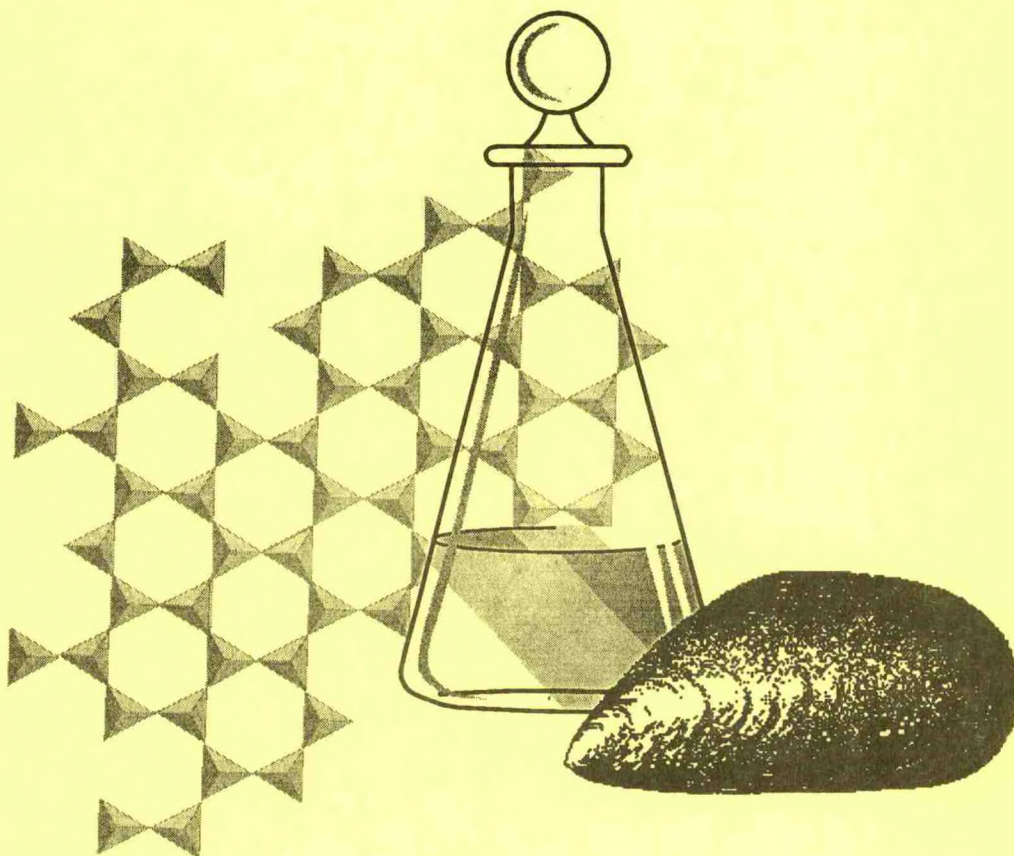


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NOAA Technical Memorandum NOS ORCA 84

**National Status and Trends Program
for Marine Environmental Quality**

**NOAA National Status and Trends Program
Seventh 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

**Coastal Monitoring and Bioeffects Assessment Division
Office of Ocean Resources Conservation and Assessment
National Ocean Service
National Oceanic and Atmospheric Administration
U.S. Department of Commerce
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Silver Spring, MD 20910**

Notice

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

S. Willie and S. Berman
Institute for Environmental Research and Technology
National Research Council
Canada

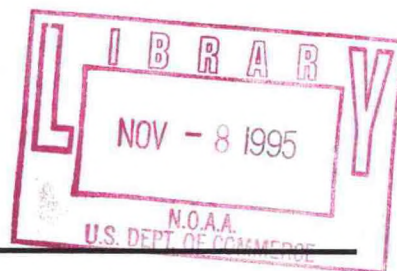
Abstract

This report, prepared by the National Research Council of Canada, summarizes results of the NOAA National Status and Trends Program seventh 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-nine laboratories receiving materials for analysis for the 1993 exercise. The exercise materials were a freeze dried mussel tissue collected off the coast of France and a freeze dried marine sediment collected in the Mississippi Delta. 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 Ti for sediments. Forty-eight 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

National Oceanic and
Atmospheric Administration

National Ocean Service

Ronald H. Brown
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Under Secretary

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Assistant Administrator

INTRODUCTORY REMARKS

The National Oceanic and Atmospheric Administration's National Status and Trends (NS&T) Program measures levels of chemical contaminants in organisms and sediments from around the coasts of the United States. A number of different laboratories have participated in making 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
Council Canada**

**Conseil national
de recherches Canada**

**Institute for
Environmental Chemistry**

**Institut de
chimie de l'environnement**

NRC - CNRC

NOAA/7

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

Scott Willie and Shier Berman

Prepared for the
Ocean Assessments Division
National Oceanic and Atmospheric Administration

November 1993

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APPENDICES

- A. Participants
- B. Data
- C. Laboratory Evaluation
- D. Digestion Procedures for Sediments and Biological Tissues
- E. Comments on the Evaluation of Intercomparison Study Results

1. INTRODUCTION

This is the seventh 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. Last year (1992) the number was further expanded to 35 laboratories. This 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 to which samples were sent.

Participating laboratories, meeting in Gaithersburg at the annual NOAA quality assurance workshop after the sixth intercomparison exercise, had agreed for the seventh study to analyze one sediment and one biological tissue as well as the certified reference materials (CRMs) NRC sediment BCSS-1 and NIST oyster tissue SRM 1566a. Because the flounder sample for the sixth exercise contained relatively low concentrations of contaminants there was a request for a biological sample with elevated levels for NOAA/7 and a Mississippi mud. The materials prepared for distribution by NRC were:

Tissue S, a freeze-dried bivalve tissue (*Mytilus edulis*) collected by the International Atomic Energy Agency (IAEA) in the Mediterranean off the French coast and further processed and bottled by the Standard Reference Materials Program of the National Institute for Science and Technology (NIST) and

Sediment T, a freeze dried Mississippi delta sediment donated by Bob Presley of Texas A&M University.

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.

Each laboratory was requested to perform five replicate analyses of each of the sediment and biological samples and CRMs for the thirteen metals Al, Cr, Fe, Ni, Cu, Zn, As, Se, Ag, Cd, Sn, Hg and Pb. For the sediments, the determination of Be, Si, Mn, Sb and Tl was also required.

In order to help provide benchmarks of accuracy for Tissue S and Sediment T, NRC also attempted to analyze each of the samples 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 five replicates analyzed by NRC were from five separate bottles. This was done in order to validate the interlaboratory homogeneity of the materials.

2. RESULTS

The prepared samples were mailed to the fifty-nine laboratories listed in Appendix A in mid-April 1993 with the deadline for receipt of results set at September 3. Of the fifty-nine laboratories on the mailing list, results were received from forty-eight. This is an increase of thirteen participants from the thirty-five in 1992. Sequential numbers were assigned to each responding laboratory upon receipt of its data. Laboratory numbers 49 and 50 were assigned to NRC.

Nineteen laboratories submitted results for the first time. Eleven laboratories did not send results, eight of these had participated in NOAA/6. Of the forty-eight sets of results, seven laboratories did not submit data for the biological tissues and four 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. With the exception of Al, Si and Fe for the sediment samples, the data are listed as received with respect to significant figures.

Each set of replicate analyses was examined using the Q test (Dixon's test)¹ for outliers and, when warranted, the laboratory mean and standard deviation were recalculated excluding the outlier. These sets are indicated by an apostrophe adjoining the laboratory number on the graphs and in Appendix B (e.g., 7'). If two or more "less than (<)" values were submitted in a set of replicate results the mean was not calculated and only the "less than" value was used for further data evaluation. To ensure that all laboratories are compared on a rather even basis, sets containing less than four results were not evaluated. The number of results used for the evaluation is noted next to the laboratory number in Appendix B along with the recalculated (if required) mean and standard deviation.

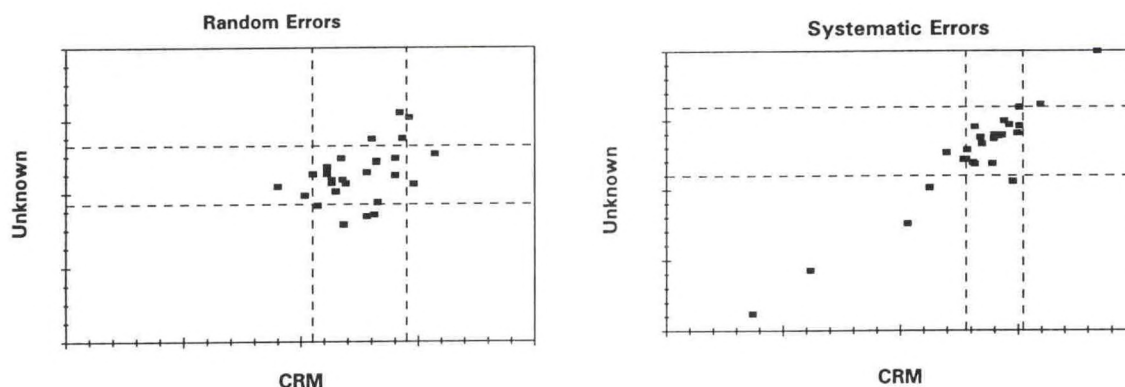
One purpose of the exercise was to arrive at an accepted value for each analyte concentration in for each unknown in order to evaluate laboratory biases. The overall mean concentration for each metal was calculated from the mean of laboratory replicates and the NRC data. These means were assumed to be 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.

The evaluated replicate data (not including outliers) 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 limits 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.

This year, at the request of a some past participants, we have 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 (excluding outliers) 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 a similar rejected results the labels become illegible. The accepted confidence range is indicated by the dashed lines.

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



BERYLLIUM

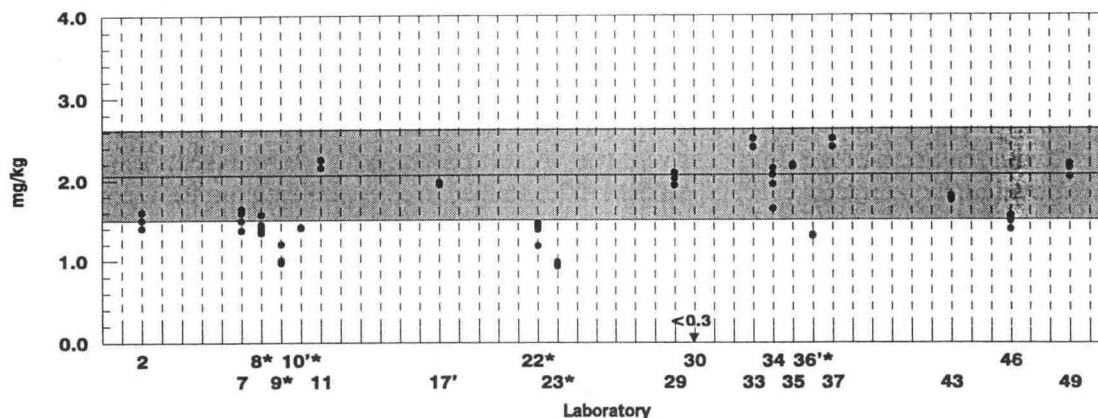
Sediment T

Accepted value = 2.06 ± 0.56 mg/kg

Results: 19

Quantitative Results: 18

Rejections: 6



BERYLLIUM

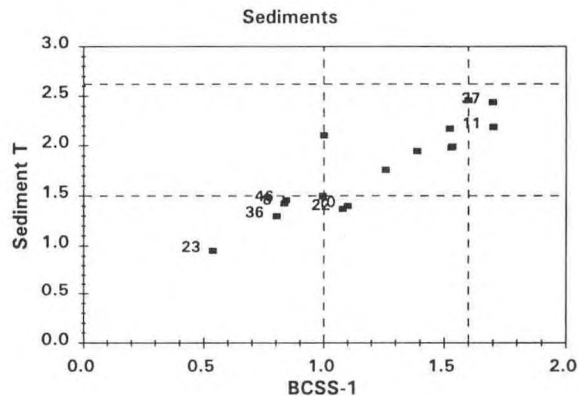
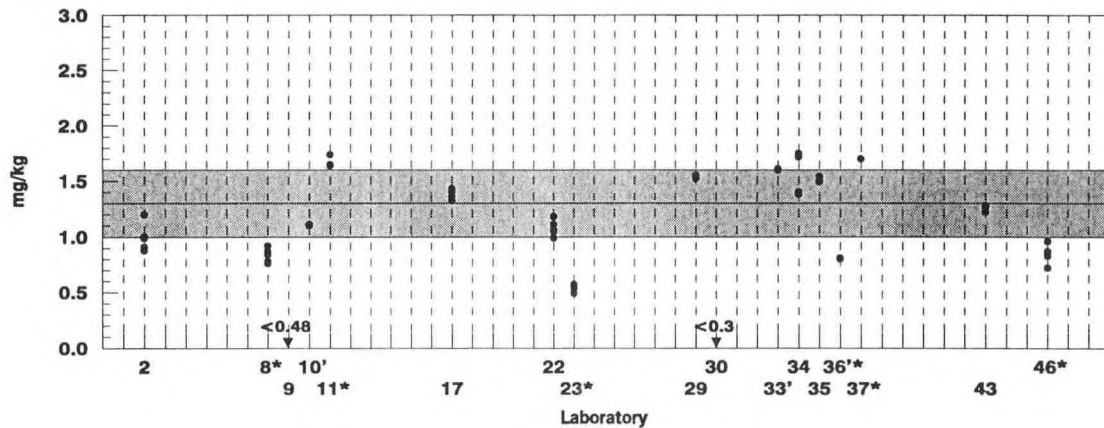
BCSS-1

Certified value = 1.3 ± 0.3 mg/kg

Results: 17

Quantitative Results: 15

Rejections: 6



The participation rate for the determination of beryllium in the sediment samples was an encouraging 35 percent considering this is the first year this element has been included in the exercise. Five of the six and four of the six laboratories that respectively report low results for beryllium in Sediment T and the CRM BCSS-1 did not use hydrofluoric acid in the digestion procedure. Ten of the twelve laboratories with results within the accepted confidence interval for beryllium in Sediment T used hydrofluoric acid. The other two's results were on the lower edge of acceptance. The Youden plot shows those laboratories with one or both beryllium results outside the ± 27 percent and ± 23 percent acceptable range for Sediment T and BCSS-1, respectively. The shape of the Youden plot indicates that systematic errors predominate. It would appear that the use of hydrofluoric acid in the decomposition step is a prerequisite for acceptable results.

The determination of beryllium was not required in the biologicals.

ALUMINUM

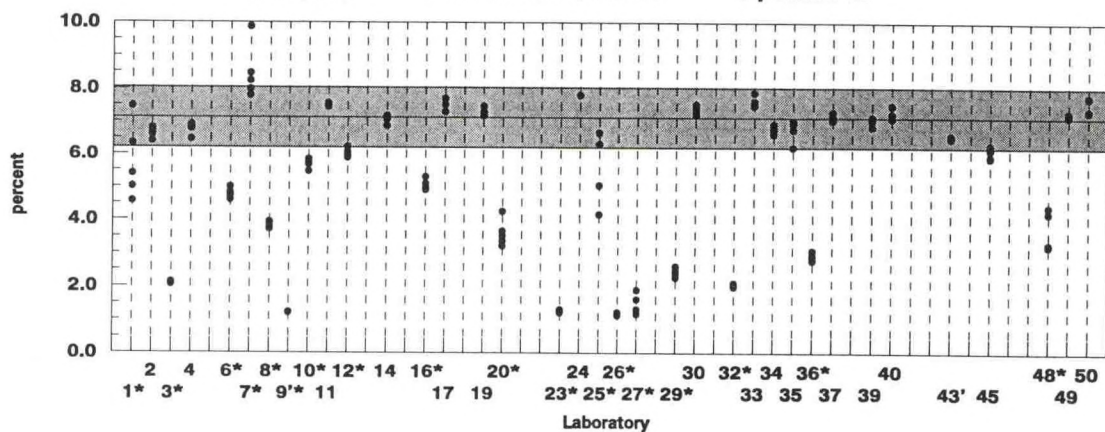
Sediment T

Accepted value = 7.12 ± 0.92 %

Results: 36

Quantitative Results: 36

Rejections: 18



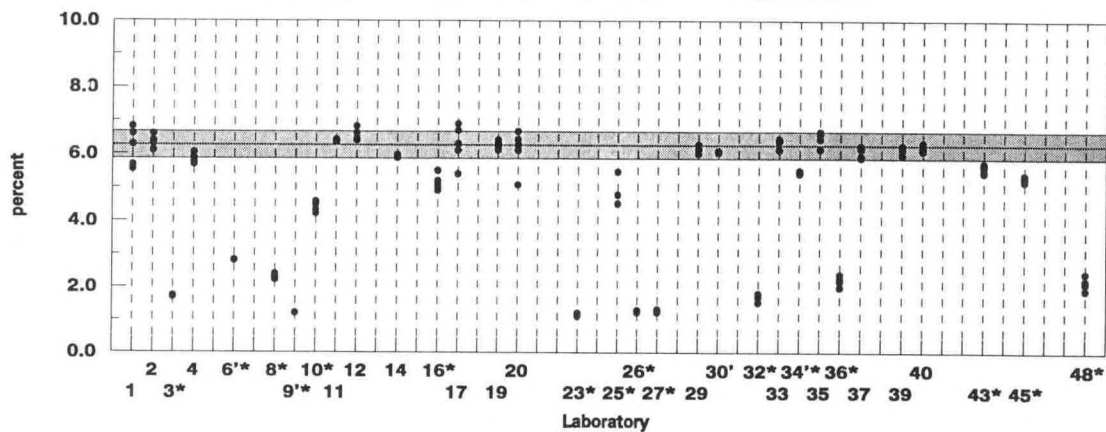
BCSS-1

Certified value = 6.26 ± 0.41 %

Results: 32

Quantitative Results: 32

Rejections: 16



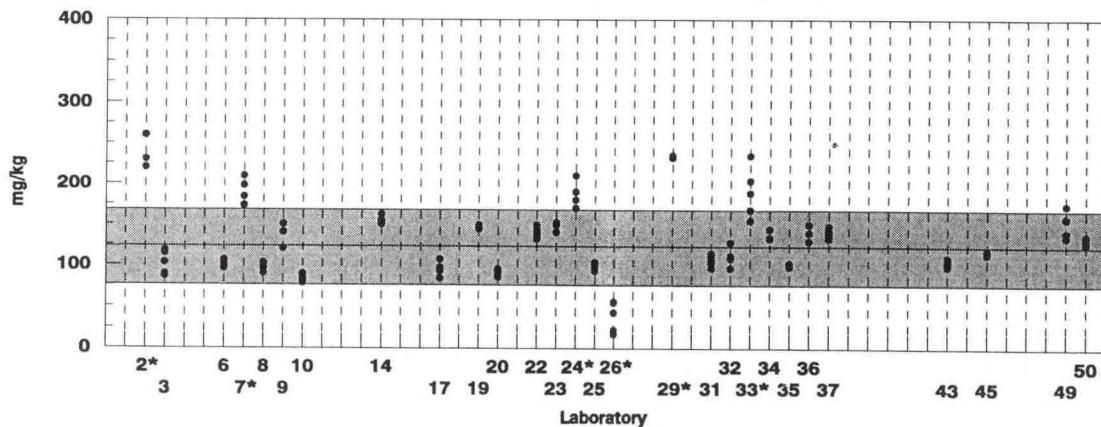
Tissue S

Accepted value = 123 ± 46 mg/kg

Results: 28

Quantitative Results: 28

Rejections: 6



ALUMINUM

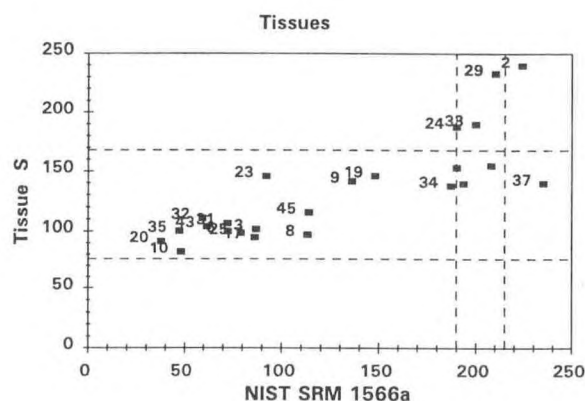
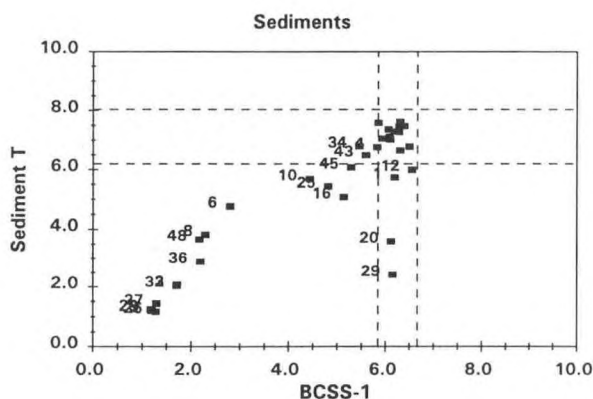
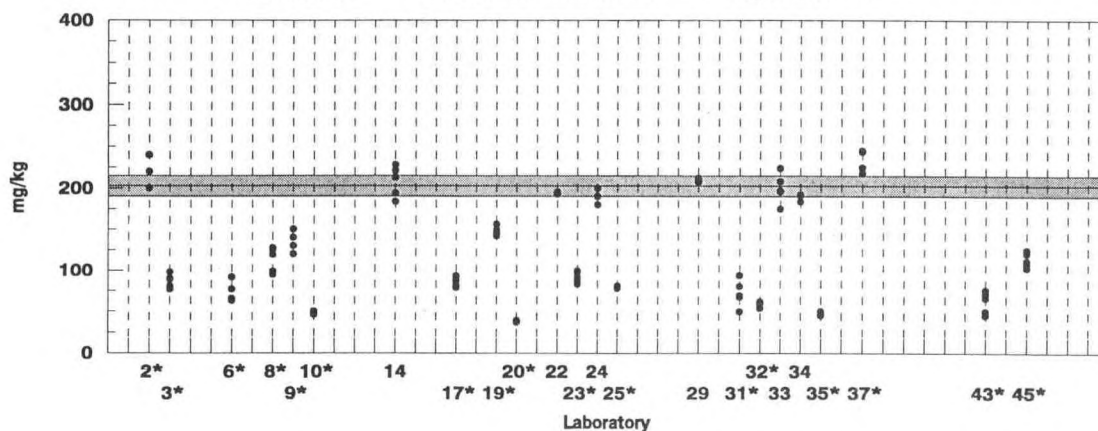
NIST SRM 1566a

Certified value = 202.5 ± 12.5 mg/kg

Results: 23

Quantitative Results: 23

Rejections: 17



As in previous NOAA exercises, a data set with low results for Al in sediments can be distinguished in the graphs reflecting incomplete digestion because hydrofluoric acid was not used. Eight of the sixteen rejected means for BCSS-1 were from the twelve new participants. It would appear from the rate of rejection that the results for Al in the sediments do not show any improvement over the previous two years even if the results from the new participants are excluded. However, a closer inspection shows that the accepted confidence interval for Sediment T is significantly less than in previous years. The results reflecting incomplete dissolution by many laboratories are clearly displayed in the Youden plot. Two laboratories (20,29) showed erratic errors which may be due to poor arithmetic.

There was a marked increase in the number of laboratories submitting results for Al in the tissue sample over previous exercises (28 vs 10 in NOAA/6). Seventy-four percent of the laboratories were within the ± 37 percent confidence interval for Tissue S but only twenty-six percent were within the ± 6 percent confidence interval for SRM 1566a. Five of the seven laboratories that reported values within the certified range for SRM 1566a used hydrofluoric acid in their tissue digestion procedure. None with low results used hydrofluoric acid. Subsequent investigation at NRC confirmed that hydrofluoric acid is necessary to quantitatively recover the Al in this SRM leading to an hypothesis that there may be some sediment associated with the oyster tissue. The Youden plot does not reveal typical systematic errors indicating that there may be matrix differences in the two tissue materials.

SILICON

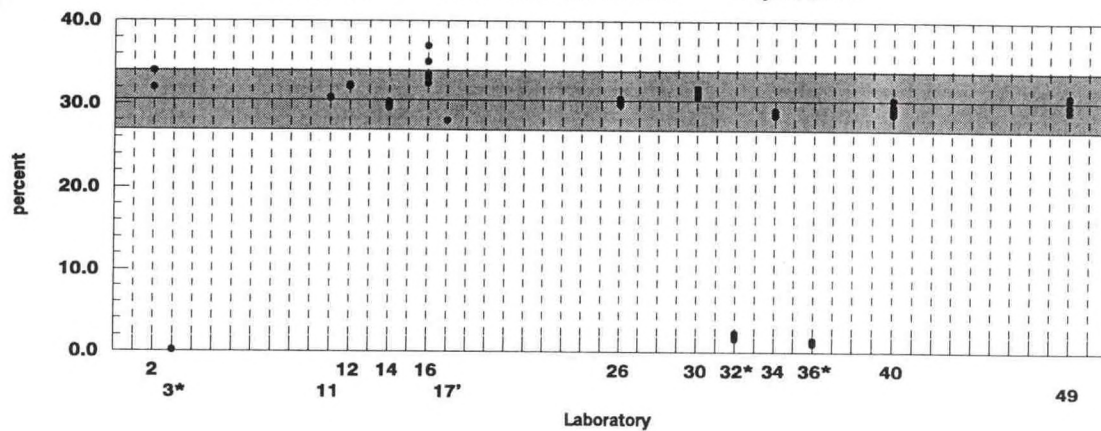
Sediment T

Accepted value = 30.5 ± 3.6 %

Results: 14

Quantitative Results: 14

Rejections: 3



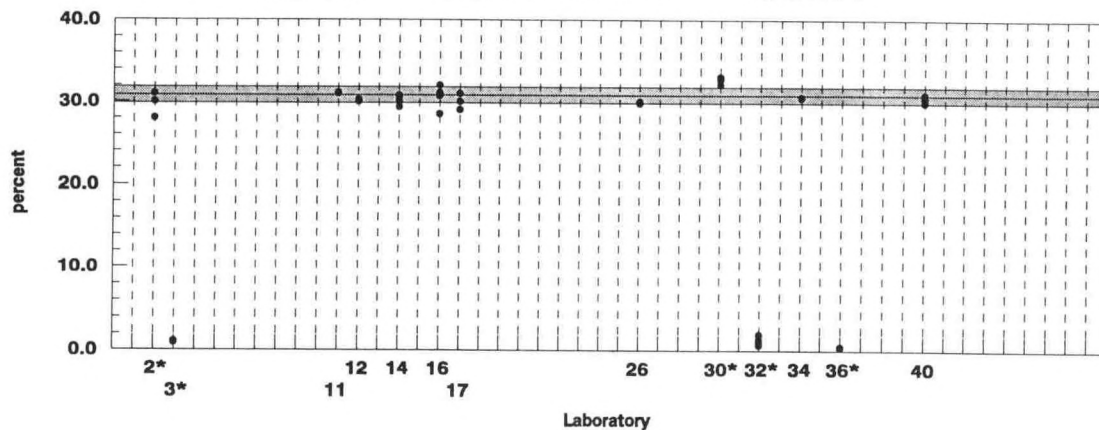
BCSS-1

Certified value = 30.8 ± 1.0 %

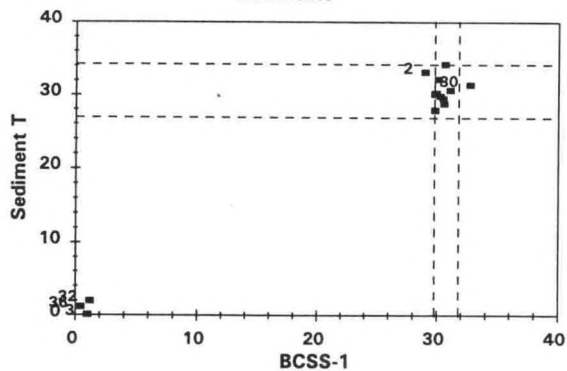
Results: 13

Quantitative Results: 13

Rejections: 5



Sediments



SILICON

This is the first NOAA exercise where there was sufficient silicon data to perform meaningful computations (14 sets vs 3 in NOAA/6). Seven sets of data came from new laboratories. This increased participation has permitted an accepted value to be calculated with a ± 12 percent confidence interval. The confidence interval for BCSS-1 is only ± 3 percent but eleven of the fourteen laboratories which reported results were very close to the certified value. It is obvious that a complete digestion procedure is necessary to obtain correct results for silicon in an aluminum silicate sediment. The overall performance of those that attempted the analyses was quite good.

The determination of silicon was not required in the biologicals.

CHROMIUM

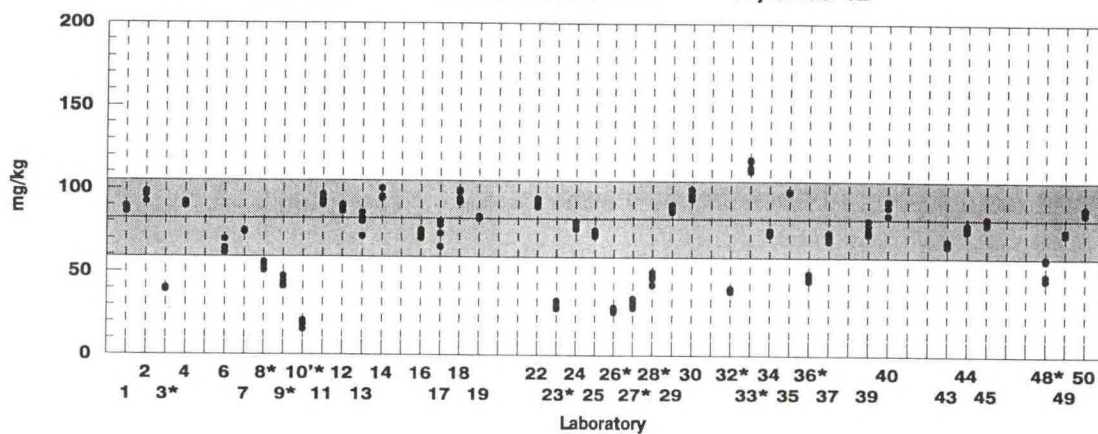
Sediment T

Accepted value = 82 ± 23 mg/kg

Results: 40

Quantitative Results: 40

Rejections: 12



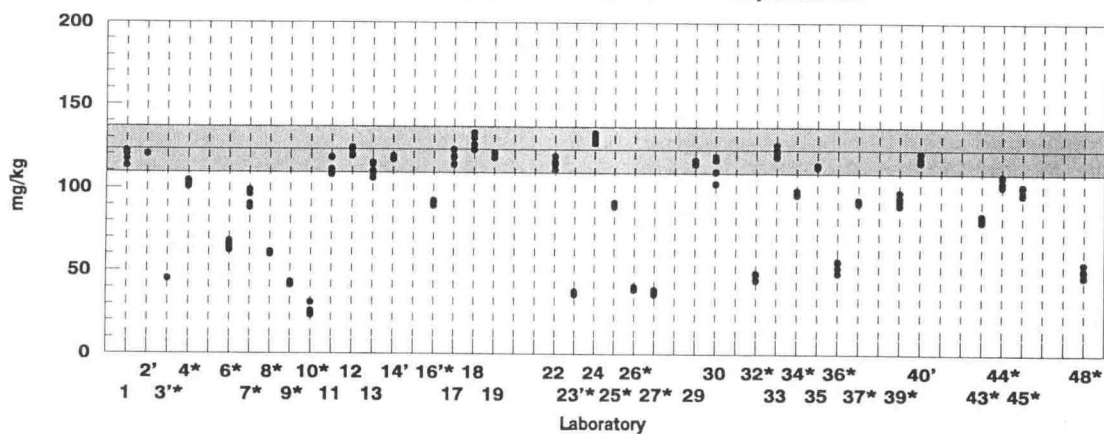
BCSS -1

Certified value = 123 ± 14 mg/kg

Results: 37

Quantitative Results: 37

Rejections: 21



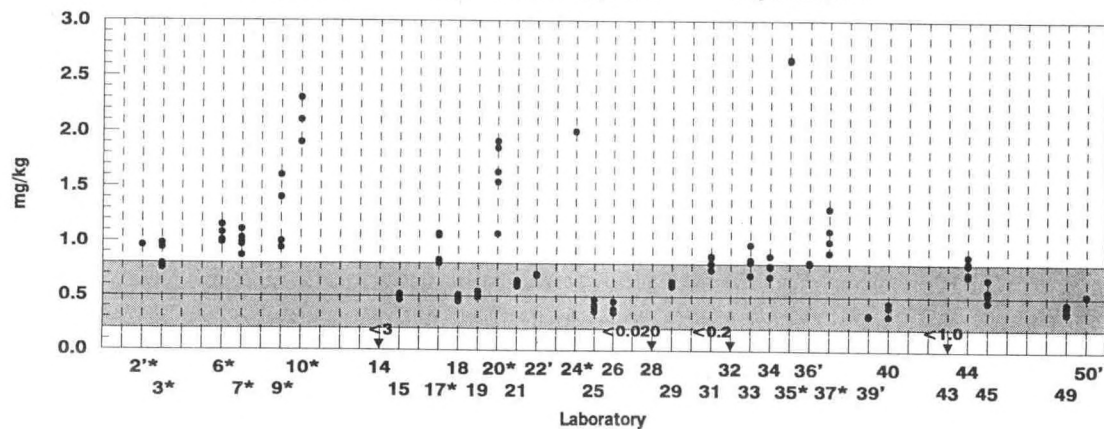
Tissue S

Accepted value = 0.50 ± 0.30 mg/kg

Results: 33

Quantitative Results: 29

Rejections: 11



CHROMIUM

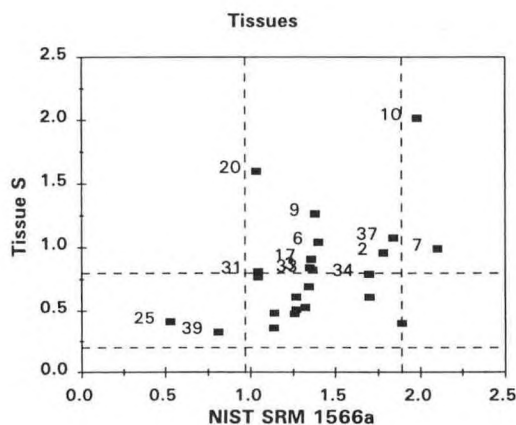
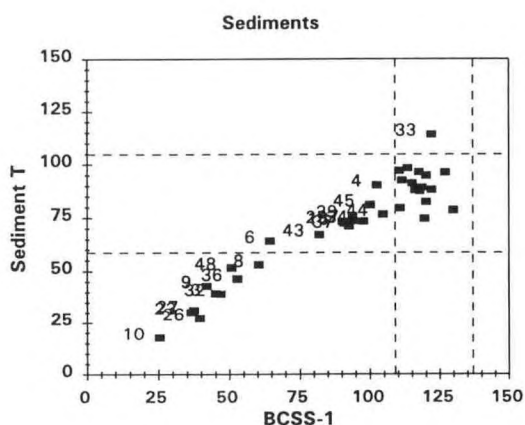
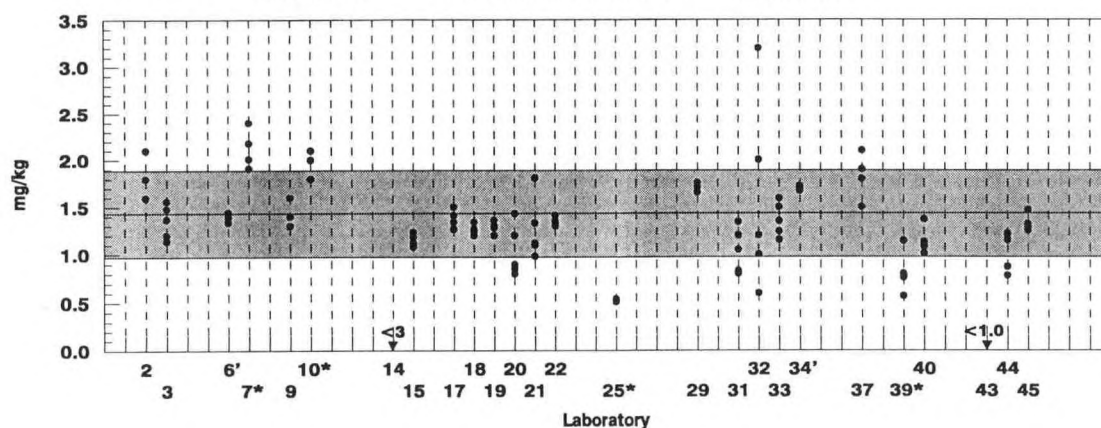
NIST SRM 1566a

Certified value = 1.43 ± 0.46 mg/kg

Results: 26

Quantitative Results: 24

Rejections: 4



Laboratories that submitted low results for aluminum in the sediments also reported low results for chromium due to incomplete digestion procedures. The overall performance for the determination of chromium in the sediments has not improved significantly with respect to NOAA/6. A textbook example of a Youden plot displaying systematic errors is evident.

The calculated concentration of Cr in Tissue S is quite low (0.5 mg/kg). The accepted confidence interval is a high ± 60 percent. However, considering that the Cr concentrations in the tissues analyzed in NOAA/5 and NOAA/6 were almost an order of magnitude higher, the achievement is probably as good or better than in past years. SRM 1566a was analyzed in NOAA/5. In that exercise the rejection rate was eight out of fifteen. This year it is only four out of twenty-four. The average intralaboratory precision for Cr in SRM 1566a is a disturbingly high 13 percent compared to 8 percent for Tissue S with one-third the concentration.

MANGANESE

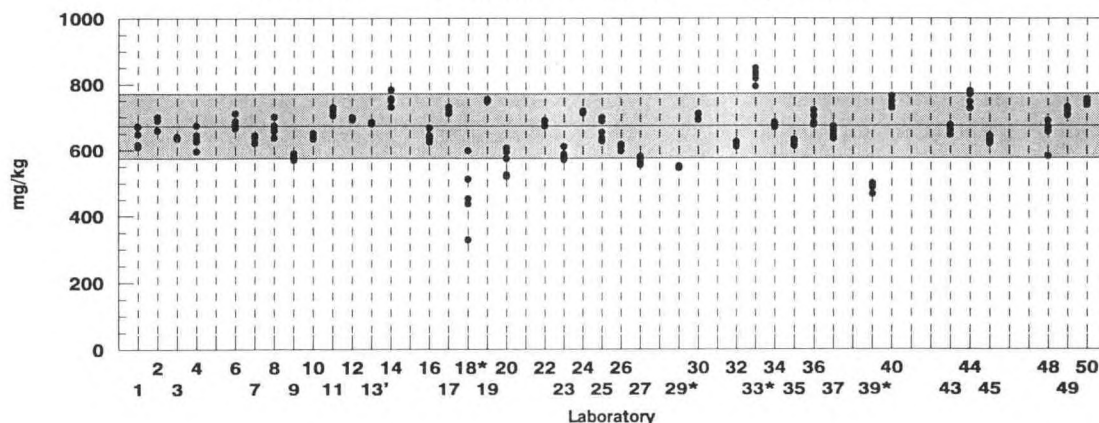
Sediment T

Accepted value = 673 ± 98 mg/kg

Results: 40

Quantitative Results: 40

Rejections: 4



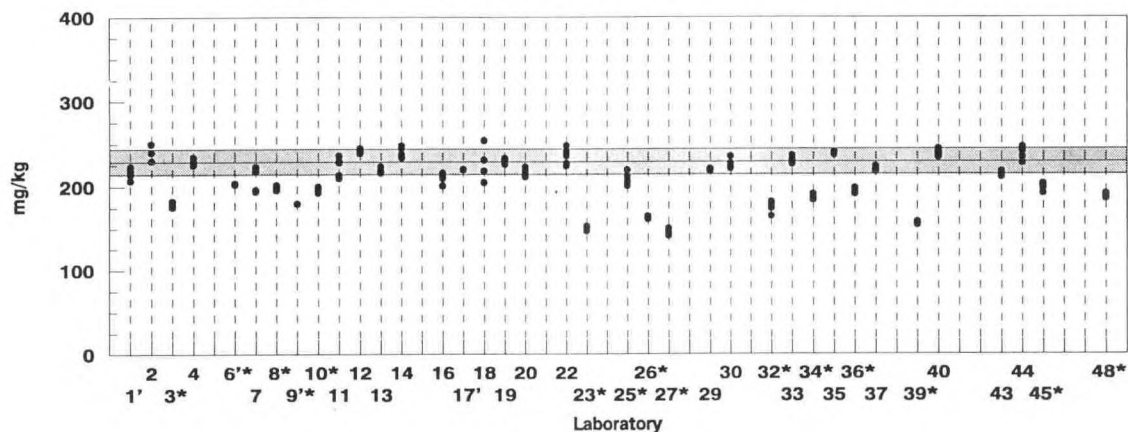
BCSS-1

Certified value = 229 ± 15 mg/kg

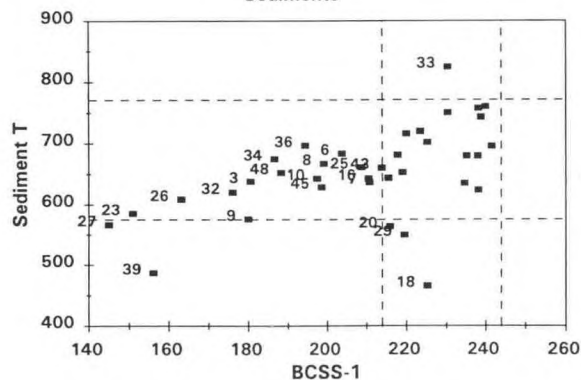
Results: 37

Quantitative Results: 37

Rejections: 15



Sediments



MANGANESE

Only four of forty laboratory means were rejected for Sediment T compared with eight of twenty-four for NOAA/6. The calculated mean has a ± 14 percent acceptable confidence interval. However, the concentration of Mn is three times that of the sediment in last year's exercise. The improvement for the analysis of BCSS-1 is only marginal. The ± 6.5 percent acceptable range for BCSS-1 allows one to again discern the laboratories that do not use hydrofluoric acid in the digestion procedure from the laboratories that perform a complete dissolution. The disparity between the manganese concentrations of the two samples results in a distortion of the Youden plot and demonstrates a limitation of comparing samples with different analyte concentrations.

The determination of manganese was not required in the biologicals.

IRON

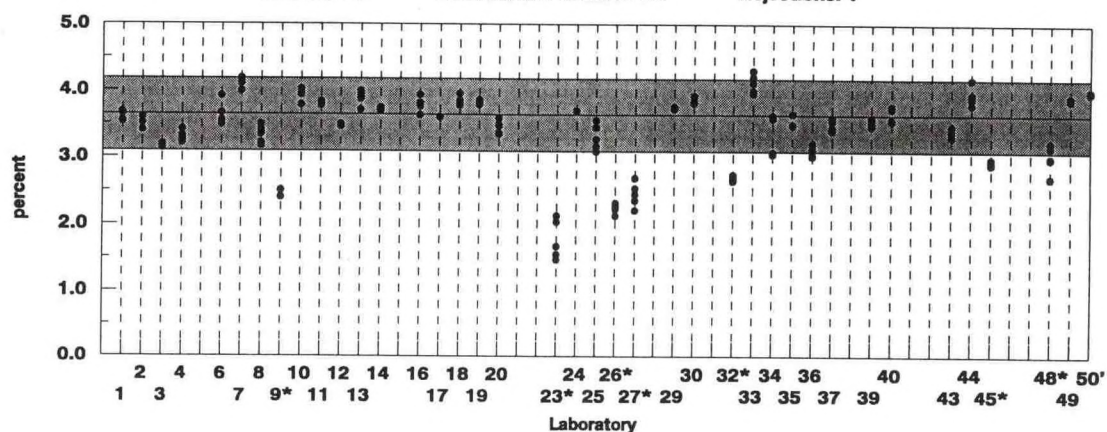
Sediment T

Accepted value = 3.64 ± 0.55 %

Results: 39

Quantitative Results: 39

Rejections: 7



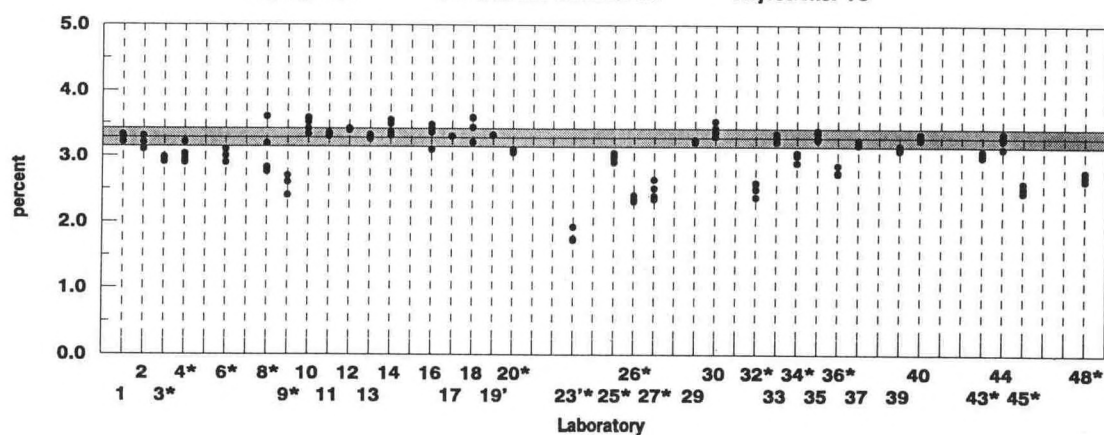
BCSS-1

Certified value = 3.28 ± 0.14 %

Results: 35

Quantitative Results: 35

Rejections: 16



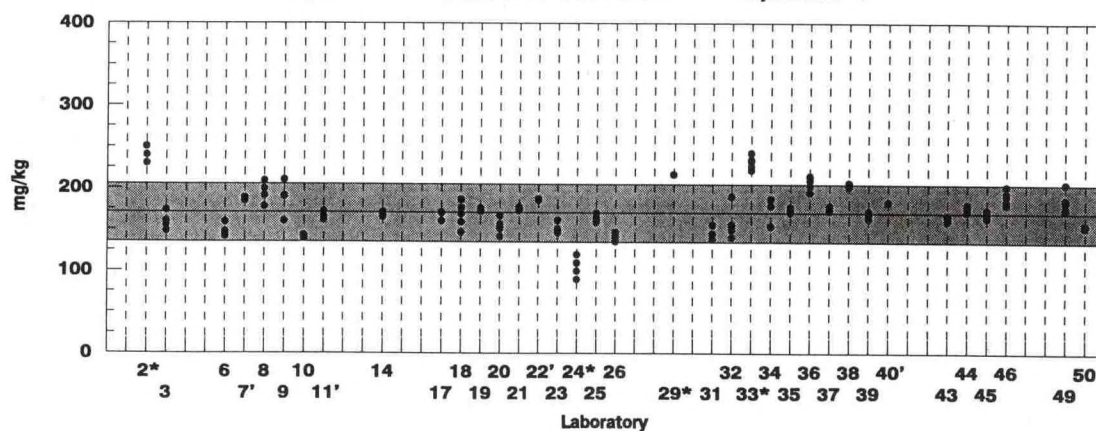
Tissue S

Accepted value = 171 ± 35 mg/kg

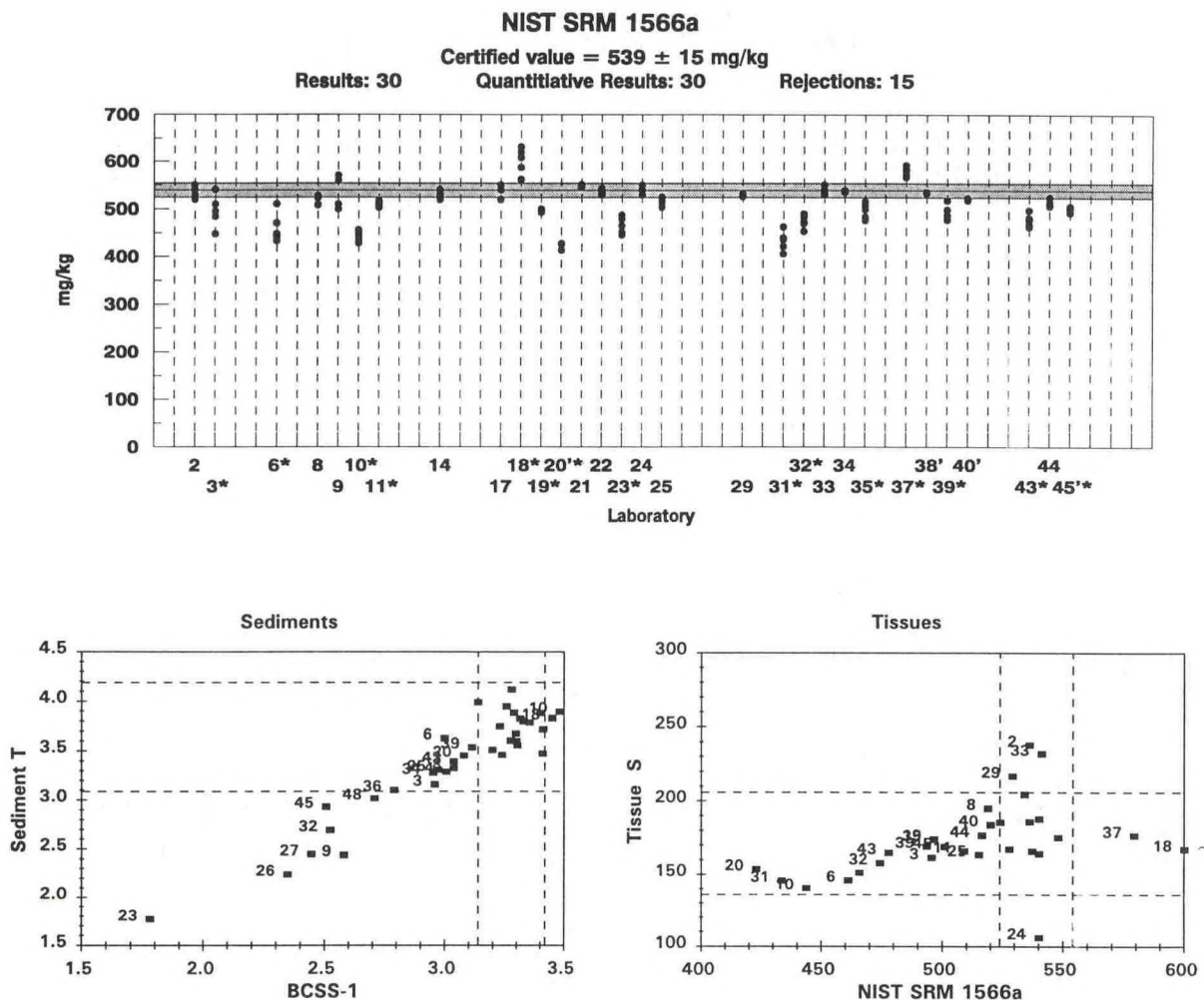
Results: 36

Quantitative Results: 36

Rejections: 4



IRON



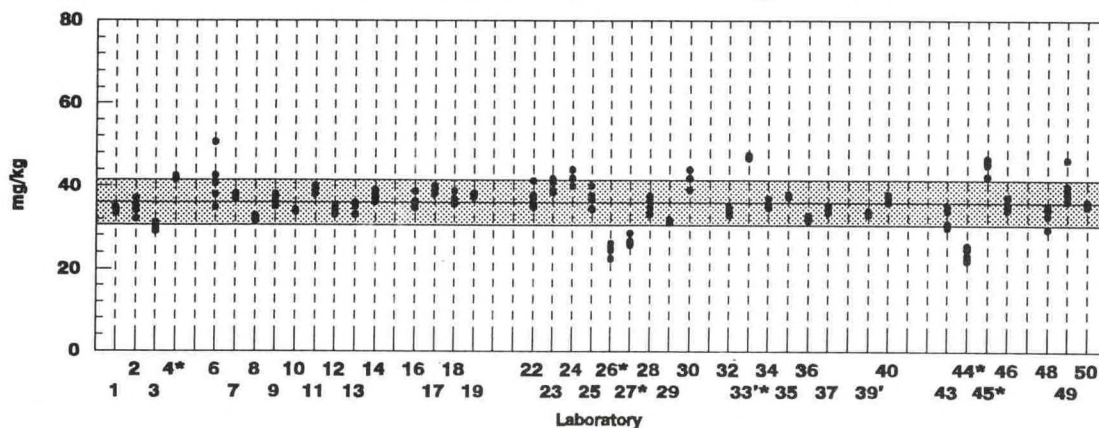
There is some apparent improvement in this year's results for the determination of iron in the sediments, especially for Sediment T. The calculated accepted range for Sediment T was ± 15 percent compared to ± 4 percent confidence interval for BCSS-1. The results parallel those of manganese, the large confidence interval for Sediment T masking the results of incomplete decomposition which are obvious for the CRM. The Youden plot is very similar to those for aluminum and chromium.

