NISTIR 7361

National Marine Analytical Quality Assurance Program: Results and Description of the NIST/NOAA 2005 Interlaboratory Comparison Exercise for Trace Elements in Marine Mammals

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DISCLAIMER

Certain commercial equipment or instruments are identified in this paper to specify adequately the experimental procedures. Such identification does not imply recommendation or endorsement by the National Institute of Standards and Technology, nor does it imply that the equipment or instruments are the best available for the purpose.

BACKGROUND

INTRODUCTION

It is important to test the congruence of laboratories that perform marine environmental analyses. The ability to accurately determine trace elements in a wide range of marine sample types is required to assess their impact on human and animal health and nutrition, provide temporal "snapshots" of marine environmental quality and to identify global, regional and point sources that release contaminants into the atmosphere and coastal ecosystems. Critical reference standards are often not available for this niche analytical community. This limitation can lead to decisions based on subjective analytical results that can have significant environmental, economic and health consequences. NIST helps benchmark and improve the quality of analytical data gathered on the marine environment by administering annual interlaboratory comparison exercises through several programs, including the National Marine Analytical Quality Assurance Program (NMAQAP), which is supported by the NOAA/NMFS Marine Mammal Health and Stranding Response Program. Part of NIST's duties under the NMAQAP include producing quality control and reference materials that are distributed in annual interlaboratory comparison exercises, organizing and coordinating the exercises, performing baseline analytical measurements on marine samples collected and stored in the NIST National Biomonitoring Specimen Bank and pursuing analytical method development. The diversity of the thirty-three participating institutions represented in this year's exercise suggest that the Interlaboratory Comparison Exercise for Trace Elements in Marine Mammals extends beyond the scope of the NMAQAP to the trace element analytical community as a whole, including academic institutions, contract laboratories, international laboratories and government agencies. This year (2005) marks the fourth iteration of the exercise. Participants were asked to perform measurements for a suite of 15 analytes (Ag, As, Cd, Co, Cs, Cu, Fe, Hg, Mn, Mo, Rb, Se, Sn, V and Zn) in two NIST quality control materials: a pygmy sperm whale liver homogenate, QC03LH3, and a white-sided dolphin liver homogenate, QC04LH4. This report summarizes the key results of the exercise and the statistical tools used for data evaluation. Consensus data was generated using the Rukhin-Vangel maximum likelihood estimation model [1], which uses weighted means statistics and considers both within and between laboratory variances. International Union of Applied Chemistry (IUPAC) guidelines are implemented to evaluate laboratory performance through the use of z-and p-scores, which provide a mechanism to assess the comparability of data produced by the participating laboratories. Finally, laboratory biases are also evaluated graphically through the use of Youden diagrams.

EXERCISE OBJECTIVES

The intent of this report is to provide a mechanism for participants to assess their performance relative to their peers and those laboratories operating in the field of marine environmental research that involves measurements of trace elements. The information obtained in this report can be shared with NOAA, a funding sponsor for the program that from time-to-time uses this resource to assess the performance of certain laboratories performing contract work for that institution. The report is non-punitive and treats all laboratories anonymously.

EXERCISE DETAILS

DESCRIPTION OF TEST MATERIALS

Pygmy sperm whale (Kogia breviceps) liver homogenate (QC03LH3) served as the control standard for the interlaboratory comparison exercise, while white-sided dolphin (Lagenorhynchus acutus) liver homogenate (QC04LH4) served as the unknown. QC03LH3 was developed from a single live-stranded animal found at station 26, Sullivans Island, Charleston County, SC on August 10, 1994. Wayne McFee (NOAA/NOS Center for Coastal Environmental Health and Biomolecular Research, Charleston, SC) collected (with assistance from personnel from NOAA/NMFS and the South Carolina Department of Natural Resources) and donated the pygmy sperm whale liver to NIST through the vehicle of the National Marine Mammal Tissue Bank maintained by NIST. The white-sided dolphin liver that was processed into QC04LH4 was donated through a similar mechanism by personnel at the New England Aquarium, including Frederick Wenzel. All of the tissues were cryogenically pulverized, homogenized and bottled under ISO Class 7 and 5 clean room conditions to provide fresh-frozen, powder-like materials.

EXERCISE REQUIREMENTS AND TARGET ANALYTES

The participating institutions were each sent ~ 8-10 grams of each of the above materials in frozen jars using liquid nitrogen (LN_2) vapor or dry ice shippers. Typically, the LN_2 shippers were used for overseas shipments and the dry ice shippers were used for domestic shipments. Each laboratory submitted data in spreadsheet format via email. Originally, samples were shipped to 36 institutions, however in some cases no data was reported back to NIST or samples were damaged and/or could not clear customs in the receiving country in an appropriate time to preserve sample integrity. This latter problem was encountered by one of the participating institutions in Australia. Laboratory 18 reported data but it was not included in the study due to a lack of sample integrity induced by breakage and leaking samples that occurred during shipping and/or resulting from the customs inspections process.

The following requirements were stipulated to the participants:
1. Analyze samples for elements (As, Cd, Cu, Fe, Hg, Mn, Mo, Rb, Se, Sn, V and Zn) using accepted analytical procedures.
2. Digest, process, and analyze three aliquots of QC03LH3
3. Digest, process, and analyze five aliquots of QC04LH4

PARTICIPATING INSTITUTIONS

The 2005 list of participating institutions is presented in Table 1 in Appendix A. These laboratories are represented by government, private and academic institutions. Figure 1 shows a pie chart of participation by country, combined for the 2005 and 2003 exercises that serves as a good indicator of the large international component of the exercise.

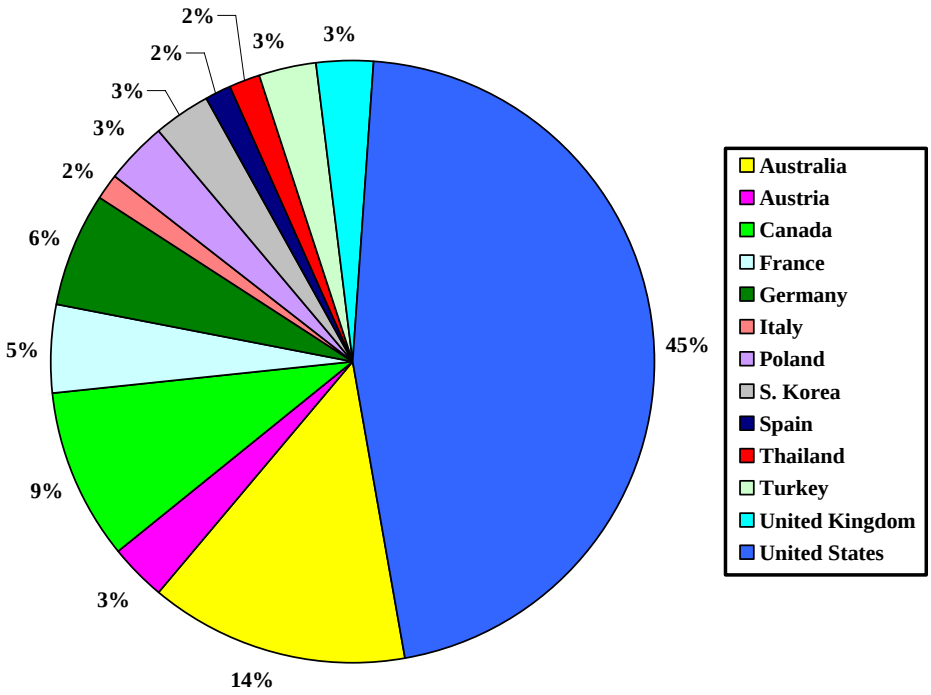

Figure 1. Participation in recent NIST/NOAA Interlaboratory Comparision Exercises for Trace Elements in Marine Mammals by country.

STATISTICAL METHODS

OUTLIER TESTING

The reported laboratory data for the control sample, QC03LH3, was used to determine potential gross outliers in the data. First, the measurement reproducibility of each laboratory was evaluated by comparing the results for the QC03LH3 control sample against established target values calculated using a composite of NIST analytical techniques and the consensus data generated on this material generated during the 2003 interlaboratory comparision exercise when it was issued as an unknown. NIST typically uses instrumental neutron activation analysis (INAA) [2] and inductively coupled plasma mass or emission spectrometry as in-house techniques to evaluate our fresh-frozen QC materials. The 2003 consensus data derived from interlaboratory testing using multiple analytical methods provides an additional source of data. When these data are combined they offer a good estimate of the concentration and uncertainty for each target element in the QC03LH3 sample. Established target reference means and expanded uncertainties for elements in QC03LH3 are presented in Appendix B, Table 2. The reference data for QC03LH3 is derived from combining data from the aforementioned sources using the Type B on Bias (BOB) method [3], which produces an equally weighted mean from the independent group means and associated expanded uncertainty that includes components of within and between laboratory variances, with the difference between the largest group mean and smallest group mean used as a proxy for between-method variance. Each laboratory was asked

to analyze n = 3 subsamples of QC03LH3. A laboratory was arbitrarily defined as an outlier for a particular element if the difference between the reported mean for the participating laboratory and the mean of the reference data differed by 20% or greater. Furthermore, a laboratory that was determined to be an outlier for an element in the QC03LH3 sample was automatically considered an outlier for the identical element in the unknown sample, QC04LH4, regardless of the degree of agreement between the reported value and the consensus mean value. Outlier data were not used in the determination of the consensus means for elements in the unknown sample, however data were treated the same statistically, in terms of computing summary statistics and z- and p-scores. Outlier data is presented in Appendix D, in Tables 4-18 and graphically if it does not severely distort the raw data plots and consensus mean plots, z-score/p-score plots or Youden diagrams. The reported data and results of the outlier tests for each laboratory as a function of element for the QC03LH3 sample are given in Appendix B, Table 2. This gross outlier rejection protocol worked well to a priori identify laboratories that would unduly distort the consensus mean of the unknown sample, QC04LH4, the measurand used as a point of reference to assess each laboratory's performance. In a minority of instances, a second level of outlier rejection was used for certain deviations of the protocol or inadequate reproducibility. Laboratory 30 did not report values for the control material, QC03LH3, and thus all reported QC04LH4 data from this laboratory were treated as outliers. Likewise, laboratory number 32 only reported n=1 measurement for the QC03LH3 and QC04LH4 materials and therefore its data was rejected because a within-laboratory variance could not be calculated for QC04LH4, a necessary requirement for the consensus mean processing algorithm described subsequently.

CONSENSUS MEAN CALCULATIONS

There are many approaches used at NIST to compute an estimate of a consensus mean and its associated uncertainty, based on using datasets from multiple laboratories and/or multiple analytical methods. The consensus means determined in this exercise are based on the weighed mean of the individual laboratory means and this weighted mean was calculated using an iterative maximum likelihood solution model. The reported raw data for QC04LH4 used to calculate laboratory means for each element is tabulated in Appendix C, Table 3. These data were subjected to outlier testing prior to determination of consensus concentrations and uncertainties. When choosing a model to estimate a consensus mean, several fundamental factors must be considered. For any given analyte, the number of reported measurements may vary for each laboratory, and the within laboratory variances can differ across laboratories. The number of laboratories will also influence the choice of method used to estimate the consensus mean. These factors should determine how to appropriately weight each laboratory, or whether to treat all laboratories equally. The plot in Fig. 2 will help to illustrate this point. Figure 2 is a homoscedasticity plot that was generated for Se in the QC04LH4 material, employing data submitted by 25 laboratories.

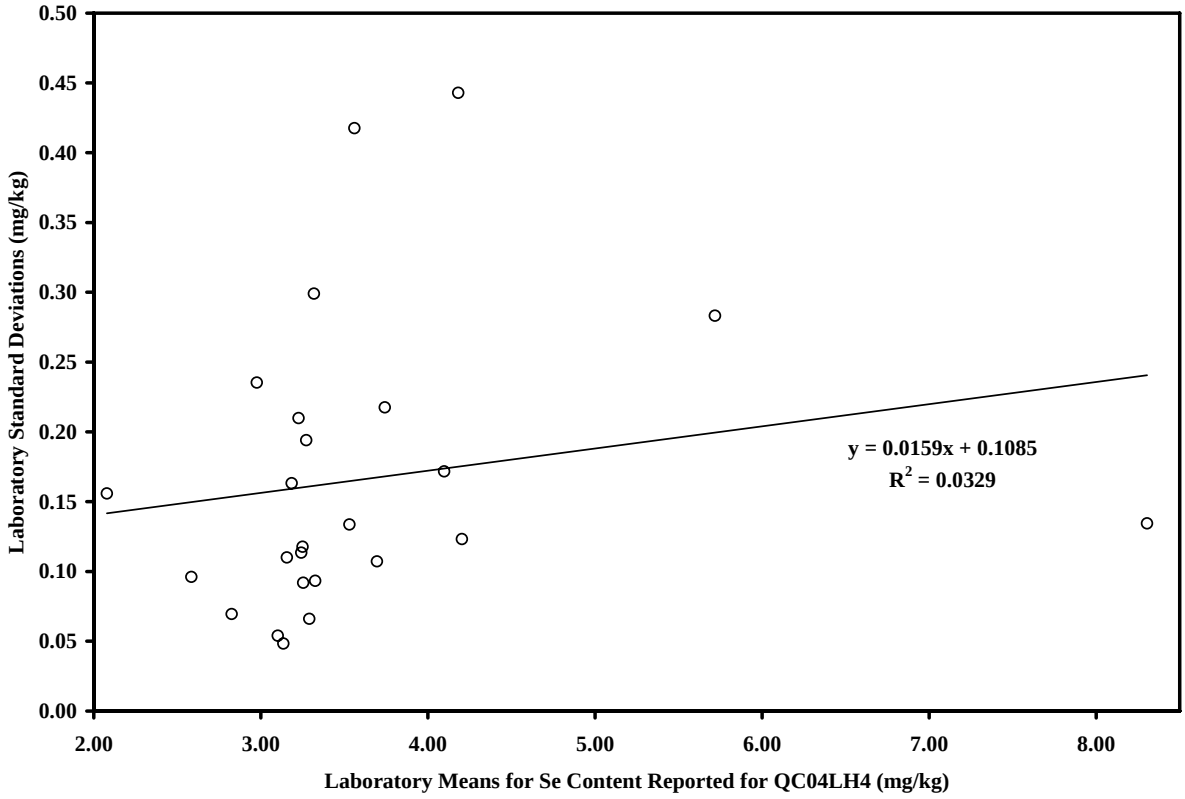

Figure 2. Homoscedasticity plot for Selenium in QC04LH4.

The vertical scatter in the plot is an indication that the variances across the laboratories are not equal, thus a consensus mean estimator model that is based on weighted means statistics may be more applicable than a simple "mean of means" model, where the estimate is an equally weighted mean that does not account for possible differences in within laboratory variability. Furthermore, consensus data is often used to assess the performance of each participating laboratory based on its proximity to the consensus value, e.g. using IUPAC guidelines (z-scores and p-scores) as in this exercise. Therefore it is desirable to incorporate an outlier rejection scheme and also provide a good estimate of the confidence interval about the consensus mean that, if possible, incorporates both within laboratory variances and between laboratory variance. This allows each participating laboratory to consider the merit of the consensus value as a point of reference. The distribution of the analyte data should always be considered as well, as most estimation models assume that the data will follow a normal distribution. Figure 3 gives example histograms and normal probability plots for the Se raw data submitted for QC04LH4. The histogram and normal probability plot in Fig. 3a indicate graphically that this particular dataset is non-normally distributed. Applying a Shapiro-Wilk test to the data corroborates the visual indications, i.e., $p < 0.0001$ is lower than the 95% significance level for p (0.01) and non-normality can be assumed. The histogram and normal probability plot are regenerated in Fig. 3b after removing suspected outlier laboratories. Here the results for the Shapiro-Wilk test yielded $p = 0.09$ and normality can be assumed. The data shown here for Se are representative of data for other elements, thus the assumption of normality is applicable to the data in this exercise with the caveat that outlier data (if left unaccounted for) could easily negate the "normality" of a dataset.

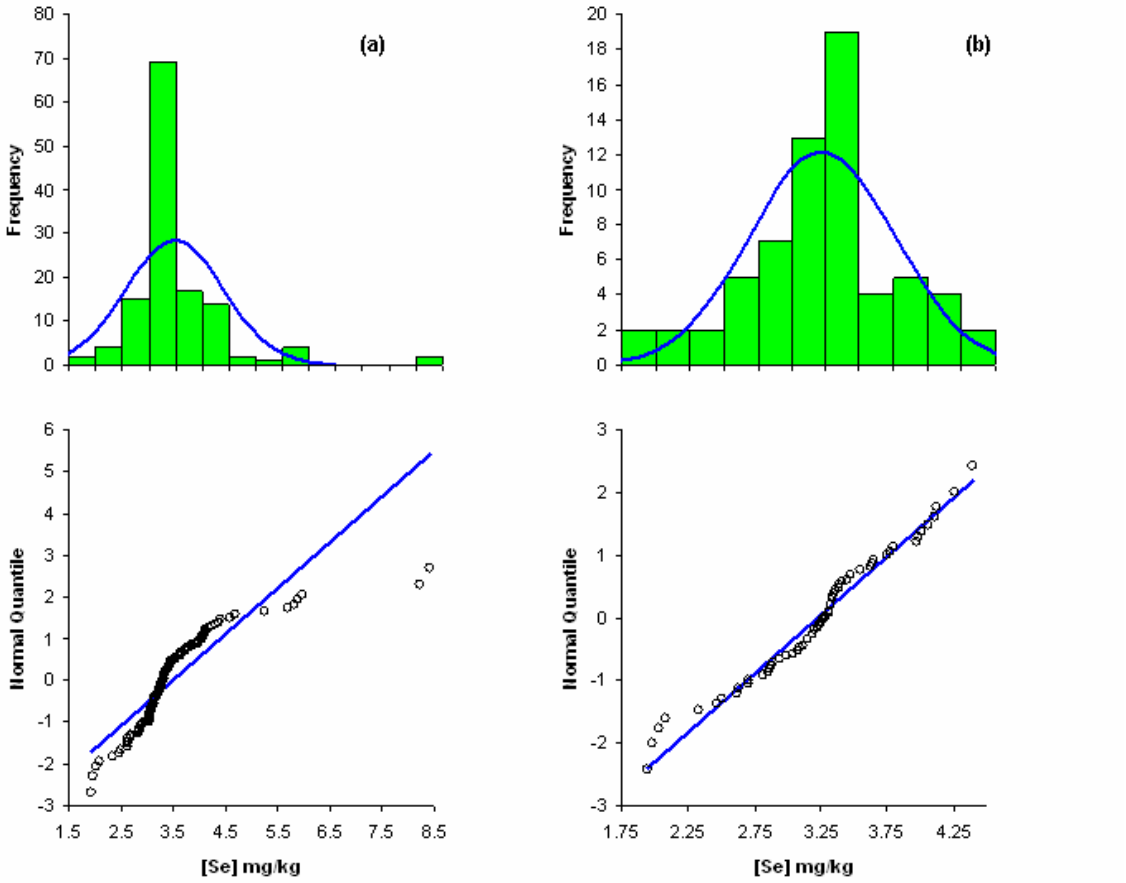

Figure 3. Histogram and normal probability plots for Selenium in QC04LH4 before (a) and after (b) removal of outliers.

The Rukhin-Vangel maximum likelihood model [1] used in this exercise addresses a number of the items discussed above. The model chosen for computing the consensus mean estimates includes an assumption of normality and helps to de-emphasize laboratory means that possess large variances. An overview of the statistical model follows to outline the procedures used to determine a maximum likelihood estimate of the consensus mean. The maximum likelihood solution used to estimate the consensus mean and its associated uncertainty is based on a one-way random effects analysis of variance (ANOVA) model that may be both unbalanced (i.e., the number of observations from each laboratory need not be equal) and heteroscedastic (i.e., the within laboratory variances can be unequal):

$$\mathbf{x_{ij} = \mu + L_i + e_{ij}}$$

Where there are i = 1, …, k laboratories and j = 1, …, n_i observations for each laboratory. In this model, μ is the consensus mean, L_i is the lab effect and e_{ij} is the error term. The L_i are normally distributed as $N(0, \sigma^2)$ and the e_{ij} are normally distributed as $N(0, \sigma_i^2)$. Here σ^2 and σ_i^2 represent the between laboratory variance and within laboratory variances, respectively. The maximum

likelihood equations are rather complicated in form and are not reproduced here. A copy of the Rukhin-Vangel paper [1] should be referenced by interested participants as it presents this topic in a statistically rigorous fashion. Alternatively, a more simplistic discussion follows that is based on the Mandel-Paule procedure for estimating a consensus mean [4,5]. Rukhin and Vangel show in [1] that the Mandel-Paule approach closely resembles that of the maximum likelihood procedures used to estimate consensus values. The Mandel-Paule algorithm consists of using weights of the form: $w_i = 1/(y + t_i^2)$ where y is an estimate of the between laboratory variance that is determined using an iterative process and t_i^2 is the within laboratory variance of the mean (i.e., s_i^2/n_i), where s_i^2 is the variance of the ith laboratory and n_i is the corresponding number of observations. It is important to again make the distinction between the procedures used in this exercise and the more familiar "mean of means" procedure for calculating the consensus mean, where the latter approach necessarily weights each laboratory identically, regardless of its analytical repeatability. In this exercise the weight of a laboratory in the consensus mean is proportional to its accuracy measured as the inverse variance, and the weights assigned actually minimize the variance of the consensus mean. The weights are used in the estimator ($\bar{x}$) of the consensus mean, μ, as:

$$\bar{x} = \frac{\sum_{i=1}^{k} w_i x_i}{\sum_{i=1}^{k} w_i}$$

where x_i is the reporting laboratory mean and the summation is from i = 1 to k where k is the number of laboratories. The between laboratory variance y is estimated by iteratively solving the following equation:

$$\sum_{i=1}^{k} \frac{x_i - \bar{x}}{y + t_i^{\,2}} = k - 1$$

The standard error of the estimate of the consensus mean is then computed using the following formula:

$$\bar{x} \pm \frac{\sqrt{\sum_{i=1}^{k} \frac{(x_i - \bar{x})^2}{(y + t_i^{\,2})^2}}}{\sum_{i=1}^{k} \frac{1}{y + t_i^{\,2}}}$$

where the summation is from i = 1 to k and k is the number of laboratories. Finally, this standard error is multiplied by a coverage factor to determine a confidence interval about the consensus mean, as given in equation (19) in the Rukhin-Vangel paper. For example, for a normal distribution, at the 95% level of confidence, $\alpha = 0.05$, and $Z_{0.975}$ translates to a coverage factor of 1.96. The only drawback to this uncertainty estimate is that it is based on asymptotics (i.e., the number of laboratory sources going to infinity). This is of course an unrealistic assumption, so

the maximum likelihood approach is reserved for cases when the number of datasets (reporting laboratories) is greater than six, as is the case for all elements reported in this exercise.

PERFORMANCE ASSESSMENT TOOLS

Z- AND P-SCORES

The z-score is a bias estimate calculated from the difference between the laboratory mean x_i and the consensus mean estimate divided by a target value (σ_{Target}) for standard deviation:

$$z = \frac{x_i - \bar{x}}{\sigma_{Target}}$$

The choice of σ_{target} will be dependent on the data quality objectives of a particular quality assurance program. For this exercise, z-scores are calculated using a fixed fit for performance criterion (σ_{Target}) of ± 10% of the consensus mean. Using two examples, this performance criterion implies that respectively for z = ± 1 or z = ± 2, the result is 10% or 20% higher (or lower) than the consensus mean. One should use z-scores to comment on congruence and not absolute concentration accuracy. With this caveat, z-scores can be classified into categories to assess the performance of each laboratory:

$$\begin{aligned} |z| &\leq 2 \text{ Satisfactory} \\ 2 \leq |z| &\leq 3 \text{ Questionable} \\ |z| &\geq 3 \text{ Unsatisfactory} \end{aligned}$$

Using a "fixed" performance criterion offers a way for each laboratory to compare their performance on different samples and against other participating laboratories. It should be recognized that any particular laboratory might have a detection limit or analytical method deficiency for a particular analyte. The acceptability of a particular laboratory's results should be judged in the context of the data quality needs and objectives of a particular program. The z-score results for the QC04LH4 samples are displayed in Appendix D as a function of element within Tables 4-18 and graphically. It should be expected that z-scores of greater than z = ± 1 will occur with greater frequency for decreasing analyte concentrations. The interlaboratory reproducibility for individual elements is assessed using a p-score (precision score) where laboratory repeatability (i.e. the coefficient of variation) is normalized to an assigned target value for the coefficient of variation:

$$p = \frac{CV_{Lab}}{CV_{Target}}$$

The value for CV_{Target} is fixed at 10% for this interlaboratory comparison exercise. Using two examples, this value for CV_{Target} implies that respectively for p = 0.5 or p = 1.2, the laboratory repeatability is 5% or 12%. The p-score results for the QC04LH4 samples are displayed in Appendix D as a function of element within Tables 4-18 and graphically. The frequency of higher p-scores can be rationalized by referring back to the z-score discussion. One cannot

ignore the fact that sample inhomogeneity may be a limiting factor when evaluating intralaboratory or interlaboratory repeatability. In fact, comparing p-scores as a function of laboratory and element can help highlight within or between jar sample inhomogeneity for candidate reference materials and not necessarily reflect poor laboratory performance.

YOUDEN DIAGRAMS

The Youden diagram [6] is a classic graphical tool used to evaluate laboratory bias when each laboratory has collected data on two similar materials. The Youden diagram offers a simple but effective means for comparing between- and within-laboratory variability, and highlighting possible outliers. The key question the Youden plot helps to answer is: Are the laboratories in the study behaving as if they are all from a single population? A youden diagram can be used to provide information on the occurrence of indeterminate (random) and determinate (systematic) errors, if the concentrations of the analytes are similar in the samples that comprise the plot. A Youden plot will exhibit a structureless "random shotgun pattern" about a point of reference [6], if all laboratories reside within a single population and indeterminate errors are occurring. Measurements appearing in the upper right and lower left quadrants of the Youden plot indicate, respectively, that a laboratory's measurements are consistently biased high or low relative to measurements performed in other laboratories. Sources of such determinate errors include calibration errors, blank correction errors, and analytical method errors such as analyte volatility (loss) and sample contamination. The Youden diagrams in Appendix D use the intersection of the assigned reference value for the control material (QC03LH3) and the maximum likelihood consensus mean value calculated for the unknown material (QC04LH4) as a relative point of reference. This bias reference point (intersection at coordinates x=1 and y=1 in each diagram) represents the best estimate of the concordance value for each element tested. A two-dimensional 95% confidence interval is cast about the point. Measurements from individual laboratories (circles) are normalized to the concordance values described above so that they can all be compared against a common benchmark. In general, laboratories falling closer to the bias reference point demonstrate congruence. Laboratories whose measurements consistently remain far away from the bias reference point demonstrate either systematic bias (lower left and upper right quadrants) or other inconsistencies (measurements appearing in alternate upper left or lower right quadrants).

RESULTS AND DISCUSSION

SURVEY OF ANALYTICAL METHODS

Figure 4. displays a bar chart of the reported analytical methods as a function of element. It is interesting but not surprising to note that the reported methods are heavily biased towards inductively coupled emission and mass spectrometries. It is likely that these routine analytical systems were used in laboratories that did not report on the instrumental technique used as well. The emergence of collision cell ICPMS, a relatively new technology in the field of inorganic mass spectrometry, combined with high resolution ICPMS, accounted for approximately 10% to greater than 15% of the analytical determinations, depending on the particular element investigated, while approximately 15% of the mercury determinations were based on cold vapor generation and atomic absorption or fluorescence detection.

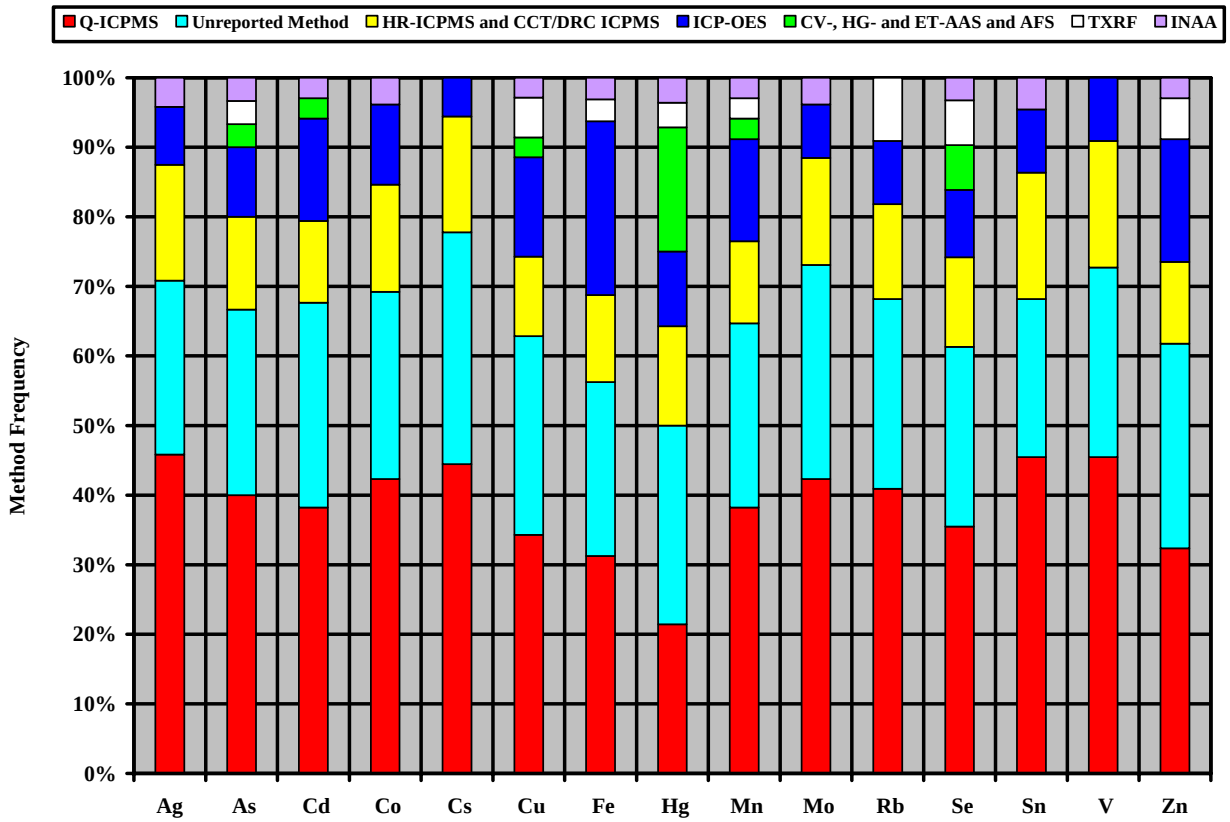

Figure 4. Reported analytical methods as a function of element.

DATA OUTPUTS

The data for each element in the exercise is presented in tabular and graphical formats for the unknown material, QC04LH4 (Appendix D). Data tables consisting of laboratory means, number of observations, associated summary statistics, assigned weights and estimates of within laboratory variances from the maximum likelihood consensus mean algorithm, and z- and p-scores as a function of laboratory are presented (Appendix D, Tables 4-18), along with the assigned consensus mean and associated expanded uncertainty for each element measured in QC04LH4. This tabular data is complemented by four plots; a raw data plot, a consensus mean plot, a plot of laboratory performance in z- and p-score space and a Youden diagram. The raw data plot allows each participating laboratory to compare their method results against other laboratories and gives some indication as to which laboratories will be more heavily weighted in the consensus mean algorithm. It can also serve as a gross indicator tool to detect potential sample inhomogeneity within and across units of the issued quality control material. The consensus mean plot displays the individual laboratory means and the assigned consensus value and its associated expanded uncertainty. This important plot allows laboratories to compare their reported mean value against an estimated "consensus" value. Further, the uncertainty about this value serves as an indicator of the quality of the consensus value estimate. If the uncertainty about the consensus mean value is large, the consensus value estimate becomes inherently less useful from the perspective of the participating laboratories. The tangible effect is that a laboratory would be less likely to alter an in-house method or protocol if there is disagreement between the laboratory and the consensus value when the consensus value possesses a large uncertainty. The consensus mean algorithm used in this study actually minimizes the uncertainty

about the consensus value by an iterative weighting process to maximize the utility of comparisons against the consensus mean for each participating laboratory. The plot over z- and p-score space serves as an indicator of congruence and analytical method repeatability. Laboratories that possess the lowest p-scores will be nearest to the abscissa and laboratories that possess the lowest z-scores will be nearest to the ordinate axis. The Youden diagram (described previously), helps laboratories to identify possible systematic and random biases associated with the analytical method employed.

ANALYTE DATA AND SCORING

Referring to the z-scores in the consensus data tables and plots in Appendix D shows that numerous subgroups of the exercise participants have demonstrated comparability within the | 0-1 | z-range for many elements, based on the use of 10% of the consensus mean as the performance criterion. For any given element, the z-score range | z | = 0-1 implies that a laboratory in this subgroup can distinguish between two samples when their respective analyte concentrations differ by 0% to 20 %. The z-scores are scalable so any laboratory may wish to challenge their performance using the qualitative IUPAC guidelines. For example, a laboratory that scores a z = -0.7 based on a σ_{Target} of 10% of the consensus mean, would score a z = -1.4, if the performance criterion was tightened to σ_{Target} = 5% of the consensus mean. The scaled result in this theoretical example would still be classified as "satisfactory" (| z | ≤ 2). Laboratory p-scores (Appendix D) were typically < 10% RSD for all elements. This type of precision (or better) should be expected for atomic spectroscopy measurements. This implies that QC04LH4 is a relatively homogeneous material, as inflated, wild ranging p-scores for small or large subsets of laboratories could be indicative of a within jar homogeneity problem for any particular element. The p-scores are necessarily inversely correlated with the maximum likelihood weights assigned to each laboratory for a particular element because of the nature of the consensus mean estimation model employed.

A view of the data collectively as a function of element reveals some interesting trends. Figure 5 charts the average and median absolute z-score as a function of element. This data is derived from the laboratory z scores in Appendix D, Tables 4-18, excluding data from outlier laboratories. The average or median absolute z-score is a metric representing the collective congruence score of the group of participating laboratories that contributed data to the consensus mean. The highest z-scores were observed for As, Se, Sn, V and Co, indicating that these particular elements were the most challenging to measure from a congruence perspective. This could be due to several factors including the element concentrations in the sample, random analytical biases and systematic laboratory biases including calibration and blank errors, element volatility or loss, recovery and certain types of chemical and spectral interferences. These factors are influenced by decisions made by the participating laboratories with regards to the employment of laboratory methods, calibration protocols and instrumentation. It is difficult to specifically pinpoint the analytical problems associated with these elements. If we assume that ICPMS methods are driving the majority of determinations for these high average z-score elements (reference Fig. 4), and that sample concentrations are not near detection limits, it might be possible to deduce that most laboratories view this subset of elements as problematic, with analytical determinations being affected by various matrix or spectral interferences and plasma processes. In addition to suffering from isobaric interferences, As and Se are also subject to differential ionization effects if the carbon content of the calibration samples and analytical samples is not matched. Referring back to the Youden diagrams (Appendix D), it appears that

most of the analytical determinations for these five elements, with the exception of Se, appear in the upper right and lower left quadrants, indicating that the systematic effects outlined above are important. Selenium is interesting in that nearly 50% of the analytical determinations for Se fall in the lower right quadrant on the Youden diagram. This indicates that for a large number of laboratories, some random analytical processes are influencing the Se measurements. Figure 6 charts the average and median p-score as a function of element. The average or median p-score is a metric representing the collective precision score of the group of participating laboratories that contributed data to the consensus mean. The highest p-scores were observed for Cd, Co, V, Sn and As, indicating that these particular elements were the most challenging to measure from a

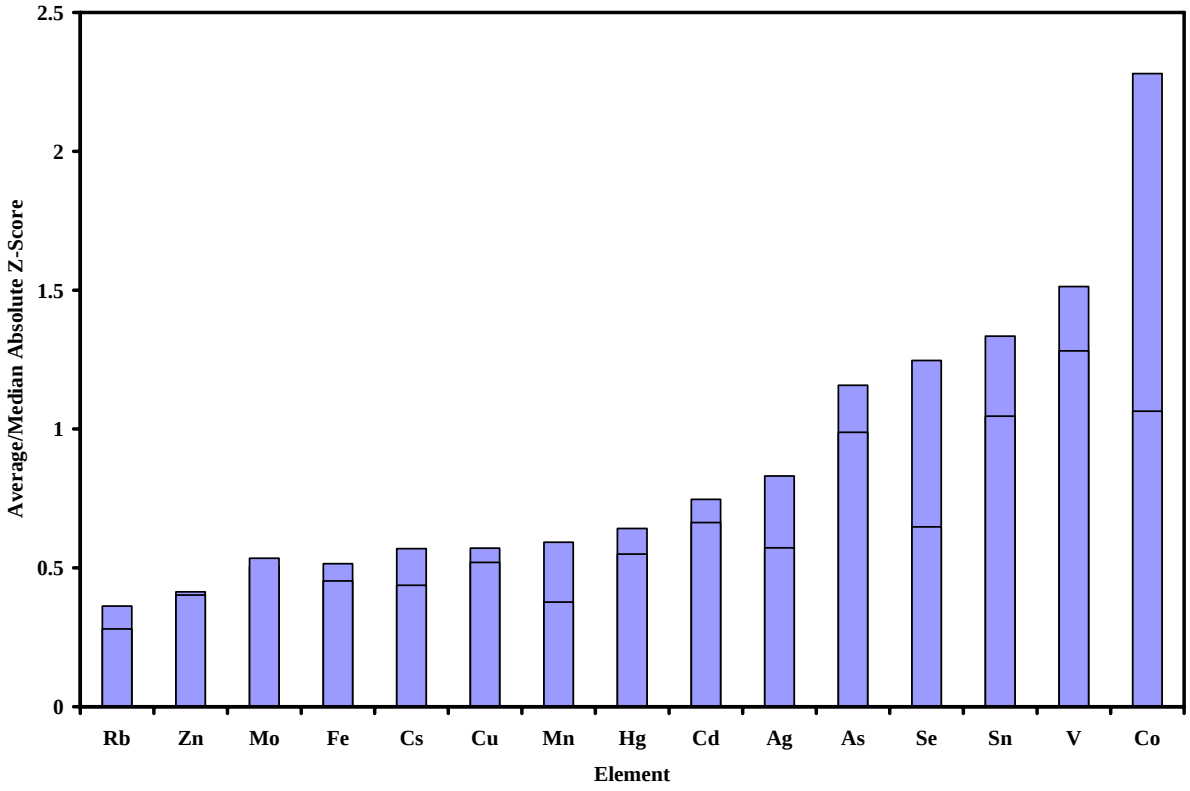

Figure 5. Average (bar) and median (line) absolute z-score as a function of element.

precision perspective, with "precision" a proxy for either decreased laboratory and/or method repeatability, or potential sample heterogeneity. It is interesting to note that four out of five of high p-score elements suffer from large average absolute z-scores as well. Although precision and congruence are mutually exclusive scientific phenomena, a regression of average p-score and average absolute z-score for the elements studied yields a moderate-to-large correlation coefficient of 0.49 (Fig. 7). A regression analysis confirms a significant relationship ($p=0.0038$ for F-test), indicating a tendency for congruent laboratories to be more precise.

