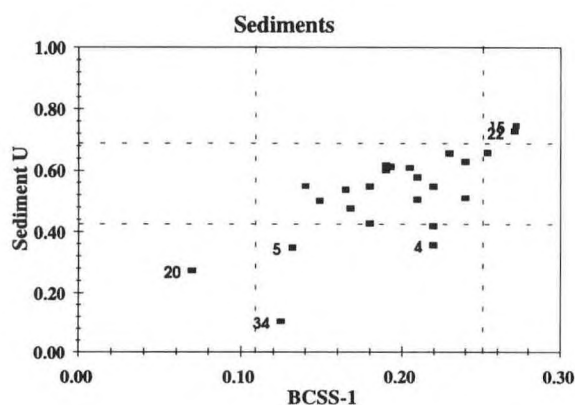
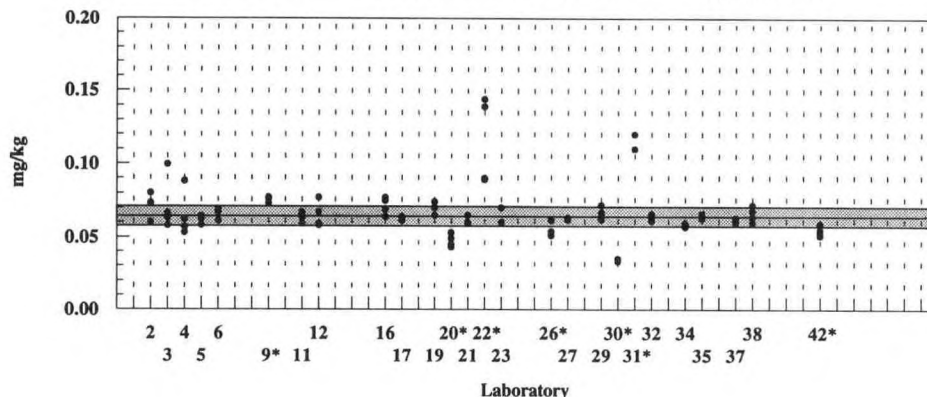
NIST SRM 1566a

Certified value = 0.0654 ± 0.0067 mg/kg

Results: 26

Quantitative Results: 26

Rejections: 7



The determination of Hg in the sediments has improved. The number of acceptable results has increased from 68 percent last year to 78 percent but the Hg concentration in Sediment U is slightly higher than the unknown in NOAA/7. Results for BCSS-1 also show improvement with the percentage of acceptable results increasing from 78 to 88 percent of laboratories. There were only three outliers from 25 sets of results. BCSS-1 is no longer certified for Hg, however, the accepted value has been close to 0.18 mg/kg for the past few years.

Results for the determination of Hg in the tissues also show improvement. For the Tissue V the improvement is small, but for SRM 1566a it is more noticeable as the percentage of acceptable results increased from 57 to 73 percent. No, it's not a typo. The calculated acceptable value for Tissue V is the same as the certified value for SRM 1566a. Both Youden plots show that systematic errors predominate.

THALLIUM

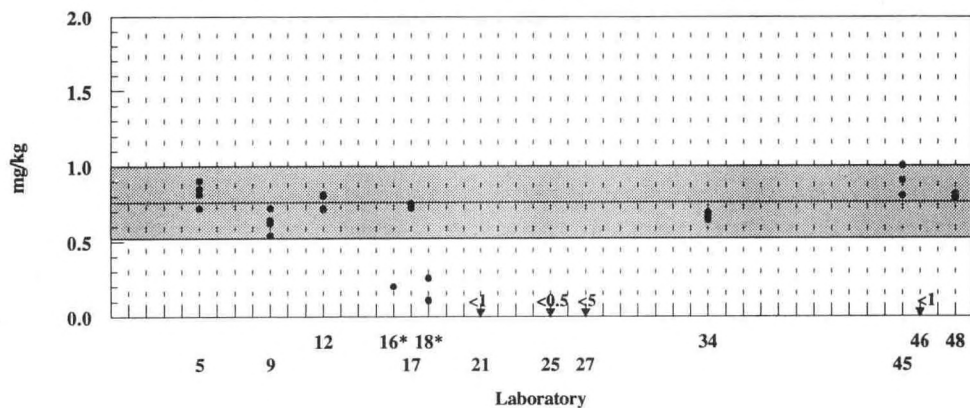
Sediment U

Accepted value = 0.76 ± 0.24 mg/kg

Results: 13

Quantitative Results: 9

Rejections: 2



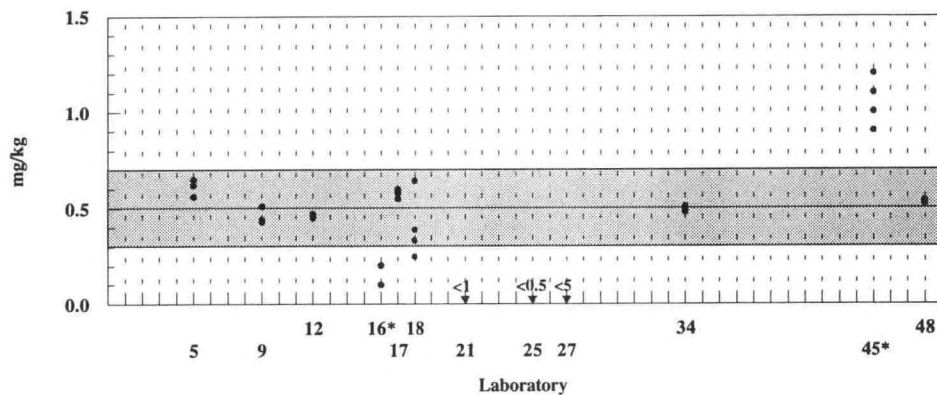
BCSS-1

Accepted value = 0.50 ± 0.20 mg/kg

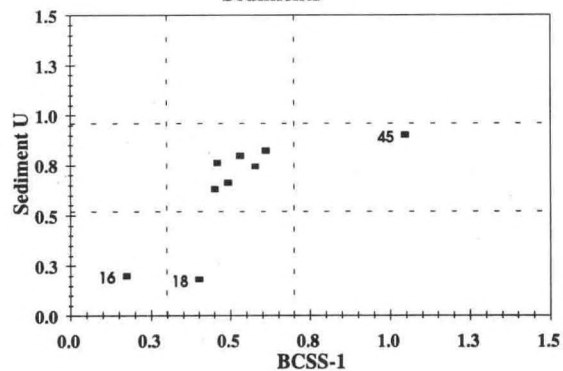
Results: 12

Quantitative Results: 9

Rejections: 2



Sediments



THALLIUM

Fewer respondents reported results for Tl in sediments this year but most laboratories that submit quantitative values do well. The quality of the data was similar to last year with two of nine laboratories rejected from both the Sediment U and BCSS-1 data. Of the nine data sets, ICPMS was used by six laboratories and three used GFAAS. Thallium is not certified on BCSS-1 but for the past two years the accepted mean has been slightly higher than 0.5 mg/kg.

The determination of thallium was not required for Tissue V.

LEAD

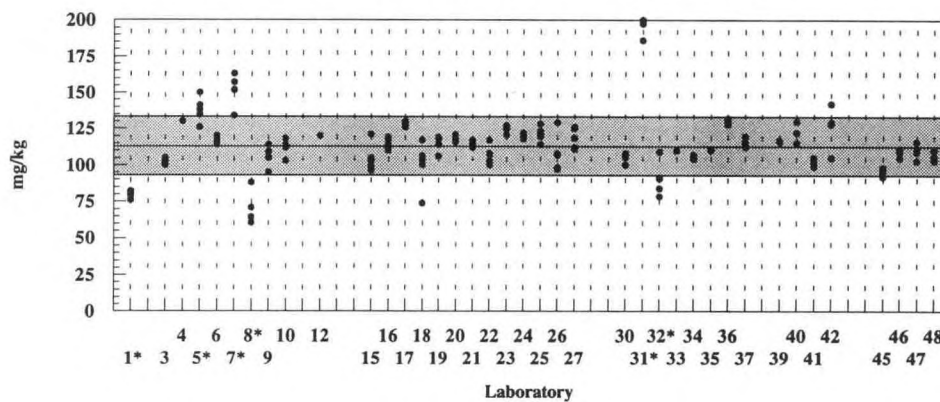
Sediment U

Accepted value = 113 ± 20 mg/kg

Results: 39

Quantitative Results: 39

Rejections: 6



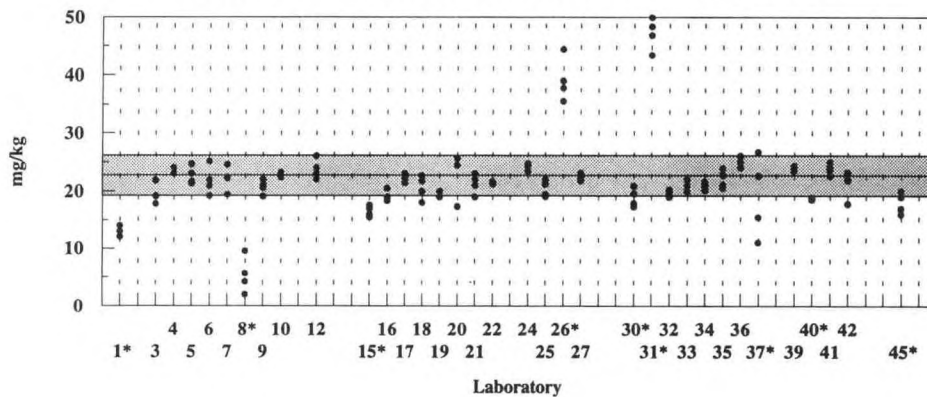
BCSS-1

Certified value = 22.7 ± 3.4 mg/kg

Results: 35

Quantitative Results: 35

Rejections: 9



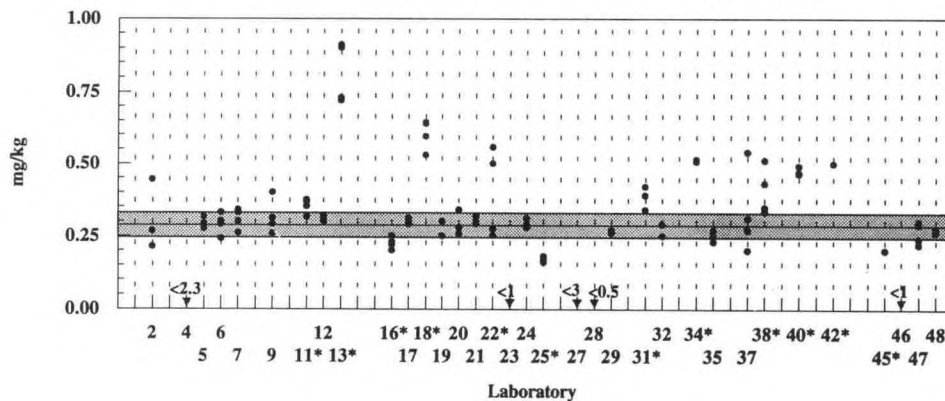
Tissue V

Accepted value = 0.287 ± 0.042 mg/kg

Results: 34

Quantitative Results: 29

Rejections: 12



LEAD

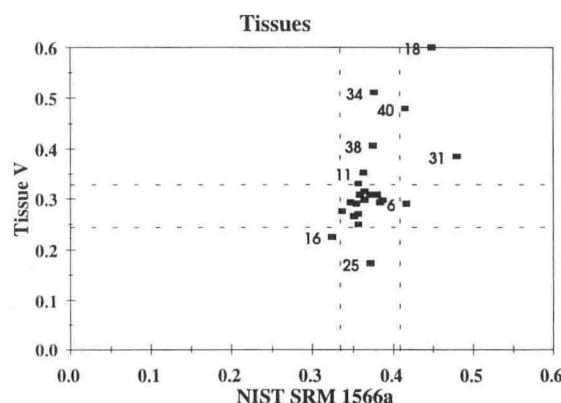
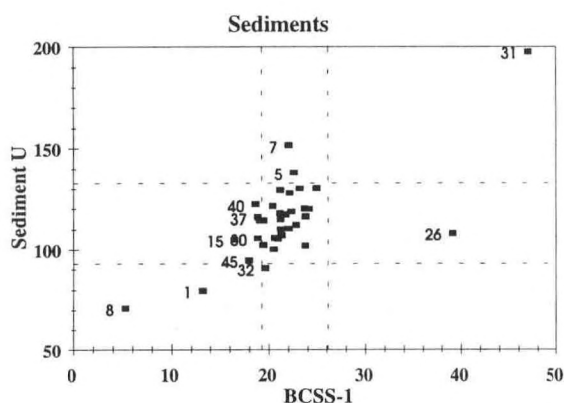
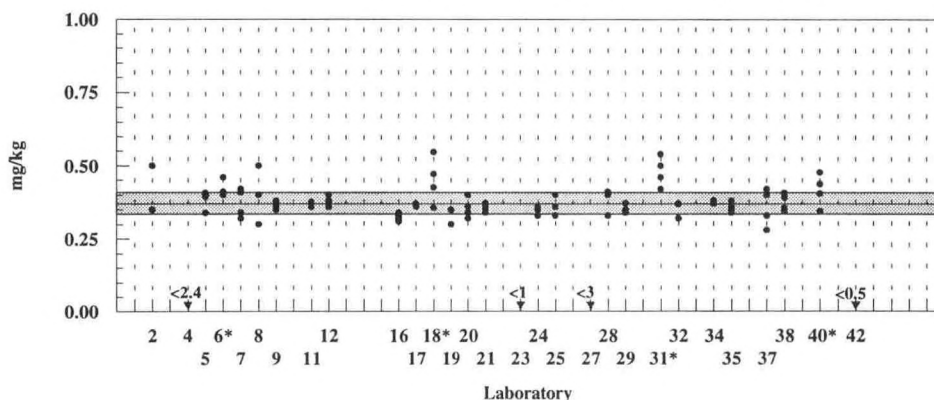
NIST SRM 1566a

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

Results: 29

Quantitative Results: 25

Rejections: 4



Performance for the determination of Pb in the sediments is good and has not changed significantly from NOAA/7. The Pb concentration in the unknown sediment is a factor of three higher this year, and accordingly, the percentage of rejected laboratories has dropped by a factor of two. There were six outliers in 39 submissions for Sediment U. Only four laboratories submitted results greater than 22 percent from the accepted value. For BCSS-1, with one-fifth the Pb concentration, only five laboratories submitted results greater than 21 percent from the certified value. There is essentially no change in the overall performance over last year.

The acceptable confidence interval for Pb in SRM 1566a has been increased to ± 10 percent for the evaluation. The concentration of Pb in Tissue V is not very different from that in SRM 1566a but the performance is significantly different for the two samples. There were 12 outliers for Tissue V and only four for the CRM. Almost all laboratories used either ICPMS or GFAAS. The rejection rate for both procedures for Tissue V was equivalent (about 40 percent). The Youden plot clearly displays that high results for Tissue V is the major problem.

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, silver 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 an inclination to tend towards "the right answer". Our experience of the last several years with the NOAA exercises has shown that if this is happening, it is not a significant factor.

The combination of CRMs and unknowns and the substantially increased participation of the last two 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, for whatever reasons, we assume that NRC is competent, there also appears to always be a group of participating laboratories that are equally competent for various analytes in the particular matrices and, if there are sufficient data, an accurate mean can be established along with an appropriate 95 percent confidence interval.

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

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 full sets of values (4 replicates) for an analyte have not been evaluated.

Detailed charts of this assessment are tabulated in Appendix C.

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

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) for the NOAA/7 study. This more demanding standard reflected an improvement of procedures and instrumentation compared to the previous NOAA exercises. This year for NOAA/8, we went a step

further and asked laboratories to analyze each replicate on four non-consecutive days. Some laboratories stated that due to time and budget restraints this was not possible, but most laboratories complied with this request. Table II lists the laboratories that performed the analysis on different days, the same day, or some combination of the two.

Table II
Analysis of Samples

	Laboratory
Different Days	1,2,3,4,5,6,7,9,11,12,13,16,17,18,19,20, 23,24,25,26,27,33,34,35,36,37,38,39,41, 42,43,45,46
Combination	10,15,21,29,30,31
Same Day	8,14,22,28,32,40

When evaluating precision it cannot be ignored 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. However, the certificate for NIST SRM 1566a acknowledges evidence of tin inhomogeneity in this CRM, which appears to be confirmed by the data (pages 30-31). Although, an evaluation of precision for this sample was listed in Appendix C according to the criteria in Table I, the overall precision rating for the laboratories in Table IV ignored the results for tin in SRM 1566a.

The overall assessment based on these criteria and the number of sets of results submitted allowed four distinct categories of accuracy performance to be discernible. These are shown in Table III for the sediments and in Table VII 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 high proportion of outliers or "less thans" or which did not submit results for a large number of analytes 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 III and VII compare the number of laboratories in each category for the last three exercises.

similar evaluation for intralaboratory precision based largely on the criteria of Table I produced two categories: **Good** and **Fair** (Tables IV and VIII). Only the laboratories that performed the analysis on different days are included in these tables.

Sediments

Six new laboratories submitted sediment data for the first time for NOAA/8. Two of these laboratories (9,33) were rated superior, two were rated good and two were rated in the "other" category. Three of the laboratories in the superior category (12,32,35) are veterans which have analyzed biological tissues and sediments in all six previous NOAA exercises in this series.

Table III
Accuracy Evaluation for the Sediments*

	Laboratory Number	NOAA/8	NOAA/7	NOAA/6	NOAA/5
Superior	5,9,12,17,19,21,27,32,33,35,36	11	8	5	3
Good	4,6,7,10,15,16,20,23,24,34,41,43,46	13	12	11	7
Fair	1,8,13,14,22,25,42,45	8	12	5	7
Others	3,18,26,30,31,37,39,40	8	10	7	6

*Laboratories 2,11,28,29,38 and 44 did not report results for the sediments

Table IV
Intralaboratory Precision Evaluation for the Sediments

	Laboratory Number
Good	1,4,5,6,9,12,13,16,17,19,20,23,24,25,27,33,34,35,36,39,41,43,46
Fair	3,7,18,26,37,42,45

A listing of the number of quantitative results submitted and the number of rejected means for the laboratories over the past three years is tabulated in Table V on page 44. The laboratory numbers are this year's designation only. This permits the laboratories to monitor their general performance over this period. Of the thirty-four laboratories that submitted sediment data for both NOAA/7 and NOAA/8, eight (4,19,20,24,27,36,45,46) improved their ratings. However, five laboratories had a worse rating, three of which descended from fair to "others" and two descended (slightly) to good

Table V

**Comparison of NOAA/8, NOAA/7, NOAA/6 and NOAA/5
Laboratory Performance for Sediments**

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

LAB	NOAA/8		NOAA/7		NOAA/6		NOAA/5	
	Sets	Rej	Sets	Rej	Sets	Rej	Sets	Rej
23	15	0	15	2	14	1	11	0
24	16	1	18	6				
25	23	10	17	5				
26	14	9	2	0	16	7	16	7
27	34	6	28	4				
30	24	14	24	13				
31	26	16	24	9	22	4	20	10
32	31	4	32	2	18	1	14	0
33	32	5						
34	36	9	34	7	30	8	22	14
35	30	2	30	2	28	1	24	2
36	26	1	24	3	26	2	20	4
37	32	20	29	13				
39	17	9						
40	14	10	20	8	12	7		
41	18	4	28	6	28	4		
42	28	11	10	4				
43	12	1						
45	36	14	32	21				
46	15	2	26	16				

X	Superior
X	Good
X	Fair
X	Others
	No results

Table VI

**Comparison of NOAA/8, NOAA/7, NOAA/6 and NOAA/5
Laboratory Performance for BCSS-1**

LAB	NOAA/8		NOAA/7		NOAA/6		NOAA/5	
	Sets	Rej	Sets	Rej	Sets	Rej	Sets	Rej
1	9	4						
3	12	8	13	8	12	7	11	5
4	14	2	11	8	11	9	10	9
5	18	1	17	3				
6	10	3	11	5	11	8	10	8
7	11	2	11	0	9	4		
8	11	6	14	13				
9	15	3						
10	8	0	9	0	-	-		
12	18	0	18	1	15	2	12	3
13	2	0	2	1				
14	2	0	3	0				
15	14	3	12	1	13	2	10	7
16	18	6	12	2				
17	16	0	15	1				
18	17	8						
19	16	1	9	2				
20	15	5	16	13	12	8		
21	15	2	14	2				
22	15	7	16	2	15	1	9	8

LAB	NOAA/8		NOAA/7		NOAA/6		NOAA/5	
	Sets	Rej	Sets	Rej	Sets	Rej	Sets	Rej
23	0	-	3	2	0	-	0	-
24	8	0	9	3				
25	12	6	7	2				
26	7	6	1	0	6	3	7	5
27	17	1	14	1				
30	12	9	12	8				
31	13	9	12	7	9	3	10	9
32	16	1	16	1	9	1	6	0
33	16	3						
34	18	1	17	1	15	3	11	5
35	15	0	15	0	14	0	12	1
36	13	1	12	1	13	1	10	3
37	16	13	14	7				
39	8	3						
40	7	5	10	7	6	6		
41	9	2	14	0	14	0		
42	14	5	-	-				
43	6	1						
45	18	9	16	11				
46	0	-	14	10				

from superior. Remember that the rating is relative and as everyone improves you also must improve to retain your former position.

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

BCSS-1 has been used as the sediment CRM since NOAA/5 and Table VI (page 45) lists the individual laboratories performance for this CRM over the three years.

There are still a good number of problems concerning the analysis of marine sediments for trace metals. The following eight analytes present difficulties to at least twenty-five percent of the participants: aluminum, iron, silver, cadmium, tin, antimony, mercury and lead. Several laboratories noted on the data sheets that their procedure only recovers the extractable elements. Unfortunately, it is not within the scope of this exercise to try to assess extraction methods.

Biological Tissues

Eight laboratories reported tissue data for the first time, six were new participants and two laboratories which submitted only sediment data in previous exercises. Twenty-eight laboratories of the forty-two laboratories which submitted data for the tissues are in the superior and good categories. Nine of the eleven laboratories (5,9,12,17,19,21,27,32,35) that produced superior results for the sediments were included in the nineteen rated superior in accuracy for the biological tissues (Table VII, page 47). Of the eight laboratories reporting data for tissues for the first time one was superior, three were good, one was fair and three were in the others category.

Table IX (page 48) shows the number of submitted sets and the number of rejected means for the biological tissue samples over the four year period from NOAA/5 to NOAA/8. Of the thirty-two laboratories that submitted tissue data for NOAA/7 sixteen improved their ratings (2,4,5,7,8,19,20,21,23,25,26,27,28,37,40,46) and six have worse ratings. Particular notice should go to laboratories 4,8,26 and 37 which improved to a superior or good category from the "other" category.

There were 771 sets of results evaluated for the tissues NOAA/8, compared to 699 for NOAA/7, 368 for NOAA/6 and 317 sets for NOAA/5. The rejection rates were respectively 143 (19%), 208 (30%), 99 (27%) and 93 (29%) sets. This improvement can be partially attributed to the expansion of acceptable range to a minimum of ± 10 percent for six elements (iron, copper, zinc, arsenic, silver, lead) in NIST SRM 1566a. This year, there were 49 (15%) rejections for 324 NIST SRM 1566a data sets (not including Al and Sn) compared to 91 (30%) rejections in 301 sets for NOAA/7 (NIST SRM 1566a), 71 (32%) rejections in 224 sets for NOAA/6 (DORM-1) and 82 (50%) rejections in 163 data set for NOAA/5 (NIST SRM 1566a). Improvements can be reported for nickel, copper and arsenic in NIST SRM 1566a.

Table VII
Accuracy Evaluation for the Biological Tissues*

	Laboratory Number	NOAA/8	NOAA/7	NOAA/6	NOAA/5
Superior	5,7,9,11,12,17,19, 20,21,23,27,28,32, 35,37	15	8	7	4
Good	2,3,4,6,8,16,24,26, 29,34,36,38,41	13	14	9	8
Fair	13,14,25,30,40,42, 43,46	8	8	9	9
Others	18,22,31,39,44,45	6	8	5	5

*Laboratories 1,10,15 and 33 did not report results for the tissues.

Table VIII
Intralaboratory Precision Evaluation for the Biological Tissues

	Laboratory Number
Good	4,5,9,11,16,17,19,20,23,24,27,34,35, 36,38,39,43,46
Fair	3,6,7,12,13,18,25,26,37,41,42,45

There are also a number of problems concerning the analysis of marine tissues for trace metals. The following four analytes present difficulties to at least twenty-five percent of the participants: nickel, arsenic, tin, and lead. Many of the problems are generally related to the low levels of some of these analytes (e.g., tin and lead).

Twenty-one laboratories that were in the good or superior category for the sediments, also analyzed the tissues. Nineteen of these twenty-one laboratories 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.

Table IX

**Comparison of NOAA/8, NOAA/7, NOAA/6 and NOAA/5
Laboratory Performance for Tissues**

LAB	NOAA/8		NOAA/7		NOAA/6		NOAA/5	
	Sets	Rej	Sets	Rej	Sets	Rej	Sets	Rej
2	10	0	8	3	11	8	10	4
3	16	2	22	8	22	11	21	12
4	22	7	21	11	24	5	21	9
5	24	1	26	8				
6	18	5	20	4	22	6	23	14
7	19	3	19	5	16	1		
8	15	3	17	8				
9	22	3						
11	24	2	23	4	26	7		
12	24	0	25	3	26	5	23	2
13	5	1	5	1				
14	4	0	19	1				
16	23	5						
17	24	0	26	1	26	4	10	0
18	23	13						
19	22	1	8	1				
20	22	3	21	9				
21	18	1	18	2	22	6	9	0
22	18	11	21	7				
23	22	2	13	6	10	5	9	1
24	12	0						

LAB	NOAA/8		NOAA/7		NOAA/6		NOAA/5	
	Sets	Rej	Sets	Rej	Sets	Rej	Sets	Rej
25	16	2	14	7				
26	12	1	2	1	16	6	16	7
27	23	4	17	2				
28	18	1	19	7				
29	16	0	21	3	21	6	23	3
30	10	4	12	3				
31	22	16	20	6	18	6	19	13
32	24	3	24	4	20	2	17	1
34	24	6	26	5	26	9	23	15
35	24	1	26	5	24	1	23	0
36	14	0						
37	24	4	26	14				
38	18	5	-	-	23	9	10	0
39	10	5						
40	14	6	20	12	4	2		
41	10	1	20	7	24	8		
42	22	9	8	2				
43	6	2						
44	1	1						
45	11	7	10	5				
46	11	2	10	5				

X	Superior
X	Good
X	Fair
X	Others

A majority of the laboratories satisfied the precision criteria of Table I. 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.