There is significant improvement for the analysis of iron in Tissue S compared to former exercises. Only four of thirty-six means were more than twenty percent from the calculated mean. The rejection rate of 50 percent for the iron results in SRM 1566a can be largely attributed to its very small certified range of ± 3 percent. The rejection rate for this CRM was 73 percent for NOAA/5. Because rejected results are invariably low we assume that the results would have been even better if more laboratories had used hydrofluoric acid or a more aggressive digestion.

NICKEL

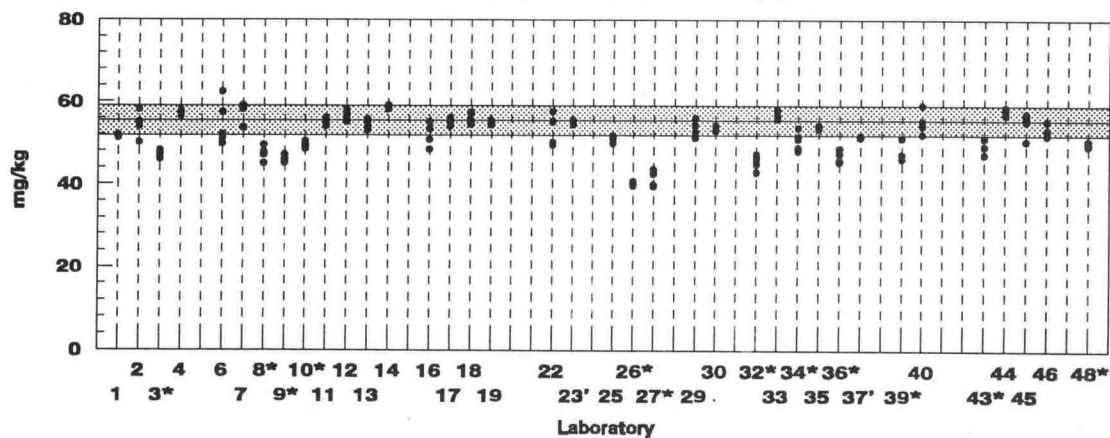
Sediment T

Accepted value = 36.0 ± 5.5 mg/kg
 Results: 41 Quantitative Results: 41 Rejections: 6



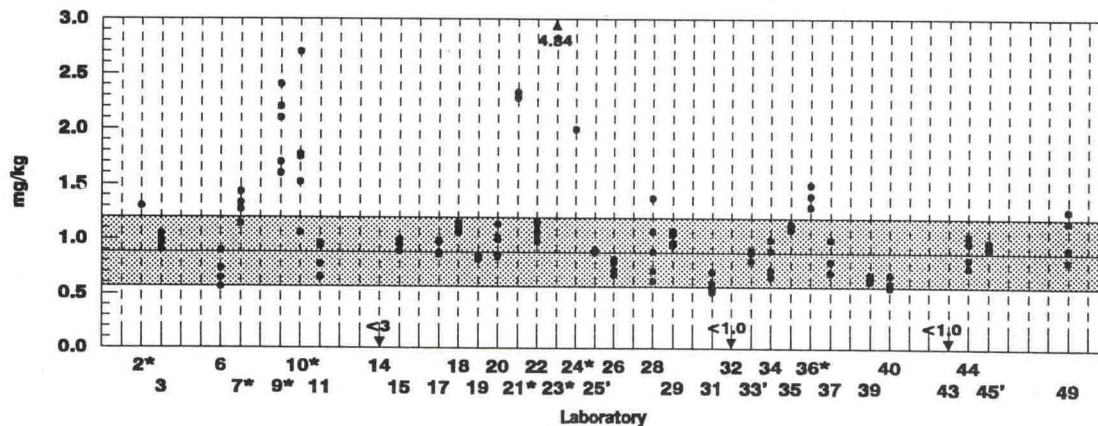
BCSS-1

Certified value = 55.3 ± 3.6 mg/kg
 Results: 37 Quantitative Results: 37 Rejections: 12



Tissue S

Accepted value = 0.88 ± 0.31 mg/kg
 Results: 34 Quantitative Results: 31 Rejections: 8



NICKEL

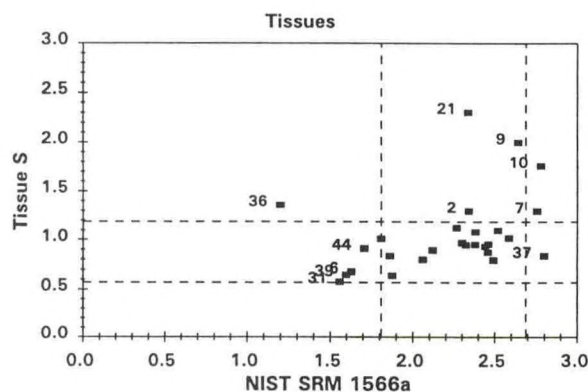
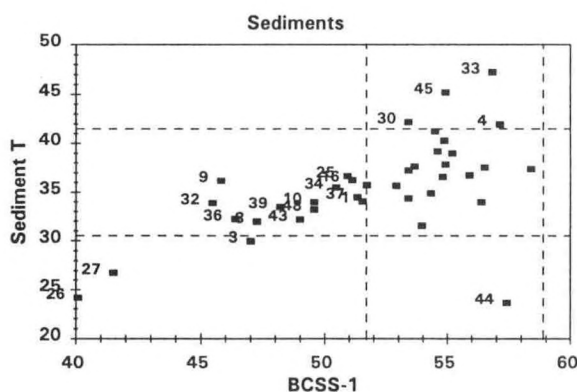
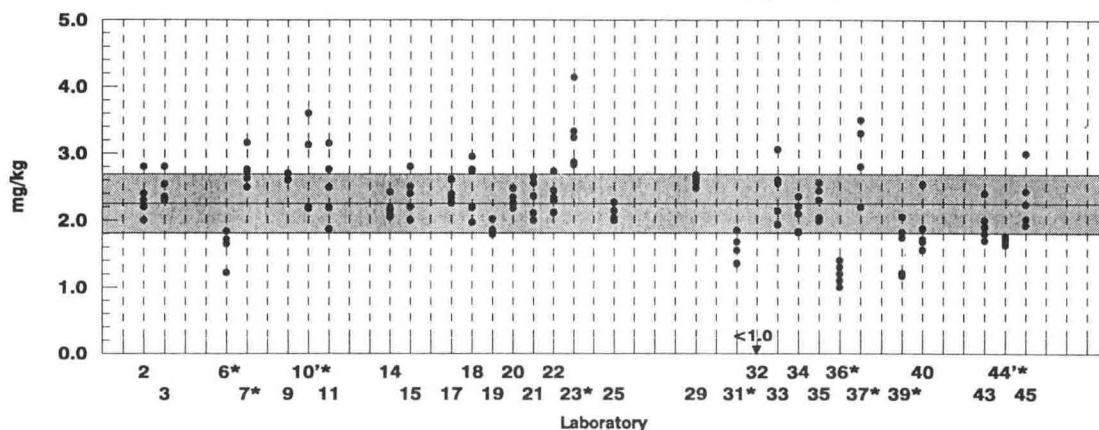
NIST SRM 1566a

Certified value = 2.25 ± 0.44 mg/kg

Results: 30

Quantitative Results: 29

Rejections: 9



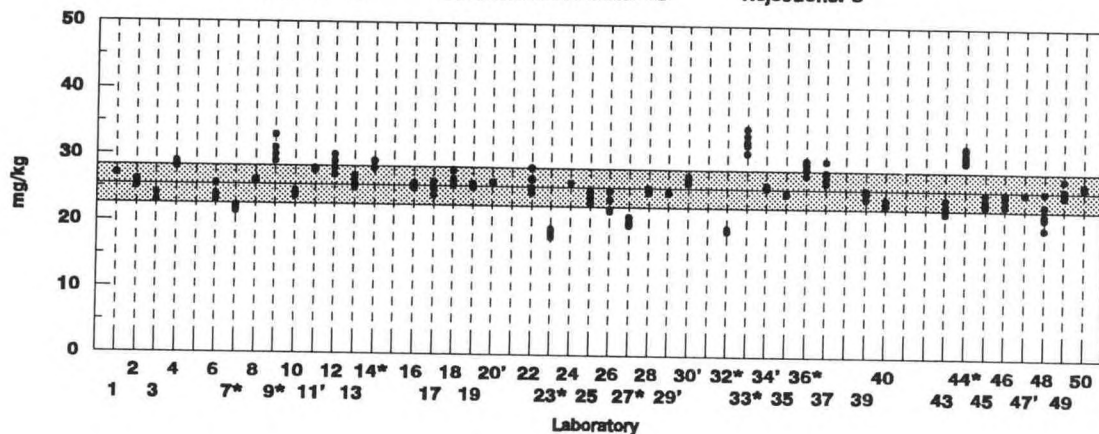
While there is no apparent improvement regarding the determination of Ni in Sediment T with respect to NOAA/6 the rejection rate for BCSS-1 has improved significantly from 42 to 32 percent. Of the laboratories that took part in NOAA/6 the rejection rate was halved from ten to five.

There is some improvement in the determination of Ni in tissue, especially when the low concentration of Ni is considered. The overall intralaboratory precision for SRM 1566a is 15 percent RSD compared to 10 percent for Tissue S, the highest of all the analytes in the tissues. These high scatters, as with Cr, are disturbing and may be an indicator of stainless steel contamination during the preparation of the materials. The Youden plot does not indicate reveal systematic errors but rather a mixture of low results for the CRM and high results for Tissue S.

COPPER

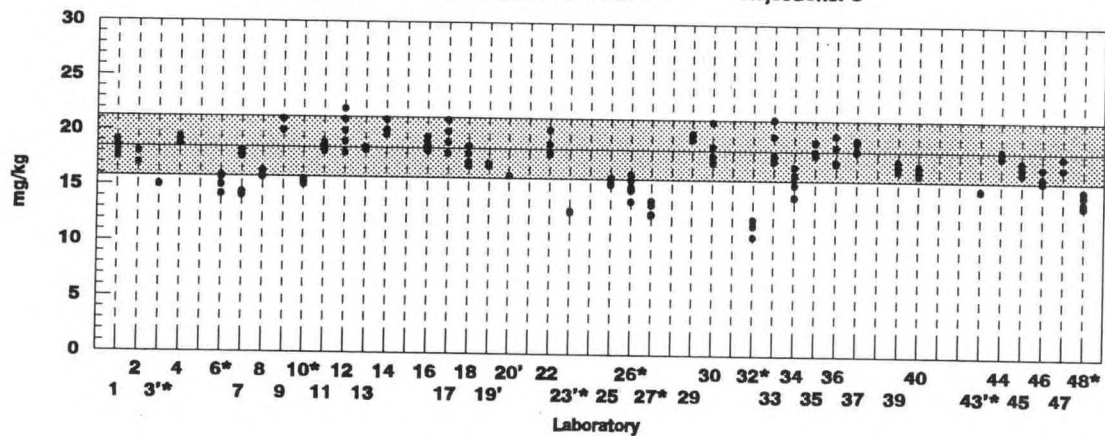
Sediment T

Accepted value = 25.4 ± 2.9 mg/kg
 Results: 43 Quantitative Results: 43 Rejections: 9



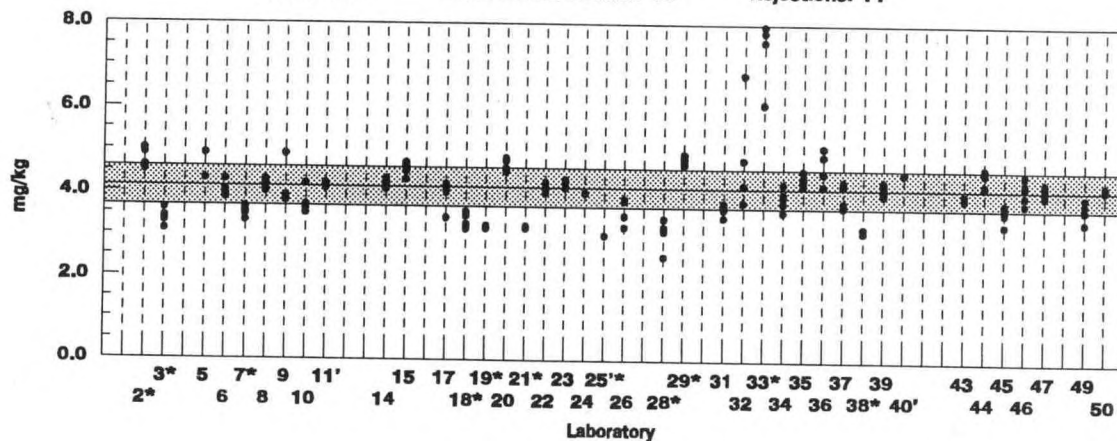
BCSS-1

Certified value = 18.5 ± 2.7 mg/kg
 Results: 39 Quantitative Results: 39 Rejections: 9



Tissue S

Accepted value = 4.13 ± 0.46 mg/kg
 Results: 40 Quantitative Results: 40 Rejections: 11



COPPER

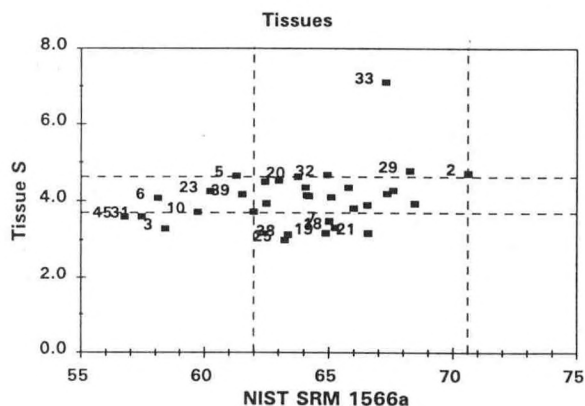
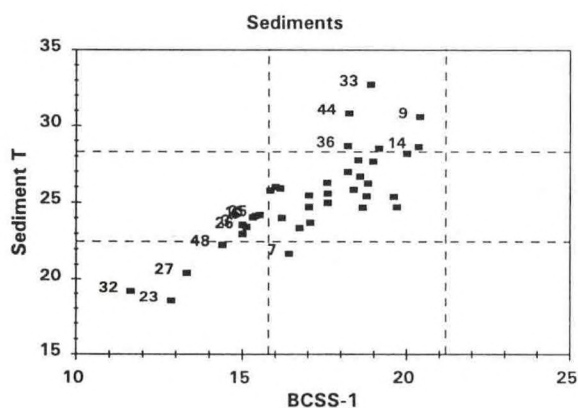
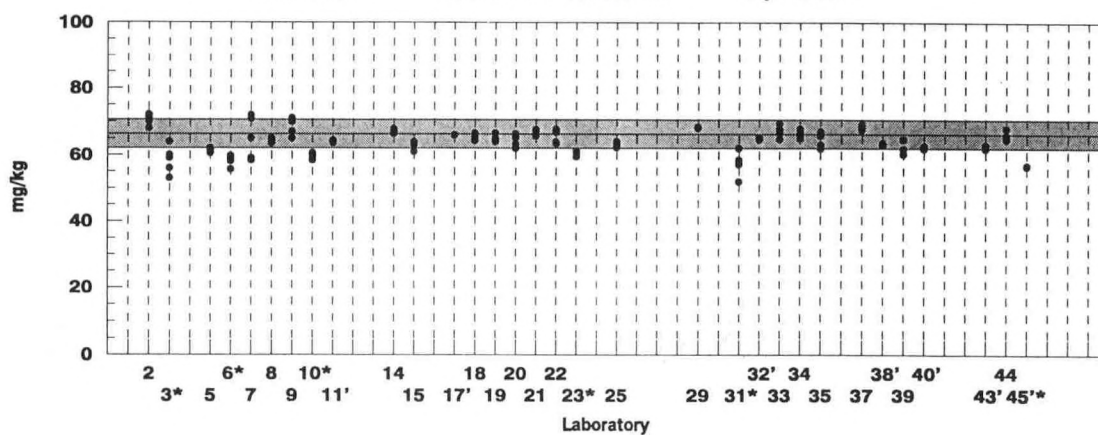
NIST SRM 1566a

Certified value = 66.3 ± 4.3 mg/kg

Results: 32

Quantitative Results: 32

Rejections: 6



The results for copper in Sediment T are significantly improved over those for NOAA/6. This is an unusual example where the statistical evaluation for Sediment T resulted in a very tight confidence interval for the unknown (± 11 percent compared to ± 15 percent for BCSS-1). Performance with regard to BCSS-1 is about the same as in NOAA/6. The Youden plot shows some systematic errors but, by and large, the same laboratories keep reappearing in the lower left quadrant.

A good improvement for the determination of copper in the biological samples is also evident. The confidence interval for Tissue S is ± 11 percent compared to ± 25 percent for the unknown biological in NOAA/6. Also, the means of only six of thirty-two laboratories were rejected for SRM 1566a compared to ten of eighteen laboratories in NOAA/5. The large difference in the copper concentrations of the two tissue samples distorts the Youden plot.

ZINC

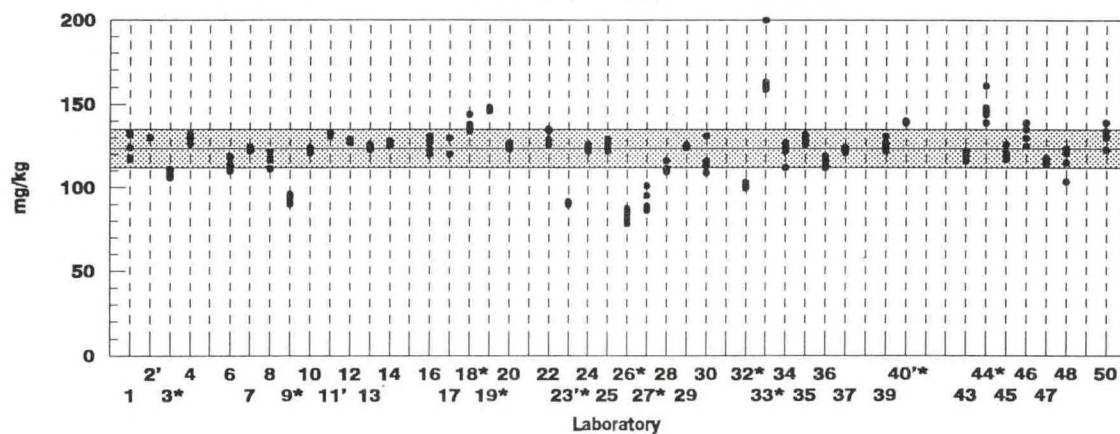
Sediment T

Accepted value = 123 ± 12 mg/kg

Results: 42

Quantitative Results: 42

Rejections: 11



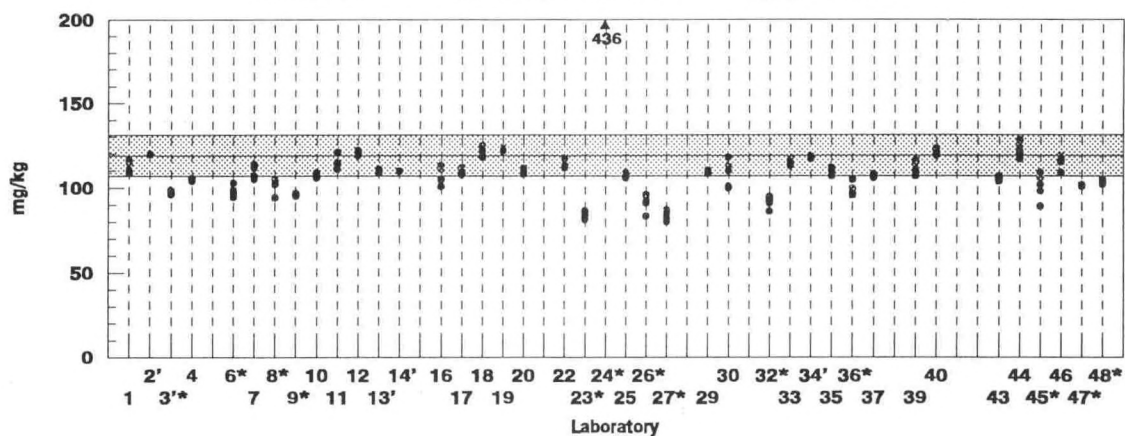
BCSS-1

Certified value = 119 ± 12 mg/kg

Results: 40

Quantitative Results: 40

Rejections: 13



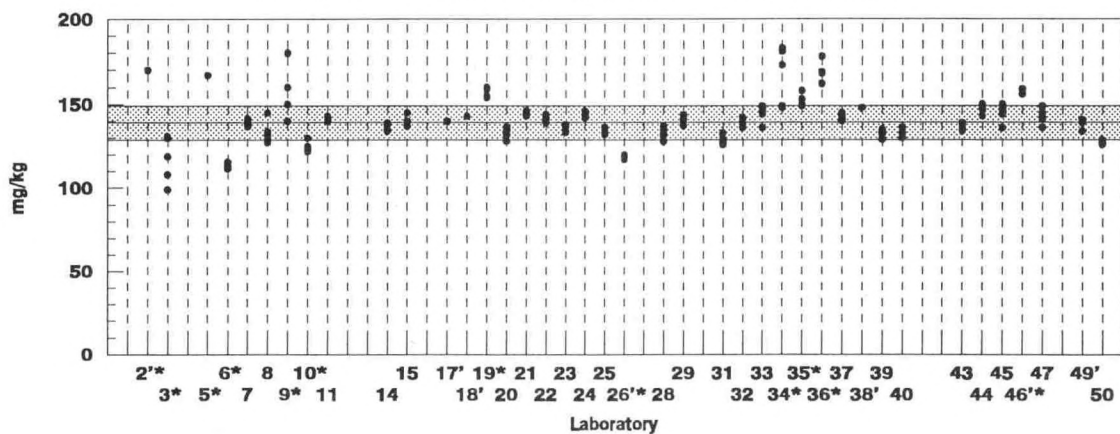
Tissue S

Accepted value = 139 ± 10 mg/kg

Results: 40

Quantitative Results: 40

Rejections: 12



ZINC

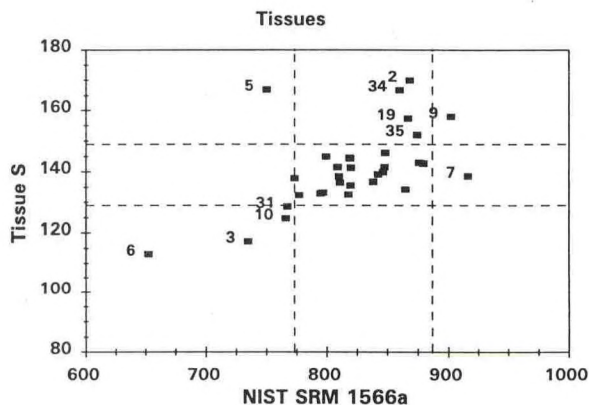
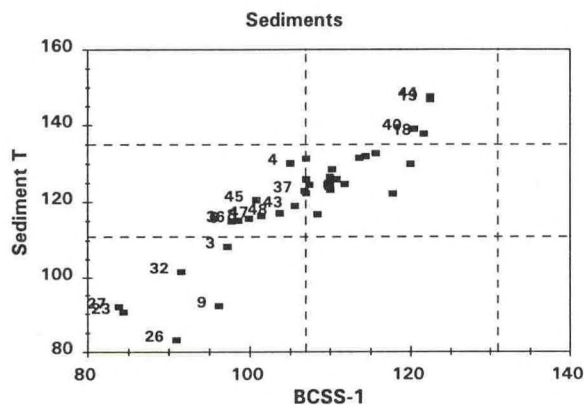
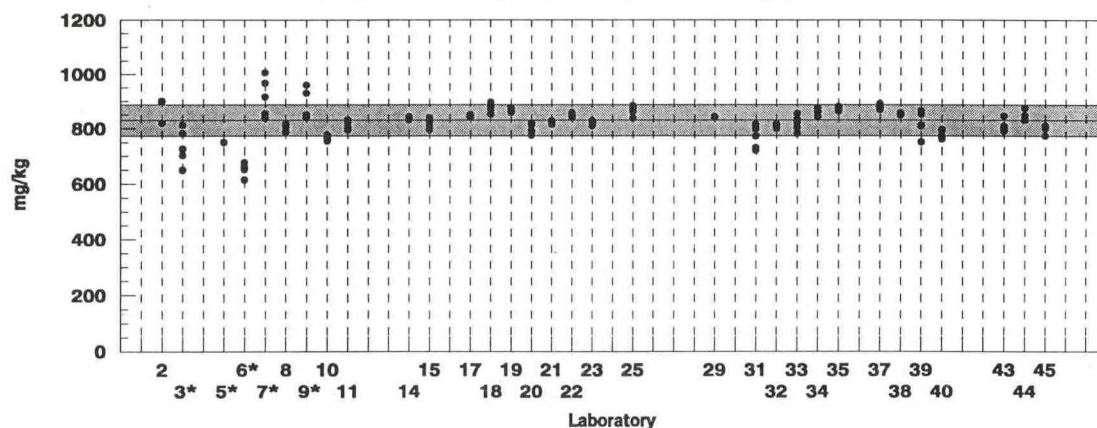
NIST SRM 1566a

Certified value = 830 ± 57 mg/kg

Results: 32

Quantitative Results: 32

Rejections: 5



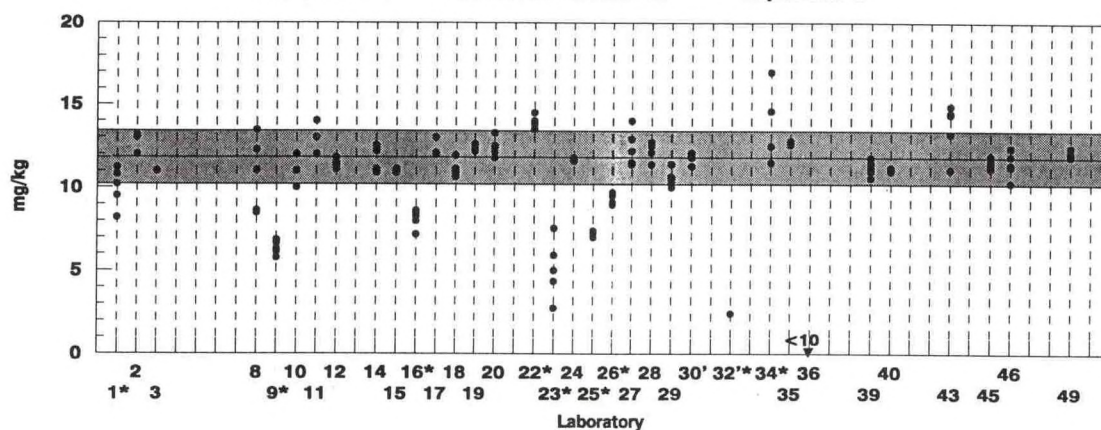
Improvement with regard to the analysis of the sediments for zinc is also evident. The calculated confidence interval for Sediment T is ± 11 percent, down from ± 24 percent last year. The rejection rate for BCSS-1 has dropped from 61 percent (NOAA/5) to 41 percent (NOAA/6) to 33 percent (NOAA/7). This steady improvement is quite encouraging. The Youden plot demonstrates that the systematic errors are the greatest problems.

There is also a good improvement for the determination of zinc in the tissues. The confidence interval for zinc in Tissue S is ± 7 percent compared with ± 13 percent for the mussel tissue with a similar concentration analyzed in NOAA/5. The rejection rate for SRM 1566a has correspondingly fallen from 41 to 16 percent. The Youden plot is distorted due to the large differences in the concentrations of zinc in the two samples. However, it is evident that more high zinc results were reported than for most other elements in the tissues.

ARSENIC

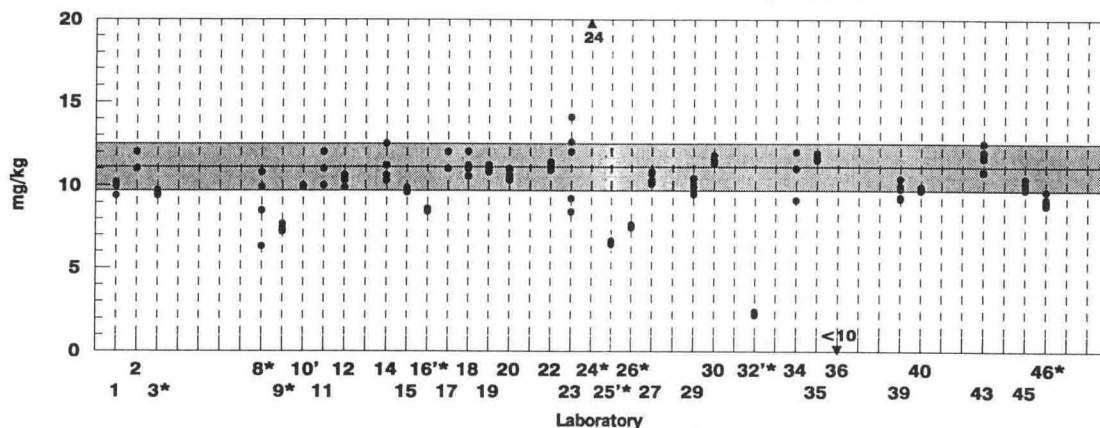
Sediment T

Accepted value = 11.8 ± 1.6 mg/kg
 Results: 34 Quantitative Results: 33 Rejections: 9



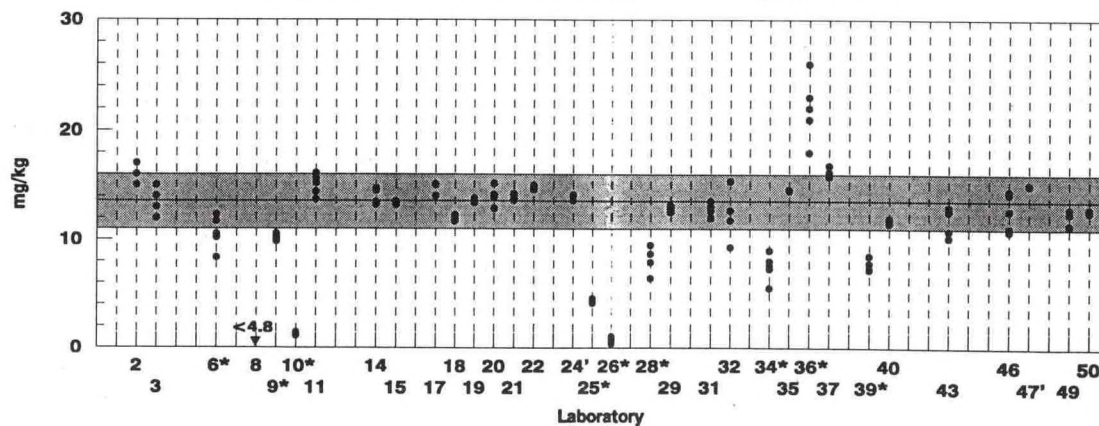
BCSS-1

Certified value = 11.1 ± 1.4 mg/kg
 Results: 32 Quantitative Results: 31 Rejections: 9



Tissue S

Accepted value = 13.5 ± 2.5 mg/kg
 Results: 33 Quantitative Results: 32 Rejections: 9



ARSENIC

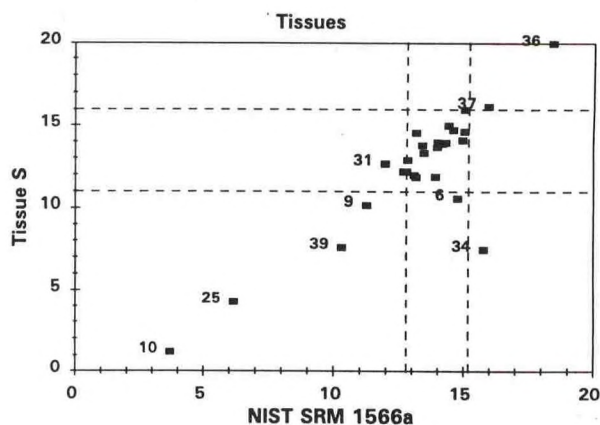
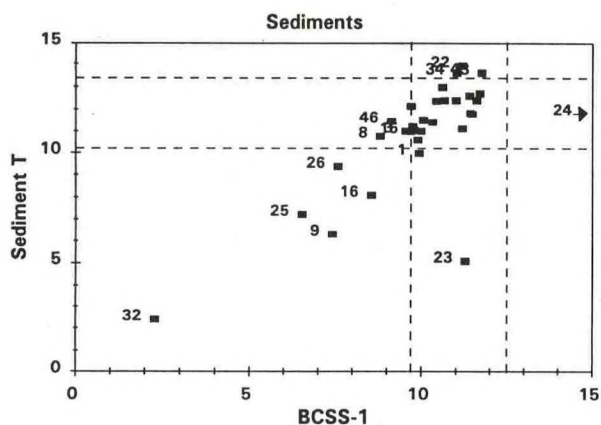
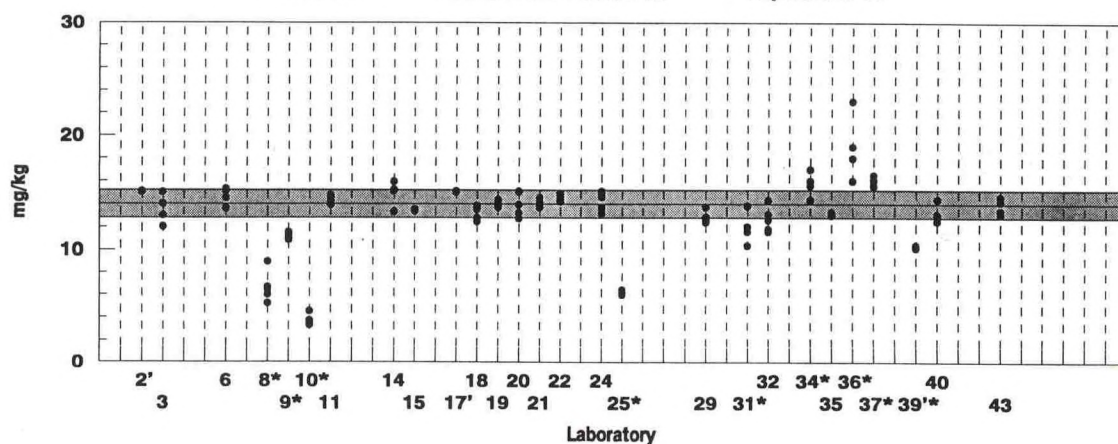
NIST SRM 1566a

Certified value = 14.0 ± 1.2 mg/kg

Results: 27

Quantitative Results: 27

Rejections: 10



The relative confidence range for the unknown sediment has decreased by a factor of three from the Chesapeake Bay sediment used as the unknown last year (± 37 to ± 13 percent). But, apparently as a consequence of this tighter data set, there was an increase in the percentage of outliers for NOAA/7 compared to NOAA/6. The rejection rate for BCSS-1 has dropped from 55 to 37 percent. The Youden plot shows that systematic errors predominate.

The confidence interval for the determination of arsenic in Tissue S is similar to that of the unknown in NOAA/6. However, the concentration of arsenic in the unknown Tissue S factor of ten lower indicating good improvement. Moreover, the confidence interval has dropped from ± 58 to ± 19 percent for a similar mussel tissue analyzed in NOAA/5. The Youden plot shows some systematic errors. The low results could be due to incomplete decomposition of very stable organoarsenic species.

SELENIUM

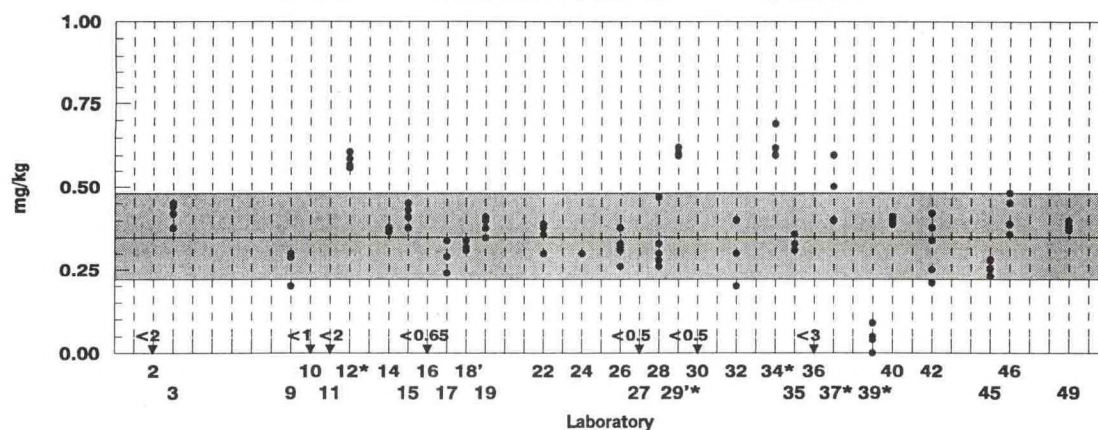
Sediment T

Accepted value = 0.35 ± 0.13 mg/kg

Results: 30

Quantitative Results: 23

Rejections: 5



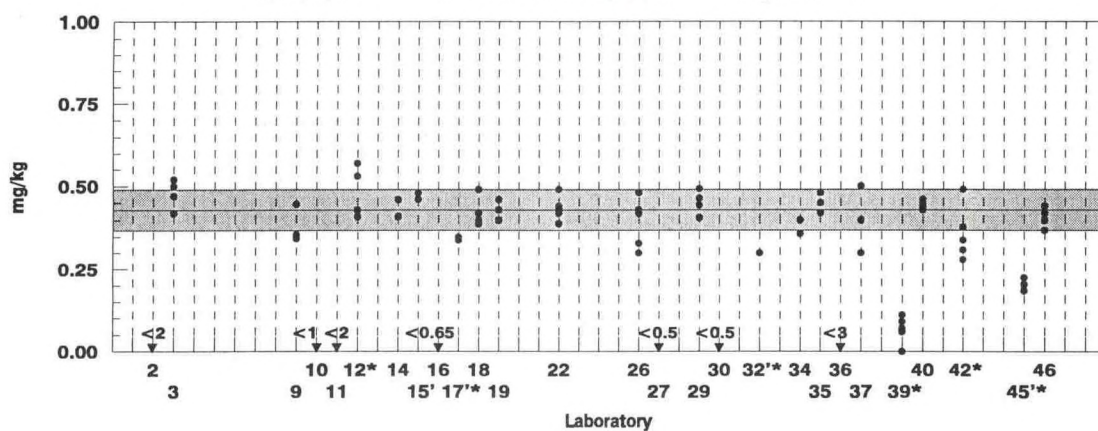
BCSS-1

Certified value = 0.43 ± 0.06 mg/kg

Results: 27

Quantitative Results: 20

Rejections: 6



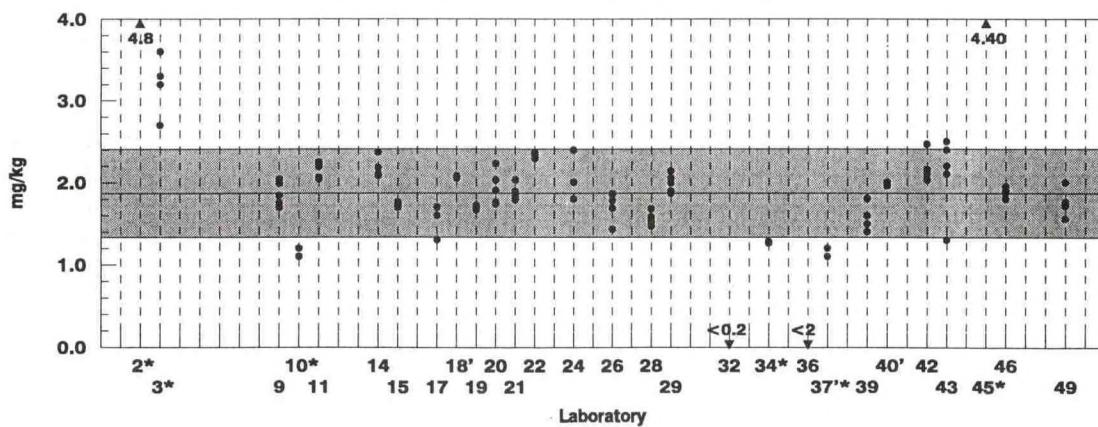
Tissue S

Accepted value = 1.87 ± 0.54 mg/kg

Results: 28

Quantitative Results: 26

Rejections: 6



SELENIUM

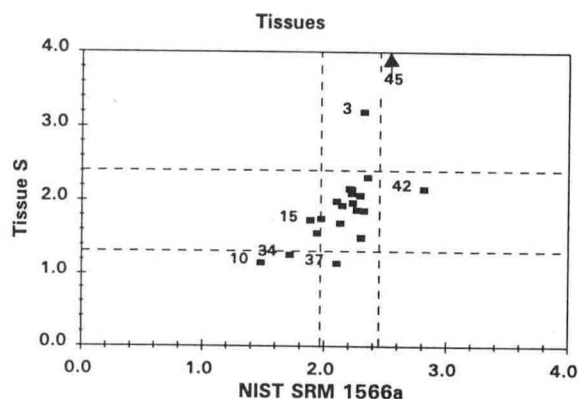
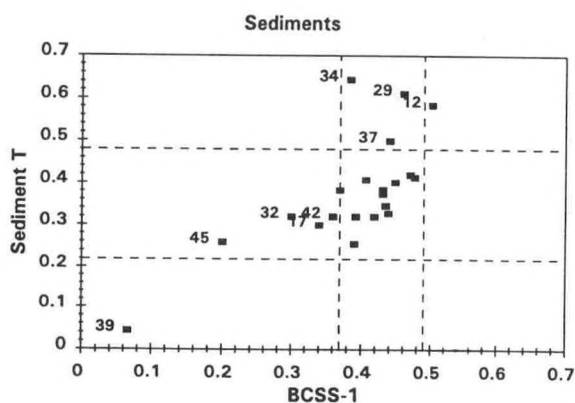
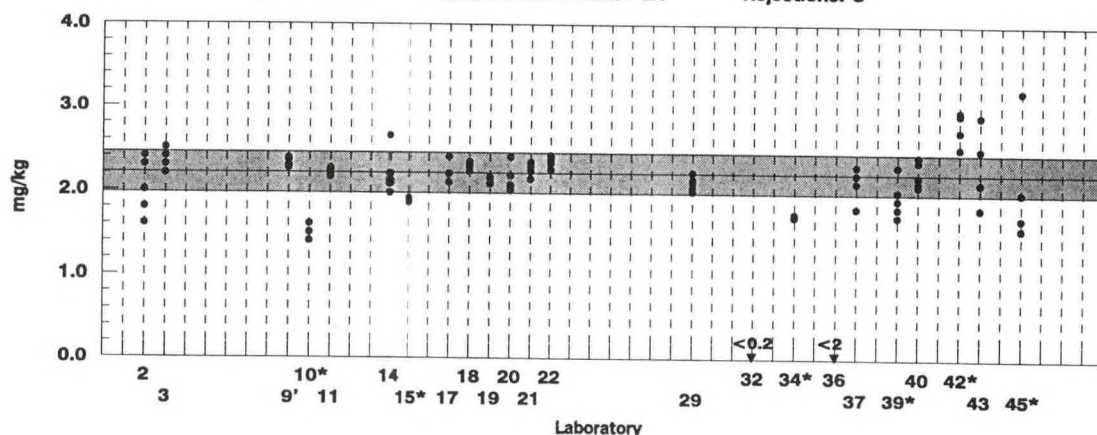
NIST SRM 1566a

Certified value = 2.21 ± 0.24 mg/kg

Results: 23

Quantitative Results: 21

Rejections: 6



Notwithstanding that the concentration of selenium in Sediment T is twice that of the sediment analyzed last year, the improvement in the calculated confidence interval from ± 60 to ± 37 percent shows good progress with what has traditionally been a difficult analyte. The rejection rate for BCSS-1 only dropped from 36 to 30 percent, but the number of laboratories submitting quantitative results increased by 43 percent. The average intralaboratory precision is greater than one would like (14 and 12 percent for Sediment T and BCSS-1 respectively). The Youden plot shows a mixture of high results for Sediment T and low results for the CRM.

There is some improvement also in the determination of selenium in the biological tissues. The calculated confidence interval dropped from ± 42 to ± 30 percent. The overall intralaboratory precision is a respectable eight percent for both samples. The Youden plot for selenium differs from the arsenic plot in that the errors seem to be more random in nature. This may indicate that selenium problems are related to the analysis rather than sample preparation. It is possible that Laboratories 2 and 45 have arithmetic problem.