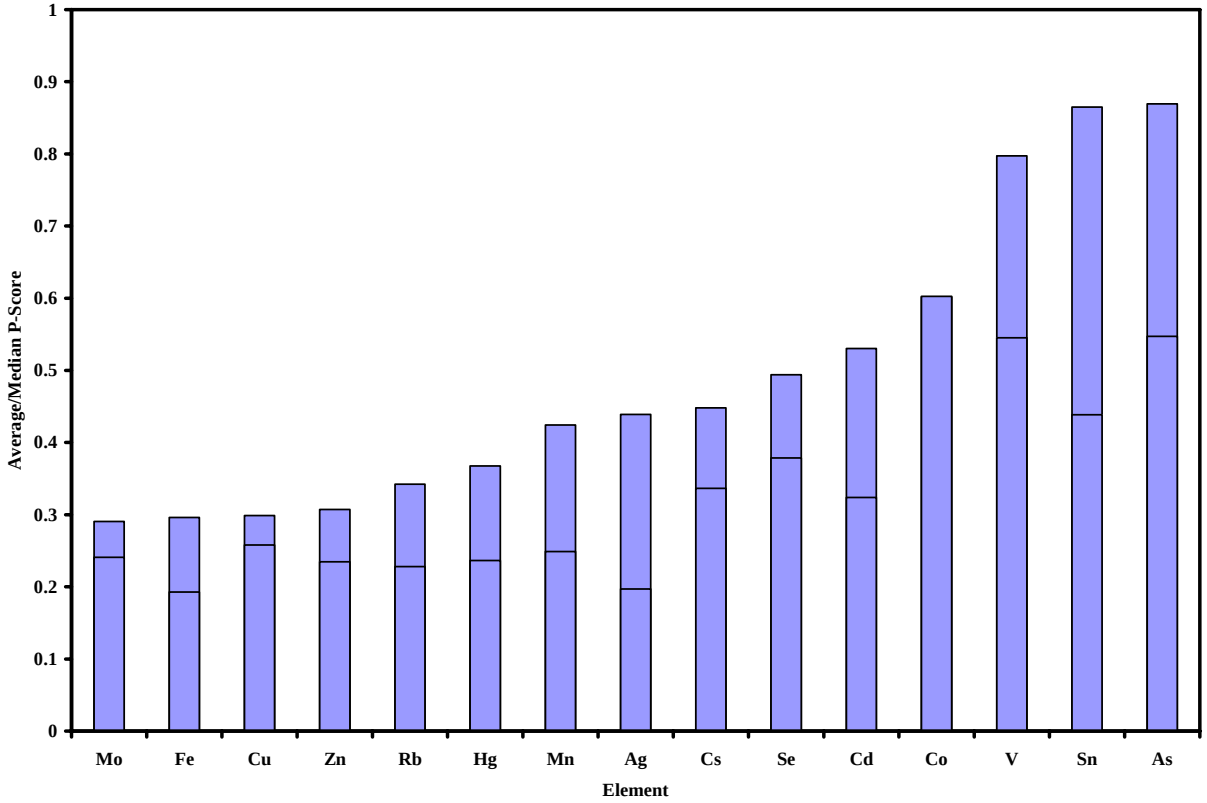

Figure 6. Average (bar) and median (line) p-score as a function of element.

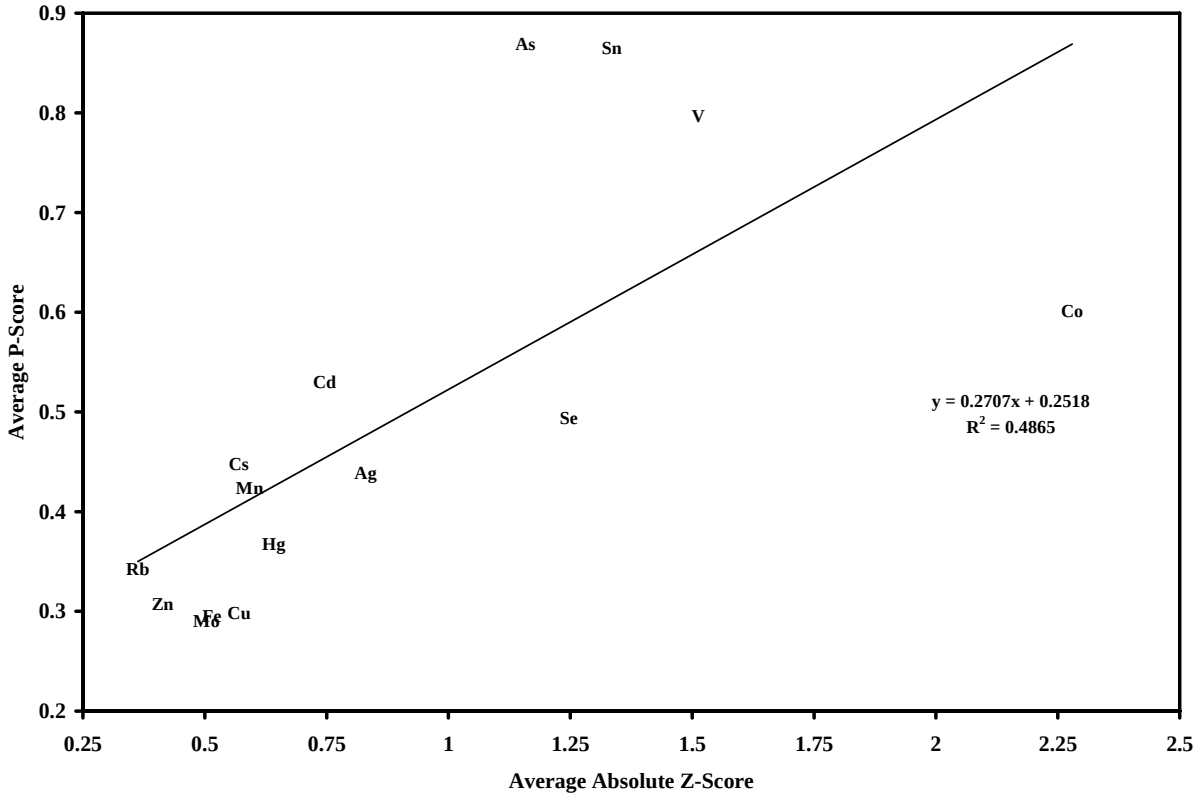

Figure 7. Average p-score plotted as a function of average absolute z-score.

CONCLUSIONS

The first iteration of this quality assurance exercise in 2000 was a modest endeavor, as only seven laboratories participated. However the 2001, 2003 and 2005 exercises have demonstrated that the scope of this quality assurance exercise is expanding beyond the interests of the marine mammal contaminants community to the analytical chemistry community as a whole, as numerous domestic and international health, environmental and diagnostic laboratories have been brought in as participants. It is hoped that a core group of these laboratories will regularly participate in future exercises to help underpin and improve the quality of trace element measurements in environmentally and clinically important marine biological tissues. International participation has been strong for both the 2003 and 2005 efforts and it is hoped that this trend will continue. NIST is currently working on collecting and producing a marine mammal whole blood quality control material for use in the 2007 and future trace element exercises to reflect the increased shift towards live animal processing in the marine mammal community. This material will serve to complement sampling efforts focused on marine specimen banking of samples obtained from both live capture and stranding network sampling, while serving as a challenging quality control matrix that is analytically relevant from both the marine animal health and human health measurements perspectives.

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APPENDIX A

List of Participating Laboratories

Table 1. List of Participating Institutions.

INSTITUTION	COUNTRY	INSTITUTION	COUNTRY	INSTITUTION	COUNTRY	INSTITUTION	COUNTRY
APPLIED SPECIATION AND CONSULTING, LLC 953 INDUSTRY DRIVE TUKWILA, WA 98188	USA	ENVIRONMENTAL RESEARCH INSTITUTE UNIVERSITY OF CONNECTICUT U-5210 LONGLEY BLDG. STORRS, CT 06269-5210	USA	INSTITUTE OF CHEMISTRY - ANALYTICAL CHEMISTRY KARL-FRANZENS UNIVERSITY GRAZ UNIVERSITÄTSPLATZ 1 8010 GRAZ, AUSTRIA	AUSTRIA	SPECTROMETRY APPLICATION LABORATORY R&T - SASOL ITALY SPA V. REALI, 4 20037 PADERNO DUGNANO (MI) - ITALY	ITALY
AUSTRALIAN NUCLEAR SCIENCE AND TECHNOLOGY ORGANIZATION ANSTO - PMB1, MENAI, NSW 2234, AUSTRALIA	AUSTRALIA	FOOD COMPOSITION LABORATORY BELTSVILLE HUMAN NUTRITION RESEARCH CENTER AGRICULTURAL RESEARCH SERVICE U.S. DEPARTMENT OF AGRICULTURE BUILDING 161, BARC-EAST BELTSVILLE, MD 20705	USA	IZMIR YUKSEK TEKNOLOJI ENSTITUSU FEN FAKULTESI, KIMYA BOLUMU GULBAHCEKOYU, URLA 35430, IZMIR TURKEY	TURKEY	TRACE ELEMENT RESEARCH LABORATORY TEXAS A&M UNIVERSITY, VAPH VMA BLDG, ROOM 107 COLLEGE STATION, TX 77843-4458	USA
BROOKS RAND LLC 3958 6TH AVENUE NW SEATTLE, WA 98107	USA	FRONTIER GEOSCIENCES INC. 414 PONTIUS AVE. NORTH SEATTLE, WA 98109	USA	KINECTRICS TORONTO, ON, CANADA M8Z 6C4	CANADA	UCLA ICP FACILITY DEPARTMENT OF CHEMISTRY AND BIOCHEMISTRY BOX 951569 607 CHARLES E. YOUNG DR. LOS ANGELES, CA 90095	USA
CANTEST LTD. 4606 CANADA WAY BURNABY B.C. V5G 1K5 CANADA	CANADA	GALAB LABORATORIES MAX-PLANCK-STRASSE 1 21502 GEESTHACHT GERMANY	GERMANY	MIDWEST RESEARCH INSTITUTE FLORIDA DIVISION 1470 TREELAND BLVD SE PALM BAY, FL 32909	USA	ULTRA-TRACE ANALYSES AQUITAINE (UT2A) HÉLIOPARC PAU-PYRÉNÉES 2, AVENUE DU PRÉSIDENT ANGOT 64053 PAU CEDEX 9 FRANCE	FRANCE
CEFAS BURNHAM LABORATORY REMEMBRANCE AVENUE BURNHAM ON CROUCH ESSEX CM0 8HA, UK	UK	GBC SCIENTIFIC EQUIPMENT PTY. LTD. 12, MONTEREY ROAD, DANDENONG, 3175 VICTORIA AUSTRALIA	AUSTRALIA	NATIONAL MEASUREMENT INSTITUTE 1 SUAKIN ST, PYMBLE, NSW, 2073 AUSTRALIA	AUSTRALIA	UNIVERSITAET HOHENHEIM LANDESANSTALT FUER LANDWIRTSCHAFTLICHE CHEMIE (710) 70593 STUTTGART, GERMANY	GERMANY
CENTRE FOR PUBLIC HEALTH SCIENCES QUEENSLAND HEALTH SCIENTIFIC SERVICES 39 KESSELS ROAD, COOPERS PLAINS, QLD 4108 AUSTRALIA	AUSTRALIA	GKSS RESEARCH CENTER INSTITUTE FOR COASTAL RESEARCH DEPT. FOR MARINE BIOANALYTICAL CHEMISTRY MAX-PLANCK-STRASSE, D-21502 GEESTHACHT, GERMANY	GERMANY	NATIONAL MEASUREMENT INSTITUTE, 51-65 CLARKE STREET, SOUTH MELBOURNE, VICTORIA 3205, AUSTRALIA	AUSTRALIA	UNIVERSITÉ DE LA ROCHELLE CENTRE COMMUN D'ANALYSES 5 ALLÉES DE L'OCÉAN 17071 LA ROCHELLE CEDEX 9 FRANCE	FRANCE
DEPARTMENT OF CHEMISTRY CHUNGNAM UNIVERSITY DAE JEON, 305-764 SOUTH KOREA	S. KOREA	HEALTH CANADA - RADIATION PROTECTION BUREAU, 775 BROOKFIELD RD OTTAWA, ON, K1A 1C1 CANADA	CANADA	ONTARIO MINISTRY OF ENVIRONMENT LABORATORY SERVICES BRANCH 125 RESOURCES ROAD ETOBICOKE, ON M9P 3V6 CANADA	CANADA	UNIVERSITY OF CALIFORNIA, DAVIS PLANT SCIENCE DEPARTMENT PLANT AND ENVIRONMENTAL SCIENCE BUILDING ONE SHIELDS AVE DAVIS, CA 95616	USA
DEPARTMENT OF CHEMISTRY, UNIVERSITY OF MASSACHUSETTS LEDERLE GRADUATE RESEARCH TOWER 710 NORTH PLEASANT STREET AMHERST, MA 01003-9306	USA	HERCULES, INC. 500 HERCULES ROAD BUILDING 8100/306 WILMINGTON, DE 19808-1599	USA	POLITECHNIKA POZNANSKA DEPARTMENT OF ANALYTICAL CHEMISTRY PIOTROWO 3 60-965 POZNAN POLAND	POLAND	UNIVERSITY OF MARYLAND EASTERN SHORE GW CARVER SCIENCE BUILDING 2123, PRINCESS ANNE, MD 21853	USA
ECOCHEMISTRY LABORATORY UNIVERSITY OF CANBERRA BUILDING 3 ALLAWOONA ST., A.C.T. AUSTRALIA 2601	AUSTRALIA	HEWLETT PACKARD COMPANY 16399 WEST BERNARDO DR SAN DIEGO, CA 92129	USA	SAWYER ENVIRONMENTAL RESEARCH CENTER UNIVERSITY OF MAINE ORONO, ME 04469	USA	UNIVERSITY OF PENNSYLVANIA SCHOOL OF VETERINARY MEDICINE NEW BOLTON CENTER 382 WEST STREET ROAD KENNETT SQUARE, PA 19348	USA

APPENDIX B

Reported Raw Data for QC03LH3

Table 2. Individual results and summary statistics (mg/kg) for replicate aliquots of QC03LH3, including results from outlier testing.

	Element	Ag	As	Cd	Co	Cs	Cu	Fe	Hg	Mn	Mo	Rb	Se	Sn	V	Zn
	Target Mean	**0.088**	**0.398**	**5.94**	**0.071**	**0.0079**	**2.74**	**694**	**3.56**	**1.43**	**0.211**	**1.61**	**7.87**	**0.094**	**0.0370**	**21.15**
	Expanded Uncertainty	**0.007**	**0.019**	**0.21**	**0.003**	**0.0003**	**0.12**	**25**	**0.67**	**0.07**	**0.008**	**0.07**	**0.88**	**0.019**	**0.0168**	**0.97**
	Target Mean ± 20%	**0.070-0.106**	**0.318-0.478**	**4.75-7.13**	**0.057-0.085**	**0.0063-0.0095**	**2.19-3.29**	**555-833**	**2.85-4.27**	**1.14-1.72**	**0.169-0.253**	**1.29-1.93**	**6.30-9.44**	**0.075-0.113**	**0.0296-0.0444**	**16.92-25.38**
	Outlier Laboratories (QC03LH3 Test or QC04LH4)	**19,22,27 28,32,33**	**7,11,27 28,30,31 32**	**8,11,26 28,30,32**	**6,15,23 28,30,32 33**	**7,17,27 28,30,32**	**11,15,26 30,33**	**32**	**15,17,32 30**	**28,30,32**	**11,28,303 2,33**	**4,28,30 32**	**11,27,30 32**	**15,17,22 28,31,32 33**	**7,9,20 24,27,28 31,32**	**11,12,303 2**
Lab. #	**Sample ID**	**Ag**	**As**	**Cd**	**Co**	**Cs**	**Cu**	**Fe**	**Hg**	**Mn**	**Mo**	**Rb**	**Se**	**Sn**	**V**	**Zn**
1	QC03LH3	0.0841	0.414	6.180	0.0669	0.0080	2.58	679.0	3.40	1.44	0.209	1.65	8.03	0.111	0.0388	20.30
1	QC03LH3	0.0822	0.412	6.110	0.0679	0.0081	2.58	704.0	3.51	1.45	0.208	1.64	8.13	0.109	0.0392	21.00
1	QC03LH3	0.0819	0.419	5.910	0.0691	0.0081	2.65	677.0	3.56	1.43	0.208	1.65	7.74	0.107	0.0392	20.00
	Mean	0.0827	0.415	6.067	0.0680	0.0081	2.60	686.7	3.49	1.44	0.208	1.65	7.97	0.109	0.0391	20.43
	Stdev	0.0012	0.004	0.140	0.0011	0.0000	0.04	15.0	0.08	0.01	0.001	0.01	0.20	0.002	0.0002	0.51
	%RSD	1.44%	0.87%	2.31%	1.62%	0.29%	1.55%	2.19%	2.35%	0.01	0.28%	0.35%	2.54%	1.83%	0.59%	2.51%
	Outlier Test: P or F	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
2	QC03LH3	0.0917	0.423	6.690	0.0695		2.78	710.0	3.51	1.37	0.213		8.08	0.086		21.70
2	QC03LH3	0.0932	0.208	6.670	0.0702		2.84	704.0	3.72	1.37	0.208		7.93	0.091		21.70
2	QC03LH3	0.0958	0.334	6.550	0.0697		2.73	712.0	3.71	1.41	0.226		7.81	0.088		22.10
	Mean	0.0936	0.322	6.637	0.0698		2.78	708.7	3.65	1.38	0.216		7.94	0.088		21.83
	Stdev	0.0021	0.108	0.076	0.0004		0.06	4.2	0.12	0.02	0.009		0.14	0.002		0.23
	%RSD	2.22%	33.58%	1.14%	0.52%		1.98%	0.59%	3.25%	0.02	4.31%		1.70%	2.75%		1.06%
	Outlier Test: P or F	Pass	Pass	Pass	Pass		Pass	Pass	Pass	Pass	Pass		Pass	Pass		Pass
3	QC03LH3	0.0890	0.347	6.260	0.0670	0.0070	2.61	693.0		1.41	0.213	1.55	8.16	0.100	0.0360	22.30
3	QC03LH3	0.0870	0.405	5.850	0.0710	0.0080	2.75	709.0		1.52	0.206	1.62	9.90	0.093	0.0410	20.90
3	QC03LH3	0.0910	0.404	6.490	0.0760	0.0082	2.89	623.0		1.27	0.207	1.71	9.28	0.087	0.0330	20.20
3	QC03LH3		0.425				2.76	687.0		1.43		1.67	7.68			21.30
3	QC03LH3						2.81	674.0		1.36		1.66	7.88			21.40
3	QC03LH3						2.79	675.0		1.32		1.61	7.74			21.20
	Mean	0.0890	0.395	6.200	0.0713	0.0077	2.77	676.8		1.39	0.209	1.64	8.44	0.093	0.0367	21.22
	Stdev	0.0020	0.034	0.324	0.0045	0.0006	0.09	29.4		0.09	0.004	0.06	0.93	0.007	0.0040	0.69
	%RSD	2.25%	8.50%	5.23%	6.32%	8.31%	3.33%	4.34%		0.06	1.81%	3.41%	10.98%	6.97%	11.02%	3.23%
	Outlier Test: P or F	Pass	Pass	Pass	Pass	Pass	Pass	Pass		Pass	Pass	Pass	Pass	Pass	Pass	Pass

Table 2. (continued): Individual results and summary statistics (mg/kg) for replicate aliquots of QC03LH3, including results from outlier testing.

Lab. #	Sample ID	Ag	As	Cd	Co	Cs	Cu	Fe	Hg	Mn	Mo	Rb	Se	Sn	V	Zn
4	QC03LH3			6.260			2.73	700.3		1.52						22.50
4	QC03LH3			6.260			2.77	700.0		1.52						23.20
4	QC03LH3			6.050			2.90	701.4		1.50						21.71
4	QC03LH3						2.38		3.67			1.59	7.98			22.04
4	QC03LH3						3.29		3.06			1.73	7.96			22.17
4	QC03LH3						2.56		2.87			1.59	8.01			22.10
	Mean			6.190			2.77	700.6	3.20	1.51		1.64	7.98			22.29
	Stdev			0.121			0.31	0.7	0.42	0.01		0.08	0.03			0.51
	%RSD			1.96%			11.24%	0.11%	13.06%	0.01		4.94%	0.32%			2.31%
	Outlier Test: P or F			Pass			Pass	Pass	Pass	Pass		Pass	Pass			Pass
5	QC03LH3								3.72							
5	QC03LH3								3.69							
5	QC03LH3								3.68							
5	QC03LH3								3.71							
5	QC03LH3								3.70							
	Mean								3.70							
	Stdev								0.01							
	%RSD								0.39%							
	Outlier Test: P or F								Pass							
6	QC03LH3		0.460	6.740	0.0940		2.68	713.0	3.60	1.74	0.203		7.90			24.70
6	QC03LH3		0.348	6.440	0.0720		2.76	692.0	3.65	1.57	0.195		7.95			24.80
6	QC03LH3		0.429	7.190	0.0990		2.80	680.0	3.75	1.49	0.195		8.05			23.40
6	QC03LH3		0.448	7.210	0.1000		2.75	698.0	3.81	1.50	0.197		7.08			23.00
6	QC03LH3		0.449	7.590	0.0738		2.99	722.0	3.54	1.50	0.196		7.68			24.50
	Mean		0.427	7.034	0.0878		2.80	701.0	3.67	1.56	0.197		7.73			24.08
	Stdev		0.045	0.448	0.0138		0.12	16.7	0.11	0.11	0.003		0.39			0.82
	%RSD		10.65%	6.37%	15.69%		4.18%	2.38%	2.99%	0.07	1.70%		5.03%			3.42%
	Outlier Test: P or F		Pass	Pass	Fail		Pass	Pass	Pass	Pass	Pass		Pass			Pass
7	QC03LH3	0.0770	0.500	6.220	0.0652	0.0129	2.55	592.2	3.62	1.30	0.189	1.54	9.86		0.0443	22.85
7	QC03LH3	0.0798	0.511	6.294	0.0649	0.0095	2.63	658.3	3.67	1.31	0.193	1.57	10.21		0.0426	23.36
7	QC03LH3	0.1112	0.453	5.150	0.0800	0.0405	2.25	654.1	2.88	1.07	0.163	1.24	7.89		0.0490	19.72
	Mean	0.0893	0.488	5.888	0.0701	0.0210	2.48	634.9	3.39	1.23	0.182	1.45	9.32		0.0453	21.98
	Stdev	0.0190	0.031	0.640	0.0086	0.0170	0.20	37.0	0.44	0.14	0.016	0.18	1.25		0.0033	1.97
	%RSD	21.26%	6.28%	10.88%	12.32%	81.21%	7.98%	5.83%	13.05%	0.11	8.97%	12.55%	13.41%		7.39%	8.95%
	Outlier Test: P or F	Pass	Fail	Pass	Pass	Fail	Pass	Pass	Pass	Pass	Pass	Pass	Pass		Fail	Pass

Table 2. (continued): Individual results and summary statistics (mg/kg) for replicate aliquots of QC03LH3, including results from outlier testing.

Lab. #	Sample ID	Ag	As	Cd	Co	Cs	Cu	Fe	Hg	Mn	Mo	Rb	Se	Sn	V	Zn
8	QC03LH3	0.0956	0.409	4.406	0.0793		2.71	732.4		1.46	0.219		6.98		0.0374	21.43
8	QC03LH3	0.0965	0.405	4.386	0.0819		2.81	762.5		1.35	0.211		7.19		0.0353	21.92
8	QC03LH3	0.0971	0.383	4.425	0.0783		2.77	763.1		1.43	0.219		7.04		0.0384	21.38
	Mean	0.0964	0.399	4.405	0.0798		2.76	752.7		1.42	0.216		7.07		0.0370	21.58
	Stdev	0.0007	0.014	0.019	0.0018		0.05	17.5		0.06	0.005		0.11		0.0016	0.30
	%RSD	0.77%	3.55%	0.44%	2.31%		1.90%	2.33%		0.04	2.22%		1.51%		4.32%	1.38%
	Outlier Test: P or F	Pass	Pass	Fail	Pass		Pass	Pass		Pass	Pass		Pass		Pass	Pass
9	QC03LH3	0.0842	0.369	5.747	0.0705	0.0077	2.78	680.2	3.18	1.41	0.218	1.61	8.45	0.106	0.0270	21.38
9	QC03LH3	0.0859	0.365	5.935	0.0707	0.0076	2.83	694.3	3.23	1.45	0.217	1.64	8.86	0.107	0.0308	21.47
9	QC03LH3	0.0858	0.380	5.923	0.0684	0.0080	2.76	688.6	3.56	1.41	0.214	1.60	8.80	0.107	0.0284	21.48
	Mean	0.0853	0.371	5.869	0.0699	0.0078	2.79	687.7	3.32	1.43	0.216	1.62	8.70	0.107	0.0287	21.44
	Stdev	0.0010	0.008	0.105	0.0012	0.0002	0.04	7.1	0.21	0.02	0.002	0.02	0.22	0.001	0.0019	0.06
	%RSD	1.14%	2.09%	1.80%	1.76%	2.68%	1.29%	1.03%	6.21%	0.02	0.96%	1.18%	2.54%	0.84%	6.69%	0.26%
	Outlier Test: P or F	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Fail	Pass
10	QC03LH3			5.457			2.71	699.6		1.61						23.52
10	QC03LH3			6.393			2.63	697.9		1.60						22.58
10	QC03LH3			5.573			2.91	795.4		1.73						25.05
	Mean			5.808			2.75	731.0		1.65						23.72
	Stdev			0.510			0.14	55.8		0.07						1.25
	%RSD			8.79%			5.13%	7.63%		0.04						5.26%
	Outlier Test: P or F			Pass			Pass	Pass		Pass						Pass
11	QC03LH3		0.670	6.040			2.57		3.74		0.180		8.46			22.20
11	QC03LH3		0.660	5.960			2.51		3.65		0.170		8.03			21.80
	Mean		0.665	6.000			2.54		3.70		0.175		8.25			22.00
	Stdev		0.007	0.057			0.04		0.06		0.007		0.30			0.28
	%RSD		1.06%	0.94%			1.67%		1.72%		4.04%		3.69%			1.29%
	Outlier Test: P or F		Fail	Pass			Pass		Pass		Pass		Pass			Pass
12	QC03LH3	0.0930	0.410	5.860	<0.1	<0.02	2.91	685.0	3.25	1.41	0.214	1.62	7.88	0.101	<0.1	2.16
12	QC03LH3	0.0970	0.389	6.110	<0.1	<0.02	2.93	703.0	3.31	1.51	0.215	1.70	7.71	0.094	<0.1	2.07
12	QC03LH3	0.0910	0.423	6.120	<0.1	<0.02	2.82	720.0	3.39	1.47	0.228	1.69	7.66	0.102	<0.1	2.20
	Mean	0.0937	0.407	6.030			2.89	702.7	3.32	1.46	0.219	1.67	7.75	0.099		2.14
	Stdev	0.0031	0.017	0.147			0.06	17.5	0.07	0.05	0.008	0.04	0.12	0.004		0.07
	%RSD	3.26%	4.21%	2.44%			2.03%	2.49%	2.12%	0.03	3.57%	2.61%	1.49%	4.40%		3.11%
	Outlier Test: P or F	Pass	Pass	Pass			Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass		Fail

Table 2. (continued): Individual results and summary statistics (mg/kg) for replicate aliquots of QC03LH3, including results from outlier testing.

Lab. #	Sample ID	Ag	As	Cd	Co	Cs	Cu	Fe	Hg	Mn	Mo	Rb	Se	Sn	V	Zn
13	QC03LH3			5.738			2.71	695.6	3.66	1.59						19.93
13	QC03LH3			5.887			2.82	669.5	3.33	1.46						20.76
13	QC03LH3			5.860			2.67	616.7	3.41	1.43						19.97
	Mean			5.828			2.73	660.6	3.47	1.49						20.22
	Stdev			0.079			0.08	40.2	0.17	0.09						0.47
	%RSD			1.36%			2.86%	6.09%	5.04%	0.06						2.31%
	Outlier Test: P or F			Pass			Pass	Pass	Pass	Pass						Pass
14	QC03LH3		0.473	6.327			2.76	753.4	3.72	1.53			7.56			20.98
14	QC03LH3		0.496	6.506			2.74	792.8	3.92	1.61			7.90			22.28
14	QC03LH3		0.447	6.314			2.83	753.7	3.76	1.61			7.19			21.72
	Mean		0.472	6.383			2.78	766.6	3.80	1.58			7.55			21.66
	Stdev		0.025	0.108			0.05	22.6	0.11	0.05			0.35			0.65
	%RSD		5.20%	1.68%			1.63%	2.95%	2.87%	0.03			4.65%			3.01%
	Outlier Test: P or F		Pass	Pass			Pass	Pass	Pass	Pass			Pass			Pass
15	QC03LH3	< 0.3	< 1	6.653	99.2032		3.51	716.6	7.63	1.50	< 0.3	1.80	7.70	0.684	< 0.1	21.69
15	QC03LH3	< 0.3	< 1	6.771	94.2779		4.28	715.6	10.34	1.46	< 0.3	1.92	7.15	2.091	< 0.1	23.87
15	QC03LH3	< 0.3	< 1	6.760	96.4551		3.49	699.5	8.38	1.47	< 0.3	1.88	8.52	0.992	< 0.1	22.18
	Mean			6.728	96.6454		3.76	710.6	8.78	1.47		1.87	7.79	1.256		22.58
	Stdev			0.065	2.4681		0.45	9.6	1.40	0.02		0.06	0.69	0.739		1.14
	%RSD			0.97%	2.55%		12.03%	1.35%	15.93%	0.01		3.14%	8.84%	58.88%		5.06%
	Outlier Test: P or F			Pass	Fail		Fail	Pass	Fail	Pass		Pass	Pass	Fail		Pass
16	QC03LH3	0.0880	0.414	6.244	0.0684		2.60	716.9	3.39	1.41	0.207		8.43	0.119	0.0374	21.43
16	QC03LH3	0.0878	0.408	5.994	0.0664		2.50	701.4	3.36	1.38	0.222		8.23	0.093	0.0371	21.18
16	QC03LH3	0.0867	0.421	6.488	0.0675		2.52	717.4	3.65	1.39	0.228		8.55	0.104	0.0363	21.15
	Mean	0.0875	0.414	6.242	0.0674		2.54	711.9	3.47	1.39	0.219		8.40	0.105	0.0369	21.25
	Stdev	0.0007	0.007	0.247	0.0010		0.05	9.1	0.16	0.01	0.011		0.16	0.013	0.0006	0.16
	%RSD	0.78%	1.64%	3.96%	1.47%		2.02%	1.28%	4.65%	0.01	4.98%		1.93%	12.77%	1.50%	0.73%
	Outlier Test: P or F	Pass	Pass	Pass	Pass		Pass	Pass	Pass	Pass	Pass		Pass	Pass	Pass	Pass
17	QC03LH3	0.0770	0.416	5.310		0.0081	2.69	670.0	2.13	1.53	0.222	1.55	7.21	0.125	0.0410	21.89
17	QC03LH3	0.0770	0.409	5.250		0.0080	2.58	658.9	1.59	1.51	0.213	1.49	6.95	0.112	0.0420	22.12
17	QC03LH3	0.0730	0.403	5.020		0.0074	2.51	682.0	3.56	1.42	0.204	1.47	6.82	0.105	0.0440	21.46
	Mean	0.0757	0.409	5.193		0.0078	2.59	670.3	2.43	1.49	0.213	1.50	6.99	0.114	0.0423	21.82
	Stdev	0.0023	0.007	0.153		0.0004	0.09	11.5	1.02	0.06	0.009	0.04	0.20	0.010	0.0015	0.34
	%RSD	3.05%	1.59%	2.95%		4.83%	3.50%	1.72%	41.95%	0.04	4.23%	2.77%	2.84%	8.90%	3.61%	1.54%
	Outlier Test: P or F	Pass	Pass	Pass		Pass	Pass	Pass	Fail	Pass	Pass	Pass	Pass	Fail	Pass	Pass

Table 2. (continued): Individual results and summary statistics (mg/kg) for replicate aliquots of QC03LH3, including results from outlier testing.

Lab. #	Sample ID	Ag	As	Cd	Co	Cs	Cu	Fe	Hg	Mn	Mo	Rb	Se	Sn	V	Zn
18	QC03LH3	0.0877	0.447	6.096	0.0778	0.0085	2.77	679.7	4.03	1.54	0.227	1.62	8.43	0.128	0.0270	22.62
18	QC03LH3	0.0863	0.423	6.107	0.0775	0.0079	2.60	651.6	3.86	1.44	0.221	1.53	8.04	0.120	0.0195	22.42
18	QC03LH3	0.0910	0.398	6.202	0.0751	0.0078	2.62	650.6	3.99	1.45	0.253	1.48	7.67	0.122	0.0464	22.32
	Mean	0.0883	0.422	6.135	0.0768	0.0081	2.66	660.6	3.96	1.48	0.234	1.55	8.04	0.124	0.0310	22.45
	Stdev	0.0025	0.024	0.058	0.0015	0.0004	0.09	16.5	0.09	0.06	0.017	0.07	0.38	0.004	0.0139	0.16
	%RSD	2.78%	5.78%	0.95%	1.94%	4.83%	3.46%	2.50%	2.22%	0.04	7.32%	4.62%	4.73%	3.34%	44.91%	0.70%
	Outlier Test: P or F	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Fail	Pass	Pass
19	QC03LH3	0.1330		6.210	0.0700		2.81	609.0	3.11	1.52	0.197	1.61			0.0320	22.00
19	QC03LH3	0.1310		6.190	0.0620		3.00	591.0	2.94	1.55	0.197	1.62			0.0390	21.90
19	QC03LH3	0.1520		6.250	0.0630		3.07	588.0	3.01	1.58	0.199	1.61			0.0390	22.00
	Mean	0.1387		6.217	0.0650		2.96	596.0	3.02	1.55	0.198	1.61			0.0367	21.97
	Stdev	0.0116		0.031	0.0044		0.14	11.4	0.09	0.03	0.001	0.01			0.0040	0.06
	%RSD	8.36%		0.49%	6.71%		4.66%	1.91%	2.83%	0.02	0.58%	0.36%			11.02%	0.26%
	Outlier Test: P or F	Fail		Pass	Pass		Pass	Pass	Pass	Pass	Pass	Pass			Pass	Pass
20	QC03LH3	0.0910	0.460	5.220	0.0750	0.0100	2.86	697.3	3.69	1.46	0.213	1.59	6.98	0.103	0.0270	21.54
20	QC03LH3	0.0870	0.401	5.444	0.0740	0.0090	2.65	711.7	3.00	1.42	0.214	1.59	7.01	0.104	0.0280	22.06
20	QC03LH3	0.0770	0.404	5.533	0.0740	0.0080	2.50	689.9	3.00	1.44	0.204	1.55	7.71	0.082	0.0280	20.82
	Mean	0.0850	0.422	5.399	0.0743	0.0090	2.67	699.6	3.23	1.44	0.210	1.57	7.23	0.096	0.0277	21.47
	Stdev	0.0072	0.033	0.161	0.0006	0.0010	0.18	11.1	0.39	0.02	0.006	0.03	0.42	0.012	0.0006	0.62
	%RSD	8.48%	7.88%	2.99%	0.78%	11.11%	6.67%	1.59%	12.21%	0.01	2.62%	1.62%	5.75%	12.90%	2.09%	2.91%
	Outlier Test: P or F	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Fail	Pass
21	QC03LH3	0.0852	0.393	6.652	0.0841		3.11	751.5	3.30	1.66	0.278		8.22	0.100	0.0196	23.36
21	QC03LH3	0.0842	0.430	6.582	0.0762		3.19	755.0	3.50	1.68	0.207		8.22	0.107	0.0160	23.48
21	QC03LH3	0.0873	0.399	6.664	0.0760		3.16	772.9	3.25	1.60	0.201		8.51	0.112	0.0217	23.44
	Mean	0.0856	0.407	6.633	0.0788		3.15	759.8	3.35	1.65	0.229		8.32	0.106	0.0191	23.43
	Stdev	0.0016	0.020	0.044	0.0047		0.04	11.5	0.13	0.04	0.042		0.17	0.006	0.0029	0.06
	%RSD	1.88%	5.01%	0.67%	5.91%		1.31%	1.51%	3.95%	0.02	18.57%		2.02%	5.68%	15.08%	0.26%
	Outlier Test: P or F	Pass	Pass	Pass	Pass		Pass	Pass	Pass	Pass	Pass		Pass	Pass	Fail	Pass
22	QC03LH3	0.8790	0.407	6.040	0.0720	0.0090	2.67	695.0	3.33	1.56	0.205	1.67	7.89	0.101	0.0500	20.30
22	QC03LH3	0.0885	0.395	5.950	0.0727	0.0072	2.74	692.0	3.32	1.51	0.204	1.65	7.68	0.190	0.0370	19.90
22	QC03LH3	0.0822	0.389	5.730	0.0714	0.0069	2.77	669.0	3.13	1.48	0.203	1.60	7.81	0.100	0.0394	19.50
	Mean	0.3499	0.397	5.907	0.0720	0.0077	2.73	685.3	3.26	1.52	0.204	1.64	7.79	0.130	0.0422	19.90
	Stdev	0.4582	0.009	0.159	0.0007	0.0011	0.05	14.2	0.11	0.04	0.001	0.04	0.11	0.052	0.0069	0.40
	%RSD	130.96%	2.31%	2.70%	0.90%	14.66%	1.88%	2.08%	3.46%	0.03	0.49%	2.20%	1.36%	39.65%	16.41%	2.01%
	Outlier Test: P or F	Fail	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Fail	Pass	Pass

Table 2. (continued): Individual results and summary statistics (mg/kg) for replicate aliquots of QC03LH3, including results from outlier testing.

Lab. #	Sample ID	Ag	As	Cd	Co	Cs	Cu	Fe	Hg	Mn	Mo	Rb	Se	Sn	V	Zn
23	QC03LH3			6.059	0.9610		2.60	725.9		1.30						18.93
23	QC03LH3			5.948	1.8724		2.57	631.0		1.27						20.02
23	QC03LH3			6.239	0.9643		2.68	740.6		1.32						19.29
23	QC03LH3			6.178	0.9852		2.64	666.2		1.32						18.49
23	QC03LH3			6.354	1.1619		2.71	753.4		1.33						19.82
23	QC03LH3			6.340	0.9474		2.67	624.3		1.35						19.51
	Mean			6.186	1.1487		2.65	690.2		1.31						19.34
	Stdev			0.160	0.3634		0.05	57.0		0.03						0.57
	%RSD			2.58%	31.64%		1.94%	8.25%		0.02						2.93%
	Outlier Test: P or F			Pass	Fail		Pass	Pass		Pass						Pass
24	QC03LH3	0.0836	0.423	6.561	0.0646	0.0083	2.60	723.3	3.88	1.55	0.209	1.63	8.91	0.090	0.0251	22.03
24	QC03LH3	0.0835	0.418	6.486	0.0638	0.0082	2.68	742.4	3.79	1.57	0.213	1.63	8.79	0.090	0.0245	22.66
24	QC03LH3	0.0824	0.428	6.574	0.0628	0.0082	2.63	702.8	3.75	1.52	0.211	1.65	8.39	0.087	0.0246	22.73
24	QC03LH3	0.0847	0.419	6.719	0.0700	0.0083	2.66	729.6	3.83	1.54	0.256	1.65	8.68	0.091	0.0260	23.74
24	QC03LH3	0.0849	0.422	6.179	0.0594	0.0084	2.74	715.0	3.87	1.57	0.217	1.65	8.55	0.091	0.0245	23.35
24	QC03LH3	0.0838	0.424	6.155	0.0584	0.0084	2.59	746.5	3.81	1.57	0.214	1.65	8.41	0.091	0.0245	24.67
	Mean	0.0838	0.422	6.446	0.0631	0.0083	2.65	726.6	3.82	1.55	0.220	1.65	8.62	0.090	0.0249	23.20
	Stdev	0.0009	0.003	0.229	0.0042	0.0001	0.06	16.5	0.05	0.02	0.018	0.01	0.21	0.002	0.0006	0.93
	%RSD	1.07%	0.80%	3.55%	6.58%	1.36%	2.16%	2.28%	1.33%	0.01	8.05%	0.65%	2.44%	1.88%	2.41%	4.02%
	Outlier Test: P or F	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Fail	Pass
25	QC03LH3	0.0850	0.417	5.750	0.0690	0.0076	2.78	736.0	3.29	1.49	0.199	1.61	8.40	0.079	0.0380	20.40
25	QC03LH3	0.0810	0.425	6.000	0.0730	0.0077	2.70	738.0	3.38	1.44	0.198	1.55	7.69	0.083	0.0360	20.10
25	QC03LH3	0.0810	0.429	5.920	0.0680	0.0081	2.73	726.0	3.39	1.44	0.200	1.62	8.01	0.082	0.0370	20.30
	Mean	0.0823	0.424	5.890	0.0700	0.0078	2.74	733.3	3.35	1.46	0.199	1.59	8.03	0.081	0.0370	20.27
	Stdev	0.0023	0.006	0.128	0.0026	0.0003	0.04	6.4	0.06	0.03	0.001	0.04	0.36	0.002	0.0010	0.15
	%RSD	2.80%	1.44%	2.17%	3.78%	3.39%	1.48%	0.88%	1.64%	0.02	0.50%	2.38%	4.43%	2.56%	2.70%	0.75%
	Outlier Test: P or F	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
26	QC03LH3		0.452	6.430			2.80			1.56			7.92			
26	QC03LH3		0.321	5.710			3.04			1.39			6.54			
26	QC03LH3		0.401	5.850			2.73			1.32			8.12			
	Mean		0.391	5.997			2.86			1.42			7.53			
	Stdev		0.066	0.382			0.16			0.12			0.86			
	%RSD		16.87%	6.37%			5.69%			0.09			11.43%			
	Outlier Test: P or F		Pass	Pass			Pass			Pass			Pass			

Table 2. (continued): Individual results and summary statistics (mg/kg) for replicate aliquots of QC03LH3, including results from outlier testing.