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. 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 probably a partial cause for the continued improvements.

However, a few laboratories still do not understand the concept of significant figures. Seeing trace analysis results reported to 4 and 5 significant figures really causes one to wonder.

4. CONCLUSIONS

There are a number of trends which can be highlighted. There were notable improvements for the determination of aluminum, iron, zinc, arsenic, silver and mercury in the sediments and nickel, selenium and mercury in the biological tissues. On the other hand, this year the performance for tin and thallium in the sediments appeared to deteriorate somewhat. The laboratories that also took part in NOAA/7, NOAA/6 and NOAA/5 generally improved or maintained their rating for both the sediments and biological tissues. As we have changed the acceptable range to a minimum ± 10 percent it is difficult to compare performance from one year to the next for some elements (eg., lead in SRM 1566a).

The use of BCSS-1 as the CRM for the last four years is a great help in comparing progress over the years, as was the use of SRM 1566a for NOAA/7 and NOAA/5.

Honours go to laboratories 5,9,12,17,19,21,27,32 and 35 for achieving a superior rating for both matrices. Another ten laboratories (4,6,7,16,20,23,24,34,36 and 41) were in the superior or good category for both tissues and sediments.

Longterm proficiency awards go to laboratories 12 and 35 for ratings in the superior group for both tissues and sediments since we started this format with NOAA/5. This year laboratory 12 submitted a total of sixty data sets, all within the acceptable range.

5. BIBLIOGRAPHY

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6. ACKNOWLEDGMENTS

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APPENDIX A
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APPENDIX B

DATA

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

BERYLLIUM
Sediment U
1.61 ± 0.67 mg/kg

Lab		Mean				SD	RSD
1	0						
2	0						
3	0						
4	4	<2.0	<2.0	<2.0	<2.0		
5	4	2.10	1.78	1.67	1.85	0.18	9.9
6	4	2.21	2.26	2.10	2.02	0.11	5.0
7	0						
8	4	2.47	2.29	2.24	2.31	0.10	4.3
9	4	1.6	1.7	1.6	1.7	0.1	3.5
10	0						
11	0						
12	4	1.2	2.2	1.5	1.8	0.4	25.5
13	0						
14	0						
15	4	1.34	1.48	1.44	1.62	0.12	7.9
16*	4	0.65	0.74	0.44	0.70	0.13	21.1
17	4	1.75	1.72	1.66	1.69	0.04	2.3
18*	4	0.714	0.561	1.02	0.760	0.191	25.0
19	4	1.2	1.1	1.1	1.0	0.1	7.4
20	4	1.35	1.34	1.43	1.23	0.08	6.1
21	4	1.9	1.9	1.8	2.0	0.1	4.3
22	0						
23	4	1.8	1.8	1.9	1.8	0.0	2.7
24	0						
25	4	1.30	1.48	1.60	1.53	0.13	8.7
26	0						
27	0						
28	0						
29	0						
30*	4	0.68	0.79	0.72	0.67	0.05	7.6
31	0						
32	0						
33	4	2	2	2.0	2.0	0.0	0.0
34	4	1.36	1.42	1.38	1.40	0.03	1.9
35	0						
36	0						
37	4	0.983	1.092	1.096	0.981	0.065	6.2
38	0						
39	0						
40	0						
41	4	1.48	1.53	1.50	1.49	0.02	1.4
42	4	0.781	0.993	1.44	1.439	0.331	28.4
43	0						
44	0						
45	4	1.8	1.9	1.8	1.8	0.0	2.7
46	4	<9	<9	<9	10	5.0	200.0
47	4	1.77	1.98	1.98	1.83	0.11	5.6
48	0						

BERYLLIUM
BCSS-1
1.3 ± 0.3 mg/kg

Lab		Mean				SD	RSD
1	0						
2	0						
3	0						
4	4	1	1	1	1	1.0	0.0
5	4	1.33	1.32	1.45	1.28	1.35	0.07
6*	4	1.77	1.79	1.67	1.64	1.72	0.07
7	0						
8*	4	2.08	2.14	2.16	2.18	2.14	0.04
9	4	1.2	1.3	1.1	1.1	1.2	0.1
10	0						
11	0						
12	4	1.4	1.6	1.1	1.1	1.3	0.2
13	0						
14	0						
15	4	1.3	1.34	1.32	1.23	1.30	0.05
16*	4	0.93	1.03	0.90	0.95	0.95	0.06
17	4	1.19	1.23	1.31	1.23	1.24	0.05
18	4	1.1	0.9	1.45	1.31	1.19	0.24
19	4	1.2	1.4	1.2	1.3	1.3	0.1
20*	4	0.90	0.85	0.93	0.92	0.90	0.04
21	4	1.5	1.5	1.5	1.5	1.5	0.0
22	0						
23	0						
24	0						
25*	4	0.61	0.80	0.96	0.87	0.81	0.15
26	0						
27	0						
28	0						
29	0						
30*	4	0.63	0.70	0.65	0.62	0.65	0.04
31	0						
32	0						
33	4	1	1	1	1	1.0	0.0
34	4	1.01	1.09	1.11	1.06	1.07	0.04
35	0						
36	0						
37	4	1.1	1.2	1.3	1.1	1.2	0.1
38	0						
39	0						
40	0						
41	4	1.18	1.30	1.11	1.29	1.22	0.09
42*	4	0.678	0.973	1.320	0.990	0.990	0.262
43	0						
44	0						
45	4	1.4	1.4	1.5	1.5	1.5	0.1
46	0						
47	0						
48	0						

The determination of beryllium was not required in the biologicals

ALUMINUM
Sediment U
5.16 ± 0.39 %

Lab						Mean	SD	RSD
1	4	5.16	5.39	5.08	5.22	5.21	0.13	2.6
2	0							
3*	4	4.62	3.93	4.39	4.52	4.37	0.30	7.0
4*	4	4.29	4.46	4.29	4.34	4.34	0.08	1.7
5	4	5.42	5.32	5.30	5.30	5.34	0.06	1.1
6	0							
7	0							
8	4	5.06	5.02	5.02	5.00	5.03	0.03	0.6
9	4	5.39	5.21	5.69	5.58	5.47	0.21	3.9
10	0							
11	0							
12	4	5.5	5.4	5.6	5.0	5.4	0.3	4.9
13	0							
14	0							
15	4	5.09	4.88	4.57	4.58	4.78	0.25	5.3
16	4	5.18	5.08	5.09	5.19	5.14	0.06	1.1
17	0							
18*	4	3.25	2.94	3.01	3.22	3.11	0.15	4.9
19	4	5.20	5.10	5.30	5.10	5.18	0.10	1.9
0	4	5.18	5.30	5.25	5.15	5.22	0.07	1.3
21	4	5.22	5.19	5.22	5.21	5.21	0.01	0.3
22*	4	2.76	3.53	2.77	2.70	2.94	0.39	13.4
23	4	5.1	5.3	5.0	5.1	5.1	0.1	2.5
24	4	5.13	5.06	5.13	4.99	5.08	0.07	1.3
25*	4	5.10	5.20	5.14	5.27	5.18	0.07	1.2
26	0							
27	4	5.13	5.05	5.04	5.03	5.06	0.05	0.9
28	0							
29	0							
30*	4	1.50	1.47	1.60	1.47	1.51	0.06	4.1
31*	4	2.67	2.46	1.91	2.13	2.29	0.34	14.8
32*	4	6.9	6.9	7.3	6.6	6.9	0.3	4.1
33	4	5.1	5.1	5.2	5.1	5.1	0.1	1.0
34	4	4.86	5.02	4.97	4.98	4.96	0.07	1.4
35	4	5.32	5.31	5.30	5.36	5.32	0.03	0.5
36	4	4.93	5.03	4.89	4.96	4.95	0.06	1.2
37*	4	2.03	2.30	2.57	2.48	2.35	0.24	10.2
38	0							
39*	4	1.21	1.22	1.20	1.23	1.22	0.01	1.1
40	0							
41	0							
42*	3	0.1	0.12	0.14		0.12	0.02	16.7
43	4	5.38	5.36	5.44	5.46	5.41	0.05	0.9
44	0							
45*	4	5.74	5.92	5.86	5.86	5.85	0.08	1.3
46	4	4.79	4.98	4.92	5.28	4.99	0.21	4.2
47	4	5.48	5.33	5.51	5.56	5.47	0.10	1.8
48	0							

ALUMINUM
BCSS-1
6.26 ± 0.41 %

Lab						Mean	SD	RSD
1	4	6.34	6.75	6.29	6.62	6.50	0.22	3.4
2	0							
3*	4	5.76	5.40	5.50	5.61	5.57	0.15	2.8
4*	4	4.18	4.18	4.18	4.20	4.19	0.01	0.2
5	4	6.27	6.27	6.16	6.28	6.25	0.06	0.9
6	0							
7	0							
8	4	6.08	5.99	6.09	6.10	6.07	0.05	0.8
9	4	6.52	6.56	6.70	6.51	6.57	0.09	1.3
10	0							
11	0							
12	4	6.6	6.6	6.5	6.4	6.5	0.1	1.5
13	0							
14	0							
15	4	6.76	6.65	6.46	6.56	6.61	0.13	1.9
16	4	6.3	5.23	5.87	6.21	5.90	0.49	8.2
17	0							
18	3	6.59	6.62	6.77		6.66	0.10	1.4
19	4	6.05	6.20	6.21	6.10	6.14	0.08	1.3
20	4	6.21	6.25	6.14	6.34	6.24	0.08	1.3
21	4	6.27	6.30	6.29	6.29	6.29	0.01	0.2
22*	4	4.44	5.00	4.89	5.36	4.92	0.38	7.7
23	0							
24	4	6.32	6.02	6.35	6.05	6.19	0.17	2.8
25*	4	7.10	7.15	7.24	7.24	7.18	0.07	1.0
26	0							
27	4	6.14	6.00	6.09	6.10	6.08	0.06	1.0
28	0							
29	0							
30*	4	2.40	1.96	1.88	1.92	2.04	0.24	11.9
31*	4	3.40	3.75	3.70	2.93	3.45	0.38	10.9
32	4	5.5	6.1	6.0	6.4	6.0	0.4	6.2
33	4	6.1	6.1	6.2	6.1	6.1	0.1	0.8
34	4	6.12	6.15	6.11	6.13	6.13	0.02	0.3
35	4	6.28	6.18	6.37	6.39	6.31	0.10	1.5
36	4	6.02	6.14	6.01	6.01	6.05	0.06	1.1
37*	4	3.36	3.87	4.23	4.09	3.89	0.38	9.8
38	0							
39*	4	1.62	1.67	1.59	1.75	1.66	0.07	4.2
40	0							
41	0							
42*	4	0.19	0.17	0.20	0.20	0.19	0.01	7.4
43	4	6.59	6.63	6.60	6.43	6.56	0.09	1.4
44	0							
45*	4	6.54	7.34	7.38	7.10	7.09	0.39	5.5
46	0							
47	0							
48	0							

ALUMINUM
Tissue V
mg/kg

Lab	Mean	SD	RSD
1 0			
2 0			
3 0			
4 4	190	190	210
5 4	149	140	163
6 4	169	167	177
7 0			
8 4	188	165	156
9 4	160	175	188
10 0			
11 4	136	133	139
12 4	230	220	210
13 0			
14 0			
15 0			
16 4	184	179	177
17 4	213	201	206
18 4	358	370	498
19 4	174	165	193
20 4	187	148	164
21 0			
22 4	488	419	417
23 4	360	350	380
24 0			
25 4	208	240	220
26 0			
27 4	223	206	224
28 4	121.25	176.82	170.55
29 4	239	237.2	237.8
30 3	186.9	170.2	160.4
31 4	155	165	164
32 4	340	340	320
33 0			
34 4	185	187	181
35 4	247	236	242
36 0			
37 4	240	340	240
38 4	205.6	151.3	140.4
39 4	156	160	156
40 0			
41 0			
42 4	110	140	135
43 0			
44 0			
45 4	186	210	196
46 4	215	222	221
47 4	216	209	375
48 0			

ALUMINUM
NIST 1566a
202.5 ± 12.5 mg/kg

Lab	Mean	SD	RSD
1 0			
2 0			
3 0			
4 4	130	110	120
5 4	76.0	74.3	71.4
6 4	95	88	93
7 0			
8 4	81.6	87.7	73.2
9 4	57	65	70
10 0			
11 4	80.8	82.0	83.2
12 4	68	71	80
13 0			
14 0			
15 0			
16 4	115	115	114
17 4	134	131	135
18 1	255		
19 4	86.0	91.5	85.9
20 0	61.9	60.0	65.4
21 0			
22 4	196	201	202
23 4	200	200	200
24 0			
25 4	148	166	175
26 0			
27 4	167	170	158
28 4	89.46	106.72	106.93
29 4	140.4	143.7	141.0
30 4	114.1	121.6	103.1
31 4	140	120	102
32 4	200	200	200
33 0			
34 4	200.6	208.2	199.6
35 4	146	143	138
36 0			
37 4	130	160	140
38 4	80.41	79.76	69.9
39 4	61.8	60.0	63.2
40 0			
41 0			
42 3	50	60	57
43 0			
44 0			
45 0			
46 0			
47 0			
48 0			

SILICON
Sediment U
30.1 ± 2.0 %

Lab					Mean	SD	RSD
1	0						
2	0						
3	0						
4	0						
5	4	29.7	30.4	30.4	30.0	30.1	0.3 1.1
6	0						
7	0						
8	0						
9	0						
10	0						
11	0						
12	4	29	28	27	28	28	1 2.9
13	0						
14	0						
15	0						
16	4	29.7	28.1	29.2	29.5	29.1	0.7 2.4
17	0						
18	0						
19	0						
20	0						
21	4	30.05	30.22	30.20	30.23	30.18	0.08 0.3
22	0						
23	0						
24	0						
25	0						
26	0						
27	4	29.1	29.3	29.2	29.2	29.2	0.1 0.3
28	0						
29	0						
30	0						
31	0						
32*	4	28	26	27	27	27	1 3.0
33	0						
34*	4	34.5	34.2	34.3	34.5	34.4	0.1 0.4
35	0						
36	4	31.1	31.3	31.1	31.2	31.2	0.1 0.3
37	0						
38	0						
39	0						
40	0						
41	0						
42	0						
43	0						
44	0						
45*	4	0.53	0.48	0.53	0.52	0.52	0.02 4.6
46	4	30.4	30	30.2	29.2	30.0	0.5 1.8
47	4	28.1	29.6	30.2	30.1	29.5	1.0 3.3
48	0						

SILICON
BCSS-1
30.8 ± 1.0(1.5) %

Lab					Mean	SD	RSD
1	0						
2	0						
3	0						
4	0						
5	4	30.3	29.9	30.6	30.3	30.3	0.3 0.9
6	0						
7	0						
8	0						
9	0						
10	0						
11	0						
12	4	30	30	30	30	30	0 0.0
13	0						
14	0						
15	0						
16	4	30.9	30.9	31.1	30.4	30.8	0.3 1.0
17	0						
18	0						
19	0						
20	0						
21	4	31.00	31.13	31.15	31.05	31.08	0.07 0.2
22	0						
23	0						
24	0						
25	0						
26	0						
27	4	30.5	30.2	30.4	30.6	30.4	0.2 0.6
28	0						
29	0						
30	0						
31	0						
32	4	31	31	31	31	31	0.0
33	0						
34	4	30.8	30.9	30.8	30.8	30.8	0.0 0.2
35	0						
36	4	31.6	31.7	31.5	31.5	31.6	0.1 0.3
37	0						
38	0						
39	0						
40	0						
41	0						
42	0						
43	0						
44	0						
45*	4	0.39	0.42	0.49	0.32	0.41	0.07 17.4
46	0						
47	0						
48	0						

The determination of silicon was not required in the biologicals

CHROMIUM Sediment U 50.8 ± 12.3 mg/kg								
Lab					Mean	SD	RSD	
1*	4	37	34	39	38	37	2.2	5.8
2	0							
3	4	46.8	44.6	42.8	38.5	43.2	3.5	8.2
4	4	47	40	40	44	43	3.4	8.0
5*	4	75.0	68.7	69.9	62.3	69.0	5.2	7.6
6	4	44.8	45.0	43.3	43.3	44.1	0.9	2.1
7*	4	74.1	64.7	77.0	66.9	70.7	5.8	8.2
8	4	49.6	62.9	48.9	48.7	50.0	2.0	3.9
9	4	52.3	53.3	50.6	51.3	51.9	1.2	2.3
10	0							
11	0							
12	4	56	50	50	49	51	3	6.2
13	0							
14	0							
15	4	51	55	55	51	53	2	4.4
16	4	60.0	54.0	60.1	59.9	58.5	3.0	5.1
17	4	60.8	62.0	62.6	60.0	61.4	1.2	1.9
18*	4	23.2	12.4	55.6	31.8	30.8	18.4	59.7
19	4	57.0	56.0	60.0	57.0	57.5	1.7	3.0
20	4	52.0	47.6	52.4	52.6	51.2	2.4	4.7
21	4	52	50	50	57	52	3	6.3
22	4	45.0	43.7	35.8	44.8	42.3	4.4	10.4
23	4	48	47	47	48	48	1	1.2
24	0							
25	4	52.6	53.3	50.2	52.0	52.0	1.3	2.6
26	4	38.1	46.1	37.1	36.6	39.5	4.5	11.3
27	4	60.2	60.9	59.9	60.0	60.3	0.5	0.7
28	0							
29	0							
30*	4	30.7	29.7	27.2	30.0	29.4	1.5	5.2
31*	4	290	52	46	143	133	114	85.8
32	4	50.7	49.4	51.3	51.3	50.7	0.9	1.8
33	4	53	54	53	55	54	1	1.8
34*	4	34.18	33.20	33.53	33.20	33.53	0.46	1.4
35	4	52.3	50.8	52.5	51.7	51.8	0.8	1.5
36	4	57	56	57	58	57	1	1.4
37*	4	17	35.6	26.1	23.9	25.7	7.7	30.0
38	0							
39*	4	27.9	28.1	28.4	28.1	28.1	0.2	0.7
40*	4	20.7	21.4	20.5	19.6	20.6	0.7	3.6
41	4	56.7	58.2	59.0	58.4	58.1	1.0	1.7
42*	4	26.0	28.2	28.4	27.6	27.6	1.1	3.9
43	4	53.3	54.5	53.0	52.8	53.4	0.8	1.4
44	0							
45	4	44	44	46	42	44	2	3.7
46	4	40	50	50	60	50	8	16.3
47	4	52.2	49.7	47.3	44.7	48.5	3.2	6.6
48	4	48.2	45.1	45.7	44.7	45.9	1.6	3.4

CHROMIUM BCSS-1 123 ± 14 mg/kg								
Lab					Mean	SD	RSD	
1*	4	75	76	73	78	76	2.1	2.8
2	0							
3*	4	88.8	96.1	86.0	72.8	85.9	9.7	11.3
4	4	140	120	120	120	125	10.0	8.0
5	4	115	114	126	122	119	5	4.5
6*	4	96.2	96.4	93.5	95.9	95.5	1.3	1.4
7	4	124.3	123.4	126.6	119.8	123.5	2.8	2.3
8*	4	96	101	98.5	96.1	97.9	2.4	2.4
9*	4	101	98.2	100.2	99.4	99.7	1.2	1.2
10	0							
11	0							
12	4	120	120	120	120	120	0	0.0
13	0							
14	0							
15*	4	102	106	106	108	106	3	2.4
16*	4	74.0	112	81.8	96.2	91.0	16.7	18.4
17	4	118	121	126	116	120	4	3.6
18*	4	101	60.6	66.6	63.6	73.0	18.9	25.9
19	4	112	110	106	110	110	3	2.3
20*	4	110	101	85.5	95.0	97.9	10.3	10.5
21	4	111	111	111	110	111	1	0.5
22*	4	94.3	114	101	104	103	8	7.9
23	0							
24	0							
25*	4	99.1	101.1	95	100	98.8	2.7	2.7
26*	4	83.7	83.0	82.3	74.5	80.9	4.3	5.3
27	4	117	109	118	121	116	5	4.4
28	0							
29	0							
30*	4	54.8	55.0	55.0	53.2	54.5	0.9	1.6
31	4	117	111	115	132	119	9	7.7
32	4	133	128	131	126	130	3	2.4
33	4	110	110	110	110	110	0.0	0.0
34	4	131	132	131	130	131	1	0.6
35	4	125	124	123	122	124	1	1.0
36	4	119	118	117	120	119	1	1.1
37*	4	25.5	46	30	42	36	10	27.0
38	0							
39*	4	51.4	52.5	52.9	52.3	52.3	0.6	1.2
40*	4	36.0	35.7	35.8	37.9	36.4	1.0	2.9
41	4	117	111	109	113	113	3	3.0
42*	4	44.0	45.7	50.5	46.8	46.8	2.8	5.9
43	4	124	122	123	137	127	7	5.6
44	0							
45*	4	88	83	79	89	85	5	5.5
46	0							
47	0							
48	0							

CHROMIUM
Tissue V
1.57 ± 0.63 mg/kg

CHROMIUM
NIST 1566a
1.43 ± 0.46 mg/kg

Lab					Mean	SD	RSD
1	0						
2	0						
3	4	2.37	2.29	2.37	1.77	2.20	0.29
4	4	1.90	2.20	1.94	1.72	1.94	0.20
5	4	1.15	1.14	1.13	1.17	1.15	0.02
6	4	1.35	1.37	1.49	1.56	1.44	0.10
7*	4	3.34	2.89	2.41	3.26	2.98	0.42
8	4	0.54	2.25	1.59	3.40	1.95	1.20
9	4	2.11	2.04	2.11	1.98	2.08	0.06
10	0						
11	4	1.52	1.64	1.93	1.87	1.74	0.19
12	4	2.2	2.2	2.2	2.2	2.2	0.0
13	0						
14	0						
15	0						
16	4	1.65	1.7	1.74	1.70	1.70	0.04
17	4	1.64	1.71	1.83	1.59	1.69	0.10
18*	4	3.19	3.41	4.04	3.91	3.64	0.40
19	4	1.30	1.15	1.20	1.25	1.23	0.06
20	4	1.62	1.78	2.03	1.86	1.82	0.17
21	4	0.89	1.11	0.99	0.97	0.99	0.09
22*	4	5.19	9.27	10.7	4.3	7.4	3.1
23	4	2	2	1	2	2	1
24	0						
25	4	1.44	1.46	1.58	1.18	1.42	0.17
26	4	2.39	1.98	2.04	1.36	1.94	0.43
27	4	2.12	1.90	2.09	2.14	2.06	0.11
28	4	1.26	1.68	1.61	1.87	1.61	0.25
29	0						
30	0						
31	4	2.22	2.12	2.13	2.26	2.18	0.07
32	4	1.10	1.35	1.47	1.23	1.29	0.16
33	0						
34	4	1.30	1.38	1.35	1.31	1.34	0.04
35	4	1.35	1.41	1.35	1.42	1.38	0.04
36	4	1.30	1.14	1.29	1.26	1.25	0.07
37	4	1.53	1.49	1.32	1.12	1.37	0.19
38	0						
39	1	1.61					
40	4	1.28	1.27	0.96	1.06	1.14	0.16
41	4	1.32	1.24	1.30	1.20	1.27	1.25
42*	4	1.05	0.49	0.66	0.72	0.73	0.23
43*	4	2.5	2.2	2.8	2.5	2.5	0.2
44	0						
45*	4	3.8	4.8	5.7	5.6	5.0	0.9
46	4	1	1	1	1	1	0
47	4	1.31	1.23	1.64	1.39	1.39	0.18
48	4	1.48	1.61	1.54	1.53	1.54	0.05

Lab					Mean	SD	RSD
1	0						
2	0						
3	4	1.75	1.38	1.86	1.27	1.57	0.28
4	4	1.37	1.46	1.47	1.37	1.42	0.05
5	4	1.24	1.18	1.32	1.29	1.26	0.06
6	4	0.96	1.06	1.14	1.23	1.10	0.12
7	4	1.87	1.98	1.79	1.65	1.82	0.14
8	3	1.86	2.47	0.5		1.61	1.01
9	4	1.24	1.16	1.04	1.25	1.17	0.10
10	0						
11	4	1.34	1.38	1.43	1.34	1.37	0.04
12	4	1.8	1.8	1.7	1.6	1.7	0.1
13	0						
14	0						
15	0						
16	4	1.96	1.74	1.84	1.83	1.84	0.09
17	4	1.68	1.57	1.34	1.44	1.51	0.15
18*	4	1.31	1.33	3.71	2.17	2.13	1.13
19*	4	0.85	0.85	0.90	0.90	0.88	0.03
20	4	1.21	1.10	1.02	1.20	1.13	0.09
21	4	1.02	1.01	0.99	1.01	1.01	0.01
22	4	<1	<1	<1	<1		
23	4	1	1	2	2	2	1
24	0						
25	4	1.20	1.49	1.77	1.46	1.48	0.23
26	4	3.0	1.70	0.76	1.17	1.66	0.97
27	4	1.49	1.54	1.53	1.59	1.54	0.04
28	4	1.36	1.56	1.54	1.26	1.43	0.14
29	0						
30	0						
31	4	1.66	1.29	1.69	1.23	1.47	0.24
32	4	1.10	1.14	1.14	1.34	1.18	0.11
33	0						
34	4	1.81	1.79	1.80	1.81	1.80	0.01
35	4	1.32	1.30	1.32	1.26	1.30	0.03
36	4	1.21	1.17	1.33	1.31	1.26	0.08
37	4	1.45	1.46	1.56	1.16	1.41	0.17
38	0						
39	1	1.05					
40*	4	0.54	0.95	0.46	0.74	0.67	0.22
41	4	1.50	1.49	1.50	1.48	1.49	0.01
42*	4	0.52	0.102	0.147	0.33	0.27	0.19
43	4	1.7	2.1	1.9	1.8	1.9	0.2
44	0						
45	0						
46	0						
47	0						
48	0						