SILVER

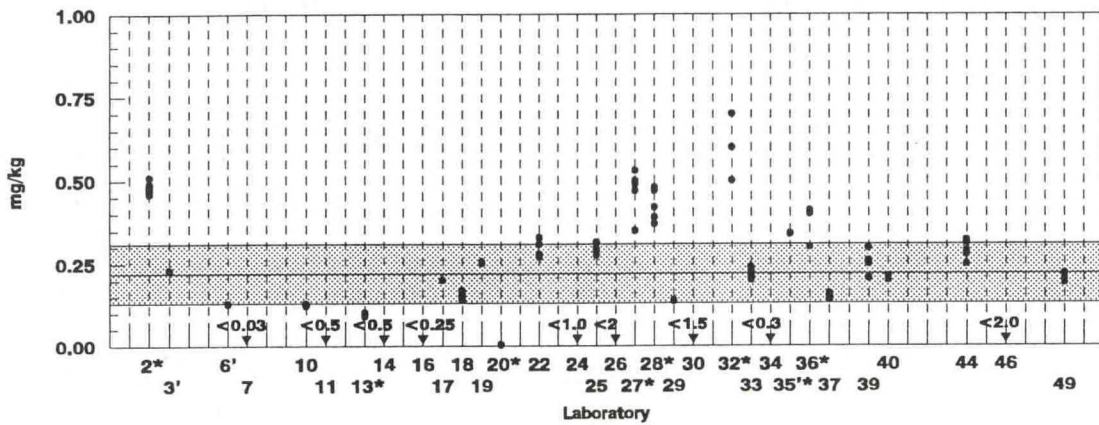
Sediment T

Accepted value = 0.22 ± 0.09 mg/kg

Results: 31

Quantitative Results: 23

Rejections: 8



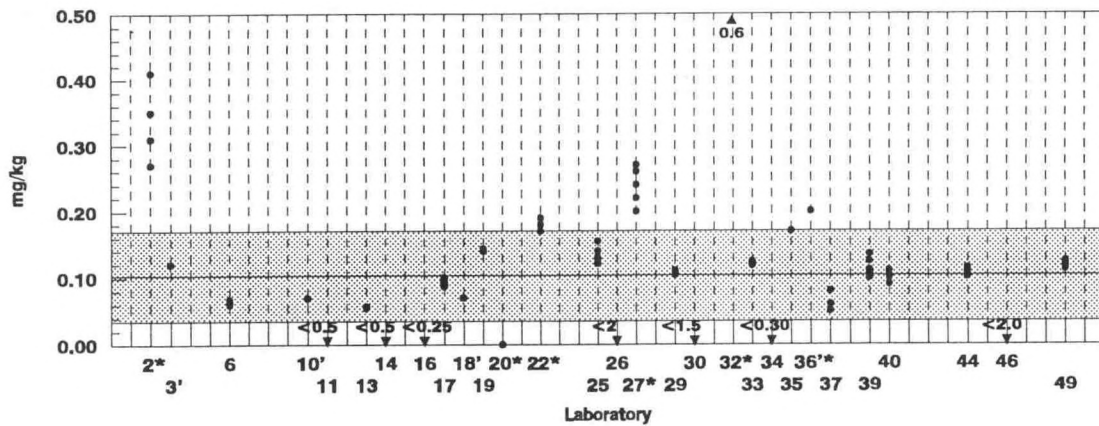
BCSS-1

Accepted value = 0.103 ± 0.068 mg/kg

Results: 29

Quantitative Results: 22

Rejections: 6



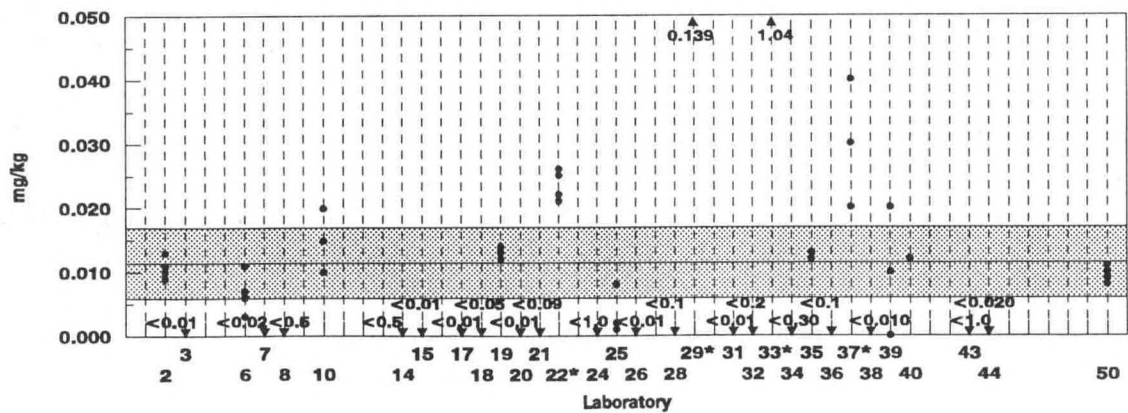
Tissue S

Accepted value = 0.011 ± 0.006 mg/kg

Results: 32

Quantitative Results: 13

Rejections: 7



SILVER

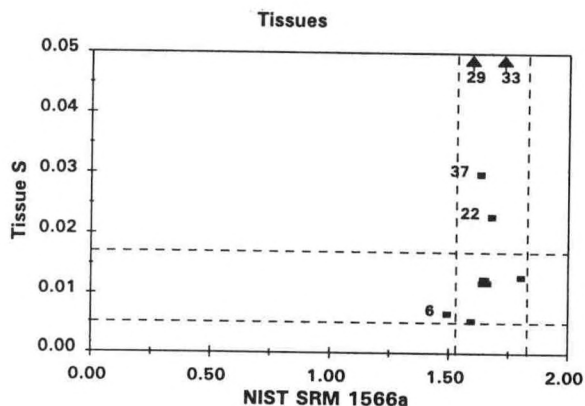
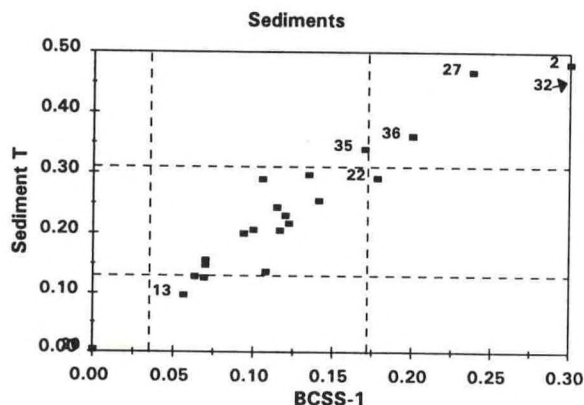
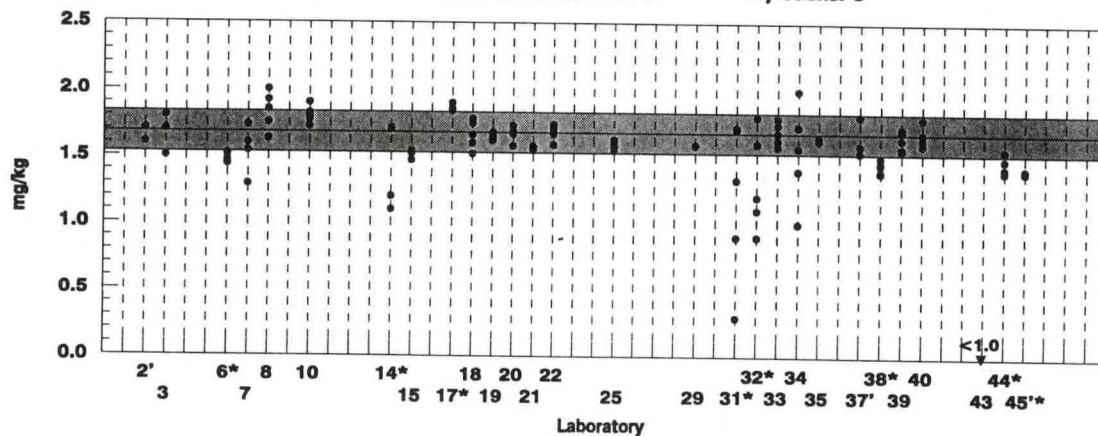
NIST SRM 1566a

Certified value = 1.68 ± 0.15 mg/kg

Results: 28

Quantitative Results: 27

Rejections: 8



Silver continues to be a problem analyte. Less than half of the participants submitted quantitative results. There is no apparent improvement for the analysis of silver in sediments over last year. BCSS-1 is not certified for silver, but we have evidence that the "true value" is not far from 0.10 mg/kg. The average intralaboratory precision is 5.3 percent RSD for Sediment T and 6.3 percent for BCSS-1 indicating the laboratories are able to determine silver with good precision. However, the calculated confidence intervals are thirty-nine and sixty-eight percent for Sediment T and BCSS-1 respectively. The Youden plot indicates systematic errors with a tendency to high results.

Only thirteen laboratories reported quantitative results for silver in the Tissue S with little apparent improvement over last year.. The concentration of silver in Tissue S is very low at one-fiftieth of the concentrations for both NOAA/6 and NOAA/5. However, the rejection rate for SRM 1566a has dropped from 42 percent in NOAA/5 to 30 percent this year. The diverse silver concentrations for the two biological samples render the Youden plot rather useless for insightful information.

CADMIUM

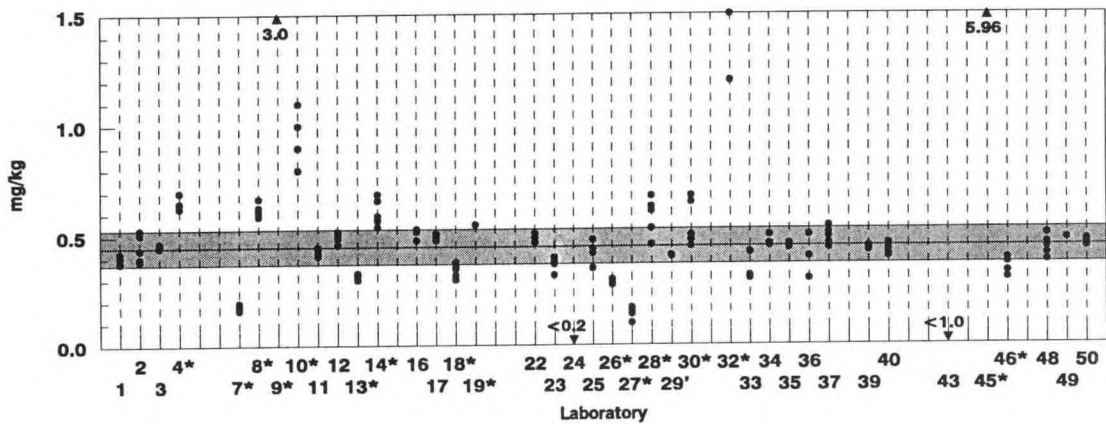
Sediment T

Accepted value = 0.45 ± 0.08 mg/kg

Results: 39

Quantitative Results: 37

Rejections: 16



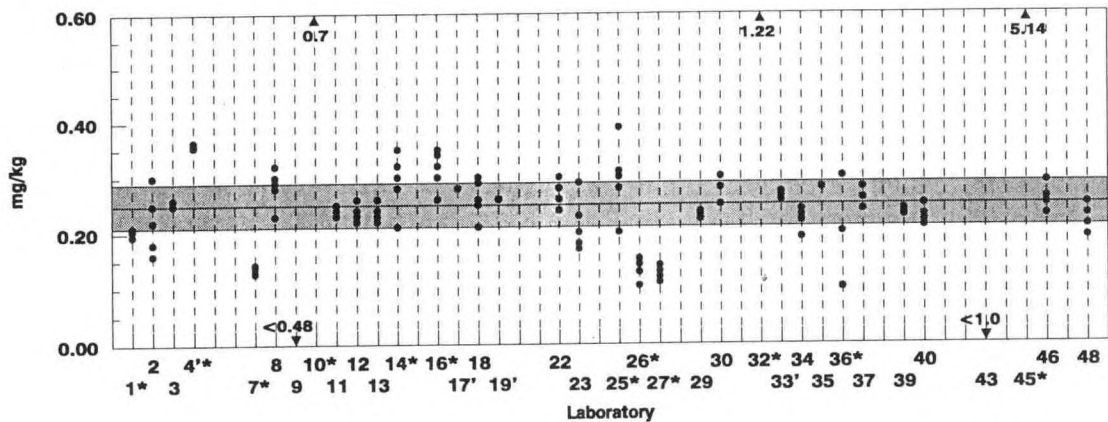
BCSS-1

Certified value = 0.25 ± 0.04 mg/kg

Results: 35

Quantitative Results: 33

Rejections: 12



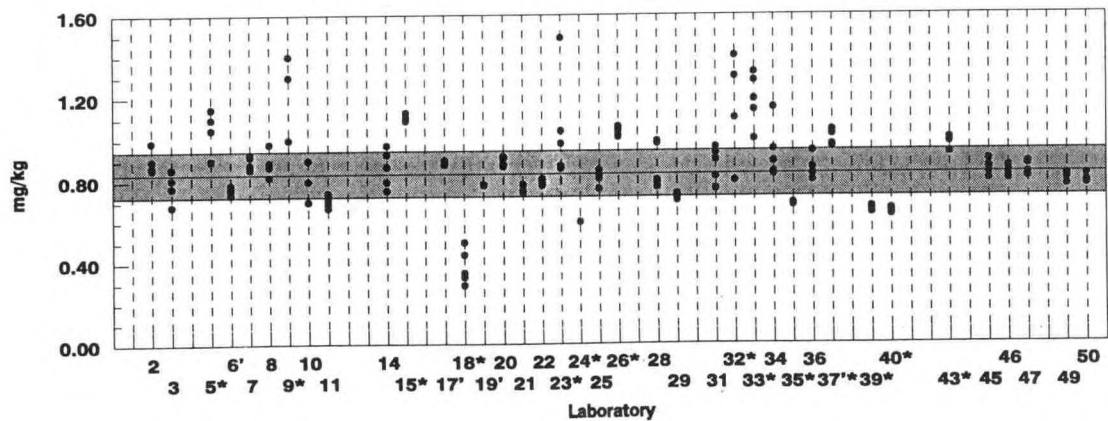
Tissue S

Accepted value = 0.83 ± 0.11 mg/kg

Results: 38

Quantitative Results: 38

Rejections: 14



CADMIUM

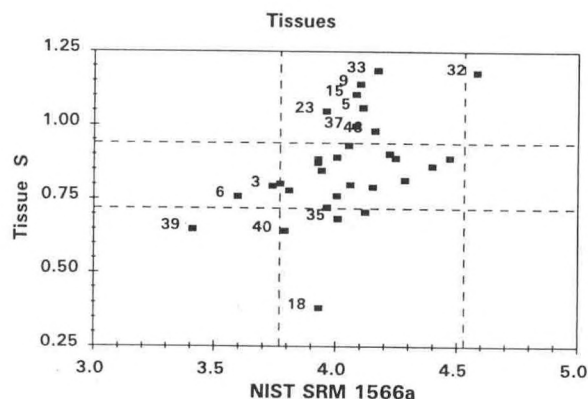
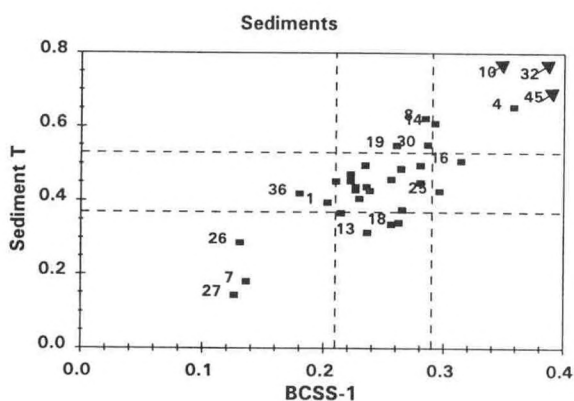
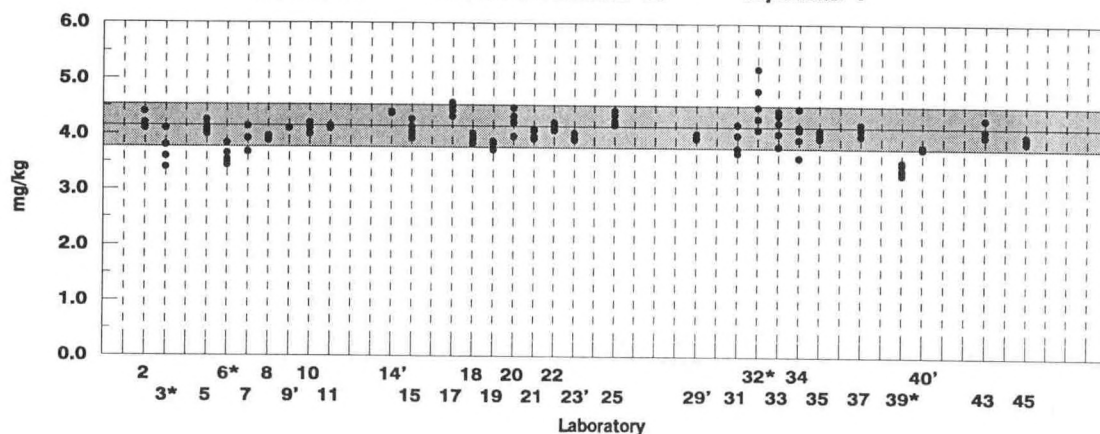
NIST SRM 1566a

Certified value = 4.15 ± 0.38 mg/kg

Results: 30

Quantitative Results: 30

Rejections: 4



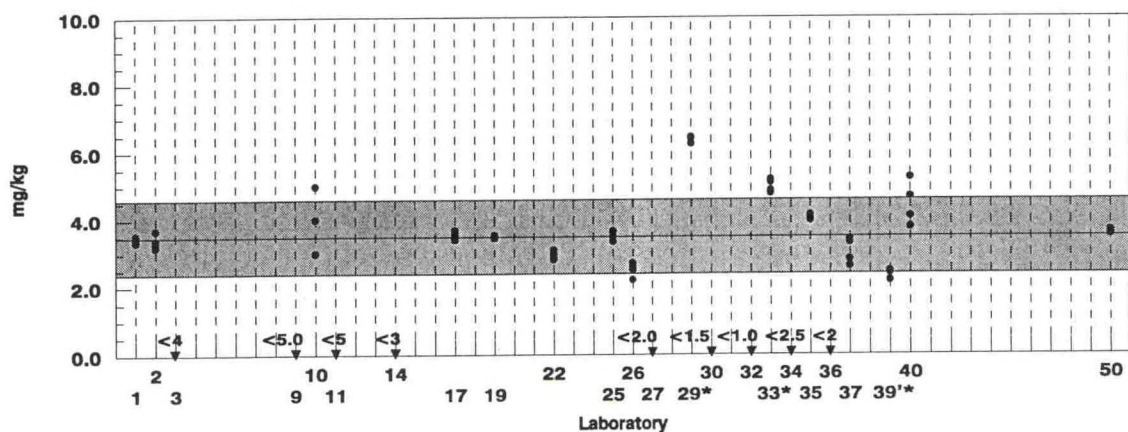
Laboratory performance for the determination of cadmium in the sediment samples is similar this year compared to NOAA/6. The accepted range for Sediment T is ± 18 percent, a factor of two less than the accepted range for the unknown sediment in NOAA/6, but the latter had one-third the concentration of cadmium. For BCSS-1, seven of twenty-four results were outside the confidence range for NOAA/6, compared to twelve of thirty-three this year. The Youden plot displays both high and low systematic errors.

There is little apparent improvement for the determination of cadmium in the tissues. It is difficult to compare with NOAA/6 because of the very low cadmium concentration in the tissue last year. But the rejection rate for SRM 1566a has dropped from 29 percent in NOAA/5 to 13 percent this year. Ten of the fourteen outliers for cadmium in Tissue S reported high results. However, the majority of these laboratories were able to report values within the certified limits for SRM 1566a. The average intralaboratory precision reported for Tissue S is 6.3 percent compared to 2.5 percent for the CRM. The Youden plot is distorted by the difference in concentrations of cadmium in the two tissues.

TIN

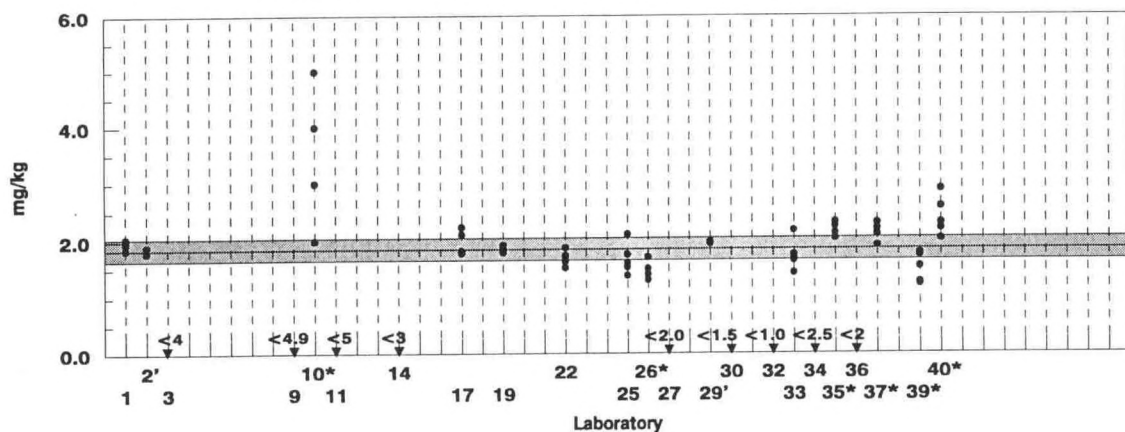
Sediment T

Accepted value = 3.48 ± 1.10 mg/kg
 Results: 24 Quantitative Results: 15 Rejections: 3



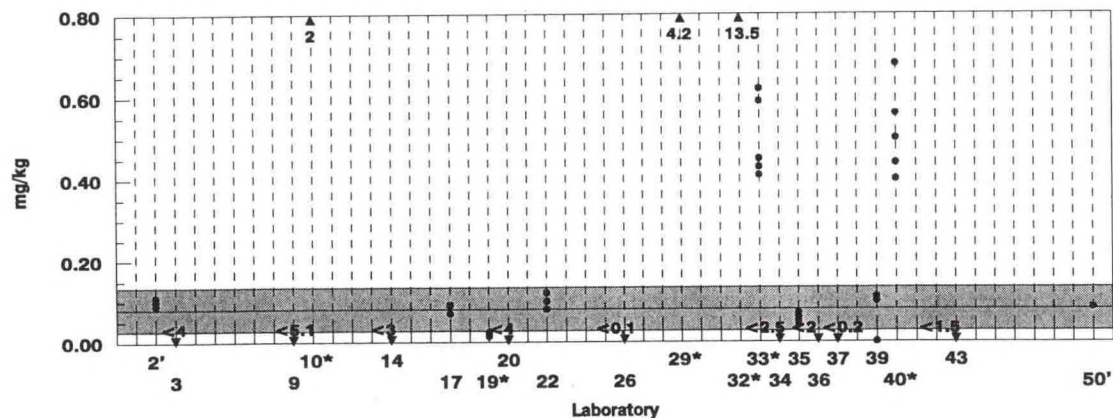
BCSS-1

Certified value = 1.85 ± 0.20 mg/kg
 Results: 23 Quantitative Results: 14 Rejections: 6

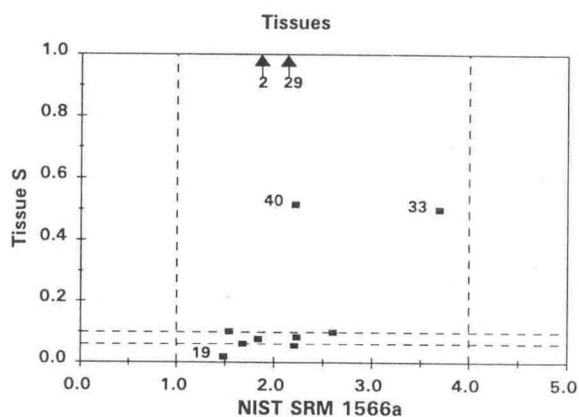
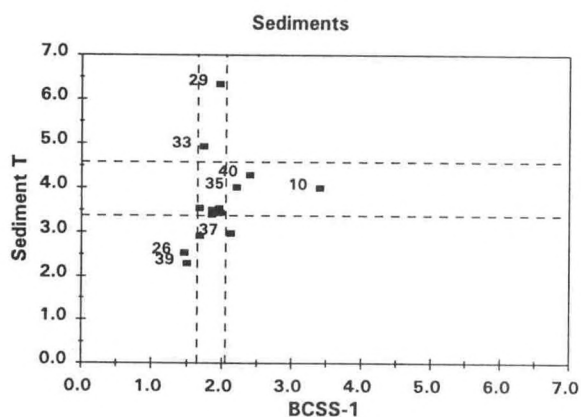
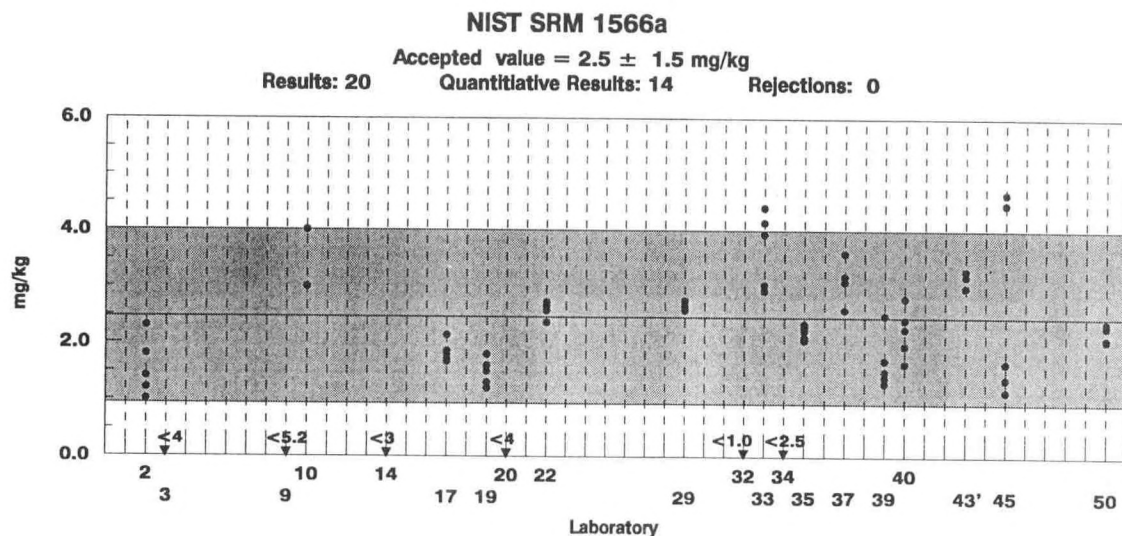


Tissue S

Accepted value = 0.080 ± 0.053 mg/kg
 Results: 21 Quantitative Results: 12 Rejections: 6



TIN



Tin continues to be a problem analyte. Only about one-quarter of the participants submitted quantitative values for tin in the sediments. The results this year are definitely worse than those for NOAA/6. Last year only one of nine quantitative results were outside the certified range for BCSS-1, this year six of fourteen results were outliers. Both the concentration and the accepted range are a factor of three larger for Sediment T than the unknown sediment in NOAA/6. The Youden plot indicates a predominance of random errors.

Last year there were insufficient results to determine an acceptable tin value in the unknown flounder tissue although NRC estimated the concentration to be about 0.05 mg/kg. This year five laboratories reported means for Tissue S within the 0.080 ± 0.053 mg/kg acceptable range. Four of the five laboratories used ICPMS to measure the tin. NIST recognises a problem with tin homogeneity in SRM 1566a and the spread of the data indicates this. Due to this situation a statistical evaluation of the data for tin in SRM 1566a was not pursued.

ANTIMONY

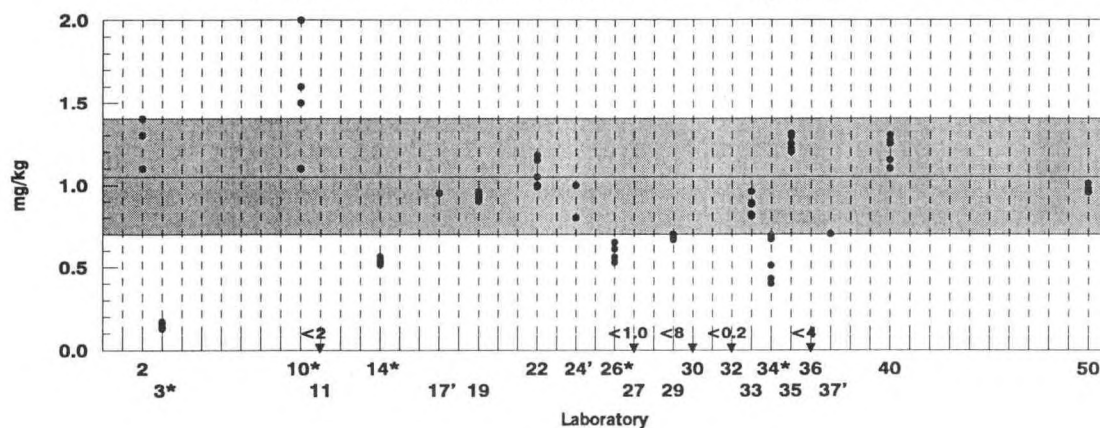
Sediment T

Accepted value = 1.05 ± 0.35 mg/kg

Results: 21

Quantitative Results: 16

Rejections: 5



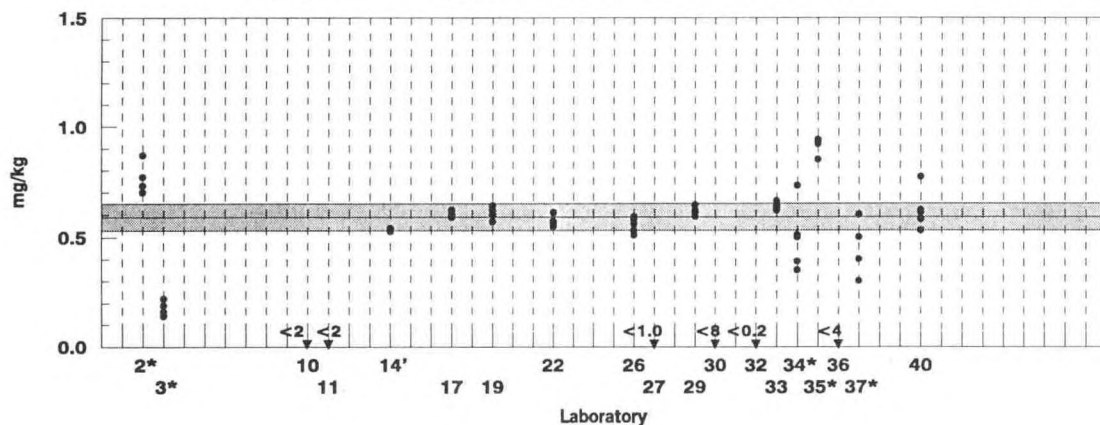
BCSS-1

Certified value = 0.59 ± 0.06 mg/kg

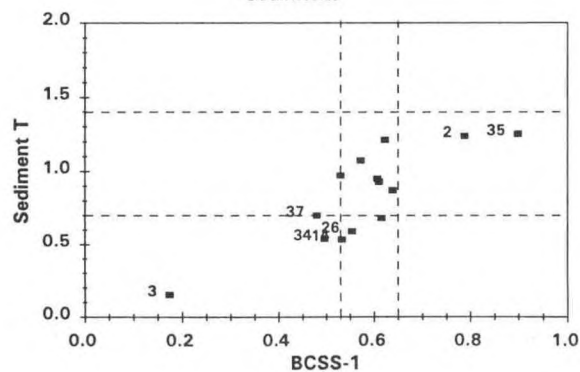
Results: 19

Quantitative Results: 13

Rejections: 5



Sediments



ANTIMONY

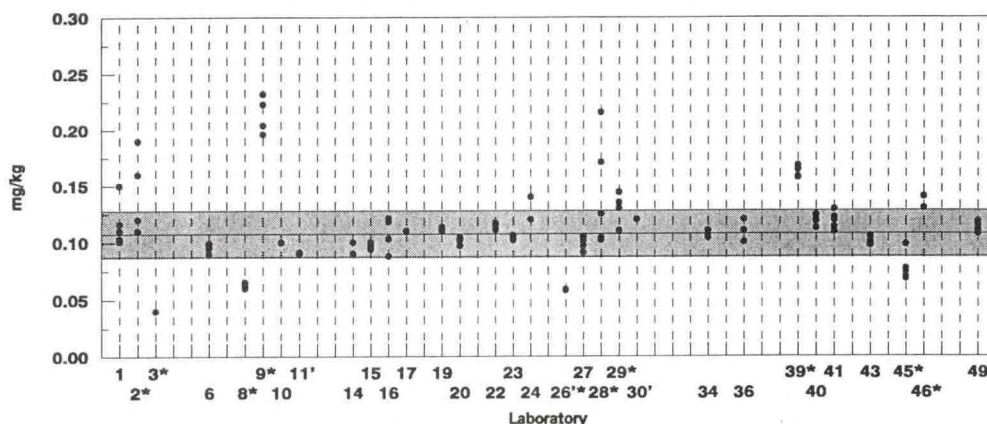
Antimony is still a problem element. There is not much improvement regarding the determination of antimony in sediments. The participation rate has doubled since last year from eight to sixteen and the acceptable range has dropped from ± 47 percent to ± 33 percent. But the antimony concentration is three times that of last year. The quality of the data has not improved for BCSS-1. The Youden plot is not particularly informative.

The determination of antimony was not required in the biologicals.

MERCURY

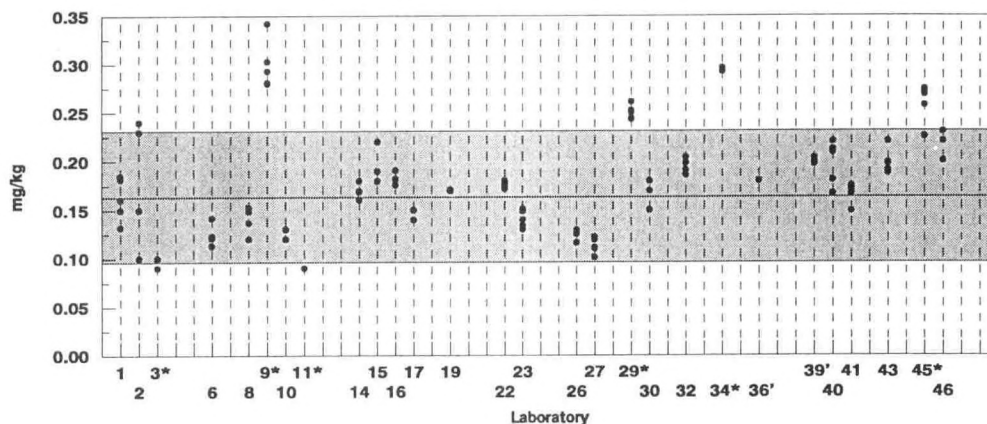
Sediment T

Accepted value = 0.107 ± 0.020 mg/kg
 Results: 31 Quantitative Results: 31 Rejections: 10



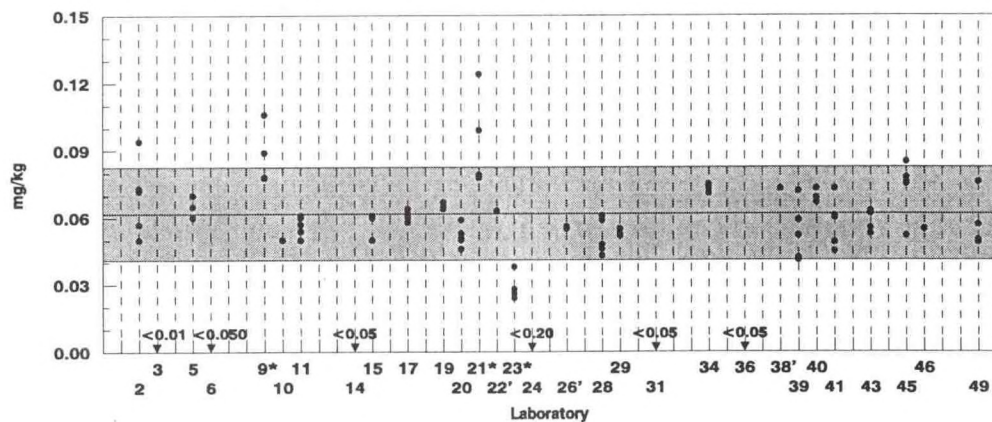
BCSS-1

Accepted value = 0.163 ± 0.067 mg/kg
 Results: 28 Quantitative Results: 28 Rejections: 6



Tissue S

Accepted value = 0.0618 ± 0.0209 mg/kg
 Results: 30 Quantitative Results: 24 Rejections: 3



MERCURY

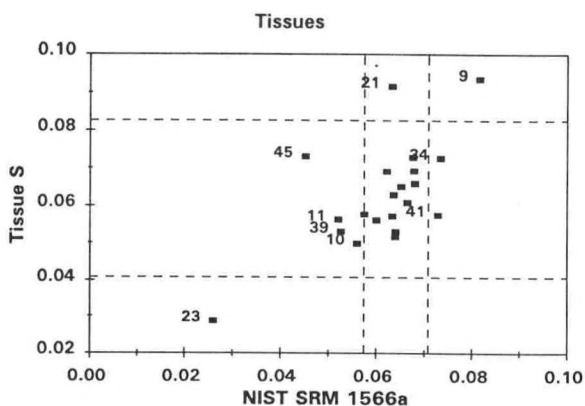
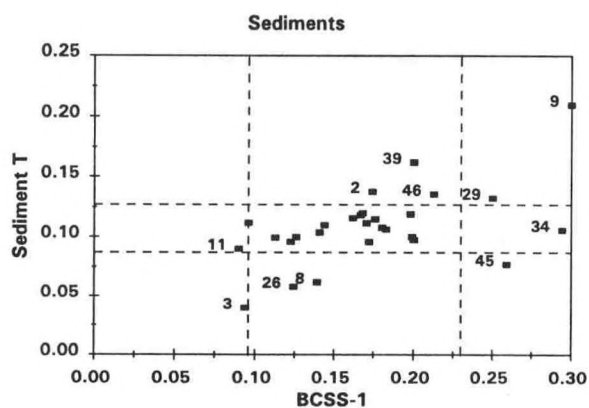
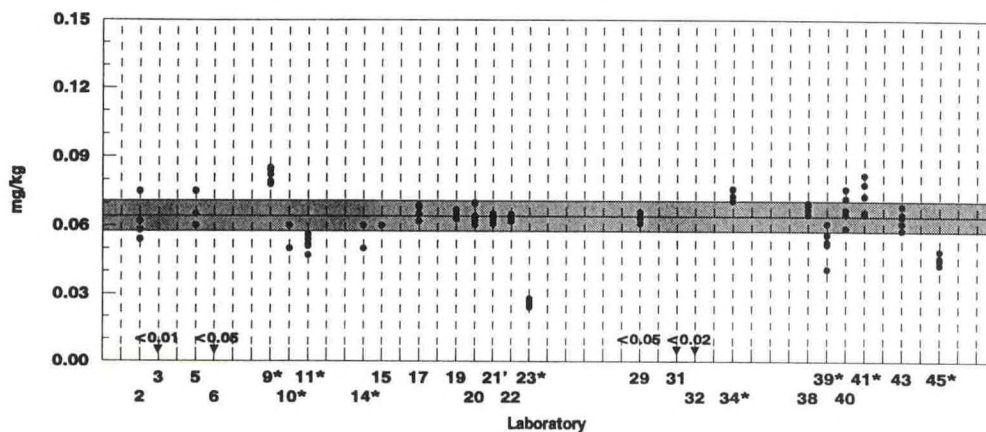
NIST SRM 1566a

Certified value = 0.0642 ± 0.0067 mg/kg

Results: 25

Quantitative Results: 21

Rejections: 9



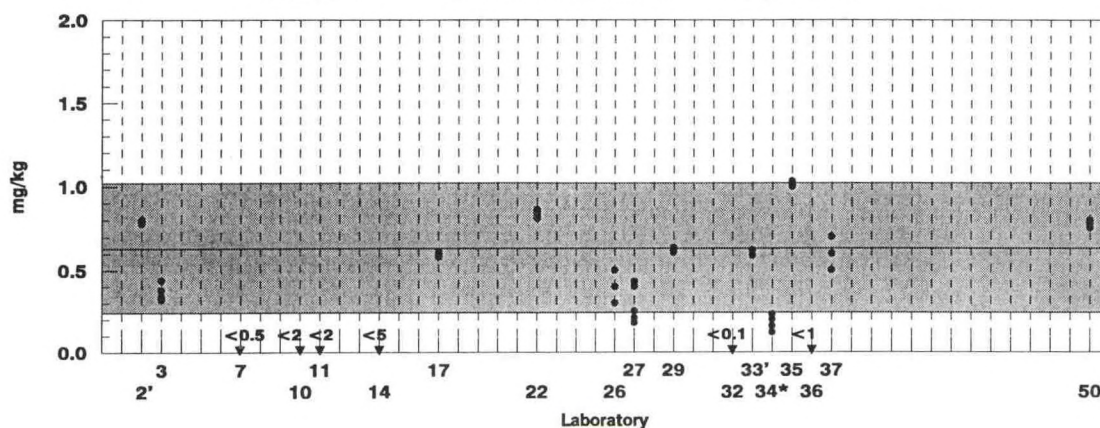
The results for Sediment T show some improvement for the determination of mercury with respect to NOAA/6. The acceptable range has dropped to ± 19 percent from ± 71 percent but the concentration of mercury is more than twice as high this year. Although, BCSS-1 is not certified for mercury, the accepted value for the past three NOAA exercises has been between 0.16 and 0.18 mg/kg with an acceptable range greater than ± 40 percent. There was no discernable improvement this year. The Youden plot displays a scattering of results.

Both of the tissues samples used this year have very low mercury concentrations which makes it difficult to compare to NOAA/7 where samples with elevated levels were used. For Tissue S with a ± 33 percent acceptable range only twelve percent of the results were outliers. This must be judged as good performance. The small certified range of ± 10 percent for SRM 1566a rejects forty-two percent of the results, about the same as for NOAA/5. The Youden plot is not informative.

THALLIUM

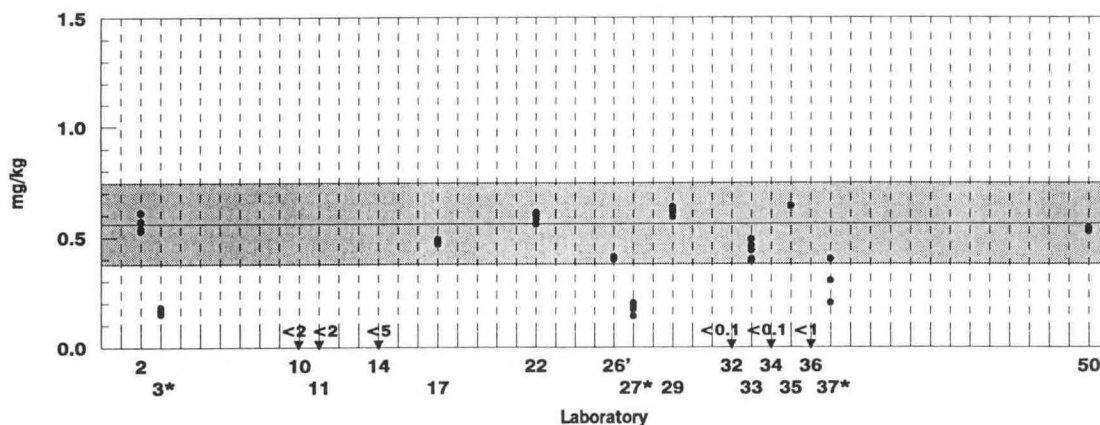
Sediment T

Accepted value = 0.63 ± 0.39 mg/kg
 Results: 18 Quantitative Results: 12 Rejections: 1

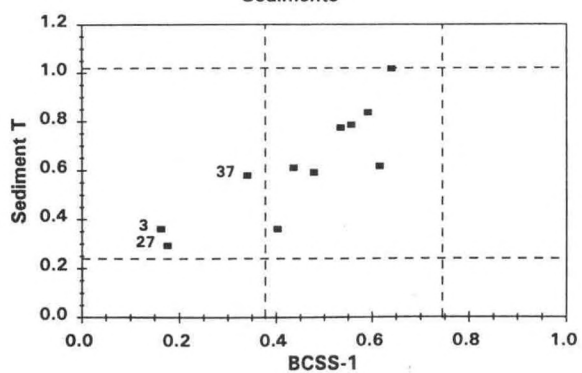


BCSS-1

Accepted value = 0.56 ± 0.18 mg/kg
 Results: 17 Quantitative Results: 11 Rejections: 3



Sediments



THALLIUM

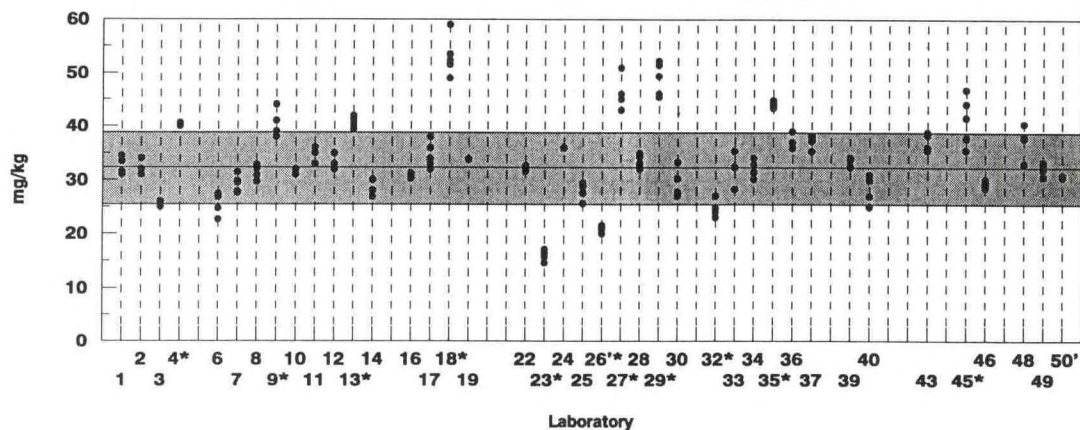
This is the first year more than two results have been received for thallium. Twelve and eleven quantitative results were submitted for Sediment T and BCSS-1 respectively. These resulted in acceptable ranges of ± 62 and ± 32 percent for the two sediments. The concentrations of thallium in both sediments are similar but the interbottle homogeneity is probably better for the CRM. The Youden plot does not reveal any significant information. We now have some data for future comparisons.

The determination of thallium was not required in the biologicals.