Lab. #	Sample ID	Ag	As	Cd	Co	Cs	Cu	Fe	Hg	Mn	Mo	Rb	Se	Sn	V	Zn
27	QC03LH3	0.1357	0.530	6.806	0.0732	0.0090	2.72	648.8	3.16	1.58	0.197	1.59	12.55	0.086	0.0260	20.85
27	QC03LH3	0.1166	0.527	6.578	0.0718	0.0091	2.66	657.8	3.07	1.51	0.195	1.57	12.40	0.080	0.0263	21.63
27	QC03LH3	0.1071	0.495	6.495	0.0672	0.0086	2.55	655.6	3.11	1.48	0.187	1.52	11.82	0.077	0.0257	21.79
	Mean	0.1198	0.517	6.626	0.0707	0.0089	2.64	654.1	3.11	1.53	0.193	1.56	12.26	0.081	0.0260	21.42
	Stdev	0.0146	0.020	0.161	0.0031	0.0003	0.09	4.7	0.05	0.05	0.006	0.03	0.39	0.005	0.0003	0.50
	%RSD	12.16%	3.78%	2.43%	4.45%	3.05%	3.36%	0.71%	1.47%	0.03	2.89%	2.13%	3.16%	5.74%	1.16%	2.36%
	Outlier Test: P or F	Fail	Fail	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Fail	Pass	Fail	Pass
28	QC03LH3	0.0962	0.577	6.445	0.0770	0.1347	2.87	724.6		2.08	1127.272	2.04	9.00	356.710	0.0577	22.63
28	QC03LH3	0.2973	0.575	6.342	0.0595	0.1387	2.89	712.9		2.10	1112.497	2.04	9.06	356.760	0.0793	22.50
28	QC03LH3	0.0998	0.599	6.324	0.0599	0.1397	2.77	703.4		2.05	1098.647	2.01	8.84	341.345	0.0599	22.02
	Mean	0.1644	0.583	6.371	0.0654	0.1377	2.84	713.6		2.08	1112.805	2.03	8.97	351.605	0.0656	22.38
	Stdev	0.1151	0.013	0.065	0.0100	0.0026	0.06	10.6		0.02	14.315	0.01	0.11	8.886	0.0119	0.32
	%RSD	70.00%	2.24%	1.03%	15.27%	1.92%	2.23%	1.48%		0.01	1.29%	0.73%	1.28%	2.53%	18.11%	1.41%
	Outlier Test: P or F	Fail	Fail	Pass	Pass	Fail	Pass	Pass		Fail	Fail	Fail	Pass	Fail	Fail	Pass
29	QC03LH3	0.0890	0.440	6.086	0.0745	0.0089	2.84	715.0	3.65	1.42	0.213	1.66	8.72	0.095	0.0395	20.89
29	QC03LH3	0.0890	0.418	6.036	0.0753	0.0089	2.94	713.0	3.65	1.41	0.241	1.54	8.98	0.098	0.0381	20.29
29	QC03LH3	0.0870	0.384	5.901	0.0697	0.0083	2.95	713.0	3.50	1.35	0.235	1.49	8.75	0.095	0.0345	19.72
	Mean	0.0883	0.414	6.008	0.0732	0.0087	2.91	713.7	3.60	1.39	0.230	1.56	8.82	0.096	0.0374	20.30
	Stdev	0.0012	0.028	0.096	0.0030	0.0003	0.06	1.2	0.08	0.04	0.015	0.08	0.14	0.002	0.0026	0.59
	%RSD	1.31%	6.81%	1.59%	4.14%	3.98%	2.12%	0.16%	2.35%	0.03	6.42%	5.36%	1.61%	2.05%	6.90%	2.89%
	Outlier Test: P or F	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
30	QC03LH3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Mean															
	Stdev															
	%RSD															
	Outlier Test: P or F															
31	QC03LH3	0.0940	0.490	6.400	0.0760	0.0082	3.02	733.4	3.16	1.57	0.220	1.66	7.56	0.140	0.1500	23.20
31	QC03LH3	0.0910	0.530	6.610	0.0790	0.0080	3.10	754.9	3.80	1.63	0.210	1.65	8.05	10.100	0.1500	23.30
31	QC03LH3	0.0920	0.550	6.700	0.0780	0.0085	3.09	770.9	3.14	1.63	0.220	1.63	8.27	0.120	0.1200	23.60
31	QC03LH3	0.0920	0.530	6.320	0.0740	0.0083	2.94	732.1	2.93	1.55	0.220	1.62	7.59	0.150	0.1200	22.00
31	QC03LH3	0.0900	0.520	6.530	0.0780	0.0076	3.02	754.1	2.74	1.61	0.220	1.65	7.93	0.120	0.1100	23.20
	Mean	0.0918	0.524	6.512	0.0770	0.0081	3.03	749.1	3.15	1.60	0.218	1.64	7.88	2.126	0.1300	23.06
	Stdev	0.0015	0.022	0.154	0.0020	0.0003	0.06	16.4	0.40	0.04	0.004	0.02	0.30	4.458	0.0187	0.61
	%RSD	1.62%	4.18%	2.36%	2.60%	4.21%	2.13%	2.18%	12.67%	0.02	2.05%	1.00%	3.86%	209.67%	14.39%	2.67%
	Outlier Test: P or F	Pass	Fail	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Fail	Fail	Pass

Table 2. (continued): Individual results and summary statistics (mg/kg) for replicate aliquots of QC03LH3, including results from outlier testing.

Lab. #	Sample ID	Ag	As	Cd	Co	Cs	Cu	Fe	Hg	Mn	Mo	Rb	Se	Sn	V	Zn
32	QC03LH3	0.0769	0.507	5.380	0.0660	0.0080		614.0	8.80	1.29	0.196	1.59	6.57	0.090	0.0399	19.72
	Mean	0.0769	0.507	5.380	0.0660	0.0080		614.0	8.80	1.29	0.196	1.59	6.57	0.090	0.0399	19.72
	Stdev															
	%RSD															
	Outlier Test: P or F	Pass	Fail	Pass	Pass	Pass		Pass	Fail	Pass	Pass	Pass	Pass	Pass	Pass	Pass
33	QC03LH3	0.0769	0.425	6.577	0.0592		2.09	666.5		1.28	0.257		8.19	0.806		29.11
33	QC03LH3	0.0805	0.440	6.337	0.0764		2.52	675.5		1.33	0.302		9.19	0.704		22.88
33	QC03LH3	0.0683	0.426	6.139	0.0606		2.58	657.0		1.20	0.275		8.72	0.342		20.65
	Mean	0.0752	0.430	6.351	0.0654		2.40	666.3		1.27	0.278		8.70	0.617		24.21
	Stdev	0.0063	0.008	0.219	0.0095		0.27	9.3		0.07	0.023		0.50	0.244		4.38
	%RSD	8.34%	1.91%	3.45%	14.60%		11.14%	1.39%		0.05	8.14%		5.78%	39.48%		18.10%
	Outlier Test: P or F	Pass	Pass	Pass	Pass		Pass	Pass		Pass	Fail		Pass	Fail		Pass

APPENDIX C

Reported Raw Data for QC04LH4

Table 3. Reported raw data (mg/kg) for the unknown sample, QC04LH4.

Lab. #	Sample ID	Ag	As	Cd	Co	Cs	Cu	Fe	Hg	Mn	Mo	Rb	Se	Sn	V	Zn
1	QC04LH4	0.4380	0.264	0.209	0.0093	0.0280	4.83	331.0	3.52	2.92	0.381	1.18	3.24	0.064	0.0356	30.40
1	QC04LH4	0.4540	0.267	0.207	0.0109	0.0277	4.86	330.0	3.45	2.95	0.385	1.22	3.15	0.064	0.0373	30.10
1	QC04LH4	0.4400	0.276	0.210	0.0103	0.0276	4.82	334.0	3.53	2.97	0.388	1.18	3.20	0.066	0.0455	28.90
1	QC04LH4	0.4350	0.275	0.209	0.0099	0.0274	4.82	333.0	3.53	2.92	0.385	1.15	3.29	0.065	0.0436	29.00
1	QC04LH4	0.4390	0.277	0.209	0.0099	0.0276	4.84	331.0	3.63	2.97	0.393	1.16	3.39	0.067	0.0450	28.80
2	QC04LH4	0.4210	0.241	0.223	0.0088		5.34	359.0	3.80	3.09	0.408		3.33	0.056		31.90
2	QC04LH4	0.4350	0.343	0.223	0.0085		5.28	358.0	3.65	3.03	0.434		3.32	0.054		31.10
2	QC04LH4	0.4290	0.322	0.218	0.0100		5.03	344.0	3.77	2.93	0.414		3.09	0.051		30.10
2	QC04LH4	0.1300	0.135	0.220	0.0081		5.14	355.0	3.80	3.03	0.395		3.15	0.052		31.10
2	QC04LH4	0.4240	0.163	0.221	0.0092		5.33	356.0	3.79	3.06	0.425		3.32	0.051		31.10
3	QC04LH4	0.5410	0.268	0.250	0.0098	0.0339	4.68	314.0		2.82	0.473	1.35	3.65	0.074	0.0406	29.80
3	QC04LH4	0.5580	0.302	0.252	0.0111	0.0339	5.30	377.0		3.39	0.463	1.37	4.25	0.077	0.0400	34.50
3	QC04LH4	0.5400	0.265	0.250	0.0098	0.0342	4.86	292.0		2.62	0.425	1.20	3.41	0.074	0.0393	28.80
3	QC04LH4	0.5630	0.271	0.250	0.0108	0.0342	5.42	336.0		3.06	0.469	1.12	4.11	0.075	0.0423	32.10
3	QC04LH4	0.5300	0.320	0.248	0.0117	0.0348	5.93	376.0		3.32	0.424	1.25	4.00	0.071	0.0429	35.00
3	QC04LH4		0.330				5.35	341.0		2.90		1.19	3.27			31.70
3	QC04LH4		0.374				5.42	338.0		2.86		1.24	3.08			29.20
3	QC04LH4		0.373				5.16	336.0		2.92		1.18	3.32			30.80
3	QC04LH4		0.347				5.41	347.0		2.80		1.21	3.32			30.30
3	QC04LH4		0.342				5.10	337.0		2.80		1.23	3.19			30.90
4	QC04LH4			0.240			5.89	360.0		3.19						31.82
4	QC04LH4			0.240			5.73	362.3		3.17						32.45
4	QC04LH4			0.250			5.64	359.5		3.16						31.77
4	QC04LH4			0.240			5.67	364.2		3.21						31.09
4	QC04LH4			0.240			5.50	356.1		3.14						31.15
4	QC04LH4						4.82		2.96			1.73	3.47			29.01
4	QC04LH4						5.18		3.33			1.57	2.88			29.09
4	QC04LH4						5.48		3.13			1.57	3.15			29.32
4	QC04LH4						5.12		3.29			1.56	3.47			28.18
4	QC04LH4						6.00		3.23			1.47	3.62			29.08
5	QC04LH4								4.08							
5	QC04LH4								4.06							
5	QC04LH4								4.02							
5	QC04LH4								4.16							
5	QC04LH4								3.95							
5	QC04LH4								3.99							
6	QC04LH4		0.302	0.223	0.0500		5.30	353.0	3.62	3.23	0.363		2.70			33.40
6	QC04LH4		0.219	0.223	0.0360		5.16	355.0	3.65	3.29	0.366		2.63			33.30
6	QC04LH4		0.274	0.244	0.0350		4.95	346.0	3.42	2.99	0.347		2.47			32.60
6	QC04LH4		0.298	0.249	0.0470		5.08	343.0	3.77	2.91	0.354		2.50			33.00
6	QC04LH4		0.294	0.259	0.0350		5.10	347.0	3.56	2.98	0.353		2.62			33.00

Table 3. (continued): Reported raw data (mg/kg) for the unknown sample, QC04LH4.

Lab. #	Sample ID	Ag	As	Cd	Co	Cs	Cu	Fe	Hg	Mn	Mo	Rb	Se	Sn	V	Zn
7	QC04LH4	0.4222	0.364	0.221	0.0108	0.0267	5.13	321.0	3.83	2.64	0.364	1.11	3.98		0.0558	34.37
7	QC04LH4	0.4175	0.341	0.223	0.0108	0.0281	4.85	332.5	3.87	2.70	0.366	1.11	4.05		0.0501	33.65
7	QC04LH4	0.4248	0.334	0.224	0.0101	0.0294	4.85	327.7	3.88	2.65	0.361	1.10	3.97		0.0475	34.50
7	QC04LH4	0.4124	0.357	0.220	0.0101	0.0266	4.89	357.7	3.87	2.65	0.362	1.10	4.39		0.0589	34.72
7	QC04LH4	0.4235	0.340	0.240	0.0098	0.0264	4.88	364.4	3.85	2.66	0.360	1.10	4.10		0.0520	34.21
8	QC04LH4	0.5574	0.215	0.147	0.0116		5.25	391.1		3.25	0.390		3.04		0.0468	31.73
8	QC04LH4	0.5663	0.216	0.147	0.0119		5.23	396.6		3.17	0.399		3.31		0.0457	32.04
8	QC04LH4	0.5590	0.217	0.146	0.0114		5.28	394.4		3.18	0.395		3.36		0.0461	31.92
8	QC04LH4	0.5561	0.217	0.157	0.0114		5.21	396.8		3.29	0.385		3.22		0.0454	32.05
8	QC04LH4	0.5698	0.216	0.146	0.0117		5.11	388.2		3.17	0.400		2.99		0.0447	31.11
9	QC04LH4	0.4893		0.209	0.0103	0.0279	5.38	355.2	3.50	3.11	0.422	1.16	3.79	0.062	0.0417	30.87
9	QC04LH4	0.4734	0.254	0.205	0.0103	0.0276	5.28	347.4	3.42	3.00	0.402	1.18	3.75	0.062	0.0416	30.19
9	QC04LH4	0.4859	0.231	0.211	0.1000	0.0278	5.31	359.1	3.41	3.07	0.412	1.20	3.77	0.074	0.0451	30.74
9	QC04LH4	0.4875	0.247	0.206	0.0110	0.0285	5.40	354.4	3.51	3.08	0.415	1.18	3.54	0.063	0.0473	30.86
9	QC04LH4	0.4853	0.236	0.201	0.0108	0.0276	5.41	343.6	3.46	3.12	0.416	1.18	3.63	0.064	0.0472	30.13
10	QC04LH4			0.228			5.24	348.2		3.10						32.33
10	QC04LH4			0.222			5.50	365.2		3.28						33.78
10	QC04LH4			0.226			5.35	366.2		3.22						33.65
10	QC04LH4			0.221			5.69	377.6		3.41						34.34
10	QC04LH4			0.224			5.34	363.1		3.22						33.87
11	QC04LH4		0.690	6.060			2.80		3.72		0.170		8.40			21.80
11	QC04LH4		0.680	6.130			2.51		3.68		0.170		8.21			21.80
12	QC04LH4	0.4210	0.241	0.199	<0.1	0.0310	5.38	366.0	3.15	3.15	0.357	1.24	3.31	0.056	<0.1	2.73
12	QC04LH4	0.4090	0.246	0.194	<0.1	0.0320	5.56	378.0	3.26	3.21	0.361	1.22	3.26	0.059	<0.1	2.72
12	QC04LH4	0.4110	0.221	0.213	<0.1	0.0310	5.42	381.0	3.31	3.31	0.343	1.25	3.19	0.062	<0.1	2.69
12	QC04LH4	0.4220	0.216	0.198	<0.1	0.0300	5.46	364.0	3.33	3.19	0.355	1.21	3.35	0.061	<0.1	2.69
12	QC04LH4	0.4030	0.221	0.204	<0.1	0.0320	5.52	373.0	3.29	3.25	0.363	1.27	3.34	0.054	<0.1	2.68
13	QC04LH4			0.206			5.18	327.9	3.17	2.75						30.01
13	QC04LH4			0.211			4.84	305.9	3.15	2.69						27.15
13	QC04LH4			0.204			4.91	297.3	3.40	2.40						27.74
13	QC04LH4			0.196			4.81	287.9	3.50	2.65						27.08
13	QC04LH4			0.185			4.79	343.1	2.72	3.38						30.96
14	QC04LH4		0.289	0.206			4.67	373.9	3.76	3.14			2.85			29.01
14	QC04LH4		0.285	0.210			4.91	381.0	3.83	3.38			2.89			28.68
14	QC04LH4		0.268	0.205			4.63	376.9	3.70	3.14			2.82			28.75
14	QC04LH4		0.295	0.217			4.96	371.8	3.76	3.21			2.71			31.93
14	QC04LH4		0.286	0.204			4.99	377.9	3.89	3.29			2.86			28.97
15	QC04LH4	< 0.3	< 1	0.282	45.7159		6.15	387.0	5.04	2.99	< 0.2	1.29	2.09	0.821	< 0.05	30.95
15	QC04LH4	< 0.3	< 1	0.285	47.4582		5.69	420.7	4.43	2.95	< 0.2	1.36	2.03	0.758	< 0.05	31.32
15	QC04LH4	< 0.3	< 1	0.294	44.9610		5.27	369.0	4.93	2.95	< 0.2	1.34	1.95	0.460	< 0.05	30.80
15	QC04LH4	< 0.3	< 1	0.287	47.7041		5.47	364.7	5.65	3.36	< 0.2	1.35	1.98	0.862	0.0574	30.90
15	QC04LH4	< 0.3	< 1	0.283	46.5521		5.29	369.0	5.37	3.12	< 0.2	1.38	2.34	0.503	0.0564	30.26

Table 3. (continued): Reported raw data (mg/kg) for the unknown sample, QC04LH4.

Lab. #	Sample ID	Ag	As	Cd	Co	Cs	Cu	Fe	Hg	Mn	Mo	Rb	Se	Sn	V	Zn
16	QC04LH4	0.4736	0.268	0.249	0.0101		4.70	358.5	3.73	2.92	0.380		3.39	0.066	0.0424	30.51
16	QC04LH4	0.4734	0.273	0.244	0.0096		4.48	345.9	3.67	2.78	0.354		3.24	0.064	0.0414	29.15
16	QC04LH4	0.4777	0.256	0.235	0.0095		4.44	339.1	3.90	2.74	0.348		3.12	0.064	0.0410	30.10
16	QC04LH4	0.4678	0.241	0.229	0.0087		4.21	319.1	3.76	2.58	0.332		2.93	0.062	0.0383	26.61
16	QC04LH4	0.4986	0.276	0.246	0.0098		4.67	356.5	3.87	2.87	0.368		3.45	0.066	0.0416	25.24
17	QC04LH4	0.4020	0.318	0.197		0.0028	4.24	332.0	2.18	2.94	0.396	1.17	5.25	0.156	0.0530	29.96
17	QC04LH4	0.4090	0.313	0.199		0.0028	4.45	346.0	1.98	3.04	0.400	1.17	5.68	0.169	0.0570	30.21
17	QC04LH4	0.4130	0.336	0.202		0.0029	4.46	333.0	4.12	3.07	0.415	1.19	5.98	0.189	0.0590	31.00
17	QC04LH4	0.4180	0.345	0.193		0.0030	4.67	346.0	2.98	3.08	0.420	1.22	5.87	0.099	0.0600	33.20
17	QC04LH4	0.4130	0.337	0.203		0.0029	4.59	333.0	3.33	3.05	0.416	1.19	5.81	0.091	0.0610	31.70
18	QC04LH4	2.7623	1.273	0.962	0.0445	0.1238	28.73	1328.7	24.66	14.29	3.420	4.22	15.94	0.454	0.6995	164.37
18	QC04LH4	2.4508	1.487	0.858	0.0372	0.1118	27.05	1258.1	22.63	13.06	2.664	4.00	14.86	0.391	0.6237	149.47
18	QC04LH4	2.7549	1.283	0.996	0.0477	0.1280	29.18	1316.9	24.36	13.81	2.455	4.47	16.35	0.425	0.4715	169.84
18	QC04LH4	2.5690	1.233	0.935	0.0390	0.1087	28.19	1303.7	24.36	13.89	2.680	4.44	15.30	0.534	0.5644	165.21
18	QC04LH4	2.8467	1.425	0.867	0.0345	0.1060	26.55	1234.5	26.17	12.70	2.088	4.44	14.25	0.459	0.5032	150.26
19	QC04LH4	1.4800		0.212	<0,010		5.58	308.0	3.19	3.32	0.362	1.14			0.0550	31.00
19	QC04LH4	1.5000		0.214	<0,010		5.55	305.0	3.26	3.41	0.373	1.16			0.0540	33.50
19	QC04LH4	1.5300		0.213	<0,010		5.32	320.0	3.32	3.41	0.381	1.17			0.0530	31.90
19	QC04LH4	1.5000		0.214	<0,010		5.40	316.0	3.37	3.34	0.371	1.16			0.0470	31.50
19	QC04LH4	1.4800		0.213	<0,010		5.43	312.0	3.20	3.42	0.368	1.16			0.0390	31.50
20	QC04LH4	0.4750	0.297	0.193	0.0110	0.0270	5.32	381.0	3.20	3.04	0.371	1.04	3.27	0.013	0.0350	28.84
20	QC04LH4	0.4630	0.279	0.181	0.0110	0.0270	5.81	361.8	2.94	3.14	0.394	1.20	2.85	0.037	0.0370	30.14
20	QC04LH4	0.4310	0.358	0.198	0.0120	0.0280	5.89	358.1	3.21	3.23	0.410	1.12	3.07	0.076	0.0390	30.91
20	QC04LH4	0.4410	0.273	0.189	0.0130	0.0270	5.81	373.2	3.10	3.13	0.393	1.16	2.65	0.050	0.0370	29.41
20	QC04LH4	0.4810	0.304	0.220	0.0120	0.0300	5.80	365.5	3.36	3.37	0.400	1.23	3.04	0.068	0.0410	31.30
21	QC04LH4	0.4461	0.271	0.227	0.0116		5.52	393.8	3.87	3.25	0.368		3.32	0.065	0.0480	33.50
21	QC04LH4	0.4958	0.255	0.237	0.0083		6.22	392.7	3.86	3.43	0.401		3.27	0.056	0.0502	34.74
21	QC04LH4	0.4913	0.269	0.221	0.0101		5.78	405.3	3.84	3.31	0.386		3.35	0.068	0.0726	33.91
21	QC04LH4	0.5029	0.261	0.225	0.0112		5.87	411.5	3.85	3.40	0.390		3.05	0.070	0.0833	33.70
21	QC04LH4	0.4925	0.284	0.226	0.0106		5.82	407.1	3.86	3.36	0.397		3.26	0.061	0.0705	34.07
22	QC04LH4	0.4690	0.259	0.204	0.0108	0.0287	5.28	366.0	3.41	3.27	0.393	1.21	3.56	0.064	0.0391	29.60
22	QC04LH4	0.4550	0.275	0.196	0.0122	0.0313	5.13	352.0	3.40	3.16	0.405	1.18	3.05	0.061	0.0334	28.90
22	QC04LH4	0.4690	0.274	0.202	0.0126	0.0295	5.29	363.0	3.50	3.26	0.449	1.21	3.15	0.057	0.0344	29.80
22	QC04LH4	0.4400	0.275	0.233	0.0135	0.0264	5.26	376.0	3.71	3.40	0.405	1.25	3.27	0.067	0.0331	29.80
22	QC04LH4	0.4390	0.260	0.217	0.0113	0.0290	5.42	370.0	3.52	3.36	0.394	1.20	3.33	0.057	0.0414	29.90
23	QC04LH4			0.224	0.5261		5.09	372.1		2.95						29.99
23	QC04LH4			0.022	0.5819		4.93	365.3		2.86						28.97
23	QC04LH4			0.220	0.4658		5.18	372.7		3.01						30.39
23	QC04LH4			0.219	0.5526		4.86	243.5		2.84						28.87
23	QC04LH4			0.236	0.6348		5.29	388.3		3.07						31.12
23	QC04LH4			0.224	0.5684		4.98	370.4		2.95						29.87
23	QC04LH4			0.226	0.5001		4.99	370.4		2.94						30.29
23	QC04LH4			0.203	0.4204		4.78	341.6		2.82						28.29

Table 3. (continued): Reported raw data (mg/kg) for the unknown sample, QC04LH4.

Lab. #	Sample ID	Ag	As	Cd	Co	Cs	Cu	Fe	Hg	Mn	Mo	Rb	Se	Sn	V	Zn
24	QC04LH4	0.4403	0.278	0.208	0.0072	0.0270	5.47	335.1	3.78	3.40	0.392	1.11	3.26	0.061	0.0313	31.38
24	QC04LH4	0.4367	0.289	0.198	0.0065	0.0304	5.02	356.1	3.45	4.00	0.386	1.22	3.05	0.059	0.0313	31.08
24	QC04LH4	0.4408	0.266	0.196	0.0068	0.0241	5.11	309.4	4.28	3.47	0.402	1.08	3.15	0.060	0.0317	30.62
24	QC04LH4	0.4446	0.313	0.192	0.0063	0.0293	5.10	332.5	3.79	3.35	0.402	1.17	3.04	0.060	0.0321	31.41
24	QC04LH4	0.4352	0.358	0.183	0.0057	0.0330	4.69	342.4	3.67	3.57	0.388	1.31	3.12	0.061	0.0305	31.38
24	QC04LH4	0.4424	0.295	0.189	0.0064	0.0287	5.23	333.1	3.84	3.31	0.403	1.20	3.31	0.062	0.0307	32.58
25	QC04LH4	0.4720	0.358	0.206	0.0109	0.0260	5.03	387.0	3.79	3.15	0.364	1.10	3.22	0.053	0.0450	27.70
25	QC04LH4	0.4720	0.300	0.218	0.0118	0.0290	4.80	382.0	3.85	3.14	0.394	1.15	3.42	0.049	0.0370	29.23
25	QC04LH4	0.4600	0.341	0.221	0.0107	0.0280	4.80	375.0	3.77	2.99	0.371	1.20	3.24	0.050	0.0430	30.60
25	QC04LH4	0.4810	0.352	0.224	0.0110	0.0220	5.02	381.0	3.82	3.01	0.369	0.90	3.34	0.051	0.0390	28.30
25	QC04LH4	0.4840	0.291	0.222	0.0117	0.0230	5.10	384.0	3.89	3.07	0.402	1.19	3.41	0.055	0.0480	27.70
26	QC04LH4		0.134	0.305			11.00			3.31			3.88			
26	QC04LH4		0.167	0.381			10.30			2.91			4.68			
26	QC04LH4		0.126	0.290			9.56			2.46			4.12			
26	QC04LH4		0.184	0.303			11.80			3.24			4.58			
26	QC04LH4		0.202	0.401			8.88			3.15			3.65			
27	QC04LH4	0.4629	0.299	0.202	0.0126	0.0936	4.67	337.8	3.11	2.99	0.348	1.07	4.06	0.033	0.0327	31.15
27	QC04LH4	0.4918	0.315	0.210	0.0128	0.0549	4.91	341.3	3.55	3.13	0.371	1.13	4.36	0.034	0.0366	31.69
27	QC04LH4	0.4930	0.312	0.212	0.0121	0.0510	4.93	341.7	3.60	3.12	0.365	1.12	4.30	0.040	0.0351	31.41
27	QC04LH4	0.4796	0.303	0.219	0.0135	0.0546	4.91	341.3	3.54	3.09	0.364	1.13	4.13	0.035	0.0305	31.41
27	QC04LH4	0.4689	0.305	0.218	0.0129	0.0519	4.74	340.0	3.80	3.03	0.358	1.11	4.17	0.030	0.0303	31.29
28	QC04LH4	0.5101	0.432	0.432	0.0196	0.1570	5.32	368.3		3.61	2131.026	1.69	3.75	220.078	0.0589	31.96
28	QC04LH4	0.4817	0.421	0.442	0.0000	0.1606	5.20	355.0		3.51	2071.284	1.65	3.47	221.513	0.0602	31.07
28	QC04LH4	0.4728	0.433	0.433	0.0000	0.1576	5.46	365.1		3.59	2138.100	1.65	3.45	233.347	0.0591	32.23
28	QC04LH4	0.4622	0.411	0.394	0.0000	0.1370	5.39	359.6		3.44	2063.405	1.56	3.56	216.311	0.0685	31.55
28	QC04LH4	0.4584	0.420	0.420	0.0000	0.1528	5.35	360.4		3.53	2070.746	1.60	3.42	211.246	0.0764	31.53
29	QC04LH4	0.4870	0.285	0.223	0.0129	0.0299	5.81	361.0	3.48	3.53	0.408	1.28	3.05	0.065	0.0505	37.29
29	QC04LH4	0.4890	0.288	0.226	0.0130	0.0299	5.63	361.0	3.93	3.39	0.411	1.22	3.17	0.066	0.0489	31.70
29	QC04LH4	0.4870	0.286	0.226	0.0112	0.0300	5.73	370.0	3.51	3.36	0.404	1.21	3.15	0.066	0.0480	32.03
29	QC04LH4	0.4930	0.290	0.231	0.0122	0.0295	5.87	365.0	3.56	3.30	0.415	1.20	3.16	0.067	0.0491	32.06
29	QC04LH4	0.4840	0.293	0.221	0.0118	0.0288	5.68	369.0	3.05	3.39	0.391	1.20	3.14	0.067	0.0515	32.03
30	QC04LH4		0.310	0.220	0.0130	0.0220	4.80		3.67	1.80	0.350	1.16	4.04			30.15
31	QC04LH4	0.4890	0.320	0.240		0.0277	5.70	384.0	4.49	3.36	0.400	1.21	3.09	1.320	0.0890	33.10
31	QC04LH4	0.5070	0.340	0.240		0.0300	5.87	397.3	4.35	3.48	0.410	1.23	3.19	3.410	0.0940	33.60
31	QC04LH4	0.4810	0.330	0.260		0.0284	5.65	386.4	3.67	3.37	0.380	1.19	3.11	0.073	0.0940	32.50
31	QC04LH4	0.4770	0.330	0.210		0.0281	5.59	382.0	3.69	3.34	0.390	1.18	3.07	0.069	0.0910	32.40
31	QC04LH4	0.4660	0.330	0.220		0.0269	5.48	378.4	3.97	3.30	0.380	1.15	3.05	0.071	0.0870	31.90
32	QC04LH4	0.3980	0.372	0.186	0.0092	0.0248		325.0	14.38	2.61	0.343	1.09	2.62	0.053	0.0880	27.46
33	QC04LH4	0.4693	0.291	0.329	0.0912		18.57	337.5		4.42	0.568		4.02	1.741		30.27
33	QC04LH4	1.5309	0.284	0.233	0.0429		5.20	342.6		4.34	0.525		3.73	0.681		31.28
33	QC04LH4	0.6762	0.274	0.196	0.0233		8.03	334.3		4.14	0.430		3.44	0.477		30.25
33	QC04LH4	0.4643	0.277	0.245			4.88	338.6		3.07	0.464		3.86	0.181		31.50
33	QC04LH4	0.4721	0.276	0.202			4.85	334.5		3.00	0.442		3.66	0.181		31.95

APPENDIX D

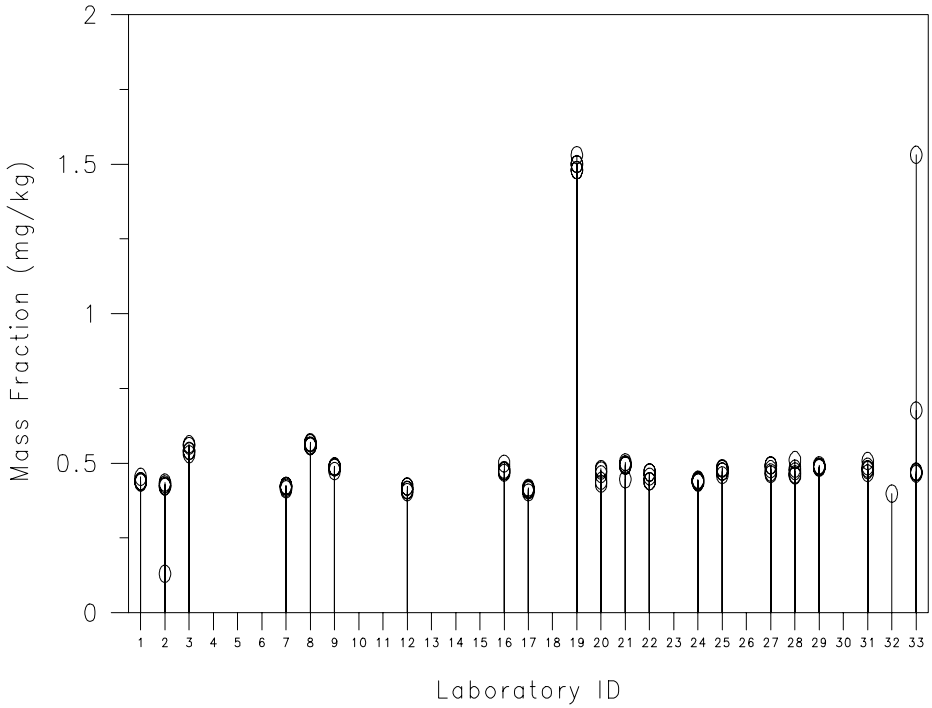
Tabular and Graphical Outputs of Performance and Consensus

Table 4. Laboratory and consensus data for Ag in QC04LH4.

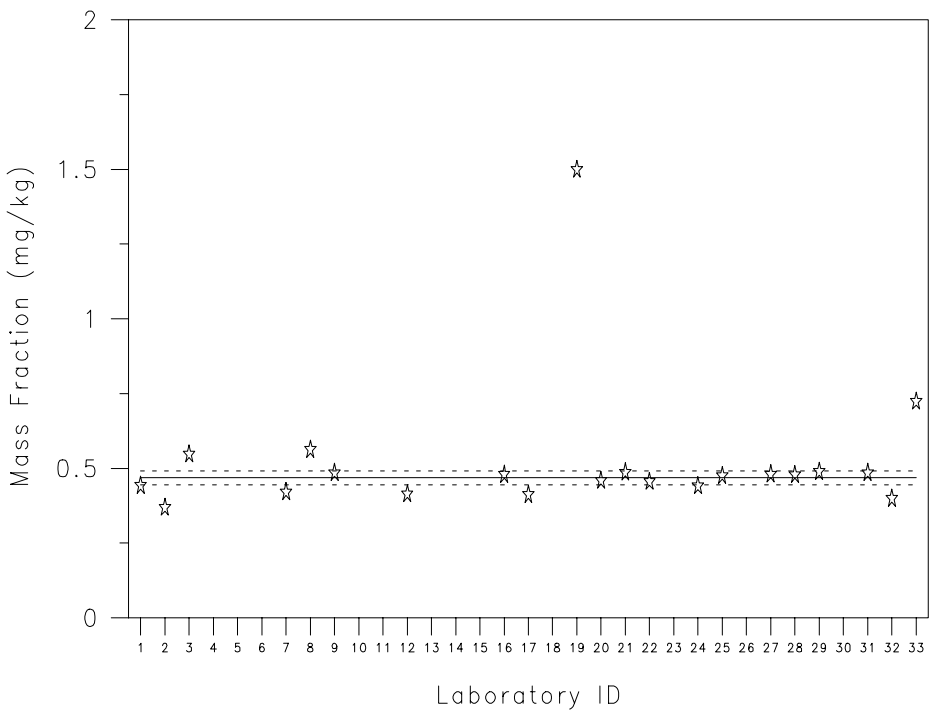
Element	Consensus Mean	Lower 95% C.L.	Upper 95% C.L.	Units
Ag	0.468	0.445	0.491	mg/kg

Lab. #	N	Laboratory Mean	Variance	Standard Deviation	Variance of mean	ML Weight	Tau Estimate	z-score	p-score
1	5	0.441	5.47E-05	0.007	1.09E-05	0.994	1.09E-05	-0.57	0.17
2	5	0.368	1.77E-02	0.133	3.54E-03	0.323	4.01E-03	-2.14	3.62
3	5	0.546	1.87E-04	0.014	3.75E-05	0.981	3.79E-05	1.68	0.25
7	5	0.420	2.60E-05	0.005	5.21E-06	0.997	5.21E-06	-1.02	0.12
8	5	0.562	3.60E-05	0.006	7.20E-06	0.996	7.22E-06	2.00	0.11
9	5	0.484	3.94E-05	0.006	7.88E-06	0.996	7.87E-06	0.35	0.13
12	5	0.413	6.62E-05	0.008	1.32E-05	0.993	1.33E-05	-1.17	0.20
16	5	0.478	1.42E-04	0.012	2.84E-05	0.985	2.83E-05	0.22	0.25
17	5	0.411	3.55E-05	0.006	7.10E-06	0.996	7.10E-06	-1.22	0.14
20	5	0.458	4.65E-04	0.022	9.30E-05	0.954	9.20E-05	-0.21	0.47
21	5	0.486	5.11E-04	0.023	1.02E-04	0.950	1.01E-04	0.38	0.47
24	6	0.440	1.23E-05	0.004	2.05E-06	0.999	2.05E-06	-0.60	0.08
25	5	0.474	8.82E-05	0.009	1.76E-05	0.991	1.76E-05	0.12	0.20
29	5	0.488	1.10E-05	0.003	2.20E-06	0.999	2.20E-06	0.43	0.07
31	5	0.484	2.34E-04	0.015	4.68E-05	0.976	4.66E-05	0.34	0.32
Outliers									
19	5	1.498	4.20E-04	0.020	8.40E-05	-	-	22.01	0.14
22	5	0.454	2.18E-04	0.015	4.36E-05	-	-	-0.29	0.32
27	5	0.479	0.00017987	0.013411445	3.5973E-05	-	-	0.24	0.28
28	5	0.477	0.00042507	0.020617243	8.5014E-05	-	-	0.19	0.43
32	1	0.398	-	-	-	-	-	-1.49	-
33	5	0.723	0.21229281	0.460752437	0.04245856	-	-	5.44	6.38

Raw data plot for Ag in QC04LH4



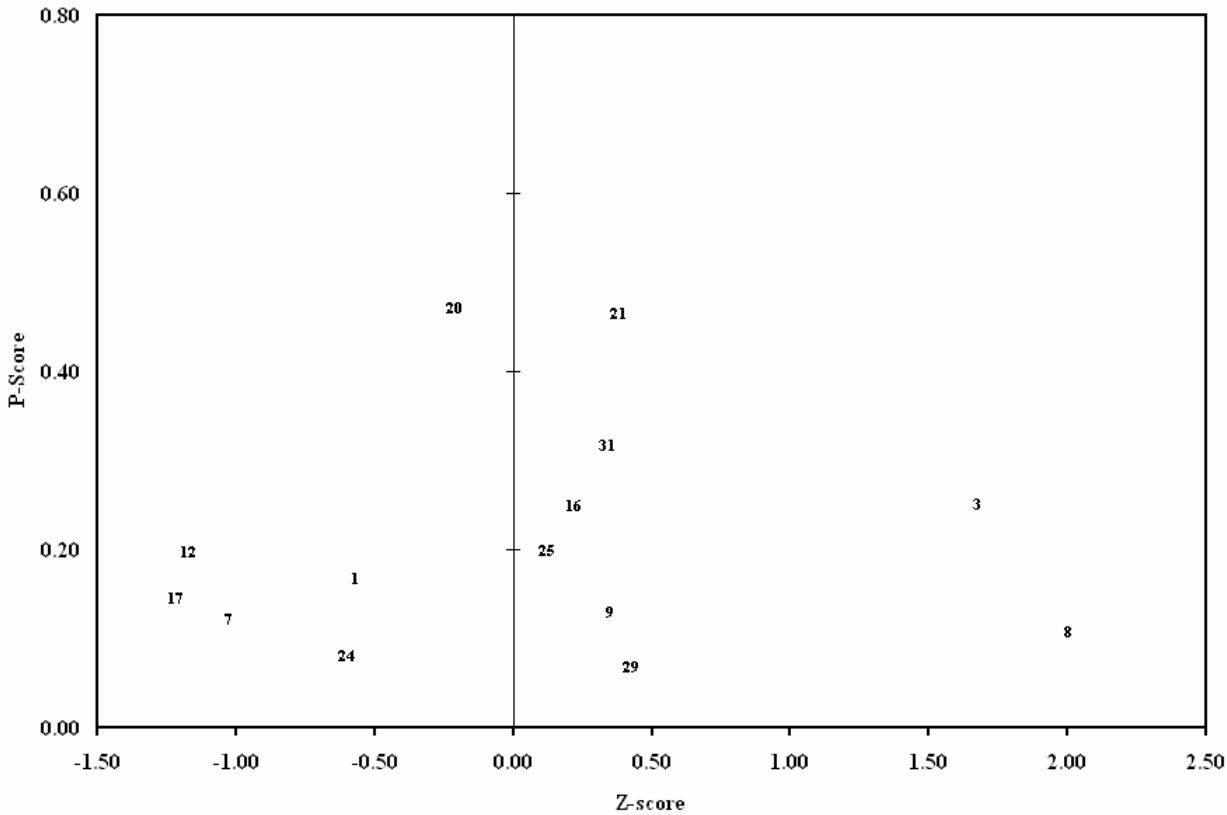
Consensus mean plot for Ag in QC04LH4



○ Replicates ——— Consensus Mean

☆ Laboratory Mean - - - - - Consensus Mean 95% C.L.