MANGANESE Sediment U 478 ± 76 mg/kg								
Lab					Mean	SD	RSD	
1	4	489	498	467	468	481	16	3.2
2	0							
3	4	431	418	398	434	420	16	3.9
4*	4	370	350	370	360	363	10	2.6
5	4	474	467	464	472	469	5	1.0
6	4	441	443	421	412	429	16	3.5
7	4	514	524	489	476	501	22	4.4
8	4	511	500	494	515	505	10	1.9
9	4	509	494	534	535	518	20	3.9
10	4	483	460	488	494	481	15	3.1
11	0							
12	4	520	460	420	480	470	42	8.9
13	0							
14	0							
15	4	490	485	481	479	484	5	1.0
16	4	448	444	433	449	444	7	1.7
17	4	509	520	503	509	510	7	1.4
18*	4	135	200	101	207	161	51	31.9
19	4	520	525	500	505	513	12	2.3
20	4	521	502	517	514	514	8	1.6
21	4	513	499	515	493	505	11	2.1
22	4	448	416	418	395	419	22	5.2
23	4	480	480	500	510	493	15	3.0
24	4	493	464	465	479	475	14	2.9
25	4	473.0	519.8	497.0	511.2	500.3	20.5	4.1
26	0							
27	4	447	455	443	434	445	9	2.0
28	0							
29	0							
30*	4	292	290	307	322	303	15	4.9
31	4	525	503	521	491	510	16	3.1
32	4	470	460	470	450	463	10	2.1
33	4	480	520	510	510	505	17	3.4
34	4	445	448	445	448	447	2	0.4
35	4	548	558	533	566	551	14	2.6
36	4	503	506	505	504	505	1	0.3
37*	4	307	370	385	401	366	41	11.3
38	0							
39*	4	259	272	273	273	269	7	2.5
40*	4	214	196	219	205	209	10	4.9
41	4	450	460	458	439	452	10	2.1
42	4	381	454	425	415	419	30	7.2
43	4	519	522	538	509	522	12	2.3
44	0							
45	4	477	461	463	467	467	7	1.5
46*	4	380	390	390	400	390	8	2.1
47	4	493	484	474	484	484	8	1.6
48	0							

MANGANESE BCSS-1 229 ± 15(23) mg/kg								
Lab					Mean	SD	RSD	
1	4	212	225	207	209	213	8	3.8
2	0							
3*	4	206	188	192	193	197	6	3.2
4	4	220	230	230	220	225	6	2.6
5	4	234	227	221	221	226	6	2.7
6	4	172	222	214	238	212	28	13.3
7	4	236	233	222	232	231	6	2.6
8	4	232	230	234	232	232	2	0.7
9	4	239	237	257	261	249	12	4.9
10	4	217	217	227	217	220	5	2.3
11	0							
12	4	220	230	210	230	223	10	4.3
13	0							
14	0							
15	4	229	228	224	222	226	3	1.5
16	4	220	212	217	220	217	4	1.7
17	4	239	240	238	234	238	3	1.1
18*	4	162	272	220	165	205	52	25.5
19	4	220	220	225	231	224	5	2.3
20	4	212	215	211	215	213	2	1.0
21	4	239	239	239	238	239	1	0.2
22	4	199	213	209	210	208	6	2.9
23	0							
24	4	238	221	243	242	236	10	4.3
25	4	214.0	231.7	221.5	232.1	224.8	8.7	3.9
26	0							
27	4	228	228	219	218	223	6	2.5
28	0							
29	0							
30*	4	195	174	192	192	188	10	5.1
31	4	236	234	240	242	238	4	1.5
32	4	220	230	230	230	228	5	2.2
33	4	230	230	230	230	230	0.0	0.0
34	4	224	222	224	226	224	2	0.7
35	4	249	243	254	245	248	5	2.0
36	4	231	230	231	228	230	1	0.6
37*	4	178	189	188	198	188	8	4.3
38	0							
39	4	202	204	204	203	203	1	0.5
40*	4	143	138	147	142	143	4	2.6
41	4	217	221	220	219	219	2	0.8
42	4	233	231	203	195	216	19	9.0
43	4	249	248	238	244	245	5	2.0
44	0							
45	4	214	217	216	220	217	3	1.2
46	0							
47	0							
48	0							

The determination of manganese was not required in the biologicals

IRON Sediment U 2.44 ± 0.12 (0.11)%									IRON BCSS-1 3.28 ± 0.14(0.16) %								
Lab					Mean	SD	RSD		Lab					Mean	SD	RSD	
1	4	2.31	2.32	2.29	2.30	2.31	0.01	0.6	1	4	3.08	3.32	3.16	3.23	3.20	0.10	3.2
2	0								2	0							
3*	4	2.06	1.94	2.00	2.02	2.01	0.05	2.5	3*	4	2.82	2.79	2.73	2.74	2.77	0.04	1.5
4	4	2.49	2.51	2.40	2.37	2.44	0.07	2.8	4	4	3.12	3.10	3.11	3.11	3.11	0.01	0.3
5	4	2.48	2.49	2.39	2.45	2.45	0.04	1.8	5	4	3.27	3.32	3.31	3.23	3.28	0.04	1.3
6*	4	2.25	2.19	2.12	2.05	2.15	0.09	4.0	6	4	3.06	3.15	3.06	3.08	3.09	0.04	1.4
7	4	2.55	2.33	2.44	2.25	2.39	0.13	5.5	7	4	3.35	3.19	3.29	3.17	3.25	0.08	2.6
8	4	2.47	2.46	2.44	2.45	2.46	0.01	0.5	8	4	3.36	3.32	3.35	3.35	3.35	0.02	0.5
9	4	2.42	2.46	2.11	2.35	2.34	0.16	6.7	9	4	3.15	3.29	3.16	3.23	3.21	0.07	2.0
10	4	2.38	2.30	2.29	2.46	2.36	0.08	3.4	10	4	3.15	3.15	3.24	3.17	3.18	0.04	1.3
11	0								11	0							
12	4	2.6	2.5	2.4	2.5	2.5	0.1	3.3	12	4	3.4	3.3	3.3	3.3	3.3	0.1	1.5
13	0								13	0							
14	0								14	0							
15*	4	2.05	2.10	2.39	2.43	2.24	0.20	8.7	15	4	3.24	3.29	3.20	3.31	3.26	0.05	1.5
16	4	2.74	2.54	2.57	2.52	2.59	0.10	3.9	16*	4	3.58	3.42	3.45	3.55	3.50	0.08	2.2
17	4	2.45	2.42	2.48	2.52	2.47	0.04	1.7	17	4	3.20	3.29	3.37	3.18	3.26	0.09	2.7
18*	4	1.11	2.21	1.86	2.05	1.81	0.49	26.9	18*	4	1.11	3.13	2.91	3.11	2.57	0.98	38.0
19	4	2.50	2.48	2.45	2.50	2.48	0.02	1.0	19	4	3.40	3.38	3.35	3.40	3.38	0.02	0.7
20	4	2.54	2.49	2.48	2.57	2.52	0.04	1.7	20	4	3.35	3.31	3.40	3.28	3.34	0.05	1.6
21	4	2.41	2.41	2.38	2.30	2.38	0.05	2.2	21	4	3.30	3.28	3.28	3.27	3.28	0.01	0.4
22*	4	1.98	2.27	2.08	2.10	2.11	0.12	5.7	22	4	3.18	3.04	3.01	3.02	3.06	0.08	2.6
23	4	2.4	2.4	2.4	2.4	2.4	0.0	0.0	23	0							
24*	4	2.28	2.29	2.18	2.16	2.23	0.07	3.0	24	4	3.21	3.08	3.13	3.19	3.15	0.06	1.9
25*	4	2.48	2.69	2.76	2.86	2.70	0.16	6.0	25*	4	3.34	3.51	3.50	3.69	3.51	0.14	4.1
26	0								26	0							
27	4	2.41	2.49	2.38	2.41	2.42	0.05	1.9	27	4	3.27	3.23	3.29	3.28	3.27	0.03	0.8
28	0								28	0							
29	0								29	0							
30*	4	2.64	2.75	2.82	2.60	2.70	0.10	3.7	30	4	3.51	3.19	3.30	2.83	3.21	0.28	8.9
31	4	2.44	2.48	2.42	2.42	2.44	0.03	1.2	31	4	3.33	3.44	3.45	3.50	3.43	0.07	2.1
32	4	2.4	2.5	2.5	2.5	2.5	0.1	2.0	32	4	3.3	3.3	3.3	3.2	3.3	0.0	1.5
33	4	2.4	2.5	2.5	2.5	2.5	0.1	2.0	33	4	3.3	3.3	3.4	3.3	3.3	0.1	1.5
34*	4	2.95	2.91	2.92	2.91	2.92	0.02	0.6	34	4	3.41	3.38	3.40	3.38	3.39	0.02	0.4
35	4	2.40	2.42	2.38	2.44	2.41	0.03	1.1	35	4	3.29	3.21	3.26	3.28	3.26	0.04	1.1
36	4	2.46	2.45	2.45	2.46	2.46	0.01	0.2	36	4	3.36	3.36	3.35	3.34	3.35	0.01	0.3
37*	4	1.46	1.02	1.23	1.04	1.19	0.20	17.2	37*	4	2.91	3.08	3.10	2.97	3.02	0.09	3.0
38	0								38	0							
39*	4	2.13	2.13	2.13	2.13	2.13	0.00	0.0	39*	4	2.83	2.85	2.86	2.86	2.85	0.01	0.5
40	0								40	0							
41	0								41	0							
42*	4	1.9	1.9	2.0	2.1	2.0	0.1	4.8	42*	4	2.6	2.6	2.7	2.7	2.7	0.1	2.2
43	4	2.45	2.51	2.41	2.45	2.46	0.04	1.7	43	4	3.28	3.31	3.23	3.48	3.33	0.11	3.3
44	0								44	0							
45	4	2.44	2.52	2.53	2.51	2.50	0.04	1.6	45	4	3.31	3.35	3.38	3.37	3.35	0.03	0.9
46	4	2.4	2.3	2.4	2.3	2.4	0.1	2.5	46	0							
47	0								47	0							
48	4	2.34	2.54	2.48	2.38	2.44	0.09	3.8	48	0							

IRON
Tissue V
449 ± 66 mg/kg

Lab		Mean					SD	RSD
1	0							
2	0							
3	4	525	495	505	472	499	22	4.4
4	4	490	490	510	480	493	13	2.6
5	4	415	440	427	427	427	10	2.4
6	4	388	382	388	386	386	3	0.7
7*	4	655	541	498	512	552	71	12.9
8	4	450	441	416	454	440	17	3.9
9	4	353	401	398	400	388	23	6.0
10	0							
11	4	405	437	397	414	413	17	4.2
12	4	490	490	460	490	483	15	3.1
13	0							
14	0							
15	0							
16	4	455	443	436	466	450	13	2.9
17	4	459	439	446	439	446	9	2.1
18	4	525	445	422	455	462	44	9.6
19	4	405	395	420	390	403	13	3.3
20	4	462	483	461	485	470	17	3.5
21	4	368	392	391	372	381	13	3.3
22*	4	591	524	536	538	547	30	5.4
23*	4	570	540	560	540	553	15	2.7
24	0							
25	4	407	439	434	466	437	24	5.5
26	0							
27	4	434	438	441	441	439	3	0.8
28	4	314.41	397.71	385.77	407.41	376.33	42.21	11.2
29	4	467.7	458.4	465.0	471.6	465.7	5.6	1.2
30	3	458	426	397		427.0	30.5	7.1
31	4	473	476	481	490	480	7	1.5
32	4	470	490	480	480	480	8	1.7
33	0							
34	4	467	467	465	468	467	1	0.3
35*	4	514	548	544	540	537	15	2.9
36	0							
37	4	435	536	437	423	458	53	11.5
38*	4	395	361	348	336	360	25	7.1
39*	4	361	362	361	361	361	1	0.1
40	0							
41	0							
42	4	429	460	445	440	444	13	2.9
43*	4	566	510	546	565	547	26	4.8
44	0							
45*	4	361	340	328	345	344	14	4.0
46	4	510	480	484	538	503	27	5.3
47	0	437	410	474	492	453	37	8.1
48	4	389	392	475	480	434	50	11.6

IRON
NIST 1566a
539 ± 15(54) mg/kg

Lab		Mean					SD	RSD
1	0							
2	0							
3	4	515	520	494	477	502	20	4.0
4*	4	460	490	450	460	465	17	3.7
5	4	541	539	540	535	539	3	0.5
6	4	490	469	474	475	477	9	1.9
7	4	562	535	530	537	541	14	2.6
8	4	523	520	523	524	523	2	0.3
9*	4	382	456	434	450	431	34	7.8
10	0							
11	4	528	539	537	554	540	11	2.0
12	4	550	550	550	550	550	0	0.0
13	0							
14	0							
15	0							
16	4	555	548	544	551	550	5	0.8
17	4	534	548	551	534	542	9	1.7
18	4	576	478	448	516	505	55	10.9
19	4	497	500	491	495	496	4	0.8
20	4	532	530	515	511	522	11	2.0
21*	4	463	492	436	437	457	26	5.8
22	4	516	510	802	515	586	144	24.6
23	4	540	540	540	530	538	5	0.9
24	0							
25	4	505	520	527	562	529	24	4.6
26	0							
27	4	535	525	527	537	531	6	1.1
28	4	484.05	479.86	488.26	492.53	486.18	5.45	1.1
29	4	592.6	535.4	548.5	523.9	550.1	30.1	5.5
30	4	514	529	500	524	517	13	2.5
31	4	600	632	605	576	603	23	3.8
32	4	540	540	540	540	540	0.0	0.0
33	0							
34	4	545	541	545	546	544	2	0.4
35	4	525	527	546	519	529	12	2.2
36	0							
37	4	490	503	480	480	488	11	2.2
38*	4	450	475	456	438	455	15	3.4
39*	4	448	448	451	450	449	2	0.3
40	0							
41	0							
42	4	527	545	527	512	528	14	2.6
43	4	599	532	520	517	542	39	7.1
44	0							
45	0							
46	0							
47	0							
48	0							

NICKEL
Sediment U
22.8 ± 5.0 mg/kg

Lab					Mean	SD	RSD
1*	4	14	14	14	14		0.0
2	0						
3	4	21.0	18.2	18.0	19.0	1.4	7.2
4	4	25	26	27	23	2	6.5
5	4	19.5	22.9	20.0	19.9	1.6	7.6
6	4	21.7	20.6	22.6	21.8	0.8	3.8
7	4	21.9	28.1	27.1	28.7	3.1	11.7
8	4	25.8	24.5	26.2	24.3	0.9	3.7
9	4	20.3	20.2	19.9	19.8	0.2	1.2
10	4	22.7	24.2	23.0	24.3	0.8	3.5
11	0						
12	4	24	22	20	26	2	9.7
13	0						
14	0						
15	4	19	16	22	24	4	17.3
16	4	20.8	20.7	20.9	20.4	0.2	1.0
17	4	27.0	28.3	28.0	27.6	0.6	2.0
18	4	11.2	29.9	22.2	14.3	8.4	43.3
19	4	21.6	22.0	22.9	23.1	0.7	3.2
20	4	29.6	28.1	22.3	26.2	3.2	12.3
21	4	22	22	21	21	1	2.7
22	4	23.2	24.0	21.8	22.9	0.9	4.0
23	4	21	22	20	22	1	4.5
24	4	22.8	22.1	24.4	22.4	1.0	4.5
25	4	21.4	23.0	22.6	22.8	0.7	3.2
26	0						
27	4	20.4	18.9	20.0	19.0	0.7	3.8
28	0						
29	0						
30	4	22.4	20.0	21.6	21.0	1.0	4.8
31*	4	19.8	15.6	17.6	12.9	2.9	17.8
32	4	22.4	22.3	21.3	20.5	0.9	4.2
33	4	22	22	23	23	1	2.6
34	4	27.8	27.2	28.1	27.7	0.4	1.4
35	4	23.0	22.8	22.9	23.4	0.3	1.1
36	4	24	23	25	24	1	3.4
37*	4	15.8	13.5	14.5	16	1.2	7.8
38	0						
39	4	24.3	24.8	24.8	24.8	0.3	1.0
40	0						
41	4	25.3	25.5	26.2	24.1	0.9	3.5
42	4	26.0	22.13	22.5	26.0	2.1	8.8
43	0						
44	0						
45	4	20	21	18	16	2	11.8
46	0						
47	4	23.4	23.9	22.8	24.4	0.7	2.9
48	4	22.2	23.3	24.4	24.1	1.0	4.2

NICKEL
BCSS-1
55.3 ± 3.6(5.5) mg/kg

Lab					Mean	SD	RSD	
1*	4	34	34	34	35	34	1	1.5
2	0							
3*	4	47.8	45.7	43.4	48.5	46.4	2.3	5.0
4*	4	45	45	45	55	48	5	10.5
5	4	53.2	50.8	56.0	57.7	54.4	3.0	5.6
6	4	58.2	54.0	49.2	51.1	53.1	3.9	7.4
7*	4	49.5	59.6	77.6	62.3	62.3	11.6	18.7
8	4	55.3	55.1	55.5	54.7	55.2	0.3	0.6
9	4	51.3	49.0	53.3	47.7	50.3	2.5	4.9
10	4	53.0	54.0	56.3	54.0	54.3	1.4	2.6
11	0							
12	4	56	55	53	54	55	1	2.4
13	0							
14	0							
15	4	52.4	52.1	49	51.8	51.3	1.6	3.1
16	4	58.5	55.3	50.5	51.0	53.8	3.8	7.0
17	4	55.1	57.9	56.2	53.1	55.6	2.0	3.6
18	4	50.9	62.4	59.7	57.1	57.5	4.9	8.5
19	4	55.0	55.0	61.3	56.4	56.9	3.0	5.3
20	4	50.3	61.2	57.0	59.0	56.9	4.7	8.3
21	4	55	55	55	55	55	0	0.0
22*	4	59.4	61.9	63.1	62.9	61.8	1.7	2.7
23	0							
24	4	59.0	53.3	55.8	51.9	55.0	3.1	5.7
25	4	53.3	53.5	51.8	52.9	52.9	0.8	1.4
26	0							
27	4	51.8	53.1	52.8	52.8	52.6	0.6	1.1
28	0							
29	0							
30*	4	47.4	48.5	48.3	50.0	48.6	1.1	2.2
31*	4	47.4	46.4	49.4	50.2	48.4	1.8	3.6
32	4	55.3	57.8	54.6	55.5	55.8	1.4	2.5
33	4	56	56	56	57	56	1	0.9
34	4	53.6	52.7	54.1	55.9	54.1	1.3	2.5
35	4	56.3	57.0	55.0	56.3	56.2	0.8	1.5
36	4	58	57	56	57	57	1	1.4
37*	4	46.1	46.9	46.2	45.5	46.2	0.6	1.2
38	0							
39	4	55.4	55.7	55.4	57.6	56.0	1.1	1.9
40	0							
41	4	56.6	54.0	52.9	53.3	54.2	1.7	3.1
42	4	60.2	54.6	58.5	54.6	57.0	2.8	5.0
43	0							
44	0							
45	4	52	51	49	49	50	2	3.0
46	0							
47	0							
48	0							

NICKEL
Tissue V
 0.92 ± 0.28 mg/kg

Lab		Mean				SD	RSD
1	0						
2	0						
3*	4	1.44	2.00	2.37	1.73	1.89	21.0
4	4	0.90	1.1	1.1	1.0	1.0	9.3
5	4	1.24	1.24	1.07	1.07	1.16	8.6
6	4	<2.0	<2.0	<2.0	<2.0		
7*	4	2.37	2.67	2.59	2.61	2.56	5.1
8*	4	3.54	1.03	0.46	2.34	1.84	74.8
9	4	1.18	0.89	1.04	1.02	1.03	11.6
10	0						
11	4	0.916	0.850	0.860	0.940	0.892	4.9
12	4	0.86	0.88	0.88	0.88	0.88	1.1
13	0						
14	0						
15	0						
16	4	0.67	0.73	0.58	0.64	0.66	9.5
17	4	0.85	0.83	0.80	0.88	0.84	4.0
18*	4	1.62	1.95	1.69	1.65	1.73	8.7
19	4	0.75	0.85	0.95	0.75	0.83	11.6
20	4	0.84	0.86	0.82	0.84	0.84	1.9
21	0						
22	4	1.27	1.31	1.16	1.14	1.22	6.8
23	4	<1	<1	<1	<1		
24	4	1.12	1.07	1.13	1.04	1.09	3.9
25	4	0.67	1.07	0.83	0.81	0.85	19.6
26	0						
27*	4	3.73	2.42	2.81	2.54	2.88	20.6
28	4	0.70	0.56	1.16	0.97	0.85	31.7
29	0						
30	0						
31*	4	1.33	1.41	0.93	1.58	1.31	21.0
32	4	0.82	0.90	1.19	0.98	0.97	16.4
33	0						
34*	4	1.26	1.31	1.30	1.29	1.29	1.7
35	4	0.98	0.98	0.99	0.97	0.98	0.8
36	4	0.77	0.68	0.64	0.78	0.72	9.5
37	4	0.72	0.89	0.59	0.88	0.77	18.6
38	4	0.934	0.905	1.29	0.829	0.990	20.7
39*	4	2.83	2.83	2.67	2.67	2.75	3.4
40	0						
41*	4	2.60	2.21	1.62	2.00	2.11	19.4
42*	4	1.02	0.46	0.28	0.749	0.627	51.9
43	0						
44	0						
45*	4	1.7	1.6	1.6	1.9	1.7	8.3
46	0						
47	4	0.96	0.99	0.93	1.05	0.98	5.2
48	4	1.04	1.11	1.09	1.05	1.07	3.1

NICKEL
NIST 1566a
 2.25 ± 0.44 mg/kg

Lab		Mean				SD	RSD
1	0						
2	0						
3*	4	2.33	3.37	2.80	2.78	2.82	15.1
4	4	2.10	2.20	2.00	2.40	2.18	7.9
5	4	2.35	2.28	2.44	2.17	2.31	4.9
6	4	2.3	2.8	2.5	2.3	2.5	9.5
7	4	2.60	3.34	1.49	2.20	2.41	32.1
8*	4	3.20	4.34	2.46	2.83	3.21	25.4
9	4	2.29	1.68	1.90	1.93	1.95	13.0
10	0						
11	4	2.46	2.19	2.59	2.55	2.45	7.4
12	4	1.9	2.1	2.0	2.6	2.2	14.5
13	0						
14	0						
15	0						
16	4	2.00	1.88	2.19	2.31	2.10	9.2
17	4	2.41	2.26	2.08	2.27	2.26	6.0
18	4	1.88	1.90	1.89	2.36	2.01	11.7
19	4	1.7	2.0	1.9	1.8	1.9	7.0
20	4	2.07	2.07	1.98	1.77	1.97	7.2
21	0						
22	2	3.64	2.30			3.0	31.9
23	4	3	2	3	2	3	23.1
24	4	1.97	1.85	1.98	1.94	1.94	3.1
25	4	1.92	2.57	2.29	1.97	2.19	13.9
26	0						
27	4	2.23	2.01	2.16	2.12	2.13	4.3
28	4	1.538	1.898	2.317	2.457	2.053	20.3
29	0						
30	0						
31*	4	4.27	2.77	3.77	4.58	3.85	20.6
32	4	2.03	2.56	2.03	2.03	2.16	12.3
33	0						
34	4	2.11	2.14	2.13	2.14	2.13	0.7
35	4	2.09	2.44	2.26	2.15	2.24	6.9
36	4	1.97	1.88	1.71	1.97	1.88	6.5
37	4	1.51	2.7	2.14	1.8	2.04	25.1
38	4	1.79	2.17	1.71	1.64	1.83	12.9
39	4	<2	<2	<2	<2		
40	0						
41	4	2.51	2.49	2.00	2.11	2.28	11.5
42	4	1.89	2.02	1.21	2.25	1.84	24.3
43	0						
44	0						
45	0						
46	0						
47	0						
48	0						

COPPER
Sediment U
72.7 ± 8.1 mg/kg

Lab					Mean	SD	RSD
1	4	62	67	66	65	2	3.3
2	0						
3	4	64.9	78.9	70.0	64.4	6.7	9.7
4*	4	47	55	52	51	3	6.4
5	4	80.9	74.1	74.1	71.7	4.0	5.3
6	4	78.5	77.4	73.0	71.8	3.3	4.4
7	4	62.3	60.9	73.9	67.2	5.9	8.9
8	4	72.6	73.4	70.5	80.3	4.2	5.7
9	4	61.4	65.9	76.3	65.5	6.4	9.4
10	4	67.2	76.6	69.8	68.0	4.3	6.1
11	0						
12	4	82	80	76	74	4	4.7
13	4	75	75	74	78	2	2.3
14	0						
15	4	72.5	73.4	72.5	70.0	1.5	2.0
16	4	72.4	73.5	73.9	70.1	1.7	2.4
17	4	67.0	66.7	63.5	67.3	1.8	2.7
18*	4	117	77.7	75.7	63.0	23.4	28.0
19	4	78	77.3	77.3	70.4	3.6	4.7
20	4	77.3	74.1	74.7	81.9	3.5	4.6
21	4	77	87	71	74	7	9.0
22*	4	84.1	88.3	78.7	92.6	5.9	6.9
23	4	72	71	70	75	2	3.0
24	4	75.3	75.2	81.3	69.4	4.9	6.5
25	4	82.0	77.3	74.4	75.4	3.4	4.4
26*	4	58.8	67.6	61.5	55.9	5.0	8.2
27	4	72.7	72.2	71.9	74.1	1.0	1.3
28	0						
29	0						
30	4	68.7	67.6	70.7	71.3	1.7	2.5
31	4	74.3	68.9	70.4	62.5	4.9	7.1
32	4	75	81	75	68	5	7.1
33	4	76	74	74	71	2	2.8
34*	4	87.44	85.79	86.78	86.81	0.68	0.8
35*	4	64.4	64.3	61.1	61.1	1.9	3.0
36	4	68	67	68	69	1	1.2
37	4	63	62	64	74	6	8.5
38	0						
39	4	80.2	79.1	79.2	80.1	0.6	0.7
40*	4	61.0	62.0	58.0	59.0	1.8	3.0
41*	4	96.9	94.3	90.4	96.1	2.9	3.1
42	4	67.9	65.7	67.2	73.2	3.3	4.8
43	0						
44	0						
45	4	76	82	82	83	3	4.0
46*	4	20.4	21.6	20.9	21.8	0.6	3.0
47	4	74.3	66.6	76.9	74.3	4.5	6.1
48	4	70.1	77.3	76.8	69.6	4.2	5.7