LEAD

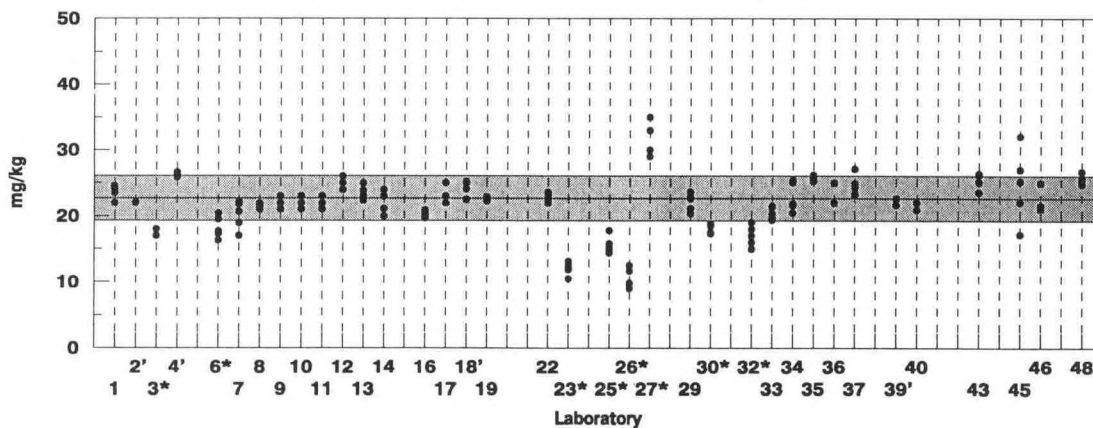
Sediment T

Accepted value = 32.1 ± 6.7 mg/kg
 Results: 40 Quantitative Results: 40 Rejections: 11



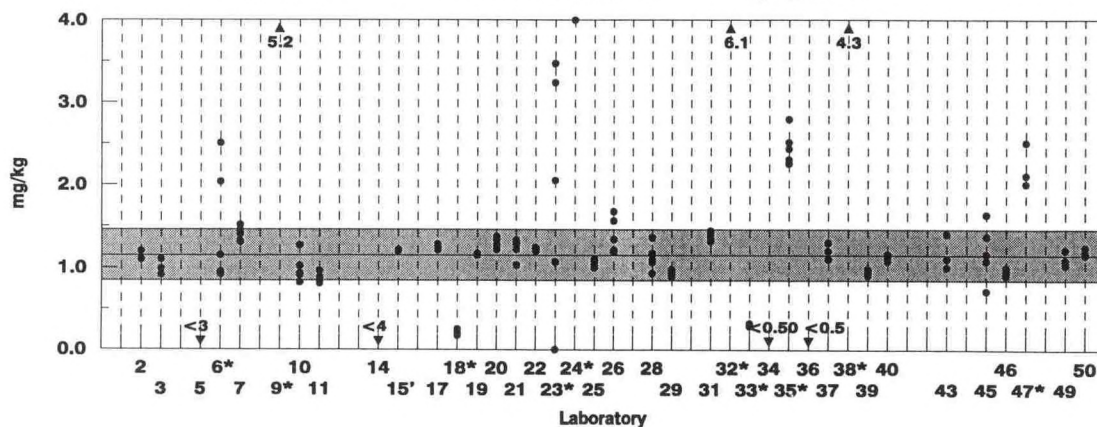
BCSS-1

Certified value = 22.7 ± 3.4 mg/kg
 Results: 36 Quantitative Results: 36 Rejections: 8

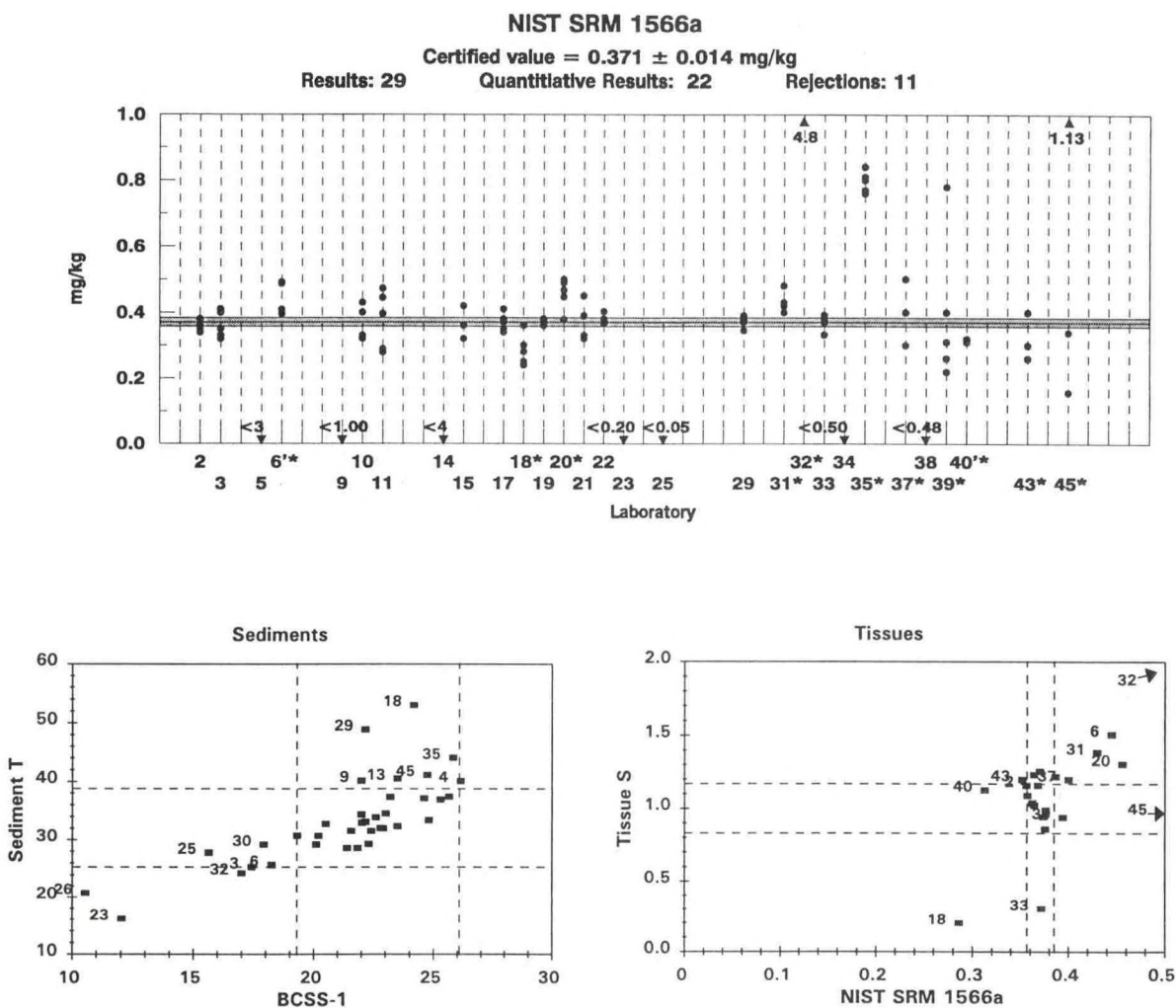


Tissue S

Accepted value = 1.14 ± 0.31 mg/kg
 Results: 38 Quantitative Results: 34 Rejections: 10



LEAD



The results for lead in the sediments did not seem to improve from NOAA/6. Last year for a sediment with one-third the concentration of lead the rejection rate was seven percent. This year, with thirteen more sets of results, the rejection rate was 28 percent. If the new participants are excluded the rejection rate drops to fifteen percent. The situation is similar with respect to the CRM. Curiously, eight of the eleven rejected means are high for Sediment T, but seven of eight outliers are low for BCSS-1.

There is also no evident improvement for the determination of lead in the tissues. For Tissue S the acceptable range has been halved (± 27 percent) with respect to NOAA/6 but the rejection rate has doubled (29 percent). The certified value for SRM 1566a has an extremely narrow confidence interval of ± 4 percent. As would be expected, a large proportion (fifty percent) of the quantitative results are outliers. This compares with sixty-six percent in NOAA/5.

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) accurate means and confidence intervals are known. This knowledge, however, presents 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. This was possible, this year for the first time, for all analytes studied.

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. For example, without the CRMs it would not be as obvious that there is a great tendency for many laboratories to produce low results for manganese and nickel in the sediments or demonstrate the good improvement in the analysis of marine samples for selenium in the tissues.

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 (5 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.

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 V 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 II for the sediments and in Table IV 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 having **Many Problems**. It should be noted that the dividing lines between the categories, especially between good and fair, are somewhat diffuse. The last three columns in Tables II and IV compare the number of laboratories in each category for the last three exercises.

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

Sediments

The average calculated confidence interval for all the Sediment T analytes is ± 23 percent compared to ± 33 percent for the unknown sediment analyzed for NOAA/6. This decrease is a reflection of three factors: i) a general improvement of the quality of the submitted data, ii) generally higher concentrations of analytes in Sediment T, and iii) an increase in the number of analyses. The last two factors are less significant because there are only a few elements where the concentration difference between the two unknown samples is greater than a factor of three, and the increase from thirty-five to fifty participants represents only a very slight decrease in the value from the *t*-distribution that is used to calculate the confidence intervals. The latter difference is significant for analytes where relatively few results were submitted in past exercises (e.g., silver, selenium, antimony). Because an individual participant's rating in Table II is relative to the performance of the group as a whole, a consequence of group improvement is that the individual laboratory must also improve to maintain its rating.

Eighteen new laboratories as well as three previous participants submitted sediment data for the first time for NOAA/7. Of this total of twenty-one new data sets, three laboratories (2,11,22) were rated superior, three were rated good, eight were rated fair and six were rated in the problem category (one submitted insufficient data to be included in Table II). Three of the laboratories in the superior category (17,19,40) are veterans which have analyzed biological tissues and sediments in all six previous NOAA exercises in this series. The other long term

veteran was rated good. Also in the superior category is Laboratory 35 which joined the studies three years ago. Special mention is deserved regarding Laboratory 29 which was rated "many problems" in NOAA/5, improved to "good" in NOAA/6 and further improved to "superior" this year.

Table II
Accuracy Evaluation for the Sediments*

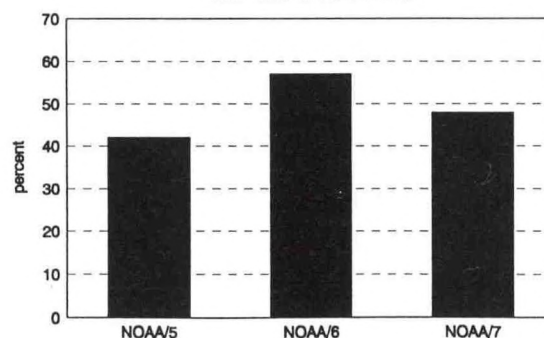
	Laboratory Number	NOAA/7	NOAA/6	NOAA/5
Superior	2,11,17,19,22,29,35,40	8	5	3
Good	1,12,13,14,18,24,30,33, 37,39,43,46	12	11	7
Fair	4,6,7,10,15,16,20,25,28, 34,44,47	12	5	7
Many Problems	3,8,9,23,26,27,32,36 45,48	10	7	6

Table III
Intralaboratory Precision Evaluation for the Sediments*

	Laboratory Number
Good	1,2,3,4,6,7,8,9,10,11,12,13,14,15, 16,17,18,19,20,22,23,24,26,29,30, 33,35,39,40,41,42,43,44,45,46,47
Fair	25,27,28,32,34,36,37,42,48

* - Laboratories 5,21,31 and 38 did not submit results for the sediments and Laboratories 41 and 42 were not evaluated due to insufficient submitted data.

Figure 1
**Laboratories in the Superior and Good Category
for the Sediments**



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 IV on page 49. The laboratory numbers are this year's designation only. This permits the laboratories to monitor their general performance over this period. Of the twenty-two laboratories that submitted sediment data for both NOAA/6 and NOAA/7 six (6,13,20,29,40,43) improved their ratings. However, six other laboratories had a worse rating, three of which descended to a poor or fair rating. Laboratory 9 was the only participant to remain in the problem category from NOAA/6. Remember that the rating is relative and you must improve to retain your former position.

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

BCSS-1 has been used as the sediment CRM since NOAA/5 and Table V (page 50) lists the individual laboratories performance for this CRM over the three years. Significant progress can be noted for Laboratories 1,17,29,35 and 40.

There are still a good number of problems concerning the analysis of marine sediments for trace metals. The following nine analytes present difficulties to at least twenty-five percent of the participants: beryllium, aluminum, chromium, zinc, silver, cadmium, antimony, mercury and lead. Many of the problems are still generally related to the incomplete dissolution of the sediment prior to analysis. Several laboratories (3,27,43) 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

Twenty-two laboratories of the forty laboratories which submitted data for the tissues are in the superior and good categories. Five of the eight laboratories (17,19,22,29,40) that produced superior results for the sediments were included in the eight rated superior in accuracy for the biological tissues (Table VII, page 45). One of the remaining three in the superior category is a new participant, another improved from good in NOAA/6 and the third is a long term veteran that rebounded from a fair last year. Of the nineteen laboratories reporting data for tissues for the first time one was superior, seven were good, four were fair and six were in the problems category (one laboratory was not evaluated). Figure 2 (page 45) indicates that there has been a steady increase in the number of laboratories in the superior and good categories for the analysis of trace metals in tissues since NOAA/5 in spite of the increased difficulty to get there.

Tissue S has significantly lower concentrations of chromium, silver and mercury compared to the fish tissue sample used for NOAA/6. Yet the average calculated confidence interval for all the analytes is ± 32 percent for Tissue S compared last year's ± 30 percent for Fish Q. Table VI (page 51) shows the number of submitted sets and the number of rejected means for the biological tissue samples over the three year period from NOAA/5 to NOAA/7. Of the twenty

laboratories that submitted tissue data for NOAA/6 eight improved their ratings (5,20,21,24,25,29,40,45) and three have worse ratings. As in the case of the analysis of the sediments, Laboratory 29 has improved from many problems in NOAA/5 to good in NOAA/6 to superior in NOAA/7.

Table VII
Accuracy Evaluation for the Biological Tissues*

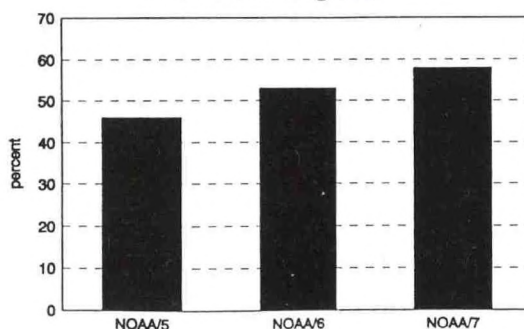
	Laboratory Number	NOAA/7	NOAA/6	NOAA/5
Superior	15,17,19,20,21,22,29,40	8	7	4
Good	2,8,11,14,18,25,31,33, 34,35,37,39,43,45	14	9	8
Fair	3,5,24,28,38,44,46,47	8	9	9
Many Problems	6,7,9,10,23,26,32,36	8	5	5

Table VIII
Intralaboratory Precision Evaluation for the Biological Tissues*

	Laboratory Number
Good	2,3,5,6,7,8,9,10,11,14,15,17,18, 19,20,21,22,23,24,25,29,34,35,37, 38,40,44,46,47
Fair	26,28,31,32,33,36,39,43,45

* - Laboratories 1,4,12,13,16,27 and 30 did not submit results for the tissues and laboratories 41 and 42 were not included in the evaluation due to insufficient data.

Figure 2
**Laboratories in the Superior and Good Category
for the Biologicals**



There were 699 sets of results evaluated for the tissues NOAA/7, up from 368 for NOAA/6 and 317 sets for NOAA/5. The rejection rates were respectively 208 (30%), 99 (27%) and 93 (29%) sets. There does not appear to be a significant difference in the rejection rate. But, remembering the performance standard for the unknown samples is relative to the group, a better estimate of the overall progress may be made by identifying the rejection rates for the CRMs. This year, there were 91 (30%) rejections in 301 NIST SRM 1566a data sets compared to 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). There is very little difference between the CRM rejection rates for NOAA/7 and NOAA/6. However, compared to NOAA/5 when NIST SRM 1566a was last used, the rejection rate has dropped significantly.

There are still a good number of problems concerning the analysis of marine tissues for trace metals. The following nine analytes present difficulties to at least twenty-five percent of the participants: chromium, nickel, zinc, arsenic, selenium, silver, cadmium, tin, and lead. Many of the problems are generally related to the low levels of some of these analytes (e.g., chromium, silver, tin). Fine particles of sediment in the shellfish materials possibly also caused some problems for the determination of aluminum and iron and even some of the other trace metals.

Sixteen laboratories that were in the good or superior category for the sediments, also analyzed the tissues. Fourteen of the these sixteen 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.

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.

Some laboratories do not seem to understand the concept of significant figures. Data can sometimes be unjustly rounded off and is information lost. Too many significant figures can mislead a reader to believe a measurement can be reproduced with great precision. Worse still, too many or too few significant figures leads to the observation that the analyst does not really understand his measuring process and the significance of his data. The number of significant figures rarely exceeds three in trace metal analysis and can be as low as two or even one. The real test is in the reproducibility (usually standard deviation) of the data. In general, only the last one or two figures would be expected to change on further replication.

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. This year for the first time inductively coupled plasma mass spectrometry (ICPMS) is listed a significant number of times (10). Almost every laboratory 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.

4. CONCLUSIONS

Participation in intercomparison exercises should assist laboratories to assess the quality of their work and whether there is improvement from year to year. Forty percent of the participants which increased the difficulty of evaluating the year to year performance. Their presence is very welcome because the larger the database the better the statistical evaluation for each analysis.

There are a number of trends which can be highlighted. There were notable improvements for the determination of silicon, nickel, copper, zinc and silver in the sediments and of chromium, iron, copper, zinc and tin in the biological tissues. On the other hand, this year the performance for tin and lead in the sediments appeared to deteriorate somewhat. Indeed as shown in Figures 1 and 2, improvements for the determination of the analytes in the tissues was more marked than that for the sediments. The laboratories that also took part in both NOAA/6 and NOAA/5 generally improved or maintained their rating for both the sediments and biological tissues.

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

Top honours must go to the five laboratories (17,19,22,29,40) that achieved a superior rating for both matrices. Next in line are the nine laboratories (2,11,14,18,33,35,37,39,43) all in the superior or good category for both tissues and sediments.

If we were to give a prize for the overall improvement from NOAA/5 to NOAA/7 for the analysis of the four samples it would have to go to Laboratory 29 (Laboratory 19 in last year's tabulation) which rose from the many problems category to a superior rating for both matrices. The pressure is now on to stay there.

5. BIBLIOGRAPHY

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6. ACKNOWLEDGMENTS

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Table IV

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

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

LAB	NOAA/7		NOAA/6		NOAA/5	
	Sets	Rej	Sets	Rej	Sets	Rej
25	24	9	22	4	20	10
26	32	21				
27	26	20				
28	10	4				
29	34	7	30	8	22	14
30	24	3				
32	27	23				
33	28	6	28	4		
34	31	11				
35	32	4	32	6	16	10
36	26	16				
37	30	7	28	9	24	7
39	28	9	28	5	22	0
40	32	2	18	1	14	0
41	2	0	16	7	16	7
42	2	1				
43	22	5	26	10	24	14
44	14	4	10	1		
45	24	13	24	10	22	8
46	18	4				
47	4	1				
48	1	10				

X	Superior
X	Good
X	Fair
X	Problems
	No results

Table V

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

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

LAB	NOAA/7		NOAA/6		NOAA/5	
	Sets	Rej	Sets	Rej	Sets	Rej
25	12	7	9	3	10	9
26	16	11				
27	13	11				
28						
29	17	1	15	3	11	5
30	12	2				
32	14	13				
33	14	0	14	0		
34	15	7				
35	16	2	15	1	9	8
36	14	10				
37	14	5	15	9		
39	14	5	14	4	11	0
40	16	1	9	1	6	0
41	1	0	6	3	7	5
42	1	1				
43	11	5	11	8	10	8
44	7	1	5	0		
45	13	8	12	7	11	5
46	9	2				
47	2	1				
48	9	7				

Table VI

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

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

LAB	NOAA/7		NOAA/6		NOAA/5	
	Sets	Rej	Sets	Rej	Sets	Rej
26	10	5				
28	8	2				
29	26	5	26	9	23	15
31	19	7				
32	17	8				
33	20	7	24	8		
34	21	5				
35	21	7				
36	10	5				
37	23	9				
38	10	3	10	0	14	4
39	24	10	24	4	20	4
40	24	4	20	2	17	1
41	2	1	16	6	16	7
42	2	1				
43	20	4	22	6	23	14
44	11	3	8	1		
45	22	8	22	11	21	12
46	8	1				
47	5	1				

X	Superior
X	Good
X	Fair
X	Problems
	No results

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 T 2.06 ± 0.56 mg/kg									
Lab						Mean	SD	RSD	
1	0								
2	5	1.5	1.4	1.5	1.5	1.6	1.5	0.1	4.7
3	0								
4	0								
5	0								
6	0								
7	5	1.49	1.37	1.64	1.59	1.64	1.55	0.12	7.5
8*	5	1.41	1.34	1.57	1.44	1.37	1.43	0.09	6.2
9*	5	0.97	1.2	1.2	1.0	1.2	1.1	0.1	10.6
10*	4	1.3	1.4	1.4	1.4	1.4	1.4	0.0	0.0
11	5	2.25	2.15	2.15	2.15	2.25	2.19	0.05	2.5
12	0								
13	0								
14	0								
15	0								
16	0								
17	5	1.85	1.96	1.97	1.94	1.94	1.93	0.05	2.5
18	0								
19	0								
20	0								
21	0								
22*	5	1.38	1.43	1.46	1.41	1.18	1.37	0.11	8.1
23*	5	0.93	0.98	0.96	0.94	0.96	0.95	0.02	2.0
24	0								
25	0								
26	0								
27	0								
28	0								
29	5	2.0890	1.9288	1.9288	2.0131	2.0131	1.9946	0.0676	3.4
30	5	<0.3	<0.3	<0.3	<0.3	<0.3			
31	0								
32	0								
33	5	2.4	2.5	2.5	2.5	2.4	2.5	0.1	2.2
34	5	2.06	2.14	2.14	1.64	1.94	1.98	0.21	10.5
35	5	2.18	2.18	2.18	2.16	2.17	2.17	0.01	0.4
36*	5	1.4	1.3	1.3	1.3	1.3	1.3	0.0	0.0
37	5	2.4	2.5	2.4	2.4	2.5	2.4	0.1	2.2
38	0								
39	0								
40	0								
41	0								
42	0								
43	5	1.79	1.74	1.77	1.77	1.74	1.76	0.02	1.2
44	0								
45	0								
46	5	1.48	1.55	1.38	1.38	1.51	1.46	0.08	5.28
47	0								
48	0								
49	5	2.03	2.03	2.14	2.19	2.14	2.11	0.07	3.4
50	0								

BERYLLIUM BCSS-1 1.3 ± 0.3 mg/kg									
Lab							Mean	SD	RSD
1	0								
2	5	1.2	1.0	0.91	0.99	0.88	1.0	0.1	12.6
3	0								
4	0								
5	0								
6	0								
7	0	1.28	1.31				1.3	0.0	1.6
8*	5	0.87	0.84	0.92	0.78	0.76	0.83	0.07	7.8
9	5	<0.49	<0.49	<0.49	<0.49	<0.49			
10*	4	1.1	1.1	1.0	1.1	1.1	1.1	0.00	0.0
11*	5	1.64	1.74	1.74	1.74	1.64	1.70	0.05	3.2
12	0								
13	0								
14	0								
15	0								
16	0								
17	5	1.43	1.4	1.43	1.32	1.36	1.39	0.05	3.4
18	0								
19	0								
20	0								
21	0								
22	5	1.11	1.06	1.05	0.99	1.18	1.08	0.07	6.6
23*	5	0.49	0.57	0.56	0.54	0.53	0.54	0.03	5.8
24	0								
25	0								
26	0								
27	0								
28	0								
29	5	1.5432	1.5298	1.5532	1.5199	1.5236	1.5339	0.0139	0.9
30	5	<0.3	<0.3	<0.3	<0.3	<0.3			
31	0								
32	0								
33*	5	1.6	1.6	1.6	1.6	1.5	1.6	0.0	0.0
34	5	1.72	1.40	1.75	1.38	1.40	1.53	0.19	12.3
35	5	1.54	1.54	1.49	1.50	1.54	1.52	0.02	1.6
36*	4	0.8	0.8	0.8	0.7	0.8	0.8	0.0	0.0
37*	5	1.7	1.7	1.7	1.7	1.7	1.7	0.0	0.0
38	0								
39	0								
40	0								
41	0								
42	0								
43	5	1.22	1.27	1.26	1.26	1.28	1.26	0.02	1.8
44	0								
45	0								
46*	5	0.96	0.87	0.72	0.83	0.83	0.84	0.09	10.3
47	0								
48	0								

The determination of beryllium was not required in the biologicals

ALUMINUM Sediment T 7.12 ± 0.92 %												
Lab							Mean	SD	RSD			
1*	5	5.39	7.46	6.33	5.00	4.56	5.75	1.16	20.2			
2	5	6.4	6.6	6.8	6.7	6.8	6.7	0.2	2.5			
3*	5	2.05	2.06	2.05	2.12	2.12	2.08	0.04	1.8			
4	5	6.8217	6.8929	6.771	6.9123	6.4643	6.7724	0.1813	2.7			
5	0											
6*	5	4.99	4.72	4.82	4.60	4.77	4.78	0.14	3.0			
7*	5	8.232	9.869	8.46	7.983	7.78	8.46	0.83	9.8			
8*	5	3.87	3.75	3.93	3.91	3.71	3.83	0.10	2.6			
9*	4	1.2	1.2	1.2	1.2	1.1	1.2	0.0	0.0			
10*	5	5.46	5.71	5.67	5.84	5.77	5.69	0.14	2.5			
11	5	7.52	7.52	7.54	7.44	7.44	7.49	0.05	0.6			
12*	5	6.22	6.07	5.98	5.89	5.88	6.01	0.14	2.4			
13	0											
14	5	7.10	7.06	7.17	7.12	6.86	7.06	0.12	1.7			
15	0											
16*	5	5.1	5.1	4.9	5.0	5.3	5.1	0.1	2.9			
17	5	7.3	7.7	7.3	7.5	7.5	7.5	0.2	2.2			
18	0											
19	5	7.46	7.17	7.20	7.29	7.30	7.28	0.11	1.6			
20*	5	3.52	3.36	3.21	3.66	4.25	3.60	0.40	11.1			
21	0											
22	0											
23*	5	1.21	1.3	1.23	1.24	1.22	1.24	0.04	2.9			
24	5	7.8	7.8	7.8	7.8	7.8	7.8	0.0	0.0			
25*	5	6.31	6.66	4.16	5.05	5.04	5.44	1.02	18.8			
26*	5	1.18	1.22	1.14	1.13	1.19	1.17	0.04	3.2			
27*	5	1.61	1.17	1.19	1.31	1.89	1.43	0.31	21.6			
28	0											
29*	5	2.4893	2.4268	2.6001	2.2694	2.3641	2.4299	0.1251	5.1			
30	5	7.48	7.39	7.53	7.27	7.21	7.38	0.14	1.8			
31	0											
32*	5	2.04	2.01	2.10	2.10	1.99	2.05	0.05	2.5			
33	5	7.57	7.57	7.62	7.49	7.88	7.63	0.15	2.0			
34	5	6.62	6.92	6.75	6.92	6.79	6.80	0.13	1.9			
35	5	7.02	6.21	6.76	6.93	7.02	6.79	0.34	5.0			
36*	5	3.07	2.93	2.79	2.78	2.92	2.90	0.12	4.1			
37	5	7.30	7.05	7.04	7.09	7.16	7.13	0.11	1.5			
38	0											
39	5	7.14	7.03	7.04	6.85	7.13	7.04	0.12	1.7			
40	5	7.50	7.22	7.09	7.24	7.48	7.31	0.18	2.4			
41	0											
42	0											
43*	4	6.49	6.53	6.5	6.58	6.24	6.53	0.04	0.6			
44	0											
45	5	6.29	6.13	5.89	6.17	5.93	6.08	0.17	2.8			
46	0	8.44	8.35	8.03								
47	0											
48*	5	3.2194	3.2443	4.408	3.2797	4.2201	3.6743	0.5882	16.0			
49	5	7.26	7.23	7.21	7.16	7.29	7.23	0.05	0.7			
50	5	7.33	7.36	7.78	7.74	7.78	7.6	0.2	3.1			

ALUMINUM BCSS-1 6.26 ± 0.41 %												
Lab										Mean	SD	RSD
1	5	6.28	6.61	6.82	5.67	5.54	6.18	0.56	9.1			
2	5	6.1	6.1	6.3	6.4	6.6	6.3	0.2	3.4			
3*	5	1.69	1.73	1.71	1.70	1.73	1.71	0.02	1.0			
4	5	5.7869	5.8814	5.7346	6.0460	5.6782	5.8254	0.1442	2.5			
5	0											
6**	4	2.80	2.80	2.70	2.80	2.80	2.78	0.04	1.6			
7	2	6.84	7.056				6.9	0.2	2.2			
8	5	2.23	2.30	2.21	2.39	2.33	2.29	0.07	3.2			
9**	4	1.2	1.2	1.2	1.2	1.1	1.2	0.0	0.0			
10*	5	4.34	4.53	4.22	4.58	4.49	4.43	0.15	3.4			
11	5	6.43	6.36	6.39	6.42	6.35	6.39	0.04	0.6			
12	5	6.83	6.63	6.46	6.43	6.41	6.55	0.18	2.7			
13	0											
14	5	5.88	5.92	5.96	5.92	5.96	5.93	0.03	0.6			
15	0											
16*	5	4.9	5.2	5.5	5.1	5.0	5.1	0.2	4.5			
17	5	6.7	5.4	6.1	6.3	6.9	6.3	0.6	9.3			
18	0											
19	5	6.12	6.25	6.31	6.41	6.28	6.27	0.11	1.7			
20	5	5.08	6.11	6.43	6.27	6.68	6.11	0.62	10.1			
21	0											
22	0											
23*	5	1.11	1.19	1.21	1.20	1.18	1.18	0.04	3.4			
24	0											
25*	5	4.53	4.79	5.47	4.52	4.78	4.82	0.39	8.0			
26*	5	1.29	1.23	1.27	1.30	1.28	1.27	0.03	2.1			
27*	5	1.23	1.29	1.28	1.32	1.32	1.29	0.04	2.9			
28	0											
29	5	6.2801	6.0231	6.1328	6.1285	6.1624	6.1454	0.0920	1.5			
30*	4	6.05	6.08	6.09	6.23	6.04	6.05	0.02	0.4			
31	0											
32*	5	1.68	1.74	1.80	1.53	1.79	1.71	0.11	6.5			
33	5	6.38	6.4	6.45	6.14	6.13	6.30	0.15	2.4			
34**	4	5.43	5.42	5.50	5.50	4.95	5.46	0.04	0.8			
35	5	6.60	6.14	6.67	6.60	6.45	6.49	0.21	3.3			
36	36	2.38	2.24	2.18	1.98	2.17	2.19	0.14	6.6			
37	5	5.93	6.19	5.89	6.15	6.24	6.08	0.16	2.6			
38	0											
39	5	6.15	5.98	5.98	6.24	6.13	6.10	0.11	1.9			
40	5	6.17	6.18	6.33	6.09	6.15	6.18	0.09	1.4			
41	0											
42	0											
43*	5	5.45	5.50	5.62	5.67	5.72	5.59	0.11	2.0			
44	0											
45*	5	5.35	5.27	5.38	5.19	5.28	5.29	0.07	1.4			
46	0	8.80	8.92									
47	0											
48*	5	2.1123	2.4285	2.2078	2.1941	1.9123	2.1710	0.1861	8.6			

ALUMINUM
Tissue S
123 ± 46 mg/kg

Lab							Mean	SD	RSD
1	0								
2*	5	230	220	230	260	260	240	19	7.8
3	5	103	89	114	117	86	102	14	13.8
4	0								
5	0								
6	5	102.6	106.0	95.6	98.2	98.9	100.3	4.1	4.1
7*	5	197.36	183.62	173.0	172.7	209.2	187.2	15.9	8.5
8	5	102.7	98.8	99.7	95.7	89.9	97.4	4.9	5.0
9	5	150	150	140	150	120	142	13	9.2
10	5	89	84	78	80	82	83	4	5.1
11	0								
12	0								
13	0								
14	5	150	162	153	155	155	155	4	2.8
15	0								
16	0								
17	5	107	94	97	93	84	95	8	8.7
18	0								
19	5	149	149	144	145	145	146	2	1.6
20	5	92.8	85.6	95.4	95.0	89.2	91.6	4.2	4.5
21	0								
22	5	137	132	143	149	139	140	6	4.6
23	5	141	149	149	152	140	146	5	3.7
24*	5	210	190	180	170	190	188	15	7.9
25	5	103.9	94.4	99.1	102.1	93.5	98.6	4.6	4.7
26	5	22	17	56	55	43.0	39	18	47.3
27	0								
28	0								
29*	5	232.65	232.65	232.45	233.48	235.42	233.330	1.232	0.5
30	0								
31	5	114.68	111.67	107.32	96.82	103.33	106.76	7.03	6.6
32	5	128	109	112	97	109	111	11	10.0
33*	5	155	204	235	189	168	190	31	16.5
34	5	145	133	134	134	144	138	6	4.3
35	5	99.2	103	98.7	98.8	103	100.5	2.3	2.2
36	5	150	130	150	140	130	140	10	7.1
37	5	137	148	140	133	143	140	6	4.1
38	0								
39	0								
40	0								
41	0								
42	0								
43	5	110	107	102	99	104	104	4	4.1
44	0								
45	5	115	115	114	119	116	116	2	1.7
46	0								
47	0								
48	0								
49	5	135	159	141	174	158	153	16	10
50	5	127	126	137	131	135	131	5	3.7

ALUMINUM
NIST 1566a
202.5 ± 12.5 mg/kg

Lab							Mean	SD	RSD
1	0								
2*	5	200	220	240	240	220	224	17	7.5
3*	5	89	77	81	98	90	102	14	13.8
4	0								
5	0								
6*	5	77.0	91.5	65.5	63.2	65.6	72.6	11.9	16.4
7	2	212.2	199.96				206.1	8.7	4.2
8*	5	119.5	99.0	127.4	125.5	94.5	113.2	15.4	13.6
9*	5	120	130	140	150	140	136	11	8.4
10*	5	50	47	50	46	47	48	2	3.9
11	0								
12	0								
13	0								
14	5	213	221	184	194	228	208	18	8.9
15	0								
16	0								
17*	5	91	82	93	87	79	86	6	6.8
18	0								
19*	5	148	149	156	142	145	148	5	3.5
20*	5	36.8	36.8	38.8	38.6	37.2	37.6	1.0	2.6
21	0								
22	5	194	193	193	193	195	194	1	0.5
23*	5	97.6	99.7	88.6	83.4	91.3	92.1	6.6	7.2
24	5	200	190	200	180	180.0	190	10	5.3
25*	5	78.7	78.3	79.6	78.3	81.1	79.2	1.2	1.5
26	0								
27	0								
28	0								
29	5	211.19	208.40	212.12	211.19	207.63	210.107	1.966	0.9
30	0								
31*	5	69.47	49.88	67.68	80.53	93.63	72.2	16.2	22.5
32	5	54	62	60	59	61	59	3	5.3
34*	5	197	208	196	175	224	200	18	9.0
35*	5	184	184	184	191	192	187	4	2.2
35	5	47.1	46.2	45.2	47.4	50.0	47.2	1.8	3.8
36	0								
37*	5	218	245	244	225	244	235	13	5.4
38	0								
39	0								
40	0								
41	0								
42	0								
43*	5	50	45	76	71	66	62	13	21.9
44	0								
45*	5	125	121	112	108	103	114	9	8.0
46	0								
47	0								
48	0								

		SILICON Sediment T 30.5 ± 3.6 %							
Lab							Mean	SD	RSD
1	0								
2	5	32.0	34.0	32.0	34.0	34.0	33.2	1.1	3.3
3*	5	0.129	0.147	0.141	0.147	0.131	0.139	0.009	6.2
4	0								
5	0								
6	0								
7	0								
8	0								
9	0								
10	0								
11	5	30.79	30.71	30.72	30.68	30.76	30.73	0.04	0.1
12	5	32.1	32.2	32.3	32.3	32.3	32.2	0.1	0.3
13	0								
14	5	29.56	29.85	30.00	30.24	30.00	29.93	0.25	0.8
15	0								
16	5	37	33.6	35.1	32.5	33.1	34.3	1.8	5.3
17*	4	28	28	28	29	28	28	0	0.0
18	0								
19	0								
20	0								
21	0								
22	0								
23	0								
24	0								
25	0								
26	5	30.3	30.7	30.4	30.1	30.0	30.3	0.3	0.9
27	0								
28	0								
29	0								
30	5	32.0	31.0	31.4	31.5	31.5	31.5	0.4	1.1
31	0								
32*	5	1.94	1.57	1.97	2.27	2.31	2.01	0.30	15.0
33	0								
34	5	28.9	28.7	28.7	28.9	29.3	28.9	0.2	0.8
35	0								
36*	5	1.0	1.2	1.3	1.2	1.4	1.2	0.1	12.2
37	0								
38	0								
39	0								
40	5	29.9	29.1	29.5	30.6	28.9	29.6	0.7	2.3
41	0								
42	0								
43	0								
44	0								
45	0								
46	0								
47	0								
48	0								
49	5	29.9	30	29.3	31.1	30.8	30.2	0.7	2.4

		SILICON BCSS-1 30.8 ± 1.0 %							
Lab							Mean	SD	RSD
1	0								
2*	5	28.0	28.0	30.0	28.0	31.0	29.0	1.4	4.9
3*	5	0.924	0.994	0.943	0.996	1.050	0.981	0.050	5.1
4	0								
5	0								
6	0								
7	0								
8	0								
9	0								
10	0								
11	5	31.08	31.03	31.08	31.05	31.02	31.05	0.03	0.1
12	5	30.0	30.1	30.1	30.2	30.1	30.1	0.1	0.2
13	0								
14	5	30.75	30.00	30.50	30.57	29.33	30.23	0.57	1.9
15	0								
16	5	31.1	28.5	30.9	32.0	30.7	30.6	1.3	4.2
17	5	31	30	29	30	29	30	1	2.8
18	0								
19	0								
20	0								
21	0								
22	0								
23	0								
24	0								
25	0								
26	5	29.8	29.8	30.0	30.0	30.0	29.9	0.1	0.4
27	0								
28	0								
29	0								
30*	5	32.1	32.9	33.1	32.7	32.8	32.7	0.4	1.2
31	0								
32*	5	0.985	1.35	0.68	1.95	1.01	1.20	0.48	40.5
33	0								
34	5	30.6	30.5	30.5	30.6	30.5	30.5	0.1	0.2
35	0								
36*	5	0.49	0.41	0.43	0.45	0.39	0.43	0.04	8.9
37	0								
38	0								
39	0								
40	5	30.7	30.9	30.3	30.5	29.9	30.5	0.4	1.3
41	0								
42	0								
43	0								
44	0								
45	0								
46	0								
47	0								
48	0								
49	0								

The determination of silicon was not required in the biologicals

CHROMIUM Sediment T 82 ± 23 mg/kg									
Lab						Mean	SD	RSD	
1	5	88.5	87.6	87.6	85.8	89.2	87.7	1.3	1.5
2	5	98	92	92	96	97	95	3	3.0
3*	5	39	39	40	40	40	40	1	1.4
4	5	91.004	90.734	91.71	89.376	89.529	90.471	0.997	1.1
5	0								
6	5	69.3	61.3	63.5	63.9	63.6	64.3	3.0	4.6
7	5	73.83	73.63	74.47	73.83	73.50	73.85	0.37	0.5
8*	5	53.43	50.65	55.73	51.01	55.40	53.24	2.38	4.5
9*	5	41	44	47	42	42	43	2	5.5
10*	4	47.4	20.3	18.8	17.9	15.1	18.0	2.2	12.2
11	5	96	90	92	93	93	93	2	2.3
12	5	89	89	88	90	86	88	2	1.7
13	5	81	71	80	85	82	80	5	6.6
14	5	100	100	94	94	95	97	3	3.2
15	0								
16	5	72.8	71.7	70.0	75.0	74.1	72.7	2.0	2.7
17	5	78	73	65	78	80	75	6	8.1
18	5	99	94	92	98	99	96	3	3.3
19	5	82.8	83.2	82.1	82.6	82.8	82.7	0.4	0.5
20	0								
21	0								
22	5	91	94	89	91	92	91	2	2.0
23*	5	29	30.4	27.9	32.0	32.6	30.4	2.0	6.5
24	5	80	78	76	80	80	79	2	2.3
25	5	71.7	73.7	74.9	72.8	74.4	73.5	1.3	1.7
26*	5	28.4	27.8	25.9	26.7	28.6	27.5	1.2	4.2
27*	5	32.2	30.7	31.4	28.3	34.1	31.3	2.1	6.8
28*	5	42.3	47.6	46.2	49.9	47.6	46.7	2.8	6.0
29	5	88.3009	89.8295	86.165	90.3194	86.3217	88.1873	1.9252	2.2
30	5	97	94	99	100	96	97	2	2.5
31	0								
32*	5	38.4	39.3	40.2	39.6	39.6	39.4	0.7	1.7
33*	5	111	113	113	118	117	114	3	2.6
34	5	75.0	73.1	72.7	74.5	73.0	73.7	1.0	1.4
35	5	98.6	98.0	98.8	98.2	98.5	98.4	0.3	0.3
36*	5	49.2	47.7	46.2	45.0	45.1	46.6	1.8	3.9
37	5	73.6	68.8	70.7	72.0	72.1	71.4	1.8	2.5
38	0								
39	5	75	81	73	73	78	76	3	4.6
40	5	92	84	89	89	93	89	4	3.9
41	0								
42	0								
43	5	67	67	68	69	66	67	1	1.7
44	5	74.9	76.4	76.6	77.4	78.6	76.8	1.4	1.8
45	5	81.7	78.9	81.1	82.4	82.0	81.2	1.4	1.7
46	0	87.3	86	90.5					
47	0								
48*	5	48.29	45.88	58.75	48.25	57.69	51.77	5.98	11.5
49	5	73.1	73.1	75.2	75.2	73.1	73.9	1.2	1.6
50	5	88.8	87.8	87	86.5	85.4	85.8	1.3	1.5

CHROMIUM BCSS-1 123 ± 14 mg/kg									
Lab							Mean	SD	RSD
1	5	122	120	117	113	117	118	3	2.9
2'	4	120	120	130	120	120	120	0	0.0
3*	4	45	45	45	46	45	45	0	0.0
4*	5	103.411	104.266	100.895	100.715	102.503	102.358	1.550	1.5
5	0								
6*	5	67.7	65.8	62	62.6	63.9	64.4	2.4	3.6
7*	5	88.17	90.27	96.20	98.7	98.4	94.3	4.8	5.1
8*	5	59.77	60.90	60.99	60.83	59.44	60.39	0.72	1.2
9*	5	41.00	42.00	41.00	42.00	43.00	41.80	0.84	2.0
10*	5	24.3	30.8	25.6	22.9	23.4	25.4	3.2	12.6
11	5	111	118	108	109	111	111	4	3.5
12	5	124	120	119	123	124	122	2	1.9
13	5	108	114	110	115	106	111	4	3.5
14'	4	111	119	118	117	117	118	1	0.8
15	0								
16*	4	92.5	91.3	89.6	89.4	105.0	90.7	1.5	1.7
17	5	114	123	119	123	118	119	4	3.2
18	5	130	126	133	123	123	127	4	3.5
19	5	118	119	121	121	121	120	1	1.2
20	0								
21	0								
22	5	111	115	119	116	114	115	3	2.5
23*	4	28.7	37.5	36.3	35.8	36.2	36.5	0.7	1.9
24	5	130	131	133	128	127	130	2	1.8
25*	5	89.2	90.7	89.1	91.6	90.3	90.2	1.1	1.2
26*	5	40.2	38.5	39.1	40.4	39.1	39.5	0.8	2.0
27*	5	38.6	37.3	35.9	36.4	38.2	37.3	1.1	3.1
28	0	47.0							
29	5	116.887	114.372	116.739	115.851	116.986	116.167	1.100	0.9
30	0	103	110	103	117	119	110	8	6.8
31	0								
32*	5	44.9	48.7	48.3	44.4	47.8	46.8	2.0	4.3
33	5	122	126	123	119	120	122	3	2.2
34*	5	96.4	97.8	96.6	97.9	99.0	97.5	1.1	1.1
35	5	114	113	113	114	113	113	1	0.5
36*	5	55.8	55.5	52.0	48.6	51.9	52.8	3.0	5.6
37*	5	92.6	93.4	91.5	91.4	93.3	92.4	1.0	1.0
38	0								
39*	5	95	92	94	98	90	94	3	3.2
40'	4	118	121	116	118	135	119	2	1.8
41	0								
42	0								
43*	5	80	81	84	82	83	82	2	1.9
44*	5	102	107	108	102	104	105	3	2.7
45*	5	96.7	102	98.2	102	101	100	2	2.4
46	0	111	115						
47	0								
48*	5	49.92	54.61	51.05	50.75	46.94	50.65	2.75	5.4

CHROMIUM
Tissue S
0.50 ± 0.30 mg/kg

Lab							Mean	SD	RSD
1	0								
2*	4	1.1	0.96	0.96	0.96	0.96	0.96	0.00	0.0
3*	5	0.75	0.98	0.77	0.79	0.94	0.85	0.11	12.5
4	0								
5	0								
6*	5	1.00	1.01	1.06	1.15	0.989	1.05	0.07	6.5
7*	5	0.87	0.99	1.03	1.11	0.97	0.99	0.09	8.8
8	0								
9*	5	1.4	0.94	1.0	1.4	1.6	1.3	0.3	22.5
10*	5	2.1	2.3	1.9	1.9	1.9	2.0	0.2	8.9
11	0								
12	0								
13	0								
14	5	<3	<3	<3	<3	<3			
15	5	0.470	0.515	0.502	0.470	0.463	0.484	0.023	4.8
16	0								
17*	5	0.83	1.05	1.07	0.8	0.81	0.91	0.14	14.9
18	5	0.48	0.49	0.51	0.46	0.45	0.48	0.02	5.0
19	5	0.50	0.50	0.53	0.54	0.49	0.51	0.02	4.2
20*	5	1.07	1.63	1.91	1.54	1.85	1.60	0.33	20.8
21	5	0.61	0.59	0.64	0.62	0.61	0.61	0.02	3.0
22*	5	0.74	0.69	0.70	0.70	0.70	0.70	0.01	1.4
23	0								
24*	5	2	2	2	2	<2	2.0	0.0	0.0
25	5	0.47	0.40	0.41	0.42	0.36	0.41	0.04	9.6
26	5	0.45	0.35	0.38	0.38	0.38	0.39	0.04	9.5
27	0								
28	5	<0.020	<0.020	<0.020	<0.020	<0.020			
29	5	0.6297	0.6098	0.6337	0.5938	0.5918	0.6118	0.0195	3.2
30	0								
31*	5	0.74	0.80	0.80	0.86	0.87	0.81	0.05	6.5
32	5	1.6	<0.2	2.6	3.6	<0.2	2.6	1.0	38.5
33*	5	0.692	0.971	0.814	0.834	0.828	0.828	0.099	12.0
34*	5	0.77	0.87	0.68	0.78	0.87	0.79	0.08	10.0
35*	5	2.64	2.65	2.65	2.64	2.65	2.65	0.01	0.2
36*	4	0.8	0.8	0.8	0.7	0.8	0.8	0.0	0.0
37*	5	1.0	0.9	1.1	1.3	1.1	1.1	0.1	13.7
38	0								
39*	4	0.38	0.33	0.33	0.32	0.33	0.33	0.01	3.0
40	5	0.32	0.44	0.40	0.32	0.32	0.36	0.06	15.7
41	0								
42	0								
43	5	<1.0	<1.0	<1.0	<1.0	<1.0			
44	5	0.87	0.69	0.79	0.81	0.71	0.77	0.07	9.6
45	5	0.551	0.460	0.525	0.662	0.454	0.530	0.085	15.9
46	0								
47	0								
48	0								
49	5	0.373	0.356	0.407	0.423	0.441	0.400	0.035	8.8
50*	4	0.519	0.491	0.520	0.515	0.517	0.518	0.002	0.4

CHROMIUM
NIST 1566a
1.43 ± 0.46 mg/kg

Lab							Mean	SD	RSD
1	0								
2	5	1.8	1.8	2.1	1.6	1.6	1.8	0.2	11.5
3	5	1.37	1.48	1.56	1.20	1.14	1.35	0.18	13.3
4	0								
5	0								
6*	4	1.39	1.77	1.34	1.43	1.44	1.40	0.05	3.6
7*	4	1.91	2.01	2.18	2.40		2.1	0.2	10.1
8	0								
9	5	1.300	1.300	1.600	1.300	1.400	1.380	0.130	9.4
10*	5	2.1	2.0	2.0	1.8	2.0	2.0	0.1	5.5
11	0								
12	0						ERR	ERR	ERR
13	0								
14	5	<3	<3	<3	<3	<3			
15	5	1.09	1.08	1.23	1.12	1.18	1.14	0.06	5.6
16	0								
17	5	1.27	1.26	1.34	1.50	1.41	1.36	0.10	7.4
18	5	1.34	1.27	1.24	1.25	1.20	1.26	0.05	4.1
19	5	1.30	1.36	1.20	1.20	1.28	1.27	0.07	5.4
20	5	0.8	0.894	1.43	0.852	1.20	1.04	0.27	26.1
21	5	0.98	1.81	1.10	1.33	1.12	1.27	0.33	25.9
22	5	1.41	1.35	1.32	1.30	1.34	1.34	0.04	3.1
23	0								
24	0								
25*	5	0.53	0.54	0.51	0.53	0.53	0.53	0.01	2.1
26	0								
27	0								
28	1	1.152							
29	5	1.7104	1.7144	1.7602	1.6567	1.6567	1.6997	0.0438	2.6
30	0								
31	5	0.83	0.80	1.05	1.20	1.34	1.04	0.23	22.3
32	5	0.60	1.20	3.20	1.00	2.00	1.60	1.03	64.3
33	5	1.59	1.35	1.24	1.15	1.50	1.37	0.18	13.2
34*	4	1.67	1.70	1.43	1.72	1.70	1.70	0.02	1.2
35	0								
36	0								
37	5	1.5	1.8	1.9	1.9	2.1	1.8	0.2	11.9
38	0								
39*	5	1.14	0.80	0.78	0.76	0.57	0.81	0.21	25.5
40	5	1.09	1.37	1.08	1.13	1.01	1.14	0.14	12.1
41	0								
42	0								
43	5	<1.0	<1.0	<1.0	<1.0	<1.0			
44	5	1.22	0.78	0.87	1.20	1.15	1.04	0.20	19.5
45	5	1.29	1.32	1.25	1.28	1.47	1.32	0.09	6.5
46	0								
47	0								
48	0								