Laboratory performance data plotted in z- and p-score space for Ag in QC04LH4



Youden diagram for Ag (mg/kg) measured in QC03LH3 and QC04LH4 samples

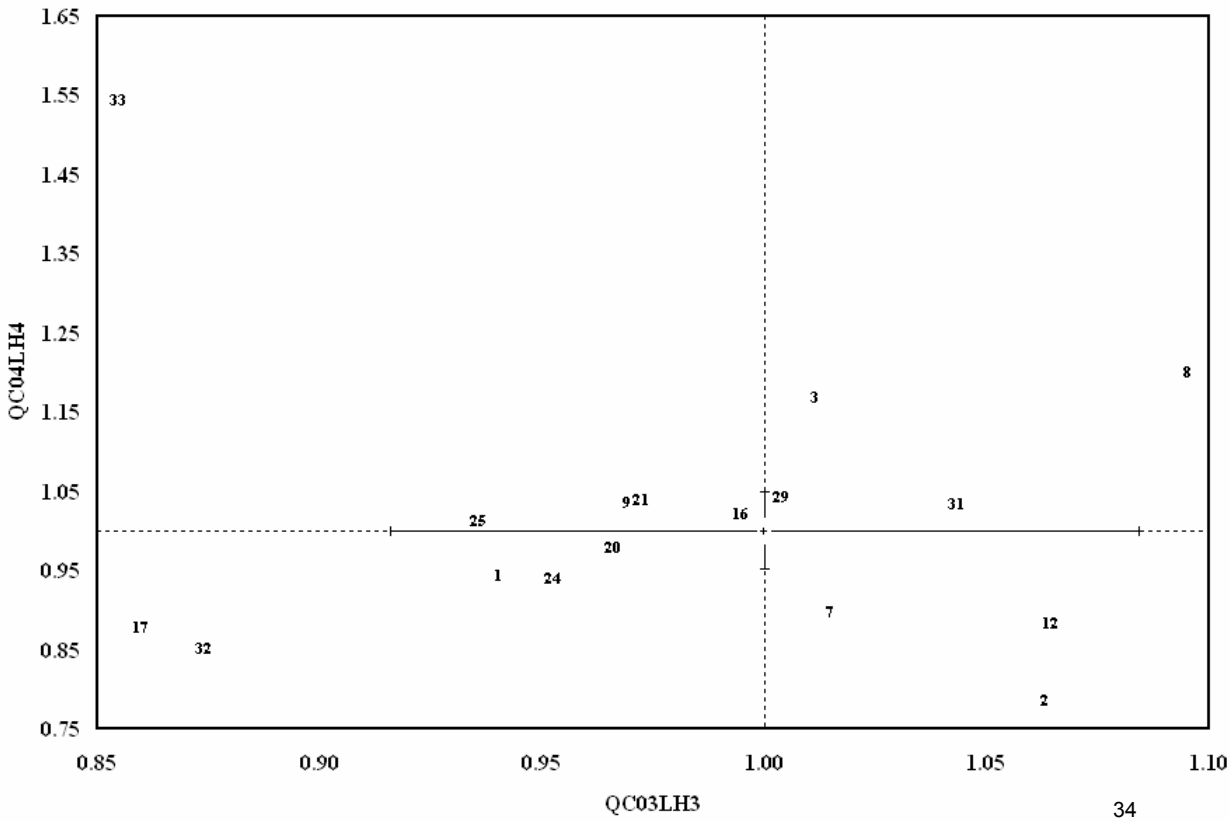
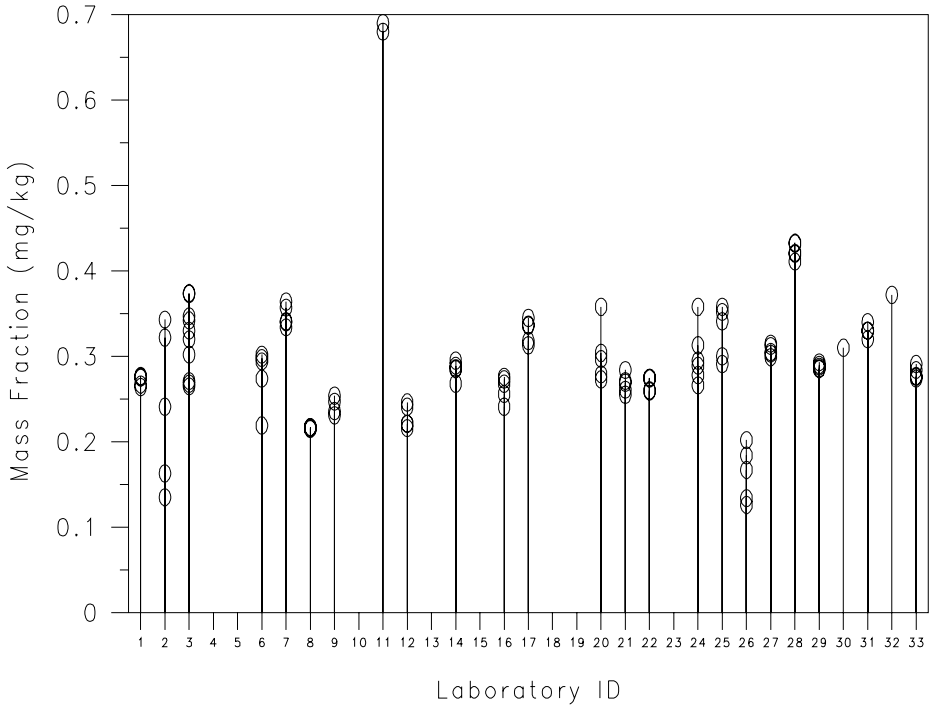


Table 5. Laboratory and consensus data for As in QC04LH4.

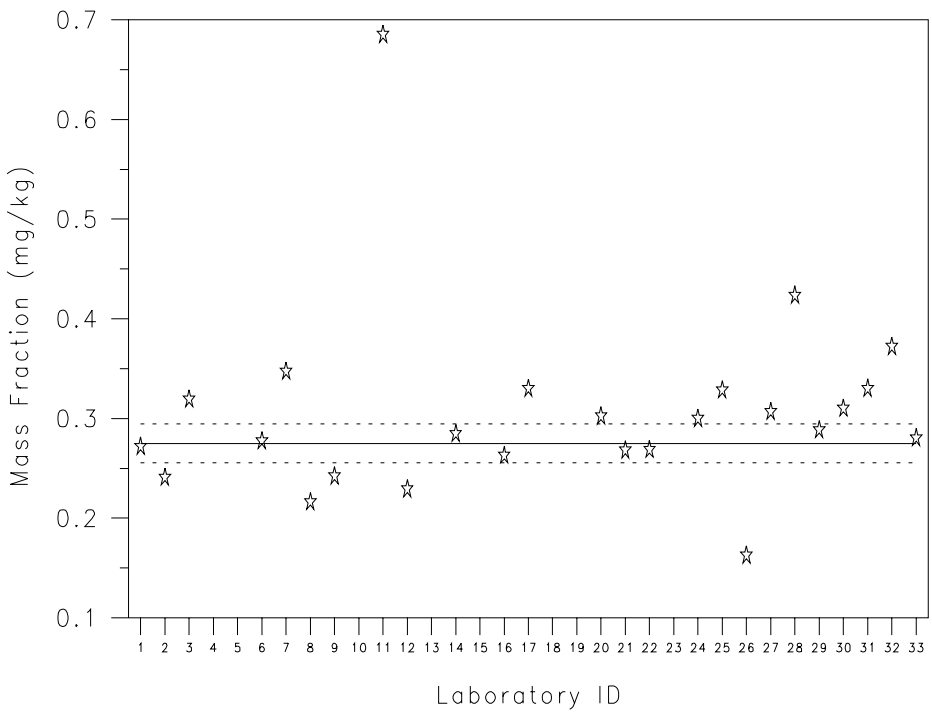
Element	Consensus Mean	Lower 95% C.L.	Upper 95% C.L.	Units
As	0.275	0.256	0.295	mg/kg

Lab. #	N	Laboratory Mean	Variance	Standard Deviation	Variance of mean	ML Weight	Tau Estimate	z-score	p-score
1	5	0.272	3.47E-05	0.006	6.94E-06	0.996	6.93E-06	-0.12	0.22
2	5	0.241	8.57E-03	0.093	1.71E-03	0.510	1.59E-03	-1.24	3.84
3	10	0.319	1.72E-03	0.041	1.72E-04	0.906	1.72E-04	1.61	1.30
6	5	0.277	1.18E-03	0.034	2.36E-04	0.878	2.29E-04	0.09	1.24
8	5	0.216	7.00E-07	0.001	1.40E-07	1.000	1.40E-07	-2.14	0.04
9	4	0.242	1.09E-04	0.010	2.72E-05	0.984	2.71E-05	-1.20	0.43
12	5	0.229	1.83E-04	0.014	3.65E-05	0.978	3.66E-05	-1.67	0.59
14	5	0.285	1.01E-04	0.010	2.03E-05	0.988	2.02E-05	0.35	0.35
16	5	0.263	2.07E-04	0.014	4.13E-05	0.976	4.11E-05	-0.44	0.55
17	5	0.330	1.86E-04	0.014	3.71E-05	0.978	3.73E-05	1.99	0.41
20	5	0.302	1.13E-03	0.034	2.27E-04	0.881	2.23E-04	0.99	1.11
21	5	0.268	1.21E-04	0.011	2.42E-05	0.985	2.41E-05	-0.26	0.41
22	5	0.269	6.93E-05	0.008	1.39E-05	0.992	1.38E-05	-0.23	0.31
24	6	0.300	1.06E-03	0.033	1.77E-04	0.904	1.75E-04	0.90	1.09
25	5	0.328	9.49E-04	0.031	1.90E-04	0.896	1.93E-04	1.94	0.94
26	5	0.163	1.05E-03	0.032	2.09E-04	0.865	2.59E-04	-4.09	1.99
29	5	0.288	1.03E-05	0.003	2.06E-06	0.999	2.06E-06	0.49	0.11
33	5	0.280	4.93E-05	0.007	9.86E-06	0.994	9.85E-06	0.20	0.25
Outliers									
7	5	0.347	1.63E-04	0.013	3.27E-05	-	-	2.62	0.37
11	2	0.685	5.00E-05	0.007	2.50E-05	-	-	14.91	0.10
27	5	0.307	4.37E-05	0.007	8.75E-06	-	-	1.15	0.22
28	5	0.424	8.46E-05	0.009	1.69E-05	-	-	5.40	0.22
30	1	0.310	-	-	-	-	-	1.27	-
31	5	0.330	5.00E-05	0.007	1.00E-05	-	-	2.00	0.21
32	1	0.372	-	-	-	-	-	3.53	-

Raw data plot for As in QC04LH4



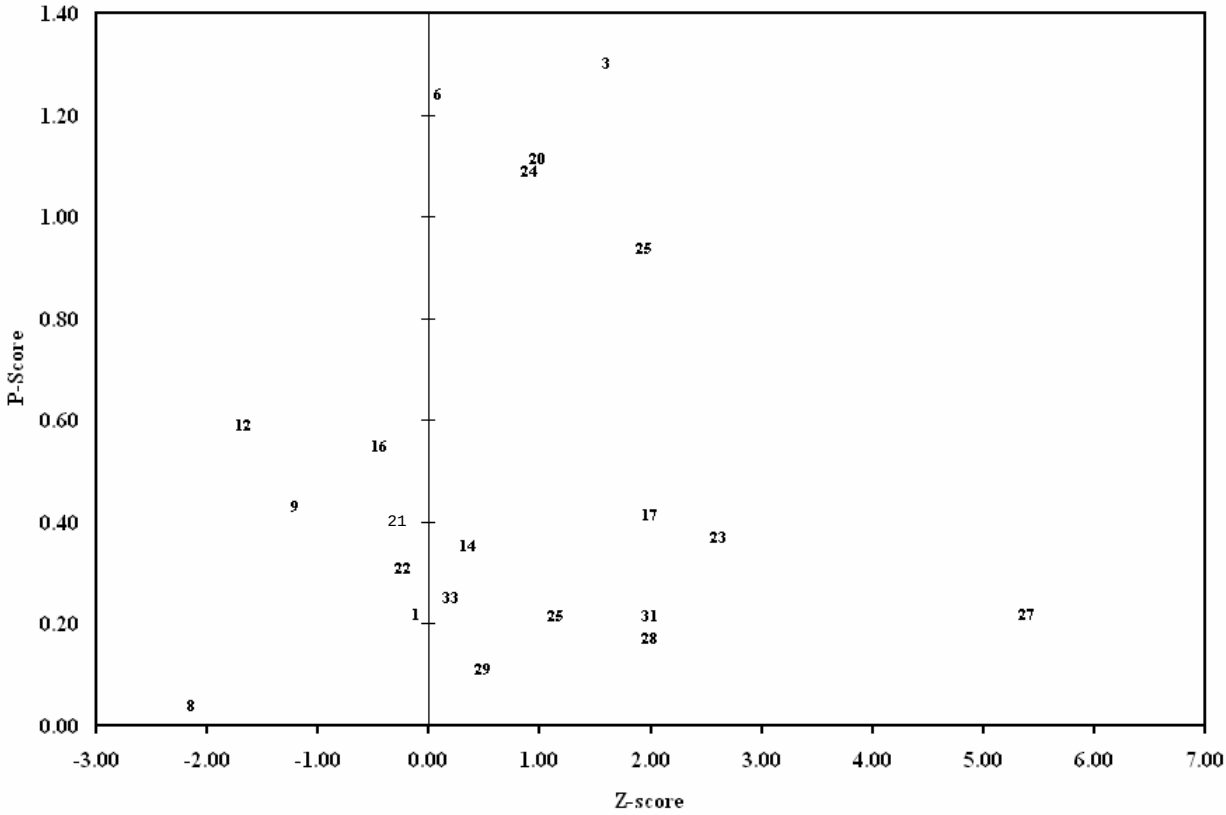
Consensus mean plot for As in QC04LH4



○ Replicates ——— Consensus Mean

☆ Laboratory Mean ----- Consensus Mean 95% C.L.

Laboratory performance data plotted in z- and p-score space for As in QC04LH4



Youden diagram for As (mg/kg) measured in QC03LH3 and QC04LH4 samples

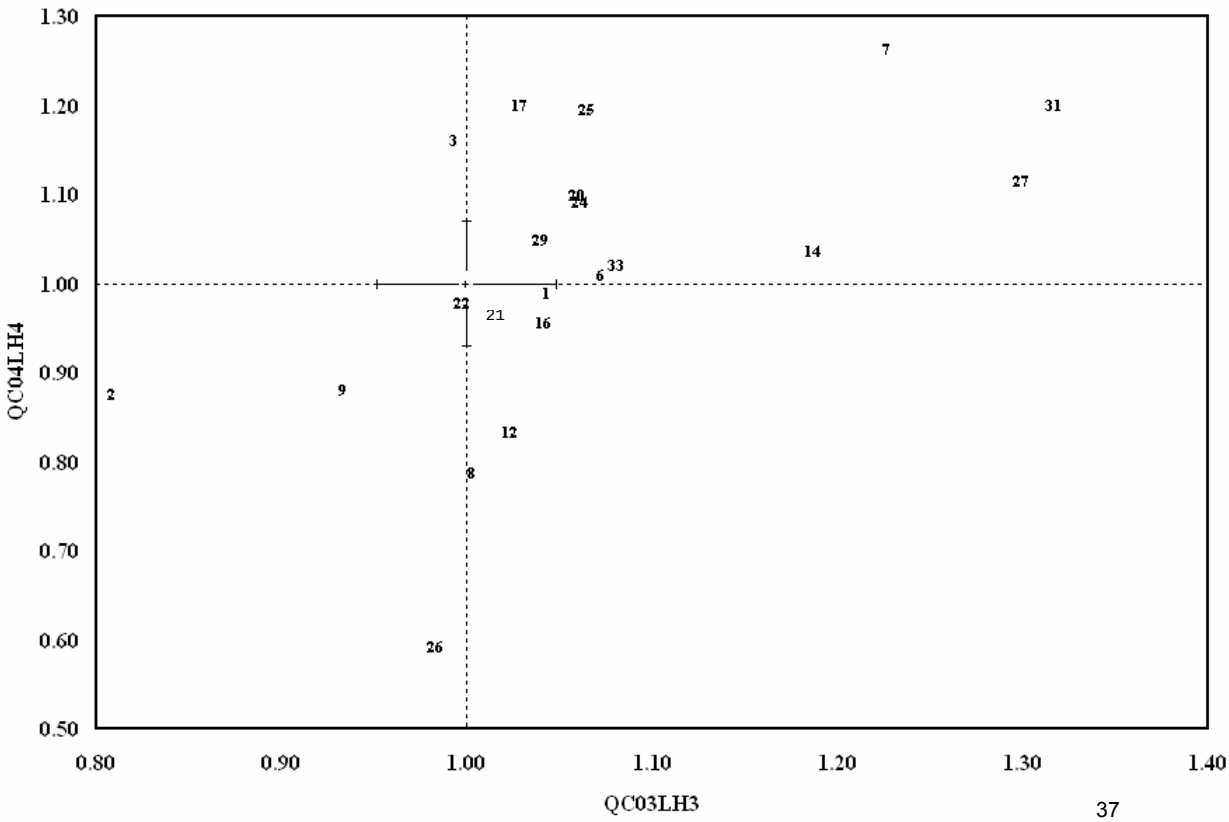
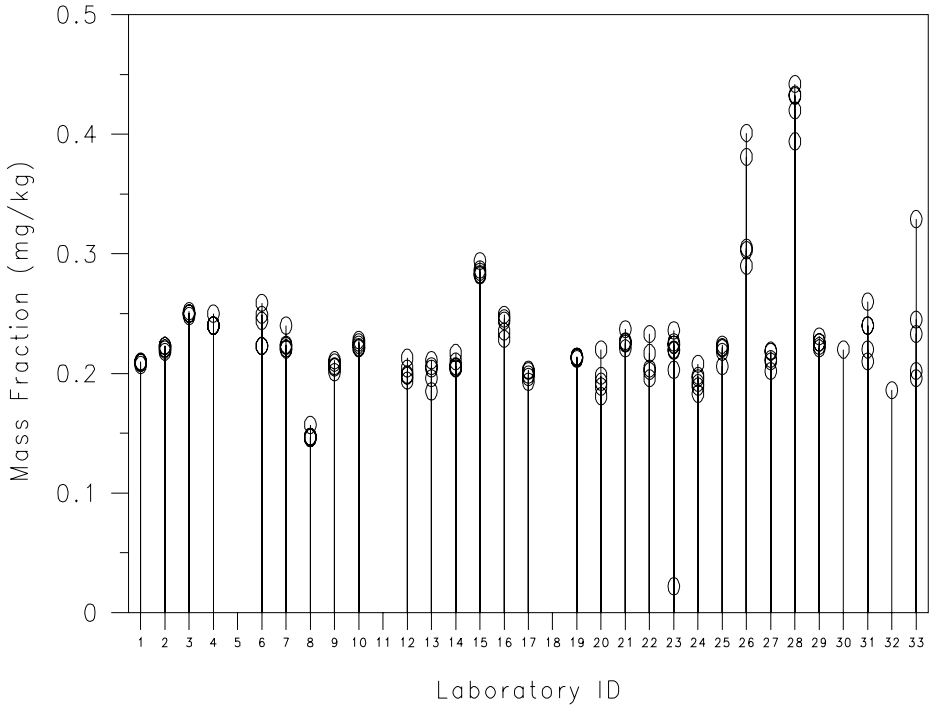


Table 6. Laboratory and consensus data for Cd in QC04LH4.

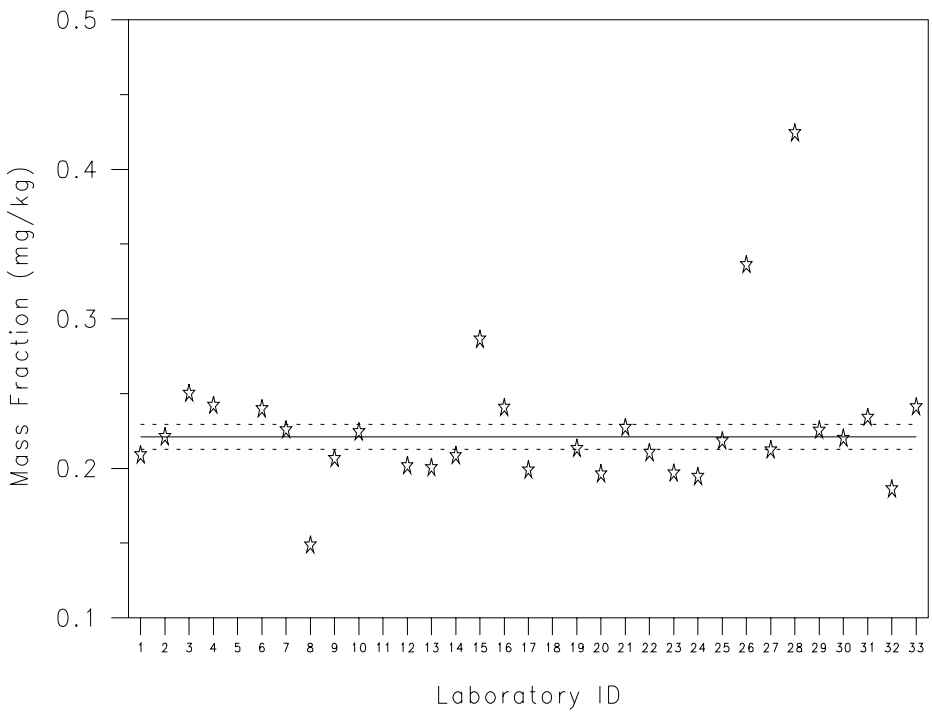
Element	Consensus Mean	Lower 95% C.L.	Upper 95% C.L.	Units
Cd	0.221	0.213	0.229	mg/kg

Lab. #	N	Laboratory Mean	Variance	Standard Deviation	Variance of mean	ML Weight	Tau Estimate	z-score	p-score
1	5	0.209	1.20E-06	0.001	2.40E-07	0.999	2.40E-07	-0.55	0.05
2	5	0.221	4.50E-06	0.002	9.00E-07	0.998	9.00E-07	0.00	0.10
3	5	0.250	2.00E-06	0.001	4.00E-07	0.999	4.00E-07	1.31	0.06
4	5	0.242	2.00E-05	0.004	4.00E-06	0.990	4.00E-06	0.95	0.18
6	5	0.240	2.59E-04	0.016	5.18E-05	0.890	5.14E-05	0.84	0.67
7	5	0.226	6.73E-05	0.008	1.35E-05	0.969	1.34E-05	0.21	0.36
9	5	0.206	1.48E-05	0.004	2.96E-06	0.993	2.96E-06	-0.66	0.19
10	5	0.224	8.20E-06	0.003	1.64E-06	0.996	1.64E-06	0.14	0.13
12	5	0.202	5.33E-05	0.007	1.07E-05	0.975	1.07E-05	-0.88	0.36
13	5	0.200	1.03E-04	0.010	2.07E-05	0.953	2.07E-05	-0.93	0.51
14	5	0.208	2.83E-05	0.005	5.66E-06	0.987	5.65E-06	-0.57	0.26
15	5	0.286	2.27E-05	0.005	4.54E-06	0.989	4.66E-06	2.95	0.17
16	5	0.241	6.93E-05	0.008	1.39E-05	0.968	1.38E-05	0.88	0.35
17	5	0.199	1.62E-05	0.004	3.24E-06	0.992	3.24E-06	-1.01	0.20
19	5	0.213	7.00E-07	0.001	1.40E-07	1.000	1.40E-07	-0.36	0.04
20	5	0.196	2.16E-04	0.015	4.31E-05	0.905	4.35E-05	-1.12	0.75
21	5	0.227	3.52E-05	0.006	7.04E-06	0.983	7.01E-06	0.28	0.26
22	5	0.210	2.18E-04	0.015	4.37E-05	0.906	4.29E-05	-0.48	0.70
23	8	0.197	5.07E-03	0.071	6.34E-04	0.404	6.12E-04	-1.10	3.62
24	6	0.194	7.31E-05	0.009	1.22E-05	0.971	1.22E-05	-1.21	0.44
25	5	0.218	5.12E-05	0.007	1.02E-05	0.976	1.02E-05	-0.13	0.33
27	5	0.212	4.72E-05	0.007	9.44E-06	0.978	9.40E-06	-0.40	0.32
29	5	0.225	1.43E-05	0.004	2.86E-06	0.993	2.86E-06	0.20	0.17
31	5	0.234	3.80E-04	0.019	7.60E-05	0.849	7.42E-05	0.59	0.83
33	5	0.241	2.84E-03	0.053	5.69E-04	0.441	5.26E-04	0.90	2.21
Outliers									
8	5	0.149	2.39E-05	0.005	4.77E-06	-	-	-3.28	0.33
11	2	6.095	2.45E-03	0.049	1.23E-03	-	-	265.72	0.08
26	5	0.336	2.60E-03	0.051	5.21E-04	-	-	5.20	1.52
28	5	0.424108	3.46E-04	0.019	6.92E-05	-	-	9.19	0.44
30	1	0.22	-	-	-	-	-	-0.05	-
32	1	0.186	-	-	-	-	-	-1.59	-

Raw data plot for Cd in QC04LH4



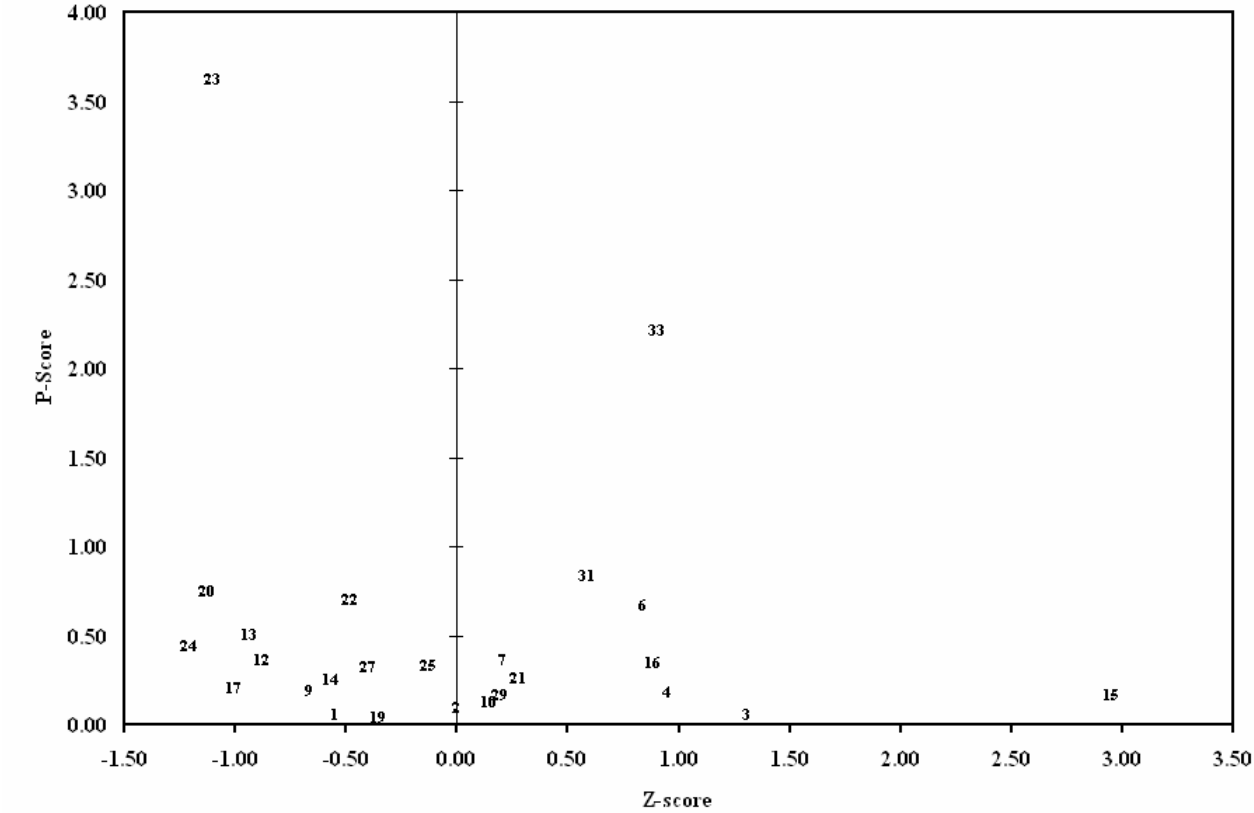
Consensus mean plot for Cd in QC04LH4



Replicates — Consensus Mean

Laboratory Mean ----- Consensus Mean 95% C.L.

Laboratory performance data plotted in z- and p-score space for Cd in QC04LH4



Youden diagram for Cd (mg/kg) measured in QC03LH3 and QC04LH4 samples

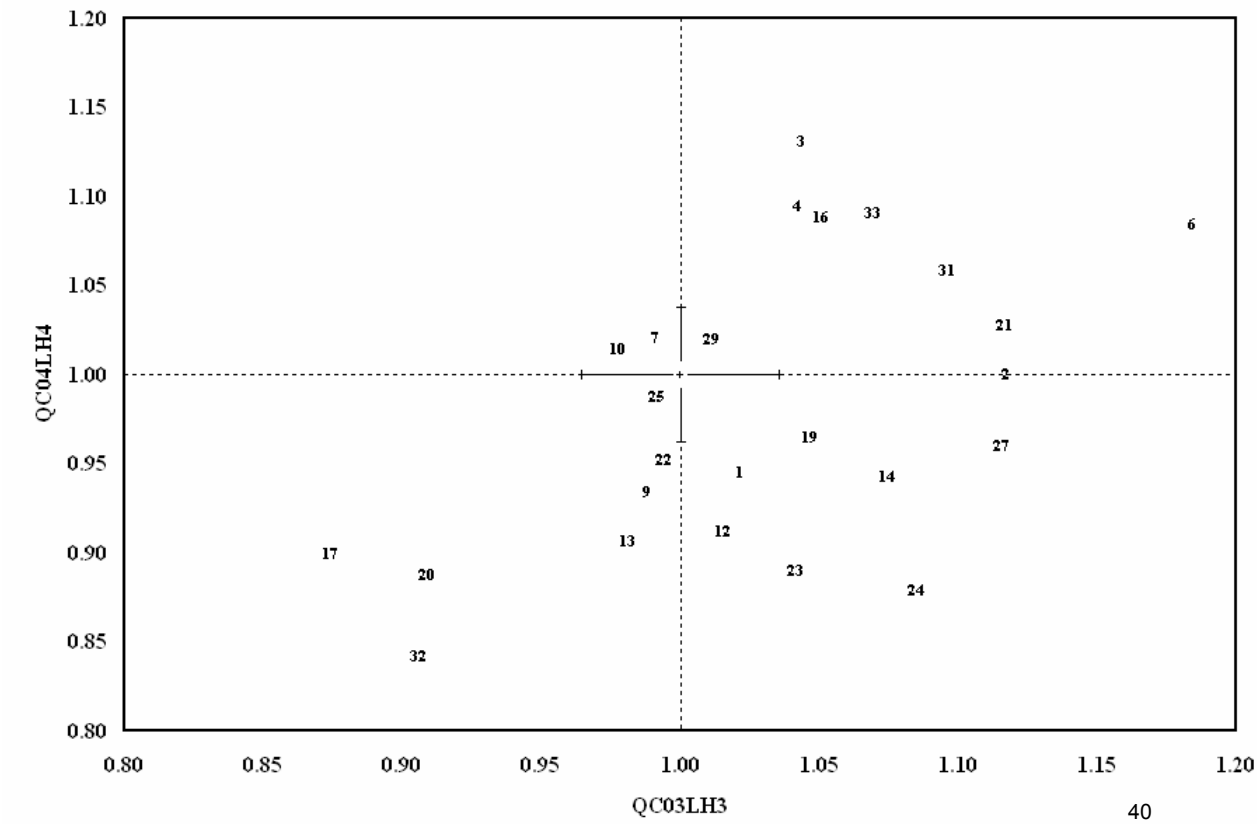
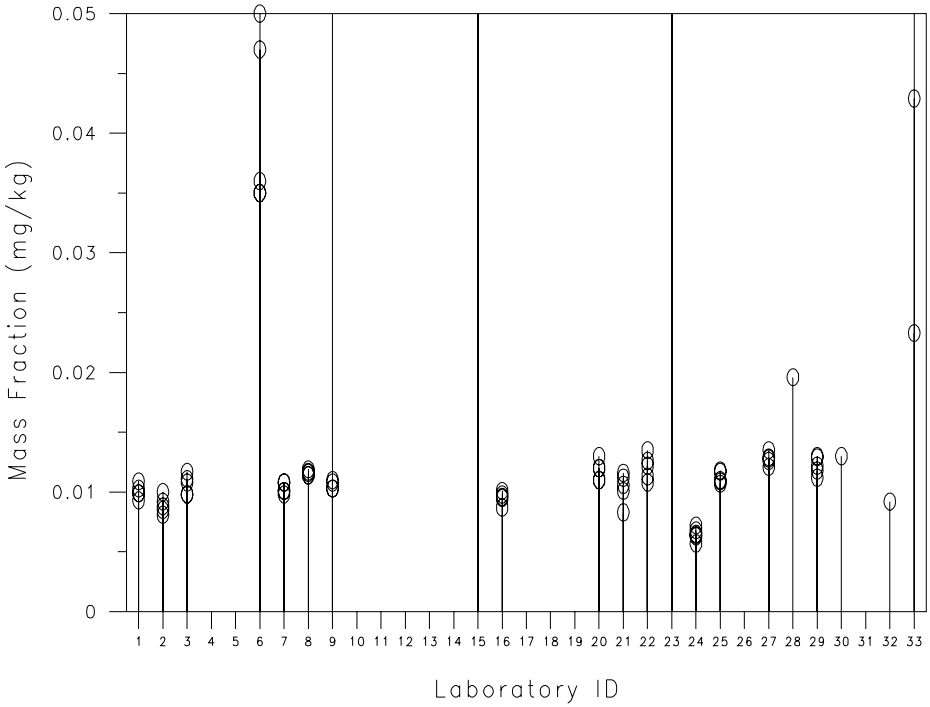


Table 7. Laboratory and consensus data for Co in QC04LH4.