COPPER
BCSS-1
18.5 ± 2.7 mg/kg

Lab					Mean	SD	RSD
1	4	17	16	16	17	1	3.5
2	0						
3	4	18.3	16.0	16.4	16.8	1.0	6.0
4	4	20	20	20	20	0.0	0.0
5	4	17.8	18.9	18.9	19.5	0.7	3.8
6*	4	24.7	22.5	19.6	21.6	2.1	9.6
7	4	17.3	18.6	20.3	19.5	1.3	6.8
8*	4	14.8	14.7	16.2	15.2	0.3	1.8
9	4	20.6	17	17.6	17.9	1.6	8.7
10	4	17.4	18.5	17.9	17.4	0.5	2.9
11	0						
12	4	20	18	19	20	1	5.0
13	4	18.9	18.4	19.4	19.1	0.4	2.2
14	0						
15	4	22.5	20.1	20.2	18.8	1.5	7.5
16	4	20.5	20.5	16.3	20.0	2.0	10.5
17	4	18.9	18.6	19.0	18.5	0.2	1.3
18	4	22.9	21.4	16.2	10.8	5.5	30.8
19	4	17.4	15.9	16.7	17.1	0.6	3.9
20	4	17.6	19.8	16.6	20.0	1.7	9.0
21	4	18	21	20	19	1	6.6
22*	4	21.8	22.2	23.0	21.6	0.6	2.8
23	0						
24	4	18.7	18.2	16.8	18.4	0.8	4.7
25	4	20.8	19.0	19.2	19.1	0.9	4.4
26*	4	13.6	14.0	14.1	13.2	0.4	3.0
27	4	17.6	17.5	18.2	19.0	0.7	3.8
28	0						
29	0						
30*	4	15.2	14.9	14.7	14.9	0.2	1.4
31*	4	10.1	11.6	12.2	11.7	0.9	7.9
32	4	17	18	18	17	1	3.3
33	4	17	17	17	17	0.0	0.0
34	4	19.4	19.1	18.9	19.1	0.2	1.1
35	4	16.6	16.9	17.1	16.9	0.2	1.2
36	4	20	21	19	20	1	4.1
37*	4	13.8	15.1	13.9	16.4	1.2	8.2
38	0						
39	4	18.1	19.2	18.5	20.6	1.1	5.8
40*	4	13.0	13.0	13.0	13.0	0.0	0.0
41*	4	27.2	25.9	26.1	24.4	1.2	4.4
42	4	16.9	16.7	17.5	15.3	0.9	5.6
43	0						
44	0						
45	4	17	15	16	17	1	5.9
46	0						
47	0						
48	0						

COPPER Tissue V 152 ± 15 mg/kg								
Lab					Mean	SD	RSD	
1	0							
2	4	152	146	156	156	5	3.0	
3	4	146	142	147	142	3	1.8	
4	4	170	160	170	170	5	3.0	
5	4	156	164	153	144	8	5.4	
6	4	146	142	143	145	2	1.3	
7	4	150	151	153	155	2	1.5	
8	4	150	152	149	153	2	1.2	
9	4	163	160	160	162	2	0.9	
10	0							
11	4	148	146	150	149	2	1.5	
12	4	150	140	160	150	8	5.4	
13	4	136	137	139	140	2	1.3	
14	0							
15	0							
16	4	155	155	152	152	2	1.1	
17	4	160	171	165	167	5	2.8	
18	4	159	169	167	140	12	7.7	
19	4	143	144	145	142	1	0.9	
20*	4	169	168	167	175	4	2.1	
21	4	151	148	154	152	3	1.7	
22*	4	166	170	170	177	5	2.7	
23	4	154	150	152	152	2	1.1	
24	4	152	151	153	148	2	1.4	
25	4	150	164	164	177	11	6.7	
26	4	150	157	153	149	4	2.4	
27	4	152	151	153	150	1	0.9	
28	4	117.82	154.52	145.79	153.73	17.22	12.0	
29	4	156.3	157.6	158.7	157.6	1.0	0.6	
30	3	141	146	149	146	4	2.8	
31*	4	176	175	174	172	2	1.0	
32	4	160	170	170	160	6	3.5	
33	0							
34	4	150.3	149.7	149.9	150.5	0.4	0.2	
35	4	155	154	155	155	1	0.3	
36	4	150	156	151	152	3	1.7	
37	4	137	143	142	144	3	2.2	
38	4	154	147	148	140	6	3.9	
39	4	161	161	161	161		0.0	
40*	4	129	131	129	129	1	0.8	
41	4	159	157	142	151	8	5.0	
42	4	153.7	155.2	150.8	155.1	2.4	1.6	
43	0							
44	0							
45	4	158	162	157	161.0	2	1.5	
46	4	161	162	161	167	3	1.8	
47	4	148	154	157	157	4	2.8	
48	4	152	151	148	151	2	1.2	

COPPER NIST 1566a 66.3 ± 4.3(6.6) mg/kg								
Lab					Mean	SD	RSD	
1	0							
2	4	65.0	64.5	60.0	62.5	63.0	2.3	3.6
3	4	61.4	59.2	62.4	60.9	61.0	1.3	2.2
4	4	65	68	66	66	66	1	1.9
5	4	66.6	65.3	63.7	62.4	64.5	1.8	2.8
6	4	64	62	62	64	63	1	1.8
7	4	63.3	66.8	64.0	63.6	64.4	1.6	2.5
8	4	64.6	64.0	64.2	64.5	64.3	0.3	0.4
9	4	63.9	63.7	64.6	64.1	64.1	0.4	0.6
10	0							
11	4	63.3	63.9	68.8	64.1	65.0	2.5	3.9
12	4	69	69	67	66	68	2	2.2
13	0							
14	0							
15	0							
16	4	66.6	67.4	67.1	65.0	66.5	1.1	1.6
17	4	66.8	66.1	67.3	67.1	66.8	0.5	0.8
18	4	54.8	59.2	70.4	65.3	62.4	6.8	11.0
19	4	62.0	62.0	62.0	61.5	61.9	0.3	0.4
20	4	67.8	66.2	67.8	68.5	67.6	1.0	1.4
21	4	66	68.2	64.2	66.3	66.2	1.6	2.5
22	4	70.2	73.3	69.0	69.0	70.4	2.0	2.9
23	4	63	62	65	66	64	2	2.9
24	4	63.7	63.0	62.2	67.3	64.1	2.3	3.5
25	4	62.1	67.0	67.8	75.6	68.1	5.6	8.2
26	4	76.0	67.7	64.6	61.9	67.6	6.1	9.0
27	4	66.2	66.7	66.2	65.9	66.3	0.3	0.5
28	4	63.29	63.08	63.85	64.05	63.57	0.46	0.7
29	4	69.9	69.1	68.6	68.4	69.0	0.7	1.0
30	4	60.3	59.7	61.3	56.9	59.6	1.9	3.2
31*	4	75.3	74.3	73.3	73.3	74.1	1.0	1.3
32	4	68	68	67	69	68	1	1.2
33	0							
34	4	62.9	62.6	62.9	62.5	62.7	0.2	0.3
35	4	65.0	65.8	65.0	64.9	65.2	0.4	0.6
36	4	63.5	62.9	63.1	63.6	63.3	0.3	0.5
37	4	59	60	61	61	60	1	1.6
38	4	62.0	63.4	61.5	58.1	61.3	2.2	3.7
39	4	65.4	64.9	65.5	65.5	65.3	0.3	0.4
40*	4	56.0	54.0	55.0	56.0	55.3	1.0	1.7
41	4	67.4	70.7	66.0	68.6	68.2	2.0	2.9
42	4	63.5	63.6	61.4	60.7	62.3	1.5	2.4
43	0							
44	0							
45	0							
46	0							
47	0							
48	0							

		ZINC						
		Sediment U						
		123 ± 12 mg/kg						
Lab		Mean					SD	RSD
1*	4	174	168	176	175	173	3	1.9
2	0							
3*	4	177	177	166	174	173	6	3.3
4	4	210	220	220	210	216	6	2.7
5	4	194	202	207	191	199	7	3.7
6	4	191	193	184	178	187	7	3.7
7	4	198	200	202	204	201	3	1.3
8	4	197	198	193	197	196	2	1.1
9	4	214	206	221	227	217	9	4.2
10	4	203	208	204	206	205	2	1.1
11	0							
12	4	220	220	190	200	208	15	7.2
13	4	200	192	192	197	195	4	2.0
14	0							
15	4	226	218	218	218	220	4	1.6
16	4	199	189	190	187	191	5	2.8
17	4	201	214	212	203	208	6	3.1
18	4	230	211	203	224	217	12	5.6
19	4	226	223	226	216	223	5	2.1
20	4	191	217	182	188	195	15	7.9
21	4	206	203	189	196	199	8	3.8
22	4	192	205	210	206	203	8	3.8
23	4	240	235	215	226	229	11	4.8
24	4	189	185	169	181	181	9	4.8
25	4	218	210.6	205.3	206.9	210.2	5.7	2.7
26*	4	139.6	162.3	136.4	142.5	145.2	11.7	8.0
27*	4	182	172	182	173	177	6	3.1
28	0							
29	0							
30	4	200	223	203	200	207	11	5.4
31	4	269	204	210	220	223	26	11.1
32	4	210	200	200	200	203	5	2.5
33	4	210	210	200	200	205	6	2.8
34	4	207	211	206	206	208	2	1.1
35	4	219	218	216	218	218	1	0.6
36	4	203	202	205	206	204	2	0.9
37	4	179	181	186	196	186	8	4.1
38	0							
39*	4	238	238	230	238	236	4	1.7
40*	4	168	163	162	161	166	4	2.7
41	4	214	218	220	220	218	3	1.3
42	4	212	195	181	195	196	13	6.5
43	0							
44	0							
45	4	195	192	197	191	194	3	1.4
46	4	205	215	212	209	210	4	2.0
47	4	194	203	224	218	210	14	6.5
48	4	201	196	195	192	196	4	1.9

		ZINC BCSS-1 119 ± 12 mg/kg						
Lab		Mean					SD	RSD
1*	4	96	93	94	97	96	2	1.8
2	0							
3*	4	98.2	99.3	93.6	91.8	95.7	3.6	3.8
4	4	110	110	110	120	113	5	4.4
5	4	112	123	121	123	120	5	4.4
6	4	109	109	105	99.3	106	5	4.3
7	4	109	107	109	109	109	1	0.9
8	4	107	105	106	108	107	1	1.2
9	4	122	120	126	129	124	4	3.2
10	4	114	113	110	113	113	2	1.5
11	0							
12	4	110	110	110	110	110	0	0.0
13	4	107	107	108	108	108	1	0.5
14	0							
15	4	111	111	111	111	111	0	0.0
16	4	113	113	108	115	112	3	2.7
17	4	116	120	114	113	116	3	2.7
18	3	122	114	116		117	4	3.5
19	4	122	117	120	124	121	3	2.5
20	4	113	106	121	103	111	8	7.2
21	4	114	115	120	112	115	3	3.0
22	4	108	108	106	108	108	1	0.9
23	0							
24	4	117	114	131	115	119	8	6.7
25	4	113.0	115.0	108.5	111.4	112.0	2.7	2.5
26*	4	70.7	73.6	72.9	70.9	72.0	1.4	2.0
27	4	106	106	111	112	109	3	2.9
28	0							
29	0							
30	4	108	109	110	109	109	1	0.7
31	4	110	118	122	129	120	8	6.6
32	4	110	120	110	110	113	5	4.4
33	4	110	110	110	110	110	0.0	0.0
34	4	110	110	109	111	110	1	0.7
35	4	118	119	118	118	118	1	0.4
36	4	111	112	114	113	113	1	1.1
37*	4	95.5	98.3	97.3	105	99.0	4.1	4.2
38	0							
39	4	109	109	110	110	110	1	0.5
40*	4	83.0	81.0	87.0	81.0	83.0	2.8	3.4
41	4	115	121	120	123	120	3	2.8
42	4	115	110	106	102	108	6	5.1
43	0							
44	0							
45	4	107	106	102	105	105	2	2.1
46	0							
47	0							
48	0							

ZINC
Tissue V
672 ± 67 mg/kg

Lab					Mean	SD	RSD
1	0						
2	4	618	627	656	674	26	4.0
3	4	620	611	587	588	17	2.8
4*	4	760	740	750	770	13	1.7
5	4	653	696	688	675	19	2.8
6*	4	594	586	592	593	4	0.6
7	4	665	672	675	666	5	0.7
8	4	663	671	660	678	8	1.2
9	4	711	687	692	719	15	2.2
10	0						
11	4	688	664	684	664	13	1.9
12	4	700	670	680	680	13	1.8
13	4	612	618	632	638	12.1	1.9
14	0						
15	0						
16	4	680	693	684	678	7	1.0
17	4	698	689	714	697	10	1.5
18	4	803	702	669	687	60	8.4
19	4	640	631	633	624	7	1.0
20	4	654	639	643	659	9	1.4
21	4	629	646	649	642	9	1.4
22	4	689	694	704	691	7	1.0
23*	4	720	750	750	780	24	3.3
24	4	660	685	646	663	16	2.4
25	4	672	727	710	771	41	5.7
26	4	710	687	671	651	25	3.7
27	4	649	678	659	651	13	2.0
28	4	622.02	682.03	667.13	704.15	82.62	12.8
29	4	684.8	683.2	684.6	688.7	2.4	0.3
30	3	683	708	705		14	2.0
31*	4	809	804	785	809	11	1.4
32	4	730	710	710	710	10	1.4
33	0						
34*	4	791	788	790	791	1	0.2
35	4	665	668	672	666	3	0.5
36	4	653	660	657	649	5	0.7
37	4	638	646	648	677	17	2.6
38	4	662	581	586	611	37	6.1
39*	4	859	842	842	842	9	1.0
40	4	650	640	640	660	10	1.5
41	4	707	690	693	701	8	1.1
42*	4	749	780	732	757	20	2.6
43	0						
44	0						
45	0						
46	4	652	657	689	679	18	2.6
47	4	648	631	649	643	8	1.3
48	4	641	642	638	640	2	0.3

ZINC
NIST 1566a
830 ± 57(83) mg/kg

Lab					Mean	SD	RSD
1	0						
2	4	793	755	729	713	35	4.7
3	4	770	755	712	719	28	3.8
4	4	870	940	890	900	29	3.3
5	4	813	834	832	816	11	1.3
6	4	770	749	751	761	10	1.3
7	4	831	843	829	847	9	1.1
8	4	851	830	830	842	10	1.2
9	4	818	817	821	865	23	2.8
10	0						
11	4	872	848	844	844	13	1.6
12	4	900	860	870	870	17	2.0
13	0						
14	0						
15	0						
16	4	871	893	884	859	15	1.7
17	4	860	847	846	836	10	1.2
18	3	873	864	921		31	3.5
19	4	810	815	790	790	13	1.6
20	4	770	772	779	775	4	0.5
21	4	800	905	834	837	44	5.2
22	4	878	897	889	898	9	1.0
23	4	820	850	850	900	33	3.9
24	4	819	851	790	839	27	3.2
25	4	824	872	866	935	46	5.2
26	4	971	863	847	780	79	9.1
27	4	847	839	845	842	4	0.4
28	4	839.23	842.82	865.75	870.07	15.69	1.8
29	4	894.7	816.7	858.8	862.6	32.0	3.7
30	4	851	818	892	861	30	3.6
31*	4	1055	1059	1028	1033	16	1.5
32	4	870	860	870	860	6	0.7
33	0						
34	4	853	850	855	852	2	0.2
35	4	826	842	851	831	11	1.3
36	4	799	803	788	801	7	0.8
37	4	795	781	792	839	26	3.2
38	4	779	730	720	781	32	4.3
39*	4	734	708	708	708	13	1.8
40	4	790	780	830	820	24	3.0
41	4	845	854	837	847	7	0.8
42	4	864	886	873	885	10	1.2
43	0						
44	0						
45	0						
46	0						
47	0						
48	0						

Lab		ARSENIC Sediment U 16.0 ± 4.7 mg/kg					SD	RSD
		Mean						
1	0							
2	0							
3*	4	10.9	7.09	9.91	9.06	9.24	1.62	17.6
4	4	15.9	14.8	14.4	14.25	14.84	0.76	5.0
5	4	18.7	18.6	20.6	19.8	19.4	1.0	4.9
6	4	14.9	18.3	17.8	17.9	17.2	1.6	9.1
7	4	14.9	14.9	13.8	14.4	14.5	0.5	3.6
8	0							
9	4	18.3	18.2	19.7	18.8	18.8	0.7	3.7
10	0							
11	0							
12	4	18	18	16	18	18	1	5.7
13	0							
14	4	19.8	19.7	19.1	18.7	19.3	0.5	2.7
15	4	12.6	14.7	12.2	12.4	13.0	1.2	9.0
16	4	12.9	13.5	13.3	12.5	13.1	0.4	3.4
17	4	16.3	16.0	16.6	16.0	16.2	0.3	1.8
18	4	11.2	13.9	15.8	14.0	13.7	1.9	13.8
19	4	15.5	16.5	16.6	15.7	16.1	0.6	3.5
20	4	14.6	14.3	14.7	14.6	14.6	0.2	1.2
21	4	12	14	14	13	13	1	7.2
22	4	11.2	16.0	12.4	9.37	12.2	2.8	22.9
23	4	16.4	16.2	16.2	15.8	16.2	0.3	1.6
24	0							
25	0							
26*	4	10.41	13.39	7.47	9.62	10.22	2.45	24.0
27	4	15.4	16.2	15.5	16.4	15.9	0.5	3.1
28	0							
29	0							
30	4	16.27	17.59	16.55	14.37	16.20	1.34	8.3
31	4	20.5	19.4	21.8	21.7	20.9	1.1	5.4
32	4	19.4	18.9	19.1	19.1	19.1	0.2	1.1
33	4	16	16	16	16	16	0.0	0.0
34	4	14.6	14.3	14.5	14.5	14.5	0.1	0.9
35	4	14.8	14.9	14.8	14.8	14.8	0.0	0.3
36	4	16.4	16.8	17.1	16.5	16.5	0.5	3.2
37	4	7.8	14.6	16.4	14.6	13.4	3.8	28.4
38	0							
39	1	16.7						
40	0							
41	1	23.4						
42*	4	23.8	19.7	22.1	20.0	21.4	1.9	9.0
43	4	16.8	17.9	17.8	17.1	17.4	0.5	2.8
44	0							
45	4	15.2	15.7	15.4	14.9	15.3	0.3	2.2
46	0							
47	4	18.8	17.8	17.1	17.2	17.7	0.8	4.4
48	0							

		ARSENIC BCSS-1 11.1 ± 1.4 mg/kg								
Lab		Mean						SD	RSD	
1	0									
2	0									
3*	4	7.50	6.11	9.07	8.53	7.80	1.30	16.7		
4	4	10.40	9.70	9.30	10.00	9.85	0.47	4.7		
5	4	12.1	11.8	12.8	12.2	12.2	0.4	3.4		
6	4	9.41	13.0	13.1	13.9	12.4	2.0	16.2		
7	4	10.3	10.5	10.1	10.6	10.4	0.2	2.1		
8	0									
9	4	12.1	11.7	11.9	11.9	11.9	0.2	1.4		
10	0									
11	0									
12	4	11	13	12	12	12	1	6.8		
13	0									
14	4	12.4	12.4	12.4	12.4	12.4	0.0	0.0		
15	4	11	11.2	9.9	11.2	10.8	0.6	5.8		
16	4	9.5	9.5	9.3	10.9	9.8	0.7	7.5		
17	4	10.8	10.7	10.6	10.8	10.7	0.1	0.9		
18	4	9.11	11.11	12.7	12.7	11.4	1.7	14.9		
19	4	10.2	9.8	10.3	10.4	10.2	0.3	2.6		
20	4	10.5	10.8	10.4	10.5	10.6	0.2	1.6		
21	4	9	9	12	10	10	1	14.1		
22*	4	7.64	7.74	7.06	7.02	7.37	0.38	5.1		
23	0									
24	0									
25	0									
26*	4	8.73	4.77	9.72	9.10	8.08	2.24	27.8		
27	4	10.9	11.3	10.8	10.8	11.0	0.2	2.2		
28	0									
29	0									
30*	4	9.28	10.50	9.22	7.03	9.01	1.44	16.0		
31*	4	14.4	15.3	16.1	15.4	15.3	0.7	4.6		
32	4	12.6	12.6	12.6	12.4	12.6	0.1	0.8		
33	4	11	11	11	11	11	0.0	0.0		
34	4	11.6	11.4	11.5	11.6	11.5	0.1	0.8		
35	4	9.7	10.6	10.4	10.2	10.2	0.4	3.8		
36	4	10.6	10.2	10.8	11.0	10.7	0.3	3.2		
37	4	10.7	11.1	9.85	9.68	10.3	0.7	6.6		
38	0									
39	1	11.0								
40	0									
41	1	12.02								
42	4	12.8	11.4	12.1	11.8	12.0	0.6	4.9		
43	4	11.3	11.8	11.6	11.6	11.6	0.2	1.8		
44	0									
45	4	11.1	11.4	11.3	11.8	11.4	0.3	2.6		
46	0									
47	0									
48	0									

ARSENIC
Tissue V
7.65 ± 1.33 mg/kg

Lab		Mean					SD	RSD
1	0							
2	0							
3	0							
4*	4	4.32	4.40	4.64	4.48	4.46	0.14	3.1
5	4	7.70	8.01	7.84	8.32	7.97	0.27	3.4
6*	4	6.63	6.66	6.44	6.19	6.96	0.43	7.2
7	4	7.4	6.6	6.8	6.6	6.8	0.4	6.2
8	0							
9	4	8.9	8.0	8.0	7.8	8.2	0.6	6.0
10	0							
11	4	8.32	8.32	7.98	8.26	8.22	0.16	2.0
12	4	8.0	7.6	6.3	8.6	7.6	0.9	12.4
13	4	7	7.4	7.3	7.7	7.4	0.3	3.9
14	4	7.69	7.66	7.81	7.68	7.71	0.07	0.9
15	0							
16	4	8.61	7.8	6.98	7.46	7.69	0.64	8.4
17	4	7.48	7.42	7.49	7.41	7.46	0.04	0.6
18*	4	2.37	2.08	2.64	2.13	2.28	0.21	9.4
19	4	6.87	6.46	6.70	6.10	6.53	0.33	5.1
20	4	7.63	7.18	8.11	7.67	7.60	0.38	5.1
21	4	7.3	7.0	7.3	7.0	7.2	0.2	2.4
22*	4	1.63	1.29	0.6	0.61	1.03	0.61	49.7
23	4	8.3	8.7	8.7	8.7	8.6	0.2	2.3
24	0							
25	0							
26	4	7.16	8.34	10.29	9.83	8.91	1.43	16.1
27	4	8.16	8.10	8.18	7.94	8.10	0.11	1.3
28	4	4.61	6.79	7.14	7.68	6.53	1.32	20.2
29	0							
30	0							
31	4	7.19	8.48	8.97	9.37	8.50	0.96	11.1
32*	4	6.10	6.69	6.26	6.26	6.08	0.27	4.4
33	0							
34*	4	11.6	11.46	11.53	11.49	11.50	0.03	0.3
35	4	7.26	7.26	7.03	7.43	7.24	0.16	2.3
36	4	7.04	6.93	6.96	7.4	7.08	0.22	3.1
37*	4	3.18	2.48	1.38	3.82	2.72	1.04	38.6
38*	4	9.48	8.98	9.21	8.66	9.08	0.36	3.8
39	1	6.46						
40*	4	6.47	6.64	6.23	4.76	6.53	0.80	14.6
41	1	3.77						
42	4	8.3	7.8	7.6	8.8	8.1	0.6	6.6
43	4	7.66	7.90	8.09	7.72	7.84	0.19	2.6
44	0							
45*	4	1.2	0.9	1	1.4	1.1	0.2	19.7
46	4	6	7	7	7	7	1	7.4
47	4	7.4	7.4	7.7	8.7	7.8	0.6	7.9
48	0					ERR	ERR	ERR