MANGANESE
Sediment T
673 ± 98 mg/kg

Lab							Mean	SD	RSD
1	5	616	649	610	671	672	644	29	4.6
2	5	690	660	660	690	700	680	19	2.8
3	5	638	635	638	638	641	638	2	0.3
4	5	632.86	596.806	645.743	626.813	674.266	635.298	28.228	4.4
5	0								
6	5	711	687	676	678	667	684	17	2.5
7	5	621.45	641.35	644.95	637.1	636.7	636.31	8.97	1.4
8	5	664.4	700.9	637.7	658.3	674.3	667.1	23.1	3.5
9	5	580	590	570	570	570	576	9	1.6
10	5	641	648	640	651	634	643	7	1.1
11	5	705	729	726	724	717	720	10	1.3
12	5	696	695	697	699	692	696	3	0.4
13	4	680	661	679	684	683	682	2	0.3
14	5	783	782	750	756	730	760	23	3.0
15	0								
16	5	635.2	640.8	644.5	624.9	666.8	642.4	15.5	2.4
17	5	720	730	710	710	710	716	9	1.2
18	5	328	453	513	437	598	466	100	21.4
19	5	754	754	747	747	750	750	4	0.5
20	5	574	520.4	594.6	525.8	606.6	564.3	39.4	7.0
21	0								
22	5	675	690	674	688	673	680	8	1.2
23	5	571	611	588	575	582	585	16	2.7
24	5	716	716	718	712	715	715	2	0.3
25	5	636	688	698	628	654	661	31	4.7
26	5	608	614	597	608	617	609	8	1.3
27	5	580	555	567	572	560	567	10	1.7
28	0								
29	5	549.383	551.44	545.267	551.613	550.553	549.651	2.605	0.
30	5	691	693	710	708	708	702	9	1.
31	0								
32	5	610	625	620	625	621	620	6	1.
33	5	817	793	849	836	829	825	21	2.
34	5	675	679	668	670	683	675	6	0.
35	5	628	631	626	612	623	624	7	1.
36	5	702	675	704	683	720	697	18	2.6
37	5	671	634	643	656	660	653	15	2.2
38	0								
39	5	487	487	467	496	499	487	12	2.6
40	5	748	764	727	731	746	743	15	2.0
41	0								
42	0								
43	5	660	662	646	674	659	660	10	1.5
44	5	745	769	779	726	770	758	22	2.9
45	5	622	621	632	642	625	628	9	1.4
46	0	858	862	826					
47	0								
48	5	655.22	581.18	669.38	666.83	688.46	652.2	41.5	6.4
49	5	705	730	706	707	720	714	11	1.5
50	5	745	736	749	754	736	744	8	1

MANGANESE
BCSS-1
229 ± 15 mg/kg

Lab								Mean	SD	RSD
1'	4	207	223	218	214	291		216	7	3.2
2	5	240	230	250	230	240		238	8	3.5
3'	5	183	183	183	176	178		181	3	1.9
4	5	229.466	225.833	228.785	225.055	234.122		228.652	3.588	1.6
5	0									
6'	4	204	203	204	204	200		204	1	0.5
7	5	194.6	196.4	217.8	222.8	222.0		210.7	14.0	6.7
8'	5	202.1	201.6	195.9	197.4	198.6		199.1	2.7	1.3
9'	4	170.00	180.00	180.00	180.00	180.00		180.00	0.00	0.0
10'	5	193	200	197	200	197		197	3	1.5
11	5	228	236	230	213	210		223	11	5.1
12	5	245	240	243	239	241		242	2	1.0
13	5	223	216	218	216	216		218	3	1.4
14	5	235	245	234	238	248		240	6	2.6
15	0									
16	5	201.2	214.5	215.3	211.3	210.0		210.5	5.6	2.7
17'	4	220	220	220	230	220		220	0	0.0
18	5	254	218	205	218	231		225	19	8.2
19	5	226	230	231	232	233		230	3	1.2
20	5	222.6	218.6	211.4	213.0	213.6		215.8	4.6	2.1
21	0									
22	5	224	227	236	248	241		235	10	4.2
23'	5	147	150	153	152	153		151	3	1.7
24	0									
25'	5	201	212	219	204	207		209	7	3.4
26'	5	165	161	163	165	162		163	2	1.1
27'	5	145	150	141	144	145		145	3	2.2
28	0									
29	5	219.673	218.322	220.495	219.740	219.213		219.489	0.798	0.4
30	0	221	222	221	235	227		225	6	2.7
31	0									
32'	5	165	182	181	174	178		176	7	3.9
33	5	236	229	231	230	226		230	4	1.6
34'	5	185	191	187	186	184		187	3	1.4
35	5	237	240	237	237	240		238	2	0.7
36'	5	198	198	192	191	193		194	3	1.7
37	5	218	223	220	217	217		219	3	1.2
38	0									
39'	5	158	156	154	158	155		156	2	1.1
40	5	234	244	237	239	240		239	4	1.5
41	0									
42	0									
43	5	211	213	215	213	217		214	2	1.1
44	5	227	246	234	243	241		238	8	3.2
45'	5	192	201	198	199	203		199	4	2.1
46	0	234	240							
47	0									
48'	5	191.14	189.92	187.35	187.25	185.77		188.29	2.18	1.2

The determination of manganese was not required in the biologicals

IRON Sediment T 3.64 ± 0.55 %																			
Lab							Mean	SD	RSD										
1	5	3.65	3.52	3.54	3.64	3.67	3.60	0.07	1.9										
2	5	3.4	3.5	3.4	3.4	3.6	3.5	0.1	2.6										
3	5	3.17	3.19	3.13	3.15	3.16	3.16	0.02	0.7										
4	5	3.2386	3.2707	3.2077	3.3199	3.4113	3.2896	0.0797	2.4										
5	0																		
6	5	3.91	3.66	3.54	3.48	3.55	3.63	0.17	4.7										
7	5	3.99	4.13	4.18	4.13	4.10	4.11	0.07	1.7										
8	5	3.17	3.34	3.41	3.21	3.49	3.32	0.13	4.0										
9*	5	2.4	2.5	2.5	2.4	2.4	2.4	0.1	2.2										
10	5	3.78	3.93	3.96	4.02	3.78	3.89	0.11	2.8										
11	5	3.79	3.80	3.80	3.77	3.83	3.80	0.02	0.6										
12	5	3.46	3.46	3.47	3.49	3.49	3.47	0.02	0.4										
13	5	3.94	3.71	3.91	3.87	3.99	3.88	0.11	2.7										
14	5	3.74	3.69	3.74	3.69	3.72	3.72	0.03	0.7										
15	0																		
16	5	3.93	3.63	3.81	3.80	3.76	3.79	0.11	2.8										
17	5	3.6	3.6	3.6	3.6	3.6	3.6	0.0	0.0										
18	5	3.85	3.78	3.79	3.78	3.95	3.83	0.07	1.9										
19	5	3.79	3.81	3.83	3.83	3.86	3.82	0.03	0.7										
20	5	3.352	3.361	3.472	3.495	3.587	3.453	0.098	2.8										
21	0																		
22	0																		
23*	5	1.55	1.67	1.47	2.04	2.13	1.77	0.30	16.7										
24	5	3.7	3.7	3.7	3.7	3.7	3.7	0.0	0.0										
25	5	3.17	3.45	3.56	3.09	3.27	3.31	0.19	5.9										
26*	5	2.26	2.28	2.13	2.23	2.32	2.24	0.07	3.2										
27*	5	2.54	2.21	2.36	2.69	2.45	2.45	0.18	7.4										
28	0																		
29	5	3.7492	3.7553	3.7615	3.7306	3.7430	3.7479	0.0119	0.3										
30	5	3.84	3.82	3.92	3.91	3.92	3.88	0.05	1.2										
31	0																		
32*	5	2.65	2.68	2.71	2.74	2.70	2.70	0.03	1.2										
33	5	4.00	3.96	4.12	4.21	4.30	4.12	0.14	3.4										
34	5	3.05	3.08	3.63	3.59	3.05	3.28	0.30	9.2										
35	5	3.48	3.50	3.49	3.66	3.66	3.56	0.09	2.6										
36	5	3.14	3.02	3.11	3.04	3.21	3.10	0.08	2.5										
37	5	3.60	3.41	3.45	3.55	3.54	3.51	0.08	2.2										
38	0																		
39	5	3.53	3.57	3.47	3.51	3.60	3.54	0.05	1.4										
40	5	3.77	3.74	3.57	3.75	3.55	3.68	0.11	2.9										
41	0																		
42	0																		
43	5	3.40	3.40	3.32	3.47	3.39	3.40	0.05	1.6										
44	5	3.799	3.891	3.948	3.926	4.177	3.948	0.140	3.5										
45*	5	2.93	2.90	2.92	2.98	2.93	2.93	0.03	1.0										
46	3	4.16	4.19	4.09			4.15	0.05	1.2										
47	0																		
48*	5	2.9915	2.7037	3.1651	3.0050	3.2301	3.0191	0.2039	6.8										
49	5	3.89	3.9	3.91	3.91	3.87	3.90	.02	0.4										
50*	4	3.98	3.89	4.00	4.00	4.01	3.99	0.01	0.3										

IRON BCSS-1 3.28 ± 0.14 %													
Lab								Mean	SD	RSD			
1	5	3.27	3.32	3.28	3.30	3.21	3.28	0.04	1.3				
2	5	3.2	3.1	3.3	3.3	3.3	3.2	0.1	2.8				
3*	5	2.98	2.98	2.96	2.91	2.96	2.96	0.03	1.0				
4*	5	2.9192	2.9747	2.9003	3.2120	3.0313	3.0075	0.1253	4.2				
5	0												
6*	5	3.10	2.90	3.00	3.00	3.00	3.00	0.07	2.4				
7	2	3.63	3.66				3.6	0.0	0.6				
8*	5	3.60	2.83	2.81	2.76	3.19	3.04	0.36	11.8				
9*	5	2.6	2.6	2.7	2.6	2.4	2.6	0.1	4.2				
10	5	3.33	3.58	3.42	3.56	3.52	3.48	0.10	3.0				
11	5	3.34	3.3	3.32	3.35	3.34	3.33	0.02	0.6				
12	5	3.39	3.40	3.42	3.42	3.42	3.41	0.01	0.4				
13	5	3.27	3.30	3.30	3.26	3.32	3.29	0.02	0.7				
14	5	3.37	3.34	3.31	3.55	3.49	3.41	0.10	3.0				
15	0												
16	5	3.36	3.43	3.48	3.41	3.10	3.36	0.15	4.5				
17	5	3.3	3.3	3.3	3.3	3.3	3.3	0.0	0.0				
18	5	3.21	3.59	3.43	3.58	3.44	3.45	0.15	4.5				
19*	4	3.32	3.25	3.31	3.31	3.32	3.32	0.01	0.3				
20*	5	3.076	3.082	3.053	3.104	3.088	3.081	0.019	0.6				
21	0												
22	0												
23**	4	1.08	1.93	1.75	1.73	1.74	1.78	0.10	5.6				
24	0												
25*	5	2.92	3.01	3.05	2.91	2.98	2.97	0.06	2.0				
26*	5	2.40	2.31	2.35	2.35	2.33	2.35	0.03	1.4				
27*	5	2.35	2.64	2.34	2.51	2.39	2.45	0.13	5.2				
28	0												
29	5	3.2136	3.2239	3.2465	3.2403	3.2309	3.2310	0.0130	0.4				
30	5	3.30	3.36	3.38	3.53	3.43	3.40	0.09	2.5				
31	0												
32*	5	2.37	2.59	2.58	2.49	2.59	2.52	0.10	3.8				
33	5	3.28	3.33	3.23	3.22	3.34	3.28	0.06	1.7				
34*	5	3.05	2.90	2.90	2.90	3.01	2.95	0.07	2.5				
35	5	3.39	3.25	3.25	3.35	3.28	3.30	0.06	1.9				
36*	5	2.86	2.86	2.75	2.73	2.75	2.79	0.06	2.3				
37	5	3.23	3.24	3.18	3.17	3.18	3.20	0.03	1.0				
38	0												
39	5	3.09	3.16	3.09	3.11	3.12	3.11	0.03	0.9				
40	5	3.33	3.30	3.29	3.32	3.25	3.30	0.03	0.9				
41	0												
42	0												
43*	5	2.99	3.02	3.07	3.03	3.08	3.04	0.04	1.2				
44	5	3.247	3.283	3.115	3.305	3.347	3.260	0.088	2.7				
45*	5	2.444	2.481	2.500	2.520	2.590	2.507	0.054	2.2				
46	0	3.15	3.21										
47	0												
48*	5	2.7652	2.7569	2.6935	2.6883	2.6334	2.7075	0.0544	2.0				

IRON
Tissue S
171 ± 35 mg/kg

Lab							Mean	SD	RSD
1	0								
2*	5	250	240	240	230	230	238	8	3.5
3	5	160	155	173	173	148	162	11	6.8
4	0								
5	0								
6	5	147.2	142.3	141.3	158.4	142.2	146.3	7.2	4.9
7*	4	187.81	184.13	187.73	186.84	198.97	186.63	1.72	0.9
8	5	199.1	198.9	177.6	190.7	208.8	195.0	11.7	6.0
9	5	190	210	190	190	160	188	18	9.5
10	5	140	139	140	143	142	141	2	1.2
11*	4	172	201	166	165	161	166	5	3.0
12	0								
13	0								
14	5	167	166	165	168	171	167	2	1.4
15	0								
16	0								
17	5	170	160	170	160	160	164	5	3.3
18	5	176	186	147	159	169	167	15	9.0
19	5	175	176	172	174	174	174	1	0.9
20	5	151.2	166.8	141.8	156.6	153.0	153.9	9.1	5.9
21	5	173	177	175	177	175	175	2	1.0
22*	4	187	186	194	186	186	186	1	0.5
23	5	148	147	151	150	161	151	6	3.7
24*	5	110	100	110	120	90	106	11	10.8
25	5	165	159	163	170	161	164	4	2.6
26	5	147	141	140	136	144	142	4	2.9
27	0								
28	0								
29*	5	217.015	217.015	217.015	216.908	216.908	216.972	0.059	0.0
30	0								
31	5	144.76	155.90	138.70	145.06	145.49	145.98	6.20	4.3
32	5	190	156	153	150	141	158	19	11.9
33*	5	235	227	243	233	222	232	8	3.4
34	5	155	155	154	187	179	166	16	9.5
35	5	171	174	175	177	172	174	2	1.4
36	5	214	203	210	195	215	207	8	4.0
37	5	179	173	178	174	179	177	3	1.6
38	5	207	205	204	205	202	205	2	0.9
39	5	172	170	171	164	169	169	3	1.8
40*	4	184	180	184	184	184	184	0	0.0
41	0								
42	0								
43	5	165	168	166	161	164	165	3	1.6
44	5	181	172	178	176	177	177	3	1.9
45	5	165	170	175	166	169	169	4	2.3
46	4	184	181	203	194		191	10	5.3
47	0								
48	0								
49	5	184	187	177	206	174	186	13	6.8
50	5	155	154	157	156	156	156	1	0.7

IRON
NIST 1566a
539 ± 15 mg/kg

Lab							Mean	SD	RSD
1	0								
2	5	520	530	540	540	550	536	11	2.1
3*	5	495	510	448	541	484	496	34	6.9
4	0								
5	0								
6*	5	434.1	510.7	448.1	442.5	470.3	461.1	30.8	6.7
7	2	560.2	601.7				581.0	29.3	5.1
8	5	508.2	526.0	527.7	509.1	523.6	518.9	9.5	1.8
9	5	500.00	510.00	560.00	570.00	560.00	540.00	32.40	6.0
10*	5	456	429	452	445	437	444	11	2.5
11*	5	517	505	507	513	503	509	6	1.1
12	0								
13	0								
14	5	520	540	531	523	525	528	8	1.5
15	0								
16	0								
17	5	520	540	540	550	550	540	12	2.3
18*	5	562	632	620	608	587	602	28	4.6
19*	5	500	500	493	494	496	497	3	0.7
20*	4	414	426	464	426	428	423	6	1.4
21	5	550	546	547	546	551	548	2	0.4
22	5	543	538	536	534	530	536	5	0.9
23*	5	479	487	452	446	465	466	17	3.7
24	5	540	550	540	530	540	540	7	1.3
25	5	514	525	504	515	518	515	8	1.5
26	0								
27	0								
28	0								
29	5	530.423	528.309	530.423	530.423	526.196	529.155	1.890	0.4
30	0								
31*	5	436.46	463.10	406.31	421.77	440.24	433.58	21.26	4.9
32*	5	454	474	484	470	490	474	14	2.9
33	5	551	531	551	533	540	541	10	1.8
34	5	538	539	536	538	536	537	1	0.2
35*	5	507	516	477	484	499	497	16	3.2
36	0								
37*	5	584	567	592	581	572	579	10	1.7
38*	4	539	535	534	534	534	534	1	0.2
39*	5	518	499	486	487	478	494	16	3.2
40*	4	519	497	519	523	519	520	2	0.4
41	0								
42	0								
43*	5	498	464	478	482	468	478	13	2.8
44	5	525	510	525	515	507	516	8	1.6
45*	4	503	501	197	493	506	501	6	1.2
46	0	537	508				523	21	3.9
47	0								
48	0								

NICKEL Sediment T 36.0 ± 5.5 mg/kg									
Lab						Mean	SD	RSD	
1	5	33.5	33.9	34.4	34.8	33.8	34.1	0.5	1.5
2	5	37	34	35	32	34	34	2	5.3
3*	5	30	29	31	30	30	30	1	2.4
4*	5	42.268	41.813	42.355	41.651	41.730	41.963	0.324	0.8
5	0								
6*	5	40.6	42.5	50.6	37.8	34.8	41.3	6.0	14.5
7	5	36.93	37.6	37.7	37.57	38.07	37.57	0.41	1.1
8	5	31.54	31.88	31.92	32.74	31.85	31.99	0.45	1.4
9	5	35	37	38	36	35	36	1	3.6
10	5	34.1	34.2	34	34.1	33.7	34.0	0.2	0.6
11	5	39	40	39	40	38	39	1	2.1
12	5	35	34	34	33	34	34	1	2.1
13	5	34.9	35.8	33.0	34.9	35.9	34.9	1.2	3.3
14	5	37	37	38	39	36	37	1	3.0
15	0								
16	5	36.3	36.0	34.6	35.7	38.7	36.3	1.5	4.2
17	5	39	39	40	38	39	39	1	1.8
18	5	36.8	36.9	35.9	38.7	35.5	36.8	1.2	3.4
19	5	38.0	38.1	38.2	37.4	37.7	37.9	0.3	0.9
20	0								
21	0								
22	5	36.9	37.8	35.5	34.8	41.3	37.3	2.5	6.8
23	5	38.9	41.3	38.5	41.0	41.8	40.3	1.5	3.7
24*	5	42	44	42	40	42	42	1	3.4
25	5	34.3	40.0	36.7	37.7	34.6	36.7	2.3	6.4
26*	5	24.6	22.6	22.5	25.0	26.1	24.2	1.6	6.5
27*	5	26.7	25.8	26.4	26.4	28.6	26.8	1.1	4.0
28	5	33.3	34.8	33.1	37.6	36.5	35.1	2.0	5.6
29	5	31.7937	31.3657	31.8932	31.6912	31.1272	31.5742	0.3189	1.0
30*	5	39	42	44	44	42	42	2	4.9
31	0								
32	5	33.6	34.9	34.0	33.0	34.0	33.9	0.7	2.0
33*	4	47.5	47.3	47.4	46.8	49.9	47.3	0.3	0.6
34	5	35.5	37	35.5	34.8	34.7	35.5	0.9	2.6
35	5	37.8	37.9	37.4	37.6	37.6	37.7	0.2	0.5
36	5	32.8	32.4	32.6	31.6	31.8	32.2	0.5	1.6
37	5	33.6	34.9	33.8	35.2	35	34.5	0.7	2.1
38	0								
39*	4	33	33	34	34	30	34	1	2.9
40	5	36	38	37	36	36	37	1	2.4
41	0								
42	0								
43	5	31	31	30	34	35	32	2	6.7
44*	5	25.6	22.0	24.8	22.5	23.3	23.6	1.5	6.4
45*	5	46.3	42.4	46.7	45.2	45.4	45.2	1.7	3.7
46	5	34.2	37.4	34.5	35.3	37.0	35.7	1.5	4.1
47	0								
48	5	32.80	29.64	34.47	34.21	35.08	33.24	2.18	6.6
49	5	46.4	38.6	40.0	36.4	37.6	39.8	3.9	9.8
50	5	36.3	36.1	35.1	35.6	35.7	35.8	0.5	1.3

NICKEL BCSS-1 55.3 ± 3.6 mg/kg									
Lab							Mean	SD	RSD
1	5	51.2	51.8	51.8	51.3	51.6	51.5	0.3	0.5
2	5	58	50	54	55	50	53	3	6.4
3*	5	46	47	48	47	47	47	1	1.5
4	5	57.362	57.838	56.891	56.509	57.124	57.145	0.499	0.9
5	0								
6	5	51	62.3	57.4	52	49.7	54.5	5.3	9.7
7	5	53.5	53.7	58.0	58.4	59.0	56.5	2.7	4.8
8*	5	46.94	47.38	49.36	47.68	44.88	47.25	1.61	3.4
9*	5	46.00	47.00	45.00	45.00	46.00	45.80	0.84	1.8
10*	5	48.5	50.0	49.8	50.3	49.3	49.6	0.7	1.4
11	5	55	56	54	54	54	55	1	1.6
12	5	58	55	56	57	56	56	1	2.0
13	5	55.6	54.1	53.6	55.3	53.0	54.3	1.1	2.0
14	5	59	58	59	58	58	58	1	0.9
15	0								
16	5	48.3	50.7	53.3	48.3	55.0	51.1	3.0	5.9
17	5	56	54	56	55	55	55	1	1.5
18	5	54.4	57.4	57.1	55.5	55.1	55.9	1.3	2.3
19	5	54.5	55.1	55.3	55.4	54.3	54.9	0.5	0.9
20	0								
21	0								
22	5	55.1	55.0	49.4	50.0	57.5	53.4	3.5	6.6
23*	4	49.9	55.5	54.5	54.4	55.1	54.9	0.5	0.9
24	0								
25	5	49.8	51.1	51.7	51.3	50.7	50.9	0.7	1.4
26*	5	40.2	39.6	40.6	40.0	40.0	40.0	0.4	0.9
27*	5	42.5	42.4	39.8	39.4	43.4	41.5	1.8	4.3
28	0	54.4							
29	5	51.1614	52.5057	56.0245	55.8367	54.2650	53.9587	2.1109	3.9
30	5	54	54	53	53	53	53	1	1.0
31	0								
32*	5	42.8	45.9	46.8	44.7	47.1	45.5	1.8	3.9
33	5	57.8	58	56.2	55.8	56.4	56.8	1.0	1.7
34*	5	51.2	50.8	53.6	48.7	48.0	50.5	2.2	4.4
35	5	53.4	53.4	54.0	53.8	53.7	53.7	0.3	0.5
36*	5	47.3	48.5	45.3	45.2	45.6	46.4	1.5	3.1
37*	4	51.5	51.2	51.2	51.4	54.5	51.3	0.2	0.4
38	0								
39*	5	51	46	46	51	47	48	3	5.4
40	5	52	59	54	54	55	55	3	4.7
41	0								
42	0								
43*	5	47	49	49	51	49	49	1	2.9
44	5	57.6	58.5	56.7	56.7	57.6	57.4	0.8	1.3
45	5	50.3	55.8	55.1	56.4	57.0	54.9	2.7	4.9
46	4	51.7	53.1	55.1	51.7		52.9	1.6	3.0
47	0								
48*	5	50.43	49.35	49.34	49.17	49.59	49.58	0.50	1.0

NICKEL
Tissue S
0.88 ± 0.31 mg/kg

Lab							Mean	SD	RSD
1	0								
2*	5	1.3	1.3	1.3	1.3	1.3	1.3	0.0	0.0
3	5	0.99	0.96	1.05	0.90	0.90	0.96	0.06	6.6
4	0								
5	0								
6	5	0.563	0.898	0.564	0.731	0.643	0.680	0.140	20.6
7*	5	1.33	1.43	1.14	1.27	1.33	1.30	0.11	8.2
8	0								
9*	5	2.1	2.2	2.4	1.6	1.7	2.0	0.3	17.0
10*	5	1.75	1.06	2.7	1.52	1.77	1.76	0.60	34.0
11	5	0.77	0.96	0.65	0.94	0.66	0.80	0.15	18.6
12	0								
13	0								
14	5	<1	<1	<1	<1	<1			
15	5	0.95	0.96	0.89	1.0	0.97	0.95	0.04	4.2
16	0								
17	5	0.97	0.88	0.98	0.86	0.99	0.94	0.06	6.5
18	5	1.15	1.10	1.06	1.11	1.09	1.10	0.03	3.0
19	5	0.84	0.84	0.85	0.82	0.83	0.84	0.01	1.4
20	5	0.86	1.14	1.02	0.84	1.0	0.97	0.12	12.7
21*	5	2.29	2.28	2.33	2.30	2.33	2.31	0.02	1.0
22	5	1.05	0.99	1.14	1.08	1.17	1.09	0.07	6.6
23*	5	5.23	5.26	4.47	4.67	4.56	4.84	0.38	7.8
24*	5	2	2	2	2	2	2.0	0.0	0.0
25*	4	0.80	0.91	0.89	0.91	0.88	0.90	0.02	2.2
26	5	0.68	0.72	0.72	0.79	0.82	0.75	0.06	7.7
27	0								
28	5	0.892	0.62	1.377	1.077	0.712	0.936	0.303	32.3
29	5	1.04623	0.9486	1.0820	1.0664	0.9732	1.0233	0.0590	5.8
30	0								
31	5	0.52	0.53	0.55	0.70	0.60	0.58	0.07	12.7
32	5	<1.0	<1.0	<1.0	<1.0	<1.0			
33*	4	0.808	1.21	0.884	0.904	0.907	0.876	0.046	5.3
34	5	0.90	0.72	0.66	1.00	0.72	0.80	0.14	17.9
35	5	1.14	1.10	1.14	1.15	1.12	1.13	0.02	1.8
36*	5	1.4	1.3	1.5	1.3	1.3	1.4	0.1	6.6
37	5	1.0	0.7	1.0	0.7	0.8	0.8	0.2	18.1
38	0								
39	5	0.68	0.63	0.66	0.62	0.65	0.65	0.02	3.7
40	5	0.68	0.68	0.60	0.56	0.68	0.64	0.06	8.8
41	0								
42	0								
43	5	<1.5	<1.5	<1.5	<1.5	<1.5			
44	5	1.04	0.99	0.82	0.97	0.75	0.91	0.12	13.5
45*	4	0.982	0.917	0.976	1.180	0.936	0.952	0.030	3.2
46	0								
47	0								
48	0								
49	5	1.27	0.81	0.91	1.17	0.92	1.02	0.19	19.1
50	0								

NICKEL
NIST 1566a
2.25 ± 0.44 mg/kg

Lab							Mean	SD	RSD
1	0								
2	5	2.8	2.4	2.3	2.0	2.2	2.3	0.3	12.7
3	5	2.30	2.35	2.32	2.54	2.80	2.46	0.21	8.6
4	0								
5	0								
6*	5	1.72	1.72	1.22	1.84	1.65	1.63	0.24	14.7
7*	4	2.5	3.16	2.63	2.73		2.76	0.29	10.4
8	0								
9	5	2.600	2.600	2.600	2.700	2.700	2.640	0.055	2.1
10*	4	2.18	3.6	3.13	2.2	9.2	2.7	0.7	25.9
11	5	3.15	2.19	2.49	1.87	2.76	2.49	0.50	19.9
12	0								
13	0								
14	5	2.18	2.05	2.08	2.14	2.42	2.17	0.15	6.7
15	5	2.8	2.5	2.4	2.0	2.2	2.4	0.3	12.7
16	0								
17	5	2.39	2.26	2.61	2.33	2.61	2.44	0.16	6.6
18	5	1.97	2.19	2.73	2.95	2.76	2.52	0.42	16.6
19	5	1.83	1.86	2.02	1.79	1.82	1.86	0.09	4.9
20	5	2.26	2.48	2.18	2.24	2.34	2.30	0.12	5.0
21	5	2.65	2.56	2.00	2.36	2.11	2.34	0.28	12.0
22	5	2.33	2.73	2.44	2.29	2.12	2.38	0.23	9.5
23*	5	4.14	3.24	2.87	2.83	3.33	3.28	0.53	16.1
24	0								
25	5	2.15	2.27	2.00	2.14	2.04	2.12	0.11	5.0
26	0								
27	0								
28	0	1.9							
29	5	2.4830	2.6304	2.6782	2.5746	2.5667	2.5866	0.0735	2.8
30	0								
31*	5	1.68	1.85	1.36	1.55	1.35	1.56	0.21	13.7
32*	5	1.2	<1.0	<1.0	1.3	2.1	1.2	0.4	33.3
33	5	3.06	2.14	2.56	2.60	1.94	2.46	0.44	17.7
34	5	1.83	2.21	2.10	1.82	2.35	2.06	0.23	11.3
35	5	2.44	1.99	2.30	2.56	2.04	2.27	0.25	10.9
36*	5	1.3	1.4	1.0	1.2	1.1	1.2	0.2	13.2
37*	5	2.8	2.2	3.5	3.3	2.2	2.8	0.6	21.6
38	0								
39*	5	1.82	1.74	1.21	1.17	2.05	1.60	0.39	24.4
40	5	2.54	1.56	1.88	1.68	1.72	1.88	0.39	20.7
41	0								
42	0								
43	5	1.7	2.0	1.8	2.4	1.9	2.0	0.3	13.8
44*	4	1.77	1.74	2.26	1.63	1.69	1.71	0.06	3.5
45	5	2.24	2.02	3.00	1.93	2.43	2.32	0.43	18.3
46	0								
47	0								
48	0								

COPPER Sediment T 25.4 ± 2.9 mg/kg									
Lab						Mean	SD	RSD	
1	5	27.0	27.0	27.0	27.0	27.0	0.0	0.0	
2	5	26	25	26	25	26	1	2	
3	5	23	23	24	24	24	1	2	
4*	5	28.873	28.358	28.809	28.055	28.489	28.517	0.336	1.178
5	0								
6	5	25.6	24.0	23.8	23.7	23.2	24.1	0.9	3.8
7*	5	21.57	21.43	21.53	22.2	21.89	21.72	0.32	1.46
8	5	25.79	26.07	25.81	26.18	25.85	25.94	0.17	0.67
9*	5	29	31	33	30	30	31	2	5
10	5	24.4	24.0	24.5	24.2	23.7	24.2	0.3	1.3
11**	4	27.6	27.6	27.9	27.9	25.9	27.8	0.2	0.7
12*	5	27	27	28	29	30	28	1	4.6
13	5	26.6	25.0	26.8	25.7	25.2	25.9	0.8	3.1
14*	5	29	28	28	29	29	29	1	1.9
15	0								
16	5	25.8	25.5	25.0	25.6	25.3	25.4	0.3	1.2
17	5	25	26	26	26	24	25	1	3.5
18	5	25.6	25.8	25.8	27.8	26.5	26.3	0.9	3.4
19	5	25.4	25.5	25.5	25.8	25.2	25.5	0.2	0.9
20*	4	26	26	26	24	26	26	0	0.0
21	0								
22	5	24.5	25.3	26.5	26.7	28.3	26.3	1.5	5.5
23*	5	18.0	19.1	17.9	18.9	18.8	18.5	0.6	3.0
24	5	26	26	26	26	26	26.0	0.0	0.0
25	5	24.6	24.7	24.8	23.9	23.1	24.2	0.7	3.0
26	5	23.6	21.9	22.1	24.9	24.8	23.5	1.4	6.1
27*	5	20.3	19.8	20.2	21.0	21.0	20.5	0.5	2.6
28	5	25.1	25.4	25.1	25.4	24.6	25.1	0.3	1.3
29*	4	24.3709	24.6681	24.7671	24.6681	24.7671	24.7176	0.0572	0.2
30*	4	32.3	26.8	26.3	26.5	27.3	27.8	2.5	9.1
31	0								
32*	5	19.1	19.1	19.4	19.4	19.0	19.2	0.2	1.0
33*	5	32.6	33.5	32.1	30.9	34.6	32.7	1.4	4.3
34*	4	25.5	25.8	26.0	22.5	25.9	25.8	0.2	0.8
35	5	24.6	24.8	24.6	24.8	24.7	24.7	0.1	0.4
36*	5	29.8	28.5	29.2	27.5	28.5	28.7	0.9	3.0
37	5	28.0	26.4	27.1	29.7	27.2	27.7	1.3	4.6
38	0								
39	5	25.4	24.7	24.9	24.7	24.0	24.7	0.5	2.0
40	5	23.3	23.1	23.4	23.9	23.3	23.4	0.3	1.3
41	0								
42	0								
43	5	23	23	23	24	22	23	1	3.1
44*	5	30.2	31.6	30.8	31.9	29.7	30.8	0.9	3.0
45	5	24.8	24	23.6	23.1	23.2	23.7	0.7	2.9
46	5	25.0	23.7	24.5	23.7	23.2	24.0	0.7	3.0
47*	4	25	25	26	25	25	25	0	0.0
48*	5	21.37	19.79	23.25	21.86	25.21	22.30	2.05	9.2
49	5	27.2	25.2	24.7	24.7	25.7	25.5	1.0	4.1
50	5	26.4	26.3	26.0	26.1	26.1	26.2	0.2	0.6

COPPER BCSS-1 18.5 ± 2.7 mg/kg									
Lab							Mean	SD	RSD
1	5	17.5	19.0	18.5	18.0	18.0	18.2	0.6	3.1
2	5	18	17	18	18	17	18	1	3
3*	4	15	15	15	16	15	15	0	0
4	5	19.283	19.355	19.136	18.755	19.211	19.148	0.234	1.224
5	0								
6*	5	15.7	15.0	15.9	15.8	14.2	15.3	0.7	4.7
7	5	14.08	14.39	17.88	17.55	18.19	16.42	2.01	12.23
8	5	16.35	16.17	16.28	16.26	15.74	16.16	0.24	1.5
9	5	20	21	21	20	20	20	1	3
10*	5	15.1	15.5	15.3	15.5	15.6	15.4	0.2	1.3
11	5	18.1	18.6	18.9	18.4	18.6	18.5	0.3	1.6
12	5	18	19	22	21	20	20	2	7.9
13	5	18.4	18.5	18.3	18.4	18.3	18.4	0.1	0.5
14	5	20	21	21	19.7	20.1	20.4	0.6	3.0
15	0								
16	5	18.2	19.0	18.5	19.5	18.7	18.8	0.5	2.6
17	5	18	20	20	21	19	20	1	5.8
18	5	17.2	18.7	16.9	18.0	17.1	17.6	0.8	4.3
19*	4	16.9	17.0	17.1	17.1	17.7	17.0	0.1	0.6
20*	4	16	16	18	16	16	16	0	0.0
21	0								
22	5	18.0	18.1	18.9	18.9	20.2	18.8	0.9	4.7
23*	4	12.1	12.9	12.8	12.8	12.9	12.7	0.3	2.7
24	0								
25	5	15.5	15.5	15.3	15.4	15.9	15.5	0.2	1.5
26*	5	16.2	15.7	15.1	14.8	13.8	15.1	0.9	6.1
27*	5	12.6	12.7	13.9	13.9	13.5	13.3	0.6	4.8
28	0	16.3							
29	5	19.8155	20.0117	19.4231	19.4231	19.8155	19.6978	0.2632	1.3
30	5	21.0	18.8	18.0	17.3	17.8	18.6	1.5	7.8
31	0								
32*	5	10.7	12.3	11.8	11.7	11.7	11.6	0.6	5.0
33	5	21.3	19.8	18.1	17.8	17.5	18.9	1.6	8.5
34	5	15.4	17.0	16.3	14.3	16.2	15.8	1.0	6.5
35	5	18.1	18.3	19.2	18.4	19.3	18.7	0.6	2.9
36	5	17.5	18.8	17.5	19.9	17.3	18.2	1.1	6.2
37	5	18.4	19.5	18.6	19.2	19.2	19.0	0.5	2.4
38	0								
39	5	17.1	16.9	17.6	16.8	16.7	17.0	0.4	2.1
40	5	17.2	16.3	17.0	16.4	16.8	16.7	0.4	2.3
41	0								
42	0								
43*	4	15	15	16	15	15	15	0	0.0
44	5	18.4	18.0	18.0	18.6	18.2	18.2	0.3	1.4
45	5	17.6	17.3	16.5	16.9	17.0	17.1	0.4	2.4
46	4	16.2	17.0	15.8	15.8		16.2	0.6	3.5
47	5	18	17	18	17	18	18	1	3.1
48*	5	15.06	14.58	14.67	13.99	13.67	14.39	0.56	3.9

COPPER
Tissue S
4.13 ± 0.46 mg/kg

Lab							Mean	SD	RSD
1	0								
2*	5	5.0	4.9	4.5	4.6	4.6	4.7	0.2	4.6
3*	5	3.4	3.3	3.6	3.1	3.1	3.3	0.2	6.4
4	0								
5	5	4.3	4.3	4.9	4.9	4.9	4.7	0.3	7.1
6	5	4.29	4.28	3.86	3.95	4.03	4.08	0.19	4.8
7*	5	3.64	3.50	3.53	3.32	3.46	3.49	0.12	3.3
8	5	4.13	4.29	4.22	4.03	4.00	4.13	0.12	3.0
9	5	4.9	3.9	3.9	4.9	3.8	4.3	0.6	13.3
10	5	4.2	3.7	3.6	3.6	3.5	3.7	0.3	7.5
11*	4	4.18	4.21	4.09	3.60	4.17	4.16	0.05	1.2
12	0								
13	0								
14	5	4.07	4.23	4.23	4.32	4.15	4.20	0.09	2.2
15	5	4.3	4.7	4.6	4.6	4.5	4.5	0.2	3.3
16	0								
17	5	4.0	3.4	3.4	4.2	4.1	3.8	0.4	10.2
18*	5	3.14	3.45	3.54	3.26	3.22	3.32	0.17	5.0
19*	5	3.19	3.22	3.22	3.15	3.15	3.19	0.04	1.1
20	5	4.76	4.51	4.82	4.58	4.50	4.63	0.15	3.2
21*	5	3.19	3.21	3.16	3.21	3.16	3.19	0.03	0.8
22	5	4.15	4.01	4.26	4.07	4.05	4.11	0.10	2.4
23	5	4.30	4.32	4.28	4.25	4.13	4.26	0.08	1.8
24	5	4	4	4	4	4	4	0	0.0
25*	4	3.0	3.0	3.0	3.0	3.1	3.0	0.0	0.0
26	5	3.47	3.86	3.20	3.46	3.82	3.56	0.28	7.8
27	0								
28*	5	3.2	3.4	3.1	2.5	3.10	3.1	0.3	11.0
29*	5	4.8337	4.9324	4.7351	4.7351	4.6858	4.7844	0.0986	2.1
30	0								
31	5	3.44	3.79	3.44	3.63	3.70	3.60	0.16	4.4
32	5	4.20	3.80	3.80	4.80	6.80	4.68	1.25	26.8
33*	5	7.81	6.12	6.11	7.59	7.96	7.12	0.93	13.0
34	5	3.58	3.94	3.78	4.00	4.23	3.91	0.24	6.2
35	5	4.21	4.34	4.31	4.40	4.56	4.36	0.13	3.0
36	5	4.5	4.5	4.2	5.1	4.9	4.6	0.4	7.7
37	5	3.7	3.7	4.2	3.8	4.3	3.9	0.3	7.3
38*	5	3.2	3.1	3.2	3.1	3.1	3.1	0.1	1.7
39	5	4.2	4.1	4.3	4.0	4.3	4.2	0.1	3.1
40*	5	4.5	4.7	4.5	4.5	4.5	4.5	0.0	0.0
41	0								
42	0								
43	5	4.0	4.0	3.9	3.9	3.9	3.9	0.1	1.4
44	5	4.52	4.63	4.21	4.19	4.25	4.36	0.20	4.6
45	5	3.30	3.80	3.70	3.58	3.64	3.60	0.19	5.2
46	4	4.00	3.80	4.50	4.30		4.15	0.31	7.49
47	5	4.1	4.2	4.3	4.0	4.1	4.1	0.1	2.8
48	0								
49	5	3.38	3.82	3.82	3.97	3.67	3.7	0.2	6.0
50	0								

COPPER
NIST 1566a
66.3 ± 4.3 mg/kg

Lab							Mean	SD	RSD
1	0								
2	5	68	72	70	71	72	71	2	2.4
3*	5	59	60	53	64	56	58	4	7.1
4	0								
5	5	60.5	61.0	61.5	62.0	61.5	61.3	0.6	0.9
6*	5	55.6	58.1	58.1	59.0	59.7	58.1	1.6	2.7
7	4	59.0	58.35	71.86	70.8		65.0	7.3	11.3
8	5	63.51	64.27	64.30	63.96	64.94	64.20	0.52	0.8
9	5	65.00	65.00	70.00	71.00	67.00	67.60	2.79	4.1
10*	5	60.6	59.4	60.0	60.2	58.4	59.7	0.9	1.4
11*	4	66.5	64.3	64.4	64.2	63.6	64.1	0.4	0.6
12	0								
13	0								
14	5	67.0	67.7	67.8	66.5	67.7	67.3	0.6	0.8
15	5	63	63	64	61	64	63	1	1.9
16	0								
17*	5	66	66	66	68	66	66	0	0.0
18	5	64.5	64.3	66.5	65.6	65.3	65.2	0.9	1.4
19	5	64.5	64.5	64.9	66.5	64.0	64.9	1.0	1.5
20	5	66.3	65.3	63.2	62.0	62.0	63.8	2.0	3.1
21	5	67.6	65.7	66.4	66.1	67.1	66.6	0.8	1.2
22	5	63.9	63.5	63.6	67.7	66.8	65.1	2.0	3.1
23*	5	60.5	60.3	59.4	59.8	61.2	60.2	0.7	1.1
24	0								
25	5	63.3	62.9	63.6	64.1	62.3	63.2	0.7	1.1
26	0								
27	0								
28	0	58.5							
29	5	68.4555	68.3576	68.1617	68.0638	68.2597	68.2597	0.1548	0.2
30	0								
31*	5	57.48	62.08	51.97	57.16	58.52	57.44	3.63	6.3
32*	4	61.3	64.7	65.3	64.7	65.0	64.9	0.3	0.5
33	5	64.9	66.7	67.6	67.8	69.5	67.3	1.7	2.5
34	5	67.9	65.7	65.1	66.9	67.1	66.5	1.1	1.7
35	5	65.9	67.1	62.0	62.1	63.2	64.1	2.3	3.6
36	0								
37	5	67.9	69.3	68.9	67.7	68.5	68.5	0.7	1.0
38*	4	65.6	63.6	63.2	63.7	63.0	63.4	0.3	0.5
39	5	64.7	61.9	60.4	60.4	60.3	61.5	1.9	3.1
40*	4	62.0	62.4	62.7	64.5	62.7	62.5	0.3	0.5
41	0								
42	0								
43*	4	67	62	63	63	62	63	1	1.6
44	5	64.9	65.9	68.1	64.7	65.3	65.8	1.4	2.1
45*	4	59.6	56.6	56.9	56.8	56.7	56.8	0.1	0.2
46	0	66.3	65.8						
47	0								
48	0								

ZINC Sediment T 123 ± 12 mg/kg													
Lab							Mean	SD	RSD				
1	5	118	124	117	133	132	125	8	6.0				
2'	4	130	130	130	120	130	130	0	0.0				
3*	5	111	106	107	110	108	108	2	1.9				
4	5	131.5	131.8	129.7	131.4	126.2	130.1	2.3	1.8				
5	0												
6	5	118	114	110	114	119.0	115	4	3.1				
7	5	122.05	122.65	124.1	123.5	124.0	123.26	0.89	0.7				
8	5	111.57	111.27	116.60	121.38	117.60	115.68	4.28	3.7				
9*	5	91	96	94	90	90	92	3	2.9				
10	5	121	124	121	124	122	122	2	1.2				
11'	4	131	144	133	132	132	132	1	0.8				
12	5	127	127	128	129	129	128	1	0.8				
13	5	125	124	126	126	123	125	1	1.0				
14	5	125	126	128	127	127	127	1	0.9				
15	0												
16	5	129	120	127	123	131	126	4	3.5				
17	5	120	130	120	120	130	124	5	4.4				
18*	5	138	137	136	144	134	138	4	2.7				
19*	5	148	148	146	146	146	147	1	0.7				
20	5	126.8	123.2	125.8	124.0	125.6	125.1	1.5	1.2				
21	0												
22	5	134	135	129	134	126	132	4	3.0				
23'	4	89.7	96.1	91.4	91.0	89.6	90.5	1.0	1.1				
24	5	124	124	124	126	122	124	1	1.1				
25	5	122	124	129	122	126	125	3	2.4				
26*	5	83.9	85.6	81.0	78.2	87.2	83.2	3.6	4.3				
27*	5	95.1	86.2	88.8	88.5	101	91.9	6.1	6.6				
28	5	111	109.5	116.2	111.5	109.7	111.6	2.7	2.4				
29	5	123.927	125.926	123.927	125.926	123.927	124.7266	1.0948	0.9				
30	5	131	116	109	113	115	117	8	7.2				
31	0												
32*	5	99.8	102	102	103	101	102	1	1.2				
33*	5	206	204	159	163	161	179	24	13.5				
34	5	127	122	126	124	112	122	6	4.9				
35	5	130	128	126	132	127	129	2	1.9				
36	5	119	115	117	112	113	115	3	2.5				
37	5	124	121	124	123	123	123	1	1.0				
38	0												
39	5	122	131	126	127	124	126	3	2.7				
40*	4	140	143	140	139	139	139	1	0.7				
41	0												
42	0												
43	5	117	120	116	122	120	119	2	2.1				
44*	5	139	161	148	144	146	148	8	5.6				
45	5	117	120	119	121	126	121	3	2.8				
46	5	135	135	139	130	125	133	5	4.1				
47	5	114	116	117	117	118	116	2	1.3				
48	5	115.22	103.64	122.25	120.8	123.50	117.08	8.15	7.0				
49	0												
50	5	130	123	131	134	139	131	6	4.5				

ZINC BCSS-1 119 ± 12 mg/kg													
Lab							Mean	SD	RSD				
1	5	110	116	114	110	109	112	3	2.7				
2'	4	130	120	120	120	120	120	0	0.0				
3*	4	97	99	97	96	112	97	1	1.0				
4	5	105.5	105.8	104.2	105.5	104.2	105.0	0.8	0.7				
5	0												
6*	5	103	98.9	95.2	97.3	94.3	97.7	3.4	3.5				
7	5	105.25	107.1	112	113.8	111.9	110.0	3.6	3.3				
8*	5	104.28	94.04	102.17	94.11	104.86	99.89	5.40	5.4				
9*	5	95.00	97.00	96.00	97.00	96.00	96.20	0.84	0.9				
10	5	106	109	106	107	107	107	1	1.1				
11	5	121	115	114	111	111	114	4	3.6				
12	5	119	120	121	121	122	121	1	0.8				
13'	4	110	117	109	111	111	110	1	0.9				
14'	4	110	110	110	113	110	110	0	0.0				
15	0												
16	5	101	105	111	113	105	107	5	4.6				
17	5	108	112	111	109	109	110	2	1.5				
18	5	118	119	122	125	124	122	3	2.5				
19	5	122	122	122	123	123	122	1	0.4				
20	5	110.6	110.2	108.2	111.4	108.6	109.8	1.4	1.2				
21	0												
22	5	117	112	112	114	113	114	2	1.8				
23*	5	81.2	83.4	86.2	85.4	85.8	84.4	2.1	2.5				
24*	5	430	410	410	460	470	436	28	6.4				
25	5	106	109	108	107	107	107	1	1.1				
26*	5	83.2	91.5	93	96	90.9	90.9	4.7	5.2				
27*	5	79.8	82.0	84.8	85.7	86.9	83.8	2.9	3.4				
28	0	100											
29	5	108.503	110.475	108.503	110.475	110.475	109.686	1.081	1.0				
30	0	118	101	100	113	110	108	8	7.2				
31	0												
32*	5	86.0	94.6	94.0	90.8	92.2	92	3	3.7				
33	5	117	117	115	113	113	115	2	1.7				
34'	4	117	119	118	117	129	118	1	0.8				
35	5	107	111	112	111	110	110	2	1.7				
36*	5	99.7	105	95.4	96.5	96.2	98.6	4.0	4.0				
37	5	106	108	107	106	107	107	1	0.8				
38	0												
39	5	107	107	114	110	116	111	4	3.7				
40	5	120	119	123	119	121	120	2	1.4				
41	0												
42	0												
43	5	104	105	106	106	107	106	1	1.1				
44	5	128	125	122	120	117	122	4	3.5				
45*	5	89	102	98.1	106	109.0	100.8	7.8	7.7				
46	4	109	115	119	119		116	5	4.1				
47*	5	102	101	102	101	101	101	1	0.5				
48*	5	104.95	104.18	103.11	102.26	104.05	103.71	1.04123	1.0				