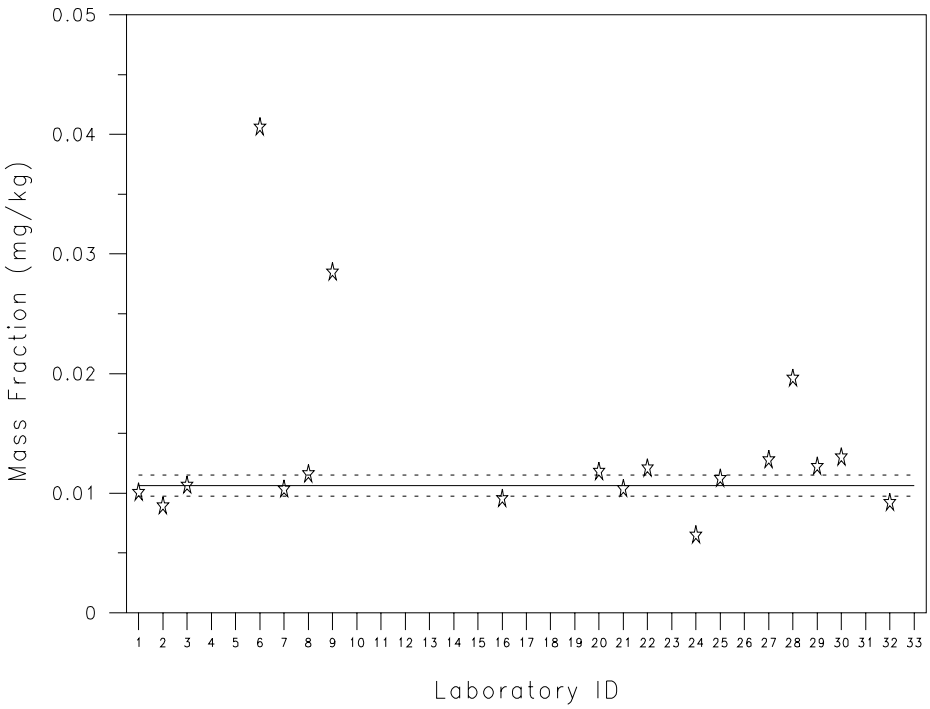
Element	Consensus Mean	Lower 95% C.L.	Upper 95% C.L.	Units
Co	0.011	0.010	0.012	mg/kg

Lab. #	N	Laboratory Mean	Variance	Standard Deviation	Variance of mean	ML Weight	Tau Estimate	z-score	p-score
1	5	0.010	3.48E-07	5.90E-04	6.96E-08	0.974	6.92E-08	-0.53	0.59
2	5	0.009	5.27E-07	7.26E-04	1.05E-07	0.960	1.05E-07	-1.60	0.81
3	5	0.011	6.93E-07	8.32E-04	1.39E-07	0.949	1.37E-07	0.02	0.78
7	5	0.010	2.07E-07	4.55E-04	4.14E-08	0.984	4.12E-08	-0.28	0.44
8	5	0.012	4.50E-08	2.12E-04	9.00E-09	0.996	9.00E-09	0.92	0.18
9	5	0.028	1.60E-03	4.00E-02	3.20E-04	0.008	3.19E-04	16.82	14.04
16	5	0.010	2.73E-07	5.22E-04	5.46E-08	0.979	5.44E-08	-1.02	0.55
20	5	0.012	7.00E-07	8.37E-04	1.40E-07	0.948	1.39E-07	1.11	0.71
21	5	0.010	1.65E-06	1.29E-03	3.31E-07	0.888	3.22E-07	-0.25	1.24
22	5	0.012	1.14E-06	1.07E-03	2.27E-07	0.919	2.26E-07	1.37	0.88
24	6	0.006	2.54E-07	5.04E-04	4.23E-08	0.983	4.31E-08	-3.90	0.78
25	5	0.011	2.47E-07	4.97E-04	4.94E-08	0.981	4.92E-08	0.56	0.44
27	5	0.013	2.57E-07	5.07E-04	5.14E-08	0.980	5.16E-08	2.03	0.40
29	5	0.012	5.72E-07	7.56E-04	1.14E-07	0.957	1.14E-07	1.51	0.62
Outliers									
6	5	0.041	5.33E-05	7.30E-03	1.07E-05	-	-	28.23	1.80
15	5	46.478	1.34E+00	1.16E+00	2.68E-01	-	-	43752.99	0.25
23	5	0.544	4.24E-03	6.51E-02	8.48E-04	-	-	502.55	1.20
28	1	0.020	-	-	-	-	-	8.47	-
30	1	0.013	-	-	-	-	-	2.24	-
32	1	0.009	-	-	-	-	-	-1.34	-
33	3	0.052	1.22E-03	3.50E-02	4.08E-04	-	-	39.40	6.67

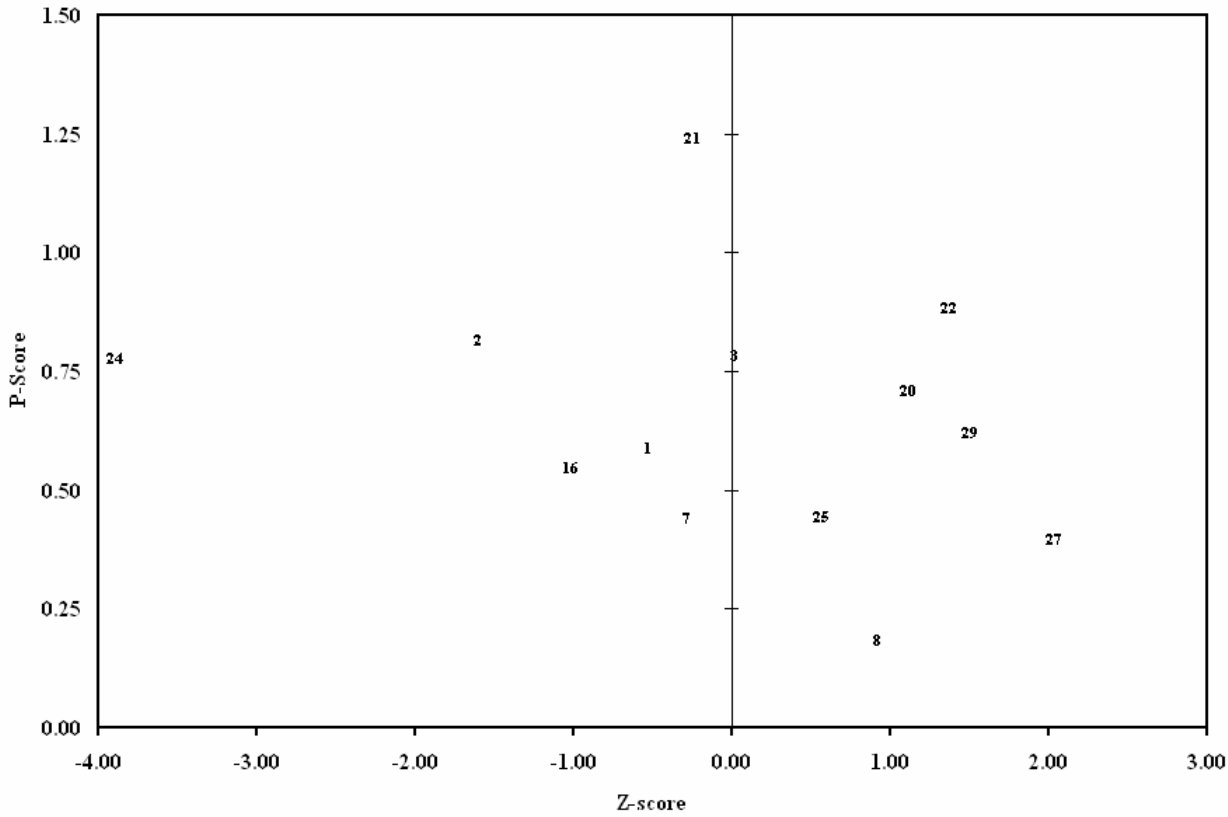
Raw data plot for Co in QC04LH4



Consensus mean plot for Co in QC04LH4



Laboratory performance data plotted in z- and p-score space for Co in QC04LH4



Youden diagram for Co (mg/kg) measured in QC03LH3 and QC04LH4 samples

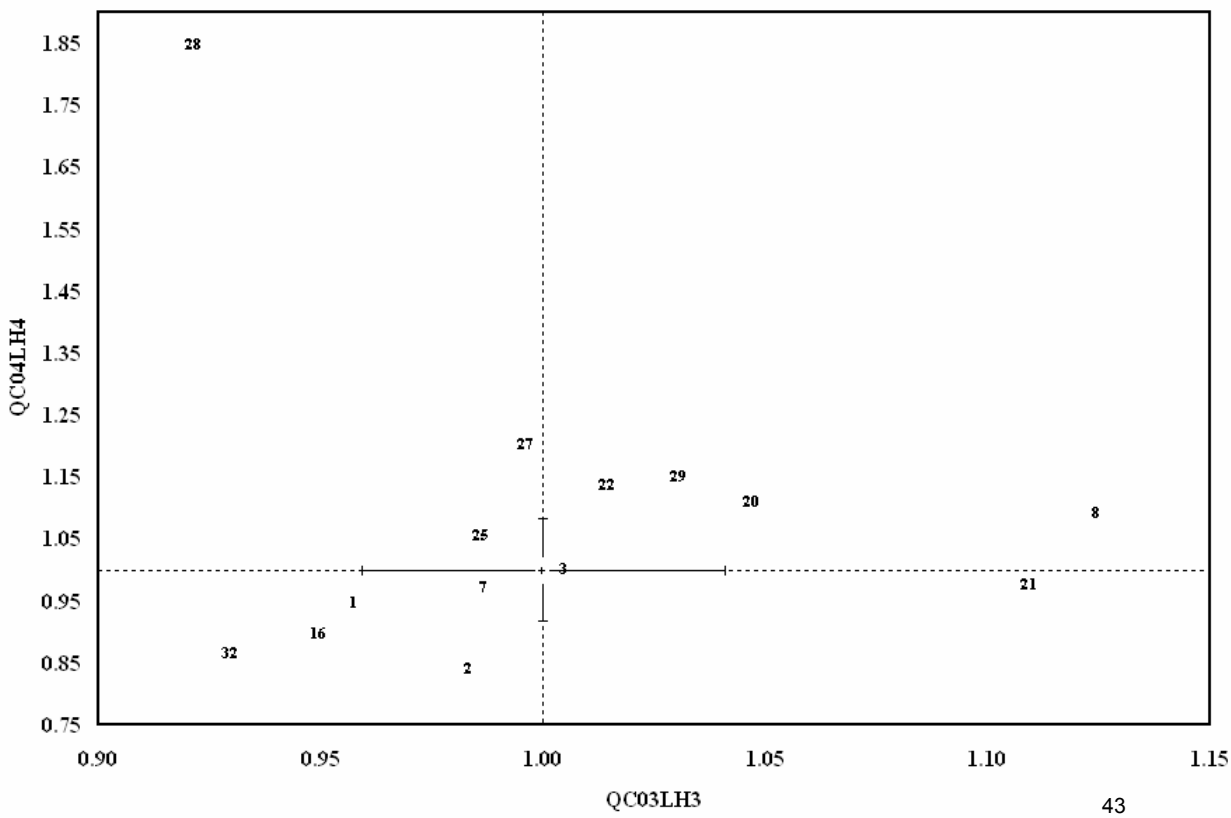
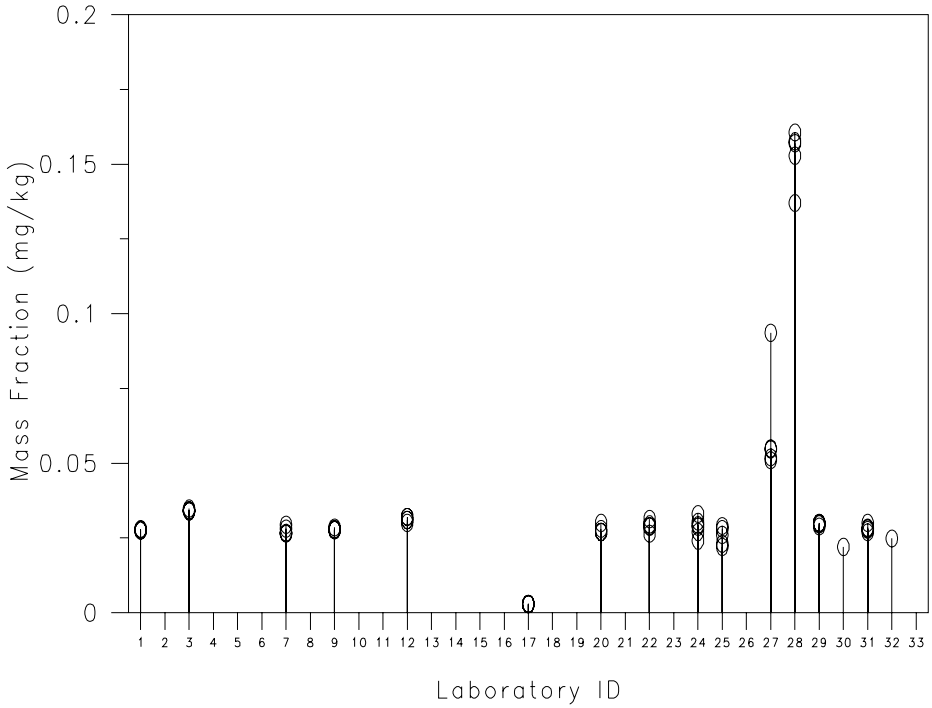


Table 8. Laboratory and consensus data for Cs in QC04LH4.

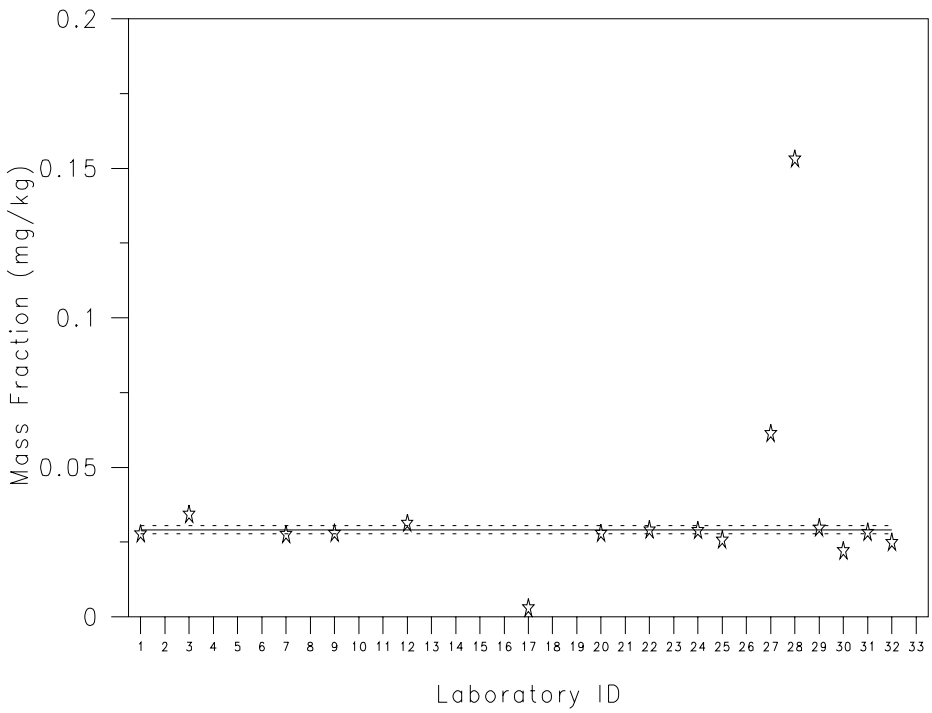
Element	Consensus Mean	Lower 95% C.L.	Upper 95% C.L.	Units
Cs	0.029	0.028	0.030	mg/kg

Lab. #	N	Laboratory Mean	Variance	Standard Deviation	Variance of mean	ML Weight	Tau Estimate	z-score	p-score
1	5	0.028	4.80E-08	2.19E-04	9.60E-09	0.998	9.60E-09	-0.50	0.08
3	5	0.034	1.35E-07	3.67E-04	2.70E-08	0.994	2.72E-08	1.75	0.11
9	5	0.028	1.37E-07	3.70E-04	2.74E-08	0.994	2.74E-08	-0.42	0.13
12	5	0.031	7.00E-07	8.37E-04	1.40E-07	0.970	1.40E-07	0.72	0.27
20	5	0.028	1.70E-06	1.30E-03	3.40E-07	0.931	3.36E-07	-0.45	0.47
22	5	0.029	3.10E-06	1.76E-03	6.19E-07	0.883	6.02E-07	-0.05	0.61
24	6	0.029	9.15E-06	3.03E-03	1.53E-06	0.758	1.46E-06	-0.12	1.05
25	5	0.026	9.30E-06	3.05E-03	1.86E-06	0.696	1.99E-06	-1.21	1.19
29	5	0.030	2.47E-07	4.97E-04	4.94E-08	0.989	4.93E-08	0.17	0.17
31	5	0.028	1.31E-06	1.14E-03	2.61E-07	0.946	2.59E-07	-0.31	0.41
Outliers									
7	5	0.027	1.69E-06	1.30E-03	3.38E-07	-	-	-0.57	0.47
17	5	0.003	7.00E-09	8.37E-05	1.40E-09	-	-	-9.01	0.29
27	5	0.061	3.30E-04	1.82E-02	6.60E-05	-	-	11.02	2.97
28	5	0.153	8.78E-05	9.37E-03	1.76E-05	-	-	42.55	0.61
30	1	0.022	-	-	-	-	-	-2.44	-
32	1	0.025	-	-	-	-	-	-1.48	-

Raw data plot for Cs in QC04LH4



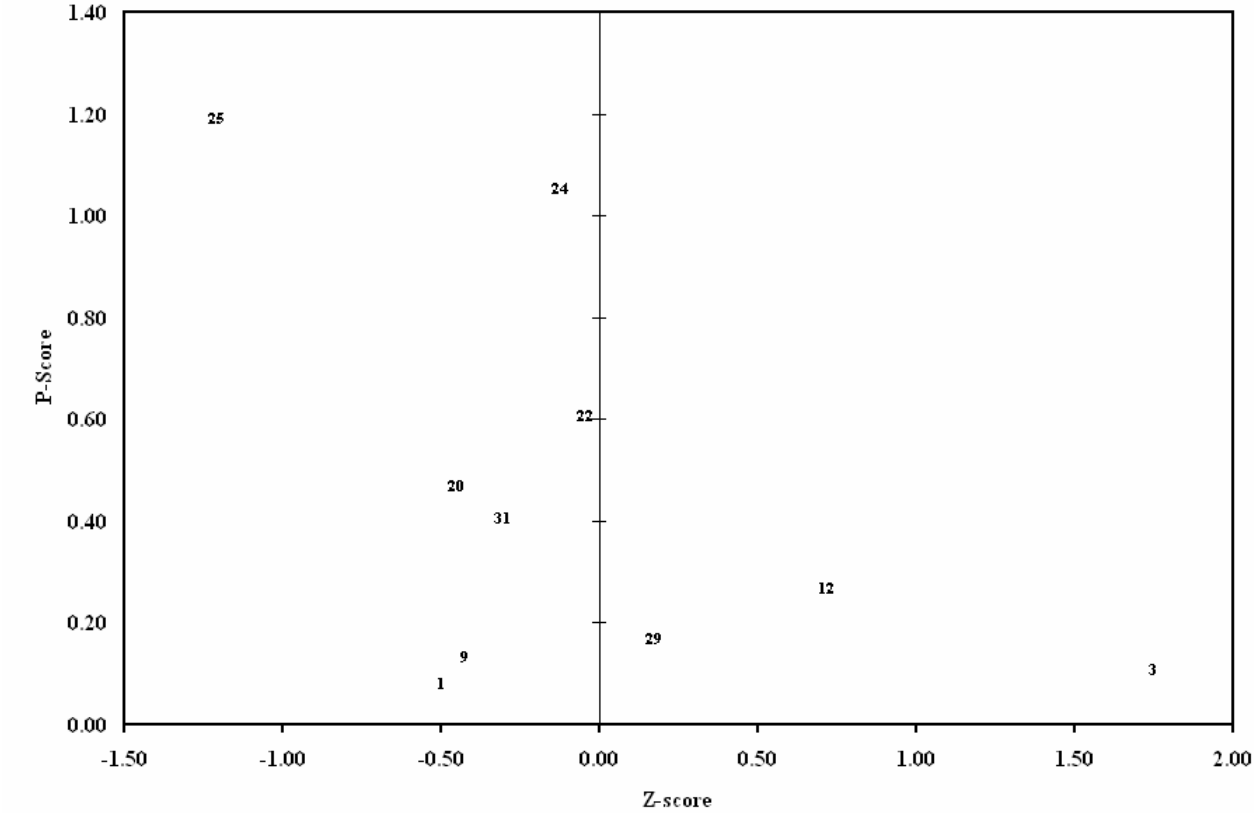
Consensus mean plot for Cs in QC04LH4



Replicates — Consensus Mean

Laboratory Mean ----- Consensus Mean 95% C.L.

Laboratory performance data plotted in z- and p-score space for Cs in QC04LH4



Youden diagram for Cs (mg/kg) measured in QC03LH3 and QC04LH4 samples

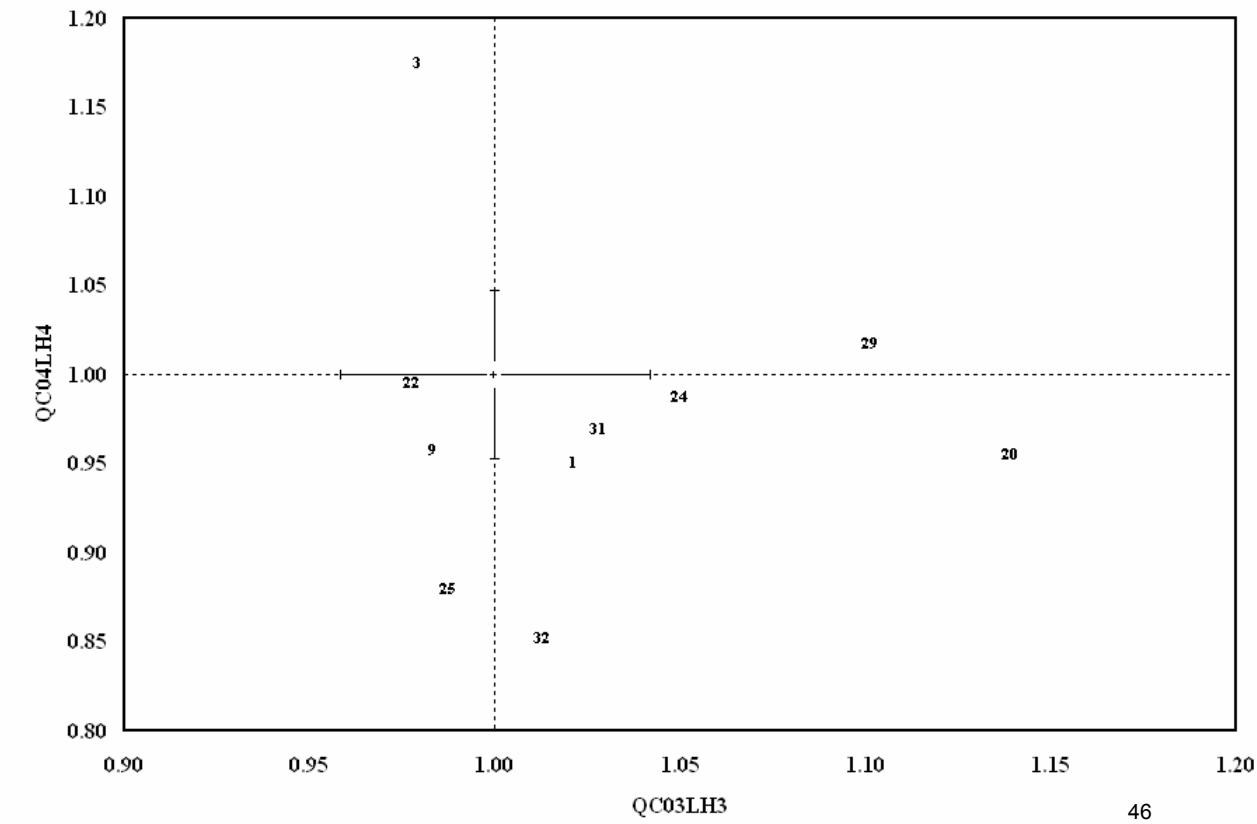
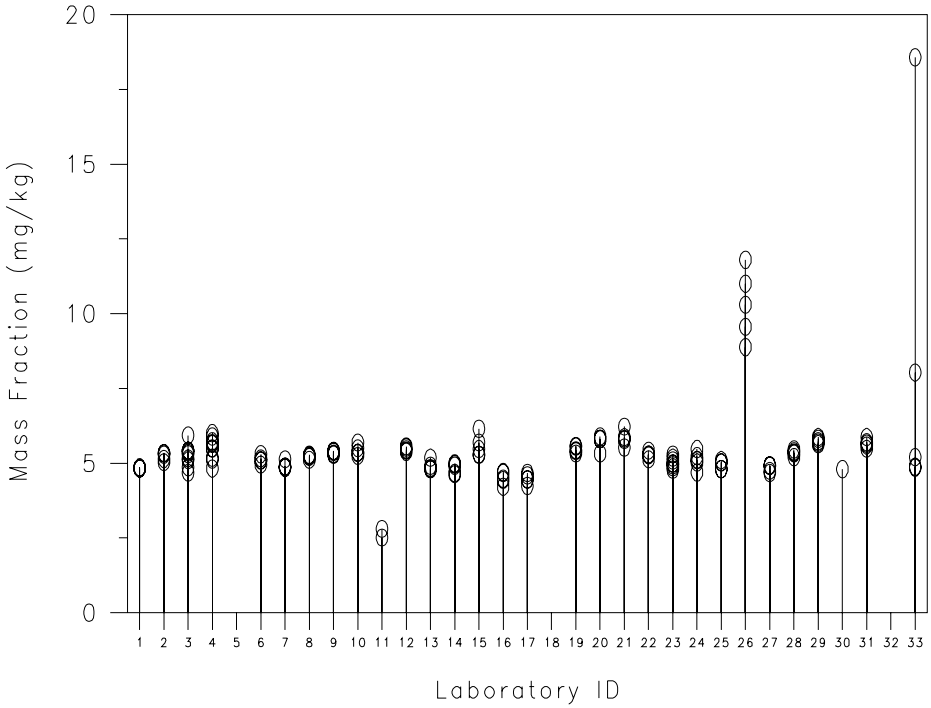


Table 9. Laboratory and consensus data for Cu in QC04LH4.

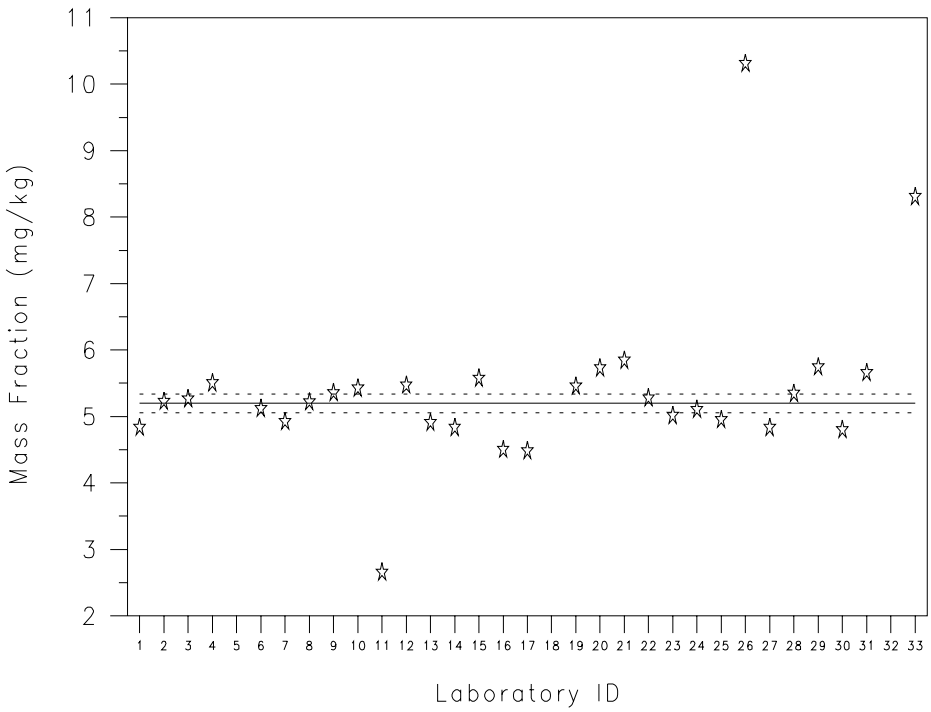
Element	Consensus Mean	Lower 95% C.L.	Upper 95% C.L.	Units
Cu	5.20	5.06	5.34	mg/kg

Lab. #	N	Laboratory Mean	Variance	Standard Deviation	Variance of mean	ML Weight	Tau Estimate	z-score	p-score
1	5	4.83	2.80E-04	0.02	5.60E-05	1.000	5.60E-05	-0.70	0.03
2	5	5.22	1.81E-02	0.13	3.63E-03	0.971	3.60E-03	0.05	0.26
3	10	5.26	1.18E-01	0.34	1.18E-02	0.912	1.17E-02	0.13	0.65
4	10	5.50	1.35E-01	0.37	1.35E-02	0.900	1.34E-02	0.59	0.67
6	5	5.12	1.62E-02	0.13	3.24E-03	0.974	3.22E-03	-0.15	0.25
7	5	4.92	1.41E-02	0.12	2.82E-03	0.977	2.81E-03	-0.53	0.24
8	5	5.22	4.18E-03	0.06	8.36E-04	0.993	8.35E-04	0.04	0.12
9	5	5.36	3.33E-03	0.06	6.66E-04	0.995	6.65E-04	0.30	0.11
10	5	5.42	3.07E-02	0.18	6.15E-03	0.952	6.10E-03	0.44	0.32
12	5	5.47	5.32E-03	0.07	1.06E-03	0.991	1.06E-03	0.52	0.13
13	5	4.91	2.55E-02	0.16	5.11E-03	0.960	5.09E-03	-0.56	0.33
14	5	4.83	2.86E-02	0.17	5.72E-03	0.955	5.73E-03	-0.70	0.35
16	5	4.50	3.92E-02	0.20	7.85E-03	0.936	8.21E-03	-1.34	0.44
17	5	4.48	2.68E-02	0.16	5.35E-03	0.956	5.54E-03	-1.38	0.37
19	5	5.46	1.16E-02	0.11	2.33E-03	0.981	2.32E-03	0.50	0.20
20	5	5.73	5.28E-02	0.23	1.06E-02	0.918	1.08E-02	1.02	0.40
21	5	5.84	6.29E-02	0.25	1.26E-02	0.901	1.33E-02	1.24	0.43
22	5	5.28	1.06E-02	0.10	2.13E-03	0.983	2.12E-03	0.15	0.20
23	8	5.01	2.81E-02	0.17	3.51E-03	0.972	3.50E-03	-0.36	0.33
24	6	5.10	6.57E-02	0.26	1.09E-02	0.918	1.08E-02	-0.18	0.50
25	5	4.95	1.97E-02	0.14	3.94E-03	0.969	3.92E-03	-0.48	0.28
27	5	4.83	1.41E-02	0.12	2.82E-03	0.977	2.83E-03	-0.70	0.25
28	5	5.34	9.23E-03	0.10	1.85E-03	0.985	1.84E-03	0.28	0.18
29	5	5.74	9.38E-03	0.10	1.88E-03	0.985	1.89E-03	1.05	0.17
31	5	5.66	2.08E-02	0.14	4.15E-03	0.967	4.18E-03	0.89	0.25
Outliers									
11	5	4.33	2.36E+00	1.54	4.73E-01	-	-	-1.66	3.55
15	5	5.57	1.31E-01	0.36	2.63E-02	-	-	0.73	0.65
26	5	10.31	1.33E+00	1.15	2.65E-01	-	-	9.83	1.12
30	1	4.80	-	-	-	-	-	-0.77	-
33	5	8.31	3.47E+01	5.89	6.94E+00	-	-	5.98	7.09

Raw data plot for Cu in QC04LH4

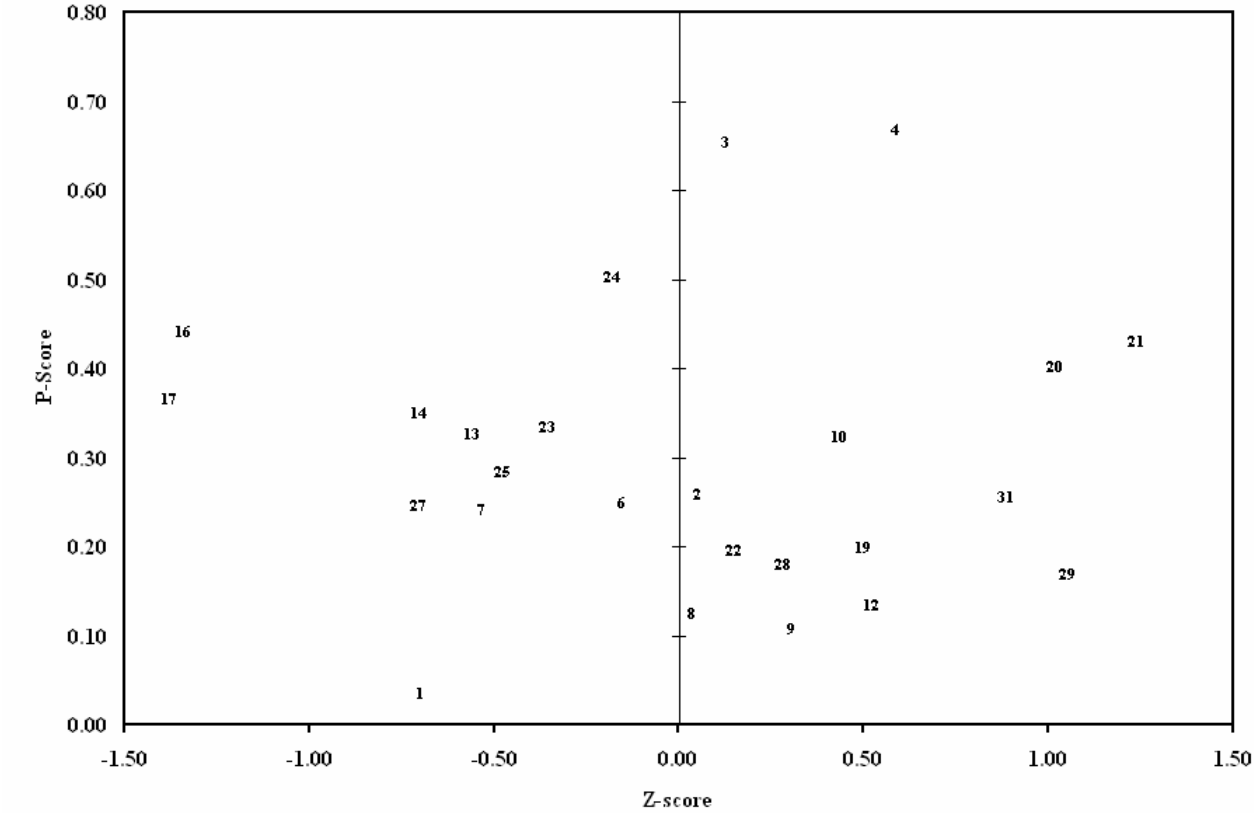


Consensus mean plot for Cu in QC04LH4



Replicates
Laboratory Mean
Consensus Mean
Consensus Mean 95% C.L.

Laboratory performance data plotted in z- and p-score space for Cu in QC04LH4



Youden diagram for Cu (mg/kg) measured in QC03LH3 and QC04LH4 samples

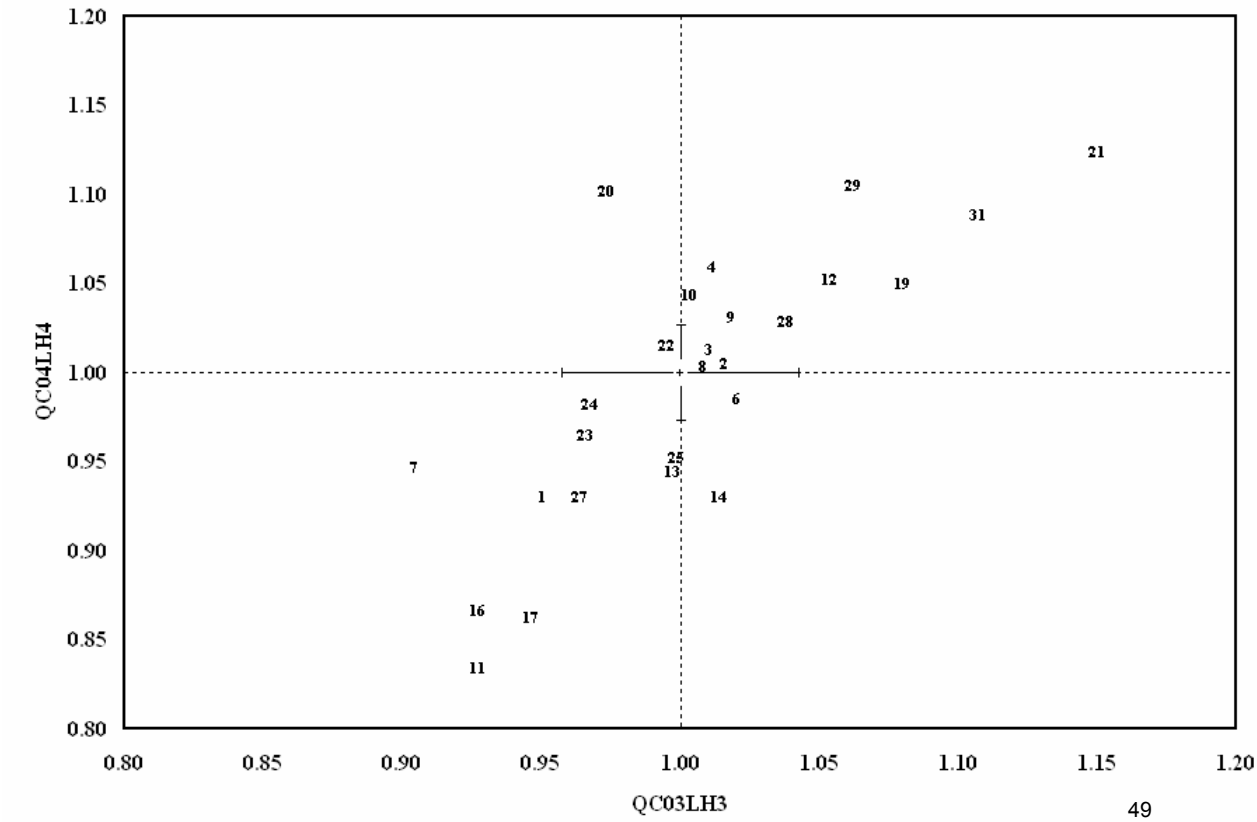
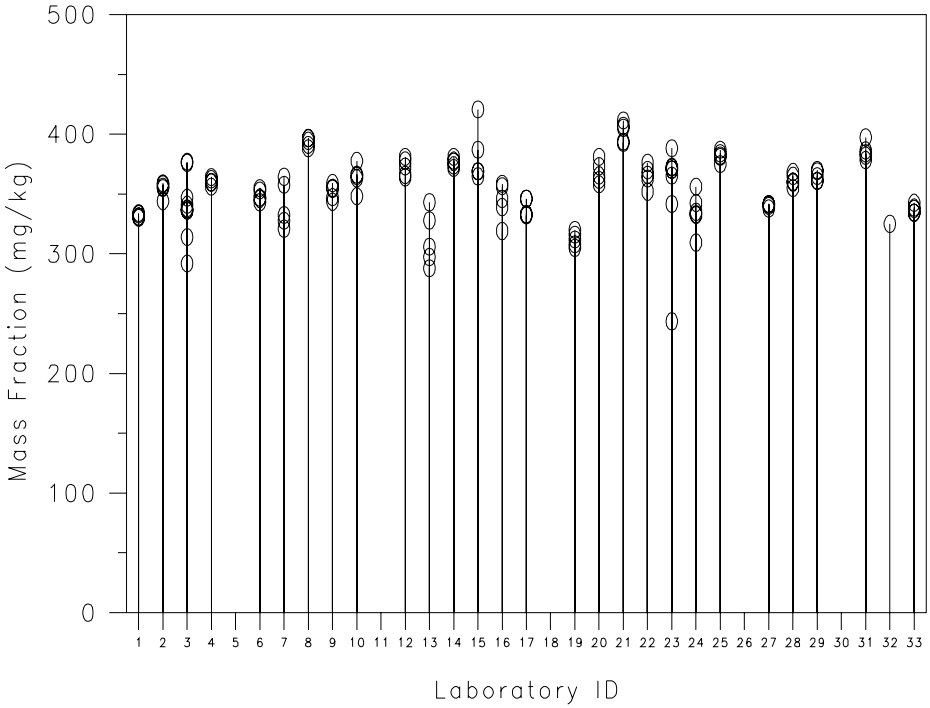


Table 10. Laboratory and consensus data for Fe in QC04LH4.