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

Lab		Mean					SD	RSD
1	0							
2	0							
3	0							
4*	4	10.00	11.26	10.67	10.52	10.69	0.61	4.8
5	4	14.0	14.3	13.8	13.8	14.0	0.2	1.7
6	4	12.7	12.4	14.2	12.4	12.9	0.9	6.7
7	4	12.3	13.9	13.0	13.9	13.3	0.8	6.8
8	0							
9	4	13.6	12.1	11.9	13.8	12.9	1.0	7.7
10	0							
11	4	16.1	16.1	13.6	14.8	14.6	0.8	6.2
12	4	16	16	14	14	16	1	4.0
13	0							
14	4	13.6	13.8	13.7	13.7	13.7	0.1	0.6
15	0							
16	4	16.2	12.9	13.3	12.3	13.4	1.3	9.3
17	4	14.3	14.1	14.0	13.9	14.1	0.2	1.2
18*	4	6.92	9.80	9.72	9.40	8.96	1.37	16.3
19	4	13.6	13.1	12.9	13.2	13.2	0.2	1.9
20	4	13.8	13.8	13.7	13.7	13.8	0.1	0.4
21	4	12.3	12.4	13.1	13.0	12.7	0.4	3.2
22	2	2.74	2.34			2.5	0.3	11.1
23	4	13.1	13.3	13.8	13.9	13.6	0.4	2.9
24	0							
25	0							
26	4	17.06	12.17	14.94	11.93	14.03	2.44	17.4
27	4	14.6	14.4	14.3	13.7	14.3	0.4	2.7
28*	4	11.37	10.76	12.44	12.62	11.80	0.89	7.6
29	0							
30	0							
31*	4	16.8	16.6	14.8	17.6	16.4	1.1	7.0
32	4	13.6	14.3	15.2	13.9	14.3	0.7	4.9
33	0							
34	4	14.02	14.16	14.08	14.10	14.09	0.08	0.4
35	4	14.3	13.8	13.6	13.8	13.9	0.3	2.4
36	4	12.9	13.0	12.8	13.1	13.0	0.1	1.0
37*	4	1.7	0.84	2.16	1.96	1.66	0.68	34.7
38*	4	16.66	16.93	16.69	16.69	16.72	0.16	1.0
39	1	11.9						
40	4	14.0	17.1	12.3	14.0	14.4	2.0	13.9
41	1	13.6						
42	4	16.8	16.8	11.8	13.7	14.6	2.2	16.3
43	4	14.9	16.3	14.8	16.1	16.0	0.2	1.6
44	0							
45	0							
46	0							
47	0							
48	0							

SELENIUM
Sediment U
1.09 ± 0.50 mg/kg

Lab		Mean				SD	RSD
1	0						
2	0						
3	4	0.726	0.727	0.679	0.722	0.714	0.023
4	4	<0.2	<0.2	<0.2	<0.2		
5	4	1.5	1.1	1.5	1.6	1.4	0.2
6	0						
7	4	1.11	1.07	1.01	1.01	1.05	0.05
8	0						
9	0						
10	0						
11	0						
12	4	1.0	1.0	0.88	1.0	0.97	0.06
13	0						
14	4	1.23	1.18	1.16	1.17	1.19	0.03
15	0						
16	4	0.85	1.00	0.73	0.77	0.84	0.12
17	4	1.21	1.18	1.27	1.19	1.21	0.04
18*	4	0.957	4.19	2.83	1.55	2.38	1.44
19	4	1.15	1.15	1.10	1.10	1.13	0.03
20	4	1.50	1.58	1.67	1.64	1.55	0.04
21	4	<1	<1	<1	<1		
22	4	0.789	0.86	0.879	0.612	0.785	0.122
23	4	1.2	1.2	1.3	1.3	1.3	0.1
24	0						
25	0						
26	0						
27	4	0.76	0.81	0.82	0.75	0.79	0.04
28	0						
29	0						
30	0						
31	4	<4.0	<3.8	<4.0	<3.9		
32	4	1.23	1.17	1.16	1.17	1.18	0.03
33	4	1.2	1.3	1.2	1.2	1.2	0.1
34	4	0.57	0.58	0.57	0.54	0.57	0.02
35	4	1.06	1.03	1.05	1.07	1.05	0.02
36	4	1.11	1.41	1.40	1.42	1.34	0.15
37	4	0.22	0.98	0.88	0.92	0.75	0.36
38	0						
39	1	0.91					
40	0						
41*	4	6.03	5.91	6.38	5.70	6.01	0.28
42*	4	0.518	0.493	0.393	0.409	0.453	0.062
43	0						
44	0						
45	4	0.8	0.8	0.8	0.8	0.8	0.0
46	4	<2	<2	<2	<2		
47	4	1.08	1.21	1.18	1.15	1.16	0.06
48	0						

SELENIUM
BCSS-1
0.43 ± 0.06 mg/kg

Lab		Mean				SD	RSD
1	0						
2	0						
3	4	0.404	0.400	0.388	0.412	0.401	0.010
4	4	0.400	0.2400	0.3400	0.5600	0.385	0.134
5	4	<0.5	<0.5	<0.5	<0.5		
6	0						
7	4	0.41	0.47	0.44	0.42	0.44	0.03
8	0						
9	0						
10	0						
11	0						
12	4	0.35	0.47	0.35	0.35	0.38	0.06
13	0						
14	4	0.434	0.430	0.380	0.392	0.409	0.027
15	0						
16*	4	0.35	0.30	0.30	0.40	0.34	0.05
17	4	0.49	0.48	0.47	0.47	0.48	0.01
18*	4	0.561	1.81	1.66	1.64	1.42	0.58
19	4	0.4	0.4	0.4	0.4	0.4	0.0
20*	4	0.57	0.62	0.65	0.58	0.61	0.04
21	4	<1	<1	<1	<1		
22	4	0.333	0.401	0.371	0.334	0.360	0.033
23	0						
24	0						
25	0						
26	0						
27	4	0.45	0.43	0.41	0.44	0.43	0.02
28	0						
29	0						
30	0						
31	4	<4.1	<4.3	<4.3	<4.1		
32	4	0.456	0.418	0.384	0.381	0.410	0.035
33	4	0.47	0.48	0.48	0.50	0.48	0.01
34	4	0.44	0.41	0.44	0.45	0.44	0.02
35	4	0.44	0.45	0.44	0.47	0.45	0.01
36*	4	0.46	0.53	0.54	0.50	0.51	0.04
37	4	0.14	<0.1	<0.1	<0.1		
38	0						
39	1	0.45					
40	0						
41	4	0.412	0.429	0.439	0.404	0.421	0.016
42*	4	0.120	0.576	0.54	0.343	0.395	0.210
43	0						
44	0						
45*	4	0.0	0.0	0.0	0.0	0.0	0.0
46	0						
47	0						
48	0						

		SELENIUM Tissue V 2.23 ± 0.73 mg/kg								
Lab		Mean					SD	RSD		
1	0									
2	0									
3	0									
4	4	1.88	1.94	2.04	1.81	1.92	0.10	5.1		
5	4	2.75	2.57	2.47	2.88	2.67	0.18	6.9		
6	0									
7	4	2.36	1.85	2.05	2.13	2.10	0.21	10.1		
8	0									
9	0									
10	0									
11	4	2.65	2.44	2.00	2.76	2.46	0.34	13.6		
12	4	3.2	3.1	2.4	2.9	2.9	0.4	12.3		
13	0									
14	4	1.95	2.06	2.24	2.02	2.07	0.12	6.0		
15	0									
16*	4	1.40	1.43	1.33	1.48	1.41	0.06	4.4		
17	4	2.52	2.61	2.66	2.50	2.57	0.08	2.9		
18	4	2.16	2.94	3.23	2.76	2.77	0.45	16.3		
19	4	2.04	2.05	2.16	2.10	2.09	0.06	2.6		
20	4	2.03	2.03	2.75	2.08	2.22	0.35	15.9		
21	4	2.43	2.69	2.55	2.60	2.57	0.11	4.2		
22*	4	1.22	1.09	1.09	0.99	1.10	0.09	8.6		
23	4	1.5	1.6	1.5	1.2	1.5	0.2	11.9		
24	0									
25	0									
26	0									
27	4	2.11	2.08	2.34	2.07	2.15	0.13	5.9		
28	0									
29	4	2.28	2.28	2.20	2.16	2.23	0.06	2.7		
30	0									
31*	4	2.6	4.6	3.7	4.4	3.8	0.9	23.6		
32*	4	1.06	0.98	0.98	1.39	1.10	0.20	17.7		
33	0									
34	4	1.83	1.77	1.79	1.81	1.80	0.03	1.4		
35	4	2.12	2.14	2.13	2.14	2.13	0.01	0.4		
36	4	2.46	2.50	2.52	2.59	2.52	0.05	2.2		
37	4	1.38	1.62	2.18	1.22	1.60	0.42	26.3		
38	0									
39	1	2.25								
40	0									
41	4	2.19	2.11	2.12	2.25	2.17	0.07	3.0		
42	4	1.37	2.181	1.10	2.12	1.69	0.54	31.9		
43	0									
44	0									
45	4	2.0	2.6	2.0	2.4	2.3	0.3	13.3		
46	4	<2	<2	<2	<2					
47	4	2.25	2.23	2.15	1.91	2.14	0.16	7.3		
48	0									

		SELENIUM NIST 1566a 2.21 ± 0.24 mg/kg								
Lab		Mean					SD	RSD		
1	0									
2	0									
3	0									
4	4	2.0	2.16	1.87	2.13	2.04	0.13	6.5		
5	4	2.18	2.23	2.46	2.23	2.28	0.13	5.5		
6	0									
7	4	2.04	1.95	1.97	2.03	2.00	0.04	2.2		
8	0									
9	0									
10	0									
11	4	2.03	2.08	2.20	2.18	2.12	0.08	3.8		
12	4	2.4	2.4	2.2	2.3	2.3	0.1	4.1		
13	0									
14	4	1.97	1.97	1.99	1.95	1.97	0.02	0.8		
15	0									
16*	4	1.58	1.63	1.63	1.55	1.60	0.04	2.5		
17	4	2.21	2.21	2.18	2.25	2.21	0.03	1.3		
18*	4	3.00	2.01	2.91	3.33	2.81	0.56	20.1		
19	4	1.90	1.97	1.97	1.95	1.95	0.03	1.7		
20	4	2.04	1.90	2.13	2.08	2.04	0.10	4.8		
21	4	2.25	2.21	2.41	2.37	2.31	0.10	4.1		
22	2	2.24	1.96			2.1	0.2	9.4		
23	4	2.3	2.2	2.1	2.6	2.3	0.2	9.4		
24	0									
25	0									
26	0									
27	4	2.22	2.04	2.11	1.94	2.08	0.12	5.7		
28	0									
29	4	2.40	2.29	2.26	2.29	2.31	0.06	2.7		
30	0									
31*	4	3.9	4.3	3.5	3.3	3.8	0.4	11.8		
32	4	2.19	2.03	2.11	2.28	2.15	0.11	5.0		
33	0									
34	4	1.96	2.01	1.95	1.98	1.98	0.03	1.3		
35	4	2.16	2.20	2.23	2.17	2.19	0.03	1.4		
36	4	2.41	2.43	2.38	2.32	2.39	0.05	2.0		
37	4	2.04	2.02	2.02	2.06	2.04	0.02	0.9		
38	0									
39	1	2.00								
40	0									
41	4	2.21	2.20	2.15	2.27	2.21	0.05	2.2		
42*	4	1.34	1.70	1.47	2.47	1.75	0.51	29.0		
43	0									
44	0									
45	0									
46	0									
47	0									
48	0									

		SILVER Sediment U 0.17 ± 0.04 mg/kg								
Lab		Mean					SD	RSD		
1	0									
2	0									
3*	4	0.416	0.376	0.557	0.290	0.410	0.111	27.2		
4	0									
5*	4	0.46	0.41	0.38	0.53	0.44	0.07	14.7		
6	0									
7	4	0.11	0.20	0.15	0.15	0.15	0.04	24.2		
8*	4	0.69	0.69	0.21	0.44	0.51	0.23	46.6		
9*	4	0.37	0.34	0.33	0.31	0.34	0.03	7.4		
10	4	0.167	0.176	0.190	0.163	0.172	0.016	9.1		
11	0									
12	4	0.18	0.17	0.19	0.17	0.18	0.01	5.4		
13	0									
14	0									
15	4	0.129	0.192	0.144	0.144	0.152	0.027	18.0		
16	4	0.16	0.15	0.30	0.20	0.20	0.07	35.4		
17	4	0.16	0.14	0.14	0.14	0.15	0.01	6.9		
18*	4	0.430	0.510	0.454	0.461	0.464	0.034	7.2		
19	4	<2	<2	<2	<2					
20	4	0.17	0.17	0.18	0.19	0.18	0.01	5.4		
21	4	<1	<1	<1	<1					
22*	4	0.12	0.126	0.113	0.114	0.118	0.006	5.1		
23	4	<0.5	<0.5	<0.5	<0.5					
24	0									
25	4	0.05	0.05	<0.05	<0.05					
26	0									
27	4	1.10	1.20	1.20	0.86	1.09	0.16	14.7		
28	0									
29	0									
30	0									
31*	4	0.88	0.63	0.52	0.39	0.61	0.21	34.4		
32	4	0.18	0.20	0.16	0.16	0.18	0.02	10.9		
33*	4	0.33	0.32	0.31	0.30	0.32	0.01	4.1		
34*	4	0.094	0.098	0.101	0.097	0.098	0.003	3.0		
35	4	0.17	0.18	0.18	0.17	0.18	0.01	3.3		
36	0									
37	4	0.189	0.172	0.123	0.120	0.151	0.035	23.0		
38	0									
39	0									
40*	4	0.213	0.247	0.191	0.252	0.226	0.029	12.8		
41	0									
42	4	0.143	0.160	0.170	0.180	0.163	0.016	9.7		
43	0									
44	0									
45*	4	0.26	0.25	0.23	0.27	0.25	0.02	6.8		
46	4	<0.5	<0.5	<0.5	<0.5					
47	4	0.18	0.20	0.17	0.19	0.19	0.01	7.0		
48	0									

		SILVER BCSS-1 0.10 ± 0.03 mg/kg								
Lab		Mean					SD	RSD		
1	0									
2	0									
3*	4	0.640	0.329	0.770	0.155	0.474	0.282	59.5		
4	0									
5*	4	0.44	0.32	0.44	0.51	0.43	0.08	18.5		
6	0									
7	4	0.03	0.08	0.09	0.09	0.07	0.03	39.8		
8*	4	0.15	0.35	0.30	0.40	0.30	0.11	36.0		
9*	4	0.38	0.34	0.32	0.31	0.34	0.03	9.2		
10	4	0.122	0.094	0.097	0.085	0.100	0.016	15.9		
11	0									
12	4	0.088	0.084	0.091	0.088	0.088	0.003	3.3		
13	0									
14	0									
15	4	0.115	0.066	0.059	0.054	0.074	0.028	38.2		
16	4	0.10	0.10	0.10	0.10	0.10	0.0	0.0		
17	4	0.11	0.11	0.10	0.12	0.11	0.01	7.4		
18*	4	0.464	0.54	0.424	0.424	0.463	0.055	11.8		
19	4	<2	<2	<2	<2					
20	4	0.13	0.14	0.12	0.13	0.13	0.01	6.3		
21	4	<1	<1	<1	<1					
22	4	0.081	0.076	0.079	0.073	0.077	0.004	4.5		
23	0									
24	0									
25	4	<0.05	<0.05	<0.05	<0.05					
26	0									
27	4	<0.5	<0.5	<0.5	<0.5					
28	0									
29	0									
30	0									
31*	4	0.31	0.51	0.46	0.36	0.41	0.09	22.3		
32	4	0.10	0.10	0.10	0.10	0.10	0.0	0.0		
33*	4	0.20	0.17	0.17	0.16	0.18	0.02	9.9		
34	4	0.116	0.112	0.108	0.111	0.112	0.003	3.0		
35	4	0.10	0.10	0.10	0.10	0.10	0.00	0.0		
36	0									
37*	4	0.075	0.076	0.053	0.047	0.063	0.015	23.8		
38	0									
39	0									
40	4	0.104	0.094	0.123	0.100	0.105	0.013	11.9		
41	0									
42	4	0.07	0.103	0.089	0.121	0.096	0.022	22.6		
43	0									
44	0									
45*	4	0.15	0.13	0.12	0.19	0.15	0.03	21.0		
46	0									
47	4	0.114	0.134	0.111	0.100	0.115	0.014	12.4		
48	0									

SILVER
Tissue V
2.51 ± 0.41 mg/kg

Lab		Mean					SD	RSD
1	0							
2	0							
3	4	3.07	2.63	2.70	2.46	2.69	0.28	10.3
4	0							
5*	4	1.66	1.76	1.63	1.67	1.68	0.06	3.1
6	0							
7	4	2.31	2.66	2.78	2.42	2.62	0.20	8.1
8	4	2.76	2.08	2.30	2.30	2.36	0.29	12.1
9	4	2.47	2.46	2.98	2.26	2.54	0.31	12.2
10	0							
11	4	2.51	2.48	2.42	2.49	2.48	0.04	1.6
12	4	2.5	2.5	2.6	2.5	2.5	0.1	2.0
13	0							
14	0							
15	0							
16*	4	3.76	2.86	3.49	3.36	3.36	0.38	11.3
17	4	2.61	2.42	2.60	2.43	2.49	0.08	3.4
18*	4	4.29	3.67	3.93	3.63	3.86	0.33	8.6
19	4	2.10	2.06	2.60	2.60	2.29	0.26	10.8
20	4	2.36	2.39	2.36	2.34	2.36	0.02	0.9
21	0							
22	4	2.36	2.32	3.16	1.98	2.46	0.60	20.4
23	4	2.4	2.6	2.6	2.8	2.6	0.2	6.3
24	4	2.87	2.80	2.70	2.82	2.80	0.07	2.6
25	4	2.5	2.1	2.2	2.2	2.3	0.2	7.7
26	0							
27*	4	3.09	3.19	3.20	3.19	3.17	0.06	1.6
28	4	1.80	2.69	2.67	2.47	2.38	0.40	16.7
29	4	2.19	2.28	2.13	2.29	2.22	0.08	3.4
30	0							
31	4	2.67	3.06	2.24	3.06	2.76	0.39	14.2
32	4	2.98	2.98	2.90	2.82	2.92	0.08	2.6
33	0							
34	4	2.32	2.66	2.48	2.41	2.44	0.10	4.2
35	4	2.46	2.44	2.34	2.44	2.42	0.06	2.1
36	0							
37	4	2.36	2.08	3.07	2.37	2.47	0.42	17.1
38	4	2.38	2.28	2.00	2.00	2.17	0.19	9.0
39	0							
40	4	2.82	2.81	2.81	2.71	2.79	0.06	1.9
41	0							
42*	4	2.96	2.87	3.20	3.67	3.18	0.36	11.3
43	0							
44	0							
45*	4	3.1	3.2	3.2	3.3	3.2	0.1	2.6
46	4	<0.5	<0.5	<0.5	<0.5			
47	4	2.64	2.72	2.72	2.61	2.67	0.06	2.1
48	4	2.70	2.73	2.68	2.68	2.70	0.02	0.9

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

Lab		Mean					SD	RSD
1	0							
2	0							
3	4	1.86	1.30	1.73	1.31	1.56	0.28	18.4
4	0							
5	4	1.66	1.59	1.61	1.60	1.59	0.06	3.7
6	0							
7	4	1.62	1.66	1.59	1.59	1.61	0.03	1.8
8*	4	1.16	1.14	1.57	1.33	1.30	0.20	16.3
9	4	1.48	1.48	1.72	1.37	1.51	0.16	9.8
10	0							
11	4	1.56	1.59	1.76	1.62	1.63	0.09	5.3
12	3	1.6	1.6	1.6		1.6	0.0	0.0
13	0							
14	0							
15	0							
16*	4	2.26	2.19	1.91	2.19	2.14	0.16	7.1
17	4	1.68	1.60	1.66	1.54	1.66	0.03	2.2
18*	4	2.57	2.18	2.66	2.53	2.48	0.21	8.4
19	4	1.66	1.46	1.80	1.80	1.66	0.18	10.8
20*	4	1.43	1.51	1.41	1.46	1.46	0.04	3.0
21	0							
22	2	2.2	1.77			2.0	0.3	16.3
23	4	1.5	1.5	1.6	1.6	1.6	0.1	3.7
24	4	1.80	1.81	1.82	1.74	1.79	0.04	2.0
25*	4	1.48	1.49	1.24	1.28	1.37	0.13	9.6
26	0							
27	4	1.69	1.80	1.80	1.72	1.76	0.06	3.2
28	4	1.57	1.66	1.52	1.61	1.59	0.06	3.6
29	4	1.50	1.98	1.51	1.46	1.61	0.26	16.3
30	0							
31*	4	2.09	1.98	1.93	1.98	2.00	0.07	3.4
32	4	1.62	1.62	1.62	1.74	1.66	0.06	3.6
33	0							
34	4	1.66	1.68	1.59	1.60	1.61	0.06	3.2
35	4	1.64	1.71	1.69	1.64	1.66	0.08	4.6
36	0							
37	4	1.57	1.63	2.32	1.46	1.72	0.40	23.6
38	4	1.46	1.68	1.51	1.51	1.51	0.06	3.6
39	0							
40	4	1.63	1.63	1.64	1.67	1.64	0.02	1.2
41	0							
42*	4	1.86	1.97	1.97	2.67	2.12	0.37	17.7
43	0							
44	0							
45	0							
46	0							
47	0							
48	0							

CADMIUM
Sediment U
1.44 ± 0.31 mg/kg

Lab		Mean				SD	RSD	
1	4	1.29	1.28	1.22	1.34	1.28	0.05	3.8
2	0							
3	0							
4	4	<2.0	<2.0	<2.0	<2.0			
5	4	1.27	1.29	1.38	1.35	1.32	0.05	3.9
6	0							
7	4	1.37	1.49	1.59	1.45	1.48	0.09	6.2
8*	4	0.96	1.02	0.76	0.90	0.91	0.11	12.2
9*	4	1.76	2.13	1.91	1.91	1.93	0.15	7.9
10	4	1.47	1.69	1.59	1.41	1.54	0.12	8.1
11	0							
12	4	1.4	1.7	1.6	1.6	1.6	0.1	8.0
13	0							
14	0							
15	4	1.32	1.31	1.33	1.23	1.30	0.05	3.5
16	4	1.48	1.40	1.48	1.42	1.45	0.04	2.9
17	4	1.26	1.21	1.26	1.20	1.23	0.03	2.6
18*	4	0.467	0.971	1.05	1.12	0.90	0.30	32.9
19	4	1.40	1.35	1.30	1.35	1.35	0.04	3.0
20*	4	1.07	1.22	1.06	1.09	1.11	0.07	6.7
21	4	1.61	1.60	1.62	1.58	1.60	0.02	1.1
22	4	1.41	1.41	1.51	1.47	1.45	0.05	3.4
23	4	1.5	1.4	1.7	1.4	1.5	0.1	9.4
24	4	1.37	1.46	1.55	1.48	1.47	0.07	5.1
25*	4	0.760	0.674	0.463	0.700	0.649	0.129	19.9
26	4	1.28	1.46	1.13	1.20	1.27	0.14	11.2
27*	4	0.89	1.02	0.86	1.16	0.98	0.14	14.0
28	0							
29	0							
30	4	1.74	1.71	1.71	1.59	1.69	0.07	3.9
31*	4	1.24	1.04	0.87	0.90	1.01	0.17	16.7
32	4	1.27	1.23	1.20	1.26	1.24	0.03	2.6
33	4	1.8	1.7	1.7	1.7	1.7	0.1	2.9
34	4	1.564	1.594	1.557	1.561	1.569	0.017	1.1
35	4	1.47	1.47	1.49	1.45	1.47	0.02	1.1
36	4	1.41	1.47	1.52	1.49	1.47	0.05	3.2
37	4	1.12	1.33	1.3	1.18	1.23	0.10	8.0
38	0							
39*	4	2.16	2.16	2.16	2.16	2.16	0.00	0.0
40	4	1.48	1.44	1.44	1.50	1.47	0.03	2.0
41	0							
42*	4	1.68	1.66	1.67	2.50	1.88	0.42	22.1
43	0							
44	0							
45*	4	0.41	0.41	0.42	0.41	0.41	0.01	1.2
46	4	1.5	1.5	1.5	1.5	1.5	0.0	0.0
47	4	1.46	1.32	1.51	1.42	1.43	0.08	5.6
48	4	1.27	1.37	1.36	1.54	1.39	0.11	8.1

CADMIUM
BCSS-1
0.25 ± 0.04 mg/kg

Lab		Mean				SD	RSD	
1	4	0.23	0.29	0.23	0.24	0.25	0.03	11.6
2	0							
3	0							
4	4	<1.0	<1.0	<1.0	<1.0			
5	4	0.27	0.22	0.22	0.28	0.25	0.03	12.9
6	0							
7*	4	0.26	0.35	0.27	0.31	0.30	0.04	13.8
8*	4	0.16	0.14	0.16	0.16	0.16	0.01	6.5
9	4	0.24	0.29	0.28	0.26	0.27	0.02	8.3
10	4	0.24	0.24	0.23	0.24	0.24	0.00	2.1
11	0							
12	4	0.25	0.23	0.25	0.24	0.24	0.01	3.9
13	0							
14	0							
15	4	0.24	0.21	0.21	0.24	0.23	0.02	7.7
16	4	0.25	0.30	0.30	0.30	0.29	0.02	8.7
17	4	0.22	0.25	0.25	0.22	0.24	0.02	7.4
18*	4	0.196	0.741	1.100	0.710	0.687	0.372	54.2
19	4	0.25	0.25	0.30	0.30	0.28	0.03	10.5
20*	4	0.18	0.18	0.18	0.18	0.18	0.00	0.0
21*	4	0.48	0.49	0.50	0.50	0.49	0.01	1.9
22	4	0.197	0.189	0.280	0.251	0.229	0.044	19.0
23	0							
24	4	0.24	0.27	0.29	0.28	0.27	0.02	8.0
25*	4	0.082	0.077	0.087	0.065	0.078	0.009	12.1
26*	4	0.47	0.42	0.25	0.39	0.38	0.09	24.7
27	4	0.24	0.27	0.22	0.24	0.24	0.02	8.5
28	0							
29	0							
30*	4	0.54	0.54	0.45	0.40	0.48	0.07	14.4
31*	4	0.09	0.12	0.09	0.06	0.09	0.02	27.2
32	4	0.21	0.20	0.21	0.23	0.21	0.01	5.9
33*	4	0.3	0.26	0.29	0.33	0.30	0.03	9.8
34*	4	115	113	114	117	115	2	1.5
35	4	0.23	0.23	0.24	0.22	0.23	0.01	3.5
36	4	0.25	0.26	0.24	0.23	0.25	0.01	5.3
37*	4	0.083	0.078	0.145	0.134	0.110	0.034	31.3
38	0							
39	4	<1.0	<1.0	<1.0	<1.0			
40	4	0.247	0.292	0.207	0.204	0.238	0.041	17.4
41	0							
42	4	0.23	0.25	0.28	0.26	0.26	0.02	8.2
43	0							
44	0							
45*	4	0.08	0.08	0.08	0.08	0.08	0.00	0.0
46	0							
47	0							
48	0							