ZINC
Tissue S
139 ± 10 mg/kg

Lab						Mean	SD	RSD
1	0							
2*	4	170	170	160	170	170	1	0.6
3*	5	119	108	130	99	131	14	11.8
4	0							
5*	5	167	167	167	167	167	0	0.0
6*	5	112.2	113.5	112.7	115.6	111.7	1.5	1.4
7	5	138.2	139.4	141.6	137.5	136.8	1.9	1.4
8	5	144.9	133.6	132.0	128.9	127.3	6.9	5.2
9*	5	160	180	160	140	150	15	9.4
10*	5	130	124	123	125	122	3	2.5
11	5	143	141	142	142	140	1	0.8
12	0							
13	0							
14	5	134	138	135	138	139	2	1.6
15	5	137	145	145	140	140	4	2.5
16	0							
17*	4	130	140	140	140	140	0	0.0
18*	4	143	145	143	143	143	0	0.0
19*	5	159	159	160	154	155	3	1.7
20	5	134.4	128	134.6	131.8	136.4	3.3	2.5
21	0	146	144	143	145	144	1	0.8
22	5	141	142	139	144	142	2	1.3
23	5	137	134	136	133	138	2	1.5
24	5	142	142	144	142	146	2	1.2
25	5	134	136	135	132	135	2	1.1
26*	4	119	117	120	120	109	1	0.8
27	0							
28	5	131.4	136.8	127.8	132.3	134.7	3.4	2.6
29	5	143.649	141.125	137.15	137.15	137.15	3.0043	2.2
30	0							
31	5	125.90	132.99	126.96	128.06	129.46	2.75	2.1
32	5	142	141	136	136	138	3	2.0
33	5	144	146	149	148	136	5	3.6
34*	5	181	148	149	173	183	17	10.3
35*	5	153	149	158	150	150	4	2.4
36*	5	168	162	169	162	178	7	3.9
37	5	143	141	145	140	145	2	1.6
38*	4	148	148	148	148	149	0	0.0
39	5	129	132	134	133	135	2	1.7
40	5	130	133	136	133	130	3	1.9
41	0							
42	0							
43	5	139	139	134	135	136	2	1.7
44	5	150	143	147	143	148	3	2.1
45	5	136	144	150	148	147	5	3.8
46**	4	156	156	167	159		2	1.3
47	5	149	136	145	141	142	5	3.4
48	0							
49*	5	141	159	139	141	134	3	2.2
50	5	126	129	126	129	127	2	1.2

ZINC
NIST 1566a
830 ± 57 mg/kg

Lab							Mean	SD	RSD
1	0								
2	5	820	820	900	900	900	868	44	5.0
3*	5	703	782	650	813	726	735	64	8.8
4	0								
5*	5	750	750	750	750	750	750	0	0.0
6*	5	614.7	652.1	662.7	654.9	676.8	652.2	23.1	3.5
7*	5	837.7	853.7	967.5	1005.5	916.1	916.1	71.9	7.8
8	5	788.7	815.8	806.1	786.8	786.0	796.7	13.5	1.7
9	5	850	840	930	960	930	902	54	5.9
10	5	776	755	773	765	760	766	9	1.1
11	5	830	794	804	821	794	809	16	2.0
12	0								
13	0								
14	5	843	836	831	842	838	838	5	0.6
15	5	826	809	827	796	839	819	17	2.1
16	0								
17	5	840	840	850	850	850	846	5	0.6
18	5	896	883	852	868	880	876	17	1.9
19	5	873	876	859	861	865	867	7	0.9
20	5	812	790	776	818	776	794	20	2.5
21	5	816	820	827	816	815	819	5	0.6
22	5	858	841	852	847	840	848	8	0.9
23	5	824	820	810	813	829	819	8	1.0
24	0								
25	5	884	837	861	866	874	864	18	2.0
26	0								
27	0								
28	1	778.0							
29	5	843.301	840.359	843.301	840.359	843.301	843.3014	1.612	0.2
30	0								
31	5	772.2	813.76	720.86	729.42	799.13	767.07	41.19	5.4
32	5	800	808	816	815	810	810	6	0.8
33	5	802	820	781	834	855	818	29	3.5
34	5	875	861	875	843	845	860	16	1.8
35	5	872	881	876	864	878	874	7	0.8
36	0								
37	5	880	891	883	869	874	879	8	1.0
38	5	848	856	852	857	851	853	4	0.4
39	5	852	751	809	812	864	818	44	5.4
40	5	773	762	796	792	762	777	16	2.1
41	0								
42	0								
43	5	846	801	808	808	791	811	21	2.6
44	5	836	849	875	831	849	848	17	2.0
45	5	774	800	804	806	811	799	15	1.8
46	2	883	903						
47	0								
48	0								

ARSENIC Sediment T 11.8 ± 1.6 mg/kg														
Lab							Mean	SD	RSD					
1*	5	10.2	10.8	8.2	9.5	11.2	10.0	1.2	11.9					
2	5	13	13	13	12	12	13	1	4.3					
3	5	11	11	11	11	11	11	0	0.0					
4	0													
5	0													
6	0													
7	0													
8	5	8.62	8.48	13.44	11.04	12.27	10.77	2.20	20.4					
9*	5	6.291	6.840	5.760	6.120	6.640	6.330	0.426	6.7					
10	5	10	11	12	12	10	11	1	9.1					
11	5	13	13	13	12	14	13	1	5.4					
12	5	11.5	11.3	11.8	11.4	11.1	11.4	0.3	2.3					
13	0													
14	5	12.51	12.20	10.91	11.10	12.44	11.83	0.77	6.5					
15	5	11.0	11.0	10.9	11.1	10.9	11.0	0.1	0.8					
16*	5	7.18	8.61	7.99	8.27	8.44	8.10	0.56	6.9					
17	5	12	13	12	13	12	12	1	4.4					
18	5	10.97	10.65	11.13	11.93	10.88	11.11	0.49	4.4					
19	5	12.5	12.6	12.2	12.3	12.5	12.4	0.2	1.3					
20	5	12.124	11.801	12.424	12.488	13.272	12.422	0.548	4.4					
21	0													
22*	5	13.8	13.5	14.5	14.0	13.8	13.9	0.4	2.7					
23*	5	4.35	<1	2.73	5.91	7.55	5.14	2.07	40.3					
24	5	11.6	11.8	11.8	11.8	11.6	11.7	0.1	0.9					
25*	5	7.20	7.32	7.40	7.29	7.00	7.24	0.15	2.1					
26*	5	9.61	9.72	9.49	8.98	9.13	9.39	0.32	3.4					
27	5	11.4	12.2	12.9	11.5	14.0	12.4	1.1	8.7					
28	5	12.6	12.7	12.1	12.5	11.4	12.3	0.5	4.3					
29	5	10.3045	10.0328	10.5634	10.6788	11.4125	10.5984	0.5188	4.9					
30	5	8.75	11.8	11.3	12.0	12.1	11.2	1.4	12.5					
31	0													
32*	4	2.20	2.40	2.40	2.40	2.40	2.40	0.00	0.0					
33	0													
34*	5	12.5	11.5	17.0	12.5	14.6	13.6	2.2	16.2					
35	5	12.7	12.8	12.7	12.8	12.6	12.7	0.1	0.7					
36	5	<10	<10	<10	<10	<10								
37	0													
38	0													
39	5	10.6	11.2	11.8	11.5	11.0	11.2	0.5	4.1					
40	5	11.0	11.1	11.0	11.0	11.0	11.0	0.0	0.4					
41	0													
42	0													
43	5	14.5	13.2	11.1	14.4	14.9	13.6	1.5	11.3					
44	0													
45	5	11.9	11.6	11.4	11.2	11.5	11.5	0.3	2.2					
46	5	11.3	12.4	10.3	11.9	11.4	11.5	0.8	6.8					
47	0													
48	0													
49	5	12.4	12.4	12.0	11.9	12.1	12.2	0.2	1.9					
50	0													

ARSENIC BCSS-1 11.1 ± 1.4 mg/kg														
Lab							Mean	SD	RSD					
1	5	9.95	10.2	10.15	9.40	9.95	9.93	0.32	3.2					
2	5	12	11	11	12	11	11	1	4.8					
3*	5	9.7	9.7	9.4	9.4	9.5	9.5	0.2	1.6					
4	0													
5	0													
6	0													
7	0													
8*	5	8.50	6.30	9.93	10.79	8.49	8.80	1.71	19.4					
9*	5	7.533	7.303	7.352	7.679	7.205	7.414	0.190	2.6					
10*	4	9.9	11	10	10	10	10	0	0.0					
11	5	12	10	11	10	10	11	1	8.4					
12	5	10.5	10.6	10.3	10.3	9.9	10.3	0.3	2.6					
13	0													
14	5	12.5	10.6	11.2	12.5	10.3	11.4	1.0	9.1					
15	5	9.87	9.59	9.71	9.69	9.61	9.69	0.11	1.1					
16*	4	7.86	8.61	8.43	8.6	8.56	8.55	0.08	0.9					
17	5	12	12	11	11	12	12	1	4.7					
18	5	11.13	11.19	12.02	11.01	10.56	11.18	0.53	4.7					
19	5	10.8	10.9	11	11.1	11.2	11.0	0.2	1.4					
20	5	10.601	11.004	10.903	10.416	10.318	10.648	0.299	2.8					
21	0													
22	5	10.9	11.3	11.1	11.2	11.4	11.2	0.2	1.7					
23	5	8.42	9.22	14.1	12.0	12.6	11.3	2.4	21.1					
24*	5	23	24	24	24	25	24	1	2.9					
25*	4	6.46	5.52	6.65	6.41	6.58	6.52	0.11	1.7					
26*	5	7.44	7.58	7.55	7.65	7.65	7.57	0.09	1.1					
27	5	10.8	10.1	10.2	10.3	10.7	10.4	0.3	3.0					
28	0	10.6												
29	5	9.5334	9.8962	10.4339	10.1314	9.4731	9.8936	0.4047	4.1					
30	5	11.3	11.5	11.8	11.3	11.5	11.5	0.2	1.8					
31	0													
32*	4	2.20	2.40	2.30	2.20	3.70	2.28	0.10	4.4					
33	0													
34	5	12.0	11.0	12.0	9.13	11.0	11.0	1.2	10.6					
35	5	11.7	11.6	11.5	11.8	11.9	11.7	0.2	1.4					
36	5	<10	<10	<10	<10	<10								
37	0													
38	0													
39	5	10.4	10.0	9.8	9.2	9.3	9.7	0.5	5.1					
40	5	9.7	9.7	9.8	9.9	9.8	9.8	0.1	0.9					
41	0													
42	0													
43	5	12	11.9	11.6	10.8	12.5	11.8	0.6	5.3					
44	0													
45	5	10.1	10.1	9.88	9.76	10.4	10.0	0.2	2.4					
46*	4	9.65	9.20	8.93	8.80		9.15	0.38	4.1					
47	0													

ARSENIC
Tissue S
13.5 ± 2.5 mg/kg

Lab							Mean	SD	RSD
1	0								
2	5	17	15	15	16	17	16	1	6.3
3	5	13	15	12	15	14	14	1	9.4
4	0								
5	0								
6	5	12.3	11.7	10.2	8.33	10.5	10.6	1.5	14.5
7	0								
8	5	<5.82	<4.84	<4.91	<4.69	<4.82			
9	5	10.46	9.961	10.52	10.16	9.827	10.19	0.30	3.0
10	5	1.1	1.2	1.2	1.2	1.4	1.2	0.1	9.0
11	5	16.1	15.6	15.2	14.4	13.7	15.0	1.0	6.4
12	0								
13	0								
14	5	13.20	14.70	14.69	14.48	13.44	14.1	0.7	5.1
15	5	13.2	13.5	13.2	13.3	13.4	13.3	0.1	1.0
16	0								
17	5	15	14	15	14	15	14.6	0.5	3.8
18	5	12.14	11.67	11.92	11.85	12.27	11.97	0.24	2.0
19	5	13.6	13.8	13.8	13.8	13.4	13.7	0.2	1.3
20	5	13.84	14.13	13.85	12.86	15.16	13.97	0.82	5.9
21	5	14.2	14.1	13.6	13.7	13.8	13.9	0.3	1.9
22	5	15.0	14.6	14.6	14.6	14.8	14.7	0.2	1.2
23	0								
24	5	14.1	14.1	14.0	13.6	11.8	14.0	0.2	1.4
25	5	4.10	4.54	4.24	4.21	4.35	4.29	0.17	3.9
26	5	1.03	0.40	0.77	0.36	0.50	0.61	0.28	46.3
27	0								
28	5	7.9	8.7	6.4	6.4	9.5	7.8	1.4	17.7
29	5	12.5683	12.8035	13.043	12.8776	13.1446	12.8874	0.2232	1.7
30	0								
31	5	12.01	13.05	12.04	12.70	13.53	12.67	0.66	5.2
32	5	9.3	11.8	12.7	15.4	11.8	12.2	2.2	18.0
33	0								
34	5	5.5	7.3	9.0	8.0	7.6	7.5	1.3	17.1
35	5	14.6	14.6	14.6	14.5	14.5	15	0	0.4
36	5	21	26	22	18	23	22	3	13.3
37	5	16.2	16.2	16.0	15.8	16.8	16.2	0.4	2.3
38	0								
39	5	8.5	7.2	7.2	7.3	7.8	7.6	0.6	7.4
40	5	12.0	12.0	11.8	11.5	12.0	11.9	0.2	1.8
41	0								
42	0								
43	5	12.8	10.8	12.6	13.0	10.2	11.9	1.3	10.8
44	0								
45	0								
46	4	14.2	14.5	11.1	10.8		12.7	2.0	15.6
47	4	15	15	15	15	14	15	0	0.0
48	0								
49	5	12.5	11.3	12.9	12.9	11.4	12.2	0.8	6.5
50	5	12.6	12.9	12.6	12.7	12.8	12.7	0.1	1.0

ARSENIC
NIST 1566a
14.0 ± 1.2 mg/kg

Lab							Mean	SD	RSD
1	0								
2	4	15	14	15	15	15	15	0	0.0
3	5	13	14	12	15	13	13	1	8.5
4	0								
5	0								
6	5	13.6	14.5	15.3	15.3	15.1	14.8	0.7	4.9
7	0								
8	4	5.20	5.98	<4.74	8.95	6.40	6.63	1.62	24.4
9	5	11.10	11.51	10.86	11.34	11.44	11.25	0.27	2.4
10	5	3.7	3.3	4.5	3.5	3.5	3.7	0.5	12.7
11	5	14.5	14.2	14.7	14.7	13.9	14.4	0.3	2.4
12	0								
13	0								
14	5	13.32	15.92	15.24	15.10	15.20	15.0	1.0	6.5
15	5	13.5	13.5	13.5	13.4	13.4	13.5	0.1	0.4
16	0								
17	4	15	15	15	14	15	15	0	0.0
18	5	12.45	12.74	13.82	12.78	13.55	13.07	0.59	4.5
19	5	13.8	13.9	14.1	14.3	13.7	14.0	0.2	1.7
20	5	12.7	13.91	13.2	15.0	15.1	14.0	1.1	7.6
21	5	14.5	14.5	14.1	14.0	13.7	14.2	0.3	2.4
22	5	14.2	14.5	14.6	14.8	14.9	14.6	0.3	1.9
23	0								
24	5	13.7	15.1	14.6	13.2	14.9	14.3	0.8	5.7
25	5	6.18	6.16	6.15	6.38	5.96	6.17	0.15	2.4
26	0								
27	0								
28	0	8.95							
29	5	12.6284	13.7236	12.4014	12.8674	12.5587	12.8359	0.5239	4.1
30	0								
31	5	12.02	13.84	10.38	11.59	12.01	11.97	1.24	10.4
32	5	11.6	13.1	11.8	14.3	12.6	12.7	1.1	8.6
33	0								
34	5	15.6	17.0	14.3	16.0	16.0	15.8	1.0	6.2
35	5	13.0	13.2	13.3	13.1	13.2	13.2	0.1	0.9
36	5	16	23	19	16	18	18	3	15.7
37	5	16.0	15.6	16.1	16.5	15.5	15.9	0.4	2.5
38	0								
39	4	11.5	10.2	10.2	10.4	10.4	10.3	0.1	1.0
40	5	14.4	12.9	12.5	13.1	12.9	13.2	0.7	5.5
41	0								
42	0								
43	5	13.1	14.6	14.2	13.4	14.2	13.9	0.6	4.5
44	0								
45	0								
46	0	13.0	13.4						
47	0								
48	0								

SELENIUM
Sediment T
0.35 ± 0.13 mg/kg

Lab							Mean	SD	RSD
1	0								
2	5	<2	<2	<2	<2	<2			
3	5	0.38	0.42	0.45	0.38	0.44	0.41	0.03	7.9
4	0								
5	0								
6	0								
7	0								
8	0								
9	5	0.2885	0.2885	0.3000	0.2000	0.2000	0.2554	0.0508	19.9
10	5	<1	<1	<1	<1	<1			
11	5	<2	<2	<2	<2	<2			
12*	5	0.56	0.59	0.61	0.59	0.57	0.58	0.02	3.3
13	0								
14	5	0.370	0.370	0.380	0.380	0.368	0.374	0.006	1.6
15	5	0.38	0.45	0.41	0.43	0.43	0.42	0.03	6.3
16	5	<0.65	<0.65	<0.65	<0.65	<0.65			
17	5	0.34	0.24	0.29	0.29	0.34	0.30	0.04	13.9
18*	4	0.32	0.31	0.31	0.34	0.48	0.32	0.01	3.1
19	5	0.38	0.4	0.41	0.35	0.38	0.38	0.02	6.0
20	0								
21	0								
22	5	0.39	0.38	0.36	0.30	0.30	0.35	0.04	12.5
23	0								
24	5	0.3	0.3	0.3	0.3	0.3	0.3	0.0	0.0
25	0								
26	5	0.38	0.26	0.32	0.33	0.31	0.32	0.04	13.4
27	5	<0.5	<0.5	<0.5	<0.5	<0.5			
28	5	0.468	0.330	0.260	0.300	0.290	0.328	0.083	25.2
29*	4	0.6219	0.5983	0.6044	0.6204	0.6829	0.6110	0.0118	1.9
30	5	<0.5	<0.5	<0.5	<0.5	<0.5			
31	0								
32	5	0.40	0.30	0.30	0.20	0.40	0.32	0.08	26.1
33	0								
34*	5	0.62	0.60	0.69	0.62	0.69	0.64	0.04	6.6
35	5	0.33	0.33	0.31	0.31	0.36	0.33	0.02	6.2
36	5	<3	<3	<3	<3	<3			
37*	5	0.5	0.5	0.4	0.6	0.5	0.5	0.1	14.1
38	0								
39*	5	0.04	0.04	0.00	0.09	0.05	0.04	0.03	72.9
40	5	0.39	0.4	0.40	0.41	0.41	0.40	0.01	2.1
41	0								
42	5	0.21	0.38	0.42	0.34	0.25	0.32	0.09	27.5
43	0								
44	0								
45	5	0.279	0.255	0.281	0.230	0.251	0.259	0.021	8.2
46	5	0.36	0.36	0.39	0.48	0.45	0.41	0.05	13.4
47	0								
48	0								
49	5	0.374	0.373	0.399	0.387	0.383	0.383	0.011	2.8
50	0								

SELENIUM
BCSS-1
0.43 ± 0.06 mg/kg

Lab							Mean	SD	RSD
1	0								
2	5	<2	<2	<2	<2	<2			
3	5	0.50	0.47	0.42	0.47	0.52	0.48	0.04	7.9
4	0								
5	0								
6	0								
7	0								
8	0								
9	5	0.3571	0.4464	0.3448	0.4464	0.3571	0.3904	0.0514	13.2
10	5	<1	<1	<1	<1	<1			
11	5	<2	<2	<2	<2	<2			
12*	5	0.57	0.57	0.53	0.41	0.43	0.50	0.08	15.3
13	0								
14	5	0.41	0.411	0.410	0.460	0.459	0.430	0.027	6.3
15*	4	0.57	0.48	0.48	0.46	0.46	0.47	0.01	2.1
16	5	<0.65	<0.65	<0.65	<0.65	<0.65			
17*	4	0.34	0.34	0.35	0.39	0.34	0.34	0.01	2.9
18	5	0.4	0.42	0.39	0.49	0.39	0.42	0.04	10.1
19	5	0.46	0.46	0.40	0.40	0.43	0.43	0.03	7.0
20	0								
21	0								
22	5	0.49	0.44	0.42	0.43	0.39	0.43	0.04	8.4
23	0								
24	0								
25	0								
26	5	0.48	0.30	0.42	0.43	0.33	0.39	0.07	19.0
27	5	<0.5	<0.5	<0.5	<0.5	<0.5			
28	0	0.427							
29	5	0.4638	0.4924	0.4434	0.4924	0.4072	0.4598	0.0360	7.8
30	5	<0.5	<0.5	<0.5	<0.5	<0.5			
31	0								
32*	4	0.40	0.30	0.30	0.30	<0.2	0.30	0.00	0.0
33	0								
34	5	0.40	0.40	0.36	0.36	0.40	0.38	0.02	5.7
35	5	0.48	0.42	0.42	0.45	0.42	0.44	0.03	6.1
36	5	<3	<3	<3	<3	<3			
37	5	0.5	0.3	0.5	0.5	0.4	0.4	0.1	20.3
38	0								
39*	5	0.07	0.00	0.06	0.11	0.09	0.07	0.04	63.0
40	5	0.46	0.46	0.43	0.45	0.44	0.45	0.01	2.9
41	0								
42*	5	0.28	0.31	0.34	0.38	0.49	0.36	0.08	22.7
43	0								
44	0								
45*	4	0.224	0.202	0.184	0.204	0.381	0.204	0.016	7.8
46	4	0.37	0.44	0.42	0.40		0.41	0.03	7.3
47	0								
48	0								

SELENIUM Tissue S 1.87 ± 0.54 mg/kg									
Lab						Mean	SD	RSD	
1	0								
2*	5	4.8	3.8	4.8	5.6	4.8	4.8	0.6	13.4
3*	5	3.2	3.6	3.3	2.7	3.2	3.2	0.3	10.1
4	0								
5	0								
6	0								
7	0								
8	0								
9	5	1.700	1.838	2.043	1.754	1.985	1.864	0.147	7.9
10*	5	1.1	1.1	1.2	1.2	1.2	1.2	0.1	4.7
11	5	2.19	2.25	2.22	2.06	2.04	2.15	0.10	4.4
12	0								
13	0								
14	5	2.08	2.08	2.10	2.18	2.37	2.16	0.12	5.7
15	5	1.73	1.74	1.70	1.74	1.76	1.73	0.02	1.3
16	0								
17	5	1.6	1.7	1.3	1.6	1.3	1.5	0.2	12.5
18*	4	2.05	2.06	2.08	2.18	2.08	2.07	0.02	1.0
19	5	1.70	1.71	1.72	1.67	1.67	1.69	0.02	1.4
20	5	2.03	2.23	1.90	1.76	1.74	1.93	0.20	10.6
21	5	1.89	1.84	1.79	1.81	2.03	1.87	0.10	5.1
22	5	2.29	2.37	2.29	2.30	2.34	2.32	0.04	1.5
23	0								
24	5	1.8	1.8	1.8	2.0	2.4	2.0	0.3	13.3
25	0								
26	5	1.78	1.43	1.69	1.85	1.86	1.72	0.18	10.3
27	0								
28	5	1.52	1.68	1.53	1.47	1.58	1.56	0.08	5.1
29	5	1.8684	2.0528	1.8928	2.1396	1.9924	1.9892	0.1124	5.7
30	0								
31	0								
32	5	<0.2	<0.2	<0.2	<0.2	<0.2			
33	0								
34*	5	1.26	1.28	1.27	1.26	1.27	1.27	0.01	0.7
35	0								
36	5	<2	<2	<2	<2	<2			
37*	4	1.1	1.1	0.2	1.2	1.2	1.2	0.1	8.3
38	0								
39	5	1.8	1.5	1.4	1.5	1.6	1.6	0.2	9.7
40*	4	1.96	1.96	1.64	2.00	1.96	1.97	0.02	1.0
41	0								
42	5	2.03	2.11	2.04	2.47	2.16	2.16	0.18	8.3
43	5	2.1	1.3	2.2	2.4	2.5	2.1	0.5	22.6
44	0								
45*	5	4.70	2.93	4.49	4.71	5.18	4.40	0.86	19.6
46	4	1.80	1.80	1.95	1.90		1.86	0.07	4.0
47	0								
48	0								
49	5	1.56	2.00	1.76	1.72	1.73	1.75	0.16	9.0
50	0								

SELENIUM NIST 1566a 2.21 ± 0.24 mg/kg									
Lab							Mean	SD	RSD
1	0								
2	5	2.4	2.3	1.6	2.0	1.8	2.0	0.3	16.6
3	5	2.3	2.5	2.2	2.2	2.4	2.3	0.1	5.6
4	0								
5	0								
6	0								
7	0								
8	0								
9*	4	2.291	2.376	1.840	2.269	2.361	2.324	0.052	2.2
10*	5	1.5	1.4	1.6	1.4	1.5	1.5	0.1	5.7
11	5	2.25	2.16	2.26	2.20	2.23	2.22	0.04	1.8
12	0								
13	0								
14	5	2.08	2.20	2.65	1.97	2.12	2.20	0.26	11.9
15*	5	1.86	1.86	1.91	1.88	1.91	1.88	0.03	1.3
16	0								
17	5	2.2	2.4	2.1	2.4	2.4	2.3	0.1	6.1
18	5	2.23	2.28	2.29	2.34	2.31	2.29	0.04	1.8
19	5	2.15	2.16	2.16	2.08	2.10	2.13	0.04	1.8
20	5	2.01	2.40	2.06	2.07	2.18	2.14	0.16	7.3
21	5	2.14	2.23	2.34	2.33	2.28	2.26	0.08	3.6
22	5	2.25	2.32	2.40	2.42	2.37	2.35	0.07	2.9
23	0								
24	0								
25	0								
26	0								
27	0								
28	0	1.83							
29	5	2.0965	1.9984	2.2173	2.0429	2.1364	2.0983	0.0847	4.0
30	0								
31	0								
32	5	<0.2	<0.2	<0.2	<0.2	<0.2			
33	0								
34*	5	1.69	1.70	1.73	1.73	1.73	1.72	0.02	1.1
35	0								
36	5	<2	<2	<2	<2	<2			
37	5	2.1	2.3	2.1	2.2	1.8	2.1	0.2	8.9
38	0								
39*	5	2.3	2.0	1.7	1.9	1.8	1.9	0.2	11.9
40	5	2.42	2.18	2.36	2.11	2.07	2.23	0.15	6.9
41	0								
42*	5	2.52	2.96	2.92	2.94	2.72	2.81	0.19	6.7
43	5	1.8	2.1	2.9	1.8	2.5	2.2	0.5	21.5
44	0								
45*	5	1.56	1.68	1.99	3.20	4.13	2.51	1.11	44.3
46	0	1.96	2.22						
47	0								
48	0								

SILVER
Sediment T
0.22 ± 0.09 mg/kg

Lab							Mean	SD	RSD
1	0								
2*	5	0.46	0.51	0.48	0.49	0.47	0.48	0.02	4.0
3*	4	0.23	0.23	0.23	0.22	0.23	0.23	0.00	0.0
4	0								
5	0								
6*	4	0.174	0.130	0.130	0.128	0.130	0.129	0.001	0.8
7	5	<0.03	<0.03	<0.03	<0.03	<0.03			
8	0								
9	0								
10	5	0.125	0.123	0.128	0.130	0.129	0.127	0.003	2.3
11	5	<0.5	<0.5	<0.5	<0.5	<0.5			
12	0								
13*	5	0.096	0.091	0.099	0.102	0.101	0.098	0.004	4.5
14	5	<0.5	<0.5	<0.5	<0.5	<0.5			
15	0								
16	5	<0.25	<0.25	<0.25	<0.25	<0.25			
17	5	0.20	0.20	0.20	0.20	0.20	0.20	0.00	0.0
18	5	0.16	0.16	0.15	0.14	0.17	0.16	0.01	7.3
19	5	0.256	0.256	0.252	0.252	0.255	0.254	0.002	0.8
20*	5	0.005	0.003	0.003	0.004	0.004	0.004	0.001	22.0
21	0								
22	5	0.31	0.28	0.27	0.33	0.27	0.29	0.03	9.2
23	0								
24	5	<1.0	<1.0	<1.0	<1.0	<1.0			
25	5	0.277	0.295	0.316	0.311	0.290	0.298	0.016	5.3
26	5	<2	<2	<2	<2	<2			
27*	5	0.5	0.49	0.35	0.53	0.47	0.47	0.07	14.8
28*	5	0.42	0.39	0.37	0.48	0.47	0.43	0.05	11.3
29	5	0.1372	0.1355	0.1363	0.1389	0.1373	0.1370	0.0013	0.9
30	5	<1.5	<1.5	<1.5	<1.5	<1.5			
31	0								
32*	5	0.50	0.60	0.60	0.50	0.70	0.58	0.08	14.4
33	5	0.202	0.200	0.213	0.229	0.240	0.217	0.017	8.0
34	5	<0.30	<0.30	<0.30	<0.30	<0.30			
35*	4	0.34	0.33	0.34	0.34	0.34	0.34	0.00	0.1
36*	5	0.3	0.4	0.4	0.4	0.3	0.4	0.1	15.2
37	5	0.15	0.15	0.14	0.16	0.14	0.15	0.01	5.7
38	0								
39	5	0.207	0.249	0.205	0.297	0.259	0.243	0.039	15.8
40	5	0.21	0.20	0.20	0.21	0.21	0.21	0.01	2.7
41	0								
42	0								
43	0								
44	5	0.249	0.321	0.313	0.288	0.278	0.290	0.029	9.9
45	0								
46	5	<2.0	<2.0	<2.0	<2.0	<2.0			
47	0								
48	0								
49	5	0.205	0.191	0.205	0.220	0.205	0.205	0.010	5.0
50	0								

SILVER
BCSS-1
0.103 ± 0.068 mg/kg

Lab							Mean	SD	RSD
1	0								
2*	5	0.27	0.31	0.35	0.27	0.41	0.32	0.06	18.4
3*	4	0.13	0.12	0.12	0.12	0.12	0.12	0.00	0.0
4	0								
5	0								
6	5	0.066	0.067	0.060	0.060	0.063	0.063	0.003	5.2
7	0	<0.03	<0.03						
8	0								
9	0								
10*	4	0.069	0.069	0.075	0.070	0.069	0.069	0.001	1.4
11	5	<0.5	<0.5	<0.5	<0.5	<0.5			
12	0								
13	5	0.057	0.056	0.055	0.057	0.057	0.056	0.001	1.6
14	5	<0.5	<0.5	<0.5	<0.5	<0.5			
15	0								
16	5	<0.25	<0.25	<0.25	<0.25	<0.25			
17	5	0.087	0.100	0.090	0.099	0.094	0.094	0.006	6.0
18*	4	0.07	0.07	0.09	0.07	0.07	0.07	0.00	0.0
19	5	0.14	0.140	0.141	0.141	0.143	0.141	0.001	0.9
20*	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	ERR
21	0								
22*	5	0.18	0.19	0.17	0.17	0.18	0.18	0.01	4.7
23	0								
24	0								
25	5	0.140	0.130	0.121	0.128	0.155	0.135	0.013	9.8
26	5	<2	<2	<2	<2	<2			
27*	5	0.24	0.20	0.27	0.22	0.26	0.24	0.03	12.0
28	0	0.148							
29	5	0.1082	0.1037	0.1099	0.1102	0.1073	0.1079	0.0026	2.4
30	5	<1.5	<1.5	<1.5	<1.5	<1.5			
31	0								
32*	5	0.8	0.6	0.7	0.5	0.4	0.60	0.16	26.4
33	5	0.124	0.118	0.124	0.123	0.122	0.122	0.002	2.0
34	5	<0.30	<0.30	<0.30	<0.30	<0.30			
35	5	0.17	0.17	0.17	0.17	0.17	0.17	0.00	0.0
36**	3	0.3	0.2	0.2	0.2	<0.1	0.20	0.00	0.0
37	5	0.06	0.05	0.08	0.08	0.08	0.07	0.01	20.2
38	0								
39	5	0.105	0.099	0.135	0.124	0.111	0.115	0.015	12.7
40	5	0.10	0.10	0.09	0.10	0.11	0.10	0.01	7.1
41	0								
42	0								
43	0								
44	5	0.103	0.103	0.114	0.107	0.101	0.106	0.005	4.9
45	0								
46	5	<2.0	<2.0	<2.0	<2.0	<2.0			
47	0								
48	0								

		SILVER Tissue S 0.011 ± 0.006 mg/kg							
Lab							Mean	SD	RSD
1	0								
2	5	0.010	0.013	0.009	0.011	0.013	0.011	0.002	16.0
3	5	<0.01	0.02	<0.01	<0.01	<0.01			
4	0								
5	0								
6	5	0.011	0.006	0.007	0.006	0.003	0.007	0.003	43.7
7	5	<0.02	<0.02	<0.02	<0.02	<0.02			
8	5	<0.55	<0.46	<0.47	<0.45	<0.46			
9	0								
10	5	0.0099	0.0100	0.0199	0.0100	0.0149	0.0129	0.0044	34.3
11	0								
12	0								
13	0								
14	5	<0.5	<0.5	<0.5	<0.5	<0.5			
15	5	<0.01	<0.01	<0.01	<0.01	<0.01			
16	0								
17	5	<0.01	<0.01	<0.01	<0.01	<0.01			
18	5	<0.05	<0.05	<0.05	<0.05	<0.05			
19	5	0.012	0.012	0.013	0.014	0.012	0.013	0.001	7.1
20	5	<0.01	<0.01	<0.01	<0.01	<0.01			
21	5	<0.09	<0.09	<0.09	<0.09	<0.09			
22*	5	0.026	0.021	0.022	0.025	0.021	0.023	0.002	10.2
23	0								
24	5	<1.0	<1.0	<1.0	<1.0	<1.0			
25	5	0.008	0.001	0.008	0.002	0.008	0.005	0.004	66.3
26	5	<0.01	<0.01	<0.01	<0.01	<0.01			
27	0								
28	5	<0.1	<0.1	<0.1	<0.1	<0.1			
29*	5	0.1391	0.1371	0.1411	0.1371	0.1401	0.1389	0.0018	1.3
30	0								
31	5	<0.01	<0.01	<0.01	<0.01	<0.01			
32	5	<0.2	<0.2	<0.2	<0.2	<0.2			
33*	5	0.883	1.10	1.08	0.97	1.16	1.04	0.11	10.7
34	5	<0.30	<0.30	<0.30	<0.30	<0.30			
35	5	0.013	0.012	0.013	0.013	0.012	0.013	0.001	4.3
36	5	<0.1	<0.1	<0.1	<0.1	<0.1			
37*	5	0.04	0.03	0.03	0.02	0.03	0.03	0.01	23.6
38	5	<0.010	<0.010	<0.010	<0.010	<0.010			
39	5	0.00	0.01	0.02	0.02	0.01	0.01	0.01	69.7
40	5	0.012	0.012	0.012	0.012	0.012	0.012	0.000	0.0
41	0								
42	0								
43	5	<1.0	<1.0	<1.0	<1.0	<1.0			
44	5	<0.020	<0.020	<0.020	<0.020	<0.020			
45	0								
46	0								
47	0								
48	0								
49	0								
50	5	0.008	0.009	0.009	0.010	0.011	0.009	0.001	12.1

		SILVER NIST 1566a 1.68 ± 0.15 mg/kg							
Lab						Mean	SD	RSD	
1	0								
2'	4	1.6	1.7	1.7	1.6	1.2	1.7	0.1	5.9
3	5	1.5	1.7	1.5	1.8	1.5	1.6	0.1	8.8
4	0								
5	0								
6*	5	1.44	1.47	1.52	1.52	1.51	1.49	0.04	2.4
7	4	1.29	1.54	1.73	1.60		1.54	0.18	12.0
8	5	1.85	1.75	1.92	1.63	2.00	1.83	0.14	7.9
9	0								
10	5	1.769	1.821	1.722	1.900	1.794	1.801	0.066	3.7
11	0								
12	0								
13	0								
14*	5	1.71	1.70	1.20	1.70	1.10	1.48	0.31	20.6
15	5	1.52	1.54	1.54	1.47	1.54	1.52	0.03	2.0
16	0								
17*	5	1.84	1.84	1.90	1.90	1.86	1.87	0.03	1.6
18	5	1.78	1.60	1.52	1.75	1.66	1.66	0.11	6.4
19	5	1.63	1.65	1.68	1.62	1.68	1.65	0.03	1.7
20	5	1.58	1.69	1.69	1.67	1.73	1.67	0.06	3.3
21	5	1.56	1.55	1.55	1.56	1.58	1.56	0.01	0.8
22	5	1.74	1.68	1.71	1.67	1.59	1.68	0.06	3.4
23	0								
24	0								
25	5	1.58	1.55	1.59	1.62	1.63	1.59	0.03	2.0
26	0								
27	0								
28	0	1.58							
29	5	1.5869	1.5909	1.5889	1.5929	1.5889	1.5897	0.0023	0.1
30	0								
31*	5	0.90	0.29	1.33	1.71	1.72	1.19	0.61	50.9
32*	5	1.20	1.80	1.60	0.90	1.10	1.32	0.37	28.0
33	5	1.79	1.74	1.58	1.68	1.63	1.68	0.08	5.0
34	5	1.00	1.40	2.00	1.73	1.57	1.54	0.37	24.3
35	5	1.65	1.65	1.63	1.65	1.63	1.64	0.01	0.7
36	0								
37'	4	0.50	1.59	1.59	1.81	1.54	1.63	0.12	7.4
38*	5	1.50	1.46	1.45	1.4	1.39	1.44	0.05	3.1
39	5	1.7	1.64	1.72	1.57	1.56	1.64	0.07	4.5
40	5	1.68	1.79	1.64	1.60	1.60	1.66	0.08	4.7
41	0								
42	0								
43	5	<1.0	<1.0	<1.0	<1.0	<1.0			
44*	5	1.56	1.43	1.41	1.40	1.49	1.46	0.07	4.6
45'*	4	1.42	1.42	1.48	1.40	1.42	1.42	0.01	0.7
46	0								
47	0								
48	0								

CADMIUM Sediment T 0.45 ± 0.08 mg/kg									
Lab						Mean	SD	RSD	
1	5	0.385	0.405	0.425	0.380	0.380	0.395	0.020	5.0
2	5	0.51	0.53	0.40	0.44	0.39	0.45	0.06	14.0
3	5	0.45	0.47	0.46	0.45	0.46	0.46	0.01	1.8
4*	5	0.699	0.649	0.651	0.628	0.648	0.655	0.026	4.0
5	0								
6	0								
7*	5	0.176	0.196	0.188	0.180	0.162	0.180	0.013	7.1
8*	5	0.62	0.59	0.67	0.63	0.61	0.62	0.03	4.8
9*	5	3.3	2.8	3.0	3.0	3.0	3.0	0.2	5.9
10*	5	1.1	1.0	0.9	0.8	0.8	0.9	0.1	14.2
11	5	0.42	0.42	0.45	0.41	0.44	0.43	0.02	3.8
12	5	0.50	0.51	0.46	0.52	0.49	0.50	0.02	4.6
13*	5	0.33	0.30	0.31	0.32	0.32	0.32	0.01	3.6
14*	5	0.57	0.69	0.66	0.59	0.54	0.61	0.06	10.3
15	0								
16	5	0.53	0.53	0.48	0.48	0.52	0.51	0.03	5.1
17	5	0.50	0.49	0.48	0.51	0.50	0.50	0.01	2.3
18*	5	0.38	0.35	0.36	0.32	0.30	0.34	0.03	9.3
19*	5	0.55	0.55	0.55	0.55	0.55	0.55	0.00	0.0
20	0								
21	0								
22	5	0.47	0.49	0.51	0.49	0.47	0.49	0.02	3.4
23	5	0.37	0.37	0.38	0.40	0.32	0.37	0.03	8.0
24	5	<0.2	<0.2	<0.2	<0.2	<0.2			
25	5	0.35	0.44	0.48	0.44	0.42	0.43	0.05	11.2
26*	5	0.274	0.280	0.300	0.300	0.285	0.288	0.012	4.1
27*	5	0.17	0.15	0.16	0.10	0.14	0.14	0.03	18.8
28*	4	0.457	0.679	0.532	0.630	0.610	0.582	0.087	15.0
29*	4	0.4084	0.4193	0.4063	0.4038	0.4072	0.4064	0.0020	0.5
30*	5	0.50	0.65	0.68	0.48	0.45	0.55	0.11	19.1
31	0								
32*	5	1.80	1.20	1.50	1.50	1.50	1.50	0.21	14.1
33	5	0.421	0.422	0.302	0.315	0.422	0.376	0.062	16.5
34	5	0.50	0.45	0.45	0.50	0.46	0.47	0.03	5.5
35	5	0.45	0.45	0.46	0.44	0.45	0.45	0.01	1.6
36	5	0.5	0.5	0.4	0.4	0.3	0.4	0.1	19.9
37	5	0.54	0.44	0.49	0.46	0.51	0.49	0.04	8.1
38	0								
39	5	0.435	0.437	0.428	0.445	0.443	0.438	0.007	1.5
40	5	0.41	0.43	0.40	0.45	0.46	0.43	0.03	5.9
41	0								
42	0								
43	5	<1.0	<1.0	<1.0	<1.0	<1.0			
44	0								
45*	5	5.99	6.32	6.08	5.61	5.80	5.96	0.27	4.5
46*	5	0.33	0.30	0.37	0.39	0.30	0.34	0.0	12.1
47	0								
48	5	0.44	0.38	0.41	0.46	0.50	0.44	0.05	10.5
49	5	0.48	0.48	0.48	0.48	0.48	0.48	0.00	0.0
50	5	0.474	0.441	0.445	0.443	0.460	0.453	0.014	3.1

CADMIUM BCSS-1 0.25 ± 0.04 mg/kg									
Lab						Mean	SD	RSD	
1*	5	0.195	0.195	0.210	0.210	0.205	0.203	0.008	3.7
2	5	0.16	0.22	0.18	0.25	0.30	0.22	0.06	25.2
3	5	0.26	0.26	0.25	0.26	0.25	0.26	0.01	2.1
4*	4	0.3589	0.3568	0.3636	0.3296	0.3553	0.3586	0.0036	1.0
5	0								
6	0								
7*	5	0.143	0.127	0.131	0.140	0.139	0.136	0.007	4.9
8	5	0.23	0.29	0.28	0.30	0.32	0.28	0.03	11.8
9	5	<0.48	<0.49	<0.49	<0.49	<0.49			
10*	5	0.6	0.7	0.7	0.8	0.7	0.7	0.1	10.1
11	5	0.23	0.25	0.24	0.23	0.24	0.24	0.01	3.5
12	5	0.26	0.24	0.23	0.22	0.22	0.23	0.02	7.2
13	5	0.26	0.23	0.24	0.22	0.23	0.24	0.02	6.4
14*	5	0.30	0.28	0.32	0.21	0.35	0.29	0.05	18.0
15	0								
16*	5	0.32	0.35	0.30	0.34	0.26	0.31	0.04	11.4
17*	4	0.28	0.29	0.28	0.28	0.28	0.28	0.00	0.0
18	5	0.21	0.30	0.29	0.26	0.25	0.26	0.04	13.6
19*	4	0.25	0.26	0.26	0.26	0.26	0.26	0.00	0.0
20	0								
21	0								
22	5	0.26	0.28	0.24	0.24	0.30	0.26	0.03	9.9
23	5	0.18	0.17	0.29	0.20	0.23	0.21	0.05	22.6
24	0								
25*	5	0.30	0.31	0.20	0.28	0.39	0.30	0.07	23.0
26*	5	0.152	0.142	0.128	0.104	0.128	0.131	0.018	13.8
27*	5	0.13	0.13	0.14	0.11	0.12	0.13	0.01	9.0
28	0	0.277							
29	5	0.2243	0.2313	0.2232	0.2370	0.2311	0.2294	0.0057	2.5
30	0	0.30	0.28	0.30	0.25	0.30	0.29	0.02	7.7
31	0								
32*	5	1.40	1.00	1.20	1.80	0.70	1.22	0.41	34.0
33*	4	0.27	0.264	0.257	0.214	0.272	0.265	0.007	2.6
34	5	0.23	0.23	0.22	0.24	0.19	0.22	0.02	8.7
35	5	0.28	0.28	0.28	0.28	0.28	0.28	0.00	0.0
36*	5	0.2	0.3	0.2	0.1	0.1	0.2	0.1	46.5
37	5	0.24	0.26	0.26	0.28	0.28	0.26	0.02	6.3
38	0								
39	5	0.232	0.229	0.240	0.233	0.241	0.235	0.005	2.2
40	5	0.21	0.22	0.25	0.23	0.22	0.23	0.02	6.7
41	0								
42	0								
43	5	<1.0	<1.0	<1.0	<1.0	<1.0			
44	0								
45*	5	4.96	5.28	5.03	5.35	5.09	5.14	0.17	3.2
46	4	0.23	0.25	0.29	0.25		0.26	0.03	9.9
47	0								
48	5	0.19	0.25	0.23	0.25	0.21	0.23	0.03	11.5

CADMIUM Tissue S 0.83 ± 0.11 mg/kg									
Lab						Mean	SD	RSD	
1	0								
2	5	0.86	0.87	0.90	0.99	0.90	0.05	5.7	
3	5	0.81	0.77	0.86	0.68	0.86	0.06	9.4	
4	0								
5*	5	0.90	1.10	1.15	1.10	1.05	1.06	0.10	9.1
6*	4	0.735	0.783	0.988	0.755	0.767	0.760	0.020	2.6
7	5	0.92	0.87	0.93	0.88	0.86	0.89	0.03	3.5
8	5	0.87	0.82	0.98	0.89	0.87	0.89	0.06	6.6
9*	5	1.0	1.0	1.0	1.4	1.3	1.1	0.2	17.1
10	5	0.9	0.8	0.7	0.8	0.8	0.8	0.1	8.8
11	5	0.67	0.73	0.74	0.71	0.69	0.71	0.03	4.0
12	0								
13	0								
14	5	0.795	0.869	0.927	0.753	0.971	0.863	0.090	10.4
15*	5	1.10	1.10	1.11	1.13	1.09	1.11	0.02	1.4
16	0								
17*	4	0.90	0.90	0.88	0.96	0.89	0.89	0.01	1.1
18*	5	0.35	0.29	0.44	0.33	0.50	0.38	0.09	22.5
19*	4	0.78	0.78	0.78	0.77	0.78	0.78	0.00	0.0
20	5	0.870	0.908	0.874	0.880	0.916	0.890	0.021	2.4
21	5	0.743	0.750	0.752	0.782	0.779	0.761	0.018	2.4
22	5	0.802	0.776	0.790	0.810	0.783	0.792	0.014	1.7
23*	5	1.49	1.04	0.86	0.98	0.87	1.05	0.26	24.7
24*	5	0.6	0.6	0.6	0.6	0.6	0.6	0.0	0.0
25	5	0.83	0.81	0.85	0.76	0.83	0.82	0.03	4.2
26*	5	1.05	1.04	1.06	1.01	1.02	1.04	0.02	2.0
27	0								
28	5	0.990	0.769	0.980	0.803	0.790	0.866	0.109	12.6
29	5	0.7289	0.7198	0.7046	0.7243	0.7363	0.7228	0.0119	1.6
30	0								
31	5	0.96	0.76	0.82	0.90	0.93	0.87	0.08	9.4
32*	5	1.10	0.80	1.40	1.30	1.30	1.18	0.24	20.2
33*	5	1.19	1.00	1.14	1.28	1.32	1.19	0.13	10.6
34	5	0.95	0.89	0.84	0.83	1.15	0.93	0.13	14.0
35*	5	0.69	0.68	0.69	0.68	0.69	0.69	0.01	0.8
36	5	0.83	0.86	0.86	0.80	0.94	0.86	0.05	6.1
37*	4	1.04	1.02	0.73	0.96	0.97	1.00	0.04	4.0
38	0								
39*	5	0.64	0.64	0.64	0.67	0.66	0.65	0.01	2.2
40*	5	0.64	0.64	0.65	0.63	0.66	0.64	0.01	1.8
41	0								
42	0								
43*	5	1.0	1.0	0.93	1.0	0.98	0.98	0.03	3.1
44	0								
45	5	0.801	0.831	0.894	0.859	0.854	0.848	0.035	4.1
46	4	0.80	0.84	0.80	0.86		0.83	0.03	3.6
47	5	0.88	0.83	0.87	0.83	0.81	0.84	0.03	3.5
48	0								
49	5	0.819	0.804	0.800	0.821	0.771	0.803	0.020	2.5
50	5	0.775	0.821	0.786	0.782	0.790	0.791	0.018	2.2