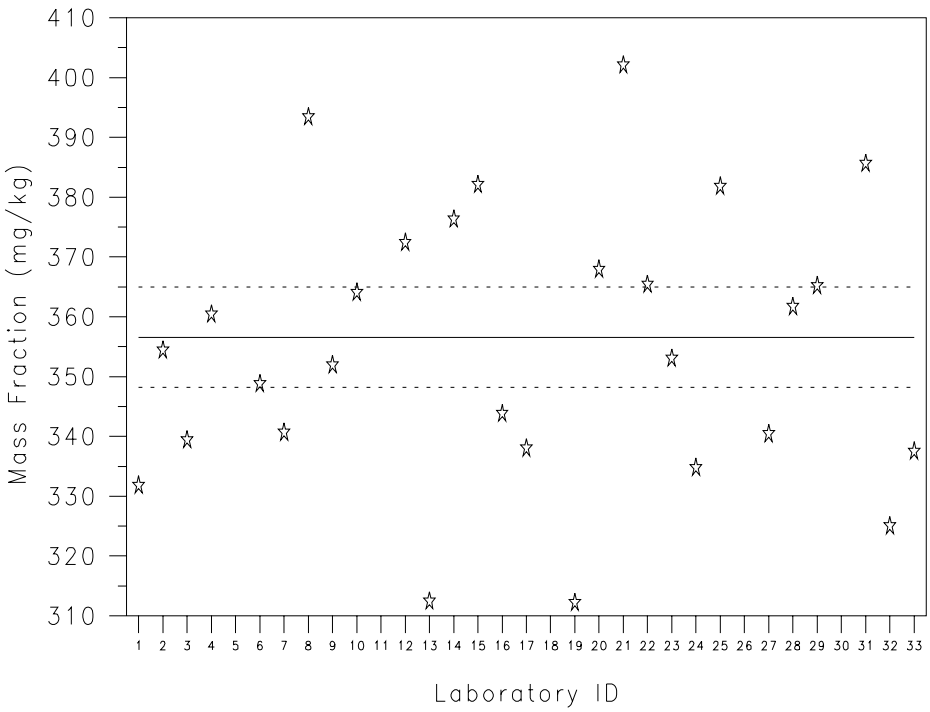
Element	Consensus Mean	Lower 95% C.L.	Upper 95% C.L.	Units
Fe	**356.6**	**348.2**	**364.9**	**mg/kg**

Lab. #	N	Laboratory Mean	Variance	Standard Deviation	Variance of mean	ML Weight	Tau Estimate	z-score	p-score
1	5	331.8	2.70E+00	1.6	5.40E-01	0.999	5.40E-01	-0.69	0.05
2	5	354.4	3.63E+01	6.0	7.26E+00	0.985	7.23E+00	-0.06	0.17
3	10	339.4	6.37E+02	25.2	6.37E+01	0.880	6.34E+01	-0.48	0.74
4	5	360.4	9.38E+00	3.1	1.88E+00	0.996	1.87E+00	0.11	0.08
6	5	348.8	2.52E+01	5.0	5.04E+00	0.989	5.03E+00	-0.22	0.14
7	5	340.7	3.69E+02	19.2	7.38E+01	0.866	7.25E+01	-0.45	0.56
8	5	393.4	1.38E+01	3.7	2.76E+00	0.994	2.76E+00	1.03	0.09
9	5	351.9	3.95E+01	6.3	7.91E+00	0.983	7.87E+00	-0.13	0.18
10	5	364.1	1.10E+02	10.5	2.21E+01	0.955	2.19E+01	0.21	0.29
12	5	372.4	5.43E+01	7.4	1.09E+01	0.977	1.08E+01	0.44	0.20
13	5	312.4	5.13E+02	22.7	1.03E+02	0.800	1.16E+02	-1.24	0.73
14	5	376.3	1.28E+01	3.6	2.55E+00	0.995	2.55E+00	0.55	0.09
15	5	382.1	5.40E+02	23.2	1.08E+02	0.811	1.09E+02	0.72	0.61
16	5	343.8	2.53E+02	15.9	5.07E+01	0.903	4.99E+01	-0.36	0.46
17	5	338.0	5.35E+01	7.3	1.07E+01	0.978	1.07E+01	-0.52	0.22
19	5	312.2	3.62E+01	6.0	7.24E+00	0.985	7.33E+00	-1.24	0.19
20	5	367.9	8.47E+01	9.2	1.69E+01	0.965	1.68E+01	0.32	0.25
21	5	402.1	7.02E+01	8.4	1.40E+01	0.970	1.44E+01	1.28	0.21
22	5	365.4	7.98E+01	8.9	1.60E+01	0.967	1.59E+01	0.25	0.24
23	8	353.0	2.13E+03	46.1	2.66E+02	0.648	2.53E+02	-0.10	1.31
24	6	334.8	2.33E+02	15.3	3.88E+01	0.923	3.88E+01	-0.61	0.46
25	5	381.8	1.97E+01	4.4	3.94E+00	0.992	3.94E+00	0.71	0.12
27	5	340.4	2.56E+00	1.6	5.11E-01	0.999	5.11E-01	-0.45	0.05
28	5	361.7	2.65E+01	5.2	5.31E+00	0.989	5.29E+00	0.14	0.14
29	5	365.2	1.82E+01	4.3	3.64E+00	0.992	3.63E+00	0.24	0.12
31	5	385.6	5.12E+01	7.2	1.02E+01	0.978	1.03E+01	0.81	0.19
33	5	337.5	1.16E+01	3.4	2.32E+00	0.995	2.32E+00	-0.53	0.10
Outliers									
32	1	325.0	-	-	-	-	-	-0.89	-

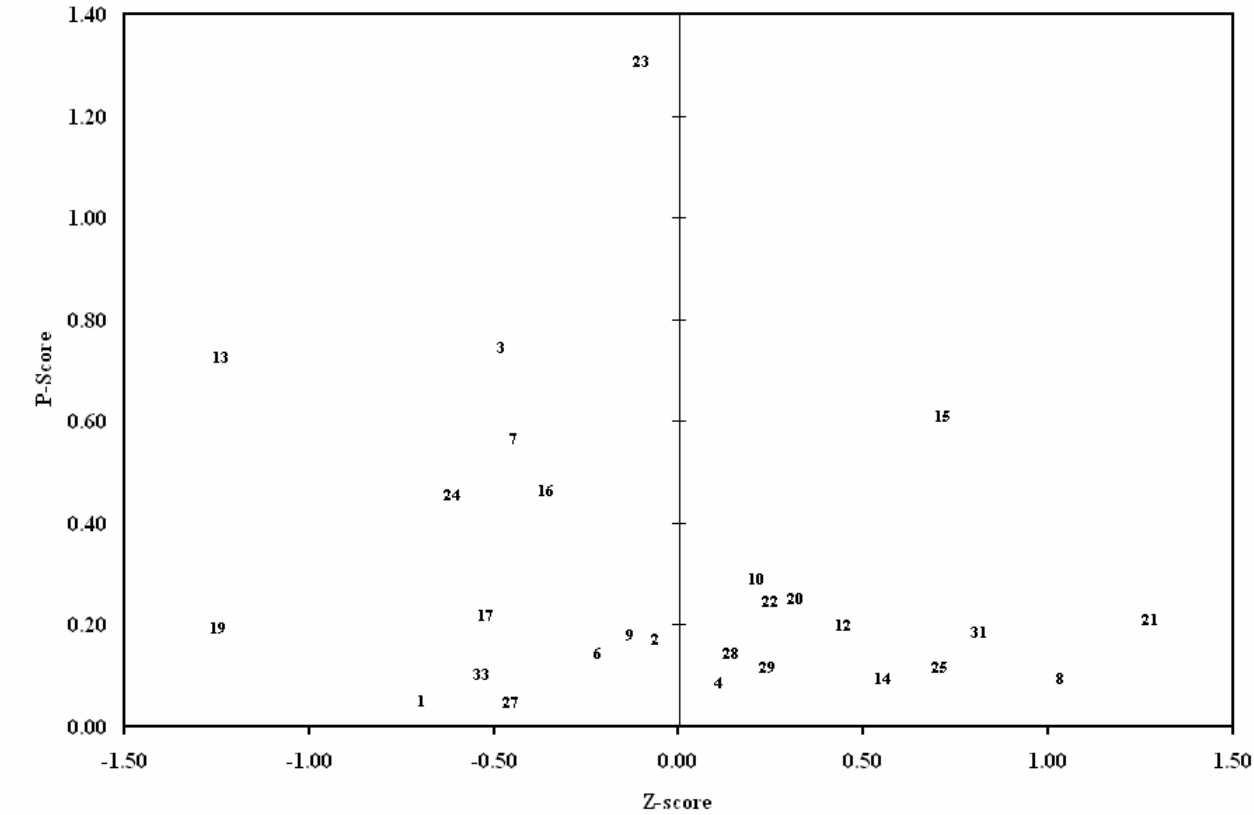
Raw data plot for Fe in QC04LH4



Consensus mean plot for Fe in QC04LH4



Laboratory performance data plotted in z- and p-score space for Fe in QC04LH4



Youden diagram for Fe (mg/kg) measured in QC03LH3 and QC04LH4 samples

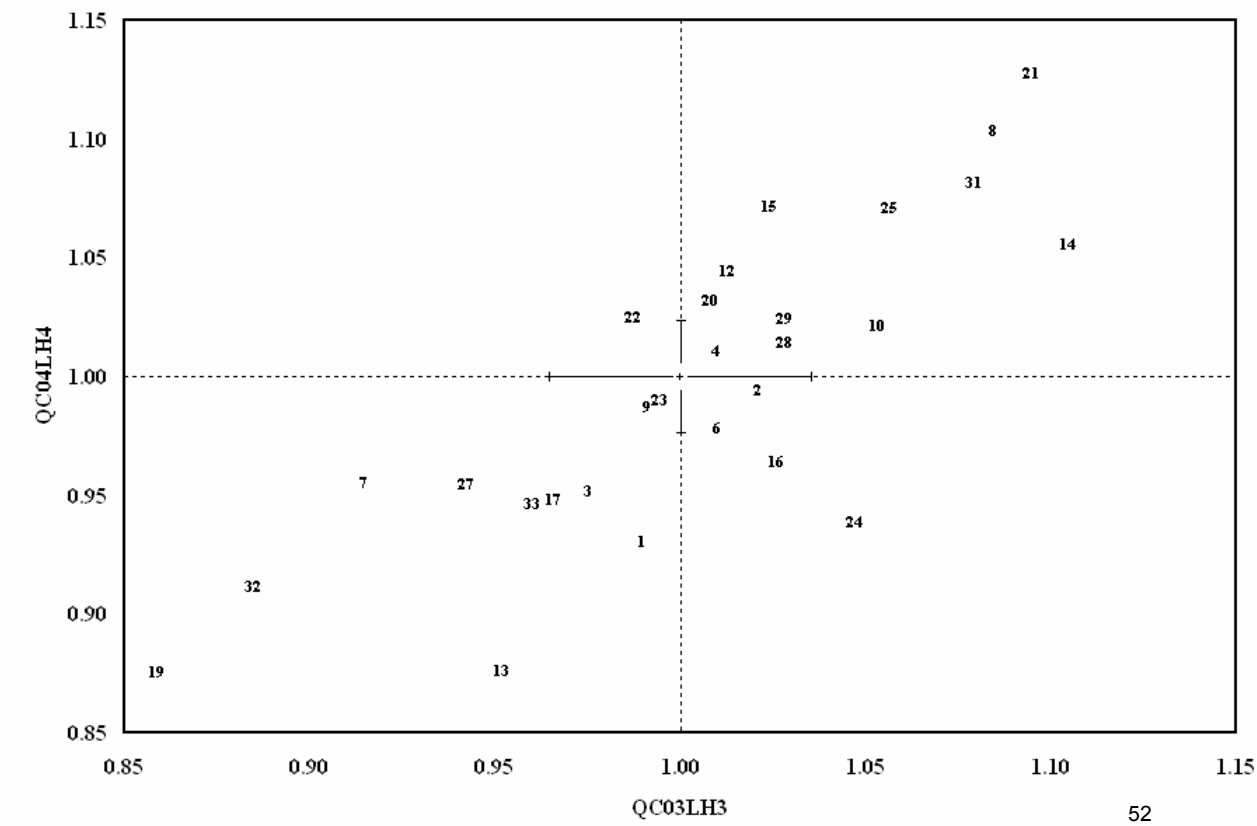
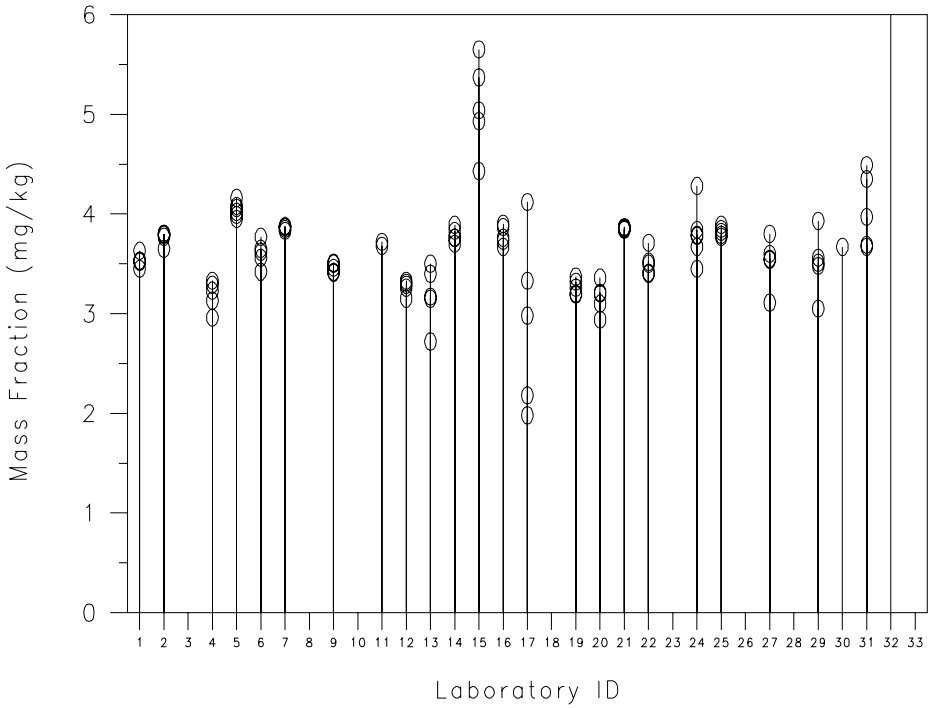


Table 11. Laboratory and consensus data for Hg in QC04LH4.

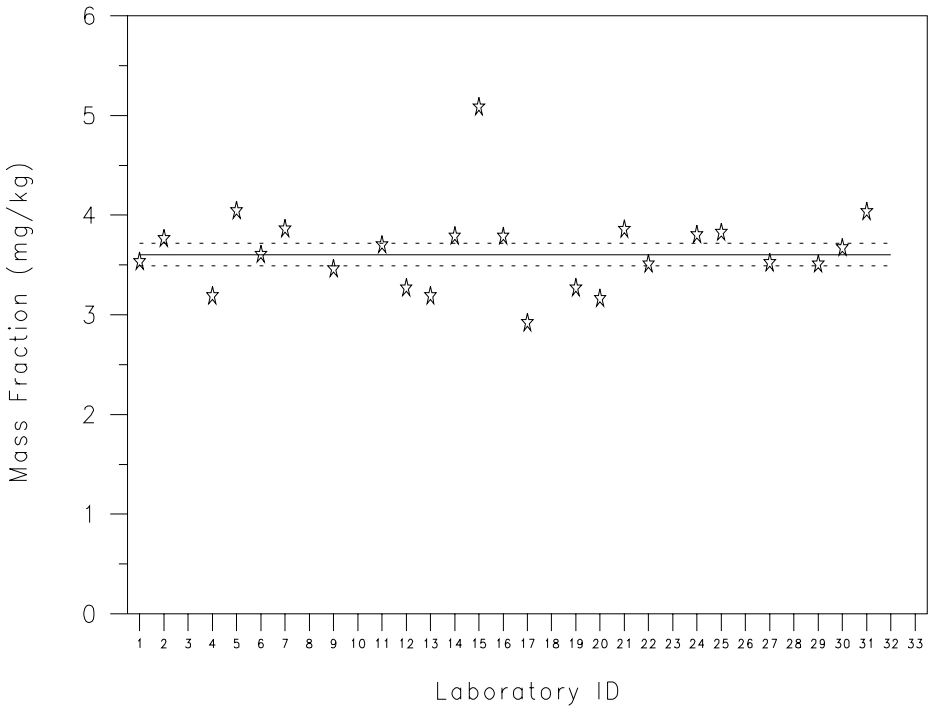
Element	Consensus Mean	Lower 95% C.L.	Upper 95% C.L.	Units
Hg	3.60	3.49	3.72	mg/kg

Lab. #	N	Laboratory Mean	Variance	Standard Deviation	Variance of mean	ML Weight	Tau Estimate	z-score	p-score
1	5	3.53	4.12E-03	0.06	8.24E-04	0.987	8.22E-04	-0.20	0.18
2	5	3.76	4.07E-03	0.06	8.14E-04	0.988	8.12E-04	0.44	0.17
4	5	3.19	2.19E-02	0.15	4.38E-03	0.935	4.49E-03	-1.15	0.46
5	6	4.04	5.47E-03	0.07	9.11E-04	0.986	9.16E-04	1.22	0.18
6	5	3.60	1.64E-02	0.13	3.29E-03	0.952	3.25E-03	0.00	0.36
7	5	3.86	4.00E-04	0.02	8.00E-05	0.999	8.00E-05	0.71	0.05
9	5	3.46	2.05E-03	0.05	4.10E-04	0.994	4.10E-04	-0.40	0.13
11	2	3.70	8.00E-04	0.03	4.00E-04	0.994	3.98E-04	0.27	0.08
12	5	3.27	5.02E-03	0.07	1.00E-03	0.985	1.01E-03	-0.93	0.22
13	5	3.19	9.08E-02	0.30	1.82E-02	0.769	1.93E-02	-1.15	0.95
14	5	3.79	5.37E-03	0.07	1.07E-03	0.984	1.07E-03	0.51	0.19
16	5	3.79	9.33E-03	0.10	1.87E-03	0.972	1.86E-03	0.51	0.26
19	5	3.27	5.97E-03	0.08	1.19E-03	0.982	1.20E-03	-0.93	0.24
20	5	3.16	2.40E-02	0.15	4.80E-03	0.929	4.96E-03	-1.23	0.49
21	5	3.86	1.30E-04	0.01	2.60E-05	1.000	2.60E-05	0.70	0.03
22	5	3.51	1.56E-02	0.12	3.11E-03	0.954	3.08E-03	-0.27	0.36
24	6	3.80	7.44E-02	0.27	1.24E-02	0.841	1.22E-02	0.55	0.72
25	5	3.82	2.28E-03	0.05	4.56E-04	0.993	4.56E-04	0.61	0.12
27	5	3.52	6.36E-02	0.25	1.27E-02	0.840	1.23E-02	-0.23	0.72
29	5	3.51	9.78E-02	0.31	1.96E-02	0.776	1.86E-02	-0.27	0.89
31	5	4.03	1.41E-01	0.38	2.81E-02	0.679	3.05E-02	1.19	0.93
Outliers									
15	5	5.08	2.14E-01	0.46	4.29E-02	-	-	4.11	0.91
17	5	2.92	7.61E-01	0.87	1.52E-01	-	-	-1.90	2.99
30	1	3.67	-	-	-	-	-	0.18	-
32	1	14.38	-	-	-	-	-	29.91	-

Raw data plot for Hg in QC04LH4



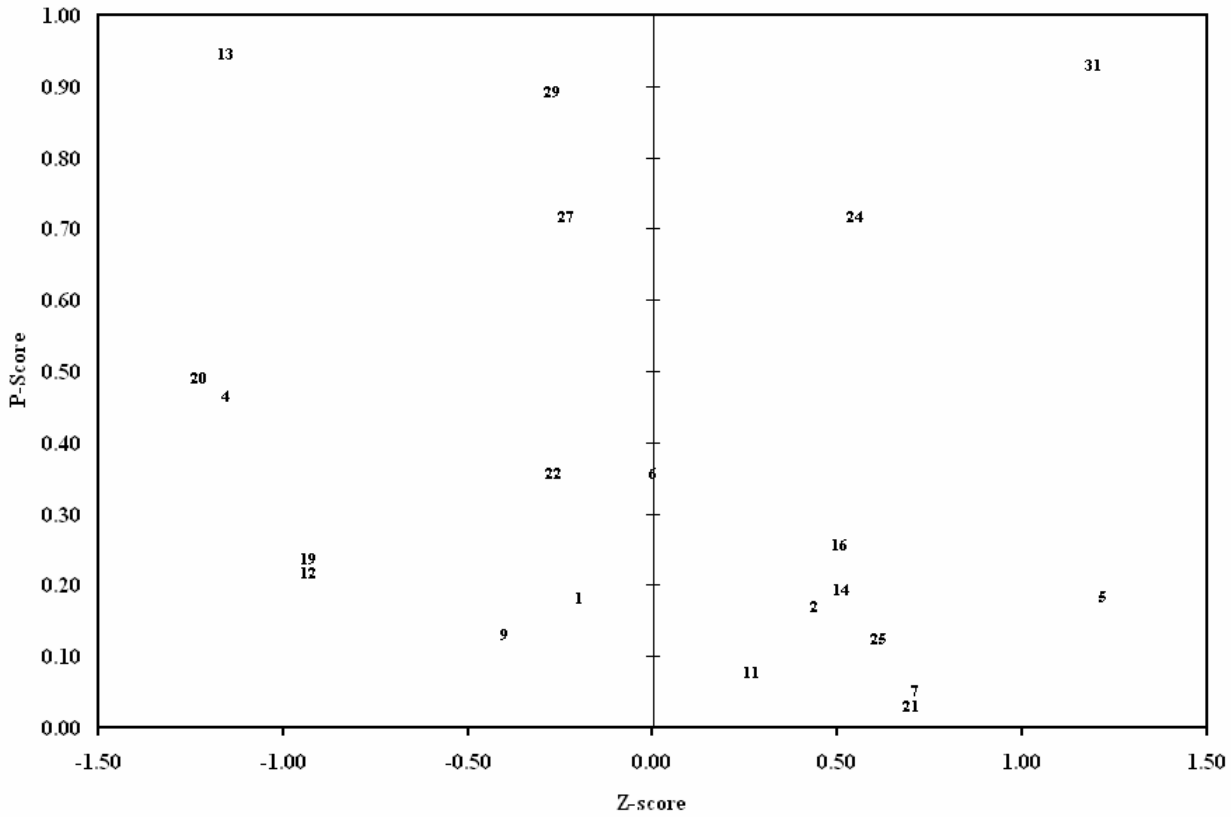
Consensus mean plot for Hg in QC04LH4



Replicates — Consensus Mean

Laboratory Mean ----- Consensus Mean 95% C.L.

Laboratory performance data plotted in z- and p-score space for Hg in QC04LH4



Youden diagram for Hg (mg/kg) measured in QC03LH3 and QC04LH4 samples

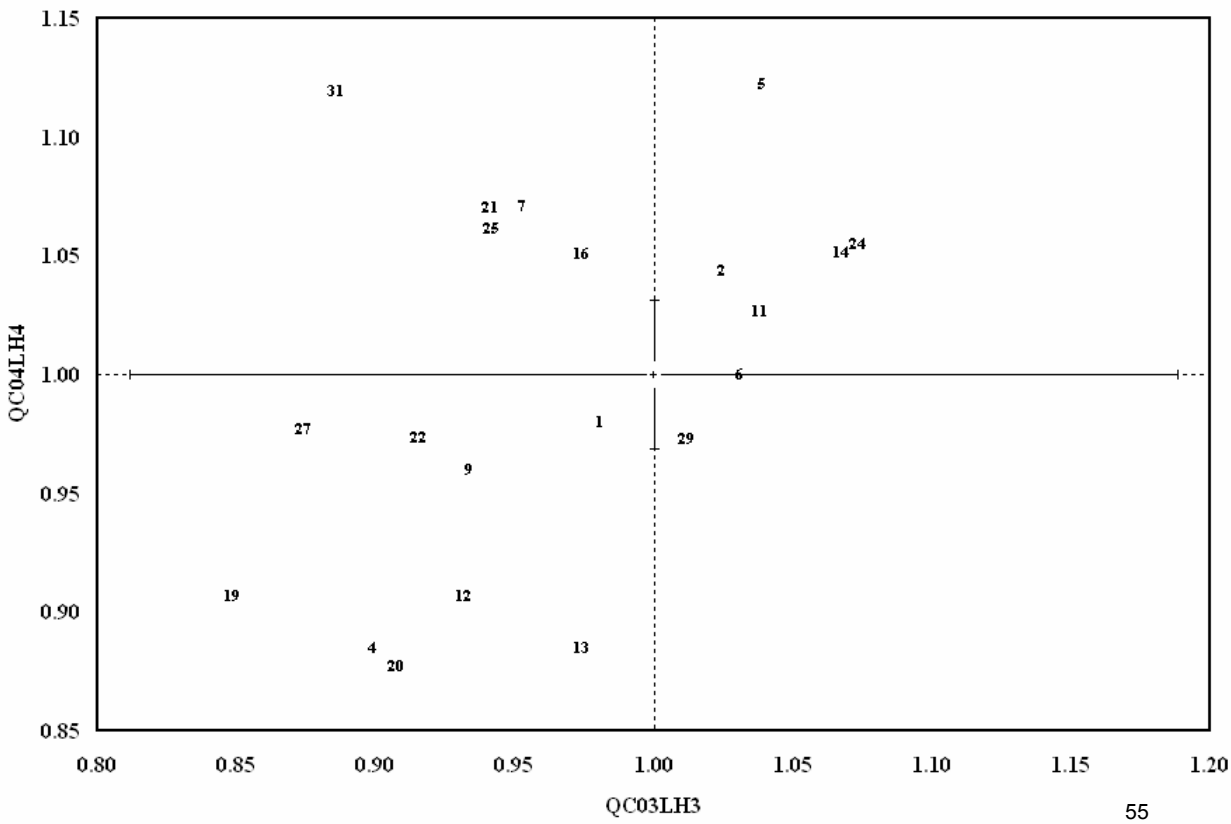
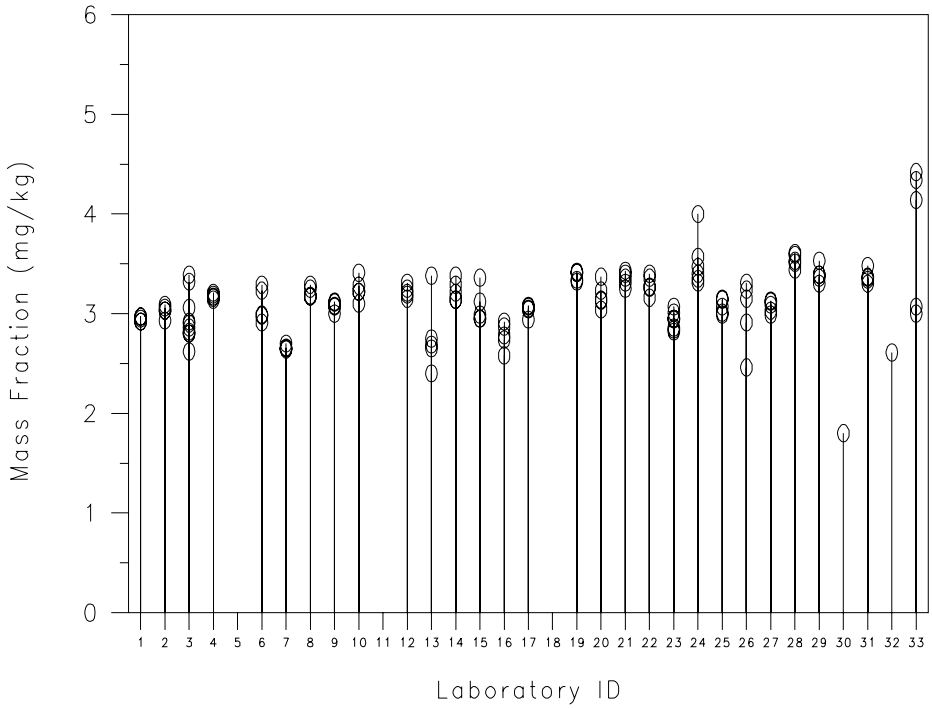


Table 12. Laboratory and consensus data for Mn in QC04LH4.

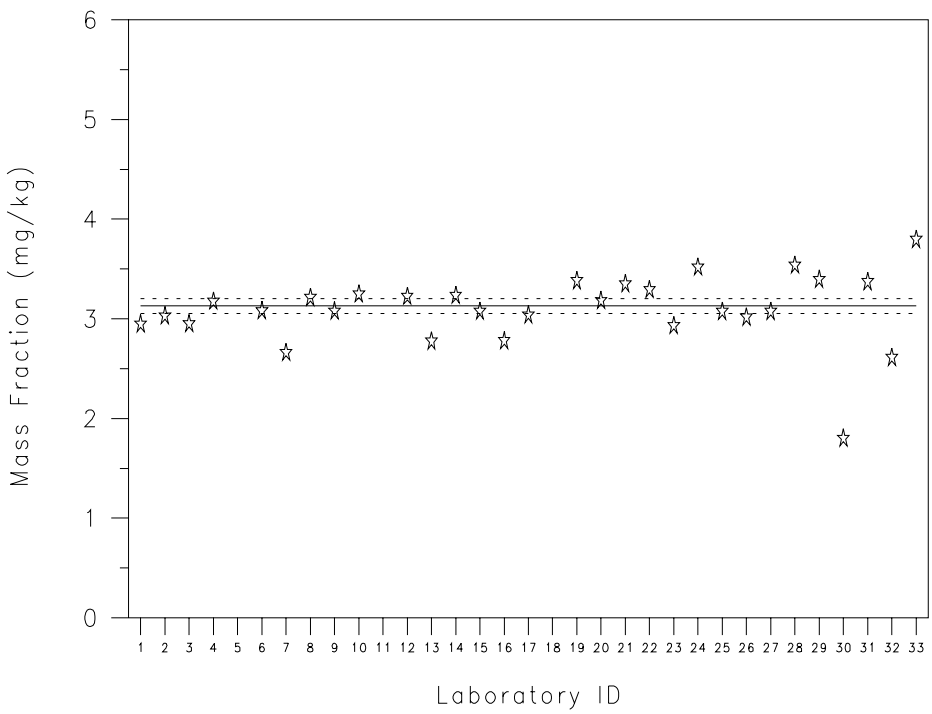
Element	Consensus Mean	Lower 95% C.L.	Upper 95% C.L.	Units
Mn	3.13	3.05	3.20	mg/kg

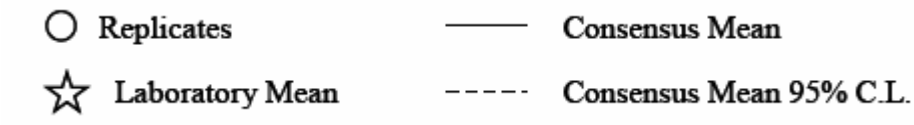
Lab. #	N	Laboratory Mean	Variance	Standard Deviation	Variance of mean	ML Weight	Tau Estimate	z-score	p-score
1	5	2.95	6.30E-04	0.03	1.26E-04	0.997	1.26E-04	-0.58	0.09
2	5	3.03	3.62E-03	0.06	7.24E-04	0.981	7.21E-04	-0.32	0.20
3	10	2.95	5.83E-02	0.24	5.83E-03	0.864	5.81E-03	-0.57	0.82
4	5	3.17	7.30E-04	0.03	1.46E-04	0.996	1.46E-04	0.15	0.09
6	5	3.08	2.84E-02	0.17	5.68E-03	0.870	5.51E-03	-0.15	0.55
7	5	2.66	5.50E-04	0.02	1.10E-04	0.997	1.10E-04	-1.50	0.09
8	5	3.21	3.02E-03	0.05	6.04E-04	0.984	6.02E-04	0.27	0.17
9	5	3.08	2.23E-03	0.05	4.46E-04	0.988	4.45E-04	-0.17	0.15
10	5	3.25	1.27E-02	0.11	2.54E-03	0.936	2.51E-03	0.38	0.35
12	5	3.22	3.72E-03	0.06	7.44E-04	0.980	7.41E-04	0.30	0.19
13	5	2.77	1.33E-01	0.36	2.65E-02	0.556	2.94E-02	-1.13	1.31
14	5	3.23	1.07E-02	0.10	2.13E-03	0.946	2.11E-03	0.33	0.32
15	5	3.07	3.04E-02	0.17	6.09E-03	0.862	5.90E-03	-0.17	0.57
16	5	2.78	1.73E-02	0.13	3.46E-03	0.910	3.63E-03	-1.12	0.47
17	5	3.04	3.13E-03	0.06	6.26E-04	0.983	6.24E-04	-0.29	0.18
19	5	3.38	2.15E-03	0.05	4.30E-04	0.988	4.31E-04	0.81	0.14
20	5	3.18	1.56E-02	0.12	3.11E-03	0.923	3.06E-03	0.17	0.39
21	5	3.35	5.15E-03	0.07	1.03E-03	0.973	1.03E-03	0.71	0.21
22	5	3.29	8.80E-03	0.09	1.76E-03	0.955	1.75E-03	0.52	0.29
23	8	2.93	7.43E-03	0.09	9.29E-04	0.975	9.29E-04	-0.63	0.29
24	6	3.52	6.45E-02	0.25	1.08E-02	0.754	1.20E-02	1.24	0.72
25	5	3.07	5.32E-03	0.07	1.06E-03	0.972	1.06E-03	-0.18	0.24
26	5	3.01	1.19E-01	0.34	2.37E-02	0.624	2.21E-02	-0.36	1.14
27	5	3.07	3.62E-03	0.06	7.24E-04	0.981	7.21E-04	-0.18	0.20
29	5	3.39	7.13E-03	0.08	1.43E-03	0.962	1.44E-03	0.85	0.25
31	5	3.37	4.50E-03	0.07	9.00E-04	0.976	9.03E-04	0.77	0.20
33	5	3.79	4.91E-01	0.70	9.82E-02	0.208	1.40E-01	2.13	1.85
Outliers									
28	5	3.54	4.37E-03	0.07	8.75E-04	-	-	1.31	0.19
30	1	1.80	-	-	-	-	-	-4.25	-
32	1	2.61	-	-	-	-	-	-1.66	-

Raw data plot for Mn in QC04LH4

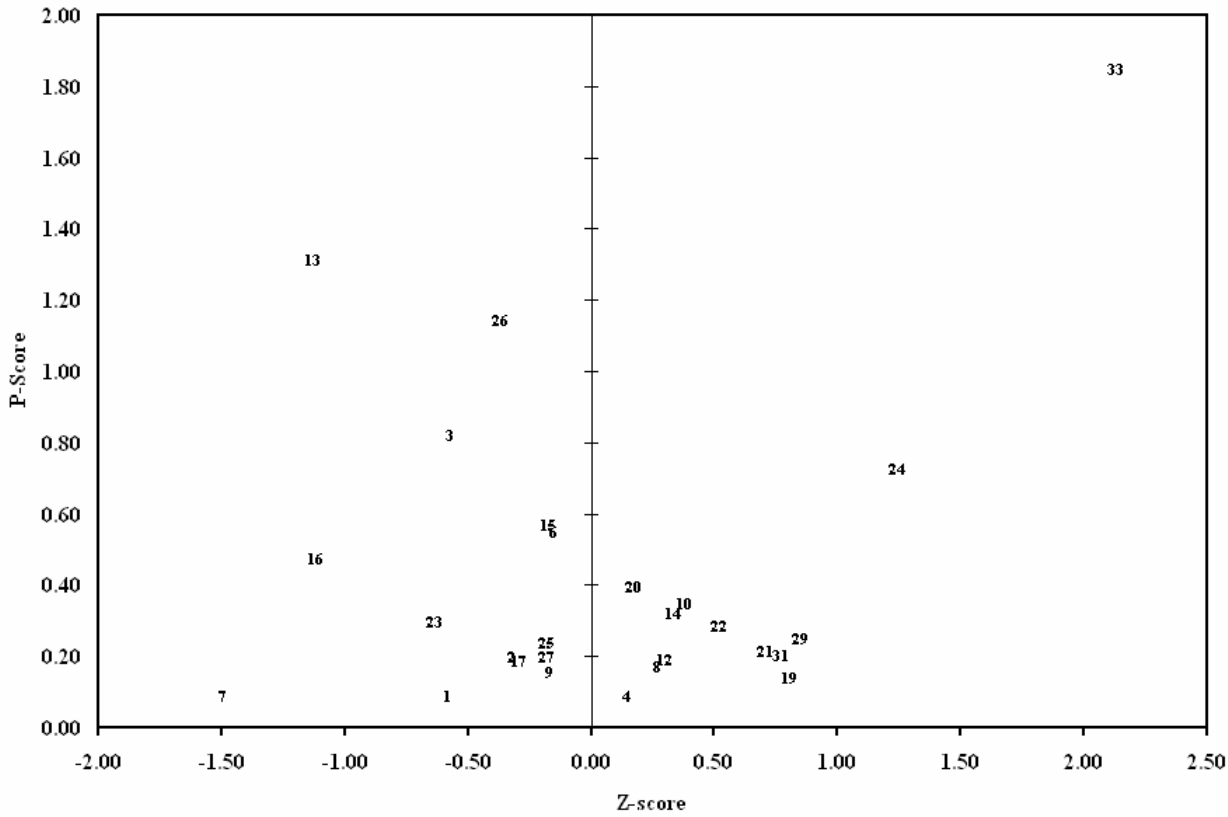


Consensus mean plot for Mn in QC04LH4





Laboratory performance data plotted in z- and p-score space for Mn in QC04LH4



Youden diagram for Mn (mg/kg) measured in QC03LH3 and QC04LH4 samples

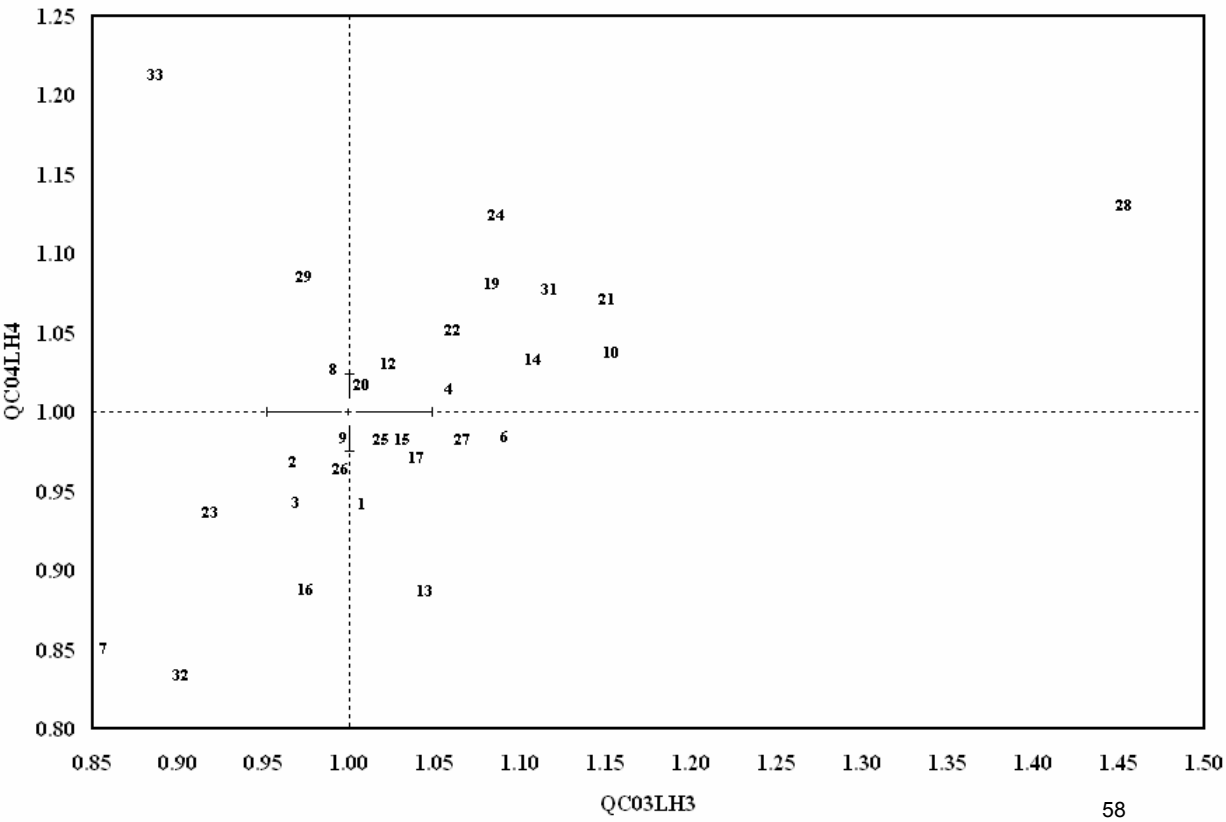
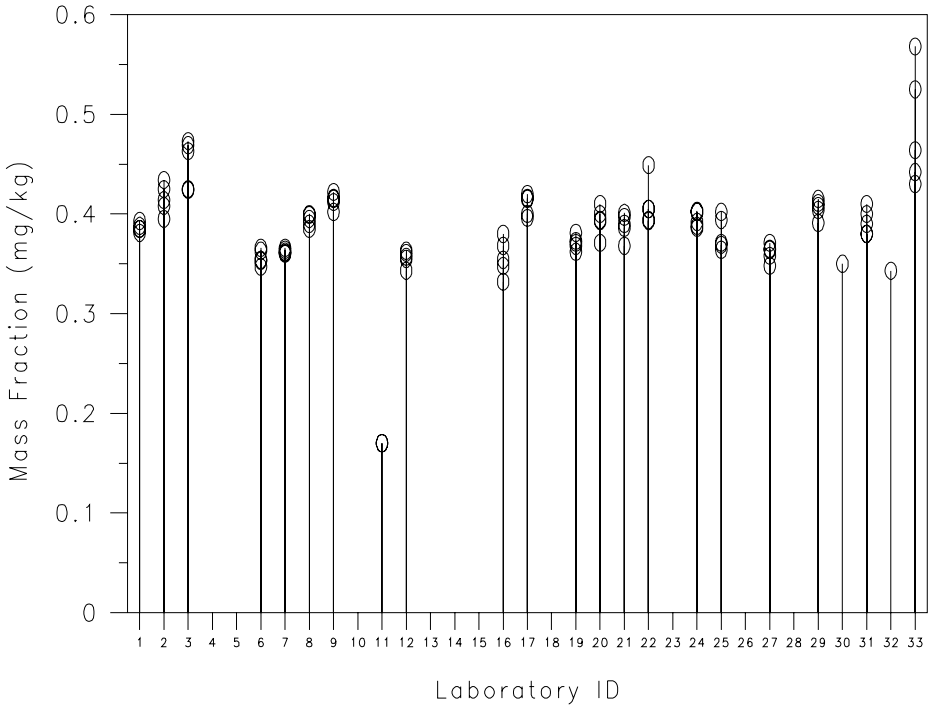


Table 13. Laboratory and consensus data for Mo in QC04LH4.