CADMIUM

Tissue V

13.6 ± 1.6 mg/kg

Lab					Mean	SD	RSD
1	0						
2	4	13.3	13.4	13.1	13.7	13.4	0.2
3	4	13.0	12.4	11.6	11.6	12.2	0.7
4	4	13	13	14	15	14	1
5	4	12.7	12.3	12.7	12.9	12.7	0.3
6*	4	11.9	11.6	11.5	11.5	11.6	0.2
7	4	13.0	14.3	14.3	14.5	14.0	0.7
8	4	13.66	13.67	13.89	14.26	13.87	0.28
9	4	13.60	13.26	15.02	13.42	13.83	0.81
10	0						
11	4	14.4	14.3	13.2	14.1	14.0	0.5
12	4	13	13	13	13	13	0.0
13	4	13.1	13.1	13.2	13.3	13.2	0.1
14	0						
15	0						
16	4	15.1	15.5	14.8	14.7	15.0	0.4
17	4	13.0	13.4	13.2	13.3	13.2	0.2
18*	4	11.0	8.44	10.2	9.41	9.76	1.09
19	4	13.2	13.1	12.9	12.9	13.0	0.1
20	4	14.0	13.5	14.0	13.6	13.8	0.3
21	4	13.3	13.6	13.2	13.3	13.4	0.2
22*	4	16.1	16.2	15.8	16.2	16.1	0.2
23	4	13.7	13.6	13.8	13.8	13.7	0.1
24	4	14.2	14.4	13.9	14.3	14.2	0.2
25	4	12.3	14.8	14.7	15.5	14.3	1.4
26	4	14.8	13.9	14.0	13.4	14.0	0.6
27	4	13.8	13.6	13.8	13.6	13.7	0.1
28	4	10.15	13.51	12.68	13.60	12.49	1.61
29	4	13.46	13.61	13.00	13.03	13.28	0.31
30*	3	11.7	11.7	12.1		11.8	0.2
31*	4	15.5	15.2	15.6	15.9	15.6	0.3
32	4	15.8	14.2	15.0	14.6	14.9	0.7
33	0						
34	4	15.00	15.21	14.84	14.62	14.92	0.25
35	4	13.24	13.25	13.23	13.23	13.24	0.01
36	4	13.3	13.9	13.6	13.8	13.7	0.3
37*	4	12.9	12	6.15	7.37	9.6	3.3
38	4	12.9	12.9	13.3	13.0	13.0	0.2
39	4	15.0	15.0	15.0	15.0	15.0	0.0
40	4	12.6	13.3	12.6	13.7	13.1	0.5
41	0						
42	4	12.7	12.7	14.2	12.9	13.1	0.7
43	0						
44	0						
45	4	14	14	14	14	14	0
46	4	14.6	14.7	14.7	14.5	14.6	0.1
47	4	13.3	13.8	13.3	13.8	13.6	0.3
48	4	12.1	12.0	11.8	12.0	12.0	0.1

CADMIUM

NIST 1566a

4.15 ± 0.42 mg/kg

Lab					Mean	SD	RSD
1	0						
2	4	3.9	3.7	3.7	3.5	3.7	0.2
3	4	4.06	3.87	3.55	3.45	3.73	0.28
4	4	4.30	4.20	4.30	4.20	4.25	0.06
5	4	4.23	4.10	4.16	4.11	4.15	0.06
6*	4	3.7	3.4	3.4	3.5	3.5	0.1
7	4	4.11	4.11	4.31	4.18	4.18	0.09
8	4	4.21	4.07	4.28	4.43	4.25	0.15
9	4	4.08	4.12	4.24	3.89	4.08	0.15
10	0						
11	4	4.42	4.21	3.97	4.32	4.23	0.19
12	4	3.8	4.0	3.9	3.8	3.9	0.1
13	0						
14	0						
15	0						
16	4	4.52	4.73	4.79	4.29	4.58	0.23
17	4	4.11	4.20	4.01	4.01	4.08	0.09
18	4	4.46	3.96	3.92	3.77	4.03	0.30
19	4	4.15	4.25	4.05	4.00	4.11	0.11
20	4	4.05	4.14	4.02	4.09	4.08	0.05
21	4	4.05	4.09	3.99	4.20	4.08	0.09
22*	4	4.50	4.85	4.86	4.83	4.76	0.17
23	4	4.0	4.0	4.2	4.2	4.1	0.1
24	4	4.17	4.25	4.30	4.20	4.23	0.06
25	4	3.90	4.49	4.54	4.64	4.39	0.33
26	4	4.72	4.27	4.14	3.78	4.23	0.39
27	4	4.18	4.21	4.22	3.92	4.13	0.14
28	4	3.73	4.04	3.93	3.95	3.91	0.13
29	4	4.34	4.31	4.07	4.01	4.18	0.17
30*	4	3.40	3.44	3.40	3.37	3.40	0.03
31*	4	5.06	5.04	4.66	4.76	4.88	0.20
32	4	4.45	4.33	4.46	4.42	4.42	0.06
33	0						
34*	4	1.81	1.83	1.80	1.81	1.81	0.01
35	4	3.86	4.10	4.21	3.89	4.02	0.17
36	4	4.25	4.14	4.39	4.32	4.28	0.11
37	4	4.07	3.81	3.19	3.90	3.74	0.38
38	4	3.84	3.98	3.92	3.83	3.89	0.07
39	4	4.21	4.21	4.21	4.21	4.21	0.00
40	4	4.90	4.44	4.45	4.57	4.6	0.2
41	0						
42	4	4.5	3.7	4.6	3.8	4.2	0.5
43	0						
44	0						
45	0						
46	0						
47	0						
48	0						

Lab		TIN Sediment U 28.9 ± 8.7 mg/kg					SD	RSD
		Mean						
1	0							
2	0							
3	0							
4	4	20	20	27	20	22	4	16.1
5	4	29.2	26.5	27.4	26.6	27.4	1.2	4.6
6	0							
7	0							
8	0							
9	4	37.9	37.4	34.4	32.1	35.5	2.7	7.7
10	0							
11	0							
12	4	28	30	33	28	30	2	7.9
13	0							
14	0							
15	4	28.1	27.7	27.0	24.8	26.9	1.5	5.5
16*	4	19.6	12.3	20.3	18.6	17.7	3.7	20.7
17	4	26.5	22.8	25.2	26.0	25.1	1.6	6.5
18*	4	2.93	4.38	4.83	3.87	4.00	0.82	20.4
19	0							
20	0							
21*	4	16	16.0	17.0	17.0	17	1	3.5
22	4	27.8	29.9	26.9	29.0	28.4	1.3	4.6
23	0							
24	0							
25	0							
26	0							
27*	4	18.3	18.7	17.8	16.4	17.8	1.0	5.6
28	0							
29	0							
30	0							
31	0							
32	0							
33*	4	35	39	42.0	43.0	40	4	9.0
34*	4	16.44	16.89	17.13	16.88	16.84	0.29	1.7
35*	4	14.4	14.3	14.3	14.6	14.4	0.1	1.0
36	0							
37	4	<2	<2	<2	<2			
38	0							
39	0							
40	0							
41	0							
42	0							
43	0							
44	0							
45	4	17.6	23.0	20.2	19.5	20.1	2.2	11.1
46	0							
47	4	30.2	29.4	28.6	33.4	30.4	2.1	6.9
48	4	31.2	29.9	27.6	28.6	29.3	1.6	5.3

Lab		TIN BCSS-1 1.85 ± 0.20 mg/kg				Mean	SD	RSD
1	0							
2	0							
3	0							
4	4	<10.0	<10.0	<10.0	<10.0			
5	4	1.77	1.78	1.76	1.76	1.77	0.01	0.5
6	0							
7	0							
8	0							
9*	4	2.1	2.4	2.3	2.1	2.2	0.1	6.7
10	0							
11	0							
12	4	2.0	2.0	1.7	1.9	1.9	0.1	7.4
13	0							
14	0							
15	4	1.79	1.64	1.85	1.49	1.69	0.16	9.5
16	4	<3	<3	<3	<3			
17	4	1.91	1.74	1.76	1.83	1.81	0.08	4.3
18*	4	4.65	8.03	8.37	7.58	7.16	1.70	23.8
19	0							
20	0							
21	4	<5	<5	<5	<5			
22*	4	0.78	1.34	1.81	1.97	1.48	0.53	36.3
23	0							
24	0							
25	0							
26	0							
27	4	<3	<3	<3	<3			
28	0							
29	0							
30	0							
31	0							
32*	4	1.56	1.47	1.44	1.44	1.48	0.06	3.8
33	4	<5	<5	<5	<5			
34	4	1.77	1.73	1.78	1.76	1.76	0.02	1.2
35	4	1.80	1.62	1.66	1.76	1.71	0.08	4.9
36	0							
37*	4	1.79	2.78	2.54	1.72	2.21	0.53	24.1
38	0							
39	0							
40	0							
41	0							
42	0							
43	0							
44	0							
45	4	1.2	2.2	1.7	3.1	2.1	0.8	39.5
46	0							
47	0							
48	0							

TIN
Tissue V
 0.041 ± 0.020 mg/kg

Lab					Mean	SD	RSD
1	0						
2	0						
3	0						
4	4	<5.0	<5.0	<5.0	<5.1		
5	4	0.026	0.026	0.030	0.030	0.028	0.003
6	0						
7	0						
8	0						
9	4	<0.1	<0.1	<0.1	<0.1		
10	0						
11	4	<4	<4	<4	<4		
12	4	0.048	0.040	0.049	0.042	0.046	0.004
13	0						
14	0						
15	0						
16	4	<0.5	<0.5	<0.5	<0.5		
17	4	0.044	0.035	0.031	0.036	0.037	0.005
18*	4	1.09	0.906	0.694	0.709	0.850	0.187
19	0						
20	0						
21	0						
22	4	<1	<1	<1	<1		
23	0						
24	0						
25	0						
26	0						
27	4	<3	<3	<3	<3		
28	0						
29	0						
30	0						
31	0						
32*	4	0.10	0.11	0.16	0.07	0.11	0.04
33	0						
34*	4	1.21	1.24	1.20	1.19	1.21	0.02
35	4	<0.2	<0.2	<0.2	<0.2		
36	0						
37	4	<2	<2	<2	<2		
38	0						
39	0						
40	0						
41	0						
42	0						
43	0						
44	0						
45*	4	10.9	14.1	16.0	13.6	13.7	2.1
46	4	<1	<1	<1	<1		
47	0						
48	4	0.032	0.037	0.042	0.039	0.038	0.004

TIN
NIST 1566a
 2.10 ± 0.76 mg/kg

Lab					Mean	SD	RSD
1	0						
2	0						
3	0						
4	4	<5.3	<5.2	<5.3	<5.3		
5	4	2.77	2.56	2.35	2.43	2.53	0.18
6	0						
7	0						
8	0						
9	4	1.9	2.1	1.7	2.0	1.9	0.2
10	0						
11	4	<4	<4	<4	<4		
12	4	2.4	2.6	3.1	2.8	2.7	0.3
13	0						
14	0						
15	0						
16	4	0.68	1.00	2.28	3.03	1.75	1.10
17	4	1.89	2.22	2.24	2.40	2.19	0.21
18	4	2.54	1.89	1.80	1.54	1.94	0.43
19	0						
20	0						
21	0						
22	4	<1	<1	2.18	1.68		
23	0						
24	0						
25	0						
26	0						
27	4	<3	<3	<3	<3		
28	0						
29	0						
30	0						
31	0						
32	4	1.83	1.58	1.26	1.33	1.50	0.26
33	0						
34	4	2.06	2.00	2.08	2.11	2.06	0.05
35	4	2.11	2.22	2.04	2.15	2.13	0.08
36	0						
37	4	1.79	2.78	2.54	1.72	2.21	0.53
38	0						
39	0						
40	0						
41	0						
42	0						
43	0						
44	0						
45	0						
46	0						
47	0						
48	4	2.31	2.07	2.09	2.32	2.20	0.14

ANTIMONY
Sediment U
0.79 ± 0.24 mg/kg
Mean

SD RSD

Lab							
1	0						
2	0						
3	0						
4	0						
5*	4	1.44	1.39	1.54	1.41	1.45	0.07 4.6
6	0						
7	0						
8	0						
9	0						
10	0						
11	0						
12	4	1.0	0.86	0.83	1.00	0.92	0.09 9.8
13	0						
14	0						
15	0						
16*	4	0.40	0.35	0.41	0.35	0.38	0.03 8.5
17	4	0.77	0.75	0.77	0.80	0.77	0.02 2.7
18*	4	0.198	0.122	0.0923	0.318	0.183	0.101 55.1
19	3	0.71	0.64	0.67		0.67	0.04 5.2
20	4	0.83	0.86	0.86	0.79	0.84	0.03 4.0
21	0						
22	4	<0.2	<0.2	<0.2	<0.2		
23	4	0.8	0.8	0.8	0.8	0.8	0.0 0.0
24	0						
25	0						
26	0						
27*	4	1.07	1.04	1.11	1.02	1.06	0.04 3.7
28	0						
29	0						
30	0						
31	0						
32	4	0.93	0.97	0.87	0.93	0.93	0.04 4.5
33	4	0.80	0.70	0.88	0.78	0.79	0.07 9.4
34*	4	1.27	1.26	1.20	1.25	1.25	0.03 2.5
35	4	0.86	0.85	0.64	0.73	0.77	0.10 13.6
36	0						
37	4	<0.1	<0.1	<0.1	<0.1		
38	0						
39	0						
40	0						
41	4	0.602	0.562	0.560	0.617	0.585	0.029 4.9
42	0						
43	4	1.0	0.93	0.97	0.93	0.96	0.03 3.6
44	0						
45*	4	0.4	0.6	0.5	0.6	0.5	0.1 18.2
46	4	<2	<2	<2	<2		
47	4	0.81	0.74	0.65	0.67	0.72	0.07 10.1
48	4	0.688	0.845	0.678	0.867	0.770	0.100 13.0

ANTIMONY
BCSS-1
0.59 ± 0.06 mg/kg
Mean

SD RSD

Lab							
1	0						
2	0						
3	0						
4	0						
5	4	0.57	0.64	0.66	0.56	0.61	0.05 8.2
6	0						
7	0						
8	0						
9	0						
10	0						
11	0						
12	4	0.60	0.67	0.59	0.68	0.64	0.05 7.3
13	0						
14	0						
15	0						
16*	4	0.13	0.14	0.16	0.16	0.15	0.01 10.2
17	4	0.57	0.57	0.68	0.57	0.57	0.01 0.9
18*	3	0.0953	0.141	1.26		0.50	0.66 132.3
19*	3	0.52	0.51	0.44		0.49	0.04 8.9
20	4	0.59	0.57	0.56	0.56	0.57	0.01 2.5
21	0						
22	4	<0.2	<0.2	<0.2	<0.2		
23	0						
24	0						
25	0						
26	0						
27	4	0.55	0.54	0.57	0.56	0.56	0.01 2.3
28	0						
29	0						
30	0						
31	0						
32	4	0.61	0.54	0.57	0.57	0.57	0.03 5.0
33*	4	0.57	0.45	0.57	0.45	0.51	0.07 13.6
34	4	0.64	0.61	0.65	0.61	0.63	0.02 3.3
35	4	0.66	0.72	0.51	0.55	0.61	0.10 15.9
36	0						
37	4	<0.1	<0.1	<0.1	<0.1		
38	0						
39	0						
40	0						
41*	4	0.923	0.825	0.834	0.891	0.868	0.047 5.4
42	0						
43*	4	0.70	0.68	0.71	0.71	0.70	0.01 2.0
44	0						
45*	4	0.4	0.3	0.4	0.3	0.4	0.1 16.5
46	0						
47	0					ERR	ERR ERR
48	0					ERR	ERR ERR

The determination of antimony was not required in the biologicals

MERCURY
Sediment U
0.55 ± 0.13 mg/kg

Lab		Mean					SD	RSD
1	0							
2	0							
3	4	0.812	0.648	0.602	0.671	0.658	0.114	17.3
4*	4	0.300	0.380	0.344	0.400	0.358	0.044	12.3
5*	4	0.349	0.323	0.358	0.360	0.348	0.017	4.9
6	4	0.63	0.62	0.61	0.65	0.63	0.02	2.7
7	0							
8	2	0.63	1.136			0.88	0.36	40.5
9	4	0.662	0.612	0.582	0.587	0.611	0.037	6.0
10	0							
11	0							
12	4	0.59	0.65	0.54	0.68	0.62	0.06	10.2
13	0							
14	0							
15*	4	0.719	0.812	0.781	0.671	0.746	0.063	8.5
16	4	0.60	0.63	0.70	0.69	0.66	0.05	7.3
17	4	0.43	0.43	0.41	0.43	0.43	0.01	2.4
18	4	0.568	0.580	0.516	0.531	0.549	0.030	5.5
19	4	0.63	0.64	0.57	0.56	0.60	0.04	6.8
20*	4	0.29	0.28	0.25	0.27	0.27	0.02	6.3
21	0							
22*	4	0.691	0.680	0.762	0.779	0.728	0.050	6.8
23	4	0.54	0.54	0.50	0.50	0.52	0.02	4.4
24	0							
25	0							
26	4	0.556	0.492	0.438	0.519	0.501	0.050	9.9
27	4	0.475	0.463	0.489	0.472	0.475	0.011	2.3
28	0							
29	0							
30	4	0.560	0.550	0.736	0.585	0.608	0.087	14.3
31*	4	1.33	1.04	1.05	1.18	1.15	0.14	11.8
32	4	0.48	0.53	0.49	0.52	0.51	0.02	4.7
33	4	0.55	0.52	0.49	0.48	0.51	0.03	6.2
34*	4	0.107	0.103	0.105	0.101	0.104	0.003	2.5
35	4	0.561	0.543	0.502	0.540	0.537	0.025	4.6
36	4	0.54	0.55	0.53	0.57	0.55	0.02	3.1
37	4	0.52	0.62	0.51	0.54	0.55	0.05	9.1
38	0							
39	0							
40	0							
41	0							
42	4	0.55	0.64	0.62	0.50	0.58	0.06	11.2
43	0							
44	0							
45	4	0.43	0.41	0.36	0.47	0.42	0.05	11.0
46	4	0.5	0.5	0.5	0.5	0.5	0.0	0.0
47	0					ERR	ERR	ERR
48	0					ERR	ERR	ERR

MERCURY
BCSS-1
0.180 ± 0.071 mg/kg

Lab		Mean					SD	RSD
1	0							
2	0							
3	4	0.177	0.207	0.225	0.254	0.216	0.032	15.0
4	4	0.162	0.220	0.206	0.162	0.188	0.030	16.0
5	4	0.132	0.121	0.126	0.121	0.125	0.005	4.2
6	4	0.24	0.22	0.21	0.23	0.23	0.01	5.7
7	0							
8	2	0.188	0.233			0.211	0.032	15.1
9	4	0.187	0.188	0.193	0.189	0.189	0.003	1.4
10	0							
11	0							
12	4	0.17	0.16	0.16	0.19	0.17	0.01	8.3
13	0							
14	0							
15*	4	0.255	0.271	0.272	0.258	0.264	0.009	3.3
16	4	0.21	0.23	0.21	0.18	0.21	0.02	8.9
17	4	0.18	0.18	0.17	0.17	0.18	0.01	3.3
18	4	0.130	0.140	0.116	0.110	0.124	0.014	10.9
19	4	0.19	0.18	0.18	0.19	0.19	0.01	3.1
20*	4	0.070	0.070	0.080	0.070	0.073	0.005	6.9
21	0							
22	4	0.235	0.225	0.262	0.271	0.248	0.022	8.8
23	0							
24	0							
25	0							
26	4	0.149	0.146	0.128	0.141	0.141	0.009	6.6
27	4	0.164	0.168	0.162	0.163	0.164	0.003	1.6
28	0							
29	0							
30	4	0.205	0.200	0.195	0.197	0.199	0.004	2.2
31*	4	0.35	0.40	0.39	0.44	0.40	0.04	9.4
32	4	0.16	0.16	0.21	0.19	0.18	0.02	13.6
33	4	0.23	0.22	0.23	0.24	0.23	0.01	3.5
34	4	0.121	0.125	0.123	0.125	0.124	0.002	1.6
35	4	0.160	0.163	0.165	0.160	0.162	0.002	1.5
36	4	0.18	0.15	0.16	0.18	0.17	0.01	9.0
37	4	0.19	0.20	0.22	0.20	0.20	0.01	6.2
38	0							
39	0							
40	0							
41	0							
42	4	0.21	0.18	0.17	0.18	0.19	0.02	9.4
43	0							
44	0							
45	4	0.22	0.17	0.17	0.13	0.17	0.04	21.4
46	0							
47	0							
48	0							

MERCURY
Tissue V
0.0654 ± 0.0192 mg/kg

Lab					Mean	SD	RSD
1	0						
2	4	0.059	0.057	0.075	0.066	0.064	0.008
3	4	0.0572	0.054	0.0414	0.0622	0.0637	0.0089
4	4	0.065	0.072	0.0969	0.0858	0.0799	0.0142
5	4	0.050	0.050	0.050	0.064	0.054	0.007
6	4	0.060	0.063	0.052	0.058	0.058	0.005
7	0						
8	2	0.089	0.065			0.077	0.017
9	4	0.071	0.074	0.068	0.067	0.070	0.003
10	0						
11	4	0.056	0.054	0.053	0.051	0.054	0.002
12	4	0.067	0.067	0.063	0.061	0.065	0.003
13	0						
14	0						
15	0						
16	4	0.069	0.078	0.063	0.075	0.071	0.007
17	4	0.062	0.063	0.063	0.060	0.062	0.001
18*	4	0.210	0.222	0.230	0.209	0.218	0.010
19	4	0.065	0.070	0.078	0.072	0.071	0.005
20	4	0.055	0.049	0.047	0.047	0.050	0.004
21	4	0.072	0.074	0.072	0.078	0.074	0.003
22	4	0.087	0.041	0.055	0.097	0.070	0.026
23	4	0.04	0.04	0.04	0.08	0.05	0.02
24	0						
25	0						
26	4	0.0444	0.0546	0.0471	0.0497	0.0490	0.0043
27	4	0.064	0.062	0.064	0.062	0.063	0.001
28	0						
29	4	0.068	0.068	0.070	0.067	0.068	0.001
30*	4	0.036	0.032	0.029	0.034	0.033	0.003
31*	4	0.10	0.09	0.09	0.13	0.10	0.02
32	4	0.063	0.071	0.072	0.071	0.069	0.004
33	0						
34	4	0.0711	0.0724	0.0707	0.0714	0.0714	0.0007
35	4	0.069	0.070	0.070	0.069	0.070	0.001
36	0						
37	3	0.08	0.07	0.07		0.07	0.01
38	4	0.062	0.070	0.067	0.067	0.067	0.003
39	0						
40	0						
41	0						
42	4	0.069	0.049	0.060	0.078	0.064	0.012
43	0						
44	4	<108	<110	<50	<30		
45	4	0.08	0.09	0.08	0.09	0.09	0.01
46	4	<0.1	<0.1	<0.1	<0.1		
47	4	0.062	0.068	0.061	0.052	0.061	0.007
48	0						

MERCURY
NIST 1566a
0.0654 ± 0.0067 mg/kg

Lab					Mean	SD	RSD
1	0						
2	4	0.073	0.060	0.060	0.080	0.068	0.010
3	4	0.0628	0.0577	0.0663	0.0993	0.0715	0.0189
4	4	0.0618	0.088	0.0567	0.053	0.0649	0.0158
5	4	0.062	0.064	0.058	0.062	0.062	0.003
6	4	0.069	0.061	0.067	0.067	0.066	0.003
7	0						
8	2	0.094	0.096			0.095	0.001
9*	4	0.073	0.076	0.077	0.076	0.076	0.002
10	0						
11	4	0.067	0.065	0.063	0.059	0.064	0.003
12	4	0.067	0.058	0.077	0.059	0.065	0.009
13	0						
14	0						
15	0						
16	4	0.069	0.077	0.064	0.075	0.071	0.006
17	4	0.062	0.064	0.063	0.061	0.063	0.001
18	1	0.0714					
19	4	0.065	0.070	0.074	0.070	0.070	0.004
20*	4	0.053	0.049	0.045	0.043	0.048	0.004
21	4	0.059	0.065	0.060	0.060	0.061	0.003
22*	4	0.090	0.089	0.144	0.139	0.116	0.030
23	4	0.07	0.07	0.06	0.07	0.07	0.01
24	0						
25	0						
26*	4	0.0536	0.0538	0.0510	0.0616	0.0550	0.0046
27	4	0.063	0.063	0.063	0.062	0.063	0.001
28	0						
29	4	0.064	0.067	0.062	0.072	0.066	0.004
30*	4	0.035	0.033	0.033	0.033	0.034	0.001
31*	4	0.11	0.11	0.12	0.12	0.12	0.01
32	4	0.061	0.066	0.064	0.064	0.064	0.002
33	0						
34	4	0.0595	0.057	0.0584	0.0579	0.0582	0.0010
35	4	0.065	0.066	0.065	0.063	0.065	0.001
36	0						
37	3	0.06	0.06	0.06		0.06	0.00
38	4	0.060	0.072	0.068	0.064	0.066	0.005
39	0						
40	0						
41	0						
42*	4	0.055	0.053	0.051	0.059	0.055	0.003
43	0						
44	0						
45	0						
46	0						
47	0						
48	0						