CADMIUM NIST 1566a 4.15 ± 0.38 mg/kg									
Lab						Mean	SD	RSD	
1	0								
2	5	4.1	4.2	4.2	4.4	4.2	0.1	2.6	
3*	5	3.8	4.1	3.6	3.4	3.8	0.3	7.0	
4	0								
5	5	4.00	4.10	4.25	4.15	4.05	0.10	2.3	
6*	5	3.50	3.54	3.44	3.66	3.84	0.16	4.4	
7	4	3.68	3.92	4.14	4.14		0.22	5.5	
8	5	3.96	3.89	3.89	3.95	3.94	0.03	0.9	
9*	4	4.100	4.100	4.100	4.600	4.100	0.000	0.0	
10	5	4.2	4.0	4.0	4.0	4.1	0.1	2.2	
11	5	4.15	4.15	4.10	4.11	4.10	0.03	0.6	
12	0								
13	0								
14*	4	4.46	4.40	4.40	4.38	4.40	0.01	0.2	
15	5	4.01	3.93	4.14	4.06	4.27	0.13	3.2	
16	0								
17	5	4.57	4.42	4.53	4.50	4.32	0.10	2.2	
18	5	3.93	3.95	4.02	3.92	3.84	0.06	1.6	
19	5	3.73	3.83	3.87	3.88	3.73	0.07	1.9	
20	5	4.48	4.33	4.21	4.23	3.97	0.19	4.4	
21	5	3.97	4.07	3.95	4.10	3.93	0.08	1.9	
22	5	4.22	4.16	4.19	4.08	4.11	0.06	1.4	
23*	4	4.03	4.88	3.95	3.95	3.91	0.05	1.3	
24	0								
25	5	4.36	4.18	4.20	4.43	4.25	0.11	2.5	
26	0								
27	0								
28	0	4.5							
29*	4	4.2791	4.0203	3.9585	3.9386	3.9426	0.0379	1.0	
30	0								
31	5	4.00	4.00	3.76	3.68	4.19	0.21	5.2	
32*	5	4.10	5.20	4.80	4.30	4.50	0.43	9.4	
33	5	4.22	4.44	3.80	4.36	4.03	0.26	6.2	
34	5	4.48	3.93	4.15	4.10	3.60	0.32	7.9	
35	5	3.97	4.04	4.09	3.95	3.99	0.06	1.4	
36	0								
37	5	4.0	4.2	4.1	4.0	4.1	0.1	2.1	
38	0								
39*	5	3.53	3.48	3.36	3.39	3.29	0.10	2.8	
40*	4	3.77	3.79	4.06	3.80	3.81	0.02	0.5	
41	0								
42	0								
43	5	4.3	4.1	4.3	4.1	4.0	0.1	3.2	
44	0								
45	5	3.89	3.90	3.94	3.97	4.01	0.05	1.3	
46	0	4.50	4.00						
47	0								
48	0								

		TIN Sediment T 3.48 ± 1.10 mg/kg							
Lab							Mean	SD	RSD
1	5	3.35	3.45	3.50	3.55	3.40	3.45	0.08	2.29
2	5	3.4	3.7	3.3	3.2	3.4	3.4	0.2	5.5
3	5	<4	<4	<4	<4	<4			
4	0								
5	0								
6	0								
7	0								
8	0								
9	5	<4.9	<5.0	<5.0	<5.0	<4.9			
10	5	3	4	5	5	3	4	1	25
11	5	<5	<5	<5	<5	<5			
12	0								
13	0								
14	5	<3	<3	<3	<3	<3			
15	0								
16	0								
17	5	3.63	3.68	3.41	3.54	3.46	3.54	0.11	3.2
18	0								
19	5	3.48	3.51	3.53	3.53	3.46	3.50	0.03	0.9
20	0								
21	0								
22	5	2.97	3.09	2.87	2.88	2.81	2.92	0.11	3.7
23	0								
24	0								
25	5	3.34	3.48	3.64	3.65	3.62	3.55	0.13	3.8
26	5	2.7	2.5	2.7	2.6	2.2	2.5	0.2	8.2
27	5	<2.0	<2.0	<2.0	<2.0	<2.0			
28	0								
29*	5	6.2433	6.4138	6.4393	6.2433	6.4040	6.3487	0.0971	1.5
30	5	<1.5	<1.5	<1.5	<1.5	<1.5			
31	0								
32	5	<1.0	<1.0	<1.0	<1.0	<1.0			
33*	5	5.18	4.77	5.09	4.76	4.85	4.93	0.19	3.9
34	5	<2.5	<2.5	<2.5	<2.5	<2.5			
35	5	4.12	3.98	3.96	4.00	4.02	4.02	0.06	1.6
36	5	<2	4	<2	4	<2			
37	5	2.6	3.3	3.4	2.8	2.8	3.0	0.3	11.7
38	0								
39**	4	2.45	2.51	2.18	2.17	2.40	2.30	0.15	6.5
40	5	4.08	3.74	4.66	5.23	3.76	4.29	0.64	14.9
41	0								
42	0								
43	0								
44	0								
45	0								
46	0								
47	0								
48	0								
49	0								
50	5	3.64	3.53	3.52	3.64	3.57	3.58	0.06	1.6

		TIN BCSS-1 1.85 ± 0.20 mg/kg							
Lab							Mean	SD	RSD
1	5	1.85	1.95	2.00	2.00	2.05	1.97	0.08	3.85
2*	4	1.8	1.8	2.2	1.9	1.9	1.9	0.1	5.2
3	5	<4	<4	<4	<4	<4			
4	0								
5	0								
6	0								
7	0								
8	0								
9	5	<4.90	<4.90	<4.90	<4.90	<4.90			
10*	5	2	5	3	4	3	3	1	34
11	5	<5	<5	<5	<5	<5			
12	0								
13	0								
14	5	<3	<3	<3	<3	<3			
15	0								
16	0								
17	5	1.81	1.82	2.24	2.11	1.78	1.95	0.21	10.7
18	0								
19	5	1.92	1.79	1.83	1.85	1.86	1.85	0.05	2.6
20	0								
21	0								
22	5	1.87	1.73	1.52	1.63	1.64	1.68	0.13	7.8
23	0								
24	0								
25	5	2.11	1.60	1.38	1.53	1.75	1.67	0.28	16.6
26*	5	1.3	1.4	1.4	1.5	1.7	1.5	0.2	10.4
27	5	<2.0	<2.0	<2.0	<2.0	<2.0			
28	0								
29*	4	1.9668	1.9412	1.9609	1.8662	1.9708	1.9600	0.0132	0.7
30	5	<1.5	<1.5	<1.5	<1.5	<1.5			
31	0								
32	5	<1.0	<1.0	<1.0	<1.0	<1.0			
33	5	1.68	1.64	1.42	1.74	2.17	1.73	0.27	15.8
34	5	<2.5	<2.5	<2.5	<2.5	<2.5			
35*	5	2.31	2.32	2.12	2.03	2.24	2.20	0.13	5.7
36	5	<2	4	3	<2	<2			
37*	5	2.1	2.2	2.3	2.1	1.9	2.1	0.1	7.0
38	0								
39*	5	1.73	1.53	1.76	1.25	1.22	1.50	0.26	17.1
40*	5	2.20	2.02	2.58	2.88	2.30	2.40	0.34	14.1
41	0								
42	0								
43	0								
44	0								
45	0								
46	0								
47	0								
48	0								

		TIN Tissue S 0.080 ± 0.053 mg/kg							
Lab							Mean	SD	RSD
1	0								
2*	4	0.11	0.10	0.09	0.11	0.28	0.10	0.01	10.0
3	5	<4	<4	<4	<4	<4			
4	0								
5	0								
6	0								
7	0								
8	0								
9	5	<5.2	<5.2	<5.2	<5.3	<5.1			
10*	5	2	2	2	2	<2	1.6	0.9	55.9
11	0								
12	0								
13	0								
14	5	<3	<3	<3	<3	<3			
15	0								
16	0								
17	5	0.09	0.09	0.07	0.07	0.07	0.08	0.01	14.0
18	0								
19	5	0.015	0.020	0.022	0.023	0.014	0.019	0.004	21.7
20	5	<4	<4	<4	<4	<4			
21	0								
22	5	0.10	0.12	0.10	0.10	0.08	0.10	0.01	14.1
23	0								
24	0								
25	0								
26	5	<0.1	<0.1	<0.1	<0.1	<0.1			
27	0								
28	0								
29*	5	4.3371	4.3709	4.0727	4.1939	4.0091	4.1967	0.1586	3.8
30	0								
31	0								
32*	5	11.5	5.6	2.1	34.7	<1.0	13.5	14.7	108.9
33*	5	0.45	0.59	0.62	0.41	0.43	0.50	0.10	19.5
34	5	<2.5	<2.5	<2.5	<2.5	<2.5			
35	5	0.06	0.04	0.06	0.05	0.07	0.06	0.01	20.4
36	5	<2	<2	<2	<2	<2			
37	5	0.3	<0.2	0.3	0.3	<0.2	0.30	0.00	0.0
38	0								
39	5	0.1	0.1	0.1	0.0	0.0	0.1	0.1	91.3
40*	5	0.40	0.50	0.68	0.56	0.44	0.52	0.11	21.3
41	0								
42	0								
43	5	<1.5	<1.5	<1.5	<1.5	<1.5			
44	0								
45	3	0.497	0.603	0.431			0.510	0.087	17.0
46	0								
47	0								
48	0								
49	0								
50*	4	0.079	0.084	0.084	0.084	0.084	0.084	0.000	0.0

		TIN NIST 1566a 2.5 ± 1.5 mg/kg							
Lab							Mean	SD	RSD
1	0								
2	5	1.2	1.8	1.0	2.3	1.4	1.5	0.5	33.6
3	5	<4	<4	<4	<4	<4			
4	0								
5	0								
6	0								
7	0								
8	0								
9	5	6.2	<5.2	6.2	5.4	<5.2			
10	5	3	3	4	4	3	3	1	16.1
11	0								
12	0								
13	0								
14	5	<3	<3	<3	<3	<3			
15	0								
16	0								
17	5	1.86	1.8	1.72	2.14	1.67	1.84	0.18	10.0
18	0								
19	5	1.5	1.6	1.8	1.2	1.3	1.5	0.2	16.1
20	5	<4	<4	<4	<4	<4			
21	0								
22	5	2.68	2.73	2.65	2.37	2.58	2.60	0.14	5.4
23	0								
24	0								
25	0								
26	0								
27	0								
28	0								
29	5	2.6535	2.7611	2.6674	2.5897	2.7531	2.6850	0.0721	2.7
30	0								
31	0								
32	5	<1.0	<1.0	<1.0	<1.0	<1.0			
33	5	4.40	4.14	3.93	3.04	2.94	3.69	0.66	17.8
34	5	<2.5	<2.5	<2.5	<2.5	<2.5			
35	5	2.23	2.35	2.11	2.06	2.29	2.21	0.12	5.5
36	0								
37	5	3.1	2.6	3.2	3.2	3.6	3.1	0.4	11.4
38	0								
39	5	1.7	1.5	2.5	1.4	1.3	1.7	0.5	28.7
40	5	1.64	2.42	1.96	2.80	2.26	2.22	0.44	20.0
41	0								
42	0								
43*	4	3.3	3.0	3.2	4.2	3.3	3.2	0.1	3.1
44	0								
45	5	4.64	4.46	1.15	1.37	1.65	2.65	1.74	65.6
46	0								
47	0								
48	0								

		ANTIMONY Sediment T 1.05 ± 0.35 mg/kg										
Lab							Mean	SD	RSD			
1	0											
2	5	1.3	1.3	1.4	1.1	1.1	1.2	0.1	10.8			
3*	5	0.17	0.16	0.13	0.17	0.14	0.15	0.02	11.8			
4	0											
5	0											
6	0											
7	0											
8	0											
9	0											
10*	5	1.1	1.6	3.5	2.0	1.5	1.9	0.9	47.9			
11	5	<2	<2	<2	<2	<2						
12	0											
13	0											
14*	5	0.515	0.563	0.529	0.535	0.540	0.536	0.018	3.3			
15	0											
16	0											
17*	4	0.95	0.95	0.95	0.95	0.92	0.94	0.01	1.4			
18	0											
19	5	0.90	0.92	0.93	0.94	0.96	0.93	0.02	2.4			
20	0											
21	0											
22	5	1.15	1.00	1.05	0.99	1.18	1.07	0.09	8.1			
23	0											
24*	4	1.6	1.0	1.0	1.0	0.8	1.0	0.0	0.1			
25	0											
26*	5	0.61	0.61	0.56	0.65	0.53	0.59	0.05	8.0			
27	5	<1.0	<1.0	<1.0	<1.0	<1.0						
28	0											
29	5	0.6983	0.6772	0.6662	0.6842	0.6921	0.6836	0.0126	1.8			
30	5	<8	<8	<8	<8	<8						
31	0											
32	5	<0.2	<0.2	<0.2	<0.2	<0.2						
33	5	0.89	0.88	0.96	0.81	0.82	0.87	0.06	6.9			
34*	5	0.67	0.69	0.51	0.40	0.43	0.54	0.13	24.8			
35	5	1.25	1.22	1.31	1.29	1.20	1.25	0.05	3.7			
36	5	<4	<4	<4	<4	<4						
37*	4	0.7	0.8	0.7	0.7	0.7	0.7	0.0	0.0			
38	0											
39	0											
40	5	1.15	1.30	1.25	1.10	1.27	1.21	0.09	7.0			
41	0											
42	0											
43	0											
44	0											
45	0											
46	0	0.65	0.65									
47	0											
48	0											
49	0											
50	5	0.962	0.954	0.983	1.010	0.955	0.973	0.024	2.5			

		ANTIMONY BCSS-1 0.59 ± 0.06 mg/kg										
Lab							Mean	SD	RSD			
1	0											
2*	5	0.70	0.87	0.77	0.87	0.73	0.79	0.08	10.0			
3*	5	0.22	0.19	0.14	0.16	0.16	0.17	0.03	18.0			
4	0											
5	0											
6	0											
7	0											
8	0											
9	0											
10	5	<2	2.9	<2	<2	<2						
11	5	<2	<2	<2	<2	<2						
12	0											
13	0											
14*	4	0.618	0.537	0.527	0.54	0.529	0.533	0.006	1.1			
15	0											
16	0											
17	5	0.60	0.62	0.62	0.60	0.59	0.61	0.01	2.2			
18	0											
19	5	0.57	0.60	0.62	0.62	0.64	0.61	0.03	4.3			
20	0											
21	0											
22	5	0.57	0.57	0.55	0.56	0.61	0.57	0.02	4.0			
23	0											
24	0											
25	0											
26	5	0.53	0.51	0.58	0.56	0.59	0.55	0.03	6.1			
27	5	<1.0	<1.0	<1.0	<1.0	<1.0						
28	0											
29	5	0.6428	0.6194	0.5924	0.6112	0.6094	0.6150	0.0184	3.0			
30	0	<8	<8	<8	<8	<8						
31	0											
32	5	<0.2	<0.2	<0.2	<0.2	<0.2						
33	5	0.64	0.66	0.63	0.62	0.64	0.64	0.01	2.3			
34*	5	0.51	0.73	0.39	0.50	0.35	0.50	0.15	29.8			
35*	5	0.94	0.92	0.85	0.93	0.85	0.90	0.04	4.9			
36	5	<4	<4	<4	<4	<4						
37*	5	0.6	0.3	0.5	0.4	0.6	0.5	0.1	27.2			
38	0											
39	0											
40	5	0.77	0.58	0.61	0.53	0.62	0.62	0.09	14.4			
41	0											
42	0											
43	0											
44	0											
45	0											
46	0	0.54	0.57									
47	0											
48	0											

The determination of antimony was not required in the biologicals

MERCURY Sediment T 0.107 ± 0.020 mg/kg									
Lab						Mean	SD	RSD	
1	5	0.110	0.103	0.116	0.150	0.101	0.116	0.020	17.2
2*	5	0.16	0.11	0.12	0.19	0.11	0.14	0.04	25.8
3*	5	0.04	0.04	0.04	0.04	0.04	0.04	0.0	0.0
4	0								
5	0								
6	5	0.099	0.095	0.099	0.090	0.098	0.096	0.004	4.0
7	0								
8*	5	0.0612	0.060	0.0654	0.063	0.062	0.062	0.002	3.3
9*	5	0.232	0.223	0.204	0.1961	0.1961	0.2102	0.0164	7.8
10	5	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0
11*	4	0.09	0.08	0.09	0.09	0.09	0.09	0.00	0.0
12	0								
13	0								
14	5	0.1000	0.0999	0.0999	0.0902	0.0900	0.0960	0.0054	5.6
15	5	0.10	0.10	0.094	0.098	0.097	0.098	0.002	2.5
16	5	0.121	0.088	0.118	0.103	0.103	0.107	0.013	12.5
17	5	0.11	0.11	0.11	0.11	0.11	0.11	0.00	0.0
18	0								
19	5	0.112	0.113	0.113	0.110	0.111	0.112	0.001	1.2
20	5	0.104	0.104	0.102	0.097	0.103	0.102	0.003	2.9
21	0								
22	5	0.111	0.116	0.114	0.117	0.117	0.115	0.003	2.2
23	5	0.106	0.105	0.104	0.102	0.103	0.104	0.002	1.5
24*	5	0.14	0.14	0.12	0.12	0.12	0.13	0.01	8.6
25	0								
26*	4	0.058	0.059	0.058	0.065	0.059	0.060	0.003	4.9
27	5	0.105	0.097	0.091	0.104	0.101	0.100	0.006	5.8
28*	5	0.102	0.104	0.125	0.171	0.216	0.144	0.049	34.2
29*	5	0.135	0.130	0.144	0.110	0.144	0.133	0.014	10.6
30*	4	0.12	0.12	0.12	0.13	0.12	0.12	0.00	0.0
31	0								
32	0	0.114	0.112						
33	0								
34	5	0.104	0.104	0.106	0.106	0.110	0.106	0.002	2.3
35	0								
36	5	0.10	0.11	0.12	0.10	0.11	0.11	0.01	7.7
37	0								
38	0								
39*	5	0.168	0.158	0.164	0.165	0.157	0.162	0.005	2.9
40	5	0.124	0.123	0.119	0.112	0.118	0.119	0.005	4.0
41	5	0.113	0.119	0.129	0.109	0.122	0.118	0.008	6.6
42	0								
43	5	0.097	0.105	0.100	0.101	0.099	0.100	0.003	3.0
44	0								
45*	5	0.098	0.068	0.074	0.070	0.077	0.077	0.012	15.5
46	5	0.13	0.13	0.14	0.14	0.14	0.14	0.01	4.0
46*	5	0.13	0.13	0.14	0.14	0.14	0.14	0.0	4.0
48	0								
49	5	0.118	0.115	0.109	0.107	0.111	0.112	0.004	4.0
50	0								

MERCURY BCSS-1 0.163 ± 0.067 mg/kg									
Lab							Mean	SD	RSD
1	5	0.161	0.185	0.150	0.182	0.132	0.162	0.022	13.7
2	5	0.24	0.15	0.23	0.10	0.15	0.17	0.06	34.1
3*	5	0.09	0.09	0.09	0.10	0.10	0.09	0.01	5.8
4	0								
5	0								
6	5	0.113	0.121	0.123	0.113	0.142	0.122	0.012	9.7
7	0								
8	5	0.137	0.137	0.120	0.153	0.149	0.139	0.013	9.3
9*	5	0.280	0.3030	0.2814	0.2928	0.3423	0.300	0.025	8.5
10	5	0.13	0.13	0.12	0.13	0.12	0.13	0.01	4.3
11*	5	0.09	0.09	0.09	0.09	0.09	0.09	0.00	0.0
12	0								
13	0								
14	5	0.180	0.180	0.170	0.169	0.161	0.172	0.008	4.7
15	5	0.22	0.22	0.19	0.19	0.18	0.20	0.02	9.4
16	5	0.182	0.182	0.182	0.176	0.191	0.183	0.005	2.9
17	5	0.15	0.14	0.14	0.15	0.14	0.14	0.01	3.8
18	0								
19	5	0.171	0.171	0.170	0.170	0.170	0.170	0.001	0.3
20	0								
21	0								
22	5	0.172	0.174	0.177	0.180	0.176	0.176	0.003	1.7
23	5	0.151	0.14	0.149	0.130	0.134	0.141	0.009	6.5
24	0								
25	0								
26	5	0.129	0.125	0.125	0.116	0.127	0.124	0.005	4.0
27	5	0.110	0.119	0.122	0.101	0.111	0.113	0.008	7.3
28	0	0.157							
29*	5	0.261	0.243	0.252	0.250	0.244	0.250	0.007	2.9
30	5	0.17	0.17	0.18	0.17	0.15	0.17	0.01	6.5
31	0								
32	5	0.186	0.186	0.204	0.191	0.198	0.193	0.008	4.1
33	0								
34*	5	0.294	0.294	0.292	0.296	0.294	0.294	0.001	0.5
35	0								
36*	4	0.18	0.18	0.20	0.18	0.18	0.18	0.00	0.0
37	0								
38	0								
39*	4	0.197	0.200	0.203	0.159	0.200	0.200	0.002	1.0
40	5	0.220	0.209	0.181	0.212	0.167	0.198	0.023	11.4
41	5	0.149	0.172	0.175	0.167	0.171	0.167	0.010	6.2
42	0								
43	5	0.220	0.198	0.197	0.188	0.191	0.199	0.013	6.3
44	0								
45*	5	0.257	0.268	0.271	0.274	0.225	0.259	0.020	7.7
46	4	0.20	0.22	0.23	0.20		0.21	0.01	7.1
47	0								
48	0								

MERCURY
Tissue S
0.0618 ± 0.0209 mg/kg

Lab							Mean	SD	RSD
1	0								
2	5	0.050	0.057	0.072	0.094	0.073	0.069	0.017	24.6
3	5	<0.01	<0.01	<0.01	<0.01	<0.01			
4	0								
5	5	0.070	0.065	0.070	0.065	0.060	0.066	0.004	6.3
6	5	<0.050	<0.050	<0.050	<0.050	<0.050			
7	0								
8	0								
9*	5	0.10623	0.1062	0.0892	0.0777	0.0891	0.0937	0.0124	13.2
10	5	0.05	0.05	<0.05	0.05	0.05	0.05	0.00	0.0
11	5	0.060	0.050	0.057	0.054	0.061	0.056	0.005	8.0
12	0								
13	0								
14	5	<0.05	<0.05	<0.05	<0.05	<0.05			
15	5	0.06	0.06	0.06	0.05	0.05	0.06	0.01	9.8
16	0								
17	5	0.061	0.060	0.064	0.062	0.058	0.061	0.002	3.7
18	0								
19	5	0.065	0.067	0.064	0.065	0.065	0.065	0.001	1.7
20	5	0.053	0.05	0.051	0.059	0.046	0.052	0.005	9.2
21*	5	0.124	0.099	0.078	0.079	0.078	0.092	0.020	22.1
22*	4	0.063	0.063	0.063	0.063	0.061	0.063	0.000	0.0
23*	5	0.026	0.038	0.028	0.028	0.024	0.029	0.005	18.8
24	5	<0.20	<0.20	<0.20	<0.20	<0.20			
25	0								
26*	4	0.059	0.056	0.055	0.056	0.055	0.056	0.001	1.8
27	0								
28	5	0.046	0.048	0.043	0.059	0.061	0.051	0.008	15.7
29	5	0.052	0.053	0.053	0.055	0.053	0.053	0.001	2.1
30	0								
31	0	<0.05	0.05	0.05	0.05	<0.05	0.05	0.00	0.0
32	0	0.066							
33	0								
34	5	0.073	0.071	0.074	0.075	0.071	0.073	0.002	2.5
35	0								
36	5	<0.05	<0.05	<0.05	<0.05	<0.05			
37	0								
38*	4	0.076	0.073	0.073	0.073	0.073	0.073	0.000	0.0
39	5	0.042	0.072	0.059	0.052	0.041	0.053	0.013	24.2
40	5	0.069	0.069	0.067	0.069	0.073	0.069	0.002	3.2
41	5	0.073	0.061	0.049	0.060	0.045	0.058	0.011	19.1
42	0								
43	5	0.0533	0.0533	0.0554	0.0630	0.0620	0.0574	0.0047	8.3
44	0								
45	5	0.052	0.085	0.076	0.078	0.075	0.073	0.012	17.0
46	4	0.055	0.055	0.055	0.055		0.055	0.000	0.0
47	0								
48	0								
49	5	0.0504	0.0573	0.0565	0.0762	0.0493	0.0579	0.0108	18.7
50	0								

MERCURY
NIST 1566a
0.0642 ± 0.0067 mg/kg

Lab							Mean	SD	RSD
1	0								
2	5	0.058	0.054	0.062	0.075	0.062	0.062	0.008	12.7
3	5	<0.01	<0.01	<0.01	<0.01	<0.01			
4	0								
5	5	0.065	0.060	0.075	0.075	0.065	0.068	0.007	9.9
6	5	<0.050	<0.050	<0.050	<0.050	<0.050			
7	0								
8	0								
9*	5	0.0818	0.0788	0.0849	0.0844	0.0776	0.0815	0.0033	4.0
10*	5	0.05	0.06	0.06	0.06	0.05	0.06	0.01	9.8
11*	5	0.051	0.056	0.054	0.052	0.047	0.052	0.003	6.5
12	0								
13	0								
14*	5	0.06	0.06	0.06	<0.05	<0.05			
15	5	0.06	0.06	0.06	0.06	0.06	0.06	0.00	0.0
16	0								
17	5	0.068	0.065	0.069	0.068	0.062	0.066	0.003	4.3
18	0								
19	5	0.065	0.067	0.067	0.063	0.064	0.065	0.002	2.7
20	5	0.0622	0.0626	0.0700	0.0604	0.0642	0.0639	0.0037	5.8
21*	5	0.076	0.063	0.064	0.061	0.065	0.063	0.002	3.2
22	5	0.065	0.063	0.065	0.063	0.062	0.064	0.001	2.1
23*	5	0.026	0.025	0.024	0.027	0.028	0.026	0.002	6.1
24	0								
25	0								
26	0								
27	0								
28	0	0.0717							
29	5	0.066	0.063	0.061	0.066	0.064	0.064	0.002	3.3
30	0								
31	5	<0.05	<0.05	<0.05	<0.05	<0.05			
32	5	<0.02	<0.02	<0.02	<0.02	<0.02			
33	0								
34*	5	0.076	0.076	0.071	0.073	0.071	0.073	0.003	3.4
35	0								
36	0								
37	0								
38	5	0.065	0.067	0.067	0.069	0.070	0.068	0.002	2.9
39*	5	0.041	0.053	0.061	0.056	0.052	0.053	0.007	14.0
40	5	0.059	0.067	0.072	0.076	0.065	0.068	0.007	9.6
41*	5	0.0816	0.073	0.0783	0.0662	0.0648	0.0728	0.0073	10.1
42	0								
43	5	0.0635	0.061	0.0575	0.0651	0.0686	0.0631	0.0042	6.6
44	0								
45*	5	0.049	0.045	0.043	0.046	0.043	0.045	0.002	5.5
46	0	0.057	0.065						
47	0								
48	0								

		THALLIUM Sediment T 0.63 ± 0.39 mg/kg							
Lab						Mean	SD	RSD	
1	0								
2'	4	0.72	0.78	0.79	0.80	0.78	0.01	1.3	
3	5	0.44	0.36	0.34	0.33	0.32	0.36	0.05	13.6
4	0								
5	0								
6	0								
7	5	<0.5	<0.5	<0.5	<0.5	<0.5			
8	0								
9	0								
10	5	<2	<2	<2	<2	<2			
11	5	<2	<2	<2	<2	<2			
12	0								
13	0								
14	5	<5	<5	<5	<5	<5			
15	0								
16	0								
17	5	0.60	0.58	0.58	0.59	0.61	0.59	0.01	2.2
18	0								
19	0								
20	0								
21	0								
22	5	0.82	0.86	0.86	0.84	0.81	0.84	0.02	2.7
23	0								
24	0								
25	0								
26	5	0.3	0.3	0.5	0.4	0.3	0.4	0.1	24.8
27	5	0.25	0.21	0.18	0.43	0.40	0.29	0.11	38.7
28	0								
29	5	0.6074	0.6352	0.6153	0.6098	0.6231	0.6182	0.0113	1.8
30	0								
31	0								
32	5	<0.1	<0.1	<0.1	<0.1	<0.1			
33'	4	0.59	0.62	0.51	0.62	0.62	0.61	0.02	3.3
34*	5	0.12	0.16	0.20	0.23	0.20	0.18	0.04	23.4
35	5	1.00	1.02	1.03	1.01	1.03	1.02	0.01	1.3
36	5	<1	<1	<1	<1	<1			
37	5	0.5	0.6	0.5	0.7	0.6	0.6	0.1	14.4
38	0								
39	0								
40	0								
41	0								
42	0								
43	0								
44	0								
45	0								
46	0								
47	0								
48	0								
49	0								
50	5	0.798	0.776	0.753	0.756	0.793	0.775	0.021	2.7

		THALLIUM BCSS-1 0.56 ± 0.18 mg/kg							
Lab						Mean	SD	RSD	
1	0								
2	5	0.61	0.57	0.53	0.54	0.53	0.56	0.03	6.2
3*	5	0.18	0.17	0.16	0.15	0.15	0.16	0.01	8.0
4	0								
5	0								
6	0								
7	0	<0.5	<0.5						
8	0								
9	0								
10	5	<2	<2	<2	<2	<2			
11	5	<2	<2	<2	<2	<2			
12	0								
13	0								
14	5	<5	<5	<5	<5	<5			
15	0								
16	0								
17	5	0.49	0.47	0.48	0.47	0.48	0.48	0.01	1.8
18	0								
19	0								
20	0								
21	0								
22	5	0.6	0.6	0.58	0.61	0.56	0.59	0.02	3.4
23	0								
24	0								
25	0								
26'	4	0.4	0.4	0.4	0.4	0.3	0.4	0.0	0.0
27*	5	0.20	0.14	<0.08	0.19	0.17	0.18	0.03	16.7
28	0								
29	5	0.5918	0.6352	0.6153	0.6098	0.6231	0.6150	0.0161	2.6
30	0								
31	0								
32	5	<0.1	<0.1	<0.1	<0.1	<0.1			
33	5	0.40	0.49	0.46	0.39	0.44	0.44	0.04	9.5
34	5	<0.10	<0.10	<0.10	<0.10	<0.10			
35	5	0.64	0.64	0.64	0.64	0.64	0.64	0.00	0.0
36	5	<1	<1	<1	<1	<1			
37*	5	0.3	0.4	0.4	0.2	0.4	0.3	0.1	26.3
38	0								
39	0								
40	0								
41	0								
42	0								
43	0								
44	0								
45	0								
46	0								
47	0								
48	0								
49	0								
50	5	0.525	0.53	0.534	0.541	0.542	.534	.007	

The determination of thallium was not required in the biologicals

LEAD Sediment T 32.1 ± 6.7 mg/kg									
Lab						Mean	SD	RSD	
1	5	33.5	34.5	31.5	31.5	31.0	32.4	1.5	4.7
2	5	31	32	34	34	34	33	1	4.3
3	5	25	26	25	25	26	25	1	2.2
4*	5	39.997	40.186	40.572	39.967	40.000	40.144	0.254	0.6
5	0								
6	5	26.8	24.7	27.4	27.2	22.6	25.7	2.1	8.0
7	5	29.75	29.50	27.85	27.6	31.45	29.23	1.57	5.4
8	5	29.68	30.84	32.62	32.14	32.81	31.62	1.33	4.2
9*	5	38	41	44	39	39	40	2	5.9
10	5	32	32	32	31	31	32	1	1.7
11	5	33	33	35	36	35	34	1	3.9
12	5	33	32	32	35	35	33	2	4.5
13*	5	41.3	41.9	39.7	40.5	39.4	40.6	1.1	2.6
14	5	26.9	30.0	28.1	28.0	30.0	28.6	1.4	4.8
15	0								
16	5	31.3	30.3	30.3	30.6	31.1	30.7	0.5	1.5
17	5	36	38	34	33	32	35	2	7.0
18*	5	52.4	59.0	53.5	49.0	51.6	53.1	3.7	7.0
19	5	33.9	33.9	34.0	34.0	33.8	33.9	0.1	0.2
20	0								
21	0								
22	5	31.6	32.3	32	32.7	31.8	32.1	0.4	1.3
23*	5	16.4	17.1	14.6	17.1	15.7	16.2	1.1	6.5
24	5	36	36	36	36	36	36	0	0.0
25	5	29.5	27.7	27.5	28.8	25.6	27.8	1.5	5.3
26*	4	20.0	21.0	20.8	21.5	27.4	20.8	0.6	2.9
27	5	45.0	43.0	45.0	51.0	46.0	46.0	3.0	6.5
28	5	34.4	35.0	32.1	33.2	32.9	33.5	1.2	3.5
29*	5	51.5216	52.2874	45.4152	49.4207	46.0239	48.9338	3.1236	6.4
30	5	30.3	27.0	27.5	27.8	33.3	29.2	2.6	9.0
31	0								
32*	5	24.0	23.0	27.0	24.8	23.0	24.4	1.7	6.8
33	5	32.5	32.4	28.3	35.4	35.4	32.8	2.9	8.9
34	5	31.4	32.9	31.6	34.1	30.2	32.0	1.5	4.7
35*	5	43.4	43.9	44.8	44.4	44.0	44.1	0.5	1.2
36	5	39	39	37	36	36	37	2	4.1
37	5	37.3	37.4	35.4	37.8	38.2	37.2	1.1	2.9
38	0								
39	5	33.8	34.2	32.4	32.7	32.7	33.2	0.8	2.4
40	5	27	25	31	30	30	29	3	8.8
41	0								
42	0								
43	5	35.6	38.8	38.4	36.1	35.9	37.0	1.5	4.1
44	0								
45*	5	37.8	35.6	44.1	41.6	46.8	41.2	4.6	11.1
46	5	29.3	29.6	29.0	28.5	30.2	29.3	0.6	2.2
47	0								
48	5	38.06	33.18	40.47	38.01	37.79	37.50	2.65	7.1
49	5	32.0	30.6	32.7	33.4	32.0	32.1	1.0	3.2
50*	5	30.9	30.8	32.7	30.6	30.7	30.8	0.1	0.3

LEAD BCSS-1 22.7 ± 3.4 mg/kg									
Lab							Mean	SD	RSD
1	5	23.5	24.0	22.0	24.5	23.5	23.5	0.9	4.0
2'	4	22	22	22	22	21	22	0	0.0
3*	5	18	18	17	17	17	17.4	0.5	3.1
4	5	25.857	26.585	29.243	25.887	26.219	26.758	1.420	5.3
5	0								
6*	5	20.4	19.5	16.3	17.3	17.7	18.2	1.7	9.2
7	5	18.95	17.0	20.65	21.80	22.15	20.11	2.14	10.6
8	5	20.98	21.63	21.51	21.93	21.83	21.58	0.37	1.7
9	5	21.00	22.00	22.00	23.00	22.00	22.00	0.71	3.2
10	5	21	23	23	22	23	22	1	4.0
11	5	23	21	21	23	22	22	1	4.5
12	5	25	24	26	24	25	25	1	3.4
13	5	22.4	23.9	24.9	23.1	23.2	23.5	0.9	4.0
14	5	24.0	21.1	20.0	23.0	21.1	21.8	1.6	7.4
15	0								
16	5	20.1	20.4	20.9	19.7	19.9	20.2	0.5	2.3
17	5	22	23	22	25	23	23	1	5.3
18'	4	24.9	22.5	34.65	25.2	24.1	24.1	1.2	5.0
19	5	22.4	22.6	22.8	22.9	22.3	22.6	0.3	1.1
20	0								
21	0								
22	5	22.5	22	23.2	22.7	23.6	22.8	0.6	2.7
23*	5	10.5	12.1	13.1	11.9	12.5	12.0	1.0	8.0
24	0								
25*	5	14.9	15.8	14.4	15.3	17.8	15.6	1.3	8.4
26*	5	9.0	12.5	9.7	9.8	11.7	10.5	1.5	14.1
27*	5	29.0	30.0	30.0	35.0	33.0	31.4	2.5	8.0
28	0	21.4							
29	5	23.6463	21.1554	22.9119	20.4092	22.6843	22.1614	1.3345	6.0
30*	5	18.5	18.8	17.5	17.3	17.5	17.9	0.7	3.8
31	0								
32*	5	16.0	19.0	17.0	18.0	15.0	17.0	1.6	9.3
33	5	20.4	21.4	21.5	19.8	19.4	20.5	0.9	4.6
34	5	21.6	25.4	20.5	25.1	21.9	22.9	2.2	9.7
35	5	26.2	25.3	25.6	26.2	25.8	25.8	0.4	1.5
36	5	25	25	22	22	22	23	2	7.1
37	5	24.3	24.9	23.3	23.4	27.1	24.6	1.5	6.3
38	0								
39'	4	21.7	22.6	25.4	22.7	21.7	22.2	0.6	2.7
40	5	22	21	21	22	21	21	1	2.6
41	0								
42	0								
43	5	25.1	26.2	26.4	25.2	23.6	25.3	1.1	4.4
44	0								
45	5	17.2	22.1	32.1	25.3	27.0	24.7	5.6	22.5
46	4	21.1	21.6	21.4	25.0		22.3	1.8	8.2
47	0								
48	5	25.37	26.71	25.76	25.63	24.83	25.66	0.69	2.7

LEAD Tissue S 1.14 ± 0.31 mg/kg									
Lab						Mean	SD	RSD	
1	0								
2	5	1.2	1.1	1.1	1.2	1.2	0.1	4.7	
3	5	1.1	0.99	1.1	0.91	1.1	0.1	8.4	
4	0								
5	5	<3	<3	<3	<3	<3			
6*	5	2.50	2.03	1.15	0.95	0.92	1.51	0.72	47.4
7	4	1.31	1.44	1.51	1.32		1.40	0.10	6.9
8	0								
9*	5	5.0	5.0	5.3	5.4	5.4	5.2	0.2	3.9
10	5	0.82	0.93	0.91	1.27	1.02	0.99	0.17	17.4
11	5	0.812	0.877	0.842	0.806	0.962	0.860	0.064	7.4
12	0								
13	0								
14	5	<4	<4	<4	<4	<4			
15*	4	1.2	1.2	1.2	1.2	1.1	1.2	0.0	0.0
16	0								
17	5	1.27	1.27	1.21	1.25	1.28	1.26	0.03	2.2
18*	5	0.17	0.20	0.25	0.19	0.19	0.20	0.03	15.0
19	5	1.16	1.17	1.15	1.16	1.16	1.16	0.01	0.6
20	5	1.27	1.33	1.34	1.22	1.37	1.31	0.06	4.6
21	5	1.28	1.03	1.30	1.22	1.33	1.23	0.12	9.7
22	5	1.22	1.20	1.22	1.22	1.24	1.22	0.01	1.2
23*	5	3.47	1.07	2.045	3.24	<0.20	2.46	1.12	45.5
24*	5	4	4	4	4	4	4	0	0.0
25	5	1.00	1.10	1.10	1.03	1.06	1.06	0.04	4.1
26	5	1.56	1.21	1.67	1.34	1.19	1.39	0.21	15.3
27	0								
28	5	1.10	1.17	0.93	1.36	1.07	1.13	0.16	14.0
29	5	0.9640	0.9800	0.9241	0.9701	0.8902	0.9457	0.0376	4.0
30	0								
31	5	1.43	1.44	1.39	1.32	1.35	1.39	0.05	3.7
32*	5	4.3	8.0	4.0	6.0	8.0	6.1	1.9	31.8
33*	5	0.322	0.321	0.291	0.301	0.289	0.305	0.016	5.2
34	5	<0.50	<0.50	<0.50	<0.50	<0.50			
35*	5	2.25	2.79	2.30	2.43	2.51	2.46	0.21	8.7
36	5	<0.5	<0.5	<0.5	<0.5	<0.5			
37	5	1.2	1.3	1.2	1.1	1.2	1.2	0.1	5.9
38*	5	4.3	4.1	4.1	4.5	4.5	4.3	0.2	4.7
39	5	0.9	0.94	0.96	0.98	0.93	0.94	0.03	3.2
40	5	1.08	1.12	1.16	1.16	1.12	1.13	0.03	3.0
41	0								
42	0								
43	5	1.0	1.1	1.1	1.4	1.4	1.2	0.2	15.6
44	0								
45	5	1.37	1.08	1.63	1.16	0.716	1.19	0.3	28.6
46	4	0.90	1.0	0.90	0.95		0.9	0.0	5.1
47*	5	2.1	2.5	2.0	2.5	2.0	2.2	0.3	11.7
48	0								
49	5	1.09	1.03	1.08	1.21	1.05	1.09	0.07	6.4
50	5	1.16	1.16	1.15	1.18	1.24	1.18	0.04	3.1

LEAD NIST 1566a 0.371 ± 0.014 mg/kg									
Lab							Mean	SD	RSD
1	0								
2	5	0.34	0.35	0.35	0.38	0.36	0.36	0.02	4.3
3	5	0.32	0.4	0.33	0.41	0.35	0.36	0.04	11.3
4	0								
5	5	<3	<3	<3	<3	<3			
6*	4	0.487	0.396	0.491	0.409	0.809	0.445	0.050	11.2
7	0	0.37	0.50	0.40			0.4	0.1	16.1
8	0								
9	5	<1.00	<1.00	<1.00	<1.00	<1.00			
10	5	0.40	0.40	0.43	0.32	0.33	0.38	0.05	12.8
11	5	0.288	0.278	0.396	0.445	0.472	0.376	0.089	23.7
12	0								
13	0								
14	5	<4	<4	<4	<4	<4			
15	5	0.42	0.36	0.36	0.32	0.36	0.36	0.04	9.8
16	0								
17	5	0.35	0.41	0.34	0.38	0.37	0.37	0.03	7.4
18*	5	0.36	0.24	0.28	0.25	0.30	0.29	0.05	16.7
19	5	0.37	0.38	0.36	0.36	0.37	0.37	0.01	2.3
20*	5	0.379	0.447	0.498	0.489	0.467	0.456	0.047	10.4
21	5	0.33	0.33	0.39	0.45	0.32	0.36	0.06	15.2
22	5	0.376	0.368	0.403	0.381	0.403	0.386	0.016	4.1
23	5	0.89	<0.20	0.36	<0.20	<0.20			
24	0								
25	5	<0.05	<0.05	<0.05	<0.05	<0.05			
26	0								
27	0								
28	0	0.374							
29	5	0.3768	0.3907	0.3847	0.3451	0.3708	0.3736	0.0176	4.7
30	0								
31*	5	0.40	0.48	0.42	0.43	0.42	0.43	0.03	7.0
32*	5	7.0	4.0	5.0	3.0	5.0	4.8	1.5	30.9
33	5	0.375	0.392	0.391	0.369	0.332	0.372	0.024	6.6
34	5	<0.50	<0.50	<0.50	<0.50	<0.50			
35*	5	0.77	0.76	0.84	0.80	0.81	0.80	0.03	4.0
36	0								
37*	5	0.4	0.5	0.3	0.4	0.4	0.4	0.1	17.7
38	5	<0.48	<0.46	<0.48	<0.48	<0.46			
39*	5	0.78	0.22	0.26	0.40	0.31	0.39	0.23	57.4
40*	4	0.31	0.27	0.32	0.31	0.31	0.31	0.01	3.2
41	0								
42	0								
43*	5	0.26	0.4	0.4	0.4	0.3	0.4	0.1	19.1
44	0								
45*	4	2.85	1.19	0.158	0.339		1.13	1.23	108.4
46	0	0.35	0.32						
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 T	--	GG	--	--	--	--	GG	LG	LX	LG
	BCSS	-	GX	--	--	--	--	--	LG	L-	GG
Al	Sed T	LX	EG	LG	EG	--	LG	HX	LG	LG	LG
	BCSS	EX	EG	LG	GG	--	LG	--	LG	LG	LG
Si	Sed T	--	EG	LX	--	--	--	--	--	--	--
	BCSS	--	LG	LG	--	--	--	--	--	--	--
Cr	Sed T	EG	EG	LG	EG	--	EG	EG	LG	LG	LX
	BCSS	EG	EG	LG	LG	--	LG	LG	LG	LG	LX
Mn	Sed T	EG	EG	EG	EG	--	EG	EG	EG	GG	EG
	BCSS	EG	GG	LG	EG	--	LG	GG	LG	LG	LG
Fe	Sed T	EG	EG	EG	EG	--	EG	EG	EG	LG	EG
	BCSS	EG	GG	LG	LG	--	LG	--	LX	LG	GG
Ni	Sed T	EG	EG	GG	HG	--	GX	EG	EG	EG	EG
	BCSS	GG	GG	LG	EG	--	GG	GG	LG	LG	LG
Cu	Sed T	EG	EG	EG	GG	--	EG	LG	EG	HG	EG
	BCSS	EG	EG	LG	EG	--	LG	EX	EG	EG	LG
Zn	Sed T	EG	EG	LG	EG	--	GG	EG	GG	LG	EG
	BCSS	EG	EG	LG	GG	--	LG	GG	LG	LG	GG
As	Sed T	LX	EG	EG	--	--	--	--	GX	LG	GG
	BCSS	EG	EG	LG	--	--	--	--	LX	LG	EG
Se	Sed T	--	H-	EG	--	--	--	--	--	EX	G-
	BCSS	--	G-	GG	--	--	--	--	--	GX	G-
Ag	Sed T	--	HG	EG	--	--	GG	L-	--	--	GG
	BCSS	--	HX	EG	--	--	EG	--	--	--	EG
Cd	Sed T	EG	EX	EG	HG	--	--	LG	HG	HG	HX
	BCSS	LG	GX	EG	HG	--	--	LG	GX	G-	HG
Sn	Sed T	EG	EG	G-	--	--	--	--	--	G-	GX
	BCSS	EG	EG	G-	--	--	--	--	--	G-	HX
Sb	Sed T	--	EX	LX	--	--	--	--	--	--	HX
	BCSS	--	HG	LX	--	--	--	--	--	--	G-
Hg	Sed T	GX	HX	LG	--	--	EG	--	LG	HG	EG
	BCSS	EX	GX	LG	--	--	EG	--	EG	HG	EG
Tl	Sed T	--	EG	EX	--	--	--	G-	--	--	G-
	BCSS	--	EG	LG	--	--	--	--	--	--	G-
Pb	Sed T	EG	EG	GG	HG	--	GG	EG	EG	HG	EG
	BCSS	EG	EG	LG	GG	--	LG	GX	EG	EG	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 T	EG	--	--	--	--	--	EG	--	--	--
	BCSS	HG	--	--	--	--	--	EG	--	--	--
Al	Sed T	EG	LG	--	EG	--	LG	EG	--	EG	LX
	BCSS	EG	GG	--	EG	--	LG	GX	--	EG	GX
Si	Sed T	EG	EG	--	EG	--	HG	EG	--	--	--
	BCSS	EG	EG	--	GG	--	GG	GG	--	--	--
Cr	Sed T	EG	EG	EG	EG	--	EG	EG	EG	EG	--
	BCSS	EG	EG	EG	EG	--	LG	EG	EG	EG	--
Mn	Sed T	EG	EG	EG	GG	--	EG	EG	LX	EG	GG
	BCSS	GG	EG	EG	GG	--	LG	EG	GG	EG	GG
Fe	Sed T	EG	EG	EG	EG	--	EG	EG	EG	EG	EG
	BCSS	EG	EG	EG	GG	--	GG	EG	GG	EG	LG
Ni	Sed T	EG	EG	EG	EG	--	EG	EG	EG	EG	--
	BCSS	EG	EG	EG	EG	--	GG	EG	EG	EG	--
Cu	Sed T	GG	GG	EG	HG	--	EG	EG	GG	EG	EG
	BCSS	EG	GG	EG	EG	--	EG	EG	EG	EG	EG
Zn	Sed T	EG	EG	EG	EG	--	EG	EG	HG	HG	EG
	BCSS	EG	EG	EG	EG	--	GG	EG	EG	EG	EG
As	Sed T	GG	EG	--	EG	EG	LG	EG	EG	EG	EG
	BCSS	EG	EG	--	EG	GG	LG	EG	EG	EG	EG
Se	Sed T	H-	HG	--	EG	EG	G-	EX	EG	EG	--
	BCSS	G-	HX	--	EG	EG	G-	LG	EG	EG	--
Ag	Sed T	G-	--	LG	G-	--	G-	EG	EG	EG	LX
	BCSS	G-	--	EG	G-	--	G-	EG	EG	EG	L-
Cd	Sed T	EG	EG	LG	HG	--	EG	EG	LG	HG	--
	BCSS	EG	EG	EG	HX	--	HX	EG	EX	EG	--
Sn	Sed T	G-	--	--	G-	--	--	EG	--	EG	--
	BCSS	G-	--	--	G-	--	--	GX	--	EG	--
Sb	Sed T	G-	--	--	LG	--	--	EG	--	EG	--
	BCSS	G-	--	--	EG	--	--	EG	--	EG	--
Hg	Sed T	EG	--	--	EG	EG	EX	EG	--	EG	EG
	BCSS	LG	--	--	EG	EG	EG	EG	--	EG	--
Tl	Sed T	G-	--	--	H-	--	--	EG	--	--	--
	BCSS	G-	--	--	H-	--	--	EG	--	--	--
Pb	Sed T	EG	EG	HG	EG	--	EG	EG	HG	EG	--
	BCSS	EG	EG	EG	EG	--	EG	EG	EG	EG	--