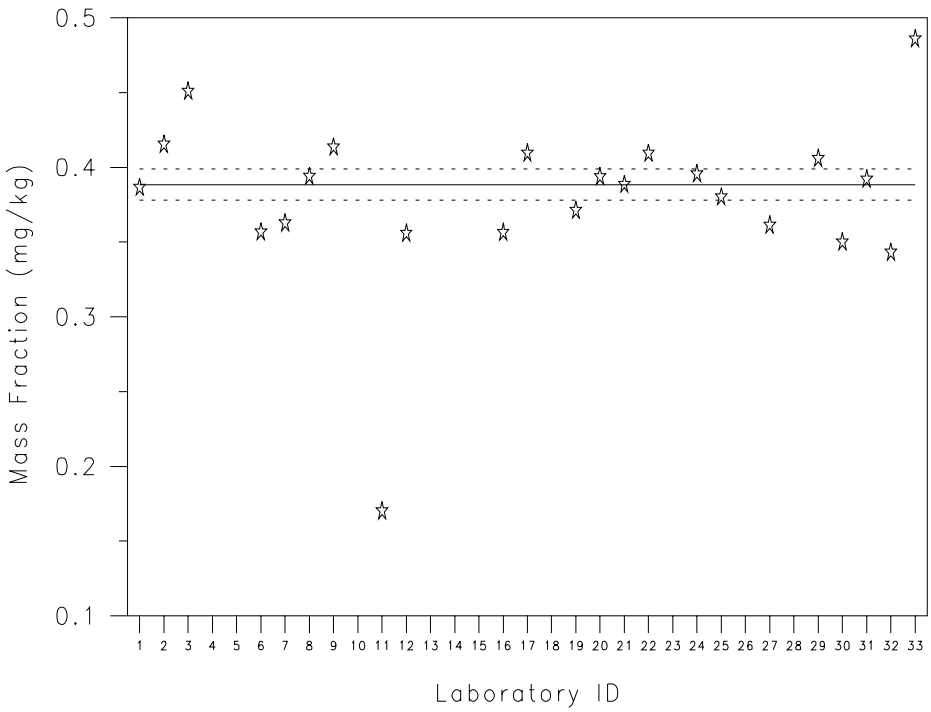
Element	Consensus Mean	Lower 95% C.L.	Upper 95% C.L.	Units
Mo	0.388	0.378	0.399	mg/kg

Lab. #	N	Laboratory Mean	Variance	Standard Deviation	Variance of mean	ML Weight	Tau Estimate	z-score	p-score
1	5	0.386	1.98E-05	0.004	3.96E-06	0.992	3.95E-06	-0.05	0.12
2	5	0.415	2.28E-04	0.015	4.55E-05	0.916	4.58E-05	0.69	0.36
3	5	0.451	5.89E-04	0.024	1.18E-04	0.749	1.69E-04	1.61	0.54
6	5	0.357	6.03E-05	0.008	1.21E-05	0.976	1.21E-05	-0.82	0.22
7	5	0.363	5.80E-06	0.002	1.16E-06	0.998	1.16E-06	-0.67	0.07
8	5	0.394	3.97E-05	0.006	7.94E-06	0.984	7.91E-06	0.14	0.16
9	5	0.413	5.38E-05	0.007	1.08E-05	0.979	1.08E-05	0.64	0.18
12	5	0.356	6.12E-05	0.008	1.22E-05	0.976	1.23E-05	-0.84	0.22
16	5	0.356	3.41E-04	0.018	6.82E-05	0.878	6.99E-05	-0.82	0.52
17	5	0.409	1.14E-04	0.011	2.28E-05	0.957	2.27E-05	0.54	0.26
19	5	0.371	4.85E-05	0.007	9.70E-06	0.981	9.68E-06	-0.45	0.19
20	5	0.394	2.05E-04	0.014	4.11E-05	0.926	4.03E-05	0.13	0.36
21	5	0.388	1.64E-04	0.013	3.29E-05	0.939	3.24E-05	0.00	0.33
22	5	0.409	5.28E-04	0.023	1.06E-04	0.828	1.04E-04	0.53	0.56
24	6	0.396	5.99E-05	0.008	9.98E-06	0.981	9.95E-06	0.18	0.20
25	5	0.380	2.85E-04	0.017	5.69E-05	0.900	5.57E-05	-0.22	0.44
27	5	0.361	7.57E-05	0.009	1.51E-05	0.971	1.52E-05	-0.70	0.24
29	5	0.406	8.47E-05	0.009	1.69E-05	0.967	1.69E-05	0.45	0.23
31	5	0.392	1.70E-04	0.013	3.40E-05	0.937	3.35E-05	0.09	0.33
Outliers									
11	2	0.170	0.00E+00	0.000	0.00E+00	-	-	-5.62	0.00
28	5	2094.912	1.33E+03	36.416	2.65E+02	-	-	53922.04	0.17
30	1	0.350	-	-	-	-	-	-0.99	-
32	1	0.343	-	-	-	-	-	-1.17	-
33	5	0.486	3.47E-03	0.059	6.93E-04	-	-	2.51	1.21

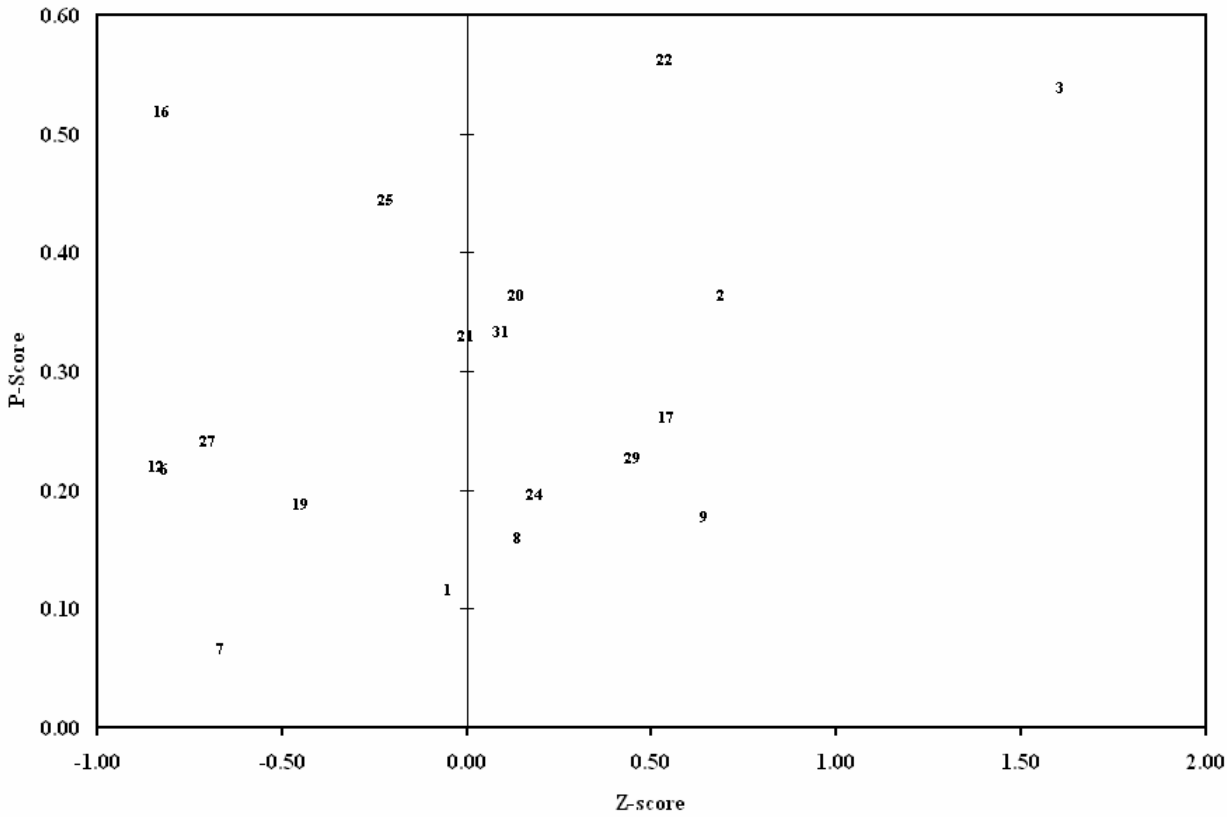
Raw data plot for Mo in QC04LH4



Consensus mean plot for Mo in QC04LH4



Laboratory performance data plotted in z- and p-score space for Mo in QC04LH4



Youden diagram for Mo (mg/kg) measured in QC03LH3 and QC04LH4 samples

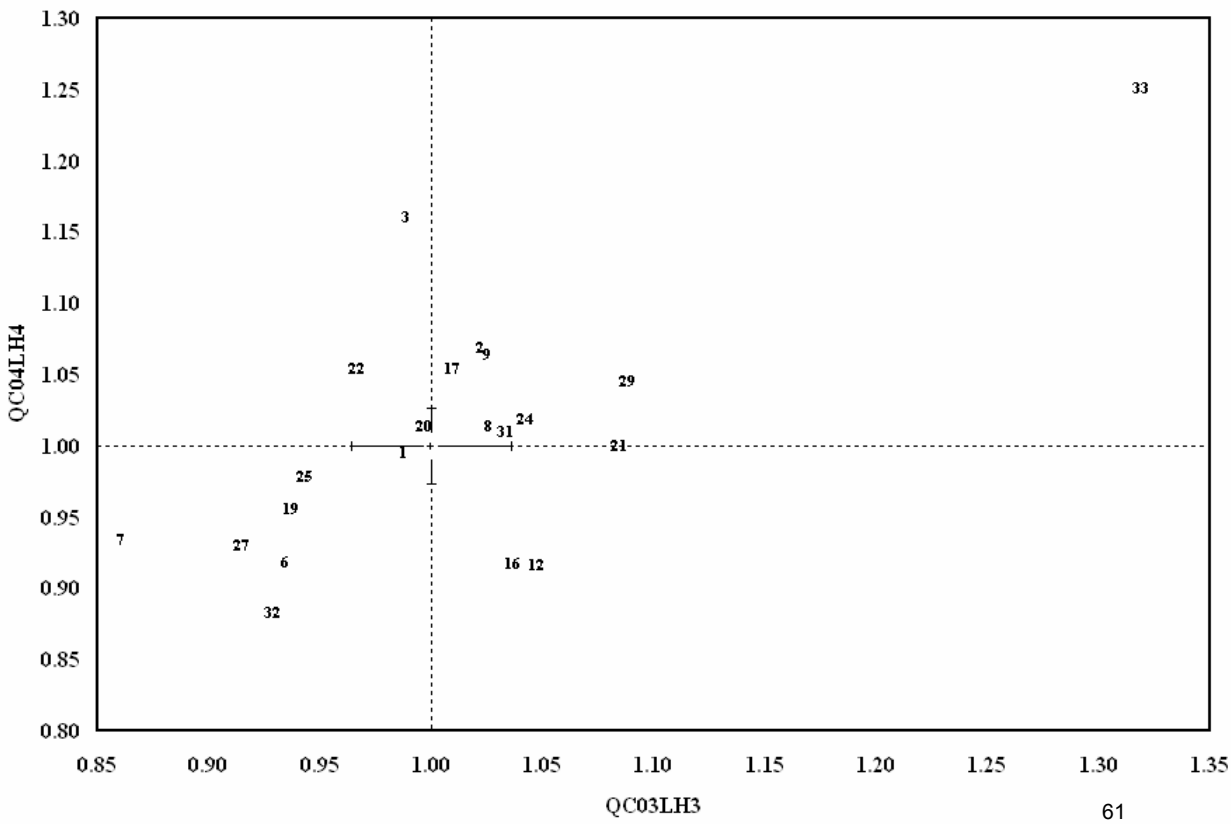
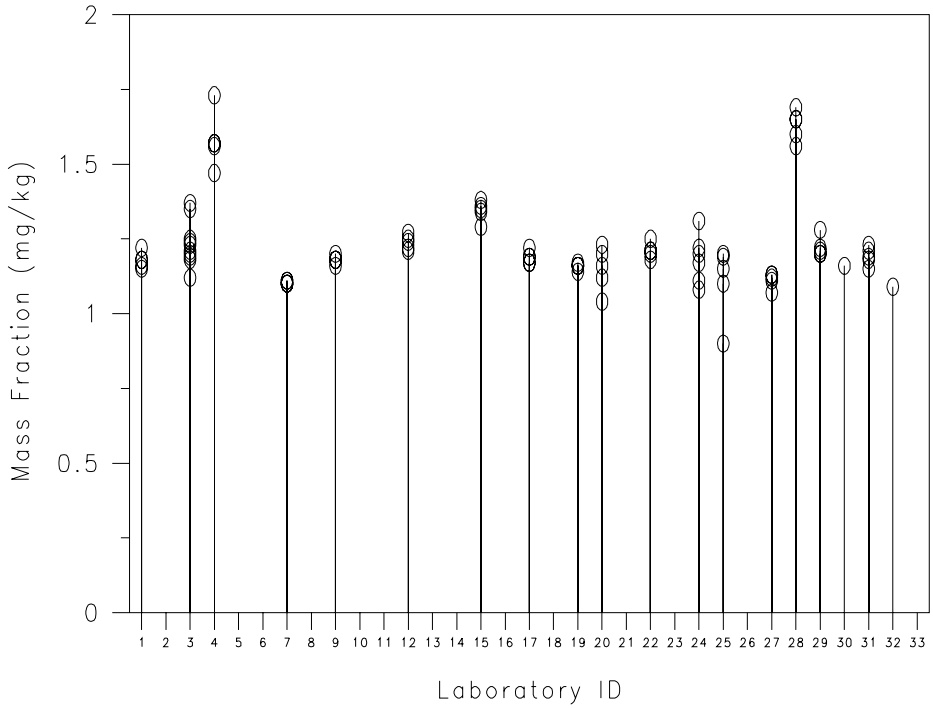


Table 14. Laboratory and consensus data for Rb in QC04LH4.

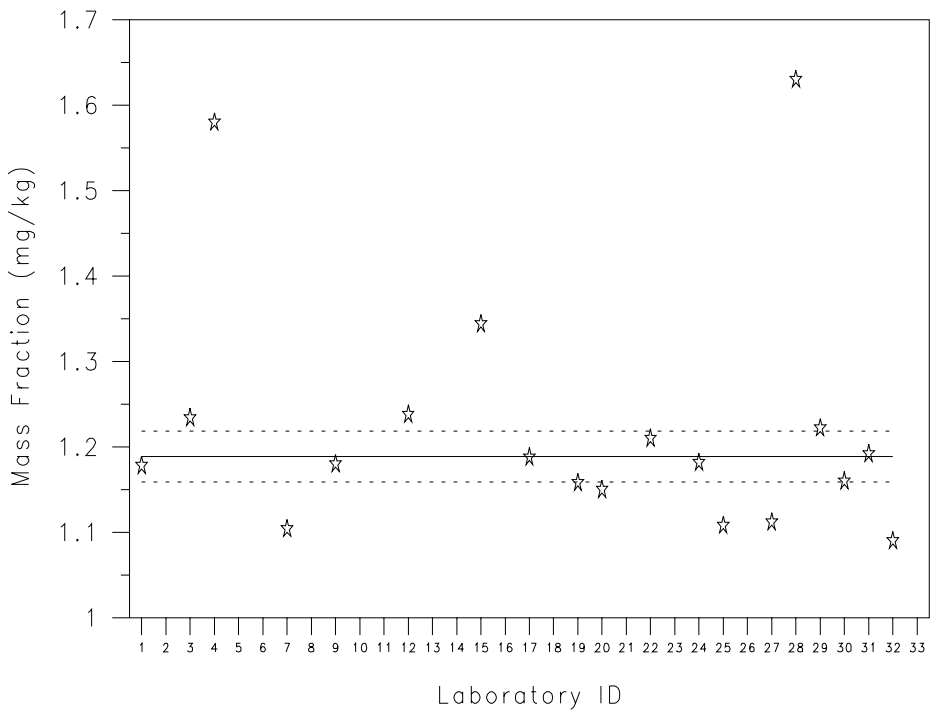
Element	Consensus Mean	Lower 95% C.L.	Upper 95% C.L.	Units
Rb	**1.19**	**1.16**	**1.22**	**mg/kg**

Lab. #	N	Laboratory Mean	Variance	Standard Deviation	Variance of mean	ML Weight	Tau Estimate	z-score	p-score
1	5	1.18	7.20E-04	0.03	1.44E-04	0.956	1.43E-04	-0.09	0.23
3	10	1.23	5.76E-03	0.08	5.76E-04	0.845	5.72E-04	0.38	0.62
7	5	1.10	3.00E-05	0.01	6.00E-06	0.998	6.00E-06	-0.71	0.05
9	5	1.18	2.00E-04	0.01	4.00E-05	0.987	3.99E-05	-0.07	0.12
12	5	1.24	5.70E-04	0.02	1.14E-04	0.965	1.14E-04	0.41	0.19
15	5	1.34	1.13E-03	0.03	2.26E-04	0.924	2.56E-04	1.31	0.25
17	5	1.19	4.20E-04	0.02	8.40E-05	0.974	8.35E-05	-0.01	0.17
19	5	1.16	1.20E-04	0.01	2.40E-05	0.992	2.40E-05	-0.26	0.09
20	5	1.15	5.50E-03	0.07	1.10E-03	0.747	1.06E-03	-0.33	0.64
22	5	1.21	6.50E-04	0.03	1.30E-04	0.960	1.29E-04	0.18	0.21
24	6	1.18	6.78E-03	0.08	1.13E-03	0.744	1.08E-03	-0.06	0.70
25	5	1.11	1.51E-02	0.12	3.01E-03	0.507	3.04E-03	-0.68	1.11
27	5	1.11	6.20E-04	0.02	1.24E-04	0.962	1.25E-04	-0.65	0.22
29	5	1.22	1.12E-03	0.03	2.24E-04	0.934	2.22E-04	0.28	0.27
31	5	1.19	9.20E-04	0.03	1.84E-04	0.945	1.82E-04	0.03	0.25
Outliers									
4	5	1.6	8.80E-03	9.38E-02	1.76E-03	-	-	3.29	0.59
28	5	1.630	2.50E-03	0.050	5.00E-04	-	-	3.71	0.31
30	1	1.160	-	-	-	-	-	-	-
32	1	1.090	-	-	-	-	-	-	-

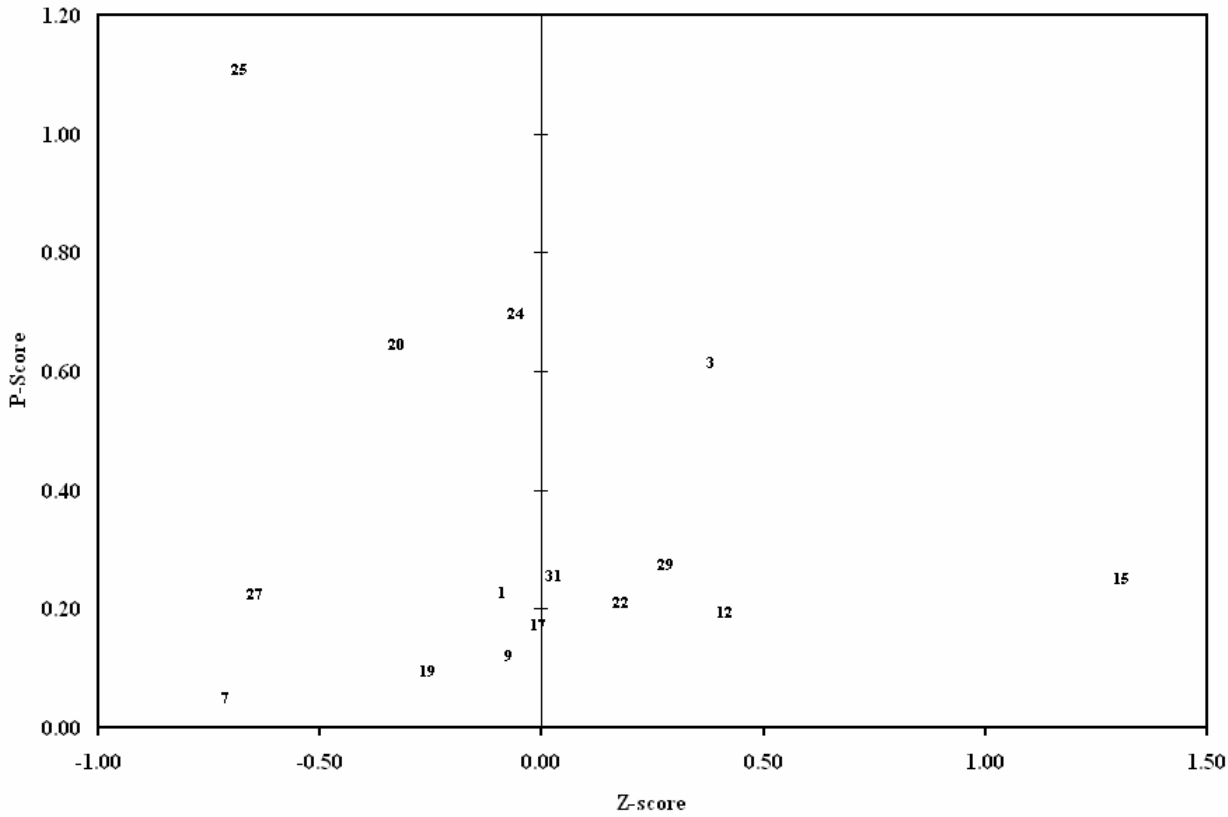
Raw data plot for Rb in QC04LH4



Consensus mean plot for Rb in QC04LH4



Laboratory performance data plotted in z- and p-score space for Rb in QC04LH4



Youden diagram for Rb (mg/kg) measured in QC03LH3 and QC04LH4 samples

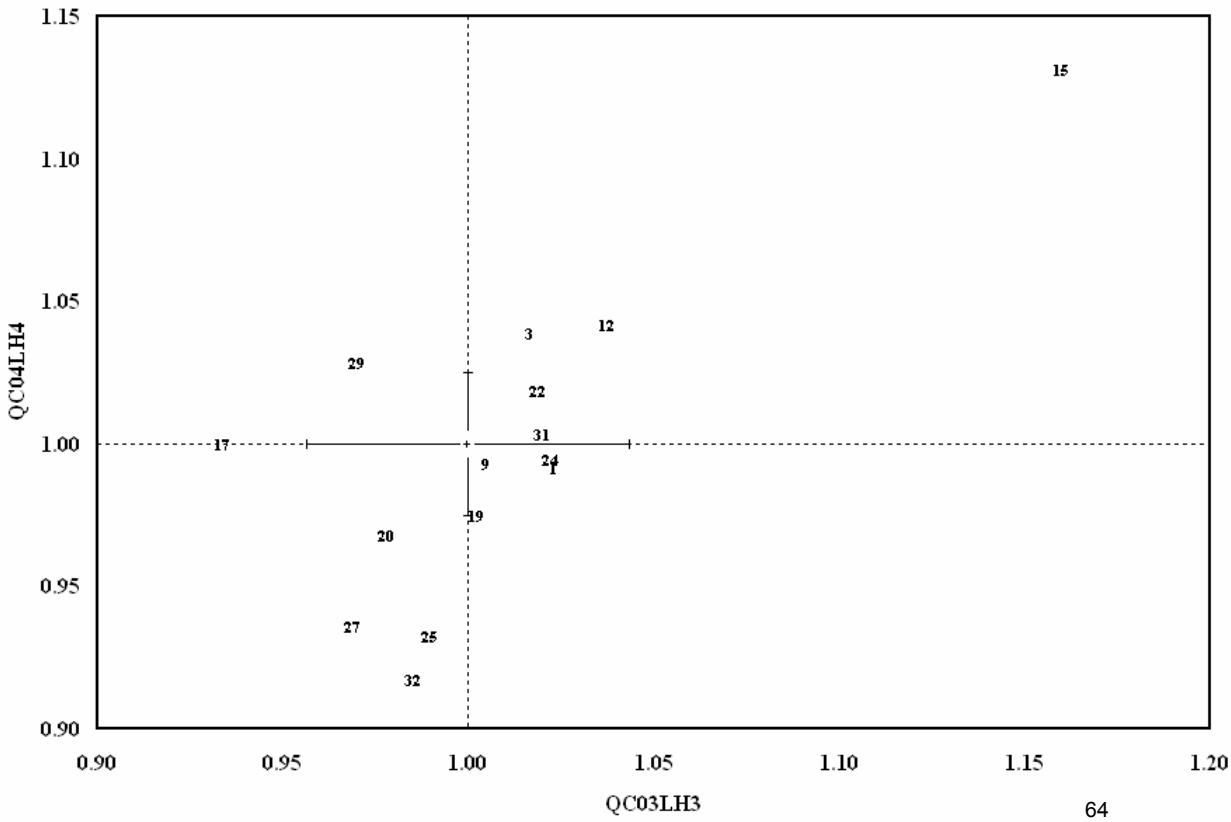
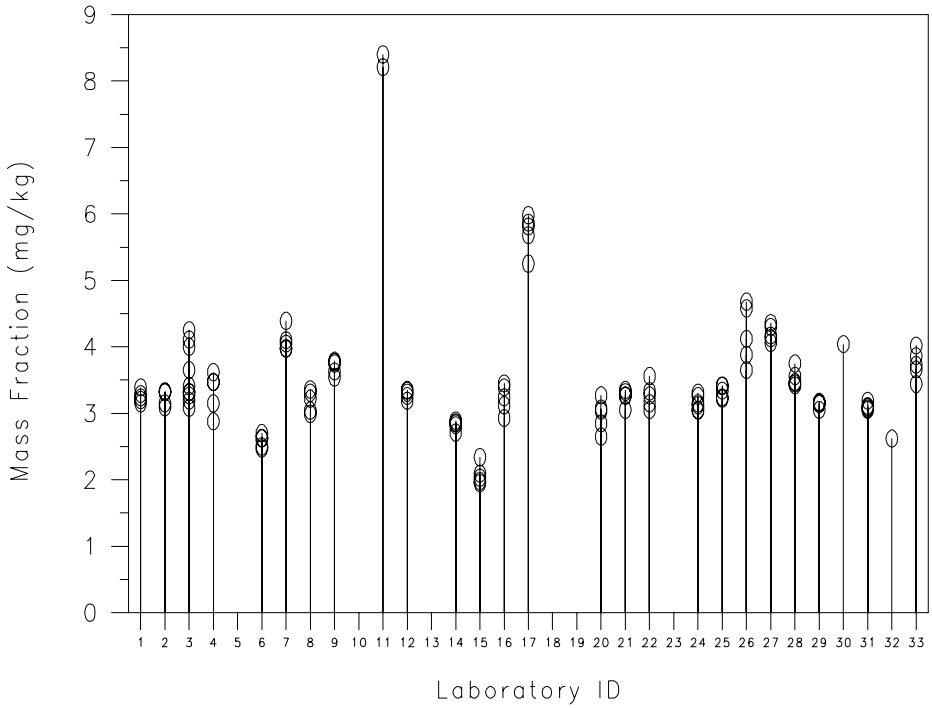


Table 15. Laboratory and consensus data for Se in QC04LH4.

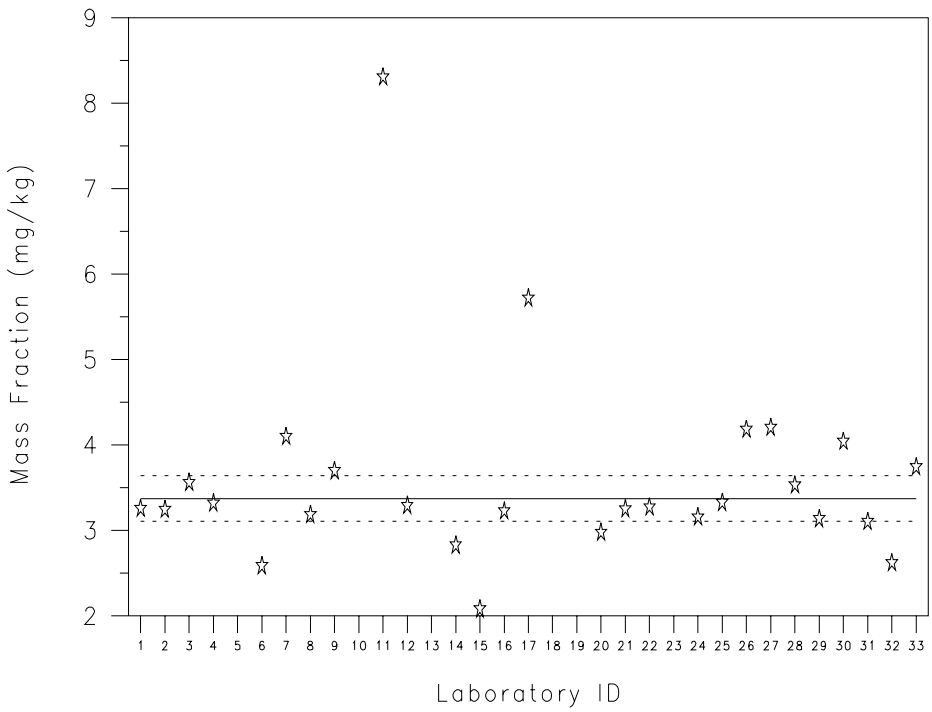
Element	Consensus Mean	Lower 95% C.L.	Upper 95% C.L.	Units
Se	3.37	3.11	3.64	mg/kg

Lab. #	N	Laboratory Mean	Variance	Standard Deviation	Variance of mean	ML Weight	Tau Estimate	z-score	p-score
1	5	3.25	8.43E-03	0.09	1.69E-03	0.996	1.68E-03	-0.35	0.28
2	5	3.24	1.29E-02	0.11	2.57E-03	0.994	2.57E-03	-0.39	0.35
3	10	3.56	1.74E-01	0.42	1.74E-02	0.960	1.74E-02	0.55	1.17
4	5	3.32	8.94E-02	0.30	1.79E-02	0.959	1.77E-02	-0.16	0.90
6	5	2.58	9.23E-03	0.10	1.85E-03	0.996	1.85E-03	-2.34	0.37
7	5	4.10	2.95E-02	0.17	5.89E-03	0.986	5.90E-03	2.15	0.42
8	5	3.18	2.66E-02	0.16	5.33E-03	0.987	5.31E-03	-0.56	0.51
9	5	3.70	1.15E-02	0.11	2.30E-03	0.995	2.29E-03	0.96	0.29
12	5	3.29	4.35E-03	0.07	8.70E-04	0.998	8.70E-04	-0.25	0.20
14	5	2.83	4.83E-03	0.07	9.66E-04	0.998	9.66E-04	-1.62	0.25
15	5	2.08	2.43E-02	0.16	4.85E-03	0.988	4.90E-03	-3.84	0.75
16	5	3.23	4.40E-02	0.21	8.81E-03	0.979	8.76E-03	-0.44	0.65
17	5	5.72	8.02E-02	0.28	1.60E-02	0.958	1.83E-02	6.95	0.50
20	5	2.98	5.54E-02	0.24	1.11E-02	0.974	1.10E-02	-1.18	0.79
21	5	3.25	1.39E-02	0.12	2.77E-03	0.993	2.77E-03	-0.37	0.36
22	5	3.27	3.76E-02	0.19	7.52E-03	0.982	7.49E-03	-0.30	0.59
24	6	3.16	1.21E-02	0.11	2.02E-03	0.995	2.02E-03	-0.65	0.35
25	5	3.33	8.68E-03	0.09	1.74E-03	0.996	1.73E-03	-0.14	0.28
26	5	4.18	1.96E-01	0.44	3.92E-02	0.913	3.96E-02	2.40	1.06
28	5	3.53	1.78E-02	0.13	3.57E-03	0.991	3.56E-03	0.46	0.38
29	5	3.13	2.33E-03	0.05	4.66E-04	0.999	4.66E-04	-0.71	0.15
31	5	3.10	2.92E-03	0.05	5.84E-04	0.999	5.84E-04	-0.80	0.17
33	5	3.74	4.73E-02	0.22	9.46E-03	0.978	9.43E-03	1.09	0.58
Outliers									
11	2	8.31	1.81E-02	0.13	9.03E-03	-	-	14.62	0.16
27	5	4.20	1.52E-02	0.12	3.03E-03	-	-	2.46	0.29
30	1	4.04	-	-	-	-	-	-	-
32	1	2.62	-	-	-	-	-	-	-

Raw data plot for Se in QC04LH4



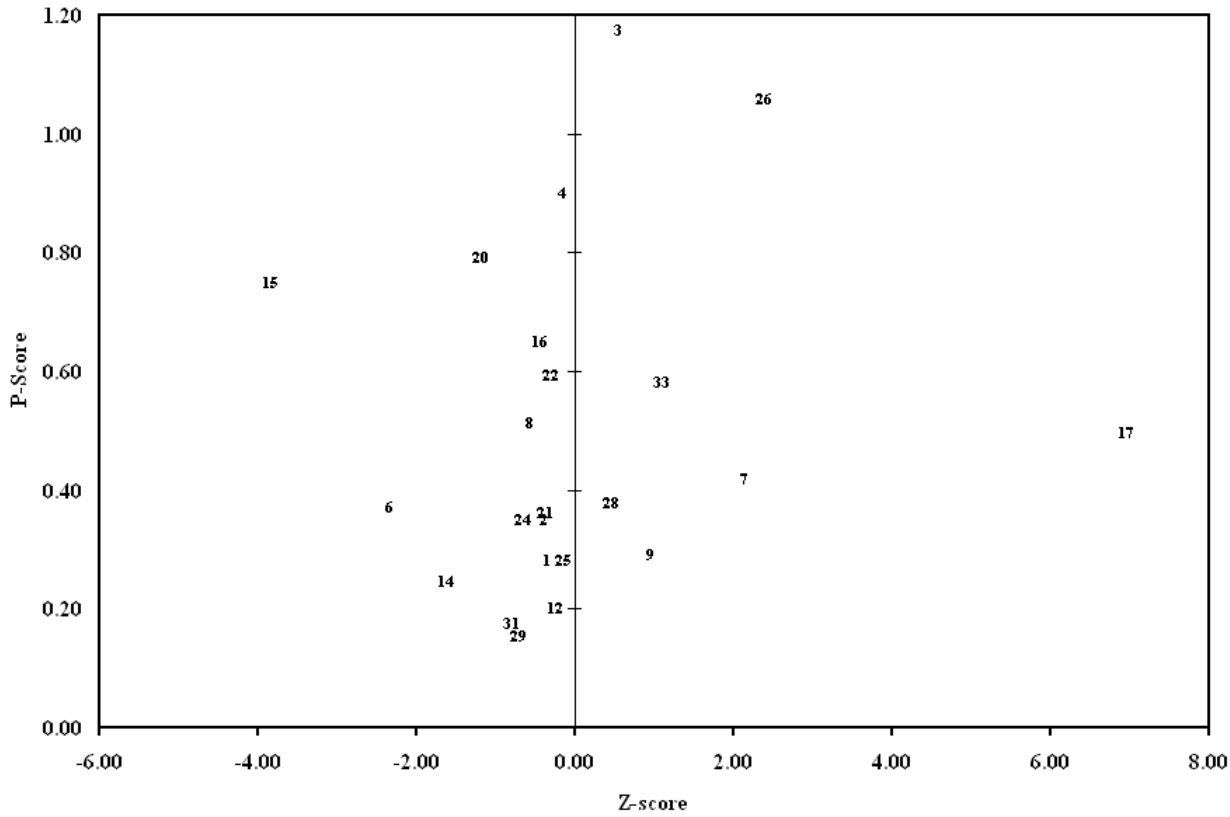
Consensus mean plot for Se in QC04LH4



Replicates — Consensus Mean

Laboratory Mean ----- Consensus Mean 95% C.L.