THALLIUM
Sediment U
 0.76 ± 0.24 mg/kg

Lab		Mean	SD	RSD
1	0			
2	0			
3	0			
4	0			
5	4	0.81	0.90	0.85
6	0	0.72	0.82	0.08
7	0			9.3
8	0			
9	4	0.72	0.54	0.64
10	0	0.62	0.63	0.07
11	0			11.7
12	4	0.80	0.81	0.71
13	0	0.72	0.76	0.05
14	0			6.9
15	0			
16*	4	0.20	0.20	0.20
17	4	0.72	0.75	0.75
18*	4	0.104	0.258	0.111
19	0	0.254	0.182	0.086
20	0			47.2
21	4	<1	<1	<1
22	0			
23	0			
24	0			
25	4	<0.5	<0.5	<0.5
26	0			
27	4	<5	<5	<5
28	0			
29	0			
30	0			
31	0			
32	0			
33	0			
34	4	0.64	0.69	0.67
35	0	0.65	0.66	0.02
36	0			3.3
37	0			
38	0			
39	0			
40	0			
41	0			
42	0			
43	0			
44	0			
45	4	0.9	0.8	1.0
46	4	<1	<1	<1
47	0			
48	4	0.783	0.788	0.811
		0.805	0.797	0.013
				1.679

THALLIUM
BCSS-1
 0.50 ± 0.20 mg/kg

Lab		Mean	SD	RSD
1	0			
2	0			
3	0			
4	0			
5	4	0.62	0.56	0.65
6	0	0.62	0.61	0.04
7	0			6.2
8	0			
9	4	0.43	0.51	0.44
10	0	0.43	0.45	0.04
11	0			8.5
12	4	0.47	0.46	0.46
13	0			0.01
14	0			1.8
15	0			
16*	4	0.20	0.20	0.10
17	4	0.60	0.58	0.59
18	4	0.247	0.643	0.387
19	0	0.331	0.402	0.171
20	0			42.5
21	4	<1	<1	<1
22	0			
23	0			
24	0			
25	4	<0.5	<0.5	<0.5
26	0			
27	4	<5	<5	<5
28	0			
29	0			
30	0			
31	0			
32	0			
33	0			
34	4	0.48	0.50	0.49
35	0	0.51	0.50	0.01
36	0			2.6
37	0			
38	0			
39	0			
40	0			
41	0			
42	0			
43	0			
44	0			
45*	4	1.0	1.2	1.1
46	0	0.9	1.1	0.1
47	0			12.3
48	4	0.525	0.530	0.534
		0.541	0.533	0.007
				1.3

The determination of thallium was not required in the biologicals

LEAD
Sediment U
113 ± 20 mg/kg

Lab					Mean	SD	RSD
1*	4	82	79	81	76	80	3 3.3
2	0						
3	4	101	99.8	103	105	102.2	2.3 2.2
4	4	130	130	130	130	130	0 0.0
5*	4	135	141	150	126	138	10 7.3
6	4	119	115	114	120	117	3 2.5
7*	4	134	163	157	152	152	13 8.3
8*	4	70.8	60.5	87.9	64.4	70.9	12.1 17.1
9	4	109	105	94.9	114	106	8 7.7
10	4	113	103	114	118	112	6 5.7
11	0						
12	4	120	120	120	120	120	0.0
13	0						
14	0						
15	4	99	96.3	121	103	105	11 10.6
16	4	119	110	117	111	114	4 3.9
17	4	126	129	130	126	128	2 1.6
18	4	73.7	103.3	117.2	106.2	100.1	18.6 18.6
19	4	118	119	114	106	114	6 5.2
20	4	117	117	116	121	118	2 1.9
21	4	112	117	113	117	115	3 2.3
22	4	117	100	103	108	107	7 7.0
23	4	127	125	121	126	125	3 2.1
24	4	122	118	118	121	120	2 1.7
25	4	114	119.7	123.1	128.3	121.3	6.0 4.9
26	4	97.1	129.0	98.2	107.0	107.8	14.8 13.7
27	4	112	125	126	111	119	8 6.8
28	0						
29	0						
30	4	108	100	108	106	106	4 3.6
31*	4	200	206	198	186	198	8 4.2
32*	4	109.0	91.1	78.4	83.9	90.6	13.3 14.7
33	4	110	110	110	110	110	0.0 0.0
34	4	104.2	106.9	105.4	104.8	105.3	1.2 1.1
35	4	110	111	110	110	110	1 0.5
36	4	130	128	131	132	130	2 1.3
37	4	115.5	112.5	119.6	115.6	115.8	2.9 2.5
38	0						
39	4	117	116	116	116	116	1 0.4
40	4	122	122	130	115	122	6 5.0
41	4	105	98.7	100	103	102	3 2.8
42	4	105	128	142	142	129	17 13.5
43	0						
44	0						
45	4	92	98	92	96	95	3 3.2
46	4	105	109	110	111	109	3 2.4
47	4	109	103	116	111	110	5 4.9
48	4	110	103	105	106	106	3 2.8

LEAD
BCSS-1
22.7 ± 3.4 mg/kg

Lab					Mean	SD	RSD
1*	4	14	14	13	12	13	1 7.2
2	0						
3	4	21.8	17.8	19.1	19.2	19.5	1.7 8.6
4	4	24	23	23	23	23	1 2.2
5	4	21.3	21.6	24.6	23.0	22.6	1.5 6.7
6	4	20.9	19.2	21.9	25.1	21.8	2.5 11.4
7	4	19.4	24.5	22.3	22.2	22.1	2.1 9.5
8*	4	5.6	4.2	9.5	1.98	5.3	3.2 59.4
9	4	21.1	22.0	19.1	20.6	20.7	1.2 5.9
10	4	22.8	23.1	22.3	23.2	22.9	0.4 1.8
11	0						
12	4	24	23	22	26	24	2 7.2
13	0						
14	0						
15*	4	17.6	17.0	15.5	16.0	16.5	1.0 5.7
16	4	20.5	18.8	18.3	19.0	19.2	0.9 4.9
17	4	22.1	22.4	21.4	23.0	22.2	0.7 3.0
18	4	20.0	22.6	18.0	21.7	20.6	2.0 9.9
19	4	20	20	19	19	20	1 3.0
20	4	24.4	25.6	17.4	17.3	21.2	4.4 21.0
21	4	21	22	19	23	21	2 8.0
22	4	21.6	21.3	21.2	21.4	21.4	0.2 0.8
23	0						
24	4	24.7	24.3	23.4	24.4	24.2	0.6 2.3
25	4	22.0	19.1	19.5	21.2	20.5	1.4 6.7
26*	4	44.4	37.8	39.0	35.5	39.2	3.8 9.6
27	4	22.2	21.8	23.1	22.4	22.4	0.5 2.4
28	0						
29	0						
30*	4	19.6	20.9	17.3	17.9	18.9	1.6 8.7
31*	4	49.9	46.8	43.4	48.3	47.1	2.8 5.9
32	4	20.3	19.9	19.0	19.5	19.7	0.6 2.8
33	4	22	20	22	21	21	1 4.5
34	4	20.2	21.6	21.3	20.9	21.0	0.6 2.9
35	4	22.8	23.9	21.1	20.6	22.1	1.5 6.9
36	4	25	26	24	25	25	1 3.3
37*	4	15.5	11	22.6	26.7	19.0	7.0 37.1
38	0						
39	4	23.5	23.5	24.3	24.1	23.9	0.4 1.7
40*	4	18.9	18.7	18.5	18.6	18.7	0.2 0.9
41	4	23.6	22.6	24.1	25.0	23.8	1.0 4.2
42	4	22.0	23.2	21.9	17.8	21.2	2.4 11.1
43	0						
44	0						
45*	4	20	19	16	17	18	2 10.1
46	0						
47	0						
48	0						

LEAD
Tissue V
0.287 ± 0.042 mg/kg

Lab						Mean	SD	RSD
1	0							
2	4	0.266	0.213	0.266	0.444	0.297	0.101	34.0
3	0							
4	4	<2.3	<2.3	<2.3	<2.3			
5	4	0.285	0.275	0.293	0.316	0.292	0.017	6.0
6	4	0.24	0.33	0.30	0.29	0.29	0.04	12.9
7	4	0.34	0.30	0.33	0.26	0.31	0.04	11.7
8	0							
9	4	0.26	0.29	0.40	0.31	0.32	0.06	19.1
10	0							
11*	4	0.374	0.352	0.368	0.314	0.352	0.027	7.7
12	4	0.30	0.30	0.32	0.31	0.31	0.01	3.1
13*	4	0.90	0.91	0.72	0.73	0.82	0.10	12.8
14	0							
15	0							
16*	4	0.22	0.25	0.23	0.20	0.23	0.02	9.3
17	4	0.29	0.30	0.29	0.31	0.30	0.01	3.2
18*	4	0.639	0.643	0.529	0.594	0.601	0.053	8.8
19	4	0.25	0.25	0.30	0.30	0.28	0.03	10.5
20	4	0.28	0.28	0.34	0.26	0.29	0.03	11.9
21	4	0.320	0.302	0.316	0.292	0.308	0.013	4.2
22*	4	0.500	0.557	0.253	0.276	0.397	0.154	39.0
23	4	<1	<1	<1	<1			
24	4	0.31	0.29	0.28	0.29	0.29	0.01	4.3
25*	4	0.17	0.18	0.18	0.16	0.17	0.01	5.6
26	0							
27	4	<3	<3	<3	<3			
28	4	<0.49	<0.50	<0.50	<0.50			
29	4	0.260	0.270	0.263	0.270	0.266	0.005	1.9
30	0							
31*	4	0.42	0.39	0.39	0.34	0.39	0.03	8.6
32	4	0.25	0.29	0.29	0.25	0.27	0.02	8.6
33	0							
34*	4	0.513	0.508	0.510	0.515	0.512	0.003	0.6
35	4	0.25	0.27	0.25	0.23	0.25	0.02	6.5
36	0							
37	4	0.27	0.2	0.31	0.54	0.33	0.15	44.6
38*	4	0.333	0.348	0.431	0.512	0.406	0.083	20.4
39	0							
40*	4	0.492	0.465	0.492	0.469	0.480	0.015	3.0
41	0							
42*	4	0.5	0.5	0.5	0.5	0.5	0.0	0.0
43	0							
44	0							
45*	4	0.2	0.2	0.2	0.2	0.2	0.0	0.0
46	4	<1.	<1.	<1.	<1.			
47	4	0.29	0.24	0.22	0.30	0.26	0.04	14.7
48	4	0.266	0.264	0.276	0.266	0.268	0.005	2.0

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

Lab						Mean	SD	RSD
1	0							
2	4	0.35	0.35	0.35	0.50	0.39	0.08	19.4
3	0							
4	4	<2.4	<2.4	<2.4	<2.4			
5	4	0.339	0.406	0.399	0.394	0.385	0.031	8.0
6*	4	0.40	0.41	0.40	0.46	0.42	0.03	6.9
7	4	0.41	0.34	0.42	0.32	0.37	0.05	13.4
8	4	0.5	0.4	0.3	0.4	0.4	0.1	20.4
9	4	0.35	0.36	0.37	0.38	0.37	0.01	3.5
10	0							
11	4	0.360	0.360	0.376	0.359	0.364	0.008	2.2
12	4	0.36	0.38	0.38	0.40	0.38	0.02	4.3
13	0							
14	0							
15	0							
16	4	0.33	0.34	0.32	0.31	0.33	0.01	4.0
17	4	0.36	0.37	0.36	0.37	0.37	0.01	1.6
18*	4	0.547	0.356	0.425	0.471	0.450	0.080	17.8
19	4	0.35	0.35	0.30	0.35	0.34	0.02	7.4
20	4	0.40	0.34	0.36	0.32	0.36	0.03	9.6
21	4	0.372	0.371	0.354	0.340	0.359	0.015	4.2
22	4	0.43	0.201	<0.2	<0.2			
23	4	<1	<1	<1	<1			
24	4	0.36	0.35	0.35	0.33	0.35	0.01	3.6
25	4	0.33	0.40	0.36	0.40	0.37	0.03	9.1
26	0							
27	4	<3	<3	<3	<3			
28	4	0.41	0.33	0.40	0.33	0.37	0.04	11.8
29	4	0.350	0.372	0.340	0.348	0.353	0.014	3.9
30	0							
31*	4	0.54	0.46	0.42	0.50	0.48	0.05	10.8
32	4	0.37	0.32	0.37	0.37	0.36	0.02	7.0
33	0							
34	4	0.372	0.378	0.381	0.377	0.377	0.004	1.0
35	4	0.38	0.34	0.36	0.35	0.36	0.02	4.8
36	0							
37	4	0.42	0.4	0.28	0.33	0.36	0.06	18.0
38	4	0.393	0.407	0.347	0.355	0.376	0.029	7.7
39	0							
40*	4	0.345	0.437	0.405	0.477	0.416	0.056	13.4
41	0							
42	4	<0.5	<0.5	<0.5	<0.5			
43	0							
44	0							
45	0							
46	0							
47	0							
48	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 U	--	--	--	G-	EG	EG	--	GG	EG	--
	BCSS-1	--	--	--	EG	EG	HG	--	HG	EG	--
Al	Sed U	EG	--	LX	LG	EG	--	--	EG	GG	--
	BCSS-1	GG	--	LG	LG	EG	--	--	EG	GG	--
Si	Sed U	--	--	--	--	EG	--	--	--	--	--
	BCSS-1	--	--	--	--	EG	--	--	--	--	--
Cr	Sed U	LG	--	EG	EG	HG	EG	HG	EG	EG	--
	BCSS-1	LG	--	LX	GG	EG	LG	EG	LG	LG	--
Mn	Sed U	EG	--	GG	EG	EG	EG	EG	EG	EG	EG
	BCSS-1	EG	--	LG	EG	EG	GX	EG	EG	GG	EG
Fe	Sed U	GG	--	LG	GG	EG	LG	GG	EG	GX	GG
	BCSS-1	GG	--	LG	EG	EG	GG	EG	EG	EG	EG
Ni	Sed U	LG	--	EG	EG	EG	EG	GX	EG	EG	EG
	BCSS-1	LG	--	LG	LG	EG	GG	HX	EG	GG	EG
Cu	Sed U	GG	--	GG	LG	GG	GG	GG	EG	GG	EG
	BCSS-1	EG	--	EG	EG	EG	HG	EG	LG	EG	EG
Zn	Sed U	LG	--	LG	EG	EG	GG	EG	EG	EG	EG
	BCSS-1	LG	--	LG	EG	EG	GG	EG	EG	EG	EG
As	Sed U	--	--	LX	EG	EG	EG	EG	--	EG	--
	BCSS-1	--	--	LX	GG	GG	EX	EG	--	EG	--
Se	Sed U	--	--	EG	L-	GX	--	EG	--	--	--
	BCSS-1	--	--	EG	GX	G-	--	EG	--	--	--
Ag	Sed U	--	--	HX	--	HX	--	GX	HX	HG	EG
	BCSS-1	--	--	HX	--	HX	--	GX	HX	HG	EX
Cd	Sed U	EG	--	--	G-	EG	--	EG	LX	HG	EG
	BCSS-1	EX	--	--	G-	EX	--	HX	LG	EG	EG
Sn	Sed U	--	--	--	GX	EG	--	--	--	GG	--
	BCSS-1	--	--	--	G-	EG	--	--	--	HG	--
Sb	Sed U	--	--	--	--	HG	--	--	--	--	--
	BCSS-1	--	--	--	--	GG	--	--	--	--	--
Hg	Sed U	--	--	GX	LX	LG	EG	--	--	EG	--
	BCSS-1	--	--	GX	EX	EG	EG	--	--	EG	--
Tl	Sed U	--	--	--	--	EG	--	--	--	EX	--
	BCSS-1	--	--	--	--	EG	--	--	--	EG	--
Pb	Sed U	LG	--	EG	EG	HG	EG	HG	LX	EG	EG
	BCSS-1	LG	--	GG	EG	EG	GX	EG	LX	GG	EG

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 U	--	EX	--	--	EG	LX	EG	LX	EG	EG
	BCSS-1	--	EX	--	--	EG	LG	EG	GG	EG	LG
Al	Sed U	--	GG	--	--	GG	EG	--	LG	EG	EG
	BCSS-1	--	EG	--	--	GG	GG	--	GG	EG	EG
Si	Sed U	--	GG	--	--	--	EG	--	--	--	--
	BCSS-1	--	EG	--	--	--	EG	--	--	EG	--
Cr	Sed U	--	EG	--	--	EG	GE	EG	LX	GG	EG
	BCSS-1	--	EG	--	--	LG	LX	EG	LX	EG	LX
Mn	Sed U	--	EG	--	--	EG	EG	EG	LX	EG	EG
	BCSS-1	--	EG	--	--	EG	EG	EG	LX	EG	EG
Fe	Sed U	--	GG	--	--	LX	GG	EG	LX	EG	GG
	BCSS-1	--	EG	--	--	EG	HG	EG	LX	EG	EG
Ni	Sed U	--	EG	--	--	GX	EG	GG	GX	EG	GX
	BCSS-1	--	EG	--	--	GG	EG	EG	GG	GG	GG
Cu	Sed U	--	GG	EG	--	EG	EG	GG	HX	EG	GG
	BCSS-1	--	EG	EG	--	GG	EG	EG	EX	EG	GG
Zn	Sed U	--	EG	EG	--	EG	EG	EG	GG	EG	EG
	BCSS-1	--	EG	EG	--	EG	EG	EG	GG	EG	EG
As	Sed U	--	EG	--	EG	EG	EG	EG	GG	EG	EG
	BCSS-1	--	GG	--	EG	EG	EG	EG	EX	EG	EG
Se	Sed U	--	EG	--	EG	--	EX	EG	HX	EG	EG
	BCSS-1	--	GX	--	EG	--	LX	EG	HX	EG	HG
Ag	Sed U	--	EG	--	--	GX	GX	EG	HG	H-	EG
	BCSS-1	--	EG	--	--	GX	EG	EG	HX	H-	GG
Cd	Sed U	--	EG	--	--	EG	EG	EG	LX	EG	LG
	BCSS-1	--	EG	--	--	EG	GG	EG	HX	GG	LG
Sn	Sed U	--	EG	--	--	EG	LX	EG	LX	--	--
	BCSS-1	--	EG	--	--	GG	G-	EG	HX	--	--
Sb	Sed U	--	EG	--	--	--	LG	EG	LX	GG	EG
	BCSS-1	--	GG	--	--	--	LG	EG	LX	LG	EG
Hg	Sed U	--	EX	--	--	HG	GG	GG	EG	EG	LG
	BCSS-1	--	EG	--	--	HG	EG	EG	EG	EG	LG
Tl	Sed U	--	EG	--	--	--	LG	EG	LX	--	--
	BCSS-1	--	EG	--	--	--	LG	EG	EX	--	--
Pb	Sed U	--	EG	--	--	EG	EG	EG	GX	EG	EG
	BCSS-1	--	EG	--	--	LG	GG	EG	GG	GG	GX

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 U	EG	--	EG	--	EG	--	--	--	--	LG
	BCSS-1	EG	--	--	--	LX	--	--	--	--	LG
Al	Sed U	EG	LX	EG	EG	HG	--	EG	--	--	LG
	BCSS-1	EG	LG	--	EG	HG	--	EG	--	--	LX
Si	Sed U	EG	--	--	--	--	--	EG	--	--	--
	BCSS-1	EG	--	--	--	--	--	EG	--	--	--
Cr	Sed U	EG	GX	EG	--	EG	GX	EG	--	--	LG
	BCSS-1	EG	LG	--	--	LG	LG	EG	--	--	LG
Mn	Sed U	EG	GG	EG	EG	EG	--	EG	--	--	LG
	BCSS-1	EG	GG	--	EG	EG	--	EG	--	--	LG
Fe	Sed U	EG	LX	EG	LG	HX	--	EG	--	--	HG
	BCSS-1	EG	GG	--	GG	HG	--	EG	--	--	GG
Ni	Sed U	EG	EG	EG	EG	EG	--	EG	--	--	EG
	BCSS-1	EG	HG	--	EG	EG	--	EG	--	--	LG
Cu	Sed U	GG	HG	EG	GG	GG	LG	EG	--	--	EG
	BCSS-1	EG	HG	--	EG	EG	LG	EG	--	--	LG
Zn	Sed U	EG	EG	GG	GG	EG	LG	LG	--	--	EG
	BCSS-1	EG	GG	--	EG	EG	LG	GG	--	--	EG
As	Sed U	EG	GX	EG	--	--	LX	EG	--	--	EG
	BCSS-1	GX	LG	--	--	--	LC	EG	--	--	LX
Se	Sed U	G-	EX	EG	--	--	--	EG	--	--	--
	BCSS-1	--	GG	--	--	--	--	EG	--	--	--
Ag	Sed U	H-	LG	G-	--	--	--	HX	--	--	--
	BCSS-1	H-	EG	--	--	L-	--	G-	--	--	--
Cd	Sed U	EG	EG	EG	EG	LX	EX	LX	--	--	EG
	BCSS-1	HG	GX	--	EG	LX	HX	EG	--	--	HX
Sn	Sed U	LG	EG	--	--	--	--	LG	--	--	--
	BCSS-1	G-	LX	--	--	--	--	G-	--	--	--
Sb	Sed U	--	L-	EG	--	--	--	HG	--	--	--
	BCSS-1	--	L-	--	--	--	--	EG	--	--	--
Hg	Sed U	--	HG	EG	--	--	EG	EG	--	--	GX
	BCSS-1	--	GG	--	--	--	EG	EG	--	--	EG
Tl	Sed U	G-	--	--	--	L-	--	G-	--	--	--
	BCSS-1	G-	--	--	--	G-	--	H-	--	--	--
Pb	Sed U	EG	EG	EG	EG	EG	EX	EG	--	--	EG
	BCSS-1	GG	EG	--	EG	GG	HG	EG	--	--	LG

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 U	--	--	EG	EG	--	--	EG	--	--	--
	BCSS-1	--	--	EG	EG	--	--	EG	--	--	--
Al	Sed U	LX	HG	EG	EG	EG	EG	LX	--	LG	--
	BCSS-1	LX	GG	EG	EG	EG	EG	LG	--	LG	--
Si	Sed U	--	LG	--	HG	--	EG	--	--	--	--
	BCSS-1	--	EG	--	EG	--	EG	--	--	--	--
Cr	Sed U	HX	EG	EG	LG	EG	EG	LX	--	LG	LG
	BCSS-1	EG	EG	EG	EG	EG	EG	LX	--	LG	LG
Mn	Sed U	EG	EG	EG	EG	GG	EG	LX	--	LG	LG
	BCSS-1	EG	EG	EG	EG	GG	EG	LG	--	GG	LG
Fe	Sed U	EG	EG	EG	HG	EG	EG	LX	--	LG	--
	BCSS-1	GX	EG	EG	EG	EG	EG	LG	--	LG	--
Ni	Sed U	LX	EG	EG	GG	EG	EG	LG	--	EG	--
	BCSS-1	LG	EG	EG	EG	EG	EG	LG	--	EG	--
Cu	Sed U	GG	GG	EG	HG	LG	EG	EG	--	EG	LG
	BCSS-1	LG	EG	EG	EG	EG	EG	LG	--	EG	LG
Zn	Sed U	GX	EG	EG	EG	EG	EG	GG	--	HG	LG
	BCSS-1	EG	EG	EG	EG	EG	EG	LG	--	EG	LG
As	Sed U	GG	EG	EG	EG	EG	EG	GX	--	--	--
	BCSS-1	HG	GG	EG	EG	EG	EG	GX	--	--	--
Se	Sed U	G-	EG	EG	GG	EG	EX	GX	--	--	--
	BCSS-1	H-	EG	GG	EG	EG	HG	L-	--	--	--
Ag	Sed U	HX	EG	HG	LG	EG	--	GG	--	--	HX
	BCSS-1	HX	EG	HG	EG	EG	--	LX	--	--	EX
Cd	Sed U	LX	EG	GG	EG	EG	EG	GG	--	HG	EG
	BCSS-1	LX	GG	HG	HG	EG	EG	LX	--	--	GX
Sn	Sed U	--	--	HG	LG	LG	--	L-	--	--	--
	BCSS-1	--	LG	G-	EG	GG	--	HX	--	--	--
Sb	Sed U	--	EG	EG	HG	HX	--	L-	--	--	--
	BCSS-1	--	EG	LX	EG	GX	--	L-	--	--	--
Hg	Sed U	HX	EG	EG	LG	EG	EG	EG	--	--	--
	BCSS-1	HG	EX	EG	EG	EG	EG	EG	--	--	--
Tl	Sed U	--	--	--	EG	--	--	--	--	--	--
	BCSS-1	--	--	--	EG	--	--	--	--	--	--
Pb	Sed U	HG	LX	EG	EG	EG	EG	EG	--	EG	EG
	BCSS-1	HG	GG	EG	EG	EG	EG	LX	--	EG	LG

Laboratory Evaluation for Sediments

		Lab 41	Lab 42	Lab 43	Lab 44	Lab 45	Lab 46
Be	Sed U	EG	GX	--	--	EG	G-
	BCSS-1	EG	LX	--	--	EG	--
Al	Sed U	--	LX	EG	--	HG	EG
	BCSS-1	--	LG	EG	--	HG	--
Si	Sed U	--	--	--	--	LG	EG
	BCSS-1	--	--	--	--	LX	--
Cr	Sed U	EG	LG	EG	--	EG	EX
	BCSS-1	EG	LG	EG	--	LG	--
Mn	Sed U	EG	GG	EG	--	EG	LG
	BCSS-1	EG	GG	EG	--	EG	--
Fe	Sed U	--	LG	EG	--	EG	GG
	BCSS-1	--	LG	GG	--	EG	--
Ni	Sed U	EG	EG	--	--	GX	--
	BCSS-1	EG	EG	--	--	GG	--
Cu	Sed U	HG	EG	--	--	GG	LG
	BCSS-1	HG	GG	--	--	GG	--
Zn	Sed U	EG	EG	--	--	EG	EG
	BCSS-1	EG	GG	--	--	GG	--
As	Sed U	--	HG	EG	--	EG	--
	BCSS-1	--	GG	EG	--	EG	--
Se	Sed U	HG	LX	--	--	EG	G-
	BCSS-1	EG	LX	--	--	L-	--
Ag	Sed U	--	EG	--	--	HG	G-
	BCSS-1	--	EX	--	--	HX	--
Cd	Sed U	--	HX	--	--	LG	EG
	BCSS-1	--	EG	--	--	LG	--
Sn	Sed U	--	--	--	--	GX	--
	BCSS-1	--	--	--	--	GX	--
Sb	Sed U	EG	--	EG	--	LX	G-
	BCSS-1	HG	--	HG	--	LX	--
Hg	Sed U	--	EX	--	--	GX	EG
	BCSS-1	--	EG	--	--	EX	--
Tl	Sed U	--	--	--	--	GG	G-
	BCSS-1	--	--	--	--	HX	--
Pb	Sed U	EG	GX	--	--	EG	EG
	BCSS-1	EG	GX	--	--	LG	--