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

Laboratory Evaluation for Sediments

		Lab 41	Lab 42	Lab 43	Lab 44	Lab 45	Lab 46	Lab 47	Lab 48
Be	Sed T	--	--	EG	--	--	GG	--	--
	BCSS	--	--	EG	--	--	LX	--	--
Al	Sed T	--	--	EG	--	GG	--	--	LX
	BCSS	--	--	LG	--	LG	--	--	LX
Si	Sed T	--	--	--	--	--	--	--	--
	BCSS	--	--	--	--	--	--	--	--
Cr	Sed T	--	--	EG	EG	EG	--	--	LX
	BCSS	--	--	LG	LG	LG	--	--	LG
Mn	Sed T	--	--	EG	GG	EG	--	--	EG
	BCSS	--	--	GG	EG	LG	--	--	LG
Fe	Sed T	--	--	EG	EG	LG	--	--	LX
	BCSS	--	--	LG	EG	LG	--	--	LG
Ni	Sed T	--	--	GG	LG	HG	EG	--	EG
	BCSS	--	--	LG	EG	GG	EG	--	LG
Cu	Sed T	--	--	GG	HG	EG	EG	EG	GG
	BCSS	--	--	LG	EG	EG	EG	EG	LG
Zn	Sed T	--	--	EG	HG	EG	EG	EG	EG
	BCSS	--	--	GG	EG	LG	EG	LG	LG
As	Sed T	--	--	GX	--	EG	EG	--	--
	BCSS	--	--	EG	--	EG	LG	--	--
Se	Sed T	--	GX	--	--	EG	EX	--	--
	BCSS	--	LX	--	--	LG	EG	--	--
Ag	Sed T	--	--	--	GG	--	G-	--	--
	BCSS	--	--	--	EG	--	H-	--	--
Cd	Sed T	--	--	G-	--	HG	LX	--	EX
	BCSS	--	--	L-	--	HG	EG	--	GX
Sn	Sed T	--	--	--	--	--	--	--	--
	BCSS	--	--	--	--	--	--	--	--
Sb	Sed T	--	--	--	--	--	--	--	--
	BCSS	--	--	--	--	--	--	--	--
Hg	Sed T	EG	--	EG	--	LX	HG	--	--
	BCSS	EG	--	EG	--	HG	EG	--	--
Tl	Sed T	--	--	--	--	--	--	--	--
	BCSS	--	--	--	--	--	--	--	--
Pb	Sed T	--	--	EG	--	HX	EG	--	GG
	BCSS	--	--	GG	--	GX	GG	--	GG

Laboratory Evaluation for Biological Tissues

		Lab 1	Lab 2	Lab 3	Lab 4	Lab 5	Lab 6	Lab 7	Lab 8	Lab 9	Lab 10
Al	Tissue S	--	HG	EX	--	--	EG	HG	EG	EG	EG
	SRM1566a	--	HG	LG	--	--	LX	--	LX	LG	LG
Cr	Tissue S	--	HG	HX	--	--	HG	HG	--	HX	HG
	SRM1566a	--	GX	EX	--	--	EG	HG	--	EG	HG
Fe	Tissue S	--	HG	EG	--	--	EG	EG	GG	GG	EG
	SRM1566a	--	GG	LG	--	--	LG	--	LG	GG	LG
Ni	Tissue S	--	HG	EG	--	--	GG	HG	--	HX	HX
	SRM1566a	--	GX	GG	--	--	LX	HG	--	EG	HX
Cu	Tissue S	--	HG	LG	--	GG	EG	LG	EG	GX	GG
	SRM1566a	--	GG	LG	--	GG	LG	GG	EG	EG	LG
Zn	Tissue S	--	HG	LX	--	HG	LG	EG	GG	HG	LG
	SRM1566a	--	GG	LG	--	LG	LG	HG	EG	HG	GG
As	Tissue S	--	GG	EG	--	--	LX	--	L-	LG	LG
	SRM1566a	--	EG	GG	--	--	EG	--	LX	LG	LX
Se	Tissue S	--	HX	HX	--	--	--	--	--	EG	LG
	SRM1566a	--	GX	GG	--	--	--	--	--	EG	LG
Ag	Tissue S	--	EX	G-	--	--	EX	G-	G-	--	EX
	SRM1566a	--	EG	GG	--	--	LG	GX	GG	--	GG
Cd	Tissue S	--	GG	GG	--	HG	EG	EG	GG	HX	GG
	SRM1566a	--	EG	LG	--	EG	LG	GG	EG	EG	EG
Sn	Tissue S	--	EG	H-	--	--	--	--	--	H-	HG
	SRM1566a	--	EX	G-	--	--	--	--	--	G-	EX
Hg	Tissue S	--	GX	L-	--	EG	G-	--	--	HX	EG
	SRM1566a	--	GX	L-	--	GG	G-	--	--	HG	LG
Pb	Tissue S	--	EG	EG	--	G-	HX	GG	--	HG	GX
	SRM1566a	--	GG	GX	--	G-	HX	--	--	G-	GX

Laboratory Evaluation for Biological Tissues

		Lab 11	Lab 12	Lab 13	Lab 14	Lab 15	Lab 16	Lab 17	Lab 18	Lab 19	Lab 20
Al	Tissue S	--	--	--	EG	--	--	EG	--	EG	EG
	SRM1566a	--	--	--	GG	--	--	LG	--	LG	LG
Cr	Tissue S	--	--	--	H-	EG	--	HX	EG	EG	HX
	SRM1566a	--	--	--	G-	EG	--	EG	EG	EG	GX
Fe	Tissue S	EG	--	--	EG	--	--	EG	EG	EG	EG
	SRM1566a	LG	--	--	GG	--	--	GG	HG	LG	LG
Ni	Tissue S	EX	--	--	G-	EG	--	EG	EG	EG	EX
	SRM1566a	GX	--	--	EG	GX	--	EG	GX	EG	EG
Cu	Tissue S	EG	--	--	EG	GG	--	GX	LG	LG	GG
	SRM1566a	EG	--	--	EG	GG	--	EG	EG	EG	EG
Zn	Tissue S	EG	--	--	EG	EG	--	EG	EG	HG	EG
	SRM1566a	EG	--	--	EG	EG	--	EG	EG	EG	EG
As	Tissue S	EG	--	--	EG	EG	--	EG	EG	EG	EG
	SRM1566a	EG	--	--	GG	EG	--	EG	GG	EG	EG
Se	Tissue S	EG	--	--	EG	EG	--	GX	EG	EG	EX
	SRM1566a	EG	--	--	GX	LG	--	EG	EG	EG	EG
Ag	Tissue S	--	--	--	H-	G-	--	G-	G-	EG	G-
	SRM1566a	--	--	--	LX	GG	--	HG	GG	EG	EG
Cd	Tissue S	GG	--	--	GX	HG	--	EG	LX	EG	EG
	SRM1566a	EG	--	--	EG	EG	--	EG	EG	EG	EG
Sn	Tissue S	--	--	--	H-	--	--	EX	--	LX	H-
	SRM1566a	--	--	--	G-	--	--	EX	--	EX	G-
Hg	Tissue S	EG	--	--	G-	EX	--	EG	--	EG	EG
	SRM1566a	LG	--	--	LG	EG	--	EG	--	EG	EG
Pb	Tissue S	GG	--	--	G-	EG	--	EG	LX	EG	EG
	SRM1566a	GX	--	--	H-	GG	--	GG	LX	EG	HX

Laboratory Evaluation for Biological Tissues

		Lab 21	Lab 22	Lab 23	Lab 24	Lab 25	Lab 26	Lab 27	Lab 28	Lab 29	Lab 30
Al	Tissue S	--	EG	EG	HG	EG	LX	--	--	HGG	--
	SRM1566a	--	EG	LG	GG	LGG	--	--	--	EG	--
Cr	Tissue S	EG	EG	--	HG	EG	EG	--	L-	EG	--
	SRM1566a	EX	EG	--	--	LG	--	--	--	EG	--
Fe	Tissue S	EG	EG	EG	LX	EG	EG	--	--	HG	--
	SRM1566a	EG	EG	LG	EG	LG	--	--	--	EG	--
Ni	Tissue S	HG	EG	HG	HG	GG	EG	--	GX	EG	--
	SRM1566a	EX	EG	HX	--	EG	--	--	--	EG	--
Cu	Tissue S	LG	EG	EG	EG	LG	LG	--	LX	HG	--
	SRM1566a	EG	EG	LG	--	EG	--	--	--	EG	--
Zn	Tissue S	EG	EG	EG	EG	EG	LG	--	GG	EG	--
	SRM1566a	EG	GE	EG	--	EG	--	--	--	EG	--
As	Tissue S	EG	EG	--	EG	LG	LX	--	LX	EG	--
	SRM1566a	EG	EG	--	EG	LG	--	--	--	GG	--
Se	Tissue S	EG	EG	--	EX	EX	--	--	EG	EG	--
	SRM1566a	EG	EG	--	--	--	--	--	--	EG	--
Ag	Tissue S	G-	HX	--	H-	GX	G-	--	G-	HG	--
	SRM1566a	EG	EG	--	--	EG	--	--	--	EG	--
Cd	Tissue S	EG	EG	HX	LG	EG	HG	--	GX	GG	--
	SRM1566a	EG	EG	EG	--	EG	--	--	--	EG	--
Sn	Tissue S	--	EX	--	--	--	G-	--	--	HG	--
	SRM1566a	--	EG	--	--	--	--	--	--	EG	--
Hg	Tissue S	HX	EG	LX	G-	--	EG	--	EX	EG	--
	SRM1566a	EG	EG	LG	--	--	--	--	--	EG	--
Pb	Tissue S	EG	EG	HX	HG	EG	GX	--	EX	EG	--
	SRM1566a	GX	GG	L-	--	L-	--	--	--	GG	--

Laboratory Evaluation for Biological Tissues

		Lab 31	Lab 32	Lab 33	Lab 34	Lab 35	Lab 36	Lab 37	Lab 38	Lab 39	Lab 40
Al	Tissue S	EG	EX	HX	EG	EG	EG	EG	--	--	--
	SRM1566a	LX	LG	GG	GG	LG	--	HG	--	--	--
Cr	Tissue S	GG	L-	GX	GG	HG	GG	HX	--	EG	EX
	SRM1566a	GX	GX	EX	EG	--	--	GX	--	LX	EX
Fe	Tissue S	EG	EX	HG	EG	EG	GG	EG	GG	EG	EG
	SRM1566a	LG	LG	EG	EG	LG	--	HG	EG	LG	LG
Ni	Tissue S	GX	G-	EG	EX	EG	HG	EX	--	EG	GG
	SRM1566a	LX	L-	GX	EX	EX	LX	HX	--	LX	GX
Cu	Tissue S	GG	GX	HX	GG	EG	GG	EG	LG	EG	EG
	SRM1566a	LG	EG	EG	EG	EG	--	EG	EG	GG	EG
Zn	Tissue S	GG	EG	EG	HX	HG	HG	EG	EG	EG	EG
	SRM1566a	GG	EG	EG	EG	EG	--	EG	EG	GG	GG
As	Tissue S	EG	GX	--	LX	EG	HX	HG	--	LG	EG
	SRM1566a	LX	GG	--	HG	EG	HX	HG	--	LG	GG
Se	Tissue S	--	L-	--	LG	--	G-	LG	--	EG	EG
	SRM1566a	--	L-	--	LG	--	G-	GG	--	LX	EG
Ag	Tissue S	G-	H-	HX	H-	EG	G-	HX	G-	GX	EG
	SRM1566a	LX	LX	EG	GX	EG	--	EG	LG	EG	EG
Cd	Tissue S	GG	HX	HX	GX	LG	EG	HG	--	LG	LG
	SRM1566a	GG	HG	EG	GG	EG	--	EG	--	LG	GG
Sn	Tissue S	--	HX	HX	G-	EX	H-	G-	--	GX	HX
	SRM1566a	--	L-	GX	G-	EG	--	EX	--	EX	EX
Hg	Tissue S	G-	--	--	EG	--	G-	--	EG	EX	EG
	SRM1566a	L-	L-	--	HG	--	--	--	EG	LX	GG
Pb	Tissue S	EG	HX	LG	L-	HG	L-	EG	HG	EG	EG
	SRM1566a	HG	HX	GG	G-	HG	--	HX	G-	HX	LG

Laboratory Evaluation for Biological Tissues

		Lab 41	Lab 42	Lab 43	Lab 44	Lab 45	Lab 46	Lab 47	Lab 48
Al	Tissue S	--	--	EG	--	EG	--	--	--
	SRM1566a	--	--	LX	--	LG	--	--	--
Cr	Tissue S	--	--	G-	GG	EX	--	--	--
	SRM1566a	--	--	G-	GX	EG	--	--	--
Fe	Tissue S	--	--	EG	EG	EG	EG	--	--
	SRM1566a	--	--	LG	LG	LG	--	--	--
Ni	Tissue S	--	--	G-	EX	EG	--	--	--
	SRM1566a	--	--	GX	LG	GX	--	--	--
Cu	Tissue S	--	--	EG	EG	GG	EG	EG	--
	SRM1566a	--	--	EG	EG	LG	--	--	--
Zn	Tissue S	--	--	EG	EG	EG	HG	EG	--
	SRM1566a	--	--	EG	EG	EG	--	--	--
As	Tissue S	--	--	GX	--	--	GX	EG	--
	SRM1566a	--	--	EG	--	--	--	--	--
Se	Tissue S	--	GG	GX	--	HX	EG	--	--
	SRM1566a	--	HG	GX	--	HX	--	--	--
Ag	Tissue S	--	--	H-	G-	--	--	--	--
	SRM1566a	--	--	L-	LG	LG	--	--	--
Cd	Tissue S	--	--	HG	--	EG	EG	EG	--
	SRM1566a	--	--	EG	--	EG	--	--	--
Sn	Tissue S	--	--	H-	--	--	--	--	--
	SRM1566a	--	--	EG	--	GX	--	--	--
Hg	Tissue S	EX	--	EG	--	GX	EG	--	--
	SRM1566a	HX	--	EG	--	LG	--	--	--
Pb	Tissue S	--	--	EX	--	GX	EG	HX	--
	SRM1566a	--	--	LX	--	HX	--	--	--

Table D-1
Sediment Dissolution Procedures

Lab No.	Sediment Dissolution Procedure	Instrumentation
1	-0.500g -HNO ₃ -microwave heating	FAAS-Al,Cr,Fe,Mn,Ni,Zn GFAAS-As,Cd,Cu,Pb,Sn
2	-0.1g -LiBO ₂ fusion	ICPMS-Si
	-0.5g -HNO ₃ , HCl -microwave heating	ICPMS-Be,Ni,Cu,Zn,As,Hg
	-0.1g -HNO ₃ , HF, HCl, HClO ₄ -closed vessel	ICPMS-Al, Cr, Mn, Fe, Se, Ag, Cd, Sn, Sb, Tl, Pb
3	-0.5g -HNO ₃ , HCl -semiclosed vessel reflux	ICPMS-Ag,As,Cd,Hg,Sb,Se,Tl ICPAES-Al,Cr,Cu,Fe,Mn,Ni,Pb,Si,Sn,Zn
4	-0.25g -HNO ₃ -closed vessel, microwave heating	ICPMS-Al,Cr,Mn,Fe,Ni,Cu,Zn,Cd,Pb
5	NA	
6	-1.0g -HNO ₃ , HCl -microwave heating	GFAAS-Ag ICPAES-Al,Fe,Zn,Ni,Cr,Cu,Mn,Pb
7	-0.5g -HNO ₃ , HF, HClO ₄ -closed vessel	FAAS-Cr,Mn,Fe,Ni,Cu,Zn,Pb GFAAS-Cr,Ni,Cu,Ag,Cd,Tl,Pb ICPAES-Be,Al,Cr,Mn,Fe,Ni,Cu,Zn
8	-1.0g -HNO ₃ , HCl -covered erlenmeyer flask	FAAS-Cr,Pb,Cu,Ni,Cd,Zn,Be,Fe,Mn,Al GFAAS-As
9	-1.00g -HNO ₃ , HCl -open beaker	GFAAS-As,Se ICPAES-Al,Cr,Fe,Ni,Cu,Cd,Sn,Pb,Mn
10	-0.75g -HNO ₃ , HClO ₄ -test tube in a block heater	GFAAS-Al,Cd,Cu,Mn,Ni,Pb,Ag ICPAES-As,Se

Lab No.	Sediment Dissolution Procedure	Instrumentation
11	-0.5g -HNO ₃ , HF, HCl, HClO ₄ -open beaker	FAAS-Cr GFAAS-Se,Sb,Tl,Ag,Cd XRF-Si,Al,Fe,As,Pb,Sn ICPAES-Be,Mn,Ni,Cu,Zn
12	-0.5g -HNO ₃ , HClO ₄ , H ₂ SO ₄	HGICP-As,Se
	-0.5g -pressed powder pellet	XRF-Al,Si,Cr,Mn,Fe,Ni,Cu,Zn,Pb
	-0.5g -HNO ₃ ,HCl -open beaker	GFAAS-Cd
13	-0.4g -HNO ₃ ,HClO ₄ -open beaker	FAAS-Cu,Fe,Mn,Ni,Pb,Zn GFAAS-Ag,Cd
14	-0.500g -HNO ₃ , HF, HCl -fusion -open beaker	FAAS-Zn,Ag,Pb GFAAS-Cd HGAAS-As,Se,Sb ICPAES-Sn,Tl DCP-Al,Cr,Cu,Fe,Mn,Ni,Si
15	-0.25g -dry ash	HGAAS-Se,As
16	-0.5g -HNO ₃ , H ₂ O ₂ , HF,HCl, H ₃ BO ₃ -microwave heating	GFAAS-As,Cu,Cr,Pb,Ag,Se,Cd ICPAES-Zn,Fe,Mn,Ni,Al,Si
17	-0.20g -HNO ₃ , HF, HClO ₄ -closed vessel	GFAAS-Se,Ag,Cd ICPMS-Sb,Sn,Tl,Be
	-0.20g -pellet	XRF-Al,As,Cr,Cu,Fe,Mn,Ni,Pb,Si,Zn
18	-0.1-0.2g -HNO ₃ ,HF, HCl,HClO ₄ -open beaker	FAAS-Mn,Fe,Zn GFAAS-Ni,Cu,Cd,Ag,Pb,Cr HGAAS-As,Se
19	-0.2g -HNO ₃ , HF, boric acid -closed vessel	FAAS-Al,Fe,Mn,Zn GFAAS-Ag,As,Cd,Cr,Cu,Ni,Pb,Sb,Se,Sn
20	-0.5g -HNO ₃ , HF -microwave heating	FAAS-Fe,Ag,Zn,Al,Cu,Mn GFAAS-As

Lab No.	Sediment Dissolution Procedure	Instrumentation
21	NA	
22	-0.4g -HNO ₃ , HF, HClO ₄ -closed vessel -microwave heating	ICPMS- Be,Cr,Mn,Ni,Cu,Zn,As,AgCd,Sn,Sb,Tl,Pb
23	-0.5g -HNO ₃ , HCl -open beaker	ICPAES-Be,Cr,Mn,Fe,Ni,Cu,Zn,As GFAAS-Pb,Cd
24	-0.500g -HNO ₃ -open beaker	FAAS-Ag,Al,Cd,Cr,Cu,Fe,Mn,Ni,Pb,Zn HGAAS-As,Sb,Se
25	-1.0g -HNO ₃ , HF -closed vessel -microwave heating	GFAAS-Sn,As,Ag ICPAES-Al,Fe,Mn,Cu,Zn,Cr,Pb,Ni,Cd
26	-0.60g -HNO ₃ , H ₂ O ₂ , HCl -open beaker	GFAAS-Cd,Sn,Sb,Tl HGAAS-As,Se ICPAES-Ag,Al,Cr,Cu,Fe,Mn,Ni,Pb,Zn
27	-1.0g -HNO ₃ , H ₂ O ₂ , HCl -open beaker	GFAAS-Cd,Ag,Pb,Tl ICPAES-Al,Cr,Cu,Fe,Ni,Zn,Mn HGICP-Sn,Se,As,Sb
28	-0.8g -HNO ₃ , H ₂ O ₂ , -closed vessel	FAAS-Cu,Cr, GFAAS-Se,Ag,Cd,Pb,Ni HGAAS-As ICPAES-Zn
29	-0.5 or 1.0g -HNO ₃ , HF, HCl -microwave heating	FAAS-Al,Fe,Mn,Cu,Zn,Be GFAAS-Cr,Ni,As,Se,Ag,Cd,Sn,Sb,Tl,Pb
30	-0.25g -HNO ₃ , HF, HCl, HClO ₄ -open beaker or closed vessel	FAAS-Cd,Pb,Cu,Zn GFAAS-As,Se ICPAES-Al,Be,Si,Cr,Mn,Fe,Ni,Ag,Sn,Sb
31	NA	
32	-1g -HNO ₃ , H ₂ O ₂ , HCl -open beaker	GFAAS-Sn,Tl ICP-Al,Si,Cr,Mn,Fe,Ni,Cu,Zn,Ag,Cd,Pb
33	-0.75g -HNO ₃ , HF -open beaker,closed vessel	GFAAS-Cr,Ni,Pb,Sn,Tl,Sb,Ag,Cd

Lab No.	Sediment Dissolution Procedure	Instrumentation
34	-0.2 -NaOH fusion	ICPAES-Si
	-1.0g -HNO ₃ , HF open beaker	GFAAS-Pb,Tl,Cd,Ag,Cr ICPAES-PB,Cd,Ag,Zn,Cr,Mn,Cu,Ni
	-1.0g -HNO ₃ , HF, HCl -open beaker	HGAAS-As,Se,Sb ICPAES-Be,Al,Fe,Sn
35	-0.2g -HNO ₃ , HF, HCl -closed vessel -microwave heating(low pressure)	HGAAS-As,Se,Sb ICPMS-Cr,Ni,Ag,Cd,Sn,Tl,Pb,Be,As ICPAES-Fe,Al,Zn,Mn,Cu
36	-0.5g -HNO ₃ , HCl	ICPAES-all elements
37	-0.5g -HNO ₃ , HF, HCl -microwave heating	GFAAS-As,Ag,Cd,Sb,Sn,Tl,Se ICPAES-Al,Be,Cr,Cu,Fe,Mn,Ni,Pb,Zn
38	NA	
39	-0.12g -HNO ₃ , HF, HCl -closed vessel -microwave heating	FAAS-Fe,Al,Zn,Mn GFAAS-Ag,As,Cd,Cr,Cu,Ni,Pb,Sn HGAAS-Se
40	-0.5g -microwave heating	FAAS-Cu,Mn,Fe,Si,Zn,Al GFAAS-Ag,Cd,Cr,Ni,Pb,Si,Sn HGAAS-Se,As
41	NA	
42	-HNO ₃ , HClO ₄ -open beaker	ICPAES-Se
43	-1.0g -HNO ₃ , HF, HCl -microwave heating	GFAAS-As,Pb ICPAES-Be,Al,Cr,Mn,Fe,Ni,Cu,Zn,Cd
44	-0.2g -HNO ₃ , HF -microwave heating	FAAS-Fe,Cr,Mn,Zn,Cu

Lab No.	Sediment Dissolution Procedure	Instrumentation
	-0.5g -HNO ₃ , H ₂ O ₂ , HCl -open vessel, heating block	ICPAES-Ni
	-0.04-0.1g -slurry	GFAAS-Ag
45	-0.25g -HNO ₃ , HF, HCl -microwave heating	ICPAES-Al,Cr,Mn,Fe,Ni,Cu,Zn,Cd,Pb
	-0.1 -HNO ₃ , HCl -closed vessel	HGAAS-As,Se
46	-1.0g -HNO ₃ , HCl (Sb-HCl only) -open beaker	FAAS-Cd,Pb,Cu,Zn HGAAS-As,Se,Sb ICPAES-Be,Ni,Mn
	-0.5g -HNO ₃ , HF, HCl, HClO ₄ -covered beaker	ICPAES-Al,Cr,Fe
47	-2g -HNO ₃ , HF, HCl, HClO ₄ -covered beaker	FAAS-Cu,Zn,As,Cd,Pb
48	-0.5g -HNO ₃ -hot reflux	GFAAS- Cd ICPAES-Al,Cr,Mn,Fe,Ni,Cu,Zn,Pb
49	-0.5g (pellet)	XRF-Al,Si,Fe
	-0.25g -HNO ₃ , HF, HClO ₄ -closed vessel, microwave heating	GFAAS-Be,Cr,Mn,Ni,Cu,As,Se,Ag,Cd,Pb
50	-0.25g -HNO ₃ , HF, HClO ₄ -closed vessel, microwave heating	ICPMS- Cr,Cu,Ni,Cd,Sn,Sb,Tl,Pb ICPAES- Fe,Zn

Table D-2
Tissue Dissolution Procedures

Lab No.	Tissue Dissolution Procedure	Instrumentation
1	NA	
2	-0.5g -HNO ₃ -closed vessel	ICPMS-Al,Cr,Fe, Ni,Cu,Zn,As,Se,Ag,Cd,Sn,Hg,Pb
3	-0.5g -HNO ₃ -closed vessel -microwave heating	ICPMS-Ag,As,Cd,Hg,Pb,Cr,Se,Cu,Ni ICPAES-Sn,Zn,Mn,Al,Fe
4	NA	
5	-1.0g -HNO ₃ , H ₂ O ₂ -covered beaker	FAAS-Cd,Cu,Pb,Zn
6	-1.0g -HNO ₃ , H ₂ SO ₄ -open beaker	GFAAS-Pb,As,Ag ICPAES-Zn,Cd,Ni,Cr,Cu,Al,Fe,Pb
7	-0.5-0.7g -HNO ₃ , H ₂ O ₂ -open beaker	FAAS-Cr,Fe,Ni,Cu,Zn,Pb GFAAS-Ni,Cu,Ag,Cd,Pb ICPAES-Al,Cr,Fe,Ni,Cu,Zn
8	-1.0g -HNO ₃ , H ₂ SO ₄ -covered erlenmeyer flask	FAAS-Cd,Cu,Fe,Zn,Al GFAAS-Ag,As
9	-5.0g -HNO ₃ , HCl -dry ash	ICPAES-Al,Cr,Fe,Ni,Cu,Cd,Sn,Mn,Pb
10	-1.0g -HNO ₃ , HClO ₄ -open beaker	GFAAS-Ag,Al,Cd,Cu,Mn,Pb HGICP-As,Se
11	-0.50g -HNO ₃ , H ₂ O ₂ -open beaker	ICPAES-Fe,Cu,Zn,As
	-0.50g -dry ash	GFAAS-Cd,Pb,Ni,Cr ICPAES -Al
12	NA	

Lab No.	Tissue Dissolution Procedure	Instrumentation
13	NA	
14	-0.50 -HNO ₃ , HF, HCl, H ₂ SO ₄ -open beaker	FAAS-Ag HGAAS-As,Se ICPAES-Cd,Cu,Fe,Ni,Sn,Zn,Pb,Cr
15	-0.25g -HNO ₃ -open tube/digestion block	FAAS-Zn,Cu GFAAS-Ag,Cd,Pb,Ni,Cr,Cu
	-0.25g -HCl -dry ash	HGAAS-Se,As
16	NA	
17	-0.2g -pellet	XRF-As,Cu,Fe,Se,Zn
	-0.30g -HNO ₃ -closed vessel -microwave heating	ICPMS-Sn
	-0.30g -HNO ₃ , H ₂ O ₂ -reflux vessel	GFAAS-Ag ICPMS-Al,Cr,Cd,Ni,Pb
18	-0.1-0.6g -HCl, Mg(NO ₃) ₂ -open beaker followed by dry ash	HGAAS-As,Se FAAS-Zn GFAAS-Ni,Cu,Cd,Pb,Cr
	-0.1-0.2g -HNO ₃ , HF, HCl, HClO ₄ -open beaker	GFAAS-Fe,Ag
19	-0.2g -HNO ₃ -closed vessel	FAAS-Fe,Zn GFAAS-Al,Ag,As,Cd,Cr,Ni,Pb,Se,Sn
20	-0.5g -HNO ₃ -microwave heating	GFAAS-As,Se ICPMS-Cr,Ni,Ag,Cd,Sn,Pb ICPAES-Fe,Cu,Zn,Al
21	-0.25g -HNO ₃ , H ₂ O ₂ -closed vessel -microwave heating	FAAS-Fe,Zn GFAAS-Cu,Ag,Cd,Cr,Pb,Se,Ni,As

Lab No.	Tissue Dissolution Procedure	Instrumentation
22	-0.2g -HNO ₃ , H ₂ O ₂ -closed vessel -microwave heating -open beaker	ICPMS- Al,Cr,Fe,Ni,Cu,Zn,As,Se,Cd,Sn,Pb
23	-0.5-1.0g -HNO ₃ , HCl -open beaker dry ash	HGAAS-Pb,Cd ICPAES-Al,Cr,Fe,Ni,Cu,Zn
24	-0.50g -HNO ₃ , H ₂ SO ₄ , HClO ₄	HGAAS-As
	-0.50g -HNO ₃ , HF, HCl, HClO ₄ -open beaker	HGAAS- Sb,Se FAAS-Ag,Al,Cd,Cr,Fe,Ni,Pb,Zn
25	-1.5g -HNO ₃ , H ₂ O ₂ -open beaker -closed vessel -microwave heating	GFAAS-Sn,As,Ag,Pb,Ni,Cr ICPAES-Al,Fe,Mn,Cu,Zn,Cd
26	-0.60g -HNO ₃ , H ₂ O ₂ , HCl -open beaker	GFAAS-Cd,Sn,Ni,Cr,Pb,Cu,Ag HGAAS-As,Se ICPAES-Al,Fe,Mn,Zn
27	NA	
28	-0.5g -HNO ₃ , H ₂ O ₂ -closed vessel	GAAS-Cr FAAS-Zn,Cu GFAAS-Se,Ag,Cd,As,Ni,Pb,Cr
29	-0.5g -HNO ₃ , HCl -microwave heating	FAAS-Al,Fe,Zn,Cu GFAAS-Cr,Ni,As,Se,Ag,Cd,Sn,Pb
30	NA	
31	-1g -HNO ₃ -open beaker	ICPMS-As,Pb ICPAES-Al,Cr,Fe,Ni,Cu,Ag,Cd,Zn
32	-1g -HNO ₃ , H ₂ O ₂ -open beaker	HGICP-As,Se ICPAES-Al,Cr,Fe,Ni,Cu,Ag,Sn,Pb

Lab No.	Tissue Dissolution Procedure	Instrumentation
33	-0.75g -HNO ₃ , HF -open beaker	GFAAS-Cr,Ni,Pb,Sn,Tl,Sb,Ah,Cd ICPAES-Al,Fe,Mn,Cu,Zn
34	-1.0g -HNO ₃ , HF -open beaker	GFAAS-As,Cd,Pb,Cr ICPAES-Al,Cd,Cr,Fe,Ag,Ni,Zn,Sn,Pb,Cu
	-1.0g -HNO ₃ -test tube/heater block	GFAAS-As HGAAS-Se
35	-0.2g -HNO ₃ , HCl -low pressure, closed vessel -microwave heating	HGAAS-As,Se,Sb ICPMS-Al,Cr,Ni,Cu,Ag,Cd,Sn,Pb,As ICPAES-Al,Fe,Zn,Mn
36	-0.5g -HNO ₃ -closed vessel -microwave heating	ICPAES-Al,Cr, Fe, Ni, Cu,Zn,As Se,Ag,Cd,Sn,Pb
37	-0.5g -HNO ₃ , HF -microwave heating	GFAAS-Ag,Cd,Ni,Sn,Pb,Se ICPAES-Al,As,Cd,Cr,Cu,Fe,Mn,Zn
38	-0.5g -HNO ₃ , H ₂ O ₂ -closed vessel -microwave heating	FAAS-Fe,Zn GFAAS-Cu,Ag,Pb,Mn
39	-0.30g -HNO ₃ -closed vessel -microwave heating	FAAS-Cu,Fe,Mn,Zn GFAAS-Ag,As,Cd,Cr,Ni,Pb,Se,Sn
40	-0.5g -microwave heating	FAAS-Cu,Fe,Zn GFAAS-Ag,Cd,Cr,As,Ni,Pb,Sb,Sn,Se
41	NA	
42	-0.5g -HNO ₃ , HClO ₄ -open beaker	ICPAES-Se
43	-1.0g -HNO ₃ , H ₂ O ₂ -open beaker followed by closed vessel -microwave heating	GFAAS-As,Se,Pb ICPAES-Al,Cr,Fe,Ni,Cu,Zn,Ag,Cd,Sn

Lab No.	Tissue Dissolution Procedure	Instrumentation
44	-0.04-0.1g -slurry	GFAAS-Ag
	-0.5g -HNO ₃ , H ₂ O ₂ , HCl -heating block, open vessel	ICPAES-Cr,Cu,Fe,Ni,Zn
45	-0.27g -HNO ₃ , H ₂ O ₂ -microwave heating	ICPAES-Al,Cr,Fe,Ni,Cu,Zn,Ag,Cd,Sn,Pb
	-0.10g -HCl -closed vessel	HGAAS-As,Se
46	-1g -HNO ₃ , H ₂ O ₂ -covered flask	FAAS-Fe,Cu,Zn GFAAS-Cd,Pb HGAAS-As,Se,Sb
47	-1g -HNO ₃ , HCl, HClO ₄ -covered flask	FAAS-Cu,Zn,As,Cd,Pb
48	NA	
49	-0.250g -HNO ₃ , H ₂ O ₂ -closed vessel, microwave heating	GFAAS-Al,Cr,Fe,Ni,Cu,Zn,As,Se,Cd,Pb
50	-0.250g -HNO ₃ , H ₂ O ₂ -closed vessel, microwave heating	ICPMS-Cr,Ni,Fe,Zn,Ag,Cd,Sn,Pb,Al,As,

Table D-3
Dissolution Procedures for the Determination of Mercury

Lab No.	Sediment Dissolution	Tissue Dissolution	Instrumentation
1	no information	NA	
2	-0.5g -HNO ₃ , HCl -open beaker	-0.5g -HNO ₃ -closed vessel	ICPMS
3	-0.5g -HNO ₃ , HCl - semi closed vessel	-0.5g -HNO ₃ -closed vessel -microwave heating	ICPMS
4	NA	NA	
5	NA	-0.20g -HNO ₃ , H ₂ SO ₄ -closed vessel	CVAAS
6	-1.0g -HNO ₃ , HCl -microwave heating	-1.0g -HNO ₃ , H ₂ SO ₄ -open beaker	CVAAS
7	NA	NA	
8	-0.5g -HNO ₃ , H ₂ SO ₄ -KMnO ₄ -autoclave 121°C	NA	CVAAS
9	-1.0g -HNO ₃ , H ₂ SO ₄ -closed vessel		CVAAS
10	-0.2g -HNO ₃ , HCl -K ₂ Cr ₂ O ₇ , K ₂ S ₂ O ₈	-0.3g -HNO ₃ , H ₂ SO ₄ -slurry -K ₂ Cr ₂ O ₇ , K ₂ S ₂ O ₈	CVAAS
11	-0.5g -HNO ₃ , HCl, HF, HClO ₄ -open beaker	-0.2g -HNO ₃ , H ₂ SO ₄ , HCl -water bath at 60°C	CVAAS
12	NA	NA	
13	NA	NA	

Lab No.	Sediment Dissolution	Tissue Dissolution	Instrumentation
14	-0.5g -HNO ₃ , HF, HCl, -open beaker	-0.5g -HNO ₃ , HF, HCl, HClO ₄ -open beaker	CVAAS
15	-0.25g -HNO ₃ -open tube/digestion block		CVAAS
16	-0.4g -HNO ₃ , H ₂ SO ₄ -95°C oven	NA	CVAAS
17	-0.2g -HNO ₃ , HF, HClO ₄ -closed vessel	-0.3g -HNO ₃ , % -reflux vessel	CVAAS
18	NA	NA	
19	-0.5g -HNO ₃ , H ₂ SO ₄ , KMnO ₄ , K ₂ S ₂ O ₈ -centrifuge tube in H ₂ O bath	-0.2g -HNO ₃ -closed vessel -CVAAS	CVAAS
20	-0.5g -HNO ₃ -microwave heating		CVAAS
21	NA	-0.25g -HNO ₃ , % -closed vessel -microwave heating	FI-CVAAS
22	-0.4g -HNO ₃ , HF, HClO ₄ -closed vessel -microwave heating	-0.2g -HNO ₃ , % -closed vessel -microwave heating	FI-CVAAS
23	-0.5g -HNO ₃ , H ₂ SO ₄ , KMnO ₄ , (NH ₄) ₂ S ₂ O ₈ -closed vessel		CVAAS
24	no information	-0.5g -HNO ₃ , HCl -open beaker	CVAAS
25	NA	NA	
26	-0.5g -HNO ₃ , HCl, KMnO ₄	-0.6g -HNO ₃ , H ₂ SO ₄	CVAAS

Lab No.	Sediment Dissolution	Tissue Dissolution	Instrumentation
27	-1.0g -HNO ₃ , %, HCl -open beaker	NA	CVAAS
28	-0.8g -HNO ₃ , H ₂ SO ₄	no information	CVAAS
29	-0.5g -HNO ₃ , H ₂ SO ₄ , HCl -KMnO ₄ , K ₂ S ₂ O ₈ , NaCl, NH ₂ OH·HCl		CVAAS
30	-0.25g -HNO ₃ , HF, HCl, HClO ₄ -open beaker -closed vessel	NA	CVAAS
31	NA	-1g -HNO ₃ -open beaker	CVAAS
32	-1g -HNO ₃ , %, HCl -open beaker	-1g -HNO ₃ , % -open beaker	CVAAS
33	NA	NA	
34	-0.5g -HNO ₃ , H ₂ SO ₄ , KMnO ₄ -tube/digestion block		CVAAS
35	-0.2g -HNO ₃ , (HF sediments), HCl -closed vessel -microwave heating		CVAAS
36	-0.5g -HNO ₃ , HCl	-0.5g -HNO ₃ -closed vessel -microwave heating	CVAAS
37	NA	NA	
38	NA	-0.5g -HNO ₃ , % -closed vessel -microwave heating	CVAAS

Lab No.	Sediment Dissolution	Tissue Dissolution	Instrumentation
39	-0.12g -HNO ₃ , HF, HCl -closed vessel -microwave heating	-0.3g -HNO ₃ -closed vessel -microwave heating	CVAAS
40	-0.5g -microwave heating	-0.5g -microwave heating	CVAAS
41	-HNO ₃ , H ₂ SO ₄ , KMnO ₄		CVAAS
42	NA	NA	
43	-0.2g -HNO ₃ , HCl -microwave heating		CVAFluorescence
44	NA	NA	
45	-0.25g -HNO ₃ , H ₂ SO ₄ -closed vessel		HGAAS
46	-1.00g -HNO ₃ , HCl -covered erlenmeyer flask	-1.00g -HNO ₃ , H ₂ O ₂ -covered erlenmeyer flask	CVAAS
47	NA	NA	
48	NA	NA	
49	-1.0g -HNO ₃ , H ₂ SO ₄ , HClO ₄		CVAAS

Appendix E

COMMENTS ON THE EVALUATION OF INTERCOMPARISON STUDY RESULTS

The purpose of an intercomparison study is to provide the participating laboratories and the intercomparison study organizers with a means of objectively assessing the reliability of results produced by those laboratories. There are three parameters which are assessed most frequently:

1. Accuracy

The assessment of **accuracy** is usually the most important goal of an ICES intercomparison study. This is an estimate of the **bias** of the participating laboratory with respect to the **assigned value** for the concentration of the analyte. In the best of cases the assigned value will have been predetermined by the coordinator and will be a practical estimate of the true value of the concentration of the analyte in the matrix. In some instances this is not possible and the assigned value will be a consensus value established by the coordinator by a **critical evaluation** of the set of results returned by the participants.

The assigned value can not be merely the consensus value of the participants because there may not be a consensus, or the consensus may be biased due to widespread use of faulty methodology.

The **bias** is equal to $(x-X)$ where

x is the analyte concentration determined by the participant , and

X is the analyte concentration value assigned by the coordinator.

The **relative bias** is $(x-X)/X$. The relative bias is usually used as the measure of accuracy rather than the absolute bias.

If the user community is able to estimate the precision s needed in order to ensure proper data interpretation, the quotient $z = (x-X)/s$ is a very valuable indicator. If z exceeds 2 there is less than a five percent probability that the laboratory can produce reliable data.

2. Intralaboratory Precision

This is an estimate of the **repeatability** of a procedure within the individual participating laboratory. Repeatability for a particular analyte concentration can be assessed by the analysis of replicate samples and is usually described by the **standard deviation** (s) of a single determination. The computation is simple:

$$s = \sqrt{\frac{\sum_{i=1}^N (x_i - \bar{x})^2}{N-1}}$$

where x_i is the determined concentration of an individual replicate,

$\bar{x}$ is the determined mean of the replicate analyses, and

N is the number of replicate analyses.

The **relative standard deviation (RSD)** is $s/\bar{x}$. This number is often multiplied by 100 to yield the **percent standard deviation**.

An estimate of the repeatability can also be calculated from a set of samples of different analyte concentrations. This is done by a linear regression procedure and yields an overall value of the standard deviation for the range of concentrations tested.

The calculation of the intralaboratory precision is always done in intercomparison exercises but, except for identifying a laboratory with serious precision problems, is of limited value. An intercomparison study is usually a snapshot in time and only provides an estimate of the true standard deviation. The number of replicate samples analyzed is usually rather small and the errors in this estimate can be very large as indicated in Figure 1 below.

The confidence limits for the estimation of a standard deviation are not symmetrical and are surprisingly large for small numbers of replicates¹. The standard deviation calculated from the results of five replicate analyses has a 95 percent confidence interval ranging from 0.6 to 2.4 times its calculated value. The probability of a "bad" result is quite high. Also, it is obvious that studies based on only one or two measurements may produce misleading results.

A far superior estimate of the standard deviation for a particular analytical procedure is acquired from long term control chart data maintained by any laboratory employing good laboratory practices.

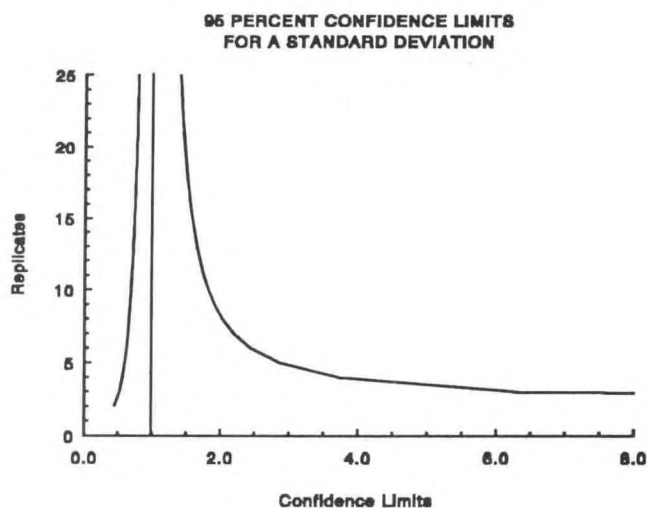


Figure 1

3. Interlaboratory Precision

This is an estimate of the **reproducibility** of submitted analyte concentrations between the participating laboratories. If there is acceptable accuracy and intralaboratory precision, then the interlaboratory precision can be used to determine whether a cooperative project is feasible between the set of laboratories. It is usually described by a standard deviation and the calculation is identical to that shown above but here

x_i is the determined concentration of an analyte from a single participating laboratory.

$\bar{x}$ is the assigned value for the analyte concentration, and

N is the total number of laboratories whose results are being intercompared.

Other information may be acquired from an intercomparison study such as the efficacy of various analytical procedures. Also, the distribution of laboratory results about the assigned values could lead to a better understanding of the causes of laboratory bias.

There may be a tendency to try to describe the population of results by a rigorous multivariate model which assumes that the determined values of the analyte concentrations are interdependent. This is a difficult concept for an experienced analytical chemist to accept. The response is, that if this is indeed the case, the analytical procedures are inadequate. However, it is possible that a portion of the population is distorting the distribution. If the former is true then this area of analysis has severe problems. If the latter is true then it would be best to find a means of isolating the group whose results may be of an acceptable calibre from the group which is distorting the distribution.

Experiences over the last decade with respect to the analysis of trace metals in various matrices indicate that, as long as the analyte concentrations are above their quantitative limits of determination (at least twice the limit of detection), a group of competent laboratories will produce a set of results homogeneously distributed about a mean which is seldom significantly different from the assigned value. There is no basic reason to believe that organic analytes would produce a dissimilar distribution. The fundamental problem is that, at the current state of the practice of analytical chemistry, the quantitative analysis of materials for trace organic constituents is a much more difficult and challenging task.

Figure 2 is an example taken from a recent intercomparison study regarding the determination of 13 trace metals in sewage treatment plant (STP) effluents². Thirty-five sets of zinc concentrations were submitted by the participants for this sample. The distribution of their mean values is shown in the diagram. The consensus mean is 59.3 micrograms zinc per litre. Aside from what is probably a high biased mean the group can not distinguish concentration differences from between 29 to 115 micrograms zinc per litre. The standard deviation can not be used to calculate this range.

The distribution is obviously skewed towards the higher concentrations and does not appear to be normally distributed. However, what we have here are some quite good laboratories and some poor laboratories. The poor laboratories generally produce high results in trace analysis because they do not have their blanks and contamination under control. They also may produce both high and low results because of poor calibration techniques, improper instrument usage, poor choice of methods and poorly trained staff. The problem is to find a relatively simple method to separate the under-achievers from the good performers (i.e., get rid of the outliers).

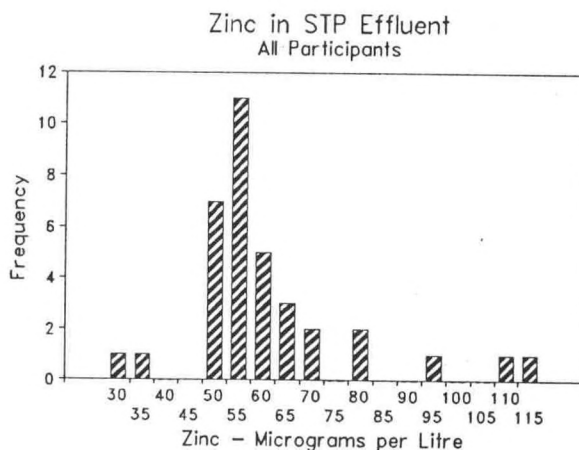


Figure 2

There are many suggestions on how to do this. ISO/REMCO, for example, supports a procedure based on the successive application of the Cochran test and the Grubbs tests³. At NRC we prefer a more statistically transparent method involving the successive application of a *t*-test at the 95 percent confidence level to isolate what we believe is a fair approximation of a normal distribution. The results of this procedure on the population of Figure 2 are shown in Figure 3 on the next page.

Eight laboratories were eliminated from the distribution in this example, a larger than usual number. The excluded mean is 55.7 ± 9.8 micrograms zinc per litre. The mean is no longer biased and the range of indiscrimination is reduced to 36 to 75 micrograms zinc per litre with 95 percent confidence.

This method may not be statistically rigorous. One or two laboratories may have been rejected (or accepted) when they should not have been. However, we have found that this type of evaluation of the results is readily understandable to the participants and to the user community of the data, most of whom have a rather unsophisticated understanding of even elementary statistics.

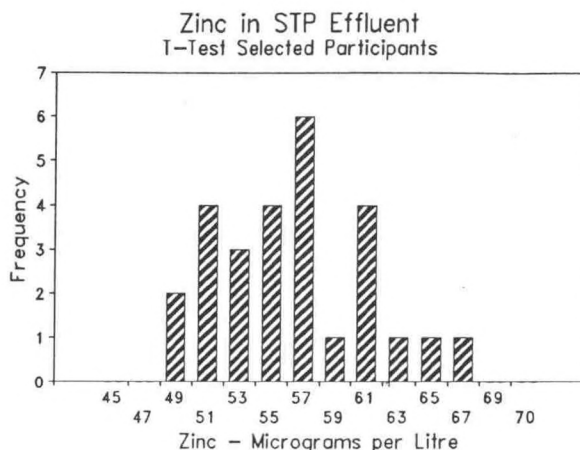


Figure 3

The main purpose of the study has been achieved. A subset of the participants has been identified as a homogeneous group and its performance has been characterized. The organizers of the study and the user community are aware of the possible consequences of using any one of the participants in a future project. They are also aware of the limitations on the quality of the data which can be produced by the group as a whole or any subset of laboratories they may choose from this group. This knowledge should be incorporated in their planning. They should be wary of any laboratory, regardless of reputation, which has not participated in an intercomparison study or which has not been accredited through some harmonized proficiency testing program related to their project interests.

The participating laboratories have gained in that they are aware of their own capabilities, based on an objective assessment. The "rejected" laboratories must examine their procedures in order to improve their capabilities, seeking outside advice if necessary. The others must also continually seek to improve. The range of indiscrimination between laboratories is still too large to produce the necessary quality of data for many environmental projects.

References

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3. Protocol for the Design, Conduct and Interpretation of Collaborative Studies, Ed. Horowitz, W., J. Pure and Appl. Chem. 60, 855-864 (1988).