Laboratory performance data plotted in z- and p-score space for Se in QC04LH4



Youden diagram for Se (mg/kg) measured in QC03LH3 and QC04LH4 samples

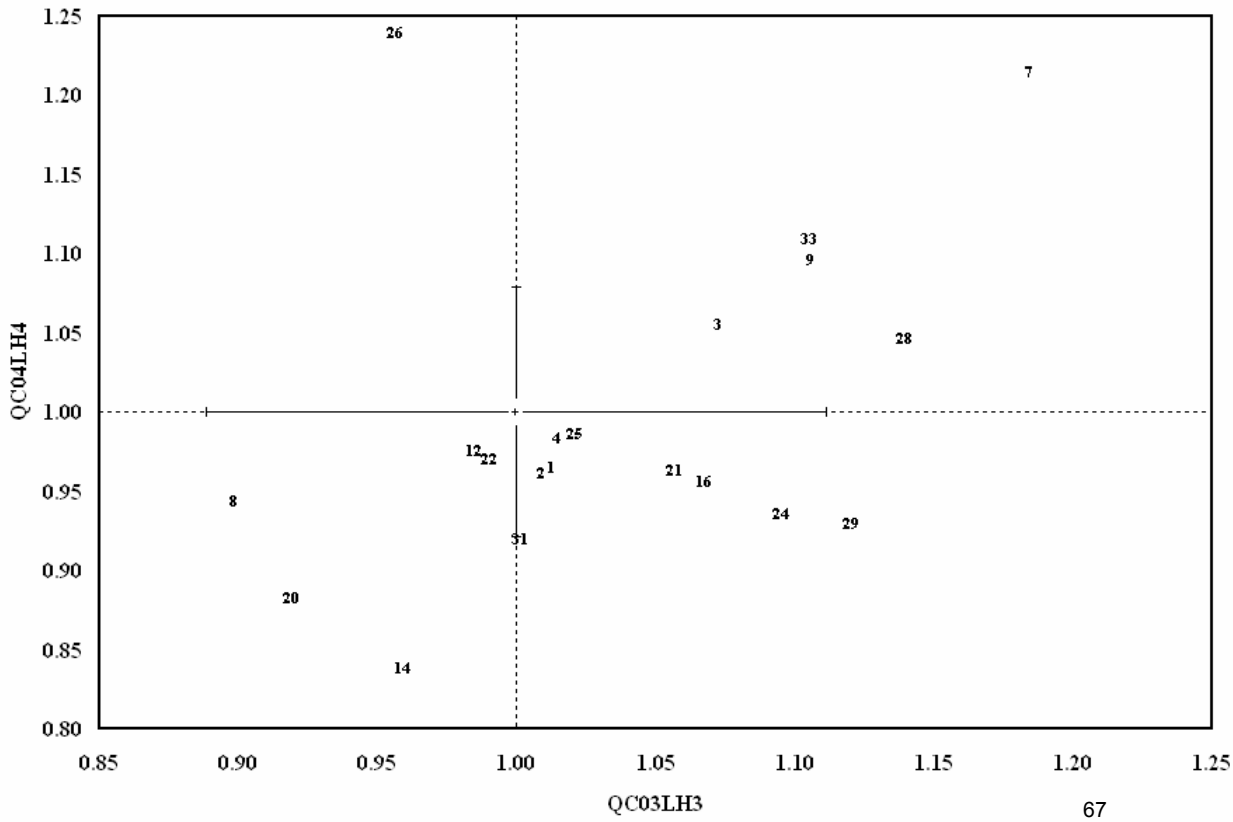
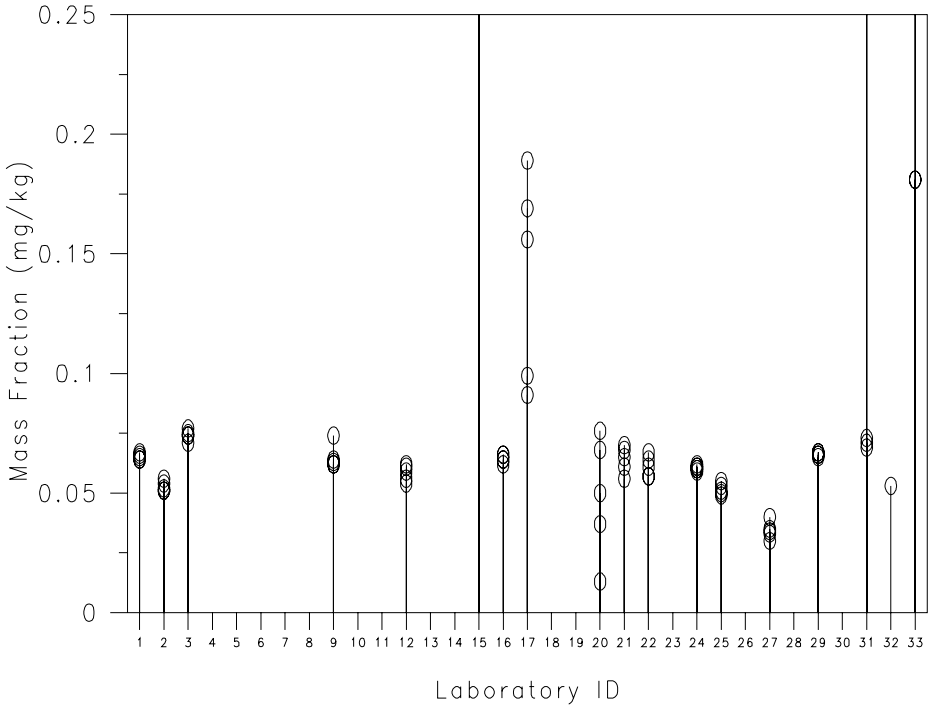


Table 16. Laboratory and consensus data for Sn in QC04LH4.

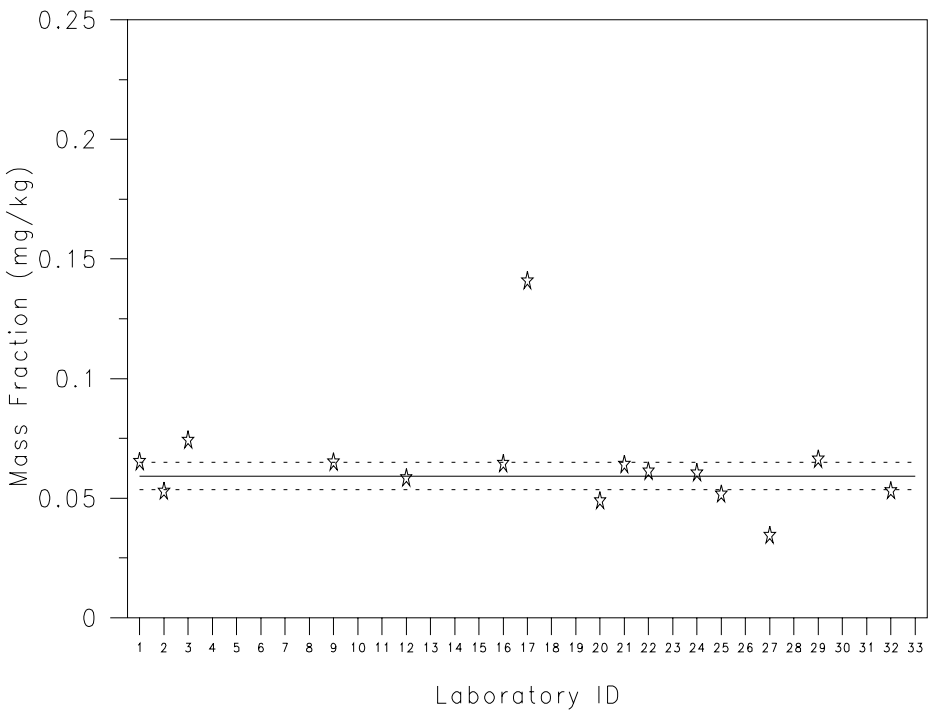
Element	Consensus Mean	Lower 95% C.L.	Upper 95% C.L.	Units
Sn	**0.059**	**0.054**	**0.065**	**mg/kg**

Lab. #	N	Laboratory Mean	Variance	Standard Deviation	Variance of mean	ML Weight	Tau Estimate	z-score	p-score
1	5	0.065	1.70E-06	0.001	3.40E-07	0.996	3.40E-07	1.00	0.20
2	5	0.053	4.70E-06	0.002	9.40E-07	0.990	9.39E-07	-1.09	0.41
3	5	0.074	4.70E-06	0.002	9.40E-07	0.990	9.43E-07	2.52	0.29
9	5	0.065	2.60E-05	0.005	5.20E-06	0.949	5.16E-06	0.96	0.78
12	5	0.058	1.13E-05	0.003	2.26E-06	0.977	2.25E-06	-0.15	0.58
16	5	0.064	2.80E-06	0.002	5.60E-07	0.994	5.59E-07	0.86	0.26
20	5	0.049	6.33E-04	0.025	1.27E-04	0.449	1.19E-04	-1.77	5.15
21	5	0.064	3.15E-05	0.006	6.30E-06	0.939	6.23E-06	0.80	0.88
24	6	0.061	1.10E-06	0.001	1.83E-07	0.998	1.83E-07	0.21	0.17
25	5	0.052	5.80E-06	0.002	1.16E-06	0.988	1.16E-06	-1.30	0.47
27	5	0.034	1.33E-05	0.004	2.66E-06	0.972	2.76E-06	-4.20	1.06
29	5	0.066	7.00E-07	0.001	1.40E-07	0.999	1.40E-07	1.17	0.13
Outliers									
15	5	0.681	3.47E-02	0.186	6.93E-03	-	-	104.84	2.73
17	5	0.141	1.89E-03	0.044	3.79E-04	-	-	13.75	3.09
22	5	0.061	2.04E-05	0.005	4.07E-06	-	-	0.32	0.74
28	5	220.499	6.74E+01	8.207	1.35E+01	-	-	37186.05	0.37
31	5	0.401	5.61E-01	0.749	1.12E-01	-	-	57.71	18.66
32	1	0.053	-	-	-	-	-	-1.13	-
33	5	0.652	4.15E-01	0.645	8.31E-02	-	-	100.03	9.88

Raw data plot for Sn in QC04LH4



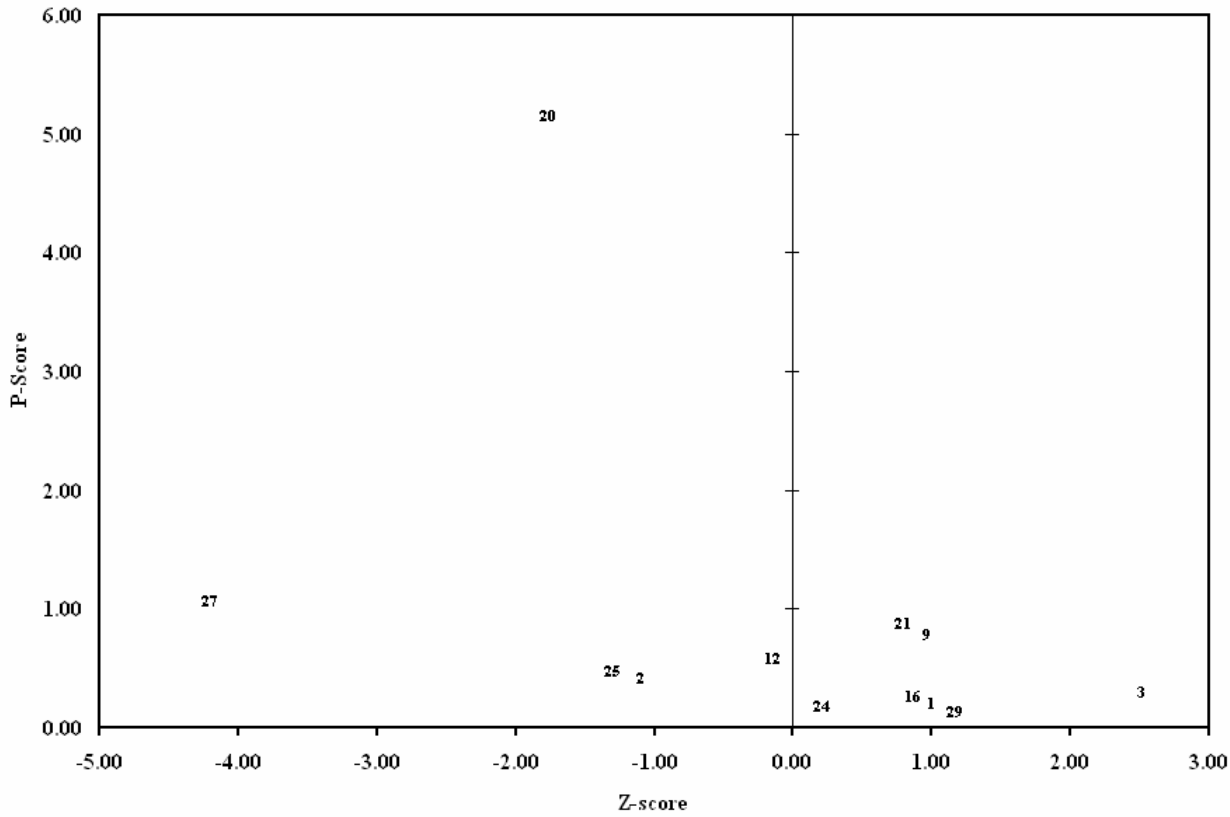
Consensus mean plot for Sn in QC04LH4



Replicates — Consensus Mean

Laboratory Mean ----- Consensus Mean 95% C.L.

Laboratory performance data plotted in z- and p-score space for Sn in QC04LH4



Youden diagram for Sn (mg/kg) measured in QC03LH3 and QC04LH4 samples

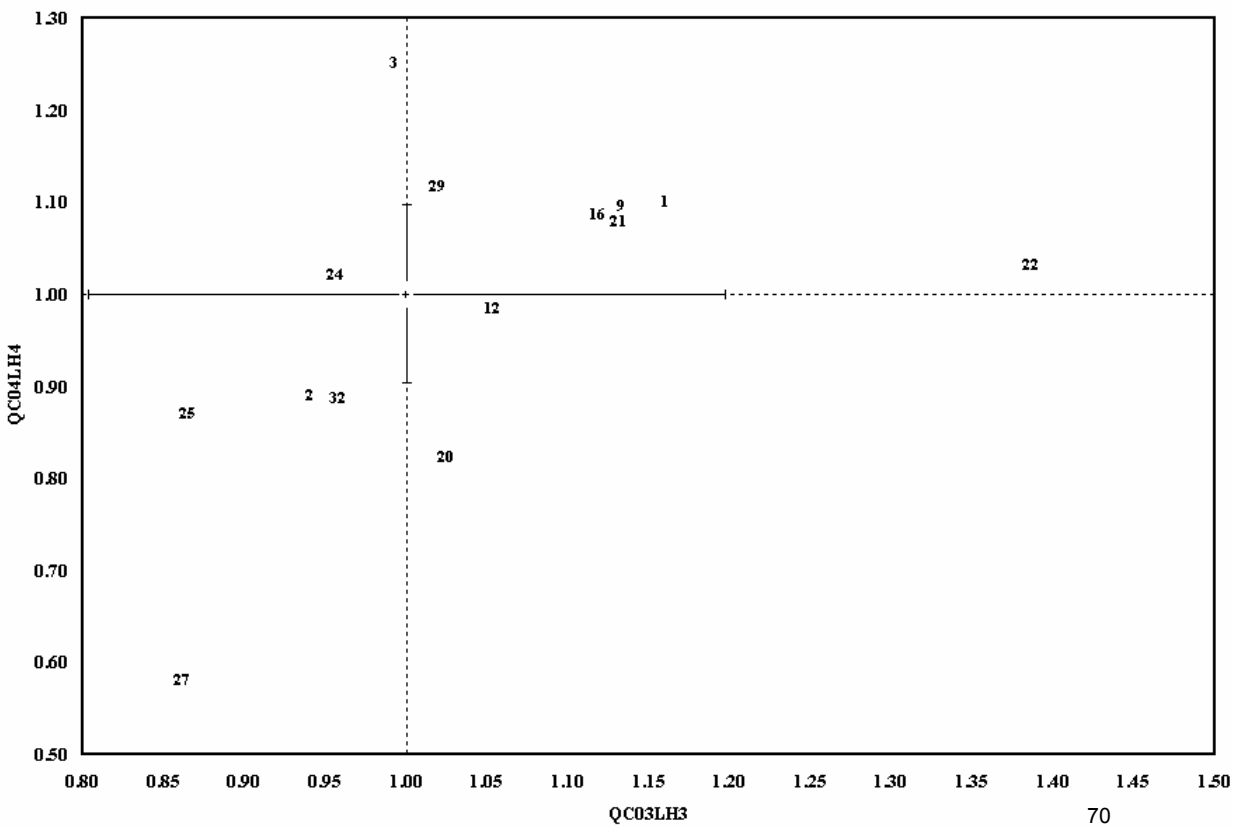
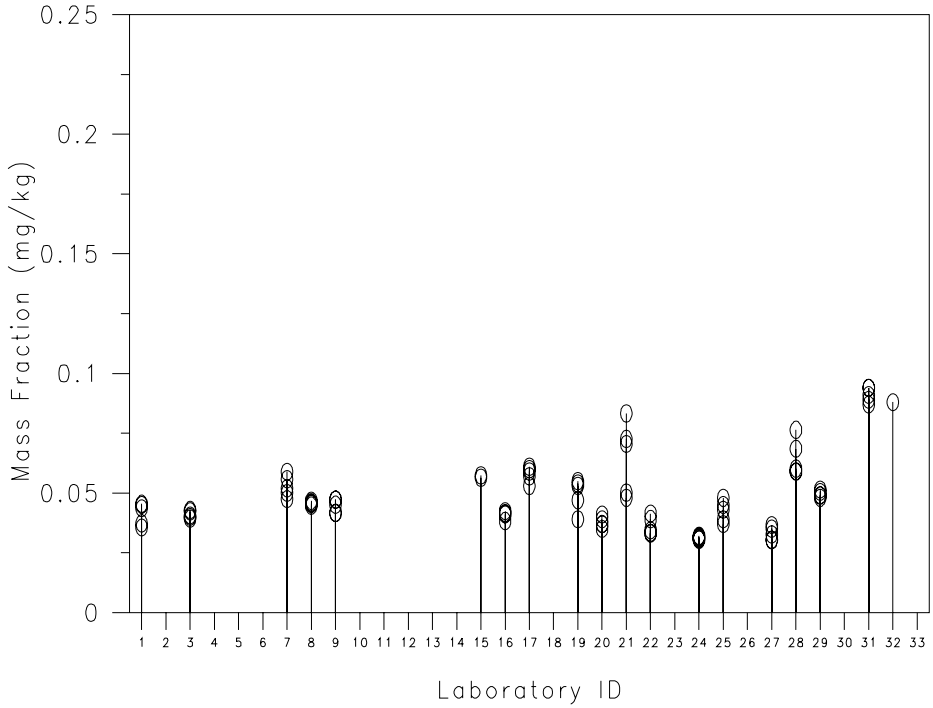


Table 17. Laboratory and consensus data for V in QC04LH4.

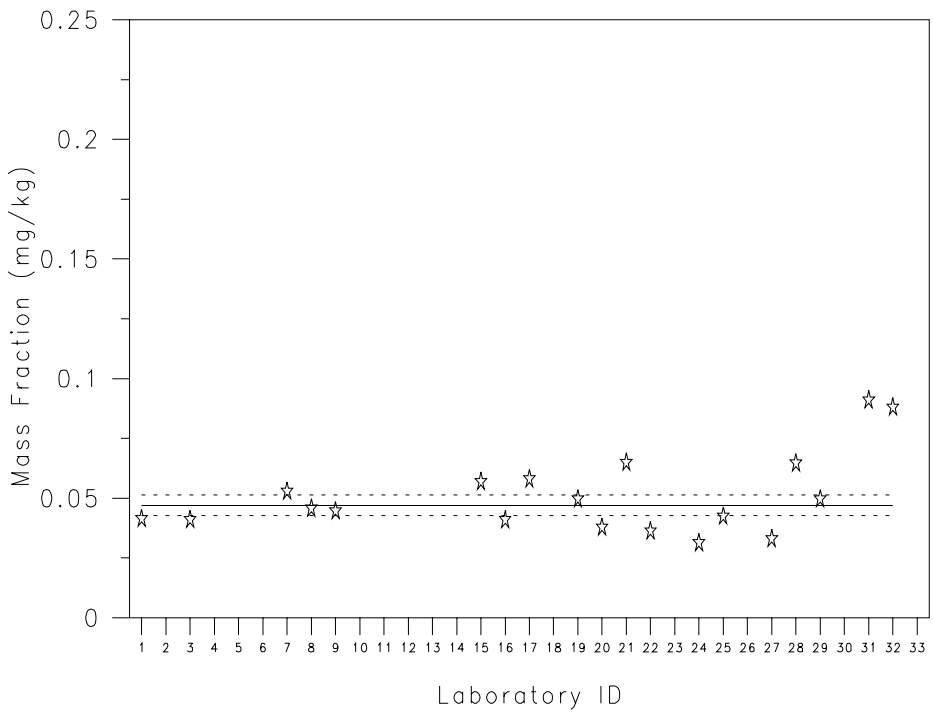
Element	Consensus Mean	Lower 95% C.L.	Upper 95% C.L.	Units
V	**0.047**	**0.043**	**0.051**	**mg/kg**

Lab. #	N	Laboratory Mean	Variance	Standard Deviation	Variance of mean	ML Weight	Tau Estimate	z-score	p-score
1	5	0.041	2.13E-05	0.005	4.25E-06	0.923	4.22E-06	-1.20	1.11
3	5	0.041	2.34E-06	0.002	4.67E-07	0.991	4.67E-07	-1.28	0.37
8	5	0.046	6.13E-07	0.001	1.23E-07	0.998	1.23E-07	-0.28	0.17
15	2	0.057	5.00E-07	0.001	2.50E-07	0.995	2.51E-07	2.09	0.12
16	5	0.041	2.44E-06	0.002	4.88E-07	0.990	4.87E-07	-1.30	0.38
17	5	0.058	1.00E-05	0.003	2.00E-06	0.961	2.03E-06	2.33	0.55
19	5	0.050	4.48E-05	0.007	8.96E-06	0.853	8.68E-06	0.54	1.35
21	5	0.065	2.33E-04	0.015	4.65E-05	0.447	6.23E-05	3.80	2.35
22	5	0.036	1.40E-05	0.004	2.81E-06	0.947	2.85E-06	-2.29	1.03
25	5	0.042	1.98E-05	0.004	3.96E-06	0.928	3.92E-06	-0.99	1.05
29	5	0.050	1.93E-06	0.001	3.86E-07	0.992	3.85E-07	0.54	0.28
Outliers									
7	5	0.053	2.06E-05	0.005	4.12E-06	-	-	1.24	0.86
9	5	0.0	7.93E-06	0.0	1.59E-06	-	-	-0.52	0.63
20	5	0.038	5.20E-06	0.002	1.04E-06	-	-	-1.97	0.60
24	6	0.031	3.58E-07	0.001	5.96E-08	-	-	-3.36	0.19
27	5	0.033	7.71E-06	0.003	1.54E-06	-	-	-2.98	0.84
28	5	0.065	5.92E-05	0.008	1.18E-05	-	-	3.73	1.19
31	5	0.091	9.50E-06	0.003	1.90E-06	-	-	9.34	0.34
32	1	0.088	-	-	-	-	-	8.70	-

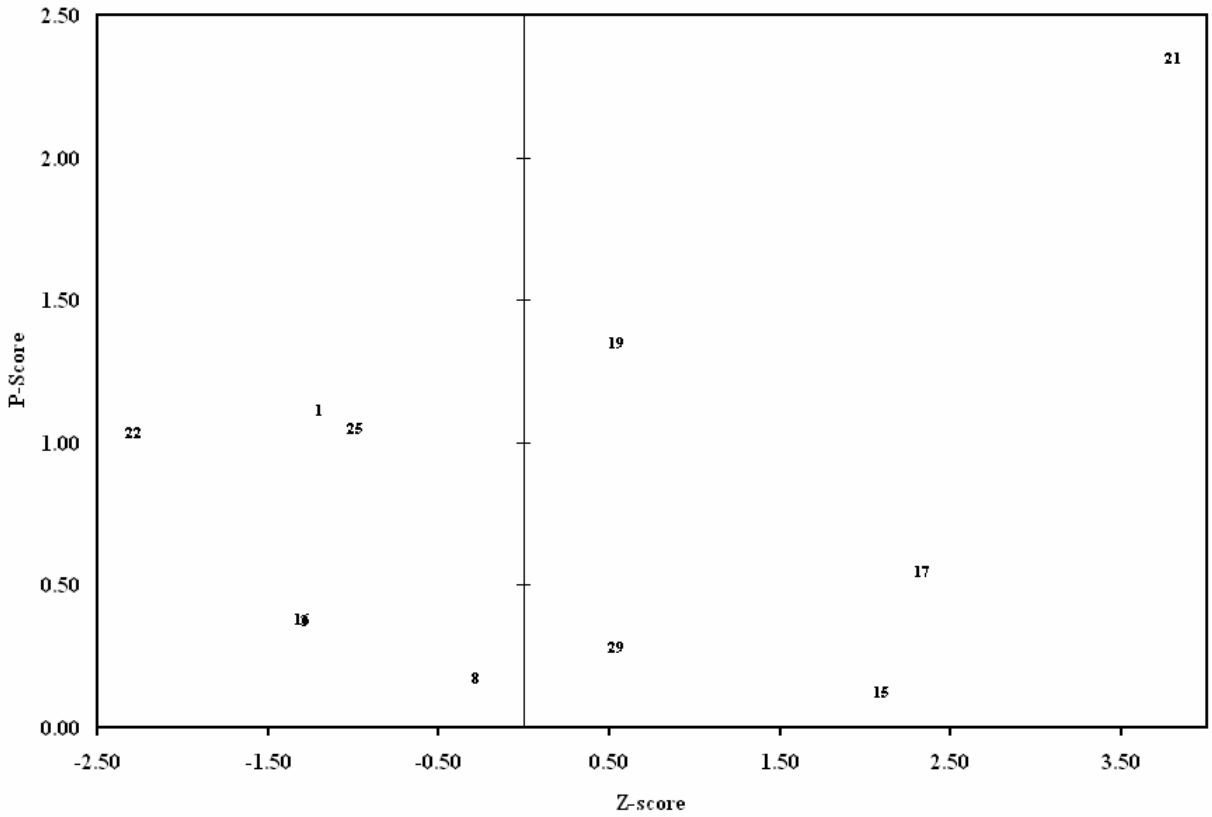
Raw data plot for V in QC04LH4



Consensus mean plot for V in QC04LH4



Laboratory performance data plotted in z- and p-score space for V in QC04LH4



Youden diagram for V (mg/kg) measured in QC03LH3 and QC04LH4 samples

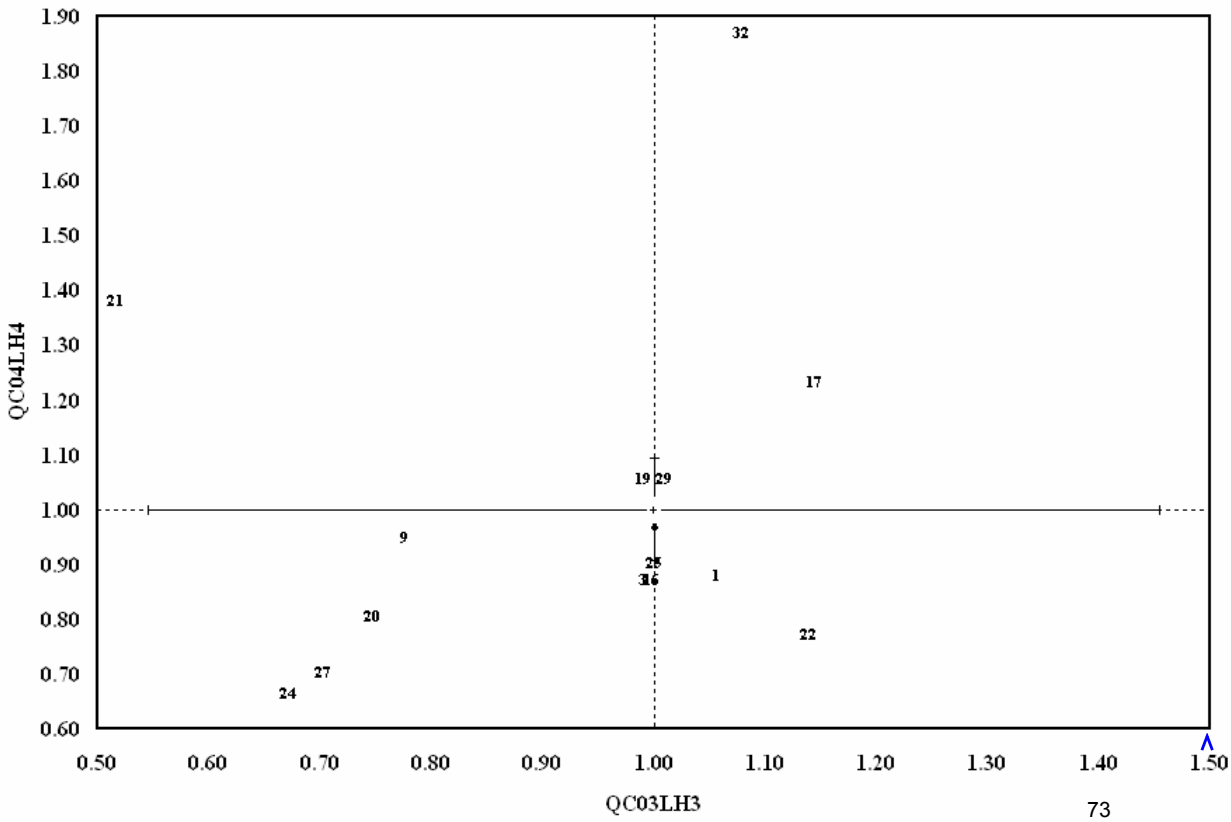
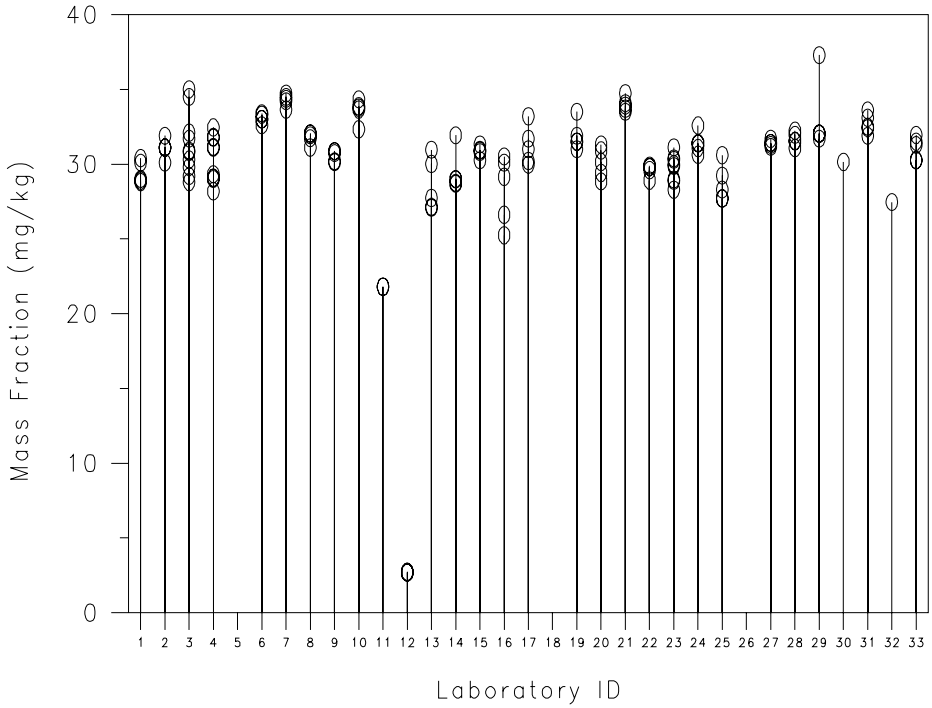


Table 18. Laboratory and consensus data for Zn in QC04LH4.

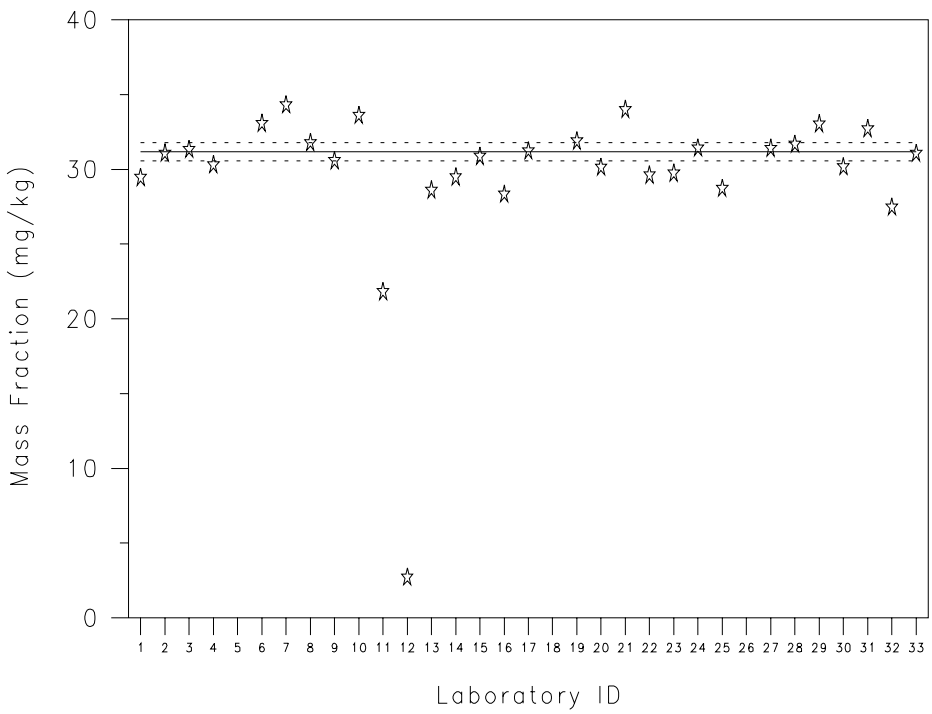
Element	Consensus Mean	Lower 95% C.L.	Upper 95% C.L.	Units
Zn	31.2	30.6	31.8	mg/kg

Lab. #	N	Laboratory Mean	Variance	Standard Deviation	Variance of mean	ML Weight	Tau Estimate	z-score	p-score
1	5	29.4	5.63E-01	0.8	1.13E-01	0.952	1.13E-01	-0.56	0.25
2	5	31.1	4.08E-01	0.6	8.16E-02	0.965	8.09E-02	-0.04	0.21
3	10	31.3	4.34E+00	2.1	4.34E-01	0.841	4.26E-01	0.04	0.67
4	10	30.3	2.28E+00	1.5	2.28E-01	0.909	2.26E-01	-0.28	0.50
6	5	33.1	9.80E-02	0.3	1.96E-02	0.991	1.96E-02	0.60	0.09
7	5	34.3	1.63E-01	0.4	3.26E-02	0.986	3.30E-02	1.00	0.12
8	5	31.8	1.53E-01	0.4	3.05E-02	0.987	3.05E-02	0.19	0.12
9	5	30.6	1.35E-01	0.4	2.70E-02	0.988	2.69E-02	-0.20	0.12
10	5	33.6	5.67E-01	0.8	1.13E-01	0.951	1.15E-01	0.78	0.22
13	5	28.6	3.18E+00	1.8	6.35E-01	0.767	6.86E-01	-0.83	0.62
14	5	29.5	1.91E+00	1.4	3.83E-01	0.855	3.84E-01	-0.55	0.47
15	5	30.8	1.46E-01	0.4	2.92E-02	0.987	2.91E-02	-0.11	0.12
16	5	28.3	5.27E+00	2.3	1.05E+00	0.654	1.19E+00	-0.92	0.81
17	5	31.2	1.70E+00	1.3	3.40E-01	0.873	3.30E-01	0.01	0.42
19	5	31.9	9.22E-01	1.0	1.84E-01	0.926	1.82E-01	0.23	0.30
20	5	30.1	1.04E+00	1.0	2.08E-01	0.917	2.06E-01	-0.34	0.34
21	5	34.0	2.25E-01	0.5	4.50E-02	0.980	4.55E-02	0.90	0.14
22	5	29.6	1.65E-01	0.4	3.30E-02	0.986	3.30E-02	-0.51	0.14
23	8	29.7	8.80E-01	0.9	1.10E-01	0.954	1.10E-01	-0.47	0.32
24	6	31.4	4.21E-01	0.6	7.01E-02	0.970	6.97E-02	0.07	0.21
25	5	28.7	1.51E+00	1.2	3.03E-01	0.877	3.16E-01	-0.79	0.43
27	5	31.4	3.96E-02	0.2	7.92E-03	0.997	7.91E-03	0.07	0.06
28	5	31.7	1.98E-01	0.4	3.96E-02	0.983	3.94E-02	0.16	0.14
29	5	33.0	5.71E+00	2.4	1.14E+00	0.664	1.14E+00	0.59	0.72
31	5	32.7	4.35E-01	0.7	8.70E-02	0.963	8.70E-02	0.49	0.20
33	5	31.1	5.78E-01	0.8	1.16E-01	0.952	1.14E-01	-0.04	0.24
Outliers									
11	2	21.800	0.00E+00	0.000	0.00E+00	-	-	-3.01	0.00
12	5	2.702	4.70E-04	0.022	9.40E-05	-	-	-9.13	0.08
30	1	30.150	-	-	-	-	-	-0.33	-
32	1	27.465	-	-	-	-	-	-1.19	-

Raw data plot for Zn in QC04LH4



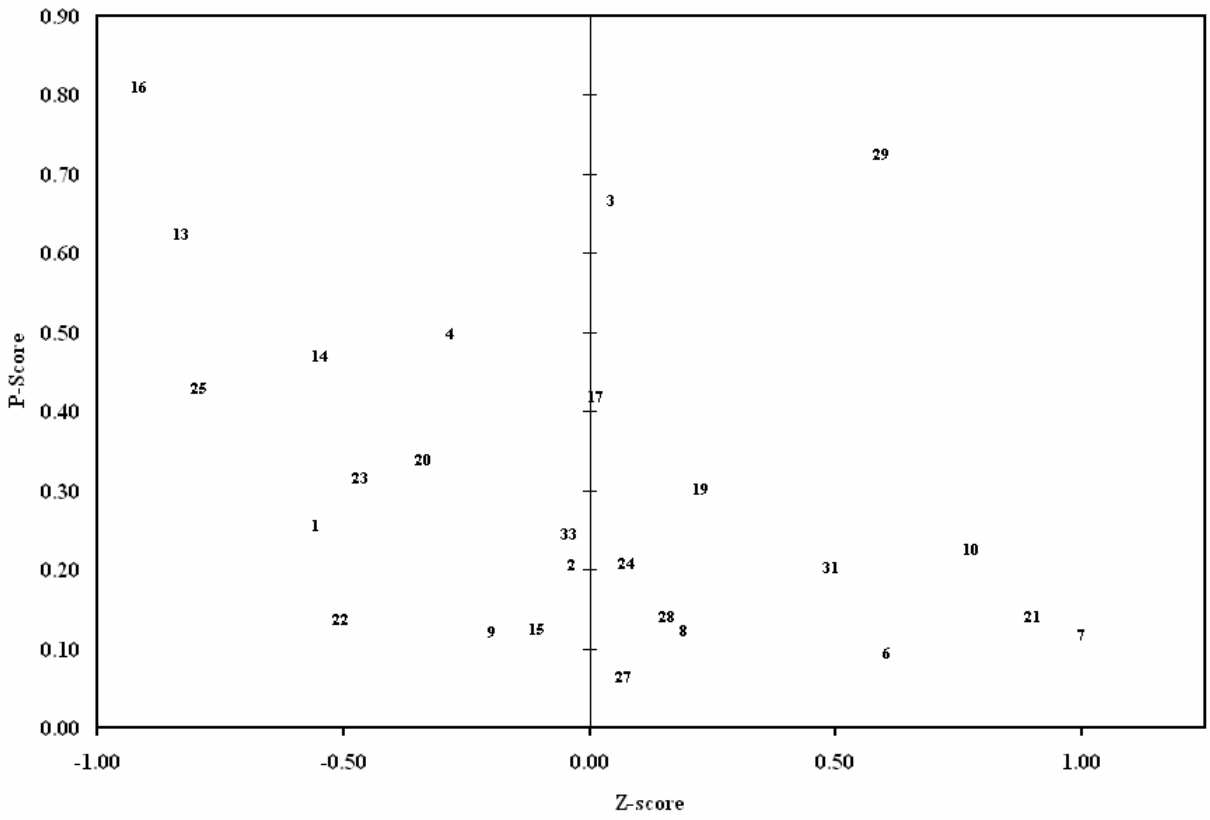
Consensus mean plot for Zn in QC04LH4



Replicates — Consensus Mean

Laboratory Mean ----- Consensus Mean 95% C.L.

Laboratory performance data plotted in z- and p-score space for Zn in QC04LH4



Youden diagram for Zn (mg/kg) measured in QC03LH3 and QC04LH4 samples