Laboratory Evaluation for Biologicals Tissues

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

Laboratory Evaluation for Biologicals Tissues

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

Laboratory Evaluation for Biologicals Tissues

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

Laboratory Evaluation for Biologicals Tissues

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

Laboratory Evaluation for Biologicals Tissues

		Lab 41	Lab 42	Lab 43	Lab 44	Lab 45	Lab 46
Al	Tissue V						
	SRM 1566a						
Cr	Tissue V	EG	LX	HG	--	HX	EG
	SRM 1566a	EG	LX	GG	--	--	--
Fe	Tissue V	--	EG	HG	--	LG	GG
	SRM 1566a	--	EG	EG	--	--	--
Ni	Tissue V	HX	LX	--	--	HG	--
	SRM 1566a	EX	GX	--	--	--	--
Cu	Tissue V	EG	EG	--	--	EG	EG
	SRM 1566a	EG	EG	--	--	--	--
Zn	Tissue V	EG	HG	--	--	--	EG
	SRM 1566a	EG	EG	--	--	--	--
As	Tissue V	--	EG	EG	--	LX	GG
	SRM 1566a	--	GX	EG	--	--	--
Se	Tissue V	EG	GX	--	--	EX	G-
	SRM 1566a	EG	LX	--	--	--	--
Ag	Tissue V	--	HX	--	--	HG	L-
	SRM 1566a	--	HX	--	--	--	--
Cd	Tissue V	--	EG	--	--	EG	EG
	SRM 1566a	--	EX	--	--	--	--
Sn	Tissue V	--	--	--	--	HX	H-
	SRM 1566a	--	--	--	--	--	--
Hg	Tissue V	--	EG	--	H-	GG	G-
	SRM 1566a	--	LG	--	--	--	--
Pb	Tissue V	--	HG	--	--	LG	G-
	SRM 1566a	--	G-	--	--	--	--

TABLE D-3
Sediment Dissolution Procedures

Lab No.	Sediment Dissolution Procedure	Instrumentation
1	- 0.500g - HNO ₃ , HF, HClO ₄	GFAAS - Cd ICPAES - Al, Cr, Mn, Fe, Ni, Cu, Zn, Pb
3	- 0.25g - HNO ₃ , HF, HCl, H ₂ O ₂ - flask and hot plate - microwave heating	ICPAES - Pb, Cd, Ag, Zn, Ni, Cu, Mn, Fe, Cr, Al
	- 0.25g - HNO ₃ , HCl	HGAAS - As, Se
4	- 1.00g - HNO ₃ , HF, HCl, H ₂ SO ₄ , H ₂ O ₂ - flask and hot plate	GFAAS - As, Se ICPAES - Al, Cr, Mn, Fe, Ni, Cu, Zn, Cd, Sn, Pb
5	- 0.5g - HNO ₃ , HCl - flask and hot plate	ICPMS - Hg
	- 0.1g - HNO ₃ , HF, HCl, HClO ₄ - flask and hot plate - closed vessel	ICPMS - Be, Al, Cr, Mn, Fe, Ni, Cu, As, Se, Ag, Cd, Sn, Sb, Tl, Zn
	- 0.1g - fusion	ICPMS - Si
6	- 0.5g - HNO ₃ , HF, HCl - microwave heating	GFAAS - Pb, As ICPAES - Ni, Cu, Mn, Fe, Cr, Be, Zn
7	- 0.1-0.2g - HNO ₃ , HF, HCl, HClO ₄ - flask and hot plate	FAAS - Cu, Fe, Mn, Zn GFAAS - Cd, Cr, Ag, Pb, Ni GFAAS - As, Se
8	- 0.5g - HNO ₃ , HF, HCl, HClO ₄ - flask and hot plate	GFAAS - Cd, Tl ICPAES - Be, Al, Cr, Mn, Fe, Ni, Cu, Zn, Ag, Cd, Pb
9	- 0.25g - HNO ₃ , HF, HClO ₄ - flask and hot plate	FAAS - Al, Fe, Mn, Zn ICPMS - Be, Cr, Ni, Cu, As, Sn, Pb, Ag, Cd, Tl

Lab No.	Sediment Dissolution Procedure	Instrumentation
10	- 0.4g - HNO ₃ , HF, HClO ₄ - flask and hot plate	FAAS - Cu,Fe,Mn,Pb,Zn,Ni GFAAS - Ag,Cd
12	- 0.2g - HNO ₃ , HF, HClO ₄ - closed vessel	GFAAS- Ag,Cd,Se XRF - Al,Si,Cr,Mn,Ni,Fe,As,Cu,Zn,Pb ICPMS -Be,Sb,Sn,Tl
13	- 2g - HNO ₃ , HF, HCl, HClO ₄ - flask and hot plate	FAAS - Cu,Zn
14	- 0.25g - HCl	HGAAS - Se,As
15	- 0.400g - HNO ₃ , HF, HClO ₄ - flask and hot plate - microwave heating	FAAS - Al,Cr,Cu,Fe,Mn,Ni,Zn GFAAS - Ag,As,Be,Cd,Pb,Sn
16	- 1.000g - HNO ₃ , HCl - flask and hot plate	FAAS - Cd,Pb GFAAS - As,Se,Ag,Sn,Sb,Tl ICPAES - Be,Ni,Cu,Zn
	- 0.250g - HNO ₃ , HF, HCl, HClO ₄ - flask and hot plate	ICPAES - Al,Cr,Mn,Fe
	- 0.1g - HNO ₃ , HCl, HClO ₄ - flask and hot plate - dry ash,	Gravimetric - SiO ₂
17	- 0.2g - HClO ₄ , HF - closed vessel - microwave heating	ICPMS - Be,Cr,Mn,Fe,Ni,Cu,Zn,As,Se, Ag,Sb,Cd, Sn,Hg,Tl,Pb
18	- 1.00g - HNO ₃ , H ₂ O ₂ , HClO ₄	FAAS - Fe,Zn,Al, Be GFAAS - As,Sb ICPMS -Cr,Ni,Cu,Mn,Se,Ag,Cd,Sn,Tl,Pb
19	- 1.00g - HNO ₃ , HCl - flask and hot plate	FAAS - Cd,Pb HGAAS - As,Se ICPAES - Be,Ag,Ni,Cu,Zn

Lab No.	Sediment Dissolution Procedure	Instrumentation
	- 0.5g - HNO ₃ , HF, HCl, HClO ₄ - flask and hot plate	ICPAES - Al,Fe,Mn,Cr
	- 0.2g - HCl - microwave heating	HGAAS -Sb
20	- 0.4-0.5g - HNO ₃ , HF, HCl - flask and hot plate	ICPMS - Cd, Se, Hg ICPAES - Be,Al,Cr,Mn,Fe,Ni,Cu,Zn, As,Se,Ag,Cd,Sb,Hg,Pb
21	- 0.5g - HNO ₃ , HF, HCl, HClO ₄ - solid sampling	FAAS -Cr GFAAS - Tl,Cd,Se,As ICPAES - Cu,Fe,Mn,Be,Zn,Ni XRF - Si,Al,Pb,As,Sn
22	- 0.1-0.3g - HNO ₃ , HF, HClO ₄ , HCl - flask and hot plate	ICPMS - Cr,Ni,Cu,Cd,Sn,Pb ICPAES - Al,Mn,Fe,Zn
	- 0.2g - HClO ₄ , H ₂ SO ₄ , HCl - flask and hot plate	HGAAS - As,Se,Sb
	- 0.5g - HNO ₃ - flask and hot plate	GFAAS -Ag
23	- 0.5000g - HNO ₃ , HCl, HF, HClO ₄ - flask and hot plate	FAAS- Cd,Pb,Ag ICPAES - Be,Al,Cr,Mn,Fe,Ni,Cu,Zn,As, Se,Sb
24	- 0.25g - HNO ₃ , HF - closed vessel - microwave heating	ICPMS - Al,Mn,Fe,Ni,Cu,Zn,Cd,Pb
25	- 0.5g - HNO ₃ , HF, HClO ₄ - closed vessel	FAAS- Pb,Fe,Cu,Al GFAAS - Tl,Cd,Ag ICPAES - Zn,Pb,Ni,Mn,Fe,Cr,Be,Cu,Al
26	- 0.5 g - HNO ₃ , HF - microwave heating	ICPAES- Cu,Pb,Cd,Zn,As,Cr

Lab No.	Sediment Dissolution Procedure	Instrumentation
27	- 0.5g - HNO ₃ , HF, HCl - flask and hot plate - fusion with LiBO ₂ (Si,Al,Fe)	FAAS- Ag HGAAS- As,Sb,Se ICPAES- Al,Si,Cr,Mn,Fe,Ni,Cu,Zn,Cd, Sn,Tl,Pb
30	- 1.0g - HNO ₃ , HCl - flask and hot plate	FAAS- Al,Be,Cd,Cr,Cu,Fe,Mn,Ni,Pb,Zn GFAAS- As
31	NA	
32	- 0.5g - HNO ₃ , HF, HClO ₄ - dry ash, HCl (As,Se)	FAAS- Al,Cu,Fe,Mn,Zn,Si GFAAS- Ag,Cd,Cr,Ni,Sb,Sn,Pb HGAAS- Se,As
33	- 0.25g - HNO ₃ , HF, HClO ₄ , HCl - flask and hot plate	HGAAS- As,Sb,Se
	- 0.5g - HF, HCl, H ₂ O ₂ - flask and hot plate - extraction into organic phase	FAAS- Ag, Cd
	- 0.2g - HNO ₃ , HF, HClO ₄ , HCl - flask and hot plate	ICPAES- Be,Al,Cr,Mn,Fe,Ni,Cu,Zn, Sn,Pb
34	- 0.3g - HNO ₃ , HF, HCl, H ₂ SO ₄ - microwave heating	FAAS- Al,Si,Mn,Fe,Cu,Zn,Be GFAAS- Cr,Ni,As,Se,Ag,Cd,Sn,Sb,Tl,Pb
35	- 0.2g - HNO ₃ , HF, boric acid - closed vessel	FAAS- Zn GFAAS -Pb,Sn,Ni,Ag,Cd,As,Cu INAA- Fe,Al,Cr,Mn,Sb HGAFS- Se
36	- 0.4g - HNO ₃ ,HCl - flask and hot plate	GFAAS- Cd
	- 0.4g - HNO ₃ , H ₂ SO ₄ , HClO ₄ - flask and hot plate	HGICP- As,Se
	- 1.0g - pressed powder pellet	XRF- Al,Si,Cr,Mn,Fe,Ni,Cu,Zn,Pb

Lab No.	Sediment Dissolution Procedure	Instrumentation
37	- 0.75g - HNO ₃ , HClO ₄ - flask and hot plate	HGFAAS- As,Se GFAAS- Cr,Ni,Cu,Ag,Cd,Pb ICPAES- Be,Al,Mn,Fe,Cu,Zn,Sn
39	- 1.00g - HNO ₃ , H ₂ O ₂ , HCl - flask and hot plate	FAAS- Al,Cr,Mn,Fe,Ni,Cu,Cd,Pb,Zn
	- 1.00g - HNO ₃ , H ₂ O ₂ - flask and hot plate	GFAAS- As,Se
40	-1.00g - HNO ₃ , -flask and hot plate	FAAS- Zn,Cu,Mn GFAAS- Cd,Pb,Ag
41	- 0.5g - HNO ₃ , HF	GFAAS- Sb HGAAS- As,Se ICPAES- Be,Cr,Mn,Ni,Cu,Zn,Pb
42	- 0.5g - HNO ₃ , H ₂ O ₂ , - flask and hot plate	FAAS- Al,Mn,Fe,Cu,Zn GFAAS- Ag,As,Se,Ni,Cd,Pb ICPAES- Cr
43	- none	INAA- Al,Cr,Mn,Fe,As,Sb
45	- 0.6g - HNO ₃ , HF,HClO ₄ - flask and hot plate	GFAAS- Cd,Ag,Sn,Sb,Tl,Pb HGAAS - As,Se ICPAES-Al,Be,Cr,Cu,Fe,Pb,Mn,Ni,Si,Zn
46	- 0.5g - HNO ₃ ,H ₂ O ₂ - closed vessel - microwave heating	ICPAES- Al,Cr,Fe,Zn,As,Se, Ag,Cd,Sn,Sb,Pb DCP -Tl
	- 0.5g - fusion, graphite crucible	ICPAES- Be,Si,Mn,
47	- 0.3 g - HNO ₃ ,HF,HClO ₄ - closed vessel - microwave heating	GFAAS-Be,Cr,Mn,Ni,Cu,As, Se,Ag,Cd,Sn,Pb ICPAES- Al,Fe,Zn HGGFAAS- Sb
48	- 0.3g - HNO ₃ ,HF,HClO ₄ - closed vessel - microwave heating	IDICPMS- Cr,Ni,Cu,Zn,Cd,Sn Sb,Tl,Pb

TABLE D-2
Tissue Dissolution Procedures

Lab No.	Tissue Dissolution Procedure	Instrumentation
2	- 1.0g - HNO ₃ , H ₂ O ₂ - flask and hot plate	FAAS- Cd,Cu,Pb,Zn GFAAS- Pb
3	- 0.25g - HNO ₃ , HCl, HF, H ₂ O ₂ - flask and hot plate - microwave heating	ICPAES- Ag,Cr,Cu,Fe,Mn,Ni,Pb,Zn,Cd
4	- 1.00g - HNO ₃ , H ₂ O ₂ , HCl - dry ash - flask and hot plate	GFAAS- As,Se ICPAES- Al,Cr,Mn,Fe,Ni,Cu, Zn,Cd,Sn,Pb
5	- 0.5g - HNO ₃ - flask and hot plate - closed vessel	ICPMS- Al,Cr,Fe,Ni,Cu,Zn,As Se,Ag,Cd,Sn,Hg,Pb
6	- 0.5g - HNO ₃ - microwave heating	GFAAS- Pb, As ICPAES- Ni,Cu,Fe,Cr,Al,Cd,Zn
7	- 0.1-0.2g - HNO ₃ , HCl, Mg(NO ₃) ₂ - dry ash - flask and hot plate	HGAAS- As,Se
	- 0.1-0.2g - HNO ₃ , HF, HCl, HClO ₄ - flask and hot plate	FAAS- Cu,Fe,Zn GFAAS- Cd,Cr,Ag,Pb,Ni
8	- 0.5g - HNO ₃ , H ₂ O ₂ , HCl - flask and hot plate	ICPAES- Al,Cr, Fe, Ni,Cu,Zn,Cd GFAAS- Pb
9	- 0.5g - HNO ₃ - closed vessel	FAAS- Al,Fe,Mn,Cu,Zn ICPMS- Be,Cr,Ni,As,Sn,Pb,Ag,Cd,Tl
11	- 0.5g - HNO ₃ - microwave heating	ICPMS- Cr,Ni,Ag,Cd,Pb,As,Se ICPAES- Fe,Cu,Zn,Al,Sn

Lab No.	Tissue Dissolution Procedure	Instrumentation
12	- 0.3g - HNO ₃ , HCl - closed vessel - microwave heating	XRF- As,Cu,Fe,Mn,Se,Zn ICPMS- Ag,Al,Cd,Cr,Ni,Pb,Sn
13	- 1g - HNO ₃ , HCl, HClO ₄ - flask and hot plate	FAAS- Cu,Zn,As,Cd,Pb
14	- 0.25g - HCl	HGAAS- As,Se
16	- 1.00g - HNO ₃ , H ₂ O ₂ - flask and hot plate	FAAS- Cd GFAAS- Cr,As,Se,Ag,Sn,Pb,Ni ICPAES- Al,Fe,Cu,Zn,Cd
17	- 0.2g - HNO ₃ , H ₂ O ₂ (HF) - closed vessel -microwave heating	ICPMS- Al,Cr,Fe, Ni,Cu,Zn,As Se,Ag, Cd,Sn,Pb
18	- 1.00g - HNO ₃ , H ₂ O ₂ , HClO ₄ - flask and hot plate	FAAS- Fe,Zn,Al ICPMS- Cr,Ni,Cu,Se,Ag,Cd,Sn,Pb GFAAS- As
19	- 1.00g - HNO ₃ , H ₂ O ₂ - flask and hot plate	GFAAS- Cd,Pb,Ni,Ag,Cr HGAAS- As,Se ICPAES- Fe,Cu,Zn,Al
20	- 0.3-0.4g - HNO ₃ , HCl - microwave heating	ICPMS- As,Cd,Hg,Ni,Pb,Se ICPAES- Al,Cr,Cu,Zn,Ag,
21	- 0.25g - HNO ₃ , H ₂ SO ₄ , HClO ₄ - flask and hot plate	HGAAS- Se,As
	- 0.25g - dry ash	FAAS- Fe,Cu,Zn,Cd GFAAS- Pb,Cr
22	- 0.2g - HNO ₃ , H ₂ SO ₄ , HCl - flask and hot plate	HGAAS- As,Se
	- 0.5g - HNO ₃ - flask and hot plate	GFAAS- Ni,Ag

Lab No.	Tissue Dissolution Procedure	Instrumentation
	- 0.1-0.3g - HNO ₃ , HF, HCl, HClO ₄ - flask and hot plate	ICPMS- Cr,Cu,Cd,Sn,Hg,Pb ICPAES- Al,Mn,Fe,Zn
23	- 0.5g - HNO ₃ , H ₂ SO ₄ , HClO ₄ - flask and hot plate	HGAAS- As
	- 0.5g - HNO ₃ , HF, HCl, HClO ₄ - flask and hot plate	FAAS- Cd,Pb,Ag ICPAES- Al,Cr, Fe, Ni,Cu,Zn,Se
24	- 0.5g - HNO ₃ , HCl - microwave heating - closed vessel	ICPMS- Ni,Cu,Zn,Ag,Cd,Pb
25	- 0.5g - HNO ₃ , H ₂ O ₂ - flask and hot plate	FAAS- Al GFAAS- Pb,Ni,Cr,Ag ICPAES-Zn,Cd,Ni,Fe,Cr,Cu,Ag
26	- 0.5g - HNO ₃ , HF - microwave heating	ICPAES- Cu,Cd,Zn,As,Cr
27	- 0.5g - HNO ₃ , HCl, HClO ₄ - flask and hot plate	HGAAS- As,Se ICPAES- Al,Cr,Fe,Ni,Cu,Zn,Cd,Sn,Pb
28	- HNO ₃ - flask and hot plate	ICPMS- Ni,As,Ag,Cd,Pb ICPAES- Al,Cr,Fe,Cu,Zn
29	- 0.25g - HNO ₃ , H ₂ O ₂ - microwave heating	GFAAS- Pb,Se ICPAES- Ag,Al,Cd,Cu,Fe,Zn
30	- 1.0g - HNO ₃ , H ₂ SO ₄ - flask and hot plate	FAAS- Al,Cd,Cu,Fe, Zn
31	NA	
32	- 0.5g - HNO ₃ , HClO ₄ - closed vessel - heat to 130°C	FAAS- Al,Cu,Fe,Zn GFAAS- Ag,As,Cd,Cr,Ni,Sn,Se,Pb

Lab No.	Tissue Dissolution Procedure	Instrumentation
34	- 0.5g - HNO ₃ , HCl - microwave heating	FAAS- Al,Fe,Cu,Zn GFAAS- Cr,Ni,As,Se,Ag,Cd,Sn,Pb
35	- 0.2g - HNO ₃ - closed vessel	GFAAS- Ag,Al,As,Cd,Cr,Cu,Ni,Pb,Se,Sn INAA- Fe,Zn
36	- 0.5g - HNO ₃ , H ₂ SO ₄ , HClO ₄ - flask and hot plate	HGICP- As,Se ICPAES- Cd,Cu,Zn
	- 0.5g - HNO ₃ , H ₂ O ₂ - flask and hot plate	GFAAS- Cr,Ni
37	- 0.75g - HNO ₃ , HClO ₄ - flask and hot plate	FAAS- As,Se GFAAS- Cr,Ni,Cu,Ag,Cd,Pb ICPAES- Be,Al,Mn,Fe,Cu,Zn,Sn
38		ICPMS- Al,As,Cd,Pb,Ni,Ag ICPAES- Cu,Fe,Zn
39	- 1.0g - HNO ₃ - flask and hot plate	FAAS- Al,Fe,Cu,Zn,Cd,Ni GFAAS- As,Se,Cr
40	- 1.00g - HNO ₃ , H ₂ SO ₄ - flask and hot plate	FAAS- Cu,Zn,Mn GFAAS- Pb,Cd,Ag HGAAS- As
41	- 0.5g - HNO ₃ , HF	ICPAES- Cr,Ni,Cu,Zn,Se
42	- 0.5g - HNO ₃ , H ₂ O ₂ - flask and hot plate	FAAS- Fe,Cu,Cd,Zn GFAAS- Ag,As,Se,Ni,Pb ICPAES- Al,Cr
43	- not applicable	INAA- Cr, Fe, As
45	- 0.60g - HNO ₃ , H ₂ O ₂ - flask and hot plate	GFAAS- Cr,Ni,Ag,Sn,Pb HGAAS- As,Se ICPAES- Al,Cd,Cu,Fe,Zn
46	- 0.5g - HNO ₃ , H ₂ O ₂ - closed vessel - microwave heating	ICPAES- Al,Cr,Fe,Cu,Zn As,Se,Ag,Cd,Sn, Pb

Lab No.	Tissue Dissolution Procedure	Instrumentation
47	- 0.25g - HNO ₃ , H ₂ O ₂ - closed vessel - microwave heating	GFAAS- Cr,Fe,Ni,Cu,As,Se,Ag,Cd,Pb ICPAES- Al,Zn,
48	- 0.25g - HNO ₃ , H ₂ O ₂ - closed vessel - microwave heating	IDICPMS- Cr,Ni,Cu,Zn,Ag,Cd,Sn,Pb
	- 0.25g - HNO ₃ , H ₂ O ₂ , HF - closed vessel - microwave heating	ICPAES - Al

TABLE D-3
Dissolution Procedures for the Determination of Mercury

Lab No.	Sediment Dissolution	Tissue Dissolution	Instrumentation
2	NA	- HNO ₃ , H ₂ SO ₄ - flask and hot plate	CVAAS
3	- 0.25g - HNO ₃ , H ₂ SO ₄ - closed vessel		CVAAS
4	- separate digestion - as tables D-1 and D-2		NA
5	- separate digestion - as tables D-1 and D-2		ICPMS
6	- separate digestion - as tables D-1 and D-2		CVAAS
8	- separate digestion - as tables D-1 and D-2		CVAAS
9	- separate digestion - as tables D-1 and D-2		
11	NA	- as table D-2	CVAAS

Lab No.	Sediment Dissolution	Tissue Dissolution	Instrumentation
12	- as tables D-1 and D-2		CVAAS
15	- separate digestion - as table D-1	NA	CVAAS
16	- as tables D-1 and D-2		CVAAS
17	- as tables D-1 and D-2 - aliquot taken before evaporation step		FI-CVAAS
18	- separate digestion - as tables D-1 and D-2		CVAAS
19	- as table D-1	- H ₂ SO ₄ /KmnO ₄ - as table D-2	CVAAS
20	- as tables D-1 and D-2		ICPMS
21	NA	- 0.25g - HNO ₃ , H ₂ SO ₄ , HCl - flask and hot plate	CVAAS
22	- 0.5g - HNO ₃ - flask and hot plate		CVAAS ICPMS(tissues)
23	- 0.5g - HNO ₃ , HCl - flask and hot plate		CVAAS
26	- HNO ₃ , H ₂ SO ₄ , KMnO ₄ - water bath		CVAAS
27	- separate digestion - as tables D-1 and D-2		CVAAS
29	NA	- separate digestion - as table D-2	CVAAS
30	- 0.3g - HNO ₃ , H ₂ SO ₄ , KMnO ₄ , K ₂ S ₂ O ₈ - hot water bath		CVAAS
32	- as tables D-1 and D-2		CVAAS
33	- 0.1g - HNO ₃ , Na ₂ Cr ₂ O ₇ - flask and hot plate	NA	CVAAS

Lab No.	Sediment Dissolution	Tissue Dissolution	Instrumentation
34	- separate digestion - as tables D-1 and D-2		CVAAS
35	- 0.2g - HNO_3 , H_2SO_4 , KMnO_4 , $\text{K}_2\text{S}_2\text{O}_8$ - hot water bath		CVAAS
36	- 0.4g - HNO_3 , HCl - flask and hot plate	NA	CVAAS
37	- separate digestion - as tables D-1 and D-2		CVAAS
38	NA	-0.2g - HNO_3 , H_2SO_4 - KMnO_4 , $\text{K}_2\text{S}_2\text{O}_8$	CVAAS
42	- separate digestion - as tables D-1 and D-2		CVAAS
44	NA	- 0.2-1.0 g - HNO_3 - closed vessel - microwave heating	CVAAS
45	- as tables D-1 and D-2		CVAAS
46	- as tables D-1 and D-2		CVAAS
47	- HNO_3 , H_2SO_4 , HClO_4 - flask and hot plate		CVAAS